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IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
on digital networks, amending Regulation (EU) 2015/2120, Directive 2002/58/EC and
Decision No 676/2002/EC and repealing Regulation (EU) 2018/1971, Directive (EU)
2018/1972 and Decision No 243/2012/EU (Digital Networks Act)**

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Glossary

Term or acronym	Meaning or definition
Advanced high capacity 5G networks	Term which includes 5G stand-alone networks, with significant densification and using mid-band spectrum and advanced network management technologies.
Alternative operators (ANOs)	Term defining operators other than the traditional ex-monopolist operator, referred to as the incumbent operator
ACM	The Netherlands Authority for Consumers and Markets
AI	Artificial Intelligence
API	Application Program Interface is a type of software interface, offering a service to other pieces of software. The term API may refer either to the specification or to the implementation.
BEREC	Body of European Regulators for Electronic Communications
BEREC Office	Agency for Support for BEREC
Bitstream	Active access to a network, usually at a regional or national level (not at local level). Word usually used for access over a copper network, but that can also be used for fibre networks.
CAP	Content and application provider
CAMARA	Common API Marketplace And Repository Architecture is an open-source project. Its primary goal is to bridge the gap between telecom networks and application developers by creating a uniform set of APIs for the mobile ecosystem.
CEPT	European Conference of Postal and Telecommunications Administrations. 46 European countries are members of CEPT.
CGC	Complementary Ground Component: Satellite systems consist of a space segment and a ground segment, which includes the complementary ground components which are ground-based infrastructure that assist, extends, or complements satellites to improve coverage, capacity, reliability, or service quality. The proposed regulatory intervention includes measures that address both the space segment and the ground segment.
Copper network	The earliest of the three main types of telecommunications networks. Mostly built between the 1900s and the 1980s, usually as a national public monopoly, it was primarily designed and used for the provision of telephone services. It was subsequently used for provision of TV and/or internet services (xDSL). The core of the network has nowadays usually been replaced with fibre but copper remains very widespread for the terminal segment of the network. Wholesale access to the copper network can be provided in the

Term or acronym	Meaning or definition
	form of active or passive access, at local or central access. An important feature of copper is that the speed achievable depends heavily on the length of the copper loop, decreasing with the loop's length.
CSO	Copper switch-off
DDPP	Digital Decade Policy Programme
D2D (Direct-to-Device)	Direct-to-device (D2D) refers to the ability of standard smartphones and other devices to connect directly to satellites for communication, without the need for specialized hardware like external antennas or dongles.
ECN	'Electronic Communications Network' means transmission systems, whether or not based on a permanent infrastructure or centralised administration capacity, and, where applicable, switching or routing equipment and other resources, including network elements which are not active, which permit the conveyance of signals by wire, radio, optical or other electromagnetic means, including satellite networks, fixed (circuit- and packet-switched, including internet) and mobile networks, electricity cable systems, to the extent that they are used for the purpose of transmitting signals, networks used for radio and television broadcasting, and cable television networks, irrespective of the type of information conveyed.
ECS	Electronic Communications Service
EECC	European Electronic Communications Code
Fibreco	Fibre company
FSS (Fixed Satellite Service)	Fixed Satellite Service (FSS) is a radiocommunication service that uses satellites to ensure communication between fixed earth stations.
FTE	Full Time Employee
FTTB	'Fibre to the Building' means that fibre optics are terminated in the building's basement.
FTTC	'Fibre to the Cabinet' means that the fibre optics are terminated in the distribution cabinets on the curb. The "last mile" to the individual households is still covered using existing copper pairs.
FTTH	'Fibre to the Home' means a network line serving residential end consumers, consisting wholly in fibre.
FTTP	'Fibre to the Premises' includes both FTTH and FTTB.
FWA	Fixed Wireless Access

Term or acronym	Meaning or definition
5G Fixed Wireless Access (FWA)	5G Fixed Wireless Access (FWA) is a technology that provides high-speed internet to homes and businesses using 5G's wireless network infrastructure.
5G Non-Standalone (5G NSA)	5G Non-Standalone (5G NSA) refers to a 5G network where a core network relies on 4G/LTE infrastructure but uses radio antennas that are based on 5G specifications.
5G Standalone (5G SA)	5G Standalone (5G SA) refers to a 5G network that is entirely built on the 5G specifications, including it dedicated 5G core network and radio antennas. 5G SA offers lower latency, faster speeds, and enhanced reliability compared to 5G NSA.
General authorisation	Legal framework established by a Member State ensuring rights for the provision of electronic communications networks or services and laying down sector-specific obligations that may apply to all or to specific types of electronic communications networks and services, in accordance with the EECC.
GADB	BEREC General Authorisation Database
Gbit	Gigabit
GDP	Gross Domestic Product
GIA	Gigabit Infrastructure Act
G.fast	‘G.fast’ is a broadband access technology that delivers ultrafast internet speeds over existing copper lines, typically in combination with fibre (FTTC) for the last segment to homes or businesses.
IMT	International Mobile Telecommunications
IoT	Internet of Things
ISP	Internet Service Provider
High quality 5G network	High quality 5G network refers to a 5G SA network that provides a high quality of service in terms of latency, data speeds and reliability, and enables the full range of 5G usage scenarios, such as enhanced mobile broadband (EMB), ultra-reliable low-latency communications (URLLC), and massive machine-type communications (mMTC), as well as network slicing.
Low Earth Orbit (LEO) satellite	A LEO satellite orbits the Earth at a relatively low altitude, typically between 500 and 2,000 kilometres. Close proximity to Earth allows for lower latency, faster internet speeds, and higher resolution imaging.

Term or acronym	Meaning or definition
Market shaping measures in spectrum assignments	Market shaping measures are measures such as one provided in art. 52(2) of EEC such as: spectrum caps, reservations, floors, conditions prohibiting transfers, or the accumulation of rights of MSS (Mobile Satellite Service).
mMTC	Massive machine-type communications
Mbps	Megabits per second
MSS (Mobile Satellite Service)	A radiocommunication service that uses satellites to connect to ground stations that move and are not fixed in place.
MNO	Mobile Network Operator
MVNO	Mobile virtual network operator
Network-as-a-Service (NaaS)	Provision of computer networking technology to an organisation as an integrated service. It underpins the optimization of resource allocations by considering network and computing resources as a unified whole.
NRAs	National Regulatory Authorities
NTN	Non-terrestrial Networks
(NI-ICS)	Number-independent Interpersonal Communication Services
OECD	Organisation for Economic Cooperation and Development
Open Gateway	A project that aims to transform communications networks into platforms. It supports application portability and seamless user experiences through standardized open APIs.
OIR	Open Internet Regulation
PIA	Passive Infrastructure Access
RSPG	Radio Spectrum Policy Group is the European Commission high level advisory group on spectrum policy
RSPP	Radio Spectrum Policy Programme
Radio Access Network (RAN)	A Radio Access Network (RAN) is the core component of a cellular network that connects user devices (like smartphones and tablets) to the core network, enabling wireless communication. It acts as the bridge between user equipment and the larger mobile network, facilitating data transmission and connectivity Market shaping measures in spectrum assignments.
RRM	Recommendation on Relevant Markets
SME	Small and Medium Enterprises

Term or acronym	Meaning or definition
SMP	Significant Market Power
Spectrum caps	Terms in spectrum auctions prohibiting participants from acquiring more than a specific amount of rights of use of Spectrum reservation
Spectrum floors	Terms in spectrum auctions setting a minimum amount of rights of use of spectrum a participant may acquire (to prevent fragmentation of spectrum)
Spectrum reservation	Term in spectrum auctions reserving part of the available spectrum for a new entrant or for a specific category of participants (e.g. verticals)
URLLC	Ultra-reliable and low-latency communications
Unbundling/unbundled access	It often: • is mandated by the NRA. • concerns the terminal part of the network (local access). When “Unbundling” is used without an adjective, it refers to a passive type of access. By contrast, “Virtual Unbundling” (usually of Local Access, or VULA) refers to a type of active access that is designed to replicate as much as possible a passive type of access (with regards to the degree of control of the access seeker). When unbundling concerns the copper network (most frequent case), it is referred to as local loop unbundling (LLU) or Sub-loop unbundling (SLU) depending on whether it concerns the entire local loop or only the sub local loop. Unbundling is also possible on a fibre P2P network. In case of a fibre GPON, only a VULA type of access can be provided.
5G-6G Verticals	5G/6G verticals are distinct industry sectors that leverage 5G’s advanced features—like high speed, low latency, massive and immerse connectivity—to create new applications and improve service efficiency. Notably, verticals include, Automotive (connected and autonomous driving, enhanced navigation); Smart Farming (IoT sensors for soil and crop health, drone monitoring, automated irrigation); eHealth (remote surgery, telemedicine, wearable health devices, real-time patient monitoring); Energy (Smart grids, real-time monitoring of infrastructure, automated control systems), Industry 4.0 (automated factories, robotics, real-time monitoring, predictive maintenance); Smart Cities (intelligent traffic management, smart lighting, public safety, etc); and Entertainment and Media (augmented reality, virtual reality, cloud gaming)
VDSL	Very High Speed Digital Subscriber Line is a type of internet connection that uses copper wires to deliver high-speed

Term or acronym	Meaning or definition
Virtual Unbundled Access (VULA)	internet. It is an improved version of DSL technologies like ADSL, using the same copper wires but transmitting data at higher frequencies and faster speeds. VULA is a virtual product, however it should be functionally equivalent to physical unbundling. Key characteristics of VULA products: - occur locally (point of handover); - be generic and provide access seekers with a service-agnostic transmission capacity which is uncontended in practice; - provide access seekers with sufficient control over the transmission network to allow for product differentiation and innovation similar to local loop unbundling (LLU); - be provided with pricing that facilitates its use in a similar manner to physical unbundling; and be provided with effective migration processes towards VULA from physical unbundling to foster take-up, and ensure that competition is preserved where technological solutions force migration from unbundled access to VULA.
VHCN	Very High Capacity Networks means either an electronic communications network which consists wholly of optical fibre elements at least up to the distribution point at the serving location, or an electronic communications network which is capable of delivering, under usual peak-time conditions, similar network performance in terms of available downlink and uplink bandwidth, resilience, error-related parameters, and latency and its variation; network performance can be considered similar regardless of whether the end-user experience varies due to the inherently different characteristics of the medium by which the network ultimately connects with the network termination point;

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

Lack of a genuine single market for electronic communications

The EU has taken a number of initiatives to ensure that Europe is the most connected continent by 2030. Adopted in 2018, the current framework for regulating electronic communications in the EU, the European Electronic Communications Code (EECC)¹ had the objective to promote connectivity and access to, and take-up of very high-capacity networks, to promote competition, drive innovation, boost consumer rights within the European single market. For Europeans, an internet connection of high quality that is fast and reliable has become a pre-condition for participation in today's economy and society. Building on the EECC, the 2022 Digital Decade Policy Programme ('DDPP')² prepares Europe to take full advantage of the digital transformation by, amongst others, aiming to have gigabit connectivity and 5G across Europe by 2030.

As laid out in the Letta³ and Draghi⁴ reports in 2024, a cutting-edge digital network infrastructure is critical for the future competitiveness of Europe's economy and social welfare. The availability of high-quality, reliable and secure connectivity for end-users as well as for key economic sectors is a must. Driven by the increasing importance of performance and security requirements for such services, digital networks are undergoing a technological transformation where cloud and edge computing capabilities are becoming an integral part of connectivity infrastructure. Furthermore, both reports identify the need to complete the single market for electronic communications, pointing towards fragmentation as one of the main obstacles for competitiveness. A modern and simplified legal framework that incentivises the transition from legacy networks to fibre, 5G/6G and cloud-based infrastructures as well as an increased cross-border operation and service provision is key.

The 2024 Niinistö⁵ report stressed the need for the EU to ensure the continuity of its key functions, such as the Single Market, and essential services such as electronic communications, including satellite-based services, critical communication and digital services. The European Preparedness Union strategy presented in March 2025 highlighted the need to protect citizens and as well to ensure vital societal functions, while the Protect EU Internal Security Strategy further outlined measures to increase security of critical infrastructure and respond to security threats, including in the digital domain. Security, defence and economy rely on the existence of cutting-edge fixed and wireless systems, and on sufficient access to radio spectrum. However, the connectivity infrastructure of the Union is not ready to address the current and future challenges of the data-driven society and economy the growing geopolitical tensions and conflicts and the future needs of all end-users. In this situation, the June 2025

¹ OJ L 321/36 17.12.2018.

² Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, OJ L 323, 19.12.2022, p. 4, ELI: <http://data.europa.eu/eli/dec/2022/2481/oj>.

³ Enrico Letta - Much more than a market (April 2024), <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

⁴ The Draghi report on the future of European competitiveness, https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en.

⁵ Safer together: A path towards a fully prepared Union - European Commission, https://commission.europa.eu/topics/defence/safer-together-path-towards-fully-prepared-union_en.

Telecommunications Council called on the EU to ensure secure, reliable and resilient connectivity, including wireless (mobile, satellite)⁶.

In the 2025 State of the Union Speech, President von der Leyen announced the Single Market Roadmap 2028 encompassing energy, capital market union, and telecommunications. The current initiative is intended to deliver on that promise.

The components considered for DNA

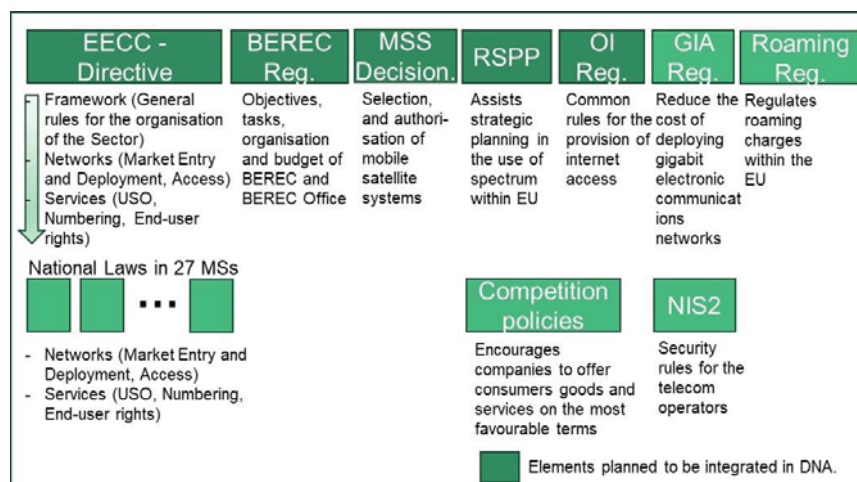
The Digital Networks Act (DNA) is planned to replace multiple existing legal acts currently in place in the EU acquis regulating the connectivity ecosystem. With a view to set the conditions for providers to operate and innovate in the Single Market, these elements need to reinforce each other. Providers need simplified and consistent authorisation rules (EECC), access to fixed networks and spectrum resources (EECC, RSPP, MSS) and a simplified and harmonised set of rules for networks and services (EECC, OIR). Finally, the governance regime needs to support and enable the Single Market. The Evaluation report (see Annex 11) reviews all these current acts to be merged in the DNA, while the Impact Assessment analyses the most important changes necessary to address the identified problems, more precisely in:

- Current Article 81 of the EECC, which deals with migration from a wholesale access perspective, but does not incentivise copper switch-off.
- Spectrum Articles 4, 28, 29, 35-37, 42, 45-55 EECC.
- Articles of the EECC dealing with authorisation, and the MSS Decision dealing with satellite services.
- Articles of EECC, RSPP and BEREC Regulation describing the objectives, the tasks and competences, and the mandate of regulatory bodies.
- Articles on access regime (Articles 76 (co-investment), 77 and 78 (mandated and voluntary separation), Article 61(3) (symmetric regulation) and Article 79 EECC (regulatory commitments)) to be eliminated, streamlined or updated/amended as needed.

The below figure summarises the various elements of the DNA, describing the main components assessed and the remaining ones not targeted.

⁶ Council Conclusions on reliable and resilient connectivity (7929/25), <https://data.consilium.europa.eu/doc/document/ST-9953-2025-INIT/en/pdf>.

Figure 1: Current acquis on electronic communications networks and services and the DNA



It should be noted that simplification measures foreseen under the DNA are specific for the electronic communications sector. They are complementary and mutually reinforcing with the Digital Omnibus, which is a horizontal simplification tool designed to streamline reporting requirements also for ECN and ECS providers resulting from other digital acts.

The initiative on the DNA is complementary to and closely coordinated with other ongoing EU initiatives listed below. In particular, the achievement of EU technological capacities across the broader value chain is only possible if externally coherent with other major initiatives in the domain of cloud, AI, data and cybersecurity. These Acts regulate different components in the digital ecosystem of the EU.

The digital ecosystem

There is a growing interplay between telecom networks and cloud/edge computing which requires a close coordination. The planned **Cloud and AI Development Act (CADA)** aims to boost EU's cloud and edge capacity by streamlining investment rules, speeding up permits, and ensuring access to land, finance, and energy for sustainable data centres. Furthermore, several initiatives have been launched, or are planned in the area of Artificial Intelligence. Under the **AI Continent initiative**, the EU has launched an Action Plan to improve access to AI data and infrastructure, support sectoral AI applications, including a specific call to support generative AI in the sector of connectivity. The informal call for expression of interest for AI Gigafactories has seen strong response, including from telecom operators, which is another indicator of the transition of digital networks towards cloud-based and AI-powered infrastructures and services⁷.

Moreover, in connection with the recently published Apply AI strategy, the **Data Union Strategy** will boost access to high-quality data, invest in infrastructure, simplify regulation, and address international data flows.

The present initiative complements these efforts by improving access to secure, fast, and reliable connectivity that is essential for the transition towards cloud-based infrastructure, data flows and AI.

⁷ <https://digital-strategy.ec.europa.eu/en/news/overwhelming-response-76-respondents-express-interest-european-ai-gigafactories-initiative>.

Assessing the investment needs in the sections 2.1.1 and 2.1.2 is notably based on the technological situation as it is known today. The more any analysis goes into the future the more blurred the picture becomes as technological, in particular, developments create new conditions. Indicatively, the advent of AI (the importance of which for Europe's competitiveness and sovereignty is raised, among others, in the Draghi report⁸) is expected to not only enable a new generation of smart connectivity services but to also radically transform the network infrastructure and its operations compared to what is in place today. The **Apply AI strategy** of the Commission⁹ of 8 October 2025 selects the area of electronic communications among the eleven key deployment/driver sectors of AI. This event is expected, in turn, to require significant investment (which given the early stages of AI cannot be reliably assessed yet) as history shows that big transformations are typically linked to high upfront costs. The Apply AI Strategy discusses such investment needs with respect to new infrastructure (e.g. data centres), skills, access to datasets, and sustainability considerations. This fast-changing digital environment reinforces the need for the new electronic communications legislation to be future proof (including removing any barriers in the creation of scale as appropriate - as per the Draghi report recommendations and further evidence¹⁰).

Risks to the resilience of the EU telecommunication sector

To address the resilience risks, the EU aims to restrict **high-risk suppliers** in 5G. However, despite the 2021 5G Cybersecurity Toolbox, only 13 Member States have acted in this regard. Dependencies remain across 4G/5G, fixed networks, submarine cables, cloud, and critical sectors. The planned **Cybersecurity Act revision** offers a chance to tackle ICT supply chain risks with targeted measures addressing both technical and non-technical threats linked to third countries. This initiative is closely coordinated and mutually interlinked with the present initiative which will reinforce security and resilience aspects related to networks.

The EECC does not explicitly address network resilience, with cybersecurity and resilience obligations now largely covered by the Network and Information Systems Security Directive (NIS2)¹¹ and under the Critical Entities Resilience (CER) Directive¹². However, there is room for harmonisation and coordination as concerns the resilience in the electronic communications sector. Although ENISA and CERT-EU support coordination, they are not sector-specific bodies and lack operational authority. A centralised European overview of preparedness and

⁸ The Draghi report: A competitiveness strategy for Europe (Part A), AI figures among the three major transformations that Europe has to undergo, p.14, https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf.

⁹ Communication from the Commission to the European Parliament and the Council, Apply AI Strategy, COM/2025/723 final, [EUR-Lex - 52025DC0723 - EN - EUR-Lex](#).

¹⁰ As an example, the particular role of larger companies in the AI transition is discussed in the McKinsey study: The State of AI in 2025 (<https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai>) whereby larger companies, according to the study, lead the way in scaling AI beyond pilots. Also that already one-third of high performers spend more than 20 percent of their digital budgets on AI.

¹¹ Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive), OJ L 333, 27.12.2022, p. 80, ELI: <http://data.europa.eu/eli/dir/2022/2555/oj>.

¹² Directive (EU) 2022/2557 of the European Parliament and of the Council of 14 December 2022 on the resilience of critical entities and repealing Council Directive 2008/114/EC, OJ L 333, 27.12.2022, p. 164, ELI: <http://data.europa.eu/eli/dir/2022/2557/oj>.

crisis management through coordination, data collection, early-warning mechanisms (e.g., IP flow disruption alerts), and resilience mapping in electronic communications is missing.

An important element of the aspects related to connectivity provided by satellites is closely coordinated with and complements measures proposed under the **EU Space Act**, which aims to create a harmonised legal framework for space activities across the European Union and with the EU support to IRIS2 constellation to increase EU satellite sovereignty. This is an important development and closely linked with the proposed initiative which responds to the ongoing integration between terrestrial and non-terrestrial connectivity.

Finally, to ensure the capacity of the EU to react to security threats and any type of crises, the European Critical Communication System (EUCCS) will be realised by 2030. It will provide broadband-based communication and services for public authorities across the EU and Schengen area, notably law enforcement, firefighters, medical emergency responders.

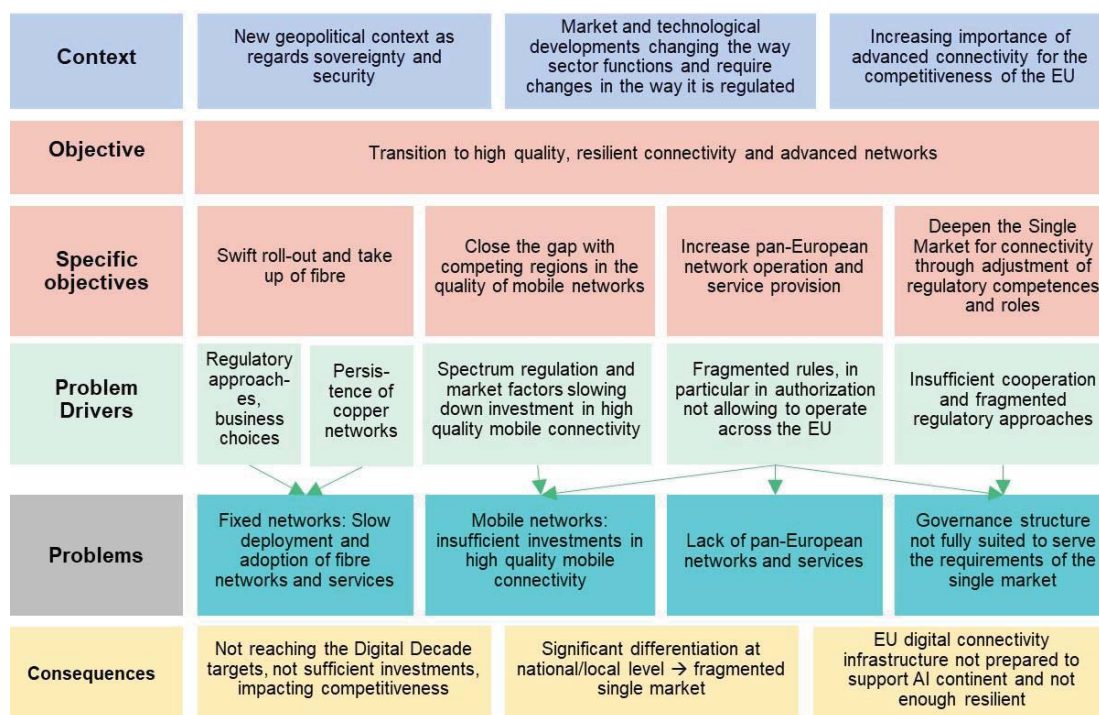
Role of Digital Decade Policy Program in promoting connectivity

The DDPP recognises the importance of fixed and mobile networks for achieving the European Union's digital targets, particularly in terms of providing gigabit connectivity and 5G coverage to all Europeans by 2030. Through the DDPP, the European Commission and Member States have expressed strong political support for the deployment of fibre and 5G networks, recognizing their crucial role in achieving the Union's digital ambitions. By prioritizing the development and deployment of fibre and mobile networks, the European Union can ensure that all citizens and businesses have access to high-quality digital infrastructure, bridging the digital divide and unlocking the full potential of the digital economy. However, the targets under the DDPP are not binding on the Member States and, although the annual reporting and recommendations issued by the Commission help to monitor progress towards the targets, they do not oblige Member States to achieve the targets at the same speed. The current initiative will provide regulatory incentives to facilitate the deployment and take up of gigabit connectivity and 5G high quality networks.

2. PROBLEM DEFINITION

Figure 2 illustrates the problems underpinning the review of the electronic communications framework and describes the problem drivers (with market and regulatory failures further elaborated in section 2.2 and in Annex 7), the problems themselves (presented below) and the consequences of those problems. Problems are interrelated and tend to have similar drivers and/or consequences.

Figure 2: Digital Networks Act Problem tree



2.1. What are the problems?

2.1.1. Fixed networks: Slow deployment and adoption of fibre networks and services

Without modern fibre optic networks, the economic and social benefits of digitalisation cannot materialise, and the EU will be at a competitive disadvantage in the digital sphere. At the same time, we observe slow deployment and adoption of fibre networks and services.

Deployment/coverage

The 2025 DDPP report shows that the Gigabit connectivity measured by Fibre-to-the-Premises (FTTP)¹³, which includes Fibre-to-the-Home (FTTH) and Fibre-to-the-Building (FTTB), stands currently at 69% (2024 data). The percentage of premises reached by fibre rose by 5 p.p. from 64% in 2023 to 69% in 2024¹⁴. According to the same report, by 2030 around 90% of premises will be reached by FTTP, but full (100%) coverage is projected to be only achieved in 2051.

The coverage gaps are problematic as they further deepen the existing geographical digital divide between rural and urban population in Europe (only 58.8% of households living in rural areas were reached by fibre in 2024¹⁵). Bridging the digital divide ensures that some areas of

¹³ When discussing the matter of insufficient fibre deployment and take-up, we do refer to FTTH networks. Those networks are capable of providing Gigabit speeds. However, there is no reliable and complete data of the current state or future projections of the deployment and take-up of FTTH networks per Member State. For that reason, the text in this section is discussing the figures for FTTP, instead of FTTH coverage and whenever feasible provides both.

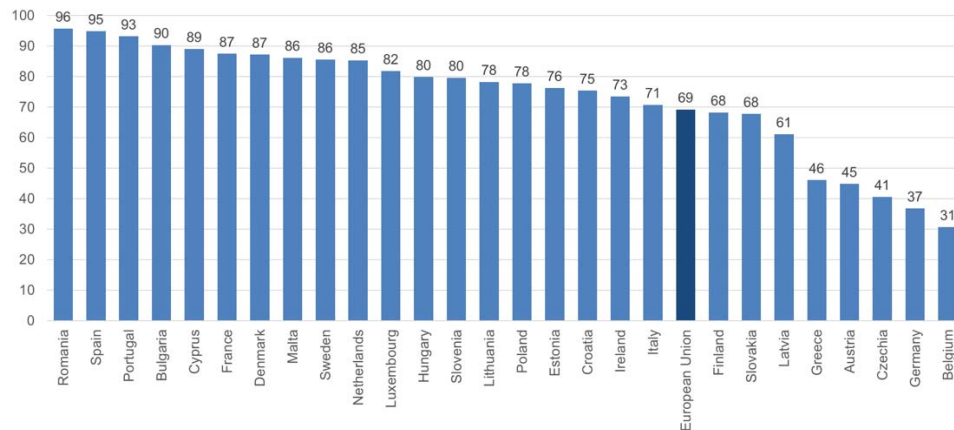
¹⁴ Annex 1 - State of EU digital transformation in 2025: progress and horizontal recommendations, 16.6.2025, SWD(2025) 290 final, p. 5. SWD Digital Decade in 2025: progress and outlook, 16.6.2025, SWD/2025/290 final, p.16.

¹⁵ Commission Staff Working Document: Digital Decade in 2025: progress and outlook.

the Union are not left behind and that EU citizens benefit of high quality of services and can achieve better productivity across the Union.

Furthermore, the FTTP coverage across the EU differs significantly undermining the single market dimension. There is insufficient coverage of FTTP in several Member States – in particular Austria, Greece, Czechia, Germany and Belgium - which results in a significant proportion of EU population not having access to fibre networks.

Figure 3: FTTP coverage in % of households in EU 27 (2024)



Source: European Commission (2025)¹⁶

In addition, it should be noted that the data refers to FTTP coverage, which includes a significant proportion of FTTB. FTTH coverage, which is fully fibre-based and is the most future-proof and high-quality fixed connectivity option, in the EU has been also expanding but not fast enough. This means that even Member States with high FTTP coverage have significant gaps in FTTH coverage.

Demand/uptake

At the same time, demand for bandwidth is increasing rapidly across the EU and fixed broadband traffic increased more than 2.5 times from 2019 to 2024¹⁷. The 2025 DDPP report shows¹⁸ that the share of fixed broadband subscriptions at speeds of 1 Gbps or higher (Gigabit connection) has been increasing (20% between 2023 and 2024) but represented only 22% of total broadband subscriptions in 2024.

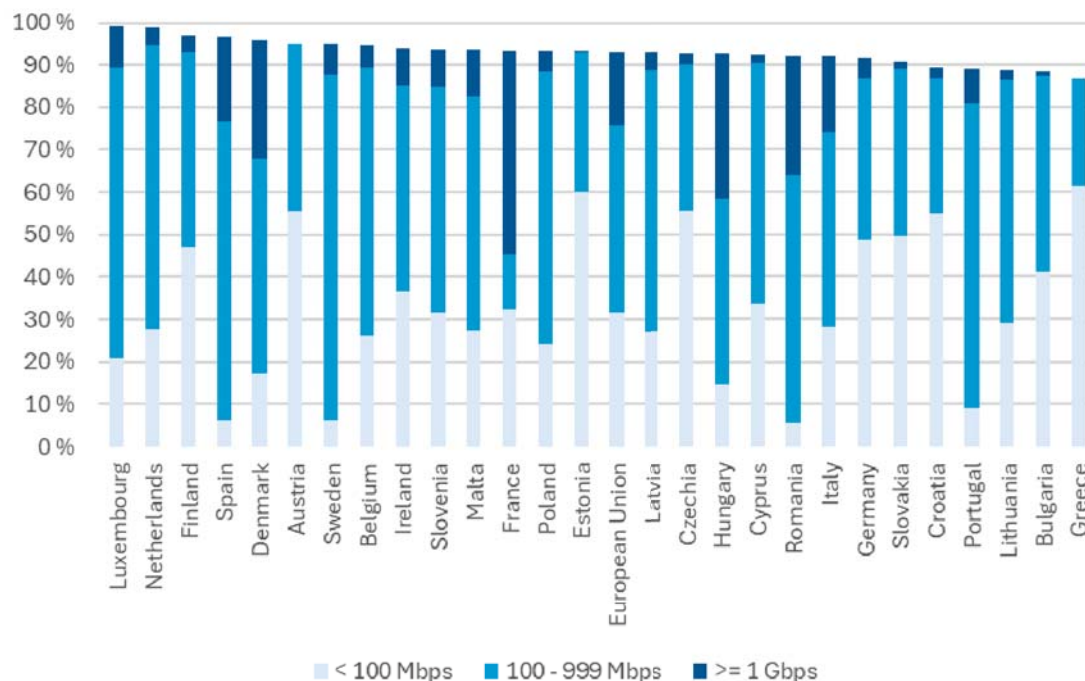
So far, there is limited take-up of Gigabit broadband with significant variations across the EU as illustrated below. Average actual broadband speeds also vary and are often lower in countries with a lower take-up of FTTH.

¹⁶ European Commission (2025): DESI dashboard for the Digital Decade (2023 onwards), Fibre to the Premises (FTTP) coverage, Total, DESI period: 2025 (data from 2024), <https://digital-decade-desi.digital-strategy.ec.europa.eu/s/2j80Egm25Oa1b/>.

¹⁷ <https://www.itu.int/itu-d/reports/statistics/2024/11/10/ff24-internet-traffic/>.

¹⁸ Annex to the DDDP 2025 Report, section 1.1.3.1, p. 18.

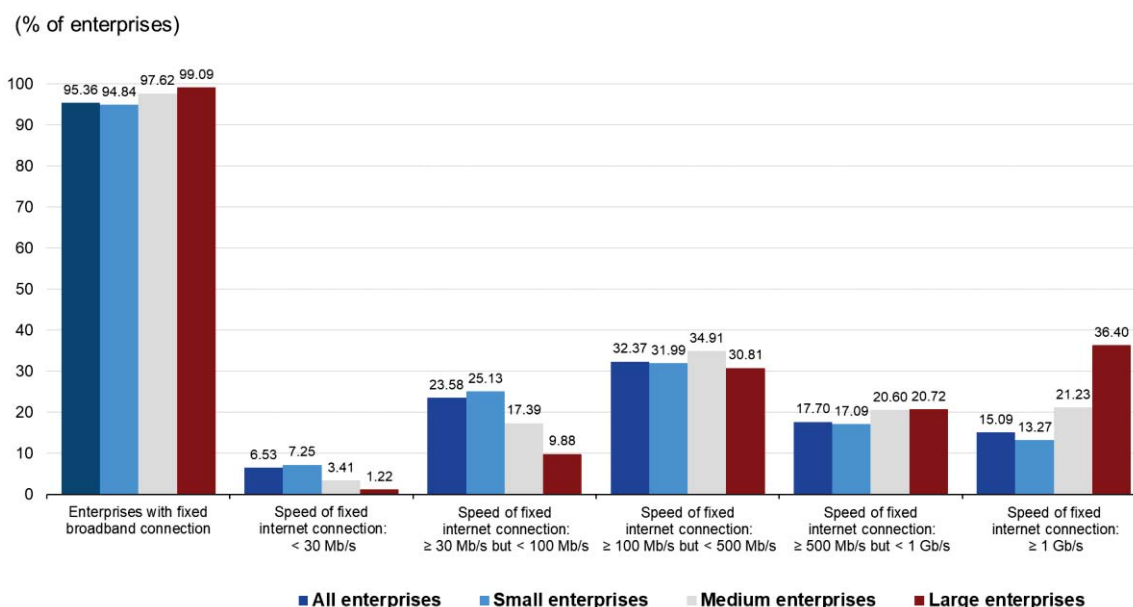
Figure 4: Broadband Penetration differentiated by bandwidth in EU 27 Countries, 2023



Source: Study on Access Regulation

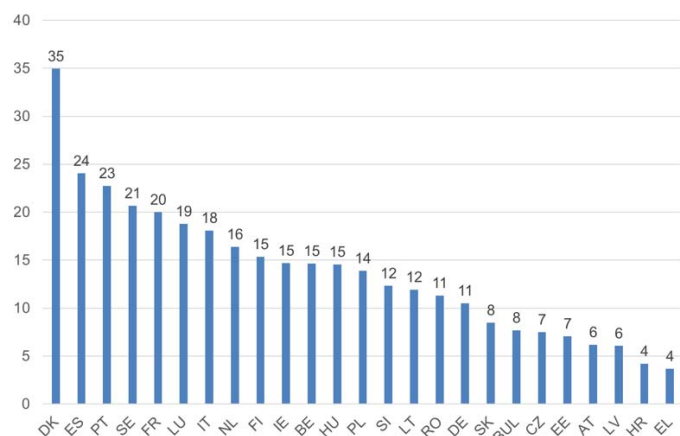
What is also worrying is that only a small proportion of SMEs (lower than for residential consumers) take up Gigabit connections, and even for large enterprises, the proportion with a Gigabit connection is less than 40%.

Figure 5: Enterprises with fixed broadband connection, by speed and size class in the EU (2024)



Data further shows that there are wide variations in the use of Gigabit connectivity amongst businesses, with take-up below 10% in a number of countries.

Figure 6: Share of businesses with Gigabit connection (download speed of at least 1 Gbit/s, 2024)



Investments/costs

To achieve (close to) full fibre coverage will ultimately require investments. According to a study by WIK-Consult¹⁹ (based on data from 2021), the capital expenditure (Capex) required to achieve 100% Fibre-to-the-Premise (FTTP) coverage across the EU is approximately EUR 114 billion. Of that, EUR 74 billion was estimated to be economically viable without subsidies in a situation of no network duplication. The remaining ‘investment gap’ (i.e. total investments needed minus available private funding) is EUR 40 billion. The total investment figure would be reduced to around EUR 108 billion, of which around EUR 29 billion would be needed in subsidies, if 5G FWA is used for the most remote households.

Based on the most recent Digital Decade data, FTTP coverage has increased from 50% (in 2021) to 69% (in 2024). The remaining investment needed to achieve full FTTP coverage would therefore be significantly less than estimated by WIK. However, the shortfall cannot be calculated with precision. This is because the Capex required to deploy FTTP or FTTH varies widely depending on a variety of factors. As an example of complexity of estimating Capex requirements, in Germany, fibre deployment costs range from about EUR 1 310 per line in the densest areas to EUR 4 350 in the least dense, where subsidies are often needed²⁰. A study²¹ on the investment gap for the deployment of VHCN in Czechia estimates that average cost for one FTTH connection (in 2030) stand at around EUR 945 in case of 90% coverage and around EUR 1 308 in case of 100% coverage. This shows also the difficulty of covering the remaining 10% due to significant increase in costs.

The table below summarises the main findings of the evaluation on fixed networks, with references to the relevant Sections of Annex 11.

¹⁹ [WIK-Consult. \(2023\). Investment and Funding Needs for the Digital Decade Connectivity Targets.](#)

²⁰ Jay, Neumann, Plückebaum: The Cost of a Nationwide Fibre Access in Germany, Communications & Strategies No 85, 1 Q. 2012, pp 169-188, March 2012. Further references can be found at Jay, Neumann, Plückebaum: Comparing FTTH access networks based on P2P and PMP fibre topologies, Journal on Telecommunications Policy, 8 July 2013.

²¹ Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G, 2024, <https://mpo.gov.cz/assets/cz/e-komunikace-a-posta/studie-k-narodnimu-planu-obnovy/2024/11/Studie-25.pdf>.

Table 1: Evaluation report findings on fixed networks

EVALUATION REPORT FINDINGS:	SECTIONS IN ANNEX 11
Limitations of the current copper switch-off regulation - The process covers only SMP operators. - The process as designed in EECC was not aimed and did not contribute in any fashion to accelerate the transition from copper to fibre, as it only gave the means to regulators to govern the process for the switch off.	See Annex 11 – Section 4.3.1 Overview and evaluation of access provisions – Effectiveness
Significant differences in availability and take-up of fibre in different Member States - Whereas 11 MS exceeded 80% of coverage, 8 MS have a fibre coverage between 70 and 80% and another 4 have reached more than 50% of households. 5 MS have a fibre coverage below 50% - Whereas most European consumers have a choice of multiple providers of VHCN services, this is based on a combination of own service providers’ network (often supported by regulated access to ducts and poles) and often regulated wholesale access to copper or fibre networks	See Annex 11 -Section 4.2. – Market developments.

2.1.2. Mobile networks: insufficient investments in high quality mobile connectivity

High-quality mobile connectivity in Europe remains underdeveloped, with slower deployment, low 5G SA take-up and weaker performance, all highlighting the need for additional private investment.

Basic (4G-based) **5G deployment** in Europe, currently reaching 94.3% population coverage²², is comparable to competing economies and expected to reach the Digital Decade target of 100%²³ by 2027, i.e. ahead of the 2030 deadline.²⁴ However, **Europe is still lagging behind** in the deployment of high-quality 5G. 5G mid-band coverage in Europe (50%) is significantly lower than in China (95%), India (95%) and the US (90%).²⁵ As illustrated by Figure 7, 5G Standalone (SA) coverage is at around 40% in Europe, compared with 45% in Asia Pacific and 91% in North America.²⁶ Recent data indicate an accelerated shift to 5G SA coverage in the

²² International comparison of Standard 5G coverage: EU 94%, US 97% , CN 95%, SK 100% and JPN 99% [5G Observatory report 2025 | Shaping Europe’s digital future](#).

²³ According to the DDPP, by 2030, all populated areas should be covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G, in accordance with technological neutrality. To measure progress in achieving the target, household coverage in the three 5G pioneer bands is used in the DESI, as a proxy.

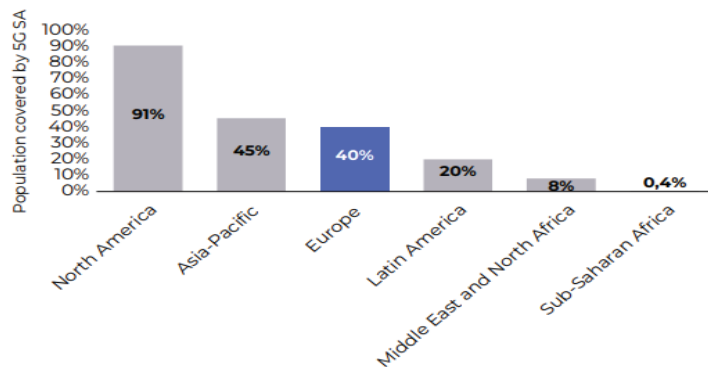
²⁴ Staff working document [Digital Decade in 2025 progress and outlook](#) Accompanying State of the Digital Decade 2025.

²⁵ For 5G mid-band coverage, different data sources use different methodologies and provide very different figures. For example, latest DESI 2025 data indicate mid-band coverage in the EU at 67.7% with however significant differences between Member States. To ensure comparability across regions, a consistent methodology must be applied. Here, estimates from Ericsson are used as they provide internationally comparable data, with figures for both Europe and other regions produced using the same methodology. Mid-band spectrum is key for efficient 5G deployment, as it provides the right balance between coverage and capacity. See also Annex 7, section 1.2.1, and Annex 11, section 5.4 (World population and mid-band coverage split per region, end of 2024).

²⁶ Source Analysys Mason, 2024.

UK, with 83% of areas outside of premises covered by at least one MNO at high confidence level.²⁷

Figure 7: 5G SA coverage, by region, 3Q 2024, Source Analysys Mason, 2024



Europe is also significantly lagging behind in **5G SA take-up**. Only about 2% of 5G users in Europe are connected via 5G SA networks, compared with 24% in the United States, 25% in India and 77% in China.²⁸ In the UK, take-up of 5G SA already represents one third of total 5G traffic, reflecting an acceleration in the transition from earlier 5G NSA deployment.²⁹ The slow pace of 5G SA adoption in Europe has direct repercussions for the **quality** of user experience. The EU27 average download speed of 69.9 Mbps is lower than of South Korea (162.2 Mbps), the US (129.3 Mbps) and China (100 Mbps), and also below the population-weighted global average (70.4 Mbps).³⁰ Other sources likewise confirm that, despite recent improvement, Europe continues to lag behind in 5G SA take-up and speed performance.³¹

It was further estimated³² that **investments** of around EUR 33.5 billion would be needed for densification, i.e. for the installation of additional base stations and small cells needed to

²⁷ OFCOM: Connected Nation, UK report, November 2025.

²⁸ Annex 7 1.2 and MedUX data on Status of 5G Quality and experience in EU and Analysys Mason (2024). 5G Global Progress Report; OpenSignal (2024). 5G Experience Report Q4.

²⁹ OFCOM: Connected Nation, UK report, November 2025.

³⁰ MedUX data on Status of 5G Quality and experience in EU. Cf. Annex 11 and Appendix IIB and Annex 7 – 1.2 for Coverage and Quality of Service graphs. MedUX performed an analysis for all MS for the Commission with the EU download speed average that reflects a highly diverse situation at a granular level, showing marked differences between top- and low-performing Member States, and notable regional disparities within countries – see per MS speeds in Annex 4. In addition to coverage, lack of densification may be one of the reasons why the EU's 5G service quality lags behind that in some other regions. In general, network densification boosts high-capacity and high-quality network performance. It was estimated that in order to achieve high-quality 5G connectivity, around 500 000 new small cells would need to be deployed by 2030, particularly in urban and suburban areas; for example, France would need to increase its mobile site density by 57%, while Germany and Poland face gaps of 31% and 59%, respectively.

³¹ For example, Ookla and Omdia, *A global evaluation of Europe's digital competitiveness in 5G Standalone*, 2025, <https://www.ookla.com/articles/europe-5gsa-2025>, find median 5G SA download speeds in the last quarter of 2024 of 221.17 Mbps for Europe, 384.42 Mbps for the Americas, 237.04 Mbps for Developed Asia Pacific and 259.73 Mbps for Emerging Asia Pacific. Country samples are selected based on having a high share of regional 5G SA measurements. The Americas sample includes the United States, Canada, and Brazil; Developed Asia comprises Australia, Singapore, Japan, Hong Kong, Macau, South Korea, and China; and Emerging Asia consists of India, Thailand, the Philippines, and Malaysia. South Korea is excluded from the Developed Asia sample for median latency calculations.

³² [WIK-Consult. \(2023\)](#). Investment and Funding Needs for the Digital Decade Connectivity Targets.

achieve high quality 5G deployment.³³ An additional amount of EUR 26–79 billion would be needed to cover the main transport paths. These 5G investment needs are expected to be met mainly through private funding, as public funding for 5G is considerably lower than for fibre: State aid is justified only where a market failure has been clearly demonstrated and, historically, public intervention in mobile networks has been exceptional³⁴. Funds available under CEF Digital (a dedicated budget of EUR 227 million for the programming period 2021–2027 and an additional EUR 106 million transferred from other strands) have focused on early 5G deployments for socio-economic drivers and on enhancing coverage along key transport corridors, and the available resources are already fully committed. Other public funding allocated to the rollout of 5G SA networks is limited and insufficient to achieve high quality mobile connectivity. It is thus crucial that the regulatory and market framework ensure the right conditions and **incentives for private investment** in high-quality 5G deployment, such as SA.

As there are significant differences between the performance and capabilities of 5G Non-Standalone (NSA) and 5G SA, lack of investment in high quality 5G affects broader EU industrial innovation and competitiveness, particularly for EU industries requiring advanced, quality-assured services.³⁵ An EU study confirms that **insufficient investment in high quality 5G**, including network densification and the deployment of fibre backhaul, is likely to limit mobile service quality and the availability of quality-assured services requiring high bandwidths and/or low latency. This contrasts with countries such as South Korea, where considerably higher mobile data usage coincides with greater investment in 5G networks, including small cells.³⁶ Noting that the uptake of 5G use cases is expected to deliver a range of **socio-economic benefits**, such as enabling safer mobility, BEREC also called for 5G SA deployment to exploit the maximum digitalisation potential of 5G.³⁷

A report³⁸ analysing 5G-enabled digitization across different use cases, such as smart factories, mining and healthcare, found that full 5G networks can support a wide range of possible innovations in different market and industrial sectors. It estimated that 5G networks in Europe can deliver around **EUR 210 billion in benefits at a cost of EUR 46 billion approximately** (which equates to a cost–benefit ratio, CBR, of 4.5).

However, due to fast technological developments in networking technology since the adoption of the Open Internet Regulation (OIR), **legal uncertainty** has arisen regarding the interpretation of the OIR provisions on high quality specialised services. Stakeholders report difficulties in assessing ex ante whether an innovative service would comply with the OIR. Consequently, they highlight the need for more guidance and predictability in order to minimise a **chilling**

³³ Given the EU's mid-band 5G coverage of 67.7%, a 5G SA take-up of only 2% and the central role of densification in driving costs, the EUR 33.5 billion estimate suggests that only a small share of the total investment has been made so far. Stakeholders also regarded this estimate as conservative, as it assumes the deployment of a single network. In practice, with several MNOs per Member State, duplication or multiplication of 5G SA networks is a plausible scenario requiring further investment. The estimate might also not fully account for the coverage and capacity needed for full 5G use cases.

³⁴ See also Annex 7, section 1.2.2 on investment needs.

³⁵ RSPG25-006 FINAL, section 2.1. cf. on the [difference of 5G SA and NSA](#). 5G SA brings ultra-low latency for real-time responsiveness, high bandwidth for data-heavy applications like AR/VR, massive device connectivity for large-scale IoT ecosystems, and enhanced reliability and security. See Annex 9, section 3.1.1. for quantification of 5G market opportunities for specific sectors/verticals and spill-over effects.

³⁶ Study on Finance and USO.

³⁷ [See BEREC BoR \(22\) 144 Report on the 5G Ecosystem](#).

³⁸ [New 5G use cases mean economic benefits for Europe - Ericsson](#). Analysys Mason for Ericsson and Qualcomm, 2020.

effect on investments and innovation, particularly in relation to network slicing used to implement specialised services.

The speed of 5G deployment and the quality of service also depend on **the availability of sufficient spectrum**. The amount of spectrum used by mobile networks has doubled in the period 2014–2024 to ensure higher service quality and to bring 4G and 5G to consumers³⁹. The growing demand for wireless services in general is increasing spectrum scarcity⁴⁰, especially in low and mid-bands needed for coverage and capacity. To access additional spectrum, MNOs compete with potential or incumbent spectrum users, such as broadcasters or the Wi-Fi industry. In addition, new players have entered the 5G ecosystem, like industrial verticals and wholesale only operators, including tower operators, with their own spectrum needs or ambitions. The lack of sufficient spectrum is also linked to limited deployment of private high quality mobile networks, with EU trailing other parts of the world.

Table 2 summarises the main findings of the evaluation on mobile connectivity and private networks spectrum sharing, with references to the detailed analysis in the relevant sections of Annex 11. The main evaluation evidence linked to lack of predictability, fragmentation and lack of Single Market, low financial attractiveness of 5G projects and inefficient use of spectrum are presented in section 2.2.2, Tables 8–10.

Table 2: Evaluation report findings on connectivity achievements and private networks

EVALUATION REPORT FINDINGS:	SECTIONS IN ANNEX 7 AND 11
Insufficient 5G mobile connectivity achievements - European High quality 5G Coverage (mid-band and SA) below leading world economies - Equally low availability and take-up and lower download speeds.	See Annex 11, section 5.4. 1. 5G Connectivity achievements
Limited uptake of private networks with EU trailing other parts of the world - Spectrum access remains uneven, due to lack of spectrum sharing between public and private networks, with only a few Member States offering transparent and affordable local licensing regimes. - Regulatory challenges for private 5G networks deployment (inconsistent availability of dedicated frequency bands, large variety of technical or administrative requirements, complexity of the licensing procedure and price variations).	See Annex 11, section 5.4. 3. Spectrum for industry: verticals and private networks Annex 7, section 1.2.1 and BEREC Report on the evolution of private 5G networks and interrelation with public networks in Europe (BoR (25) 33)

2.1.3. Lack of pan-European networks and services

2.1.3.1. Barriers to cross-border innovative networks and services

Developments such as IoT, AI, cloud and edge computing, data analytics, and content delivery networks are transforming the connectivity from a vertical sector into a highly converged ecosystem with newly emerging business models. As networks virtualise and shift to the cloud and edge, traditional telecoms, cloud, content, and software providers seamlessly integrate processing across the entire infrastructure⁴¹. Fragmentation of rules in such a converged

³⁹ See Anex 8 1.2.4 GSMA data on Average MHz assigned to mobile operators for frequency bands below 7 GHz.

⁴⁰ See Annex 7, section 2.2.1 on Inefficient use of spectrum.

⁴¹ This process has been described in detail under the pillar I of the 2024 EC White Paper 'How to Master Europe's Digital Infrastructure Needs'.

ecosystem prevents scale economies and results in sub-optimal investments in next-generation connectivity. This is especially hindering for innovative services such as Network-as-a-Service (NaaS), network slicing, edge computing, and IoT-based industrial connectivity, which can only achieve viability as pan-European services. Their business models depend on seamless interoperability, cloud integration, and continuous data flows across Member States. With fragmented market entry conditions, divergent compliance rules across the EU and unpredictable regulation, these services remain confined within national markets, preventing operators from achieving economies of scale and end-users from accessing new digital solutions.

The economic potential of these services is substantial. The network slicing market alone could grow globally from EUR 1.8 billion in 2025 to EUR 12.6 billion in 2030⁴², while the NaaS market is expected to expand from EUR 28.13 billion in 2025 to EUR 140.45 billion in 2032⁴³. Europe currently holds the second-largest global market share and could capture 20–25% of global revenues from network application programme interfaces (APIs), equivalent to EUR 1.5–7.5 billion by 2030, if the potential is unlocked through an enabling regulatory framework, removing potential barriers⁴⁴.

The evaluation report (Annex 11) concludes that the fragmentation of rules, particularly the rules for market entry (the national approaches on the conditions that may be attached under the **general authorisation (GA) regime**⁴⁵) prevent undertakings from deploying pan-European innovative services⁴⁶. These rules vary considerably⁴⁷.

⁴² Mordor Intelligence, 2024: <https://www.mordorintelligence.com/industry-reports/network-slicing-market>. The study defines the network slicing market as the revenue generated from commercial 5G Stand-Alone slices provisioned across virtualized RAN, core, and transport domains to meet customer-specific service-level agreements. The model captures software licenses, slice-management services, and enabling infrastructure directly tied to slice creation and life-cycle management for public mobile networks. Scope exclusion: legacy 2G/3G managed services, private campus Wi-Fi, and hardware sold for non-slice-aware 5G deployments remain outside the baseline.

⁴³ Fortune Business Insights, 2024: <https://www.fortunebusinessinsights.com/network-as-a-service-market-106700>

⁴⁴ Analysys Mason, 2025: <https://www.analysismason.com/research/content/regional-forecasts-/network-api-forecast-rdmm0-rma21/>.

Additionally, as regards the IoT market, the industry has not provided any quantitative analysis linking directly the regulatory fragmentation to costs of foregone innovation; however, there is a wealth of qualitative sources with stakeholders arguing that fragmentation increases costs, reduces scale and cross-border service provision. (Thingsdata: <https://thingsdata.com/information/the-european-iot-market-an-in-depth-analysis/>.)

European Commission Final Report – sector inquiry into consumer *Internet of Things*: https://competition-policy.ec.europa.eu/system/files/2022-01/internet-of-things_final_report_2022_en.pdf.

Vodafone Group: Why a European Policy Framework for the Internet of Things Matters. 2019.: <https://www.vodafone.com/news/public-policy-news/why-a-european-policy-framework-for-the-internet-of-things-matters>.

It is predicted that overall consumer IoT revenue worldwide will grow from EUR 105.7 billion in 2019 to approximately EUR 404.6 billion by 2030. Source: Transforma Insights (22 December 2020). <https://www.statista.com/statistics/1183471/iot-revenue-worldwide-by-vertical/>

⁴⁵ Under Title II (Institutional set-up and governance), Chapter II (General authorisation) of the EECC Art. 12-19.

⁴⁶ See section 4.3.2 of the Final 1st Interim Report on Completing the DSM and Evaluation Report p. 6.1. on effectiveness of general authorisation.

⁴⁷ This is the case both for the same type of network or service provided in more than one Member State (e.g. end-users' protection conditions remain nationally specific and are especially various for cross-border M2M services) or per types of networks and services (NB-ICS/NI-ICS, public ECN/non-public ECN and public ECS/non-public ECS).

The most diverging rules are in the area of end-user protection as well as lawful access to data, data retention, cybersecurity or privacy, as well as specific national requirements such as different reporting formats and frequencies, notification of the beginning of the activity in national languages varying rules on digital identity verification. These existing divergences in national notifications, different national requirements laid down by pieces of national law different from electronic communications legislation cause barriers to the Single Market and were noted by BEREC⁴⁸. The patchwork of rules means that identical services can face entirely different compliance requirements depending on the Member State(s) in which they are offered. This raises costs, delays market entry and deters innovation, particularly for SMEs and providers with a footprint in several Member States who must tailor their services to each jurisdiction⁴⁹. The optional or selective application GA conditions to various providers further distorts competition and fragments the Single Market, creating an uneven level playing field and delaying the introduction of new services⁵⁰.

The absence of a harmonised regulatory regime limits the ability of European operators and other actors in the value chain, such as hardware and software suppliers, to fully exploit growth opportunities and to upscale innovative, investment-intensive digital services consistently and uniformly across the Union. The ongoing technological developments are increasing interdependencies within the digital ecosystem, yet collaboration among key actors (ECN providers, cloud services, CAPs, AI developers, device manufacturers, etc.) remains insufficient to address emerging challenges related to traffic efficiency, coordinated network capacity planning, sustainability, and the delivery of innovative services.

Combined recurrent and variable costs for a cross-border provider could range from EUR 15 million to EUR 25 million, with expenditure that is pure overhead, providing no competitive advantage or service improvement⁵¹. Detailed breakdown of this cost estimate is provided in section 7.3 of this report. Approximately EUR 0.40–0.70 million of the combined costs are related to GA (to apply for GA, notify NRAs and competent authorities and provide relevant updates if required, separately across 27 Member States). Combined with the total annual operational costs for compliance with legal obligations, the total cost would be in the order of EUR 0.50–1.20 million⁵².

⁴⁸ BEREC 2024 Opinion on the national implementation and functioning of the general authorisation, and on their impact on the functioning of the internal market, pursuant to Article 122, paragraph 3 EECC, page 6 and 12. BEREC noted that ‘such inconsistencies fall outside the BEREC remit, but still BEREC would like to underline the importance of better looking into this matter, as further consistency in the overall notification-related fulfilments - beyond those already standardised by the EECC, enshrined in electronic communications legislation - would enhance the simplicity of market entry for ECN/ECS providers, hence the single market dimension.’

⁴⁹ However, it should be noted that certain data requirements, such as on sensitive data related to national security, state security, defence, or public security, remain excluded from the Union harmonisation efforts. Article 4(2) TEU remains basis for these exclusions and is consistently reinforced throughout data-related EU legislation.

⁵⁰ The differentiated national implementation of the EECC and the following detrimental effects to the Single Market that could arise by “gold-plating” is discussed by Letta, (2024), Much More than a Market, p. 125 and has been emphasised by a significant number of stakeholders who have contributed to the 2025 Call for Evidence on the DNA, 2024 White Paper ‘How to master Europe’s digital infrastructure needs’ as well as the 2023 ‘Exploratory consultation on the future of the electronic communications sector and its infrastructure’.

⁵¹ Cross-border (pan-European) provider for the purpose of this estimation means an operator with a meaningful physical presence and regulatory footprint in all 27 EU Member States.

⁵² While a significant number of respondents (95 out of 326) to the Call for Evidence have stressed that a simplified, harmonised GA and reporting framework are essential to reduce regulatory fragmentation, enable cross-border operations, and stimulate investment and innovation, they have not supplemented this with quantitative analysis on costs they incur due to the fragmented rules they face. However, this additional quantitative data was collected via desk research and further interview with stakeholders.

Currently there is no coherent and harmonised approach fostering the extension of **network resilience**, given that threats – whether cyberattacks, physical disruptions, or natural disasters – have increasingly cross-border effects. Annual cost of network outages for companies in Europe is estimated in the order of hundreds of millions⁵³. The societal implications go far beyond costs for companies as network outage means unavailability of emergency calls, potentially leading to loss of life and threat to public safety⁵⁴.

Table 3: Evaluation report findings on resilience, general authorisation and end users

EVALUATION FINDINGS	SECTIONS IN ANNEX 11
Lacking pan-European approach to preparedness and resilience of connectivity networks: - Resilience of integrated electronic communications infrastructures (terrestrial, non-terrestrial/satellite, submarine) has become an important concern which had not been addressed by the EECC, only partially and in a limited manner. Resilience is only considered in EECC in the context of availability of services.	Annex 11, section 3.4 General objectives
General authorisation: - The EECC general authorisation regime successfully lowered barriers to market entry, enhanced transparency, and promoted consistency across the EU. However, divergences in national implementation and BEREC general authorisation database management (e.g., duplicate notifications, different templates, varying update practices) still create obstacles, particularly for cross-border operators. - Compliance costs under Art. 12 and 16 EECC are generally considered low and proportionate by both governments and stakeholders. Still, differences in national implementation (e.g., varying reporting obligations) impose extra administrative burdens, especially on smaller operators. - While internally coherent, the general authorisation framework lacks external coherence with other EU/national rules (cybersecurity, lawful interception, data retention, e-privacy). This undermines the single market and highlights the need for further harmonisation and coordinated security conditions. - The authorisation regime remains relevant, facilitating market entry and enabling NRAs to monitor compliance. However, some stakeholders call for expanding its scope (e.g., to NI-ICS providers) to ensure fair competition and consistent end-user protection. - The evaluation also found a need for simplification, further harmonisation and consistency to reduce administrative burdens and support new, more software-based networks and virtualised communications services.	Annex 11, section 6.1., Annex 11, section 6.2, Annex 11, section 6.3, Annex 11, section 6.4 and 6.5.
End-Users: - The evaluation report found that the current sector specific rules are largely satisfactory and while they provide for maximum harmonisation, their effectiveness is reduced by the possibilities of derogation included in the articles; - The use by Member States of the possibility to derogate from sector specific rules has increased regulatory fragmentation of the consumer protection rules and has been mentioned as a barrier to the Single Market	

⁵³ Splunk, Splunk Report Shows Downtime Costs Global 2000 Companies \$400B Annually, https://www.splunk.com/en_us/newsroom/press-releases/2024/conf24-splunk-report-shows-downtime-costs-global-2000-companies-400-billion-annually.html.

⁵⁴ The Connexion, Emergency numbers disrupted in France: Inquiry opened into 4 deaths, <https://www.connexionfrance.com/news/emergency-numbers-disrupted-in-france-inquiry-opened-into-4-deaths/436843>.

EVALUATION FINDINGS	SECTIONS IN ANNEX 11
preventing operators to operate at scale or provide consistent cross border services.;	

2.1.3.2. Barriers to pan-European satellite services

Satellite systems provide broad regional or global coverage and have inherent cross-border nature and pan-European (or global) potential, as opposed to terrestrial mobile networks. In times of rapid expansion of innovative direct-to-device (D2D) services and related satellite constellations, the existing EU framework based exclusively on national authorisation of satellite services and on national spectrum resources creates barriers to the provision of pan-European services and forces satellite operators to respect unnecessary differences in authorisation rules and conditions in countries where they provide satellite services. Consequently, fragmentation of authorisation rules has a greater negative impact on satellite than on terrestrial networks, as it substantially limits the provision of pan-European satellite services, challenging the economic viability of satellite projects, and ultimately, undermining the EU global competitiveness and innovation capacity in satellite connectivity.

In particular, Low Earth Orbit (LEO) constellations for hybrid terrestrial-satellite systems (Non-Terrestrial Networks - NTN) are emerging as the modern equivalent of traditional mobile communication towers, offering Direct-to-Device (D2D) connectivity⁵⁵ and will be an essential element of the 6G mobile networks⁵⁶. This infrastructure is vital for ensuring equitable access to high-speed internet, particularly in underserved and remote regions, while also strengthening European capabilities in critical communications (emergency and defence)⁵⁷, and a key component of resilient communication networks enabling continuous connectivity under challenging conditions.

Although Europe used to be a frontrunner in satellite communications, it has failed to anticipate the innovation potential of this market and was slow to invest in LEO constellation deployment⁵⁸. With only 773 LEO satellites launched and 3120 planned, the EU lags China (i.e. 220 launched, 27198 planned) and the USA (i.e. 7633 launched, 33397 planned) as reported in the Commission Study on the MSS in the 2 GHz band⁵⁹.

According to the Draghi report, satellite connectivity is increasingly vital for the EU's technological sovereignty, playing a crucial role in fulfilling the communication needs of citizens, businesses, and governments; yet this domain is increasingly coming under the dominance of non-EU players. Increasing dependence on third country constellations raises concerns around lock-in effects, creates the risk of arbitrary and voluntary “shut downs”, and

⁵⁵ LEO constellations can provide global, uniform, low-latency coverage because they are constantly moving around the Earth, many moving satellites can cover every point on Earth eventually and hand over coverage/service to each other.

⁵⁶ [5G Non-Terrestrial Networks by Alessandro Vanelli-Coralli and Nicolas Chuberre, et al.](#)

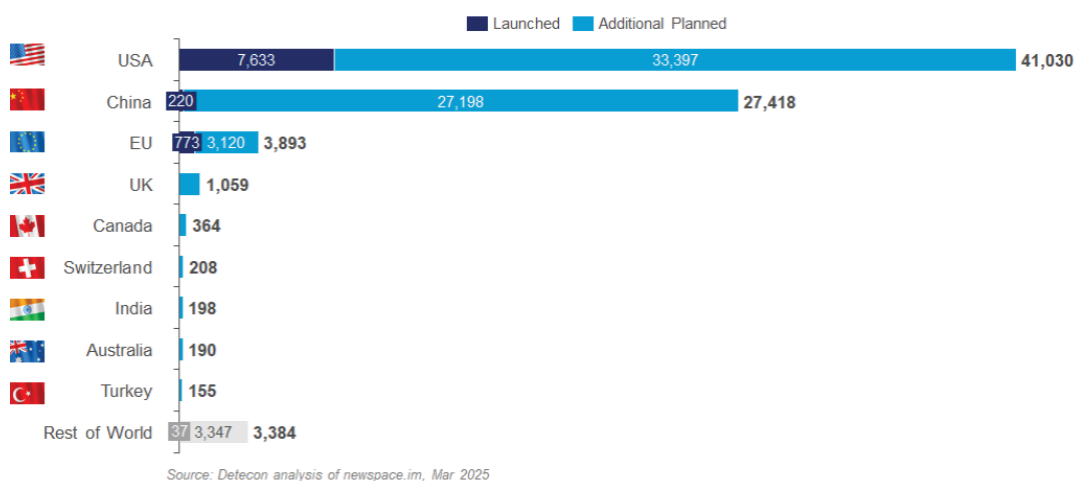
⁵⁷ Satellite technologies are inherently dual-use, designed to serve both civilian and defence purposes.

⁵⁸ The EU is the world's third largest player in most aspects of the satellite sector, following the United States and China. As of 2023, Europe's share of the downstream market was estimated to represent 23.0% (EUR 89 billion) of the total global market value (EUR 387 billion) – see Euroconsult (2023) as cited in the European Commission's Impact Assessment for the Space Act ([SWD\(2025\) 335 final](#)), part 1/2, p. 4.

⁵⁹ European Commission: DETECON Study on mobile satellite services (MSS) in the 2 GHz band in the EU – Implementation of the current regulatory framework and an overview of the satellite connectivity market – Final report, 2025, <https://data.europa.eu/doi/10.2759/5764760>.

challenges European security and strategic autonomy, including its access to satellite orbits and spectrum resources.

Figure 8: Broadband Internet, D2D and IoT satellite constellations in terms of total number of launched and planned country/region⁶⁰



In the coming years, the number of authorisations is expected to increase significantly, resulting in subsequent increases of compliance costs for operators and enforcement costs for authorities⁶¹. Continuation of the current complex division of competences and fragmented authorisation approaches risks delaying deployment of innovative satellite D2D services. In addition to their own compliance costs, new Union-wide satellite operators would face varying administrative costs depending on the specific Member State in which they operate. One-off administrative fees for authorisations (general and individual) range from a few thousand up to around EUR 110 000, plus annual fees typically between EUR 10 000 and 50 000. In addition, site authorisations for ground stations may entail a one-off permit cost of up to EUR 130 000 per site and annual administrative costs of EUR 5 000–30 000, while spectrum usage charges can reach EUR 1000–10 000 per site annually.

Historically, access to spectrum for satellite services has been largely guaranteed at low fees given relatively low spectrum scarcity (particularly in the high frequency bands Ku and Ka), the limited number of operators and end-users and the possibility of spectrum sharing (See Annex 10, section 1 Spectrum essentials). Satellite spectrum was hence assigned on a first come first served basis at a low fee or assigned in comparative selection procedures.

⁶⁰ [Detecon International GmbH 2025](#). This data are to be considered with caution and as indicative. Detecon tabulates the launches and planned satellites adding up the satellite constellations by country of ownership (ignoring the complexities of multiple shareholders from different countries, unless it is close to a 50/50 split). Note that this metric excludes the most optimistic claims of some of the announcements, including Starlink's additional 4 450 to 12 000 satellites in the USA column (reported as submitted to the ITU in 2019) and the additional 10 700 satellites which the Thousand Sails constellation may expand to which would add to the China column. Note that counting satellites may also not be the most accurate metric, as it does not account for weight. Comparing kilograms in orbit is probably a more meaningful metric, if such ever becomes available.

⁶¹ Cf. also Annex 7, section 1.3. for future authorisation needs of new constellations, as for example IRIS 2 and existing barriers.

There is an important economic potential related to D2D connectivity. It has been estimated that satellite D2D market could generate EUR 116.6 billion in total worldwide service revenue between 2022 and 2032⁶².

Consequently, investment priorities in the satellite sector have historically concentrated on the development of space and ground infrastructure, including launch capabilities, while spectrum acquisition represented only a fraction of the cost. This contrasts with the terrestrial mobile sector where access to spectrum constitutes a key investment asset, representing a cost of around 7% of mobile service revenues and about 35–40% of Capex and is coupled with regulatory obligations related to coverage and quality of service. Since satellite spectrum in general is authorised at a much lower price than terrestrial mobile bands, the associated investment costs for satellite spectrum are far less than 7%. This is expected to change in the future with the development of D2D services, intensifying competition to access valuable spectrum in lower satellite bands, such as the 2 GHz MSS band.

Finally, against this background of proliferation of constellations and of regulatory fragmentation, the enforcement of ITU rules against harmful radio frequency interference represents a challenge⁶³. Unlike terrestrial communications, the spectrum used for satellite communications requires a higher degree of international and national coordination because satellites operate across multiple countries and regions. The growing demand for LEO satellites to access spectrum significantly increases the risk of interferences. However, the current tools for addressing bilaterally satellite interference at the level of ITU are slow and inefficient and do not allow to leverage the strength of the internal market, e.g. threat of blocking access to the internal market. This shift of regulatory paradigms requires stronger EU coordination to develop and enforce efficiently common rules supporting the single market and advocate for them internationally⁶⁴.

The table below presents the main barriers analysed in further detail in section 2.2.4 of the evaluation report, in relevant studies⁶⁵ and in Annex 7, section 1.3.3 (Table on satellite spectrum fees), that negatively affect the deployment of pan-European satellite services in the 2 GHz band.

⁶² [Analysis Mason, March 2024, Lluc Palerm and Jiachen Zhang](#): Satellite direct-to-device technology needs to evolve through four phases before reaching its full potential see [link](#).

⁶³ The EU Space Act proposal envisages preventive interference measures for satellite operations in the EU (different from satellite communication services) by requesting the use of cryptography-encryption in the Union satellite operations and assessing the risks to lose control of assets with capacity to emit interferences susceptible to adversely impact the security of other space operations.

⁶⁴ Annex 7, section 1.3 Barriers to the development of advanced and resilient satellite connectivity.

⁶⁵ See also IDATE Study on Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States – Final report, Publications Office, 2019, <https://data.europa.eu/doi/10.2759/974409> and DETECON, Study on mobile satellite services (MSS) in the 2 GHz band in the EU – Implementation of the current regulatory framework and an overview of the satellite connectivity market – Executive summary, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2759/4700547>.

Table 4: Evaluation report findings on satellite connectivity

EVALUATION FINDINGS:	ANNEXES SECTIONS
Technical and legal obstacles to the provision of cross-border satellite services: The spectrum framework has been ineffective in ensuring a harmonized approach for satellite: great variability in - the form and conditions of authorisation (general authorisation or individual rights of use) and spectrum assignment, - timing of authorisation, - the fees charged (no fees, One-time administrative/ application fee. Annual radio spectrum user fees, Fixed amount etc.) - inconsistent reporting obligations and - the treatment of CGCs (separately or not). - risk that the service is not authorised in all Member States, i.e. coverage gaps.	Annex 7, section 1.3. Barriers to the development of advanced & resilient sat connectivity Annex 11, section 5.5.4. Supporting satellite EU-wide connectivity IA section 2.2.4 on Fragmentation of spectrum authorisation conditions for satellite services Annex 7, section 1.3.3 Fragmentation in sat authorisation - Table on fragmentation MSS Fees
Increasing risk of future interference that can distort competition especially if enforcement mechanisms are not effective, and do not ensure a level playing field in accessing spectrum resources leading to inefficient use of resources.	Annex 11, Appendix IIB Annex 7, section 1.3.2

2.1.4. Governance structure not fully suited to serve the requirements of the single market

The evaluation (Annex 11) showed that whilst significant progress in harmonisation has been made over time, the EU legal framework and the governance structure did not result in achieving a full Single Market in the electronic communications sector, and the EU is still characterised by fragmented national markets.

The articulation of competences and roles of the actors involved in the governance system (the European Commission, NRAs, and other competent authorities for spectrum and other specific areas, BEREC, and RSPG) is complex, not sufficiently clear for stakeholders, and not fully suited to support the Single Market. While all institutional actors pursue the general objectives as set out in Article 3 EECC, BEREC was established to ensure greater harmonisation of practices among the NRAs, promote an effective internal market in this sector, and act as an exclusive forum for cooperation among NRAs, and between them and the Commission. Moreover, according to Article 3 of the BEREC Regulation, BEREC must ensure a consistent implementation of the regulatory framework for electronic communications⁶⁶.

As the results of evaluation show, BEREC remains a platform for coordination among NRAs, but while it strives to achieve a common EU approach, its positions in some cases remain influenced by national perspectives. Consequently, its outputs often leave space for inconsistent implementation of the regulatory framework, diminishing their impact on harmonisation of rules for the internal market⁶⁷. For example, although the electronic communication networks and services are provided under GA, i.e., without prior authorisation, the GA notification

⁶⁶ EECC, Roaming Regulation (Regulation (EU) 2022/612 of the European Parliament and of the Council of 6 April 2022 on roaming on public mobile communications networks within the Union, OJ L 115, 13.4.2022, p. 1, ELI: <http://data.europa.eu/eli/reg/2022/612/oj>), Open Internet Regulation, Gigabit Infrastructure Act (Regulation (EU) 2024/1309 of the European Parliament and of the Council of 29 April 2024 on measures to reduce the cost of deploying gigabit electronic communications networks, amending Regulation (EU) 2015/2120 and repealing Directive 2014/61/EU, OJ L, 2024/1309, 8.5.2024, ELI: <http://data.europa.eu/eli/reg/2024/1309/oj>).

⁶⁷ According to industry views (Study on Digital Single Market), BEREC has insufficiently contributed to harmonisation, e.g. in the area of end-user rights, where national legislation and practices diverge.

templates differ significantly⁶⁸. In some cases, consensual elaboration and adoption of BEREC guidelines on GA conditions and GA notification templates or common positions result in either guidance that is either overly complex, or too general and not specific enough⁶⁹. The BEREC Office has only administrative/support functions, and hence its potential to provide more support on substantial matters, injecting thus a more neutral position in the development of BEREC preparatory work, remains underutilised as it is the smallest EU decentralised agency (yet with staff overrunning the authorised budgetary levels).

As for spectrum governance, results of evaluation show that fragmented national authorisation processes for satellite services across the EU create significant barriers to swift and efficient service rollout. These inefficiencies inflate costs and administrative burden without delivering added value to customers, ultimately undermining the competitiveness of EU satellite services and slowing down innovation.

The RSPG advises the Commission and other EU institutions on issues related to radio spectrum policy, including on the EU position in view of the periodic World Radiocommunications Conferences. Although valuable, RSPG opinions tend to focus on technical aspects. Inter alia due to the lack of a proper support structure (a small secretariat function is provided by DG CNECT, with the majority of the substance work based on resources of national authorities) the RSPG is not fully exploring its mandate to advise EU institutions on broader aspects of radio spectrum policy in general (e.g. economic, political, cultural, strategic, security, health and social issues). There is furthermore untapped potential to more systematically include the input of other expert groups for the formulation of RSPG positions. The voluntary mechanisms, such as a peer review under Article 35 EECC, have not been sufficient for strengthening the Single Market⁷⁰.

Moreover, even though the EECC requires close cooperation between BEREC and RSPG where spectrum issues have regulatory implications, in practice this coordination has been limited to few joint opinions or reports. Regarding other issues, the synergies between BEREC and RSPG also remain unexploited resulting in non-holistic RSPG opinions, like is the case of

⁶⁸ The BEREC guidelines for the notification template have not eliminated differences in notification forms used at national level. The differences in both templates as well as, more significantly, in the conditions applied nationally, are either hindering the undertakings from providing their networks and services cross border or are generating compliance costs and administrative (e.g. translation) burden. It has influence on the competition (lack of cross-border provision of services), as well as on investment decisions of undertakings to develop or consolidate cross-border.

⁶⁹ The BEREC Guidelines on conditions and criteria for the assessment of the co-investments in very high capacity networks adopted pursuant to Article 76 EECC were developed without hindering NRAs experiences (i.e. in Spain, France) resulting in a very complex set of provisions de facto never used, thus depriving stakeholders of a legal framework that could have provided a stable and predictable regulatory framework for co-investments in fibre deployments.

Another example could be BEREC Guidelines on Common Approaches to the Identification of the Network Termination Point (NTP) in different network topologies from March 2020, which were intended to assist NRAs in consistently identifying the NTPs and provide guidance how to consistently define the NTP, but they left room for different specific interpretations and did not bring desired harmonisation effect across EU.

⁷⁰ In particular, it was not successful in shifting auctions from money making into more pro-investment oriented and in rectifying cases of artificially induced spectrum scarcity or artificially induced unsuccessful market entry which resulted in inflated spectrum prices. This in turn affected the ability of operators to invest in high quality 5G connectivity (e.g. DE or CZ).

the D2D satellite service⁷¹, where RSPG signalled that some of the issues need to be addressed by BEREC. Both BEREC and RSPG are adopting their opinions aiming for compromise on sensitive issues, accommodating different national views, in some cases to the detriment of the broader EU perspective. Both BEREC and RSPG rely on the resources of their members for the work on substance, which bears certain limitations⁷².

Furthermore, a governance set up with multiple layers and involvement of different authorities at national and EU level affects also the ability of the actors to have a full overview of all aspects of the market. For example, as regards network resilience, although NIS2 and CER harmonise minimum requirements for risk management by digital infrastructure entities, enforcement is left to the Member States. Approaches that focus on risks at the national level tend to overlook interdependencies affecting multiple Member States simultaneously. There is lack of sufficient strategic coordination when it comes to network resilience and preparedness⁷³.

The identified flaws affect the functioning of the market, as the governance set up has impact on how and at what level regulatory decisions are being taken. The governance determines which authorities and to what extent can influence those decisions, whose impacts on connectivity, investment and competition are intertwined, and – as observed in the Letta report – the divergences in the approaches of the involved authorities at different regulatory levels hinder the long-term objective of a genuine Single Market.

The above analysis is further supported by the findings of the evaluation report, as summarised in the below table.

Table 5: Evaluation report findings on governance

EVALUATION FINDINGS:	ANNEXES SECTIONS
Independence of NRAs: - The EECC introduces stronger formal safeguards for NRA independence, especially concerning the appointment and dismissal of leadership. - Member States retain substantial discretion in implementing these provisions, resulting in varied national approaches. - Despite a harmonised EU-level framework, both de jure and de facto independence of NRAs continue to differ across countries. - Adequate financial and human resources for NRAs remain essential to ensure effective performance and contribution to EU-wide regulatory coordination through BEREC.	Annex 11, section 9.1
BEREC and BEREC Office: - BEREC has effectively delivered on its core objectives and guidelines, though these alone cannot fully drive single-market integration due to necessary national flexibility.	Annex 11, section 9.2 and appendix III to the Evaluation Report.

⁷¹ Radio Spectrum Policy Group, Opinion on the EU-level policy approach to satellite Direct-to-Device connectivity and related Single Market issues, 17.06.2025, RSPG25-020 FINAL, https://radio-spectrum-policy-group.ec.europa.eu/document/download/72e52901-fa1a-474a-9480-a222c5b36545_en?filename=RSPG25-020final-RSPG_Opinion_on_D2D_and_Single_Market_Issues.pdf

⁷² Relying fully on the resources of their members for the work on substance means that any constraints that the relevant authorities have, be it of budgetary nature, staffing or workload, are reflected in their ability to effectively contribute to the work of BEREC and RSPG.

⁷³ See also the last conclusion in the evaluation findings on the lack of pan-European approach to preparedness and resilience of connectivity networks.

EVALUATION FINDINGS:	ANNEXES SECTIONS
- Rapid expansion of EU digital regulation—including the DSA, DMA, Data Act, Data Governance Act, and AI Act—has created new responsibilities for national authorities that are not reflected in BEREC’s mandate, limiting coherent EU-wide action. - NRAs lack many of the powers needed in new digital areas, making BEREC increasingly dependent on structured cooperation with other authorities and on developing new skills. - Technological convergence involving cloud, edge computing and AI requires BEREC to broaden its expertise and adapt to a more EU-focused governance approach addressing resilience and sustainability. - Even when taking into account existing instruments addressing the physical or cyber resilience of infrastructures, not sufficient emphasis is given to the EU preparedness for crisis and to the role of national regulatory authorities and BEREC in enhancing the EU preparedness based on an EU networks’ contingency plan. - The BEREC Office provides solid support but needs stronger analytical, data and professional capacities to meet growing regulatory and technological challenges. - Efficiency is hindered by reliance on larger NRAs, uneven expertise across authorities, high staff turnover in the BEREC Office, and insufficient IT tools; providing more content-related support could improve balance and the quality of outputs. - BEREC’s ability to produce coherent outputs would improve through deeper work on emerging topics such as AI, cybersecurity, sustainability and spectrum, particularly for cross-border satellite services. - Although BEREC brings clear EU added value, its consensus-driven structure and limited mandate restrict its role in advancing harmonisation and ensuring relevance as markets become more pan-European and complex.	Annex 11, section 3.4 General objectives (on the resilience of infrastructures)
RSPG: - The RSPG provides high added value to EU spectrum policymaking through its opinions, reports, and strong contribution to WRC preparations, despite operating with very limited administrative resources. - The RSPG has a tendency to focus mainly on technical issues, and to a lesser degree on economic, political, cultural, strategic, health and social considerations, which are also part of its mandate. Sometimes, the opinions lack the EU vision. - Effectiveness of its peer review mechanism is increasingly constrained: it has not influenced national authorisation practices, and voluntary participation prevents consistent alignment with EECC objectives. - The RSPG Good Offices lack appropriate tools for solving interference issues with third countries or, between Member States involving the non-EU harmonised spectrum. - Member State participation and engagement vary significantly, with smaller administrations often unable to contribute across all workstreams, limiting the group’s ability to produce balanced and comprehensive outputs. - Cooperation with other EU bodies—especially BEREC—is insufficient, hindering the development of holistic, cross-sector spectrum policies and weakening coherence across the governance framework.	Annex 11, section 9.3.

2.2. What are the problem drivers?

2.2.1. Fixed networks

The deployment of fibre networks and the take-up of fibre-based services has developed differently across the EU.

Regulatory approaches and business choices have had a significant but varied influence on fibre deployment and on the FTTH coverage achieved to date. The first section below presents the effects of the various regulatory approaches and business choices on fibre deployment. The second section describes why the persistence of copper networks has been detrimental to fibre deployment and take-up.

It should be mentioned that other aspects are also relevant but are not analysed in detail because they cannot be directly addressed by policy interventions. These are for example, consumer inertia, social/cultural preference for fibre technology, income levels and price sensitivity.

The table below provides a concise overview of the problem drivers and how they relate to the core issue i.e., slow deployment and adoption of fibre.

Table 6: Causal link between root causes/problem drivers and problem

Problem drivers/root causes	Causal link with slow deployment and adoption of fibre
1) Regulatory approaches and business choices	The delay in regulating ducts and poles, the technology choices made by incumbents and the incentives for FTTC deployment have reduced FTTH investments in certain countries.
2) Persistence of copper networks	The persistence of legacy copper infrastructures decreases operators' incentives to deploy FTTH networks and, where FTTH exists, end-users' willingness to adopt fibre services.

2.2.1.1. Regulatory approaches and business choices

The current EU regulatory framework aims at creating a pro-competitive and investment-friendly regulatory environment. One of the objectives is the promotion of connectivity and access to and take up of VHCN. The market environment has changed dramatically as a consequence of investments required to replace the copper networks by fibre and the emergence of players other than the historic telecom incumbents that are deploying FTTH networks. Nevertheless, the EECC has no provisions specifically promoting FTTH investments.

However, the various national implementation by NRAs, choices by other national authorities as well as business choices by operators led to differentiated results across and did not ensure the implementation of strategies to achieve (close to) full FTTH coverage across the UE as defined in the DDPP.

Overall, the regulatory approaches described below do not offer an EU-wide solution to rapidly and effectively increase FTTH coverage and take-up but provide overview of which practices seem to have worked in which specific circumstances.

A more detailed description of the different countries and the various regulatory approaches can be found in Annex 7.

Competition driven fibre deployment

Bulgaria and Romania have achieved high fibre (FTTP coverage above 90%) through competition driven fibre deployment. Alternative network operators did not use wholesale access to the incumbent's copper network; they grew through investing into their own network. In Romania, the main alternative operator initially invested in coax and afterwards replaced its network with fibre. In Bulgaria, numerous local operators of LAN (local access networks) and coax networks (DOCSIS 3.0), replaced their networks with fibre in response to the increased demand, indirectly incentivising the incumbent to deploy fibre networks as well. Hereby, low deployment costs was a crucial factor enabling this strategy, especially due to commercial access to poles and less stringent rules (regarding deployment) in Romania, and the effective access to physical infrastructure (initially as a remedy under SMP regulation, and afterwards through symmetric rules under the Broadband Cost Reduction Directive BCRD⁷⁴) in Bulgaria.

In Poland and the Baltic states, fibre deployment has been primarily driven by competition from hybrid coax-fibre networks. In large cities in Poland, the presence of upgraded cable networks with good service quality forced the incumbent to replace its copper network with fibre. Similarly, in large cities in Latvia and Estonia infrastructure-based competition drove the incumbent to invest into fibre. However, since infrastructure competition emerged mainly in densely populated urban areas, full fibre coverage is unlikely to be achieved solely based on this type of competition.

Countries characterised by the historic presence of two nationwide parallel networks i.e. a copper and a cable network are Belgium, the Netherlands and Malta. While there are some similarities in market structure (i.e. nationwide duopoly), there are significant differences in outcome.

In the Netherlands and Malta, competition between the copper and cable networks has led to fibre deployment by the operators. However, a similar starting situation in Belgium (presence of parallel copper and cable network) has not yet led to significant fibre deployment, possibly due to higher deployment costs.

Access to physical infrastructure (PIA)

Access to PIA, especially a well-developed duct system can greatly facilitate fibre deployment. The Spanish regulator decided early on to regulate access to the ducts and copper network but left newly deployed networks unregulated. As a result, alternative operators could receive wholesale access to the copper network to start developing their business (short term solution) and deploy their own fibre network in the ducts as a longer-term strategy. The success of this approach relied on the extensive duct system of the incumbent (117 000 km of ducts were used by network operators) and the fact that access seekers use only regulated passive networks of Telefónica to deploy own fibre.

The approach in Portugal has also been based on the promotion of access to PIA, which allowed for partial deregulation of wholesale access.

The French regulatory model (since 2009) relies strongly on access to Orange's PIA (instead of access to the fibre network). This is combined with symmetric access to the in-building wiring or to cables going beyond the building (depending on the area).

⁷⁴ Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks, OJ L 155, 23.5.2014, p.1, ELI: <http://data.europa.eu/eli/dir/2014/61/oj>.

In all the above cases, access to the SMP operator's PIA was a crucial element. However, even with the presence of a well-developed PIA, State aid and a long-time horizon (at least 10 years) was necessary to reach a high level of fibre coverage.

Fibre deployment by municipal or public companies

In the Nordic countries, public and local authorities have invested in fibre deployment via their utility companies. Those networks were built in parallel with the existing infrastructures of the local incumbent operators. Part of these networks is based on a wholesale-only model, meaning the network operator has no downstream retail business but offers wholesale access to its network. Access seekers can use the utilities' fibre networks and do not need to invest in their own networks.

In Ireland, the joint venture between an energy company (SIRO) and an alternative operator (Vodafone) has been deploying a fibre wholesale-only network. The vertically integrated incumbent has also been rolling out a fibre network.

Choice of FTTC over FTTH

The incumbent operators in Germany, Italy, Greece, Belgium, Czechia and Austria followed a partial network upgrade strategy. They have replaced the copper wires with fibre until the street cabinet (fibre-to-the-cabinet or FTTC) but left copper for the final part. Such a network, combined with vectoring (a technology allowing to increase the speed over copper at relatively low costs) provides better level of services for end-users. The business choice of the incumbents was influenced by the topology of the network, the specificities of the countries concerned and the motivation to improve service quality quickly and cheaply. However, the short-term success of the strategy reduced the incumbents' incentives to invest into FTTH and has resulted in very low FTTH coverage in the mentioned countries.

Regulators in these countries did not adopt measures to effectively incentivise FTTH deployment. In particular, they did not give access to PIA (or imposed this only recently), but mandated access to active products. This allowed for service-based competition at retail level but did not stimulate infrastructure competition and fibre deployment.

Based on the above analysis (more detailed in Annex 7), although there is no one solution fitting all circumstances, some general trends can be identified, for example countries that chose upgrading the legacy copper networks (FTTC) currently lag behind with fibre deployment. When it comes to access regulation, countries where regulators followed the incumbent's choice of FTTC are characterized by persistence of copper networks and slow deployment of fibre. Conversely, countries in which NRAs decided to facilitate access to civil infrastructures have been more successful in fibre deployment.

In addition, the following factors were key for the roll out of fibre: 1) central planning based on geographic surveys (e.g. France); 2) the use of symmetric measures. Public authorities support either by state aids or by direct investment via publicly owned company has also played an important role.

Finally, the Evaluation report (Annex 11) underlines that the provisions of the EECC setting out the conditions for copper switch off by operators having significant market power were not aimed at facilitating copper switch off and in many cases delayed the process.

2.2.1.2. Persistence of copper networks

The persistence of legacy copper infrastructures decreases operators' incentives to deploy FTTH networks and, where FTTH exists, adoption of fibre-based services by end-users.

In general, countries with a high share of copper networks have lower fibre coverage than those with a low share⁷⁵. One of the reasons for that is that the presence of a copper network reduces the incentives of **deploying** a fibre network in the same area. Deploying a new fibre network is capital intensive, therefore it is crucial that the new network attracts significant number of customers within a relatively short period. To reduce the risk of not reaching a critical number of customers (demand risk), network operators typically collect commitments from a minimum number of potential customers to subscribe to fibre-based services before they go ahead with deployment. In areas covered by a copper network, end-users' incentives to commit to subscribe to fibre-based services is lower than in areas without a copper network, especially if the copper network can provide speeds above 100 Mbps). This can translate into insufficient demand at the stage of assessing the economic feasibility of deployment and ultimately result in no or delayed deployment of the FTTH network.

The link between the presence of a copper network and the **adoption** of fibre-based services is more direct than with deployment. Customers on copper networks may delay the migration to fibre due to inertia, higher price, the possible works needed for bringing fibre to their homes or (perceived) lack of need. This can result in low take-up of fibre-based services (39% of broadband subscriptions in 2025)⁷⁶ and insufficient revenues for the fibre network operator. In turn, the low take-up can lead to charging relatively high prices for fibre services to cover investment costs⁷⁷. Higher prices will further reduce demand and take-up. If new fibre networks turn out to be unprofitable, investors will be unwilling or at least less likely to finance the deployment of new fibre networks. This means that the low take-up on existing fibre networks can also slow down further fibre deployment.

As can be seen from the following chart, a common factor amongst the countries with the lowest fibre deployment (Greece, Austria, Czechia, Germany, Belgium and Italy) is the high share of upgraded copper networks (specifically FTTC). As previously explained, FTTC deployment, which allows for the achievement of increased speed with relatively low capital investment, appears to have reduced the relevant operators' incentives to invest into FTTH.

In the absence of any rules to limit an incumbent from discriminating against alternative networks in the copper switch-off process, the incumbent's business case for fibre deployment is considerably stronger than that of entrants. This is particularly true for wholesale only companies which lack any retail customer base of their own, but is also true for alternative operators, which typically have lower broadband retail market shares than that of the incumbent, and therefore a smaller customer base which could be transferred to a new fibre

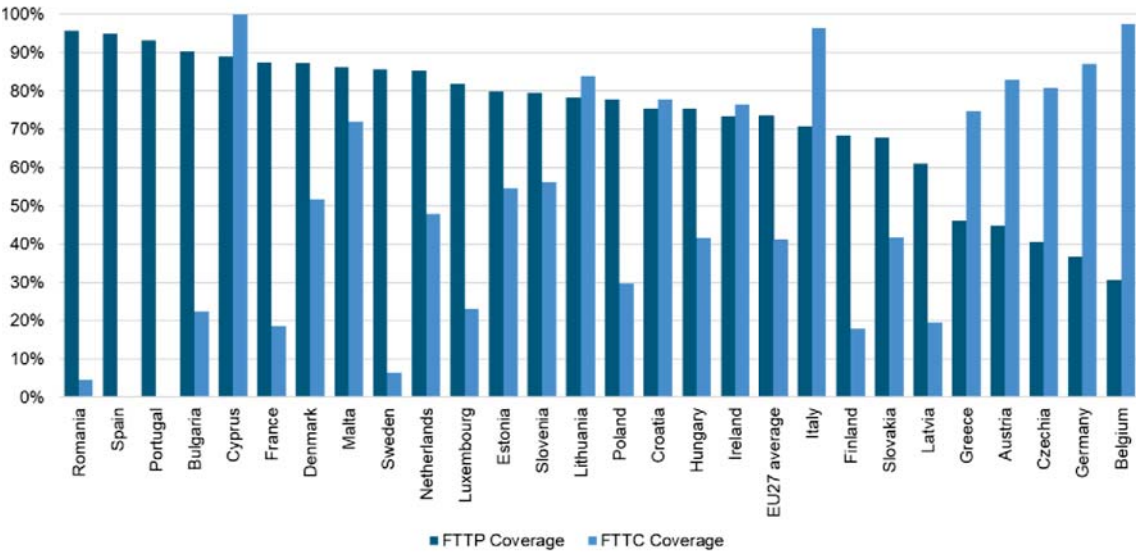
⁷⁵ A common factor amongst the countries which lag furthest behind in FTTP deployment is upgraded copper networks (FTTC/VDSL) were widely deployed by the incumbent. The deployment of this interim technology may have provided short term gains for incumbents in terms of lower capital intensity, while allowing them to improve the speeds they offered to customers. However, it also implies that the required investments in FTTH (i.e. the deployment of fibre from the distribution point to the premise, and (for MDUs) in-building) were deferred to a later stage. Those countries are: Belgium, Germany, Czechia, Austria, Greece.

⁷⁶ Study on Access Regulation.

⁷⁷ A comparison of OECD price baskets from 2023 also shows a higher price level for retail Gigabit broadband in countries where there is lower fibre coverage, showing that Gigabit has been priced at a premium – presumably to differentiate from lower bandwidth offers available via VDSL and cable.

network. Indeed, fibre networks that were deployed by alternative fibre investors in countries where there is widespread persisting competition from legacy upgraded copper (FTTC) or cable networks have struggled to reach profitability, due to the low take-up on the new fibre networks, which restricted the revenues needed to make a return on the levels of capex invested.

Figure 9: FTTP and FTTC coverage per Member State



Source: WIK based on European Commission / OMDIA and Point Topic (2025).⁷⁸

2.2.2. Mobile networks: Spectrum regulation and market factors slowing down investment in high quality mobile connectivity

Currently, **investment incentives** for high-quality 5G deployment are **negatively affected by** several interrelated **problem drivers and root causes**, most notably market factors limiting monetisation opportunities and fragmented, insufficiently investment-conducive spectrum regulation. Table 7 summarises these drivers and their link to insufficient investment in high-quality mobile connectivity.

Table 7: Causal link between Root causes/Problem drivers and Problems for mobile networks

Problem driver/root causes	Causal link with the underinvestment problem
1) Spectrum related regulatory fragmentation and disincentives to invest in high quality mobile connectivity	The discrepancy in assignment timelines, auction conditions (market shaping measures, coverage obligations, reserve prices, insufficient flexibility for spectrum sharing) negatively affects predictability and leads to different market outcomes (in terms of spectrum costs per MHz, investment, mid-band coverage (from 30% to 100%) and network speeds. Cost of spectrum rights could be artificially inflated by e.g. limiting the amount of auctioned spectrum, use of market shaping measures, negatively affecting mobile operators’ investment capacity. Cost of capital employed for new spectrum rights’ acquisition or retaining the existing ones without guaranteeing adequate return could impede mobile operators to invest more in the network deployment.

⁷⁸ European Commission/OMDIA and Point Topic (2025): Broadband coverage in Europe 2024 – Mapping progress towards the coverage objectives of the digital decade – Final report, <https://data.europa.eu/doi/10.2759/9441597> (last accessed on 14.07.2025).

Problem driver/root causes	Causal link with the underinvestment problem
2) Lack of financial attractiveness and predictability	Uncertainty about revenue opportunities for mobile network operators: Operators do not deploy if they are not certain to monetise investments, especially if average revenue per user (ARPU) levels are already low compared to international competitors (see comparison in Annex 11). Decreasing revenues per MHz, compared to the increasing amount of spectrum needed to provide high quality 5G services. Financial investors are reluctant to support mobile projects due to risks related to low predictability (recurrent spectrum reauctioning with unpredictable auction conditions, insufficiently long licences). Low predictability of 5G SA projects affecting cost of capital.
3) Low demand for high quality 5G connectivity and “chicken and egg” effect	There is low take up of bandwidth-intensive quality assured services which would offer monetisation opportunities through network slicing, but demand also does not develop due to lack of availability of quality assured services .
4) Inefficient spectrum use due to insufficient sharing	Unexploited potential of sharing, secondary spectrum trading and local licencing have led to underutilisation of spectrum & inefficiencies inhibiting optimal spectrum reallocation, despite increasing spectrum needs, including from private networks
5) High cost of high quality 5G/6G and unexploited economies of scale	Investment decisions are more difficult when investments costs for high quality 5G deployment are increasing , as for example for network densification and economies of scale are not exploited.

The problem drivers summarised above and further analysed below aim to provide a comprehensive picture of the main factors leading to insufficient investment in high-quality mobile connectivity. However, while low demand and limited monetisation opportunities are significant contributors to underinvestment in high-quality 5G, **spectrum regulation** remains primarily a **supply-side intervention**. Consequently, spectrum options presented in section 6.2. address supply-side drivers, namely regulatory fragmentation, limited predictability and inefficient spectrum use. Nonetheless, spectrum measures may also generate **demand-side effects**: Improved quality of service, wider network coverage and, potentially, lower retail prices (to the extent they depend on spectrum costs) can stimulate demand, e.g. by enabling quality assured services and addressing the “chicken and egg” issue. The options also aim to broaden access for specific private and temporary use cases. Demand is further expected to be supported by the ongoing spectrum harmonisation for private networks.

2.2.2.1. Spectrum related regulatory fragmentation and lack of predictability

The speed of 5G deployment and the quality of service also depend on the availability of sufficient spectrum accessible under **predictable, investment-friendly conditions**. In this context, the Draghi report highlights a problem of fragmented, “uncoordinated spectrum policies across Member States mostly designed to maximise frequencies pricing”. This is contrasted with the situation in the US, where centralised spectrum governance supports large-scale, nationally coordinated auctions with uniform licensing conditions, thereby facilitating rapid deployment of new technologies and cross-border service provision.⁷⁹ The Draghi report further stresses the “costly proliferation of different obligations for EU telecom operators, with limited consideration for investment commitments, service quality or innovation”. Although the EECC harmonised certain aspects of assignment of 5G spectrum, Member States still retain a significant degree of discretion over auction design and conditions attached to spectrum use

⁷⁹ See Annex 10.

rights. This has led to significant discrepancies in assignment timelines and **fragmented application of award and authorisation conditions associated with different outcomes in terms of 5G coverage, quality of service and underlying investment.**⁸⁰

Fragmentation in spectrum regulatory approaches outlined above is reflected in **substantial differences in market outcomes** across the EU in terms of 5G mid-band coverage, download speeds, upload speeds, latency and consumer prices. The box below summarises the analysis of regulatory design in 5G auctions and its relationship with market outcomes and investment incentives.

Evidence of regulatory fragmentation and lack of predictability in EU spectrum assignment

The fragmented nature of European spectrum governance was particularly evident in the **assignment of the 5G pioneer bands** (700 MHz, 3.6 and 26 GHz). These bands were made available at different times across the EU.⁸¹ The overall authorisation process spanned over a decade and about half of Member States did not meet the deadline of 31 December 2020. Some auctions applied demanding coverage and quality of service obligations as well as reasonable spectrum prices aligned with investment needs, while others pursued higher revenues, resulting in weaker coverage outcomes. **Auction designs reflecting long-term infrastructure goals** have proven more effective in promoting rapid deployment.⁸² In some Member States, **market-shaping measures** intended to promote competition, such as spectrum reservations and set-asides for new entrants and vertical users, instead deprived operators of spectrum needed to ensure quality of service and contributed to higher spectrum prices, reducing operators' investment capacity.⁸³ At the same time, increasing cost of new 5G and 6G deployment appears to reduce the feasibility of maintaining several parallel infrastructures, thereby weakening the potential of set-asides to sustain infrastructure-based competition.

Fragmentation is also evident in the wide divergence of **average spectrum prices** (€/MHz/pop). For the 700MHz band, prices range from €0.08 per MHz per population in Croatia and Estonia to more than €0.69 in France. For the 3.6 GHz band, values range from below €0.01 in Romania and Bulgaria to €0.38 in Italy. Lowest prices, generally below €0.002, are observed in the 26 GHz band due to limited range and early market stage. Although many factors influence auction prices, including broader economic conditions and competitive dynamics, national regulatory choices such as market-shaping measures and reserve prices also play a role. Such interventions may distort price formation in the auction process and push final prices above economically sustainable levels, reducing the resources for network investment.

Fragmentation also extends to licence duration and renewal conditions, **limiting predictability and creating uncertainty for long-term investment.** The EECC required Member States to ensure at least 20 years of regulatory predictability for wireless broadband services by granting licences with a minimum duration of 15 years, plus a possible 5-year extension based on clear criteria relating to spectrum utilisation and competition. In practice, Member States have interpreted and implemented this requirement in different ways. While 92% of pioneer band licenses from 2020 onwards were issued for 15 years or more, the duration of licenses has often

⁸⁰ See analysis in the section *Evidence of regulatory fragmentation in EU spectrum assignment* below.

⁸¹ Operators need a combination of spectrum bands to deliver high-quality 5G services, since no single band can effectively meet all 5G technical requirements on its own. Cf. Annex 10, section 2. Spectrum for 5G.

⁸² See Annex 11, section 5.4.4. Conditions of assignment (duration, coverage, price).

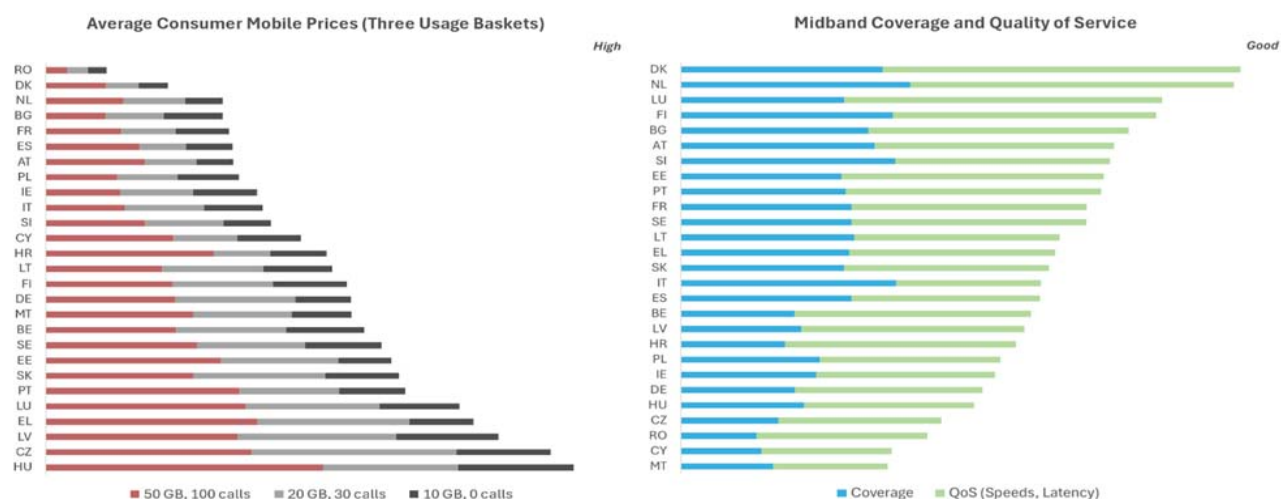
⁸³ See Annex 11, section 5.4.6 Market shaping measures. Corresponding correlations confirmed in the below analysis.

been insufficient to ensure adequate return on investments or to encourage more ambitious deployment of high-quality 5G networks and services.⁸⁴ The need for operators to obtain licences in several bands, combined with limited licence duration, requires participation in frequent re-auctioning, which increases uncertainty about the ability to reacquire existing rights and reduces operators' incentives for long-term network investment as well as the attractiveness to investors. According to GSMA, approximately 500 licences will expire in the next decade. Stakeholders increasingly call for longer durations, automatic renewals or indefinite licences with clear revocation safeguards and incentives for secondary trading. In the US, the FCC streamlined and harmonised licence renewal and service-continuity rules in 2017 to provide a consistent framework and predictable, expedited renewals where licensees continue to meet the initial requirements and use the band at or above those levels.⁸⁵

Analysis of the link between market outcomes and regulatory approaches on 5G auction design

As regards the effects of regulatory approaches on investment incentives, several conclusions can be drawn from the comparison of market outcomes and auction design across Member States. EU mobile markets are largely competitive, typically with three to four MNOs and consumer prices remaining relatively low by international standards. For example, EU mobile broadband prices are significantly lower than in the US.⁸⁶ Yet, consumer prices vary considerably across the EU. A similarly diverse picture emerges for Mid-band coverage and Quality of service: a combined indicator (based on mid-band coverage, latency, download and upload speeds) reveals substantial differences between Member States. The left panel of Figure 10 presents average consumer mobile prices across three usage baskets, with stacked bars indicating the contribution of each basket to the overall average. The right panel reports normalised mid-band coverage and quality-of-service scores, showing their respective contributions.

Figure 10: Consumer Prices, Mid-Band Coverage and Quality of Service across EU Member States



Left panel of Figure 11 shows overall mid-band performance by decomposing market outcomes into normalised coverage, quality and consumer price components (with higher price bars

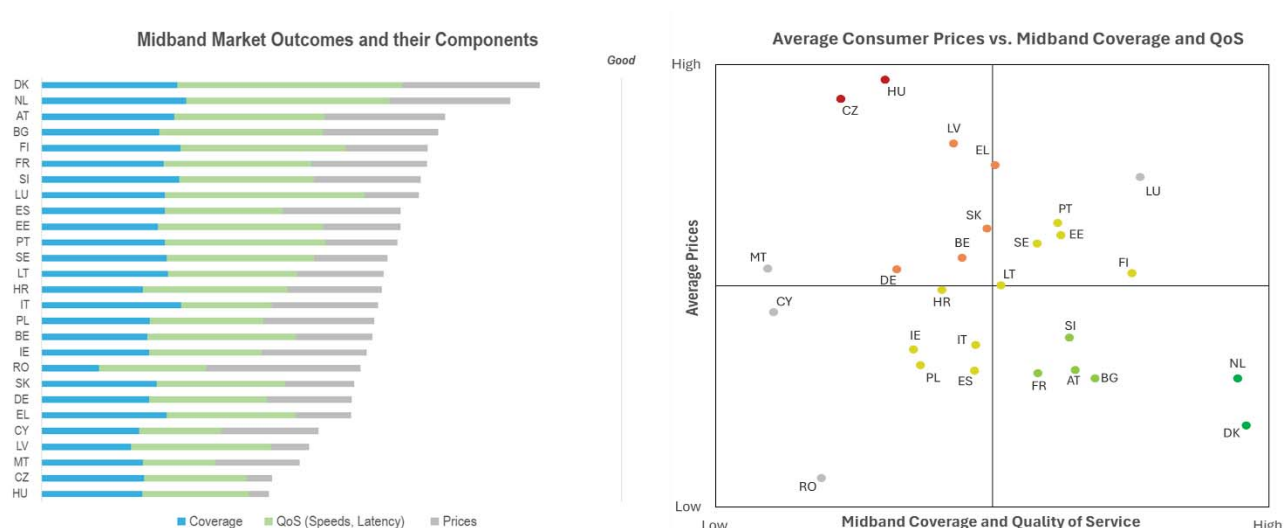
⁸⁴ See Annex 11, section 5.4.4. Conditions of assignment (duration, coverage, price).

⁸⁵ [FCC Reforms License Renewal Rules for Wireless Spectrum | Federal Communications Commission](#). For basic info on spectrum governance in the US, see also Annex 10, section 2.

⁸⁶ Mobile and Fixed Broadband Prices in Europe 2022, p. 23.

indicating lower prices here). The right panel plots z-standardised average prices against z-standardised coverage and quality scores, highlighting the diverse performance patterns observed across the EU.

Figure 11: Overall mid-band performance and Consumer Prices in Relation to Mid-Band Coverage & Quality of Service

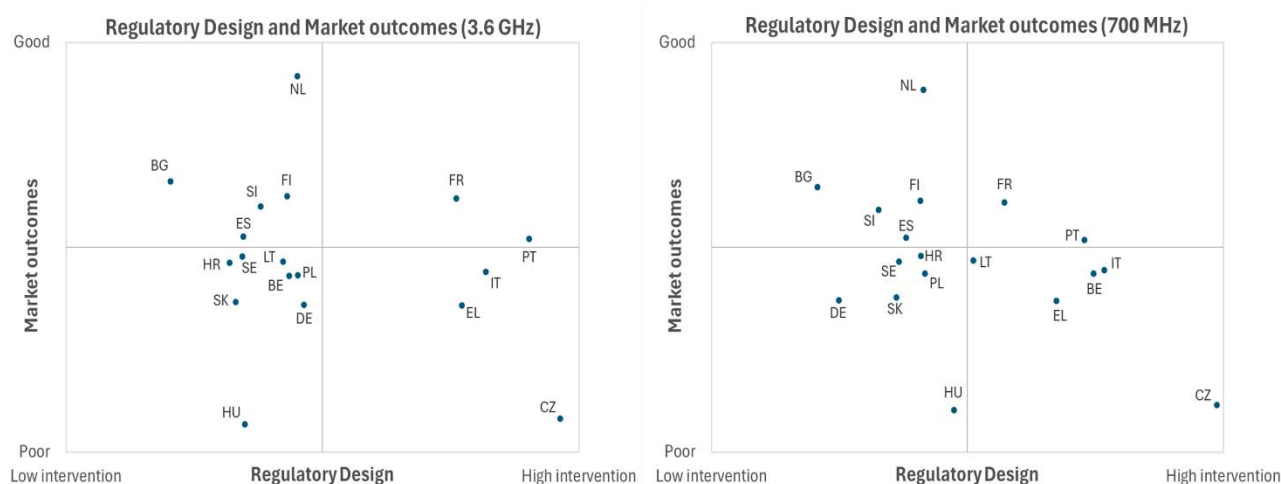


Differences in consumer prices, coverage and quality of service may be linked, alongside other factors such as demand, competition and GDP per capita, to Member States' diverse regulatory approaches to 5G spectrum assignment. The following analysis examines the **potential relation between market outcomes and key elements of regulatory design** in the 3.6 GHz and 700 MHz auctions. For initial insights, Figure 12 compares a composite measure of market outcomes, based on consumer prices, mid-band coverage and quality of service, with a composite measure of regulatory design that reflects spectrum caps, access obligations, auction prices and reservations or set-asides for new entrants and vertical users.⁸⁷ The **visual analysis** suggests that more interventionist regulatory approaches may, in some cases, be associated with less favourable market outcomes, particularly in the 700 MHz band. This might indicate that the more intrusive and less investment-oriented auction and award conditions currently applied in certain Member States may be linked to more limited coverage and quality of service as well as higher consumer prices. At the same time, the patterns observed in this simplified descriptive representation are not conclusive and do not amount to a statistical correlation. Rather, they motivate the subsequent regression analysis.⁸⁸

⁸⁷ Construction of these standardised measures, including the underlying scoring and weighting, is set out in Annex 4.3.

⁸⁸ Figures 10-12 and the indicative visual analysis rely on composite indicators of regulatory design and market outcomes, constructed using weighted underlying indicators. The weighting choices are described in Annex 4.2.5 and 4.3.10. While the weighting was designed carefully to reflect the most relevant factors, any aggregation of heterogeneous indicators involves methodological choices that may affect the presentation of outcomes. Accordingly, the figures and the associated visual analysis are included for illustrative purposes and are intended to be descriptive rather than conclusive and do not preclude the outcomes of the regression analysis done for each variable separately.

Figure 12 Regulatory Design and Market Outcomes in the 3.6 GHz and 700 MHz Bands



The **regression analysis**⁸⁹ performed for this impact assessment confirms that some elements of regulatory design are associated with material differences in market outcomes. While non-regulatory factors such as GDP per capita, population density, rural share and competitive structure – which are controlled for in the regression specifications – remain important determinants of investment and performance, several regulatory choices show consistent correlation with both operator incentives and end-user outcomes. Across the different model specifications, spectrum reservations and set-asides emerge as the regulatory variable most consistently associated with weaker outcomes. Higher set-aside and reservation shares tend to coincide with higher auction prices (€/MHz/pop), higher consumer prices, and lower 5G download speeds. Given that regulatory choices may also react to pre-existing market conditions, these results do not establish a causal link. Nonetheless, the observed associations are consistent with the intuition that restricting the effective supply of spectrum increases cost pressure on operators, dampens investment incentives and leads to weaker quality of service and higher consumer prices. While targeted access obligations may lower consumer prices, they also display a marginally significant negative correlation with overall 5G coverage, indicating a potential trade-off between affordability and investment incentives. Spectrum caps, although potentially useful for safeguarding competition when appropriately applied, do not appear to be systematically associated with differences in market outcomes. Coverage obligations also display little explanatory capacity for the observed variation in market outcomes, which, however, may reflect the difficulty of comparing such obligations across Member States given their diverse design, geographic context and implementation conditions.

The results suggest that certain auction and award conditions may provide insufficient incentives for investment in high quality mobile networks, as reflected in weaker outcomes in terms of coverage, consumer prices and quality of service, particularly where spectrum availability is restricted, or obligations reduce operational flexibility.⁹⁰ Our findings broadly align with recent empirical literature. Jung and Katz (2022) show that flexible and predictable spectrum policies, such as secondary markets and sharing frameworks, support higher investment, improved coverage and lower prices. Bahia and Castells (2022) link greater spectrum availability to higher coverage and faster download speeds. Zagdanski, Castells and

⁸⁹ Details and methodology of the analysis are set out in Annex 4.3 and in the Study on Digital Single Market.

⁹⁰ The methodology and possible limitations for this multiple regression analysis are explained in Annex 4, section 3.

Bahia (2025) find that higher spectrum prices correlate with weaker coverage and lower speeds. Sridhar and Prasad (2021) demonstrate that restricted spectrum supply and high reserve prices tend to elevate spectrum prices.

The above driver is supported by the analysis in the evaluation report as summarised in Table 9.

Table 8: Evaluation report findings on limited predictability, fragmentation, lack of Single Market

EVALUATION FINDINGS	ANNEX SECTIONS
Limited Predictability EECC's goal of ensuring 20-year predictability and enhancing investment certainty and business efficiency by supporting long-term planning has been only partially met Insufficient licence duration and insufficient guarantees for renewals Increased spectrum needs and need to participate to periodic spectrum re-auctioning under uncoordinated conditions.	See Annex 11, section 5.4.4. Conditions of assignment (duration, coverage, price)
Significant delays in the assignment of all three 5G pioneer bands - authorisation of 5G pioneer spectrum across the EU spanning over 10 years - about half of MSs has not met the overall deadline of 31 December 2020 - correlation exists between time of 5G spectrum assignment and 5G deployment and 5G population coverage	See Annex 11, section 5.4.2. Delays in 5G pioneer band assignment
Fragmented authorisation conditions across MS, however auction designs aligning spectrum awards with long-term infrastructure goals more effective in promoting rapid deployment. Market shaping measures leading to occasionally very high spectrum prices hampering operators' investment capacity. Reserve prices, leading to occasionally very high spectrum prices. Cost of spectrum: Average spectrum prices (€/MHz/pop) for 5G band (700 MHz, 3.3–3.8 GHz) in MS show a significant discrepancy in prices per MHz per population: For 700 MHz, from €0.08 (€/MHz/pop) (Croatia, Estonia) to over €0.69 (France). For mid-band (3.3–3.8 GHz), prices vary widely, from under €0.01 (Romania, Bulgaria) to €0.38 (€/MHz/pop) in Italy, highlighting differing national auction strategies and demand levels.	See Annex 11, section 5.4.7. Market shaping measures See Annex 11, section 5.6.3. Reserve prices for the 5G auctions See Annex 11, section 5.6.2. Spectrum costs
Lack of Single Market approach Ineffective assignment harmonisation due to voluntary peer review with limited impact. Unused voluntary joint authorisation procedure, as prospective users have cannot request it. Insufficiently effective support and solidarity provided by the EU and Member States in case of interference caused by a third country. RSPG good offices mechanism has not been fully effective in tackling cross-border harmful interferences (does not apply for non-harmonised bands & missing legal basis for coordination issues linked to interferences with third countries). Spectrum sharing is voluntary and has seldom been used and there has only been a limited and fragmented secondary trading market.	See Annex 11, section 5.5.1. Coordination/harmonization of assignments - Peer review Annex 11, section 5.6.3. on the Cost of Peer review See Annex 11, section 5.5.2 Spectrum coordination and addressing cross border harmful interferences See Annex 11, section 5.5.3. Spectrum sharing, transfer and leasing

2.2.2.2. Lack of financial attractiveness

Investment incentives for high-quality 5G are weakened by limited monetisation prospects and low demand for advanced mobile services. European mobile markets continue to generate considerably lower average revenue per user (ARPU) than major international peers,⁹¹ possibly due to highly competitive, low-price European markets.⁹² The Draghi Report similarly notes that revenues per subscriber are less than half of the levels observed in the US and Japan.⁹³ Moreover, revenue per MHz in Europe has declined sharply over the past decade, with GSMA data showing a 58% decrease between 2014 and 2024. The absence of tailored 5G offers based on network slicing further limits the revenue opportunities originally envisaged when operators bid for the 5G pioneer bands. At the same time, spectrum represents a substantial cost, accounting for around 7% of mobile service revenues and about 35–40% of capital expenditure, and operators' spectrum needs for delivering high-quality 5G are rising.⁹⁴ In addition, fragmented or insufficiently predictable spectrum conditions, including divergent licence durations and the need to participate frequently in re-auctioning processes⁹⁵ increase investment risk and constrain operator's ability to secure necessary financing. Financial investors echoed these concerns, highlighting the high and uncertain costs and demand risks associated with 5G deployments.⁹⁶ This contrasts with more positive attitudes to FTTH, which has attracted significant investments from long-term infrastructure funds.

This combination of low expected returns, uncertain monetisation prospects and non-negligible investment risk weakens operators' incentives and capacity to invest in high-quality 5G.⁹⁷

EEA Average

⁹¹ Connect Europe, State of Digital Communications, 2025. EU mobile ARPU (14.8 EUR/month) is considerably lower than in the US (41.70 EUR/month). Even when adjusted for GDP per capita, the US ARPU remains 67% higher (24.9 EUR/month). ARPUs in Japan, South Korea and China are all at least 33% higher than in the EU. Moreover, EU ARPU has been declining at a faster rate than in other economies having fallen 5.9% in 2022–2023, compared to a fall of 3.5% in the USA and a rise of 2.2% in China. (see Figure 11 in Annex 11, section 5.4.5).

⁹² In global comparison, Europe stands out as the region with the most affordable broadband services (See Annex 11.8).

⁹³ Mario Draghi, *The future of European competitiveness*, European Commission, Publications Office of the European Union, Luxembourg, September 2024. The report notes a similar relative position for European capex per capita.

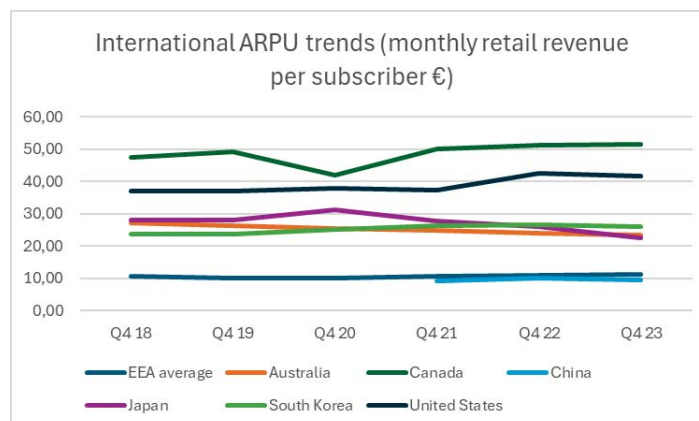
⁹⁴ GSMA, *Global Spectrum Pricing*, GSMA, May 2025, accessed 4 December 2025, <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/05/Global-Spectrum-Pricing-v2.pdf>.

⁹⁵ See section 2.2.2.3.

⁹⁶ Study on Finance and USO.

⁹⁷ The Draghi Report warns that Europe's telecom sector's lower investment capacity compared with major peers may constrain the rollout of state-of-the-art connectivity required to digitise manufacturing, supply and distribution chains.

Figure 13 International ARPU trends



Source: BEREC International Roaming Benchmark Data for EU, Connect Europe for China, Japan, South Korea and the US, Canadian Radio-television and Telecommunications Commission (CRTC): Communications Market Reports, Current Trends - Mobile Wireless

The above driver is supported by the analysis in the **evaluation report** as summarised in Table 9.

Table 9: Evaluation report findings on financial attractiveness of 5G projects

EVALUATION REPORT FINDINGS:	ANNEX SECTIONS:
Low financial attractiveness of 5G projects: Limited and decreasing mobile profitability /ARPU. Relatively high spectrum prices if compared to declining/low mobile revenues. While spectrum needs have increased over the last decade, average revenue per MHz in Europe declined by 58% between 2014 and 2024. Spectrum costs account for some 7% of mobile service revenues across Europe with spectrum costs represent about 35-40% of their capital expenditures. Spectrum cost negatively impacts coverage, speeds and services provided to end users: 10-percentage point (p.p.) higher spectrum cost to recurring revenue ratio decreased 4G and 5G coverage by up to 6 p. p. and average speeds by up to 8%.	See Annex 11, section 5.4.6. Mobile profitability and financial attractiveness Annex 11, section 5.6.2. Spectrum cost

2.2.2.3. Low demand for high quality 5G connectivity and “chicken and egg” effect

Demand-side conditions, including relatively low 5G take-up and low consumer willingness to pay for high-quality 5G, reinforce these challenges. Only around 40% of mobile data connections in Europe were 5G-based in 2025,⁹⁸ and full take-up is not expected before 2035.⁹⁹

⁹⁸ See GSMA (2025): The Mobile Economy Europe 2025, <https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/wp-content/uploads/2025/01/0125-Mobile-Economy-Europe-2025-web.pdf>, page 11.

⁹⁹ Study on Finance and USO.

This is partly due to operators initially deploying 5G largely in NSA mode in lower spectrum bands and delaying the launch of high-quality 5G networks. As a result, **users often experience limited performance improvements** compared with 4G and are sceptical about the potential advantages of high-quality 5G. Concerns about pricing of high quality 5G connectivity and insufficient information on expected download and upload speeds further limit consumers' willingness to upgrade. Demand for high-quality 5G is also held back by extensive off-loading of bandwidth-intensive content on mobile devices to Wi-Fi,¹⁰⁰ limited involvement of SMEs as main beneficiaries in pilot projects for enhanced services,¹⁰¹ and low adoption in the public sector.¹⁰² BEREC likewise identifies low demand and delayed availability of 5G SA as an important factor contributing to the slow 5G take-up in Europe.¹⁰³

As confirmed by the WIK Financial Study,¹⁰⁴ this creates a clear “**chicken-and-egg**” dynamic: On the one hand, operators hesitate to deploy high-quality 5G beyond mandatory (coverage) obligations where demand is uncertain and revenue prospects are limited. On the other hand, the absence of widespread high-quality 5G is a key factor behind the low take-up of bandwidth-intensive, quality-assured services, which would otherwise offer monetisation opportunities for operators.

2.2.2.4. Inefficient spectrum use due to insufficient sharing

A further driver of insufficient investment in high-quality mobile connectivity is the additional cost created by inefficient spectrum use. This inefficiency results from growing spectrum demand and scarcity, suboptimal use of sharing and trading mechanisms and fragmented local access frameworks.

Growing demand for wireless services is making access to spectrum increasingly difficult. **Spectrum scarcity** reduces spectrum utilisation, limits opportunities for new entrants, and delays the roll-out of high-quality 5G and other innovative services. Where operators cannot obtain sufficient spectrum, they must densify their networks to maintain quality of service, increasing their investment needs.¹⁰⁵ At a time of increasing spectrum scarcity, spectrum use is also hindered by inflexible authorisation conditions that complicate and increase the cost of spectrum sharing, transfers and leasing.

Despite its recognised benefits and practicality, **spectrum sharing** in the EU remains limited.¹⁰⁶ Where applied, it is typically implemented in static rather than more flexible dynamic forms.¹⁰⁷

¹⁰⁰ <https://wifinowglobal.com/news-and-blog/germany-wi-fi-carries-87-of-smartphone-traffic>
<https://www.opensignal.com/2024/10/31/wi-fi-drives-smartphone-data-consumption-in-the-us-but-trends-vary-across-operators>.

¹⁰¹ This may explain scepticism about the potential advantages this technology, as they have not yet experienced them (cf. interviews conducted in the context of the WIK (2023) study for BEREC on wholesale mobile connectivity and [Realising the Benefits of 5G \(publishing.service.gov.uk\)](#); DD 2030 Cyprus Report final.docx.pdf (dmrid.gov.cy)).

¹⁰² This is also indicated from interviews with MNOs conducted for WIK financial study.

¹⁰³ BEREC input to the consultation on the White Paper BoR (24) 100_1 and to the Call for Evidence.

¹⁰⁴ WIK Financial Study.

¹⁰⁵ See Annex 7, section 2.2.1. on Inefficient use of spectrum.

¹⁰⁶ Cf. Radio Spectrum Policy Group Opinion and Report on the status and outlook of spectrum sharing (see documents [RSPG21-022](#) and [RSPG21-016](#)); A prominent recent *international* example is the 2018 3-tier (military, licensed or unlicensed WBS) sharing arrangement for the 3 550 MHz to 3 700 MHz band within the frame of the so-called Citizens Broadband Radio Service (CBRS).

¹⁰⁷ As highlighted in the 2021 RSPG Report on Spectrum Sharing (RSPG21-022).

Often, unclear compliance requirements for coverage and quality-of-service obligations further discourage shared-use arrangements. Although the EECC promotes the **transfer and lease of spectrum usage rights**, inconsistent national implementation and the absence of centralised guidance have kept their uptake low. Feasibility and value of these mechanisms are often reduced by delays and additional costs arising from burdensome approval requirements and licence conditions, such as strict coverage obligations or short licence durations. While some Member States have introduced more flexible spectrum leasing models, others maintain rigid frameworks that hinder optimal reallocation. As a result, **secondary spectrum trading** remains rare, with only a few transactions in recent years.¹⁰⁸

In addition, **nationwide licences** remain the norm in the EU. While appropriate for MNOs serving the mass market, this limits industrial verticals such as manufacturers, ports or airports from obtaining spectrum rights on a location basis, often necessary for 5G high-quality assured service or reliability requirements. Where **local access** exists, it remains fragmented: At least 13 Member States have made spectrum available for local use, but in different frequency bands, through different procedures (auctions or on a first-come, first-served basis) and under diverse conditions, including variation in prices and licence durations (ranging from 5 to 20 years).¹⁰⁹ With no united EU framework in place, divergent national rules create uncertainty, limit economies of scale for equipment and replication of vertical use solutions and ultimately discourage investment in high-quality industrial 5G use cases.

Given the limited uptake of sharing and trading mechanisms and constrained local spectrum access, spectrum remains underused. This underutilisation is further reinforced by weak enforcement of tools such as “**use-it-or-share-it-or-lose-it**” provisions, intended to enable regulators to revoke or reassign unused spectrum to prevent hoarding.¹¹⁰ Their implementation varies across Member States. While Germany includes clear rollout obligations in some licences, others (e.g. Poland, Slovakia, Hungary) apply the principle more cautiously. In several states the clauses exist in legislation, but enforcement is poorly documented, raising uncertainty about their effectiveness. Outside the EU, “use-it-or-lose-it” rules are applied more consistently, with active enforcement in the UK, Canada and Australia.¹¹¹

Tailored local or shared-access regimes in other jurisdictions illustrate that more **flexible approaches** can unlock previously suppressed demand. Several **global peers** are taking advantage of **innovative technological tools** such as AI and real-time databases to improve spectrum utilisation. In the UK, Ofcom’s shared-access licences across several bands (1.8 GHz, 2.3 GHz, 3.8–4.2 GHz, 26 GHz) offer low administrative burden and affordable fees, attracting nearly 900 licensees by July 2024 and encouraging further expansion. In the US, the Citizens Broadband Radio Service (CBRS) framework enables dynamic sharing in the 3.5 GHz band among licensed, unlicensed and government users (e.g. maritime military radar), supporting thousands of deployments by 2023 and unlocking significant economic benefits.¹¹² By lowering entry barriers, CBRS has opened previously underutilised spectrum to a wide range of

¹⁰⁸ Examples include flexible models in the Netherlands and Finland, and more restrictive approaches in Poland. Recently, trading transactions have been recorded, for example, in Slovakia, Belgium and Latvia. See Annex 11, section 5.5.3.

¹⁰⁹ See Annex 11, section 5.4.3. Spectrum for industry: verticals and private networks.

¹¹⁰ See Annex 7, section 2.2.2. Insufficient flexibility for inter-service and intra-service sharing (“use-it-or-lose-it”).

¹¹¹ See Annex 11, section 5.5.3. Spectrum sharing, transfer and leasing (“use-it-or-lose-it”).

¹¹² See Annex 7, section 2.2.2. Insufficient flexibility for inter-service and intra-service sharing (CBRS)

applications, including private enterprise networks, industrial sites and rural broadband, with estimated annual consumer surplus of USD 8–26 billion¹¹³.

The above driver is supported by the analysis in the evaluation report as summarised in Table 10.

Table 10: Evaluation report findings on inefficient use of spectrum

EVALUATION FINDINGS	ANNEX SECTIONS
Inefficient use of spectrum - Massive increased needs of spectrum to provide higher quality of mobile services and to satisfy needs beyond the electronic communications sector. - Insufficient network sharing and fragmented secondary market across the EU with limited uptake of spectrum trading/leasing, with restrictive national policies inhibiting optimal spectrum reallocation. Growing importance of interservice spectrum sharing, i.e. between different users providing different services.	Annex 7, section 2.2.1. Inefficient use of spectrum: difficulty to satisfy increased demand due to spectrum scarcity. Annex 11, section 5.4.3. Spectrum for industry: verticals and private networks, and section 5.5.3. Spectrum sharing, transfer and leasing and Use it or lose it principle. Annex 7, section 2.2.2. Insufficient flexibility for interservice and intra service sharing.

2.2.2.5. High cost of networks and unexploited economies of scale

Further factors limiting investment in high-quality mobile connectivity are the high cost of deploying advanced networks and the limited scope for economies of scale in the EU, where several MNOs in each Member State operate largely parallel infrastructures under fragmented regulatory conditions.

High-quality 5G networks as well as future 6G networks are **significantly more costly to deploy than previous generations**. A major cost driver is network densification required to deliver high-quality service in terms of latency, data speeds and reliability.¹¹⁴ The need for densification stems from the use of mid-band and high-band spectrum, which can carry large volumes of data but provide limited coverage because of their propagation characteristics.¹¹⁵ To cover the same area, operators must deploy many more base stations and cells. In addition, many existing 4G base stations and backhaul links are insufficient for 5G performance, requiring operators to upgrade backhaul capacity, often through new fibre deployment or other high-capacity links. Standalone 5G also requires a new core network (“5GC”). These densification efforts, backhaul upgrades and the rollout of a virtualised 5G core with cloud-native functions substantially increase investment needs with the cost increase, depending on the deployment strategy.¹¹⁶ Precise cost estimates for 6G deployment are not yet available.

¹¹³ Harold Furchtgott-Roth, “The Potential Market Value and Consumer Surplus Value of the Citizens Broadband Radio Service (CBRS) at 3550-3700 MHz in the United States” (2017).

¹¹⁴ Such performance enables advanced 5G and future 6G features, such as ultra-reliable low-latency communications.

¹¹⁵ For further details see Annex 10 for Radio spectrum essentials and properties of 5G pioneer spectrum bands.

¹¹⁶ Studies indicate that full 5G deployment can cost 50–70 % more than 4G see GSMA: 5G-era Mobile Network Cost Evolution (2019). WIK-Consult 2023 study on investment and funding needs for the Digital Decade indicates that investment requirements for full 5G in midband spectrum are three times higher than that for basic 5G.

Nevertheless, many of the structural drivers¹¹⁷ of higher 5G costs are likely to persist, suggesting that deployment costs will remain high. Moreover, operating multiple network generations simultaneously (2G/3G/4G before switch-off, alongside 5G SA and later 6G) entails parallel infrastructure and maintenance costs.

The high fixed costs associated with deploying advanced networks also increase the relevance of **economies of scales**. Traditionally, economies of scale have been assumed less pronounced in mobile than in fixed markets, where infrastructure duplication is typically uneconomical. Spectrum policy for mobile networks was therefore designed on the expectation that several parallel mobile networks could be viably sustained. Currently, three to four MNOs are present in most Member States.¹¹⁸ With the cost-intensive transition to high-quality 5G, however, recovering fixed investments over each operator's customer base has become more challenging, weakening the business case for full 5G roll-out, particularly in less densely populated and lower-revenue areas.¹¹⁹ Several studies confirm that limited economies of scale arising from the high fixed costs of 5G deployment can constrain the number of economically viable parallel networks.¹²⁰ A WIK study on 5G network development in Denmark highlights the economic challenges of replicating full 5G infrastructures across multiple operators.¹²¹ An EU study suggests that regulatory attempts to achieve four-player mobile markets through, inter alia, spectrum reservations or caps may have weakened investment incentives by assuming levels of duplication that are not sustainable under the cost structure of full 5G.¹²²

A comparison with the U.S. illustrates how **centralised spectrum governance facilitates economies of scale**, while **regulatory fragmentation limits the scope for similar efficiencies in the EU**. In the USA, three nationwide mobile service providers – AT&T, T-Mobile and Verizon – collectively account for around 371 million connections and hold approximately 82% of spectrum available to mobile communication.¹²³ Together with smaller operators, they benefit from a highly centralised spectrum governance system: A single federal licensing regime, uniform coverage conditions and centralised interference management reduce transaction costs and allow consolidation of compliance, engineering and legal tasks, thereby supporting nationwide planning and investment.¹²⁴ In the EU, similar economies of scale cannot be fully replicated. Even if new spectrum were assigned at EU level or under fully harmonised authorisation conditions, other regulatory frameworks such as data protection security, privacy, lawful interception, data retention and end-user protection would remain nationally fragmented.

¹¹⁷ These include densification requirements, higher-capacity backhaul, increased core and edge complexity linked to virtualised and cloud-native architectures, and the need for new spectrum bands to meet higher performance requirements.

¹¹⁸ For a distribution of mobile markets with three and four MNOs in the EU, see Annex 7, section 2.2.3.

¹¹⁹ See WIK financial study findings.

¹²⁰ "Investment and funding needs for the Digital Decade connectivity targets" <https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets> and the economic challenges of replicating full 5G mobile networks are also referenced in a study by WIK on the implications of 5G for network development in Denmark https://digst.dk/media/anppemw3/final_mobile_report_denmark_clean_non-confidential.pdf.

¹²¹ https://digst.dk/media/anppemw3/final_mobile_report_denmark_clean_non-confidential.pdf.

¹²² See WIK financial study, section 4.1.3. on economies of scale.

¹²³ 2024 COMMUNICATIONS MARKETPLACE REPORT, FCC, December 30, 2024.

¹²⁴ See Annex 10.

These divergent requirements result in higher compliance costs and the need to address national specificities, limiting operators' ability to achieve comparable efficiencies.¹²⁵

2.2.3. *Fragmented authorisation conditions, not allowing to operate across the EU*

2.2.3.1. Fragmented general authorisation conditions

The key drivers of problems with the **general authorisation (GA)** regime in the EU electronic communications sector arise from the Directive's regulatory flexibility, which has led to fragmentation and inconsistent application of the GA conditions. The EECC harmonised the list of possible GA conditions, but it remained maximum and national discretion was kept on attaching the conditions. Consequently, Member States did not take a uniform approach to GA regime and introduced divergent secondary legislation and/or administrative (regulatory) decisions to further specify the conditions. This situation results in potentially up to 1 053 conditions specified at national levels, a cross-border operator (present or with a regulatory footprint in 27 Member States) could be required to comply with. This complexity makes compliance burdensome and fragmentation costs linked to GA, for staff necessary for compliance with the divergent conditions for such an operator could range between EUR 0.50–1.20 million per year, or even up to EUR 6–11 million per year/operator if the totality of compliance costs (the need to align with all the national conditions) is taken into account.¹²⁶

Additionally, diverging security, data-related and privacy requirements further complicate operations for cross-border providers, particularly due to differences in rules on data retention, lawful interception, and network localisation. For instance, according to the EECC¹²⁷ NI-ICS are exempted from the condition for enabling lawful interception and hence, some Member States took a different approach towards such services providers¹²⁸. Next, procedural inconsistencies, such as the non-mandatory use of BEREC's notification template or no notification requirement at all¹²⁹ and the lack of standardised reporting formats, lead to varied administrative obligations across Member States. For a detailed analysis and evidence see evaluation report, Annex 11.

The lack of Single Market is becoming more evident especially with the ongoing technological and market transformation taking place in the electronic communications sector. Content and Application Providers (CAPs) and cloud providers are increasingly entering the electronic communication networks market with investments into content delivery networks, submarine cables, backbone networks, and edge/cloud platforms; however, they benefit from a 'Country of origin' regime for their operations, while traditional telecom players currently need to comply with 27 sets of rules, as further detailed in section 2.2.4. and are hence disincentivised from providing cross-border services. This leads to limited deployment of advanced and resilient connectivity and opportunity cost of foregone innovation (for examples of innovative services see section 2.1.3). Similarly, lack of cooperation between actors in this extended connectivity ecosystem limits the delivery of such innovative services. Moreover, the provision

¹²⁵ For an analysis of elements related to an EU-level authorisation for terrestrial spectrum see section 6.2.3, as well as sections 2.1.3, 7.2 and 8.1.2. General authorisation aspects are discussed in section 1.4. of Annex 11 (Evaluation report).

¹²⁶ See section 2.1.3 of the IA and Annex 3, section 2.3. and Annex 4, section 1.6 to this report with more detailed information on that estimation.

¹²⁷ Part A, Nr 4 Annex I of the EECC.

¹²⁸ Reference in section 4.3.3 and 4.3.4 of the Final 1st Interim Report on Completing the Single Market.

¹²⁹ In France.

of such services (e.g. network slicing to provide “specialized services” under the OIR) may require further regulatory predictability.

Table 11: Causal link between root causes/problem drivers and problems

Problem driver/root causes	Causal link with the general authorisation problem
Divergent national implementation of GA rules	Produces inconsistent conditions and fragmented authorisation practices across the EU.
Limited coordination and inconsistent procedures	Leads to varying notification and reporting obligations, reducing predictability for operators.
Insufficient EU-level oversight and alignment mechanisms	Allows divergence to persist over time, maintaining complexity and compliance burdens.
Asymmetry with CAPs/cloud providers and weak cooperation within the connectivity ecosystem	Creates unequal treatment, hampers coherent development of cross-border/innovative services, and discourages telecom operators from scaling across the Single Market.
Lack of mechanisms for gradual alignment of national rules,	Prevents convergence over time and maintains high compliance burdens for multi-country operators

2.2.3.2. Fragmented satellite authorisation conditions

Table 12: Causal link between root causes/problem drivers and problems

Problem driver/root causes	Causal link with the satellite authorisation problem
Diverse satellite selection and spectrum authorisation and procedures inadequate to address D2D challenges	Delays in the provision of pan-European satellite services, lack of EU satellite spectrum selection procedures representing a potential barrier to EU provision of certain services undermining EU global competitiveness in satellite connectivity
Unexploited economies of scale due to fragmented satellite spectrum authorisation conditions	Cost of dealing with fragmented satellite spectrum authorisation processes and conditions in 27 MS, and risk of having authorisation gaps in some MS, represent an operational barrier to scale up and ensure pan-European provision of services constraining the EU’s ability to act on a global stage.
Increased number of the new LEO constellations and related expected increase of EU satellite spectrum authorisation requests	Increase of cost for authorities to process satellite authorisation requests and for enforcement and increased cost for operators to comply with authorisation conditions Increased risk of harmful interferences due to increasing connectivity provided via LEO satellite networks
Inefficient enforcement of ITU rules against harmful interference and lack of level playing field	Slow and inefficient bilateral tools prevent the EU from fully leveraging the strengths of its internal market to solve harmful interference issues and to ensure a level playing field for all operators in the provision of satellite services

In the present context of rapid development of satellite services, including innovative D2D services, the existing framework based exclusively on national authorisation of **satellite services** and spectrum resources prevents the development of a single market for satellite

services. To date, the only exception has been the selection at EU level of licensees for the 2 GHz band spectrum, which aimed to facilitate the provision of pan-European Mobile Satellite Services (MSS)¹³⁰; but, even in that case, spectrum authorisation remained at national level, leading to different licensing approaches¹³¹ and not fully harmonised authorisation conditions, with different fees or conditions attached to the licences.

There is wide evidence on the fragmentation of the satellite authorisation systems in 27 Member States, confirmed by the 2025 Mobile Satellite Services (MSS) study¹³², previous MSS studies¹³³ and an RSPG opinion¹³⁴. Firstly, the precedent of the **several years long authorisation process for MSS operators** selected at EU level provides concrete evidence of how fragmentation of rules hinders the supply of satellite services with high cost for the operators¹³⁵. The MSS study concludes that although the MSS Decision harmonises certain authorisation conditions, the implementation in practice has been rather uneven and resulted in authorisation delays. Several national conditions attached to the various licences and authorisations were not justified by national laws and, this undermined the objective of the previous regulatory harmonisation of spectrum. The divergences in procedure, conditions and fees were so significant that operators could not reasonably estimate the timeline and regulatory cost for their business plans and secure financing, thus, delaying the provision of satellite services¹³⁶. Further, the experience of fragmented regulation in this band confirms that delays in the authorisation significantly impact revenue timing. For satellite communication service providers, the most substantial cost burden arises from postponed commercial launches, potentially resulting in tens of millions of euros in lost revenues (see details in section 6.3.2).

Secondly, a more recent study confirms that although many Member States are authorising satellites under general authorisation, the conditions attached to the general authorisation differ significantly and, are not always suited to satellite services¹³⁷. Moreover, the procedures for obtaining individual authorisations for the ground segment are lengthy and the requirements in some Member States complex, and difficult to satisfy for new-comers, SMEs¹³⁸.

¹³⁰ MSS support various types of pan-European services, such as broadband, public protection and disaster relief (PPDR) services, broadcasting and multicasting, covering in particular hard to reach areas.

¹³¹ For example, 24 Member States issued individual licences for the Complementary Ground Components (CGC), whereas 2 Member States followed a general authorisation approach. With regards to the MSS spectrum, 20 Member States issued individual licences, 2 Member States authorised them under general authorisation, one Member State took a hybrid approach, and another one issued a “block licence”.

¹³² Mobile satellite services (MSS) in the 2 GHz band in the EU - Implementation of the current regulatory framework and an overview of the satellite connectivity market, July 2025, Detecon International GmbH, available at <https://op.europa.eu/en/publication-detail/-/publication/4c769094-41b5-11f0-b9f2-01aa75ed71a1/language-en>.

¹³³ Gerus, V., Manero, C., Pujol, F. et al., Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States – Final report, Publications Office, 2019, <https://data.europa.eu/doi/10.2759/974409>.

¹³⁴ RSPG24-007 Opinion on assessment of different possible scenarios for the use of the frequency bands 1980-2010 MHz and 2170-2200 MHz by the Mobile Satellite Services beyond 2027.

¹³⁵ Both existing operators had difficulties implementing their systems on a timely basis. While these operators were selected in 2009 (EC Decision 2009/49), they were subject to an enforcement process in 2013, delaying the provision of actual services for many years.

¹³⁶ See Annex 7, section 1.3. Table on MSS fee structure, per Member State.

¹³⁷ SM enablers study.

¹³⁸ SM enablers study.

Thirdly, apart from the 2 GHz band, for which selection is done at EU level, there is currently no process or guarantee for providers to obtain spectrum at pan-European level and a high risk of having coverage gaps.

Finally, enforcement of authorisation conditions and ITU rules is uncoordinated at EU level and depends on the good will of national administrations to implement them through a slow and complex bilateral process, with RSPG having no mandate to address interference from third countries.

In sum, the fragmentation of national regulatory competences for satellite authorisations delays the deployment of innovative satellite services and undermines EU's competitiveness in a rapidly evolving global satellite market. This delay would be driven by: (i) lack of, or unequal access to spectrum throughout the EU, (ii) inconsistent conditions and interpretation of compliance and reporting obligations (in terms of format, frequency and requirements) increasing administrative costs; and (iii) operational challenges caused by the inability to enforce compliance when harmful interference from other constellations occurs, a probability which is likely to increase in the next years.

2.2.4. Insufficient cooperation and fragmented regulatory approaches

As regards governance, the main driver is the insufficient cooperation between different authorities and fragmented regulatory approaches.

This main driver is composed of smaller root causes; one example is national influence on BEREC and RSPG that may result in some cases in limiting EU single market perspective. BEREC consists of NRAs, and positions are shaped mainly by national perspectives rather than by a common EU-wide vision. Moreover, a lack of a more structured coordination mechanism between BEREC and RSPG led to a very limited cooperation between the two bodies where spectrum issues have regulatory implication. Another example is the expanding regulatory scope of NRAs' creating inconsistencies among the NRAs and between the tasks of NRAs and BEREC. While some NRAs take on responsibilities beyond electronic communications under frameworks such as the DSA, Data Act, or NIS2, in other Member States these tasks are entrusted to other CAs. The expanding responsibilities and non-uniform allocation of tasks at national level also affecting EU-level coordination create diverging approaches to the implementation of the regulatory framework and oversight at national level, resulting in lack of holistic overview of authorities over all aspects of the electronic communications market, including e.g. network resilience. It also perpetuates differences in standard procedures, compliance obligations and administrative processes going beyond those justified by differences in the functioning of national markets, as observed also by Letta in his report. Furthermore, resource constraints and structural weaknesses also contribute to driving the problem as many NRAs and other competent authorities face challenges in terms of funding and staffing. It affects their ability to carry out both existing and newly assigned functions, while also remaining active in BEREC or RSPG and contributing to their work.

Finally, the growing need for specialised expertise adds pressure to an already stretched governance framework. As responsibilities expand into new areas linked to digital markets and emerging technologies, the demand for skilled human resources increases. Without sufficient expertise, the risk is that responses remain incomplete or inconsistent, reinforcing fragmentation. This hampers both the functioning of the Single Market and the creation of a level playing field in the broader connectivity ecosystem, as not all Member States or operators are equally equipped to deal with evolving regulatory and technological challenges (further details in section 2.4 of Annex 7).

Table 13: Causal link between root causes/problem drivers and problems

Problem driver/root causes	Causal link with governance related problem
National influence on BEREC and RSPG	Limits development of a coherent EU Single Market perspective.
Weak coordination between BEREC and RSPG	Leads to fragmented approaches to spectrum-related regulatory issues.
Diverging NRA mandates and expanding responsibilities	Create inconsistencies in regulatory tasks and weakens coherent EU-wide governance.
Diverging approaches to implementation and oversight by competent authorities at national level.	Results in lack of full overview at national and EU level. Perpetuate differences in standard procedures, compliance obligations and administrative processes not justified by differences in the functioning of national markets.
Uneven allocation of new digital regulatory responsibilities	Produces asymmetric governance structures and cross-border supervision gaps.
Resource and capacity constraints within NRAs and other competent authorities	Hinder effective fulfilment of tasks and consistent participation in EU-level governance.
Growing need for specialised expertise	Leads to uneven regulatory responses and reinforces fragmentation across the Single Market.

2.3. How likely are the problems to persist?

2.3.1. Fixed networks: Slow deployment and adoption of fibre networks and services

The likelihood of slow deployment and adoption of fibre networks and services is high. If no proactive steps are taken, FTTP coverage in the EU is expected to reach 90% in 2030¹³⁹. However, full FTTP coverage at EU level, according to the predictions based on ‘business as usual’ scenario, show that the 100% coverage will be only achieved by 2051 if no further action is taken¹⁴⁰ while the Digital Decade Policy programme calls for ‘Gigabit connectivity for all by 2030¹⁴¹. Especially Member States with a high share of copper networks are unlikely to achieve full fibre coverage by 2030 or even by 2035.

If copper networks remain widespread¹⁴², the EU risks insufficient investments in fibre deployment, which will perpetuate significant differences in connectivity between Member States, hindering the creation of a single market and the cohesion of our society. Ultimately, the EU’s connectivity infrastructure will be ill-prepared to support the development of an AI-

¹³⁹ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁴⁰ Annex 1 - State of EU digital transformation in 2025: progress and horizontal recommendations, 16.6.2025, SWD(2025) 290 final, p. 5. SWD Digital Decade in 2025: progress and outlook, 16.6.2025, SWD(2025) 290 final, p.16.

¹⁴¹ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁴² The share of copper is estimated to decrease to around 19% by 2030 and around 11% by 2035. See Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC. Source: WIK based on FTTH Council (2025) and WIK market potential model.

driven continent and will lack the necessary resilience to ensure reliable and secure digital services.

Though there is no lack of available capital to deploy FTTH to reach nearly all EU households and businesses, the problem is that it is not financially viable to deploy FTTH to the last 10% unless there is only one FTTH network in the rural areas. The existence of copper and FTTC networks in parallel splits the userbase and thus the available revenues, which makes FTTH non-viable in those areas, when, otherwise, it would be viable, with a mixture of available state aid and private financial resources. The high profits that can be made on this largely fully depreciated legacy infrastructure also limit incentives for the owners of that infrastructure to upgrade it to FTTH themselves. Indeed, as experience shows, in countries/areas where the incumbents do not face competition from a rival, they are reluctant to upgrade their legacy networks to FTTH. A definite plan for copper switch-off when there is a given coverage of FTTH in a certain area would make it viable for an alternative fibre investor to deploy FTTH and would in consequence also create incentives for the copper owner to upgrade its infrastructure to FTTH. Thus, the transition to fibre is inextricably linked with copper switch-off, the selected policy of which would lead to an increased FTTH coverage FTTH take-up. By this, it would be aligned with the digital decade target of gigabit connectivity for all citizens.

As has been shown in literature¹⁴³, full coverage of FTTH would require EUR 40 billion of subsidy and EUR 29 billion in the case where 5G FWA is also used, while EUR 19 billion had already been allocated to broadband deployment via EU funding alone. It is obvious that when the significant additional EU funds allocated after that date are taken into account, along with the national State Aid funding (which is substantial in countries such as Italy and Germany) – the funding gap seems to be minimal. Therefore, the size of the problem (i.e. the remaining gap) is not related to investment / availability of capital, but rather to the near universal persistence of parallel legacy infrastructure in rural areas.

According to WIK's forecast, under current conditions only 60% of households with access to fibre (FTTH) will subscribe to a fibre-based service by 2030 (FTTH take-up)¹⁴⁴. This means that even if an FTTH network is available, 40% of households will continue to use copper networks or less future-proof technologies for different reasons mentioned above (high prices, inertia etc). Further, the share of households with fibre subscription among those with broadband connection (FTTH penetration) is expected to reach only 48% in 2030 and 59% in 2035. In countries where copper network is still widely used today, the take-up of Gigabit speeds will be below 20% in 2035¹⁴⁵. By 2035, under the status quo, around 11% of broadband subscribers (roughly 50 million people) in the EU will still rely on copper-based internet connection¹⁴⁶. In some Member States, the share is expected to be significantly higher, which would likely negatively impact national and regional discrepancies in terms of economic and

¹⁴³ WIK's 2023 study for the EC on investments to meet the Digital Decade targets.

¹⁴⁴ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁴⁵ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

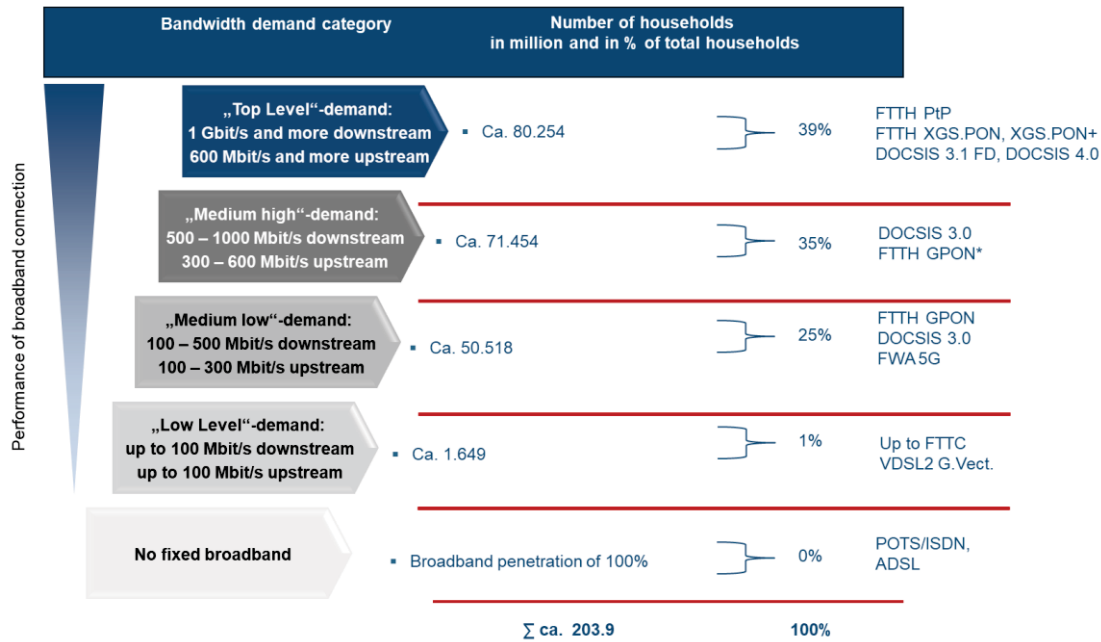
¹⁴⁶ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

social development. In absence of any action, more than two thirds of households will have connections with speed below 1 Gbit/s by 2035.¹⁴⁷

It is expected that 30% of customers will have access to Gigabit connection by 2035, while 40% of customers will demand Gigabit speeds in 2035.¹⁴⁸ In 2035 there will be a gap between demand and take-up of Gigabit services of 10 percentage points.

The following figure provides an overview of the expected bandwidth demand in 2035¹⁴⁹.

Figure 14: Bandwidth demand of EU27 in 2035 in the absence of constraints



Source: Study on Access Regulation.

In the near future, higher bandwidth is needed for households and businesses to support moving to online Government and commercial applications as well as entertainment. It is expected that nearly 40% of households will need downstream bandwidths of at least 1 Gbit/s and upstream bandwidths of 600 Mbit/s or more by 2035.¹⁵⁰ The connectivity needs for small businesses are likely to be even greater and will require more symmetric bandwidth (equal upstream and downstream speeds) to accommodate the use of advanced technologies such as cloud computing, big data and artificial intelligence as envisaged in the DDPP.¹⁵¹

¹⁴⁷ Some of the end-users with below 1 Gbit/s speed connections will have higher speeds available but will not choose to subscribe due to higher prices. Others will have no above 1 Gbit/s speed connection available to them. Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁴⁸ WIK study.

¹⁴⁹ The estimates were derived by updating WIK’s peer-reviewed market potential model, and are based on projections regarding the propensity of consumers to use given applications, bandwidth requirements of those applications, household composition and simultaneous device use by individuals and objects within households.

¹⁵⁰ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁵¹ SME take-up of Gigabit broadband expected to increase by 3.6 times from 2024 to 2035. See Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

Copper networks are unable to satisfy the future requirements for fixed internet access, regarding upload and download speeds, latency and reliability. In that regard, the average download speeds in countries with high share of VDSL is around 150 Mbit/s (30% lower than in countries with high share of fibre or coax).¹⁵²

Overall, the presence and use of copper networks will continue to disincentivise and delay the deployment and adoption of fibre networks and services.

2.3.2. *Mobile networks: lack of investment in high quality mobile connectivity*

Without policy intervention, the underlying drivers of insufficient investment in high-quality mobile connectivity are bound to persist. Additionally, demand for spectrum is likely to increase, as data consumption is projected to rise.¹⁵³ **With growing spectrum needs**, the cost of acquiring spectrum is expected to place increasing pressure on operators' balance sheets, particularly in view of their declining revenues.¹⁵⁴ Spectrum costs may represent a larger share of operator revenues than today. Even if unit prices were to fall over time, the need to acquire larger volumes of spectrum means that **the overall spectrum cost burden is likely to increase**, especially in Member States whose auction conditions prioritise revenue generation over investment.¹⁵⁵ This would reduce the attractiveness of mobile operators and mobile deployment projects for financial markets and further weaken operators' capacity to fund high-quality 5G and future 6G deployment.¹⁵⁶

Growing spectrum scarcity will also increase the importance of efficient sharing arrangements in the 6G era. However, without a coherent EU-level framework, spectrum sharing and its advantages are likely to remain dependent on uncoordinated national decisions, limiting its potential to ease scarcity or support innovation.¹⁵⁷ In addition, market-shaping measures that create **artificial scarcity**, such as disproportionate set-asides or reservations, could continue to push up spectrum prices and reduce investment headroom. Due to its voluntary nature, the current peer-review process is unlikely to detect and address such investment-constraining auction designs, failing to deliver robust spectrum assignment that is predictable, well-justified, and consistently applied.¹⁵⁸ Furthermore, while legal deadlines for the release of harmonised bands will continue to apply, **predictability** regarding the timing of 6G spectrum availability would remain **insufficient**.

¹⁵² Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁵³ The *Ericsson Mobility Report* (November 2024, p. 10) forecasts that European mobile data consumption will increase substantially between 2025 and 2035 across all traffic types (downloads, messaging, app usage, audio and video streaming), with heavy users expected to exceed 110 GB per month. Mobile data usage per active smartphone in Western Europe is projected to rise from 23 GB to 49 GB per month, placing Europe above global average. Some studies, however, argue that data consumption is approaching a plateau of 15–20 GB per user per month (William Webb, *The End of the Telecoms History*, 2025). Others rebut this claim and provide evidence of significantly higher consumption levels already observed in several countries (Stefan Zehle, Coleago Consulting, *The End of Telecoms History? Not Really*).

¹⁵⁴ See evaluation Annex 11, section on cost of spectrum and on mobile market ARPU profitability.

¹⁵⁵ GSMA, "Global Spectrum Pricing report," [Global Spectrum Pricing](#), GSMA, London, 2025 (2025), p. 14.

¹⁵⁶ See section 2.2.2.2. ad 2.1.2 and Annex 9.

¹⁵⁷ In this regard, the RSPG Report on spectrum sharing (RSPG21-016) refers only to a limited number of shared-use cases in EU Member States, in particular between different technologies (and services).

¹⁵⁸ See section 2.2.2 and evaluation findings Annex 11, section 5.5.1. & 5.6.2.

Under these conditions, 5G and later 6G deployment would progress but not at a pace sufficient for the EU to close the **gap with global peers** such as the USA, China and South Korea.¹⁵⁹ Limited predictability, insufficiently investment-oriented award conditions and high spectrum costs would continue to constrain operators' investment capacity, resulting in persistent gaps in **coverage, service quality** and the availability of advanced, quality-assured services for verticals and SMEs.¹⁶⁰ Without adequate spectrum access and sufficient investment, reduced speeds and higher congestion are likely, **restricting consumers'** ability to **use** bandwidth-intensive or latency-sensitive applications, such as video streaming and emerging AR-based services, particularly when not off-loaded to Wi-Fi.

2.3.3. *Lack of pan-European networks and services*

2.3.3.1. Barriers and limited development of innovative services

Without greater harmonisation of general authorisation conditions, procedures, and security-related rules, wherever possible and justified, the European electronic communications market will remain fragmented. This lack of regulatory consistency will hinder market integration, increase compliance costs, and create uncertainty for service providers, ultimately slowing down innovation and investment in the sector. Similarly, without encouraging cooperation between actors in this extended connectivity ecosystem and, when needed, providing more guidance to ensure regulatory predictability across the EU, delivery of such innovative services could be hampered. The persistence of the problem also impacts negatively the EU's economic security.

2.3.3.2. Barriers to pan-European sovereign satellite services

The EU's strategic initiatives in the space domain — including the EU Vision for a Space Economy, the financial support for the IRIS² constellation, and the forthcoming Space Act — are designed to stimulate investment and enhance Europe's competitiveness and strategic autonomy in space. While these initiatives address investment-related challenges as well as safety, resilience and environmental aspects of space activities¹⁶¹, they do not tackle the underlying fragmentation of spectrum regulation and authorisation frameworks, the absence of a harmonised mechanism for accessing satellite spectrum for the provision of satellite communication services in the EU.

Without a regulatory intervention at Union level, this fragmentation is likely to persist, reducing the overall effectiveness of these initiatives and limiting progress towards the EU's broader policy objectives in the space sector. Satellite operators will continue to be obliged to request authorisation for the use of spectrum individually at every Member State without any guarantee of getting it everywhere, potentially facing 27 different conditions, duration, fees, conditions which act as barriers to economies of scale as described in section 2.1 and 2.2.

¹⁵⁹ See EC study Single Market enablers.

¹⁶⁰ Based on GSMA econometric estimates historically a 10 p.p. higher spectrum cost to recurring revenue ratio decreased coverage by up to 6 p.p. and decreased average speeds by up to 8%, *Ibid*, p. 10.

¹⁶¹ The Space Act establishes the conditions that Union space operators must meet to obtain authorisation for conducting space activities, particularly regarding safety, resilience, and environmental sustainability. These rules cover the authorisation, registration and supervision of space activities in the Union, orbit traffic management, governance and enforcement aspects and capacity-building measures, including the establishment of a Union space label.

Further, the evolving geopolitical context as well as the growing demand for satellite systems will increasingly lack¹⁶² a coordinated authorisation framework to strategically and effectively provide satellite services that protect EU's interests by prioritising security, resilience, technological leadership, and digital sovereignty.

Inefficiencies caused by regulatory barriers are expected to worsen in a context of integrated satellite and mobile communication services enabled by 6G technologies. Traditional boundaries between terrestrial and satellite networks are becoming blurred, requiring a coordinated and forward-looking regulatory framework to prevent market fragmentation and spectrum interference, particularly in frequency bands that will be jointly used by both terrestrial-mobile and satellite operators¹⁶³ (see Annex 7, section 1.3). Without further action, the EU risks missing the opportunity for the timely development of autonomous, resilient and sovereign D2D mobile and IoT connectivity¹⁶⁴. No Member State on its own has sufficient strength and dissuasive enforcement mechanisms to enforce the ITU obligations related to the avoidance of harmful interference, especially on large operators, and the strength of the single market remains unexploited¹⁶⁵. Member States on their own are not unequipped to efficiently enforce ITU rules but also, they are not able to ensure an equitable use of spectrum and orbits by all space actors in the world, be they commercial, scientific or governmental¹⁶⁶.

Forum shopping and fragmentation could become a serious liability in terms of national security capabilities, including lawful interception. It is therefore essential to ensure that international law is respected effectively and Union interests not only for communications but also for other satellite applications are protected.

2.3.3.3. Governance structure not fully suited to serve the requirements of the single market

There are currently many issues which contribute to regulatory fragmentation and stand in the way of coherent and effective EU-wide governance framework for electronic communications, as mentioned in the problem drivers' section (2.2.4).

¹⁶² In the in June 2025targeted consultation on the use of the 2 GHz spectrum band — considered the sweet spot for the provision of innovative mobile satellite services (MSS) — respondents highlighted two main future needs. First, stakeholders emphasised the importance of addressing issues related to security, strategic autonomy in the digital supply chain, and the preservation of EU sovereignty. Second, several respondents noted the current lack of EU-wide spectrum resources dedicated to modern European satellite systems capable of providing secure and reliable communications for public safety and public security services across all Member States.

¹⁶³ Annex 7, section 1.3. Barriers to the development of resilient satellite connectivity.

¹⁶⁴ See section 2.1.3. for its socio economic potential and Figure 2 Broadband satellite constellations.

¹⁶⁵ Interference from large LEO constellations has been evidenced to affect radioastronomy, both in ground-based and space-based observations: cf. [Unintended electromagnetic radiation from Starlink satellites detected with LOFAR between 110 and 188 MHz | Astronomy & Astrophysics \(A&A\)](#) and [Draft IAU CPS position statement 9Z8xE01.pdf](#). In addition, the CEPT/ECC has investigated the effect of harmful interference from the Iridium 2nd generation LEO satellite system on radioastronomy in the ECC Report 349.

¹⁶⁶ A few non-EU large satellite constellations with evolving (still partly pending) ITU filings might soon secure a dominant part of the available satellite spectrum and orbits due to the ITU's first-come-first. In this regard, the FCC has been examining or approving authorisations of Starlink's mobile satellite service across a wide range of both terrestrial spectrum below 3 GHz (within its "Supplementary Coverage from Space" ruling), and internationally harmonised satellite spectrum (at ITU level) in the so-called Ku, Ka, V, E, and W bands. Furthermore, at this stage, Amazon's Kuiper plans to use spectrum in the Ka and Q/V bands.

In the current setup, BEREC will in the coming years face significant and persistent challenges in functioning as a unifying regulatory body, which may weaken its ability to drive harmonisation across the European digital and electronic communications markets, while the BEREC Office will continue to struggle with limited resources and tasks, failing to fully leverage its potential.

Regarding the RSPG, identified problems in relation to the peer review and Good Offices will also persist. Even with the current amount of workload, the RSPG effectiveness is reaching its limits; this would affect its ability to take new tasks needed for further alignment of spectrum management in the EU, inter alia those linked to the satellite spectrum management. The issue will become more acute if the RSPG secretariat is not enhanced to provide it with administrative and preparatory support.

3. WHY SHOULD THE EU ACT?

3.1. Subsidiarity: Necessity of EU action

Services remain less and less national and increasingly have a significance that transcends Europe as a whole. As availability and take-up of connectivity provides a key input to European industry and is vital to enable societal participation in the digital economy as well as to drive European competitiveness, there is a strong case for the EU to establish ambitions regarding connectivity EU wide, as well as providing tools that will support the achievement of this goal.

In addition, communications networks are essential in supporting cross-border trade in digital services. Moreover, some of the problems involve cross-border services specifically. These include the provision of services to multi-national businesses. A common framework for competition should also enable cross-border entry. It is notable in this regard that a number of telecom providers and infrastructure companies operate in multiple countries.

The EU connectivity sector is still fragmented along national borders, so that end-users and EU operators cannot reap the full potential of the single market. The EECC as a Directive has shown limits regarding time-to-market (with a transposition delay up to 4 years) and level of harmonisation (primary focus on national markets). The achievement of the single market has been also hampered by practices of some Member States going beyond EU rules, deepening market fragmentation and increasing overall regulatory burden.

3.2. Legal basis

The legal basis for the review of the regulatory framework remains Article 114 of the Treaty on the Functioning of the European Union (TFEU)¹⁶⁷. This Article confers on the EU legislature discretion, depending on the general context and the specific circumstances of the matter to be harmonised, as regards the harmonisation technique most appropriate for achieving the desired result, in particular in fields which are characterised by complex technical features.

Despite improvements since the regulation of electronic communications started the establishment of a single telecoms market in the Union, electronic communications markets remain national (see merger control decisions in which the Commission found that markets are national on the basis of, amongst others, the current regulatory environment)¹⁶⁸, with different supply and demand conditions, different spectrum licences awarded on a national basis, and

¹⁶⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12016ME%2FTXT>.

¹⁶⁸ See for instance M.10896 - Orange/MasMovil/JV and M.8792 - T-Mobile NL/Tele2 NL.

different (albeit partially harmonised) regulatory regimes. Telecom operators must adapt their strategies to national constraints and differences even when they form part of larger multinational groups. This fragmentation of the EU market alongside national borders prevents the EU from reaping the full potential of an EU-wide telecoms market. While there are many operators in the EU, the level of concentration is high. Electronic communication network operators are not able to realise scale effects because differences in national rules keep telecom markets mainly national.

Therefore, in view of the objective of improving the conditions for the establishment and functioning of the internal market, Article 114 of the TFEU remains the appropriate legal basis also for this initiative.

3.3. Subsidiarity: Added value of EU action

The initiative will have significant added value compared to action taken at Member States level. Strengthening European competitiveness requires access to fast, secure, and resilient digital infrastructure. In a context where the digital connectivity landscape is changing rapidly with convergence of telecom, satellite, cloud and edge technology, driven by virtualisation and AI, the EU will only be able to achieve those objectives through a more harmonised legal environment across the EU that avoids inconsistent national administrative practices or implementation conditions that limit the opportunities of the single market.

Experience with the EECC shows that Member States have not been able to address the sectoral challenges in a timely way, due to the long time needed for transposition of the Code into national law. In addition, the transposition of Directives into national law has been often accompanied by additional layers of rules resulting in overregulation.

Overall, the scale of the problems in the digital ecosystem requires a legislative initiative at EU level because they have increasingly an EU dimension, and can be more efficiently resolved at Union level, leading to overall greater benefits, more accelerated and harmonised implementation, and lower costs than if Member States acted alone.

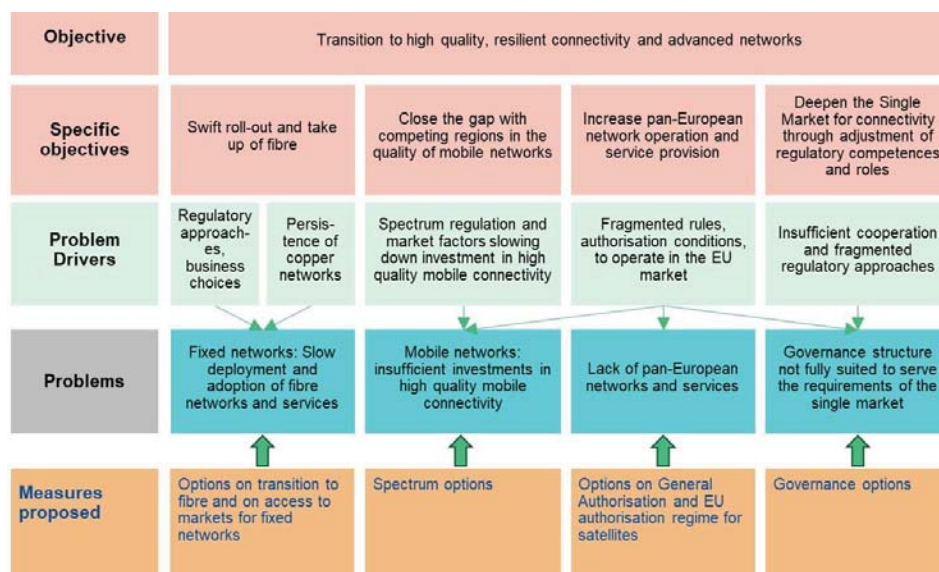
4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

To support the Union's policy objectives of consumer welfare, industrial competitiveness, security and resilience and environmental sustainability, the DNA aims to incentivise market players to innovate and invest in advanced connectivity and computing infrastructures enabling the AI Continent.

4.1. General objective

The main objective of the proposed intervention is deeply rooted in the main findings of the Draghi, Letta and Niinistö reports, namely competitiveness, single market and preparedness. The general objective to which the initiative should ultimately contribute is the: preparation of the transition to high quality and resilient networks of the future.

Figure 15: Digital Networks Act high level intervention logic



High-quality, reliable and resilient connectivity for all, including in rural and remote areas, is essential for the EU to maintain its competitive edge and social standards. Achieving this requires reducing technological dependencies across the value chain and securing substantial investments, which in turn depends on a modern regulatory framework that supports the transition from copper networks to fibre networks; the roll-out of high-quality 5G and - in future - 6G, other wireless networks and cloud-based infrastructure; and scaling-up of businesses while keeping pace with emerging technologies such as quantum communication.

Cutting-edge digital network infrastructure – one of the cardinal points of the EU’s Digital Decade Policy Programme 2030 and a goal under the AI Continent Strategy - is essential for a competitive EU industry and a thriving (digital) economy. Without it, the consumers will miss out on the benefits of advanced technologies while industry - in particular vertical sectors - will fail to exploit innovation potential. Enterprises need advanced connectivity and computing infrastructures to process data closer to their operations and customers, enabling to enhance innovative applications and services including those that require real-time data and AI processing, such as Internet of Things (IoT) devices, autonomous vehicles, smart grids, predictive maintenance, real-time monitoring and automation. This links strongly with competitiveness call in Draghi report.

Creating a genuine digital innovation in turn will allow for the deepening of the Single Market for connectivity as called for in Letta report, with conditions boosting investments and competitiveness. This is enabled by the removal of remaining obstacles and by facilitating a convergent, predictable and fair regulatory framework for investment in electronic communications networks, services, associated facilities and associated services, which can consequently be provider easier cross-border.

Finally, as stressed out in the Niinistö report, the importance of electronic communications, including satellite-based services, critical communication and digital services in the context of security, resilience and preparedness should be clearly reflected.

4.2. Specific objectives

For each of the below specific objectives, we have already identified quantifiable and traceable indicators, which are described in section 9, having a basis for an operational performance monitoring framework.

4.2.1. *Swift roll-out and take-up of fibre*

The specific objectives in relation to transition to fibre and access regulation are to: (i) foster the deployment of fibre networks, and (ii) the adoption of fibre-based services (take-up), which is crucial for providing high-speed and high-quality digital services to the European society and economy. This, in turn, will require preserving and promoting sustainable competition in a full fibre environment, allowing consumers to benefit from the full capabilities of the infrastructure while supporting efficient investments. The goal is also to support the single market in the electronic communications markets by facilitating the provision of services across the EU and by streamlining the regulatory framework, making it more efficient for all stakeholders involved.

As explained in section 9, this does not necessarily translate into 100% coverage and take up of fibre everywhere in the EU. Looking at the experience of countries where the fibre roll out is most advanced, it seems that the maximum fibre coverage that can be achieved is between 95% and 98% as there are always some areas (2-5%) of the territory where the deployment of fibre is not economically viable.

4.2.2. *Close the gap with competing regions in the quality of mobile networks*

Investments in high quality mobile networks will need to increase to ensure that the EU economy remains competitive. The EU will need to catch up with global leaders on deployment of wireless high quality networks (5G SA based on mid-band spectrum, network densification and 6G in the future) to better serve end-users and enable quality-assured services, that require high bandwidths, high speeds and/or low latency and realise full 5G and 6G innovation potential throughout the Single Market and in very different sectors¹⁶⁹.

This objective can be measured in terms of improved quality of mobile connectivity for consumers and businesses in terms of higher download and upload speeds, lower latency and in general better end user quality of experience as explained in section 9.

4.2.3. *Increase pan-European network operation and service provision*

Advanced digital network infrastructures and services, including LEO satellite constellations, will become a key enabler for transformative digital technologies and services such as Artificial Intelligence (AI). It is increasingly likely that many AI's breakthroughs will come not just from algorithms alone, but also from enhancing the infrastructure and connections that support them. Instead of relying solely on fibre and terrestrial 5G/6G networks, AI systems are beginning to leverage constellations of LEO satellites capable of delivering ubiquitous, reliable and high-capacity connectivity anywhere¹⁷⁰.

¹⁶⁹ See for example Annex 9 Section 3.1.1 on economic benefits of 5G by sector.

¹⁷⁰ As LEO satellites reduce latency and constellations with inter-satellite links create global mesh networks, satellites act as both data pipes and data sources, feeding AI models with vast datasets from Earth observation, IoT

Removing regulatory barriers to facilitate the deployment of innovative pan-European satellite communication services and promote the integration of terrestrial and satellite D2D sovereign technologies within the new space ecosystem is essential to reinforce the Union's industrial and scientific capacities, better serve end-users with connectivity services and consolidate Europe's strategic autonomy, including supply chains, in the space sector. To strengthen EU competitiveness and strategic autonomy across the value chain, this initiative focuses on enabling scale, innovation, and fair competition, including the space sector and facilitates provision of satellite services also increasing reliability and security of EU connectivity.

This objective can be measured in terms of number of providers using the cross-border general authorisation regime, number of new EU-wide spectrum authorisations for satellite services completed within a reasonable timeline and number of satellite interference issues in the EU which have been timely and effectively addressed, as explained in section 9.

4.2.4. Deepen the Single Market for connectivity through adjustment of regulatory competences and roles

In line with the Digital Decade targets of Gigabit connectivity for all and 5G in all populated areas, the objective of the initiative is a transition to high quality, resilient connectivity and advanced networks. In this context it is important that the rules as well as the governance framework continue supporting the Single Market development. The specific objective is therefore to deepen the Single Market for connectivity through adjustment of regulatory competences and roles. The governance structure must correspond to the needs of the developing market and all governance levels must be able to effectively cooperate to ensure that decisions are taken in line with subsidiarity rules and that as a result vulnerable end-users are protected, while connectivity is further enhanced, ensuring resilience, security and preparedness including through harmonisation of spectrum authorisation conditions. The initiative therefore focuses on strengthening the well-functioning aspects of the current governance set up while striving to rectify the identified shortcomings and improving the governance set up to make it future proof.

This objective can be measures through the number of high-quality outputs that have a direct link to Single Market objectives, i.e., strengthening harmonisation, supporting consistent regulatory implementation, and facilitating the completion of the EU Single Market for electronic communications, as explained in section 9.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1. What is the baseline from which options are assessed?

5.1.1. Transition to fibre

The EECC introduced the promotion of connectivity through access to and take-up of VHCN as a new objective of the regulatory framework, alongside the promotion of competition, the development of the internal market and the interests of Union citizens. The framework delivered as regards promotion of competition and protection of end users. The market environment

devices, and other satellite operations. Thanks to satellite networks, devices operating in remote areas—for example sensors for agriculture, energy or logistics—can stay connected to powerful AI systems. In the era of ubiquitous and reliable satellite connectivity, remote devices will no longer run in isolation, they will become part of a coordinated, real-time AI network, which shares data, updates, and makes decisions across vast distances.

changed as a consequence of infrastructure-based competition in many geographic areas, in particular through the emergence of players (other than the historic telecom incumbents) deploying FTTH networks in certain geographic areas. Despite the overall effectiveness of the ex-ante regulation which removed part of high entry barriers and in many areas allowed greater tendency towards effective competition, the objectives of the deployment and take up of fibre networks cannot be fully achieved by the current framework. The current framework, under the baseline scenario, cannot secure the ambitious EU-level connectivity targets¹⁷¹. The patchy approach to supporting fibre deployment and competition on quality in different countries lead to lack of predictability which is crucial to foster investment thus contributing to gaps in coverage and broadband speed.¹⁷²

Under the baseline, there is no legal provision actively supporting or accelerating the copper switch-off. The conditions for copper switch-off are set by Article 81 EEC. This provision requires operators with Significant Market Power (SMP) subject to network access obligations to notify national regulatory authorities when they plan to decommission or replace their copper networks. The aim of this provision is to ensure that migrations from regulated networks are transparent with a clear timetable and adequate notice periods, do not harm competition or end-users' rights and that alternative access products of comparable quality are available. The provision is not intended to accelerate migration to fibre. In fact, Article 81 EEC may sometimes slow down the migration to fibre because it allows NRAs to impose conditions on how the copper switch-off process is implemented by SMP operators. According to the BEREC progress report on managing copper network switch-off and the NRA surveys conducted for the 'Study on Access Regulation', 9 countries¹⁷³ are planning to switch-off copper by 2030 or earlier. 16 countries¹⁷⁴ have not set a target date and 7 countries¹⁷⁵ are lagging behind in fibre roll-out and FTTH penetration (in % of broadband subscriptions).

As regard the evolution of the fibre coverage in the baseline scenario, there are particular difficulties in stimulating FTTH deployment (from any provider) when the incumbent has upgraded copper to provide higher levels of quality over FTTC (which often can provide a decent quality of 250 Mbps upstream). In this situation, as it is still making a return from its upgraded legacy copper network which may have been fully depreciated, the copper network owner has no incentive to deploy FTTH itself or to switch-off copper and transition its customers to another FTTH network, even if one exists. Taking into account the countries that are affected by this problem, WIK expects that under the status quo, FTTH coverage¹⁷⁶ will reach only 77.9% in 2030 and 90.6% in 2035.¹⁷⁷ Furthermore, the experience of countries which are more advanced in fibre roll-out shows that around 2-5% of households, normally located in very remote areas, will not be covered with FTTH networks in the long term and may only be served by alternative technologies.

¹⁷¹ Digital Decade Policy Programme <https://eur-lex.europa.eu/EN/legal-content/summary/2030-digital-decade-policy-programme.html>.

¹⁷² Wide gaps exist between Member States in high performance FTTH infrastructure with coverage of more than 80% in some countries such as ES and PT and less than 50% in others, such as EL, BE and DE. There is also a significant urban rural digital divide, with rural coverage of FTTH lying around or below 10% in a number of countries (CZ, EL, BE).

¹⁷³ DK, FR, LU, MT, PT, RO, SE, ES and CY.

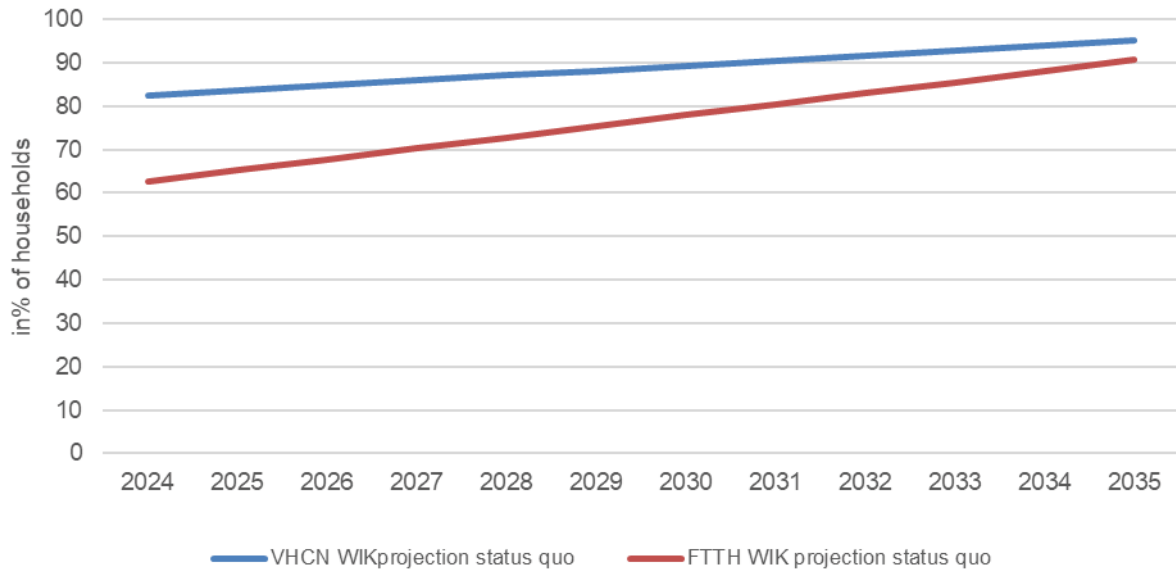
¹⁷⁴ AT, BU, CZ, DE, EE, EL, FI, HR, HU, IE, LV, LT, the NL, PL, SK and SI.

¹⁷⁵ Austria, Belgium, Czechia, Germany, Greece, Latvia and Slovakia.

¹⁷⁶ Fibre coverage refers to the share of households passed by a fibre network.

¹⁷⁷ WIK study.

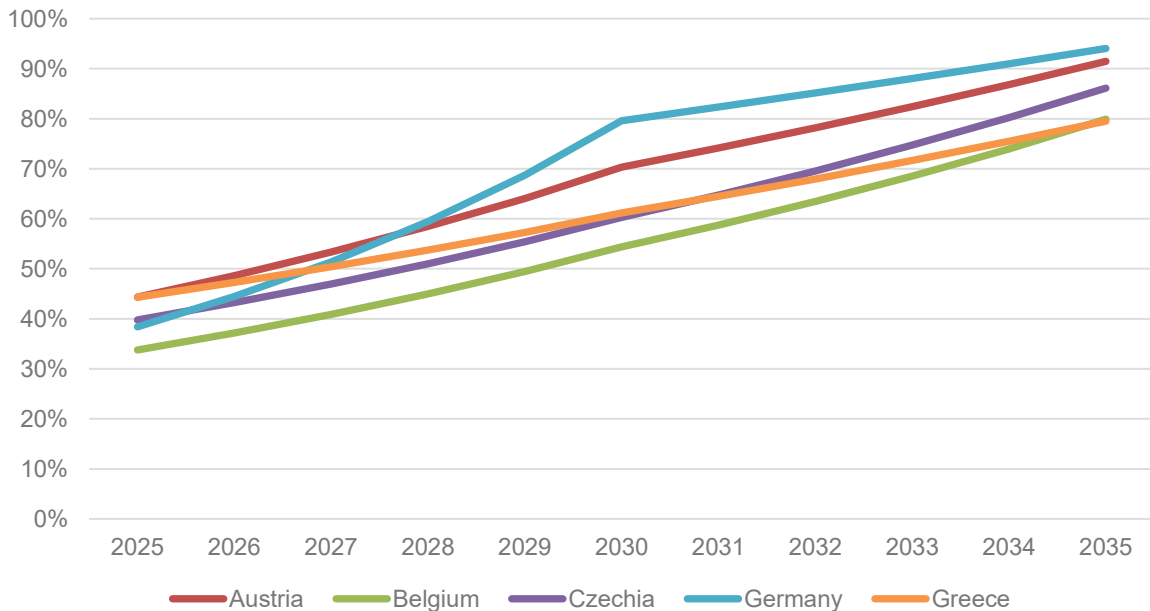
Figure 16: EU VHCN and FTTH coverage (% households), Actual data to 2024 and Forecasts



Source: WIK-Consult based on EC Broadband Coverage in Europe, Analysys Mason and FTTH Council Europe

Meanwhile, while countries with a lower FTTH coverage such as Austria, Belgium, Czechia, Germany and Greece can be expected to have a higher growth-rate in fibre roll-out than those which are more advanced, it is unlikely that they will reach high FTTH coverage by 2035. As can be seen in the following chart, the coverage gap in some cases will be significant.

Figure 17: Estimated FTTH coverage (excl. FTTB) in Austria, Belgium, Czechia, Germany and Greece in 2035 under the status quo (in % of HH)

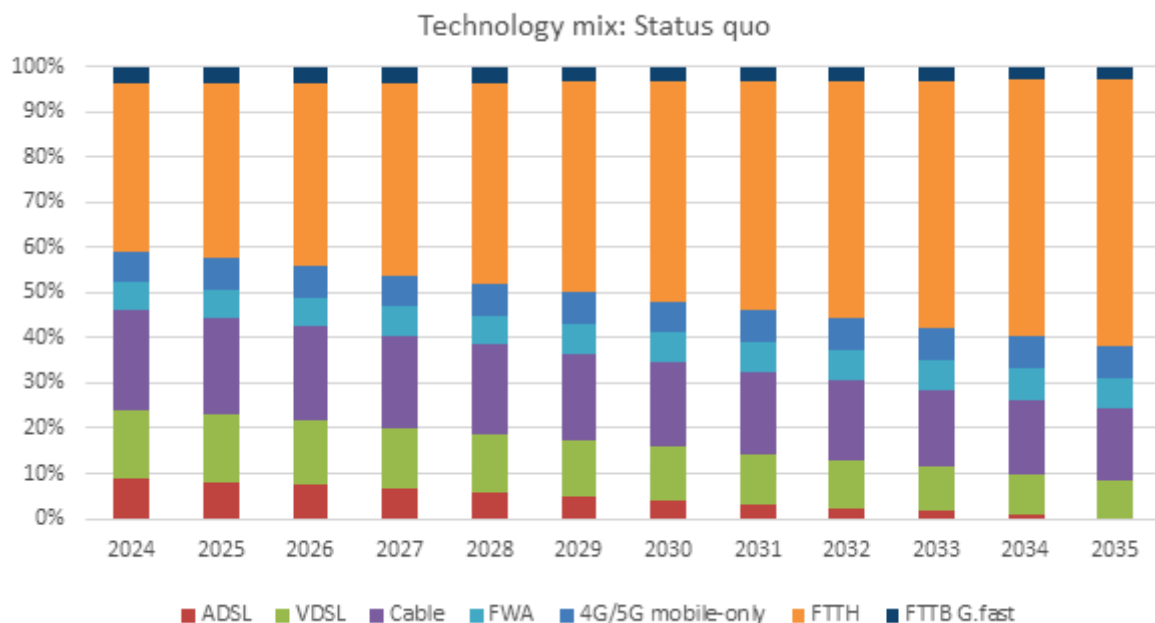


Source: WIK based on development of FTTP coverage in EU27 Member States from 2017-2024, own estimates, FTTH Council (2025).

Regarding the remaining technologies, WIK projects that under the status quo, in 2035 there will remain 8% broadband subscribers on VDSL as the EU Member States lagging in fibre roll-out will not have switched-off their copper networks by 2035. Because the prevailing DOCSIS 3.1 technology is capable of Gigabit download speeds, WIK expects cable take-up to remain

more stable in the near term, but with declines to come, as customers transition (or are upgraded by their existing operators) to more performant and energy efficient FTTH. Meanwhile FWA take-up is expected to expand from a low base as 5G FWA offers are launched and as this service starts to replace DSL, in particular in less dense areas or in countries where FTTH/B is less widespread. The resulting projections concerning the technology mix under the status quo are shown below. As some countries in the EU allow copper switch-off with customers being migrated to mobile networks or FWA when the copper network operator does not have fibre coverage, WIK expects a share of 7% 4G/5G mobile-only broadband customers and a share of 7% for FWA connections. FTTB G.fast is expected to have a share of 3.4% in 2030 which will decrease to 2.9% in 2035.

Figure 18: Projected EU technology mix to 2035: status quo (in % of broadband subscriptions)



Source: WIK based on FTTH Council (2025) and WIK market potential model.

Concerning the expectations related to FTTH investment under the status quo, the expected persistence of copper and cable networks until 2035 and beyond has important implications for the evolution of the investment gap (i.e. the difference between Capex required to achieve full coverage and the capex that is likely to be invested). According to the WIK study prepared for the Commission published in 2023¹⁷⁸ based on data from 2021, there was a remaining Capex requirement of approximately EUR 114 billion to achieve 100% coverage of Fibre-to-the-Premise (FTTP) EU-wide, of which EUR 74 billion was estimated to be economically viable without subsidies in a situation of **no network duplication (i.e. an operator resulting in take-up of around 75% or more)**, resulting in an ‘investment gap’ (i.e. here defined as a difference between total investments needed and private funding) under this assumption of EUR 40 billion. If a combination of FTTP and FWA is used (i.e. no full fibre coverage), the total investment figure would be reduced to around EUR 108 billion, of which around EUR 29 billion would be needed in public investments, if 5G FWA is used for the most remote households. Based on the most recent Digital Decade data, since 2021, FTTP coverage has

¹⁷⁸ <https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets>.

increased from 50% to 69% (in 2024). The remaining investment (Capex) needed to achieve full FTTH coverage would therefore be significantly less than estimated in 2023. However, the shortfall cannot be calculated with precision. This is because the Capex required to deploy FTTH varies widely depending on a variety of factors, while economic viability further depends on ARPU and take-up.

Access regulation is currently based on SMP and on symmetric regulation¹⁷⁹. Under the SMP regime, regulatory intervention on a specific product and geographic market can be justified if proven that these markets are characterised by high barriers to entry, do not tend towards effective competition, and that competition law instruments are insufficient to tackle the identified competition problems (so called ‘three criteria test’)¹⁸⁰. An undertaking is deemed to have SMP, if, either individually or jointly with others, it enjoys a position equivalent to dominance, i.e. a position of economic strength, which gives it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers. Guidance on market definition and SMP assessment has been provided in the 2018 SMP Guidelines¹⁸¹ and in the 2020 Recommendation on Relevant Markets (RRM)¹⁸². Under the RRM two markets are currently recommended as susceptible for ex ante regulation (i.e. the wholesale local access market and the market for wholesale dedicated capacity). Additionally, guidelines on the imposition of remedies were provided in 2024 in the Gigabit Recommendation¹⁸³.

As explained above, given the differentiated pace of deployment of fibre network at national and sub-national level and the need to adapt the regulation to the competitive situation at regional/local areas, evidence gathering by NRAs is key to inform their decisions and recommend policy interventions to support the deployment and take up of fibre. The current means of evidence gathering (Article 22 EEC) would remain limited in the baseline scenario and insufficient for the scope. Furthermore, the baseline scenario, despite its objective to ensure a consistent regulatory approach, cannot prevent patchy implementation of access remedies, which constitutes *per se* a barrier to the provision of services across different Member States, undermining the single market objective.

In conclusion, under the base line scenario, the timeline for fibre deployment and switch-off of copper would be entirely in the hands of operators with the shortcomings identified above.

¹⁷⁹ In particular, Article 61(3) EEC provides that access obligations can be imposed, upon reasonable request, with respect to wiring and associated facilities inside buildings or up to the first concentration or distribution point where the replication of these network elements would be economically inefficient or physically impracticable; under strict conditions such obligations can be extended up to a point beyond. These provisions are applicable outside of the context of a market analysis, and irrespective of whether the undertaking concerned has been designated as having significant market power.

¹⁸⁰ The decision to define a market as susceptible to ex ante regulation should also (alongside the first two criteria) depend on an assessment of the sufficiency of competition law to address adequately the market failures identified. This third criterion aims to assess the adequacy of competition law to tackle identified persistent market failure(s). Competition law-based interventions are likely to be insufficient where frequent and/or timely intervention is indispensable to redress persistent market failure(s). In such circumstances, ex ante regulation should be considered an appropriate complement to competition law.

¹⁸¹ Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services (2018/C 159/01).

¹⁸² Commission Recommendation (EU) 2020/2245 of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with the Code (2020 Recommendation on Relevant Markets) (OJ L 439, 29.12.2020, p. 23-31).

¹⁸³ Commission Recommendation (EU) 2024/539 of 6 February 2024 on the regulatory promotion of gigabit connectivity (C/2024/523) (OJ L, 2024/539, 19.2.2024).

NRAs could only intervene to preserve competition at Member State level and end-users' rights without being able to ensure to the latter the high level of connectivity services they may require. This leads to market fragmentation and regulatory unpredictability, and it is not contributing to the development of the internal market for electronic communications.

5.1.2. Spectrum

The current framework leaves Member States **substantial discretion in designing assignment procedures, authorisation conditions, and pricing approaches**. This has resulted in a heterogeneous regulatory landscape and the absence of a coherent Single Market approach. This fragmentation was particularly evident in the assignment of the 5G pioneer bands, a process that unfolded over more than ten years and far beyond the planned schedule, delaying the availability of the corresponding services in many markets. Fragmentation is also illustrated by the variety of approaches to reserve prices. In a subset of auctions analysed in the Commission study, 6 out of 37 closed at the reserve price, suggesting that minimum prices may have been set too high to attract competitive bidding. Significant differences have also been observed in spectrum prices, coverage obligations and market-shaping measures¹⁸⁴.

The current regime has **delivered competitive prices** for mobile connectivity for consumers across the EU, albeit with different levels and some exceptions.¹⁸⁵ While it has ensured spectrum availability and led to quasi-ubiquitous **basic 5G coverage**, it has **not generated sufficient investment in high-quality 5G networks**. As a result, performance outcomes in terms of speeds and quality are suboptimal in several Member States.¹⁸⁶ The **weak outcomes** are linked to persistent gaps in mid-band 5G coverage, the slow rollout of 5G SA and insufficient network densification, which is likely to persist, as indicated by interviews with major operators on their deployment plans.¹⁸⁷

Under the status quo, **spectrum represents a significant cost component** for mobile operators¹⁸⁸. While spectrum needs have increased over the last decade, average revenue per MHz in Europe has declined by 58% between 2014 and 2024.¹⁸⁹ This reduction has not been fully mirrored in spectrum prices, which have declined overall but not at a comparable pace. The discrepancy was suggested to reflect regulatory interventions, such as reserve prices or measures artificially increasing spectrum scarcity, which are likely to persist under the baseline. At the same time, across the EU, fragmented national approaches have resulted in significant differences in prices per MHz per population.¹⁹⁰ Divergent national pricing policies and high

¹⁸⁴ See section 2.2.2.3 for an assessment of their impact on market outcomes. Further explained in Annex 4, section 3.

¹⁸⁵ See consumer price market outcomes high heterogeneity as presented in section 2.2.2.3.

¹⁸⁶ See Quality of service market outcomes as presented in section 2.2.2.3 and Annex 4.

¹⁸⁷ The majority of MNOs responding to a questionnaire distributed for the 'Study on Finance and USO' did not report any concrete plans to densify their networks with the deployment of small cells, at least in the short term. As regards the 2030-2035 horizon it is unlikely that MNOs would have internal investment plans that extend beyond the next 5 years, also noting that future plans will also depend on the external factors which are hard to predict, such as the evolution of demand, and potentially changes to current approaches towards spectrum licencing and any associated conditions.

¹⁸⁸ Across Europe, spectrum costs account for around 7% of mobile service revenues and about 35-40% of capital expenditure Ingravallo, R., & Solomon, G. (2022). Spectrum Licence Renewals and Europe's Digital Future.

¹⁸⁹ GSMA Global Spectrum Pricing 2025.

¹⁹⁰ See section 2.2.2.3. and Average spectrum prices from Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

spectrum fees have been found to contribute to substantial opportunity costs.¹⁹¹ Mid-band spectrum in Europe remains relatively expensive: its price level corresponds on average to around 14.5% of operator revenues, almost three times the level in North America, and may reach up to 20% in some Member States.¹⁹²

Cost pressures may intensify with future rollouts of advanced technologies. Forecasts of substantial growth of mobile data consumption in the coming decade and larger spectrum volumes required for high-quality networks and new use cases imply an increase in spectrum cost even if unit prices were to decline. Beyond spectrum acquisition, investment needs include network densification, identified by stakeholders as the costliest aspect of 5G deployment. Based on stakeholder input, this is estimated to require some EUR 33.5 billion and expected to persist at least until 2030, as operators currently do not plan large-scale densification. Additionally, the **attractiveness of mobile network projects for investors is likely to remain limited** due to risks arising from regular technology shifts, volatility in the consumer base, the finite nature of spectrum rights as well as uncertainty regarding the timing of 6G spectrum availability.¹⁹³ Under these circumstances, operators' willingness and ability to secure financing for high-quality deployment is expected to remain constrained. Overall, **the investment headroom for high-quality mobile networks would remain limited.**

Under the baseline, the many divergences across Member States are expected to persist. Fragmented award practices and heterogeneous authorisation conditions would continue to create uneven spectrum availability and inconsistent investment incentives, while also complicating activities for operators present in multiple Member States. Certain market-shaping measures could continue to be applied in uncoordinated ways that maximise spectrum fees or maintain low retail prices at the expense of investment incentives. If the peer review mechanism remained voluntary and without binding effect, it would offer no assurance that investment-constraining award designs are detected in time for the Commission to intervene ex ante.¹⁹⁴ The application of mechanisms intended to promote more efficient spectrum use, such as sharing, secondary trading, leasing and local licensing, would remain occasional and insufficient, limiting their capacity to alleviate scarcity or support industrial 5G deployment. Cross-border interference coordination with third countries would continue to be inefficient, as the Commission would remain able to resolve interference only in harmonised bands, leaving Member States to address issues in non-harmonised spectrum. The harmonisation process would continue to rely exclusively on Member States contribution through CEPT, where participation of non-EU countries may influence timelines and predictability. The procedure which allows several Member States to jointly establish common aspects of an authorisation process and jointly conduct a selection process will remain largely unused, limited by the fact that it can only be initiated by the Member States.¹⁹⁵

The direction of the patterns of spectrum regulatory approaches and market outcomes identified in our analysis indicates how these performance indicators may evolve under the baseline.¹⁹⁶

¹⁹¹ See section "Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks".

¹⁹² "Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks" reporting GSMA data.

¹⁹³ Study on Finance and USO.

¹⁹⁴ See summary tables with evaluation findings in section 1.2.1 ad 1.2.2.

¹⁹⁵ See summary tables with evaluation findings in section 1.2.1 ad 1.2.2.

¹⁹⁶ Controlling for non-regulatory factors, the analysis presented in section 2.2.2.3 suggests that certain auction and award conditions correlate with differences in prices, coverage and service quality across Member States. If

Member States applying more restrictive award conditions, such as considerable spectrum reservations or set-asides, could continue to increase spectrum costs, consumer prices and to lower the download speeds. Reliance on access obligations may continue to involve trade-offs between consumer prices and 5G coverage. Persistently high spectrum prices could carry a risk of lower overall download speeds¹⁹⁷. At the same time, Member States with more investment-oriented assignment frameworks may continue to achieve relatively stronger results in mid-band coverage and quality of service. As a result, the availability of advanced, quality-assured services requiring reliable high-speed, low-latency performance would progress slowly, selectively, remaining constrained in parts of the EU.¹⁹⁸

Overall, under the baseline, the spectrum framework is likely to remain of **limited effectiveness and efficiency in supporting high-quality mobile connectivity and a functioning Single Market**.¹⁹⁹ The persistence of fragmented award practices, investment-impeding assignment conditions and limited predictability would continue to constrain operators' incentives and ability to plan and finance high quality 5G deployment and would slow the transition towards 6G. As a result, the delivery of anticipated economic and societal benefits from advanced mobile connectivity would be delayed.

5.1.3. Authorisation

The baseline focusses on better enforcement of the existing **authorisation regime** i.e.:

- general authorisation at the Member State of the provision of the network or service (TN or NTN), using a template of authorisation conditions developed by BEREC²⁰⁰ and a General Authorisation Data Base (GADB)²⁰¹ maintained by the BEREC Office;
- and assignment of spectrum for satellites at national level, while voluntarily addressing divergences via BEREC/RSPG.

The Commission may use its powers to adopt implementing acts to facilitate compliance with cybersecurity requirements by public ECN/ECS providers under NIS 2. Taking into utmost account the BEREC Opinion, the Commission may publish a report on the functioning of the general authorisation and outline areas where BEREC could further address obstacles to the proper functioning of the internal market (Article 122 (3) EECC, non-legislative initiative).

existing regulatory practices were maintained, these patterns could persist, even though the analysis does not claim to reveal causal relations.

¹⁹⁷ While the last association does not reach conventional levels of statistical significance in our regressions, it is consistent with econometric estimates presented in the WIK Study that historically a 10 p.p. higher spectrum cost to recurring revenue ratio decreased average speeds by up to 8% (and coverage by up to 6 p.p.). Zagdanski, Jakub; Castells, Pau; Bahia, Kalvin: The Dynamics of Spectrum Cost in the Era of 4G and 5G and Its Impact on Mobile Network Development and GSMA, "Global Spectrum Pricing report," GSMA, London (2025), p. 10.

¹⁹⁸ Analysis by Mason shows that capex in 5G mobile plateaued at 20% of total European telecom capex in 2023, with capex in FTTH networks more than double this value. Lower numbers of small cells in Europe compared with the US and Asia are reported in surveys conducted by the Small Cell Forum (SCF) - SCF (2024). [SCF Market forecast report](#).

¹⁹⁹ See section 2.3.2 on how the problem would evolve and the more detailed findings of the evaluation report in section 2.2.1 and 2.2.2 that further describe the baseline with supporting evidence.

²⁰⁰ <https://www.berec.europa.eu/en/document-categories/berec/regulatory-best-practices/guidelines/berec-guidelines-for-the-notification-template-pursuant-to-article-12-paragraph-4-of-directive-20181972-of-the-european-parliament-and-of-the-council>.

²⁰¹ <https://www.berec.europa.eu/en/tools/general-authorization-database>.

Under this baseline scenario identified shortcomings would remain; it would not effectively foster innovative, resilient pan-European networks and services, as the current general authorisation regime remains fragmented and unevenly implemented across the Member States. It would also do little to increase the number of pan-European services, since the existing national authorisation frameworks continue to create administrative burdens for cross-border operations; these are especially severe for satellite services, which are inherently cross-border.

Barriers to the development of pan-European satellite networks and services will persist since the authorisation of satellite networks and services will not be coordinated and will continue to be entrusted to 27 national authorities, even for pan-European services. Continuing with the current complex division of national regulatory competences for satellite authorisations – many of which differ substantially in application procedures (including costly testing requirements), licence conditions and fee structures – will limit the deployment of innovative satellite D2D services in an increasingly competitive global market, significantly undermining EU competitiveness.

Such a fragmented authorisation regime will lack predictability, legal certainty, transparency and raise market access barriers due to complexity, increased compliance and scale-up cost, and prolonged time to market²⁰², which could eventually undermine investor confidence and, ultimately, increase the cost of capital for new satellite projects²⁰³. According to a study, a 4-month delay in authorisation for the deployment of D2D services in a major LEO constellation with a global average number of subscribers of around 300 000, could cost a company in terms of lost revenue EUR 18.3 million²⁰⁴. Looking at potential future impacts on another EU constellation, a complete inability to deliver IRIS² services across the EU for one month in 2030 would lead to an estimated loss of about EUR 50 million in potential revenue. A one-month loss of service in a single Member State would reduce revenue in proportion to that State's share of total EU revenue.

Barriers to pan-European satellite services will also be driven by inconsistent interpretation of compliance and reporting obligations (in terms of format, frequency and requirements) increasing administrative costs. For instance, as part of the authorisation process, operators are asked to conduct in-country testing in each MS which would indicatively cost EUR 3.2 million across all Member States (see section 6.3.2 for a more detailed analysis).

In a context of exponential increase of the number of satellites and satellite constellations in the following years²⁰⁵, access to EU markets will remain uncoordinated, to the detriment of late-comer satellite systems which will face limited access to spectrum, increased risk of interference and high costs. Selection of providers of pan-European services is possible only for the limited spectrum available in the 2 GHz band (2x30 MHz), while for other bands relevant for pan-European provision of services, satellite operators need to be awarded spectrum rights in every Member State, with the risk of gaps in their coverage. Finally, uncoordinated enforcement does not allow Member States to act effectively against harmful

²⁰² Opinion on Assessment of Different Possible Scenarios for the Use of the Frequency Bands 1980–2010 MHz and 2170–2200 MHz by the Mobile Satellite Services Beyond 2027 ([RSPG24-007 FINAL](#)).

²⁰³ Detecon (2025). [Study on Mobile Satellite Services \(MSS\) in the 2 GHz band in the EU: Implementation of the current regulatory framework and an overview of the satellite connectivity market, study for the European Commission](#).

²⁰⁴ Study on Digital Single Market.

²⁰⁵ See Detecon data presented in section 2.1.3.2. on number of launched and planned satellite constellations per country/region.

interferences that will be increasingly problematic with exponential uptake of LEO constellations. Where satellite operators do not respect international law, a lengthy bilateral process at the ITU level would need to be followed to ensure compliance, without the possibility to leverage the strength of the internal market against very strong operators, limiting EU's competitiveness and sovereignty.

Under the baseline scenario, fragmented and uneven implementation of the authorisation regime is expected to persist, limiting the effects of the technical harmonisation of spectrum and slowing the effective deployment of pan-European networks and services, drawing on lessons learnt in the 2GHz MSS band. The growth of pan-European electronic communications services is projected to remain modest, constrained by administrative burdens and delays in cross-border authorisations, which could plausibly reduce sectoral investment in R&D²⁰⁶ and innovation²⁰⁷.

Comparative benchmarking indicates that countries with unified regulatory frameworks, such as the United States (FCC) and South Korea (where the Ministry of Science and ICT established a "5G+ Spectrum Plan"), achieve faster spectrum allocation and more uniform deployment of innovative services²⁰⁸, highlighting that the EU baseline scenario is likely to lag behind international peers in promoting pan-European connectivity and digital innovation, thereby undermining EU's global competitiveness.

5.1.4. Governance

The baseline scenario assumes that the governance set up remains unchanged. The current division of competences and roles between the Commission, NRAs and other CAs, BEREC, and RSPG will remain. BEREC continues to be a network of NRAs, assisted by the BEREC Office, an EU decentralised agency with legal personality. RSPG remains a Commission expert group composed of high-level representatives of Member States and the Commission. The tasks, including any additional tasks stemming from DNA, would continue to be allocated to the Commission or the Member States' authorities.

Under the baseline scenario the RSPG Secretariat provided by the Commission would use their current resources to support RSPG on administrative issues. For performing the new tasks on spectrum, the Commission would need to be strengthened with 12 FTEs, equivalent to EUR 1.83 million. The BEREC Office would also need to be strengthened to ensure proper support for BEREC in performance of its tasks stemming from the DNA. It would necessitate an additional 2.5 FTEs corresponding to approximately EUR 262 348. Assuming operational,

²⁰⁶ A 2025 report by PEI (Polish Economic Institute) on the EU telecommunications market states: 'the low level of R&D and innovation spending (...) translates into the attractiveness of telcos as workplaces (...) and notes that weak innovation may hinder entry into new business areas. The report links fragmentation to this problem by explaining how the sector's structural issues lower returns and reduce funds available for innovative activities. https://pie.net.pl/wp-content/uploads/2025/01/PEI_Report_European_telecommunications_market.pdf.

²⁰⁷ According to ECIPE, 2025 report 'Strengthening the Supply-Side Innovation in the EU Telecommunications' EU-based telecom companies spent €81 billion on R&D in 2023, but their share in global telecom R&D has dropped significantly: from 44% in 2003 to just 16% in 2023. This decline suggests that EU telecom firms' ability to scale R&D is being outpaced by non-EU competitors, which could be linked to fragmentation (less scale, less efficient investment).

²⁰⁸ See Australian Communications and Media Authority 2024 report on 'International benchmarking study of spectrum utilisation requirements in wireless broadband licences' <https://www.acma.gov.au/publications/2024-12/report-policy-tracker-report-international-benchmarking-study-spectrum-utilisation-requirements-wireless-broadband-licences> and Korean "5G+ Spectrum Plan" by the Ministry of Science and ICT adopted in 2019 : <https://smartcity.go.kr/en/2019/12/05>.

building and equipment costs increase by ~5%, the annual costs for the BEREC Office would increase by approximately EUR 0.5 million.

Identified shortcomings would remain. BEREC and RSPG will continue to play purely advisory role on narrow set of tasks with limited scope of cooperation, with further synergies unexploited. BEREC would take on the new tasks such as preparing guidelines and best practices within its remit. Considering that the functions of the BEREC Office would remain the same as currently, its support to BEREC would be equally limited mostly to administrative and data base handling tasks. The RSPG secretariat provided by the Commission will not be able to provide to RSPG more support on substance (in this option such support would still need to be provided by the Commission itself). Furthermore, it is questionable whether all new measures foreseen by DNA could be implemented under the baseline scenario governance structure, such as spectrum single market procedure. Complexity will keep increasing by the proliferation of different bodies to which BEREC participates or cooperates within the digital sphere²⁰⁹.

5.2. Description of the policy options

Each option block is built from a set of concrete policy measures that directly address the problem drivers identified in section 2. Recognising that problem drivers vary in nature and impact; the options are designed with increasing levels of regulatory ambition. The packaging process therefore moves from relatively light adjustments to more structural reforms, ensuring that each option block represents a coherent and internally consistent response to the four blocks of problems and their drivers. Presentation of each option block is accompanied by a table mapping the measures under each block against the specific problem drivers. Measures within each option block are selected to complement each other.

5.2.1. Transition to fibre

To fill the gaps in terms of fibre deployment and take-up, the options cover:

1. measures to foster the deployment and take up of fibre, including measures to expedite the copper switch-off, given the negative effects that the persistence of legacy copper networks has on deployment and take-up, and
2. Updates to access regulation to align it with the future full fibre landscape, to ensure that, during the copper switch-off phase and following it, end-users continue to benefit from choices of services at affordable conditions and that competition is preserved. This will enable operators to design more flexible offers to ensure consumers can choose among different services at affordable prices and, thus further push take up of fibre.

All the options include some simplifications by removing the Code provisions related to remedies that have not been used (e.g. co-investments), in line with the findings of the Code evaluation report (Annex 11). To protect end-users following the copper switch-off, under all options presented below, the Universal Service obligations will be kept ensuring that affordable and adequate internet access is available, irrespective of location and income. The key elements of the options are shown in the table below, followed by a more detailed description of the measures under each of the option and in Annex 8. The matrix of all combinations of options and choice of the ones described below is done under discarded options.

²⁰⁹ e.g. RSPG, ENISA, NIS Cooperation Group, EDIB, DMA High Level Group.

Table 14: Transition to fibre options and links to the problem driver and specific objective

Problem driver	Specific Objective	Policy options			
		P01 Non-binding CSO and updated access regulation	P02 Conditional CSO and updated access regulation	P03 Market driven CSO and bottleneck-based access regulation	P04 Mandatory CSO and symmetric regulation
Factors slowing down the deployment and adoption of fibre networks/ services (persistence of copper and some regulatory approaches)	SP01: Swift fibre deployment and take-up in all MSs	Transition to Fibre Plan with non-binding date for copper switch-off	MS to prepare a Transition to Fibre Plan and communicate it to the Commission; Mandatory date for copper switch off by 2030, subject to sustainability conditions Obligation on MSs to ensure that copper switch-off starts by 2030 in all areas with at least 95% fibre coverage and comparable prices for fibre-based broadband. Vulnerable consumers to be protected. If the above coverage and affordability conditions are not met, Member States should set out the measures to transition to fibre by 2035. Review of the Transition to Fibre Plan by 2035. This process will be subject to the Commission's scrutiny. Introduce some changes to the access regime to make it effective also during and after the copper-switch off phase: Increased focus on regional markets through geographic surveys (strengthening of Art. 22); Complement SMP regulation (which is maintained) with tools that NRAs could use where needed, in particular in relation to sub-national markets: Update existing "symmetric regulation" under article 61.3 to enable NRAs to apply it for access to in-house wires (upon request) and beyond the first distribution point on their own initiative where warranted. Strengthening the provisions on in-building wiring to facilitate deployment.	Market driven fibre deployment and copper switch-off process managed by operators (Art.81 is removed, and no condition to the switch off apply); Bottleneck approach applied on areas with a single fibre network;	Transition to Fibre Plan with binding date for copper switch-off No sustainability conditions or additional safeguards.
		Very limited changes to access regulation Guidelines on EU wholesale access products	Updates to access regulation in particular symmetric rules EU wholesale access products	Bottleneck approach applied on areas with a single fibre network; Only symmetric access to passive networks (ducts and poles)	Regulated access to all fixed networks Regulated access to ducts and poles List of EU wholesale access products

Option 1: Non-binding copper switch-off and limited updates to access regulation

Member States will prepare plans for FTTH coverage, including proposed measures to foster fibre deployment, and communicate those to the Commission [by 2029].

For copper switch-off, this option sets a non-binding target date of 2030. The obligation existing in the Code to notify NRAs of the network switch-off will be extended to cover all copper network operators, not only those with SMPs. Operators will be required, where appropriate, to submit a copper switch-off plan to the NRAs. New conditions for migrating to alternative fibre networks will be defined in Article 81. BEREC will be mandated to publish guidance on best practices for copper switch-off and geographic surveys. The references to 100 Mbps in Article 22 of the EECC regarding geographic surveys will be changed to VHCN as defined in the EECC.

For access regulation, the market analysis framework will be retained, subject to the prior assessment whether the measures already in place (e.g. GIA) are sufficient to remedy the problems identified. As it is currently the case, with respect to the markets that are recommended for ex ante regulation, there is a presumption that the three criteria test (i.e. existence of high entry barriers, lack of tendency towards effective competition and insufficiency of competition law) is met. For other markets, the three criteria test applies (to facilitate fibre deployment and address the issues related to access to in-building wiring, NRAs will be also able to impose (upon request) access to in-building wiring and access beyond in-building wiring could be imposed ex-officio (and not only upon request as currently the case). Article 61(3) will be amended accordingly. NRAs would be able to require operators deploying FTTH to provide a connection (drop cable) to households which are passed by fibre within a given distance.

To ensure more consistency in NRAs' regulatory practices across the EU and address the single market fragmentation, the EU wholesale access products will be introduced. BEREC will be mandated to establish guidelines on the EU wholesale access products. NRAs could impose other remedies but would need to justify the reasons for such differentiation.

Option 2: Conditional copper switch-off and updated access regulation

This option contains a combination of measures geared at fostering fibre deployment and take-up, including via an EU-wide copper switch off date by 2030, subject to certain conditions. It aims at increasing accountability of Member States, who should adopt a coordinated strategy at national level and concrete measures to support fibre deployment (which would, in turn, facilitate meeting the conditions for the switch-off of copper and increase take up). It includes a review date in 2035 and very strong safeguards for end-users.

As regards copper switch-off, by 2029 Member States should submit to the Commission's scrutiny a "Transition to Fibre Plan" setting out their strategy for the entire country. The plan will include:

- the identification of the areas where transition to fibre is feasible and the copper switch off process will start as soon as possible and at the latest in 2030;
- for the areas where copper switch off cannot start by 2030, set out the measures to transition to fibre at the latest in 2035.

In assessing whether the copper switch-off should start the following aspects should be considered by Member States:

1. Sufficient coverage by fibre networks in a given area [indicative 95%]
2. Ensuring affordability through comparable prices for comparable services

3. Ensuring that appropriate safeguards, including alternative solutions, for vulnerable customers are in place.

The first two aspects are addressed via the conditions (“sustainability conditions”), that are requirements for the copper switch off to start. The third aspect will be addressed via additional safeguards and measures that will be set by NRAs or other national authorities.

By 2035 Member States should review the fulfilment of the Transition to Fibre Plan and transmit it for Commission’s scrutiny. In the review Member States should, in particular:

- ensure that in all the areas of the country where the copper switch off started, it is completed asap, and
- for all remaining areas where fibre deployment is not viable (e.g. remote areas geographically difficult to reach), explain the reasons for the exceptions and provide alternative connectivity solutions for customers in these areas.

NRAs will also be required to contribute to the process by (i) gathering data on network coverage that will be the input for the Transition to Fibre Plan; (ii) producing the lists of areas for CSO, based on Commission’s guidance on the definition of these areas to be issued shortly after adoption of the DNA; (iii) advising national authorities for the preparation of the Fibre Transition Plan; (iv) conducting market reviews, in the context of the national authorities’ decision to order the switch off of copper networks, and adopting remedies as needed, and (v) review the switch off plans of the operators and oversee the migration process.

For access regulation, this option provides greater flexibility in the application of ex ante regulation by providing NRAs with more tools to be used depending on the features of the market.

The NRAs should first analyse whether the existing symmetric regulation (GIA) would be sufficient to address the identified problems. In the next step, if GIA is not sufficient, the NRAs could decide to apply SMP regulation or the symmetric rules under Article 61(3), depending on what is most appropriate to address the identified competition problems in a given area. In this option the application of the symmetric rules is broader than in option 1 as it covers not only the possibility to impose access to in-building wiring but also access beyond the building if the criteria of Article 61(3) EECC (high and non-transitory barriers to replicability) are met. Access to the in-building wiring part would be imposed upon request whereas access provided beyond in-building wiring could be imposed ex-officio (and not by request as it is currently the case) to facilitate deployment and to tackle more localised competition concerns.

The approach to geographic surveys would be expanded, requiring NRAs to gather data on retail markets and the underlying infrastructure periodically. This data will be important for NRAs to assess the market conditions and decide whether ex ante intervention is required.

To support the standardisation of wholesale offers, a list of essential wholesale products will be included in the DNA, and the Commission would have to adopt an Implementing Act to establish best practice specifications and/or to amend the list, following consultation with BEREC.

Option 3: Market driven copper switch-off and bottleneck-based access regulation

For copper switch-off, this option removes NRAs’ oversight over the copper switch-off process and give operators full discretion over the timing and conditions of the copper switch-off (i.e. remove Article 81).

For access regulation, this option focuses on deregulation by removing: (i) SMP-based regulation, and (ii) regulation on in-building wiring (Article 61(3)).

SMP-based regulation would be replaced by a "bottleneck" approach mandating wholesale access only in areas with a single fibre network. EU wholesale products will be provided.

Access to civil engineering infrastructure is handled via the GIA exclusively.

The option supports coherent access regulation across the EU by giving the Commission veto right on imposing regulation. Further, it eliminates the provision on geographic surveys and data gathering regarding infrastructure deployment (Article 22 of EECC). This option would be a significant shift from the current ex ante approach as it would rely mainly on ex post competition enforcement and would limit the ex ante regulation to quite exceptional cases where there are no means to create any form of competition. As a consequence, many markets that are characterised by non-competitive characteristics would not be regulated anymore, as some access products would be often available on commercial basis, but would not necessarily allow effective replicability of the local market leader's services and hence service competition.

Option 4: Mandatory copper switch-off and symmetric regulation

For copper switch-off, this option mandates ECN operators to switch off their copper networks by 2030. No conditionality or other form of sustainability checks or safeguards is envisaged. NRAs are tasked with gathering and publishing relevant data on copper switch-off, including geographic surveys of FTTH, cable, and Gigabit-capable fixed wireless networks, along with the status of copper to fibre migration.

For access regulation, this option replaces SMP-based regulation and Article 61(3) with a requirement for all fixed operators to provide wholesale local access on fair terms, enabling dispute resolution by NRAs if no agreement is reached within two months. It requires operators of copper networks, or those previously deemed to have SMP, to provide access to ducts and poles based on cost-orientation and non-discrimination, with guidelines from the EC or BEREC. To support harmonisation, an initial list of basic wholesale products will be included in the Annex to the DNA for NRAs to consider during the resolution of access disputes.

For a more detailed description of the policy options, see Section 1 of Annex 8.

5.2.2. Spectrum

Spectrum options have been designed with the objective to ensure very high quality 5G and future 6G mobile connectivity for European businesses and citizens with the view to closing the gap with competing regions in high quality wireless networks by 2040. By creating a pro-investment predictable spectrum authorisation framework and enabling efficient use of spectrum and innovation, spectrum measures can decisively contribute to boost investment in wireless networks by 2035 and ensure quality of service needs are fulfilled, also for quality-assured services. The policy intervention will pave the way for early 6G deployment, including 6G-NTN in synergy with satellite authorisation measures described in the relevant section. The options therefore propose solutions to increase predictability, reduce fragmentation, incentivise investments in high quality mobile networks and ensure more efficient use of spectrum.

Each option progressively increases the intensity of intervention in six groups of measures that are linked with the problem drivers illustrated in Section 2.2.2, and are echoing measures which have been proposed in the Draghi report on EU competitiveness:

- (i) longer **licence duration** (causal link with the driver of lack of predictability and financial attractiveness)
- (ii) **harmonisation of spectrum authorisation conditions** and **consistent use of market shaping measures** (causal link with the driver of regulatory fragmentation insufficiently incentivising investments, excessive cost of spectrum, lack of predictability)
- (iii) **roadmaps to ensure availability of spectrum**, including for the coordinated launch of 6G (causal link with the driver of lack of predictability and regulatory fragmentation)
- (iv) **enhancing spectrum sharing** in compliance with competition law causal effect with the driver of regulatory fragmentation not ensuring efficient use of spectrum)
- (v) **facilitating spectrum harmonisation for innovators** (driver of regulatory fragmentation not ensuring efficient use of spectrum), and
- (vi) **ensuring sovereignty/security**, including by addressing harmful interferences (causal effect with the driver of lack of predictability and inefficient use of spectrum).

The Draghi Report proposed similar measures which have to a certain extent inspired and informed the proposed measures. More specifically, the report suggested:

- 1) harmonising EU-wide spectrum licensing rules and processes, including for satellite uses, and orchestrate EU-wide auction design features to create scale benefits and incentivise the consolidation of continental digital networks, a measure which is echoed in the proposed harmonisation of spectrum authorisation and award conditions and in the EU satellite authorisation;
- 2) harmonising the release of new frequency bands to allow investment across Member States by EU players, guarantee the timing of harmonisation and include the release of additional WiFi-dedicated bands into the spectrum guidelines, to allocate enough spectrum to 5G and 6G, which is echoed in the proposals related with the spectrum roadmap and in the proposal relevant for the petition for rule making;
- 3) introducing a Commission veto on auctions not following harmonised guidelines which is echoed in the proposal for mandatory spectrum single market procedure and veto on market shaping measures;
- 4) at least doubling the duration of frequency licences, with the possibility of reselling during their lifespan, which is echoed in the proposal for unlimited license duration by default, quasi automatic renewal and facilitation of spectrum trading and leasing;
- 5) banning reservations in spectrum allocation and restrict the imposition of caps for spectrum holdings only to cases of dominant position, which are echoed in the proposal with the reinforcement of the robustness of the competition assessment before imposing such remedies.

Table 15: Spectrum options and links to the problem driver and specific objective

Problem drivers	Specific policy objectives	Policy options - Spectrum		
		PO1 soft harmonisation	PO2 more single market to enhance investment, innovation	PO3 strong harmonisation and EU level awards
PD2: Spectrum regulation and market factors slowing down investment in very high-capacity mobile services	SPO2: Close the gap with competing regions in high quality wireless networks	<u>Duration:</u> Longer licence duration (min 25 years)	<u>Duration:</u> Unlimited licence duration by default, with safeguards for revocation and strong renewal guarantees. (For details see below)	<u>Duration:</u> Indefinite licence duration
		<u>Assignment conditions:</u> Toolbox of best pro-investment /pro-efficient use authorisation practices, developed by EC with RSPG	<u>Assignment conditions:</u> Mandatory application of pro-investment auction designs with common set of criteria to promote effective competition For public networks , possibility for EC to recommend pro-investment authorisation processes aspects and conditions ²¹⁰ ; any deviation thereof should be justified; possibility of EC decision, if deviations persist, or to promote pan-European provision of services or to incentivise scale (e.g. 6G). For public/non-public networks , on request, possibility of harmonising authorisation conditions in through RSPG; possibility to establish award procedure and conditions on EU level with involvement of RSPG; possibility of one-stop-shop procedure	<u>Assignment conditions:</u> Full harmonisation of authorisation processes aspects and conditions (e.g. auction design, reserve prices, award fees, annual fees, coverage obligations, QoS). Mandatory deadlines for assignments set for every band, with auction on standard pre-established condition if a deadline is passed .
		<u>Authorisation regime:</u> Possibility for EC to recommended authorisation regime for EU harmonised bands, and promotion of flexible licencing .	<u>Authorisation regime:</u> Possibility for EC to decide on authorisation regime .	<u>Authorisation regime:</u> EU level award of harmonised spectrum for certain services. Mandatory authorisation regime for nationally assigned spectrum, with a possibility to request joint selection procedure .

²¹⁰ This measure echoes the proposal in the Draghi report to harmonise EU-wide spectrum licensing rules and processes, including for satellite uses, and orchestrate EU-wide auction design features to create scale benefits and incentivise the consolidation of continental digital networks.

Problem drivers	Specific policy objectives	Policy options - Spectrum		
		PO1 soft harmonisation	PO2 more single market to enhance investment, innovation	PO3 strong harmonisation and EU level awards
		<u>Ex ante control:</u> Ex ante single market procedure by EC and RSPG/BEREC of spectrum assignment measures resulting in non-binding EC opinion on measures	<u>Ex ante control:</u> Mandatory ex ante single market procedure by EC and RSPG/BEREC of spectrum assignment measures resulting in EC decision on measures with possibility of EC veto on market shaping measures , if they are not justified	<u>Ex ante control:</u> Mandatory ex ante single market procedure by EC and RSPG/BEREC of national spectrum assignment measures resulting in EC opinion with possibility of EC veto on market shaping measures , if they are not addressing only the case of dominance
		<u>Coordination of assignment timing:</u> Spectrum roadmap for 6G developed by EC with RSPG and regularly updated	<u>Coordination of assignment timing:</u> National roadmaps based on spectrum strategy and spectrum roadmaps, with obligation to authorise spectrum within less than 24 months from harmonisation, scrutinised by the EC with the assistance of the RSPG, and consequences for not respecting the timelines.	
		<u>International governance:</u> Recommended coordination of positions at CEPT on issues related to security / technology sovereignty	<u>International governance:</u> Mandatory coordination of position at CEPT on issues related to security / technology sovereignty	<u>International governance:</u> In exceptional cases, harmonisation work carried out by ad hoc / high-level only MSs group instead of by CEPT
		<u>Petition of rule-making mechanism</u> with EC obligation to respond to request and justify eventual refusal	<u>Petition for rule making mechanism</u> to request spectrum harmonisation with procedures and obligations for competent authorities	<u>Petition for rule making mechanism</u> with an extended scope to also cover authorisation aspects and innovative approaches to improve spectrum efficiency
		<u>Spectrum sharing:</u> Soft Harmonisation – 1) removing legal / regulatory obstacle for spectrum sharing / pooling , especially in rural/ underserved areas & 2) promoting flexible spectrum licensing	<u>Spectrum sharing:</u> More Single Market – 1) stronger and more coordinated EU approach through mandatory spectrum sharing (subject to technically feasible and not distort competition), including “use it or share/lose it” conditions and dynamic geolocation databases & 2)	<u>Spectrum sharing:</u> Hard Harmonisation - Mandatory EU framework for spectrum sharing across all EU-harmonised bands and generalise use of dynamic geolocation database systems to all bands.

Problem drivers	Specific policy objectives	Policy options - Spectrum		
		PO1 soft harmonisation	PO2 more single market to enhance investment, innovation	PO3 strong harmonisation and EU level awards
			address barriers to assigning spectrum to wholesale network operators	
		Cross-border harmful interference issues: - deadlines introduced in current mechanism for solving issues between Member States - enhance solidarity in case of issues with third countries	Cross-border harmful interference issues: - mechanism for solving issues between Member States with deadlines extended to non harmonised spectrum - enhance solidarity in case of issues with third countries	Cross-border harmful interference issues: - mechanism for solving issues between Member States coupled with private enforcement - mechanism for coordinating Member States response under RSPG to issues with third countries

Safeguards for indefinite duration of licenses

While unlimited duration of licenses provides regulatory predictability for spectrum users and allows the development of a functioning secondary market for spectrum trading and leasing, it could have negative effects on competition, if it is not subject to strict conditions. The risk that indefinite duration of licenses would prevent market entry and reduce competition, availability, quality of services, and investment incentives²¹¹ could however be addressed through **regulatory safeguards** that protect competition and prevent spectrum hoarding, a number of which have already been integrated into various licensing regimes, such as obligations to provide wholesale access or enable spectrum sharing. Such measures will be subject to *ex ante* single market procedure under the new rules.

By choosing appropriate authorisation conditions - such as “use-it-or-share-it or lose-it” conditions and rollout obligations - and by enforcing them, the regulators would ensure spectrum would not be left idle or blocked and would be made available to more efficient or innovative competitors. They can also combine long or indefinite durations with periodic checkpoints, conditional renewal regimes or revocation powers that allow rights to be reviewed, adjusted, or withdrawn, if needed for spectrum management or public interest objectives. For example, such licences could be revoked in case of technical or market developments justifying new assignment (such as reduced interest of customers for a service provided by certain technology or lack of competition).

Indefinite duration of rights of use does not hinder the deployment of up-to-date technologies as rights of use are granted under the principle of technology neutrality. This facilitates a smooth transition between successive technology generations (e.g. from 4G via 5G to 6G). The combination of indefinite duration and technology neutrality enables operators to adopt the latest and most efficient technologies as soon as they emerge, ensuring flexibility and continuity in network evolution. Since mobile markets are largely competitive, market pressure is forcing operators to constantly invest to retain the competitive edge.

Overall, while long or indefinite licences raise valid concerns, these can be addressed through well-established policy tools that balance the need for long-term investment certainty with the preservation of a dynamic, competitive, and efficient spectrum market. There is already experience with long or indefinite duration licenses and simplified renewals already in other jurisdictions, such as in the UK or the US²¹², from which lessons are drawn. In any case as indicated in Section 2.2.2. with full 5G there are limitations to the economically viable duplication of networks given high investment costs.

Feasibility of spectrum sharing options

Spectrum sharing has been already used by several jurisdictions to open previously underutilised spectrum to a wide range of applications, including private enterprise networks, industrial sites, and rural broadband, as indicate the examples from the UK, where sharing is enabled in several bands, and the US, where dynamic spectrum sharing is increasingly used.

Spectrum sharing arrangements should be in compliance with competition law and agreements will be subject to the competition law single market procedure by the national competent authority. In particular, sharing would primarily apply between services which are not in direct competition (e.g. between mobile and Wi-Fi or between mobile and PMSE). Intra service sharing would be feasible provided that it would not distort competition, for example by ensuring that commercially sensitive

²¹¹ See BERECA input.

²¹² See section 2.2.2.3 for FCC streamlined and harmonised license renewal and service continuity rules.

information is not made transparent or exchanged between the competing parties. The technical feasibility and economic viability of spectrum sharing would be determined on a case-by-case basis, taking into account technological development, implementation costs, and stakeholders' market strategies. Technical feasibility and related risks will be assessed through CEPT studies and taken into account in Commission implementing decisions on spectrum harmonisation. The authorisation of specific spectrum sharing arrangements by Member States (or the Commission in relevant scenarios) should be informed by EU-level opinions of the Radio Spectrum Policy Group and by extensive stakeholder consultations. The imposition of use-it-or-share-it conditions may entail the risk of inadequate assessment of technical and/or economic feasibility and therefore should be subject to single market procedure, e.g. in the peer review process. Duly justified spectrum sharing arrangements and/or obligations could also be considered as part of the evolving EU spectrum roadmap.

As regards spectrum sharing, the different options differ regarding the level of harmonisation.

Option 1 focuses on removing legal or regulatory barriers to spectrum sharing or pooling and promotion of flexible spectrum licensing, e.g. licences limited to a particular location or time period, especially for verticals, through non-binding measures (guidelines, best practices).

Option 2 introduces a stronger and more coordinated EU approach, through legally binding measures. Spectrum sharing would be mandated where technically feasible, and does not distort competition. It would be integrated into standard regulatory practice for selected harmonised bands. Generalised use of “use it or share it or lose it” condition would ensure the efficient spectrum use of spectrum and act as a safeguard against spectrum hoarding in the case of indefinite-duration licences. To move to dynamic ways of spectrum sharing that are already in use in other jurisdictions, the option includes also development of dynamic geolocation databases in frequency bands where sharing would be most beneficial. It would also address possible barriers to assigning spectrum to wholesale network operators.

Option 3 establishes a mandatory EU framework would be established to impose spectrum sharing across all EU-harmonised bands. Under this framework, the use of dynamic geolocation database systems would be generalised to all bands.

While spectrum sharing may contribute to a more efficient use of spectrum, it could also raise concerns with regards to its compliance with competition law. For this reason, all options involving spectrum sharing in this impact assessment are considered as involving spectrum sharing in compliance with competition law.

For detailed description of the policy options, see section 2 of Annex 8.

5.2.3. Authorisation

The key aim of the measures related to general authorisation and authorisation for satellite services is to simplify and harmonise the fragmented regulatory environment.

The three options aim to improve conditions for resilient and scalable pan-European digital networks and services, but with differing levels of harmonisation and market impact. option 1 partially harmonises authorisation and strengthens enforcement, reducing some fragmentation but leaving authorisations largely national, including for satellite spectrum. option 2 establishes a “single passport” for the general authorisation of all networks and services excluding satellite and an EU level simplified authorisation and, if relevant, EU-level selection for satellite spectrum, creating

coherent cross-border conditions and enabling market scale, and combined with coordinated enforcement at EU level to establish a level playing field in satellite. option 3 applies country-of-origin authorisation EU-wide, simplifying compliance and accelerating deployment, but risks regulatory arbitrage and uneven enforcement.

All options for simplified authorisation regimes work in complement with the simplification of other relevant DNA rules, which can represent barriers to cross-border operation and provision of innovative services. These include guidance for voluntary cooperation in the broader ecosystem to avoid litigation as well as more harmonised end-users rules, with less possibilities for Member States to derogate, while keeping strong protection for consumers.

Table 16: Authorisation options and links to the problem driver and specific objective

Problem drivers	Specific policy objectives	Policy options - <u>Authorisations</u>		
		General authorisation and authorisation for satellite services		
		PO1 Partial harmonisation of authorisation	PO2 “Single “passport” for other networks and services than satellite and an EU-level authorisation for satellite spectrum	PO3 Country-of-origin authorisation for cross-border and B2B services
PD4 Fragmented authorisation conditions, not allowing to operate across the EU	SPO4: Increase pan- EU network operation and service provision General authorisation	Emphasis on enforcement of the EECC GA regime. National notification is still required in each MS. The notification process is simplified only for cross-border operators (BEREC Office not a MS is notified, and it informs the concerned NRAs/CA)). Focusing Commission on implementing acts for security of public ECNs and ECS to facilitate compliance with security requirements; Improvements to the non-mandatory notification template by BEREC Issuing a non-mandatory reporting template by BEREC Upgrading the BEREC Database on notifications	Notification in one Member State and “Single passport” issued by a Member State chosen by the provider (MS of notification). This MS triggers the coordination process for providers launching new networks or services, and for existing providers that choose to operate under the Single passport regime. It is optional for purely local providers, but once a cross-border provider requests it, the MS must issue it. BEREC issues Guidelines, in cooperation with the Commission and other competent authorities, on consistency, coherence and streamlined applicable further harmonised GA conditions (approximation of conditions). More coherent requirements, and esp., non-DNA related via a facilitating mechanism based on coordination between Member States to facilitate compliance. Enforcement remains at the country of destination level based on EU-wide pre-coordinated conditions and requirements	Limited to certain service providers only of cross-border nature; GA conditions of only one Member State apply while other should respect, mutually recognise and assist the country of origin in exercising enforcement powers. GA remain national i.e., of only one Member State.

Problem drivers	Specific policy objectives	Policy options - <u>Authorisations</u>		
		General authorisation and authorisation for satellite services		
		PO1 Partial harmonisation of authorisation	PO2 “Single “passport” for other networks and services than satellite and an EU-level authorisation for satellite spectrum	PO3 Country-of-origin authorisation for cross-border and B2B services
			Unleashes cross-border provision of networks and services and is adjusted according to the technology evolution and transition to more software-based networks and more virtualised services.	
PD4 Fragmented rules, in particular in authorization, not allowing to operate across the EU	SPO4: Increase pan-EU network operation and service provision Satellite spectrum authorisation	EC empowered to conduct selection procedure for licencing satellite spectrum for pan-EU services ; however, spectrum assigned at national level under common template for authorisation conditions	Simplified authorisation at EU level for satellite spectrum: EC empowered to issue declarations to provide satellite networks or services and authorisations to use relevant spectrum including individual rights of use of spectrum, in the relevant Member States or the entire EU Full harmonisation of authorisation conditions Selection at EU level in case of spectrum scarcity Binding EU-level compliance and enforcement framework for access to the EU market, with possibility of authorisation withdrawal for the entire Single Market	EC empowered to conduct a selection procedure for licensees of MSS satellite spectrum for the provision of pan-European services EC supported by RSPG and BEREC Office to set common requirements for access to EU satellite market and create a coordinated compliance and common enforcement mechanism Country of origin issues the rights of use following the common requirements and imposes sanctions in case of non-compliance

For detailed description of the policy options, see section 3 of Annex 8.

Other relevant DNA rules, which can represent barriers to cross-border operation, such as end-users rules would be streamlined, with less possibilities for Member States to derogate, while keeping strong protection for consumers.

5.2.4. Governance

Key aim of this intervention area is to create a governance system both for market regulation and spectrum management that is suitable for the new EU level tasks with Single Market dimension and allows for decision taking on the most efficient level. Apart from addressing the specific objective of adjusting regulatory competences and roles to deepen the Single Market for connectivity, the options aim to accommodate the tasks stemming from preferred options in other policy areas in the best way possible in line with the specific objective.

Table 17: Governance options and links to the problem driver and specific objective

Problem drivers	Specific policy objectives	Policy options		
		PO1: BEREC and RSPG as two separate bodies supported by the BEREC Office	PO2: EU agency (BEREC and BEREC Office merged), providing an office to the RSPG	PO3: Two separate agencies – BEREC + BEREC Office & RSPG
Insufficient cooperation and fragmented regulatory approaches	SPO4: Deepen the Single Market for connectivity through adjustment of regulatory competences and roles	Participation of Office's staff in BEREC and RSPG working groups, possibly taking over some co-chairs' workload, to increase BEREC and RSPG impact on harmonisation. Improved cooperation between BEREC and RSPG thanks to the common Office. Enhanced cooperation with other agencies, expert groups and bodies through the contacts at the BEREC Office level.	Merging BEREC and BEREC Office into an agency to increase its involvement in the substance work and facilitate harmonisation. Otherwise as in option 1.	BEREC & BEREC Office as in option 2. RSPG as an agency will take over some decision-making powers from the Commission. Enhancing cooperation between the two agencies would be ensured by regular check-point meetings; reaching out to other EU agencies, expert group and bodies.
		Mandating representation of other CAs each time a subject within their remit is discussed within BEREC. NRAs will perform a role of national contact points responsible for coordinating and presenting their positions at the BEREC level.	As in option 1.	As in option 1.
		Strengthening of the BEREC Office to enable it to support BEREC and RSPG both on administrative tasks and on substance. Thanks to links with both BEREC and RSPG, and cooperation with other relevant authorities, the Office will gain an overview of different aspects of market functioning.	EU agency merging BEREC and its Office will streamline its internal structure. It will be equipped with staff able to take on more tasks, including decision-making tasks in the future. This would improve the relevance and coherence of its outputs. Otherwise as in option 1.	Two fully fledged agencies equipped with staff able to take on more tasks, including some decision-making on spectrum and in the future other decision-making tasks. Having two separate agencies responsible for electronic communications and spectrum will strengthen the EU-level responsiveness. The coordination aspect will however be weakened due to separation between BEREC and RSPG.

For detailed description of the policy options, see section 4 of Annex 8.

5.2.5. Options discarded at an early stage

Fibre transition – discarded options and approach to choosing the best combinations of the options component

A wide range of policy combinations are available. For copper switch-off, options range from deregulatory to highly interventionist approaches along the following lines:

- Full deregulation: removal of existing CSO provisions (e.g. Article 81 EECC) and leaving switch-off entirely to the market. (
- Non-binding target date: a legislative recommendation without enforceability.
- Conditional CSO requirement: mandatory CSO only in areas meeting predefined conditions (FTTH availability and equivalent quality/price alternatives).
- Unconditional CSO requirement: mandatory switch-off by a fixed deadline regardless of alternative infrastructure conditions.

Similarly, access regulation could follow several pathways:

- Highly deregulatory: replace SMP framework with a narrower “bottleneck” approach focused on a single closed network.
- Maintain SMP framework with minimal amendments: simplification where possible (removal of unused and potentially incoherent measures) and limited adaptations to improve usability of measures that have proven to be valuable where applied such as Article 22 (geographic surveys) and Article 61(3)
- Maintain SMP framework with more substantial improvements: of the existing regime with simplification where possible (removal of unused and potentially incoherent measures) and more extensive adaptations to improve usability of measures that have proven to be valuable where applied such as Article 22 (geographic surveys) Article 61(3), as well as strong guidance regarding wholesale access specifications, requiring justification for departure.
- Symmetric regulation: replace the existing access regime with a broader set of access obligations for all operators

The combinations that were ultimately selected for full analysis are shown in the following table.

Table 18: Range of potential policy choices

	CSO deregulation	Non-binding CSO	Conditional CSO	Unconditional CSO
Access deregulation (bottleneck)	Option 3			
Access status quo with small amendments		Option 1		
Access status quo with more significant amendments			Option 2	
Symmetric access regulation – all players provide access				Option 4

These combinations (Options 1-4) combine policy choices with the same level of intervention for both components, copper switch-off and access regulation. Thus they are the most coherent combinations. They also cover a sufficiently wide range of approaches from market based to strong EU-level involvement. For example:

- Extensive deregulation of wholesale access on the assumption that the market would function better in the absence of intervention in delivering FTTH investment is compatible with a laissez faire approach to copper switch-off, as the market could be assumed in this context also to deliver CSO when appropriate for investors and end-users. Under such a scenario it would also be logical that the market would be assumed to deliver appropriate wholesale access products and thus no provision is made for EU-level standardisation. This is captured in option 3.
- An incremental approach to CSO, based on non-binding deadlines established in legislation, and therefore leaving discretion to Member States is coherent with an incremental approach to access regulation, where the existing regime is maintained but complemented with non-binding but legislatively backed guidelines on wholesale access product specifications, and minor amendments to address identified problems e.g. in data gathering and lack of attention to Article 61(3). This is captured in option 1.
- A mandatory, but conditional approach to CSO (to address concerns about the potential impact of an unconditional approach on end-user) is compatible with an approach which introduces a requirement for NRAs to gather data about CSO and to conduct market analyses relating to CSO to ensure that wholesale access regulation is fine-tuned to support the mandatory CSO process and to secure positive consumer outcomes (e.g. by ensuring that wholesale access regulation is adjusted as needed to reflect changes in market structure resulting from CSO). This approach, of setting binding requirements, but with some flexibility to deviate at national level based on national circumstances is also consistent with the policy pursued under option 2 of introducing a requirement for NRAs to follow best practice wholesale product specifications unless they can justify the alternative approach proposed.
- A mandatory and unconditional approach to CSO with a deadline of 2030 is unlikely to leave sufficient time for a market analysis process to address any issues resulting from the associated changes in market structure. A blanket obligation in this case for all operators owning access networks to offer wholesale access (without the need to assess an intervention threshold in this regard) would be needed to ensure that customers can be transitioned from the decommissioned copper networks to alternative networks. At the same time, if there is an obligation applying on all operators to offer wholesale access (rather than those with market power or control of an asset that is hard to duplicate), it would be disproportionate to mandate strict price control or require strict specifications regarding the wholesale products offered. Thus, under option 4, the symmetric obligation to offer access is associated with an obligation to do so under fair and reasonable terms and conditions, and is likely to apply to bitstream rather than physical or virtual unbundling.

Other combinations of policies relating to copper switch-off and wholesale access were considered but rejected on the basis that they were not internally coherent.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1. Transition to fibre

The quantification of economic and environmental impacts associated with the different options for the transition to fibre is based on a 3-step process. First, the effects of the different policy options on FTTH coverage and take-up as well as their capability to promote competition in broadband quality (via infrastructure competition where viable or otherwise access regulation permitting full differentiation) are assessed. Then the projected increases in FTTH coverage and take-up is translated

into average speeds and per user consumption. Second, the effects of increased take-up of FTTH and increased speeds on GDP are estimated. Lastly, the effects of broadband speeds on data consumption are analysed to quantify the implications for electricity consumption and CO2 emissions. The relevant impacts are estimated for 2030 and 2035 to capture the short-term and mid-term impacts of the options. The complete methodology and results are described in detail in Annex 4.

Table 19: Quantitative and qualitative analyses performed

	Quantitative analysis	Qualitative analysis
Macroeconomic impacts (GDP)	✓	
Conduct of business (coverage, take-up and speed)	✓	
Position of SMEs	✓	✓
Administrative burdens on businesses	✓	✓
Sectoral competitiveness, trade and investment flow		✓
Functioning of the internal market and competition		✓
Public authorities	✓	✓
Technological development / digital economy	✓	✓
Territorial impacts (specific (types of) regions and sectors)		✓
Innovation		✓
Resilience, technological sovereignty		✓

Gigabit broadband delivers direct benefits to citizens as well as indirect benefits to society. Examples of direct benefits include home care applications, quick and efficient emergency response, greater educational opportunities, support for teleworking and improved entertainment options.

In addition to boosting consumer welfare, these applications can also save money both for the individuals concerned and for the service provider. A quantitative model estimation²¹³ of the projected social impacts of faster broadband speeds (although not FTTH per se) shows that the increase in teleworking driven by faster broadband would save about 60 million hours of leisure time per annum in the UK between 2008 and 2024. In addition, by avoiding commuting costs, it estimated total household savings of GBP 270 million (EUR 310 million) per year. Furthermore, it projected that increased productivity from teleworking could reach GBP 1.8 billion (EUR 2.1 billion) by 2024.

Faster broadband can also support more efficient delivery of healthcare. A study assessing developments in Sweden²¹⁴ found significant savings in using digital FTTH-based homecare especially in rural areas. It concluded that even with limited adoption, these solutions could contribute to annual net cost reductions of USD 0.6 million (EUR 0.5 million) in a rural municipality with 8 000 residents by 2020. Overall, reliable and fast connectivity has a clear positive social impact, and its future potential is likely to grow. However, a quantification of the social impact is not possible. Consequently, the social impact of options cannot be assessed in detail.

²¹³ SQW (2013), UK Broadband Impact Study. The study looked at the impact of faster broadband speeds being available from 2008 onwards. 2008 was the launch date for Virgin's 50Mbit/s service.

²¹⁴ Forzati, M. and C. Mattson (2014), FTTH-enabled digital home care – A study of economic gains, Department for Networking and Transmission, Acreo AB.

In addition to energy and CO₂ savings, the copper switch-off may have other environmental benefits such as mitigation of water pollution. According to an investigation by the Wall Street Journal, cables covered in toxic lead laid decades ago by telecom companies pose a health hazard in the USA²¹⁵. Lead-sheathed telecom cables may be also found in the EU²¹⁶. Replacing lead-sheathed cables with fibre optic ones reduces any actual or perceived environmental risks.

The primary impact of the copper switch-off and access measures are on FTTH coverage, FTTH take-up and download speed. The different options of the transition to fibre impact in different ways both the coverage and the take up of the FTTH network. Copper switch-off is expected to lead to increased FTTH coverage, by removing unviable network duplication from legacy copper networks. In doing so it reduces penetration risk (i.e. low take-up) on FTTH networks, improving the business case for FTTH deployment. Specifically, the mandatory copper switch-off date, with and without sustainability conditions respectively in options 2 and 4 is expected to accelerate the fibre deployment until 2030 compared to options 1 and 3. However, option 4 may lead to a deceleration of FTTH coverage afterwards, as many subscribers will be forced to switch to mobile/wireless technologies and their willingness to change to fibre afterwards remains to be seen, especially in the case where their new connections perform well. On the other hand, option 2 is expected to achieve similar FTTH coverage in a less intrusive and a more user-friendly way.

The numbers presented below are projected average values for the EU.²¹⁷ The underlying calculations assume that the sustainability conditions allow for the continued operation of copper networks in areas with insufficient FTTH coverage (below 95%) for a maximum of five years.

Table 20: FTTH coverage²¹⁸

Year	Option 0	Option 1	Option 2	Option 3	Option 4
2030	78%	79%	83%	77%	84%
2035	91%	93%	98%	86%	98%

Source: WIK

Table 21: FTTH take-up²¹⁹

Year	Option 0	Option 1	Option 2	Option 3	Option 4
2030	48%	51%	55%	47%	61%
2035	59%	67%	78%	53%	80%

Source: WIK

The availability of fibre networks is anticipated to affect the mixture of access technologies in the access network after the CSO, which in turn impacts the average download speeds of the subscribers. Better results for FTTH take up in 2030 are anticipated for options 2 (55%) and 4 (61%). In addition, option 4 eliminates FTTB/G.Fast due to the mandatory nature of the CSO in 2030, but on the other

²¹⁵ The Wall Street Journal, America Is Wrapped in Miles of Toxic Lead Cables, 9 July 2023.

²¹⁶ FinanzNachrichten.de, RESEARCH/Berenberg: Altkabel-Blei geringeres Telekom-Problem in Europa, 17 July 2023.

²¹⁷ The projected values were calculated by WIK based on its own model.

²¹⁸ Fibre coverage figures refer to the share of households passed by a fibre network.

²¹⁹ Fibre take-up figures refer to the share of FTTH subscribers among all households.

hand it leads to an increased percentage of 4G/5G mobile only technologies (15%, while 7% for all other options in 2030). In the course of time until 2035, option 2 is expected to reach similar FTTH share (78% compared to 80.4% of option 4), but with a significantly higher penetration of cable networks (9% vs 3%). This impacts the expected download speeds in 2035: while option 4 has the best performance in 2030, in the longer term, the access network technology mixture of option 2 leads to a better outcome (7% better performance than the second best, reaching an average speed of 743 Mbps).

Table 22: Download speed (Mbps)

Year	Option 0	Option 1	Option 2	Option 3	Option 4
2030	293	301	314	288	328
2035	584	651	743	542	691

Source: WIK

The changes in coverage, take-up and speed translate into an impact on GDP over 10 years (2025-2035) for the entire EU. The GDP impact is estimated based on several econometric studies showing a positive causal relationship between adoption of high speeds and GDP growth.²²⁰

The coefficient used to reflect this relationship falls within the identified range of 0.01 to 0.08, reflecting the full span of values reported in recent studies²²¹. This range is presented to illustrate the sensitivity of the results and to ensure that all plausible eventualities are covered. However, based on the weight of the empirical evidence and recent findings highlighting the gradual materialisation of economic benefits as households and firms adapt their behaviour and undertake complementary investments, a coefficient of 0.06 is considered the most robust and policy-relevant estimate. This value is therefore used as the central assumption throughout the Impact Assessment.

The monetized positive impacts on the GDP corresponding to different coefficient values are presented in the table below. In addition to the central coefficient (0.06), results are shown for the lower and upper bounds (0.01 and 0.08) and for one additional lower-range value (0.03), in order to illustrate the sensitivity of outcomes to alternative assumptions.

Table 23: Accumulated GDP impact (2025-2035) of options (EUR billion)

Coefficient	Option 0	Option 1	Option 2	Option 3	Option 4
0.08	2 073	2 179	2 514	1 938	2 388
0.06	1 535	1 679	1 862	1 437	1 761
0.03	753	822	910	706	862
0.01	248	270	299	233	238

²²⁰ Study on Access Regulation, section 6.3.

²²¹ See: Briglauer, Wolfgang; Krämer, Jan; Palan, Nicole (2023): Socioeconomic benefits of high-speed broadband availability and service adoption: A survey, Research Paper, No. 24, EcoAustria - Institute for Economic Research, Vienna, available at: <https://hdl.handle.net/10419/279416>.

It should be mentioned that the upper part of the empirically supported range is considered as the most appropriate for the estimation of the impact, in a forward-looking context, given the currently limited gigabit take-up in the EU27. This value reflects the “speed → adoption → productivity → GDP” pathway and the cumulative nature of the associated economic effects.

Moreover, a linear relation was assumed for the estimation of the impact of the increase in download speed on the annual GDP growth. It is the simplest approach, and it lies in the midway between the more conservative degressive and the more optimistic progressive approaches. However, it should be stressed that irrespective of the approach, there is always a positive correlation, as the GDP is expected to benefit (i.e., increase) from the increase in the download speed.

The environmental impact of the transition to fibre, namely the CO₂ emissions, result from the electricity consumption of the different options. More specifically, CO₂ emissions are estimated by multiplying total electricity consumption by the corresponding year-specific emission intensity factor²²². Energy consumption in fixed networks is closely tied to the number of active access lines, the type of technology used, and the capacity of network equipment installed. It is usually expressed in kWh per line per year, and the total consumption can be modeled as a function of subscriber migration between technologies with different per-line energy profiles. The emission intensity factor is declining due to the percentage increase of the renewable energy sources. Finally, to monetize the environmental impact of greenhouse gas emissions, a fixed damage cost set at EUR 800²²³ per tonne of CO₂e has been used.

The following table presents the monetary effect of the different options.

Table 24: Monetary effect of the environmental impact of the different options in EUR billion

	Option 0	Option 1	Option 2	Option 3	Option 4
Aggregate t CO₂e (m)	13.7	13.6	13	13.7	12.5
EUR billion	10.96	10.88	10.4	10.96	10
Difference from baseline	0.00	-0.08	-0.56	0.00	-0.96
Difference (%)	0.0%	-0.7%	-5.1%	0.0%	-8.8%

It becomes thus obvious that the options envisaging a definite CSO date outperform the other options. The larger percentage of cable access network in option 2 than in option 4 has this time a negative impact, as the electricity consumption per subscriber in HFC networks is quite big.

It should be mentioned that options 2 and 4 would also be linked with more environmental benefits in terms of lower CO₂ emissions per GB consumed than options 1 and 3 due to the higher share of

²²² <https://www.eea.europa.eu/en/datahub/datahubitem-view/3b7fe76c-524a-439a-bfd2-a6e4046302a2?activeAccordion=1091606>.

²²³ <https://www.umweltbundesamt.de/daten/umwelt-wirtschaft/gesellschaftliche-kosten-von-umweltbelastungen#gesamtwirtschaftliche-bedeutung-der-umweltkosten>.

FTTH in the technology mix. Under option 2, there is a reduction in electricity intensity for data traffic, from around 0.18 kWh per GB to 0.05 kWh/GB, a reduction of around 71% from 2025 to 2035. This value is 14% lower in option 2 compared to the status quo scenario.

The Universal Service Obligation (USO) option chosen and included under all options, maintains largely the status quo but would address potential gaps following copper switch-off and ensure that vulnerable groups have access to the services needed to enable social and economic participation in an environment where there is further reliance on online services. Based on the extrapolation of current data, USO would not have an impact on average speed and coverage.

6.1.1. Option 1: Non-binding copper switch-off and updated access regulation

Economic: This option results in a relatively low increase in GDP of EUR 144 billion (compared to baseline).

Environmental: This option results in a small decrease (0.7%), corresponding to EUR 0.08 billion, in CO2 emission (compared to baseline) over the period 2025-2035.

Societal: Due to the non-binding nature of the copper switch-off, this option interferes only minimally with copper network operators' commercial freedom to operate or to switch off their network. This option would achieve only incremental improvements to the technology mix but also avoid market disruptions thus it is unlikely to have negative societal impacts and, in particular, no impact on vulnerable consumer groups is expected.

6.1.2. Option 2: Conditional copper switch-off and updated access regulation

Economic: This option results in the highest GDP impact with an increase in accumulated GDP of EUR 327 billion (compared to baseline). It delivers the highest coverage (together with option 4) and the second highest take up in longer run.

Environmental: This option results in a 5.1% (EUR 0.56 billion) decrease in CO2 emission (compared to baseline) over the period 2025-2035.

Societal: The mandatory copper switch-off, subject to conditions, represents a restriction to the "freedom to conduct a business" enshrined in Article 16 of the EU Charter of Fundamental Rights. Limitations of this freedom are possible if they are found to be necessary to achieve a recognised objective of general interest, but they must be proportionate. Operators have been replacing parts of their copper networks with fibre based on their own business considerations. This indicates that copper switch-off is not contrary to their interests. Due to its positive social, economic and environmental impact, this option seems in line with the principle of necessity. In addition, the sustainability conditions and the possibility to allow the continuation of copper network on a longer timeframe ensure that this option respects the principle of proportionality.

Under this option, most end-users would migrate to FTTH, with associated improvements in service quality. Some end-users would need to migrate to wireless or mobile alternatives, but the sustainability conditions ensure that the overwhelming majority of end-users (at least 95%) will benefit from improved services without (any significant) price increases. Further, Member States would remain responsible for ensuring that adequate broadband services are available, using USO provisions where needed, and including also other safeguards and coverage by alternative technologies in the areas where fibre deployment is not viable after 2035. The risks for vulnerable consumers are present but significantly mitigated by these protections.

6.1.3. Option 3: Market driven copper switch-off and bottleneck-based access regulation

Economic: This option results in a EUR 98 billion decrease in GDP (compared to baseline).

Environmental: Compared to the baseline scenario, this option results in an identical environmental impact over the period 2025-2035.

Societal: This option leaves the copper switch-off process to the operators. Thus, it does not restrict the freedom to conduct business. It would alter the technology mix in a way that removes existing safeguards supporting retail broadband competition. This would likely lead to market consolidation and reduced competition. The resulting higher prices would disproportionately affect vulnerable consumers, including low-income households and individuals in constrained market segments.

6.1.4. Option 4: Mandatory copper switch-off and symmetric regulation

Economic: This option results in a EUR 226 billion GDP increase (compared to baseline). It scores the highest in terms of FTTH coverage and take-up.

Environmental: This option results in the biggest decrease (9% - EUR 0.96 billion) in CO2 emission (compared to baseline) over the period 2025-2035.

Societal: This option mandates copper switch-off without sustainability conditions. Therefore, it intervenes strongly with the freedom to conduct business.

Option 4 could result in a large proportion of copper-dependent consumers—including the elderly, disabled, and those in remote locations—being disconnected and obliged to rely on mobile or wireless connectivity instead. These alternatives may not always match the quality or reliability of copper, potentially leading to deterioration in the consumer experience.

6.2. Spectrum

6.2.1. Option 1: Soft harmonisation

The main **economic impact** of spectrum option 1 is an increase in investments in high quality mobile networks driven by soft harmonisation measures. Part of the impact on GDP calculated over a period from 2025 to 2035 is estimated using a model linking changes in mid-band coverage, take-up and speed to GDP, based on econometric evidence of a positive relationship between increased adoption and internet speed and economic growth.²²⁴ This option's overall indicative GDP impact for the EU over 2025 to 2035 is estimated at EUR 1 505 billion compared to EUR 1 480 billion under the baseline. To account for potential uncertainties of the model,²²⁵ a sensitivity analysis has been performed, assuming a smaller or larger impact of increased mobile broadband speeds on productivity and GDP and yielding an estimated GDP impact ranging from EUR 174 to EUR 2 049 billion.²²⁶ Beyond the modelled effects, additional spillover effects on different sectors are expected

²²⁴ Study on Access Regulation, section 6.3.

²²⁵ These uncertainties reflect, inter alia, the reliance of Briglauer et al. (2025) on pre-2019 evidence capturing 4G rather than 5G related improvements, and the fact that the estimate accounts for mobile broadband adoption rather than directly quantifying speed increases. See Annex 4, section 2 for further details on the model and the corresponding sensitivity analysis.

²²⁶ These estimates are based on the application of the lower and higher extreme coefficient estimated by Briglauer et al. (2025), therefore 0.01 % and 0.113 % compared to 0.048%. For details see Annex 4, section 2.

from 5G, IoT and future 6G deployment. However, impacts related to accelerating the transition to 6G cannot yet be quantified, as commercial launch of 6G is still around five years away. These estimates are consistent with the literature on the global economic impact of 5G. For example, Oxford Economics estimates an impact of USD 2.1 trillion by 2030. PwC forecasts a total impact of USD 1.3 trillion until 2030²²⁷.

The **environmental footprint** of mobile networks under option 1 is estimated at 5 252 490 t CO₂eq of mobile/wireless broadband network emissions which is less than the 5 257 074 t CO₂eq under the baseline scenario.²²⁸ Emissions are expected to be significantly lower in 2035 compared to 2025 even under the baseline, driven partly by lower electricity consumption per unit of data traffic resulting from the shift to a more performant 5G technology and partly by a reduction in the emissions intensity of electricity generation. Differences in total emissions between the options are negligible. When monetised, environmental impacts are very similar across options, at approximately EUR 4.63 billion under the baseline and around EUR 4.62 billion under options 1, 2 and 3, a marginal improvement.²²⁹

The proposed options are expected to have positive **societal impacts**, particularly for digital inclusion, social equity, and public service delivery. Higher coverage reduces geographic and socio-economic connectivity gaps by expanding individuals' effective access to digital communication, information, and public services. At the same time, high QoS, defined by reliable, high-speed and low-latency connections, determines whether users can meaningfully engage in digital activities such as online education, telehealth, mobile banking, remote work and other services with specific quality requirements. Together, these factors strengthen social and community ties, support participation in civil society, and promote economic integration, particularly in rural or underserved areas. However, their inclusive impact depends on complementary conditions such as affordability, digital literacy, and the existence of supportive institutional frameworks. option 1 is expected to deliver a moderate improvement in societal outcomes, as longer licence duration and improved roadmap coordination may help accelerate the reduction of disparities in network rollout between urban and rural areas.

The narrow scope and non-binding nature of measures entails low to moderate **costs** for competent authorities and operators, outweighed by benefits. In terms of direct compliance costs, the toolbox of good practices has low compliance burden and limited one-off adjustment costs. Longer licence duration rules imply changes but will simplify licensing over time. More stringent upfront conditions (e.g. coverage, investment milestones, QoS) may require moderate additional resources. Mandatory peer review would entail modest administrative costs, but legal complexity and enforcement risks are low. Increased coordination of award timing would require regular exchanges between institutions. The structured competition assessment may add modest costs but help prevent distortive awards. Promoting flexible authorisation and spectrum sharing in line with competition law may entail moderate compliance costs where new procedures or technical tools are required. Smaller operators may face transitional capacity-building costs, outweighed by efficiency gains in spectrum use. As the measures are largely non-binding and coordination-based, enforcement costs are minimal. Additional monitoring of licence conditions and interference is manageable. In terms of short-term indirect costs,

²²⁷ Oxford Economics (2023). [The Global Economic Potential of 5G-Enabled Technology](#). PwC (2021).

²²⁸ The reported CO₂ values are based on a model presented in Annex 4.2. They reflect a defined set of assumptions and should be interpreted as outputs of a scenario-based estimation rather than precise measurements. Potential uncertainties of the model are addressed through a sensitivity analysis of environmental impacts in Annex 4, section 2.2.6. Depending on the assumed annual energy-efficiency improvement factor (5%–30%), total emissions associated with Option 1 range approximately between 5,106,615 and 5,682,062 t CO₂eq, while differences between policy options remain very small.

²²⁹ Greenhouse gas emissions are monetised using a fixed damage cost of EUR 800 per tonne of CO₂eq, based on estimates by the [German Environment Agency \(UBA\)](#).

adapting to new licence conditions could require capacity building. Longer licence durations may also reduce flexibility, where needs or technologies evolve rapidly, mitigated by mid-term reviews.

Regarding **benefits**, regulators and spectrum authorities may see legal costs decline over time through peer learning and reduced litigation or renegotiation. Operators benefit from lower risk premiums and more predictable obligations. A key direct benefit of option 1 is the adoption of minimum 25-year licence duration with conditional renewal, balancing investment security and accountability. Good practices for spectrum authorisation may enhance coherence and predictability, improving auction efficiency and leading to more balanced trade-offs between price-based and coverage-based objectives. However, competent authorities would still maintain large flexibility in auction design, limiting predictability in a manner similar to the baseline. Also, the absence of a veto power on market shaping measures might still occasionally lead to insufficient investment incentives and unexploited opportunities to increase quality of service. Mandatory notification of authorisation procedures and peer review would improve transparency in spectrum award conditions. Overall, the role of competent authorities, especially regarding measures implemented at national/local level, will be important as they will be the main enforcers of the rules responsible for coherence improvements.

Coordinating award timing on the basis of evolving roadmaps may foster investment planning and incentivise more synchronised technology adoption, especially where competent authorities use their powers to adjust the duration of rights to ensure simultaneous expiry, as currently provided for under Article 49(4) EECC. For end-users, it may lead to better service availability and quality, particularly in border regions affected by interference. By moderately improving policy coherence, reducing fragmentation, and preventing interference, option 1 contributes to wider macroeconomic and social benefits. Efforts for prior coordination in harmonisation work within CEPT in security or technology sovereignty may promote early alignment on sensitive topics, fostering a more cohesive EU position. Good practices for spectrum sharing and flexible authorisations may enhance **efficient spectrum use** by exploiting underused bands more efficiently. Common criteria and structured peer review may bring some alignment of competition assessments and moderately improve legal certainty.

6.2.2. Option 2: More Single Market to enhance investment and innovation

Consistent and investment-friendly spectrum policies foster macroeconomic growth by accelerating network upgrades, coverage, private infrastructure spending and regional digital cohesion. Findings from the analysis of regulatory approaches and market outcomes presented in section 2.2.2.3 and Annex 4 section 3 indicate that more investment-friendly auction designs can ease cost pressures on operators, create better incentives for network upgrades and contribute to lower consumer prices. While the underlying correlations do not imply causality, they provide a useful signal of how market conditions may evolve under different award designs. In this sense, limiting set-asides and reservations under option 2 could facilitate lower spectrum costs for operators and improvements in 5G download speeds. Increasing burden of proof for access obligations could help remove constraints on deployment, thereby enabling more extensive 5G population coverage. Furthermore, a progressive reduction of prices that MNOs pay per MHz/pop could potentially support higher 5G speeds.²³⁰

The main **economic impact** of option 2 is greater investment in high-quality mobile networks driven by a more harmonised spectrum policy, which improves predictability, reduces fragmentation and

²³⁰ The regression analysis presented in section 2.2.2.3 points to a possible inverse relation between spectrum prices and overall download speeds. While this last association does not reach conventional levels of statistical significance in our regressions, it is consistent with GSMA econometric estimates that historically a 10 p.p. higher spectrum cost to recurring revenue ratio decreased coverage by up to 6 p.p. and decreased average speeds by up to 8%. GSMA, “Global Spectrum Pricing report,” Global Spectrum Pricing, GSMA, London, 2025 (2025), p. 10.

strengthens investment incentives, leading to increased quality of mobile connectivity for end users. Part of its impact on GDP over 2025 to 2035 is estimated using the model linking changes in midband coverage, take up and speed to GDP.²³¹ The model projects an increase in mid-band coverage from around 67% today to approximately 96% by 2035 under option 2, considering any mid-band spectrum.²³² This option's overall indicative GDP impact for the EU over 2025 to 2035 is estimated at EUR 1 553 billion compared to EUR 1 480 billion under the baseline. A sensitivity analysis accounting for potential uncertainties of the model yields a GDP impact ranging from EUR 179 to EUR 2 116 billion, with the lower bound reflecting model conservatism and the upper bound representing upside potential from increased 5G mobile broadband speeds.²³³ Beyond the modelled estimates²³⁴, additional spillover effects on different sectors are expected from enhanced 5G and IoT deployment.²³⁵ The model can also not quantify longer-term effects related to the acceleration of 6G deployment and additional economies of scale, expected to materialise towards and beyond 2035. When comparing the options, these effects are taken into account qualitatively.

option 2 is expected to generate additional GDP effects due to timely 6G deployment, but this impact cannot be quantified yet given the technology is still under development, meaning real-world data on adoption, performance, and impact on productivity or GDP is not available.²³⁶ Early standardisation efforts and research roadmaps suggest that 6G will enable enhanced capabilities (such as real-time distributed intelligence, ultra-low latency, integrated sensing and communication, and improved energy efficiency), with potentially cross-sectoral economic benefits similar or even superior to those of 5G. option 2 will enable a smooth transition to the next generation of mobile networks (6G) which is essential to ensure Europe's position at the forefront of innovation. The first complete 6G standard (3GPP Release 21) is expected by 2028, with early commercial deployments starting around 2030.²³⁷ The upcoming EU-level spectrum regulatory decisions will thus be crucial in shaping the conditions for early trials, early planning, industrial uptake, and Europe's global competitiveness to ensure that the EU will close the gap with countries such as the US, China, South Korea. In this context, by reducing the time between Commission harmonisation decisions and national authorisations to less than 24 months, option 2 would facilitate fast and simultaneous 6G deployment across the EU. However, due to the lack of reliable data, the analysis does not include a precise assessment of

²³¹ As under option 1 above. See Annex 4 for methodology.

²³² 5G mid-band coverage is defined as the 1–7 GHz range to capture the effects of the spectrum options on upcoming renewals and awards relevant for high-quality mobile connectivity. The projection builds on current DESI coverage data and the assumption that overall 5G coverage across all frequency bands will approach 99–100% by 2035. 5G mid-band coverage is therefore estimated by excluding from total 5G coverage areas expected to remain covered only by low-band frequencies. On this basis, mid-band coverage is projected to reach around 96% under option 2 as well as under option 3, as both options are assumed to provide comparable incentives for mid-band deployment within the period considered. See Annex 4, section 2.3.2 for the methodology also explaining considered speed and consumption assumptions.

²³³ These estimates are based on the application of the lower and higher extreme coefficient estimated by Briglauer et al. (2025), therefore 0.01 % and 0.113 % compared to 0.084% to take into account uncertainties, as for example that the study period of Briglauer et al. (2025) ends in 2019 and was based on improvements related to the 4G era and not 5G or the fact that the estimate only accounts for adoption of mobile broadband but does not directly estimate speed increases. For details see Annex 4, section 2.

²³⁴ These possible 5G-specific effects have not been included in the calculations - see also Annex 4.

²³⁵ For more detailed examples of possible impacts in sectors like healthcare, manufacturing, automotive and transport, energy and environment and agriculture see Annex 9, section 3.1.1.

²³⁶ While quantification of economic effects has been possible for 5G technologies, it is not yet feasible to reliably quantify the potential impacts of 6G given the technology is still under development, and no real-world data is available. Any forward-looking assessment of 6G's economic contribution must remain qualitative. See also Annex 9, section 3.1.2. on 6G standard timeline.

²³⁷ ETSI (2023). [ETSI White Paper: 6G: Building the Foundation for the Next Decade](#).

network densification, and it is thus not possible to quantify to what extent the initially estimated EUR 33 billion investment needs may be reduced.

The **environmental footprint** of 5G mobile networks under option 2 is estimated at 5,250,198 t CO₂eq mobile/wireless broadband network emissions, lower than the 5,257,074 t CO₂eq under the baseline. When monetised, environmental impacts under option 2 are estimated at around EUR 4.62 billion, compared to EUR 4.63 billion under the baseline. The reported values reflect a defined set of assumptions and should be interpreted as outputs of a scenario-based estimation rather than as precise measurements. The uncertainty range around these values depends on the sensitivity of key parameters and is addressed via a sensitivity analysis.²³⁸ Across all options, emissions are projected to fall by more than 96% between 2025 and 2035, mainly due to substantial reductions in electricity consumption per gigabyte enabled by new mobile technologies. Differences between options are negligible. Option 2 will also accelerate spectrum assignment and subsequent deployment of future mobile generations such as 6G, which are being designed with energy efficiency and renewable energy integration as core principles.²³⁹ The additional energy-saving effect of 6G is not included in the model, but it is likely to be significant. Spectrum measures enabling swift assignment of 6G frequencies are expected to yield further benefits not captured here, both in terms of absolute energy savings and the speed of their materialization. Edge computing and AI-driven energy optimization, such as adaptive sleep modes, intelligent traffic steering, and predictive maintenance, will further enhance the sustainability of mobile networks. Yet, while AI can increase energy efficiency, it may also increase electricity demand due to higher computing requirements. Any comprehensive assessment should therefore weigh AI-enabled efficiency gains against the incremental power needs of expanded compute infrastructure.

Mobile networks can also contribute to **emission reductions in other sectors**. This was not captured in the model. In industrial settings, 5G enables real-time process monitoring, predictive maintenance and automation, reducing CO₂ emissions, waste and energy consumption.²⁴⁰ In logistics, 5G supported systems optimise routing and warehouse operations, lowering transport emissions. In the energy sector, 5G plays a key role in integrating decentralized renewable sources, improving grid stability and reducing fossil-based balancing energy. By enabling precise demand forecasting and load management, 5G helps lower CO₂-intensive peak generation. In agriculture, 5G enabled precision farming reduces fertiliser and pesticide use and supports optimised irrigation and energy use, further reducing emissions. Across all sectors, 5G's low latency and high device density allow for better monitoring and response, leading to lower energy losses and more sustainable operations.

Option 2 is expected to generate positive **societal impacts** in terms of digital inclusion, social equity, and public service delivery, by increasing high-speed mobile network coverage and quality of service and facilitating broader service availability via spectrum sharing and reduced barriers for wholesale-only operators. Enabling advanced 5G and early 6G deployment supports productivity, job creation, and innovation in key sectors such as transport, energy, health, and manufacturing. Improved network rollout facilitates the uptake of smart services, from remote health to connected mobility, generating positive environmental and social spillovers. Enhanced regulatory certainty supports rural coverage obligations and inclusive digital transformation, while spectrum sharing obligations in underserved

²³⁸ The model, the relevant assumptions as well as the sensitivity analysis are presented in Annex 4, section 2. Depending on the assumed annual energy-efficiency improvement factor (5%–30%), total emissions associated with Option 2 range between 5 104 940 and 5 678 545 t CO₂eq.

²³⁹ <https://www.iis.fraunhofer.de/de/ff/kom/mobile-kom/6g-mobilfunk.html#cop2053987201>.

²⁴⁰ For this paragraph see: Franken, Wissner and Sörries (2019). [Entwicklung der funkbasierten Digitalisierung in der Industrie, Energiewirtschaft und Landwirtschaft und spezifische Frequenzbedarfe](#), WIK discussion paper No 451.

areas would ensure a broader distribution of long-term spectrum benefits. Improved interference responses would enhance connectivity, particularly in cross-border regions. More predictable and stronger competition oversight would help prevent over-concentration or fragmentation, supporting market sustainability and consumer welfare through lower prices and better service availability.

Along the 14 647 km of EU-external land borders,²⁴¹ often coinciding with interference hotspots, this option could yield meaningful efficiencies and enhance EU sovereignty, investor confidence, and internal market cohesion while improving solutions for end-users. Mandating prior coordination at CEPT ensures that security- and sovereignty-related decisions reflect EU-wide interests, reducing risks of fragmented or contradictory national positions, with clearer position in CEPT and ITU. This may be particularly relevant for satellite navigation, defence communication, or constellation filings.

Option 2 introduces additional **costs** for public authorities at national and EU level, due to procedural adaptation and increased single market procedure of licence conditions. These would be proportionate in high-value bands where early harmonisation and coordination are critical for technology leadership. Mandatory spectrum sharing mechanisms would involve legal, technical, and administrative efforts. In terms of enforcement costs, monitoring renewal conditions and validating least-distortive spectrum remedies must be implemented at both national and EU levels, requiring institutional and legal oversight. Additional EU-level staff²⁴² would be needed to review national submissions, assess compliance and issue formal objections or Decisions. Enforcement costs may increase due to overseeing compliance with new pro-security and spectrum-sharing obligations, and because of enhanced cooperation to address petitions for harmonisation and to mitigate cross-border interference, particularly in non-harmonised bands. These tasks may require real-time monitoring infrastructure, due diligence mechanisms for licensing and central support functions for wholesale-only market access models.

In terms of **cost savings**, operators benefit from less harmful interference, lower legal risk and greater investment certainty, which lowers capital costs and improves access to financing. The public sector benefits from smoother coordination, better auction outcomes, and fewer failed awards. Regulatory intervention and litigation are reduced. By reducing the frequency of auctions, longer licence duration and renewals are likely to lower administrative costs significantly in the long term. Faster resolution of cross-border interference problems would decrease transaction costs for regulators and operators.

Option 2 is expected to deliver significant competitiveness **benefits** for the EU industry by providing maximum investment certainty and regulatory clarity, especially for cross-border and long-term spectrum users. These benefits would translate into improved quality and coverage of 5G and 6G services for mobile operators and end-users. Catching up with leading world economies would allow for a more inclusive society by expanding access to high-quality mobile connectivity and quality-assured services across Europe. Indefinite licence durations by default provide a strong and credible long-term investment signal. Where shorter duration is applied, the reversed burden of proof removes the threat of unpredictable non-renewal decisions. Long-term licences secure sustained access to spectrum assets, encouraging long-term network investment amid rising spectrum needs.²⁴³ They also

²⁴¹ Buzmaniuk, S. (2021). [The Union's external borders: a European debate revisited](#). Robert Schuman Foundation.

²⁴² Staffing implications for public authorities are assessed in section 6.4, which discusses impacts of governance options. Under spectrum option 2, administrative workload is expected to increase mainly at EU level, with an estimated additional 5 FTEs for the Commission and 15 FTEs for the BEREC Office, reflecting their expanded responsibilities both in spectrum as in satellite authorisation areas. Staffing levels in Member States are not expected to change materially, as many functions remain with NRAs.

²⁴³ Country-average spectrum assigned to mobile operators for frequency bands below 7 GHz in the EU has passed in the period from 2014 to 2024 from 457 MHz to 830 MHz according to GSMA and is likely to further increase with 6G.

enhance planning stability and financial predictability, lower risk premium on capital expenditures and reduce the cost for capital-intensive 5G and future 6G deployments, which require 5G SA core components supported by high-capacity fibre infrastructure. Further, long-term licences, strongly advocated by the industry,²⁴⁴ could strengthen incentives for developing secondary markets, as entities acquiring spectrum through transfer or leasing would benefit from long-term certainty over its use. The Commission's role in overseeing authorisation processes would enhance regulatory convergence, and ensure more consistent, investment-friendly auction design, flexible licensing conditions and pro-security obligations²⁴⁵. The possibility to harmonise authorisation conditions would further facilitate cross-border service provision, allowing operators to achieve scale. Possible binding common conditions developed on request for private networks would enable innovators to scale up network-as-a-service solutions.

Option 2 would allow for early planning, timely authorisation, and cross-border coordination for 6G bands,²⁴⁶ as well as appropriate 6G spectrum award conditions – such as duration, license flexibility, reserve prices, coverage and quality obligations – to support investment amid technological and commercial uncertainty.²⁴⁷ Greater predictability regarding 6G deployment will incentivize timely deployment and long-term industrial research for high-value vertical use cases, benefit equipment manufacturers and operators, and ensure wide availability of devices and services. Pro-security and sharing obligations would contribute to more secure networks, ensuring coherence with forthcoming cybersecurity regulatory revisions. More widely applied spectrum-sharing mechanisms, such as “use-it-or-share-it” conditions and dynamic geolocation databases, would facilitate access to spectrum for a broader range of users and help ensure efficient spectrum use under indefinite licence durations.²⁴⁸

6.2.3. Option 3: Strong harmonisation and EU level awards

The main **economic impact** of option 3 lies in increased investment in high-quality mobile networks driven by stronger harmonisation and clearer EU-level rules. The underlying economic mechanisms are like those highlighted in the analysis of regulatory approaches and market outcomes presented in section 2.2.2.3 and in Annex 4, section 3. While not causal, the identified correlations between certain market shaping measures and market outcomes provide useful indications of how more predictable and investment-friendly spectrum award conditions can support better network performance. The estimated GDP impact is the same as for option 2, as both options forecast the same mid-band coverage and assumes that similar economies of scale are to be reached in the 2025-2035 period via proposed policy measures.²⁴⁹ Using the same modelling approach as for options 1 and 2, the overall EU-wide GDP impact of option 3 over 2025 to 2035 is estimated at EUR 1 553 billion compared to EUR 1 480 billion under the baseline, with a sensitivity range of EUR 179 to EUR 2 116 billion under alternative assumptions on the impact of increased mobile broadband speeds.²⁵⁰ As under option 2, the quantitative model does not capture spillover effects on different sectors or longer-term effects related to the acceleration of 6G deployment and additional economies of scale. These effects

²⁴⁴ [VVA, PolicyTracker and LS Telcom \(2023\)](#), p. 19.

²⁴⁵ As discussed in the Draghi Report, these may, e.g., include supply-chain scrutiny and trusted vendor requirements.

²⁴⁶ RSPG (2024). [Opinion on Spectrum Policy for Next-Generation Wireless Systems \(6G\)](#).

²⁴⁷ LS Telcom, PolicyTracker & VVA (2023). [Study on Assessing the Efficiency of Radio Spectrum Award Processes in the Member States](#).

²⁴⁸ Annex 3 includes indications on practical implications of spectrum measures under option 2 for main stakeholders. Annex 3, section 2.2. presents the main costs and benefits per stakeholders, comparing them with options 1 and 3.

²⁴⁹ See Annex 4, section 2.2.3 on how economies of scale are taken into account in the model.

²⁵⁰ These estimates are based on the application of the lower and higher extreme coefficient estimated by Briglauer et al. (2025), therefore 0.01 % and 0.113 % compared to 0.048%. For details see Annex 4, section 2.

are expected to materialise towards and beyond 2035, cannot yet be quantified, and are therefore taken into account qualitatively when comparing spectrum policy options in section 7.2.

The **environmental footprint** of 5G mobile networks under option 3 is nearly the same as for option 2, estimated at 5,403,147 t CO₂eq of mobile and wireless broadband network emissions, below the baseline of 5,413,504 t CO₂eq.²⁵¹ When monetised, environmental impacts under option 3 are also estimated at around EUR 4.62 billion, compared to EUR 4.63 billion under the baseline. The same considerations as for option 2 apply to the expected impacts of 6G.

By establishing uniform licensing conditions and EU-level awards, option 3 could improve equitable availability of high-quality mobile connectivity, with corresponding positive **societal impacts**, such as greater access to education, health, public services, alongside improved inclusion and progress in bridging the digital divide. However, this option entails potentially significant social risks from the far-reaching restructuring of a sector which has relied on national operators for over 100 years. EU level awards and longer or indefinite licence duration could, in the long run, reduce the number of operators to a small group of EU-wide players, leading to market exit and associated social impacts.

In terms of **costs**, this option entails the highest direct compliance costs across all stakeholder groups. Centralisation would limit the autonomy of NRAs, triggering legal reform, and systemic procedural changes. A fully centralised model requires a well-resourced EU-level institutional structure with legal, economic, and technical capacity that would coexist for a relatively long transitional period with national spectrum governance structures that would monitor numerous existing spectrum holdings previously assigned at national level and manage renewals to possibly align diverging national expiry dates in a way to allow for future EU level assignments. Overall, the costs are very high, both in absolute terms and relative to current practice, making a differentiated approach – targeting only certain bands or cross-border use cases – essential to mitigate excessive burdens. Enforcement costs would be substantial both at national and EU level, as a new governance framework would need to be established. The complexity of Commission decisions subject to judicial review by EU Courts might increase. Private enforcement in cross-border interference cases increases litigation risk. Enforcement would need to balance consistency with subsidiarity. A dedicated high-level group introduces a new governance layer, requiring additional administrative resources. Indirect costs arise from transition complexity, and possible short-term disruptions to network rollout due to legal and administrative overheads.

While potentially generating economies of scale for licensees, **EU-level spectrum awards** could also introduce **inefficiencies** that risk disrupting the functioning of the EU mobile market and delaying 6G deployment and with costs to be sustained both at national and EU level, especially in the short-medium term. EU-wide awards would most likely apply to auctions of new 6G spectrum around 2030, as 5G spectrum has only very recently been assigned by Member States for a duration of at least 15 years. For example, an EU-level award allocating four blocks in the upper 6 GHz band would result in only four MNOs holding spectrum across the EU. For any MNO without substantial national holdings in lower bands, this amount and kind of spectrum would be insufficient to support broad coverage and sustainable, high-quality 6G deployment. Conversely, MNOs failing to obtain spectrum in EU-level awards would still be expected to offer 6G services. However, while benefiting from the technology, they would not have access to the new mid-band spectrum required for capacity and

²⁵¹ The reported values reflect a defined set of assumptions and should be interpreted as outputs of a scenario-based estimation rather than precise measurements. The model, the relevant assumptions as well as the sensitivity analysis are presented in Annex 4, section 2. Depending on the assumed annual energy-efficiency improvement factor (5%–30%), total emissions associated with Option 3 range between 5,104,733 and 5,678,338 t CO₂eq.

performance. The use of spectrum is hence likely to be inefficient in the **short term**, particularly given the very limited secondary markets for mobile spectrum in the EU to date, which constrains the ability of operators to reallocate spectrum efficiently.²⁵²

In the **medium term**, if multiple future bands are assigned via EU-level awards, structural imbalances could deepen. MNOs repeatedly failing to obtain spectrum, notably smaller and local operators, could be forced to exit the mobile market or become MVNOs. EU-wide auctions would also face practical challenges, as Member States have awarded spectrum at different times and under varying conditions. Substantial efforts and time would be needed to synchronise licence expiry dates and band-specific conditions to enable centralised auctioning, likely creating significant uncertainty for market players and delays. During the transition to a new market structure, deployment could be disrupted or even stalled, and administrative cost high as NRAs would need to continue managing and monitoring existing national licences with non-synchronized deadlines alongside a parallel EU-level licensing framework. Effective market functioning would require well-developed secondary markets and instruments preventing spectrum hoarding and maximising efficiency of spectrum use, such as spectrum sharing. In the **long term**, larger operators could benefit from reduced regulatory fragmentation, lower cross-border interference and reduced need to redesign network strategies for each Member State. Public authorities would avoid inconsistent award outcomes and reduce national litigation. EU institutions would benefit from standardised reporting, performance metrics and streamlined enforcement.

Option 3 offers broad **benefits** by aligning spectrum policy with EU-wide investment, innovation, and connectivity objectives. These benefits are likely to materialise in the long term, in which larger operators could benefit from reduced regulatory fragmentation, lower cross-border interference and reduced need to redesign network strategies for each Member State, which would support a more effective exploitation of economies of scale. Public authorities would avoid inconsistent award outcomes and reduce national litigation. EU institutions would benefit from standardised reporting, performance metrics and streamlined enforcement. Centralisation would better ensure that awards contribute directly to strategic goals. Operators would benefit from consistency in licence duration, award timing, and renewal criteria. Private enforcement in interference cases may facilitate faster resolution of problems. A legally binding EU-wide mechanism for response to third-country interference significantly would strengthen EU's capacity to defend its interests in international spectrum and satellite matters. This option ensures that discussions related to security or sovereignty matters affecting spectrum harmonisation are made within a closed, politically accountable forum.

In terms of **indirect benefits**, a more coherent and integrated spectrum regime could generate strong macroeconomic impacts in the long term. It could accelerate deployment of advanced networks, strengthen the single market, and support industrial transformation and green transition objectives, such as remote work, smart mobility and precision farming. Spectrum harmonisation could facilitate cross-border expansion. However, while the industry recognizes the need for consolidation, it focuses more on in-country consolidation and does not view centralized auctions as the most effective way to achieve better market outcomes. Centralised planning enhances transparency, accountability, and data availability, facilitating better monitoring of public policy outcomes. However, the deployment of mobile networks is local and requires extensive capex in physical infrastructures, such as base stations or antennas. Thus, access to spectrum at pan-European level would not necessarily result in higher economies of scale. According to interviews conducted for the 'Study on Finance and USO', the majority of MNOs identifies only limited advantages from cross-border provision of mobile

²⁵² The EECC Evaluation report finds that spectrum trading, leasing and sharing mechanisms in the EU mobile sector have been used only to a very limited extent in practice. See Annex 11, section 5.5.3.

services, mainly linked to cloud and core networks, rather than to radio access networks. While operators could optimise network deployment, they would still sustain additional costs to offer retail cross-border services stemming from remaining fragmentation of legal requirements in areas such as legal interception, cybersecurity, data protection, data retention and end-user protection. Those factors and other non-infrastructure-based costs might affect commercial interest to provide EU-level services.

In the long run, EU-level spectrum auctioning could generate **large cost savings for Member States**, as the overall cost of organising such auctions would be comparable to that of a single large Member State, such as Germany. However, organising such auctions would entail a **significant increase in specialised EU-level staff** and could require additional funding from Member States or the industry, as it would represent a new task for EU institutions, while in the short-medium time horizon, many tasks would also remain with national authorities due to existing spectrum holdings monitoring and renewals as well as the need to align timeline of expiry of holdings.²⁵³ Further costs may arise from national-specific conditions, including harmful interference and monitoring of national licences in the medium-term.

Overall, Option 3 offers significant strategic and integrated benefits in the long term, particularly for EU-wide investment mobilisation, innovation leadership, and industrial resilience. However, it also presents considerable challenges in the short-medium term.

6.3. Authorisation

6.3.1. Option 1: Partial harmonisation of authorisation (general and satellite)

Option 1 incurs many one-off costs for the **general authorisation regime**. However, simplified procedures such as a unified notification template and single notification reduce administrative and compliance costs, enabling providers – especially SMEs – to allocate resources to innovation and growth rather than bureaucracy. By lowering barriers to market entry, option 1 stimulates cross-border service provision, fosters greater competition, and expands consumer choice, directly contributing to a more dynamic and competitive European digital market²⁵⁴.

As regards **satellite authorisations** more specifically, option 1 offers a modest improvement in the consistency, transparency, and predictability of satellite authorisation across the EU. It however simplifies the regulatory environment through a common template for authorisation conditions, potentially reducing compliance costs and enabling satellite operators to better plan investments. This provides some legal certainty and regulatory predictability for businesses, including SMEs. The broader macroeconomic and social benefits depend on the uncertain outcome of new satellite operators entering the market. This option would have a slight positive impact to New Space SMEs through reduction of regulatory burden but remains doubtful if it would promote investment confidence and if it would facilitate creation of EU-wide MSS networks contributing to strategic autonomy in space-based communications by reducing reliance on third-country operators.

Option 1 brings positive **impact on digitalisation**, enhances accessibility and reduces administrative burden across Member States, by linking national single points of contact with the Single Digital

²⁵³ Staffing implications for public authorities are assessed in section 6.4, which discusses impacts of governance options. Under spectrum option 3, administrative workload is expected to increase mainly at EU level, with an estimated additional 5 FTEs for the Commission and 15 FTEs for the BEREC Office, reflecting their expanded responsibilities. Staffing levels in Member States are not expected to change materially, as many functions remain with national authorities.

²⁵⁴ More detailed description of the impact can be found in the accompanying Annex 9, part 1.3. and 4.

Gateway for businesses [and/or] the BEREC website, and by providing digital tools for coordination among national authorities beyond the EECC conditions. This directly supports the European 2030 Digital Compass vision of a connected, digitally empowered Europe with seamless cross-border services and could also contribute to the goals of the Digital Decade by potentially improving the efficiency of EU connectivity services through satellite constellations.

While no direct **environmental impacts** are expected under option 1 for authorisation measures, indirect benefits may arise as digitalised procedures reduce paperwork and physical interactions, supporting more sustainable administrative practices. Option 1 measures facilitating EU wide authorisation of services would to a minimal extent produce indirectly the environmental and societal impacts illustrated under option 2 and in Annex 9.

6.3.2. *Option 2: Single “passport” for other networks and services than satellite and an EU-level authorisation for satellite spectrum*

Single passport

The benefits of the single ‘passport’ applicable to all cross-border networks and services, except satellite, include cost savings for different stakeholders. The maximum list of conditions to be attached to the general authorisation, the mandatory use of the BEREC notification template and simplification of the annual reporting will result in reduced administrative burden and compliance costs for all cross-border ECN and ECS providers. Simplification of conditions attached to the rights of use of extraterritorial numbers will further reduce costs for B2B service providers.

For the operators the benefit would be significant in comparison to the baseline with around 50–80% faster market entry and reduced regulatory uncertainty. The savings would also include reduced human resources costs, especially of new market entrants and cross-border operators, with reduction of costs linked to the need to have compliance teams present across 27 Member States and around 50% reduction of reporting (e.g., by cutting red tape on different reporting forms and reporting periods). Further savings will be achieved thanks to harmonising and removal of specific national conditions such as: national language requirements, the need to have national representative or digital ID, adaptation to local notification portals, and having specific national reporting forms. The single passport will cover the authorisation conditions that will be harmonised for all Member States and the national (non-DNA) rules that will still apply and that will be approximated. Further cost reduction for single passport providers will come from the approximated conditions to facilitate the compliance with the applicable non-DNA related conditions – such as cybersecurity and lawful interception obligations. For public administrations (Member States/NRAs and reinforced BEREC Office), the changes will reduce staff requirements for a savings of some 50%.²⁵⁵ Assuming a burdened labour cost of EUR 95 400, this could represent annual savings of around EUR 82 000.

The strategic outcome of option 2 is that especially smaller or mid-size providers can expand cross-border more easily, fostering a more integrated EU telecom market with greater services’ choice for end-users.

On the other hand, the single ‘passport’ brings **costs** linked to BEREC guidelines to clarify the applicable conditions in MS and for issuing standard declarations by Member States of notification, as well as costs for coordination between authorities for approximation of national rules over time.

²⁵⁵ This will not include MS which do not require GA (DK) or which have GA but require notification (FR).

The single passport must be issued by a MS upon request of an operator wanting to operate cross-border, but it is optional for purely local providers, who prefer to operate nationally or regionally and remain authorised under national rules. They can still benefit from harmonised BEREC guidelines and templates. The new recurrent costs will thus depend on the number of such notifications from cross-border operators but are likely to be lower than under option 1. NRAs are likely to still have internal databases and documentation that they need to create for the purposes of monitoring. Certain divergences at the national level will remain in relation to procedural issues related to general authorisation (e.g. administrative fees, fees for scarce resources) and to matters beyond the DNA.

Option 2 promotes **digitalisation** thanks to a centralised BEREC database and mandatory notification template which reduce administrative burdens and compliance costs for providers, particularly SMEs while enabling faster market entry and deployment of electronic communications networks and services.

As regards the impact on the environment the introduction of the single “passport” has no direct impact.

EU satellite authorisation

As regards EU satellite authorisation, the positive impact on competitiveness will materialize in terms of cost savings for different stakeholders, thanks to the simplification of the regulatory environment, in particular for services which rely on scarce spectrum such as D2D, and the long-term benefits of creating a streamlined and harmonised system for the authorisation of satellite spectrum. Removing the barrier of navigating 27 authorisation regimes benefits all constellations, particularly those which currently lack spectrum in all Member States. Existing satellite operators can scale up services where they previously lacked authorisations. Providers, in particular new entrants, save primarily on administrative costs and delays associated with regulatory fragmentation and different conditions (see section 2.2.4), and secondarily on direct economic costs. This can have a greater positive impact to New Space SMEs than option 1.

The **economic benefits** and simplification potential can be also assessed in terms of:

(i) Satellite communication service providers would avoid a reduction of revenues due to delays caused by Member State-by-Member State authorisation and spectrum assignment, and occasionally due to legal uncertainty. Indeed, the largest cost burden on satellite communication service providers stems from delays to commercial launch, which can amount to tens of millions of euros in foregone revenues for a provider with a large client base. As an example, for a major LEO constellation with a global average number of subscribers of around 300.000, the inability to deliver services due to authorisation issues for 4 months in one of the more populated MS could cost a company in terms of lost revenue 18,3 million EUR²⁵⁶. Based on a similar logic, the inability to deliver IRIS² services for the EU would be EUR 50 million per month, see section 5.1.3.

If these delays in authorisation happen when the satellite communication service provider is first entering the market, then the immediate financial impact is lower because the number of customers is initially low and increases progressively. However, such delay in obtaining authorisation and spectrum assignment can affect the business case with delayed revenues possibly stretching out over many years with a substantial loss of potential revenue. Similar consequences could apply to any

²⁵⁶ Study for Digital Single Market.

satellite communication service, subject to the obvious adjustments for the size and characteristics of the specific service. See Annex 9, Section 3.2. for a more detailed assessment.

(ii) Reduced costs and staff needs for both satellite communication service providers and national regulatory authorities (NRAs/SMAs), stemming from the elimination of duplicative and fragmented regulatory processes. An important cost driver today is the need for operators to comply with differing national authorisation conditions that are often not adapted to satellite services (see Section 2.2.4 on fragmentation).

The introduction of a single EU-level authorisation for satellite services could lead to considerable reduction in administrative costs, staff needs and delays for satellite communication service providers. The exact magnitude of such reductions is difficult to assess, as costs depend on numerous specific factors and vary significantly across Member States; moreover, in some cases the administrative cost for the authorisation can't be clearly distinguished from the spectrum cost. The reduction of administrative costs quantified in section 2.1.3 is expected to be most significant in cases involving individual rights of use and authorisation of ground components, compared with the use of satellite spectrum under general authorisation. Regarding staff resources, some operators estimate that securing spectrum authorisations across all Member States for an EU-wide constellation requires roughly 6 FTEs centrally plus 1–2 FTEs per Member State; these costs would be around EUR 200.000 per EU country/year. Finally, as part of the authorisation process, operators are asked to conduct in-country testing in each MS, which would require at least 6 FTEs dedicated to regulatory testing, deployment of a temporary ground station/gateway (which incurs in CAPEX costs) with an additional EUR 120.000 for gateway movement, as well as, engineering resource required for the movement/installation of the gateway. Overall, this would cost indicatively around EUR 3.2 million across all Member States.

The staff savings for competent authorities linked to the introduction of an EU-level authorisation for satellite services can be estimated based on current staffing levels and expected efficiency gains. Data from 16 NRAs and SMAs indicate around 63.5 FTEs currently engaged in satellite authorisation and spectrum assignment and another 34 FTEs in enforcement, corresponding to roughly 98 FTEs EU-wide.²⁵⁷ Including about 1.5 FTEs at the European Commission for its present coordinating role brings the total to approximately 100 FTEs involved in satellite-related spectrum tasks. Under the EU authorisation, **staffing reductions** would mainly occur at NRAs and SMAs, as much of the administrative assessment and licensing work would be centralised at EU level. Member States would, however, remain responsible for monitoring, interference management and inspection of ground components. Additional resources would be needed at the BEREC Office (up to 12 FTEs) to manage operational functions transferred from Member States at the Commission (roughly 3.5 additional FTEs) to oversee and coordinate implementation. Overall, staffing would decrease by about 20–30%. Assuming an average labour cost of EUR 95 400 per FTE, this corresponds to annual savings of roughly EUR 2–3 million once the system is fully operational.

The proposed EU-level authorisation regime could enable Member States and EU institutions to absorb the expected rise in authorisation requests without requiring additional administrative resources. As regards the expected workload, we consider the rapid growth of Low Earth Orbit (LEO)

²⁵⁷ See 'Study for Digital Single Market' for explanation on how this estimate has been done based on a Survey among RSPG members.

constellations²⁵⁸ and data from the US indicating significant growth in applications for space and earth stations. If such growth was to continue, the associated labour requirements and budget would also increase, yet at a lower rate due to economies of scale. Under business-as-usual conditions, staffing needs might increase by roughly one-third over the next five years, but with the expected efficiency gains discussed above, overall personnel would likely remain close to today's level.

(iii) more efficient addressing of harmful interferences issues which cause serious operational challenges due to the difficulty to enforce compliance with Radio Regulations; option 2 ensures all players play by the rules, thanks to the coordinated enforcement of satellite rules. This is particularly relevant in markets characterised by big LEO constellations, where interference issues are likely to increase in the next years.

(iv) Users of Satellite communication services would fully benefit from the consumer surplus thanks to timely availability of services and reduced legal uncertainty, without coverage gaps in some MS. If the satellite communication service provider is not authorised to offer the service, consumers cannot purchase or use it. There will always be a loss of surplus when a satellite communication service provider lacks authorisation to deliver its service, but the net loss of consumer surplus might be higher or lower than the loss of revenue to the satellite communication service provider, depending on availability or not of substitute services.

Even if investment decisions about launching services/operations are not taken based on initial general authorisation or licensing requirements, option 2 could overall facilitate pan-European services, especially in the cases of spectrum scarcity where a Single Market approach from selection to authorisation and enforcement would facilitate the deployment and expansion of satellite technologies, which will play a major role in advancing digital transformation and connectivity across Europe.

As regards **costs**, the shift from national to EU-level authorisation would result in substantial direct compliance costs for Member States and EU. Member States would undertake legal reforms, and the roles among national regulators, the Commission, the RSPG, and the COCOM would need to be redefined. This requires expanding administrative and technical capacities at EU level, which could be covered by administrative charges and fees. For an assessment of additional FTEs at EU level for tasks related to EU satellite authorisations see Governance Section 6.4.1. Indirect costs could include institutional friction, alongside potential political and administrative resistance from some Member States over ceding authority on spectrum rights. For additional analysis, see Annex 9.

As regards **social impact**, satellite services can fill the connectivity gap in unserved areas²⁵⁹ where terrestrial roll-out is not technically or economically viable. They can enhance the provision and

²⁵⁸ Higher number of satellite authorisation requests are expected in the future, in particular for LEO constellations. According to the Detecon MSS Study (2025), around 9 000 LEO satellites were in operation worldwide at the beginning of 2025, and this number is expected to grow by at least a factor of six over the next decade, equivalent to roughly 60 000 operational LEO satellites by 2035 globally. This study also identifies around 25 global operators/LEO constellations with launched, planned or announced LEO satellites relevant in the coming years. These numbers will surely impact the FTEs needed to address these requests and ensure enforcement, monitoring and dealing with increasing harmful interferences. Detecon International GmbH 2025, p. 11 and p.105.

²⁵⁹ Large connectivity gaps still remain to reach full territorial coverage. According to the Digital Decade targets, all EU households should have access to gigabit connectivity by 2030. However, studies estimate that between 33 and 71 million EU residents may still be left without gigabit-capable fixed access by that time if relying on fibre and mobile networks alone: Johnson, O., & Kürsteiner, A. (2023). [The role of the satellite market in provisioning broadband access in Europe up to 2030](#). Paper presented at the 32nd European Conference of the International Telecommunications Society (ITS): Realising the Digital Decade in the European Union – Easier Said Than Done?, Madrid, Spain, 19–20 June 2023.

resilience of public services and contribute to public safety, environmental monitoring, and civil protection and enable digital inclusion and wider access to e-health, distance education, and e-government services.

Option 2 promotes **digitalisation** thanks to a centralized satellite authorisation system which reduce administrative burdens and compliance costs for satellite operators, including SMEs, while enabling faster market entry and deployment of electronic communications networks and services. The measure contributes to a more connected and efficient digital single market across Europe. It further promotes D2D, accelerating digital transformation across Europe.

As regards the impact on the environment in terms of satellite services, greater availability of pan-European services might further enable and ensure scale for satellite based environmentally beneficial services²⁶⁰. In terms of infrastructure, satellite systems do not require extensive terrestrial infrastructure, therefore satellite broadband may represent a less invasive and more environmentally benign alternative to large-scale physical deployment of cables, towers, or roadside base stations, especially in remote or environmentally sensitive areas. However, the environmental sustainability of satellite connectivity also depends on factors such as satellite manufacturing, launch activities, orbital lifetime, energy consumption during operation, and end-of-life disposal. As an example, the carbon footprint of LEO satellite-based broadband – when calculated per subscriber per year – may be significantly higher than that of terrestrial fibre or mobile networks. Depending on assumptions, emissions per user for LEO-based services could be between 100 kg and 469 kg CO₂eq annually, compared to around 60 kg CO₂eq for typical 4G mobile access.²⁶¹ This is due in part to the energy intensity of manufacturing, frequent satellite launches to maintain constellations, and less efficient ground infrastructure. Future EU-wide satellite frameworks as the Space Act, could however incentivise more sustainable system design and operations reducing environmental impact of space activities.

Annex 3 includes indications on practical implications of the EU satellite authorisation measures for main stakeholders and Annex 3 Section 2.3. presents the main costs and benefits per stakeholder of option 2, comparing them with option 1 and option 3.

6.3.3. Option 3: Country of Origin regime for cross border/B2B providers

Under **option 3**, the Member State of notification would incur **increased administrative costs** to handle the authorisation, compliance and enforcement process, for satellite and B2B services for the entire EU, including liaising with other authorities. Other Member States will forego the direct costs of the authorisation process but will incur costs for participating in the coordination and enforcement mechanism. This option reduces administrative burden for satellite operators, by streamlining costs for authorisations, testing and reporting. EU Member States would need to agree to mutually recognize spectrum authorisations granted by the Country of Origin and, develop trust and cooperation across them. Given the strong national components of spectrum regulation, this option

²⁶⁰ Satellites can indirectly contribute to emission reductions and more efficient resource use in other sectors. For example, satellite-enabled IoT systems can optimise irrigation, energy grids, or logistics chains, while reliable broadband access supports remote work and reduces travel needs. In the EU context, such co-benefits are particularly relevant for agriculture, energy, and transport sectors, especially in rural regions – see European Investment Bank (EIB). (2025). [Global Broadband MEO Satellite Constellation](#) (Project No. 20230498).

²⁶¹ Ogutu B. Osoro, Edward J. Oughton, Andrew R. Wilson & Akhil Rao. (2023). [Sustainability assessment of Low Earth Orbit \(LEO\) satellite broadband megaconstellations](#) (arXiv:2309.02338).

would be politically challenging. MS would essentially relinquish complete control over their spectrum assets to other jurisdictions without oversight or authority.

In terms of **indirect costs**, a transitional period would be needed, which would be accompanied with some uncertainty or administrative complexity as Member States phase in the harmonised conditions. Delays in fully implementing the EU-level selection framework could also be expected, which, based on the experience with the MSS 2 GHz Decisions, could persist for some years, but are not necessarily disproportionate to the scale of market and governance improvements. The additional **cost savings** of this option will all accrue for satellite and other B2B providers, and the SMEs among them will benefit significantly. There is also a clear benefit for the development of the single market of satellite services and B2B services, as well as increase in the offering of such services. The savings will occur due to the reduction in administrative and compliance costs.

In terms of the **benefits**, option 3 enhances consistency and reduces administrative burden for providers of cross-border services, for instance costs incurred due to mandatory in-country testing will no longer apply. The application of one framework for spectrum selection and assignment, backed by EU-wide authorisation conditions, would reduce fragmentation and regulatory uncertainty in the long term. However, given that cross-border operators would still need to abide by the legislation of the Member State of the provision of the service, the benefits would not be maximised and we would not expect that such a regime would encourage new multi-Member State market entry, or pan-European coverage that would not have occurred in its absence. Where the country of origin/notification is the same as the one under the EU Space act, **indirect benefits** from the relevant synergies could be expected.

Option 3 facilitates EU wide authorisation of services and would to a smaller extent produce indirectly the **environmental and societal impacts** illustrated under Option 2 and in Annex 9.

6.4. Governance

6.4.1. Option 1 - BEREC and RSPG as two separate bodies supported by the BEREC Office

Option 1 represents a relatively small change to the current governance structure (cf. section 5.2.4).

In terms of **economic** impacts, it implies a relatively small increase in direct and indirect costs for the EU budget, mainly due to increased tasks and functions of the BEREC Office. Based on the tasks assigned to BEREC and RSPG under the preferred options in the areas of access, spectrum, general authorisation and satellite authorisation, it is estimated that to provide support to both BEREC and the RSPG, the BEREC Office's staff would need to increase by an additional 25 FTEs, implying that under option 1 the Office staff would grow by slightly more than half (52%) compared to the current situation. The vast majority of these FTEs (80%) would be needed for RSPG related activities, i.e. spectrum related (including ex ante spectrum single market procedure) and EU satellite authorisation. Currently the BEREC Office has 48 staff (in 2024)²⁶² and annual costs amount to EUR 8.1 million (of which 62.2% is staff expenditure, 21.5% expenditure for buildings, equipment and similar and 16.3% is operational costs). The current staff expenditure (yearly average) in BEREC per employee is approximately EUR 104 939. Therefore, the indicated increase of FTEs would result in staff

²⁶² The Commission has, in its Opinion on the BEREC Single Programming Document, consistently over the past years signalled that the current staffing levels (48 in 2024) are above the authorised levels (36 FTEs). However, no action has been taken to address this de facto situation further to asking the BEREC Office to address this discrepancy. As the current tasks of the BEREC Office are performed with the actual staffing level covered with the current budget of the BEREC Office, the Impact Assessment recognises the status quo and the corresponding budget allocation and costs.

increase by slightly more than a half (52%) to 73 FTEs. Assuming that the new total staff expenditure would be approximately EUR 7.661 million (average cost of 1 FTE x 73), and other costs increase by 20%, i.e. the costs for building and equipment would rise to EUR 2.090 million and the operational costs would rise to EUR 1.589 million; therefore, the annual costs for the BEREC Office would increase to approx. EUR 11.420 million. This increase in budget (EUR 3.320 million) includes additional costs associated with the increase in the organisation of BEREC and RSPG working groups' activities; an increase of 25% in the latter would amount to upward of EUR 80 000 per year in additional organisational and reimbursement costs. The above figures do not include the possibility of establishing a small liaison office in Brussels. For comparison purposes, the costs of maintenance of the ENISA local office in Brussels for up to 10 FTEs are around EUR 170 000 per year, and staff expenditures are higher as standard rates applies with no corrective coefficient²⁶³.

The increase of staff represents the largest increase of costs and will be partially offset by Commission staff no longer providing administrative support to RSPG (1.5 FTE), and synergies realised when BEREC and RSPG are supported by the BEREC Office. The Commission will also need reinforcement to cope with its additional tasks, in particular in terms of additional decision-making powers for satellite authorisation, petition for rule making or ex ante single market procedure. This required increase is estimated at 10 FTE; additional posts could be partially financed from fees.

Participation cost in working groups for NRAs and CAs are expected to increase for both BEREC and RSPG. Assuming 25% increase in activities of both these bodies, for BEREC, the average time spent by the NRAs on working groups would increase by c.a. 550 hours corresponding with EUR 26 400²⁶⁴ in additional staff expenditure for participation in BEREC per year. An increase of 25% in RSPG activities would amount to 115 additional hours per Member State, or on average around EUR 5 500 in additional costs for staff per Member State²⁶⁵. However, some cost savings will materialise on the side of the NRAs and other CAs, thanks to the work done by the BEREC Office staff on substance, which will to an extent offset cost increases. In this regard, the largest impact results from possible Co-Chairmanship of the BEREC working groups, estimated to require 70-90% FTE for each working group²⁶⁶. Likewise, cost savings at national level are likely to happen thanks to EU satellite authorisation. Most of the costs entailed by this increase would be borne by the EU budget and, in the case of BEREC Office, possibly also by contributions from the NRAs or other CAs, and via direct fees paid by market participants, such as for EU satellite authorisations for services performed by it.

Currently, under Regulation (EU) 2018/1971 and its Financial Regulation, almost all BEREC and BEREC Office revenue comes from an EU subsidy, with only small contributions from the EEA EFTA countries for example. The EU budget model offers predictability, transparency, and equal treatment, however, depending solely on EU budget allocations carries risks in particular in budget restriction phases.

Therefore, we explored a fee-based scheme (e.g. levying charges on electronic communications networks and services providers for certain kinds of authorisations, spectrum use for satellites) similarly to decentralised agencies that are relying on other sources of revenues. While the revamped

²⁶³ ENISA single programming document 2022-2024 – Table 28 on the indicative resources for the Brussels local office (one-off cost + maintenance costs).

²⁶⁴ Using an EU27 average hourly staff costs of EUR 48 based on ISCO figures for relevant staff categories.

²⁶⁵ For both BEREC and RSPG, the exact figures would vary depending on the Member State.

²⁶⁶ Assuming that BEREC Office staff would co-chair all the BEREC WGs, total savings for NRAs would be equals 12 x [0.7-0.9] FTE per year. However, this would depend on the allocation of tasks to the BEREC Office staff and may not be justified or possible for all working groups.

BEREC Office will remain structurally distinct from many EU decentralised agencies as it will continue to support BEREC and the RSPG, it will be increasingly involved in delivering regulatory outcomes directly to private entities, which creates a possibility to charge for “service-based-fees”. Specifically, the satellite fees could be linked to the procedure for upcoming EU-level spectrum assignment, extension and renewals established in the DNA. Such fees could be spread over periods longer than 10 years, providing for a constant and stable revenue. Furthermore, if needed and operationally feasible, administrative charges/spectrum fees could be collected from undertakings subject to EU satellite authorisation after the entry into force of the DNA.

Introducing contributions directly from the market (e.g. from providers of electronic communications networks and services) could appear equitable insofar as the industry benefits from BEREC (and RSPG) work. Yet, this raises concerns about double charging (since many providers already pay national regulators whose staff is also the main contributor to BEREC’s work), and about smaller operators being disproportionately burdened, and is consequently not a favoured solution.

In summary, the optimal path seems to lie in retaining EU budgetary funding as the backbone of the BEREC Office’s financing, while setting out complementary revenue sources in the form of satellite spectrum authorisation fees and, possibly, also fees for other scarce resources administered at EU level, supplemented by voluntary and in-kind national contributions. Such mix would provide for a stable and proportionate budget aligned with the functions of the revamped BEREC Office.

As regards **social impacts**, the arrangements with two advisory bodies and a supporting agency in option 1 largely corresponds to the baseline and is not expected to have significant direct societal impacts. An indirect social impact of a strengthened BEREC Office would be more harmonised implementation of telecom regulations, particularly as regards cross-border aspects such as satellite authorisations and EU-level access remedies.

With regard to **environmental impacts**, option 1 shows only minor differences from the baseline scenario. The number of in-person meetings is not expected to increase significantly even with new tasks, as additional interactions needed would remain mainly online (with no environmental costs). Assuming 1-3 additional large in-person meetings compared to the baseline, the added environmental impact translates into 43-130 tons of CO₂ emissions per year, due to air travel²⁶⁷. In addition, higher BEREC Office staffing would require larger premises, and these environmental costs would not be offset by reductions on the NRAs’ side.

There is no expected impact on **fundamental rights**.

6.4.2. Option 2 - EU Agency (BEREC and BEREC Office), supporting also the RSPG as Spectrum office

Option 2 involves merging BEREC with the BEREC Office into an EU agency with full legal personality (and related responsibilities), which would also provide administrative support to RSPG, which would remain an advisory body like in option 1.

In terms of **economic impacts**, transforming BEREC and the BEREC Office into a fully-fledged agency with increased responsibilities is expected to require significantly increasing the staffing levels of the latter to 90 FTEs (by 88%) and a 50% increase in operational expenditure (premises,

²⁶⁷ According to BEREC Office’s GHG calculations, 3 Plenary meetings per year contribute 110-130 tons of CO₂ emissions.

equipment), raising the EU budget contribution to around EUR 14.2 million. For example, the working groups that are now managed by BEREC would be managed by the BEREC agency and it might be assumed that the BEREC agency's representatives could (co-) chair working groups. To the extent that the agency would also support the RSPG work, the same assumptions regarding the FTEs were made as in option 1. The budget increase would also cover additional costs associated with the increase in the organisation of working groups' activities; an increase of 50% in the latter would amount to upward of EUR 160 000 per year in additional organisational and reimbursement costs. At the same time, shifting certain decisions to the EU level would also bring cost savings for NRAs and other CAs, thereby reducing the burden on Member States. The impacts of supporting the RSPG are comparable to option 1 (depending also on the Office's location). Under this option, the costs entailed for the agency would mostly be borne by the EU budget and via direct fees/contributions paid by market participants, and possibly also by in-kind and voluntary contributions from the NRAs and other CAs (like in option 1). The Commission will also need reinforcement to cope with its additional tasks (estimated at 5 FTEs, down from 12 FTEs in the baseline). The efficient use of resources would be addressed by mandating a positive opinion of the Commission in BEREC's decisions pertaining to budgetary and HR matters. Ultimately, the main positive economic effect stems from increased harmonisation and more centralised approach to spectrum management, leading to consistency across Member States and more integrated communications markets.

As in other options, option 2 is not expected to have significant direct **societal impacts**.

Its **environmental impact** is also relatively insignificant, and broadly comparable to option 1. However, the largest effect arises from the need for significantly larger premises to accommodate around 75 FTEs. In addition, one-off environmental impacts would result from staff relocations to and from Riga, given the BEREC Office high staff turnover.

There is no impact on **fundamental rights**.

6.4.3. Option 3 - Two separate agencies – (BEREC + BEREC Office) & RSPG

As regards **economic impacts**, option 3 is the costliest for the EU budget. The cost of merging BEREC and the BEREC Office into an EU agency is similar to option 2 (reduced by the costs related to providing support to RSPG), driven mainly by a staffing increase to 80 FTEs equivalent to around EUR 8.955 million, with expenditures for buildings and equipment and operational costs raising by 20%, respectively, to approx. EUR 2.090 million and approx. EUR 1.589 million. Consequently, it is estimated that its annual costs of the BEREC agency will increase from EUR 8.1 million to around EUR 12.235 million per year. At the same time, establishing of the RSPG as fully-fledged agency with decision-making powers would entail one-off costs (e.g. for premises) and recurrent expenses for staffing, office space, equipment and operations. The RSPG agency would be comparable in size to the BEREC agency under option 2. It will take over support and preparatory tasks (under option 1 and 2 performed by the BEREC Office) as well as take on some of the substantial tasks (performed by the Commission under option 1 and 2). In addition, it will also need to be equipped with support staff. With these assumptions, and assuming that the RSPG agency is located in a Member State similar in terms of salary coefficient, its annual costs will be similar to those of BEREC described under this option. However, creating another independent agency would also generate additional costs from duplicating certain roles and services (e.g. support staff, finance, HR, administration, IT), which could not be shared. The costs entailed for the two agencies would be covered from the EU budget, and – as under option 1 and 2 – via direct fees paid by market participants and possibly NRAs and other CAs' contributions. The efficient use of resources could be ensured by requiring a positive opinion from the Commission on BEREC and RSPG decisions related to budgetary and human resources matters. To enhance cooperation between the two agencies, regular check-point meetings

should be organised. However, the separation of the two bodies would not allow for realising the full synergy potential.

Similar to other options, option 3 will not have significant direct **societal impacts**, while the indirect impacts will be similar to both option 1 and option 2 (i.e. increased harmonisation in the implementation of the EU legislation).

Option 3 will have the greatest **environmental impact**, as in addition to those described under option 2 (which will remain), RSPG – as a separate agency - will require its own premises. It is not expected that the transformation of RSPG into an agency would imply a significantly higher number of in-person meetings or travel costs, compared to baseline scenario or other options.

There is no impact on **fundamental rights**.

7. HOW DO THE OPTIONS COMPARE?

7.1. Transition to fibre

The key differences among the various options considered for the transition to fibre are: 1) the approach taken towards the copper switch-off obligation; 2) the kind of access regulatory framework to be used (exclusively SMP-based versus other approaches) and 3) the introduction of EU-wholesale access products with different degrees of involvement from the Commission.

Effectiveness

Baseline option: The current regulatory framework is not intended to accelerate the migration from copper to fibre. Article 81 of the EECC provides for NRAs' involvement in the migration only if the legacy infrastructure is regulated (based on SMP) and after the operator decided to decommission (or replace) parts of its network. Most relevantly, the NRAs' role is limited to ensuring that the decommissioning process includes a transparent timetable and conditions - with the aim to safeguard competition and the rights of end-users. Consequently, Article 81 can slow down but not accelerate the copper switch-off process.

Option 1 – Non-binding CSO and limited updates to the access regulation

Option 1 maintains the current access regulation regime, offering regulatory predictability to support continued investment and competition in fibre networks. However, the framework's flexibility may hinder progress in Member States lagging in fibre deployment or failing to implement wholesale access products that encourage innovation and differentiation. Non-binding targets and national plans alone are unlikely to fully resolve investment stand-offs in countries with extensive FTTC networks, leaving entrenched concerns unresolved.

Option 2 - Conditional CSO and updated access regulation

The conditional but mandatory copper switch-off in this option is likely to significantly boost FTTH deployment and adoption, increasing end-user speeds without raising retail prices and by ensuring appropriate safeguards for vulnerable end-users. However, these benefits depend on several factors being pursued together:

- Member States producing Transition to Fibre Plans to address commercial deployment gaps and support in-building fibre standardization.

- NRAs collecting data, reviewing CSO plans, and conducting market reviews to assess impacts on market dynamics and adopt possible measures as needed
- Addressing competition barriers through a combination of the three-criteria test, followed by Article 61(3) and/or SMP access regulation (in particular SMP-based PIA remedies), and wholesale access products based on best-practice that enable quality and price differentiation.

The review of the RRM is a separate procedure outside of the current impact assessment. Possible effects of a potential Commission's decision not to issue a RRM or not to recommend any markets for ex ante regulation are discussed in detail in Annex 9, section 1. If there is no longer a requirement for the Commission to publish such a list of recommended markets, this would change the presumption, which has applied until now, that there are likely to be wholesale markets which are susceptible to ex ante regulation across the EU. This will result in indirect costs and benefits for **ECN operators** which will differ depending on the implications this has for specific operator groups that may have been (or might otherwise be) considered likely to be subject to ex ante regulation or may have relied on ex ante regulation to provide broadband services to end-users.

However, making the RRM optional does not automatically imply that it will be removed (or that it will be adopted). The potential impacts discussed are hypothetical and depend on several factors: the Commission deciding not to adopt an RRM, and NRAs choosing not to act proactively. Therefore, the actual effects of making the RRM optional remain uncertain and contingent on future decisions and actions.

Option 3 - Market driven CSO and bottleneck-based access regulation

Option 3 shifts access regulation towards deregulation, relying on existing measures for physical infrastructure access under the GIA. Ex ante regulation of fibre networks would be limited to areas with a single closed network, and SMP and Article 61(3) measures would be removed. The goal is to let the market drive fibre deployment and take-up. However, this approach creates uncertainty and may undermine confidence among alternative fibre investors due to a shift from SMP regulation to GIA, potentially increasing wholesale prices and deterring investments. Reduced oversight could worsen fibre access conditions in less competitive areas, and voluntary wholesale access might not ensure fair competition with ultimate negative effects on end-users in terms of reduced choices and affordability. Copper switch-off could accelerate in areas benefiting incumbents but harm alternative providers in FTTC-dominant countries with negative results on end- users.

Option 4 - Mandatory CSO and symmetric regulation

Option 4 simplifies the regulatory framework by replacing the current SMP and Article 61(3) regime with an obligation for all operators for wholesale access. A strict deadline for copper switch-off would accelerate FTTH deployment but might over-rely on public funding and leave some consumers without adequate fixed broadband. 9 countries plan to switch off copper by 2030, while others lag in fibre roll-out and may need additional public funding. Obligating former SMP controllers to provide duct access on cost-oriented terms would increase certainty for alternative fibre investors, fostering more deployment. Symmetric regulation for wholesale fibre access could increase broadband choices but might make access obligations less stringent, focusing on bitstream access with fair and reasonable pricing. This could reduce support for differentiated offers, increase administrative costs, and create uncertainty, potentially lowering competition quality compared to other options.

The following table provides a synthesis of expected effects of the different options on outcomes, taking into account the combined effects of the individual policies.

Table 23: Overview of effectiveness of options compared with the status quo

Options and associated policy measures	FTTH coverage (homes passed as % HH)	FTTH take-up (homes connected as % HH)	Competition: infrastructure / service	Effects on quality (speed / take-up of Gigabit)	Effects on price (affordability of high speed BB)	Single market / consistency	Simplification
Option 1: non-mandatory CSO and continuity on SMP with some updating of Art 61(3), and best practice wholesale (non-binding)	+ Effects from CSO	+ Effects from CSO and right to connect	(+) Some limited negative effect from CSO, but addressed through SMP, Art 61(3) and EU wholesale access products	(+) Art 61(3) and best practice wholesale	0	(+)	(+)
Option 2: Conditional CSO and updated access regulation (data requirements, Art 61(3)). RRM optional	++ Effects from mandatory CSO conditioned on FTTH coverage,	++ Effects from CSO and right to connect	(+) Negative effect from CSO, but addressed through CSO-linked market review obligation, art 61(3) and EU wholesale access product. optional RRM may have later negative effects from uncertainty.	++ Positive from CSO, market review linked to CSO, wholesale products, but later uncertainty if RRM optional	0 CSO provisions safeguard affordability on lower bandwidths, higher bandwidths addressed through market review linked to CSO. Later uncertainty if RRM optional	(+) More consistency regarding CSO, uncertainty regarding access if RRM optional	(+)
Option 3: Reliance on market forces for copper switch-off and access	- Delays in CSO, deterrence of alternative fibre investment	- Effects from FTTH / CSO delays	-- Shift away from current access regulation and removal of required measures and uncertainty around new rules	-- Negative impacts from reductions in competition, reduced FTTH	-- Negative impacts from reduction in competition	+	++
Option 4: CSO obligation without sustainability clause, strong PIA regulation, extension of wholesale access obligations to all	++ Rapid effects to 2030 mitigated by FWA and slower FTTH deployment after 2030	++ Effects from CSO and right to connect	+ Reduced infrastructure comp from CSO mitigated by strong PIA + greater service competition (but on bitstream)	+ Positive from CSO / FTTH, strong PIA but negative from move of access regulation to bitstream regulation	- Negative effects from move to bitstream / fair and reasonable pricing	+	+

operators while limiting strength of obligations							

Coherence

Coherence within the DNA and with other EU instruments is considered across all options:

- Internal Coherence: All options aim to remove inconsistencies.
- References to 100 Mbps in geographic surveys, inconsistent with VHCN objectives, are updated or removed.
- Options 3 and 4 face challenges due to their reliance on ex ante regulation concepts not directly linked to competition analysis and as far as option 4 is concerned some concerns related to proportionality may also arise.
- Option 2 ensures coherence by coupling copper switch-off with market reviews and standardized wholesale access specifications, promoting a harmonized FTTH framework. However, the periodic market reviews may be conducted only if and when the NRAs consider this to be justified. This could lead to some uncertainty.

External Coherence:

- Removing Article 76 addresses potential conflicts with the assessments of cooperation agreements.
- Updating 100 Mbps aligns with the Broadband State Aid Guidelines and Digital Decade Policy Programme targets.
- Options 1 and 2 align with competition law by using the SMP concept.
- Options 3 and 4 depart from competition law principles, potentially leading to incoherent access regulation rules compared to competition authorities' conclusions.

Coherence with the GIA:

- All options are coherent with the GIA.
- Option 2 reinforces this coherence by prioritizing GIA-based regulation for ducts and poles, aligning with the 2024 Gigabit Recommendation.
- Option 3 replaces SMP regulation by access to civil engineering infrastructure, handled via the GIA exclusively.
- Option 4 establishes specific rules to grandfather SMP PIA provisions, triggering Article 3(9) GIA (i.e. passive networks that are already subject to some access regimes (e.g. State aid) fall under those regimes for as long as such access obligations are in place) and adding symmetric measures for fibre access.

Efficiency²⁶⁸

The opportunity costs (i.e. lost profits) of copper switch to the operators cannot be quantified due to lack of publicly available data. However, it is clear that operators will need to replace their copper

²⁶⁸ Concrete information on direct and indirect costs, explaining who will bear the costs, distinguishing between administration (public authorities), businesses (operators) and citizens, end-users, is included in Annex 9, section 1.1.

networks to keep pace with demand and competition thus the mandatory copper switch-off, subject to conditions, has only the effect of bringing forward the date of the switch-off.

The administrative costs measured in FTEs and converted in monetary values can be: (i) divided in one-off and recurrent costs and (ii) attributed to competent (i.e., public) authorities and stakeholders (i.e., operators). The annual cost for an FTE, that has been considered in the analysis, is EUR 95 400. The result for the different options is compared with the one of option 0 (status quo).

Costs have been allocated for the following categories: (i) one off: FTTH and copper switch-off plans and implementation, Data gathering under Article 22, forecasts and declarations, Market analysis, SMP and symmetric (Article 61(3)) regulation, Best practice wholesale access specifications, and (ii) recurring: Data gathering under Article 22, forecasts and declarations, Market analysis, SMP and symmetric (Article 61(3)) regulation, Dispute resolution in relation to EECC.

Table 24: *Estimated change in one-off and recurring administrative costs*

Option	One-off FTE (CSO + data + market review + wholesale products)	Change in one- off FTE	Change in one- off costs	Recurring FTE (Data gathering, market analysis, dispute resolution)	Change in recurring FTE	Change in recurring cost (€000)	% Change in recurring cost
Option 0: Status quo	150	-	-	2 172	-	-	
Option 1: Non-binding CSO and limited updates to access regulation	417	267	25 471 8 00	2 331	159	15 69	7%
Option 2: Conditional CSO and updated access regulation	915	765	72 981 0 00	2 570	398	37 922	18%
Option 3: Market driven CSO and bottleneck-based access regulation	-	-150	- 14 310 0 00	948	-1 224	-116 770	-56%
Option 4: Mandatory CSO and symmetric regulation	944	794	75 699 9 00	2 939	767	73 124	35%

Source: Study on Access Regulation

It is worth noting that option 3 has a very positive impact on both one off and recurring costs, as it results to significant reduction for both (EUR 130 million). All other options are “more expensive” from the baseline scenario, as their additional total costs range from approximately EUR 40 million for option 1 to almost EUR 150 million for option 3, with option 2 lying in-between at EUR 110 million.

Option 1 will result in low one-off and recurring direct costs and minimal indirect costs. The improvements in coverage, penetration, and speeds are modest, but there are some gains in GDP and CO2 emissions. This option is a middle-ground approach, providing some benefits without significant disruptions

Option 2 will result in moderate one-off and recurring direct costs and high indirect costs. It also has high impact on coverage, penetration, and speed improvements, along with notable gains in GDP and CO2 emissions. This option is balancing high costs with high benefits.

Option 3 would lead to the lowest direct costs but high indirect costs due to investor uncertainty and reduced competition. The benefits in terms of coverage, penetration, and speeds are modest, with minimal impacts on GDP and CO2 emissions.

Option 4 will result in high one-off and recurring direct costs and significant indirect costs. It offers the highest benefits in terms of penetration, GDP and CO2 emissions. This option is would be the most effective, but also the most costly and disruptive.

In summary, option 2 provides the highest GDP growth and significant environmental benefits, while option 4 offers the best FTTH coverage and take-up but with stronger intervention. option 3 is the least economically beneficial and has minimal environmental impact, and option 1 maintains the status quo with minimal interference in business operations.

Stakeholders' feedback

The acceleration of the **copper switch-off** process is mainly supported by alternative fibre companies which favour binding copper switch-off deadlines. Financial investors point to ongoing losses by fibre companies and challenges to achieve take-up targets due to the persistence of legacy copper networks. Incumbents are favouring non-binding targets. Business associations are largely against a mandatory copper switch-off date. Public authorities express support facilitating the copper switch-off but mostly argue for a nuanced approach. BEREC considers the suggested date of 2030 for completing copper switch off “overly ambitious”.

The stakeholders' feedback **on in-building fibre wiring** shows that alternative fibre investors favour the inclusion of the in-building fibre wiring in the definition of VHCN. In contrast, some incumbent operators and alternative operators consider the costs of extending the definition of VHCN to cover in-building fibre wiring to exceed the benefits. Yet, as indicated in the Evaluation Report (Annex 11), eight NRAs, decided to regulate access to in-building wiring (which is done at request of operators). Consumer protection organizations have a more balanced view, with a slight preference towards including in-building fibre in the definition of VHCN.

The stakeholders' feedback on the **removal of rarely used provisions** shows that 50% of NRAs and 62% of alternative operators favour removing Article 76 (co-investment). 35% of NRAs and 57% of alternative operators consider removing wholesale-only provisions (Article 80). While some incumbents and fibre investors consider that provisions regarding functional separation (Article 77) could be removed, this is opposed by NRAs, consumer protection authorities and alternative operators.

The feedback on the **EU-wide wholesale product** indicates that stakeholders specialized in the provision of services to multi-national businesses confirm its value in supporting cross-border service provision. Other stakeholders, which are more focused on national service provision, suggest that the impact of standardised wholesale characteristics on cross-border provision in multiple countries would be limited. Some NRAs and national competent authorities signal that there could be some value from such provisions in facilitating the provision of retail broadband services in national markets with different wholesale access providers and potentially different legal bases for regulation. BEREC and two national regulators (AKOS and HAKOM) question the feasibility and usefulness of the pan-EU harmonised access product(s).

The need for **access regulation** is still considered necessary by nearly all respondents, except some of the incumbent operators. Most respondents, including all alternative fibre investors and alternative operators prefer the status quo to be retained as regards access regulation. Only some former incumbent operators suggest that access provisions could be entirely removed. Telecom operators, and particularly those making use of SMP PIA favour the status quo or the direct inclusion in the DNA of an obligation on operators with previous SMP obligations regarding PIA to provide this under strict conditions.

EU-added value

The options vary significantly in the added value they provide compared to Member States acting alone:

- Option 1: Introduces EU-wide non-binding targets and best practice guidelines, offering some added value. However, these are unlikely to drive significant changes as they lack binding requirements to address issues like ambition in copper switch-off targets and inconsistencies in wholesale access products.
- Option 2: Provides additional added value by introducing binding requirements for copper switch-off, data gathering, and wholesale specifications. It supports subsidiarity and proportionality by:
 - Allowing Member States to determine the most appropriate dates and means for copper switch-off.
 - Making switch-off conditional on consumer benefits.
 - Empowering NRAs to oversee the process and apply necessary conditions.
 - Enabling NRAs to adopt remedies beyond best practice specifications if justified.
- Option 3: Could limit the scope for authorities to intervene in copper switch-off and apply ex ante regulation, reducing flexibility to foster VHCN availability and competition. While it grants flexibility in wholesale product specifications, this may compromise consistency at the EU level.
- Option 4: Achieves consistency in access regulation across the EU by limiting derogations and requiring all operators to meet reasonable wholesale access requests. However, this may limit subsidiarity and proportionality, restricting Member States' ability to adapt rules to specific circumstances like low FTTH coverage and limited speed competition, thereby reducing scope for innovation and differentiation.

Summary

The table below shows a comparison of the options in terms of effectiveness, efficiency, coherence and EU added value.²⁶⁹ Effectiveness is compared as the likelihood to achieve the specific objectives of the measure - fostering fibre take-up (including take-up of Gigabit offers) and coverage but also includes a comparison of the effect on the Single Market as a result of the proposed access regulation and variation of the wholesale access products. Option 2 is the preferred option.

Table 25: Comparison of the Transition to fibre options

	Effectiveness				Efficiency			Coherence		EU added value
	FTTH coverage	FTTH take-up / boost penetration	Take-up of Gigabit speeds	Consistency / single market	Administrative cost (short / long run)	Main unintended costs 251	Benefits in relation to cost	Internal	External	
Option 1	+	+	+	+	-	n/a	+	+	0	+
Option 2	++	++	++	+	- / -	A small % consumers may need to transition to wireless / mobile. Copper network owners not investing in fibre may experience reduced profitability	++	+	+	++

²⁶⁹ EU-added value is analysed under Annex 9, section 1.1.

	Effectiveness				Efficiency			Coherence		EU added value
	FTTH coverage	FTTH take-up / boost penetration	Take-up of Gigabit speeds	Consistency / single market	Administrative cost (short / long run)	Main unintended costs 251	Benefits in relation to cost	Internal	External	
Option 3	-	-	-	-	++	--- Risk of delays to copper switch-off and under-regulation impacting competition and single market	-	-	-	--
Option 4	++	++	+(+)	+++	---	- Risk of unconnected households, reduced quality of competition	+	-	-	++

7.2. Spectrum

Effectiveness

The baseline offers limited effectiveness in promoting investment. Regulatory uncertainty, divergent assignment conditions and insufficient licence duration, stall deployment, especially cross-border.

Option 1 partially addresses the problem by promoting best practices, however the voluntary nature of the approach limits its effectiveness. Structured spectrum Single Market procedure and coordination of timing of awards via evolving roadmap improves consistency and transparency, while maintaining flexibility, but may not deliver tangible results in terms of single market.

Option 2 is more effective as it provides legal certainty by introducing default indefinite license duration (conditional and with safeguards of revocation). It improves predictability through pro-investment and pro-security authorisation conditions and facilitates access to spectrum for wholesale-only operators. The combination of *ex ante* spectrum single market procedure of assigning measures with possibility to veto on market shaping measures and limited licence duration, binding authorisation conditions and increased transparency and predictability of the timing of auctions ensures consistent pro-investment authorisation practices, incentivises cross-border provision of services and facilitates attaining scale. These features are particularly effective in unlocking investment in key bands for high quality 5G (and future 6G) which are estimated to generate the highest GDP impact, as confirmed by the historical data analysis and correlations between regulatory approaches and market outcomes and by the model indicative estimates of up to EUR 1.55 trillion in cumulative GDP benefits (and even more for 6G investments in the longer term). This option promotes harmonised EU-wide 6G deployment in strategically important bands, reinforces EU competitiveness, particularly for vertical sectors and opens up new opportunities for development of new spectrum-based services thanks to spectrum sharing.

Option 3, while yielding a comparable GDP impact to option 2 over the 2025–2035 period,²⁷⁰ reaches the highest level of effectiveness in the long term, as effectiveness is not assessed solely on the basis of the GDP estimates but also reflects effectiveness gains beyond the modelling horizon and scope.²⁷¹

²⁷⁰ The GDP model estimates economic impacts based on projected changes in mid-band coverage and mobile broadband download speeds from 2025 to 2035. For this period, options 2 and 3 are assumed to yield similar model inputs, with mid-band coverage increasing to around 96% and average download speeds reaching approximately 265 Mbps by 2035.

²⁷¹ The effectiveness gains of option 3 do not fully materialise in the short to medium term. Due to the continued relevance of existing national spectrum holdings and non-harmonised regulatory frameworks, including rules on lawful interception and consumer protection, EU-level assignments initially complement rather than replace national spectrum holdings. As

Through EU-level spectrum awards for specific bands, harmonised licence conditions, and indefinite license durations option 3 addresses persistent sources of regulatory fragmentation and lack of predictability at national level. By mandating coordinated spectrum authorisation and enabling shared governance at EU level, option 3 establishes a highly stable, scalable investment environment across the Union, possibly fostering cross-border consolidation between telco operators. It is the most effective option as it also includes a compliance mechanism at EU level, introducing a binding interference response framework and substitutes CEPT with an EU-only high-level group in sensitive areas, thereby maximising the EU's strategic coherence and response capacity. It enables deployment in mid-band spectrum which provides the largest economic gains, and the harmonised framework strengthens conditions for pan-European investments.

Sensitivity analysis: To account for potential uncertainties of the model that estimated indicative GDP impacts, a sensitivity analysis has been conducted, relying on varying estimates based on the methodology presented in Annex 4, Section 2. Under the lower-sensitivity scenario, accounting for multiple uncertainties and assuming a smaller impact of increased mobile broadband speeds on productivity and GDP (e.g., due to uncertainties regarding effective use of 5G-enabled technologies across sectors or slower diffusion of digital applications), the cumulative GDP impact for the EU over the period 2025–2035 is estimated at EUR 179 billion for options 2 and 3, compared to EUR 171 billion for the baseline and EUR 174 billion for option 1. Conversely, under the upper-sensitivity scenario, which assumes a higher responsiveness of GDP to broadband speed improvements (for instance, reflecting faster adoption of 5G-driven innovations or stronger network effects), the overall GDP impact for the EU over the same period is estimated at EUR 2,116 billion for options 2 and 3, compared to EUR 2,015 billion for the baseline and EUR 2,049 billion for option 1. These results illustrate that while the magnitude of impacts varies substantially across sensitivity assumptions, the relative differences between policy options remain limited, suggesting that the overall ranking of options is robust to variations in the assumed elasticity of GDP to broadband speed increases.

Efficiency

The **baseline** scenario involves minimal administrative costs, but its inefficiencies lie in missed investment opportunities and persistent market fragmentation.

Option 1 is cost-effective: promoting long licence durations and best practices brings improved predictability with relatively low regulatory burden. Replacing the peer review processes with the spectrum Single Market procedure and coordinating the timing of assignment through an evolving roadmap slightly increases procedural complexity but remains manageable for Member States.

Option 2 introduces moderately higher compliance and procedural costs for public authorities due to increased monitoring of renewal conditions, increased transparency of spectrum assignment procedures and implementation of pro-investment and pro-security authorisation conditions, including robust competition analyses/review mechanisms and safeguards for competition law compliance. However, in the long run, cost reduction should be expected thanks to longer duration, reduced re-auctioning and efficiency gains which would contribute to the development of new services. Option 2 enables economies of scale through greater harmonisation of authorisation conditions and improved alignment of auction timelines, reducing regulatory fragmentation and compliance costs for operators active in multiple Member States. This option's measures are proportionate and highly efficient for strategic spectrum bands, which are expected to bring GDP

a result, their immediate impact on network deployment and performance is limited. Only in the longer term, as existing rights of use expire and spectrum is progressively assigned under the EU framework, do the full effectiveness gains of Option 3 materialise, including better conditions for pan-European deployment and the realisation of economies of scale.

gains. Options 2 and 3 demonstrate comparable superior environmental efficiency, with the lowest CO₂ per euro of GDP among all scenarios.

Option 3, while slightly more effective than option 2, entails the highest administrative and legal costs and is thus less efficient than option 2, particularly during the transition period characterised by parallel EU and national governance structures. Member States would need to adjust national laws and procedures to accommodate for a centralised framework, and the EU would require significant institutional capacity to oversee assignments, monitor compliance, and resolve disputes. Initially operators would keep holdings they already have in several bands to ensure mobile services and the additional spectrum awarded at EU level to a limited number of operators would only add up to the existing spectrum holdings of a significant number of operators and would not be sufficient on its own for network deployment, also considering that 6G networks are expected to be built as an evolution of 5G networks. There would be a need to maintain both spectrum governance structures at national and EU level. Only in the long term when existing national assignments would come to an end and the timelines would be aligned additional bands could be assigned at EU level and additional efficiencies would materialize, including at the administrative level (linked with the lower number of providers. EU-wide awards, though having the potential to maximise economies of scale for certain operators in the long term, would also bring significant uncertainty and could disturb the functioning of the mobile market, until a new structure of the market is established, a process which could take years, given the number of spectrum bands and their different expiry dates.²⁷² The long-term benefits for pan-European infrastructure and high-value bands could potentially justify the significant initial cost. In the long term, it is likely that only few undertakings (3-4 maximum) would be able to retain enough spectrum at EU level for sustainable operation, and the majority of operators currently operating in the EU would be forced to sell assets, exit the market or become virtual operators.

Sensitivity analysis: To account for potential uncertainties of the model that estimated indicative environmental impacts, a sensitivity analysis has been conducted for the energy-efficiency factor, which is set at 22% per year in the base model. Variations in this factor accordingly affect the different options. Annex 4 shows the results of this analysis that leads to a stable ranking across all scenarios: option 3 always performs best, followed by options 2, 1, and 0. However, the differences between options are very small, around 0.1–0.2% (e.g., baseline 22%: 5,257,074 vs. 5,250,198 for option 0 vs. 3). Around the baseline, absolute emissions decline almost linearly by several tens of thousands of units per additional efficiency percentage point, with slightly diminishing marginal returns. Prioritizing an increase in the efficiency factor delivers meaningful GHG reductions, while the choice among options 0–3 yields only marginal gains. For details see Annex 4, Section 2.

The below table shows the costs and benefits of all options, explaining who will bear the costs, distinguishing between administration (public authorities), businesses (operators) and citizens, end-users.

²⁷² EU-wide awards have the potential to generate economies of scale in the long term, notably where operators deploy networks on a pan-European basis. However, given the inherently local nature of network deployment (e.g. geography, site acquisition, permitting and local workforce requirements), as well as the continued application of non-harmonised rules in areas such as lawful interception, data protection and consumer protection, such economies of scale are unlikely to materialise in the short to medium term (until 2035). Within the modelling horizon, they are not expected to offset the transition costs associated with restructuring governance and market arrangements at EU level.

	SPECTRUM		
	01. Soft harmonisation	02. More single market to enhance investment and innovation (PREFERRED OPTION)	03. Strong harmonisation and EU level rules
Costs by stakeholders			
End users: Citizens and industrial sectors (e.g. verticals)	neutral	neutral	neutral
Operators	(0/+) Neutral to low adaptation costs to new licence types (0) Neutral adaptation costs related to spectrum sharing as no operator generated barriers will be tackled (0/-) Neutral to reduced costs of acquiring new spectrum and retaining used spectrum, even with licence duration of 20+5 years, provided recommendations on investment-oriented auction designs and conditions are followed	(+) Low costs for adaptation to new licence types (+) Low costs for adaptation to spectrum sharing under principle “use-it-or-share-it” (-) Reduced costs of acquiring new spectrum due to auctions more focused on incentivising investments, more targeted usage of market shaping measures and investment-oriented spectrum licensing conditions (--) Reduced costs of retaining already used spectrum thanks to less re-auctioning under a default indefinite licence duration (e.g. for 3.6 GHz spectrum)	(+) Low cost for adaptation to new licence types (+/++) Low to medium cost of adaptation to spectrum sharing, especially via dynamic geolocation database (--) Reduced costs of acquiring new spectrum due to harmonised auction process aspects and conditions (--) Reduced costs of retaining used spectrum – as under option 2 (++) High cost of market restructuring resulting from EU-level spectrum awards – in short term, a risk of inefficiencies if only few operators (3-4 maximum) are able to acquire spectrum at EU level, and in the medium term, a risk for operators that will repeatedly fail to secure spectrum to sell assets, exit the market or become virtual operators. These costs decrease in the long term.
Administration	(0/+) Neutral to low compliance costs of the toolbox of best practices (e.g. award conditions, auction formats, fee models, and obligations) as non-binding, compared to 6G roadmap, mandatory ex ante spectrum Single Market procedure	(+) Moderate adaptation costs (continued) to EC recommendations and decisions addressing authorisation process aspects and conditions, authorisation regimes, updating EU spectrum strategy and roadmaps, and national roadmaps, including after	(++) High adaptation costs to fully harmonised authorisation process aspects and conditions, mandatory assignment deadlines and extended mandatory ex ante spectrum Single Market procedure

	SPECTRUM		
	O1. Soft harmonisation	O2. More single market to enhance investment and innovation (PREFERRED OPTION)	O3. Strong harmonisation and EU level rules
	(+) If relevant, a low one-off adjustment cost to EC recommendations (e.g. adapting internal procedures): (0/+) Neutral to low additional expenses due to mandatory ex ante Single Market procedure; applied on a case-by-case basis, at each auction, with a lower expected frequency due to longer licence duration; mostly administrative costs (e.g. dossier and presentations preparation) as substantiation of market shaping measures is required already under the EECC (+) If relevant, low compliance costs linked to the non-binding EC opinion resulting from the spectrum Single Market procedure (+) Increase in BEREC office cost for activities surrounding the spectrum scrutiny (up to 2 FTEs) (the current staff expenditure in BEREC Office per employee EUR 111.935 x 2 = EUR 223 870) (0/+) Neutral to low costs of removing barriers to spectrum sharing (0/+) Neutral to low additional cost of monitoring compliance with licence conditions' due to longer duration (20+5 to currently 15+5 years) (+) On case-by-case basis, additional costs in monitoring / enforcing intra-	successful petition, mandatory ex ante Single Market procedure (+) Limited additional expenses for the ex-ante spectrum Single Market procedure, but higher than under option 1; on case-by-case basis, but fewer auctions expected than under option 1 due to in general unlimited licence duration; (+) If relevant, moderate costs with ensuring compliance with the binding EC opinion, especially in case of EC veto (+) Higher increase in BEREC office cost for activities relevant to the spectrum Single Market procedure (2 FTEs) than in option 1 due to more formalised procedure (the current staff expenditure in BEREC Office per employee EUR 111.935 x 2 = EUR 223 870) (+) Moderate costs for introducing monitoring and enforcement of sharing mechanisms that may require real-time monitoring infrastructure (e.g. dynamic database) (+) On case-by-case basis, moderate costs associated with	(++) High compliance costs related to introduction of the EU-level spectrum awards due to synchronisation of existing licences' expiry dates and conditions and need to conduct procedures at EU level (+/++) Limited to high additional expenses with ex ante spectrum Single Market procedure because NRA needs to prove dominance in case it would like to introduce market shaping measures; (+/++) If relevant, moderate to high costs to ensure compliance with the binding EC opinion, especially in case of EC veto (+) Increase in BEREC office cost for activities relevant to the spectrum Single Market procedure (2 FTEs) similar to option 2 (the current staff expenditure in BEREC Office per employee EUR 111.935 x 2 = EUR 223 870) (+/++) Moderate to high costs for introducing monitoring and enforcement of sharing mechanisms that may require real-time monitoring infrastructure (e.g. dynamic database) (+/++) On case-by-case basis, moderate to high costs with implementation of measures resolving cross-border interference issues

	SPECTRUM		
	01. Soft harmonisation	02. More single market to enhance investment and innovation (PREFERRED OPTION)	03. Strong harmonisation and EU level rules
	EU 3rd state cross-border interference (0/+) Neutral to low administrative costs with monitoring the 6G roadmap developments (+) Low mainly administrative costs related to a system for petition for harmonisation;	implementation of measures resolving cross-border interference issues (+) Moderate costs associated with establishing and implementing a system for petition for harmonisation	(++) High costs associated with establishing and implementing a system for petition for harmonisation and ensuring adequate follow up
Benefits by stakeholders			
End users: Citizens and industrial sectors (e.g. verticals)	(+) Limited improvements to quality of service due to wider high quality 5G coverage and higher speeds (+) Limited benefits for industry from increased possibility to ask for harmonisation of spectrum (+) Increased investment planning for vendors and verticals on the basis of 6G roadmap leading to more synchronised technology adaption (0/+) Neutral to low benefits from spectrum sharing thanks to removal of legal barriers	(++) Considerably improved coverage and quality of service for mobile connectivity, faster availability of 6G (++) End users, especially in rural/underserved areas benefit indirectly from faster rollout, broader service options, higher QoS and higher coverage with high-quality networks enabled by investment oriented spectrum licensing, local licensing, shared access and interference free connectivity, especially in cross-border areas. (++) Innovation acceleration for Industry (verticals, SMEs, R&D actors) benefiting from enhanced 5G QoS and specialised services offers and from access to localised/licensed spectrum for innovative services (e.g. private 5G, IoT), particularly in manufacturing, health, agriculture, and transport and from the capacity to scale up thanks to the harmonisation of authorisation conditions. (++) Accelerated shift from 5G to 6G with enhanced capabilities such as real-time distributed intelligence, ultra-	(++) Considerably improved coverage and quality of service for mobile connectivity, faster availability of 6G The benefits are comparable to option 2

	SPECTRUM		
	O1. Soft harmonisation	O2. More single market to enhance investment and innovation (PREFERRED OPTION)	O3. Strong harmonisation and EU level rules
		low latency, integrated sensing and communication, and improved energy efficiency, all of which may generate cross-sectoral economic benefits similar or even superior to those observed for 5G.	
Operators	(+) Greater coherence and predictability thanks to 6G roadmap and toolbox of best practices that could result in lower entry barriers, facilitation of networks expansion and avoidance of overlay high prices based on new auction designs. Direct benefits of longer licence duration (min 25 years with conditions for renewal) resulting in increased investment capacity, planning stability and reduced risk premium on capital expenditures Greater level playing field as spectrum Single Market procedure helps to identify potential national measures which would create a barrier in the Single Market or do not comply with EU law.	(++) Increased investment capacity, lower financing cost thanks to higher predictability, improved legal certainty, clearer, more predictable procedures through EU-level licensing guidance, in general unlimited licence duration, automatic renewals and stakeholder petition mechanisms. Investment oriented spectrum auctions overall, reducing spectrum costs and increasing investment incentives. Lower entry barriers for SME: Simplified and more flexible access regimes and harmonisation of authorisation conditions reduce administrative and regulatory burdens for SMEs entering niche or local spectrum markets. Benefits from increased flexibility: The preferred option adapts certain eligibility restrictions that previously limited participation in spectrum awards (e.g. requirements linked to network coverage or service provision), which enables wholesale-only operators and new entrants to gain better access to spectrum; this	(++) Increased investment capacity due to fully harmonised authorisation procedures aspects and conditions, unlimited licence duration and consistency in award timing and renewal criteria Benefits associated with reduction of compliance costs borne by cross-border operators due to misaligned conditions between Member States Other benefits comparable to option 2

	SPECTRUM		
	O1. Soft harmonisation	O2. More single market to enhance investment and innovation (PREFERRED OPTION)	O3. Strong harmonisation and EU level rules
		stimulates service competition and service diversification. Better response to interference translates into reduced costs by enabling the use of otherwise underutilised spectrum through the resolution of cross-border interference issues, both within the EU and with third countries (mainly along external land borders), thereby preventing related service disruptions.	
Administrations	(+) In the long term, limited benefits from the reduction of some costs due to the simplification of some processes and harmonisation	(++) In the medium/long term, benefits from significant reduction in administrative costs due to fewer auctions and greater use of licence renewals, which can ease administrative workload, improve planning certainty and lower transaction costs. Increased spectrum efficiency due to a push towards innovative spectrum sharing solutions. The preferred option supports the uptake of advanced sharing mechanisms (e.g. dynamic spectrum access, AI-based coordination), unlocking additional efficiencies and supporting coexistence in dense spectrum environments.	(+/++) Improved auction efficiency and spectrum use by applying standardised metrics and binding rules In the long term, benefits from a reduction in administrative costs, but lower than in option 2 due to too the high effort required to maintain harmonisation, which might be burdensome for smaller administrations Enhanced coordination in addressing harmful interference from third countries
Net Value for Stakeholders			
Net Value for Citizens and industrial sectors (e.g. verticals)	Positive ++	Positive +++, no additional cost for citizens, but several additional benefits from improved quality of service and increased competitiveness for businesses (e.g. verticals) due to use of quality-assured services	Positive +++, no additional cost but several additional benefits from improved quality of service and increased competitiveness for businesses (e.g. verticals) due to use of quality-assured services
Benefits	++ Some benefits linked to better quality of service	+++ Considerable benefits linked to better quality of	+++ Benefits linked to better quality of service (speeds,

	SPECTRUM		
	O1. Soft harmonisation	O2. More single market to enhance investment and innovation (PREFERRED OPTION)	O3. Strong harmonisation and EU level rules
	(speeds, latency, etc.) and increased coverage with high quality 5G and accelerated 6G deployment.	service (speeds, latency, etc.) and increased coverage with high quality 5G and accelerated 6G deployment. Considerable spillover effect on different sectors of the economy from high quality 5G/specialized quality-assured services and IoT, especially in sectors like healthcare, manufacturing, automotive and transport, energy environment and agriculture.	latency, etc.) and increased coverage with high quality 5G and accelerated 6G deployment. Considerable spillover effect on different sectors of the economy from high quality 5G/specialized quality-assured services and IoT, especially in sectors like healthcare, manufacturing, automotive and transport, energy and environment and agriculture.
Costs	(0) Neutral for citizens Industry might need to invest in innovation to introduce quality assured services and make best use of the offered connectivity	(0) Neutral for citizens Industry might need to invest in innovation to introduce quality assured services and make best use of the offered connectivity	(0) Neutral for citizens Industry might need to invest in innovation to introduce quality assured services and make best use of the offered connectivity
Net Value for Operator	(+) the benefits outweigh the costs for operators	(+++) the benefits largely outweigh the costs for operators	(++) the benefits largely outweigh the costs for main operators
Benefit		Increased predictability and investment capacity, reduced costs associated with the inability to use spectrum due to harmful interferences	Increased predictability and investment capacity.
Costs		(-) Low costs for adaptation to new licence types (-) Low costs for adaptation to spectrum sharing under principle “use-it-or-share-it”	(--) In the short term, only few undertakings (3-4 maximum) would be able to acquire spectrum at EU level, which means that most operators currently operating in the EU would be forced to sell assets, exit the market or become virtual operators. Costs reduced in the long term.

Coherence

The baseline is only partially coherent with EU investment needs and Digital Decade goals. High quality 5G and future 6G investments are expected to be financed mainly by the private sector (see section 2.1.2 and 2.3.2 and Annex 7, Section 1.2.1.). Diverging licence regimes and insufficiently investment-oriented auctions hinder the coherent rollout of 5G.

Option 1 falls short of ensuring sufficient incentives for private investments. The use of a toolbox, peer review, and coordinated roadmaps for spectrum awards supports convergence without imposing binding obligations, marginally improving policy coherence.

Option 2 improves coherence significantly by integrating spectrum policy with wider EU objectives on connectivity, investment, and preparedness as well as cybersecurity. Renewal conditions, coherent pro-investment authorisation and spectrum sharing ensure a more strategic, structured and predictable policy environment. The integration of the 5G toolbox in the conditions attached to rights of use of spectrum will increase coherence with the Cybersecurity Act. The coordination of national roadmaps under a common EU framework ensures synchronisation across Member States. This option supports coherence with broader strategic agendas, such as the Digital Decade, 6G roadmap coordination, the European Preparedness Union Strategy and the ProtectEU Internal Security Strategy, without removing Member State autonomy in non-harmonised bands.

Option 3 has the potential to bring the highest level of internal coherence by embedding spectrum governance into a common investment strategy but challenges the balance of powers with national regulators. It ensures that awards for strategic bands are aligned with cross-border deployment objectives, security priorities, and Digital Decade targets. Indefinite licenses, a harmonised approach to renewal, remedies aiming to safeguard or increase competition, all support long-term planning and minimise policy fragmentation. However, full centralisation requires careful alignment with existing structures to ensure subsidiarity is respected.

Stakeholder's feedback

As regards **option 1** operators are positive to longer license duration, easier renewals, more harmonisation of authorisation procedures and of conditions. They, however, favour an even more ambitious mechanism similar to the existing framework for market analysis. They see positively the evolving roadmap on spectrum availability and policies incentivising sharing and flexible use. Member States and NRAs do not see the need for license durations beyond 20 years or for common spectrum authorisation procedures and conditions. The RSPG acknowledged the potential for improvement of the peer review as well as the need for pro-investment assignment conditions.

The bundle of measures in **option 2** received most support from telcos which support measures increasing regulatory predictability and reducing market fragmentation: indefinite or very long license durations, automatic renewals, lower spectrum costs, and flexible usage rules. Telcos converge in that market-shaping measures should be controlled on the basis of a competitive analysis scrutinised ex ante. While in favour of pro sharing and flexibility policies, they caution against mandatory obligations. Stakeholders endorse EU-wide harmonisation of the availability of spectrum and technical and economic conditions. Member States and NRAs see no need for harmonised spectrum authorisation and oppose common authorisation procedures and conditions. The RSPG expressed a view against a mandatory single market procedure with veto. Competent authorities were more positive to measures promoting sharing and flexibility in spectrum use.

As regards **option 3**, while telcos and vendors are in favour of unlimited license duration and full harmonisation of spectrum authorisation conditions, they are strongly against awards at EU level or under strict deadlines and are split with regard to cross-border coordination and interference management. The RSPG recognised the potential to improve the cooperation between Member States in addressing cross-border interference. It expressed strong preference for maintaining the current model, including the preparation of technical harmonisation of spectrum by CEPT. The Electronic Communications Committee of the CEPT also expressed the view that the existing framework between the EU and CEPT is resilient and working well.

Summary

The table below summarises the overall costs and benefits for the different stakeholders by each option. Annex 3 Section 2.2. presents in detail the main costs and benefits per stakeholders of the three Options.

Table 26: Summary of costs and benefits for Spectrum options

	O1. Soft harmonisation	O2. More single market to enhance investment and innovation	O3. Strong harmonisation and EU level awards
Net Value for Citizens and industrial sectors (e.g. verticals)	Positive ++	Positive +++, no additional cost for citizens, but several additional benefits from better quality of mobile services and increased competitiveness due to use of quality assured services	Positive +++, no additional cost but several additional benefits from better quality of service and increased competitiveness due to use of quality assured services
Net Value for Operator	+ the benefits outweigh the costs for operators	+++ the benefits largely outweigh the costs for operators	++ the benefits largely outweigh the costs for main operators

The table below shows comparison of the options in terms of effectiveness, efficiency, coherence and EU added value. Based on this assessment, option 2 is considered to be the preferred option.

Table 27: Summary assessment of policy options – spectrum high quality mobile networks

Criterion	Baseline	Option 1	Option 2	Option 3
Effectiveness	–	+	++	++
Efficiency	–	+	+++	++
Coherence	0	+	++	++
Relevance	–	+	++	++
EU added value	0	+	++	++

7.3. Authorisation

Effectiveness

The **baseline scenario** is not effective in achieving the stipulated objectives, as it does not allow reducing the costs of compliance nor removing obsolete/simplifying complex provisions.

Option 1 moderately simplifies and reduces fragmentation. For **cross-border services**, like satellite and B2B, it moderately improves effectiveness through a **one-stop shop notification system** coordinated by the BEREC Office. However, it does not fully address fragmentation e.g. on cybersecurity, lawful interception, data retention, administrative charges, and emergency communications. It preserves national decision-making, but promotes convergence in satellite authorisation conditions and also includes costly reporting obligations. The EU-level satellite selection mechanism supports scale, certainty for pan-European satellite operators, eases spectrum access and market entry.

Option 2 improves compliance with all authorisation conditions (through coordination mechanism) and removes excessive national authorisation requirements as they would be embedded in the EU regulation as fixed and exhaustive list of conditions. It centralises the selection, assignment and authorisation for satellite spectrum entirely at EU level and offers the highest level of effectiveness, considerably simplifying satellite authorisations and avoiding duplications. This reduces the burden for providers and national competent authorities and maximises predictability for operators ensuring spectrum is authorised throughout the EU territory, without white spots, facilitating scale. It enables providers to innovate and grow across borders supporting EU competitiveness and strategic autonomy, also ensuring more effectively that all players play by the rules. While enabling wider availability of satellite services it fully ensures economic, social and environmental benefits described in section 6.3.

Option 3 removes MS flexibility to include additional general authorisation requirements and reduces significantly the administrative burden and supporting scale based on a **country-of-origin regime** with mutual recognition. It promotes convergence in satellite authorisation conditions aligned with ITU rules, more likely effective enforcement in the hands of one MS, and introduces an EU-level selection mechanism for MSS spectrum, which may enhance coordination for pan-European networks. However, its effectiveness is limited as satellite providers remain bound by Member States laws and enforcement stays national.

Efficiency

The **baseline scenario** shows very low cost-efficiency since undertakings face additional administrative and compliance burdens without clear benefits. **Option 1** entails a better trade-off than the baseline scenario with slightly reduced burdens for cross-border providers, especially SMEs, more competition and innovation thanks to coordination mechanisms. Benefits are however limited to cross-border services providers, such as B2B and satellite. The harmonised authorisation template adds some moderate coordination overhead, as it builds on existing multiple structures. Minimum common requirements facilitate smoother market entry in the satellite market. **Option 2** brings more significant costs and benefits. Providers will benefit from a reduced administrative and compliance burden, quicker access and lower costs likely increasing competition, EU competitiveness and innovation capacities, and end-user choice. One-off costs are expected e.g. for the national single point of contact, for coordination with Member States, or linking with the Single Digital Gateway/BEREC website. This option implies a higher EU-level costs for the centralisation of all satellite spectrum assignment and authorisation procedures (dedicated staffing, governance structures, and legal enforcement mechanisms). These are, however, off-set by cost saving at the national and operators level due to elimination of duplicative national procedures. This option is highly cost-effective in the long run, enables faster processing of market access, and provides a single, standardised route for all satellite operators, including pan-European constellations. Transaction costs

drop and economies of scale are achieved through unified procedures and enforcement mechanisms, enhancing the competitiveness of EU space sector. **Option 3** (country of origin regime for satellite operators and B2B services) entails the highest administrative costs, requiring dedicated staffing, governance structures, and legal enforcement mechanisms in all Member States and BEREC/RSPG Office. It entails the highest adaptation costs although less efficient than option 2 in eliminating duplicative national procedures with a worse cost benefit ratio.

The below table shows the costs and benefits of all options, explaining who will bear the costs, distinguishing between administration (public authorities), businesses (operators) and citizens, end-users.

	General authorisation and authorisation for satellite services		
	O1. Partial harmonisation of authorisation	O2. ‘Single passport’ for other networks and services than satellite and an EU-level authorisation for satellite spectrum (PREFERRED OPTION)	O3. Country-of-origin authorisation for cross-border and B2B services
Costs by stakeholders			
End users (Citizens/businesses using connectivity)	neutral	neutral	neutral
Operators	(---) Higher costs than in Option 2 and 3 For GA: Many (up to 27) one-off costs for the general authorisation regime, emphasis on enforcement of the current regime. For GA: Cost of national authorisation in each MS remains, even with one-stop-shop (comparable to baseline). Satellite operators: will still have to pay multiple administrative fees, reporting costs will not change, as there would be at least one reporting obligation per Member State. For those operating in several Member States, there would also be modest one-off costs to adapt to the common template for satellite authorisations. NRAs or SMAs impose, on average, one-off administrative cost for satellite authorisation	(-) Small one-off cost to adapt to the harmonised conditions (both for GA and EU Satellite Authorisation) For GA: Lower than in option 1. Notification in 1 MS only (cost reduction from potentially 27) but (--) enforcement remains at country of destination level. For satellite: the overall costs for the operator for the authorisation process will be much lower than in option 1, see estimates of reduction of costs under operator’s benefits (substantial reduction of administrative burden due to EU-level authorisation replacing the 27 authorisations required under the baseline and option 1), despite the possible application of an EU-level spectrum fee or administrative charge	(-) Lower costs of adaptation to the new GA regime than in option 1 and 2 (but only for a limited scope of players, i.e. cross-border and B2B) For GA: Reduction from 27 to 1 GA regime and enforcement in the country of origin only, but only for limited scope of players (cross-border and B2B). For satellite: the costs are much lower than under option 1, see estimates of reduction of costs under operator’s benefits (substantial reduction of administrative burden due to country of origin authorisation replacing the 27 authorisations needed under the baseline and option 1). The centralized procedure is challenging to implement within a national country-of-origin authorisation framework for network service providers, including satellite operators, operating across multiple EU Member States. Therefore, this option is seen as less effective

	(general and individual) of up to EUR 160 000. In addition, site authorisation for satellite ground stations entails a one-off permit cost of up to EUR 130 000, with annual cost reaching up to EUR 30 000. Furthermore, some Member States also apply spectrum usage charges, which may amount up to EUR 10 000/ site annually (according to operators' input).		for ensuring consistent application of the GA regime and reducing fragmentation. While new satellite operators might benefit, existing satellite operations cannot be integrated into the new regime, and new authorizations would likely be granted at different times. Furthermore, operators will suffer from significant asymmetries, since they might direct notifications to few MSs seeking the best applicable regime due to the country-of-origin principle (forum shopping and a "race to the bottom").
Administration	(-) Administrations will have to face one-off costs to operationally adapt to the improved non-mandatory notification template for general authorisation by BEREC and the template for satellite authorisation. Fee collection and enforcement will continue at a national level. For GA: the total staff requirement across all MSs/NRAs would not increase under option 1 as it is in the baseline (currently MS/NRAs have approximately 8 FTEs). For satellite authorisation, the total staff requirement across all MS would be similar to the baseline estimated at 98FTEs for authorisation and enforcement plus increases to cope with the increased workload stemming from satellite authorisations requests (estimated increase of authorisation requests x 2.4 times).	(-) For GA: Very low recurrent cost for monitoring and information exchange. Lower than in option 1 – depending on the number of notifications from cross-border operators (cost of receiving and verifying notifications and issuing declarations, cost of coordination between authorities). Increase in human resources in BEREC Office (2 FTEs) taking over tasks and administrative burden from MSs/NRAs (the current staff expenditure in BEREC per employee EUR 111 935x2= EUR 223 870). For satellite, additional costs at EU level due to EU-level satellite authorisation and, in the case of spectrum scarcity for satellite providers, selection, spectrum assignment, and monitoring / enforcement. The increase in resources at EU level will be more than compensated by the overall savings at national level (see benefit section). In a context of considerable increase in the workload, it could be expected that the proposed EU-level authorisation regime could ensure that, at least over the next years, workload increases are absorbed without requiring additional administrative resources at national level.	(--) Higher than in option 1 and similar to option 2 (<i>GA conditions of only one MS apply while other MS should respect, mutually recognise and assist CoO in enforcement</i>). National administrations to have increased costs for the notifying Member State and require other Member States to participate in coordination and enforcement without direct control. The application of fees might remain problematic if affected MSs would maintain collection of fees from satellite operators providing satellite services across the Union. Satellites: Some MSs might need to considerably increase FTEs due to forum shopping. Similarly to option 1: the baseline estimated at 98FTEs for authorisation and enforcement plus increases to cope with the increased workload stemming from satellite authorisations requests (estimated increased x 2.4 times). Coordinated enforcement of ITU rules via authorisation conditions (e.g. harmful interference) might require additional FTEs efforts. One-off costs during the transitional period. There would be some uncertainty or

		At EU level, for all spectrum measures (including terrestrial authorisation in Section 7.2 above), a progressive annual growth (depending on number of satellite authorisations requests), amounting to additional 5 FTEs for EC (approx. EUR 786 000) and 15 FTE for the BEREC Office (approx. EUR 1.6 m in the first year up to EUR 3.4 m in year 2034) is to be considered and is quantified in the governance section. These FTEs would handle the operational functions transferred from national authorities and will oversee and coordinate implementation and cooperation with Member States.	administrative complexity as Member States phase in the harmonised conditions. The country-of-origin principle and mutual recognition would still leave multi-Member State satellite providers subject to rules of each Member State in which they operate, thereby increasing fragmentation and creating incentives for forum shopping practices that are detrimental to the intervention objectives.
Benefits by stakeholders			
End users (Citizens/businesses using connectivity)	Neutral or minimal benefits	+++Greater choice of services for end-users (B2C included). Increased availability in all MS (EU-wide coverage) Increased Consumer Surplus due to timely availability of New Space innovative services, reduced coverage gaps and reduced legal uncertainty (e.g. one-month EU-wide service interruption estimated to reduce consumer surplus in the order of tens of millions EUR, depending on service substitutability and affected user base). Improved benefits from pan-European D2D services, better capacity to communicate in case of major disasters and in case of emergency situations in underserved areas. More secure networks. Lower risk of service disruption for end users due to satellite harmful interferences.	+Like in option 2, but limited only to cross-border services and B2B (not B2C)
Operators	+ Indirect benefits thanks to simplified and digitalised procedures (max. list of conditions for GA, unified notification template for satellite services, single notification/one stop-shop for cross-border operators) For satellite, operators will work under simplified	++ (due to GA) +++ (due to satellite) For GA: Providers benefit from a single passport or declaration authorising the provision of networks and services, which is valid in all 27 Member States, instead of having to go through individual national procedures.	++ For GA: Higher than in option 1 and 2, but limited to certain cross-border service providers, such as satellite services and B2B providers. Satellite operators could pick and choose (forum shopping) and concentrate all FTEs in the selected Member States for satellite authorisations.

	procedures such as a unified notification template and a single notification process. However, operators will have to fill in a common template to be sent to 27 different Member States whose reporting requirements could differ significantly in terms of procedures and fees structures.	Cost savings, reduced admin. burden and additional costs savings from lower compliance costs for all cross-border ENS and ECS providers of around 40-44%, as alignment with divergent national conditions (potentially over 1050 across MS) would no longer be required, amounting to approximately EUR 6-11 million per operator per year. For satellite: Solution to harmful interference issues (ensures all players play by the rules thanks to the coordinated enforcement of satellite rules) Other benefits: faster market entry and ECN/ECS deployment (avoiding a reduction of revenues due to delays, e.g. in a major EU constellation one-month EU-wide service interruption could lead to an estimated loss of potential revenue of some EUR 50 million per month.), greater consistency of regulatory conditions, innovative cross-border services e.g. B2B also New Space SMEs For satellite, operator savings linked to complying with one single set of authorisation conditions and limited loss of revenues due to possible delays in spectrum authorisation. As an example, some operators estimated that for securing spectrum authorisations for a satellite constellation covering the entire EU, an operator needs several FTEs centrally for assessing the scope and requirements to launch services across each Member States, including working on spectrum assignments and additional further resources per Member State to apply for spectrum authorisation and significant additional resources if Member States have specific in-country requirements such as testing before the launch of satellite services Overall, a digital single market for satellite could reduce costs by an estimated 60-80%.	Therefore, administrative benefits would be similar to option 2 as well as the enforcement FTEs efforts, which will be concentrated in one or some MSs. Mechanisms to tackle harmful interference will benefit operators but the timely and efficiency of them might be lower than option 2.

Administrations	+ One -stop-shop mechanism for cross-border operators might relieve some pressure from MS/NRAs to BEREC Office level.	++ Some cost savings for NRAs/MSs thanks to a single notification in 1 MS only and passporting procedure that simplifies entry to the market. For GA: $\approx$ EUR 382,000 in annual administrative savings, which corresponds to 50% reduction in staff effort from baseline: from 8 FTEs in MSs to 4 FTEs under option 2 (2 in BEREC Office and 2 in MS). Explained as follows: A standardised cost per FTE of EUR 95,400 per year (“burdened labour cost”, including salary and overheads). multiplied by the reduction of 4 FTEs by this unit cost gives: $4 \times \text{EUR } 95,400 = \text{EUR } 381,600$ ($\approx$ EUR 382,000) in annual administrative savings. For satellite: Savings in a context of a stable number of satellite authorisation requests: administrations would experience a net reduction in costs, with roughly 20-30% total staffing reduction to around 70-80 FTEs from previously 100 FTEs. This could result in annual savings of approximately EUR 2-3 million, although such savings will not occur automatically. However, considering the likely workload increase (despite high uncertainty on future numbers, applications for ground stations could double and those for satellites increase by a factor of 2.4), and considering scale economies as well as the progressive efficiency gain, the proposed EU-level authorisation regime could thus ensure that, at least over the next years, workload increases are absorbed without requiring additional administrative resources at national level.	++ Similar like in Option 2 but limited due to narrower scope as some Member States would significantly reduce costs while a limited number of others will have their FTE costs increased substantially, similar to what would be expected under option 2 for EU bodies.
Net Value for Stakeholders			
End users (Citizens/businesses using connectivity)	Neutra to slightly positive, but limited global EU competitiveness in space	+++ Positive. Benefits are considerable, and the intervention is cost neutral for end users.	++ Positive, but limited global EU competitiveness in space

		Strong global EU competitiveness in space.	
Benefits	+ Slightly positive. The measures will be insufficient to overcome the expected delays in the deployment of EU wide satellite services and D2D services foreseen in the baseline.	Timely and Increased offer of satellite services with EU-wide coverage (all MSs), improved benefits from D2D services, better capacity to react in case of major disasters and in case of emergency situations in underserved areas. More secure networks. Less service disruption due to satellite harmful interferences.	The measures will only slightly improve the expected delays in deployment of EU wide satellite services and D2D services foreseen in the baseline
Costs	Neutral	Neutral	Neutral
Net Value for Operator	(0) to + Slightly positive, benefits only marginally outweigh costs. While satellite operators will work under slightly simplified procedures such as a unified notification template and single notification process (benefits), they would have to continue dealing with various national fees and reporting requirements. Costs would remain similar to the baseline scenario, with however the improvement of the centralised selection system in case of scarce resources enabling scale for competitive services.	+++ Positive: Benefits largely outweigh costs, since minor initial adjustment costs are offset by major long-term savings, faster and simpler market access, shortened “time to market” and better level playing field between satellite operators with more efficient solutions for harmful interferences.	+ Positive: Benefits largely outweigh costs and risks, similar like under option 2 but limited to certain players (cross-border and B2B), and associated with risks, including incentives for forum shopping practices in areas that cannot be fully harmonised, such as national security, which should not be subject to a trade-off. Benefits in terms of immediate responses to harmful interference are slightly lower than under option 2.
Benefits	(0) + On GA: only small indirect benefits possible thanks to simplified and digitalised procedures	+++ Single streamlined authorisation procedure for all ECN/ECS cross-border providers to enter single market with passport valid across 27 Member States to provide innovative cross-border networks and services. Estimated cost savings (40-44%) due to reduction of admin. burden and compliance costs between EUR 6-11 m yearly per operator . Cost savings (reduction of admin. burden and additional reduction of compliance costs for all cross-border ECN and ECS providers) to align with existing national divergent conditions across UE MS.	++ Simplified entry market conditions, but for a limited group of players. Lower costs of adaptation than in option 1 and 2, due to national procedures and conditions, including enforcement, as only those of the MS of origin would apply.

		Satellite: Resolution of harmful interferences issues. Avoided revenue losses due to delayed market entry. For a major EU-wide constellation, such revenue losses are estimated at EUR 50 M per month of delay. Administrative costs will be indicatively reduced by around EUR 3.2 M per new service launched across all MSs. Reduced administrative and compliance burden for cross-border providers. Reduced staff cost. Overall cost reduction of 60%-80%	
Costs	Higher than in options 2 and 3. GA: Multiple one-off costs. No major reduction in national authorisation cost. Satellite: Multiple administrative fees and unchanged reporting costs, with modest one-off cost to adapt to the harmonised conditions for cross-border providers. Typical costs: one-off authorisation up to EUR 160 000 plus site permit up to EUR 160 000 (including annual fees). Annual spectrum charges up to EUR 10 000 per site.	Small one-off adaptation cost (small adjustment to harmonised conditions for GA and EU satellite authorisation). GA: lower cost than in option 1, single notification in one MS instead of up to 27. Satellite: Authorisation Cost considerably lower than under option 1, EU-level authorisation replaces 27 national procedures, greatly reducing administrative burden despite possible spectrum fees/administrative charges at EU level.	Lower than in options 1 and 2. GA: single regime and enforcement based on the country-of-origin principle; costs savings limited to cross-border and B2B providers. Satellite: major cost reduction vs option 1, one authorisation issued by a MS replaces 27 national ones. Implementation challenges: difficult to apply within national frameworks, limited consistency and integration of existing operators, risk of forum shopping and a “race to the bottom” due to the country-of-origin principle.

Coherence

The baseline scenario, as well as options 1 and 3 lack coherence with the overall EU simplification agenda and with national requirements on cybersecurity, lawful interception, data retention and e-privacy. **Option 1** moderately improves coherence supporting greater alignment with ITU rules but inconsistencies may persist and does not fully address strategic goals on sovereignty. Although option 1 entails some soft harmonisation of applicable general authorisation conditions by Member States where networks and services will be provided, in particular for satellite, it will not address the fragmentation, including as regards compliance requirements in certain areas, such as cybersecurity, lawful interception, data retention, administrative charges, and emergency communications. **Option 2** exhibits higher coherence providing mechanisms to address issues with national rules on

cybersecurity, lawful interception, data retention and e-privacy and providing harmonised GA conditions /BEREC guidelines to ensure coherent application. As regards satellite, **options 2 and 3** provide highest coherence with EU-wide objectives, notably competitiveness, industrial policy, and international coordination with a fully harmonised and centralised authorisation regime for satellite spectrum, combined with joint or EU-level rights of use and standardised conditions for all operators directly supporting EU strategic goals in space policy, defence, and secure communications. The effective enforcement of market access rules will support the provision of innovative space services as envisaged in the proposed Vision for the EU Space Economy²⁷³.

Sections addressing relevance and EU added value per authorisation option can be found in Annex 9, section 1.3.

Stakeholder's feedback

Amongst **stakeholders**, the telco community was generally positive on the idea of harmonising and easing applicable conditions attached to authorisation. They agreed on the need of harmonisation of security requirements, but were cautious about mandating any changes in the implementation of legal requirements which come with significant costs and efforts. On the specific application of the CoO principle stakeholders were rather sceptical, some ECNs raised the risk that non-telco new entrants that do not invest in network infrastructure could benefit “unfairly” from such regime, in particular if this was combined with the introduction of a standard EU wholesale access product. Member States and NRAs did not see added value for the application of the CoO principle indicating that a significant set of national rules would remain. A two-layer authorisation/governance would be unnecessary complex, not working in practice and bearing risks of “forum shopping”. Consumer organisations acknowledged the benefits of harmonisation but were concerned that de-regulation lowers consumer protection and thus stressed the need to safeguard national consumer protection measures.

Operators with interest in pan-European satellite services stress that a harmonised, pan-European approach to **satellite market** access is essential to unlock the full potential of satellite connectivity across the EU and raise concerns that the growing demand for satellite access, combined with fragmented and non-harmonised authorisation procedures, may lead to discriminatory outcomes, encourage ‘forum shopping’, and create barriers to cross-border satellite service development. In the targeted consultation most support was expressed for a simplified and harmonised EU template (option 1), an EU-level mechanism for selection of satellite operators (e.g. based on MSS decision), and a common satellite authorisation at EU level were also reasonably popular with stakeholders, with positive opinion doubling the negative. Stakeholders have urged the Commission to create a level playing field for terrestrial mobile networks, incumbent satellite operators, and new satellite constellations in the EU market, while addressing potential interference risks of D2D satellite services to terrestrial systems. Their feedback also emphasised the importance of addressing issues related to security, strategic autonomy in the digital supply chain, and the preservation of EU sovereignty. The association of satellite operators calls for regulatory simplification by reducing unnecessary burdens and fragmentation in EU regulations. Additionally, the RSPG, recommends the Commission to adopt common requirements for access to the EU market and implement a coordinated enforcement mechanism.

Summary

²⁷³ See Building Block 1: A Single market for Space in European Commission (2025). A vision for the European Space Economy, COM(2025) 336, pp. 4-5.

The table below summarises the overall costs and benefits for the different stakeholders by each option. Annex 3, section 2.3 presents in detail the main costs and benefits per stakeholders of the three options.

Table 28: Summary of costs and benefits for Authorisation options

	O1. Partial harmonisation of authorisation	O2. ‘Single passport’ for other networks and services than satellite and an EU – level authorisation for satellite spectrum	O3. Country-of-origin authorisation for cross-border and B2B services
Net value for End users (Citizens/businesses using connectivity)	Neutral: to slightly positive with limited global competitiveness	+++ Positive – benefits are considerable and the intervention is cost neutral for end users. Strong global competitiveness	++ Positive with limited global competitiveness
Net Value for Operator	(0) to + Slightly positive, benefits only marginally outweigh costs. While satellite operators will work on slightly simplified procedures such as a unified notification template and single notification process (benefits), they would have to continue dealing with various national fees and reporting requirements. Costs would remain similar to the baseline scenario, with however the improvement of the centralised selection system in case of scarce resources enabling scale for competitive services	+++Positive: Benefits largely outweigh costs, since minor initial adjustment costs are offset by major long-term savings, faster and simpler market access, shortened “time to market” and better level playing field between satellite operators with more efficient solutions for harmful interferences A single market for satellite would reduce costs of delays, and avoid revenue losses that for a major EU-wide constellation are estimated at EUR 50 M per month of delay. Administrative costs will be indicatively reduced around EUR 3.2 M across all member states.	+: Positive: Benefits largely outweigh costs with risk, similar like under option 2 but limited to certain players (cross-border and B2B), associated with the risks (incentivise forum shopping practices in areas that cannot be fully harmonised such as national security), which should not be subject to a trade-off. Slightly minor benefits on immediate reaction to harmful interference than option 2.

The table below shows comparison of the options in terms of effectiveness, efficiency, coherence and EU added value. Based on the assessment option 2 is considered the preferred option.

Table 29: General and satellite authorisations: Summary assessment of policy options

Criterion	Baseline	Option 1	Option 2	Option 3
Effectiveness	0	+	+++	0/+
Efficiency	0	+++	+	0/+
Coherence	0	+	+++	0/+
Relevance	0	+	+++	0/+
EU added value	0	+	+++	0/+

7.4. Governance

Effectiveness

The effectiveness of the governance policy options is assessed with their ability to address the objectives related to regulatory harmonisation and improved decision-making on cross-border tasks and to accommodate the tasks resulting from the preferred options in other areas.

Baseline option has proven to have insufficient impact on regulatory harmonisation, and identified shortcomings in BEREC and RSPG work will continue. RSPG as an expert group served by a small secretariat provided by the Commission, even if enforced, will not be able to take on new tasks, including in the context of ex ante single market procedure of authorisation procedures. Without administrative assistance from the BEREC Office, the Commission will not be able to undertake EU satellite authorisation.

Option 1 will contribute to achieving the above-mentioned objectives hence increasing effectiveness, while preserving the main elements of the current governance setup. BEREC and RSPG will remain separate entities without legal personality. They will continue their respective tasks of advising EU institutions on spectrum policy (RSPG) and coordinating consistent application of regulation by NRAs (BEREC). The decisions related to cross-border issues will be more centralised and, therefore, more consistent and potentially quicker. The strengthened BEREC Office providing secretariat services to both BEREC and RSPG can exploit synergies, enhancing its effectiveness. Stronger support on substance by the BEREC Office to BEREC will lessen the burden on NRAs, while ensuring more consistency. Stronger administrative and preparatory support by the BEREC Office to the RSPG, as compared with current situation, will increase the latter's ability to undertake new tasks and ensure more consistency, while lowering the burden on the Commission that would be entrusted with additional decision-making powers. At the same time this option provides a more stable mechanism for close cooperation, in particular on spectrum issues that have regulatory implication.

In **option 2**, the main difference is in merging BEREC with its Office, which will result in integrating and strengthening BEREC bringing further synergies, increasing its effectiveness and simplifying the legal framework in line with the Common Approach. As in option 1, the increased support provided by the BEREC Office to the RSPG (comparing to the one offered today by the Commission), will enhance the effectiveness of the latter. Under this option, effectiveness gains may be reduced by BEREC and the RSPG remaining separate entities.

Option 3 with BEREC and RSPG as independent agencies can effectively address regulatory coherence and cross-border challenges (although it may not vary significantly from option 2). If there is a clear division of responsibilities between BEREC and the RSPG, the centralised decision-making by these agencies would allow for focused regulatory approaches. However, the effectiveness may be hindered by potential overlaps in competence and duplications and the need for coordination between the two agencies, which will be weakened in absence of the BEREC Office link.

Efficiency

Under the baseline scenario the potential for more coordinated spectrum management, including issuing EU satellite authorisation, and links between BEREC and RSPG work remain unexplored. It is expected that efficiency increases by empowering the Commission to take decisions on certain cross-border tasks proposed in **option 1**, especially EU satellite authorisation and in relevant cases selection of licensees for satellite spectrum. Furthermore, more centralised decision-making should bring cost savings for NRAs. Relocating the RSPG secretariat from the Commission to the BEREC

Office could increase efficiency, if the latter is reinforced in terms of resources. Also, more involvement of BEREC Office in substantive tasks of BEREC could lead to increased efficiency of BEREC overall and possible reduction of pressure on NRAs and their constrained resources. Similarly, **option 2** should bring efficiency gains and some cost savings for NRAs thanks to more centralised decision-making as in option 1. There will be transition costs associated with merging BEREC and its Office and granting the new agency the additional role of secretariat to the RSPG. However, the potential for reduced duplication and more efficient resource use could lead to overall cost savings in the long run. BEREC can streamline operations, leading to better allocation of resources and reduced administrative burdens compared to the baseline. On spectrum, efficiency gains match those of option 1. In **option 3**, empowering the Commission to monitor certain cross-border tasks may lead to efficiency gains in this area compared to the baseline (but not as much as in options 1 and 2). However, the creation of two separate independent agencies (BEREC and RSPG) will lead to significantly increased administrative costs for the EU and potential duplication of efforts, as synergies will not be realised. The need for coordination between the two agencies may also create additional costs and slow down decision-making processes.

The below table shows the costs and benefits of all options, explaining who will bear the costs, distinguishing between administration (public authorities), businesses (operators) and citizens, end-users.

	Governance		
	O1. BEREC&RSPG as two separate bodies supported by the BEREC Office	O2. EU agency (BEREC and BO merged), providing an office to the RSPG	O3. Two separate agencies – BEREC + BO and RSPG
Costs by stakeholders			
Citizens	0/Neutral	0/Neutral	0/Neutral
Operators	0/Neutral, unless fees are considered	0/Neutral, unless fees are considered	0/Neutral, unless fees are considered
Administration	One-off cost for adaptations to new role: for EC limited and for BEREC Office moderate, including in overtaking the provision of RSPG secretariat from EC; Total annual cost increase from EUR 8.1. m to approx. EUR 11.420 m (increase EUR 3.320 m). In comparison to the baseline it translates to 56% more for staff expenditure and by 20% for other costs i.e. building, equipment + operational costs increase. Recurrent: Costs structure for BEREC Office:	One-off cost for transforming BEREC and BEREC Office in EU agency, including Spectrum office Overall, BEREC agency will need around 90 FTEs (i.e. doubling 2023 FTEs of BEREC Office) Recurrent: • EUR 14.8 m the annual cost of BEREC agency Cost structure for BEREC Office: - double increase of current staff, - 50% of operational expenditure (premises, equipment), - 50% increase in the organisation of working group activities – 160 000 per year.	One-off cost for transforming BEREC and BEREC Office One-off cost for establishing the RSPG agency Recurrent EUR 12.6 m per year for each of agency merged BEREC&BEREC Office and RSPG. Recurrent for RSPG: premises + recurrent expenses for staffing, office space, equipment and operations.

	Governance		
	O1. BEREC&RSPG as two separate bodies supported by the BEREC Office	O2. EU agency (BEREC and BO merged), providing an office to the RSPG	O3. Two separate agencies – BEREC + BO and RSPG
	- EUR 7.8 m - increase of staff expenditure, - EUR 2.089 m - increase of other costs, - EUR 1.589 m - increase of operational costs, - Additional costs due to increase in the BEREC and RSPG working groups' activities – EUR 80 000 per year. Around EUR 170.000 yearly for one-off and maintenance cost. Recurrent costs for: - the COM: 12 FTEs to cover additional tasks, mainly in EU satellite authorisation and spectrum scrutiny • For MS: EUR 5 500 yearly (115 hours of working groups) For BEREC: EUR 26,400 yearly (550 hours of working group meetings). For the NRAs: 2.5 recurrent FTEs per NRA to cover additional tasks, amounting to EUR 238, 500 in additional yearly cost per NRA.		
Benefits by stakeholders			
Citizens	+ Potential for increased competition and innovation due to increased harmonisation resulting from more effective governance system (expect moderate-high impact due to more centralised/ integrated	+ like in option 1	0/+ Like in option 1 but only moderate- impact expected;/lower than in other options due to more complex governance set up.

	Governance		
	O1. BERECS&RSPG as two separate bodies supported by the BERECS Office	O2. EU agency (BEREC and BO merged), providing an office to the RSPG	O3. Two separate agencies – BERECS + BO and RSPG
	governance system than in baseline)		
Operators	+ Potential for increased harmonisation / level playing field and lower compliance costs for cross-border and satellite operators (expect moderate-high impact due to more centralised/integrated governance system than in baseline)	+ Like in option 1	0/+ Like in option 1 but expect only moderate- impact; lower than in other options due to more complex governance set up.
Administration	+ Moderate cost savings for EU budget/increased efficiency and transfer of responsibilities to BERECS Office and RSPG. Preserving main elements of current governance set up. Moderate cost reduction for COM (limited effect on the EU budget). Cost savings for MS budget due to transfer of certain cross-border tasks to the EU level. BEREC Office takes more 'substance related' responsibilities and this relieves some pressure from NRAs. NRAs costs would increase only incrementally. NRAs' costs would increase only incrementally, notwithstanding the need for their increased collaboration in BERECS.	++ The agency takes over RSPG's secretariat function (lower burden/cost for the COM than in option 1) and provides support on admin and preparatory tasks to the RSPG. Cost savings for MS budget due to transfer of certain cross-border tasks to the EU level.	0/+ Lower benefits than in option 1 due to potential overlaps in competence and duplications, the need of coordination between two agencies. Cost savings for MS budget due to transfer of certain cross-border tasks to the EU level and 2 separate agencies.
Net Value for Stakeholders	+	+	
Net Value for Citizens	+	+	0/+
Benefits	+	+	0/+
Costs	0	0	0

	Governance		
	O1. BEREC&RSPG as two separate bodies supported by the BEREC Office	O2. EU agency (BEREC and BO merged), providing an office to the RSPG	O3. Two separate agencies – BEREC + BO and RSPG
Net Value for Operator			
Benefits	+ indirect Increases effectiveness while preserving the main elements of the current governance set up. Further empowerment of NRAs and NCA, contributing to enhanced market development. Option 1 ultimately lower compliance costs for cross-border operators, and in terms of satellite spectrum/EU authorisation fosters innovation and investment in new technologies.	+ indirect	0/+ indirect (lower due to more complex governance set up than in option 1 and 2)
Costs	0/unless fees	0/unless fees	0/unless fees

Coherence

Under the **baseline scenario**, the division of tasks between authorities at national and EU level has shown shortcomings when it comes to coherence of the outputs. BEREC and RSPG works are separate, despite existence of interrelated topics, such as satellite communications, and synergies remain unexploited. Keeping the current setup would perpetuate that situation. **Option 1** promotes coherence as regards the application of the law across Member States by empowering the Commission to make decisions on certain cross-border-related tasks, including on harmonising spectrum authorisation conditions and procedures, and satellite spectrum authorisation issues. While separate roles of BEREC and RSPG may lead to some overlaps and potential contradictions, the BEREC Office can help build a unified approach and promote coherent regulatory responses on cross-border issues. **Option 2** could promote coherence by empowering the Commission to make decisions on spectrum similarly to option 1. Merging BEREC and the BEREC Office will bring together the regulatory work and the administrative support, potentially bringing more coherence in BEREC's work and enhancing its ability to foster the consistent implementation of the regulatory framework. BEREC will also fulfil the role of secretariat of the RSPG, which could potentially contribute to the coherence in the work of the latter and BEREC. In addition to benefits of option 2, **option 3** could increase coherence by empowering BEREC and RSPG to make decisions as regards cross-border issues. However, this would contribute less to coherence than option 2 where competence to adopt cross-border decisions is with the Commission. The establishment of the RSPG as an independent agency could lead to clearer lines of accountability, but it may also create challenges in coordination and coherence with existing frameworks. The potential for conflicting decisions or approaches could undermine overall regulatory coherence.

Sections addressing relevance and EU added value per governance options can be found in Annex 9 section 1.4.

Stakeholders' feedback

In response to the **Call for Evidence**, many stakeholders mentioned the need to differentiate between (1) the national markets which should remain under supervision of independent NRAs whose expertise is invaluable and (2) horizontal/harmonised and cross-border issues which could be better addressed at EU level. Some mentioned also a need to differentiate between governance of access regulation and spectrum management. While acknowledging the achievements of BEREC and RSPG, various stakeholders (company/business group, business associations and public authorities) showed openness to improving coordination and to enhancements (including new tasks) aimed at handling single market topics, while avoiding overcentralisation and maintaining flexibility for national circumstances and Member States' competences. The responding public authorities acknowledged that the DNA could improve EU governance by enhancing respective roles of BEREC, BEREC Office and RSPG to address various pan-European tasks, and granting them sufficient administrative and regulatory capacity.

In the **targeted consultation** carried out in the context of the study, respondents were very positive for providing the RSPG with more administrative support (more than 75% of respondents), as proposed in option 1 and 2. However, over 75% of the respondents do not consider that a change of nature of the RSPG, from expert group to a body, would be beneficial. Respondents were also overwhelmingly against making the RSPG a fully-fledged EU agency with legal personality and decision-making powers on cross-border spectrum matters as proposed in option 3. Merging BEREC and BEREC Office as proposed in option 2 was supported only by few respondents, while the majority of respondents strongly opposed it. Looking at different aspects of the three different policy options investigated, the measures under options 1 gained more support among the respondents to the targeted survey than option 2 and 3.

Summary

The table below summarises the overall costs and benefits for the different stakeholders by option.

Table 30: Summary of costs and benefits for Governance options

	O1. BEREC&RSPG as two separate bodies supported by the BEREC Office	O2. EU agency (BEREC and BO merged), providing an office to the RSPG	O3. Two separate agencies – BEREC + BO and RSPG
Net Value for Citizens and industrial sectors (e.g. verticals)	+	+	0/+
Net Value for Operator	+ (unless fees)	+ (unless fees)	0 (unless fees)

The table below shows comparison of the options in terms of effectiveness, efficiency, coherence and EU added value. Option 1 is considered to be the preferred option.

Table 31: Governance: Summary assessment of policy options

Criterion	Baseline	Option 1	Option 2	Option 3
Effectiveness	0	++	++	+

Criterion	Baseline	Option 1	Option 2	Option 3
Efficiency	0	++	++	-
Coherence	0	+	++	+
Relevance	0	+	++	++
EU added value	0	++	++	+

8. PREFERRED OPTION

8.1. Preferred options

8.1.1. Transition to fibre

Based on the assessment provided in section 7, option 2 is selected as the preferred option to achieve the objectives of the DNA set out in section 4. It has high cumulative score across key evaluation criteria including effectiveness and efficiency.

Option 2 has a good performance in addressing the identified problems in terms of accelerating FTTH deployment and take-up.

Regarding access regulation, option 2 builds upon the successful elements of the existing regulatory framework, retaining the well-functioning SMP regime and the three-criteria test, however, re-focusing intervention on market failures, enabling NRAs to use more easily symmetric measures, where appropriate, and putting emphasis on use of less intrusive regulatory tools where possible. option 2, like all the other options, includes some simplification by removing provisions of the EECC related notably to remedies that have not been used.

With respect to the economic and environmental impacts (see section 6), option 2 results (i) in the highest GDP impact with an increase in accumulated GDP in the range of EUR 157 - 327 billion (above baseline, depending on the selected scenario, i.e., more conservative – less conservative), (ii) in the second highest CO2 emission impact with a 5.1% decrease (EUR 0.56 billion less, compared to the baseline) and (iii) in the highest impact in terms of average download speeds (314 Mbps in 2030 and 743 Mbps in 2035).

As for the social impacts, the impact of the options cannot be quantified. However, option 2 is very likely to result in highest positive social impact as it is performing well in terms of FTTH coverage (83% in 2030 and 98% in 2035) and FTTH take-up rate (55% in 2030 and 78% in 2035). It delivers the highest coverage (together with option 4), and the second highest take up in the longer run.

Regarding the impact on fundamental rights, option 2 ranks medium, however, considering its positive effects on EU society and the economy—including increased internet speeds, GDP growth, and reduced CO2 emissions—it appears consistent with the principle of necessity. Due to the presence of the sustainability conditions which allow for the continued operation of copper networks in areas with insufficient FTTH coverage (below 95%) for additional time, this option is in line with the proportionality principle.

Option 2 leads to an increase in direct recurring (administrative) costs by 18% in FTEs per year (EUR 38 million) and EUR 73 million one-off cost, compared to the status quo. Those costs can be

offset or mitigated by the significant benefits brought along with this option, including increased Gigabit connectivity and improved competition. As mentioned above, this is expected to generate substantial positive impacts on GDP and reduce the emissions linked to electronic communications.

8.1.2. Spectrum

Option 2 represents a balanced approach between the extremes of soft and strong harmonisation of rules, aiming to foster the Single Market while respecting the unique circumstances of individual Member States. It targets harmonisation primarily in areas where substantial investments are necessary, such as spectrum for public networks and focuses particularly on critical aspects like authorisation conditions for 6G. The strategy begins with soft harmonisation through Commission recommendations, escalating to mandatory measures only if disparities persist. This approach allows Member States to retain their competence in assigning terrestrial spectrum, albeit under the Commission's supervision, requiring ex ante spectrum Single Market procedure of their draft measures. The Commission holds veto power over market-shaping elements, such as spectrum caps, and limited licence duration while also providing input on other aspects. By maintaining a degree of flexibility in spectrum assignment, this option ensures a balanced solution that strengthens predictability and enhances legal certainty, improves financing access, reduces capital costs, and boosts investment. It avoids a rigid, uniform approach, allowing Member States to address specific national circumstances, such as geographical and population density-related coverage obligations, ensuring that authorization timelines can be adapted accordingly.

Option 2 delivers high and systemic benefits, for large-scale and cross-border spectrum investments. While costs are significantly higher than in option 1, the reduction in regulatory risk, combined with a credible, enforceable commitment to licence stability and market-friendly conditions, offers major advantages for accelerating the EU's connectivity goals, increasing EU competitiveness also opening up new opportunities to new spectrum users.

The preferred option 2 is the most efficient given that overall benefits significantly outweigh its costs. It would ensure timely deployment of high quality 5G and future 6G networks, and achieve the general objective of reinforced competitiveness and resilience. It would be synergic and coherent with the transition to fibre, which is needed to achieve full 5G, and the satellite options in ensuring the general objective of high quality and resilient connectivity. Moreover, in areas where fibre deployment is not economically viable, a high quality mobile or FWA (Fixed Wireless Access) solution, based on mid-band or mmW 5G SA could be deployed as a viable alternative for connecting cost-effectively end-users. Lastly, satellite options would be complementary since they would ensure not only wider territorial coverage through D2D services, including of the most remote regions, but also higher security, resilience and continuity of service, for example by providing backhaul (satellite based backhaul as complement to fibre based backhaul), disaster response and emergency network restoration and redundancy. It also strengthens coherence and synergies with security policy proposed in specific policy instruments (e.g. Cyber Security Act). Option 3 also has merits and would also achieve the objectives pursued, in particular as regards EU spectrum authorisation. However, by harmonising spectrum award and authorisation conditions, option 2 can achieve the same outcome with less intrusive measures. Option 2 has similar economic and environmental impact as option 3 and its direct and indirect costs are significantly lower than option 3. It hence emerges as the one with the best benefits/cost balance and fully justifies the intervention. More specifically, option 2 would provide maximum investment certainty and regulatory clarity, creating an environment conducive to investment in high quality mobile infrastructure. Option 2 builds upon the current architecture of national authorisation procedures and improves regulatory predictability by strengthening the Single Market through an enhanced role of ex ante supervision carried out by the Commission with the support of BEREC and the RSPG. It ensures that all the objectives of the regulatory framework,

including connectivity and competition are catered for in a consistent and coordinated manner, while taking into account national specificities and particularities. Although it requires to create an ex ante spectrum single market procedure mechanism, this can be done in a cost efficient manner, without unreasonable delay, by exploiting the 25-year experience gained by similar scrutiny mechanisms in ex ante market regulation. The cost is manageable, thanks to more frequent recourse to spectrum renewals, which is expected in the long term to significantly decrease the number of auctions. Option 2 ensures the most efficient use of spectrum, by creating the conditions for spectrum sharing where it is more impactful and where the benefits justify the costs, in particular interservice. Lastly, it presents significant cost savings, thanks to the increased predictability and legal certainty, which lowers capital costs and improves access to financing.

8.1.3. Authorisation

As regards authorisation, the preferred option is **option 2** with single authorisation for terrestrial networks and EU authorisation for satellite spectrum.

2 would reduce more significantly the administrative and compliance costs (lower one-off costs) as well as the reporting costs. This option would achieve greater consistency of regulatory conditions under the general **authorisation** and, consequently, more legal certainty for all providers. It would bring greater transparency and regulatory predictability, which would be more relevant for SMEs that have less resources to cope with legal requirements. Shorter time to enter the market by new providers should also be expected and an increased cross-border provision of ECS. As a result, barriers to innovation and to creation of integrated core network and service platforms would be removed to the benefit of increased competition and choice for end-users.

For **satellite authorisation**, the preferred option ensures a unified framework for the selection of licensees, spectrum assignment and enforcement, thereby eliminating fragmentation and regulatory uncertainty. It allows to fully exploit the strength of the Single Market as regards enforcement of authorisation conditions. It brings maximum benefits for all satellite operators, in particular those deploying pan-European or global constellations, by eliminating regulatory barriers reducing compliance costs and uncertainties in spectrum access, supports the objective of transition to resilient connectivity and early deployment of converged TN and NTN 6G networks. This option would be complementary to the EU Space Act and other EU instruments supporting EU investments in space, as it would maximise the chances of the EU to exploit satellite communications, in particular, the potential of D2D connectivity – including commercial, defence and emergency communications – with major benefits to end-users, and to the overall EU competitiveness in space, ensuring that all operators play by the same rules, through effective enforcement (e.g. as regards harmful interferences). It further allows for a more strategic and efficient use of scarce satellite spectrum to the benefit of the EU by better protecting its interests in terms of security, technological leadership, and economic autonomy.

The option would be complemented by the ancillary simplification measures mentioned in the introduction such as on end-users as well as incentivising a voluntary cooperation between actors in the extended connectivity ecosystem.

8.1.4. Governance

Regarding governance, the preferred choice is **option 1**, which ensures continuity while deepening cooperation and strengthening EU-level coordination. It builds on the existing set up of BEREC and the BEREC Office, while upgrading the RSPG from a Commission expert group to a body with a secretariat provided by the BEREC Office. Although this option ranked as second-best in the

comparison in section 7.4, it is favoured by stakeholder consultation feedback. Option 1 scores the highest-equal to option 2 in effectiveness, efficiency and coherence. In terms of effectiveness, upgrading the RSPG to a body separate from the Commission, supported by the strengthened BEREC Office with new coordination tasks, will enhance the effectiveness of spectrum management. Since spectrum management will be governed in the same way under option 1 and 2, their assessment is equal. On coherence, the BEREC Office, by providing administrative and support services to both BEREC and RSPG strengthens the existing link between the two bodies, enabling better coordination and a more coherent outcomes than the baseline – again, equal under options 1 and 2. Furthermore, while option 2 scores higher in relevance and EU added value than option 1, both those option are equivalent as regards spectrum governance and differ in merging BEREC and BEREC Office into and agency. The new BEREC tasks will continue to be more of monitoring/advisory nature and there are no new tasks that would require equipping BEREC with a legal personality and, therefore, merging BEREC and the BEREC Office into an agency is not necessary for carrying them out. Under option 1 the decision-making powers will remain with the Commission, ensuring in such way stronger single market dimension. Consequently, option 1 will ensure the desired benefits with moderate costs.

8.2. REFIT (simplification and improved efficiency)

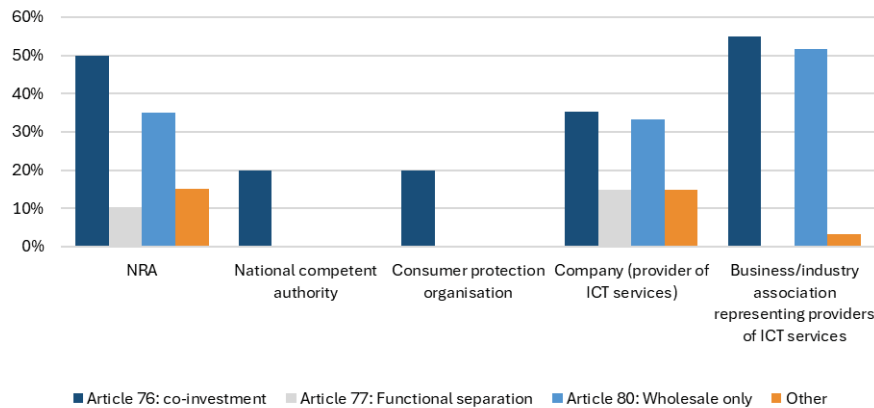
As regards, access regulation, the preferred option would remove a number of provisions relating to SMP regulation such as those regarding co-investment (Article 76 EECC) and functional separation (Articles 77 and 78 EECC)²⁷⁴. At the same time, enabling the NRAs to impose access to in-house wiring and beyond the first concentration point from own initiative (and not at request as this is currently the case) would simplify the way how access regulation is implemented. This would have the effect of simplifying existing rules and remove the perceived shortcomings and unnecessary complexities and potential lack of coherence associated with those provisions that led to the limited usage of them.²⁷⁵ Furthermore, the impacts on fibre coverage, take-up and competition of their removal is likely to be limited. This is particularly true for Article 76 EECC²⁷⁶, which has been superseded by wider analysis by NRAs of the implications of commercial arrangements including co-investment in the context of the market analysis procedure. The REFIT potential of these provisions had been also recognized by the stakeholders.

²⁷⁴ While some incumbents and fibre investors consider that provisions regarding functional separation could be removed, this is opposed by NRAs, consumer protection authorities and alternative operators, as they consider that it provides a useful role as a last resort measure, which could be used to incentivise organisation changes within dominant firms that would improve compliance.

²⁷⁵ Provisions relating to functional separation have never been used. There have been no approved instances of co-investment in line with Article 76 EECC and wholesale only provisions have only been considered relevant in two cases (DK and IT).

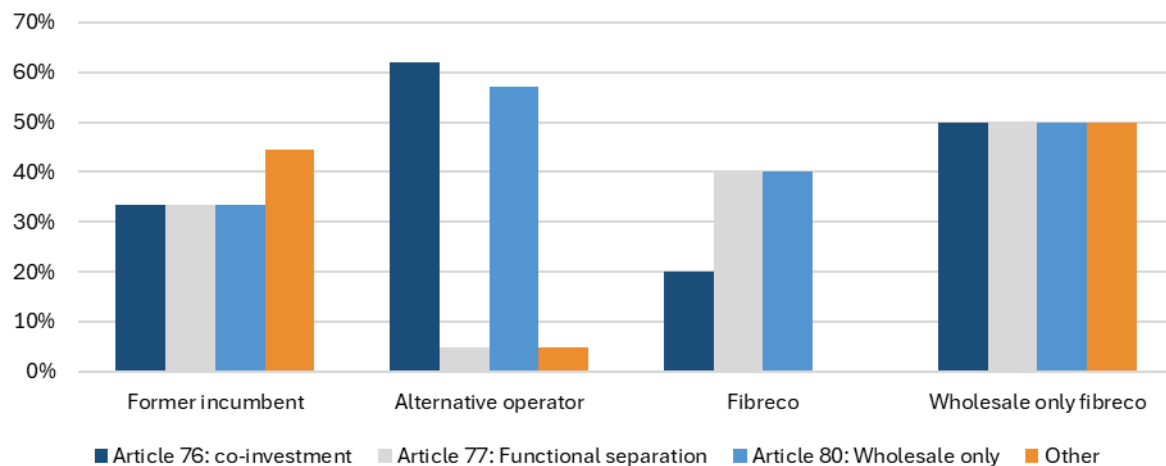
²⁷⁶ Feedback from stakeholders tends to confirm that Article 76 could be removed. 50% of NRAs and 62% of alternative operators favour its removal.

Figure 19: Potential for removal by article: stakeholder perspectives



Source: Stakeholder survey June-July 2025

Figure 20 : Potential for removal by article: perspective of telecom providers



Source: Stakeholder survey June-July 2025

Furthermore, the preferred option would simplify, strengthen and increase oversight with the aim of securing more uniform implementation of remedies in the benefit of the Single market. Harmonisation of specifications for key wholesale products as well as attention to quality of service guarantees for businesses should simplify the use of access products and also contribute to the development of competition in services for multi-site and multinational enterprises.

As regards spectrum, the consolidation of relevant provisions of the RSPP in the EECC presents significant REFIT benefits, as it ensures consistency, by eliminating duplicative and outdated provisions that hinder EU competitiveness in the deployment of innovative services.

The **EU authorisation for the provision of satellite networks and services and use of satellite spectrum** presents significant simplification and improved efficiency potential as it would reduce the cost of satellite authorisation for satellite operators, providers and national authorities. A satellite operator willing to provide services across the EU would not need to follow 27 authorisation processes, respect 27 sets of authorisation conditions, which include diverse and costly reporting obligations and ineffective enforcement measures, and obtain spectrum rights in all Member States. On the contrary, the Commission, with the assistance of the Office, would receive the requests and

issue the authorisations to provide satellite services as well as authorisations to use spectrum including individual rights of use of spectrum, either in some Member States where the provider wishes to provide services, or in the entire EU. The authorisation conditions, including reporting elements, would be common across the EU and developed with the assistance of the Office and the RSPG. The Commission would also ensure selection at EU level in case of spectrum scarcity.

The elimination of duplicative and fragmented regulatory processes will make it easier and less costly for satellite operators to comply with authorisation conditions and will ensure they can obtain quicker EU-wide authorisation and will considerably reduce the risk of lost revenues in specific Member States, due to delays in national authorisations²⁷⁷.

Further, there would be a **binding EU-level compliance and enforcement framework** for ensuring that satellite constellations' access to the EU market complies with the common conditions in line with international law. Enforcement at EU level (including withdrawal of the authorisation for the entire single market) would be effectively addressing interference issues simplifying the possibility for operators to be protected from harmful interference and, at the same time, it would incentivise preventively the respect of the authorisation requirements.

8.3. Application of the 'one in, one out' approach

The OIOO assessment examines exclusively the administrative costs and administrative cost savings resulting from the preferred policy options. The preferred policy option for transition to fibre introduces limited new administrative burdens for business, primarily linked to the conditional copper switch-off. These relate to information, notification, coordination and reporting obligations vis-à-vis national authorities and affected stakeholders. As summarised in Annex 3, these new administrative requirements are estimated to result in approximately EUR 73 million in one-off administrative costs, mainly reflecting efforts to prepare for copper switch-off plans and the new market analysis methods, and approximately EUR 38 million in recurring administrative costs per year.

At the same time, the preferred policy option is expected to generate administrative cost savings through the harmonisation of authorisation conditions and the simplification of regulatory requirements. These measures are expected to reduce administrative burdens for ECNs and ECS, in particular those operating cross-border, by streamlining information requirements, reducing duplication of procedures and lowering ongoing monitoring and compliance efforts (around EUR 60 million reduction across all Member States per year). While stakeholders confirmed the relevance of these administrative cost savings, the available information do not allow for a robust quantification. These savings are therefore assessed qualitatively as moderate and recurring, as reflected in Annex 3.

Due to the limitations in quantifying the administrative cost savings, a quantified net balance under the OIOO principle cannot be established. However, taking into account the limited magnitude of the identified one-off and recurring administrative costs and the presence of non-quantified but substantiated recurring administrative cost savings, the preferred policy option is expected to be broadly neutral to positive in terms of administrative burden over time. As indicated in Annex 3, the recurrent administrative burden is therefore assessed as a net OUT under the OIOO framework.

²⁷⁷ For some quantifications see Section 6.3.2.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

In the following table, we relate the problems and related objective identified in the context of this Impact Assessment to the specific indicators proposed to measure the success. Further details about the indicators can be found in Section 2 of Annex 9.

Table 32: Links between problems, specific objectives and indicators

Problem	Objective	Indicators
Fixed networks: Slow deployment and adoption of fibre networks and services	Swift roll-out and take-up of fibre	FTTH homes passed absolute and as % HH FTTH homes connected Take-up FTTH
Mobile networks: insufficient investment in high quality mobile connectivity	Close the gap with competing regions in the quality mobile networks	Quality of Service and Quality of Experience 5G SA coverage and availability 5G mid-band population coverage Spectrum readiness (MHz/pop, assigned in 5G mid-band and future 6G pioneer bands) 5G SA availability Time to obtain spectrum authorisation Number of Licenses with sharing conditions Amount of spectrum used by more than one user/category of user
Lack of pan-European networks and services	Increase pan-European network operation and service provision	Number of providers using the cross-border general authorisation regime Number of new EU satellite authorisation licensees Number of operators selected through a centralised selection procedure for satellite harmonised bands Time to complete satellite authorisation requirements Number of interference issues in the EU which have been timely and effectively addressed
Governance structure not fully suited to serve the requirements of the single market	Deepen the Single Market for connectivity through adjustment of regulatory competences and roles	Number of high-quality outputs that have a direct link to single-market objectives - strengthen harmonisation, support consistent regulatory implementation, and facilitate the completion of the EU single market for electronic communications. Measured by % of planned single-market-related outputs delivered on schedule (from the Work Programme) and their quality (reflecting impact, uptake, and regulatory relevance of

Problem	Objective	Indicators
		the outputs) and quantity (the volume of outputs relevant to single-market completion e.g. BEREC guidelines, opinions). Annual measurement, with at least yearly tracking by the BEREC Office.



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PART 2/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
on digital networks, amending Regulation (EU) 2015/2120, Directive 2002/58/EC and
Decision No 676/2002/EC and repealing Regulation (EU) 2018/1971, Directive (EU)
2018/1972 and Decision No 243/2012/EU (Digital Networks Act)**

{COM(2026) 16 final} - {SEC(2026) 14 final} - {SWD(2026) 14 final}

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ANNEX 1: PROCEDURAL INFORMATION

1. LEAD DG, DECIDE PLANNING/CWP REFERENCES

This Staff Working document was prepared by Directorate B 'Electronic Communications Networks and Services' of Directorate General 'Communications Networks, Content and Technology'.

This Staff Working document is accompanied by the Review Report assessing the functioning of the EECC since its applicability as of 21 December 2020, in particular Articles 61(3), 76, 78 and 79, which you can find in Annex 11.

2. ORGANISATION AND TIMING

In accordance with the Better Regulation Guidelines, an Inter-service consultation group (ISCG) was set up with representatives from various Directorates General and services of the Commission to assist DG Communication Networks, Content and Technology in the preparation of the Impact Assessment and legal proposal. The ISCG, chaired by SG, DG CNECT is supported by the representatives of the following DGs: BUDG, COMP, DEFIS, DIGIT, ECFIN, EMPL, ENV, FISMA, GROW, HOME, JRC, JUST, MOVE, REGIO, RTD, SG, SJ, TRADE and CLIMA.

The ISCG met for the first on 16 May 2025, where it provided information on the background of the Digital Network Act, on the policy elements to consider, on the high-level policy options and on the summary of consultation activities, together with the planned timeline of the initiative.

Shortly after the ISCG was consulted on the draft Call for Evidence on the Digital Networks Act looking to collect views on how to address the current and emerging challenges in the European electronic communication sector.

On 10 July 2025, the ISCG met again and discussed state of play of the DNA package, the problem tree and intervention logic and the high-level evaluation and options for the different policy areas.

On 16 September 2025, the ISCG met to discuss the draft Impact Assessment SWD, and comments received orally and in written have been duly considered for the finalisation of this Impact Assessment.

On 20 November, the ISCG group met before resubmission of the Staff Working Document to the Regulatory Scrutiny Board (RSB). On 26 November 2025, the Impact Assessment to the revision of the Digital Networks Act was resubmitted to the RSB. On 17 December 2025, the RSB issued 'positive opinion with reservations'. The remarks of the RSB were addressed in this Impact Assessment as follows below.

Changes made in the revised version of the Impact Assessment report

The table hereafter provides an overview of the main changes made in the revised version of the Impact Assessment report in the light of the RSB recommendations accompanying its second positive opinion on the draft assessment report. In addressing these points, the lead Service has further extensively reviewed the draft impact assessment report.

Key issue/what to improve	Addressed in revised IA report: section number and annex	How have the issues been addressed
In assessment of impacts, uncertainties of key assumptions are not sufficiently addressed, hence resulting projections and comparison of options are not robust.	Throughout the IA report and annex 4	Annex 4 better explains the underlying assumptions and methodology applied. The IA now also includes a sensitivity analysis based on a range of parameters for assessing the impacts of the different options.
It is not clear what the direct and indirect costs are and how they are distributed among different stakeholder groups. Environmental impacts are not monetised. Administrative costs and cost savings are not quantified for all options.	Section 6 and annex 3	Section 6 and annex 3 have been updated to address these comments.
The report should clarify the magnitude of the problem and proportionality of the copper switch off options taking into account that FTTP coverage is projected to reach 90% by 2030 according to the 2025 Digital Decade Policy Programme report, while reaching the remaining 10% would be subject to significant costs.	Section 2	Based on existing studies, the investment gap for full fibre coverage is quantified and evaluated under different scenarios of technology mix (e.g., use of FWA in remote and rural areas).
The report should more systematically justify the key assumptions underpinning the analysis of impacts. For fibre and spectrum coverage and penetration, it should explain how the projections were derived, which demand, and supply factors were considered and how. The report should provide a sensitivity analysis of the projections on the key underlying assumptions.	Section 6 And Annex 2.3.2.	For spectrum , section 6 justifies the assumptions linked to 5G mid-band coverage projection, including the definition of mid-band (1-7 GHz) and the assumptions explaining why Options 2 and 3 reach the same coverage level. The Annex 4 also further clarifies average speed assumptions and projections and strengthened the explanation underpinning the projected speeds. For fixed , also in section 6, the links between the FTTH coverage, the technological mixture in the access network, the average download speed and the impact on GDP is assessed and analysed for the different policy

Key issue/what to improve	Addressed in revised report: section number and annex	How have the issues been addressed
		options. Existing studies for the relation of the broadband speed and GDP have been considered and a sensitivity analysis for different values of the related coefficient is presented. Results are quantified for the different options/ scenarios for the transition to fibre.
The report should better justify how the key coefficient linking the speed and GDP has been established. It should better assess marginal benefits and marginal costs, including 2 based on perceptions of economic actors. The rationale for assuming linear effects on GDP even of marginal increase of speed at given overall speed levels should be substantiated and where relevant non-linear assumptions considered. Given the high variability of the estimates in literature and resulting uncertainties regarding the impact on GDP, the report should use conservative assumptions or ranges. This uncertainty should be highlighted in the summary table of the report and Annex 3.	Section 6 and annexes 3 and 4	For spectrum, the coefficient and sensitivity range are discussed in Annex 4 with a reference to empirical literature. A clarification was added to explain the use of linear modelling. For fixed, in Section 6, there is a detailed analysis of the relation between the broadband speed (in relation with FTTH coverage, technological mixture and FTTH take up) and GDP. Based on available studies, the range of the relevant coefficient is defined, and its selected value is justified. A sensitivity analysis for different values of the coefficient is presented for the available policy options. In Annex 4, further information and a more detailed analysis can be found.
Given the expected highest effectiveness of spectrum Option 3, the report should substantiate or re-assess the same quantitative projection of Option 2 and Option 3 in terms of the coverage which directly drives the economic impact of the options and in turn their comparison. The assumptions, calculations and related narratives need to be fully aligned through the report and annexes. The report should explain how different levels of economies of scale of various	Section 6 and annex 4	For spectrum , further explanations are provided, including the limitations of the model used. The IA also outlines how economies of scale are taken into account in the model.

Key issue/what to improve	Addressed in revised report: section number and annex	How have the issues been addressed
spectrum options were accounted for in the modelling.		
The report should provide a summary table of the costs and benefits of all options, quantified and monetised to the extent possible, and establish the benefit-cost ratios. The report should be explicit regarding who will bear the costs and clearly distinguish between public authorities, businesses and citizens.	Annex 3	A summary table of the costs and benefits of all options included into the Annex, monetising the impacts to the extent possible. A description regarding who will bear the costs can be found in the details provided in Annex 3 for each 4 policy areas, plus in Annex 9.
The estimates of administrative costs and cost-savings that are currently expressed in FTEs, should be converted into monetary values. The assessment and comparison of spectrum options on efficiency criteria should include a full quantification of total administrative costs over the appropriate assessment period taking into account expected smaller number of regulated entities for Option 3.	Sections 6 and 7, and Annex 3.	The summary table of the costs and benefits of all options included into the Annex contains the monetary values of the FTEs expressed in later sections. For fixed, the estimated change in one-off and recurring administrative costs in FTEs and its quantification in billion EUR is presented in section 7. For spectrum and satellite in Annex 3, the IA clarifies the administrative costs at EU level for the preferred option for all spectrum measures (including terrestrial and satellite spectrum authorisation). An explanation has been added in Section 6 indicating that the new well-resourced EU-level institutional structure with legal, economic, and technical capacity that would coexist for a relatively long transitional period with national spectrum governance structures.
The report should strengthen the environmental impact analysis by better integrating the lifecycle findings presented in Annex 9. The resulting impacts should be	Section 6 and Annex 4.6	For spectrum , environmental impacts were monetised and integrated into the assessment, with a clarification on how to interpret the CO ₂ results.

Key issue/what to improve	Addressed in revised report: section number and annex	How have the issues been addressed
monetised and included in the overall assessment of costs and benefits. The reporting of the results should clearly highlight the underlying uncertainty as the analytical Annex 4 states that reported CO ₂ values should not be interpreted as measurements with high numerical precision but rather as outputs of a scenario-based estimation model.		For fixed , section 6 presents the analysis regarding the environmental impact of the transition to fibre, namely the CO ₂ emissions, as a function of the electricity consumption of the different options (which depends on the technological mixture of the access network of the different policy options). Further details analysis can be found in Annex 4.
The report should present a more systematic and comprehensive sensitivity analysis across all policy options. It should identify the key parameters driving results, explain how sensitive these results are to changes in the most important assumptions and state where uncertainty remains high and reflecting this in the conclusions.	Sections 6 and 8	For satellites , uncertainty around key inputs was explicitly highlighted, clarifying that simplification potential and cost reductions depend on assumptions regarding the timing and scale of future constellations, with savings therefore difficult to quantify. For spectrum , GDP and environmental sensitivities results are presented in the main text via footnotes, and remaining uncertainty is acknowledged. For general authorisation and introducing a Union-level passport for electronic communications networks and services : The report provides data on costs and analyses the possible efficiency gains.
The report should be a concise self-standing document. By removing repetitions all and inconsistencies the report should be reduced in length. All four problems and corresponding policy blocks should		The IA report and its annexes have been reviewed to address this comment.

Key issue/what to improve	Addressed in revised report: number and annex	IA section and	How have the issues been addressed
be analysed in a uniform way throughout all sections of the report.			

3. CONSULTATION OF THE RSB

An upstream meeting was held with the Regulatory Scrutiny Board (RSB) on 23 June regarding the impact assessment for the Digital Network Act. The points raised by the RSB members has been addressed in this document.

This staff working document was discussed at the RSB meeting on 22 October 2025.

4. EVIDENCE, SOURCES AND QUALITY

The options considered in this impact assessment were designed by taking into account the following main inputs:

- i. The contributions received to the **exploratory consultation** on the future of the electronic communications sector and its infrastructure, launched in February 2023.
- ii. The stakeholders' feedback to the **White Paper - 'How to master Europe's digital infrastructure needs?'** of February 2024.
- iii. The stakeholders' feedback received for the **Call for Evidence on DNA** published in 2025.

The three review studies that were conducted to support the preparation of this impact assessment are:

- i. Study 2024-025 on "Completing the Digital Single Market (DSM): Regulatory enablers for cross border networks - FWC No FW-00141705; referred to as 'Study on Digital Single Market'.
- ii. Study 2024-026 on 'Review of Access Regulation under the European Electronic Communications Code and analysis of future Access policy in full fibre environment' - FwC No FW-00141705; referred to as 'Study on Access Regulation'.
- iii. Study 2024-028 on 'Financial conditions, demand and investment needs and their regulatory and policy implications including on the universal service' - FwC No FW-00141705; referred to as 'Study on Finance and USO'.

The Impact assessment was carried out on the basis of interim study results of the three review studies quoted above. Finalisation is planned at this stage by the end of January 2026.

The analysis of the studies is primarily based on secondary data (public reports, data and opinions published by stakeholders and unpublished sources received directly from stakeholders) and on primary data collected directly from stakeholders through the Commission's Call for Evidence on the DNA¹ and a targeted survey of stakeholders (including a dedicated survey of NRAs and NCAs).

¹ See: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14709-Digital-Networks-Act_en.

The data from the Commission's Call for Evidence (326 responses) was analysed and included in the studies as relevant (mainly in the sections related to feasibility). This data is of qualitative nature and not specific enough for the analysis of proposed policy options because the Call for Evidence was held fairly high-level and did not outline any policy options.

Additionally, a quantitative model has been also developed and used as part of the study, for which the methodology is described in detail in Annex 4.

ANNEX 2: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

1. STAKEHOLDER CONSULTATION STRATEGY

A derogation from the obligation to conduct a public consultation was granted as in line with the Better Regulation guidelines, the Commission has been consulting widely to gather key information and ensure that the public interest is well reflected in the design of the Digital Networks Act (DNA). In particular, consultation activities regarding the topics that will be part of the future DNA and other related activities started already in 2023, with the launch of a very broad **exploratory consultation on the future of the electronic communications sector and its infrastructure**. With over 56 questions (many with sub-questions), requesting quantitative and qualitative information, it gathered the views of all stakeholders on the changing technological and economic trends and their current and possible future impact on the connectivity sector and its infrastructure, and required changes in the regulatory framework and overall sectoral policy. The exploratory consultation, launched via the eSurvey tool, received 437 responses and 164 position papers, fully relevant for the scope of the planned DNA initiative. The Commission also received many contributions outside the formal consultation tool. Two main takeaways of this large broad consultation - a need for innovation and efficient investment into future networks, and the need to leverage the Single Market to exploit economies of scale - are directly in line within the DNA's scope.

More recently, in February 2024, the Commission opened a consultation on its **White Paper 'How to master Europe's digital infrastructure needs?'** (White Paper). The consultation, which aimed to go more in-depth on the takeaways of the 2023 exploratory consultation, focused on three pillars (technology, single market and resilience) and proposed different scenarios to address the identified challenges. Titled 'Completing the Digital Single Market', Pillar II was the lengthiest and most substantial section of the White Paper. It identified challenges and discussed possible scenarios for public policy action to incentivise building the digital networks of the future with a view to meet future connectivity needs of all end-users, underpinning the competitiveness of our economy; it is thus very much aligned with the scope of the DNA. The White Paper was published on 'Have Your Say' for feedback for 18 weeks and received 357 feedback contributions. Pillar II attracted feedback from most stakeholders with 191 contributions providing feedback on Pillar II scenarios, which are directly linked to the DNA. The mission letter to Executive Vice-President Virkkunen explicitly indicated that the DNA should take "into account responses to the Commission's White Paper of February 2024".

Building on the significant feedback from the exploratory consultation and the White Paper, the Commission launched on 6 June 2025 a 4-week **Call for Evidence** aimed to inform the public and stakeholders about the Commission's plans so they could provide feedback on the intended initiative, the problems identified, its objectives and main policy options. The Call for Evidence was published via 'Have Your Say' and gathered 326 contributions including 271 additional papers.

In addition, complementing the Call for Evidence, the contractors of the three studies commissioned by the Commission for the preparation of the EECC review, the impact assessment and the legal proposal, have conducted two rounds of **targeted consultations** to 134 selected stakeholders, one in January 2025, and the second one between June and July 2025 to complete the evidence gathering exercise. The targeted industry stakeholders represented different ECN and ECS providers and other service providers. The majority were fixed network operators but also included a sizable number of CAPs and broadcasters. The targeted consultations were also responded by 18 EU NRAs and 7 NCAs.

The targeted consultations provided additional insights as regards various policy options considered, complementing the high-level options illustrated in the Call for Evidence. Some insights have been added briefly in this respect in the assessment of the Call for Evidence input.

In parallel, between March and July 2025, the Commission organised strategic **workshops with BEREK and the Radio Spectrum Policy Group (RSPG)**, to gather the views of high-level representatives from the competent authorities of all Member States. Furthermore, a **dedicated workshop** was organised **with BEUC and the correspondent national consumer organisations** on 16 July 2025 to ascertain the concerns and challenges for consumers and end-users of electronic communications. These efforts have been complemented with a high number of meetings held with industrial stakeholders active across the whole digital value chain, and their business associations.

2. SUMMARY OF THE OUTCOME OF THE STAKEHOLDER CONSULTATIONS

2.1. Statistical summary of the consultation activities

The **exploratory consultation** received 437 responses to the consultation including 164 position papers, of which 108 contributions were submitted by companies (25%), 87 by business associations (20%), 124 by citizens (114 by EU citizens and 10 by non-EU citizens) (28%), 47 by non-governmental organisation (“NGOs”) (11%), 16 by research / academic institutions (3,7%), 14 by consumer organisations (3,2%) and 5 by trade unions (1%). In addition, 17 public authorities provided feedback (4%), representing a mix of bodies with different scope, such as European (2), national (13), and regional/local authorities (2). As regards the country of origin of the respondents, most of the replies (85%) came from EU Member States. The remaining replies came from stakeholders located outside the EU, mainly from the United States (7,7%) and the United Kingdom (2,7%).

The **White Paper** received 357 contributions of which 116 were submitted by business associations (32%), 103 by companies (29%), 32 by public authorities (9%), 26 by NGOs (7%), 23 by citizens (21 by EU citizens and 4 by non-EU citizens), 21 by research / academic institutions, 3 by consumer organisations and 4 by trade unions. 14 Member States provided feedback via the ‘Have your Say’ platform, while 3 NRAs and 8 regional authorities sent contributions outside the platform. As regards the country of origin of the respondents, most of the replies (93%) came from EU Member States. The remaining replies came from stakeholders located outside the EU, mainly from the United States (5%) and the United Kingdom (1%).

In response to the **Call for Evidence**, the Commission received 326 feedback contributions, including 271 with additional papers, which provide a comprehensive evidence base for the Impact Assessment and the subsequent DNA legislative proposal. Out of those contributions, 128 were submitted by companies (39%), 98 by business associations (30%), 29 by NGOs (9%), 26 by citizens (25 by EU citizens and 1 by non-EU citizen) (8%), 10 by research / academic institutions (3%), 6 by consumer organisations (2%) and 4 by trade unions (1%). In addition, 12 public authorities, mostly regulatory or authorities with governmental competences, provided feedback (4%). Over 90 % of the contributions were submitted from EU Member States. Of the remaining contributions the majority originated from the United States.

2.2. Analysis of the responses to the consultations

2.2.1 Exploratory Consultation

Respondents identified network virtualisation, open networks, and edge cloud as the technological breakthroughs that will have the largest impact in the coming years. These technologies are expected to bring about a shift from traditional electronic communications networks to cloud-based, virtualised, software-defined networks, driving down costs, improving the resilience and security of networks and introducing new, innovative services, while transforming the ecosystem and business models.

These developments are also considered capable to promote the digital single market, whilst most of the respondents consider that full integration of the market is hampered by the sector fragmentation. The majority, mostly companies and business organisations, welcomed the idea of more integration in the spectrum market and a more harmonised approach to spectrum management across the EU, including the need of addressing harmful interference from third countries at the EU-level. The views of respondents were instead not conclusive in relation to the issues of fairness to consumers and the fair contribution by all digital players.

A full summary report on the results of the exploratory consultation can be consulted at <https://digital-strategy.ec.europa.eu/en/library/results-exploratory-consultation-future-electronic-communications-sector-and-its-infrastructure>.

The exploratory consultation provided a robust basis to further investigate and assess the evolution of the sector and the needs of the digital infrastructure, and to engage in a thorough reflection on scenarios for policy intervention that can unleash the Single Market for digital networks and make our connectivity more secure and future-proof.

2.2.2. *White Paper*

The White Paper analysed the challenges Europe currently faces in the rollout of future connectivity networks and presented possible scenarios for public policy action going forward, including possible future DNA, divided in three pillars.

Under pillar I (Creating the 3C Network – Connected Collaborative Computing) on the trends and challenges in the digital infrastructure, stakeholders agreed on the importance of modern, secure and resilient digital infrastructures for EU competitiveness and recognised the trend towards cloud- and software-based infrastructures and the need to significantly upgrade the network infrastructures. Many stakeholders also referred to the evolving geopolitical context, which reinforces the need for competitiveness in this field.

The broad range and convergence of players in the broader ecosystem around digital networks is widely recognised, illustrated by partnerships between telecom suppliers and operators with cloud providers and CAPs. However, Internet and cloud players underlined that general cloud services and telecom services remain distinct.

Most players involved in network roll-out agreed with the Commission's diagnosis of the sector and the challenging investment environment. Players less focussed on infrastructure rollout, e.g. access seekers, some Internet players, and some other players, did not see the financial situation of telecom operators as particularly problematic.

Consumer groups were concerned about the focus on infrastructure and would have welcomed a clearer recognition of consumer issues. Whereas the need for higher quality of services was acknowledged, price and choice for consumers were underlined as remaining important.

Regarding the several possible scenarios proposed to address those challenges, attract investments, foster innovation, increase security, and achieve a true Digital Single Market in the context of a proposal for a future DNA, input received on the relevant scenarios is provided below:

On ***Completing the Single Market (Pillar II)***, the objective of achieving a true digital single market was widely supported. Improvements towards a Single Market for telecom services were also seen as an opportunity by many, although rather in the long term in view of the considerable obstacles identified. The need for scale across borders was in particular recognised by stakeholders considering cross-border network operations or services provision. Setting a regulatory environment enabling centralisation of networks and services was welcomed by many, in particular larger players, while smaller and local players raised the risk of consolidation and less competition. The broader ISP community was positive on the prospect of simplification and harmonisation of rules. However, some

concerns were raised as regards additional complexity in incentivising cross-border operations/services. Several respondents pointed to important barriers which are considered challenging to remove, e.g. security and law enforcement.

In relation to the proposal to *remove ex ante access regulation*, AltNets and access seekers showed concerns to lose current conditions that are a basis for their infrastructure and business model (e.g. ducts, bitstream). The proposal for a harmonised access product was not fully understood by market players and NRAs and telcos raised the concern that such a product could ease the entry of non-EU players who do not invest in infrastructure. The business association of large ECNs showed a preference for a voluntary market solution under fair and reasonable terms, rather than a regulatory remedy with price obligations.

The measures proposed to *accelerate copper switch-off* were welcomed by some AltNets as a means to end the (former) incumbents' copper dominance but had a cautious reception by incumbents as it risks undermining their position, if conditions are not appropriate.

On spectrum, on the scenario suggesting a more integrated spectrum governance at EU level, Member States and NRAs considered the existing spectrum governance model appropriate and signalled opposition to centralising competences at EU level, or to modifying the current institutional set-up regarding cooperation with the CEPT. However, they were open to discuss improvements to the peer review process. On common deadlines for the availability of bands, some raised concerns as regards the need to consider national particularities.

The telco community was positive on the prospect of more coordinated assignment procedures and conditions (e.g. increased licence duration, auctions more focused on investments, a notification mechanism to enhance consistency) across the EU, but did not support a centralised EU-level assignment process or full harmonisation, and was sceptical on synchronisation of timing of assignment procedures. However, telcos were generally positive about a spectrum roadmap, and more EU harmonisation on spectrum allocation, fees, reporting obligations, technology standards.

There was overall support for maintaining the current cooperation framework with the CEPT. Although the telcos were also open to having an *ad-hoc* cooperation group, alternative to CEPT, for clearly defined cases impacting security and resilience.

Other stakeholders from the broader digital supply chain had mixed positions, some positive towards an increased level of spectrum harmonisation.

On a more harmonised approach to general authorisation and the possible application of the CoO principle to activities less connected to consumer retail markets and local access networks, the telco community was generally positive on the idea of harmonising and easing applicable conditions attached to authorisation. They agreed with the reinforcement and, if possible, harmonisation of security requirements, but were cautious about mandating any changes in the implementation of legal requirements which come with significant costs and efforts (e.g. complex systems for lawful intercept or data retention). They also raised concerns regarding the risks of non-telco entrants that do not invest in infrastructure to benefit from a CoO-based authorisation regime combined with a standard wholesale access product.

Member States and NRAs did not see scope for the application of the CoO principle indicating that a significant set of national rules would remain. Consequently, they considered a two-layer authorisation/governance as unnecessary complex, not working in practice and bearing risks of "forum shopping".

On ensuring a Level Playing Field, the large telco incumbents were positive to the idea of the regulatory level playing field but raised questions about the regulatory solution. Cloud providers were concerned about being included in the scope of telco-specific regulation. Cloud operators consider themselves as core network operators, use peering or transit, and regulation was considered

unjustified and counterproductive. Some smaller telcos were sceptical about the requirement to centralise core networks and its real benefit. Member States and NRAs questioned the idea of core networks as basis for the level playing field and related legal rights and obligations.

On ***Secure and resilient digital infrastructures in Europe (Pillar III)***, stakeholders broadly welcomed the focus on security and resilience in general, and on submarine cable infrastructures specifically, highlighting the importance of cybersecurity and the EU initiatives and funding. There was substantive support across stakeholders for the measures envisaged on cables such as the Cable Projects of European Interest. A few non-EU stakeholders were critical towards restricting access to funding or markets for companies based on geographical / security grounds, in particular regarding high-risk vendors.

The feedback to the White Paper was crucial to conclude that a new regulatory framework is needed to overcome the barriers to and complete the digital single market and ensure the security and resilience of our networks, as well as contribute to the competitiveness and digital sovereignty of the Union.

2.2.3. Call for Evidence

The feedback received is described below following the objectives and policy options set out in the Call for Evidence, complemented when appropriate with feedback obtained from the targeted consultations and the workshops organised with BEREC and the RSPG, as well as with BEUC and national consumer organisations.

Simplification

Most stakeholders supported broadly the objective of reducing reporting obligations and removing unnecessary regulatory burdens, with some business associations emphasising the need to avoid duplication in data collection. A national association of ECNs and a broadcaster noted that, while the objective is shared, the benefits would depend on the specific regulatory design. A business association of mobile network operators expressly welcomed the objective advocating for excluding business customers from consumer protection rules and for re-focusing of Universal Service obligations on affordability. One non-European ECN welcomed removing excessive compliance burdens for cross-border operators and a provider of IoT solutions noted that this would benefit entry of operators in new markets across the EU. Some NRAs were however more reticent. On the reduction of reporting obligations, one NRA submitted that national regulators need market data to adopt well founded measures, and another NRA warned against equating simplification with de-regulation.

On the *general authorisation regime*, while some of the respondents (namely public authorities and some companies) stated that no or limited changes to the general authorisation regime are warranted and stressed the importance of national contexts, many companies and industry associations pointed however that the divergent conditions of the general authorisation applied across Member States create obstacles to cross-border operations and deters new entry. They mostly advocated for more harmonisation of the general authorisation conditions and streamlining practices with a single Member State notification for cross-border providers and BEREC with a possible coordination role, to reduce fragmentation and allow for network centralisation and coherent service provision across Members States.

In particular, ECNs generally called for simplification of the general authorisation regime, ensuring that it is proportionate and aligned with technological advancements. This included reducing unnecessary regulatory barriers that can hinder the deployment of new technologies and services. They also emphasised the need for improved coordination among NRAs to ensure consistent application of rules and obligations, which would further facilitate the business environment for in particular telecom operators, currently subject to the obligations. Industry associations acknowledged

however the need for some national flexibility to address country-specific security or spectrum concerns.

Other stakeholders, including namely NGOs and some companies and industry associations, supported a partial harmonisation of the general authorisation regime applicable to e.g., satellite and B2B providers, based on the application of the conditions of the Member State of main establishment (“CoO” principle) and the mutual recognition in all other Member States where networks and services are provided. On the specific application of the CoO principle, some ECNs raised the risk that non-telco new entrants that do not invest in network infrastructure could benefit “unfairly” from such regime, in particular if this was combined with the introduction of a standard EU wholesale access product.

Responding Member States and NRAs however did not see scope for a fully-fledged CoO regime for electronic communication services because a significant set of national rules would remain. In their view, the application of the CoO principle would lead to a two-layer authorisation/governance that would be unnecessary complex, not working in practice and raising risks of “forum shopping”.

Consumer organisations acknowledged the benefits of harmonisation, but were concerned that de-regulation lowers consumer protection and thus stressed the need to safeguard national consumer protection measures.

As regards *universal service*, most stakeholders acknowledged the need for the USO framework to flexibly accommodate varying regional needs and market conditions across Member States. Member States, NRAs and consumer organisations advocated for an inclusive and future-proof USO framework that supports digital inclusion, ensuring all citizens, particularly those in rural or underserved areas, have access to high-quality internet services. Most telecom operators argued that the market now provides a wide variety of offers to meet the needs of consumers, and suggested that USO could be phased out. Public intervention, for example through voucher schemes, would be a more efficient way to address the needs of vulnerable and low-income consumers. A smaller number of companies and associations welcomed the possibility to re-focus USO on affordability, while others emphasised the need to focus on stimulating demand.

There was a call from internet service companies to leverage technological advancements and cost-effective solutions to meet universal service goals without imposing significant financial strains on the sector, emphasising the importance of a technologically neutral approach.

Regarding *end-users protection*, Member States, NRAs and consumer organisations emphasised that robust consumer protection must be maintained, but supported simplification of end-user rules where possible, for example regarding enhanced transparency and clearer information for consumers. These stakeholders highlighted the importance of sector-specific end-user protection. Consumer organisations, in particular, pointed to the necessity of rules concerning contract terms, pricing transparency, and quality of service, amongst others. Moreover, these stakeholders, as well as several companies and business associations acknowledged the need for sector-specific rules on number portability and switching. These rules empower consumers through improved rights to switch providers, facilitating competitive markets and better service offerings, while preventing unfair lock-in practices by operators.

More broadly, most telecom operators and service providers called for simplification and the removal of sector-specific rules in cases where it is not, in their view, justified, considering the high level of protection already afforded by horizontal consumer law. Many companies and business associations also called for removing end-user protections in the case of business-to-business transactions. Some companies and one Member State suggested that an EU approach to anti-fraud prevention would be welcome. Moreover, as digital services proliferate, stakeholders, in particular those representing telecoms providers, emphasised the need for regulatory frameworks to expand beyond traditional

telecommunications, encompassing digital service providers to ensure consistent protection across all digital platforms. Other business associations did not see the need for extending the rules to different business models.

In the dedicated workshop with consumer organisations (BEUC and national organisations), held on 16 July 2025, consumers notably advocated for maintaining competition in the electronic communications market and not weakening overall current levels of consumer protection across national retail markets. They further supported reinforcing, at EU level, the cross-border implementation and enforcement of consumer rules.

Spectrum

Overall, most stakeholders advocated for investment-friendly spectrum policy that enhances legal certainty and efficiency in spectrum use, while Member States and NRAs stressed the need to maintain national discretion over the assignment process to match local market demands and argued against longer license duration. There was considerable support, especially from the industry, for reducing market fragmentation, strengthening ex ante scrutiny at EU level, including making it mandatory, acknowledging that the system so far has not been effective in ensuring consistency in market shaping measures, supporting investment and sustainable competition. Industry supported coordination of national authorisation procedures and conditions as well as of the timing of assignment through national roadmaps coordinated with an EU roadmap. The vast majority of telecom operators supported extended license durations to foster investment; some however cautioned against rigid timelines for spectrum awards. Additionally, several stakeholders, in particular alternative operators endorsed policies like "use it or trade it or lose it" to prevent spectrum hoarding and promote innovative spectrum use, while opposing centralised EU control and emphasising the importance of spectrum sharing and cooperation among Member States to address cross-border interference and enhance network efficiency. The need to facilitate spectrum sharing as well as pro-investment spectrum authorisation conditions was very prominent also at the RSPG workshop of 16 June 2025 and at the targeted consultation confirming expected effectiveness of enhanced spectrum sharing and trading and of pro-investment conditions as coverage and quality of service commitments. The RSPG also acknowledged that there is room to improve the current peer review procedure. Member States showed openness to improve coordination in spectrum management, while underlining the national competences in this field and the need to maintain national procedures and current governance.

A harmonised, pan-European approach to satellite market access was considered essential to unlock the full potential of satellite connectivity across the EU by a number of satellite operators who noted that the growing demand for satellite access, combined with fragmented and non-harmonised authorisation procedures, may lead to discriminatory outcomes, encourage 'forum shopping', and raise barriers to cross-border satellite service development. Satellite operators called in particular for regulatory simplification (e.g. of existing reporting obligations) and the elimination of unnecessary regulatory burdens, for instance through greater consistency regarding requirements for satellite authorization, compliance and enforcement frameworks and reduced overlaps in EU regulations. An EU-level mechanism for selection of satellite operators (e.g. based on MSS decision), and a common satellite authorisation at EU level were also supported by some operators. Stakeholders also highlighted the need to ensure long-term spectrum predictability through flexible and transparent assignment conditions. Furthermore, stakeholders stressed the need for a level playing field between satellite constellations accessing the EU market and terrestrial mobile networks, and to address the potential interference risks that Direct-to-Device satellite services may pose to existing terrestrial systems.

The need for a level playing field, including common authorisation requirements, was unanimously acknowledged by the RSPG. The RSPG's Opinion on the EU-level policy approach to satellite

Direct-to-Device connectivity and related Single Market issue (RSPG25-020 Final) also includes this recommendation. Moreover, during the discussion on different aspects of satellites connectivity at the TTE (Telecom) Council of 6 June 2025, Member States were very supportive of stronger coordination in the satellite field, including common authorisation requirements and common enforcement mechanisms.

Level Playing Field

Traditional telecom operators called for a recalibration of the regulatory framework that currently places them at a disadvantage compared to CAPs. They advocated for the principle “same service – same rules” and for a fair regulatory environment when it comes to issues related to IP interconnection. The key arguments of telecom operators were that the majority of data traffic on telecom networks comes from a small number of very large CAPs, which creates a disproportionate burden on telecom networks, while most of the investment burden falls on telecom operators. Also, during commercial negotiations on peering, telecom operators claim CAPs have strong bargaining power and impose peering conditions on telcos, while telcos lack leverage to demand compensation.

However, a significant number of respondents, i.e. CAPs, consumer associations, Internet-related associations and some individual contributors, opposed any dispute resolution mechanism in the IP-interconnection system that would introduce any type of “network compensation” mechanism from content providers to network providers. In their view, such regulation could undermine the principle of Open Internet, increase costs for end-users, restrict competition and strengthen the market power of large operators, without a justified need for regulatory intervention. Member States and NRAs opposed regulatory intervention in the interconnection market unless market failure is clearly demonstrated.

Cloud providers rose concerns over being included in telco sector-specific regulation. European small cloud operators were concerned that they would be burdened by “telco-style regulation”.

However, quite a few contributions coming from a wide spectrum of stakeholders (cloud, CAPs, smaller ECNs) supported the idea of creating effective cooperation among the actors of the broader connectivity ecosystem in e.g. traffic management, forecasting and analysis, enhancing network performance, reliability, efficiency, energy efficiency and enhancing innovation.

On *Open Internet*, many connectivity providers pointed that under the Open Internet rules the treatment of specialised services lacks clarity and requested further guidance. However, the Internet community and consumer groups opposed changes to the Open Internet rules that would, in their view, create a privileged tier for so-called “innovative services”. In their view, this could contravene the core principles of Open Internet, and for the Internet community could also lead to discriminatory practices by telcos that would tilt the competitive balance unfavourably, creating entry barriers, particularly disadvantageous for smaller and newer market entrants.

Access Policy including copper switch-off

Whereas incumbent operators called largely for removing *ex ante* regulation in case of sustainable competition and to focus on limited bottlenecks, access seekers and consumer associations had more cautious stance on deregulation, warning against prematurely relaxing SMP obligations, which might jeopardise smaller players and stunt fibre network investment. Access seekers and consumer associations praised the current system for its ability to accommodate market-specific conditions and encourage competition and investment in broadband infrastructure. While incumbent operators considered that regulation is not needed due to the changing competitive environment and that it hampers investments in networks.

NGOs, consumer associations and academic and research associations largely mirror the arguments of access seekers and consumer associations supporting *ex ante* regulation, based on the existing regulatory framework (built on the well-established concepts of “Significant Market Power” and

“Three Criteria Test”) Most public authorities also argued for maintaining the existing EU regulatory framework.

Most companies and business associations expressed concerns over a *pan-EU harmonised wholesale access product*, arguing that such a uniform product might not meet the nuanced demands of varying national market conditions and could place disproportionate burdens on operators.

As regards *copper switch-off*, some ECNs (AltNets) advocated for setting a specific EU-wide target date to encourage fibre adoption and environmental benefits. Others stressed the need for transition plans based on actual fibre coverage instead of rigid deadlines. Concerns were raised about potential digital exclusion and market distortions if the switch-off is premature. Many stakeholders favoured voluntary mechanisms with derogations to protect underserved areas, urging for policy support to address infrastructure challenges and ensure competition neutrality during the transition to future-proof fibre networks.

The Commission takes the diverse viewpoints into account and intends to propose an access framework that fosters sustainable competition and investment incentives towards advanced networks. As regards the access framework, the Commission will work towards a targeted improvement and simplification of the existing framework that will still be based on well-established concepts of competition law. Targeted modifications (such as rendering the recommended markets optional or more focus on the survey of geographical market) could be introduced to enable the Commission and NRAs to better reflect market developments.

Governance

Respondents emphasised the importance of clear and consistent governance structures to ensure that regulatory decisions are predictable and conducive to long-term planning for telecommunications operators. The majority of respondents (operators, business associations, public authorities) supported preserving the independence of national regulatory authorities, ensuring they have the autonomy and resources necessary to address specific national and regional market conditions effectively.

Many stakeholders, namely large operators and EU-wide business associations, called for improved coordination between NRAs and EU-level bodies to avoid regulatory fragmentation and conflicting policies that could hinder market efficiency. This included enhancing mechanisms for cooperation and information sharing among Member States to ensure coherent implementation of regulations across the EU, although it was underlined the need to maintain the current balance of powers with NRAs keeping decision-making powers.

There was also a focus on the need for adaptive governance frameworks that can respond to the rapid pace of technological advancements and market changes, ensuring that regulations remain relevant and supportive of innovation.

ANNEX 3: WHO IS AFFECTED AND HOW?

1. PRACTICAL IMPLICATIONS OF THE INITIATIVE

Copper switch-off and access regulation measures: practical implications for:

- **Operators:** Copper network operators would be obliged to switch-off their copper networks by the end of 2030 but may continue operating them longer under the sustainability clause. Operators would be required to provide more granular geographic data to the NRA or other competent authority regarding the location and nature (technology) of network infrastructure
- **NRAs (or competent authorities):** Requirement to assess copper switch-off plans and to ensure that the process is handled effectively and in a manner that protects consumer welfare and preserves competition. Collect geographic data and assess progress regarding FTTH deployment and copper switch-off.
- **EC and BEREC:** Establish best practice specifications for wholesale access products and adopt an Implementing Act.

Spectrum measures: practical implications for:

- **EU level (EC, BEREC Office):** The Commission will harmonise certain licencing processes and conditions and establish the EU spectrum strategy and roadmaps and monitor their implementation, taking into account RSPG advice. RSPG will be able to take on activities easier as it will be supported by the reinforced BEREC Office that will help not just in meeting organisation but will be able take over some preparatory work, like preparing first drafts or summarising comments.
- The Commission as well as RSPG and BEREC, supported by the BEREC Office, will have to analyse draft measures on auction designs and conditions and the Commission will have the right to ask the relevant competent authority to amend the draft measure if it contains elements that could be detrimental to a long-term sustainability of the market or if the duration of rights would not guarantee proper return on investments.
- **Member States' authorities:** For each planned auction, the competent authorities (CAs) will need to submit a draft measure to the Commission, BEREC and RSPG checking via BEREC Office, and they will need to change it if asked by the Commission. The CAs will need to follow the guidance given by the Commission harmonisation acts in designing authorisation processes and conditions. They will prepare national spectrum roadmaps implementing the EU roadmaps and they will need to assign spectrum within defined timeframes. A Member State will be able to ask for RSPG assistance in cases of harmful interference from other Member State, and for support from the Commission and other Member States if the harmful interference is caused by a non-EU country. Member State will have to endeavour to stop or mitigate harmful interference to other Member States in set deadlines.
- **Operators** will benefit from more harmonised spectrum conditions and will be able to scale up and provide their services in other Member States. Unlimited licence duration or longer licence duration with easier renewal possibility will give operators certainty and stability for long-term investment planning without uncertainty brought by periodical reauctioning of spectrum. Operators will not be obliged to pay exorbitant prices for new spectrum as pro-investment auction design and conditions will apply and be ex ante checked by the Commission, RSPG and BEREC. The spectrum roadmaps will provide operators with information when a particular band becomes available so they could easier plan their investments. Operators and other spectrum users will timely benefit from interference free environment along the Member States' borders.

- **Innovators** will be able to obtain access to spectrum easier and for the time they need it. They will be able to initiate the process under which the current use of particular spectrum band could be reconsidered and if relevant changed.

Satellite measures: practical implications for:

- **Satellite Operators** will face reduced regulatory burden to access satellite spectrum as a single authorisation will be granted by a single European authority. This consistent and harmonised regulatory framework in space communications across the EU will, together with the EU Space Act, facilitate the deployment of European LEO (Low-Earth Orbit) mega-constellations, and, ultimately, enhance EU space competitiveness in the global market.
- **Member States' authorities:** the transfer of responsibility for satellite authorisations, spectrum assignment, monitoring and enforcement from Member State institutions to the Commission will have a clear impact on staffing needs: Member States will require fewer resources. Finally, deadlocks and conflicts among Member States are expected to be avoided or significantly reduced.
- **EU level (EC, BEREC Office):** EU satellite authorisations will be issued by Commission, assisted by the BEREC Office. They will also carry out selection procedure in case of scarcity of satellite spectrum. This will need to significantly increase their staffing (see section 2.4. of this Annex).

2. SUMMARY OF COSTS AND BENEFITS

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	Amount	Comments
<i>Direct benefits</i>		
Reduction in CO ₂ emissions	0.7 million tonnes EUR ~ 0.56 billion for fix and EUR 0.01 billion reduction from mobile	Accumulated impact for the period 2025-2035
Streamlined and harmonised system for general authorisation (single 'passport') and EU authorisation for satellite spectrum assignment across the EU	Providers benefit from single passport/declaration (authorising the provision of networks and services, which is valid in all 27 Member States). Those providing pan-European or global constellations transitioning from 27 separate authorisations to a single one. - Savings linked to complying with one single set of authorisation conditions and avoided duplication (1 procedure instead of 27) - Avoided lost revenues due to possible delays in authorisation in some MS (examples of possible savings) - Increased consumer benefit No coverage gaps (EU continuous connectivity) because of lack of authorisation in some MS. Estimated cost savings due to reduction of admin. burden and compliance costs from EUR 15-25 million to between EUR 6-11	EU selection for satellite services in cases of spectrum scarcity (access under EU general authorisation in case of no scarcity). EU assignment of satellite spectrum management will also address the regulatory fragmentation that has been acute in the MSS 2 GHz band. Easier access to satellite spectrum will be of value not only for new market entrants, who need to face complex and lengthy requirement in some MS, but also for established firms

I. Overview of Benefits (total for all provisions) – Preferred Option		
<i>Description</i>	<i>Amount</i>	<i>Comments</i>
	million yearly per operator (40-44% reduction). Satellite: One-off administrative costs related to in country requirements for a new satellite service tin MSs will be indicatively reduced around EUR 3.2 million across all MS.	
More effective enforcement of satellite rules for all players	Providers benefit from a level playing field where all providers respect rules (e.g. ITU rules on interferences) Avoided revenue losses due to delayed market entry.	The coordinated enforcement mechanism of satellite rules ensures stronger enforcement and quicker solutions of harmful interferences issues.
Costs savings for EU budget	Costs savings / increased efficiency by transfer of administrative and substantive responsibilities to BEREC Office and RSPG. This Option would also reduce direct costs for the Commission (albeit with limited effect on the EU budget).	Expected direct cost savings are moderate, but could be amplified by increase in task linked to DNA
Costs savings for MS budget	Cost savings due to transfer to certain cross-border decisions to the EU level. The BEREC Office would take on more 'substance-related' responsibilities and this would relieve some of the pressure on NRAs. In view of the above, it is estimated that in preferred Option, NRAs' costs would increase only incrementally, notwithstanding the need for their increased collaboration in BEREC.	Expected direct cost savings are moderate, but could be amplified by increase in task linked to DNA
Indirect benefits		
Increase in GDP due to increase in fibre and mid band 5G coverage and take up, as well as average speeds	For fix a GDP increase of EUR ~157(more conservative scenario) EUR - 327 (less conservative scenario) billion for fibre.	Accumulated GDP impact for the period 2025–2035 compared to the status quo. Main beneficiaries are businesses and consumers through productivity gains associated with higher broadband speeds and mid band 5G /fibre take-up.
Increased GDP thanks to higher QoS/speed due to increased mid band coverage	The preferred Option would lead to an overall GDP increase over 10 years (2025-2035) of EUR 1 553 billion compared to 1 489 of the baseline, therefore an increase of EUR 73 billion. A sensitivity analysis accounting for potential uncertainties of the model yields a GDP impact ranging from EUR 179 to EUR 2 116 billion, with the lower bound reflecting model conservatism and the upper bound representing upside potential from increased 5G mobile broadband speeds. Relevant increases would then range from EUR 8 billion (lower bound reflecting model conservatism) to EUR 101 billion (upper bound representing upside potential from increased 5G mobile broadband speeds). To	The GDP increase calculated by the model is only a partial representation of the measure impact since it does not take into account the spill-over effects on vertical sectors (like for example healthcare, manufacturing, automotive and transport, energy and environment and agriculture) and the additional gains linked to the timely deployment of 6G. See qualitative description below.

I. Overview of Benefits (total for all provisions) – Preferred Option		
<i>Description</i>	<i>Amount</i>	<i>Comments</i>
	assess the overall impact properly this quantitative analysis is integrated by the qualitative one since the 6G impact cannot be taken into account in the quantitative analysis	
Accelerated shift from 5G to 6G	Not quantified	Early standardisation efforts and research roadmaps indicate that 6G is expected to enable enhanced capabilities such as real-time distributed intelligence, ultra-low latency, integrated sensing and communication, and improved energy efficiency—all of which may generate cross-sectoral economic benefits similar or even superior to those observed for 5G.
Innovation acceleration	Not quantified	Industry (verticals, SMEs, R&D actors) benefits from enhanced 5G QoS and specialised services offers and from access to localised/licensed spectrum for innovative services (e.g. private 5G, IoT), particularly in manufacturing, health, agriculture, and transport and from the capacity to scale up thanks to the harmonisation of authorisation conditions.
Improved legal certainty	Not quantified	NCAs, industry, and Commission benefit from clearer, more predictable procedures through EU-level licensing guidance and stakeholder petition mechanisms.
Lower entry barriers for SMEs	Not quantified	Simplified and more flexible access regimes and harmonisation of authorisation conditions reduce administrative and regulatory burdens for SMEs entering niche or local spectrum markets.
Potential green benefits (indirect) Reduction in CO ₂ emissions	Marginal The ecological footprint of 5G mobile networks under the preferred Option would lead to 5,250,198 CO_{2e} mobile / wireless broadband network emissions which is lower than the 5,257,074 t CO_{2e} under the baseline. When monetised, environmental impacts under the preferred Option are estimated at around EUR 4.62 billion, compared to EUR 4.63 billion under the baseline, a marginal improvement. (See Annex 4, Section 2 for methodology and findings). In monetary terms this represents a EUR 0.01 billion reduction from mobile. The options show an average of over 96% reduction from 2025 to 2035, due to significant decrease in electricity consumption per gigabyte linked to new mobile technologies, however the difference between	Reduction on CO₂ is marginal compared to baseline; however the model presents only part of the environmental benefits. Additional gains are expected from 6G. Potential for smart systems (e.g. connected transport or logistics) through IoT and private 5G. The preferred option will further accelerate deployment of future mobile generations like 6G that are being designed with energy efficiency and renewable energy integration as core principles and should therefore favourably impact energy efficiency. In parallel, the deployment of edge computing and AI-driven energy optimisation (e.g., adaptive sleep modes, intelligent traffic steering, and predictive maintenance) will further enhance the sustainability of mobile networks. While

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	Amount	Comments
	the baseline and the preferred option is negligible. There will be additional energy-saving effect of 6G and of its accelerated introduction due to spectrum measures that has not been included in this model given the technology is still being developed, however this is likely to be significant, given that future mobile generations such as 6G are being designed with energy efficiency and renewable-energy integration as core principles.	AI can make processes more energy-efficient, it may also increase electricity demand due to the greater computing capacity required. Any comprehensive assessment should therefore weigh AI-enabled efficiency gains against the incremental power needs of expanded compute infrastructure.
Push toward innovative spectrum sharing solutions	Not quantified	The preferred option supports the uptake of advanced sharing mechanisms (e.g. dynamic spectrum access, AI-based coordination), unlocking additional efficiencies and supporting coexistence in dense spectrum environments.
Petition mechanism supports harmonisation for innovators	Not quantified	The stakeholder petition mechanism empowers innovators (e.g. in satellite-IoT or non-terrestrial networks) to request harmonised spectrum access at EU level, enabling timely deployment of emerging technologies.
Regulatory outcomes	Enhanced harmonisation due to increased decision-making power by EC and BEREC Office as a fully-fledged agency, and RPSG as an independent advisor.	More consistent regulatory outcomes across MS ultimately contributes to increased harmonisation / level playing field for market operators, and reduction of compliance costs for economic operators.
Market development	Further empowerment of NRAs and NCA, contributing to enhanced market development	Ultimately leads to lower compliance costs for cross-border operators, and in terms of satellite spectrum/EU authorisation fosters innovation and investment in new technologies.

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate in the comments column which stakeholder group is the main recipient of the benefit; (3) For reductions in regulatory costs, please describe in the comments column the details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.); (4) Estimates of GDP impacts are indicative and scenario-based. They are derived from literature-based coefficients linking improvements in broadband speed and take-up to productivity and GDP growth. Given the high variability of estimates in the empirical literature and uncertainty regarding marginal effects at higher speed levels, absolute values are sensitive to key assumptions. Sensitivity analysis is provided in Annex [X]; results should therefore be interpreted as orders of magnitude rather than precise forecasts, while the relative comparison between options remains robust

II. Overview of costs – Preferred option						
	Citizens/Consumers		Businesses		Administrations	
	One-off	Recurrent	One-off	Recurrent	One-off	Recurrent

Action (a)	Direct adjustment costs						The BEREC Office would be strengthened by recurrent 25 FTEs to fulfil new tasks, including support to the COM and RSPG (currently BEREC Office has staff 48 FTEs). The annual cost of BEREC Office is estimated for approx. EUR 12 m (currently EUR 8.1. m). 10 FTEs estimated to cover additional tasks by the COM.
	Direct administrative costs			EUR 49 m	EUR 25 million	EUR 24 m	EUR 13 million
	Direct regulatory fees and charges				Satellite operators will no longer pay multiple fees; instead, a single fee will be paid to one European Authority		Fees are considered for services provided to the operators, however not finalised, therefore not quantified at this stage.
	Direct enforcement costs						
	Indirect costs						

(1) Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

In the following sections, we provide further details by policy areas.

2.1. Transition to fibre

I. Overview of Benefits (Transition to fibre) – Preferred Option		
Description	Amount	Comments
Direct benefits		
Reduction in CO ₂ emissions	0.7 million tonnes EUR ~ 0.56 billion	Accumulated impact for the period 2025-2035
Indirect benefits		
CSO and access – increase in GDP due to increase in fibre coverage and take up, as well as average speeds	EUR ~157(more conservative scenario) - 327 (less conservative scenario) billion	Accumulated GDP impact for the period 2025–2035 compared to the status quo. Main beneficiaries are businesses and consumers through productivity gains associated with higher broadband speeds and fibre take-up.

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate in the comments column which stakeholder group is the main recipient of the benefit;(3) For reductions in regulatory costs, please describe in the comments column the details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.); (4) Estimates of GDP impacts are indicative and scenario-based. They are derived from literature-based coefficients linking improvements in broadband speed and take-up to productivity and GDP growth. Given the high variability of estimates in the empirical literature and uncertainty regarding marginal effects at higher speed levels, absolute values are sensitive to key assumptions. Sensitivity analysis is provided in Annex [X]; results should therefore be interpreted as orders of magnitude rather than precise forecasts, while the relative comparison between options remains robust

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Action (a)	Direct adjustment costs						
	Direct administrative costs			CSO and access – 510 FTEs ² – EUR 49 m	CSO and access – 265 FTEs per year – EUR 25 m	CSO and access – 255 FTEs – EUR 24 m	CSO and access – 133 FTEs per year – EUR 13 m
	Direct regulatory fees and charges						
	Direct enforcement costs						
	Indirect costs						

(2) Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

² One FTE is EUR 95 400/year

2.2. Spectrum

I. Overview of Benefits (Spectrum) – Preferred Option		
<i>Description</i>	<i>Amount</i>	<i>Comments</i>
Direct benefits		
Compliance cost reduction	Not quantified	Businesses (especially SMEs and non-MNOs) benefit from reduced legal/advisory burden and simpler access to harmonised spectrum via more flexible licensing and spectrum sharing. In the long term, fewer auctions and greater use of licence renewals can ease administrative workload for both operators and public authorities, improving planning certainty and lowering transaction costs.
Improved service quality and availability for end users	Not quantified	End users, especially in rural/underserved areas, benefit indirectly from faster rollout, broader service options, higher QoS and higher coverage of high-quality networks enabled by investment oriented licensing conditions, local licensing and shared access. For consumers, better response to interference translates into improved connectivity, especially in cross-border areas.
Increased competition	Not quantified	The preferred option adapts certain eligibility restrictions that previously limited participation in spectrum awards (e.g. requirements linked to network coverage or service provision), which enables wholesale-only operators and new entrants to gain better access to spectrum; this stimulates service competition and service diversification.
Reduced spectrum underutilisation	Not quantified	Wholesale-only operators and NCAs benefit from enforced use-it-or-share-it-or-lose-it and shared access rules, unlocking unused capacity in mid-bands. In addition, it enables the use of spectrum by resolving cross-border interference issues, both within the EU and with third countries (mainly along external land borders), thereby preventing related service disruptions.
Indirect benefits		
Increased GDP thanks to higher QoS/speed due to	The preferred Option would lead to an overall GDP increase over 10 years (2025-2035) of EUR 1,553 billion compared to 1 480 of the baseline. A sensitivity analysis	The GDP increase calculated by the model is only a partial representation of the measure impact since it does not take into account the spill-over effects on vertical sectors (like for

increased mid band coverage	accounting for potential uncertainties of the model yields a GDP impact ranging from EUR 179 to EUR 2,116 billion, with the lower bound reflecting model conservatism and the upper bound representing upside potential from increased 5G mobile broadband speeds.	example healthcare, manufacturing, automotive and transport, energy and environment and agriculture) and the additional gains linked to the timely deployment of 6G. See qualitative description below.
Accelerated shift from 5G to 6G	Not quantified	Early standardisation efforts and research roadmaps indicate that 6G is expected to enable enhanced capabilities such as real-time distributed intelligence, ultra-low latency, integrated sensing and communication, and improved energy efficiency—all of which may generate cross-sectoral economic benefits similar or even superior to those observed for 5G.
Innovation acceleration	Not quantified	Industry (verticals, SMEs, R&D actors) benefits from enhanced 5G QoS and specialised services offers and from access to localised/licensed spectrum for innovative services (e.g. private 5G, IoT), particularly in manufacturing, health, agriculture, and transport and from the capacity to scale up thanks to the harmonisation of authorisation conditions.
Improved legal certainty	Not quantified	NCAs, industry, and Commission benefit from clearer, more predictable procedures through EU-level licensing guidance and stakeholder petition mechanisms.
Lower entry barriers for SMEs	Not quantified	Simplified and more flexible access regimes and harmonisation of authorisation conditions reduce administrative and regulatory burdens for SMEs entering niche or local spectrum markets.
Potential green benefits (indirect) Reduction in CO ₂ emissions	Marginal The ecological footprint of 5G mobile networks under the preferred Option would lead to 5,250,198 CO _{2e} mobile / wireless broadband network emissions which is lower than the 5,257,074 t CO _{2e} under the baseline. When monetised, environmental impacts under the preferred Option are estimated at around EUR 4.62 billion, compared to EUR 4.63 billion under the baseline, a marginal improvement. (See Annex 4, Section 2 for methodology and findings). The options show an average of over 96% reduction from 2025 to 2035, due to significant decrease in electricity	Reduction on CO ₂ is marginal compared to baseline; however the model presents only part of the environmental benefits. Additional gains are expected from 6G. Potential for smart systems (e.g. connected transport or logistics) through IoT and private 5G. The preferred option will further accelerate deployment of future mobile generations like 6G that are being designed with energy efficiency and renewable energy integration as core principles and should therefore favourably impact energy efficiency.

	consumption per gigabyte linked to new mobile technologies, however the difference between the baseline and the preferred option is negligible.	
Push toward innovative spectrum sharing solutions	Not quantified	The preferred option supports the uptake of advanced sharing mechanisms (e.g. dynamic spectrum access, AI-based coordination), unlocking additional efficiencies and supporting coexistence in dense spectrum environments.
Petition mechanism supports harmonisation for innovators	Not quantified	The stakeholder petition mechanism empowers innovators (e.g. in satellite-IoT or non-terrestrial networks) to request harmonised spectrum access at EU level, enabling timely deployment of emerging technologies.

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate in the comments column which stakeholder group is the main recipient of the benefit; (3) For reductions in regulatory costs, please describe in the comments column the details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.;).

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Action (a)	Direct adjustment costs	–	–	Low (procedural adaptation for SMEs and verticals engaging in new models)	Low (adaptation to new licence types and petition processes)	Moderate (NCAs and EC – setup of spectrum scrutiny system, EU spectrum strategy and spectrum roadmaps and national roadmaps, petition system, shared dynamic geolocation database,)	Moderate (continued adaptation to EC recommendations and decisions addressing authorisation process aspects and conditions, authorisation regimes, spectrum Single Market procedure, updating EU spectrum strategy /roadmaps and national roadmaps, including after successful petition) At EU level for all spectrum measures (listed above and also including satellite

							spectrum authorisation below) a progressive yearly growth to additional 10 FTE for EC (approx. EUR 768,000) and 15 FTE for BERECE Office (approx. EUR 1.8 m in the first year up to EUR 3.4 m in year 2034) is to be considered and is quantified in the governance section.
	Direct administrative costs	–	–	–	–	Moderate (public consultation, review of petitions, spectrum scrutiny implementation)	Moderate (licensing support and stakeholder engagement, contribution to RSPG-work,)
	Direct regulatory fees and charges	–	–	–	–	–	Low (spectrum levies may slightly increase to cover NCA admin tasks)
	Direct enforcement costs	–	–	–	–	Moderate (monitoring compliance with sharing and use-it-or-lose-it rules, with harmonising recommendation and decisions)	Moderate (investigation,)

- (3) Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

2.3. Authorisation

I. Overview of Benefits (Authorisation) – Preferred Option		
Description	Amount	Comments

Direct benefits		
Streamlined and harmonised system for general authorisation (single ‘passport’) and EU authorisation for satellite spectrum assignment across the EU	Providers benefit from single passport/declaration (authorising the provision of networks and services, which is valid in all 27 Member States). Those providing pan-European or global constellations transitioning from 27 separate authorisations to a single one. - Savings linked to complying with one single set of authorisation conditions and avoided duplication (1 procedure instead of 27) - Avoided lost revenues due to possible delays in authorisation in some MS (examples of possible savings) - Increased consumer benefit - No coverage gaps (EU continuous connectivity) because of lack of authorisation in some MS.	EU selection for satellite services in cases of spectrum scarcity (access under EU general authorisation in case of no scarcity). EU assignment of satellite spectrum management will also address the regulatory fragmentation that has been acute in the MSS 2 GHz band. Easier access to satellite spectrum will be of value not only for new market entrants, who need to face complex and lengthy requirement in some MS, but also for established firms
More effective enforcement of satellite rules for all players	Providers benefit from a level playing field where all providers respect rules (e.g. ITU rules on interferences)	The coordinated enforcement mechanism of satellite rules ensures stronger enforcement and quicker solutions of harmful interferences issues.
Indirect benefits		
Reduced administrative burden	Not quantified	For authorisation use of a centralised BEREC database and mandatory notification template will reduce administrative burdens and compliance costs for providers, particularly SMEs and satellite operators. Reduced burden and swifter resolution of potential disputes, especially in the area of IP peering through the voluntary conciliation mechanism. For satellite, it will be reduced regulatory burden as there will be only EU-level authorisation decisions; consistency could improve the internal market. Reduce burden will not only affect authorisations but also compliance and enforcement of competences, operators and other national competent authorities will benefit from it.
Innovation acceleration	Not quantified	More innovation (creation of new services and solutions) by all ECN/ECS providers, More investments towards new services, including New Space, and technologies (e.g. 5G/6G, XR, services requiring low-latency, such as automated driving etc.) by ECN/ECS providers and LEO operators.

Improved legal certainty	Not quantified	Since the Commission will directly manage authorisation processes, it should be well positioned to ensure consistent and predictable time frames for transition for existing bands and innovative New Space D2D services, including the 2 GHz band. A more predictable regulatory environment and higher investments will lead to more RDI activity by all companies.
More choice in services offered, more competition	Not quantified	New services are likely to appear due to increased innovation increasing the choice for (end-)users. A more predictable regulatory environment attracts more companies to the market, especially SMEs, including New Space SMEs

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate in the comments column which stakeholder group is the main recipient of the benefit; (3) For reductions in regulatory costs, please describe in the comments column the details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.).

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Action (a)							At EU level for all spectrum measures (including terrestrial authorisation above) a progressive growth to additional 10 FTE for EC and 15 FTE for BEREC Office is to be considered and is quantified in the governance section.
	Direct administrative costs			Satellite providers in multi-Member States,	Low recurrent costs of monitoring/	For satellite authorisation s: one-off costs to establish new	Substantial costs due to EU-level authorisation and, in the

				modest one-off costs to adapt to harmonised conditions.	information exchange	coordination mechanisms. And one-off transition costs to Member States	case of spectrum scarcity for satellite providers, selection, spectrum assignment, monitoring.
	Direct regulatory fees and charges			Satellite operators will no longer pay multiple fees and administrative charges; instead, a single fee and administrative charge will be paid to one European Authority		Fee collection and administrative charges will be transferred from competent national authorities to the European Authority	
	Direct enforcement costs			Satellite operators will be able to establish dedicated teams focused on enforcement, responding to requests from a single organisation. This streamlined approach will reduce internal regulatory compliance costs.		Increased costs due to EU-level selection, general, spectrum assignment, monitoring and enforcement	EU substantial costs for enforcement responsibilities
	Indirect costs						

1. Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

2.4. Regulatory governance

I. Overview of Benefits (Regulatory governance) – Preferred Option		
Description	Amount	Comments
Direct benefits		
Costs savings for EU budget	Costs savings / increased efficiency by transfer of administrative and substantive responsibilities to BEREC Office and RSPG. This Option would also reduce direct costs for the Commission (albeit with limited effect on the EU budget).	Expected direct cost savings are moderate, but could be amplified by increase in task linked to DNA
Costs savings for MS budget	Cost savings due to transfer to certain cross-border decisions to the EU level. The BEREC Office would take on more ‘substance-related’ responsibilities and this would relieve some of the pressure on NRAs. In view of the above, it is estimated that in preferred Option, NRAs’ costs would increase only incrementally, notwithstanding the need for their increased collaboration in BEREC.	Expected direct cost savings are moderate, but could be amplified by increase in task linked to DNA
Indirect benefits		
Regulatory outcomes	Enhanced harmonisation due to increased decision-making power by EC and BEREC Office as a fully-fledged agency, and RPSG as an independent advisor.	More consistent regulatory outcomes across MS ultimately contributes to increased harmonisation / level playing field for market operators, and reduction of compliance costs for economic operators.
Market development	Further empowerment of NRAs and NCA, contributing to enhanced market development	Ultimately leads to lower compliance costs for cross-border operators, and in terms of satellite spectrum/EU authorisation fosters innovation and investment in new technologies.

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate in the comments column which stakeholder group is the main recipient of the benefit; (3) For reductions in regulatory costs, please describe in the comments column the details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.).

II. Overview of costs – Preferred option						
		Citizens/Consumers		Businesses		Administrations
		One-off	Recurrent	One-off	Recurrent	One-off Recurrent
Action (a)	Direct adjustment costs					EC: limited one-off costs for transition to a new model. BEREC Office, supporting RSPG: moderate one-off costs for adaptation to new role. The BEREC Office would be strengthened by recurrent 25 FTEs to fulfil new tasks, including support to the COM and RSPG (currently BEREC Office has staff 48 FTEs). The annual cost of new BEREC Office is estimated for approx. EUR 12 m (currently EUR 8.1 m). 10 FTEs estimated to cover additional tasks by the COM.

	Direct administrative costs						Participating costs in working groups for NRAs and CAs expected for i) BEREC: EUR 26 400 per year (corresponding with c.a. 550 hours), ii) Member States: EUR 5 500 (corresponding to 115 hours).
	Direct regulatory fees and charges						Fees (ranging between EUR 2.3 m in 2028 to EUR 5.2 m in 2034) are considered for satellite spectrum authorisation, and, if available, fees for the rights of use of pan-European numbering resources. The satellite fees are linked to the spectrum fees linked to procedures for upcoming EU-level spectrum assignment/extension/renewals established in the DNA and MSS (first procedure for 2 GHz MSS band expected to take place in 2027). As complement, if needed and operationally feasible, administrative charges/spectrum fees could be collected from undertakings subject to EU satellite authorisation after the entry into force of the DNA.
	Direct enforcement costs						
	Indirect costs						

1. Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

3. APPLICATION OF ‘ONE IN’ ‘ONE OUT’ APPROACH

III. Application of the ‘one in, one out’ approach – Preferred option(s)			
[million EUR]	One-off (annualised total net present value over the relevant period)	Recurrent (nominal values per year)	Total
Businesses			
New administrative burdens (INs)	Low (EUR 73 m) – FTTH and copper switch-off plans	Low (EUR 38 m) – Additional data gathering for forecasts and declarations	Low (EUR 73m one-off and EUR 38 m recurring)
Removed administrative burdens (OUTs)	Satellite: Administrative costs will be indicatively reduced around EUR 3.2 m across all MS	EUR 6-11 m yearly per operator, resulting an overall yearly EUR 60m cost saving, calculating with min. 10 operators.	EUR 6-11 m yearly per operator. Resulting an overall EUR 60 m cost saving Satellite: Administrative costs will be indicatively reduced around EUR 3.2 m across all MS
Net administrative burdens*	-	Negative (Net OUT_	Negative (Net OUT)
Adjustment costs**		-	-
Citizens			
New administrative burdens (INs)	0	0	0
Removed administrative burdens (OUTs)	0	0	0
Net administrative burdens*	0	0	0
Adjustment costs**	0	0	0
Total administrative burdens***	+EUR 73 m	Negative (Net OUT)	Negative (Net OUT)

4. RELEVANT SUSTAINABLE DEVELOPMENT GOALS

IV. Overview of relevant Sustainable Development Goals – Preferred Option(s)			
Relevant SDG	Expected progress towards the Goal	Comments	
Relevant Green Deal compliance with EU	The preferred option of the transition to fibre switch-off initiatives will result in 4 %	In addition to energy and CO2 savings, the copper switch-off may have other	

Climate targets and contributing EU policies	decrease in CO2 emission (compared to Option 0) over the period 2025-2035	environmental benefits such as mitigation of water pollution.

ANNEX 4: ANALYTICAL METHODS

This Annex describes the analytical methodology used to estimate the socio economic and environmental impacts of the policy options assessed under the Digital Networks Act (DNA), both for options affecting fix networks deployment (Section 1) and high-quality mobile network deployment (Section 2). The Annex also presents in Section 3 the methodology for the regression analysis analysing possible links between regulatory approaches and market outcomes.

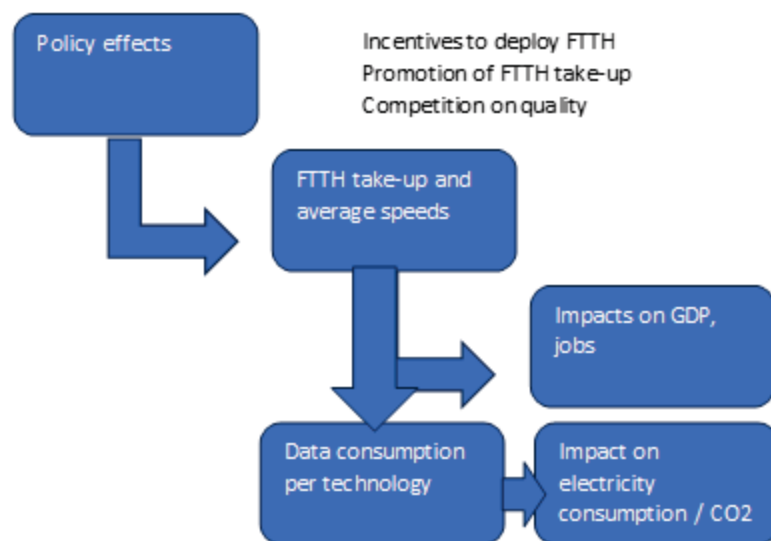
The description is based on the studies accompanying the Impact Assessment for a Digital Networks Act” Study 2024-025 on "Completing the Digital Single Market (DSM): Regulatory enablers for cross border networks - FWC No FW-00141705; and Study 2024-026 on 'Review of Access Regulation under the European Electronic Communications Code and analysis of future Access policy in full fibre environment' - FwC No FW-00141705.

1 METHODOLOGY FOR THE DEMAND MODELLING AND QUANTITATIVE IMPACT ASSESSMENT OF THE COPPER-SWITCH-OFF AND ACCESS OPTIONS

1.1 Analytical approach to the socio-economic and environmental Impact Assessment

The quantification of economic and environmental impacts of the different policy options for the Digital Networks Act is based on a 3-step process. This process is illustrated for fixed broadband in the diagram below.

Figure A4 1-1: Three-step approach to assessing socio-economic and environmental impacts



Source: WIK-Consult.

Impacts on coverage, take-up and competition

Each policy option is assessed in terms of its impacts on FTTH coverage and take-up as well as competition in broadband quality (via infrastructure competition where viable or otherwise access regulation permitting full differentiation). These impacts translate into projected increases on average download speeds (e.g. take-up of gigabit offers) and data consumption (per user and on aggregate).

Quantification of GDP impact

Expected changes in broadband speeds are linked with GDP impacts using coefficients derived from academic literature.

Quantification of environmental impact

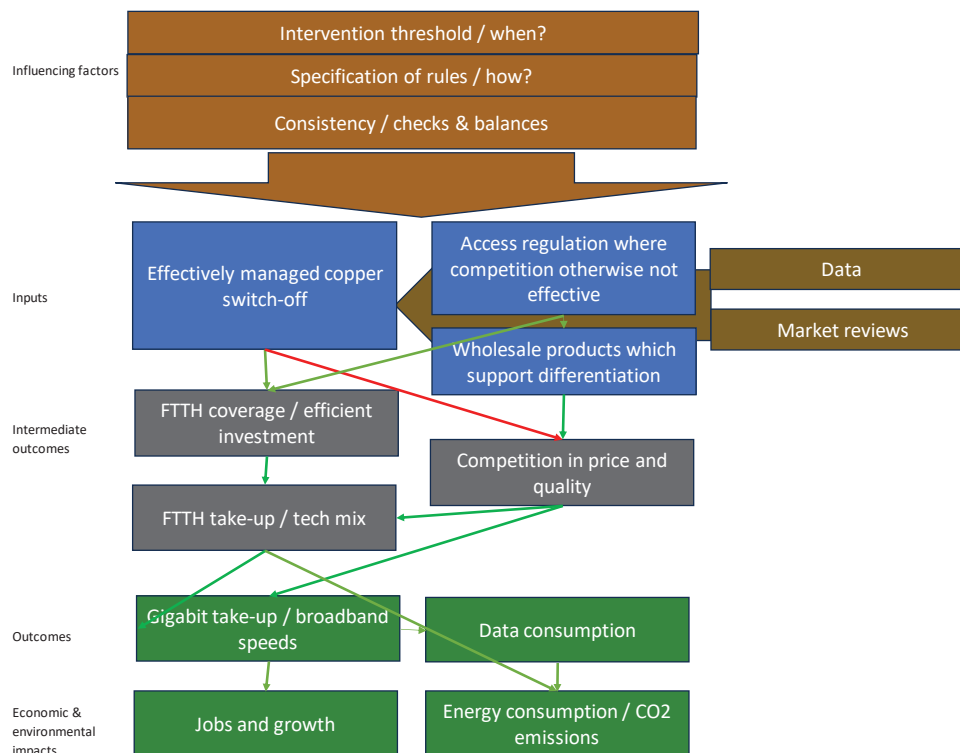
Expected changes in broadband speeds and data consumption result in changes to electricity consumption and CO2 emissions, based on technology-specific data.

1.2 Quantification of impact of the different options on FTTH coverage, take-up, average speeds and data consumption (all evidence combined in one document and summarised at the top)

This section elaborates on the assumptions, data sources and modelling parameters used to estimate impacts on GDP and CO2 emissions for fixed and mobile broadband.

The diagram below shows the intervention logic linking access policy options, outcomes and impacts.

Figure A4 1-2: Intervention logic linking policy initiatives with economic and environmental impacts



Source: WIK-Consult.

Based on the intervention logic, the table below provides an overview of the directional effects of the policy options on outcomes such as FTTH coverage, take-up and related factors. The different elements of each option are separated to indicate their directional effects (showed using + and -). These directional effects serve as inputs for quantifying the impacts of the entire option (on FTTH coverage and take-up, the wider technology mix, average speeds and data consumption).

The rationale for these assessments is provided in the subsequent sections.

The quantification of the impact of the options on FTTH coverage, FTTH take-up and penetration, average speeds and average data consumption is the basis for the estimates of GDP and environmental impact. The impact on GDP is calculated as a function of download speed, while for the environmental impact, CO2 emissions are calculated based on the share of subscribers by technology. The modelling also shows the data consumption per GB and the electricity intensity of the different options.

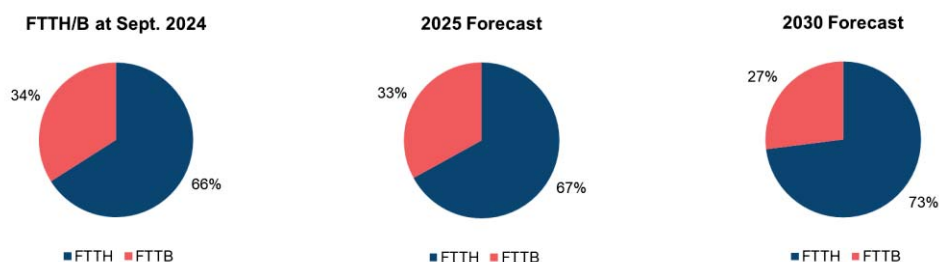
1.2.1 Impact on FTTH coverage

The projected effects of the policy options on FTTH coverage over time is shown in figure A4 1-3. The projections are based on the directional effects of the options.

The impact on coverage refers specifically to FTTH coverage and excludes FTTB using G.fast. Where relevant, FTTB/HFC is treated as cable coverage. Based on broadband coverage data differentiated by technology, on the number of subscribers differentiated FTTH and FTTB from the FTTH Council market panorama, on data of NRAs which have differentiated between technologies as well as FTTB and FTTH and on information about regulation of in-building telecommunications infrastructure (e.g. for building owners) it is possible to approximate in which countries FTTB means FTTB with HFC in the building or with G.fast/vectoring in the building.

According to FTTH Council forecasts, the share of FTTB in Europe is expected to reach 27% in 2030. In 2018, the FTTH Council forecasted a 36.2% share for 2025 but the latest data indicate a share of 34% in 2024 (see figure below).

Figure A4 1-3: FTTH/B Architecture Evolution from FTTB to FTTH

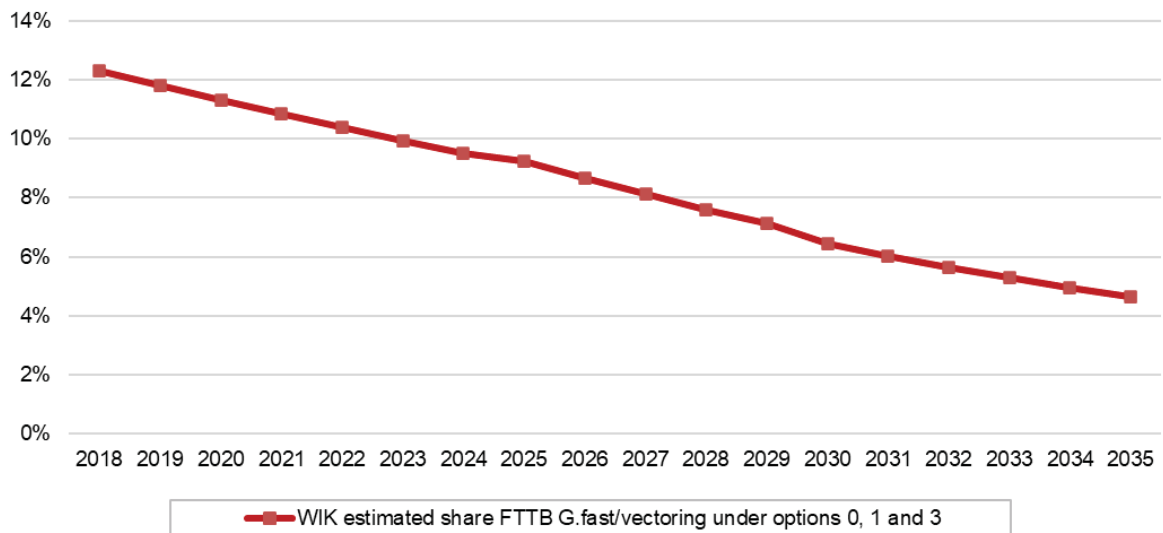


Source: FTTH Council (2025).³

A projection of the decline in FTTB until 2035 would result in an FTTB G.fast share of around 4% under options 0, 1 and 3. Under option 4, FTTB G.fast ceases to be relevant in 2030 due to the CSO provisions. Under option 2, FTTB G.fast becomes negligible by 2035 due to the mandatory copper switch-off (CSO) without a sustainability clause. The share of FTTB G.fast under options 0, 1 and 3 decreases gradually as shown in the figure below.

³ FTTH Council (2025): FTTH/B Forecast for Europe With thanks to European Market View FTTH Council Europe's Market Intelligence Committee, <https://www.ftthcouncil.eu/resources/all-publications-and-assets/2362/ftth-market-forecasts-2024-2030> (last accessed on 26.03.2025).

Figure A4 1-4: Development of share of FTTB G.fast



Source: WIK based on FTTH Council

Based on coverage and subscriber data, FTTB using G.fast/vectoring plays a significant role in five Member States (CZ, LT, EE, IT, SK), whereas in countries such as BE, DE and PL, FTTB with in-building HFC appears more prevalent.

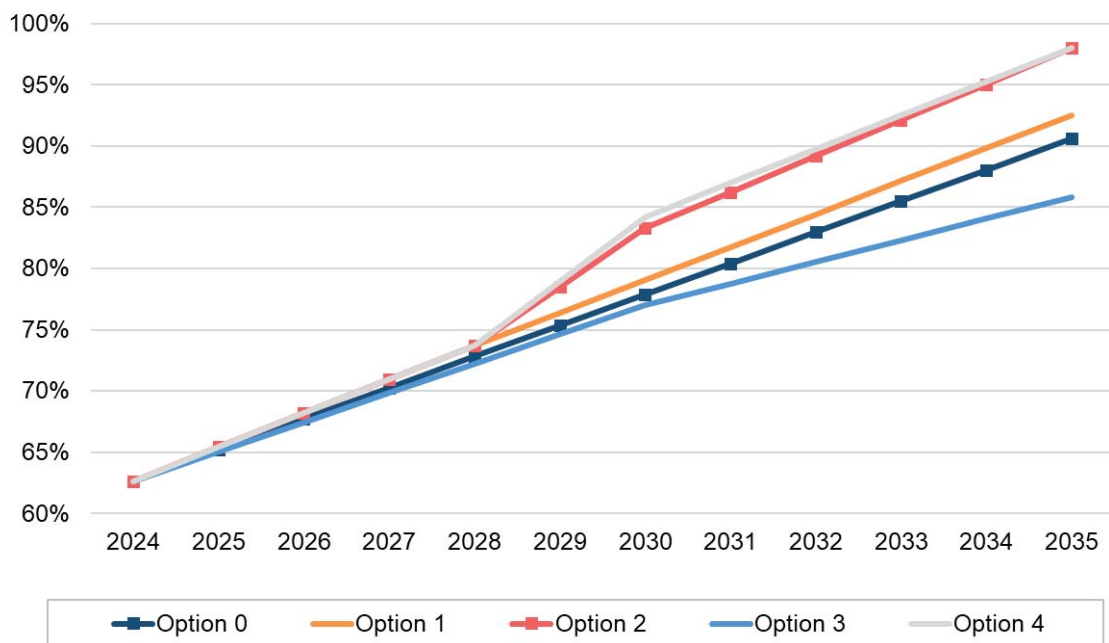
In practice, mobile or FWA technologies have been used as alternatives to FTTH to support connectivity in remote areas (e.g. Sweden and Estonia) following copper switch-off. This approach is also being discussed in countries that are further advanced in terms of fibre roll-out and copper switch-off.⁴ However, countries with less dispersed rural populations might opt for greater coverage with FTTH.

The highest FTTH coverage in 2030 is projected under options 2 and 4. Under option 4 accelerated fibre roll-out occurs until 2030 due to the mandatory CSO by 2030, complemented by SMP-based duct access obligation that supports alternative fibre deployment. The lowest FTTH coverage is projected under option 3, as the absence of a CSO target and more limited access to physical infrastructure reduce incentives for network roll-out.⁵

⁴ See WIK (2020): Copper switch-off: European experience and practical considerations https://www.wik.org/fileadmin/Studien/2020/Copper_switch-off_whitepaper.pdf.

⁵ This is based on the implications of this option for the conditions for SMP PIA, noting that SMP PIA is considerably more widely used than GIA PIA. GIA PIA is assumed not to compensate for the loss of SMP PIA as conditions for telecom PIA under GIA are less favourable, and the regime as a whole is based on dispute resolution rather than ex ante regulation, a mechanism that has been found to be less effective in addressing entrenched barriers associated with PIA.

Figure A4 1-5: FTTH coverage by option (this does not include measures to address the connectivity gap and USO yet)



Note: FTTB G.fast coverage under all options is not included in the FTTH coverage.

Source: WIK based on DESI dashboard for the Digital Decade (2023 onwards), <https://digital-decade-desi.digital-strategy.ec.europa.eu/s/dbXJPLz04nqNw/>

Table A4 1-1: FTTH coverage in 2030

Option 0	Option 1	Option 2	Option 3	Option 4
77.9%	79.1%	83.3%	77.0%	84.2%

Source: WIK.

Table A4 1-2: FTTH coverage in 2035

Option 0	Option 1	Option 2	Option 3	Option 4
90.6%	92,5%	98,0%	85,8%	98,0%

Source: WIK.

1.2.2 Impact on FTTH penetration and technology mix

FTTH penetration (FTTH subscriptions as a percent of households) differs across the policy options.

Option 1 is projected to increase FTTH penetration by a Compound Annual Growth Rate (CAGR) of approx. 5%, slightly above the 4% growth rate under the status quo.⁶

Option 4 is expected to have the strongest effect on FTTH penetration as it does not include a sustainability clause for the mandatory CSO.

Under option 2, which includes a sustainability clause, FTTH penetration is projected to be slightly lower than under option 4 at 78% in 2035, but still significantly higher than the status quo.

Under option 4, FTTH penetration increases sharply in 2030 due to the strict CSO deadline, resulting in the forced migration of customers who would otherwise have remained on copper. The mandatory CSO date is also likely to result in gaps in FTTH coverage in certain countries. In such cases, affected end-users would be migrated to other technologies in 2030 (mandatory CSO date), resulting in a higher share of FWA and 4G/5G mobile connections under option 4 compared to options 1 and 2. After 2030 the share of FWA and mobile 4G/5G decreases under option 4, as FTTH coverage and take-up continue to progress after the CSO. However, if more performant full 5G and 5G-based FWA technologies become available, customers may have reduced incentives to switch to FTTH once it becomes available, potentially weakening the FTTH business case. The extent to which these outcomes materialise remains uncertain.

ADSL is expected to be gradually phased out across the EU, as customers transition to FTTH, DOCSIS 3.1, FWA or 4G/5G mobile broadband. Given that DOCSIS 3.1 technology is capable of Gigabit download speeds (and DOCSIS 4.0 upgrades are planned in some countries as for example in the Netherlands⁷), cable take-up is expected to remain relatively stable in the near term, but decline over time as customers transition (or are upgraded by their existing cable operators) to more performant and energy efficient FTTH/B. Meanwhile FWA penetration is expected to increase from a low base as 5G FWA offers expand and replace DSL, in particular in less dense areas or in countries where FTTH/B is less widespread.

Projected FTTH penetration under options 1, 2 and 4 includes the impact of a “right to connectivity” for consumers in regions with close to full FTTH coverage. In such regions, the right to connectivity enables homes passed by fibre (within a distance defined by the competent authority) to be connected to FTTH at a standard tariff.⁸ This applies only to regions where the fibre network has been commercially rolled out.

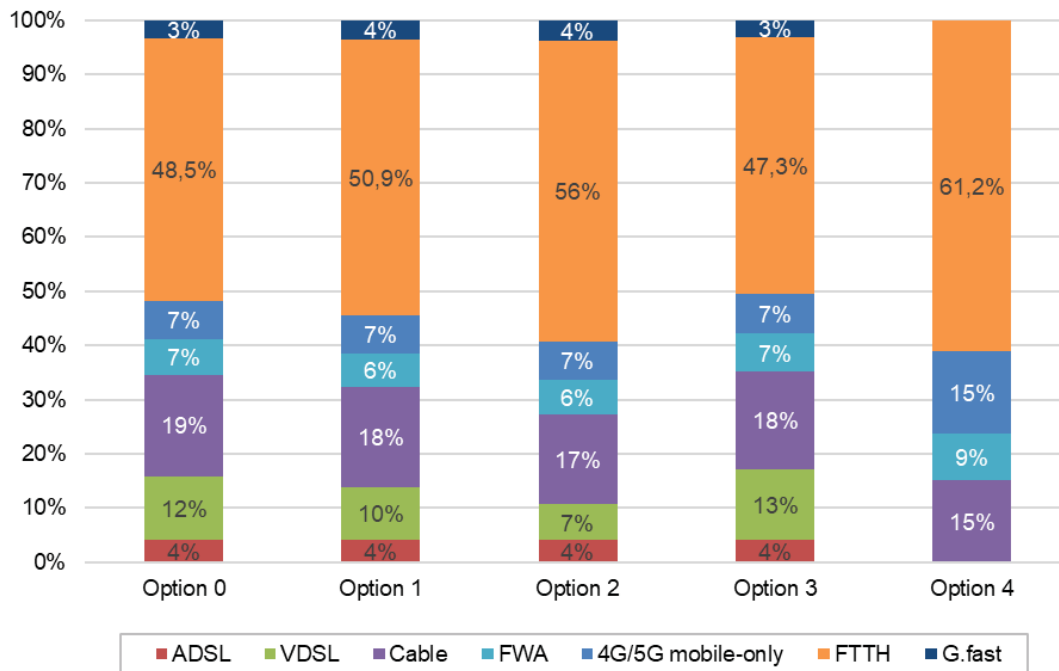
The graphs below show the technology mix (share of technology in % of households) including FTTH penetration associated with each option.

⁶ As regards take-up of FTTH, IDATE estimates that as of September 2024, there was a take-up rate of 55% (as a proportion of households served by fibre) across the EU27 and the UK. This was an increase of 2% pp on the previous year. IDATE projects that take-up rates of FTTH will increase to 70% of FTTH homes passed by 2030. IDATE (Sept 2020) FTTH/B Market panorama and IDATE (2021) European FTTH/B Historical and forecasts.

⁷ Study on Access Regulation.

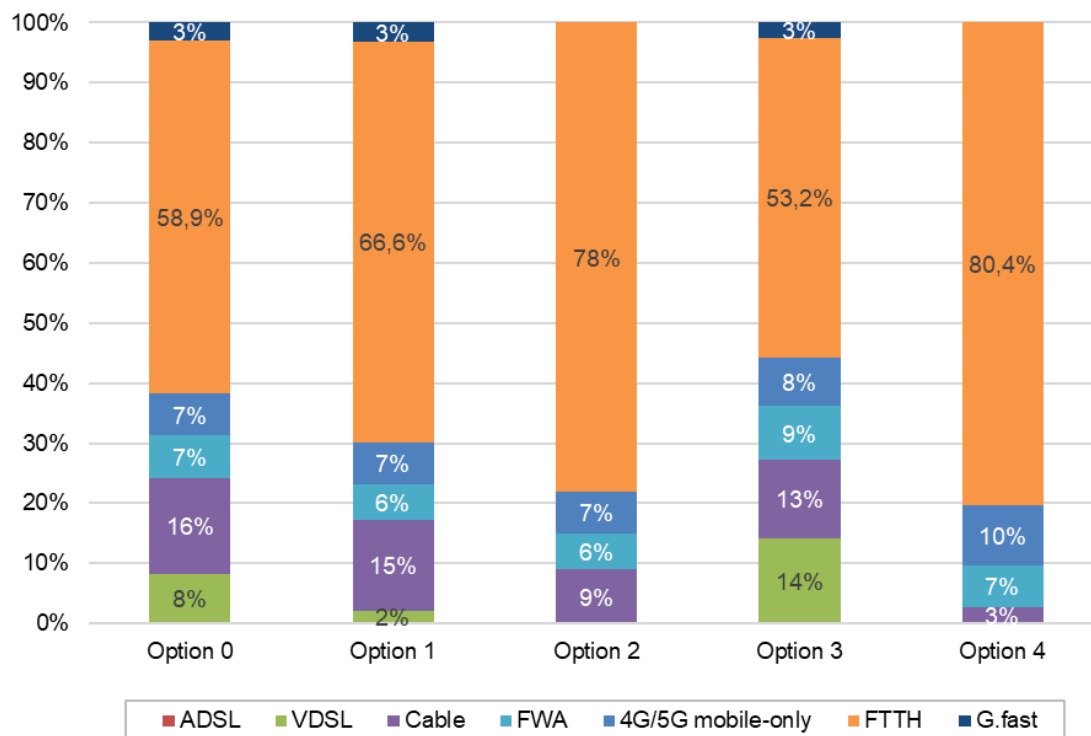
⁸ These assumption is based on empirical observations of the German fixed broadband market. See , page 19, Last Call 07.07.2025.

Figure A4 1-6: Technology shares by option in 2030 (in % of households)



Source: WIK-Consult.

Figure A4 1-7: Technology shares by option in 2035 (in % of households)



Source: WIK-Consult.

Universal Service Obligation

To estimate the impact of USO affordability measures on gigabit take-up among consumers with low incomes or special social needs, it was first analysed which Member States are likely to introduce affordability measures at a gigabit level for each option, and then estimate the subsequent take-up of those measures. Under option 1, no Member State is expected to define adequate broadband at a gigabit level.

As noted in earlier sections, the most popular tariff in France, Romania, Spain, Portugal, Ireland, Denmark, Hungary, Latvia and Luxembourg is expected to be a gigabit tariff by 2035. Consequently, the affordability measures imposed on consumers with low incomes and special social needs under option 2 will impact gigabit take-up in these Member States.

As option 3 phases out the affordability provision, this option will not have an impact on gigabit take-up.

Option 4 updates adequate broadband to a gigabit level by 2030. All Member States, except those addressing universal service entirely outside the USO regime are expected to implement affordability measures.

To estimate take-up of affordability measures, the analysis relies on the current proportion of consumers with low incomes or special social needs who benefit from these measures, as reported by the NRAs. Six NRAs have provided these figures:

Table A4 1-3: Beneficiaries of currently applied affordability measures for consumers with low income or special social needs (Ø 2021-2024)

	Belgium	Bulgaria	Cyprus	Czech Republic	Hungary	Spain	Ø
Total	200 529	115 379	25 853	27 065	9	19 186	64 670
% of HH	3.86%	4.04%	6.90%	0.59%	0.00%	0.10%	2.58%

Source: WIK-Consult calculation based on National bodies (Answers to the WIK-Consult questionnaire).

The average percentage of households benefiting from existing measures for people on low incomes and with special needs (2.58%) is used as a predictor of future take-up.⁹ This percentage is extrapolated to all Member States expected to introduce USO reaching a gigabit level. Where a gigabit connection is defined as adequate broadband, vulnerable consumers are assumed to receive affordability measures.

For the estimation, the take-up of affordability measures is assumed to grow linearly between 2030 and 2035. This assumption reflects several factors:

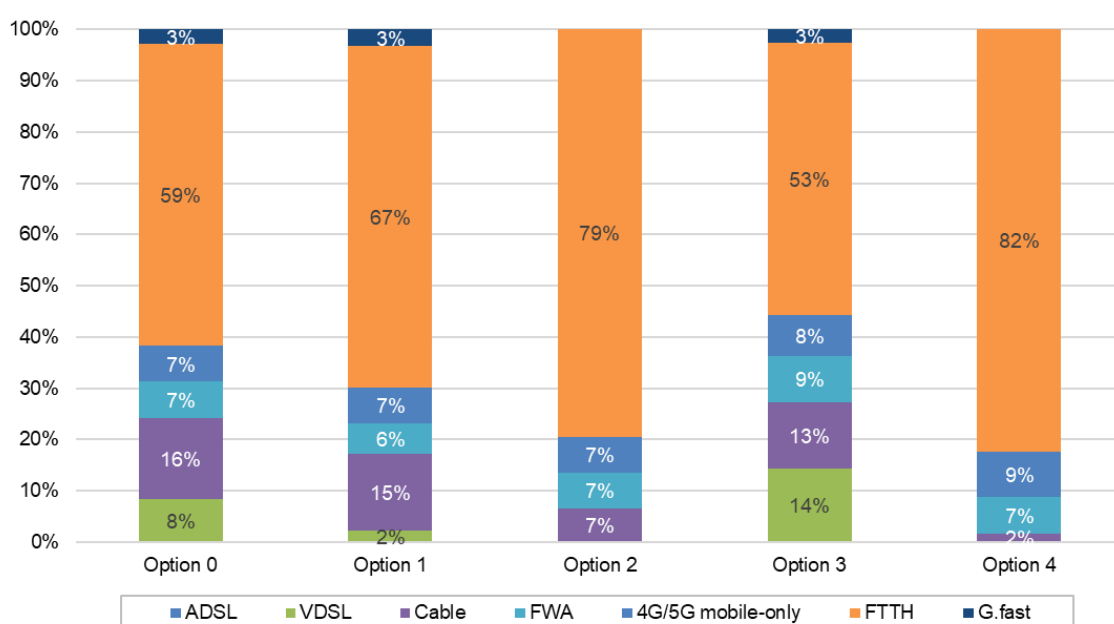
⁹ The estimator is based on historical data and total households, as it represents the best approximation. There are several factors that complicate an estimation based on the number of eligible consumers. Firstly, the definition of eligible consumers is the responsibility of the Member States and therefore varies. There is no EU-wide statistic that would represent this group of consumers. Secondly, statistics about unemployment or disabilities usually reference to the share of total population instead the share of households. Therefore, they do not allow conclusions to be made about take-up as a share of total households.

- Implementation of the amended USO regime in the Member States is expected to take time and not be simultaneous across all countries. While some Member States have already introduced affordability measures, others may need to develop new ones.
- Awareness of these measures among eligible consumers is expected to increase steadily.
- Some eligible consumers are likely to remain tied to their existing (non-gigabit) broadband subscription due to minimum contract terms, even where gigabit tariffs become more popular.

Under option 2, affordability measures at a gigabit level are expected to be introduced in nine Member States by 2035. This would lead to 1% increase in the FTTH penetration (in % of households).

Under option 4, most Member States are expected to introduce affordability measures at a gigabit level. This would have an impact on the FTTH penetration of 2%.

Figure A4 1-8: Technology mix by 2035 including USO



Source: WIK-Consult.

1.2.3 Impact on speed

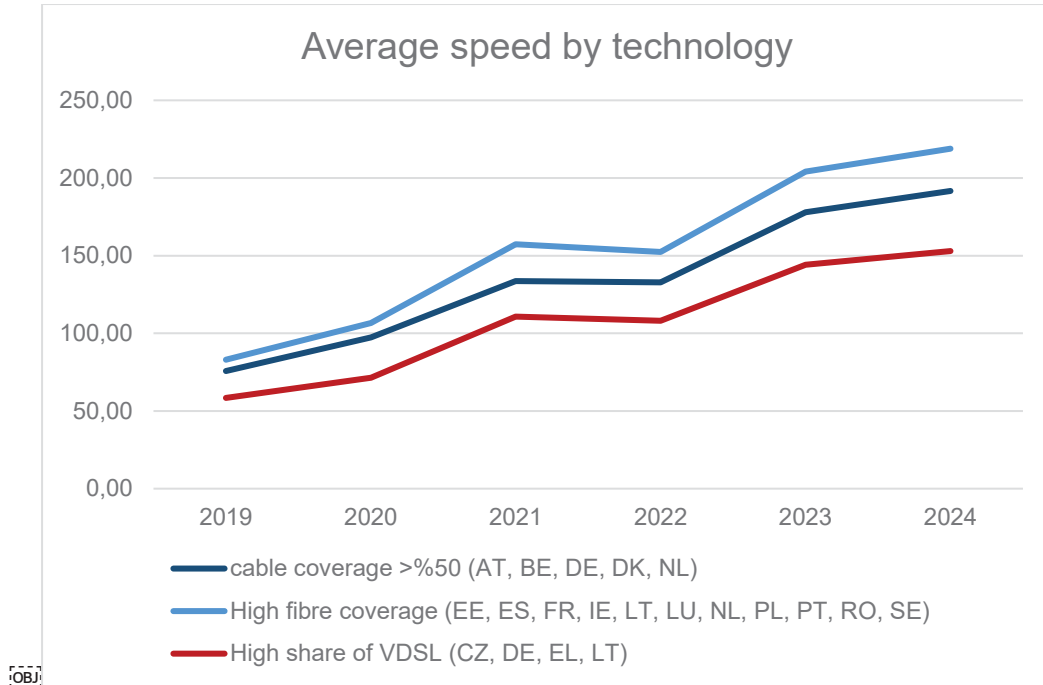
For the purpose of the impact assessment, actual speeds delivered over the different technologies are projected to evolve as follows:

- FTTC speeds will continue to increase from 100 Mbps by around 4%.
- Cable speeds will increase from 200 Mbps by 7%.
- ADSL speed will remain stable at 10 Mbps (based on the development of Ookla broadband speeds in countries with a high share of VDSL, cable and fibre respectively in terms of coverage and subscriptions).
- Fibre speeds will accelerate from 250 Mbps across all options until 2029 by 8% reflecting technological progress in active equipment associated with fibre lines. From 2030 onwards the growth rates differ with a growth rate which increases from 8 to 16% for option 2, 15% for options 1, 3 and 4 (with a faster increase under option 1 after 2030).

The evidence supporting these assumptions regarding average speeds by technology is elaborated below.

The figure below shows average broadband speeds today. These are shown by groups of countries based on the prevailing technologies in those countries.

Figure A4 1-9: Average Broadband speeds (in Mbps) for Member States grouped by technology



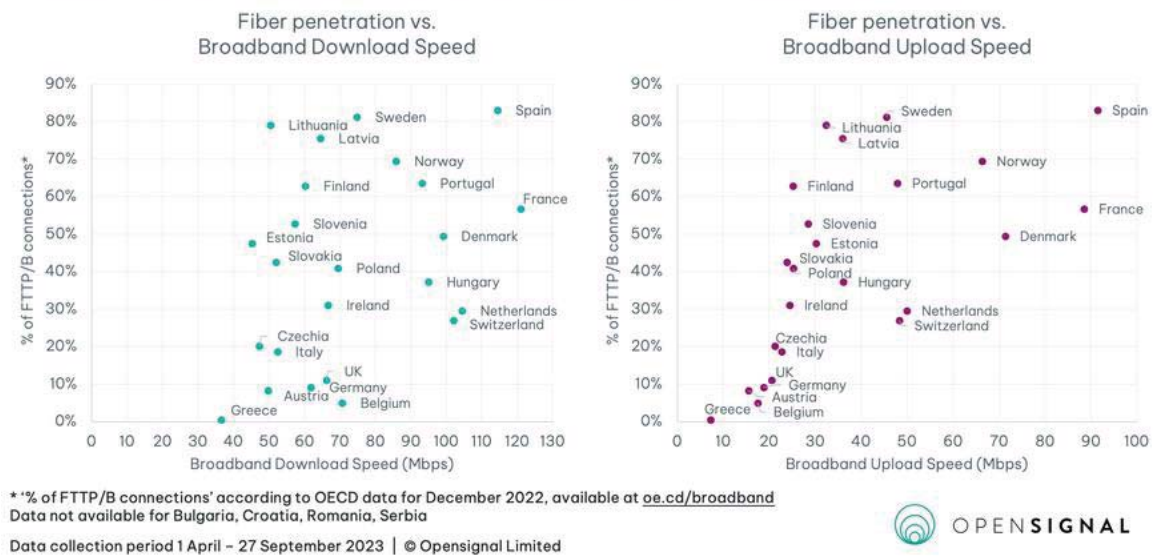
Source: WIK based on Ookla Speedtest data, European Commission (2025) and Ofcom.¹⁰

As shown in the chart above, higher fibre coverage is associated with higher average speeds but fibre penetration is a stronger predictor of average speeds. This is supported by data showing significantly higher average speeds in countries with higher FTTH penetration rate. For example, Openvault reports that fibre penetration is a strong indicator for internet speeds experienced by users. Openvault also points out the relevance of upload speeds which reflect particularly well the speeds experienced by users with a fibre connection. The figure below shows this relation for 2023.

¹⁰ Ookla Speedtest data retrieved from <https://www.balkanicaucaso.org/eng/Areas/Europe/EU-Internet-connections-are-getting-faster-and-faster-235091>; European Commission (2025), DESI dashboard for the Digital Decade (2023 onwards), <https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi/indicators> and Ofcom (2024) Connected Nations UK Report, the UK regulatory authority Ofcom, reports that in 2024, download speeds offered over ADSL were on average 14,8 Mbps and over FTTC 58 Mbps.

Figure A4 1-10: Fibre penetration and internet speeds

Fiber penetration in broadband markets is a strong indicator for internet speeds experienced by our users, particularly well reflected in upload speeds



Source: <https://www.opensignal.com/2023/10/12/european-markets-show-significant-disparity-in-broadband-user-experience> (last accessed on 01.07.2025)

Notably, the CTU in Czechia has corrected the data on speeds for cable networks to adapt to effective speeds (as compared to advertised speeds). The availability of gigabit was revised to exclude those cable connections which do not provide gigabit speeds.¹¹

A headline speed of 250 Mbps is assumed for FTTH, consistent with average fixed speeds observed in countries with a high FTTH penetration. Speeds provided via FTTH could accelerate further due to the evolution in the capabilities of the technology in general. However, speeds actually purchased and received depend not only on the take-up of FTTH but on the degree to which there is competition on quality either through infrastructure competition (where viable) or otherwise through wholesale product specifications such as unbundled fibre which allow competition on quality, as evidenced in countries such as France, Italy and (in relation to the availability of symmetric offers) Sweden.

As mentioned above, the assumed annual speed increase on fibre is 8% under all options until 2029. This reflects technological progress in active equipment associated with fibre lines. From 2030 onwards the growth rates differ to reflect the potential for competition on quality resulting from the policy options pursued. This leads to a growth rate rising from 8% to 16% for option 2, 15% for options 1, 3 and 4 (with a faster increase under option 1 after 2030).

The evolution of average broadband speeds differs across the policy options due to variation in Gigabit pricing, which reflects the extent of competition and the type of wholesale access products available. Passive wholesale products such as fibre unbundling enable greater competition, particularly in pricing, speed and innovation. As a result, the increase in broadband speeds could be highest under options 2, which include a provision for best practice specifications for fibre unbundling and VULA. However, the impact of these provisions depends on proactive regulatory

¹¹ CTU (2024): ZPRÁVA O VÝVOJI TRHU ELEKTRONICKÝCH KOMUNIKACÍ SE ZAMĚŘENÍM NA ROK 2023, p. 47, https://ctu.gov.cz/sites/default/files/obsah/stranky/472017/soubory/zovt_2023.pdf (last accessed on 01.08.2025).

action by NRAs. In contrast, bitstream is expected to be the predominant form of access under options 3 and 4.

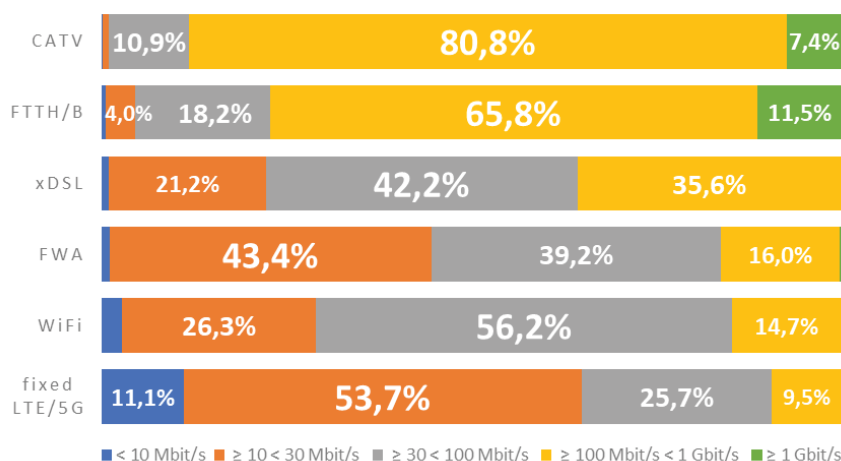
Speeds provided via FTTB G.fast are lower than FTTH and cable but higher than VDSL. An average speed of 150 Mbps is assumed, with an annual growth rate of 4% for FTTB G.fast.

Comparison of average speed by technology shows lower speeds on cable networks. An average speed of 200 Mbps is assumed, with an annual growth rate of 7% for cable networks.

Average broadband speeds via 4G/5G FWA are estimated at around 70 Mbps based on Ookla Speedtest results available for rural areas in the US from Verizon and T-Mobile.¹² In its 2025 Connected Nations report on planned network deployment in the UK Ofcom expects FWA networks offering at least 100 Mbps download speeds. In Denmark, the average marketed speed of FWA subscriptions was 78 Mbps. Average FWA speeds are estimated at around 120 Mbps in 2024. As FWA connections are progressively upgraded with (and new connections added based on) 5G, the average speeds are expected to increase by around 8% per year.

The CTU also reports internet access connections differentiated by technology and speed which include WiFi (unlicensed), FWA and mobile (see figures below).

Figure A4 1-11: Internet access differentiated by technology and speeds in the Czech Republic (2023)



Source: CTU (2025).¹³

An average mobile broadband speed of 100 Mbps is assumed, based on the average mobile download speed of 124 Mbps in the EU-27 in 2025 reported by Ookla.¹⁴ The assumed speed is lower because mobile broadband is likely to be more relevant in rural areas, and Opensignal data indicates a gap of ca. 20% between mobile broadband speeds in urban and rural areas.¹⁵

Where customers can migrate to cable, the effective speeds are likely to increase compared with copper. However, where only mobile or FWA is available, speeds are likely to be lower. Depending

¹² <https://www.ookla.com/articles/fixed-wireless-access-us-q3-2023>.

¹³ CTU (2024): ZPRÁVA O VÝVOJI TRHU ELEKTRONICKÝCH KOMUNIKACÍ SE ZAMĚŘENÍM NA ROK 2023, p. 53, https://ctu.gov.cz/sites/default/files/obsah/stranky/472017/soubory/zovt_2023.pdf (last accessed on 01.08.2025).

¹⁴ <https://www.speedtest.net/global-index> (last access on 03.07.2025).

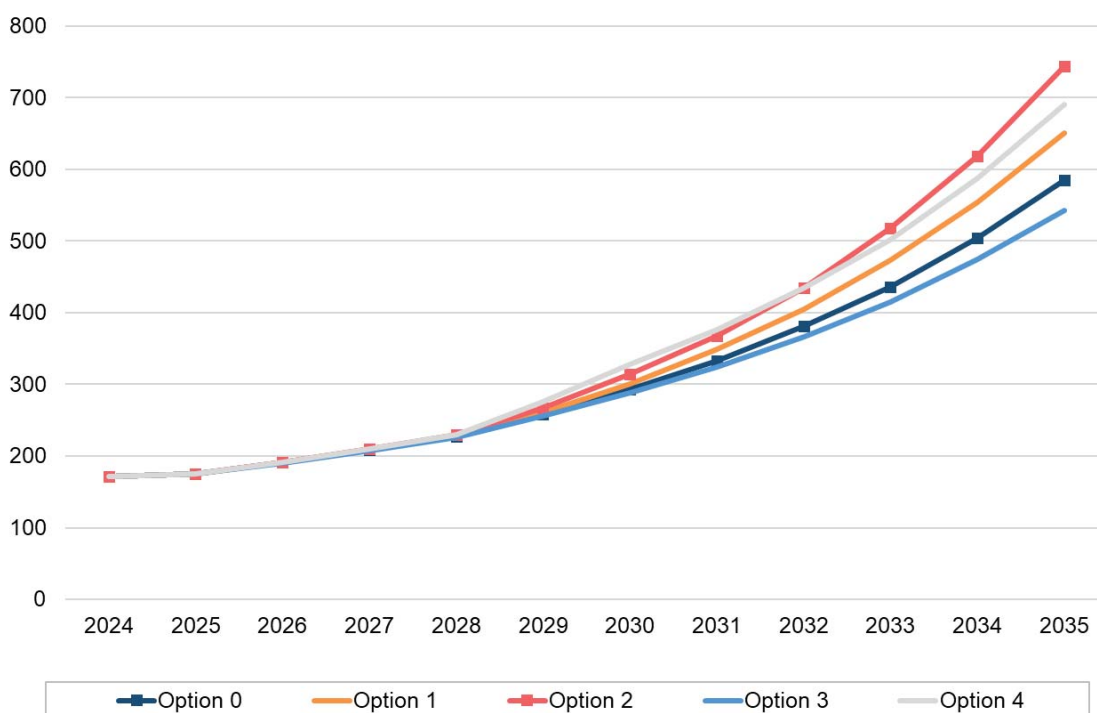
¹⁵ See <https://www.opensignal.com/2024/05/07/frances-urban-rural-mobile-experience-gap-has-narrowed-with-5g> (last accessed on 03.07.2025).

on the mobile and FWA technology available, speed and reliability may be less than under the status quo with copper for these customers. If more performant full 5G and 5G FWA technologies are available, customers may experience increased performance compared with copper. In the mobile impact assessment growth rates of 6% for 5G average speeds are assumed resulting in bandwidths of 250 Mbps in 2035. However, in the case of in-building usage of 5G for stationary access to the internet, the increased performance can only be achieved to serve households and businesses based on dense fibre networks which are deployed at least to the building. In particular in modern buildings which are energy efficient (e.g. with thermal insulation) the indoor signal reception deteriorates and reduces bandwidths and latency significantly. In case fibre is deployed to the building and the network operators decides to use wireless technologies in the building, WiFi 6 is more efficient. As explained, mobile broadband is likely to be more relevant in less dense and rural areas where fibre networks are less dense. As a result, lower bandwidths have been assumed for mobile networks.

The implications of each policy option on the average download speeds are shown in the following figure. The measures related to access regulation under option 2 are assumed to accelerate take-up of gigabit speeds.

Average download speeds across the EU are expected to reach around 743 Mbps under option 2 by 2035. Average speeds under the other options are projected between 500 and 700 Mbps, which is not significantly higher than the base case. Option 4 would reach speeds of 691 Mbps. With 542 Mbps, Option 3 would result in lower speeds in 2035 than the evolution of average speeds under the status quo, due to limits on SMP PIA impeding FTTH deployment and limitations on access regulation that may not address all cases of ineffective competition and do not reward or require forms of wholesale access that support competition based on quality.

Figure A4 1-12: Projected average download speeds by option (in Mbps)



Source: WIK-Consult

Table A4 1-4: Projected average download speeds by option in 2030 (Mbps)

Option 0	Option 1	Option 2	Option 3	Option 4
293	301	314	288	328

Source: WIK.

Table A4 1-5: Projected average download speeds by option in 2035 (Mbps)

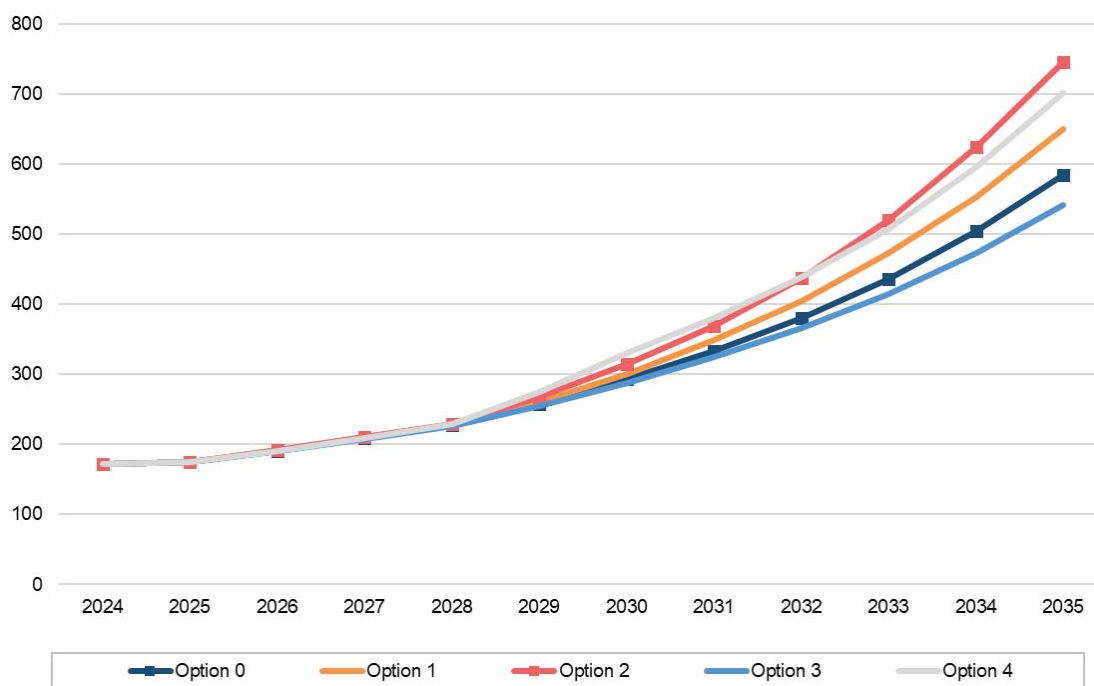
Option 0	Option 1	Option 2	Option 3	Option 4
584	651	743	542	691

Source: WIK.

The figure below shows the implications for average actual download speeds experienced by consumers of the options including the impact of universal service obligation. Under option 2, including USO, the average download speed across the EU would be expected to reach around 746 Mbps by 2035 — an impact of around 2 Mbps from the USO. By comparison, the impact of USO on option 4 is 10 Mbps.

Universal Service Obligation

Figure A4 1-13: Projected download speeds (in Mbps) by option including USO



Source: WIK-Consult

1.2.4 Impact on data consumption

There is relatively little information available that distinguishes between the bandwidth used by customers with DSL connections and that used by customers with cable or FTTH connections. However, there is a recognised link between the download speed and overall data consumption.

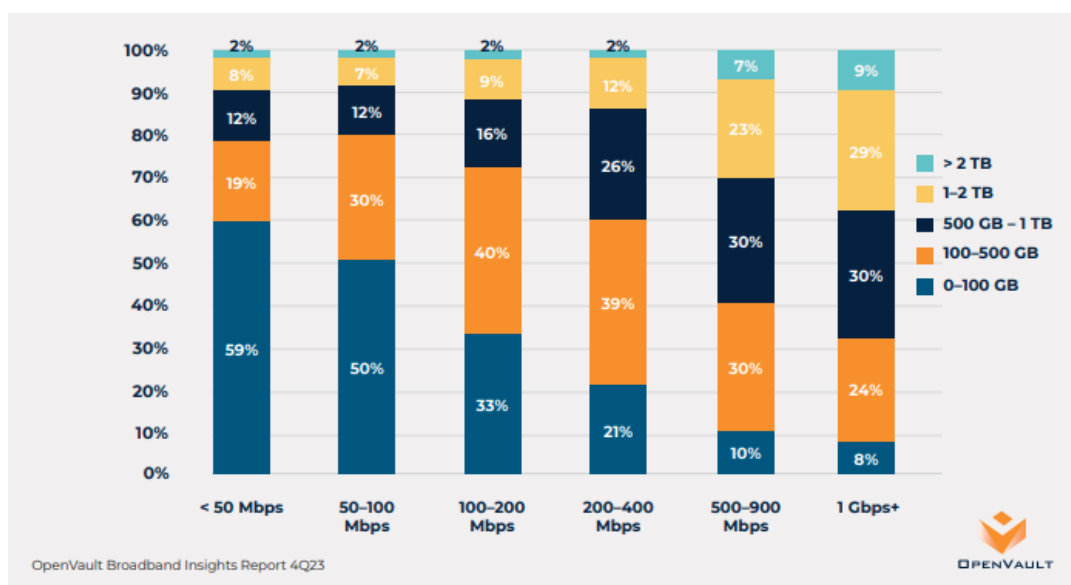
Extrapolating from the distribution of broadband connections in Austria, Belgium, Denmark, Ireland, Germany, Portugal and the UK, ADSL users account for approximately 40 GB of data consumption per month, while cable users consume up to 450 GB. For FTTH, average monthly consumption is assumed at 600 GB, based on the relation between broadband speeds (see below) and average consumption in countries with high fibre take-up.

Data consumption for FWA is estimated as a function of its relative speeds compared with FTTC, which can be considered the nearest in technological performance today. Projections are developed by increasing consumption in line with anticipated speed growth for the different technologies

Evidence on the link between download speed and overall data consumption is discussed below.

As regards absolute consumption, OpenVault reports that at the end of 2023 the average household's usage was 641 GB, up from 587 GB in the previous year.¹⁶

Figure A4 1-14: Data usage by provisioned speed tier – 4Q 2023 (Openvault)

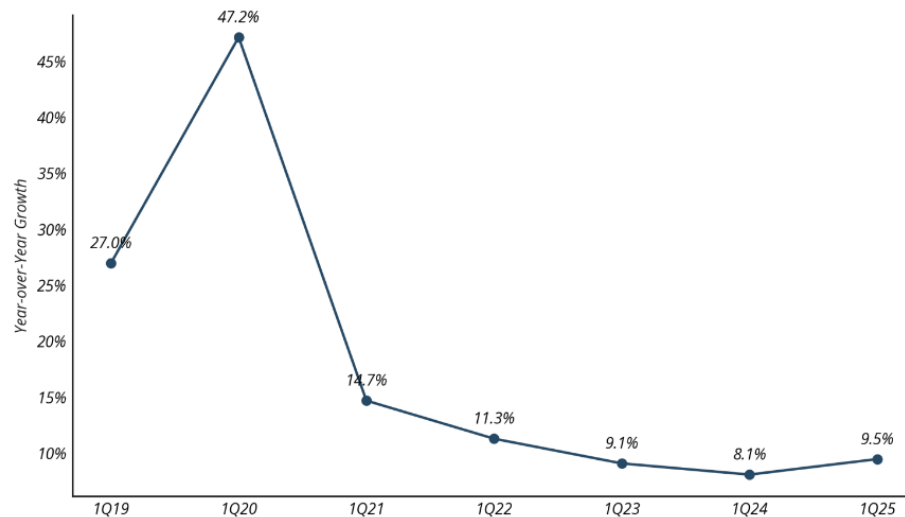


Source: Openvault (2023): Broadband Insights Report (OVBI) 4Q23, https://openvault.com/wp-content/uploads/2024/02/OVBI_4Q23_Report_v3.pdf

Openvault also highlights in its Q1 2025 Broadband Insights that after growing by nearly 50% during the pandemic year of 2020, the rate of growth for average daily consumption declined steadily in the ensuing years but in Q1 2025 not only rebounded but also accelerated with a 9.5% growth rate.

¹⁶ https://openvault.com/wp-content/uploads/2024/02/OVBI_4Q23_Report_v3.pdf.

Figure A4 1-15: Year-over-Year global average usage growth



Source: Openvault (2025): A Boom in Business and a Peek at Peaks, OpenVault Broadband Insights.

FTTH networks offer higher speeds than legacy networks. Higher FTTH coverage is associated with higher fixed data consumption. Countries with more than 80% FTTP coverage (Spain, Portugal, Latvia, Lithuania, Bulgaria) are also in the top quartile of high FTTP penetration and overall high fixed data usage (GB/month). Belgium and Denmark, which have high cable coverage, exhibit consumption patterns similar to FTTP countries, with high level of fixed data usage. Conversely, countries with low FTTP tend to show lower fixed data consumption.¹⁷

The same report notes that FTTH subscribers tend to use more data-intensive applications, and that data consumption typically doubles when a customer is upgraded from xDSL to FTTP.

Data from Ofcom on the average monthly data usage per connection in the UK shows that the data usage for full-fibre connections is significantly higher than the average monthly data usage over all connections.

Table A4 1-6: Average monthly data usage per connection GB in the UK (2024)

	Average monthly data usage per connection (GB)	
	All connections	Full-fibre connections
England	539	805
Northern Ireland	510	589
Scotland	480	627
Wales	508	646
UK	531	766

Source: Ofcom analysis of provider data (July 2024). Data usage is the total data downloaded and uploaded over the broadband connection during July 2024. Due to a change in methodology, this usage data is not directly comparable with usage data reported in previous years.¹⁸

¹⁷ <https://www.adlittle.com/en/insights/report/evolution-data-growth-europe>.

¹⁸ Ofcom (2024): Connected Nations UK Report 2024, p. 14, <https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/multi-sector/infrastructure-research/connected-nations-2024/connected-nations-uk-report-2024.pdf?v=386497>.

According to Ofcom's current market review¹⁹, consumers in the UK – who tend to have higher levels of broadband usage than in other European countries - consumed 535 GB per connection in 2024, up from 453 GB in the previous year. Consumers with FTTP connections have higher data usage than those using other broadband technologies, with an average of 766 GB per month for FTTP connections.²⁰

The quantification of average monthly bandwidth consumption for the different options shows the following results:

- Under the status quo, average monthly bandwidth consumption is projected to increase threefold within 10 years (from around 400 GB in 2025 to 1 371 GB in 2035).
- Under option 2, the results show a fourfold increase (from 400 GB to 1 768 GB).
- Under option 3, there is a threefold increase (from 400 GB to 1 266 GB),
- Under options 1 and 4, the increase is fourfold (from 400 GB to 1 535 and 1 642 GB respectively).

The different technology shares under the policy options are expected to affect total data consumption as shown in the following chart (see Figure A4 116). Option 2 is expected to result in the consumption of around 357 Exabytes (EB) by 2035 compared with around 277 Exabytes in the status quo. Option 4 would result in a total data consumption of 332 EB respectively in 2035. Option 1 is expected to result in the consumption of around 310 EB in 2035. Option 3 would show the lowest bandwidth consumption with 256 EB in 2035.

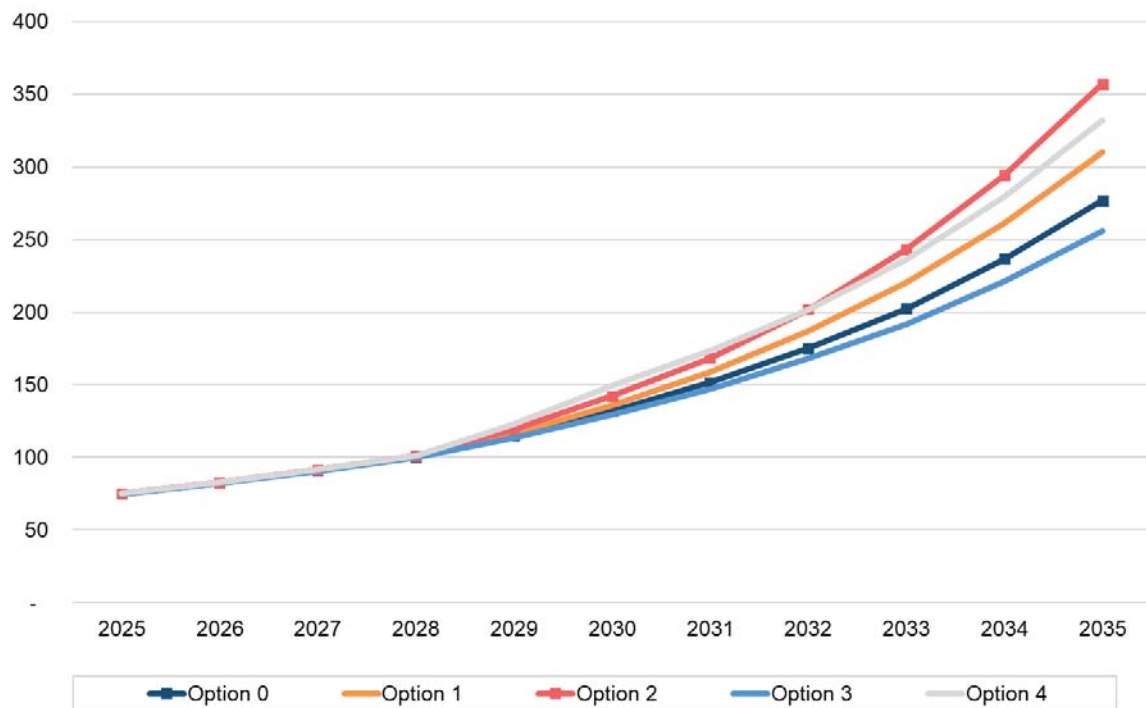
¹⁹ As the UK represents a high usage country, the assumption is that the average bandwidth consumption for the EU per technology is at around half of the levels reported for the UK. Electronic communications statistics of the NRAs and Ofcom (2024): Connected Nations UK Report 2024, p. 14,

<https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/multi-sector/infrastructure-research/connected-nations-2024/connected-nations-uk-report-2024.pdf?v=386497>.

²⁰ Ofcom (2025): Promoting competition and investment in fibre networks: Telecoms Access Review 2026-31, Volume 2: Market definition and SMP assessment,

<https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/consultation-telecoms-access-review-2026-31/main-documents/volume-2-market-definition-and-smp-assessment.pdf?v=392945>, p. 23.

Figure A4 1-16: Total data consumption EU (in Exabyte) by option (projections to 2035)



Source: WIK-Consult

Table A4 1-7: Total data consumption by option in 2030 (in Exabyte)

Option 0	Option 1	Option 2	Option 3	Option 4
132	136	142	129	149

Source: WIK.

Table A4 1-8: Total data consumption by option in 2035 (in Exabyte)

Option 0	Option 1	Option 2	Option 3	Option 4
277	310	357	256	332

Source: WIK.

Data consumption estimates for the calculation of sensitivity in the environmental impact

The tables below show data consumption on fibre networks under the assumption that usage is not linked to speed and grows more slowly after CSO in 2030. Under this assumption, differences between the options reflect differences in the technology mix. Overall, total data consumption would be lower due to the smaller increase in average data consumption per subscriber per technology (GB per moth).

Table A4 1-9: Total data consumption by option in 2035 (in Exabyte)

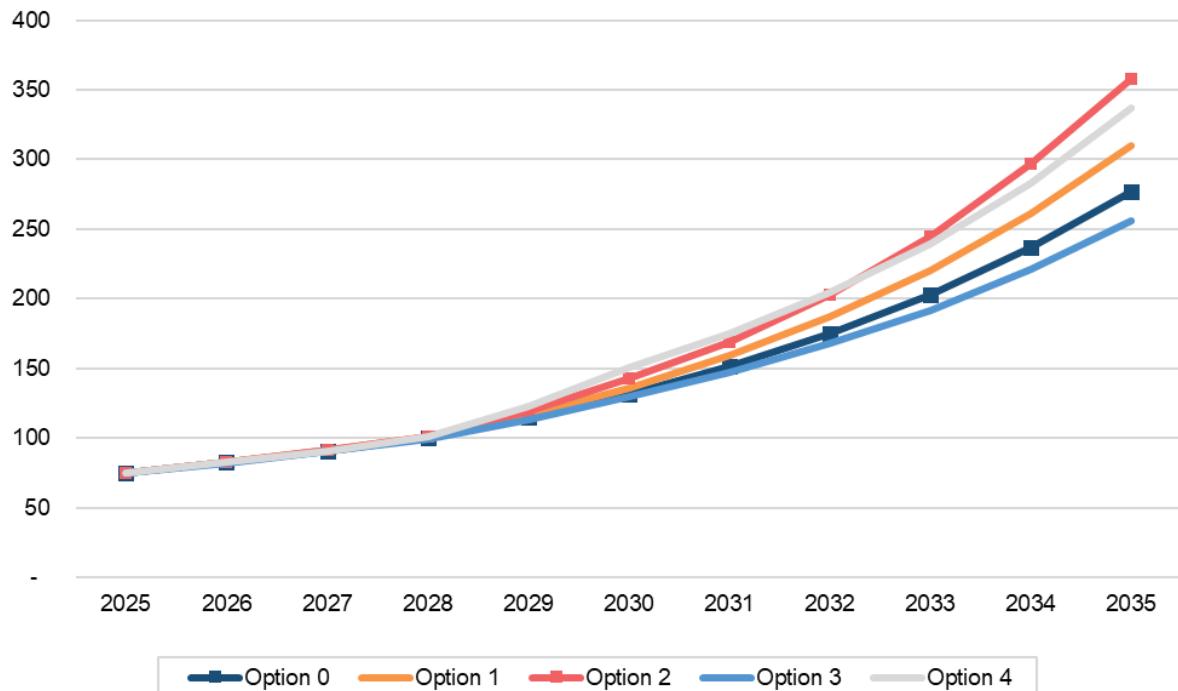
	Option 0	Option 1	Option 2	Option 3	Option 4
Data consumption not speed related and smaller increase	223	240	261	207	258
Delta to speed related data consumption with strong growth	-54	-70	-96	-49	-74
In %	19%	22%	27%	19%	22%

Source: WIK.

Universal Service Obligation

The figure below shows the expected total data consumption by option by 2035 taking the options for the universal service into account. While universal service has no impact on total data consumption under the status quo, option 1 and option 3, it is expected to increase total data consumption by around 2 EB by 2035 under option 2 and by 5 EB under option 4.

Figure A4 1-17: Total data consumption in the EU 27 (in Exabyte) including USO (projections to 2035)



Source: WIK-Consult

1.3 Economic impacts

This section estimates the economic impact of improved broadband quality, drawing on available academic literature.

It summarises recent literature on the economic impacts of faster broadband in terms of GDP growth and job creation and it then presents the results of the associated theory-based modelling exercise.

1.3.1 Economic impact of fixed broadband in the literature

A wide range of literature supports a link between fixed broadband connections and economic benefits, including increases in GDP.²¹ More recently, as broadband has become prevalent, attention has shifted to examining whether higher quality broadband - defined in terms of speed or technology - is linked to greater economic benefits than “basic” or lower speed broadband. Existing literature generally confirms this relationship.

A 2025 study by Briglauer et al./EcoAustria, based on panel data for 32 OECD countries, analysed the causal effect of high-speed broadband networks coverage (fixed and mobile) as well as the adoption (take-up) of high-speed broadband services on GDP²². The study looked at two observation periods: 2005-2020 and 2009-2020. In the later period, the networks with much higher speeds played a bigger role in broadband connections.²³ The study shows that fixed broadband *adoption* for both observation periods exerts a substantial and significant impact on GDP while network *deployment* per se has only minor multiplier-related effects on economic growth. In the longer period (2005-2020) **a 1% increase in fixed broadband adoption** impacts per capita GDP growth in a range of 0.026% to 0.033%. The effects are considered conservative because they do not include difficult-to-measure effects such as consumer surplus, nor do they capture longer-term benefits that emerge as users familiarise themselves with new high-speed services or as companies make complementary investments in digital transformation. Positive effects on economic resilience during exceptional events such as the COVID pandemic, are also not captured. As policy conclusion, the authors recommend focussing public funding not only on supply-side deployment of broadband infrastructure but also on demand-side measures to accelerate the adoption of fast fibre-based connections, thereby generating far greater welfare effect in terms of GDP and consumer surplus. Suggested measures include vouchers, tax reliefs and increase of “e-literacy”.

Earlier research by Briglauer and Gugler also found positive macroeconomic effects of fibre-based broadband infrastructure investments by utilising a comprehensive panel dataset of

²¹ See for example Roller and Waverman (2001), Datta and Agarwal (2004) and other references listed in Castaldo, Fiorini and Maggi (2016). More recently, Castaldo et al. (2018) https://www.dss.uniroma1.it/RePec/sas/wpaper/20161_CFM.pdf, find a positive correlation between fixed broadband diffusion and economic growth across all 23 OECD countries. By constructing a panel data regression centred around GDP growth, the authors find detailed positive results regardless of the economic forecasts applied to the model. Their results support the hypothesis that broadband diffusion is both statistically significant and positively correlated with real GDP growth per capita.

²² Briglauer, Wolfgang; Cambini, Carlo; Gugler, Klaus; Sabatino, Lorian (2025): Economic benefits of new broadband network coverage and service adoption: evidence from OECD member states, Industrial and Corporate Change, 2025, 00, 1-26, available at: <https://doi.org/10.1093/icc/dtae043>

²³ The study does not refer to actual measured average speeds.

Member States for the period from 2003 to 2015.²⁴ The study assessed the causal impact of fibre-based broadband on GDP controlling for basic broadband adoption. **In contrast to their 2023 study²⁵, it did not consider the simultaneous impact of network coverage and adoption, and the dynamic effects related to broadband adoption.** Therefore, the estimated effects of fibre-based broadband adoption were significant but rather small. The study estimates that **1% increase in fibre-based broadband adoption causes an GDP increase of about 0.002%-0.005%.** Hybrid fibre broadband has a slightly lower incremental effect over basic broadband of about 0.002%-0.003%.

An ITU (2025) study²⁶ on the economic impact of digital transformation, using the Generalised Method of Moments (GMM), finds that fixed broadband continues to have a significant impact on the world economy and that the coefficient of impact has slightly increased since the previous 2021 study conducted by the ITU. Although the main regressors used are adoption/penetration rather than Mbps, speed may affect GDP indirectly via adoption proxies and network quality. This could partly explain why the economic contribution of fixed broadband is found to be greater in higher-income countries, which generally have higher take-up of higher-bandwidth fixed broadband than developing countries, where lower-bandwidth mobile connections play a more significant role. Based on a global dataset extending to the end of 2023, the ITU concludes that a hypothetical 10% increase in fixed-broadband penetration would raise GDP per capita by 1.59%.

Another study by Briglauer et al. (2023) provides an overview table of previous studies on the impact of broadband and the adoption of related services on economic development since the early 2000s.²⁷

²⁴ See: [Briglauer, Wolfgang und Klaus Peter Gugler \(2019\), Go for Gigabit? First Evidence on Economic Benefits of High-speed Broadband Technologies in Europe](#), Journal of Common Market Studies 57(5) , 1071-1090, available at: <https://doi.org/10.1111/jcms.12872>.

²⁵ Briglauer, W., Cambini, C., Gugler, K. et al. Net neutrality and high-speed broadband networks: evidence from OECD countries. Eur J Law Econ 55, 533–571 (2023). <https://doi.org/10.1007/s10657-022-09754-5>.

²⁶ ITU, The impact of digital transformation on the economy – Econometric Modelling, April 2025, <https://www.itu.int/hub/publication/d-pref-econ-mod-2025/>.

²⁷ See: Briglauer, Wolfgang; Krämer, Jan; Palan, Nicole (2023): Socioeconomic benefits of high-speed broadband availability and service adoption: A survey, Research Paper, No. 24, EcoAustria - Institute for Economic Research, Vienna, available at: <https://hdl.handle.net/10419/279416>.

Table A4 1-10 Overview studies on impact of broadband on GDP

Author(s)	Dataset	Broadband data	Methods	Main results
Edquist et al. (2018)	135 countries 2002–2014	Adoption Wireless ≥256 kbit/s 3G and 4G	FE IV	On average, a 10 % increase of mobile broadband adoption causes a 0.8% increase in GDP. This economic effect gradually decreases over time. The effect of mobile broadband is smaller in OECD countries than in the rest of the world.
Bahia et al. (2019)	160 countries 2000–2017	Adoption Wireless 2G, 3G, and 4G	FE IV GMM	A 10% increase in mobile adoption raises GDP per capita between 0.59% and 0.76%. Mobile has a substantial effect on top of basic wireline broadband and is stronger for countries with a more skilled population.
Briglauer and Gugler (2019)	EU 27 countries 2003–2015	Adoption Wireline FTTx	FE IV	A 10% increase in FTTx connections leads to an (incremental) increase in the GDP of around 0.02–0.03% in the OLS estimation and 0.02–0.04% in the IV case (controlling for basic broadband).
Katz and Callorda (2020)	159 countries Quarterly data 2008–2019	Adoption Wireline 1–10 Mbit/s; 10–40 Mbit/s; >40 Mbit/s	FE	A 100% increase in download speed (for >40 Mbit/s) increases the GDP by 0.73%.
Briglauer et al. (2021)	Germany 401 counties 2010–2015	Availability Wireline Average speed level ≥2 Mbit/s to ≥50 Mbit/s	FE IV	An increase in broadband availability of 1 p.p. increases the regional GDP per capita by 0.18% (0.31% considering regional externalities across neighboring counties), and rural areas benefit more from broadband availability.
Briglauer et al. (2023a)	32 OECD states country-level 2002–2020	Adoption and availability Wireline and wireless FTTx 3G and 4G	FE IV	A 1% increase in broadband adoption contemporaneously affects GDP per capita in a range of 0.026% to 0.034%, while mobile broadband adoption increases GDP between 0.079% and 0.088%. Controlling for adoption, wireline, and wireless broadband availability does not show a significant effect.
De Clercq et al. (2023)	1348 EU regions 2011–2018	Availability Wireline ≥30 Mbit/s; ≥100 Mbit/s	FEC	An increase in coverage with broadband ≥30 Mbit/s by 1 p.p. increases GDP growth by 0.09 p.p. This effect is larger in urban areas than in rural areas. Effects exhibit diminishing returns with respect to a higher minimum bandwidth level (≥100 Mbit/s instead of ≥30 Mbit/s).

Source: Briglauer et al. (2023)

A study by Katz/Jung (2022) investigated the contribution of fixed broadband speed to the economic growth of the USA between 2010 and 2020.²⁸ Within this period the fixed broadband average download speed of US households grew with a CAGR of 33.04% from 10.03 Mbps in 2010 to 174.23 Mbps in 2020. Based on several econometric models, the authors estimate that within these 10 years, this annually 33.04% speed growth caused a GDP-growth 0.44% per year (CAGR). Converted, **10% higher speed would trigger 0.1332% GDP-growth on average**. This effect of higher broadband speeds is slightly higher than the effect of the expansion of fixed broadband networks that additionally induced an annually GDP growth of 0.41% (CAGR).

A study by Katz/Callorda (2020)²⁹ analysed the impact of the cable industry's investments in faster HFC networks on economic growth. To this end, they used an econometric model that incorporated data from 2008 and 2019 from 159 countries. The model's results indicate that **1% increase in broadband speed yields a 0.73% increase in GDP**.

A study by Rohman/Bohlin (2012)³⁰ of OECD countries estimated that **doubling the connection speed related to an additional 0.3 percentage points to annual GDP growth**. WIK, together with Ecorys and VVA also identified a correlation between broadband speeds

²⁸ Katz, Raul; Jung, Juan (2022): The contribution of fixed broadband to the economic growth of the United States between 2010 and 2020, Telecom Advisory Services LLC, Network On, June 2022, available at: https://www.teleadv.com/wp-content/uploads/ContributionofFixedBroadbandtoEconomicGrowth_RaulKatz.pdf.

²⁹ Katz/Callorda (2020): Assessing the Economic Potential of 10G Networks, Telecom Advisory Services LLC, <https://www.teleadv.com/wp-content/uploads/Assessing-the-Economic-Potential-of-10G-Networks.pdf>.

³⁰ Rohman, Ibrahim Kholilul and Erik Bohlin (2012): Does broadband speed really matter for driving economic growth? Investigating OECD countries, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2034284.

across the EU and Total Factor Productivity across a number of sectors in the context of a 2016 study supporting the Impact Assessment for the EU Electronic Communications Code,³¹ and concluded that if past relationships between broadband speed and GDP growth were to be replicated going forwards, **an accelerated deployment of FTTP/B infrastructure which resulted in 55% of households using FTTP by 2025 could result in GDP levels 0.54% higher than the status quo.**

A recurrent issue in estimating the impact of broadband speed on economic growth is the endogeneity of broadband. For this reason, Kongaut/Bohlin (2017)³² implemented a two-stage regression model to deal with the endogeneity problem. The authors estimated a production function that maps the impact of broadband download speed on GDP per capita across OECD countries. The broadband speed function is obtained in the first stage and then plugged into a panel data equation in the second stage. **Their model indicates that a 10% increase in broadband speed yields an 0.8% increase in GDP per capita.** However, the study authors note that the effects of broadband speed are greater in countries with lower income.

Nadiri et al. (2018)³³ also find for the US, a positive link between **high-speed broadband deployment** and productivity gain. This effect is achieved through cost savings across all industries, although the extent of these gains varies by sector.

Confirming these results, Koutroumpis (2018)³⁴ observes also on the basis of analysis of data from OECD countries that fixed broadband adoption along with increasing network quality has had a positive effect on national economic output. The study concludes that new services and telework has helped increase GDP by an average of 0.38% each year for the OECD countries and that this effect is related to the quality of infrastructure. **On average a country at the highest speeds (capped by the 9.8 Mbps threshold) would gain 0.08% more on its annual GDP compared to an identical country at the lowest speeds (the lowest quartile in the sample, which is 0-1Mbps).** Koutroumpis acknowledges the diminishing returns to scale associated with higher speeds, but argues that the threshold beyond which further increases in speed become unproductive should increase over time, as new services emerge to help firms and individuals make productive use of improved infrastructure.

Hasbi (2017) investigated the impact of very high-speed broadband networks on local growth.³⁵ It is based on panel data from 2010 to 2015 covering more than 36 000 French

³¹ WIK, Ecorys and VVA (2016) support for the Commission in the Impact Assessment for the Review of the EU framework for electronic communications SMART 2015/0005.

³² Kongaut, C., Bohlin, E., 2017. Impact of broadband speed on economic outputs: An empirical study of OECD countries. *Economics and Business Review* 3 (17), 12–32. doi:10.18559/ebr.2017.2.2.

³³ Nadiri, M.I., B. Nandi and K.K. Akoz (2018): Impact of modern communication infrastructure on productivity, production structure and factor demands of US industries: Impact revisited, New York University, United States, Telecommunication Policy Volume 42, July 2018, pages 433-451, available at: <https://www.scopus.com/record/display.uri?eid=2-s2.0-85048129273&origin=inward&txGid=d54ecdbd045c2987e0384a0d2fa1e01b>.

³⁴ P. Koutroumpis (2018): The economic impact of broadband: Evidence from OECD countries", University of Oxford, August 2018, available at: https://www.ofcom.org.uk/_data/assets/pdf_file/0025/113299/economic-broadband-oecd-countries.pdf.

³⁵ Hasbi, Maude (2017): Impact of Very High-Speed Broadband on Local Economic Growth: Empirical Evidence, 14th Asia-Pacific Regional Conference of the International Telecommunications Society (ITS): "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24th-27th June, 2017,

municipalities except Paris, Lyon and Marseille. The study analysed positive local effects on the number of companies in the tertiary sector and the creation of new businesses. The local population benefits from spill overs as unemployment decreases. This study does not provide a quantitative effect on GDP growth.

An earlier study on the economic effects of gigabit broadband availability, conducted by Analysis Group in 2014, showed that in US metropolitan areas with at least 50% household coverage of fixed gigabit broadband, the per capita GDP is approximately 1.1% higher than in metropolitan areas with little or no availability of gigabit services.³⁶

A recent industry white paper³⁷ by the US Fiber Broadband Association estimates the value of time lost when using a typical fixed broadband connections of 100 Mbps download and 20 Mbps upload speed compared with a symmetrical Gigabit bandwidth connections.³⁸ The study finds that the average consumer loses 19.8 minutes per day when performing standard online activities, amounting to 13.5 full workdays per year. According to the white paper, upgrading home users from 100/20 Mbps to symmetrical Gigabit fibre could increase US GDP by 1.2% (or USD 326 billion).

Various studies have also identified links between FTTH or faster broadband and **employment**.

An OECD report which examined the effect of fibre networks in 290 municipalities in Sweden for the period 2010 – 2012 further found that on **average 1% higher FTTP/FTTB penetration is correlated with a 0.11% higher employment rate**, when controlling for other significant factors such as urbanisation level, population evolution, income, education level and business creation.³⁹

Canada, Singer et al. (2015)⁴⁰ investigate the effect of FTTP rollout on employment on the basis of the deployment experiences in 39 regions between 2009 and 2014. They estimate that **fibre deployment to 100% of a region is associated with an increase in employment of about 2.9%** – even if the region already previously benefited from a broadband infrastructure.

Briglauer et al. (2023) also provides an overview table (see Table A4 1-11) of previous studies on the effect of broadband via the labour market on GDP.

International Telecommunications Society (ITS), Calgary, available at: <https://www.econstor.eu/handle/10419/168484>.

³⁶ Sosa/Analysis (2014): Early Evidence Suggests Gigabit Broadband Drives GDP, Analysis Group, available at: https://www.analysisgroup.com/globalassets/content/insights/publishing/gigabit_broadband_sosa.pdf.

³⁷ The Underappreciated Need to Enable AI and Data Center Growth: Increased and More Strategic Fiber Interconnections, https://fiberbroadband.org/wp-content/uploads/2025/07/FBA-103_AI_Datacenter_WhitePaper_lv6.pdf.

³⁸ See: RVA (2024): Gigabit Fiber Can Add \$326B to US GDP, White Paper on behalf of Fibre Broadband Association, available at: https://fiberbroadband.org/wp-content/uploads/2024/08/GigabitFiber_WhitePaper_FIN-2.pdf.

³⁹ Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris.

⁴⁰ Singer, H., Caves K. and A. Koyfman (2015) Economists Incorporated: The Empirical Link Between Fibre-to-the-Premises Deployment and Employment: A case study in Canada, Annex to the Petition to Vary TRP 2015-326, Bell Canada.

Table A4 1-11: Overview studies on impact of broadband on labour market

Author(s)	Dataset	Broadband data	Methods	Main results
Bai (2017)	USA 496 counties 2011–2014	Availability Wireline >1 Gbit/s; 1 Gbit/s–100 Mbit/s; 100 Mbit/s–3 Mbit/s; >3 Mbit/s	FD	Positive effects of broadband speed on employment in the initial publication. However, due to an error discovered by Whitacre et al. (2018), the original model specification produced no statistically significant results.
Firgo et al. (2018)	Austria 2.122 municipalities 2013–2016	Availability Wireline and wireless (aggregated) Average speed level: <2 Mbit/s to >100 Mbit/s	OLS FE SEM	A 100% increase in download speed increases employment measured at the place of work by 0.282 p.p.; the effect on employment growth in rural municipalities is 0.303 p.p., and the effect on urban employment growth is insignificant.
Balsmeier and Woerter (2019)	Switzerland 447 firms 2014–2015	Adoption Wireline FTTH, FTTC >100 Mbit/s	FD (digitalization) IV (bandwidth)	A CHF 100,000 increase in investment in digitalization is associated with about 5.8 more jobs for highly educated workers, 4 fewer jobs for mid-skilled workers, and about 2.3 fewer jobs for the low-skilled. Overall, a digital investment of CHF 100,000 created 1.6 jobs. The authors are cautious with their IV estimates.
Nordin et al. (2019)*	Sweden 9200 SAMS areas 2000–2014	Availability Wireline and wireless (aggregated) >100 Mbit/s	FE (SAMS) IV (municipality)	An increase of 10% in broadband >100-Mbit/s coverage in the whole sample leads to a 0.1% decrease in employment, whereas splitting the sample between rural and urban areas leads to an increase in employment of 0.098% in rural areas and a decrease in urban areas. FE estimates are robust in the IV model.
Katz and Callorda (2020)	159 countries (quarterly) 2008–2019	Adoption Wireline 1–10 Mbit/s; 10–40 Mbit/s; >40 Mbit/s	FE	A 100% increase in (average) download speed increases employment in all sectors by 0.23% (and by 1.53% in the service sector).
Lobo et al. (2020)	USA Tennessee 95 counties 2011–2015	Availability Wireline and wireless (aggregated) ≤100 Mbit/s; ≥100 Mbit/s; ≥1000 Mbit/s	FE	Counties with >100 Mbit/s have 0.26 p.p. lower unemployment rates than counties with low broadband speed; rural counties with >100 Mbit/s have 0.39 p.p. lower unemployment rates than high-speed urban counties.
Fabling and Grimes (2021)**	New Zealand 7500 firms 2010–2012	Adoption Wireline FTTH/B 100 Mbit/s–1 Gbit/s	OLS IV	FTTH/B adoption has a negative impact on firm employment. This reduction is observed contemporaneously and reaches its peak over a 4-year horizon (potentially due to increased outsourcing once FTTH/B is adopted in firms). Negative employment effects are observed, especially in firms with initial low computer intensity.
Campbell (2022)	USA North Carolina 5.158.485 students 2011–2019	Availability Wireline FTTx	DiD DCDH	FTTx availability increases local employment by 2.4 p.p.
Hasbi and Bohlin (2022) ***	Sweden 2000 urban areas 2009–2017	Adoption Wireline 7 broadband speed ranges with mean download speed: 33 Mbit/s	FE	Overall, there is no significant effect of different broadband speed ranges on unemployment. However, broadband is associated with an unemployment reduction for low-skilled workers in bigger cities.
Isley and Low (2022)****	USA Rural counties (population <20,000) April and May 2020	Adoption and availability Wireline and wireless ≥25 Mbit/s	IV	Higher wireline broadband availability and higher wireline broadband adoption led to higher employment rates in rural areas. A 1 p.p. increase in broadband availability increased the employment rate by 0.368 p.p. A 1 p.p. increase in wireline broadband adoption increased the employment rate by 0.869 p.p.
Abrardi and Sabatino (2023)	Italy 7485 municipalities 2019–2020	Availability Wireline FTTH/FTTC ≥30 Mbit/s, ≤1000 Mbit/s	FE IV	One additional year of access to high-speed broadband connections increases local employment by 1.3 p.p.

Notes: * Nordin et al. (2019) defined SAMS (small area for market statistics) by population density level and used a threshold of 25 per km² to indicate urban/rural areas. ** Authors do not provide a numerical interpretation of marginal effects related to dummy variables indicating fiber adoption; marginal effects appear to be high. *** Urban areas are defined as areas with contiguous buildings with no more than 200 m between houses and at least 200 residents; within these areas, the authors observe 23 million access connection speed tests. **** Authors use below 30 Mbit/s (>25 Mbit/s) threshold but include all broadband access technologies, including FTTx. Moreover, the contribution is one of the few that employs both measures for wireline and wireless technologies, as well as distinct measures for availability and adoption.

Source: Briglauer et al. (2023)⁴¹

⁴¹ See: Briglauer, Wolfgang; Krämer, Jan; Palan, Nicole (2023): Socioeconomic benefits of high-speed broadband availability and service adoption: A survey, Research Paper, No. 24, EcoAustria - Institute for Economic Research, Vienna, available at: <https://hdl.handle.net/10419/279416>.

Some studies have also identified links between average broadband speeds and employment.

As regards the effects of Gigabit speeds, utilizing a panel of 496 U.S. counties sampled from 2011 to 2014, Bai (2017)⁴² found that **increasing broadband speeds from 100 Mbps to 1 Mbps was more effective in boosting country employment than increasing speeds from 3 Mbps to 100 Mbps**. Similar to the findings that GDP effects may be subject to diminishing marginal returns, Bai found that increasing broadband speeds beyond 1 Gbps would have a smaller, although still positive, effect on employment. However, it is also possible that new applications and the increased bandwidth requirements associated with teleworking in the wake of the COVID pandemic, might increase the employment effects and productivity gains⁴³ associated with speeds above 1 Gbps.

A similar look at the relationship between broadband speeds and effects on GDP was made by Kongaut/Bohlin (2017).⁴⁴ Speed data was taken from Ookla in a combination of fixed and mobile broadband download speeds, and other economic and population data was taken from OECD and World Bank statistics. The study calculates five models with different control variables for the impact of broadband speed on GDP per capita. **All five models suggest significant positive impacts**, but their values vary from 0.01 to 0.08. The study authors' preferred model could be interpreted as an increase in broadband speed of 10% is leading to an increase in GDP per capita of 0.8%. But the authors also ask for caution with interpreting these exact numbers as they did not intend to quantify exact effects of broadband speed on GDP. What they did was to **show the clear causality between broadband speed and economic growth and the significance of this relationship**.

1.3.2 Theory-based modelling for the quantitative impacts

Drawing on the literature, a theory-based model is used to estimate how projected increases in fixed internet speeds impact GDP.

Coefficient for the link between increase in speed and GDP growth

The academic literature consistently finds a positive impact of VHCN on GDP. Several studies (e.g. Briglauer et al. (2025), Briglauer/Guggler (2019), Sosa/Analysis (2014)) analyse the impact of improved availability and increased penetration of high-speed broadband. These studies quantify the effect of increased coverage and penetration on economic growth.

A defining characteristic of the new broadband networks is their substantially higher performance, particularly in terms of data transmission speed. The most recent study by

⁴² Bai, Y. (2017), The faster, the better? The impact of Internet speed on employment, *Information Economics and Policy*, 40, 21-25.

⁴³ Although it does not specifically look at ultrafast broadband, on the basis of survey data from 166 businesses in Wales, WERU (2017), Superfast broadband business exploitation project: Economic impact report, Cardiff University. argues that SMEs with superfast broadband are more likely to engage in innovation activity than standard broadband users. The report also finds that superfast broadband users tend to be characterised by higher labour productivity growth.

⁴⁴ See Kongaut, Chatchai and Bohlin, Erik (2017): Impact of broadband speed on economic outputs: An empirical study of OECD countries, *Economics and Business Review*, Vol 3 (17), No. 2, 2017:12-32, available at: <https://www.econstor.eu/handle/10419/101415>.

Briglauer et. al (2025) provides evidence of a causal relationship implies a causality between increases in speed and a positive GDP impact.

For the quantification of the impact of an increase in speed on GDP, this analysis draws on several studies that estimate the causal relationship between broadband speed and economic growth. The table below shows selected estimates of the impact of increased speeds on GDP.

Figure A4 1-18:Quantifications of impact of increased speeds in literature

Study	Quantification	GDP increase caused by a 1% higher speed
Kongaut/Bohlin (2017)	“10% increase in broadband speed yields an 0.8% increase in GDP per capita”	0.08%
Katz/Callorda (2020)	“1% increase in broadband speed yields a 0.73% increase in GDP”	0.73%
Katz/Jung (2022)	“33.04% speed growth caused a GDP-growth 0.44% per year”	0.01332%

Sources: Kongaut/Bohlin (2017), Katz/Callorda (2020), Katz/Jung (2022)

Linear vs. degressive/progressive impact on annual GDP growth

All academic studies consulted ensured that the quantifications were based on causal effects rather than random correlations.

The question arises whether increases in speed have a linear impact on annual GDP growth and what coefficient should be applied. The studies indicate that the effect of VHCN is not necessarily linear. Briglauer et al. (2025) argue that full economic benefits only unfold over time, for example as consumers adopt better and new services enabled by higher speeds and more reliable connections, and as firms make complementary investments in digital transformation. Koutroumpis (2018) acknowledges diminishing returns at higher speeds, but argues that the threshold beyond which further increases in speed become unproductive rises over time, as new services emerge to help firms and individuals make productive use of improved infrastructure.

Since it is unclear, to what extent the coefficient used for the link between increased speed and GDP should decrease or increase, the model applies a linear factor over the projection period.

In the impact assessment projected increases in broadband download speeds arising from the different options were converted to GDP impacts based on the equation that 1% increase in speed results in 0.06% increase in GDP. The coefficient applied lies in the corridor of the coefficients indicated in the literature (0.01%-0.08%). This corridor excludes outliers such as the results from the study by Katz/Callorda (2020) that a 1% increase in broadband speed yields a 0.73% increase in GDP. As regards the remaining studies, a coefficient in the upper range was chosen because take-up of gigabit speeds in the EU27 is not yet very high. The demand forecast showed that there is a gap between gigabit take-up and the forecasted demand (without restrictions). This means that there is potential to leverage benefits from increased gigabit take-up. A sensitivity analysis is included assuming a coefficient of 0.01%. Calculations were made for each year between 2025-2035.

The impact of increased fixed broadband speeds on GDP per capita

Table A4 1-12 displays **the overall impact over 10 years (2025-2035) on GDP for each option (in EUR billions)**. Option 2 has the highest impact on GDP with an increase in GDP of EUR 1,862 billion. Option 3 has the lowest cumulative impact. It is possible that there may be declining marginal returns relating to the impact of increasing broadband speeds on productivity (expected to be driven by factors such as support for home-working, use of digital public and commercial services and associated efficiencies, increased availability of higher capacities for businesses including SMEs). However, there could equally be increased returns if higher speeds for broadband in premises unlock new behaviour patterns or new business models or improve efficiencies e.g. in the delivery of healthcare and other public services etc. The results of the impact of speed increases on GDP are shown in the table below for four different estimated values of the coefficient: 0.01 (low estimate), 0.03 (medium estimate – lower part), 0.06 (medium estimate – higher part) and 0.08 (high estimate). This does not change the comparison of the different options.

The results under options 2 are subject to the uncertainty and problems related with the approach to access regulation. GDP benefits could be increased further if those problems were addressed.

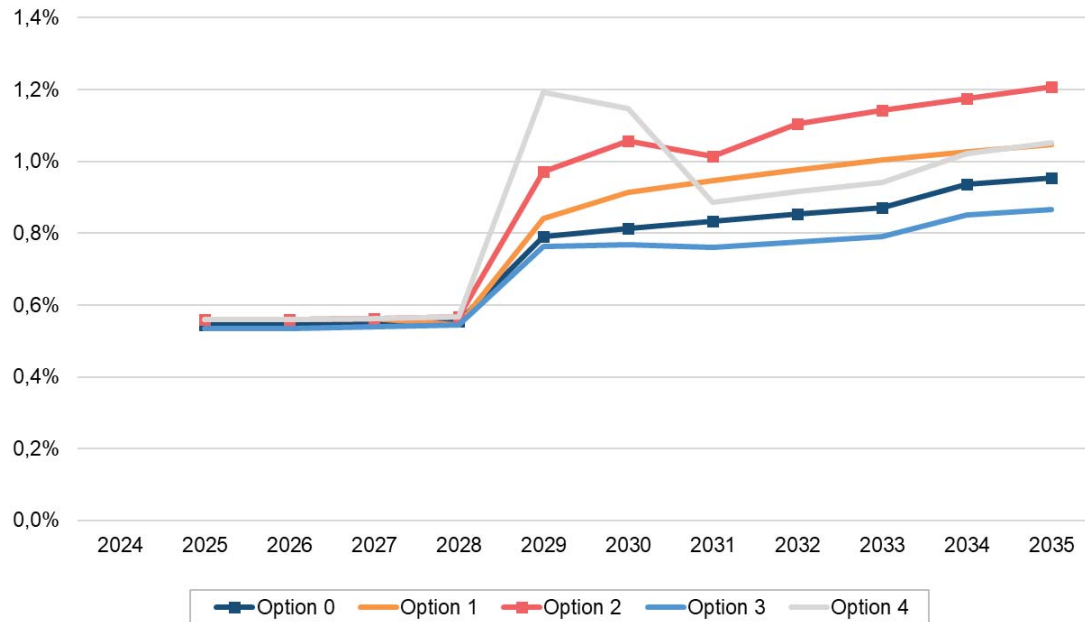
Table A4 1-12: Accumulated GDP impact (2025-2035) of options (EUR billion)

Coefficient	Option 0	Option 1	Option 2	Option 3	Option 4
0.08 (high estimate)	2 073	2 179	2 514	1 938	2 388
0.06 (medium estimate – upper part)	1 535	1 679	1 862	1 437	1 761
0.03 (medium estimate – lower part)	753	822	910	706	862
0.01 (low estimate)	248	270	299	233	238

It should be mentioned that a coefficient value in the upper half part but well below extreme estimates (i.e., around 0.06) is considered as the most appropriate for the estimation of the impact, because take-up of gigabit speeds in the EU27 is not yet very high. The forecasted demand gap between gigabit take-up and the demand shows that there may be potential to leverage benefits from increased gigabit take-up and the economic benefits will appear in the course of time. Using a coefficient at the upper end of the empirically supported range for speed-related effects is justified in a forward-looking assessment that explicitly models the “speed → adoption → productivity → GDP” pathway. A coefficient of 0.06% reflects both the substantial role of speed in enabling adoption and the cumulative, quality-driven economic effects.

Figure A4 1-19 shows the anticipated impact on GDP growth per capita of FTTH download speed over 10 years (2025-2035), based on the elasticity of GDP growth per capita, estimated at 0.08% GDP increase per each percent point of broadband speed increase. The expected economic growth is a multiple of the FTTH download projections, that is, an elasticity coefficient multiplies the projected download speed.

Figure A4 1--19: FTTH download speed impact on GDP growth of access options



Source: WIK based on FTTH projections and literature review.

The strong growth from 2028 to 2029 of Option 4 reflects the accelerated fibre roll-out induced by the strict mandatory copper switch-off date. After copper switch-off, fibre roll-out continues at a slower pace. Fibre roll-out and the extension of coverage is linked with higher take-up and to an increase in speed. But the increase in speed is limited by low take-up of gigabit speed under this option due to the high share of active wholesale access and higher price levels and a price structure with high surcharges for higher bandwidths. Further, under option 4 a coverage gap remains and in consequence copper switch-off results in a higher share of FWA and 4G/5G mobile which are linked with lower speed compared to fibre or cable. Under option 2 fibre roll-out does not accelerate to the same extent as under option 4 but access to passive wholesale products could result in a higher choice of speeds at lower price levels and smaller price steps for higher bandwidths.

Option 2 has the strongest impact on GDP followed by option 4. Such results are consistent with the literature, highlighting the role of FTTH in enhancing economic performance.

Universal Service Obligation

Table A4 1-13: Accumulated GDP impact (2025-2035) of options (billion EUR)

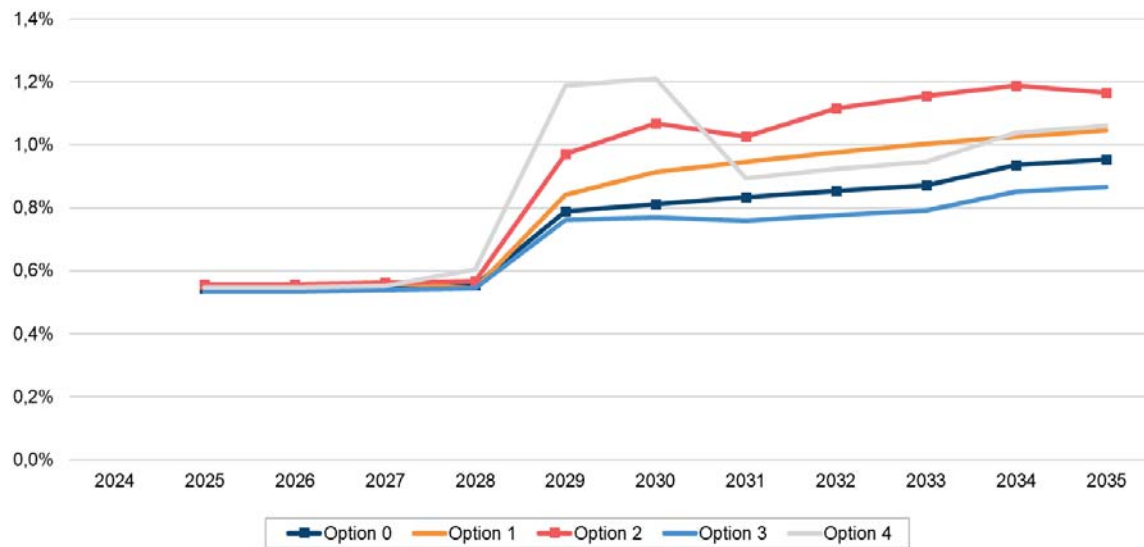
Scenario	Option 0	Option 1	Option 2	Option 3	Option 4
Excl. USO	1 535	1 679	1 862	1 437	1 761
Incl. USO	1 535	1 679	1 865	1 437	1 781

Δ USO (from 2030 onwards)	0	0	3	0	20

Source: WIK-Consult

Table A4 1-13 shows the estimated impact of each USO option on GDP. USO option 2 and option 4 would have an estimated impact of 5 (option 2) and 28 (option 4) billion EUR respectively. In total the GDP impact would still be highest under option 2 at EUR 2 525 billion.

Figure A4 1-1920: FTTH download speed impact on GDP growth of access options including USO options 2 and 4



Source: WIK based on FTTH projections, Bohlin Rohman Kongaut (2017) and Briglauer et al. (2025).

Figure A4 1-20 shows the expected impact of the access and USO options on GDP growth. While options 1 and 3 of USO would have no impact on GDP, options 2 and 4 have a positive impact, as shown in Table A4 1-13. However, the growth curve is essentially determined by the impact of the access options.

1.4 Impacts on society

The terms societal impact and social impact are often used synonymously and interchangeably in literature. While societal impact refers to the impact of science on various levels and areas of society, social impact often refers to a more personal level of influence, affecting people directly (private) or indirectly (public). In this section, the term societal impact is used to cover direct benefits to citizens as well as indirect benefits to society of ultrafast broadband.

1.4.1 Societal impact of VHCN

Examples of societal benefits from Gigabit broadband include home care applications as well as greater educational opportunities, support for teleworking and improved entertainment options. In addition to boosting consumer welfare, these applications can also save money both for the individuals concerned and for the service provider.

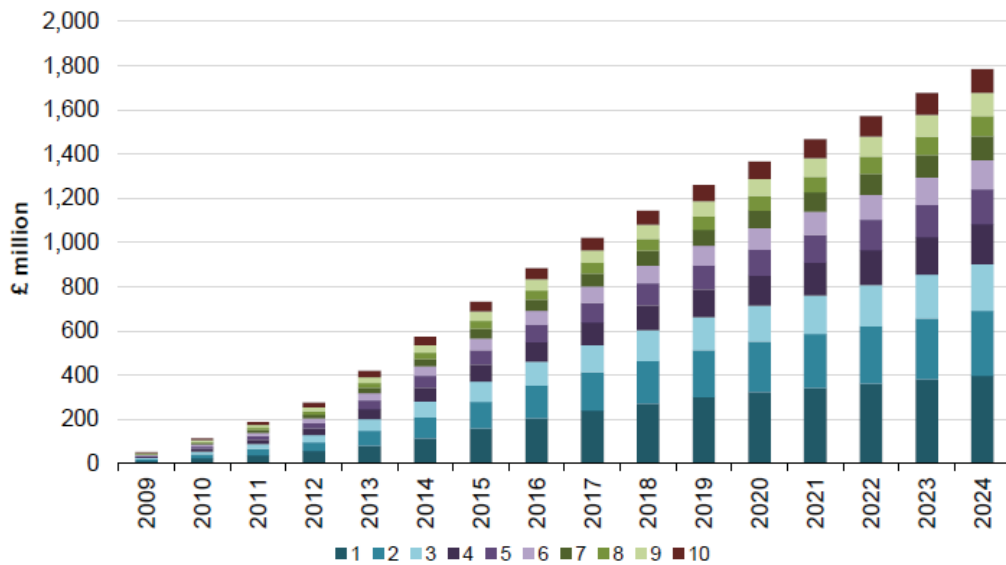
A recent evaluation of the Superfast Broadband Programme in the UK⁴⁵ found that it led to an increase in house prices of between GBP 1 900 and GBP 4 900. This increase in willingness to pay can be interpreted as a gain in social welfare associated with access to superfast and gigabit capable broadband networks. In 2018, Simetrica-Jacobs found that having access to superfast broadband was associated with an increase in wellbeing worth around GBP 225 (equivalent to around EUR 260) per household per year. While in these studies, superfast broadband was defined as having a download speed of only 30 and 24 Mbps respectively, other research confirms that services which require higher bandwidths could provide equal (or even greater) contributions to consumer welfare and play an important role in reducing inequalities. For example, one important function of Gigabit broadband, which has received increased attention following the COVID-19 pandemic, is the ability to support remote working.

In a 2015 article published in *Psychological Science in the Public Interest* Allen et al. (2015) found that teleworking is associated with many benefits for employees, such as increased job satisfaction, organizational commitment, and job performance and lower work stress and exhaustion. In contrast, Eurofund (2022a) reports that during the pandemic, teleworkers registered lower well-being scores, which can be partly explained by pandemic-related restrictions. A meta-analysis by Eurofund (2022b) suggests that teleworking positively impacts job productivity during the pandemic. Citing evidence from Austria, Belgium, Czech Republic, Finland, Germany, Ireland, Italy, Luxembourg, Malta and the Netherlands they report that 39-68% of employees say that remote working increases their productivity. Aksoy et al. (2023) quantified the time savings associated with teleworking, drawing on data from 27 countries. In their sample, the average daily time saving when working from home was 72 minutes. Workers allocated 40% of this time to their jobs and around 11% to caregiving activities.

A quantitative model estimation by SQW (2013) of the projected social impacts of faster broadband speeds indicates that the increase in teleworking driven by faster broadband would save about 60 million hours of leisure time per annum in the UK by 2024. In addition, by avoiding commuting costs, the additional teleworking enabled by faster broadband would lead to total household savings of GBP 270 million per year by 2024. Furthermore, SQW projected that increased productivity from teleworking could reach GBP 1.8 billion by 2024.

⁴⁵ Superfast Broadband Programme Evaluation: Key Benefits and Impacts, 1 March 2025, <https://www.gov.uk/government/publications/superfast-broadband-programme-evaluation-benefits-and-impacts/superfast-broadband-programme-evaluation-key-benefits-and-impacts>.

Figure A4 1-21: Net annual GVA impact of faster broadband speed on increased teleworker productivity in the UK, 2008 – 2024



Source: SQW (2013), UK Broadband Impact Model. 1-10 represents population density from the least dense to the most dense

However, Samek Lodovici et al. (2021) note on a societal level that teleworking may contribute to the emergence of new employment and social inequalities, between those who can telework and those who cannot, because they are employed in non-teleworkable sectors/occupations or have no access to a broadband connection. Thus, the absence of a suitable connection to support teleworking (and the failure to digitize in sectors which could take advantage of remote working opportunities) could have detrimental effects on equality and societal cohesion.

Inadequate broadband connectivity is likely to be a particular challenge for rural areas, because the cost of deployment is significantly higher. The effects of inadequate connectivity (amongst other factors) may have been amongst the drivers of rural unemployment and depopulation. It is estimated that the population in urban regions will increase between 2023 and 2051 on average by 1.0% per year while rural regions will shrink by 3.3% per year. However, various studies suggest that improved broadband connectivity in rural areas could help to reverse these trends and ensure more equitable distribution of economic benefits. For example, using data from 290 Swedish municipalities between 2007 and 2010, Forzati and Mattson (2012) found that an increase in the proportion of the population living within 353 metres from a fibre-connected (FTTP) premise was linked to both higher migration and a positive change in employment (resulting both from migration and independently). A study by de Clercq et al. (2023) confirms that high-speed broadband (at least 100 Mbps) can significantly boost economic growth in rural regions across 1 348 EU regions between 2011 and 2018. This highlights the importance of expanding high-speed digital infrastructure in rural Europe in order to close the urban-rural digital divide. According to the World Social Report 2021 published by the UN, improved Internet access and connectivity will provide better jobs and higher standards of living for the roughly 3.4 billion people living in rural areas. The latest World Social Report 2025 emphasises that there is still a digital divide between rural and urban areas, a division that is made more meaningful by innovations in education, employment, civic participation, social protection and more.

Faster broadband can also support more efficient delivery of healthcare in rural areas (as well as elsewhere). A study assessing developments in Sweden found significant savings in using digital FTTH-based homecare especially in rural areas. It concluded that even with limited adoption, these solutions could contribute to annual net cost reductions of USD 0.6 million in a rural municipality with 8 000 residents by 2020. In another study, examining the effects of ultrafast broadband deployed in the rural county of Cornwall in the UK, Garner et al. (2019) found, that eHealth readiness improved over 18 months from 4.36 out of 10 to 4.59 out of 10. The authors concluded that one of the reasons for improved readiness for the adoption of eHealth services was the rollout of ultra-fast broadband, which increased both people's personal ability to use eHealth and their methods of access.

The COVID-19 pandemic also highlighted the importance of ultrafast connectivity for education, confirming the need not only to ensure high performance connectivity for students but also for schools and higher education institutions themselves.

A study by Briglauer et al. (2024) provides an overview of previous research on the impact of fast broadband on education, which shows mixed results. A New Zealand study (Grimes and Townsend, 2018) found that fibre availability in state schools had a positive effect on grades, increasing them by around 1 percentage point per year in primary schools. Similar results were found by Campbell (2024) when analysing students' maths and reading test scores in the US. However, an Italian study by Cambini et al. (2021) found that the availability of high-speed broadband decreased the maths and Italian test scores of 8th graders. This effect was particularly evident among male students whose parents had a low level of education and who attended schools with low IT usage. Briglauer et al. (2024) conclude that progress must be made in closing the digital divide, both between urban and rural areas, and between those who can afford high-speed internet connections, and those who cannot. Another report from the Broadband Commission reports as well as a White Paper by Hyperoptic illustrates, on the basis of various case studies, the overall benefits education and school connectivity can bring to society.

1.4.2 Societal Impact of Internet access on vulnerable consumer groups

The impacts on the technology mix of the different options associated with copper switch off and access could have an important effect on vulnerable consumer groups. While Option 1 would involve incremental improvements and limited disruption, Options 3 and 4 could entail significant changes impacting vulnerable consumer groups. By removing safeguards which currently support competition in retail broadband services, Option 3 would be likely to lead to market consolidation competition, leading to higher prices, which could have a disproportionately negative impact on vulnerable consumer groups. Meanwhile option 4 could result in a high proportion of consumers relying on copper (which may include the elderly, disabled and those in remote locations) being disconnected and forced to rely on mobile or wireless connectivity. The quality or reliability of these connections may not in all cases match those available via copper, leading to a deterioration in consumer experience. While option 4 would safeguard retail competition, because competition would be based on active wholesale access on fair and reasonable pricing, it may not provide sufficient safeguards to avoid price increases in cases where service providers are reliant on an infrastructure provider which can exploit market power. Conversely, option 2 would provide explicit safeguards for consumers to ensure that copper switch-off would not occur unless consumers can be transferred to equivalent services without price increases. It would also likely result in improvements in quality for a similar price, as consumers would be transferred for the most part to more performant FTTH networks. As CSO could occur where

FTTH coverage is at 95%, it can be expected that some consumers would nonetheless be transferred to wireless or mobile alternatives. The onus would be on Member States in this case to ensure that appropriate safeguards are provided to ensure that all customers receive an adequate broadband service, through use of USO provisions on adequate broadband availability, where necessary.

Those transferred to fibre-based broadband should however experience numerous benefits as described in the following literature.

While 94% of all EU households have internet access⁴⁶, significant gaps remain for low-income households, consumers with disabilities, and the elderly. In 2022, 2.4% of the EU's total population could not afford an internet connection. This figure was significantly higher for people at risk of poverty, at 7.6%⁴⁷. Similarly, while 93.5% of people aged 16–74 without disabilities in the EU used the internet regularly (at least once a week in the previous three months), the figure was significantly lower for those with disabilities at 78.2%. The gap widens with age: among 55–74-year-olds, only 70.8% of people with severe disabilities used the internet regularly, compared to 84.3% of those without disabilities in the same age group.⁴⁸ The use of internet can help to reduce inequalities and improve welfare for those consumer groups.

For example, Zuo (2021)⁴⁹ analysed the effects of a discounted broadband programme launched in 2021 in the US for low-income families in the U.S on labour market outcomes. He found that enrollees were 14.3% more likely to be employed.

Access to the internet and digital engagement can improve older people's social lives, thereby enhancing their well-being. Mohan and Lyons (2024)⁵⁰ examined patterns of internet use and psychosocial outcomes for over 3,500 people aged 50 and over in Ireland using the Irish Longitudinal Study on Ageing. They found that high-speed broadband access increased internet use and improved quality of life among older adults. However, there is little evidence that internet access reduces loneliness in this group. Studies have found positive associations between internet use and the health of older people. Tavares (2020)⁵¹ used data from 66,279 individuals aged 50 to 106 collected by the Survey of Health, Ageing and Retirement in Europe (SHARE). Their analysis showed that internet use was related to older people reporting better health, even when after socio-economic characteristics were taken into account. Silva et al. (2022)⁵² analyse the impact of internet usage on the social isolation of

⁴⁶ Eurostat (2024): Digital economy and society statistics - households and individuals, available at: https://ec.europa.eu/eurostat/tistics-explained/index.php?title=Digital_economy_and_society_statistics_-_households_and_individuals.

⁴⁷ Eurostat (2023), How many EU people can afford an internet connection?, available at: <https://ec.europa.eu/eurostat/de/web/products-eurostat-news/w/edn-20230801-1>

⁴⁸ Eurostat (2025), Disabled people less likely to be internet users, <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250313-1>.

⁴⁹ Zuo, G. W. (2021), Wired and hired: Employment effects of subsidized broadband Internet for low-income Americans. *American Economic Journal: Economic Policy*, 13(3):447–482

⁵⁰ Mohan, G., & Lyons, S. (2024), High-speed broadband availability, Internet activity among older people, quality of life and loneliness. *new media & society*, 26(5), 2889–2913.

⁵¹ Tavares, A. I. (2020). Self-assessed health among older people in Europe and internet use. *International journal of medical informatics*, 141, 104240.

⁵² Silva, P. et al. (2022), The Contribution of the Internet to Reducing Social Isolation in Individuals Aged 50 Years and Older: Quantitative Study of Data From the Survey of Health, Ageing and Retirement in Europe. *Journal of medical Internet research*, 24(1), e20466.

people aged above 50 in Europe. Their study found that internet use reduces the risk of social isolation among elderly people.

Similarly to the group including elderly people, internet access has been shown to have a positive impact on the wellbeing of people with disabilities. Duplaga and Szulc (2019)⁵³ use a dataset collected from the panel study “Social Diagnosis” from 2015 to analyse the effects of internet usage on the health and wellbeing of people with disabilities via regression. The data collected consists of interview responses from 2 529 people. This work presents that people with disabilities tend to have a more positive view of their lives, less experience of loneliness, and report less frequent suicidal thoughts. Furthermore, Duplaga and Szulc found that people with disabilities tend to have better physical health due to a lower chance of consuming alcohol and smoking, while having a higher chance of being physically active.

The impact of the COVID-19 pandemic on vulnerable consumer groups highlights another important aspect regarding the benefits of internet access. Caton et al. (2024)⁵⁴ conducted a study on the impact of internet usage on people with disabilities via interviews during April and May 2021 in the United Kingdom. Their results suggest that people with disabilities were able to combat social isolation and loneliness during the COVID-19 pandemic by maintaining social connections through online activities.

In summary, the literature review has shown that internet access generally benefits the physical and mental well-being of consumers with disabilities due to reduced loneliness. The COVID-19 pandemic demonstrated the importance of having access to the internet especially for vulnerable consumer groups.

1.5 Environmental impacts

The deployment and operation of fixed broadband can have significant environmental impacts. This section considers the potential effects of the policy options on greenhouse gas emissions (GHG). It also examines the wider potential of fibre networks to support GHG emission reductions in other sectors.

1.5.1 *The lifecycle of environmental impacts linked to networks*

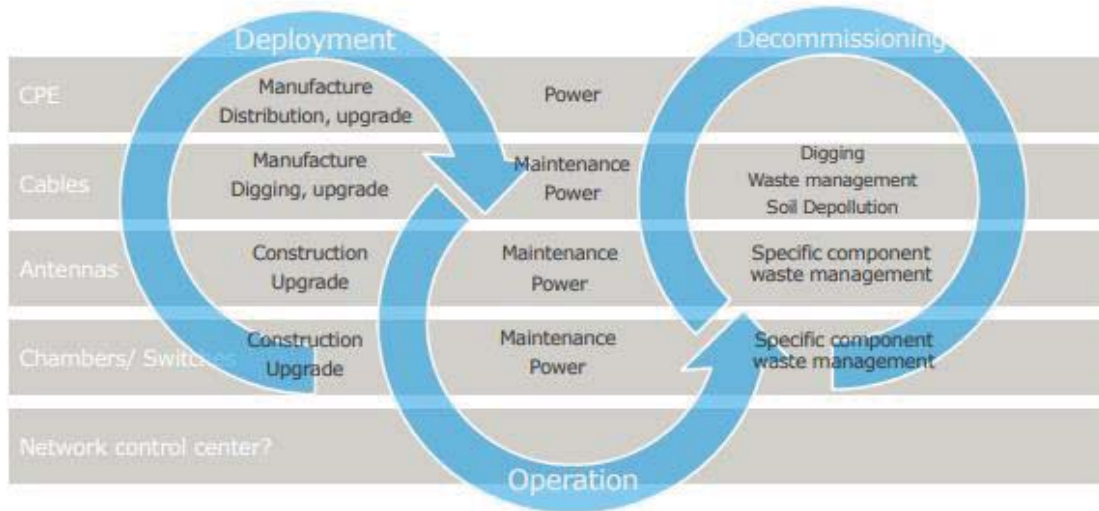
The environmental impacts associated with electronic communications networks can be classified into three distinct phases⁵⁵ The **deployment phase**, encompassing the manufacturing of equipment, ducts, and cables, as well as the civil engineering works required for network installation, including excavation and construction activities. The **operation phase**, referring to the continuous functioning of the network, entails mainly the electricity consumption but also regular maintenance activities to ensure reliable service delivery. The **decommissioning phase**, involving the dismantling and removal of network infrastructure and equipment, together with the management and recycling of the resulting waste materials.

⁵³ Duplaga, M. & Szulc, K. (2019), The Association of Internet Use with Wellbeing, Mental Health and Health Behaviours of Persons with Disabilities. *International Journal of Environmental Research and Public Health*, 16(18), 3252.

⁵⁴ Caton, S. et al. (2024), Online social connections and internet use among people with intellectual disabilities in the United Kingdom during the COVID-19 pandemic. *New Media & Society*, 26(5), 2804-2828.

⁵⁵ See Godlovitch et. al (2021): Environmental impact of electronic communications, Study for BEREC.

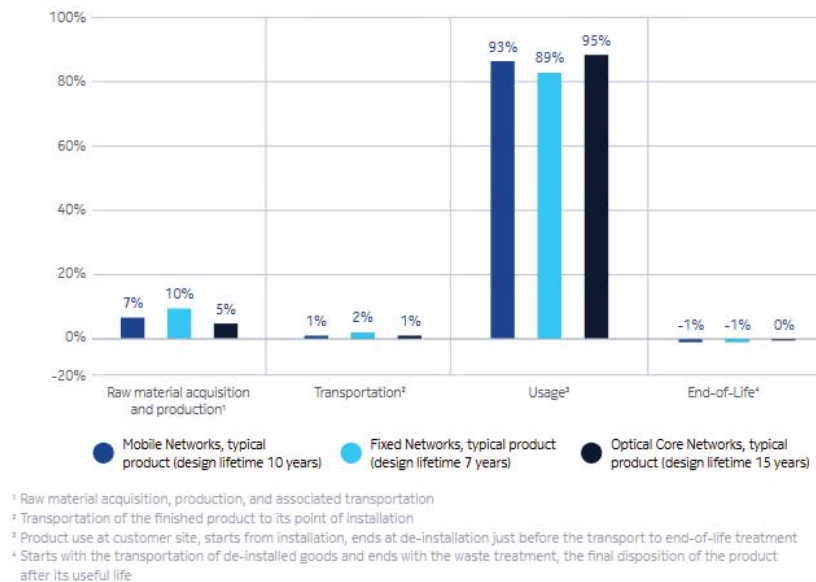
Figure A4 1-22: Lifecycle overview of the environmental impacts for electronic communications networks



Source: Ramboll and WIK-Consult

The usage phase accounts for the largest share of the footprint by far. Sample calculations by Nokia for typical fixed and mobile networks show that around 90 % of emissions occur during this phase (see Figure A4 1-23). The zero or negative contribution of the end-of-life phase in this sample calculation is due to recycling of copper and other precious raw materials. Recycling prevents higher emissions from newly extracted raw materials.

Figure A4 1-23: Percentage of GHG emissions from different product lifecycle stages



Based on product life-cycle assessments of typical configurations. Calculated with constant electricity usage @ 1kW.

Source: Nokia (2019)⁵⁶

⁵⁶ Nokia (2019): People & Planet Report 2019.

1.5.2 Fixed network deployment

Research on the environmental effects of fixed network deployment shows that construction methods have a significant impact on ecological outcomes.⁵⁷ Smaller excavation volumes and infrastructure reuse provide the most substantial benefits. Life Cycle Assessment studies, such as Solivan's (2015)⁵⁸ analysis of fibre cable construction, show that micro-trenching and ploughing methods minimise environmental disruption compared to traditional trenching. This is particularly true when they are used under asphalt surfaces, as they reduce fuel consumption for machinery and limit the transformation of natural land. Further environmental gains can be achieved by reusing existing infrastructure, including ducts, sewer pipes, water pipes, gas pipes and cable decoring. As demonstrated by Ecobilan (2008)⁵⁹ and Stockman and Zhao (2014)⁶⁰, this produces significantly lower environmental impacts than traditional civil engineering works. While underground cable installation primarily causes environmental damage during the construction phase, overhead wires create permanent visual impacts, which are particularly problematic in environmentally sensitive areas, such as cultural heritage sites and ridgelines.

In a study by the Fibre Broadband Association (2024)⁶¹ an estimate was made of the carbon footprint associated with the manufacturing one kilometre of FTTH compared with an HFC network. The sample calculation resulted in a carbon footprint of 883 kg CO₂e for one kilometre of FTTH and 2,408 kg CO₂e for one kilometre of HFC. In this comparison with an HFC network, the manufacturing of an all-fibre network produces an approximately 60% lower carbon footprint.

1.5.3 Fixed network operation

1.5.3.1 Environmental impact of broadband operation in the literature

The operation is an important part of the lifecycle of electronic communications networks as these systems often remain in place for many years. In a study of an Italian dense urban area (Griffa et al., 2010) found the use phase to dominate emissions representing between 57.5% and 73% of total emissions of FTTx deployment.

A wide range of studies has been conducted to analyse CO₂ emissions and energy consumption in access networks in the last decade.⁶² The available studies vary significantly with regard to their methodological approach and are targeted to different regions and technological mixes. The most relevant methodologies that are applied to quantify the effects include bottom-up approach, top-down approach and life cycle analysis.⁶³

⁵⁷ Godlovitch et. al (2021): Environmental impact of electronic communications, Study for BEREC.

⁵⁸ Solivan (2025): Life Cycle Assessment on fiber cable construction methods.

⁵⁹ Ecobilan (2008): Developing a generic approach for FTTH solutions using LCA methodology.

⁶⁰ Stockman and Zhao (2014): White Paper: Innovative FTTH Deployment Technologies.

⁶¹ Fiber Broadband (2024): Fiber Broadband Deployment is Paramount to Achieving Zero Carbon Footprint.

⁶² An extensive literature overview is provided by Briglauer et al. (2023): The Impact of ICT on Electricity and Energy Consumption and Resulting CO₂ Emissions: a Literature Review, in: International Review of Environmental and Resource Economics, 2023.

⁶³ See in detail Zuloaga, G. et al. (2024): Sustainability: modern fixed and mobile networks compared across different regional structures, WIK Working Paper No. 10, Bad Honnef, December 2024, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Working_Papers/2024/WIK_Working_Paper_No10.pdf.

Relevant studies with a focus on fixed broadband operation include the following:

Several studies have investigated the environmental impact and energy consumption associated with alternative wired systems. Aleksic & Lovric (Energy Consumption and Environmental Implications of Wired Access Networks, 2011) found FTTH could reduce GHG emissions per Gbit by 88% compared to the prevailing mix of Digital Subscriber Line (DSL) and Hybrid Fibre Coax (HFC) in 2008. Baliga et al. (Energy Consumption in Wired and Wireless Access Networks, 2011) found that at higher access rates a Passive Optical Network (PON) has clear energy advantages over other networks such as HFC, DSL, and FTTH. Similarly, Oberman (Nachhaltigkeitsvergleich der Zugangsnetz-Technologien FTTC und FTTH, 2020) found an improved higher energy efficiency of PON compared to FTTC. Finally, Breide et al. (Energy consumption of telecommunications access networks, 2021) found reduced energy consumption of the PON access network of above 80% compared to VDSL2 and a reduction of 10% including CPE.

Griffa et al. (Carbon Footprint of Next Generation Fixed Networks, 2010) indicates, however, that when considering deployment FTTH may indeed lead to higher emissions compared to FTTC in absolute terms but suggest that with low-power modes on CPE this may significantly improve over time. Baliga et al. (Energy Consumption in Wired and Wireless Access Networks, 2011) also indicate potential for improvement in energy efficiencies over time, suggesting that “the per-user power consumption of most high-speed access technologies should fall by around 70 percent from 2010 to 2020”.

Looking across from the first version JRC’s Code of Conduct on Energy Consumption of Broadband Equipment to the most recent in 2020 (EC JRC, 2020), also indicates significant energy efficiency improvement potential across all network equipment. It is therefore generally recognized that fibre (PON) can reduce energy consumption for the data delivered to the end user. It is also likely that these systems will improve their energy efficiency over time.

Where a connection is not fully utilized, however, the potential reductions in CO₂ emissions are likely to be much lower. For example, the reduction in energy consumption is much less in a 10% utilization case (Obermann, 2020). In aggregate, however, the copper switch-off is likely to reduce energy consumption and hence emissions. In a study by WIK-Consult, Godlovitch et al. (Neutral fibre and the European Green Deal, 2020) found that “if there was a complete migration from the current technology mix in the EU to all fibre ... the power consumption would be reduced from 52,608 GWh to 10,857 GWh. Moreover, if there is a complete switch to point-to-point (PtP) connections the power consumption would decrease further to 3,376 GWh.” They find that this would reduce GHG emissions by more than 90% if all households switched to PtP FTTH connections.

Zuloaga et al. (2025)⁶⁴ quantify the ecological effects of fibre roll-out and copper-to-fibre migration on energy consumption and carbon emissions. Using disaggregated data on fibre coverage and take-up rates in Germany, they estimate energy-consumption differences across access technologies and model several deployment and migration scenarios through 2050. They find that FTTH is the most energy-efficient access technology (in terms of kWh/GB), particularly when compared with alternatives commonly found in Germany such as FTTB and DOCSIS. Energy savings increase substantially when policy measures accelerate

⁶⁴ Zuloaga, G. et al. (2025). CO₂-Bilanz der Kupfer-Glasfaser-Migration in Deutschland [Carbon footprint of the copper-to-fibre migration in Germany]. WIK research programme 2025, publication expected by 12/2025.

full-fibre migration to FTTH – especially in urban regions, where comparatively less efficient technologies such as FTTB and DOCSIS remain prevalent.

Zuloaga et al. (2024)⁶⁵ analyse and quantify the energy consumption and CO₂ emissions associated with operating access networks (including fixed broadband (FTTH) and mobile networks (4G/5G)) in Germany, using a bottom-up modelling approach. The study also investigates how different settlement structures impact the environmental footprint of telecommunications networks. Based on these findings, the study analyses whether using mobile networks is a more sustainable way to supply rural areas than fixed network technologies. The analysis shows that, from an environmental perspective, FTTH access networks perform better than mobile access networks. These findings apply to all regional structures but are particularly significant for rural areas. Energy consumption in FTTH access networks is driven by usage, i.e. the number of end users. Regarding differences between FTTH topologies (PtP and Point to Multipoint - PtMP), the energy curves of PtP and PtMP converge with an increasing number of end customers.

The study estimates, that FTTH PtP totals 31.5 kWh/a per connection, while FTTH PtMP reaches 30.8 kWh/a per connection. It takes into consideration results from other studies for validation (see Table A4 1-14).

Table A4 1-14: Energy consumption FTTH PtP and PtMP

	FTTH PtP kWh/a per connection	FTTH PtMP kWh/a per connection
Zuloaga (2024) ⁶⁶	31.5	30.8
Obermann (2022) ⁶⁷	30.7	53.4
Breide et al. (2021) ⁶⁸	52.9	37.1

Source: Zuloaga et al. (2024)⁶⁹

Zuloaga et al. (2024)⁷⁰ analyse the ecological impact of Austria's fibre broadband deployment applying a bottom-up model. The study assesses energy consumption and CO₂ emissions for six rollout scenarios (2025 to 2050) and for different technologies. Scenario modelling results show that a complete transition to FTTH could reduce cumulative CO₂

⁶⁵ Zuloaga, G. et al. (2024): Sustainability: modern fixed and mobile networks compared across different regional structures, WIK Working Paper No. 10, Bad Honnef, December 2024, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Working_Papers/2024/WIK_Working_Paper_No10.pdf.

⁶⁶ Zuloaga, G. et al. (2024): Sustainability: modern fixed and mobile networks compared across different regional structures, WIK Working Paper No. 10, Bad Honnef, December 2024, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Working_Papers/2024/WIK_Working_Paper_No10.pdf.

⁶⁷ See Obermann, K. (2022): Nachhaltigkeitsvergleich Internet-Zugangsnetz-Technologien. Technische Hochschule Mittelhessen, 03.03.2022, Expert Study for Federal Association of Broadband Communication (BREKO), https://www.brekoverband.de/wp-content/uploads/2025/03/gutachten_nachhaltigkeit_2_v09_final_2024-1-22.pdf.

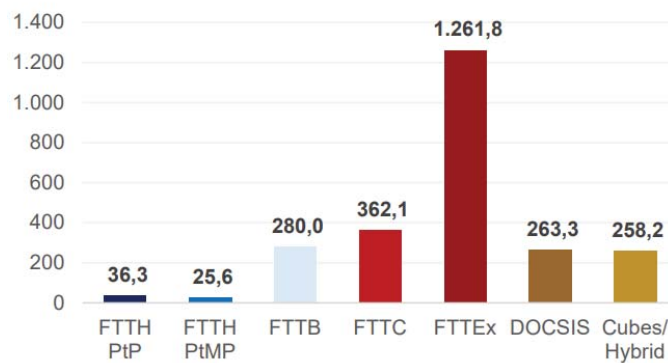
⁶⁸ See Breide, S., Helleberg, S., Schindler, J., Waßmuth, A. (2021). Energy Consumption of Telecommunication Networks. Prysmian Group.

⁶⁹ See in detail Zuloaga, G. et al. (2024): Sustainability: modern fixed and mobile networks compared across different regional structures, WIK Working Paper No. 10, Bad Honnef, December 2024, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Working_Papers/2024/WIK_Working_Paper_No10.pdf, page 45 ff.

⁷⁰ Zuloaga, G. et al. (2024): Ökologische Effekte des Glasfaserausbaus (ecological effects of fibre roll out), study for RTR, November 2024, [Oeko-Effekte_20241206_Bericht \(1\).pdf](#).

emissions by 2050 by up to 33.8% compared to a moderate baseline scenario. In contrast, alternative scenarios could result in substantial increases in energy demand, particularly if data volume requirements increases rapidly and the existing stationary mobile based broadband connections are kept instead of being migrated to energy-efficient fibre networks. The study concludes that early and complete migration to FTTH is critical for maximising environmental benefits and aligning with Austria's climate targets.

Figure A4 1-24: Energy efficiency in Austrian access networks 2024 (Wh/Mbps per user)



Source: Zuloaga et al. (2024)⁷¹

Analysys Mason (2023)⁷² deals with energy consumption in different networks in the context of a broader study. It outlines that copper-based FTTC and coax-based DOCSIS technologies use 8 to 18 times more power than fibre-based GPON technology per connection (just for the network equipment).

⁷¹ Zuloaga, G. et al. (2024): Ökologische Effekte des Glasfaserausbau (ecological effects of fibre roll out), study for RTR, November 2024, Oeko-Effekte_20241206_Bericht (1).pdf, page 39.

⁷² See Analysys Mason (2023): Full-fibre networks in Europe: state of play and future evolution, report for Meta, 3 May 2023, https://www.analysysmason.com/contentassets/1d7e13ed1dba4cc6917daa023f27834b/analysys_mason_fibre_in_europe_may2023.pdf.

Figure A4 1-25: Energy Usage and environmental impact of different fixed network technologies

Figure B.9: Power used by connection by

broadband access technologies [Source: Analysys Mason Research, 2021]

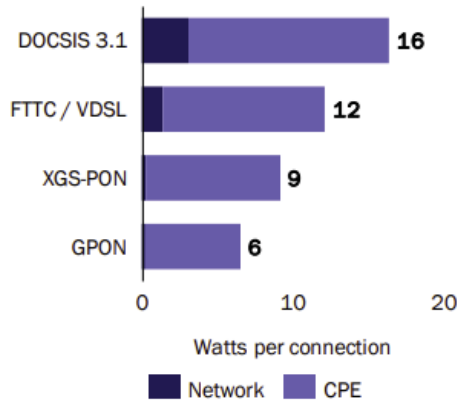
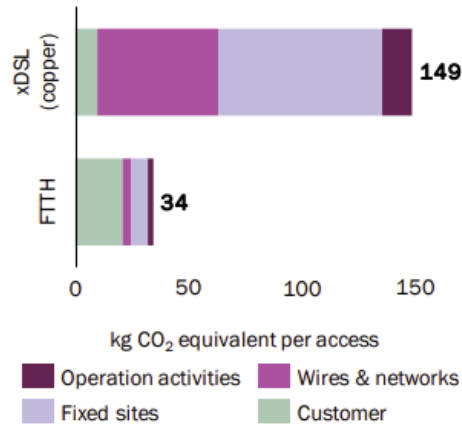


Figure B.10: Environmental impact of fixed

network technologies (copper and FTTH) [Source: Telefónica, 2022]

Source: Analysys Mason⁷³

Obermann (2022)⁷⁴ provides a comprehensive comparison of internet access network technologies regarding environmental sustainability, emphasising energy consumption and CO₂ emissions across FTTH, FTTB, FTTC, and HFC networks. Employing a bottom-up approach, the analysis measures power consumption of network components, evaluates deployment scenarios across urban and rural regions, and considers varying load levels to assess utilisation effects. The findings highlight FTTH as the most energy-efficient technology, consuming up to six times less energy than HFC networks. Additionally, implementing sleep modes in network equipment could reduce energy consumption by up to 40%.

Breide et al. (2021)⁷⁵ provides a detailed analysis of energy consumption and CO₂ emissions across broadband access technologies, including FTTH differentiating it in PtP and PtMP architectures. They use network energy consumption averages derived from actual regional network nodes from six municipalities in North Rhine-Westphalia, Germany. Findings indicate that FTTH PtMP is the most energy efficient technology, with consumption ranging between 56 kWh/year per capita, significantly lower than HFC and VDSL2, which require approximately 61 kW and 88 kW, respectively.

⁷³ See Analysys Mason (2023): Full-fibre networks in Europe: state of play and future evolution, report for Meta, 3 May 2023, https://www.analysysmason.com/contentassets/1d7e13ed1dba4cc6917daa023f27834b/analysys_mason_fibre_in_europe_may2023.pdf, page 15.

⁷⁴ See Obermann, K. (2022): Nachhaltigkeitsvergleich Internet-Zugangsnetz-Technologien. Technische Hochschule Mittelhessen, 03.03.2022, Expert Study for Federal Association of Broadband Communication (BREKO), https://www.brekoverband.de/wp-content/uploads/2025/03/gutachten_nachhaltigkeit_2_v09_final_2024-1-22.pdf.

⁷⁵ See Breide, S., Helleberg, S., Schindler, J., Waßmuth, A. (2021). Energy Consumption of Telecommunication Networks. Prysmian Group.

Godlovitch et al. (2020)⁷⁶ analyses the role of fibre networks for the European green deal based on a detail analysis of the Stokab fibre network with regard to its contribution to Stockholm's ecological sustainability. It estimates that a complete migration from the current fixed broadband technology mix in the EU to all fibre would result in emissions from the use of broadband access falling from 15.5 Mio t CO₂ to 3.2 Mio t (fibre technology mix) and to 1.1 Mio t of CO₂ (only point to point (PtP) connections) per year, if the existing power sources remained unchanged. This represents a reduction in emissions of more than 90% if all broadband connections in the EU moved to PtP FTTH.

1.5.3.2 Theory based quantification of the environmental impact of the different options

To estimate the environmental impact of increased FTTH coverage, a two-step procedure is applied. First, total electricity consumption resulting from changes in the access network technology mix is estimated. Second, the corresponding electricity demand is translated into CO₂ emissions. Based on the emission calculation, the CO₂ emissions per MB can be derived, as well as electricity intensity (kW/GB).

Estimation of total electricity consumption

Total electricity consumption in the access network is derived from (i) the evolution of the technology mix over time across the different options and (ii) the electricity intensity of each access technology. The technology mix reflects how the number of subscribers using ADSL, FTTC, FTTB, FTTH, cable, mobile, or FWA evolves in each scenario, thereby capturing shifts from copper-based to fibre-based infrastructures. As the subscriber distribution changes, the aggregate electricity demand of the access network changes accordingly, since each technology exhibits a distinct power profile. Each technology is associated with a specific data-transmission capability, allowing us to account for the increase in data consumption that is expected across each of the options.

The technology mix is obtained from the projected number of subscribers per access technology over time, implying a growing share of fibre connections (and associated data traffic) and a declining share of copper-based connections as defined by each option.

For the electricity intensities (kWh/ subscriber) across different types of access network technologies, the model uses the values reported by Zuloaga et al. (2024). The electricity consumption per subscriber is as follows:

- ADSL: 3.6 W per subscriber
- FTTC: 10.3 W per subscriber
- Cable: 15 W per subscriber
- FWA: for FWA a consumption of 0,069 kWh/GB was assumed
- FTTH: 4.6 W per subscriber

⁷⁶ See Godlovitch et al. (2021) Neutral fibre and the European Green Deal, WIK study for Stokab, October 2020, https://stokab.se/download/18.15d457b6178eff38ee02a4/1619693498369/Neutral%20fibre%20and%20the%20European%20Green%20Deal_2021.pdf.

- Mobile: 8.8 W per subscriber
- G.fast: 16 W per subscriber

Electricity consumption has therefore been calculated as follows:

$$E_{ANT,n} = sub_{ANT,n} * EI_{ANT} * 365 * 24$$

Where:

- $E_{AT,n}$ = total electricity consumption, W, for access network technology, ANT, in year n
- sub_{AT} = number of subscribers for access network technology, ANT in year n
- $EI_{xG,2010}$ = electricity intensity, W/subscriber, for access network technology ANT

For FWA, electricity consumption is derived directly from kWh/GB and projected data traffic.

Annual electricity use across the access network is then obtained by summing the technology-specific values according to the technology mix in each year and scenario.

Estimation of CO₂ emissions

To quantify GHG emissions resulting from electricity consumption, the model uses EEA data on the emission intensity of electricity generation.⁷⁷

For Europe, the CO₂ intensity of electricity generation is expected to decline rapidly as renewable energy sources expand, falling from 0.161 kg CO₂e per kWh in 2025 to 0.046 kg CO₂e per kWh in 2035. A linear trajectory between the two years is assumed.

CO₂ emissions are then estimated by multiplying total electricity consumption by the corresponding year-specific emission intensity factor.

The results are summarized in Table A4 1-15. This shows that in the Status Quo (Option 0), aggregate emissions of 13.7 million tonnes CO₂e can be expected across the 2025-2035 period. Options 1 and 3 show slightly lower CO₂e, for option 1 however with a higher level of data consumption than options 0 and 3. Option 4 leads to a considerable reduction in emissions of almost 8% compared to the status quo also with a higher data consumption. However, the data consumption under option 4 is lower than under option 2 which also leads to a reduction of CO₂e of around 0.6 m (ca. 6% compared to the status quo) despite showing the highest data consumption.

The results under option 2 are subject to the uncertainty and problems related with the approach to access regulation. Emissions could be reduced and efficiency increased further if those problems were addressed.

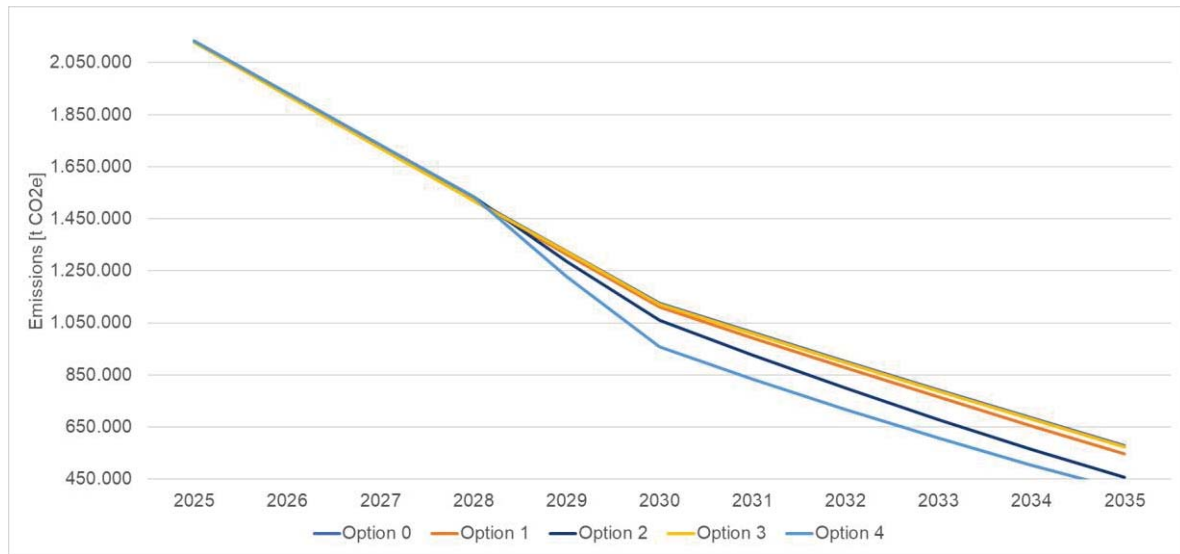
Table A4 1-15: Emissions summary for fixed broadband network 2025-2035

⁷⁷ <https://www.eea.europa.eu/en/datahub/datahubitem-view/3b7fe76c-524a-439a-bfd2-a6e4046302a2?activeAccordion=1091606>

	Option 0	Option 1	Option 2	Option 3	Option 4
Aggregate t CO ₂ e	Ca. 13.7 m	Ca. 13.6 m	Ca 13.1 m	13.7 m	12.6 m
Difference		Ca -0.15 m	Ca -0.6 m	Ca -0.04	Ca -1.1 m
Relative difference to status quo		-1.07%	-4.5%	-0.33%	-8%

Source: WIK.

Figure A4 126: Emissions (in t CO₂e) by option (projections to 2035)



Source: WIK-Consult

Table A4 1-16: Electricity intensity summary for fixed broadband network 2025-2035

	Option 0	Option 1	Option 2	Option 3	Option 4
kWh/GB in 2035	0.048	0.05	0.037	0.052	0.04
Difference to 2025 in %	73%	73%	79%	71%	77%
Relative difference to status quo		-0%	-22%	8%	-16%

Source: WIK.

Data consumption

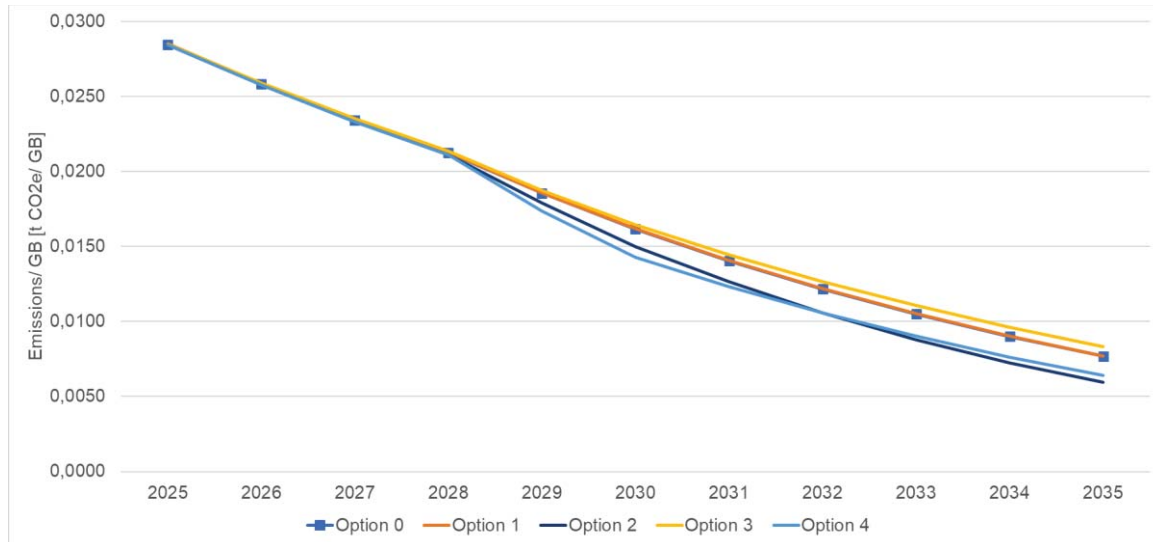
On fibre networks, data consumption is not the main driver of electricity consumption and as a result the CO₂ emissions. This means that a growth in data consumption on fibre networks leads to significantly lower increase in CO₂ emissions compared to a growth in data consumption on copper, cable or mobile networks. Against the background that fibre networks are significantly more energy efficient than copper, cable and mobile networks, the migration to fibre networks means that

- either CO₂ emissions are reduced significantly if the data consumption remains unchanged, or

- data consumption can grow only with a small impact on CO2 emissions.

The results of the modelling can be used to calculate the CO2 emissions per GB for the different options (see figure below). The results show that under options 2 and 4, the decrease of CO2 emissions per GB is lower than under options 1 and 3.

Figure A4 1-27: Emissions per GB (in t CO2e) by option (projections to 2035)



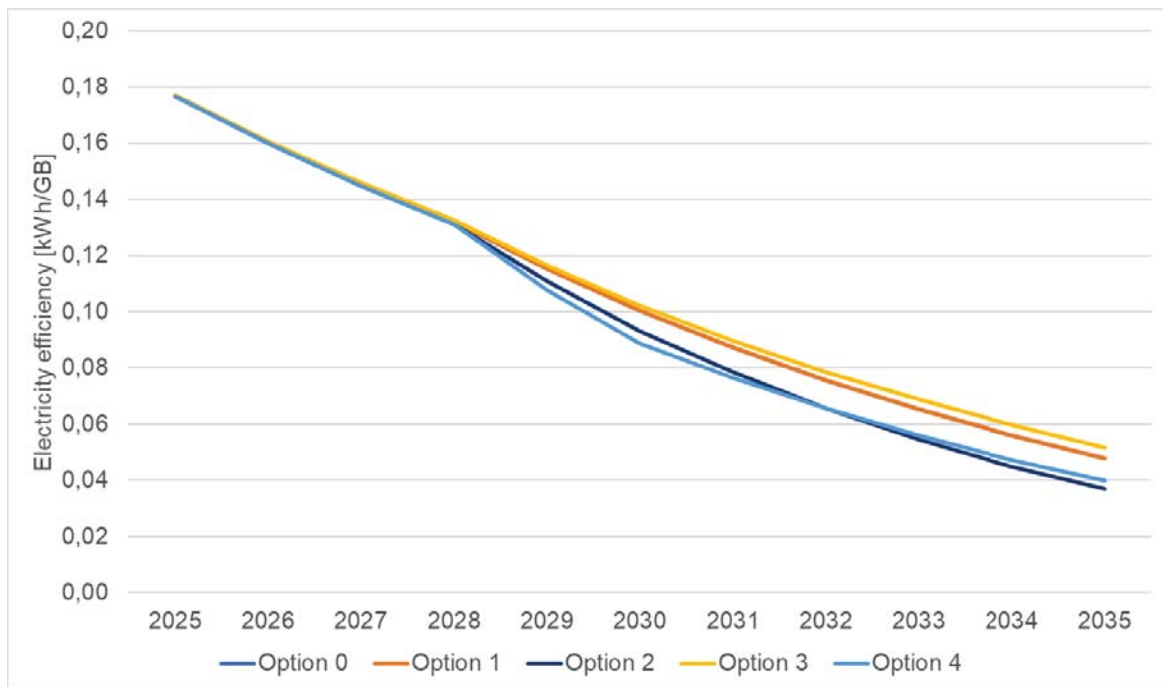
Source: WIK-Consult

Electricity intensity

Total electricity consumption of the access network is calculated based on number of subscribers and the electricity intensity of data consumption. This approach takes into account the expected increase in data consumption under each option.

Results show a significant reduction in electricity intensity for data traffic, from around 0.18 kWh per GB to 0.037 kWh/GB under option 2. Across all the options it shows the biggest reduction with around 79% from 2025 to 2035. With an electricity intensity that is 22% lower in Option 2 compared to the status quo scenario.

Figure A4 11-28: Electricity intensity (in kWh/GB) by option (projections to 2035)



Source: WIK-Consult

Universal Service Obligation

Table A4 1-17: Emissions summary for fixed broadband network 2025-2035 including USO

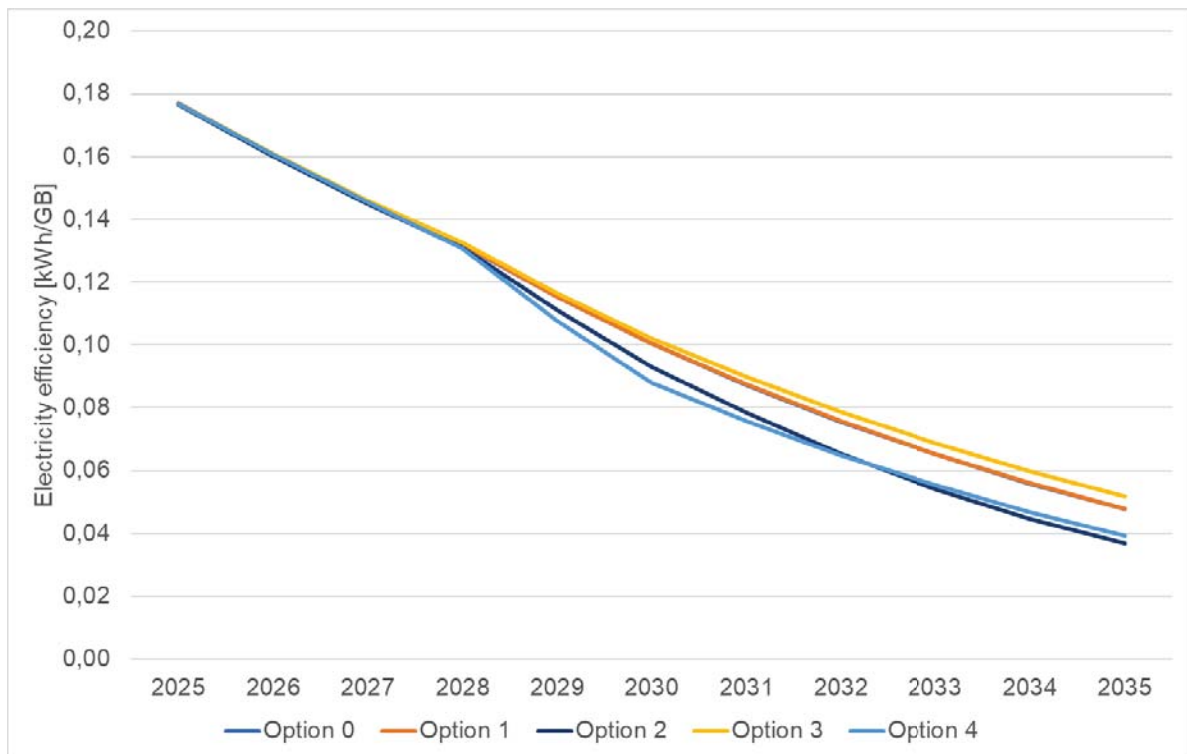
		Option 0	Option 1	Option 2	Option 3	Option 4
Without USO	Aggregate t CO ₂ e	Ca. 13.7 m	Ca. 13.6 m	Ca 13.1 m	13.7 m	12.6 m
	Difference		Ca -0.15 m	Ca -0.6 m	Ca -0.04	Ca -1.1 m
	Relative difference		-1.07%	-4.5%	-0.33%	-8%
Including USO	Aggregate t CO ₂ e	Ca. 13.7 m	Ca. 13.6 m	Ca. 13 m	Ca. 13.7 m	Ca. 12.5
	Difference		Ca. -0.15 m	Ca. -0.7	Ca. -0.04	Ca. -1.2
	Relative difference		Ca. -1%	Ca. -5%	Ca. -0.3%	Ca. -9%

Source: WIK-Consult

The table Universal Service Obligation

Table A4 1-17 shows the estimated GHG emissions for the various options, including those for USO. Affordability measures targeting low-income households or individuals with specific social needs are expected to increase gigabit broadband adoption under Options 2 and 4.

Figure A4 1-29: Electricity intensity (in kWh/GB) by option including USO (projections up to 2035)



Source: WIK-Consult

As shown in Figure A4 1-29, option 2 leads to significant reductions in the electricity intensity of data traffic, from 0.177kWh per GB to 0.037 kWh per GB (this is 22% lower than the electricity intensity under the status quo in 2035). The impact of USO on electricity efficiency is limited.

1.5.3.3 Sensitivity analysis of data consumption

The impact of options on data consumption was also quantified for the scenario in which the growth in data consumption on fibre networks is not related to speed increase and in which data consumption grows at a slower pace after CSO in 2030. The difference in data consumption between the options under such an assumption would be related to differences in the technology mix. Overall, there would be a lower level of data consumption due to the smaller increase in average data consumption per subscriber per technology.

As the CO₂ emissions are calculated based on the technology mix, a different scenario for the data consumption would not impact the accumulated CO₂ emissions. However, the data consumption would be lower in all options and as shown in the table below.

Table A4 1-18: quantified data consumption with lower growth and no link between access speeds and data consumption

	Option 0	Option 1	Option 2	Option 3	Option 4
Data consumption not speed related	223	240	261	207	258

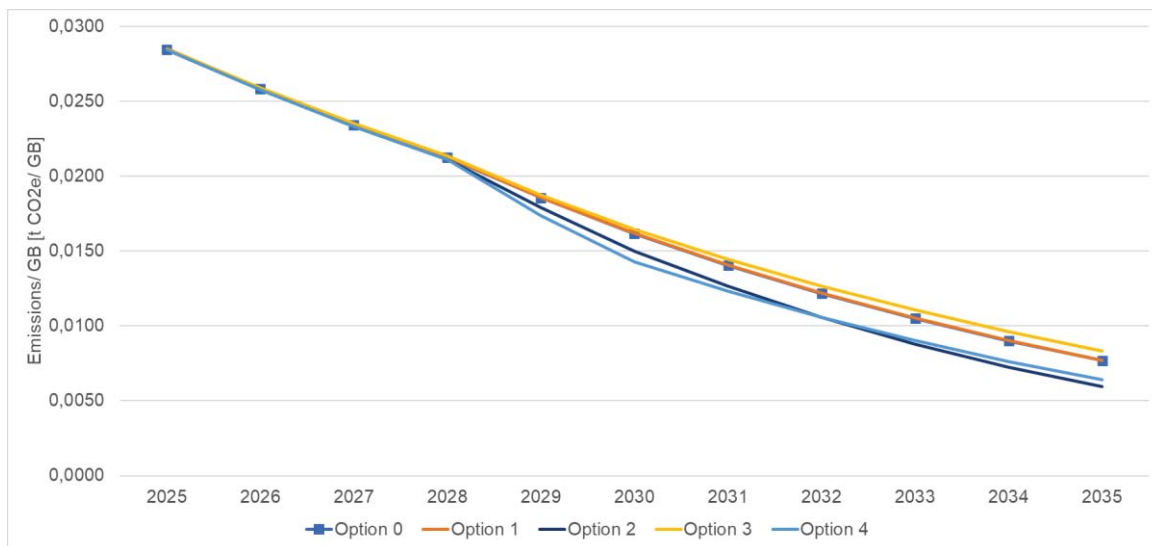
and with slower growth					
Delta to speed related data consumption with strong growth	-54	-70	-96	-49	-74
In %	19%	22%	27%	19%	22%

Source: WIK.

Data consumption

The calculation of the CO₂ emissions per GB for the different options under the different scenario of data consumption is shown in the figure below. The CO₂e per GB would decrease less under options 2 and 4 if there is no link between speed growth and data consumption and if data consumption would not increase to the same extent. However, options 2 and 4 would still be linked with more environmental benefits in terms of lower CO₂ emissions per GB than options 1 and 3 due to the higher share of FTTH in the technology mix.

Figure A4 1-30: Emissions per GB (in t CO₂e) by option (projections to 2035)

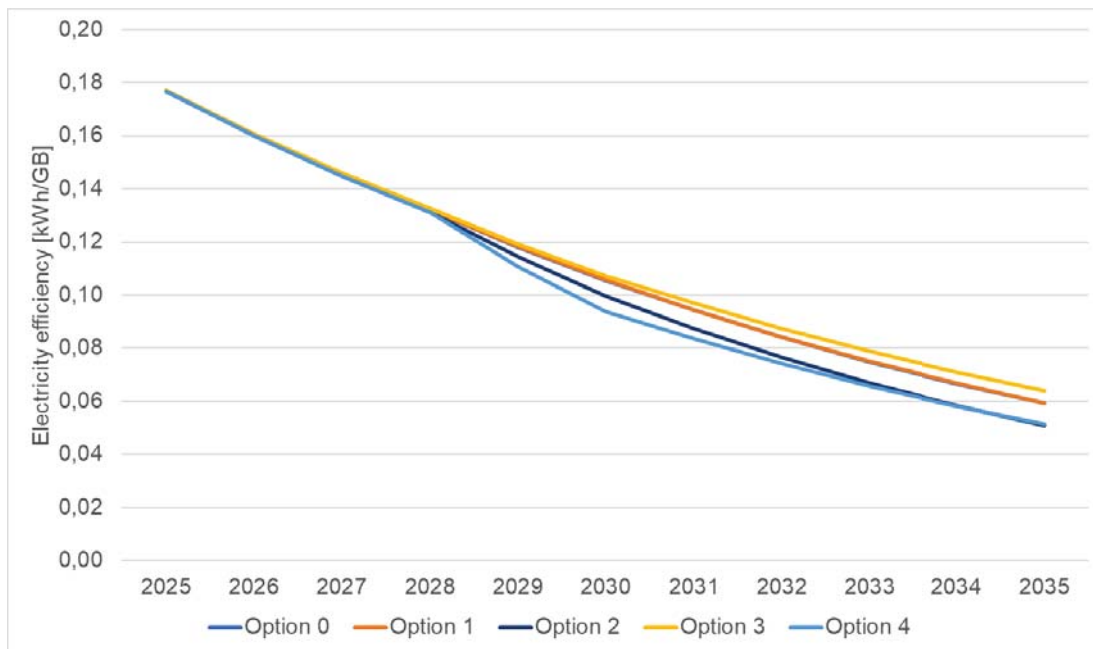


Source: WIK-Consult

Electricity intensity

In this scenario for data consumption results show a reduction in electricity intensity for data traffic, from around 0.18 kWh per GB to 0.05 kWh/GB under option 2, this is less 0.02 kWh/GB than assuming speed related and stronger growth for data consumption. Option 2 shows a reduction of around 71% from 2025 to 2035. With an electricity intensity that is 14% lower in Option 2 compared to the status quo scenario (in the other data consumption scenario it was 22% lower).

Figure A4 1-31: Electricity intensity (in kWh/GB) by option (projections to 2035)



Source: WIK-Consult

1.5.4 Fixed network end-of life

Fibre optic lines generally have a longer lifespan than copper lines due to their greater durability and lower susceptibility to damage or theft. In contrast, copper lines are more frequently recycled due to their high material value and reusability, which mitigates the environmental impact of replacement. As most fibre optic lines have not yet reached the end of their service life, future disposal practices remain uncertain. The situation is quite different for copper networks, which represent valuable raw material reserves for their operating companies following the copper switch-off. Nevertheless, the end-of-life impact of both materials is relatively minor compared to that arising from production, installation and operation.

To give an idea of the scope of recycling potential: BT recycled more than 4 300 tonnes of copper in 2023.⁷⁸ The company estimates to be able to recover around 200,000 tonnes of copper from their old legacy network through the 2030s. There are estimates that the fully extracted copper networks of BT in UK could be worth up to GBP 1.5 bn, depending on the fluctuating market prices and costs of extraction.⁷⁹ TXO, a UK-based engineering firm specialising in the circular economy, estimates that 800 000 tonnes of copper could be reclaimed from telecommunications networks worldwide over the eight to ten years. Using recycled copper brings causes more than 90% less environmental impact than mining

⁷⁸ BT Group (2024): Annual Report 2024, <https://www.bt.com/bt-plc/assets/documents/investors/financial-reporting-and-news/annual-reports/2024/2024-bt-group-plc-annual-report.pdf>, P. 60.

⁷⁹ <https://www.ispreview.co.uk/index.php/2024/09/bt-get-105m-for-first-sale-of-old-uk-copper-telecoms-cables.html>.

copper.⁸⁰ Given the high demand for copper for the expansion of electricity grids and the electrification of many sectors, copper prices are expected to remain high or even rise.

1.6 Methodology for estimation of fragmentation costs

The estimate builds on a model for an operator with a meaningful physical presence and regulatory footprint in all Member States, which owns a telecom network, hosts its own numbers and delivers voice and data services.

The costs are broken down into four key categories: personnel, regulatory fees and contributions, compliance and legal and consultancy costs for proceedings.

Estimated annual regulatory compliance costs for an EU telecom operator

Category	Description / Key Assumptions	Per-Country Estimate	Total (27 MS)	Estimated Range (million EUR)
1. Personnel: Regulatory Affairs & Legal Teams	- Largest and most critical cost component. - Requires dedicated regulatory and legal experts in each Member State. Major Markets (10): Germany, France, Italy, Spain, Netherlands, Poland, Belgium, Sweden, Austria, Ireland. Other 17 Countries: Denmark, Finland, Portugal, Czech Republic, Hungary, Slovakia, Slovenia, Croatia, Greece, Romania, Bulgaria, Estonia, Latvia, Lithuania, Luxembourg, Cyprus, Malta. - Major markets: full-time regulatory affairs manager (EUR 120 000) + legal support (EUR 80 000) → EUR 200 000 per country. - Other markets: part-time manager (0.5 FTE = EUR 50 000) + legal	Major markets: EUR 200 000 Others: EUR 100 000	(10×200 000) + (17×100 000 k) = EUR 3.7 m	EUR 3.5–4.0 m

⁸⁰ <https://www.datacenterdynamics.com/en/opinions/the-world-is-running-short-of-copper-telecoms-networks-could-be-the-answer/>.

	support (EUR 50 000) → EUR 100 000 per country. - On-the-ground presence essential for managing NRA relations and ensuring compliance with national remedies. Additional HR-related detail: According to internal estimates, the pure HR cost for a medium-sized operator could range between EUR 0.40–0.70 m annually to manage GA (General Authorisation) obligations — including applying for authorisations, notifying NRAs/Competent Authorities, and providing required updates across all 27 MS. When combined with total annual operational compliance and legal costs, this figure could reach EUR 0.50–1.20 m.			
2. Regulatory Fees & Contributions	- Mandatory payments to NRAs: administrative fees, numbering fees, and Universal Service contributions. - Based on turnover and operational scale in each country. - Similar obligations apply to cross-border operators. - Average assumed at EUR 150 000 per country (range EUR 50 000–EUR 300 000 depending on market size).	EUR 150 000	27×150 000 = EUR 4.05 m	EUR 3.5–4.5 m
3. Compliance Reporting & Audits	- Regular NRA reporting on network quality, service availability, fault repair, wholesale access, etc. - NRAs frequently	EUR 200 000	27×200 000 = EUR 5.4 m	EUR 4.5–6.0 m

	perform audits, requiring preparation by internal teams and external consultants. - Reporting requirements vary by country; no unified EU template.			
4. Legal & Consultancy for Proceedings	- Covers participation in public consultations, and potential appeals. - Requires support from economic and legal consultants. - Cost varies with complexity and frequency of regulatory actions.	—	—	EUR 2.0–5.0 m
→ Total Annual Cost Estimate	Combined recurring and variable costs across all 27 EU Member States.	—	—	EUR 15–25 m
Potential Savings under Full EU Harmonisation	- A single EU-level authorisation, reporting, and fee framework could significantly reduce administrative duplication. - Would eliminate multiple national submissions and overlapping NRA obligations.	—	—	Savings of EUR 6–11 m (about 40–44% reduction from EUR 15–25 m) per year without changes in the fee framework. Savings of EUR 10–15 m/year (≈60–80% reduction if with single fee framework).

Summary of the estimates – between low and high are the following:

- The largest recurring burden comes from **reporting and audit obligations** (EUR 4.5–6.0 million), reflecting the effort required to produce country-specific documentation and undergo reviews.
- **Personnel costs** for in-house and external regulatory/legal expertise are also significant (EUR 3.5–4.0 million), highlighting the need for sustained specialist capacity to manage national requirements. Out of this, the pure HR cost related to applying for General Authorisation (GA), notification and providing relevant

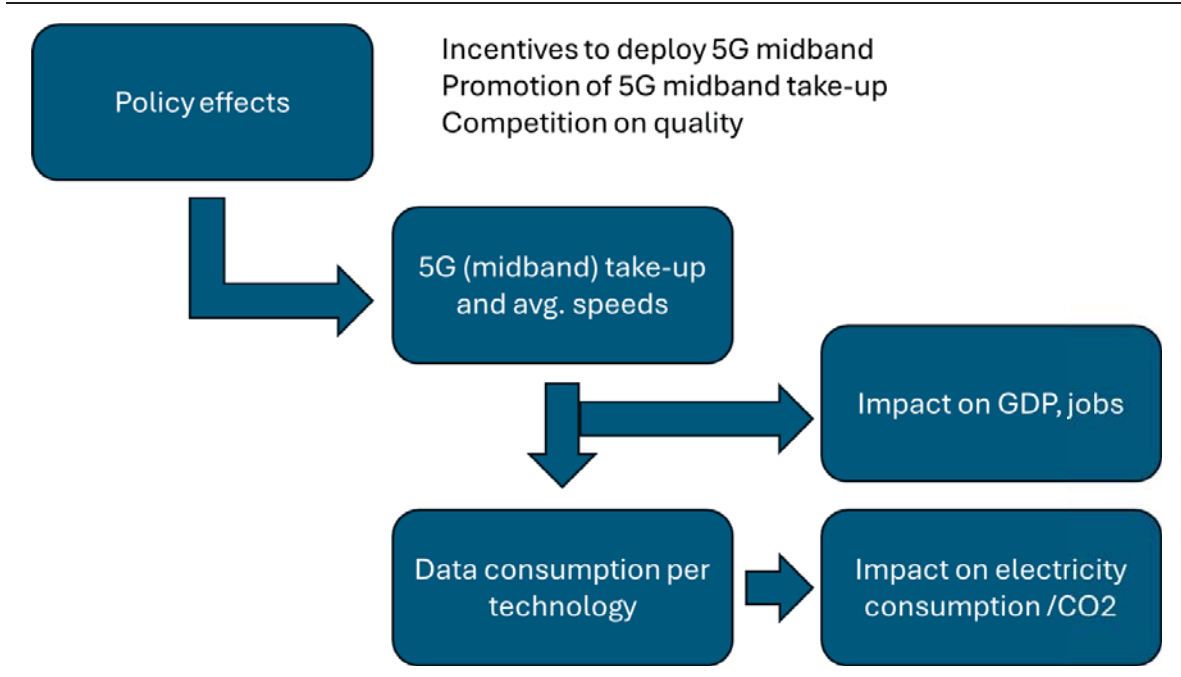
updates, if required, separately across 27 Member States, could range between EUR 0.40–0.70 million. Including the total annual operational costs for compliance and legal obligations, the figure could reach approximately EUR 0.50–1.20 million.

- **Fees and contributions** to national authorities (EUR 3.5–4.5 million) represent fixed costs linked to operating rights, numbering, and universal service obligations.
- **Major regulatory proceedings**, such as consultations and appeals, vary more widely (EUR 2.0–5.0 million) depending on the number and complexity of cases in a given year.
- **Annual regulatory compliance costs** are estimated at **EUR 15–25 million**, representing overhead created by market fragmentation. In a fully harmonised single market, streamlined authorisation and reporting, if there is a single fee foreseen it could reduce this burden by 60–80%, creating savings of EUR 10–15 million per year. However, in the scenario where there is no single fee proposed the burden reduction is lower 40–44% and cost savings would be approximately EUR 6–11 million per year.
- This scenario represents a **best-case estimate of cost reduction** due solely to regulatory harmonisation and the elimination of fragmented, overlapping national requirements, including the hypothetical assumption that national fees are replaced by a single EU-level fee, eliminating multiple mandatory contributions. It also provides estimation of costs reduction without changes in the fee framework.

2 METHODOLOGY FOR THE MODELLING AND QUANTITATIVE IMPACT ASSESSMENT OF THE SPECTRUM OPTIONS

2.1 Overview of the methodology

The quantification of economic and environmental impacts associated with the different spectrum options for the Digital Networks Act is based on a 3-step process. This process is illustrated for mobile broadband in the following diagram.

Figure A4 2-1: Three-step approach to assessing socio-economic and environmental impacts

Source: WIK-Consult.

In the first step, the effects of the different policy options on full 5G⁸¹ coverage and take-up were assessed. It was estimated what the projected increases in full 5G coverage and take-up would mean for consumers in terms of the average speeds (download speeds) they would enjoy and the per user (and total data) that would be consumed.

In a second step, the effects of increased take-up of full 5G and mobile broadband speeds on GDP were assessed with reference to academic literature.

Then the effects of mobile broadband speeds on data consumption were assessed and the implications for electricity consumption and CO2 emissions were analysed.

In this Annex, the underlying assumptions and methodology used are elaborated as well as the approach taken to estimate impacts on GDP and GHG emissions associated with policy options affecting mobile broadband.

⁸¹ In this context, full 5G refers to 5G SA, making use where appropriate of mid and high-band spectrum, and involving network densification in areas of high demand to ensure consistent delivery of high bandwidths.

2.2 Options considered

Table A4 2-1 Policy options on spectrum

	PO1 soft harmonisation	PO2 more single market to enhance investment, innovation	PO3 strong harmonisation and EU level rules
Duration	Longer licence duration (min 25 years)	Indefinite licence duration by default , with safeguards of revocation and exceptions with strong renewal guarantees	Indefinite licence duration
Assignment conditions	Toolbox of best pro-investment/pro-efficient use authorisation practices , developed by EC with RSPG	Mandatory application of pro-investment auction designs with common set of criteria to promote effective competition For public networks , possibility for EC to recommend pro-investment authorisation processes aspects and conditions ; all deviation thereof should be justified; possibility of EC decision, if deviations persist, or to promote pan-European provision of services or to incentivise scale. For non-public networks , on request, possibility of harmonising authorisation conditions in certain Member States through RSPG	Full harmonisation of authorisation processes aspects and conditions (e.g. auction design, reserve prices, award fees, annual fees, coverage obligations, QoS) Mandatory deadlines for assignments set for every band, with auction on standard pre-established condition if a deadline is passed
Authorisation regime	Possibility for EC to recommend authorisation regime for EU harmonised bands, and promotion of flexible licencing	Possibility for EC to harmonise certain authorisation and award conditions	EU level award of harmonised spectrum for certain services Mandatory authorisation regime for nationally assigned spectrum, with a possibility to request joint selection procedure
Ex ante control	Ex ante spectrum Single Market procedure by EC and RSPG/BEREC of spectrum assignment measures resulting in non-binding EC opinion on measures	Mandatory ex ante spectrum Single Market procedure by EC and RSPG/BEREC of spectrum assignment measures resulting in EC opinion on measures with possibility of EC veto on market shaping measures and/or limited licence duration , if they are not justified	Mandatory ex ante Spectrum Single Market procedure by EC and RSPG/BEREC of national spectrum assignment measures resulting in EC opinion with possibility of EC veto on market shaping measures , if they are not addressing only the case of dominance
Roadmaps	Spectrum roadmap for 6G developed by EC with RSPG and regularly updated	National roadmaps based of the EU strategy and spectrum roadmaps and consequences for not respecting the timelines	

	PO1 soft harmonisation	PO2 more single market to enhance investment, innovation	PO3 strong harmonisation and EU level rules
International governance	Recommended coordination of positions at CEPT on issues related to security / technology sovereignty	Mandatory coordination of position at CEPT on issues related to security / technology sovereignty	In exceptional cases, harmonisation work by ad hoc/ high-level only MSs group instead of CEPT
Petition rule-making	Petition of rule-making mechanism with EC obligation to respond to request and justify eventual refusal	Petition for rule making mechanism to request spectrum harmonisation with procedures and obligations for competent authorities	Petition for rule making mechanism with an extended scope to also cover authorisation aspects and innovative approaches to improve spectrum efficiency
Spectrum sharing	Removing legal / regulatory obstacle for spectrum sharing / pooling , especially in rural/ underserved areas Promoting flexible spectrum licensing	Stronger and more coordinated EU approach through mandatory spectrum sharing (subject to technically feasible and not distort competition) , including “use it or share/lose it” conditions and dynamic geolocation databases Addressing barriers to assigning spectrum to wholesale network operators	Mandatory EU framework for spectrum sharing across all EU-harmonised bands Generalising the use of dynamic geolocation database systems to all bands
Cross-border harmful interference	Deadlines introduced in current mechanism for solving coordination issues between Member States Enhancing solidarity in case of issues with third countries	Mechanism for solving coordination issues between Member States with deadlines and extended to non harmonised spectrum Enhancing solidarity in case of issues with third countries	Mechanism for solving coordination issues between Member States coupled with private enforcement Mechanism for coordinating Member States response under RSPG to issues with third countries

2.3 Assumptions concerning the effect of spectrum related policy measures on mid-banc coverage, download speeds and data consumption

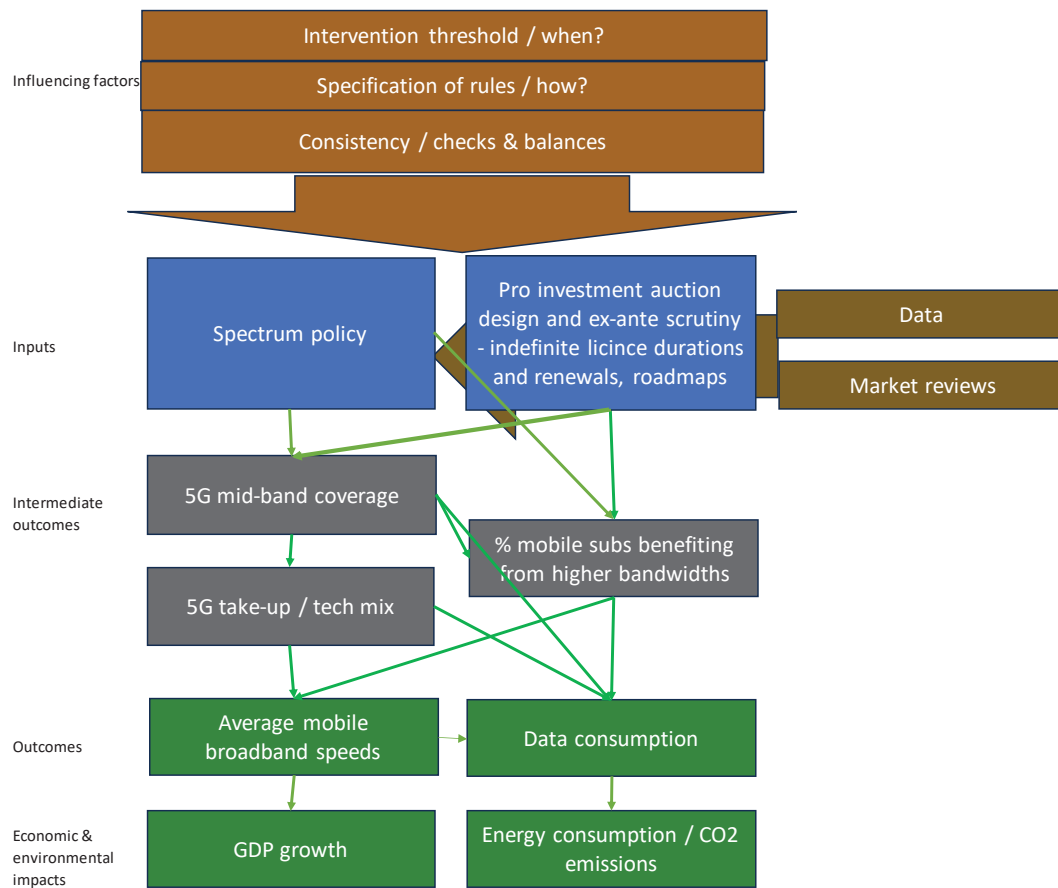
2.3.1 *Intervention logic linking mobile policies with outputs*

The following Figure A4 2-2 shows the intervention logic linking mobile policy options, outcomes and impacts.

In this context, it is relevant to note that there are two key drivers underlying the different inputs:

1. Spectrum policy determines how much and which types of radio spectrum are made available to mobile operators, as well as the conditions attached to its use.
2. The proposed spectrum options ensuring longer licence duration, harmonisation of spectrum authorisation conditions and consistent use of market shaping measures would lead to a pro-investment auction design and conditions and will directly affect the allocation of mid-band frequencies (that is particularly critical for achieving wide 5G and in the future 6G coverage and high capacity. By defining license durations, auction designs, market shaping measures, and usage rights, regulators influence the cost of spectrum and investment and other investment outcomes, like the speed and the scale of 5G rollout and the possibility to benefit from economies of scale. The longer licence durations, easier renewals and more predictable regulatory approaches also enhance financial attractiveness of mobile projects with better access to capital. Such certainty encourages sustained, long-term commitments in network infrastructure, in particular against a background of increasing spectrum needs. Moreover, the granting of rights of use with indefinite duration does not prevent regulators from foreseeing periodic checks and updates of coverage or quality of service obligations. Moreover, indefinite duration will be coupled with “*use it or share it or lose it*” obligations which would exclude spectrum hoarding. A supportive, harmonised spectrum policy therefore promotes faster and more cost-effective deployment of mid-band infrastructure and enables a greater proportion of users, including industrial ones, to benefit from higher bandwidths, and quality.
3. Predictability is further enhanced by ex-ante auction scrutiny that increases consistently applied pro-investment auction design.
4. The proposed EU spectrum strategy and roadmaps to ensure transparent and timely availability of spectrum, including for the coordinated launch of 6G will have a positive effect on predictability and future swift deployment.
5. The proposed measures on enhanced spectrum sharing might further promote the deployment of high-quality private networks that can provide specialised services with guaranteed quality of service.
6. Coverage obligations, often attached to spectrum licenses, further guide the spatial distribution of 5G networks. These obligations compel operators to extend service to underserved or rural areas, ensuring that 5G deployment does not remain concentrated in urban centres. The resulting improvement in 5G mid-band coverage drives broader adoption and a more balanced technology mix, as users across regions gain access to advanced services. At the same time, such obligations, in particular where they are combined with high reserve prices, can affect the pace and cost of deployment, potentially influencing investment priorities and collaboration among operators.

Figure A4 2-2: Intervention logic linking mobile policy initiatives with economic and environmental impacts



Source: WIK-Consult.

Drawing on the intervention logic, an overview of the assumed directional effects of the different options on outcomes concerning mobile 5G (mid-band) coverage, average download speeds and other factors is shown in the following table. The different elements of each option are separated to show the directional effects for each aspect (showed using + and -). These are then used to adjust the inputs for the quantification of the overall impacts of the option bundles on 5G mid-band coverage and average download speeds. The rationale for these assessments is explained in the following sections.

Table A4 2-2: Directional effects of options on outputs (December 2035)

Objectives	Options	Coverage of 5G in mid-band spectrum	Business use of 5G incl. in verticals	Average 5G mobile download speeds	Average mobile download speeds (all)	Geographic coverage	Service innovation	Consistency in spectrum awards and licence conditions	Security and resilience
Boost deployment of high capacity mobile	Option 0	90%	0	250	n/a	n/a	n/a	n/a	n/a
	Option 1	2% increase on baseline	+	2% increase on baseline (255 Mbps)	n/a	n/a	n/a	n/a	n/a
	Option 2	6% increase on baseline	++	6% increase on baseline (265 Mbps)	n/a	n/a	n/a	n/a	n/a
	Option 3	6% increase on baseline	++	6% increase on baseline (265 Mbps)	n/a	n/a	n/a	n/a	n/a
Provide wider access to spectrum to boost innovation and support efficient use	Option 0	n/a	0	n/a	n/a	0	0	n/a	n/a
	Option 1	n/a	+	n/a	n/a	+	+	n/a	n/a
	Option 2	n/a	++	n/a	n/a	++	++	n/a	n/a
	Option 3	n/a	++	n/a	n/a	+++	+++	n/a	n/a
Provide for greater consistency in spectrum assignment procedures and conditions to boost service deployment	Option 0	n/a	n/a	n/a	n/a	0	0	0	n/a
	Option 1	n/a	n/a	n/a	n/a	++	+	++	n/a
	Option 2	n/a	n/a	n/a	n/a	+++	++	++++	n/a
	Option 3	n/a	n/a	n/a	n/a	++++	+++	++++	n/a

2.3.2 Translation of directional effects into quantitative input assumptions

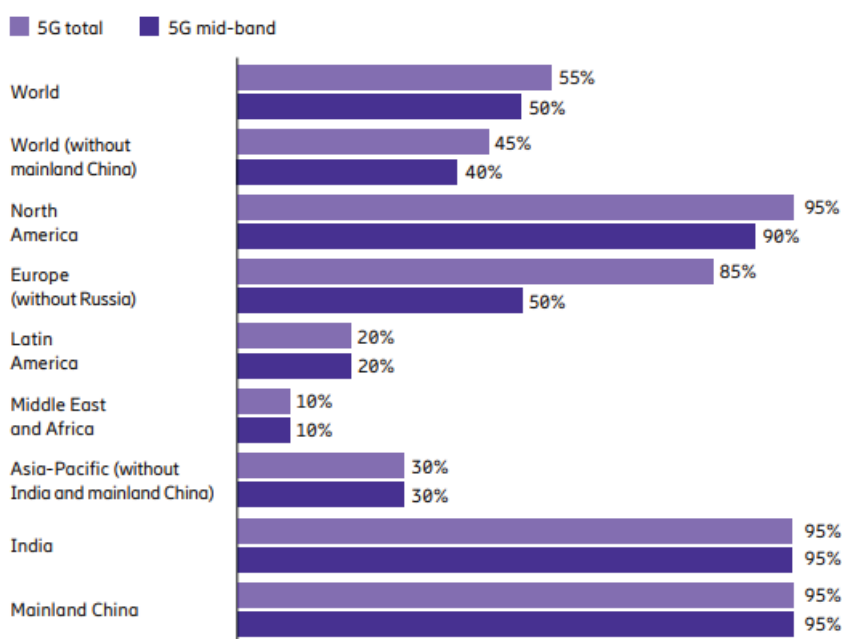
The directional effects of the different options on coverage of 5G in midband spectrum, business use of 5G, average 5G mobile download speeds, geographic coverage etc. have been translated into quantitative estimates regarding the impact of the different options on 5G broadband coverage and mobile broadband speeds. These quantitative estimates are shown in the following table, along with additional aspects for which directional (qualitative) effects are shown.

2.3.2.1 Assumptions regarding mid-band coverage

The Commission has urged Member States to fully assign mid-band spectrum (in particular 3.4–3.8 GHz) and implement coordinated rollouts to boost capacity and performance. The 3.6 GHz band has now been assigned across all Member States⁸². Ericsson notes that although Europe is now in line with the global average of 50 percent in 5G mid-band coverage, further deployments are needed to achieve coverage levels comparable to those in North America and India.⁸³

Figure A4 2-3: Mid-band coverage (in % of population) split by region, end 2024

Figure 7: World population and mid-band coverage split by region (end of 2024)



Note: The figures in these graphs are rounded and refer to the coverage of each technology. The ability to utilize the technology is subject to factors such as access to devices and subscriptions.

¹ Ericsson and GSA (May 2025).

Source: Ericsson (2025) - <https://www.ericsson.com/49e9b6/assets/local/reports-papers/mobility-report/documents/2025/ericsson-mobility-report-june-2025.pdf>

⁸² 5G Observatory Report 2025: <https://ec.europa.eu/newsroom/dae/redirection/document/116970> .

⁸³ <https://www.ericsson.com/49e9b6/a/ssets/local/reports-papers/mobility-report/documents/2025/ericsson-mobility-report-june-2025.pdf>.

Mid-band spectrum is critical for applications like industrial automation, real-time gaming, and connected vehicles due to its balance of coverage and throughput.⁸⁴

5G mid-band spectrum can be defined in different ways. In the Ericsson mobility report, a leading industry data source, it is defined as 1-7 GHz⁸⁵. However, the only data available for midband 5G from official EU sources – the DESI report – measures the coverage of 3.4-3.8 GHz.

The DESI data were prioritised because of its official status and transparent methodology.

DESI data is supplied by National Regulatory Authorities (NRAs) and reflects at least at least one operator providing 3.6 GHz service on at least one site within a 1 km² grid. These grid results are aggregated to regional or national figures. Coverage is calculated by counting households in each 1 km² cell where service is reported, based on the European Population 1 km² Grid or other recognised data sources of spatial population data.⁸⁶

Ericsson's 2025 Mobility Reports gives mid-band 5G coverage in Europe as 50%, considerably below India and China on 95% and North America on 90%.⁸⁷ Ericsson's Europe figure is also below the DESI mid-band estimate of 68% EU coverage. It is hard to understand why the European figure is so low and this is another reason to base projections on the DESI data.

However, relying solely on 3.4-3.8 GHz does not capture the effects of the policy options on renewing existing mobile bands such as 1800 MHz, 2.1 GHz and 2.6 GHz or the expected award of the upper 6 GHz band. Policy proposals relating to licensing or awards would have little direct effect on 3.6 GHz as it has already been assigned in all Member States, although investment-related measures could be beneficial.

5G mid-band was therefore defined as 1-7 GHz, while the DESI figures were used as a basis for estimating likely coverage in this wider range. The same methodological assumptions as DESI were applied, with coverage estimated on the basis of 1 km² blocks with a base station including at least one mid-band transceiver.

The estimate began by considering the likely maximum coverage of 3.4-3.8 GHz by 2035. An important consideration is the propagation characteristics of the band. Its maximum coverage radius – 2 km – is about a third of what can be achieved in the lower bands. For example, 2.1 GHz can reach about 6 km. (See diagram below)

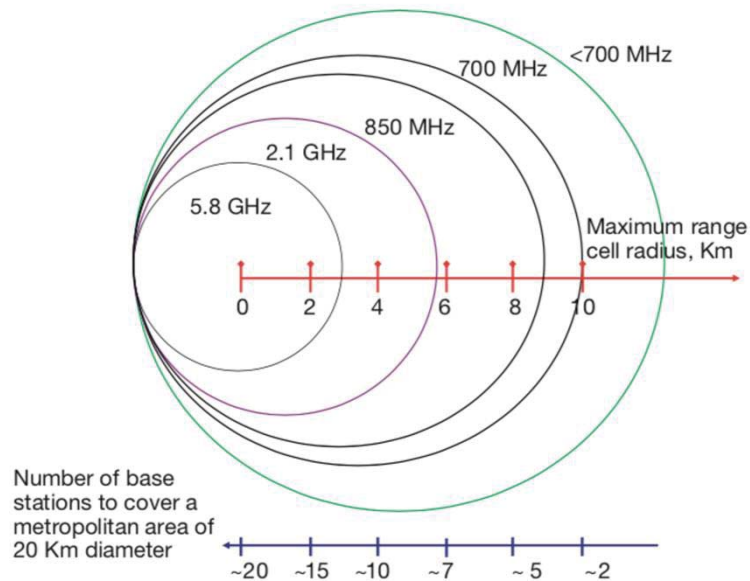
⁸⁴ <https://www.ericsson.com/en/reports-and-papers/mobility-report/dataforecasts/network-coverage>.

⁸⁵ See <https://www.ericsson.com/en/reports-and-papers/mobility-report/articles/securing-the-right-5g-spectrum>.

⁸⁶ See [DESI methodological note](#) and discussion with European Commission.

⁸⁷ Ericsson Mobility Report June 2025 p 10 see <https://www.ericsson.com/en/reports-and-papers/mobility-report/reports/june-2025>.

Figure A4 2-4: Propagation characteristics of common mobile bands (Source: BBC R&D⁸⁸)



The economics of covering rural areas using 3.4-3.8 GHz are therefore challenging. Sub-1 GHz coverage bands such as 700 MHz would be the more cost-effective choice as they require fewer base stations.

The difficulties of covering rural areas can be seen in the DESI data: in 2025 just 26% of rural EU households had access to 3.4-3.8 GHz compared to 68% of *all* EU households.⁸⁹ Recent figures estimate that 72% of the total population of the EU population live in cities, towns and suburbs⁹⁰ so this is a useful crosscheck for our analysis.

On the other hand, the DESI data shows that seven Member States already have coverage of over 80% of households (See graph below). The Netherlands scores the highest with coverage of 99% of households but is the second most densely populated⁹¹ country in the EU with a 93% urban population⁹². Italy, which has the second highest 3.4-3.8 GHz coverage, is the sixth most densely populated⁹³ EU country with 72% living in urban areas⁹⁴.

⁸⁸ Retrieved from [Economic Impacts of Alternative Uses of the Digital Dividend - Intereconomics](#).

⁸⁹ https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi/charts/desi-indicators?indicator=desi_5gcov_3400_3800&indicatorGroup=desi2023-2&breakdown=hh_deg3&period=desi_2024&unit=pc_hh&country=AT,BE,BG,HR,CY,CZ,DK,EE,EU,FI,FR,DE,EL,HU,IE,IT,LV,LT,LU,MT,NL,PL,PT,RO,SK,SI,ES,SE.

⁹⁰ See [European Environment Agency](#) 2015 briefing p129.

⁹¹ Eurostat 2023

https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D3DENS_custom_10822572/bookmark/table?lang=en&bookmarkId=9daaf3b7-86a3-40fc-9171-fcd05d859892&c=1712824409289.

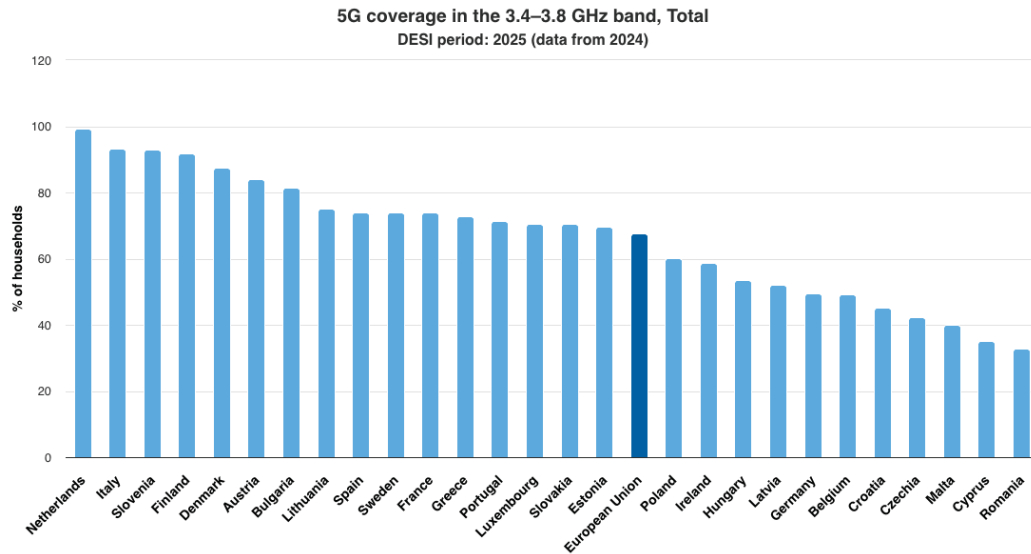
⁹² World Bank 2024 <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>.

⁹³ Eurostat 2023

https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D3DENS_custom_10822572/bookmark/table?lang=en&bookmarkId=9daaf3b7-86a3-40fc-9171-fcd05d859892&c=1712824409289.

⁹⁴ World Bank 2024 <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>.

Figure A4 2-5: DESI figures on 5G coverage in 3.4-3.8 GHz band



In the lower half of the coverage scale the examples of Romania and Ireland suggest that settlement patterns will act as a brake on 3.4-3.8 GHz coverage. Romania has 55% urban population and Ireland has 65%⁹⁵, meaning that rollout of a low propagation band like 3.4-3.8 GHz would be relatively expensive.

As operator interviews showed little evidence of network densification, MNOs are likely installing 3.4-3.8 GHz on their existing base stations. This means that 3.4-3.8 GHz could extend into rural areas if the operator already has wide coverage in its current grid. It was therefore assumed that 3.4-3.8 GHz could grow to 85%, somewhat more than the proportion of the EU living in urban and suburban areas.

To expand this estimate to include all 1-7 GHz bands, the DESI figure for overall 5G coverage was used as a guide. This is currently an EU average of 94%⁹⁶. It is reasonable to assume that all 5G coverage would be 99-100% by 2035. The estimate of 1-7 GHz coverage was therefore derived as the "all 5G coverage" figure minus the additional coverage provided by 700, 800 and 900 MHz.

It was estimated that the without any new policy intervention, average 5G coverage in 1-7 GHz coverage would be 90%.

Taking into account the impact of policy options relating to award design, licence length and fewer market shaping measures on stimulating investment for all licence renewals and upper 6 GHz, the following growth in coverage was estimated:

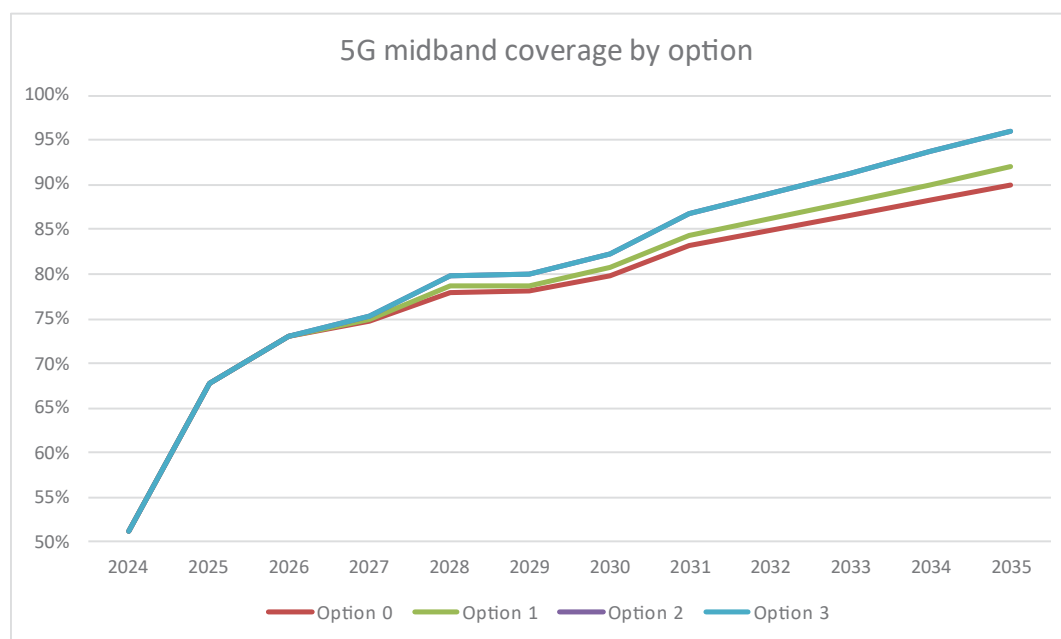
- Baseline: 90%
- Option 1: 92%
- Option 2: 96%
- Option 3: 96%

⁹⁵ Ibid.

⁹⁶ https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi/charts/desi-indicators?indicator=desi_5gcov&indicatorGroup=desi2023-2&breakdown=total_pophh&period=desi_2025&unit=pc_hh&country=AT,BE,BG,HR,CY,CZ,DK,EE,EU,FI,FR,DE,EL,HU,IE,IT,LV,LT,LU,MT,NL,PL,PT,RO,SK,SI,ES,SE

The figure is the same for options 2 and 3 because it is not considered that the option 3 proposals on licence length, processes, or market shaping measures will make a significant difference.

Figure A4 2--6: 5G midband coverage by option



Source: WIK-Consult.

The evolution of 5G coverage can be segmented between coverage of low- and mid-band spectrum usage. European mobile network operators employ the 3.5 GHz band for 5G as this delivers the fast average speeds and reasonable coverage. According to Opensignal other bands see less frequent 5G use.⁹⁷

2.3.2.2 Assumptions regarding download speed projections

Mobile network speeds in Europe have steadily improved since 2020, driven by the ongoing rollout of 5G. Many EU countries have seen substantial speed increases as 5G adoption has grown. According to an OpenSignal analysis, European markets experienced an average increase in mobile download speeds of around 7.4 Mbps in 2023 alone. This increase was largely due to 5G deployment and more efficient use of the radio spectrum.⁹⁸

Median 5G SA download speeds in Europe reached 221.17 Mbps, slower than those in the Americas (384.42 Mbps) and both Developed (237.04 Mbps) and Emerging (259.73 Mbps) Asia Pacific. Southern and Central European countries have overtaken the Nordic countries in terms of download speed. Greece (547.52 Mbps) had the fastest median download speed in Q4 2024 thanks to its use of the 3.5 GHz band, while Spain and Austria

⁹⁷ [More frequencies, higher impact: How spectrum band usage for 5G is expanding across Europe | Opensignal.](#)

⁹⁸ <https://www.opensignal.com/2024/02/01/mobile-network-speeds-leaped-ahead-in-2023-but-some-markets-lag-behind>.

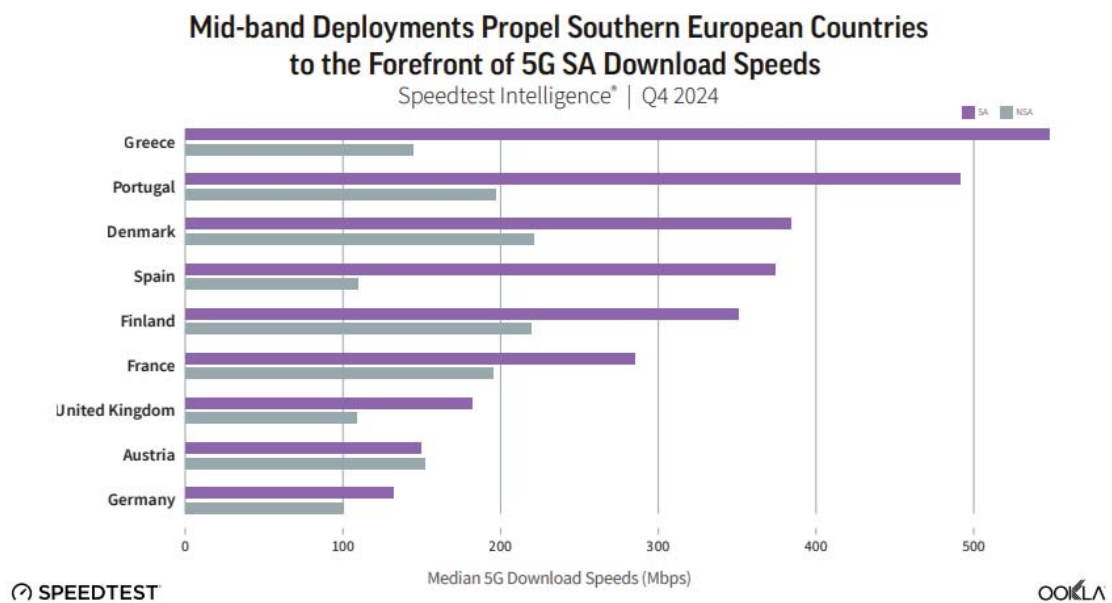
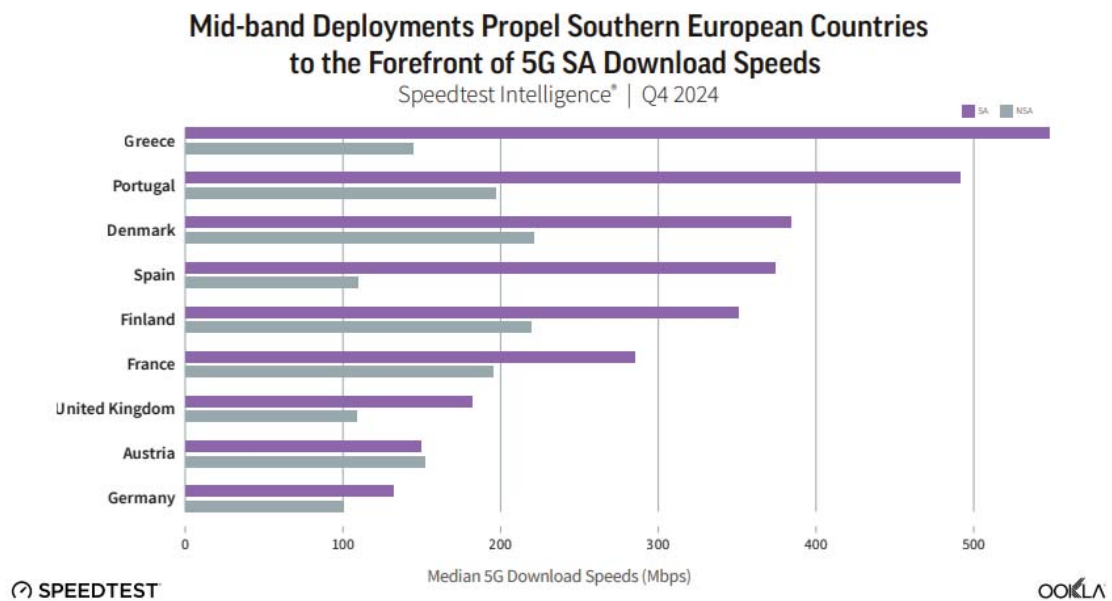
had the best rural 5G SA coverage due to their intensive deployment of the 700 MHz band.⁹⁹

The difference in 5G download speed across European countries is increasingly defined by spectrum strategy. Markets that deploy mid-band spectrum are achieving much faster 5G speeds. Conversely, countries that use low-band 5G are falling behind in terms of speed. However, lower bands like 700 MHz are needed to add capacity or to meet coverage obligations.¹⁰⁰

⁹⁹ Country sample selected based on having a high share of regional 5G SA samples. The Americas sample includes the United States, Canada, and Brazil; Developed Asia comprises Australia, Singapore, Japan, Hong Kong, Macau, South Korea, and China; and Emerging Asia consists of India, Thailand, the Philippines, and Malaysia. South Korea is excluded from the Developed Asia sample for median latency calculations. Ookla/ Omdia (2025), A Global Evaluation of Europe's Digital Competitiveness in 5G Standalone, p.19.

¹⁰⁰ <https://www.opensignal.com/2025/07/02/more-frequencies-higher-impact-how-spectrum-band-usage-for-5g-is-expanding-across-europe/dt>.

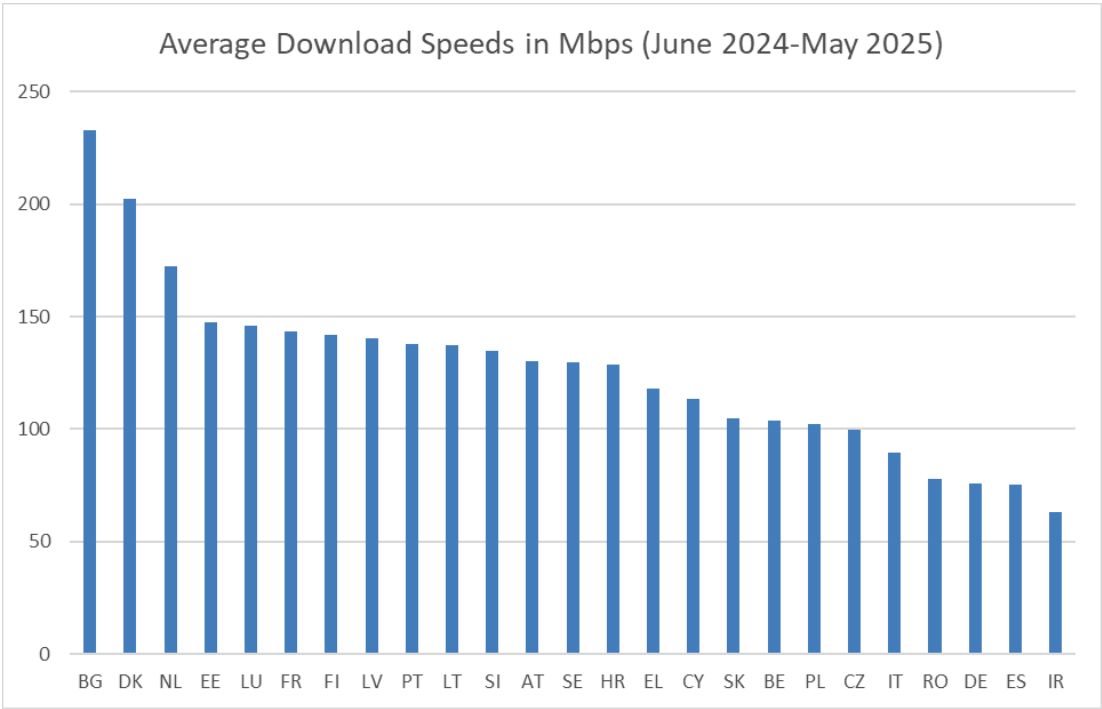
Figure A4 -2-7: Mid-band deployments in Europe and higher download speeds



Source: Ookla/ Omdia (2025), A Global Evaluation of Europe's Digital Competitiveness in 5G Standalone, p. 25.

The Figure A4 2-8 below shows average mobile broadband speeds today in the EU.

Figure A4 -2-8: Broadband speeds per Member State



Source: Ookla (2025), <https://www.speedtest.net/global-index>

Opensignal does not publish a list of download speeds for all the EU member states but some information can be gleaned from its individual country reports¹⁰¹. The table below gives the download speed for the top performing operator in 11 EU Member States based on tests from in the past two years. The average is 214 Mbps.

Table A4 2-3: Average 5G download speeds from best performing MNOs in each country (Source: Opensignal¹⁰²)

Member State	Mbps
Denmark	331.7
Greece	187.7
Czechia	130.1
Poland	127.5
France	246.6
Finland	260.1
Italy	231.3
Romania	242.3
Spain	267.4
Netherlands	166.5
Germany	165.5

¹⁰¹ See <https://www.opensignal.com/market-insights>.

¹⁰² Ibid Various reports from 2023 -2025.

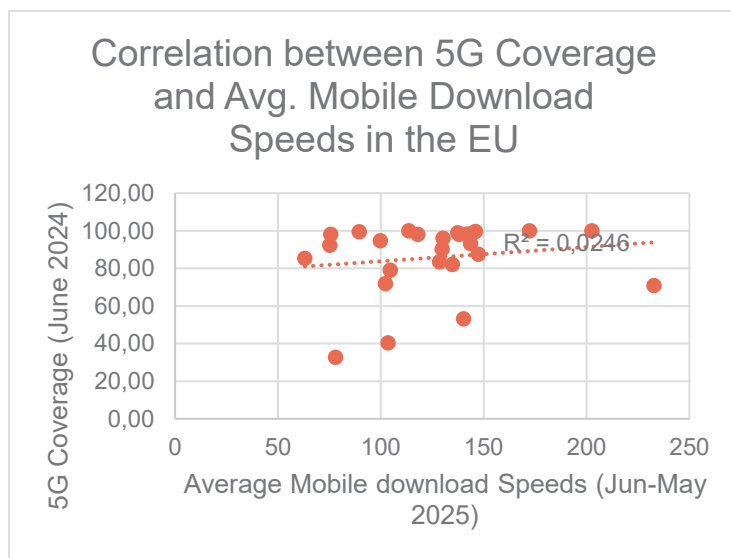
Average	214.2

This is likely to be an over-estimate because the worst performing operators are not included. However, it is much closer to the Ookla figure of 117 Mbps for all mobile technologies.

A general positive correlation can be observed: countries with higher 5G coverage tend to exhibit higher download speeds, though this relationship is not perfectly linear, see for example:

- Bulgaria (BG) has the highest download speed (232.79 Mbps) despite moderate 5G coverage (70.9%), suggesting strong network performance or efficient spectrum use.
- Denmark (DK) and Netherlands (NL) show both 100% 5G coverage and very high speeds (202.67 and 172.28 Mbps), reinforcing the expected link between widespread 5G and high throughput.
- On the other hand, Belgium (BE) and Romania (RO) have low 5G coverage (40.4% and 32.8%) and correspondingly low download speeds (103.53 and 78.05 Mbps).
- Germany (DE) is an exception, with high 5G coverage (98.1%) but relatively low download speeds (75.67 Mbps), indicating that coverage alone does not guarantee performance, possibly due to non-midband deployments or network congestion.

Figure A4 -2-9: 5G coverage and Average Mobile download Speeds, 2025



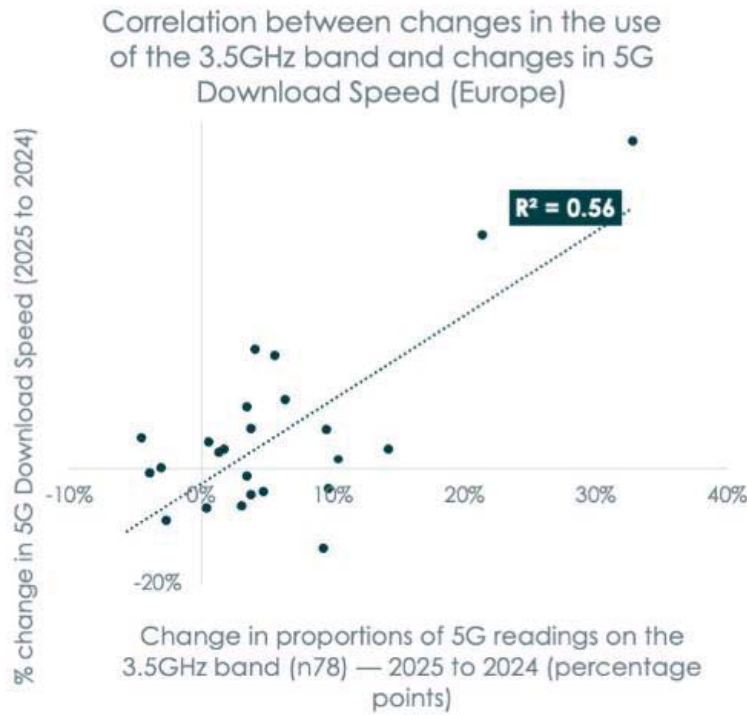
Source: WIK based on Ookla (2025) and Statista (2024)

In summary, while higher 5G coverage generally aligns with better download performance, other factors such as spectrum quality, network capacity, and deployment density play a crucial role in actual speed outcomes.

The 3.5GHz band is widely seen as ideal for 5G because it balances capacity and coverage, making it well-suited for enhanced mobile broadband services. Open Signal's analysis

shows a strong correlation ($R^2=0.56$) between increased 3.5 GHz usage and improvements in average 5G download speed.¹⁰³

Figure A4 2-10: Correlation between changes in the use of 3.5GHz band and changes in 5G Download speed



Source: OpenSignal (2025). Data collection period: Feb 1 – May 1, 2024, Feb 1 – May 1 2025.

Currently, European operators rely heavily on the 3.5GHz band for 5G – which also delivers the fastest average speeds. According to Opensignal other bands see less frequent 5G use, which is currently changing.¹⁰⁴

As 5G evolves, operators will increasingly use lower frequencies to boost capacity using multi-band carrier aggregation. Sweden is one of the examples where the 2.1 GHz band seems to be gaining prominence in 5G roll-outs. This evolving spectrum landscape underscores a strategic balance between speed and coverage, as operators adapt their deployments to meet growing demands.

For speed projections, different mobile broadband speed is assumed based on the used technologies. According to recent estimates by Opensignal, the average 5G download speed for the 700 MHz band is 104.3 Mbps. For mid-band spectrum it is on average 217.6 Mbps.¹⁰⁵

¹⁰³ [More frequencies, higher impact: How spectrum band usage for 5G is expanding across Europe | Opensignal.](#)

¹⁰⁴ [More frequencies, higher impact: How spectrum band usage for 5G is expanding across Europe | Opensignal.](#)

¹⁰⁵ <https://www.opensignal.com/2025/07/02/more-frequencies-higher-impact-how-spectrum-band-usage-for-5g-is-expanding-across-europe/dt>.

There is a one published figure for the 5G average download speed in the whole EU: Medux estimates this at 70 Mbps¹⁰⁶.

Figure A4-2-11: Average download speed across Member States (Mbps, Q1 2025)



However, other companies suggest a higher figure. [Ookla](#) puts the median EU speed in *all mobile technologies* at 117 Mbps. The number for 5G is likely to be higher if the slower results from earlier mobile generations are removed.

The model assumes an average mobile broadband speed of ca. 69 Mbps across all technologies.¹⁰⁷ As a reasonableness check, Statista reports an average mobile download speed of 62.4 Mbps for 2023, making the modelled assumption for 2024 a plausible incremental increase on recent observed data.¹⁰⁸ The average mobile broadband speed is lower because 4G mobile broadband is likely to be more relevant in rural areas and, based on data from Opensignal, a gap of ca. 20% between mobile broadband speeds in urban and rural areas can be assumed.¹⁰⁹

There are only marginal speed differences between the options as speed is mainly driven by the availability of mid-band 5G usage which will not be available widespread until 2035. Nevertheless, over the next decade, mobile download speeds are expected to increase substantially, and could potentially quadruple¹¹⁰ relative to current levels.

Without further policy intervention, two main factors are expected to contribute to higher average mobile download speeds towards 2035:

1. Upgrading from 4G to 5G

¹⁰⁶ See <https://medux.com/blog/all-5g-networks-are-not-created-equal-unveiling-true-qoe-5g-europe-III>

¹⁰⁷ The average mobile download speed is calculated as a weighted average of observed technology-specific speeds, where the weights reflect the distribution of mobile subscriptions across technologies and frequency bands. First, population coverage of 5G mid-band, as reported by DESI, is multiplied by the share of mobile subscriptions that benefit from 5G, based on GSMA data, resulting in the share of mobile subscriptions benefiting from 5G mid-band coverage. Second, the average speed projection is calculated by multiplying the share of subscriptions benefiting from each technology by the corresponding average download speed and aggregating across technologies. Technology-specific speeds are based on Opensignal measurements (4G: 42 Mbps; low-band 5G: 104.3 Mbps; mid-band 5G: 217.6 Mbps). Differences in average download speeds across options are mainly driven by differences in 5G mid-band coverage.

¹⁰⁸ <https://www.statista.com/statistics/689876/average-mobile-speeds-download-and-upload-in-western-europe/>.

¹⁰⁹ See <https://www.opensignal.com/2024/05/07/frances-urban-rural-mobile-experience-gap-has-narrowed-with-5g> (last accessed on 03.07.2025).

¹¹⁰ This increase should be interpreted as an indicative, order-of-magnitude development rather than a precise forecast, given data limitations and methodological differences across sources.

- With the natural telecoms equipment replacement cycle of 8 years, it is assumed that all networks will be upgraded from 4G to 5G by 2035. According to Opensignal, 5G is four times faster than 4G.¹¹¹
- EU-wide 5G coverage is currently 94% according to DESI.
- The transition from 4G to 5G is estimated to increase average mobile download speeds to around 177 Mbps. This reflects the refarming of existing mobile bands (such as 900 MHz, 1800 MHz and 2.6 GHz) from 4G to 5G and the progressive rollout of 5G by multiple operators in already covered areas, which increases capacity and enables more efficient spectrum use.

2. Moving from 5G NSA to 5G SA

- According to Ookla, 5G SA is currently available to only 2% of European consumers, much less than China (80%), India (52%), and the United States (24%)¹¹².
- Median download speeds on 5G SA were 57% higher than 5G NSA in Europe and 84% higher in China.
- With no changes to policy, it seems reasonable to assume that 5G SA will continue to roll out, reaching levels of at least 40% availability
- Starting from a current average 5G download speed of around 177 Mbps (predominantly reflecting 5G NSA), applying a 57% uplift implies an average 5G SA speed of approximately 278 Mbps. Combining 40% of subscriptions at this level with the remaining 60% continuing at around 177 Mbps yields a population-weighted average of approximately 217 Mbps.
- This figure is adjusted upwards to around **250 Mbps** to reflect the possibility of higher 5G SA adoption rates over time and the fact that leading operators in at least six EU Member States already report download speeds exceeding this level.

2.3.2.3 Modelling the impact of the policy options

Policy changes can improve download speeds in three ways: firstly, by encouraging investment in the expensive business of upgrading whole networks to 5G SA. Secondly, by ensuring the affordability of the upper 6 GHz band when it is auctioned. The additional mid-range bandwidth in 6 GHz will increase download speeds without the need to install expensive new base stations. Thirdly, by allowing the purchase of more spectrum in renewals and any other awards by relaxing the use of market-shaping measures. This can also improve speeds by providing additional bandwidth.

The stronger measures suggested in Option 2 relating to licence length, award design, market shaping measures and the need to consider the policy impact on investment can therefore make a greater impact on download speeds.

Based on the baseline figure of 250 Mbps by 2035, the impacts of the policy options were considered as follows:

Option 1: 2% increase in download speed

¹¹¹ See <https://www.opensignal.com/2023/06/29/5g-is-more-consistent-than-4g-across-all-hours-of-the-day-in-the-uk>.

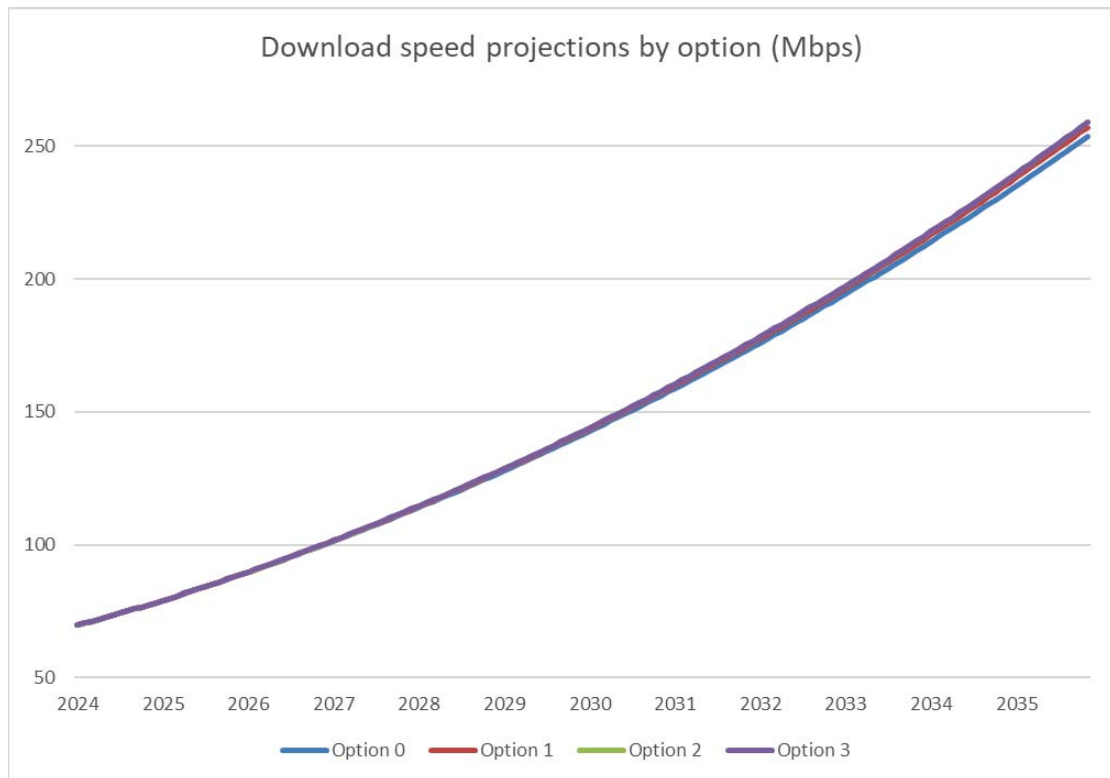
¹¹² See <https://www.ookla.com/articles/europe-5gsa-2025>.

Option 2: 6% increase in download speed

Option 3: 6% increase in download speed

As discussed for 5G midband coverage the figure is the same for Options 2 and 3 because it is not considered that the Option 3 proposals on licence length, authorisation processes or market shaping measures will lead to significantly different outcomes in the proposed analysis period (2025-2035) and would lead to similar results in terms of benefits from reduced fragmentation, increased predictability and economies of scale considering the scope of the model assessment.

Figure A4 2-12: Projected download speeds by option



Source: WIK-Consult

2.3.2.4 Assumptions regarding 5G take-up

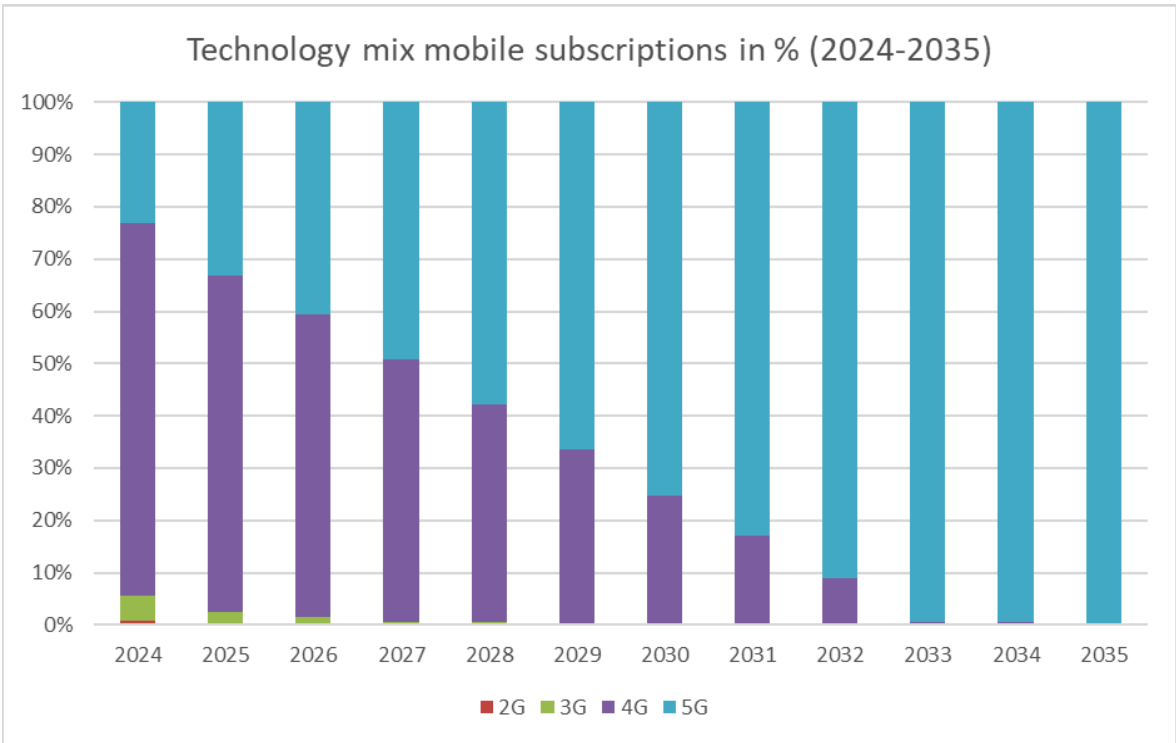
Figure A4 2-13 shows the projected evolution of mobile subscription technologies from 2024 to 2035. It highlights a clear and steady transition toward 5G. In 2024, 4G still holds the majority share, while 5G accounts for around one-quarter of subscriptions. However, over time, 5G rapidly gains ground, surpassing 50% by 2027 and becoming the leading mobile technology.

By 2030, 5G is projected to account for approximately 75% of all mobile subscriptions, making it the dominant access technology. The decline of 4G continues steadily until it nearly disappears by 2033. By 2035, 5G makes up almost 100% of the mobile subscription base, effectively replacing earlier generations.¹¹³ This shift reflects growing consumer

¹¹³ It is reasonable to assume that the new 6G standard will be introduced at the start of the 2030s. As detailed technical specifications are not yet available, a 6G share has not been estimated here for the reasons of simplification.

adoption, increasing device compatibility, and the gradual phase-out of legacy networks across Europe and globally.

Figure A4 2-13: Evolution of mobile technology shares in the EU27 (in % of mobile subscriptions) 2024-2035

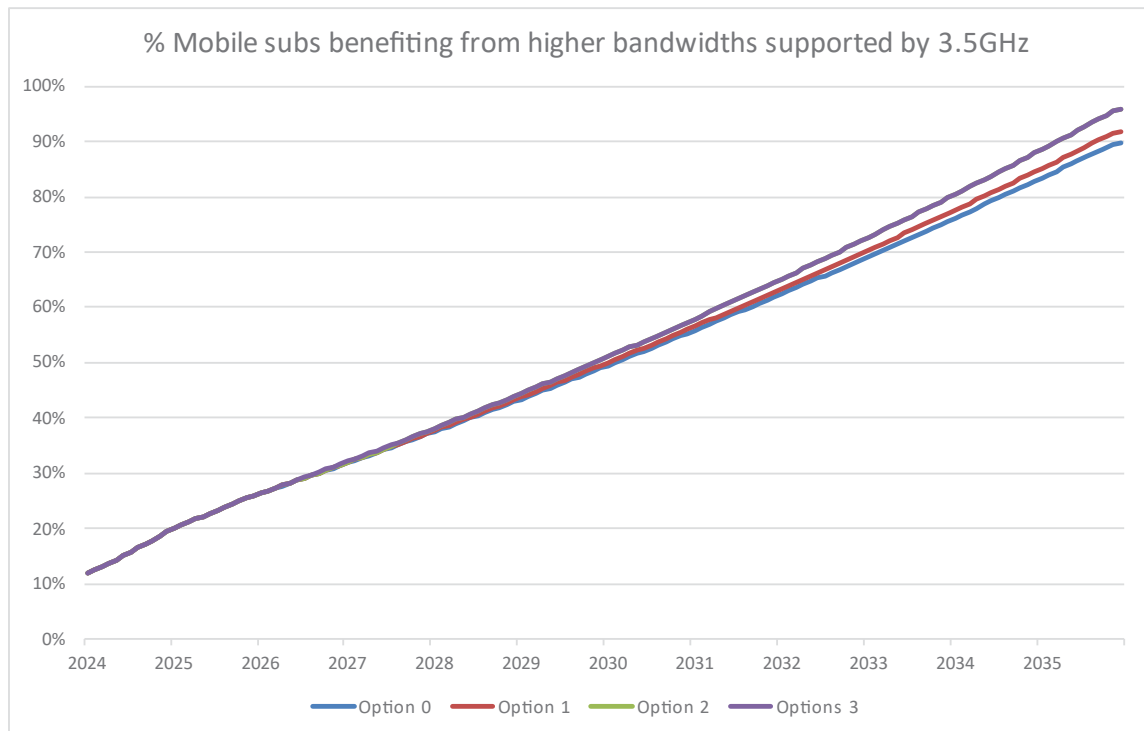


Source: WIK Consult

While projections for overall 5G adoption are increasingly robust, any specific predictions regarding the take-up or use of 5G midband (3.4–3.8 GHz) remain speculative due to a critical lack of publicly available data on the number of users connected via midband spectrum. Most statistics and market reports – such as those from Ericsson Mobility Report, or GSMA – track 5G adoption in aggregate without distinguishing between low-band, midband, or millimeter wave usage. This limits the precision of forecasts related to midband-specific take-up.

The following development was estimated for the options with regard to the impact of midband (see Figure A4 2-14).

Figure A4 2-14: Mobile subscriptions benefiting from higher bandwidth supported by 3.5 GHz



Source: WIK-Consult estimates.

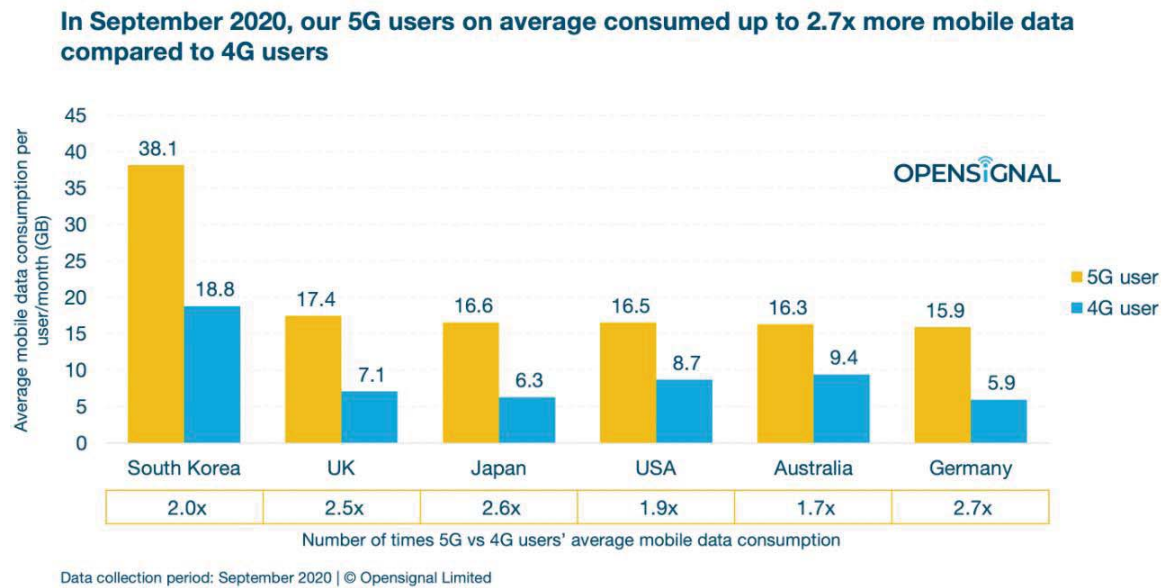
The figure illustrates the projected percentage of mobile subscribers who will benefit from higher bandwidths enabled by the 3.5 GHz spectrum between 2024 and 2035, under the four different action options. Starting from a baseline of around 10% in 2024, all options show a steady increase over time, reaching approximately 90-95% by 2035.

2.3.2.5 Assumptions regarding mobile data consumption

Regarding mobile data consumption, there is relatively limited information available which distinguishes between bandwidth used by customers with 5G connections compared to 4G customers. More importantly, it is even more difficult to find data on bandwidth consumption between 5G customers using low- or mid-band frequencies. However, there is a link between the download speed and overall data consumption. Opensignal reports that 5G users consume more data than 4G users which can be contributed to higher available speeds. This ranges from a factor of 1.9 in the US where mainly low-band 5G is employed to countries like the UK, Japan or Germany where due to mid-band 5G the factor is on average 2.6.¹¹⁴

¹¹⁴ <https://www.opensignal.com/2020/10/21/5g-users-on-average-consume-up-to-27x-more-mobile-data-compared-to-4g-users>

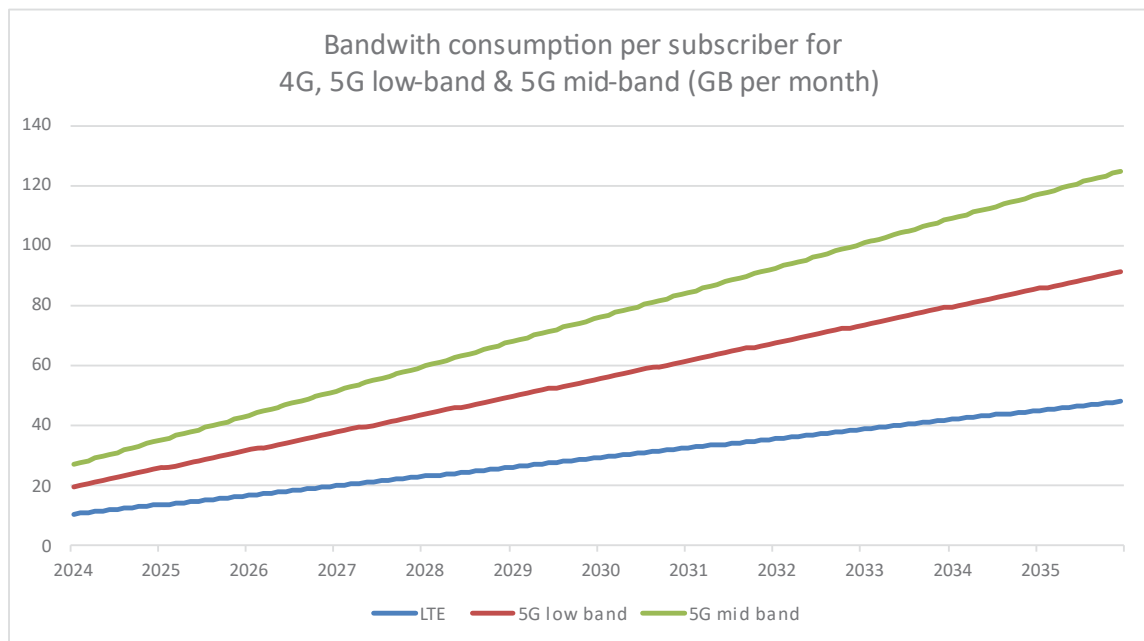
Figure A4 2-15: Data usage by mobile network technology (Opensignal)



Source: Opensignal (2020): 5G users on average consume up to 2.7x more mobile data compared to 4G users, <https://www.opensignal.com/2020/10/21/5g-users-on-average-consume-up-to-27x-more-mobile-data-compared-to-4g-users>

The different technology shares affect total bandwidth consumption as shown in the following FigureA4 2-16. The graph shows the projected monthly bandwidth consumption per subscriber from 2024 to 2035, broken down by technology: LTE, 5G low-band, and 5G mid-band. Consumption increases steadily across all technologies, with 5G mid-band showing the highest usage, reaching over 120 GB/month by 2035, followed by 5G low-band and LTE. This trend highlights the growing data demands associated with more advanced mobile technologies.

Figure A4 2-16: Estimated bandwidth consumption per subscriber for 4G, 5G low-band and 5G mid-band until 2035



Source: WIK-Consult

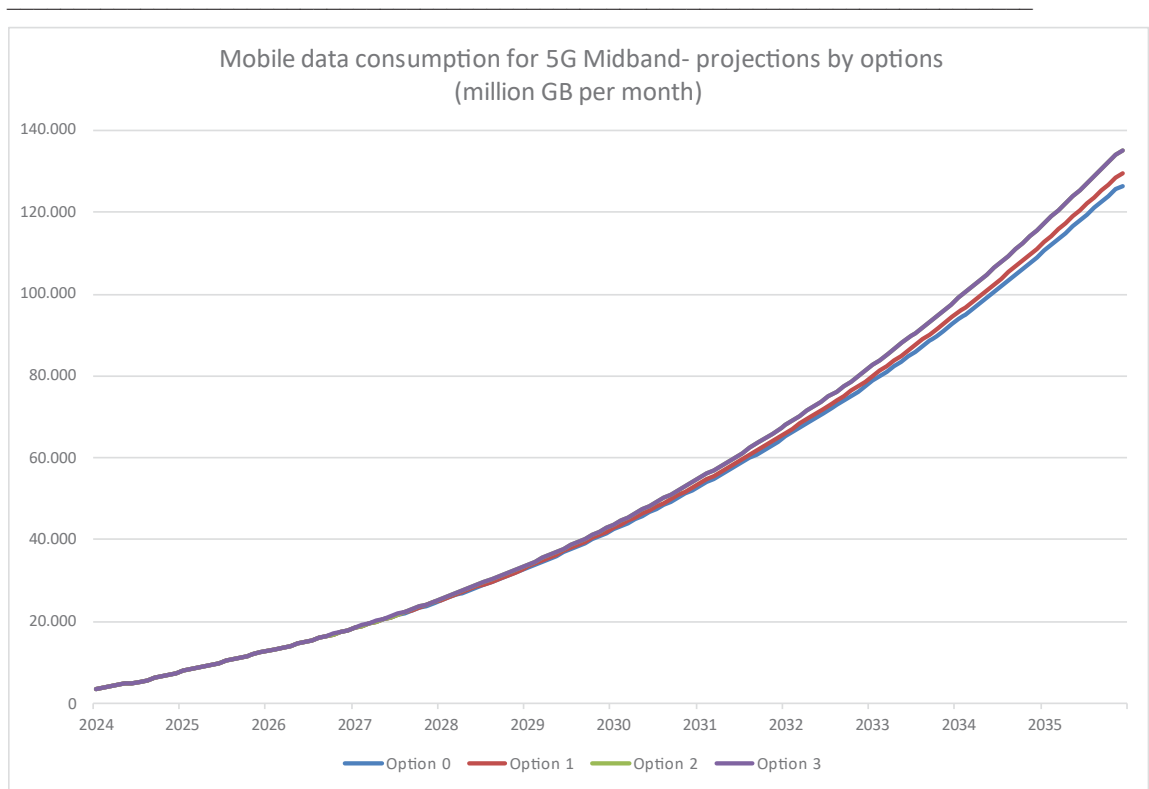
Mobile data usage in the EU has increased exponentially. On average, a smartphone user in Western Europe consumed 19 GB of data per month in 2023, rising to 22 GB in 2024. Ericsson forecasts that mobile data consumption will rise up to 47 GB per month by 2030, increasing by 20 % per year. Overall, mobile data consumption in Europe will reach 37 EB per month in 2030.¹¹⁵ Similarly, the GSMA forecasts that mobile data usage in Europe will increase up to 7 GB per user per month by 2030.¹¹⁶

Figure A4 2-16 displays projected monthly mobile data consumption for 5G mid-band from 2024 to 2035 across the four mobile policy options. Data usage grows steadily for all options, with Option 3 resulting in the highest consumption, approaching 140 million GB/month by 2035.

¹¹⁵ Ericsson Mobility report 2025, available at: <https://www.ericsson.com/49e9b6/assets/local/reports-papers/mobility-report/documents/2025/ericsson-mobility-report-june-2025.pdf>, Ericsson Mobility report key figures, available at: <https://www.ericsson.com/en/reports-and-papers/mobility-report/key-figures>.

¹¹⁶ GSMA (2023): The Mobile Economy 2023, available at: <https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/wp-content/uploads/2023/03/270223-The-Mobile-Economy-2023.pdf>.

Figure A4 2-17: Mobile data consumption for 5G midband – projections by options until 2035



Source: WIK-Consult

The following table provides an overview of the estimates regarding the quantitative effects of the different policy options and the underlying justification.

Table A4 2-4: Assumptions and estimates for quantification of impact

	Option 0	Option 1	Option 2	Option 3	Description quantification estimates
Coverage of 5G in mid-band spectrum	90%	92%	96%	96%	Coverage data employed from DESI from 2023 until 2025. The average coverage of 5G midband rose from just under 41% to 68% between 2023 and 2025. It can be assumed that coverage will now increase at a slower rate. By 2035, midband 5G coverage is expected to reach around 90%.
Business use of 5G¹¹⁷	0	+	++++	++++	Business use cases are primarily driven by use of IoT and vertical application with private 5G networks.
Average 5G mobile download speeds	250	2% increase on baseline	6% increase on baseline	6% increase on baseline	Medux estimates current average mobile speeds at 70 Mbps. However, other estimates suggest a higher figure. Ookla puts the median EU speed in all mobile technologies at 117 Mbps. The number for 5G is likely to be higher if the slower results from earlier mobile generations are removed.
Geographic coverage	0	++	++++	+++++	Pro-investment approach to awards will reduce the cost of roll-out. Spectrum sharing will allow operators targeting underserved areas to access frequencies for FWA or mobile services.
Service innovation	0	++	++++	+++++	Petition for rule-making will allow innovators access to spectrum, as will increased spectrum sharing
Consistency in spectrum awards and licence conditions	0	++	++++	++++	6G spectrum roadmap, stronger measures on licence duration and harmonisation of authorisation regime will all increase consistency.

¹¹⁷ Business use cases were not employed in the GDP estimation. The focus of the GDP estimation was based on improved speeds. The benefit of using 5G private networks is resilience and security.

2.4 Methodology for the estimation of GDP impacts resulting from increases in full 5G adoption and associated speed increases

Potential effects of the different policy options on GDP were estimated with reference to academic literature linking increased adoption of mobile technologies and GDP. Specifically, the assessment of the impact on GDP relies on elasticities provided in a recent study by Briglauer et al./EcoAustria (2025). The authors note that coefficient estimates suggest that a 1% increase in per capita weighted mobile broadband adoption leads to an increase of GDP per capita by 0.084–0.113%. They analysed a panel dataset covering 32 OECD countries from 2002 until 2020 where the authors estimate the following formula:

$$\log GDP_{\{it\}} = \beta_0 + \beta_1 \log CAPITAL_{\{it\}} + \beta_2 \log LABOUR_{\{it\}} + \beta_3 \log BB_{COV_{\{it\}}^{\{j\}}} + \beta_k \log BB_{ADOP_{\{it\}}^{\{k\}}} + \beta_h \log EDUC_{\{it\}}^{\{h\}} + \beta_4 \log years\_adop_{\{it\}}^{\{k\}} + \alpha_i + \alpha_t + \varepsilon_{\{it\}}$$

$BB\_ADOP_{\{it\}}^{\{k\}}$ is the aggregated number of customers that adopt new broadband connections. β_k estimates the percentage change in the increase of GDP per capita when mobile broadband adoption increases by 1 percent. The estimate of 0.084% corresponds closely to Edquist et al. (2018), that find an elasticity of 0.08%.

As the study focuses on the *adoption* (and not merely coverage) of mobile broadband during a period when the then new generation technology 4G was deployed, it implicitly reflects the impact of increasing mobile broadband capabilities on GDP. As the considered policy options are not likely to significantly affect standard 5G (including NSA) coverage (which is near universal) or 5G uptake (which is currently limited inter alia by the devices in use), assessment of the impacts focused on the degree to which the options are likely to improve mobile broadband quality, as measured by increases in speed.

This would reflect findings from other studies that link economic benefits to the deployment of new generation (more performant) mobile technologies. For example, Oxford Economics (2023)¹¹⁸ estimates that mid-band deployment and mmWave spectrum with 5G technologies could contribute USD 2.1 trillion (1.7 %) to global GDP until 2030. The inference that the influence of mobile broadband adoption of more recent generations affects GDP via improvements in broadband quality is supported by a study by Edquist (2021),¹¹⁹ which aimed to investigate the **association between mobile broadband speed and labour productivity** by building panel data of 116 countries over 2014–2019. Their results suggest a significant and robust effect when an one-year lag of mobile broadband speed is introduced. Their modelling suggests that a 10% increase in mobile broadband speed in a given period is associated with a 0.2% increase in productivity in the following period.

Forecasted increases in broadband speeds resulting from the different options were converted to GDP impacts based on the estimate from Briglauer et al./EcoAustria (2025) noted above. Calculations were made for each year between 2024 until 2035. The results are presented in the main report. The

¹¹⁸ Oxford Economics (2023): The Global Economic Potential of 5G-Enabled Technology, available at: https://www.oxfordeconomics.com/wp-content/uploads/2023/03/GlobalEconomicPotential5G_290323.pdf.

¹¹⁹ Edquist H. “The Economic Impact of Mobile Broadband Speed”, 23rd Biennial Conference of the International Telecommunications Society (ITS), June 2021, available at: <https://www.econstor.eu/bitstream/10419/238018/1/Edquist.pdf>.

resulting forecasts are consistent with other findings in the literature. For instance, with predictions by Oxford Economics¹²⁰ or PwC.¹²¹

While estimates have assumed a linear relationship between improvements in mobile broadband speed and GDP, there are uncertainties around this assumption. The panel data used by the authors covers the 4G era. Therefore, the estimate does not include improvements relating to the use of verticals and latency. It is unclear how the estimate would change in the 5G era. Therefore, the estimate should be viewed conservatively.¹²² The model does not account for spillover effects on different sectors of the economy. These 5G-specific effects have not been included in the calculations due to significant uncertainty surrounding the measurement of the impact of technologies for which there is limited empirical evidence. Nevertheless, these spillover effects could provide an additional upside to the effects outlined in the study.¹²³

To account for potential uncertainties, a sensitivity analysis is conducted that relies on varying estimates (0.01 % to 0.113 %). The lower bound is taken into consideration to account for multiple uncertainties. These are for example that the study period of Briglauer et al. (2025) ends in 2019 and does not account for speed increases due to 5G or the fact that the estimate only accounts for adoption of mobile broadband but not directly estimates speed increases. The upper bound (0.113 %) is the higher coefficient estimated by Briglauer et al. (2025). This can be seen as more upside potential from increased 5G mobile broadband speeds.

Table A4 2-5: Sensitivity analysis: Cumulative 5G impact on GDP 2025-2035 (in billion EUR)

Scenario	Option 0	Option 1	Option 2	Option 3
Baseline (coefficient 0.084 %)	1 480	1 505	1 553	1 553
Lower bound (coefficient 0.01 %)	171	174	179	179
Upper bound (coefficient 0.113 %; Briglauer et al. (2025))	2 015	2 049	2 116	2 116

Source: WIK-Consult.

Under the lower-sensitivity scenario, which assumes a smaller impact of increased mobile broadband speeds on productivity and GDP (for example, due to uncertainties regarding the effective use of 5G-enabled technologies across sectors or slower diffusion of digital applications), the cumulative GDP

¹²⁰ Oxford Economics (2023): The Global Economic Potential of 5G-Enabled Technology, available at: https://www.oxfordeconomics.com/wp-content/uploads/2023/03/GlobalEconomicPotential5G_290323.pdf

¹²¹ World Economic Forum and PwC “The Impact of 5G: Creating New Value across Industries and Society”, January 2020; page 9.

¹²² As mobile broadband is still evolving (5G, IoT, edge computing), time series are too short to robustly identify non-linear dynamics, or to make assumptions regarding whether the effects would be regressive or progressive. For this reason, a linear relationship between speed improvements and GDP is applied as an indicative approximation. This approach is consistent with the literature underpinning the selected coefficients and is complemented by a sensitivity analysis covering a wide range of elasticities.

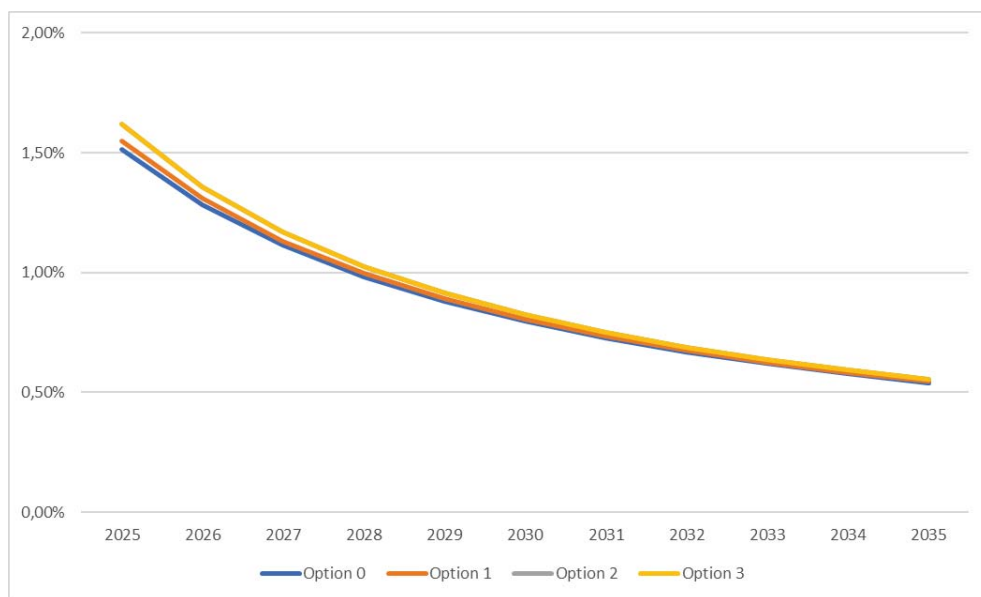
¹²³ Also, with regard to 6G it must be noted, that the technology is still under development, meaning real-world data on adoption, performance, and impact on productivity or GDP is not available.

impact for the EU over 2025–2035 is estimated at EUR 179 billion for option 2, compared to EUR 171 billion for the baseline and EUR 179 billion for option 3.

Conversely, under the upper-sensitivity scenario, which assumes a higher responsiveness of GDP to broadband speed improvements (for instance, reflecting faster adoption of 5G-driven innovations or stronger network effects), the overall GDP impact for the EU over the same period is estimated at EUR 2,116 billion for option 2, compared to EUR 2,015 billion for the baseline and EUR 2,116 billion for option 3.

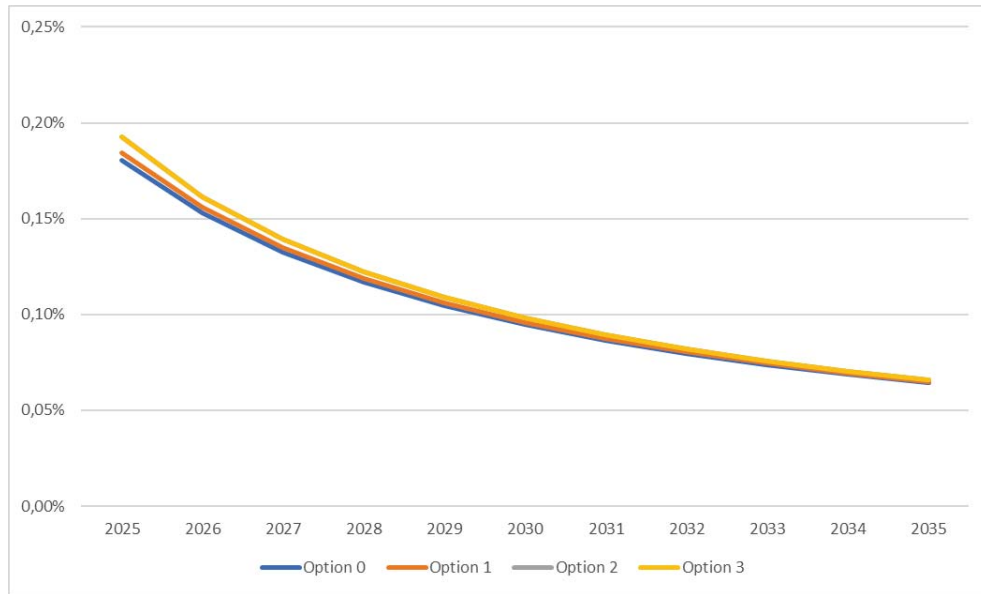
These results illustrate that while the magnitude of impacts varies substantially across sensitivity assumptions, the relative differences between policy options remain limited, suggesting that the overall ranking of options is robust to variations in the assumed elasticity of GDP to broadband speed increases.

Figure A4 2-18: 5G download speed impact on GDP growth (baseline)



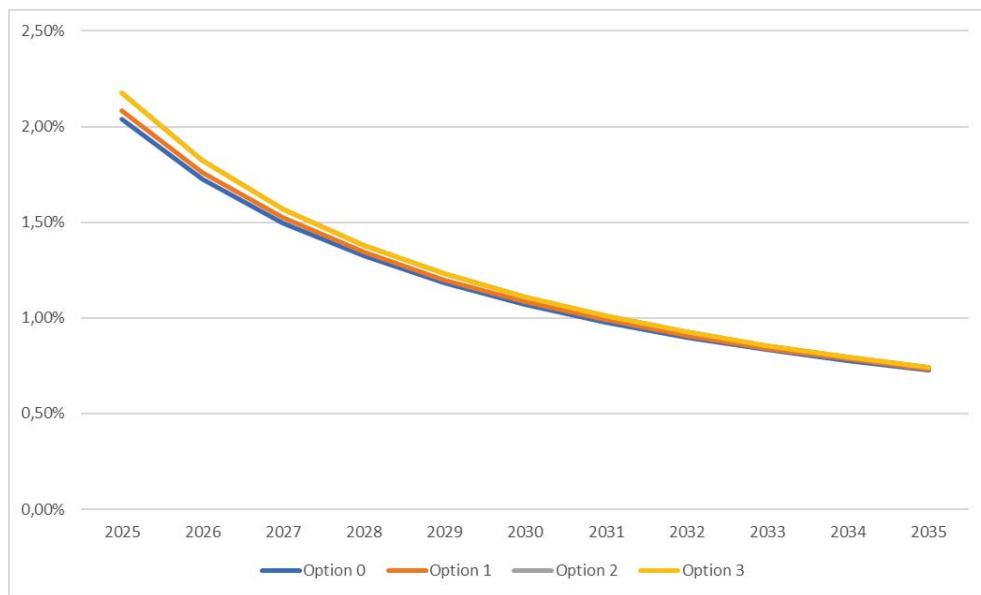
Source: WIK based on Briglauer et al. (2025).

Figure A4 2-19: 5G download speed impact on GDP growth (lower bound)



Source: WIK based on Briglauer et al. (2025).

Figure A4 2-20: 5G download speed impact on GDP growth upper bound)



Source: WIK based on Briglauer et al. (2025).

2.5 Methodology for the estimation of environmental impacts

In order to estimate the environmental impact of full 5G coverage, estimates were derived for increases in bandwidth consumption associated with the increased deployment and associated take-up of different technologies. The bandwidth use per technology was then translated into environmental impacts based on linkages identified in literature. The details are provided below.

To investigate the environmental impact of annual data consumption across networks, the analysis builds upon the model developed by (Andrae & Edler, 2015). Here the electricity consumption for

4G (LTE) is found to be 0.6 kWh per GB in 2010. As a best estimate the energy efficiency is assumed to improve by 22% annually until 2020.

The electricity consumption per network can therefore be calculated based on the following equation (Andrae & Edler, 2015):

$$E_{xG,2010+n} = ADT_{xG} * EI_{xG,2010} * (100\% - EE\%)^n$$

Where:

- $E_{xG,2010+n}$ = total electricity consumption, kWh, for network xG in year 2010+n
- ADT_{xG} = annual data traffic, GB, for network xG
- $EI_{xG,2010}$ = electricity intensity, kWh/GB, for network xG
- EE = annual electricity efficiency improvement

For 5G the model is refined to differentiate between basic 5G and full 5G. Laidler (Curtailling carbon emissions - can 5G help?, 2019) estimates that a 5G cell has 8-15% the electricity intensity compared to a like-for-like 4G cell. mmWave 5G has potential to fall to 1-2% of a 4G cell, it is therefore estimated that midband (3.5GHz) may be able to obtain electricity intensity of 6.5% of 4G using the midpoints. Accordingly, the energy intensity of 5G is estimated as follows:

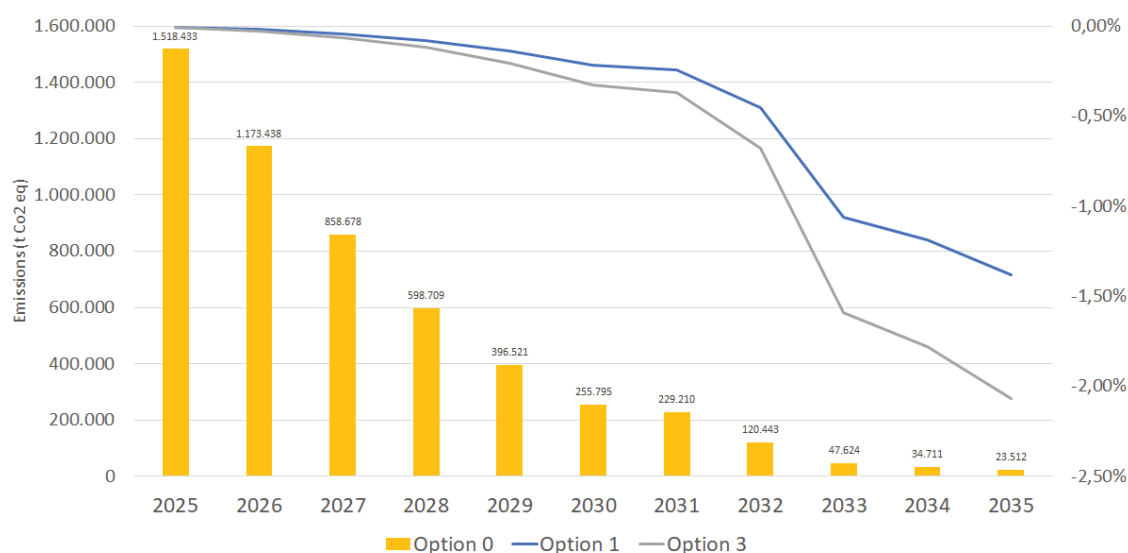
- Basic 5G: 0.069 kWh per GB
- Full 5G: 0.025 kWh per GB

The analysis also accounts for the shift in electricity generation in the EU from fossil fuels to renewables. This is based on calculations made by enerdata¹²⁴ showing decrease from 0.161 kg CO₂e per kWh in 2025 to 0.046 kg CO₂e per kWh in 2035.

Figure A4-2-20 shows the results in terms of the development for the different options.

¹²⁴ <https://eneroutlook.enerdata.net/forecast-world-co2-intensity-of-electricity-generation.html>.

Figure A4 2-21: Development of GHG emissions



In this analysis, increased data traffic is considered (based on projections). Network densification is not explicitly modelled, but may be reflected indirectly in the estimates, as the energy efficiency associated with the operation of “full” (mid-band) 5G is likely to be affected by densification that often (although not always) takes place in order to meet increasing bandwidth demand. In this context, it is relevant to note that per individual base station, mid band can transmit more data simultaneously (higher efficiency per station) – but the energy consumption per MB across the same area might be higher, due to the increased infrastructure that is required. Concerns have been raised in several studies in this regard¹²⁵ that increased use of mid-band spectrum with densification could reduce the energy efficiency associated with mobile broadband provision.

The main environmental impacts are expected in the operation phase. Studies from mobile equipment manufacturers suggest that the environmental impact of new generations of mobile communications at the deployment phase is likely to be limited compared with impacts associated with network operation.¹²⁶

2.6 Findings

The table presents greenhouse gas (GHG) emissions projections across four options for the years 2025 to 2035. In general, the emissions decrease progressively each year for all options, with Option 0 starting at the highest emissions in 2025 and reducing to the lowest in 2035. The total emissions in Option 0 are 5,257,074, while Options 1, 2, and 3 show a slight reduction, with differences of -4,584, -6,670, and -6,877, respectively. These small differences translate into negligible percentage changes, with the percentages of difference between the options ranging from -0.09% to -0.13%. This indicates that the variations in GHG emissions across the four options are minimal, suggesting similar strategies for emissions reductions in the given time frame. Overall, the slight differences in the totals demonstrate that the options lead to similar results in terms of GHG reduction.

¹²⁵ See for example literature reviewed in WIK-Consult (2022) for BEREC <https://www.berec.europa.eu/en/document-categories/berec/reports/external-sustainability-study-on-environmental-impact-of-electronic-communications>.

¹²⁶ Estimates from equipment manufacturers such as Nokia (2020) suggest that the operation phase is responsible for about 90% of the emissions associated with electronic communications networks, with raw materials and transportation associated with the deployment phase accounting for the remainder.

For completeness, greenhouse gas emissions are also **monetised** using a fixed damage cost per tonne of CO₂e. Applying a damage cost of EUR 800 per tonne of CO₂e, the resulting climate-related damage costs attributable to mobile telecommunications amount to approximately EUR 4.63 billion under the baseline and around EUR 4.62 billion under Options 1, 2 and 3.¹²⁷ Consistent with the emissions results, differences in monetised environmental impacts across options are negligible.

Policy option 2 will further accelerate deployment of future mobile generations like 6G that are being designed with energy efficiency and renewable energy integration as core principles and will therefore favourably impact energy efficiency

The reported CO₂ values should not be interpreted as measurements with high numerical precision but rather as outputs of a scenario-based estimation model. These results represent the outcome of a defined set of assumptions. The actual uncertainty range around these values is broader and depends on the sensitivity of key parameters.

A sensitivity analysis with respect to the total data consumption is not conducted insofar as the model assumes a linear relationship, i.e., a 10% increase in data volume would lead to a 10% rise in GHG emissions when the assumed technology mix stays the same. For this reason, a sensitivity analysis is conducted for the energy-efficiency factor, which is set at 22% per year in the base model. Variations in this factor accordingly affect the different options. Table A4 2-6 shows the results.

Table A4 2-6: Sensitivity analysis: Variations in energy-efficiency factor

		Absolute GHG emissions			
		Option 0	Option 1	Option 2	Option 3
Energy efficiency improvement factor	5%	5,689,509	5,682,062	5,678,545	5,678,338
	10%	5,542,002	5,535,594	5,532,596	5,532,390
	20%	5,298,659	5,293,826	5,291,616	5,291,410
	22%	5,257,074	5,252,490	5,250,404	5,250,198
	30%	5,110,378	5,106,615	5,104,940	5,104,733
		Deviation from initial value			
Energy efficiency improvement factor	5%	8,23%	8,18%	8,15%	8,15%
	10%	5,42%	5,39%	5,37%	5,37%
	20%	0,79%	0,79%	0,78%	0,78%
	22%	0,00%	0,00%	0,00%	0,00%
	30%	-2,79%	-2,78%	-2,77%	-2,77%

¹²⁷ Greenhouse gas emissions are monetised using a fixed damage cost of EUR 800 per tonne of CO₂e, based on estimates by the [German Environment Agency \(UBA\)](#).

The ranking is stable across all scenarios: Option 3 always performs best, followed by Options 2, 1, and 0. However, the differences between options are very small, around 0.1–0.2% (e.g., baseline 22%: 5,257,074 vs. 5,250,198 for Option 0 vs. 3).

Around the baseline, absolute emissions decline almost linearly by several tens of thousands of units per additional efficiency percentage point, with slightly diminishing marginal returns. Prioritizing an increase in the efficiency factor delivers meaningful GHG reductions, while the choice among Options 0–3 yields only marginal gains.

The additional energy-saving effect of 6G has not been included in this model. Nevertheless, it is likely to be significant, given that future mobile generations such as 6G are being designed with energy efficiency and renewable-energy integration as core principles. In this context, spectrum measures that enable the swift assignment of 6G frequencies are expected to yield further benefits, not captured here, in terms of absolute energy savings and the speed at which those savings materialize. In parallel, the deployment of edge computing and AI-driven energy optimisation (e.g., adaptive sleep modes, intelligent traffic steering, and predictive maintenance) will further enhance the sustainability of mobile networks.

At the same time, 6G is expected to improve energy efficiency at the network and service levels. While AI can make processes more energy-efficient, it may also increase electricity demand due to the greater computing capacity required. Any comprehensive assessment should therefore weigh AI-enabled efficiency gains against the incremental power needs of expanded compute infrastructure.

3 METHODOLOGY FOR THE ANALYSIS OF SPECTRUM-AUCTION REGULATORY APPROACHES AND MARKET OUTCOMES

3.1 Introduction

This annex sets out the methodology used to analyse the possible relationship between regulatory approaches applied in recent 5G spectrum awards and the resulting market outcomes across Member States. The objective of this exercise is to present market outcomes and to assess whether, and to what extent, specific elements of auction and award design may influence investment incentives, market performance and user experience in mobile broadband markets.

To this end, the analysis considers the most relevant indicators of market outcomes and regulatory design for the 3.4–3.8 GHz and 700 MHz bands. Given the substantial heterogeneity observed across Member States in both market outcomes and regulatory approaches, the assessment proceeds in two steps. First, composite indicators of market outcomes as well as regulatory design were constructed to provide initial visual insights into potential relationships. These simplified representations help to identify broad patterns but are not intended to constitute statistical evidence. Building on these initial observations, the second step consists of a multiple regression analysis examining the associations between individual regulatory instruments and the various market-outcome indicators, while controlling for key non-regulatory factors.

The following sections of this annex describe the data sources used, the approach for quantifying and scoring regulatory design and market outcomes, the construction of the composite indicators, as well as the methodology applied in the multiple regression analysis.

3.2 Fragmented Market Outcomes

3.2.1 Selection of market-outcome indicators

To assess how 5G markets perform across Member States, the analysis focuses on three core dimensions of **market outcomes**: coverage, quality of service and consumer prices. These dimensions capture, respectively, the geographic reach of 5G networks, the performance experienced by end-users, and the affordability of mobile broadband services.

For **coverage**, the analysis considers both overall 5G population coverage and 5G coverage in the 3.4–3.8 GHz band. Mid-band 5G coverage is particularly relevant for this initiative, as it reflects the availability of high-quality 5G services in the key pioneer band targeted by recent spectrum awards. At the same time, overall 5G coverage is included to provide a more complete picture of the extent to which 5G networks are available, in particular when analysing outcomes associated with the 700 MHz band.

For **quality of service**, the indicators used comprise average download speeds, 5G-specific download speeds, upload speeds and latency. Download speeds, and especially 5G download speeds, are central to end-user experience and the support of data-intensive applications, while upload speeds and latency are particularly relevant for business users and advanced use cases that rely on real-time communication or upstream data flows.

For **consumer prices**, the analysis relies on standardised usage baskets that reflect different types of mobile users. Three packages are considered: 50 GB with 100 calls, 20 GB with 30 calls, and 10 GB with no calls. These baskets are designed to be broadly representative of high, medium and lower-usage consumers and, as PPP-adjusted price indicators, allow for consistent comparisons across Member States.

3.2.2 Data sources

The indicators used in this section are based on existing, harmonised data sources:

- **Coverage:** 5G population coverage and 5G coverage in the 3.4–3.8 GHz band are taken from the Commission’s Digital Decade / DESI monitoring tool (DESI indicators, reference year 2024), as presented in the Digital Decade DESI visualisation environment.
- **Quality of service:** Average download speed, 5G download speed, average upload speed and latency were provided by MedUX.¹²⁸
- **Consumer prices:** Price indicators for the three mobile usage baskets are drawn from the study “Mobile and Fixed Broadband Prices in Europe 2023”¹²⁹, which provides a PPP-adjusted comparison of retail prices across Member States.

3.2.3 Member States considered in the analysis

Data on market outcomes were collected for all Member States across the full set of performance indicators defined in Section 3.2.2. However, it should be noted that the datasets used for the

¹²⁸ Data provided to EC on the Status of 5G Quality and Experience in Europe” prepared for the European Commission as part of the MedUX Impact programme (September 2025). For details on the methodology see <https://medux.com/blog/europes-5g-progress-meeting-expectations>.

¹²⁹ Empirica (2025): [Mobile and fixed broadband price in Europe in 2023: Insights into the European Broadband Market | Shaping Europe’s digital future](https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-price-europe-2023-insights-european-broadband-market) (Available online at: <https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-price-europe-2023-insights-european-broadband-market>).

subsequent visual assessment in Section 3.3.10 and for the regression analysis in section 3.4 cover a smaller group of Member States. This reflects limitations in the availability of information required to characterise regulatory approaches in recent 5G spectrum awards, as well as the absence of band-specific final auction prices in some Member States. Further details are provided in the corresponding sections. To provide a comprehensive picture of differences in mobile-connectivity performance across the EU, all Member States are nevertheless retained in the descriptive comparison of cross-country market-outcomes variation presented in Section 3.2.4.

3.2.4 Observed Variation in Market Outcomes across Member States

The data for all Member States included in this analysis are presented in Table A4 3-1: covering the three dimensions of market outcomes: 5G coverage (both overall and in the 3.4–3.8 GHz band), quality-of-service indicators (average download speed, 5G download speed, upload speed and latency), and PPP-adjusted consumer prices for the three usage baskets. The figures illustrate a highly fragmented landscape, with substantial variation across Member States in each of the outcome variables.

Table A4-3-1: Market-Outcome Indicators for the 21 Analysed Member States

MS	5G coverage (%)	5G 3.6 GHz coverage (%)	Avg. DL Speed (Mbps)	Avg. 5G DL Speed (Mbps)	Avg. UL Speed (Mbps)	Avg. Latency (Ms)	Price for 50 GB, 100 calls (EUR, PPP)	Price for 20 GB, 30 calls (EUR, PPP)	Price for 10 GB, 0 calls (EUR, PPP)
AT	99,5%	84,0%	76,23	125,05	21,7	19,1	16,99	8,82	6,23
BE	96,9%	49,3%	83,96	134,59	19,3	22,5	22,34	18,76	13,40
BG	81,3%	81,3%	94,67	170,51	19,6	23,7	10,11	10,11	10,11
HR	94,2%	45,2%	86,79	146,09	18,3	27,3	28,78	9,65	9,65
CY	100,0%	35,0%	51,15	73,65	13,9	38,5	21,85	10,88	10,88
CZ	99,1%	42,4%	45,87	66,41	14,4	20,0	35,17	35,17	16,06
DK	100,0%	87,5%	155,59	206,08	27,2	21,4	10,32	5,61	4,94
EE	91,5%	69,5%	85,36	195,00	18,9	23,0	29,98	20,06	9,05
FI	99,5%	91,9%	99,01	179,71	18,3	24,3	21,69	17,17	12,57
FR	94,3%	74,0%	85,33	163,58	17,5	27,3	12,92	9,24	9,24
DE	99,1%	49,5%	58,87	91,43	17,2	23,0	22,04	20,64	9,53
EL	99,8%	72,9%	67,2	121,71	14,7	20,6	36,21	26,03	10,87
HU	85,6%	53,4%	47,3	91,21	15,4	23,9	47,42	23,11	19,73
IE	89,9%	58,8%	52,83	90,77	16,1	23,1	12,61	12,61	10,93
IT	99,5%	93,3%	51,25	110,95	12,8	38,1	13,54	13,54	9,98
LV	71,1%	52,2%	73,2	137,69	20,1	25,9	32,79	27,16	17,48
LT	99,7%	75,1%	71,92	150,99	16,0	31,0	19,92	17,27	11,83
LU	99,6%	70,6%	132,16	192,45	22,2	20,3	34,26	22,81	13,66
MT	100,0%	40,0%	52,8	69,90	12,3	43,6	25,22	16,82	10,30
NL	100,0%	99,4%	122,13	154,02	31,5	18,3	13,24	10,67	6,41

MS	5G coverage (%)	5G 3.6 GHz coverage (%)	Avg. DL Speed (Mbps)	Avg. 5G DL Speed (Mbps)	Avg. UL Speed (Mbps)	Avg. Latency (Ms)	Price for 50 GB, 100 calls (EUR, PPP)	Price for 20 GB, 30 calls (EUR, PPP)	Price for 10 GB, 0 calls (EUR, PPP)
PL	89,3%	60,2%	63,78	148,63	13,9	35,9	12,15	10,42	10,42
PT	98,7%	71,4%	83,23	186,24	16,9	20,7	33,09	17,05	11,37
RO	46,8%	32,8%	46,46	100,16	17,2	27,6	3,57	3,57	3,23
SK	87,9%	70,6%	67,39	106,04	19,7	24,7	25,22	22,58	12,61
SI	96,7%	92,9%	78,64	120,62	18,0	25,7	16,97	13,43	8,14
ES	95,7%	74,0%	62,47	133,23	15,7	30,8	16,03	7,94	7,94
SE	98,6%	74,0%	98,57	130,41	22,1	32,5	25,9	18,48	12,99
CV*	12,4%	28,5%	34,9%	29,9%	23,3%	24,7%	45,7%	46,1%	33,5%

*CV = Coefficient of variation computed as Standard deviation divided by the Mean, indicating relative dispersion.

Although consumer prices in most Member States are relatively low by international standards, the underlying data reveal pronounced differences within the EU, with some Member States displaying significantly higher retail prices across all usage baskets than others. A similarly diverse picture emerges for 5G mid-band coverage. While a number of Member States has already achieved extensive population coverage in the 3.4–3.8 GHz band, others lag considerably behind, resulting in uneven access to advanced 5G performance across the Union. Differences are likewise observed in overall 5G coverage, although the dispersion is generally less pronounced than in the mid-band and more problematic only for a limited number of Member States. The quality-of-service indicators show substantial disparities as well. Average and 5G-specific download speeds vary widely among Member States, and the same applies to upload speeds and latency. These differences translate directly into heterogeneous user experiences, particularly for data-intensive or latency-sensitive applications. Taken together, the results indicate that market outcomes for 5G connectivity remain fragmented across the EU, with considerable variation in prices, mid-band 5G availability and network performance, as reflected in the dispersion measure presented in Table A4 3-1. This heterogeneity provides the basis for examining whether differences in regulatory approaches to spectrum assignment may, among other factors, contribute to the observed differences in market outcomes.

3.2.5 Composite Measure of Market Outcomes

For the statistical analysis presented in Section 4 of this annex, the individual values of each market-outcome indicator were used directly. However, to provide an initial visual overview of a potential relation between market outcomes and regulatory approaches, a composite indicator was constructed. This composite indicator serves exclusively for graphical illustration and does not enter the regression analysis.

The composite indicator is constructed as a weighted average of the nine market-outcome variables, grouping coverage, quality of service and consumer-price indicators into a single measure of overall 5G performance. Before applying the weights, each variable was normalised to ensure comparability. For indicators where a higher value represents a better outcome (e.g. coverage or download speeds), each Member State's value was rescaled relative to the best performance observed in the sample, while also reflecting its distance from the lowest performance possible. Conversely, for indicators where a lower value signals a better outcome (i.e. latency and consumer prices), the rescaling was

inverted so that lower values receive higher normalised scores. This approach ensures that all indicators contribute on a uniform “higher-is-better” scale and that the relative position of each Member State reflects both how close it is to the sample leader and how far it is from the weakest outcome possible. The resulting normalised indicators were then aggregated using the following weighting structure:

Table A4 3-2: Weighting Structure for the Composite Market-Outcome Indicator

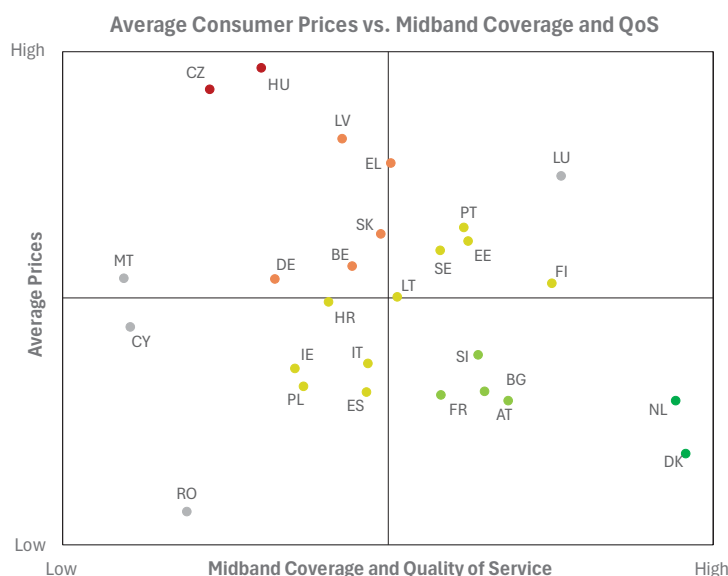
Criterion	Weight
Overall 5G	0.125
5G	0.125
Download	0.150
5G	0.100
Upload	0.100
Latency	0.100
Price: 50	0.100
Price: 20	0.100
Price: 10	0.100
Total	1.000

The weighting reflects the three core dimensions of mobile broadband performance. Coverage accounts for one quarter of the composite indicator, balancing the importance of general 5G availability with that of high-capacity mid-band deployment. Quality-of-service indicators collectively receive the largest share, recognising that end-user experience is driven primarily by download performance, with upload speed and latency included to capture wider performance characteristics relevant for business users and advanced applications. Consumer prices represent 30% of the composite and are weighted equally across the three usage baskets to reflect affordability for different user profiles without assuming a particular distribution of consumption patterns given that there is no information available on the take up of considered broadband consumption baskets. The weighted sum obtained for each Member State was then standardised using z-scores, allowing the resulting index to be plotted on a common scale with the similarly standardised regulatory-design score presented in the next section. This rescaling facilitates interpretation of the figures without altering the underlying structure of the composite indicator.

In addition to this overall composite, a second index was derived to support the visual exploration of the relationship between consumer prices and network performance in the figures presented in Section 2.2.2 of the main report (Consumer Prices in Relation to Mid-Band Coverage and Quality of Service and Consumer Prices, Mid-Band Coverage and Quality of Service Across Selected Member States). For this purpose, only the indicators directly related to the capacity-driven performance of 5G networks were retained. Accordingly, overall 5G coverage was not included in this index, and its weight was fully reallocated to the mid-band (3.6 GHz) 5G coverage indicator, ensuring that the coverage dimension reflects the availability of high-capacity 5G services only. After removing the price dimension (0.30), the weights of the remaining coverage and quality-of-service indicators were re-scaled to sum to one. The resulting measure provides a focused representation of mid-band 5G availability and quality of service, allowing for direct comparison with the price indicators.

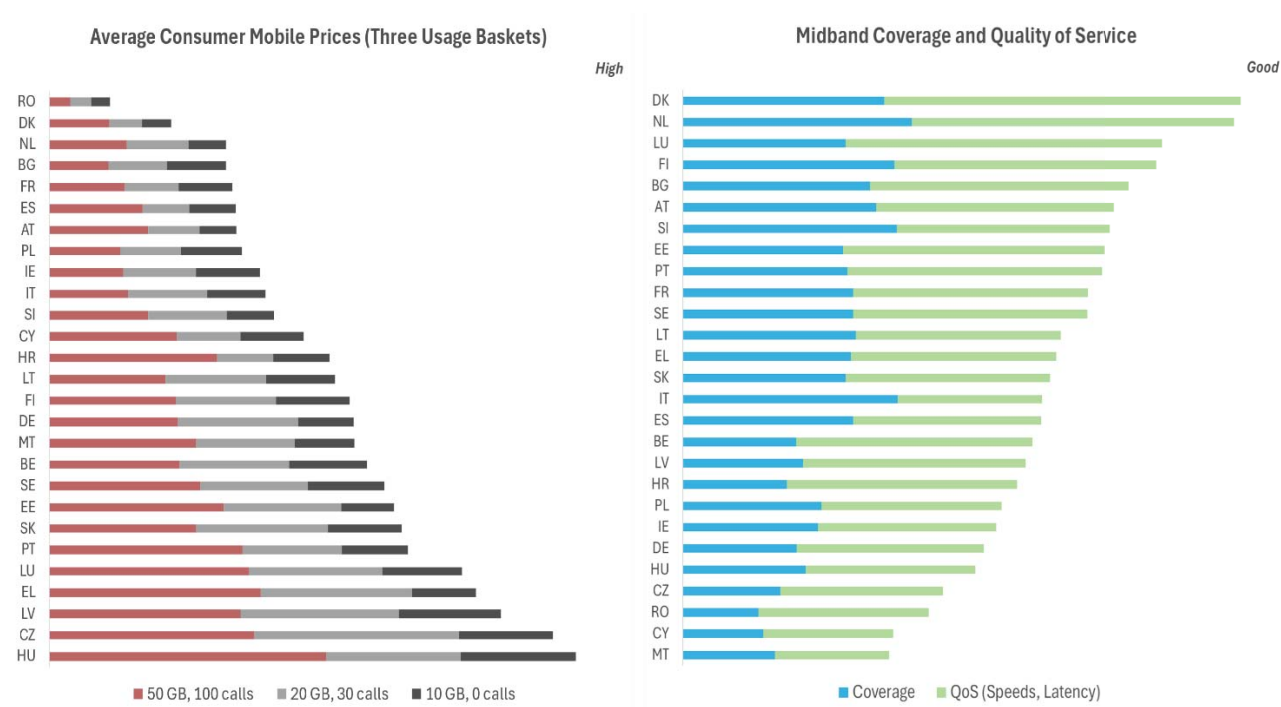
Figure A4 3-1 below illustrates how Member States fall into distinct performance configurations when comparing retail price levels with mid-band coverage and quality of service. As shown, some Member States combine relatively low consumer prices with strong mid-band performance, while others display higher price levels alongside more limited coverage and network quality.

Figure A4-3-1: Consumer Prices in Relation to Mid-Band Coverage and Quality of Service



In Figure A4-3-2, the same market outcomes are presented in a way to transparently reflect the various elements assessed. The left-hand panel of the figure presents average consumer prices in each Member State calculated as a weighted mean across the three usage baskets, with each basket entering according to its assigned weight and its observed price level. The right-hand panel of this figure presents the corresponding values of the mid-band coverage and quality-of-service index, enabling a side-by-side comparison of affordability and performance across the EU.

Figure A4-3-2: Consumer Prices, Mid-Band Coverage and Quality of Service across selected Member States



3.3 Fragmented Regulatory approaches

This section describes the methodology used to characterise regulatory approaches in the assignment of 5G spectrum and to assess the extent to which these approaches vary across the EU. The analysis focuses on the two 5G pioneer bands, 3.4–3.8 GHz and 700 MHz, as these bands play a central role

in enabling high-capacity and wide-area 5G connectivity. The aim is to categorise Member States according to the relative intrusiveness of their auction and award conditions, based on a set of observable regulatory indicators. The resulting regulatory-design scores serve as inputs to the multiple regression analysis conducted in the following section.

3.3.1 Selection of indicators of regulatory approaches

To capture the degree of regulatory intervention applied in the assignment of 5G spectrum, the analysis considers a set of auction and award conditions that are both observable across Member States and directly relevant to operators' ability and incentives to invest in 5G networks. The indicators selected for both the 3.4–3.8 GHz and the 700 MHz bands are:

- **Spectrum caps** – limits on the maximum amount of spectrum any single operator may acquire in a given band. These caps shape market structure and may restrict incumbent operators' ability to expand capacity.
- **Access obligations** – including obligations relating to MVNO access, service-provider access or national roaming. These requirements influence wholesale market conditions and may affect operators' business models and investment strategies.
- **Coverage obligations** – requirements to achieve defined population or geographic coverage levels within specified timeframes. These obligations can support wide-area rollout but may also impose significant deployment costs.
- **Reservations and set-asides** – spectrum blocks specifically reserved for new entrants, regional operators or vertical/industrial users. Such measures restrict the effective supply available to existing MNOs and may influence auction dynamics and investment incentives.
- **Final auction prices (Price/MHz/pop)** – the final price paid per MHz per capita. Although influenced by demand and competitive dynamics, high final prices may reflect auction design or limited spectrum availability and can affect operators' ability to invest post-auction.

These indicators were selected because they represent the core dimensions along which Member States differ in their regulatory design choices, and because they are sufficiently comparable across countries and across both pioneer bands.

3.3.2 Data sources

Information on regulatory conditions was obtained primarily from the **Cullen International spectrum database**, which provides harmonised cross-country information on spectrum caps, access and coverage obligations as well as estimates of final auction prices. To ensure completeness, particularly regarding reservations and set-asides, this material was supplemented with information from **PolicyTracker**, and cross-checked where relevant against recent Commission studies and publicly available auction documentation. These sources together provide a consistent evidence base for comparing regulatory approaches across Member States and for developing the indicators used in the subsequent analysis.

3.3.3 Member States considered in the analysis of regulatory approaches

The analysis covers the Member States for which sufficiently detailed and comparable information on regulatory conditions was available for at least one of the two pioneer bands. The following countries were included in the assessment: Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

For some Member States, however, not all indicators could be used in the band-specific assessments. In the 3.4–3.8 GHz band, Denmark and Romania were excluded from analyses involving final auction price estimates (EUR/MHz/pop) because the combinatorial auction format did not allow the

attribution of payments to specific frequency bands. In the 700 MHz band, Austria, Denmark and Romania were excluded from price-based comparisons for the same reason. These Member States are nonetheless retained for the descriptive overview of regulatory measures to provide a comprehensive picture of the diversity of approaches across the EU.

3.3.4 *Observed Variation in Regulatory Approaches across Member States*

While the European Electronic Communications Code has harmonised certain principles of spectrum management, Member States retain broad discretion in the detailed design of spectrum awards. The information assembled for the two pioneer bands shows a wide variety of approaches across countries and across regulatory instruments.

Across both the 3.4–3.8 GHz and the 700 MHz bands, spectrum caps differ substantially, ranging from relatively restrictive limits that leave operators with little flexibility to acquire additional spectrum, to more permissive frameworks that allow bidders to obtain large shares of the band. Access obligations vary from general obligations to negotiate access to explicit requirements for national roaming or mobile virtual network operator access. Coverage obligations differ not only in their presence but also in their intensity, with some Member States imposing detailed population or geographic coverage targets within defined timeframes, and others applying only limited or generic rollout conditions, or none at all. The use of reservations and set-asides likewise varies, with some awards reserving portions of the band for specific user groups such as new entrants or local or industrial networks, while many make the full band available to mobile network operators. Finally, final auction prices per megahertz and per inhabitant display considerable dispersion across awards in both bands, reflecting differences in auction formats, competitive dynamics, spectrum availability and regulatory conditions.

Taken together, these observations confirm that regulatory approaches to the assignment of the two pioneer bands remain highly heterogeneous across the Union, both in terms of the breadth and intensity of intervention and in terms of the specific combinations of caps, access conditions, coverage obligations, reservations and price outcomes applied in different national contexts.

For the purposes of both the visual exploration and the multiple regression analysis examining the relationship between market outcomes and regulatory approaches, a quantitative assessment of the regulatory frameworks and their cross-country differences was required. To this end, a set of scores was developed for each of the regulatory categories under the lead of a spectrum-auction expert, as described in the following subsection. While these scores provide the necessary granularity for the regression analysis, a composite regulatory-design index was also constructed for the visual analysis to summarise the overall restrictiveness of the award conditions applied in each Member State. The construction of such scores inevitably involves a degree of judgement, yet care was taken to apply consistent criteria and to reflect the underlying regulatory differences as objectively as possible.

3.3.5 *Scoring of Spectrum Caps*

3.3.5.1 3.4–3.8 GHz band

The categorisation of spectrum caps in the 3.4–3.8 GHz awards is based on an assessment of how intrusive the applicable limits are in practice. Expert opinion generally considers that mobile network operators require 80–100 MHz of contiguous mid-band spectrum to achieve the full performance potential of 5G in this band.¹³⁰ This benchmark is consistent with the distribution of licences observed

¹³⁰ See Qualcomm opinion

in Europe: in the PolicyTracker Spectrum Database, only 11 percent of the 254 national licences in multi-operator European markets in the 3.3–3.8 GHz range exceed 100 MHz, with the largest licence reaching 200 MHz.

Against this background, spectrum caps were scored according to the maximum amount of 3.4–3.8 GHz spectrum an operator could hold after the award, including any existing holdings:

- **Score 3:** no spectrum caps applied, allowing operators to acquire any amount of spectrum in the band
- **Score 2:** caps above 100 MHz, that is caps allowing holdings beyond the level generally required to reach full 5G capacity
- **Score 1:** caps between 80 and 100 MHz, corresponding to the range considered adequate for fully exploiting the capabilities of the band
- **Score 0:** caps below 80 MHz, that is below the recommended threshold for optimal mid-band 5G performance

A few country-specific points require clarification to ensure the scoring is applied consistently:

- **Czechia (score 0):** in the 3.4–3.8 GHz band, the award imposed a 60 MHz cap for the three existing mobile network operators and a 100 MHz cap for potential new entrants. The cap also included spectrum already held in the 3.6–3.8 GHz range. Given that the three incumbent operators entered the auction with pre-existing assignments, their total possible holding remained below 80 MHz, placing Czechia in the lowest scoring category.
- **Germany (score 3):** it was confirmed that no band-specific cap was applied in the 3.6 GHz award, meaning operators could in principle acquire unlimited amounts of mid-band spectrum.¹³¹
- **Netherlands (score 2):** the cross-band cap of 384 MHz did not constrain operators' ability to secure 100 MHz in the 3.6 GHz band. The operator with the largest existing portfolio, Odido, held 260 MHz before the award and could still have acquired an additional 120 MHz before reaching the overall limit.
- **Slovakia (score 2):** the applicable cap allows mid-band holdings of up to 140 MHz, which places it above the 100 MHz threshold.
- **Slovenia (score 2):** although a total cap of 190 MHz applies across the 2.3 GHz and 3.4–3.8 GHz ranges, the 2.3 GHz band contains only 100 MHz of unpaired spectrum, typically in blocks of around 40 MHz. In practice, this means the cap does not restrict an operator's ability to obtain 100 MHz in the 3.6 GHz band.

3.3.5.2 700 MHz band

The categorisation of spectrum caps in the 700 MHz band follows an assessment of how restrictive the applicable limits are relative to common sub-1 GHz holdings and typical 700 MHz assignment patterns. Across the EU, most mobile network operators hold 2×10 MHz in the 700 MHz band, which is generally considered adequate for delivering wide-area 5G coverage.¹³² With 2×30 MHz available

<https://www.ofcom.org.uk/siteassets/resources/documents/consultations/uncategorised/93522-award-of-the-spectrum-bands/responses/qualcomm.pdf> p8 and BT

<https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/129955-award-of-the-700-mhz-and-3.6-3.8-ghz-spectrum/responses/response-to-2020-further-consultation-bt>, p8.

¹³¹ See para 101 here:

https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/FrequencyAward2018/20181214_Decision_III_IV.pdf?__blob=publicationFile&v=1.

¹³² See e.g. PolicyTracker Spectrum Database.

in total, the band can conveniently be divided among three operators, which aligns with the market structures observed in many Member States. Because the 700 MHz band has propagation characteristics similar to those of 800 MHz and 900 MHz, regulators can also balance overall sub-1 GHz holdings across these three bands.

Against this background, spectrum caps were scored according to the maximum amount of 700 MHz spectrum an operator could obtain, taking into account existing sub-1 GHz holdings where relevant:

- **Score 3:** no caps applied, allowing operators to acquire any amount of 700 MHz spectrum
- **Score 2:** caps above 2×10 MHz, that is above the most common assigned bandwidth
- **Score 1:** caps of 2×10 MHz, corresponding to the most widely allocated bandwidth across the EU
- **Score 0:** caps below 2×10 MHz, that is below the standard assignment level

Several country specific points require clarification for consistency of scoring:

- **Austria (score 2):** the applicable caps allowed operators to acquire more than 2×10 MHz, placing Austria in the category above the commonly assigned bandwidth.
- **Denmark (score 2):** the cap of 2×35 MHz across the 700 MHz, 800 MHz and 900 MHz FDD bands meant operators could obtain more than 2×10 MHz in the 700 MHz band while remaining within the overall limit.
- **Lithuania (score 0):** for most operators, the effective cap restricted potential 700 MHz holdings to below 2×10 MHz, which places Lithuania in the lowest scoring category.
- **Netherlands (score 2):** excluding the 700 MHz band, operators already held 50 MHz or 40 MHz of sub-1 GHz spectrum, meaning they could have acquired more than 2×10 MHz in 700 MHz and still remained below the 80 MHz low-band cap; the effective cap therefore allowed holdings above the standard assignment level.
- **Slovenia (score 2):** under the combined cap of 2×35 MHz across the 700 MHz, 800 MHz and 900 MHz FDD bands, an operator could hold the typical 2×10 MHz in both 800 MHz and 900 MHz while still being able to obtain more than 2×10 MHz in the 700 MHz band.

3.3.6 Scoring of Access Obligations

3.3.6.1 3.4–3.8 GHz band

The classification of access obligations in the 3.4–3.8 GHz band is constrained by the limited availability of consistent, detailed information on the exact nature of wholesale access requirements across Member States. For this reason, a simplified quantitative approach was applied, starting from a **base score of 10**, which reflects the situation in which **no access obligations** are imposed on spectrum assignees. Points are then deducted depending on the type of obligation attached to the award, with the level of deduction representing the relative intrusiveness of the obligation from the perspective of a mobile network operator.

- A **deduction of 3 points** is applied where the award requires **access for mobile virtual network operators**. MVNO obligations typically require operators to provide wholesale access under reasonable terms but generally leave more flexibility to negotiate commercial arrangements. They are therefore considered moderately intrusive.
- A **deduction of 2 points** is applied where obligations relate to **service-provider access**. These obligations usually involve a lighter form of wholesale access with fewer technical or operational constraints. As they impose a comparatively limited intervention in the operator's control over retail and wholesale strategy, they are scored as less intrusive than MVNO or roaming obligations.

- A **deduction of 4 points** is applied in cases where **national roaming** must be provided. Such obligations can significantly affect operators' network planning, customer acquisition strategies and competitive positioning, especially when applied to support a new entrant. National roaming therefore represents the most intrusive form of access requirement and receives the largest deduction.

This scoring framework allows the varying degrees of intervention associated with different types of wholesale access obligations to be reflected in a consistent manner, even where the underlying regulatory texts differ in their formulation or detail.

3.3.6.2 700 MHz band

For the 700 MHz awards, access obligations were assessed using the same scoring framework as for the 3.4–3.8 GHz band, reflecting the comparable role of wholesale access requirements and the broadly similar information available for both bands. The assessment starts from a base score of 10, with deductions of 3 points for MVNO access, 2 points for service-provider access, and 4 points for national roaming, corresponding to the relative intrusiveness of each obligation for the spectrum assignee.

3.3.7 Scoring of Reservations and Set-Asides

3.3.7.1 3.4–3.8 GHz band

The categorisation of reservations and set-asides in the 3.4–3.8 GHz band is based on an assessment of how intrusive these measures are in practice for operators seeking to acquire sufficient mid-band spectrum for effective 5G deployment. Reservations for new entrants and set-asides for vertical or local private networks reduce the pool of spectrum available to national mobile operators and may limit their ability to obtain the 80–100 MHz typically needed for high-performance mid-band 5G.

To ensure comparability across Member States and with the 700 MHz band, the analysis quantifies the extent of each reservation or set-aside as a percentage of the total 400 MHz available in the 3.4–3.8 GHz range. Smaller set-asides have limited effect, whereas reservations at or above 20 percent can materially constrain national operators, especially in markets with four mobile network operators, where the remaining bandwidth may not be sufficient. The percentage of spectrum reserved enters the regression analysis in its original form, with no further scoring or transformation applied. Several country specific constellations require clarification for consistency of scoring:

- **Denmark:** around 10 MHz at 3.4–3.41 GHz was made available for local private networks, representing a small share of the band.
- **Germany:** 100 MHz at 3.7–3.8 GHz was set aside for local industrial use under a dedicated licensing framework.
- **Greece:** 10 MHz at 3.4–3.41 GHz was reserved for research purposes. As this portion lies at the edge of the band and does not affect the ability of operators to obtain standard mid-band holdings, it is included for completeness but treated as having limited practical impact.
- **Netherlands:** 100 MHz of the 3.6 GHz band remained outside the national award to support local and private networks.
- **Slovenia:** a small part of the band was allocated for local use in a three phase award process open initially to vertical users and municipalities.
- **Sweden:** 80 MHz in the 3.72–3.8 GHz range was designated for local licences rather than national assignment.

3.3.7.2 700 MHz band

The categorisation of reservations in the 700 MHz band follows the same principle, assessing how far reservations for new entrants reduce the amount of spectrum available for national operators in a band where 2×10 MHz assignments are widely regarded as standard for ensuring effective 5G coverage. Reservations are expressed as a percentage of the total 60 MHz of paired 700 MHz spectrum, enabling comparability across Member States and with the mid-band assessment. Larger reservations, especially near or above 20 percent, can materially restrict spectrum availability in markets with four operators. As in the 3.4–3.8 GHz band, the percentage reserved is used directly in the regression models.

Several country specific constellations require clarification for consistency of scoring:

- **Belgium:** part of the 700 MHz band was reserved for a potential new entrant as part of a broader reservation scheme across multiple mobile bands.
- **Czechia:** one 2×10 MHz block was formally reserved for a new operator. Although the block was ultimately acquired by an existing operator, the reservation formed part of the auction design and is treated as such.
- **Italy:** a newcomer was eligible for an additional reserved package and successfully obtained two 2×5 MHz blocks under this mechanism.

3.3.8 Scoring of Final Auction Prices (EUR/MHz/pop)

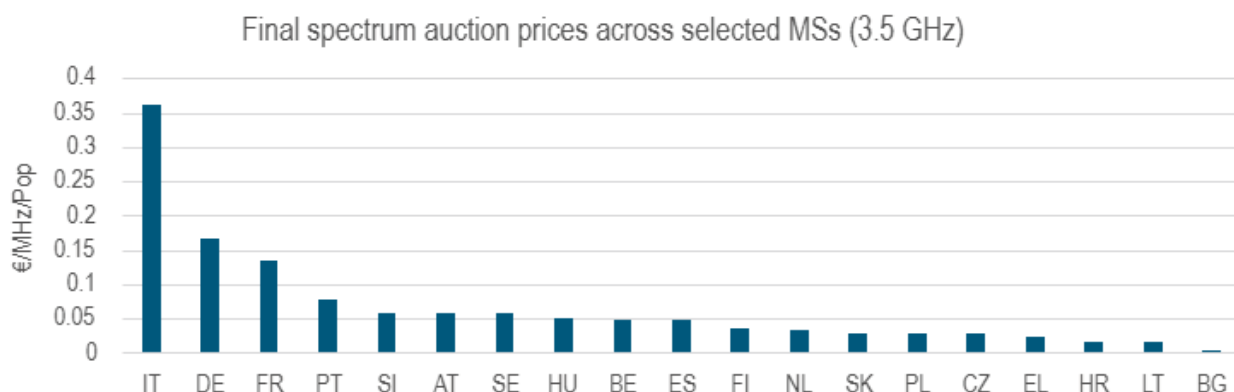
The quantification of final auction prices in the 3.4–3.8 GHz band is based on a standardised metric expressed in euro per MHz per population (EUR/MHz/Pop), which enables a consistent comparison of price levels across Member States irrespective of market size or bandwidth offered. Thus, final auction prices also enter the regression analysis directly, without the need to construct a separate score. The data were sourced from the Cullen International Spectrum Database, which provides harmonised information on spectrum assignments and auction outcomes.

Observed price levels reflect the combined effect of several factors, including the reserve prices set by regulators, the competitive intensity in the auction, the structure of national mobile markets, and the broader award conditions such as coverage obligations, access requirements, and reservations or set-asides. As a result, cross-country variation in prices cannot be attributed solely to regulatory design but captures the full interaction between regulatory and market drivers.

3.3.8.1 3.4–3.8 GHz band

For the 3.4–3.8 GHz band, band-specific price estimates could not be derived for Denmark and Romania, as the auction format did not allow for disaggregated information by band. These Member States are therefore excluded from the mid-band price analysis conducted in the next section but remain part of the wider assessment where other data are available. Figure A4 3-3 presents the distribution of 3.4–3.8 GHz auction prices across the Member States for which data are available. The coefficient of variation, defined as the standard deviation divided by the mean, amounts to 122%.

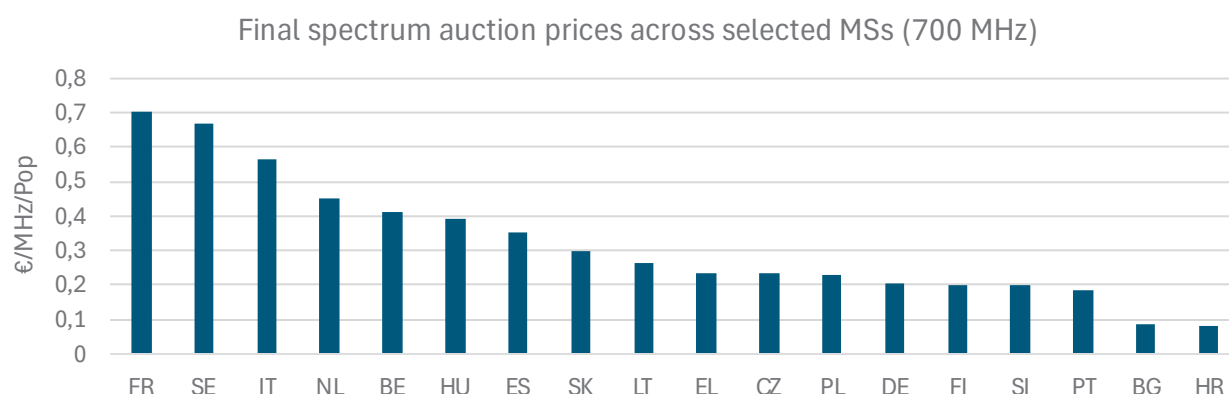
Figure A4-3-3: Distribution of 3.4–3.8 GHz auction prices across Member States



3.3.8.2 700 MHz band

For the 700 MHz band, final price estimates are not available for Austria, Denmark, and Romania, owing to similar limitations. Consequently, these Member States are excluded from the price-based analysis for this band conducted in the next section. Figure A4 3-4 illustrates the variation in 700 MHz auction prices across the Member States included in this part of the assessment. The coefficient of variation, defined as the standard deviation divided by the mean, amounts to 57%.

Figure A4-3-4: Distribution of 700 MHz auction prices across Member States



3.3.9 Scoring of Coverage Obligations

Coverage obligations have been assessed and scored but this scoring has been used only in a limited way and has not been included in the composite regulatory indicator due to reasons explained in section 3.3.10.

3.3.9.1 3.4–3.8 GHz band

The categorisation of coverage obligations in the 3.4–3.8 GHz band is based on an assessment of how intrusive the requirements are in practice for operators deploying mid-band 5G networks. To ensure comparability across Member States, the assessment focuses on coverage and rollout conditions that explicitly relate to the use of 3.6 GHz spectrum and therefore have a direct bearing on the deployment of high-capacity 5G infrastructure.

Coverage obligations were assessed on a **scale from 0 to 10**, where **10 corresponds to awards without any coverage obligation** and **0 to the most demanding set of requirements**. The scoring reflects expert judgement based on several elements, including:

- the required share of national population or territory to be covered
- the presence of specific geographic or functional areas to be covered, such as rural regions, transport corridors or priority locations
- explicit 5G New Radio deployment targets or technology specific requirements
- quantified roll out conditions such as the minimum number of base stations to be deployed
- obligations related to shared networks or infrastructure provision

Obligations that require extensive geographic reach, explicit 5G deployment and performance targets, and significant roll out commitments receive lower scores on this scale, as they are considered more intrusive from the perspective of the spectrum assignee. Obligations that are more limited in scope or expressed in generic terms receive higher scores.

3.3.9.2 700 MHz band

For the 700 MHz band, a different scoring framework is applied, reflecting the availability of the Spectrum Award Efficiency Study (2022)¹³³ that evaluated coverage obligations in 700 MHz awards across the EU. This study developed a set of criteria distinguishing obligations by their scope and complexity, and these criteria were translated into a five-point scoring scale for the purposes of this analysis. The same scoring approach was applied to Member States not included in the original study to ensure consistency across the sample.

Coverage obligations were assigned a score from 0 to 4, where higher values reflect more extensive and detailed requirements:

- **Score 0 – No coverage obligation:** The licence contains no explicit 700 MHz coverage requirement.
- **Score 1 – Generic coverage requirements:** Obligations formulated in broad terms such as percentage of population or territory, number of locations or number of base stations, without further differentiation.
- **Score 2 – More specific coverage requirements: Obligations** that go beyond generic indicators and include targeted geographic or functional requirements.
- **Score 3 – Coverage requirements combined with user-experience elements: Obligations** combining basic coverage metrics with performance-related conditions, for example minimum download or upload speeds, explicit references to 5G deployment or requirements supporting certain 5G use cases.
- **Score 4 – Detailed coverage requirements combined with user-experience elements:** Obligations involving more granular coverage specifications, such as requirements for non-urban areas, underserved communities or transport routes, together with explicit user-experience conditions such as minimum speed, latency or reliability thresholds.

Higher scores thus reflect obligations that are **more intrusive** for spectrum assignees, either because they impose more granular geographic deployment targets or because they include performance-based requirements in addition to basic rollout metrics.

¹³³ LS telcom, PolicyTracker and VVA (2022): Study on assessing the efficiency of radio spectrum award processes in the Member States, including the effects of applying the European Electronic Communications Code ([Available online at: https://op.europa.eu/publication-detail/-/publication/036d50f1-a1e2-11ed-b508-01aa75ed71a1](https://op.europa.eu/publication-detail/-/publication/036d50f1-a1e2-11ed-b508-01aa75ed71a1)).

3.3.10 Composite measure of Regulatory approaches

For the econometric analysis presented in Section 3.5, each regulatory indicator enters the regression directly, without any aggregation or weighting. Specifically, the models use the original expert-based scores for spectrum caps, access obligations, and coverage obligations, as well as the directly observed numerical values for final auction prices (in EUR/MHz/Pop) and the percentage of spectrum reserved or set aside. No further transformation is applied in the regression models.

However, to provide an initial visual overview of the potential relationship between regulatory design and market outcomes, a composite indicator of regulatory approaches was constructed. This composite measure serves exclusively for graphical illustration and does not enter the regression analysis. It is plotted against the composite market-outcome indicator described in Section 3.2.5.

The composite regulatory indicator is based on the four regulatory dimensions: spectrum caps, access obligations, final auction prices, and reservations or set-asides. Each dimension is first normalised to ensure a consistent zero-to-one scale, where one denotes the least intrusive regulatory approach and zero the most intrusive. For all score-based variables (spectrum caps, access obligations, and coverage obligations in the 3.4–3.8 GHz and 700 MHz bands), normalised values were obtained by rescaling the expert scores relative to the range of observed values. Regarding auction prices, Member States with the lowest price per MHz per population receive values closest to one, while higher price levels translate into lower normalised scores. For reservations and set-asides, the score reflects the share of the band not reserved, ensuring that a greater amount of spectrum available to national operators results in a higher score.

As regards coverage obligations, while this regulatory dimension has been assessed and some preliminary regression analysis done it has not been included in the composite indication, accordingly coverage obligations receive a weight of zero. To be noted that for this preliminary assessment of coverage obligations in the 700 MHz band, where the original categories increase in numerical value as obligations become more demanding, the transformation was inverted to maintain the “higher-is-less intrusive” score interpretation consistent across all dimensions.

The exclusion of coverage obligations from the composite index reflects both the conceptual and methodological difficulties associated with developing comparable scores across Member States with very different geographic and demographic conditions, and the fact that coverage obligations did not display explanatory power in the preliminary regression analysis presented in Section 3.5.

For the composite regulatory-design indicator, the resulting normalised variables were aggregated using the weighting structure shown in Table X, reflecting the relative importance of the different dimensions in shaping operator flexibility and investment incentives.

Table A4 3-3: Weighting Structure for the Composite Regulatory-Design Indicator

Criterion	Weight
Spectrum caps	0.20
Access obligations	0.30
Auction prices	0.20
Reservations/Set-asides	0.30
Total	1.00

The weighting is designed to capture the influence of those parts of the regulatory approach that directly influence operators’ ability to obtain and use spectrum in an investment-enhancing manner. Reservations and set-asides receive a weight of 0.30, reflecting their potentially substantial effect on

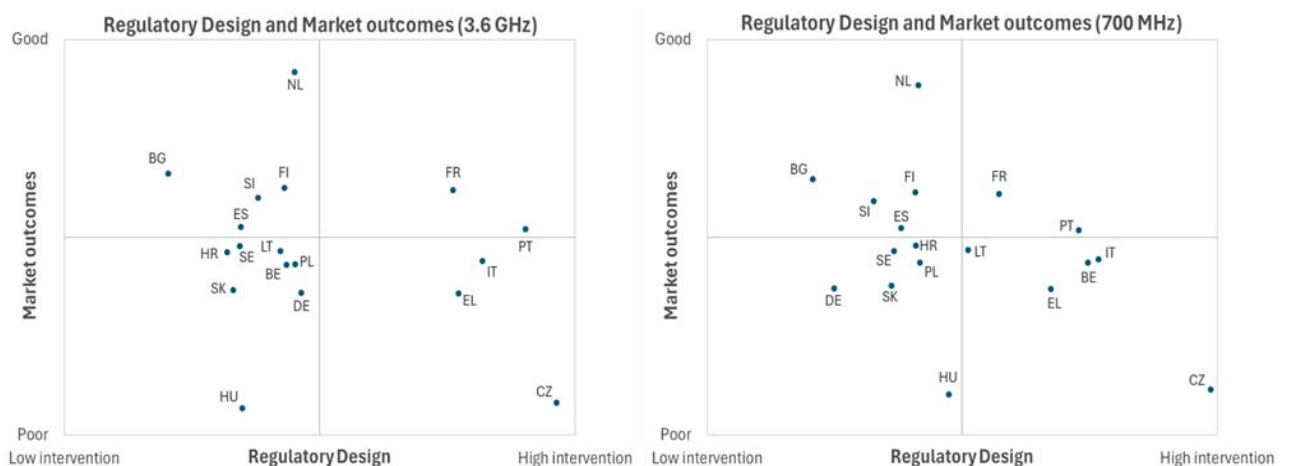
the amount of spectrum available for national networks. Access obligations are similarly weighted at 0.30, acknowledging their direct impact on the commercial flexibility of licence holders. Spectrum caps and auction prices are weighted at 0.20 each, capturing their influence while recognising that their effects tend to be more context-dependent and intertwined with market structure.

The weighted sum for each Member State was then standardised using z-scores, allowing the resulting index to be plotted on a common scale with the composite market-outcome indicator. This rescaling facilitates the visual comparison presented in Section 3.2.2 of the main report without altering the underlying structure of the composite.

3.4 Visual comparison of Market outcomes and Regulatory approaches

Figure A4 3-5 below illustrates the resulting comparison between the composite regulatory-design indicator and the composite measure of market outcomes. The visual representation suggests that more interventionist regulatory approaches may, in some cases, be associated with less favourable market performance, particularly in the 700 MHz band. This may indicate that more restrictive and less investment-oriented auction and award conditions applied in certain Member States are linked to more limited coverage, lower quality of service and higher consumer prices. At the same time, and as emphasised above, the patterns visible in this simplified comparison are not conclusive and do not constitute statistical evidence. Rather, they provide motivation for the more sophisticated regression analysis presented in the following section.

Figure A4-3-5: Regulatory Design and Market Outcomes in the 3.6 GHz and 700 MHz Bands



3.5 Analysis of possible correlations between regulatory approaches and relevant market outcomes

This section presents the methodology and results of an econometric analysis exploring how selected elements of regulatory design are associated with market outcomes in 5G deployment across Member States. The exercise follows a structured regression-based approach applied to the best available cross-country data. It aims to identify patterns that may help explain variations in coverage, prices and quality of service by relating them to differences in spectrum-auction designs, while recognising the important role of non-regulatory drivers and the inherent limitations of a small sample.

3.5.1 Methodology and Tools

The analysis of potential correlations between regulatory approaches and market outcomes follows a structured and iterative regression-based methodology. The starting point is a set of theoretically

grounded hypotheses, informed by economic reasoning, existing regulatory frameworks and observed market structures. On this basis, potential explanatory variables were identified, including GDP per capita, rural population share, population density, spectrum caps, access and coverage obligations, set-aside or reservation percentages, and average band prices expressed in euro per MHz per population.

Multiple ordinary least squares (OLS) regression models were then estimated, varying the dependent variable across four key outcomes: 5G household coverage, 5G download speeds, retail consumer prices for the three different usage baskets, and spectrum-auction prices expressed in euro per MHz per population. In some specifications, spectrum prices also enter as explanatory variables in order to examine how they relate to coverage, quality of service and retail prices. Each model was evaluated with respect to its overall statistical significance, its explanatory power as measured by R^2 and adjusted R^2 , and the direction and magnitude of each coefficient. Particular attention was paid to the effects of regulatory variables such as spectrum caps, access and coverage obligations, reservations and set-asides, and average band prices, both in terms of statistical significance and consistency of the estimated relationships with theoretical expectations.

In practical terms, the regression models were specified in a way that made it possible to examine the influence of each factor while holding other variables constant. This approach helped indicate, for example, whether higher set-aside shares are associated with higher consumer prices, or whether access obligations show any relationship with download speeds or overall 5G coverage. Simpler specifications were also estimated to verify whether certain structural variables, such as GDP per capita, exert a strong standalone influence and whether their effects persist when additional factors are included.

The model specifications were refined iteratively by estimating reduced forms, adding or removing explanatory variables, and exploring potential confounding influences or interaction effects. This iterative process made it possible to isolate robust relationships, identify key findings, and assess the policy relevance of different regulatory instruments. The ultimate goal was to move beyond correlation and toward plausible causal inference, while remaining attentive to sample limitations and diagnostic robustness.

The models were implemented as ordinary least squares (OLS) regressions using the statistical software STATA. OLS provides a solid and sufficiently reliable basis for the exploratory assessment carried out here. Interpretation of the regression outputs was supported by AI-based analytical assistance. However, the analytical process was overseen by an experienced economic expert, Prof. J. Scott Marcus, who reviewed all AI-generated results for methodological soundness and overall reasonableness.

Unless stated otherwise, the reported results are statistically significant at the 95% level. A small number of results achieve significance at the more demanding 99% level. Some estimates reach only marginal significance at the 90% level, while others that fall short of conventional significance thresholds may still be informative when interpreted in context. Such cases are clearly indicated.

It should be noted that statistical significance applies separately to the model as a whole and to the individual explanatory variables. Where a model is statistically significant overall but a specific variable is not, this is indicated accordingly, and such findings are interpreted as suggestive rather than definitive.

3.5.2 *Data and Variables*

Table A4 3-4 provides an overview of all variables used in the regression analysis, distinguishing between outcome variables, regulatory indicators and exogenous controls. The analysis uses raw values where available, combined with expert-based scoring where necessary, as indicated below.

This approach preserves quantitative comparability while still capturing meaningful differences in regulatory approaches across Member States and ensures that variables enter the analysis in their original form wherever feasible.

The **outcome variables** comprise the market-performance measures described in Section 3.2.4, including overall 5G household coverage, 5G coverage in the 3.4–3.8 GHz band, average and 5G download speeds, latency and consumer prices for the three us-age baskets. Spectrum-auction prices, expressed in euro per MHz per population for both the 700 MHz and 3.4–3.8 GHz bands, are also treated as outcome variables where the aim is to identify their determinants. However, in several model specifications these price variables also enter as explanatory inputs in order to examine how they relate to coverage, performance and retail pricing. All of the variables mentioned in this paragraph enter the analysis in their raw form.

The **explanatory variables** comprise two groups. The first consists of **exogenous/structural drivers** that influence 5G deployment and performance independently of spectrum-auction design. These include GDP per capita, population density, rural population share and the number of mobile network operators, all of which are used in their raw form. These variables capture fundamental economic and demographic conditions that shape deployment costs, investment incentives and consumer demand. Their inclusion is essential for disentangling the effects of regulatory design from broader structural determinants, since market outcomes such as coverage, prices, download speeds and investment incentives cannot be attributed to regulatory choices alone. Prosperity levels influence both operator investment incentives and consumers' willingness to pay; population density and rural share shape the cost of network roll-out; and the competitive structure contributes to pricing dynamics and investment behaviour.

The second group of explanatory variables comprises **regulatory variables**, covering the different dimensions of auction design described in Section 3.3. For reservations and set-asides, the analysis uses the raw percentage of the band reserved, allowing the regressions to capture the direct effect of limiting the spectrum available to incumbent or potential operators. For spectrum caps, access obligations and coverage obligations, the analysis relies on structured comparative scores, developed by a spectrum expert (Martin Sims) on the basis of harmonised information from Cullen International and PolicyTracker. These scores provide a consistent comparative representation of regulatory intensity across Member States in cases where policies differ qualitatively and cannot be directly compared using numerical values alone. The scoring methodologies for each category of regulatory measure are set out in Section 3.3.

The dataset covers **21 Member States** for which comparable information is available, specifically Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden. For models involving band-specific auction prices, the sample is reduced because not all auction formats allow the derivation of final prices that are specific to a single band. In the 3.4–3.8 GHz band, auction prices cannot be derived for Denmark and Romania, resulting in a maximum sample of 19 Member States. In the 700 MHz band, band-specific prices cannot be derived for Austria, Denmark and Romania, which reduces the usable sample to 18 Member States. All auctions considered in this analysis were conducted between 2018 and 2025. Given the small cross-sectional sample and the absence of a time series, the estimation strategy must be parsimonious and efficient, focusing on variables that are theoretically justified and empirically meaningful.

Table A4-3-4: Indicators Used as Dependent Variables, Independent Variables and Exogenous Controls

Data item (Variable)	Source of data	Form used	Exogenous/ Control	Explanatory/ Independent	Outcome/ Dependent
5G coverage of HHs (total)	DESI Indicators, 2024	Raw			X
5G coverage of HHs (3.4–3.8 GHz)	DESI Indicators, 2024	Raw			X
Average Download Speed (Mbps)	MedUX 2025	Raw			X
Average 5G Download Speed (Mbps)	MedUX 2025	Raw			X
Average Latency (Ms)	MedUX 2025	Raw			X
50 GB mobile data with 100 calls (€, PPP)	EU Mobile Broadband Prices 2023	Raw			X
20 GB mobile data with 30 calls (€, PPP)	EU Mobile Broadband Prices 2023	Raw			X
10 GB mobile data only with 0 calls (€, PPP)	EU Mobile Broadband Prices 2023	Raw			X
Nominal GDP per capita (2025) (EUR 000)	Wikipedia / IMF	Raw	X	X	
Population density per km ²	Wikipedia / Eurostat	Raw	X	X	
Rural population (%)	EU Commission	Raw	X	X	
Number of MNOs	BEREC 2023	Raw	X	X	
Spectrum caps	Cullen International, Spectrum Database	Scored		X	
Access obligations (MVNOs/Service providers/National roaming)	Cullen International, Spectrum Database	Scored		X	
Coverage obligations (3.4–3.8 GHz)	Cullen International, Spectrum Database	Scored		X	
Coverage obligations (700 MHz)	PolicyTracker / Spectrum Efficiency Study	Scored		X	
Percent of band reserved / set aside	Policy Tracker	Raw		X	
Final auction prices (€/MHz/pop)	Cullen International, Spectrum Database	Raw		X	X

Together, these variables provide the basis for examining potential relationships between regulatory design choices and key market outcomes, while controlling for the structural and economic conditions that play a central role in shaping 5G deployment and performance across the EU.

3.5.3 Summary of Results

The regression analysis identifies several robust relationships between regulatory approaches and market outcomes, as well as a number of suggestive patterns. The exercise confirms that variation in certain regulatory elements is associated with material differences in market outcomes. While non-regulatory factors such as GDP per capita, population density, rural share and competitive structure – which are controlled for in the regression specifications – remain important determinants of investment and performance, several regulatory choices show consistent relationships with both operator incentives and end-user outcomes.

In the following, all reported specifications in which the regulatory variables of interest reach statistical significance likewise satisfy conventional significance requirements for the overall model, as indicated by standard F-statistics. The specifications include the core structural controls used throughout the analysis (see above).

Across a range of model specifications, **spectrum reservations and set asides** emerge as the regulatory variable most consistently associated with weaker market outcomes. The share of spectrum that is reserved or set aside is correlated with higher spectrum auction prices, higher consumer prices and lower 5G download speeds, with most of these relationships reaching conventional significance thresholds.

- Regarding **auction prices**, higher reservation and set-aside shares are correlated with higher prices per MHz per population, consistent with the economic expectation that limiting the amount of spectrum available for competitive bidding increases scarcity. For the 700 MHz band, the estimated coefficient is positive but does not reach statistical significance. For the 3.4–3.8 GHz band, the estimated effect is statistically significant with a p-value of 0,028 and sizeable in magnitude, indicating that increases in the reservation or set-aside share are associated with materially higher auction prices.

- Regarding **consumer prices**, the relationship between reservations and set-asides intensity and retail price levels is statistically significant and economically meaningful. In the model using the 20 GB and 30 calls basket, the coefficient on the reservations and set-asides shares is statistically significant with a p-value of 0.011. A ten-percentage point increase in the reservation and set-aside shares is associated with an increase of EUR 3.98 in the price of this basket, indicating a notable effect on affordability for end users.
- Regarding **download speeds**, higher reservation and set-aside shares are correlated with weaker performance. For overall average download speed, the estimated coefficient is negative but does not reach statistical significance. For 5G download speeds, however, the coefficient on the reservation and set-aside shares is statistically significant with a p-value of 0,003. A ten-percentage point increase in set asides is associated with a reduction of approximately 20.8 megabits per second in 5G download speeds. This represents a substantial decline in performance in absolute terms.

Given that regulatory choices may also react to pre-existing market conditions, these results do not establish a causal link. Nevertheless, the observed associations are consistent with the intuition that restricting the effective supply of spectrum increases cost pressure on operators, dampens investment incentives and leads to weaker quality of service and higher consumer prices.

The results for **access obligations** indicate a pattern of potentially meaningful effects, although the statistical significance of these results varies across specifications. Overall, access obligations tend to be associated with lower consumer prices and with lower 5G population coverage, while their estimated impact on download speeds is negative but not statistically significant.

- A model using the 20 GB and 30 calls basket shows a marginally significant negative correlation between access obligations and **consumer prices**, with the estimated coefficient carrying a p-value of 0.088.
- Furthermore, access obligations display a marginally significant negative correlation with **5G population coverage**, with the estimated coefficient carrying a p-value of 0.067.
- Access obligations also show a negative, though statistically insignificant, association with **overall average download speeds**.

These findings point to a possible trade-off between affordability and deployment incentives. While access obligations may exert downward pressure on consumer prices, they may at the same time reduce operators' incentives to expand network coverage.

Spectrum caps, although potentially useful for safeguarding competition when appropriately applied, do not appear to be systematically associated with differences in market outcomes. **Coverage obligations** likewise display little explanatory power for the observed variation in market outcomes, which, however, may reflect the difficulty of comparing such obligations across Member States given their diverse design, geographic context and implementation conditions.

Overall, the results point to a coherent pattern. The most consistent regulatory determinant of market outcomes is the extent to which spectrum is withheld from competitive bidding through reservations or set asides. Higher set aside shares are associated with higher costs for operators, reduced investment incentives and higher prices for end users. Access obligations show weaker and less consistent effects but may have a marginally negative impact on network deployment. Spectrum caps and coverage obligations do not appear to drive substantial variation in market outcomes in the present dataset. These results should be interpreted with appropriate caution in light of the methodological limitations discussed in section 3.5.4.

3.5.4 Limitations

The interpretation of the regression results should take account of several methodological limitations inherent in this type of cross-country analysis.

First, the dataset is necessarily small, as it is restricted to the group of EU Member States for which complete and comparable information on regulatory design and market outcomes is available. Analyses based on around twenty observations are common for EU-level policy considerations but they inevitably limit statistical power and make results more sensitive to individual country cases. This constrains the complexity of the models that can be estimated and means that relationships may change significance when additional controls are introduced.

Second, several regulatory variables rely on structured expert scoring, particularly where regulatory choices differ qualitatively across Member States and cannot be expressed through simple numerical indicators. This concerns especially coverage obligations, where Member States use highly diverse formulations, geographic definitions, timelines and implementation conditions. These differences make direct numerical comparison difficult and require a degree of judgement to translate into consistent categories. The scoring therefore provides an **approximation of regulatory intensity** rather than an exact quantitative measure, although care was taken to apply transparent distinctions and consistent criteria.

Third, the regressions were implemented in specialised econometric software (STATA), which enables standard diagnostic checks, including assessments of multicollinearity, heteroskedasticity, functional-form misspecification and influential observations. These diagnostics help to identify specifications in which results may be sensitive to modelling choices or to individual Member States. However, given the small cross-sectional sample and the absence of a time dimension, diagnostic tests have limited statistical power and cannot eliminate concerns about omitted variables or endogeneity. Accordingly, findings, particularly those close to conventional significance thresholds, should still be interpreted as indicative correlations rather than precise causal estimates.

Fourth, it is important to recall that a wide range of non-regulatory factors influence market outcomes and investment incentives in mobile networks. These include demand for mobile services, income levels, population density, rural share, geographic conditions, competitive structure, legacy network assets and differences in national cost conditions. While the regression analysis incorporates several key control variables, it cannot fully capture the full set of structural and country-specific factors that shape 5G deployment and performance.

Finally, regulatory choices may in some cases be endogenous to market conditions, for example when more interventionist auction designs are adopted in response to pre-existing concerns about competition, pricing or investment. In such cases, part of the observed association may reflect underlying market characteristics rather than the effect of the regulatory choice itself. The cross-sectional nature of the dataset does not allow us to distinguish between these mechanisms. Time-series or panel data would in principle allow before–after comparisons of market outcomes following specific auctions and provide stronger grounds for causal inference, but obtaining and integrating such data into the model would require substantial additional effort and resources, which lies beyond the scope of this analysis. The regression results should therefore be interpreted as descriptive associations rather than causal estimates.

Taken together, these limitations are typical for EU-wide comparative studies and reflect the nature of the available data rather than shortcomings of the analytical approach. They underline, however, that the results should be understood as indicative of general patterns rather than as precise causal estimates.

ANNEX 5: COMPETITIVENESS CHECK

1. OVERVIEW OF IMPACTS ON COMPETITIVENESS

1.1. Transition to fibre

Dimensions of Competitiveness	Impact of the initiative (++ / + / 0 / - / -- / n.a.)	References to sub-sections of the main report or annexes
Cost and price competitiveness	n.a.	Could not be quantified
International competitiveness	0	Annex 7
Capacity to innovate	+	Annex 4
SME competitiveness	+	Annex 6

1.2. Spectrum

Dimensions of Competitiveness	Impact of the initiative (++ / + / 0 / - / -- / n.a.)	References to sub-sections of the main report or annexes
Cost and price competitiveness	n.a.	Could not be quantified
International competitiveness	++	Annex 3
Capacity to innovate	++	Annex 3
SME competitiveness	+	Annex 6

1.3. Authorisation

Dimensions of Competitiveness	Impact of the initiative (++ / + / 0 / - / -- / n.a.)	References to sub-sections of the main report or annexes
Cost and price competitiveness	n.a.	Could not be quantified
International competitiveness	++	Annex 3
Capacity to innovate	+	Annex 3
SME competitiveness	+	Annex 6

1.4. Regulatory governance

Dimensions of Competitiveness	Impact of the initiative (++ / + / 0 / - / -- / n.a.)	References to sub-sections of the main report or annexes
Cost and price competitiveness	0	-
International competitiveness	+	Annex 3
Capacity to innovate	+	Annex 3

SME competitiveness	0	-

2. SYNTHETIC ASSESSMENT

Access

Regulated access combined with the specifications of key wholesale products that enable service differentiation, under the preferred option should serve to stimulate competition on speeds, helping to foster greater availability of Gigabit speeds at an affordable price, and fostering uptake.

Provisions regarding standardised wholesale product specifications should be positive for **broadband service providers**, providing they are defined in a manner that supports product differentiation and innovation. While broadband service providers would also incur costs to adapt their systems to new types of wholesale product offerings, the advantages in terms of lower costs to connect multiple infrastructures and greater innovation potential (including in retail services that could be monetised) are likely to significantly outweigh implementation costs.

Demand modelling based on evolutions in applications and the requirements of SMEs suggest that 50% of SMEs will require Gigabit connectivity by 2035, and many will require symmetric bandwidths. The preferred option could make a substantial contribution to ensuring that these needs are met. Harmonisation of specifications for key wholesale products and quality of service guarantees for businesses should contribute to the development of competition in services for multi-site and multinational enterprises. This is important, noting that retail and wholesale market shares of incumbents in the supply of such services are often higher than for residential customers, and competition may be limited by the lack of availability of wholesale access with appropriate service guarantees at all required locations.¹³⁴ Further details on the impacts on SMEs can be found in Annex 9.

Spectrum

The proposed spectrum measures are expected to yield significant **benefits** to the **competitiveness of the EU industry**. They are designed to provide maximum investment certainty and regulatory clarity, especially for cross-border and long-term spectrum users and therefore bring significant benefits to telecom operators and finally to end users in terms of quality of service and of 5G and 6G services. The shift to indefinite licence durations by default delivers a strong and credible long-term investment signal. Where exceptionally shorter duration is applied, the reversed burden of proof removes the threat of unpredictable non-renewal decisions. Long-term licences provide investment certainty and planning stability, reduce the risk premium on capital expenditures and are strongly advocated by the industry¹³⁵. They also improve financial predictability, and lower the cost for capital-intensive 5G and future 6G deployments. The Commission's role in overseeing

¹³⁴ For example, analysis conducted in the context of the review of the RRM shows that in countries where NRAs have segmented the market for dedicated capacity by geography, incumbent market shares of 70% or more have been observed in the non-competitive zones for dedicated capacity. Limitations in competition have also been found e.g. in Spain in the provision of services to multi-site businesses.

¹³⁵ [VVA, PolicyTracker and LS Telecom \(2023\)](#), p. 19.

authorisation processes ensures greater regulatory convergence and guarantees investment-friendly auction designs, flexible licensing conditions, or pro-security obligations (e.g. supply chain scrutiny, trusted vendor requirements). The possibility for the Commission to harmonise authorisation conditions would also have the benefit of facilitating cross-border provision of service and consolidation between telco operators, which would allow these operators to obtain scale. Binding common conditions upon request for private networks enable innovators to scale up network-as-a-service solutions. Restricting market-shaping measures to commonly agreed EU criteria limit distortions while maintaining national flexibility. Inconsistent national practices (e.g. unjustified market shaping measures and reserve prices) may be corrected, contributing to a level playing field and reducing cross-border investment barriers. While early planning, timely authorisation, and cross-border coordination for 6G bands is key¹³⁶, the success of 6G spectrum awards depends on how auction conditions—such as duration, license flexibility, reserve prices, and obligations—are designed to support investment in a context of technological and commercial uncertainty¹³⁷. Predictability and affordability will be critical to incentivise timely deployment and long-term industrial research for high-value vertical use cases. Coordination of timing of spectrum awards will also enhance predictability for equipment manufacturers and operators, bringing benefits in terms of synchronous deployment, and availability of devices and services. Pro-security and sharing obligations bring benefits in terms of more secure networks for all.

The preferred option is expected to deliver significant benefits, for large-scale and cross-border spectrum investments. The reduction in regulatory risk, combined with a credible, enforceable commitment to licence stability and market-friendly conditions, offers major advantages for accelerating the EU's connectivity goals, increasing EU competitiveness also opening up new opportunities to new spectrum users.

SME competitiveness

In the report on the future demand in the business sector [ref demand chapter of Study on Finance and USO] WIK showed that for SMEs QoS, reliability and scalability is essential to be able to satisfy future demand for connectivity also for smaller SMEs. For large business customers the availability of dark fibre would allow for the (self-) provision of customised bundles of services and innovation in this segment.

3. COMPETITIVE POSITION OF THE MOST AFFECTED SECTORS

Figures provided in third party reports as well as data gathered for this Annex 5 provide a **mixed view of financial performance in the telecom sector**, with differences between service types as well as countries, business models and operators with different degrees of scale and history.

¹³⁶ RSPG (2024). Opinion on Spectrum Policy for Next-Generation Wireless Systems (6G). Available at: <https://rspg-spectrum.eu>.

¹³⁷ LS Telecom, PolicyTracker & VVA (2023). Study on Assessing the Efficiency of Radio Spectrum Award Processes in the Member States. Available at: <https://op.europa.eu/en/publication-detail/-/publication/036d50f1-a1e2-11ed-b508-01aa75ed71a1>.

Some stakeholders claim a real term **decline in revenues**, with low **ARPU**s for **mobile services in particular**. Fixed broadband revenues are significantly higher.

- Available data suggest that revenues for retail telecom service providers have not increased in line with inflation, in particular during the inflationary spike that followed the COVID pandemic.
- Mobile ARPU's in Europe in particular are generally lower on average than in other regions.
- However, higher and more stable ARPU's have been achieved in fixed broadband.
- The profitability of incumbent operators in Europe is similar to that in other regions.

Smaller mobile operators and new entrants are struggling in several countries in Europe and internationally. JVs/extensive network sharing may have helped to support profitability in some cases.

- Financial challenges experienced by new entrants in crowded European mobile markets.

There are differences in profitability between vertically integrated telcos in different European countries. Contrasting levels of investments in FTTH and degree of network duplication alongside differences in willingness to pay may explain some of these differences.

- As regards country-specific differences, an analysis of third party reports as well as data gathered shows that within Europe **profitability is relatively robust amongst both incumbent and alternative operators in Germany, Austria, Sweden and some of the Baltic countries (Lithuania and Latvia)**, with France following. Spain, Italy and (of the non-EU countries, the UK) show specific weaknesses.
- The reasons for country specific differences are likely to vary. However, factors that may be relevant in supporting higher profit margins in Germany and Austria are delays in the deployment of FTTH regulated dark fibre backhaul for mobile, and reliance on low-band spectrum for deployment of 5G SA. Meanwhile, earlier deployment and the lack of duplication of alternative FTTH networks by incumbents in Sweden (through the commercial decision of the incumbent) and France (as a result of symmetric regulation) together with more rapid migration to fibre in the absence of FTTC may have supported the business case for fibre. Both France and Sweden have four player mobile markets. However, in both cases, there is widespread availability of dark fibre backhaul (via regulation in France and from municipal operators in Sweden). Sweden also benefits from spectrum pooling and deep network sharing, which is likely to have limited the investment requirements for mobile. Deployment of 5G SA and mobile network densification has been relatively limited thus far in Sweden and France, which may also have enabled stronger financial results.
- In contrast, Italy and Spain have both experienced significant FTTH deployment including widespread duplication of FTTH networks, as well as intense competition with disruptive entry in the mobile segment, which may have impacted prices and profit margins. A lack of country-specific breakdowns amongst larger

telecom groups make it challenging to assess levels of profitability at country-level elsewhere in Europe.

ROCE and FCF are affected by the investment cycle. Improvements in ROCE following investment depend critically on take-up / market share

- Data shows that **capex levels tend to vary over time**, and that capex intensity has been higher for alternative operators than for incumbents, although the figures are now converging. Although the data is not disaggregated in a manner that would allow such analysis, it can be inferred from the timing of capex increases in different countries that variations in capex levels over time reflect investment cycles in FTTH and/or 5G (including the acquisition of s). In turn changes in capex affect other metrics relating to returns and profitability.
- Variations in the ROCE may reflect the degree of success in transferring or acquiring customers onto newly built or upgraded infrastructure alongside any impacts on ARPU that may be affected by willingness to pay, and the degree to which the company has relied on debt financing. FCF as a proportion of revenues is also likely to be affected by investment cycles which are funded through cashflow, and thus reductions in FCF as a % revenue may be particularly pronounced amongst operators which have been able to invest in FTTH based on high cashflows from their legacy business, but have not yet converted these investments to customers or higher revenues.

Cable operators that have not yet upgraded to FTTH tend to have strong financial performance. This could change once upgrades are made.

- Due to the performance capabilities of DOCSIS 3.1 (and potential upgrade path to DOCSIS 4.0), **pure cable operators in countries such as Belgium and the UK may have benefited from higher returns due to the lack of urgent pressure to upgrade networks to FTTH and therefore lower capex requirements** than rivals. In contrast, cable operators that invested heavily in FTTH, show the same pattern as for other fibre investors – with high capex % linked to lower ROCE and reduced FCF % during the period of the deployment.
- **Wholesale only operators are struggling to make returns. Low take-up is an important problem.** Further insight on the drivers of financial outcomes in specific capital intensive segments (including the impact of capex timing, take-up, and debt) can be gained by looking at results of pure fibre investors and towercos.
- Amongst investors for whom data is available, low take-up seems to be a particular concern.
- Financial results provided in third party reports show an **expansion in revenues for towercos, with ROCE lying between 4-6%. This is below ROCE expected for vertically integrated telecom operators, but reflects the perception of the business model of towercos as a low risk investment.**

Levels of debt amongst wholesale only fibre cos are high. Debt levels amongst vertically integrated operators in Europe have increased, but are comparable with levels in other regions.

- Another concern regarding the majority of regional investors / wholesale only companies reviewed are the very high levels of leverage.
- The ratio of net debt to EBITDA amongst EU headquartered vertically integrated operators lies between 2.5-4 and has in most cases increased in recent years.

Many EU telecom operators operate multi-nationally. However cross-border presence does not seem to be linked to improved financial performance in the current fragmented Single market for electronic communications

- The analysis of company data shows that many telecom groups headquartered in the EU, as well as some groups headquartered elsewhere, have built a portfolio of businesses across different countries.
- The data does not provide clear indications of whether or not there are benefits to operating in multiple markets in the current scenario with no genuine Single market for electronic communications. There are examples of successful regional fibre investors and more localised tower companies that perform better than larger scale companies. Meanwhile some multinational operator groups are financially struggling while others are better positioned. This may however result from the fact that companies today operate as national entities with limited exploitation of synergies in the core. There is limited data available for standalone providers of specialist cross-border services such as automotive IoT and the provision of services to multi-national businesses. The data available suggest relatively low returns for the players concerned.

ANNEX 6: SME CHECK

OVERVIEW OF IMPACTS ON SMEs

Relevance for SMEs
Based on the European Commission's SME filter¹³⁸, this initiative is considered relevant for SMEs. While most of the impacts for SMEs are indirect (as potential downstream business consumers), some direct impacts may also exist for a targeted number of SMEs. This is the case for ECN operators, for instance, as well as for some other network operators.
(1) IDENTIFICATION OF AFFECTED BUSINESSES AND ASSESSMENT OF RELEVANCE
Are SMEs directly affected? In which sectors?
<i>The Initiatives assessed as part of DNA would not introduce any obligations specifically impacting SMEs as consumers of electronic communications services. SMEs acting as ECN operators or other (non-ECN) network operators (e.g. New Space SMEs) may be impacted as described in the sections relating to those categories of stakeholders. Those effects that are specific to SMEs acting as ECN or other network operators are highlighted in this section.</i>
Estimated number of directly affected SMEs
<i>< 50 (assumption based on EU market of ECN operators)</i>
Estimated number of employees in directly affected SMEs
<i>< 1000 (assuming average of 20 employees per impacted SMEs)</i>
Are SMEs indirectly affected? Yes In which sectors? What is the estimated number of indirectly affected SMEs and employees?
<i>All SMEs who are consumers of electronic communications services are indirectly impacted by the DNA initiatives, as it is expected that their demand for higher bandwidth will increase. Further details of this impact are described in section 2.2 of Annex IV, containing the number of businesses by different segments and the expected bandwidth demand change. The modelling of the broadband requirements of SMEs in possible scenarios was carried out in three phases by the contractor for the Study on access regulation:</i> <i>- Starting point was the SME user segmentation</i> <i>- Next, scenarios were developed to show possible shifts in the SME user segments up to 2035</i>

¹³⁸ <https://ec.europa.eu/docsroom/documents/63274>

- Finally, bandwidth requirements of the user segments were estimated for different scenarios in 2035
(2) CONSULTATION OF SME STAKEHOLDERS
How has the input from the SME community been taken into consideration?
The Commission has been consulting widely to gather key information and ensure that the public interest is well reflected in the design of the Digital Networks Act (DNA). The SME community had the opportunity to express their viewpoint not only during the exploratory consultation and the White Paper (as further outlined in Annex II), but recently by responding to the Call for Evidence aimed to inform the public and stakeholders about the Commission's plans. A share of 16% of the total respondents to the Call for Evidence identified themselves as SMEs, and focusing on the 128 businesses responding, 40% claimed to be SME. This represents a growing trend as in the earlier consultations a share of 10% of the total respondents to the White Paper identified themselves as SMEs, and focusing on the 103 businesses responding, 33% claimed to be SME, while a share of 5% of the total respondents to the Exploratory Consultation identified themselves as SMEs, and focusing on the 108 businesses responding, 22% claimed to be SME. The feedback provided by SMEs were duly considered during the assessment of the initiatives.
Are SMEs' views different from those of large businesses?
SMEs acting as ECN operators or other (non-ECN) network operators had similar viewpoints as other large enterprises providing similar services.

(3) ASSESSMENT OF IMPACTS ON SMEs¹³⁹
What are the estimated direct costs for SMEs of the preferred policy option? (Fill in only if step 1 flags direct impacts)
Qualitative assessment
Direct adjustment costs: Low one-off costs for procedural adaptation for SMEs and verticals engaging in new models.
Quantitative assessment
EUR 407 billion accumulated impact on GDP for the period 2025-2035 for all EU economy (including SMEs as well) compared to the status quo as described in Annex 3.

¹³⁹ The costs and benefits data in this annex are consistent with the data in annex 3. The preferred option includes the mitigating measures listed in section 4.

What are the estimated direct benefits/cost savings for SMEs of the preferred policy option¹⁴⁰?
Qualitative assessment
<i>Simplified procedures such as a unified notification template and single notification reduce administrative and compliance costs, enabling SME providers to allocate resources to innovation and growth rather than bureaucracy. These also positively impact competitiveness by enhancing legal certainty and regulatory predictability for SMEs.</i>
<i>Compliance cost reductions: SMEs benefit from reduced legal/advisory burden and simpler access to harmonised spectrum via more flexible licensing and spectrum sharing.</i>
Quantitative assessment
<i>Please refer to Annex 3 for the figures on all consumers.</i>
What are the indirect impacts of this initiative on SMEs? (Fill in only if step 1 flags indirect impacts)
<i><u>Innovation acceleration:</u> SMEs benefit from access to localised/licensed spectrum for innovative services (e.g. private 5G, IoT), particularly in manufacturing, health, agriculture, and transport and from the capacity to scale up thanks to the harmonisation of authorisation conditions.</i>
<i><u>Lower entry barriers for SMEs:</u> Simplified and more flexible access regimes and harmonisation of authorisation conditions reduce administrative and regulatory burdens for SMEs entering niche or local spectrum markets.</i>

(4) MINIMISING NEGATIVE IMPACTS ON SMEs
Are SMEs disproportionately affected compared to large companies?
If yes, are there any specific subgroups of SMEs more exposed than others?
<i>SMEs are not foreseen to be disproportionally subject to negative impacts of the measures proposed.</i>
Have mitigating measures been included in the preferred option/proposal? (Yes/No)
<i>Considering the absence of disproportionate impacts for this specific initiative, no specific mitigation measures are included.</i>

¹⁴⁰ The direct benefits for SMEs can also be cost savings.

Certain options assessed in the Impact Assessment however favour SMEs more than other companies, e.g. cross-border SMEs are likely to benefit most comparatively to other companies, by engaging in cross-border provision of ECN/ECS, a centralised BERECS database and mandatory notification template which reduce administrative burdens and compliance costs for providers, particularly SMEs.

The impact of the cooperation mechanism option on SMEs would be more limited, since the sector is largely dominated by bigger players, but the introduction of a Code of Conduct could still benefit smaller CAPs and local ISPs by improving transparency and ensuring non-discrimination in IP peering practices.

CONTRIBUTION TO THE 35% BURDEN REDUCTION TARGET FOR SMEs
Are there any administrative cost savings relevant for the 35% burden reduction target for SMEs?
<i>Not applicable, due to the lack of specific direct impact on SMEs for this initiative</i>

ANNEX 7: FURTHER EVIDENCE ON THE PROBLEMS AND PROBLEM DRIVERS

1 PROBLEMS

1.1 Fixed networks: Slow deployment and adoption of future-proof networks and services

High-speed internet is a foundational infrastructure requirement for the EU's digital transformation and long-term strategic goals. Without future-proof connectivity, the EU risks falling behind in innovation, economic growth, and global influence. High-speed internet is a cornerstone of the EU's vision for a sustainable, inclusive, and technologically advanced society by 2030 and beyond. Below are the key reasons why the EU requires a resilient, high-speed internet connectivity.

- 1) Economic Growth and Competitiveness
- 2) The EU aims to become a global leader in the digital economy. High-speed internet enables businesses (especially SMEs) to adopt advanced technologies like cloud computing, AI, and big data analytics, which are essential for innovation and productivity.
- 3) Manufacturing and industrial sectors rely on high-speed connectivity for smart factories, IoT-enabled systems, and automation, which are central to the EU's Industry 4.0 strategy.
- 4) Global Trade and Services: High-speed internet supports cross-border e-commerce, digital services, and remote collaboration, helping EU businesses compete in the global market.
- 5) Social Inclusion and Equity
- 6) Rural and remote areas in the EU still lack adequate broadband access. High-speed internet ensures all citizens, regardless of location, can access education, healthcare, and public services.
- 7) Post-pandemic, remote work and online learning have become essential. High-speed internet enables seamless video conferencing, access to digital resources, and participation in the modern workforce.
- 8) E-Government Services: Efficient digital public services (e.g., tax filing, healthcare appointments, social benefits) require reliable, fast internet to ensure transparency and accessibility for all EU citizens.
- 9) Innovation and Research: High-speed internet is critical for universities, research institutions, and tech hubs to collaborate on cutting-edge projects in fields like AI, quantum computing, and genomics.
- 10) Startups and SMEs need fast, reliable connectivity to develop and scale innovative solutions, contributing to the EU's goal of becoming a "digital powerhouse."
- 11) Environmental Sustainability
 - High-speed internet supports smart grids, energy-efficient buildings, and real-time environmental monitoring, helping the EU meet its Green Deal targets for carbon neutrality by 2050.

- Broadband access enables remote work and virtual meetings, reducing the need for physical travel and lowering carbon emissions.

12) Digital Sovereignty and Security

- Reducing Dependence on Foreign Tech: The EU seeks to reduce reliance on non-EU tech giants by building its own digital infrastructure. High-speed internet underpins this digital sovereignty agenda.
- Robust connectivity is essential for implementing secure digital systems and protecting EU citizens' data in an increasingly connected world.

13) Future-Proofing for Emerging Technologies

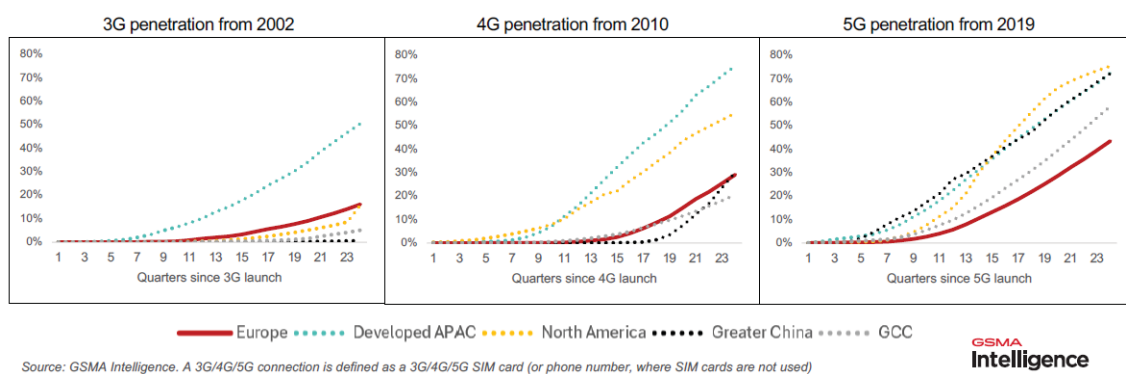
- High-speed fibre networks are the backbone for 5G and future wireless technologies, enabling innovations like autonomous vehicles, smart agriculture, and real-time robotics.
- EU's European Data Strategy relies on high-speed internet to process and analyse large datasets, driving advancements in healthcare, transportation, and public policy.
- Connecting billions of IoT devices (e.g., smart meters, traffic sensors) requires ultra-fast, low-latency networks to function effectively.

1.2 Mobile networks: lack of investment and investment needs

1.2.1 Lack of investments in fully-fledged 5G networks

Since the '3G era', Europe has increasingly lagged in the adoption of new technologies. Europe was one of the leading regions for the deployment and adoption of 3G technologies. For 4G, it fell behind the US; for 5G, it has lagged the US, China and the GCC¹⁴¹, as well as developed APAC markets¹⁴² (Figure A7 1-1).

Figure A7 1-1: 3G/4G/5G penetration



High quality 5G networks are considered a key element for a thriving digital economy. Businesses (referred to as "verticals") need to have advanced connectivity to digitize their

¹⁴¹ Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates).

¹⁴² GSMA Intelligence.

operational processes and value chains, and drive competitiveness and profitability, while consumers require increased capacity and quality-assured mobile services.

Despite considerable differences between Member States due to the inherently different market and regulatory landscapes¹⁴³, the Single Market delivered on basic 5G coverage and low mobile prices for consumers, that are on average significantly lower than in the US. The Single Market underpinned by the EECC, however, did not deliver on the mass deployment of advanced wireless infrastructures and services, like 5G SA or advanced industrial and IoT services, due limited demand and investment capacity, leaving Europe considerably behind India, China and US¹⁴⁴.

Consumer experience in the EU indicates that basic 5G does not necessarily ensure a step change quality of service (QoS) compared to 4G; that can be only achieved by 5G SA, enabling slicing and QoS differentiation.

There is a significant divergence between theoretical 5G coverage and the 5G coverage and quality of 5G services actually available to the end-users. On average, in major EU cities, end-users are still connected 25% of time only to 4G.

MedUX data confirm that EU consumers and businesses continue to face frequent fallback to 4G – in major EU cities, end-users are on average 25% of time connected only to 4G as indicated MedUX field measurements - and limited access to high-quality 5G (mid-band and standalone). Further details are provided in Annex 11 (see several figures on quality of services and quality of experience).

Currently, there is still a significant number of European MNOs in an intermediate stage of 5G adoption, as they maintain the massive use of 5G NSA without a clear perspective for adopting 5G SA. This implies relevant limitations for innovative features enabled by 5G SA, including network slicing, thus preventing the efficient deployment of a set of relevant use cases. While the expectation is that in the coming few years, the EU will catch up with the other major regions regarding 5G SA, thanks to improved technology maturity, a better developed device ecosystem and a growing demand among enterprises for more advanced use cases requiring 5G SA, the competitiveness of the European economy depends on its ability to lead and not to trail in the deployment of transformative technologies.

Deployment of 5G SA networks in the mid-band is significantly more expensive than of basic 5G networks, when the cost of densification of networks is included. In terms of the spectrum used, low-band spectrum (700 MHz in the EU, 600 MHz in North America) allows rapid roll-out of networks to provide basic 5G coverage. However, due to limited capacity, a 5G network based on low-band spectrum can only provide marginal improvements in end-user experience when compared with LTE networks.¹⁴⁵

Lack of investment in 5G SA can also negatively affect the transition to and timely deployment of 6G networks, as 5G SA, with its enhanced capabilities and flexibility, is an

¹⁴³ Mobile broadband prices vary widely across the EU not only in nominal terms but also at price purchasing parity. See European Commission, Directorate-General for Communications Networks, Content and Technology, Mobile and fixed broadband prices in Europe <https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-prices-europe-2022>

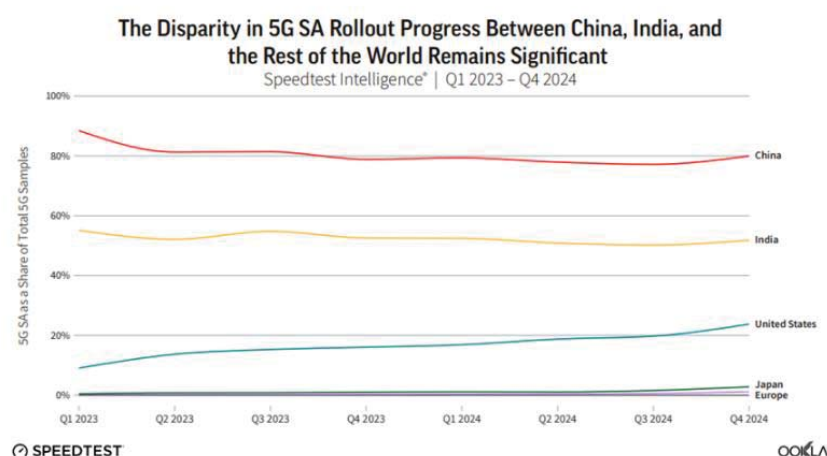
¹⁴⁴ Ookla, 2024, *A Global Evaluation of Europe's Competitiveness in 5G SA*, p.14.

¹⁴⁵ Connect Europe (2025), *State of Digital Communications*, p. 23.

enabling bridge towards 6G deployment and thus essential to ensure that Europe can be at the forefront of global innovation.

Based on Ookla speed tests, 5G SA availability in Europe was as low as 2% in late 2024, compared to 80% in China, 52% in India and 24% in the US¹⁴⁶ (Figure A7 1-2). Most European users experience 5G mainly as faster 4G, without the full benefits of 5G SA. These include ultra-low latency, where connections respond almost instantly; greater reliability, allowing networks to remain stable even in crowded places like stadiums or festivals; and advanced features such as network slicing, which can dedicate parts of the network to emergency services, autonomous cars, or industrial automation.

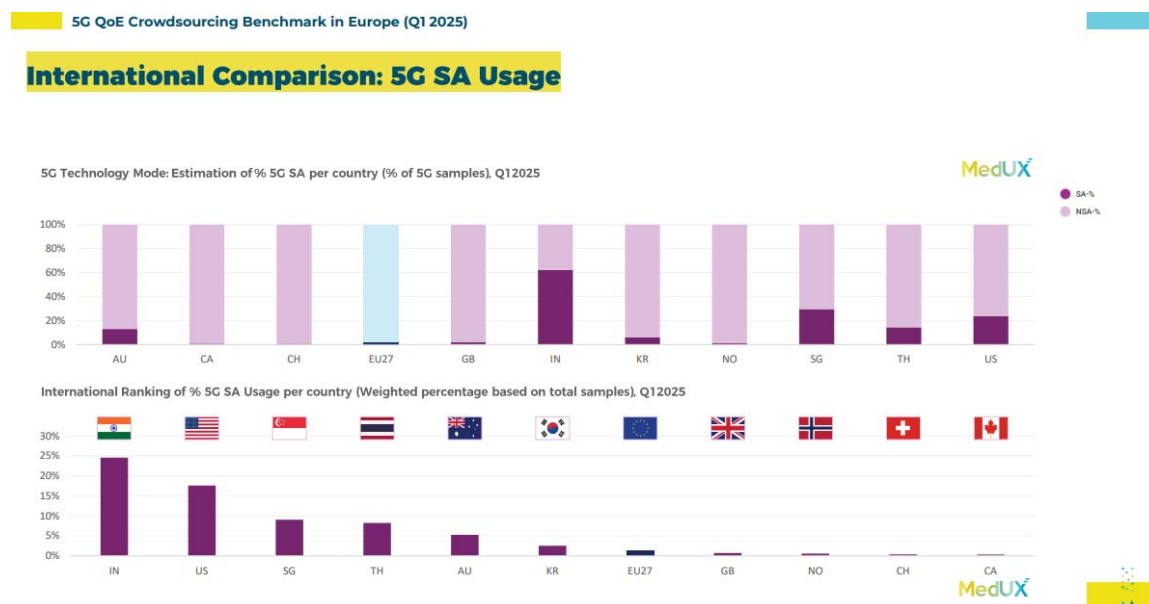
Figure A7 1-2: 5G SA share of total 5G samples for different regions. Source: Ookla/Omdia (2025), *A Global Evaluation of Europe's Digital Competitiveness in 5G Standalone*, p. 1.



Ookla speed tests findings for Europe are in line with MedUX's finding of 2.1% 5G SA availability when users are connected to 5G; when considering all access technologies, 5G SA accounts for only 1.2% of usage. In the international comparison, MedUX data indicate that in 5G SA adoption, the EU is far behind a number of countries (for example, India records 25% 5G SA usage and the US 18%).

¹⁴⁶ Analysys Mason (2024). 5G Global Progress Report; OpenSignal (2024). 5G Experience Report Q4.

Figure A7 1-3: International comparison: 5G SA usage, Source Medux



The limited deployment in mid-bands has limited the speeds achievable on 5G SA networks in Europe.

While mid- and high-band spectrum can deliver higher capacity and faster speeds it has more limited propagation characteristics, and hence smaller antenna coverage areas. Therefore, 5G SA deployments in mid-band depend more on **network densification**, e.g. through installing addition of small cells. North America, China, and Southeast Asia have significantly higher number of small cell deployment, compared to Western and Eastern Europe.

The Commission study¹⁴⁷ also considers that limited use of mid-band spectrum in 5G deployment in Europe, despite the widespread availability of this spectrum in most Member States as of 2022,¹⁴⁸ is confirmed by the lower numbers of small cells compared with those of the US and Asia as reported in surveys conducted by the Small Cell Forum (SCF).¹⁴⁹

¹⁴⁷ Study on Digital Single Market.

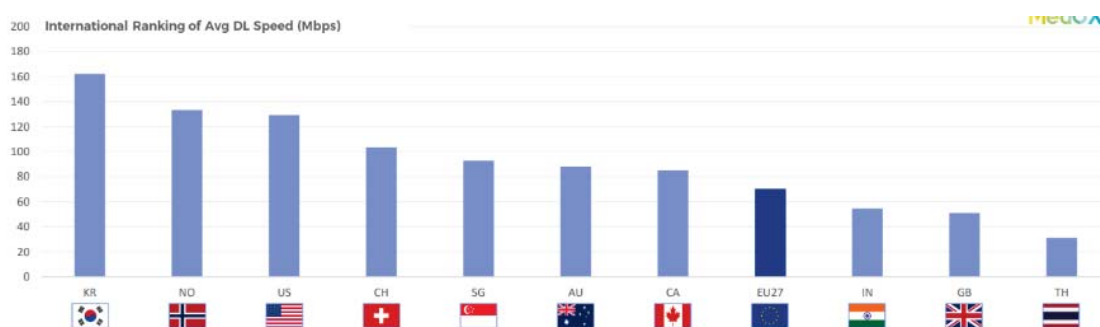
¹⁴⁸ BEREC (2023). Study on wholesale mobile connectivity, trends and issues for emerging mobile technologies and deployments, BoR(23) 41: <https://www.berec.europa.eu/en/document-categories/berec/reports/study-on-wholesale-mobile-connectivity-trends-and-issues-for-emerging-mobile-technologies-and-deployments>.

¹⁴⁹ SCF (2024). SCF Market forecast report: <https://www.smallcellforum.org/docs/scf-market-forecast-report/?>.

Network densification across the EU remains well below the levels required to support advanced 5G services¹⁵⁰. Without significant densification, especially in bands above 3.6 GHz (e.g. mm-wave bands), the promise of 5G to support high-throughput, low-latency industrial use will remain unfulfilled.

From the **societal perspective**, the rate of fully-fledged 5G deployment has direct repercussions in terms of quality of experience for end users. EU27 average download speed stands at 69.9 Mbps, which is lower than South Korea (162.2 Mbps), the US (129.3 Mbps) and China (100 Mbps) and also below international average values standing at approx. 70.4Mbps, according to MedUX data (see Figure A7 1-4 and Evaluation Report Annex 11 Appendix II B)¹⁵¹. Ookla puts the median EU speed in all mobile technologies at 117 Mbps. The number for 5G is likely to be higher if the slower results from earlier mobile generations are removed.¹⁵²

Figure A7 1-4: International comparison of average downlink speed, Source Medux



This underperformance has also economic repercussions, as Briglauer et al. (2025) states that the adoption of mobile broadband is a key driver of economic growth in terms of GDP (See Annex 4). It is the actual speeds experienced by customers and businesses that result in economic growth, not coverage.

The EU is also trailing other parts of the world in the **deployment of private networks**, which are early adopters of 5G SA. As regards the deployment of private 5G networks, in its report¹⁵³ BEREC highlights several spectrum-related and regulatory challenges holding back the deployment of private 5G networks in the Union. Among these are in particular the inconsistent availability of dedicated frequency bands for private networks, the large variety of technical or administrative requirements between the Member States resulting in complexity with regard to the licensing procedure and price variations, challenges pertinent to the specific characteristics of stakeholders (like the timely licensing for private networks that will cover urgent circumstances, or the differentiation of the license with regard to its duration) or the contradiction between the need for temporary licences and

¹⁵⁰ See additional data in WIK-Consult. (2023). Investment and Funding Needs for the Digital Decade Connectivity Targets. Study for the European Commission, DG CONNECT (Unit B5). Available at: <https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets>.

¹⁵¹ Medux data on Status of 5G Quality and experience in EU.

¹⁵² Study on Digital Single Market.

¹⁵³ BEREC [Report](#) on the evolution of private 5G networks and interrelation with public networks in Europe (BoR (25) 33 of 13 March 2025).

location-nomadic licences (e.g. for media production for outdoor events) and longer-term licences (e.g. at ports).

1.2.2 Investment needs

As regards **investment needs**, a Commission study¹⁵⁴ estimated in 2023 a need of EUR 11.5 billion investments for ‘basic 5G’ (upgrade existing 4G sites), but indicated that the ‘full 5G’ (stand-alone 5G) deployment will require EUR 33.5 billion for network densification. In addition, between EUR 26 billion and EUR 79 billion is needed for main transport corridor connectivity, depending on deployment options.

These investment needs are expected to be covered mainly through **private investments**, with a very **limited and targeted support from State aid** in cases where a market failure has been clearly demonstrated. While many Member States have implemented substantial programmes to grant public support for the roll-out of fixed broadband network in market failure areas, the amount of State aid for the deployment of mobile networks notified to the Commission under the Broadband Guidelines¹⁵⁵ has been much more limited and is concentrated in a few countries (notably Italy¹⁵⁶, Spain¹⁵⁷ and Germany¹⁵⁸). Article 52a of the General Block Exemption Regulation¹⁵⁹ also foresees the possibility to grant State Aid for mobile network deployment without a notification if several conditions are fulfilled including the existence of a market failure, the use of open and competitive selection procedures, the imposition of wholesale access obligations, and the respect of proportionality and transparency requirements¹⁶⁰.

The JRC’s update of “Mapping of EU Funds to Digital Decade Targets 2021–2027”¹⁶¹ estimates a Digital Decade-related budget of approximately EUR 177 billion. Within this funding, support for 5G remains relatively modest compared to funding of fixed broadband

¹⁵⁴ WIK-Consult. (2023). Investment and Funding Needs for the Digital Decade Connectivity Targets. Study for the European Commission, DG CONNECT (Unit B5). Available at: <https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets>.

¹⁵⁵ Communication from the Commission on the Guidelines on State aid for broadband networks 2023/C 36/01. OJ C 36, 31.1.2023, pp. 1–42.

¹⁵⁶ SA.100557 (2022/N) IT RRF- Italian 5G plan; SA.39090 (2014/N) - Mobile telephony in mountainous areas of Bolzano (Passo Rombo) IT 07/04/2015 Article 4(3); SA.39089 (2014/N) - Mobile telephony in mountainous areas of Bolzano (Favogna, Mazia, Alpe Guazza).

¹⁵⁷ State Aid SA.108821 (2023/N) – Spain RRF-Modification of the measure “RRF –Support for 5G equipment and infrastructure”; State Aid SA.104933 (2023/N) – Spain RRF - Support for 5G equipment and infrastructure; State Aid SA.104933 (2023/N) – Spain RRF - Support for 5G equipment and infrastructure; SA.103451 (2022/N) ES - RRF -Deployment of backhaul networks for mobile connectivity; SA.64394 (2021/N) RRF - Spain- National aid scheme for passive infrastructure for mobile networks; and SA.57216 (2021/N) Mobile coverage in rural areas in Galicia-Spain.

¹⁵⁸ SA.59574 (2021/N) Deployment of high-performance mobile infrastructure in Germany; SA.56426 (2021/N) High-performance mobile infrastructure roll-out in Lower Saxony –DE; SA. 54684 (2020/N) High-capacity mobile infrastructure roll-out in Brandenburg-DE; SA.58074 (2020/N) Mobilfunk Bayern Modification – DE; SA. 55578 (2020/N) Mobilfunk - Mobile telecommunication Hessen-DE; SA.48324 (2018/N) – Mobilfunk Bayern.

¹⁵⁹ Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty Text with EEA relevance. OJ L 187, 26.6.2014, pp. 1–78.

¹⁶⁰ Up to 2023, only EUR 5.78 million has been reported by Member States.

¹⁶¹ JRC Publication

https://publications.jrc.ec.europa.eu/repository/bitstream/JRC141966/JRC141966_01.pdf.

initiatives. Notably, the CEF Digital programme's "5G and Edge Cloud for Smart Communities" and "5G corridors" strands had a dedicated budget of EUR 227 million for 2021–2027, with an additional EUR 106 million transferred from other strands already awarded. This funding targeted early 5G deployments focused on socio-economic use cases, particularly for public administrations and providers of services of general economic interest (e.g., hospitals, schools, municipalities), as well as enhancing 5G coverage along key transport corridors. The level of funding specifically allocated to the rollout of 5G SA networks remain limited.

Further, the Recovery and Resilience Facility (RRF) has supported 5G rollout across a broader range of use cases. For instance, Italy's 5G Plan allocates EUR 2.02 billion to incentivise deployment in areas of market failure, while Spain has committed EUR 680 million to extend 5G SA networks in underserved rural areas. The **General Block Exemption Regulation (GBER)** has facilitated the use of additional funds managed by Member States to improve mobile connectivity in underserved zones. The currently limited use of the GBER, inter alia by exempting under Article 52a, aid for 4G and 5G (with Member States reporting EUR 5.78 million in block-exempted aid up to 2023) reflects primarily the fact that most 5G rollout has taken place in commercially viable areas where no market failure exists, rather than any constraint arising State aid rules. Overall, while CEF Digital, RRF, and funds managed by Member States (including EU funds under shared management) collectively provide several billion euros for targeted 5G initiatives, total public funding dedicated specifically to 5G remains significantly lower than the multi-billion euro investments directed toward fixed broadband under broader digitalisation programmes, confirming that the vast majority of 5G deployment has been driven by private investment. This trend is expected to continue in the future, with public financing limited to cases of demonstrated market failure.

According to the Commission study¹⁶², the limited use of State aid for 5G may have constrained support for higher-risk investments, in particular given that demand for innovative applications enabled by 5G is still at an early stage.

1.3 Satellite: Barriers to the development of advanced and resilient connectivity

Before turning to the specific barriers to develop resilient connectivity through pan-European satellite services, it is important to outline the technological context to clarify the broader policy implications.

1.3.1 Non-Terrestrial Networks in 5G and 6G

Synergies between mobile (terrestrial) and satellite (non-terrestrial) network components began emerging within the 5G ecosystem, marked notably by the 3GPP's standardization of 5G over Non-Terrestrial Networks (NTN) in Release 17 in 2022. Rel-17 provided detailed specifications enabling 5G systems to incorporate satellite components, thereby unlocking new possibilities of communication and innovative services over satellite networks. Since then, numerous partnerships between telecommunications companies and

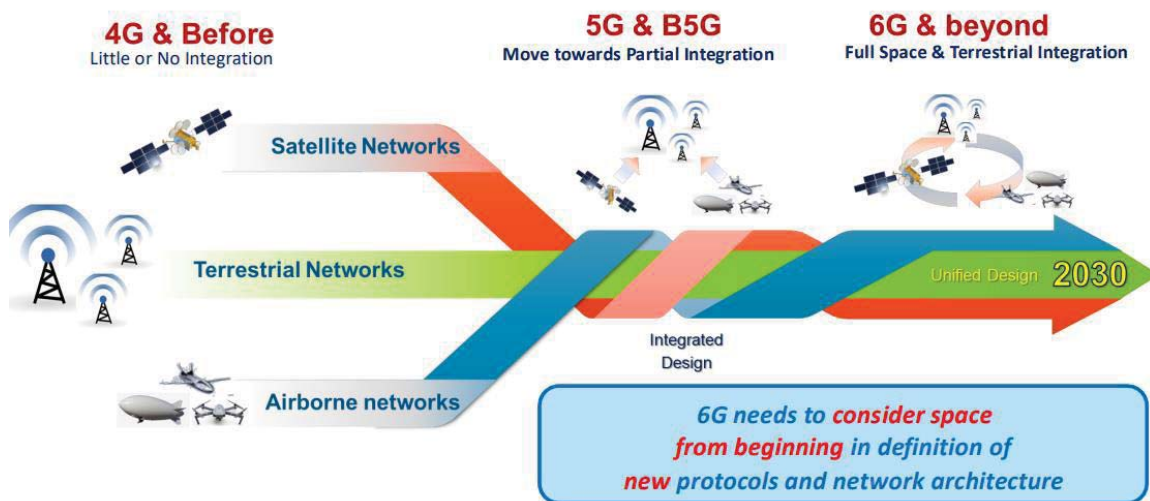
¹⁶² Study on Finance and USO.

governance structures, paving the way for a more integrated and harmonised regulatory approach.

1.3.2 Pan-European satellite services

In an unstable geopolitical situation of growing security risks and attacks of different nature against EU connectivity infrastructures and services, from natural disasters due to climate change to jamming or spoofing of signals used for navigation, **satellite** connectivity has become an essential component of a sovereign, secure and resilient connectivity ecosystem, thanks to technical progress, reduced costs and improved launch and manufacturing. Low Earth Orbit (LEO) providers now offer or develop advanced connectivity services such as Direct-to-Device (D2D), and Internet of Things (IoT) services, comparable to terrestrial mobile or fixed connectivity services. At the ITU level, the vision, requirements and evaluation guidelines for 5G satellite radio interfaces were defined¹⁶⁴, and 3GPP (a global organisation that defines the technical standards for mobile networks) has been developing specifications for 5G non-terrestrial networks (NTN), including satellite, following the acceleration of the convergence of TN and NTN¹⁶⁵ (Figure A7-1-6). Satellite will be native in 6G.

Figure A7 1-6: 6G: Towards a fully integrated ecosystem (source: GSOA)



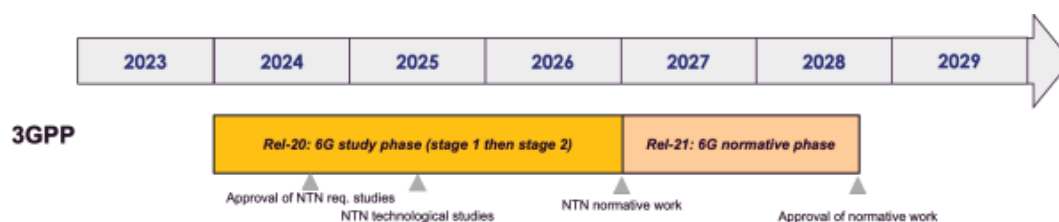
Since the 3G-PPT publication of Rel-17 in mid-2022, NTN has been integrated into the 5G/6G landscape, marking a significant milestone for the satellite community by being the first terrestrial standard to natively incorporate a space component¹⁶⁶.

¹⁶⁴ Report ITU-R M.2514-0: Vision, requirements and evaluation guidelines for satellite radio interface(s) of IMT-2020.

¹⁶⁵ The 3GPP Rel-17 from 2022 defined the first specifications addressing NTN, which have been further developed and extended in Rel-18 (in 2024) and Rel-19 (to be released in 2025).

¹⁶⁶ Technical specifications developed by 3G-NTN cover several use cases. The key use case categories enabled by 6G-NTN are the following: i) service ubiquity and Global Connectivity which targets the digital divide by providing direct connectivity to end-user terminals (including smart phones, household devices and IoT sensors); ii) service continuity and network resilience that ensures uninterrupted service delivery by

Figure A7 1-7: 3G-PPP standardisation plan for 6G



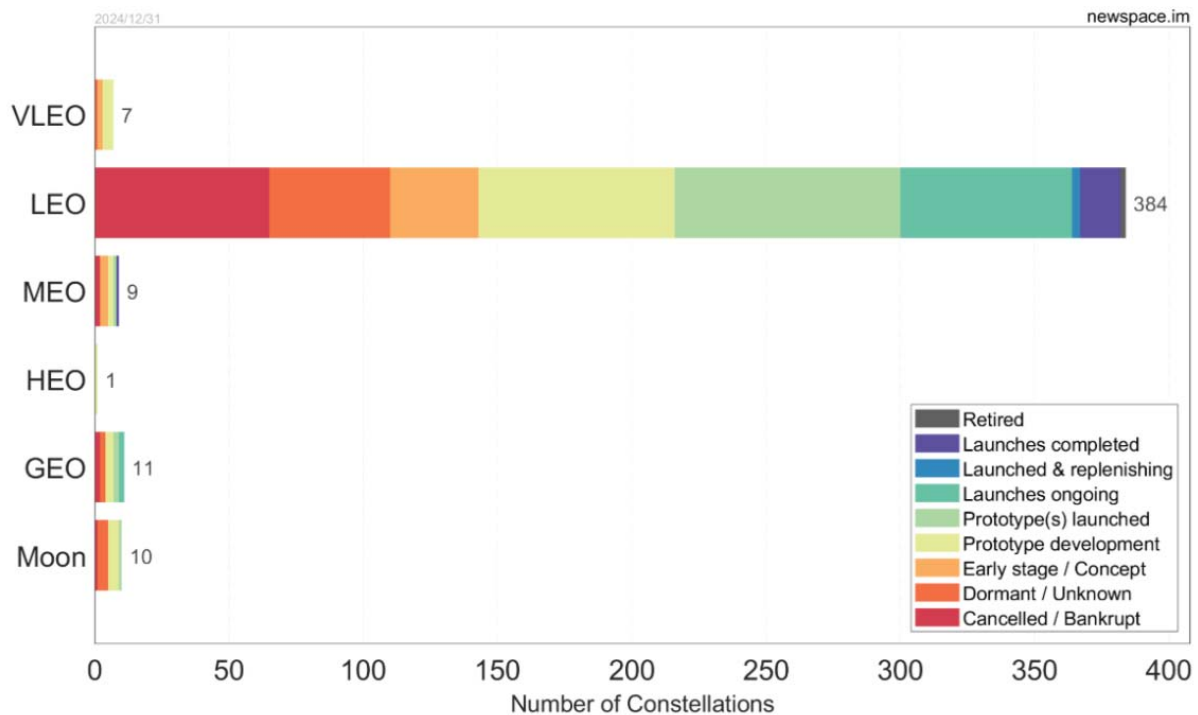
The dramatic drop in launch cost in recent years thanks to improved technology is enabling business models that would not have been viable in the past, resulting in a dramatic increase in planned satellite deployments. The great majority of this activity has been for Low Earth Orbit (LEO) constellations, each of which entails a great many satellites.¹⁶⁷ A summary of NewSpace data by Detecon (2025)¹⁶⁸ makes clear that the number of constellations early in the planning or prototyping stages is large (see Figure A7 1-8). The number of new satellites planned, either as extensions to existing constellations or as new constellations, totally dwarfs the total number of satellites in service today, even when one discounts the most speculative plans. This has also implication on the number of expected authorisation requests.

integrating terrestrial (TN) and non-terrestrial (NTN) components. Key use cases include maintaining connectivity for high-speed terrestrial platforms, such as trains, autonomous vehicles, and commercial aircraft, where consistent handover and latency-sensitive services are critical. The iii) use case refers to service scalability and efficient broadcast-multicast delivery useful for mission critical public safety, dissemination of software and firmware updates, and Broadcast of alerts, educational content, or media services.

¹⁶⁷ Majoor, R. and Perty, H.-P. (2025). Study on mobile satellite services (MSS) in the 2 GHz band in the EU: Implementation of the current regulatory framework and an overview of the satellite connectivity market, Study by Detecon for the European Commission, pp. 104-109: <https://op.europa.eu/en/publication-detail/-/publication/5c28e25b-41b3-11f0-b9f2-01aa75ed71a1/language-en>.

¹⁶⁸ Majoor, R. and Perty, H.-P. (2025). Study on mobile satellite services (MSS) in the 2 GHz band in the EU: Implementation of the current regulatory framework and an overview of the satellite connectivity market, Study by Detecon for the European Commission, pp. 104-109: <https://op.europa.eu/en/publication-detail/-/publication/5c28e25b-41b3-11f0-b9f2-01aa75ed71a1/language-en>.

Figure A7 1-8: Satellite constellations launched and planned.



Source: newspace.im, March 2025 as reported in Majoor, R. and Perty, H.-P. (2025). Study on mobile satellite services (MSS) in the 2 GHz band in the EU: Implementation of the current regulatory framework and an overview of the satellite connectivity market, Study by Detecon for the European Commission, pp. 104-109: <https://op.europa.eu/en/publication-detail/-/publication/5c28e25b-41b3-11f0-b9f2-01aa75ed71a1/language-en>.

Although Europe used to be a frontrunner in satellite communications, it has failed to anticipate the innovation potential of this market and was slow to invest in LEO constellation deployment¹⁶⁹. The EU is facing critical capacity, competitiveness and sovereignty challenges, as regards launching capacity and deployment of LEO constellations as illustrated in section 2.1.2. with only 773 LEO satellites launched and 3120 planned, the EU lags behind China (i.e. 220 launched, 27 198 planned)¹⁷⁰. and the USA (i.e. 7 633 launched, 33 397 planned). The increasing dependence on third country constellations raises concerns around lock-in effects, creates the risk of “shut down” and challenges European security and strategic autonomy. Moreover, existing and planned

¹⁶⁹ The EU is the world’s third largest player in most aspects of the satellite sector, following the United States and China. As of 2023, Europe’s share of the downstream market was estimated to represent 23.0% (EUR 89 billion) of the total global market value (EUR 387 billion) – see Euroconsult (2023) as cited in the European Commission’s Impact Assessment for the Space Act ([SWD\(2025\) 335 final](#)), part 1/2, p. 4. [Detecon International GmbH 2025](#). Detecon tabulates the launches and planned satellites Adding up the satellite constellations by country of ownership (ignoring the complexities of multiple shareholders from different countries, unless it is close to a 50/50 split). Note that this metric excludes the most optimistic claims of some of the announcements, including Starlink’s additional 4450 to 12 000 satellites in the USA column (reported as submitted to the ITU in 2019) and the additional 10 700 satellites which the Thousand Sails constellation may expand to which would add to the China column. Note that counting satellites may also not be the most accurate metric, as it does not account for weight. Comparing kilograms in orbit is probably a more meaningful metric, if such ever becomes available.

constellations of thousands of satellites from third countries risk accumulating orbit and spectrum resources for their commercial interests, rather than EU's strategic ones.

The convergence of satellite and mobile technologies within the 6G ecosystem represents a **structural disruption to long-standing regulatory paradigms**. Historically, mobile communications—governed under the IMT (International Mobile Telecommunications) framework—and satellite communications have been treated as distinct domains, each with different spectrum allocations, authorisation-licensing regimes, and other operational assumptions (i.e. national spectrum planning, regulatory bodies and other governance structures, etc). Furthermore, the increasing need for shared use of terrestrial mobile spectrum by satellite systems to provide complementary coverage in remote and scarcely populated regions exerts pressure for a revision of the ITU framework to globally allow convergence of terrestrial and satellite spectrum use. This calls for reinforced EU-coordination for the establishment of rules in support of the single market and their promotion in the ITU regulatory process. These must address the risk of interference from satellite mega-constellations, and underpin its monitoring and prevention. In this regard, serious interference cases have been reported vis-à-vis EU's radio astronomy services from LEO constellation such as Starlink satellites¹⁷¹ could be high enough to seriously disturb ground-based observatories and space-based telescopes. Stakeholders from the radioastronomy sector stress the need of a minimally disturbed dark and radio-quiet sky for conducting fundamental research in astronomy and important public services such as planetary defence, technology development, and high-precision geolocation¹⁷². Similarly (unintended) LEO satellite interference could potentially affect other satellite applications, including earth observation or space connectivity. This ineffective and uncoordinated enforcement of ITU interference rules against harmful radio frequency interference at EU is likely to become more challenging with the growing global demand of LEOs satellites to access satellite spectrum.

In response, the EU Infrastructure for Resilience, Interconnectivity and Security by Satellite (IRIS2)¹⁷³ consortium up to 2030 was developed to provide secure connectivity services to the EU and its Member States as well as broadband connectivity for governmental authorities, private companies and European citizens, including in underserved areas. Among others, the current barriers would impede IRIS2 constellations access to the spectrum.

¹⁷¹ [Unintended electromagnetic radiation from Starlink satellites detected with LOFAR between 110 and 188 MHz | Astronomy & Astrophysics \(A&A\).](#)

¹⁷² Call to Protect the Dark and Quiet Sky from Harmful Interference by Satellite Constellations: [Draft IAU CPS position statement 9Z8xE01.pdf](#).

¹⁷³ Multi-orbital constellation of 290 MEO and LEO satellites, deployed by SpaceRISE, an industry consortium, comprising three major EU satellite operators.

1.3.3 Fragmentation in satellite authorisation

There is wide evidence on the fragmentation of the satellite authorisation systems in 27 MS as confirmed by a recent study on MSS¹⁷⁴, previous studies¹⁷⁵ and as described in Section 2.2.4.

Against this background of exponential growth of the number of satellites, and of by default limited availability of spectrum resources, there are several barriers that can prevent the development of EU wide services. An important barrier is the **increasing risk of interference that can distort competition especially if enforcement mechanisms are not effective, and do not** ensure a level playing field in accessing spectrum resources leading to **inefficient use of resources**. An additional barrier is also represented by technical and legal obstacles to the provision of cross-border satellite services, and navigate through different authorisations in each Member State with different procedures, national conditions and fees and the risk that the service is not authorised in all MS.

Evidence of this fragmentation is presented in studies related to the MSS authorisation process in all Member States conducted for the Commission in 2014¹⁷⁶, 2019¹⁷⁷, and 2025¹⁷⁸ that clearly demonstrate that there was a great deal of variability in (1) the nature of the authorisation and spectrum assignment, (2) when it was authorised with spectrum assigned, (3) the fees that the selected MSS operators had to pay to each Member State, and (4) the handling of CGCs.

As far as the nature of the authorisation and spectrum assignment, the situation as of 2019 was:¹⁷⁹

- **License exemption (i.e. no license required):** Austria.

¹⁷⁴ Mobile satellite services (MSS) in the 2 GHz band in the EU - Implementation of the current regulatory framework and an overview of the satellite connectivity market, July 2025, Detecon International GmbH, available at <https://op.europa.eu/en/publication-detail/-/publication/4c769094-41b5-11f0-b9f2-01aa75ed71a1/language-en>.

¹⁷⁵ Gerus, V., Manero, C., Pujol, F. et al., Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States – Final report, Publications Office, 2019, <https://data.europa.eu/doi/10.2759/974409>.

¹⁷⁶ Olswang (2014). MSS authorisation regimes, authorisations and enforcement in the EU Member States, study for the European Commission: <https://op.europa.eu/sl/publication-detail/-/publication/0ccf1b70-dbd6-4530-8f09-f44262856dab/language-en>.

¹⁷⁷ Pujol, Frédéric, Manero, Carole, Enjalbal, Ariane, Carle, Basile and Victoria Gerus (2019). Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States, study for the European Commission: <https://op.europa.eu/en/publication-detail/-/publication/7997aa72-d865-11e9-9c4e-01aa75ed71a1/language-en>.

¹⁷⁸ Majoor, R. and Perty, H.-P. (2025). Study on mobile satellite services (MSS) in the 2 GHz band in the EU Implementation of the current regulatory framework and an overview of the satellite connectivity market, Study by Detecon for the European Commission: <https://op.europa.eu/en/publication-detail/-/publication/5c28e25b-41b3-11f0-b9f2-01aa75ed71a1/language-en>.

¹⁷⁹ The quote is from the 2019 study rather than the 2025 study because the latter does not provide equivalent tables with Member State details. Pujol, Frédéric, Manero, Carole, Enjalbal, Ariane, Carle, Basile and Victoria Gerus (2019). Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States, study for the European Commission, p. 24: <https://op.europa.eu/en/publication-detail/-/publication/7997aa72-d865-11e9-9c4e-01aa75ed71a1/language-en>.

- **General authorisation:** Belgium, Croatia, The Czech Republic, Denmark, Estonia, Finland, Hungary, Ireland, Lithuania, Luxembourg, The Netherlands, Poland and Sweden.
- **Individual rights of use:** Bulgaria, Cyprus, France, Germany, Greece, Italy, Latvia, Malta, Portugal, Romania, Slovakia, Slovenia, Spain, United Kingdom.

The individual rights of use granted in Bulgaria, Cyprus, Germany, Greece and Portugal covered both the satellite and terrestrial CGC component, thus facilitating implementation of an integrated MSS and CGC network. Elsewhere, MSS and CGC rights are distinct.

As for **when each selected company was authorised with spectrum assigned**, the steps taken at the EU level probably accelerated the process, but it was still slow and highly variable. Even though the selection was completed in 2009, five years later it was still early days. “As of the end of March 2014, Solaris [was] entitled to use the specific radiofrequencies and to operate a mobile satellite system (MSS component) in seventeen Member States. Inmarsat [was] entitled in nine. As of the end of March 2014, Solaris [was] entitled to provide CGCs in four Member States. Inmarsat [was] entitled only in one jurisdiction.”¹⁸⁰

As regards fees, Table A7 1-1 presents the high level of variability in the fee structure for satellite authorisation in the MSS band with conditions covering the full range of options no fees, one-time administrative/assignment/authorisation fees, annual radio spectrum use fees and other annual fees.

Table A7 1-1: MSS fee structure, per Member State (as of 2019)

Applicable fees		Member States
No fees		AT, HR, DK, EE, FI, IE, LV, LT, LU, NL
One-time administrative/ application fee		BE, CZ, EL, ES, HU, IT, MT, PT, SE, SK
Annual radio spectrum user fees	Fixed amount	BG, EL, IT, MT, PL, RO
	Radio spectrum reserved/ bandwidth	FR, SI, SK ES
One-time assignment/ authorisation fee		BG, DE
Other annual fees		BE, BG, CY, EL, ES, FR, PT, SE, SI SK

Source: Based on Pujol, Frédéric, Manero, Carole, Enjalbal, Ariane, Carle, Basile and Victoria Gerus (2019). Mobile Satellite Services (MSS) authorisation regimes, authorisations and enforcement in the EU Member States, study for the European Commission: <https://op.europa.eu/en/publication-detail/-/publication/7997aa72-d865-11e9-9c4e-01aa75ed71a1/language-en>.

The conditions for CGCs are even more varied. Recital 18 of the MSS Decision explains the following: “Complementary ground components are an integral part of a mobile

¹⁸⁰ Olswang (2014). MSS authorisation regimes, authorisations and enforcement in the EU Member States, study for the European Commission: <https://op.europa.eu/en/publication-detail/-/publication/0ccf1b70-dbd6-4530-8f09-f44262856dab/language-en>.

satellite system and are used, typically, to enhance the services offered via the satellite in areas where it may not be possible to retain a continuous line of sight with the satellite due to obstructions in the skyline caused by buildings and terrain. In accordance with Decision 2007/98/EC, complementary ground components use the same frequency bands as MSS (1980 to 2100 MHz and 2170 to 2200 MHz).

A more recent study¹⁸¹ confirms that though many Member States are authorising satellites under general authorisation, the conditions attached to the general authorisation differ significantly and, according to satellite operators, are not always suitable for satellite operators. The Ground segment requires individual authorisations in all Member States, which is accompanied with lengthy coordination procedures and complex requirements especially in some Member States. While such requirements can be met by large, experienced market operators, they are difficult to satisfy for new-comers, New Space SMEs and startups¹⁸².

1.3.4 D2D communications market potential

With 6G enabling direct-to-device (D2D) communications, the clear demarcation between terrestrial and satellite networks is becoming increasingly obsolete. This blurring of boundaries necessitates an integrated regulatory response to avoid fragmentation and interference issues, especially in spectrum bands that will be shared across terrestrial and satellite operators. Therefore, to fully capitalize on the potential of future hybrid connectivity scenarios in Europe—where users seamlessly transition between terrestrial base stations and non-terrestrial network (NTN) satellite nodes—it is required to: i) issue EU harmonised spectrum authorisations for operators providing hybrid services and ii) promote spectrum sharing between terrestrial and satellite systems as endorsed in the RSPG opinion on 6G vision. Ultimately, the risk for the EU is to miss the opportunity for the timely deployment of autonomous and sovereign satellite systems, in particular for catching up with the advance of large-scale LEO/MEO satellite constellations, in order to secure self-sustained global, low-latency broadband services both, for the governmental and business use cases. Such satellite systems are crucial for the provision of (D2D) connectivity, i.e. satellite communications directly to mobile or fixed mass market equipment such as off-the-shelf mobile phones, modules on board transport vehicles or IoT sensors, using either terrestrial or dedicated mobile satellite spectrum (such as the EU-harmonised 2 GHz/S-band). The benefits of sovereign D2D service availability include the removal of the present dependence on non-EU satellite operators, and the deployment of convergent, ubiquitous, secure and resilient wireless services across the Union, especially for emergency situations and PPDR. It should be noted, that the D2D market is rendered an important economic potential. According to GSMA intelligence¹⁸³, the global market size for D2D is set to rise from 25.88 in 2025 to USD 32.74 billion in 2035¹⁸⁴ (an increase of 26.5%) the whole market.

¹⁸¹ Study on Digital Single Market.

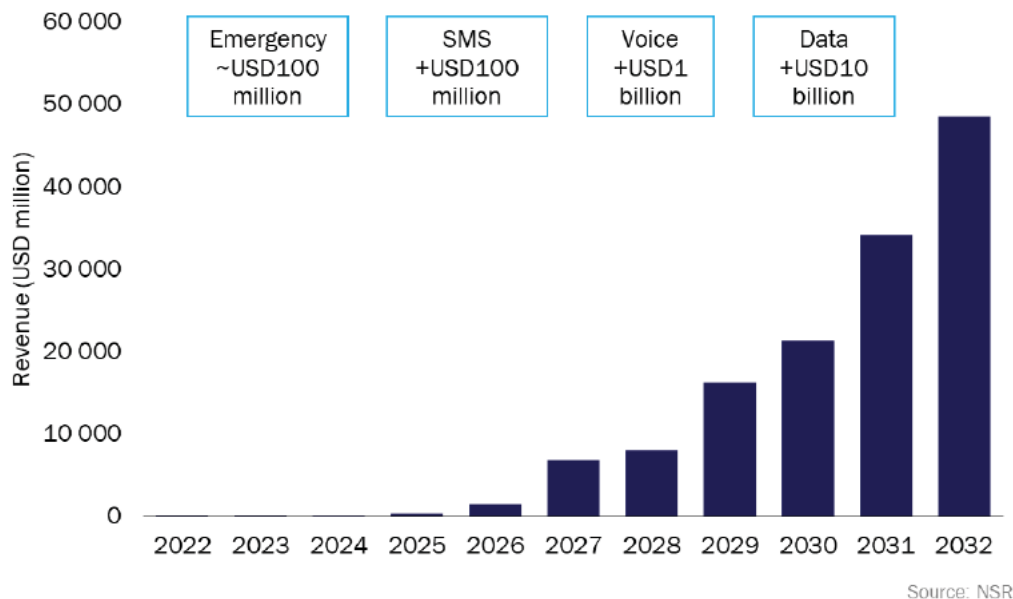
¹⁸² Study on Digital Single Market.

¹⁸³ Report “Satellite 2.0: going direct to device”: <https://www.gsmainelligence.com/research/research-file-download?id=69042417&file=220322-Satellite-2.0-going-direct-to-device.pdf>.

¹⁸⁴ With a share of 3% in the total telecom market.

According to Analysys Mason the global satellite direct-to-device market could generate USD 137 billion in cumulative service revenue between 2022 and 2023.

Figure A7 1-9: Satellite D2D service revenue, worldwide, 2022–2032



Source: NSR

Recently, alternative business models have begun to take shape, diversifying the landscape of the industry. While today some models rely heavily on customer acquisition and significant capital investment (each new user requires the purchase and installation of hardware such as a dish and a router), other strategies consist of developing space-based mobile networks designed to connect directly to unmodified smartphones. This latter approach circumvents the traditional hardware requirement by deploying satellites equipped with large phased-array antennas that function as orbiting cell towers (similar to terrestrial base stations in the space), delivering mobile broadband directly to users' smartphones, which eliminates the need for dishes, satellite phones, or any additional user hardware.

Currently, smartphones do not support 3GPP NTN (Non-Terrestrial Network) standards, so satellite operators must partner with mobile network operators to access terrestrial frequencies and reach smartphone users. These models are proposed by AST SpaceMobile (who has already an agreement in Europe with Vodafone¹⁸⁵) or Skylo (who uses satellites from Viasat and Echostar both licensees the 2GHz MSS band), that completely change the economic approach by focusing on the smartphone—the device already used by around five billion people globally. Through a single commercial agreement with a mobile carrier (who increases network coverage without substantial CAPEX given that satellite networks can already cover large territories), millions of users can be reached at once. However, these partnerships with mobile operators are likely a transitional solution. Once the chips in the smartphones begin to support 3GPP NTN standards, LEO (Low Earth Orbit)

¹⁸⁵ <https://www.vodafone.com/news/corporate-and-financial/vodafone-and-ast-space-mobile-sign-agreement-to-create-european-direct-to-device-satellite-service-provider>

satellites will be able to connect directly to smartphones, eliminating the need to rely on terrestrial networks. This particular model proposed by SpaceX¹⁸⁶ will put emphasis on the large-scale connectivity establishing a new connectivity market with global scale, i.e. billions of world-wide smartphone users, rather than individual sales and/or wholesales, and this difference, in the telecommunications sector, is highly significant with major regulatory implications.

2 PROBLEM DRIVERS

This section provides additional details for the problem drivers presented in Section 2.2 of the main document.

2.1 Factors slowing down the deployment and adoption of fibre networks/services

2.1.1 Regulatory approaches, business choices and persistence of copper networks

The table below provides an overview of the application by NRAs of provisions related to SMP findings and access obligations. The differing regulatory approaches by NRAs contributed to the variations in fibre deployment and take-up.

Figure A7 2-1: Overview of application of EEC provisions Articles 22, 26, 61 (3), 72-80

Country	Geographic survey (Art. 22)	SMP findings and access obligations								Symmetric Regulation (Art. 61 (3))	Dispute resolutions related to access (Art. 26)
		SMP regulation	Access to civil engineering (Art. 72)	price flexibility for fibre (Art. 74)	Regulatory treatment of VHCN (regulatory relief) (Art. 76)	Functional Separation (Art. 77)	Voluntary separation by a vertically integrated undertaking (Art. 78)	Commitment procedure (Art. 79)	Wholesale-only operators (Art. 80)		
Austria	Yes	partial M2									5
Belgium	Yes, with invitation to declaration	M1, M2, 3b	Yes	reasonable margin							1
Bulgaria	No	PIA	separate market				no regulatory relief				0
Croatia	Yes	M2, partial M1 and 3b	Yes	price cap based on cost model						1st distr. pt.	13
Cyprus	Yes	M1 and M2	Yes							in-building	2
Czech Republic	Yes, with invitation to declaration	partial M1		ERT			no regulatory relief				1
Denmark	Yes	partial M1		Price ceilings based on cost model			no decision				
Estonia		PIA, partial M1 and 3b	separate market								1
Finland	Yes	partial M1									
France	Yes	PIA, M2, sym M1	separate market	Price range and replicability test						1st distr. pt.	1
Germany	Yes	M1 and M2	Yes	ERT							9
Greece		M1, M3b and M2	Yes							in-building	0
Hungary	Yes	M2, partial M1 and M3b (withdrawal of current market review)									1
Ireland	Yes	PIA, partial M1 and M2	separate market	copper price anchor, price flexibility for VUA rental							
Italy	Yes, with invitation to declaration	partial M1, M3b and M2	Yes		not accepted		pending	not accepted	pending	in-building	3
Latvia	Yes, with invitation to declaration	partial M1 and M3b	separate market								17
Lithuania	Yes	M1 and M2, partial M3b	Yes								0
Luxembourg	Yes	M1, M2 and M3b		ERT							4
Malta	Yes	M1 (withdrawal of current review)									0
Netherlands	Yes										0
Poland	Yes	Partial M1 and M3b	Yes	Yes						in-building	0
Portugal	Yes, with invitation to declaration	PIA, partial M1 and M2	separate market	in M1 fair and reasonable pricing						in-building	19
Romania	Yes, with invitation to declaration										
Slovakia	Yes	M1 and M3b	Yes	ERT							
Slovenia	Yes, with invitation to declaration	M1 and M2, partial M3b	Yes	ERT							
Spain	Yes	M2, partial M1 and M3b	Yes	ERT			no regulatory relief			1st distr. pt.	15
Sweden	Yes, with invitation to declaration	M1		ERT							70

¹⁸⁶ [SpaceX planning first tests of new direct-to-device spectrum next year - SpaceNews](#)

Source: WIK's interim report

In addition, the following table provides an overview of the degree of infrastructure competition and regulatory approaches taken towards FTTC / VDSL and FTTH in a sample of 15 European countries (14 EU + the UK) and juxtaposes these against outcomes in terms of FTTH coverage, take-up, retail competition (via HHI), and retail pricing.

Figure A7 2-2: Overview of degree of infrastructure competition and regulatory approaches with outcomes in terms of FTTH coverage, take-up, retail competition and retail pricing.

	Regulatory approach						Outcomes					
Country	Strong SMP PIA (to support alternative deployment) Y / N	Role of infrastructure competition (pre-existing + regulatory focus)	Use of Art 61(3)?	Declarations to deploy consistent with Art 22 EECC?	Support for FTTC / VDSL deployment e.g. through low SLU price or long-term pricing / pricing flexibility?	Flexibility or forbearance on regulation of FTTH?	FTTH coverage = FTTH homes passed / total household (Digital Decade DESI 2025)	FTTH take-up = FTTH subscriptions / total FTTH homes passed (data for 2024 from FTTH HHI)		Gigabit take as % BB lines (DESI 2025)	Gigabit pricing absolute per month, double play	100 Mbit/s FTTH or cable pricing in relation to 30Mbit/s %
	FTTC / VDSL focus											
Germany	N (SMP PIA Ref Offer since 2024)	Pre-existing cable but partial coverage	Y (in-building only)		Y vectoring + long-term pricing	Y (ERT)	37	26,4	na	5.7		18%
Austria	N	Pre-existing cable but partial coverage	N		Y – retail minus / encouragement of vectoring, then commercial agreement	Y – retail minus, then commercial agreement	45	24,7	Higher than average, decreasing	1.2		25%

UK	Y (separate market)	Pre- existing cable but partial coverage			Y pricing flexibility FTTC / VULA	Y	73	37.1		6		
Greece	Y (remedy M1)	No cable, regulatory efforts to enable new entry	Y (in- building only)		N?	N (CO)	46	28,3	na	0		4%
Czechia	N	Pre- existing cable but partial coverage	N	Y	Y (ERT) ¹⁸⁷	Y (ERT)	41	45,4	Lower than average, increasing	4,3		
Italy	Y	No cable, regulatory efforts to enable new entry	Y (in- building only)	Y	Y SLU pricing	N	71	27,6	Lower than average, decreasing	25,2		
Early FTTH focus incl. SMP PIA in-building standards and access												
France	Y (separate market)	No Mutualisa tion Art 61(3) ->	Y (first distrib point – 1,000 HH	Y	N	N	87	83,8	na	58,9		

¹⁸⁷ ERT with regard to both copper and fibre LLU and VULA access

		80% HH monopoly in FTTH	in less dense areas)									
Spain	Y (Remedy M2)	Pre-existing cable partial coverage + regulatory focus on additional infrastructure competition	Y (first distribution point, but with restricted no. HH)		N	Y	95	91	Lower than average	25,4		
Portugal	Y (separate market)	Pre-existing cable (extensive) + regulatory focus on additional infrastructure comp	Y (in-building only)	Y	N	Y	93	89,9	na	15,1		8%
	Duopoly – nationwide historic cable											
Netherlands	N	Pre-existing	N		Y – long-term pricing /	Y – long-term pricing /	85	38	na	10,5		6%

		nationwid e cable			commerci al offers ¹⁸⁸	commerci al offers						
Belgium	N remedy in M2, but limited ducts	Pre- existing nationwid e cable	N	Y		Y (reasonabl e margin)	31	35,7	Higher than average increasing	5,5		
Malta	N	Pre- existing nationwid e cable	N	N		Y (ERT)	86	59,4	Higher than average, stable	17		
Early regional / public / utility FTTH investors												
Sweden	N	Municipal networks have significan t coverage	N	Y		Y (ERT)	86	81,9		9,8		
Denmar k	N	Utility networks have significan	N			N – currently price ceilings	87	56,5	Lower than average, decreasing	33,7		

¹⁸⁸ The Dutch NRA permitted KPN to agree wholesale contracts with long-term volume discounts for the new FTTC VULA product introduced in 2015. The pricing regime was based on commercial agreement subject to review by the NRA. The Dutch NRA notes that the incumbent was incentivised to reach agreement due to its proposal to prohibit vectoring and to set wholesale charge on the basis of cost-orientation in the absence of agreement.

		t FTTH coverage				based on cost model							
	Cable & FTTH consolidator												
Romania	N	Former cable operator engaged in early FTTH deployment & consolidation	N	Y			96	81,7		Higher than average, increasing	34,2		

Source: WIK's interim report

In the table above, Member States have been grouped based on common characteristics that could influence market outcomes. This enables an analysis of the effects of similarities and differences in the regulatory or wider political approaches.

- First group: FTTC/VDSL group

The first group covers Member States in which FTTC / VDSL has played a significant role. This includes Germany, Austria, Belgium, the UK, Greece, Czechia and Italy. A common feature amongst most of these countries is that regulatory incentives were given for the deployment of FTTC VDSL. In Germany this included support for FTTC VDSL vectoring by the incumbent and support for long-term pricing arrangements for FTTC VDSL Layer 2 bitstream that locked in alternative operators into multi-annual VDSL access arrangements. Flexible pricing for FTTC VDSL VULA was provided in Austria, the UK and Czechia, while in Italy, the regulatory regime supported competition in the deployment of FTTC VDSL through reductions in pricing for subloop unbundling and regulatory approaches which sought to limit the use of vectoring that would have impeded competition in the upgrade of the subloop with VDSL. Outcomes in this group of countries regarding FTTH coverage and take-up and the associated levels of take-up of Gigabit broadband are poor, with the exception of Italy. Italy's significantly higher FTTH coverage than the other countries in this group may be explained by a number of factors. These include the significant use of EU Funding to support FTTH deployment and policies that facilitated FTTH deployment by the alternative fibre investor Open Fiber, including shareholdings from the public investment body CDP and (at the outset the utility Enel), stringent application of the BCRD to utility duct and pole access, SMP PIA regulation, access to in-building fibre wiring under Article 61(3), and a system of declarations that sought to identify black, white and grey areas for fibre investment. High coverage of FTTH in Italy along with infrastructure competition has resulted in low prices and relatively high take-up of Gigabit broadband compared with many other countries. However, infrastructure competition between FTTC and fibre, which limited take-up at wholesale level has been a key factor underlying the underperformance of Open Fibre and its ability to carry out the network. Finally, Belgium, where the number of vectored copper/VDSL lines is significant is characterised by low fibre roll-out, high prices and limited use of passive infrastructure.

As regards Czechia, while Gigabit broadband offers are available at an affordable price, the footprint is limited by the limited coverage of FTTH in this market. It is notable that Gigabit pricing is particularly high in Austria. This market is one of only four cases in which WLA SMP regulation was removed, as it was considered that commercial wholesale offers would be sufficient to support competitive outcomes. However, the prevalence of active access in this market with high charges for higher bandwidths may limit the prospects for competition on quality.

- Second group: early FTTH focus with SMP PIA and Art. 61(3)

The second group of Member States listed focused on the deployment of FTTH from an early stage (pre 2010) and designed the regulatory approach with this aim in mind. This group includes France, Spain and Portugal. Common features of the regulatory approach in this group were strong and early regulation of **SMP- based access to physical infrastructure**, coupled with **standards for in-building fibre wiring** and **rules regarding access to such wiring consistent with Article 61(3) EECC**. Systems

involving declarations regarding the deployment of FTTH were also applied in France and Portugal. However, there are also some important differences in the approaches that were taken. France sought to limit unviable duplication of FTTH networks from the outset by requiring the mutualisation of fibre terminating segments (essentially unbundled fibre loops) at points enabling access to at least 1,000 households in areas outside the most densely populated conurbations. This meant that for around 80% of total households, only one fibre access line was constructed, thereby creating a monopoly on fibre. However, the deployment of fibre to these households was linked to access obligations which included requirements to offer co-investment through Indefeasible Rights of Use (IRU) and rental, at rates which were ultimately determined by the NRA via dispute resolution based on principles of cost-orientation with a premium to reflect risk (including risk relating to the timing of the co-investment). France is one of the only countries in the EU to have applied Article 61(3) in an extensive way, going well beyond access to in-building wiring to stipulate a location for connection which was considered viable for access seekers.¹⁸⁹ Conversely, Portugal took a considerably more conservative approach to access regulation, limiting its application of Article 61(3) to in-building wiring, and forbearing from SMP access regulation on FTTH for a considerable period, while encouraging infrastructure-based competition (duplication of fibre access networks). While SMP access obligations on FTTH were eventually introduced in Portugal, they cover a small proportion of access lines.

The regulatory approach taken in Spain falls somewhere in between the two. While, like Portugal, there was a strong emphasis on infrastructure competition and forbearance on access to FTTH at higher speeds for some time, access to fibre terminating segments was provided under Article 61(3) to small groups of households in some cases, and SMP WLA regulation was eventually applied outside areas characterised by infrastructure competition.

All three of these Member States have achieved very high levels of FTTH coverage and take-up. However, differences can be seen in the pricing and take-up of Gigabit broadband, with extremely high take-up rates of Gigabit broadband in France (59% of broadband connections), but relatively low rates in Portugal, and mid-level rates in Spain which might be explained by the higher price premiums for Gigabit broadband in those countries. It seems likely (also taking into account experience in Italy)¹⁹⁰ that the universal availability of passive access to fibre (fibre unbundling) in France on the basis of IRU, coupled with the limitations on infrastructure duplication may have enabled lower overall costs than in Spain and Portugal and increased competition on quality and thus lower prices for Gigabit offers. France is also one of the few out of those countries for which data was available where significant fibre investment had occurred, and alternative broadband providers were able to meet or approach their cost of capital.

- Third group: Presence of copper and cable network operators

¹⁸⁹ The only other similar case is Croatia, but this provision was introduced considerably later, and the Croatian regulatory system differs from that of France in other ways.

¹⁹⁰ In Italy in contrast, while there are offers for passive access to fibre on the basis of IRU, which supports affordable Gigabit offers, the persistence of FTTC in Italy has deterred migration to FTTH where deployed.

Member States characterised by the historic presence of the incumbent and cable include Belgium, the Netherlands and Malta. Belgium can also be mentioned here, as it also displays characteristics of this group of countries (in addition to the characteristics related to the first group). SMP PIA has not been mandated in Malta or the Netherlands and plays a very limited role in Belgium also because of the limited presence of ducts in Belgium. However, SMP access regulation or other measures with a similar effect has been applied with a focus on active rather than passive wholesale products. In Belgium, SMP access regulation was applied to the incumbent and cable operator, while in Malta SMP access regulation applies only to the incumbent. In the Netherlands, the incumbent entered into binding commitments following a market investigation under competition law. Flexible approaches to wholesale price regulation on fibre access have been applied in these countries, with Economic Replicability Test (ERT) in Malta, reasonable margin in Belgium and long-term pricing arrangements in the Netherlands. While there are some similarities in market structure, there are significant differences in outcome. While the Netherlands and Malta have achieved high fibre coverage rates and moderate fibre take-up (limited by the existence of parallel cable networks), very limited fibre deployment has occurred in Belgium.

Indeed, in Belgium, wholesale competition is mainly driven by regulated access to cable (not fibre) networks. There are also notable differences in outcomes for consumers, with high prices and low take-up for Gigabit offers in Belgium, while low prices have been reported for Gigabit offers in Malta.

- Fourth group: Early regional / public / utility FTTH investors

Sweden and Denmark are characterised by regional fibre operators, controlled by municipalities in the case of Sweden and by utilities in the case of Denmark. These players have been the primary contributors to high coverage of FTTH in these countries, although incumbents have also deployed FTTH in certain areas or to certain types of dwellings e.g. SDUs in Sweden. FTTH take-up is significantly lower in Denmark than in Sweden, likely as a result of the presence of a competing cable network owned by the incumbent, which may have impacted profitability of Danish fibre utilities such as Fibia. As the primary investors in FTTH in these countries have been able to exploit their own duct and pole facilities and there are limited expectations regarding additional infrastructure competition, there has been limited focus on regulation of PIA or regulation of access to in-building wiring. Attention has focused more on promoting competition in retail markets through SMP regulation. In Sweden, the SMP access regime currently in force applies only on the incumbent (based on ERT for fibre unbundling). While data from the NRA suggests that municipalities have very high market shares on fibre in many areas, in particular for Multi-Dwelling Units (MDU), and do not always operate on the basis of passive-only networks, these networks are not currently subject to access regulation. In contrast, following a recent market review, certain regional fibre utilities have been designated as having SMP in Denmark. Access regulation has been applied but is on the basis of bitstream. Gigabit pricing is higher and take-up of Gigabit connections is lower than may be expected given the long history of FTTH deployment in these countries. It is possible that this may be affected by limitations in competition on quality that may result from the lack of demand for and access to fibre unbundling in the Danish market alongside the lack of attention to access conditions from municipalities in Sweden in areas where they have a leading position in the supply of wholesale fibre access. The Finnish market is historically divided

into local geographic markets with local incumbents. In some of those geographic markets there are wholesale-only, open networks which remain unregulated due to the absence of competition problems.

Finally, in Ireland, the joint venture between local energy company and alternative operator (Vodafone) is deploying an alternative fibre wholesale-only network to the one currently being rolled out by the local incumbent. This is complemented in Ireland by deployment under the State aid framework, with open wholesale access.

- Fifth group: Competitive constraints stemming from alternative networks in densely populated areas – Poland and the Baltic states

Investments in fibre are also indirectly driven by existing competition, in particular from hybrid coax-fibre networks. Large scale investments in fibre, followed by partial deregulation took place in larger cities of Poland, due to the presence of upgraded cable networks offering much better quality of services than the incumbent's copper network. Similar situation can be observed in Latvia and Estonia where large cities are characterised by infrastructure-based competition and fibre investments. In those areas access to physical networks (ducts and poles) is not imposed to facilitate investments in independent networks. The regulated access to cables is however needed in more rural areas.

An analysis of access regimes under the EECC and outcomes for competition, investment and consumer welfare suggests that the current access-related rules under the EECC have enabled certain countries to achieve highly positive results, but some regulatory approaches did not support or even delayed the achievement of the Gigabit connectivity targets.

The analysis of practices across the EU suggests that high fibre coverage has been driven by infrastructure competition in the presence of low barriers such as access to SMP ducts or low deployment costs (e.g. Spain, Portugal, Romania) and/or central planning e.g. France, which made use of geographic surveys, symmetric regulation and declarations to limit duplication of fibre networks and provide investor certainty by limiting the risks of overbuild. Public authorities support either by state aids or by direct investment via publicly owned company has also played an important role.

A common factor amongst the countries which lag furthest behind in FTTP deployment is that they feature FTTC/VDSL deployment by the incumbent (e.g. Austria, Belgium, Germany and Italy). The deployment of this interim technology ('vectoring' which allows elimination of cross talks for higher bandwidths) may have provided short term gains in terms of lower capital intensity, while improving services to customers (e.g. downstream/upstream rate 250/40 Mbps and for very short copper lines up to 100 meters – Gbps bandwidth is possible). However, the strategy to deploy FTTC led to a deferral by incumbents of required investments in FTTP to a later stage. In addition to deferring the incumbents' investments, the availability of FTTC / VDSL may also have served to deter deployments in fibre by alternative investors, by limiting the performance gap between copper and fibre. In turn, this has hindered take-up of fibre, further undermining the business case. If the demand/take-up developments do not meet the expectations of operators and/or investors, the incentive to invest further and to invest in new infrastructure projects is reduced.

Profitability of the operators

Regulation also has consequences in terms of revenues and profitability of the telecom operators. However, it is important to note that regulation is only one of many factors that influence these financial outcomes. It must be noted from the outset that while segmented fixed and mobile Average Revenue Per user (ARPU) data may be available, profitability is generally only provided in aggregate form, collating the results from fixed and mobile together, and often also combining results from multiple countries, in particular for smaller markets.

With that said, the financial results show that there are differences in profitability between vertically integrated telcos in different European countries, and in many cases differences between the profitability of incumbents compared with alternative operators / access seekers (with incumbents typically being more profitable). It is possible that (along with other factors), aspects of the regulatory regime which affect FTTH deployment and associated investment requirements and the duplication of FTTH networks (infrastructure competition) may have influenced the different outcomes seen.

An overview of results from one of the Barclays 2024 reports is provided below. It appears that all incumbents are meeting their cost of capital apart from Telecom Italia. The financial performance of alternative operators is lower, but there are country-specific variations. The following list provides an overview from strongest to weakest financial performance, in terms of the number of players with Return on Capital Employed (ROCE) close to or exceeding the company-specific Weighted Average Cost of Capital (WACC) (or incumbent WACC where not provided):

- In Germany, all the main broadband providers listed are profitable or appear close to profitability, with particularly strong performance from the incumbent and from 1&1, which was at the time of the data provided, mainly a service provider (in both fixed and mobile). TF Deutschland is not profitable, but as its broadband market share and fixed investments are understood to be limited, this may result from dynamics relating to the mobile market.
- In France, the incumbent and two of the main alternative broadband providers are profitable or appear close to profitability. Only Altice is reported as making very low returns, although its company-specific WACC is not given.
- In the Netherlands, the incumbent is highly profitable. The alternative operator Odido's ROCE is significantly lower (and below the incumbent WACC), while Vodafone Ziggo is not meeting its WACC.
- In Spain, the incumbent is significantly exceeding its WACC, but its competitors are falling significantly short of their cost of capital.
- In Italy all operators are falling far short of their cost of capital.

The degree of investment in FTTH (and associated cost) and the timing of that investment is likely to have affected profitability as well as the extent to which FTTH networks were duplicated as opposed to shared amongst broadband providers. This could for example have contributed to higher levels of profitability in Germany, which had limited FTTH deployment as of 2023. In contrast, in Italy the acceleration in FTTH deployment, infrastructure competition from Open Fiber and relatively low retail prices may have

contributed to low levels of profitability including for the incumbent. However, other factors including commercial decisions and debt levels are also likely to have played a role. In Spain, the focus on infrastructure competition, requiring high levels of investment by all broadband players may have contributed to low levels of profitability amongst alternative broadband operators.

In contrast, the relatively higher levels of profitability amongst alternative operators in France compared with other countries may have been supported by limitations in FTTH duplication, encouraged by regulatory policies which favoured co-investment rather than infrastructure competition, alongside the earlier deployment of FTTH (compared with Italy and Germany) and associated higher take-up.

Data available to WIK shows that specialist alternative fibre investors are amongst those with the most troubling financial results. While municipal operators such as Stokab have been able to achieve adequate returns on capital with early fibre investment using a wholesale only model to stimulate take-up, others e.g. Fibia, SIRO, Open Fiber and CityFibre with later FTTH investments, greater reliance on debt and in a market with significant competition, are yet to translate their investments into profitability. Amongst investors for whom data is available, low take-up seems to be a particular concern. It is notable that in all cases with the exception of Stokab, which deployed fibre from the early 2000s, at a time when the performance available from competitors on copper and cable was limited, fibre was deployed by the other regional operators listed in competition with upgraded cable networks (in particular by TDC in Denmark) and FTTC/VDSL (by incumbents and access-seekers in Italy, the UK and Ireland). The duplication of fibre networks deployed by fibre investors by incumbents in the UK, Ireland and Italy is likely to have presented another challenge. Poor financial outcomes amongst the alternative fibre investors described above may have been influenced by policies in some countries which actively favoured the prolongation of copper infrastructure through promoting FTTC/VDSL deployment by incumbents. In turn, the improved quality on copper networks is likely to have deterred consumers from switching to fibre. In addition, the overall profitability for some operators still using FTTC/VDSL infrastructures did not incentivise their move towards fibre.

Although regulatory approaches appear to have impacted operators' profitability to some extent – among other contributing factors - this does not allow us to infer that the operators showing higher profitability were those that invested more heavily in fibre.

2.1.2 Persistence of copper networks slows down the deployment and adoption of fibre networks/services

A forward-looking assessment to support coverage and target potential regulation in a full fibre environment should include an assessment of the replicability of fibre networks, as well as identifying potential gaps, which may need to be addressed via State Aid. However, to date NRAs can only rely on Article 22 EECC (geographic surveys) of the Code, which does not include an assessment relating to VHCN or fibre coverage and instead allows data gathering based on speeds of only 100 Mbps. Provisions relating to forecasts are also optional. Therefore, the evidence available to NRA to inform their regulatory decisions and recommend policy choices to policy makers is limited.

In addition, the current prioritisation of SMP regulation over symmetric measures may have deterred the use of measures which would have been more suitable to supporting sustainable investment and competition in a fibre environment. It should be noted that the EECC *mandates* NRAs to carry out market analyses on relevant markets that have been identified as susceptible to ex ante regulation via the publication of such markets in the Relevant Market Recommendation by the Commission, and to regulation based on SMP where this is found. This focus on SMP regulation is mirrored in the large number of provisions that have been developed to guide the application of SMP regulation under the EECC, some of which have proven not to be effective.¹⁹¹ In contrast, while it has proven to be very effective in supporting sustainable competition and investment in fibre when applied in an extensive way e.g. in France, the application of Art 61(3) which allows NRAs to mandate “symmetric access” to fibre terminating segments is *optional* and the burden of proof is high when mandating access at points beyond in-building wiring, up to first distribution point.

Meanwhile, the proportion of wholesale access lines which may be physically rented by access seekers (allowing for unbundled access), which permits the widest degree of innovation¹⁹² as the access seeker has a full control of the rented line, remains limited, at a constant 20% of incumbent FTTH lines.¹⁹³ Although many NRAs impose access to passive infrastructure (ducts and poles) to allow investments in own fibre networks, active access to the existing lines of SMP operators still remains indispensable in a large number of markets¹⁹⁴. The majority of currently deployed FTTH lines, due to their physical characteristics, cannot be rented but may be used for wholesale products which restrict access seekers from utilising the full capabilities of the infrastructure or tie such capabilities to prices set by the access provider. This could serve to limit competition on quality, undermining the provision and take-up of Gigabit offers.

To illustrate the problem, the figure below shows the types of access to FTTH provided on incumbent networks. WIK concludes that these are frequently based on (or favour through pricing conditions) active access in forms which limit service differentiation^{195,196}.

¹⁹¹ For example, there has been no successful cases of application of Article 76 (co-investment in VHCN) despite the development of detailed Guidelines on this subject by BEREC.

¹⁹² Innovation made possible via fibre unbundling is discussed inter alia in WIK (2023) Neutral fibre as a platform for innovation. The study noted that in Stockholm unbundled fibre had enabled Rapid 5G deployment with one of the fastest 5G download speeds of Nordic cities in Q2 2022; Innovation in business communication in Stockholm with low latencies, use of capacities of 10 and 100 Gbps symmetric; trials with quantum communication by KTH Royal institute of Technology and Ericsson; Broadcasting and media application, mobile links on top of DF achieving 1.6 Tbit/s for public events.

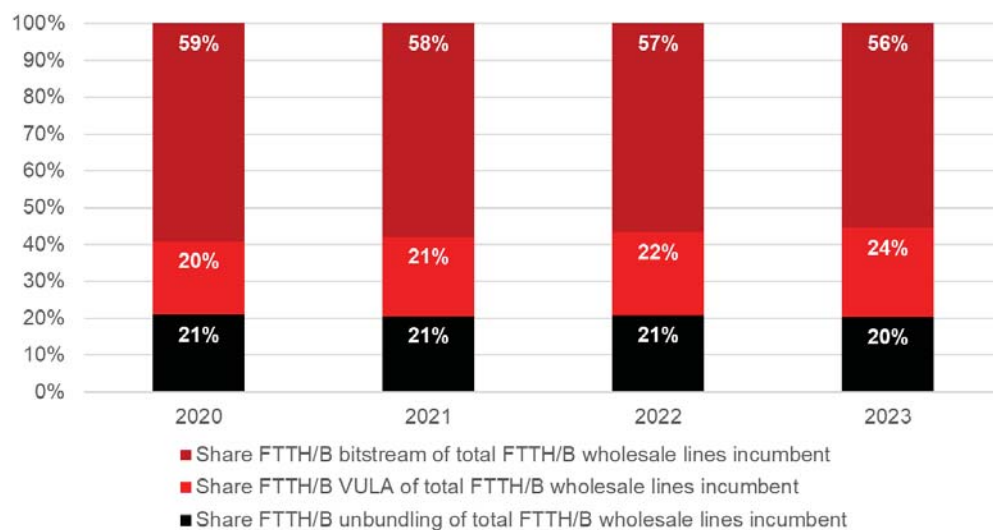
¹⁹³ Study on access policy including review of the relevant markets recommendation, and review of access provisions of the EECC.

¹⁹⁴ In Spain and in France access seekers can use only regulated access to passive networks, In the remaining regulated markets passive access is regulated together with some forms of active access to the existing regulated networks of SMP operator.

¹⁹⁵ This is noted inter alia in benchmarks conducted for a 2020 study for the Danish authorities – competition and investment in the Danish broadband market
<https://www.wik.org/en/publications/publication/competition-and-investment-in-the-danish-broadband-market>.

¹⁹⁶ In similar vein, studies show that commercial wholesale access (MVNO) offers on mobile networks often limit differentiation of the access seeker compared with the host. This may not be necessary in cases where

Figure A7 2-3: Wholesale share of unbundling where access seeker physically rent the connection and controls it vs active access (access seeker has only 'virtual' access and access provider retains control of the connection) on incumbent FTTH lines, 2020-2023



Source: WIK based on NRA data gathering for Study on Access Regulation.

The lack of wholesale products enabling differentiation, is also likely to have affected the provision and take-up of Gigabit offers, for the reasons explained above.

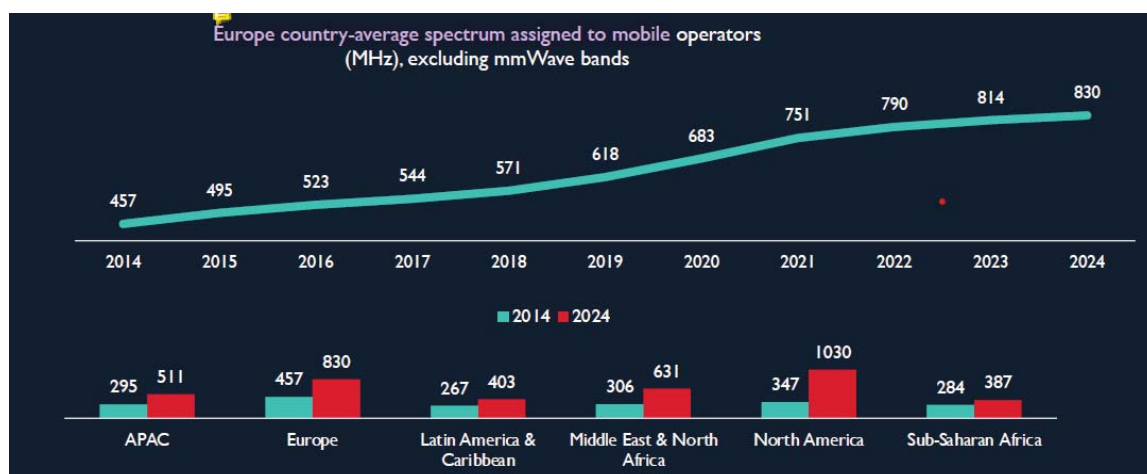
2.2 Spectrum regulation and market factors slowing down investment in high quality mobile connectivity

2.2.1 Inefficient use of spectrum: difficulty to satisfy increased demand due to spectrum scarcity

The increasing diversity of wireless services and applications for consumers and different technologies and sectors (e.g. 4G/5G/6G, IoT, satellite, verticals/local use, public safety etc), the expansion of connected devices as well as competing network technology options for service delivery have been intensifying spectrum usage and squeezing the available spectrum resources, in particular in low and mid-bands, which offer both good coverage and capacity.

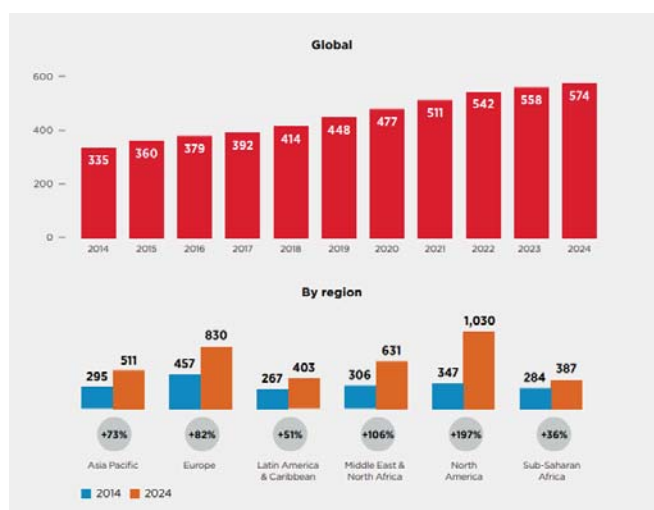
mobile markets are competitive at the retail level on the basis of infrastructure competition, but could become relevant in the event of consolidation which limits retail competition. In addition, in particular where there are conflicts of interest or limited competition, availability of the required wholesale capabilities to provide cross-border quality-assured services including for IoT may not be present.

Figure A7 2-4: Europe country-average spectrum assigned to mobile operators



Average MHz assigned to mobile operators for frequency bands below 7 GHz; Source: GSMA, “Global Spectrum Pricing 2025.05.15,” p. 15. Available at: https://www.gsma.com/spectrum/wp-content/uploads/2025/05/GSMA_Global_Spectrum-Pricing_2025.05.15.pdf

Figure A7 2-5: Spectrum holdings



This is demonstrated on the one side by the fact that according to GSMA European operators had to nearly double the average spectrum holdings assigned to them by country to bring 4G and 5G to consumers and on the other side by the controversy and competing demands for the sub-700 MHz band (by terrestrial broadcasting and mobile operators as well as by users of wireless microphones) and for the upper 6 GHz band (by various stakeholders including from the satellite, mobile and RLAN communities). Both frequency bands are considered as potentially last opportunities to access valuable spectrum in the low-band and mid-band range, respectively.

This growth in wireless data consumption and spectrum demand, combined with the persistent inefficient use of certain spectrum bands (e.g. mm-waves but also mid-bands like 2.6 GHz) is not matched by a bold regulatory mindset and market readiness to take up in particular spectrum trading and sharing solutions, to ensure timely and efficient access to spectrum. The result is artificial spectrum scarcity as well as hindrance to innovation and service expansion.

Therefore, the following problems have emerged:

1. Spectrum is often not (a) timely available, (b) authorised / accessible to maximise its benefits, (c) used in some geographical regions.
2. Efficient use of spectrum is not ensured through sharing/flexibility; coverage obligations or other auctions conditions could be an obstacle to pooling spectrum for collaborative use, use it or share it or lose it principles are not enforced. Immature regulatory mindset to make shared use a mainstream approach of spectrum authorisation, taking advantage of innovative technological solutions, results in a lack of incentives and framework for spectrum sharing. The RSPG, in its opinion RSPG21-022¹⁹⁷, recognised that spectrum sharing in the Union has so far been implemented in a rather static and conservative manner and emphasized the need for further development — particularly to enhance the efficient use of radio spectrum and to provide incentives for innovation.

Despite technological advancements that enable secure and efficient spectrum sharing—such as dynamic frequency selection, spectrum sensing, and real-time coordination databases—these tools are not widely adopted. Rigid licensing conditions, exclusive long-term rights without use-it-or-share-it flexibility, and obligations linked to coverage or infrastructure investment discourage collaboration or shared use.

2.2.2 Insufficient flexibility for interservice and intra-service spectrum sharing

The RSPG emphasises the growing importance of interservice spectrum sharing, i.e. between different users providing different services, often using incompatible radio access technology¹⁹⁸, on the path to 6G. Interservice spectrum sharing promotes investment and competitiveness of EU economy, delivering to citizens and businesses wider access to communications services, intra-service sharing (i.e. between peer users offering similar service), which optimises investment cost, makes use of innovative technical solutions and similarly ensures efficient spectrum use. In its Opinion on the 6G Strategic Vision,¹⁹⁹ the RSPG calls on policymakers, spectrum managers, spectrum users and industry to shift their mindset and prepare for more flexible interservice sharing models. It also recommends that spectrum sharing be further promoted through EU legislation.

Interservice sharing is consistent with competition law principles, as it concerns sharing between services that are not competing. However, with rising cost of network investments in newer technology generations (6G, LEO satellite constellations), the deployment of inter-service spectrum sharing arrangements, including also active infrastructure, may receive due regulatory review and should always remain subject to potential competition scrutiny.

Current regulatory frameworks do not provide sufficient flexibility for spectrum use across different services/technologies (e.g. terrestrial vs. satellite) or among similar/competing market actors (e.g. between mobile operators). As market structures and user needs evolve, spectrum authorisation remains locked into outdated models. Long-duration licences are

¹⁹⁷ Opinion on Spectrum Sharing – Pioneer initiatives and bands (RSPG21-022) https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-01/RSPG21-022final_RSPG_Opinion_Spectrum_Sharing.pdf.

¹⁹⁸ RSPG Report on 6G Strategic Vision (RSPG26-006).

¹⁹⁹ RSPG Report on 6G Strategic Vision (RSPG26-006).

often not accompanied by mechanisms to lease, trade, or share spectrum, leading to its inefficient utilisation.

Awarded players not fully using assigned spectrum/ spectrum hoarding

Inefficient spectrum use—including the risk of spectrum hoarding, where operators hold significant amounts of assigned spectrum without fully utilising it—exacerbates spectrum scarcity. This problem has been already experienced in Germany, where BNetzA introduced strict conditions on spectrum assignments in the 3.7–3.8 GHz band for private and local 5G networks. Under its "use-it-or-lose-it" rule, a spectrum assignment can be revoked if it has not been used within one year of being granted, or if it remains unused for the intended purpose for more than a year. The regulator also monitors roll-out and spectrum utilisation and has the authority to revoke underused spectrum—demonstrating a proactive enforcement approach to prevent hoarding. Other regulatory solutions introduced more horizontal approaches against hoarding, like for example in Africa for high-demand bands where licensed spectrum that remains unused for 2 years can be reclaimed by the regulator. In the U.S., the Citizens Broadband Radio Service (CBRS, 3.5 GHz) introduced a dynamic three-tier sharing model that prevents spectrum hoarding. Under the “use-it-or-share-it” principle, licensed users (Priority Access Licenses, PALs) must actively use their spectrum or allow unlicensed users to access it opportunistically. This prevents spectrum from lying idle and ensures efficient use via a Spectrum Access System. Launched in 2020, CBRS has enabled broad participation by new players and is seen as a model for applying ‘use-it-or-share-it’ principles to other bands.

The "use-it-or-share- or-lose-it" principle when included in the licences allows regulators to revoke or reassign unused spectrum. However, these principles are rarely enforced, and sharing remains optional rather than standard practice.

Underutilised Technological Capabilities for Sharing and Conservative Regulatory Approaches

Despite advances in technologies that enable efficient spectrum sharing—such as dynamic frequency selection, automated access systems, AI-driven allocation, and real-time databases—these tools remain underused. Their limited adoption hinders real-time coordination and enforcement of shared usage rights, reducing overall spectrum efficiency. At the same time, spectrum sharing solutions require not only technology progress but also a bolder regulatory mindset (as demonstrated in the RSPG opinion on spectrum sharing)²⁰⁰.

While the EECC provides for flexibility and shared use, these provisions are seldom applied in practice. Mechanisms such as “use it or share it” remain underused. Moreover, strict coverage obligations and auction conditions often hinder spectrum pooling and discourage more collaborative or efficient models of use.

Meeting future connectivity needs will require a more dynamic and adaptive spectrum allocation strategy. This includes broader application of spectrum sharing mechanisms and flexible licensing models to ensure that valuable spectrum is used efficiently and equitably in light of rising demand from 6G, IoT, and satellite services.

The spectrum inventory, developed by the Joint Research Centre (JRC), covers spectrum use between 400 MHz and 6 GHz. Its objective was to identify frequency bands where

²⁰⁰ RSPG Opinion on Spectrum Sharing – Pioneer initiatives and band (RSPG21-022).

spectrum efficiency can be improved, enable spectrum sharing and reallocation opportunities, and support the analysis of spectrum use. Member States are responsible for collecting national spectrum data, while the Commission conducts the analysis of technology trends, future needs, and spectrum demand.

However, key limitations of the current inventory are that it is not available to operators, and functions primarily as a static database, lacking the capability to reflect real-time spectrum usage. This significantly reduces its practical value—particularly for spectrum sharing, where up-to-date information on frequency occupancy is essential to be provided to the sector to ensure efficient use and prevent interference.

In addition, the tool’s maintenance involves a high annual cost—estimated by the JRC at approximately EUR 100 000—despite its very limited utilisation²⁰¹.

An additional non-addressed need is the lack of regulatory instruments allowing innovative users that develop projects requiring harmonised spectrum to activate the process of harmonisation.

In the EU, spectrum harmonisation is initiated by the Commission, with strategic guidance from the RSPG. The Commission may mandate CEPT to conduct technical studies, which subsequently form the basis for an Implementing Decision adopted in cooperation with Member States via the RSC. While the RSPG provides strategic guidance and engages stakeholders through consultations and workshops, the current framework presents a regulatory gap: there is no formal mechanism to ensure that emerging or innovative spectrum needs from the stakeholders are systematically addressed. Stakeholders currently have no way to directly trigger a harmonisation process. As spectrum demand becomes increasingly diverse and innovation-driven, this lack of a structured bottom-up channel limits the EU’s ability to respond swiftly and effectively to evolving market needs.

By contrast, the US provides a clear example of bottom-up regulatory access through the FCC’s petition for rulemaking process. Under U.S. law, any interested party can formally petition the FCC to issue, amend, or repeal a regulation, including those related to spectrum allocation. One notable example is the Citizens Broadband Radio Service (CBRS) in the 3.5 GHz band, where input from rural ISPs, technology stakeholders, and other interested parties led to a dynamic spectrum-sharing framework. This approach opened 150 MHz of mid-band spectrum to new and local operators under a use-it-or-share-it model. In Europe, a comparable mechanism that enables stakeholders to initiate harmonization remains absent from the current spectrum framework

2.2.3 EU mobile markets and number of mobile network operators

The figure below shows the **number of mobile network operators that were present in selected countries in Europe as of 2025**, indicating that four players are present in the vast majority of cases, especially once more recent entry is considered in Portugal, Belgium and Germany.

²⁰¹ Between 2019 and 2024, usage was extremely low: the inventory was not accessed at all in 2021 and 2024, and in 2019 and 2020, it was accessed fewer than five times. In 2022, usage rose to around 20 accesses, with a further increase to approximately 60 accesses in 2023.

the level of consumer protection. Despite the efforts of the directive to further harmonise the possible GA conditions a considerable discretion remained for the Member States to further develop and specify the various requirements, often by adding more requirements justified by national specifics and thus, considerably increasing the excessive bureaucracy, especially for cross-border operations and smaller players.

2.4 Governance problem drivers

As regards **governance**, the first driver is the strong national influence on BEREC and RSPG that may result in some cases in limiting EU single market perspective. BEREC consists of NRAs, and positions are shaped mainly by national perspectives rather than by a common EU-wide vision. Moreover, a lack of a more structured coordination mechanism between BEREC and RSPG led to a very limited cooperation between the two bodies where spectrum issues have regulatory implication. Since decisions are in practice taken by consensus, its outcome in some cases reflects compromises between NRAs instead of a more ambitious, single, harmonised approach putting the benefits of a Single Market above individual Member State's interests. This limits BEREC's ability to ensure consistent implementation of rules across the Union, leaving the Single Market fragmented. The persistence of diverging national practices makes it harder for operators to expand services cross-border and sustains the complexity of meeting different authorisation and regulatory conditions. Regarding RSPG, particular national interests are at least in some contentious cases, prioritised over EU-wide benefits.

The second governance driver is the expanding regulatory scope of NRAs' creating inconsistencies among the NRAs and between the tasks of NRAs and BEREC. While some NRAs take on responsibilities beyond electronic communications under frameworks such as the DSA or Data Act, in other Member States these tasks are entrusted to other CAs. These additional tasks broaden the regulatory agenda of NRAs beyond core connectivity issues and, although enrich discussion, can in the future complicate efforts to harmonise approaches across Member States as the governance landscape is not homogenous. Because the pace and focus of implementation differ nationally, the overall framework becomes less coherent. This makes it more difficult to achieve a level playing field, as operators may be subject to different combinations of requirements depending on the jurisdiction in which they operate. Furthermore, due to its NRA members' involvement or expertise in certain topics, such as e.g. cloud switching, BEREC often becomes a natural forum to discuss such issues, while as a body it lacks a legal empowerment to contribute.

A third set of drivers for the governance concerns resource constraints and structural weaknesses. Many NRAs face challenges in terms of funding and staffing, which affect their ability to carry out both existing and newly assigned functions. Similarly, the BEREC Office has faced high staff turnover in recent years, which for a small agency creates operational strain, loss of institutional knowledge, and reduced efficiency²⁰². These limitations weaken the ability of BEREC to support harmonised implementation across the EU and sustain the persistence of fragmented regulatory outcomes, making the Single Market harder to realise. Similarly, even within the current scope of RSPG tasks and

²⁰² Based on 'The BEREC input to the EC on the functioning of BEREC and the BEREC Office in view of the evaluation under Article 48 of the BEREC Regulation', September 2023: Average 2018-2022: 13.87% (2018: 18.87%; 2019: 24.1%; 2020: 5.48%; 2021: 4.60%; 2022: 16.28% (p. 29) [BoR \(23\) 114 BEREC input to the European Commission on the functioning of BEREC and the BEREC Office.pdf](#).

workload, it is challenging for some of the Member States to be actively involved in the RSPG work that could result in RSPG outcomes biased to the interests of some Member States. Due to extremely limited staff (1,5 FTE), the RSPG secretariat provided by DG CNECT cannot offer any support on substance.

ANNEX 8: DETAILS OF THE POLICY OPTIONS

1 TRANSITION TO FIBRE

Option 1: Non-binding copper switch-off and limited updates to access regulation

For CSO, this option sets a non-binding EU target date of 31 December 2030. Member States would be required to submit national plans for fibre deployment and CSO. Article 81 EECC would be amended to cover all copper network operators, not only those with SMP. BEREC would be mandated to publish guidance on best practices for CSO and geographic surveys. References in Article 22 EECC on geographic surveys, which currently focus on networks with a performance of at least 100 Mbps would be changed to reflect the progress in network deployment and allow NRAs to focus on gigabit networks.

For access regulation, the current SMP framework, including SMP Guidelines and the Relevant Market Recommendation, would be retained.

Access to physical infrastructure would remain possible under the Gigabit Infrastructure Act (GIA). Where the GIA is not considered sufficient, NRAs may include additional access obligations based on SMP.

Article 61(3) EECC would be amended to allow NRAs to impose access to in-building wiring. NRAs could require operators deploying fibre to provide a drop cable connection to buildings passed by fibre within a given distance.

Access beyond the first concentration point under Article 61(3), second subparagraph, would continue to be available as a complementary tool.

To ensure more consistent regulatory practices and reduce fragmentation in the single market, harmonised EU wholesale access products would be established. BEREC would issue guidelines on these harmonised EU wholesale products. NRAs could still impose other remedies, provided they justify the reasons for doing so.

Option 2: Conditional copper switch-off and updated access regulation

This option contains a strong mechanism geared at fostering fibre deployment and take-up, including via a EU-wide copper switch off date by 2030, subject to certain conditions, and increasing accountability of Member States. It includes a review date in 2035 and very strong safeguards for end-user.

By 2029 Member States will submit to the Commission's scrutiny a "Transition to Fiber Plan" setting out their strategy for the entire country. The plan will include:

- the identification of the areas where transition to fibre is feasible and the CSO process started or will start at the latest in 2030
- for the areas where CSO cannot start by 2030, set out the measures to transition to fibre at the latest in 2035

In assessing whether the CSO should start by 2030 the following aspects should be considered by Member States:

1. Sufficient coverage by fibre networks in a given area [indicative 95%]
2. Ensuring affordability through comparable prices for comparable services
3. Ensure that appropriate safeguards, including alternative solutions, for vulnerable customers are in place

The first two aspects will be addressed via the so-called “sustainability conditions”, that are requirements for the copper switch-off to start in a certain area.

More precisely, the sustainability conditions, which will need to be met cumulative are the following:

- Fiber coverage in a certain area of 95%
- Availability of retail offers for broadband connections over alternative technologies (to copper) that offer comparable or increased capabilities to those available over copper at the same or lower price.

The third aspect will be addressed via additional safeguards and measures that will be set by NRAs or other national authorities.

By 2035 Member States should review the fulfilment of the Transition to Fiber Plan and transmit the review for Commission’s scrutiny. In particular, they should:

- ensure that in all the areas of the country where the CSO started, it is completed as soon as possible, and
- in all remaining areas where fiber deployment is not viable (e.g. remote areas geographically difficult to reach), explain the reasons for the exceptions and provide alternative connectivity solutions for customers in these areas.

NRAs will be required to:

- gather and publish on an annual basis geographic data regarding FTTH coverage, and retail broadband pricing segmented by technology and speed with separate reporting of copper / FTTC-based broadband, cable (including FTTB/HFC), FTTH-based and FWA-based broadband.
- Produce a list of areas meeting the sustainability conditions for CSO as described above, based on Commission’s guidance on how to define these areas to be issues shortly after adoption of the DNA
- Conduct a market analysis in line with the process outlined in relation to access (see below), to assess the market conditions and effects of the CSO obligation on competition, investment and retail pricing for mass-market and enterprise connectivity and ensure that consumers can benefit from choice, quality and reasonable prices, during and after the transition to full FTTH.
- Adopt, as needed, safeguards for vulnerable customers or advise national authorities on how to do so.

- For areas meeting the conditions for mandatory copper switch-off, require ECN operators deploying FTTH to provide a connection (drop cable) on standard terms and conditions to households which are passed within a given distance from the network, to be defined at national level.
- For other areas not (yet) meeting the conditions, NRAs would be empowered, but not required to impose such a connectivity obligation.
- Advise the relevant national authorities responsible to order, where needed, the copper switch off.
- Review and approve the copper switch off plans of the operators, following the national authority's decision to order the switch off of their copper network. These plans should include a timeframe for the completion of the copper switch off (maximum within 3years). The NRAs will oversee the completion of this plan and may adopt sanctions if the timeframe is not complied with.

Consistency across the EU will be achieved via a Commission's scrutiny over the Transition to Fiber Plan and the copper switch-off process and the Commission's guidance setting out the criteria for the definition of the areas for the copper switch off. For access regulation, this option provides NRAs with more tools for ex ante regulation, allowing for a targeted use-based on the market situation. The possibility for SMP regulation remains based on the three criteria test.

The NRAs should first analyse whether the existing symmetric regulation (GIA)-would be sufficient to address the identified problems. In the next step, if GIA is not sufficient, the NRAs could decide to apply SMP regulation or the symmetric rules under Article 61(3), depending on what is most appropriate to address the identified competition problems- in a given area. In this option the application of the symmetric rules is broader than in option 1 as it covers not only the possibility to impose access to in-building wiring but also access beyond the building if the criteria of Article 61(3) EECC (high and non-transitory barriers to replicability) are met. Both access to the in-building wiring part and access provided beyond in- building wiring could be imposed ex-officio (and not by request as it is currently the case) to facilitate deployment and to tackle more localised competition concerns.

For access, this option provides greater consistency in the application of ex ante regulation. The possibility for SMP regulation remains. The approach to geographic surveys would be expanded, requiring NRAs to gather data on retail markets and the underlying infrastructure periodically. These data would be important for NRAs to assess the market conditions and decide whether ex ante intervention is required.

To support the standardisation of wholesale offers, a list of essential wholesale products will be included in the DNA, and the European Commission would have to adopt an Implementing Act to establish best practice specifications and/or to amend the list, following consultation with BEREC. NRAs must ensure that these harmonized products are reflected in wholesale access obligations under ex ante regulation. They could focus, for instance, on FTTH physical and virtual unbundling alongside Ethernet leased lines and business grade QoS. The NRAs could impose also other remedies in justified cases, but the Commission will have a veto over remedies that go beyond the pan-European wholesale access products and when the draft measures have a negative effect on the single market.

Option 3: Market driven copper switch-off and bottleneck-based access regulation

For CSO, this option relies on market-driven transition to fibre. NRAs' oversight over the CSO would be removed and operators would have full discretion over the timing and conditions of the CSO.

For access regulation, this option focuses on deregulation. SMP-based regulation would be replaced by a bottleneck approach, whereby wholesale access obligations would only apply in areas served by a single fixed network.

Where price regulation applies to wholesale access products, cost-orientation would be replaced with fair, reasonable and non-discriminatory terms and conditions. Access to civil engineering infrastructure is handled via the GIA exclusively. This option would also include harmonised EU wholesale access products, combined with a Commission veto right over remedies.

Article 22 EECC on geographic surveys would be deleted.

Option 4: Mandatory copper switch-off and symmetric regulation

For CSO, this option establishes a mandatory EU-wide CSO. It would require operators to switch off their copper networks by 31 December 2030 and would require Member States to develop plans for fibre deployment and CSO. No sustainability conditions are envisaged.

NRAs would be tasked with collecting and publishing data on CSO, including geographic surveys of Gigabit-capable fixed wireless networks, along with the status of copper to fibre migration. Article 22 would be updated to replace the current 100 Mbit/s threshold and to collect forecasts for unserved areas.

The scope of Article 81 EECC would be extended to all copper networks operators, including those with no SMP.

For access regulation, this option would replace the existing SMP regime and Article 61(3) EECC with a requirement for all fixed network operators to provide wholesale local access on fair terms and dispute resolution by NRAs if no agreement is reached within two months. The option would also require copper network operators, including those previously deemed to have SMP, to provide access to ducts and poles based on cost-orientation and non-discrimination, in line with guidelines from the Commission or BEREC.

To support harmonisation, an initial list of harmonised EU wholesale access products would be included in the DNA. The NRAs would consider imposing them during the resolution of access disputes. The Commission may adopt an Implementing Act to specify best practices or amend this list. The harmonisation of regulatory approaches would be supported through a veto right for the Commission regarding the application of the access remedies.

2 SPECTRUM

Detailed description of the policy options for Spectrum:

Option 1: Soft harmonisation

In this option **the minimum licence duration** would be extended from current 20 years to 25 years still following the Article 49(2) EECC rule (initial 20 years extended by 5 years). When authorising spectrum, the national competent authorities would be supported by a **toolbox of best practices on pro-investment and pro-efficient use of spectrum authorisation** processes that could address, e.g. auction designs, reserve prices, annual fees, coverage commitments, QoS obligations, spectrum sharing solutions, and be developed by the Commission assisted by RSPG. To enhance investment and improve spectrum use efficiency in underserved/rural areas, any unjustified legal or regulatory obstacles to spectrum sharing or pooling would be removed. This option also envisages promoting **flexible spectrum licencing**, e.g. licences limited to a particular location or time period, especially for verticals. The Commission could, following an RSPG opinion, recommend an **authorisation regime** to be used in particular EU harmonised spectrum band.

When designing **spectrum assignment measures**, the competent authorities would need to assess potential market shaping measures, e.g. limiting the max amount of spectrum per operator, on the basis of a forward-looking analysis of the market competitive conditions (Article 52 EECC). All draft assignment measures would need to be submitted to **an ex ante spectrum Single Market procedure** by the Commission, and RSPG and BEREC. The Commission would, taking into account RSPG and BEREC opinions, issue a non-binding opinion on the necessity of such measures, which the competent authority would need to take into account. The timely and coordinated launch of 6G would be facilitated by an **evolving spectrum roadmap** developed and regularly updated by the Commission assisted by RSPG to provide predictability and information necessary for investment planning. Deadlines would be introduced to the procedural steps under Article 28 EECC to faster resolve **cross-border interference** between Member States. Enhanced solidarity from EU and Member States, with possibility of bidding measure, would be established in the case of interference from third countries. Stakeholders would have a possibility request the Commission to launch a harmonisation of a particular spectrum band use (**petition for rule making**), and the Commission would need to reply within a defined timeframe and justify an eventual refusal. For the issues potentially affecting EU security or technology sovereignty, discussed at the **CEPT**, Member States would be recommended to coordinate their positions.

Option 2: More single market to enhance investment and innovation

This option envisages **harmonisation of spectrum authorisation conditions and procedures**. The Commission would **recommend pro-investment authorisation processes** aspects and conditions for spectrum used for **public networks**, notably for 6G, based on RSPG opinion; if deviations persist, or if there is a need to promote the pan-European provision of service or the need to pursue economies of scale, the Commission would be allowed to adopt measures to harmonise the authorisation conditions. The Commission would be able to decide on the **authorisation regime** (general authorisation or individual) for certain bands, to ensure that it best promotes efficient and strategic use of spectrum, including sharing. This would allow to take into account specific requirements necessary for public security, including harmonised spectrum available for critical communication. This measure draws from the Draghi report which suggested to harmonising EU-wide spectrum licensing rules and processes, to provide for quasi automatic renewal and facilitation of spectrum trading and leasing.

With the view to regulatory predictability and to incentivising the development of a secondary market for spectrum, licenses would be granted or renewed for an **unlimited duration** by default (provided of course that the conditions are fulfilled, that there is no technology or competition development justifying a new assignment procedure and subject to revocation under certain conditions), and in case of shorter duration with strong guarantees of renewal, if the licence conditions are fulfilled, based on a reversed burden of proof mechanism). Any additional condition accompanying the renewal would be proportionate to the value of it. Operators of **public and non-public networks** would have a right to request that competent authorities from different Member States supported by RSPG harmonise their authorisation conditions for the use of particular spectrum band, thus allowing scaling up of business cases at EU level. **Spectrum sharing would be mainstreamed**, in due respect of competition law, on the basis of extensive use it or share it or lose it-conditions (also to ensure efficient use of spectrum in cases of indefinite duration licenses) and the development of dynamic geolocation databases in bands where sharing would be most beneficial. Obstacles to the assignment of spectrum to wholesale network operators, such as coverage or quality obligations, would be addressed, to ensure the most efficient use of spectrum and cost-efficient deployment.

While designing **spectrum assignment measures**, the competent authorities would be obliged to apply pro-investment auction designs, with more consistent set of rules to promote effective competition based on commonly set criteria. They would be required to justify spectrum policies with regard to the impact on investment and the economic sustainability of the market structure envisaged (for example taking into account the level of service and infrastructure competition and in particular the number of infrastructures that can be economically sustained in the market, with reference to the characteristics of the spectrum awarded and associated investment requirements needed to achieve the quality of service targeted) and choose every time the least distortive measure. Spectrum assignment measures would be subject to mandatory **ex ante spectrum Single Market procedure** at EU level as in Option 1; however, it could result in a Commission opinion on the necessity of the measures, with veto on market shaping measures and limited licence duration. This measure echoes the proposal for Commission veto on auctions not following harmonised guidelines in the Draghi report, in particular as regards reservations.

The EU spectrum strategy with spectrum roadmaps would cover not just spectrum for the 6G launch but also for other technologies, such as WiFi. Competent authorities would need to develop corresponding **national roadmaps**, which would provide increased legal certainty and regulatory predictability to investors and authorise spectrum within a period of time shorter than 24 months. If a competent authority does not assign spectrum within defined timelines, it could be taken to the national court on the grounds of failure to act. This measure echoes the proposal in the Draghi report to harmonise the release of new frequency bands to allow investment across Member States by EU players, guarantee the timing of harmonisation and include the release of additional WiFi-dedicated bands into the spectrum guidelines, to allocate enough spectrum to 5G and 6G.

The current mechanism for addressing **harmful interference** between Member States would be extended to non-harmonised bands (in addition to setting deadlines). Lastly, a **petition for rule-making** mechanism would be established for innovators to request the harmonisation of a band across the EU, with a procedure and obligations for the authorities to consider such request, giving innovators a structured process to support their innovative

projects. Member States would be required to coordinate their positions at CEPT for issues related to security or technology sovereignty²⁰³.

Option 3: Strong harmonisation and EU level rules

In this option **fully harmonised authorisation processes** aspects and conditions (e.g. auction design, reserve prices, award fees, annual fees, coverage obligations, QoS) would be imposed. The assignment of spectrum will be based on **indefinite licence duration**. To exclude any artificial spectrum scarcity, the national authorities would be only authorised to impose **market shaping measures** (e.g. spectrum caps) in case of dominance. The competence for awarding harmonised spectrum for certain services, would be transferred at Union level, under certain conditions (e.g. delays in assignment). All assignment measures for spectrum assigned at national level, should be submitted to *ex-ante* spectrum scrutiny as under Option 2 with the same possible outcome. For spectrum assigned nationally, in addition to mandating an authorisation regime, including flexible authorisation, operators would have a right to request from multiple authorities to assign to them spectrum in a **joint selection procedure** under harmonised authorisation conditions. A mandatory EU framework would be established to increase efficiency and enable spectrum sharing across all EU-harmonised bands. This framework would require the use of dynamic geolocation database systems. Coordination of the timing of assignment for every band would be done through deadlines set in hard law. Passed the deadline, the band would be auctioned on the basis of standard pre-established conditions. A mechanism under RSPG would coordinate the response of Member States to harmful interferences from third countries while for interferences between Member States it would be coupled with private enforcement to increase its effectiveness. Lastly, the scope of the petition for rulemaking would be extended beyond harmonisation of spectrum to also cover authorisation aspects like (innovative) shared spectrum use (e.g. shared use, local licences, temporary licences), as well as innovative approaches to improve spectrum efficiency. In exceptional cases, instead of CEPT, an ad hoc/high-level group of EU MS-only representatives would carry out the harmonisation work.

3 AUTHORISATION

Option 1: Partial harmonisation of authorisation:

Option 1 addresses the lack of resilient pan-European networks by improving consistency through partial harmonisation of authorisation conditions and stronger enforcement of the EECC regime. Enhanced BEREC tools and templates help reduce fragmentation and improve security compliance. It supports more pan-European services by simplifying regulatory processes, though impact remains limited. Authorisations stay largely national. This option establishes an EU-level maximum list of conditions for the general authorisation (updated), while conditions for satellite services would be softly harmonised through a common template. Providers still obtain authorisation from the Member State of destination. However, cross-border providers (e.g. satellite operators, other B2B providers not offering B2C services) would benefit from a one-stop shop notification system. The BEREC Office could act as the one-stop shop, or as an intermediary between the notifying

²⁰³ An example could be the harmonisation of spectrum for critical communications for the use by public security or safety authorities.

Member State and those where services are provided. Under this option even with the one-stop shop, national authorisation is still required in each Member State and conditions and rules applicable are not further simplified and harmonised.

Under this option, **on satellite**, to better address the existing barriers to the development of pan-European satellite services, the Commission would be empowered to conduct a **selection procedure** for licensees of satellite spectrum for the provision of pan-European services. This would ensure that licensees may cost-efficiently deploy services covering the entire single market. Conditions for rights would still be defined and spectrum assigned at national level.

Option 2: Single “passport” for other networks and services than satellite and an EU-level authorisation for satellite spectrum

Single “passport” for other networks and services than satellite

Option 2 strengthens pan-European resilience by introducing a “single passport” for networks and services and harmonised EU-level authorisation for satellite spectrum. This creates a coherent regulatory environment, enabling seamless cross-border operations and reliable connectivity. It effectively promotes more pan-European services by removing administrative barriers and fostering market scalability and ensuring coordinated enforcement to establish a level playing field in satellite.

This option proposes to simplify and fully harmonise all EECC conditions for the general authorisation, through a fixed and exhaustive list of conditions applicable in all Member States.

Providers would notify in one Member State only (the ‘Member State of notification’). Its competent authority would then coordinate with all other Member States where the provider intends to operate to ensure compliance with applicable rules. During this process, the authority would be assisted by the [BEREC Office], which would provide technical and procedural guidance to ensure consistency across the Union. Once coordination is complete, the Member State of notification issues the declaration(s) authorising the provision of networks and services, which are then valid in all Member States.

Specific national rules and non-DNA requirements, such as the ones related to e.g. cybersecurity, data retention or lawful interception would be coordinated among Member States. To facilitate the process BEREC would issue guidelines to provide technical and procedural guidance to approximate that conditions as much as possible across the union. Coordination would first take place to inform the development of these BEREC guidelines, ensuring clarity on the applicable conditions and rules, and would subsequently continue for the approximation of any remaining national rules. These guidelines would also cover nationally specific rules/conditions. Such a cooperation mechanism could provide additional value over time.

Terrestrial spectrum would continue to be assigned at national level, by each Member State, based on measures defined in section 5.2.2.

EU-level authorisation for satellite spectrum

There would be a simplified authorisation at EU level. More specifically, the operator, by derogation to the Member State notification system, would notify its intention to provide satellite networks or services to the Commission which would issue the declarations to provide networks or services and the authorisations to use spectrum including individual rights of use of spectrum, in the Member States where the provider wishes to provide services, even in the entire EU. In performing this task, the Commission would be assisted by [BEREC] Office. In cases of spectrum scarcity, the Commission would undertake a **selection at EU level** granting them spectrum licences through binding acts.

There would also be a binding **EU-level compliance and enforcement framework** for ensuring that satellite constellations' access to the EU market complies with the common conditions in line with international law, thus addressing RSPG call for common authorisation requirements and for a coordinated enforcement approach²⁰⁴. Coordinated enforcement at EU level would include withdrawal of the authorisation for the entire single market.

Option 3: Country-of-origin authorisation for cross-border and B2B services

Option 3 improves cross-border resilience by allowing one Member State's authorisation to apply EU-wide, reducing duplication and speeding service deployment. It facilitates pan-European services by simplifying compliance and encouraging expansion. However, it poses serious risks of forum shopping, as providers could exploit jurisdictions with weaker enforcement, undermining fairness and market integrity.

This policy option entails the introduction of a general authorisation and notification obligation in only one country (the country of origin) for cross border (e.g., satellite) and B2B services. While providers would be obliged to respect the legislation of the Member States where they provide services, only the **Member State** of origin would impose authorisation conditions and would be able to prevent the operator from providing services. It also foresees the simplification of conditions attached to the rights of use of numbers when used extraterritorially for B2B services.

As regards **satellite**, the Commission would be empowered to conduct a selection procedure for licensees of satellite spectrum for the provision of pan-European services. In order to manage access to the EU market of satellite constellations from third countries, the Commission, supported by the RSPG and (BEREC/RSPG) Office, would set common requirements for satellite authorisations based on International Telecom Union (ITU) and create a coordinated compliance and common enforcement mechanism among Member States for allowing and efficiently control satellite constellations' access to the EU market. The **country of origin** would issue the rights of use following the common requirements and impose sanctions in case of non-compliance. This option entails mutual recognition of all applicable general authorisation conditions by all other Member States where networks and services will be provided.

²⁰⁴ RSPG25-020.

4 GOVERNANCE

Option 1 – BEREC and RSPG as two separate bodies supported by the BEREC Office

Under this option, the RSPG would become a self-standing body²⁰⁵, with a structure similar to BEREC²⁰⁶. The RSPG will receive support from the BEREC Office, which will take over the RSPG secretariat function currently provided by DG CNECT. BEREC well-established two-tier structure would otherwise remain unchanged.

Given the lack of legal personality, BEREC and RSPG would not adopt any binding decisions. The decision-making competence would remain with the Commission, and Member States' authorities. BEREC and the RSPG would advise, issue opinions, guidelines and undertake other types of activity supporting the EU policymaking (monitoring, reporting etc.). Member States and RSPG will maintain their competence on spectrum policy. To better align approaches in spectrum assignments, all major assignments will be subject to a mandatory Single Market spectrum procedure where RSPG and the Commission will be able to comment on draft measures in their entirety. The Commission could veto market shaping spectrum assignment conditions. The Commission advised by RSPG with a support of BEREC Office could also coordinate aspects of spectrum assignment, such as the development of authorisation conditions, manage the EU satellite authorisation and coordinate their enforcement, and select satellite licensees in cases of spectrum scarcity, following the example of the 2 GHz band.

BEREC Office (EU agency) would provide expert and administrative assistance to both BEREC and RSPG. Specific mechanisms will be set up to ensure coherence and coordination between BEREC and RSPG as well as in areas where NRAs have responsibilities beyond electronic communications under frameworks such as the DSA, Data Act, or NIS2. This option includes also mandatory participation of Office's staff to BEREC and RSPG working groups, including taking over some co-chairs' workload if needed, which should increase BEREC's and RSPG's impact on harmonisation. The representativeness of BEREC output will be enhanced by mandating representation of other CAs each time a subject within their remit is discussed within BEREC. Under this option, NRAs will perform a role of national contact points responsible for coordinating and presenting their positions at the BEREC level.

Option 2 - EU Agency (BEREC and BEREC Office merged), providing an office (support on administrative and preparatory tasks) to the RSPG

In this option, BEREC and the BEREC Office structures will be merged into a fully-fledged EU decentralised agency. This EU agency would take over the RSPG secretariat function currently provided by DG CNECT and provide support on administrative and preparatory tasks to the RSPG. The governance in the spectrum area would remain the same as in option 1, i.e. the RSPG would be established as a self-standing body with

²⁰⁵ The same logic was followed in 2009, when BEREC was created from an EC advisory group.

²⁰⁶ i.e. a Board and working groups.

working groups, evolving from the status of Commission expert group, tasks division will be also the same as in option 1.

The agency can be entrusted with decision-making powers on selected cross-border issues. To accomplish these tasks, the agency would need to be equipped with more staff and resources, entailing administrative and financial costs. National regulatory authorities would keep implementation powers. The impact on harmonisation and representativeness of BEREC as well as the coordination between BEREC and RSPG will be addressed as in option 1.

Option 3 - Two separate agencies – BEREC + BEREC Office & RSPG

Under this option, BEREC and the RSPG would become two separate – due to their diverse membership (NRAs for BEREC and NRAs and other CAs for RSPG) as well as different remit (electronic communications market regulation for BEREC and cross-sectoral radio spectrum policy for RSPG) – fully-fledged EU decentralised agencies, with legal personality and decision-making powers. This option would require establishing some enhanced coordination between BEREC and RSPG. The Commission would have a monitoring or supervisory role and some decisional powers with respect to certain spectrum-related tasks, e.g. veto powers under Single Market/EU spectrum scrutiny procedure (see option 2).

The two agencies may have the power to take binding decisions on new cross-border related tasks, where required and within the limits of their competences. In relation to spectrum, this option is likely to affect the allocation of shared competences between the Commission and the Member States, e.g., the selection and authorisation of operators of satellite spectrum, enforcement measures.

ANNEX 9: ANALYTICAL BACKGROUND FOR THE ASSESSMENT OF IMPACTS AND COMPARISON OF POLICY OPTIONS

1. IMPACT AND COMPARISON OF THE POLICY OPTIONS

This section provides further details on the impacts and comparison of the policy options.

1.1. Transition to fibre

1.1.1. Effectiveness

The effectiveness of the policy options is assessed against their ability to achieve the general objectives. These objectives correspond to a set of intermediate and outcome indicators, including FTTH coverage and take-up, retail market concentration (HHI), take-up of Gigabit offers, prices for high-speed and Gigabit broadband, and average actual download and upload speeds.

Some of these indicators are assumed to be interrelated based on the data analysis. For example, FTTH take-up is linked to FTTH coverage (homes passed) and the availability of in-building fibre wiring in MDUs. Average download and upload speeds depend on FTTH take-up and on the take-up of Gigabit offers on Gigabit-capable networks, which is influenced by the price of Gigabit offers relative to other bandwidths. These prices, in turn, may be affected by infrastructure-based competition and other competitive dynamics that enable differentiation in speed and quality.

Objective	Indicators
Foster full fibre coverage and take-up	FTTH coverage (homes passed as % HH) FTTH adoption (homes activated as % HH)
Foster competition to boost innovation and take-up of higher speeds	
Address fragmentation impeding the single market	Consistency in wholesale access specifications across the EU including QoS guarantees for business services % take-up of wholesale access via mechanisms which permit differentiation (unbundling, uncontended VULA offering full flexibility)
Simplification by updating and removing redundant provisions	

The policy options differ in their approach to copper switch-off and access regulation, including when market analyses are triggered and what remedies are applied. The following sections present evidence on how these policies are likely to affect FTTH

deployment and take-up, as well as end-user choice, price, and quality. This evidence informs the assessment of how effective each policy option is.

Effects of the national Plans

The requirements on national authorities to draft a national plan setting out the measures to achieve transition to fibre, based on the input of the NRAs, ensures coordination at national level. In particular, in the option where these plans are subject to the Commission's scrutiny (Transition to Fibre Plan is submitted for Commission scrutiny in option 2), also consistency at EU level is ensured. The plans also ensure accountability of Member States in putting in place the right measures to directly and indirectly foster the deployment of fibre networks.

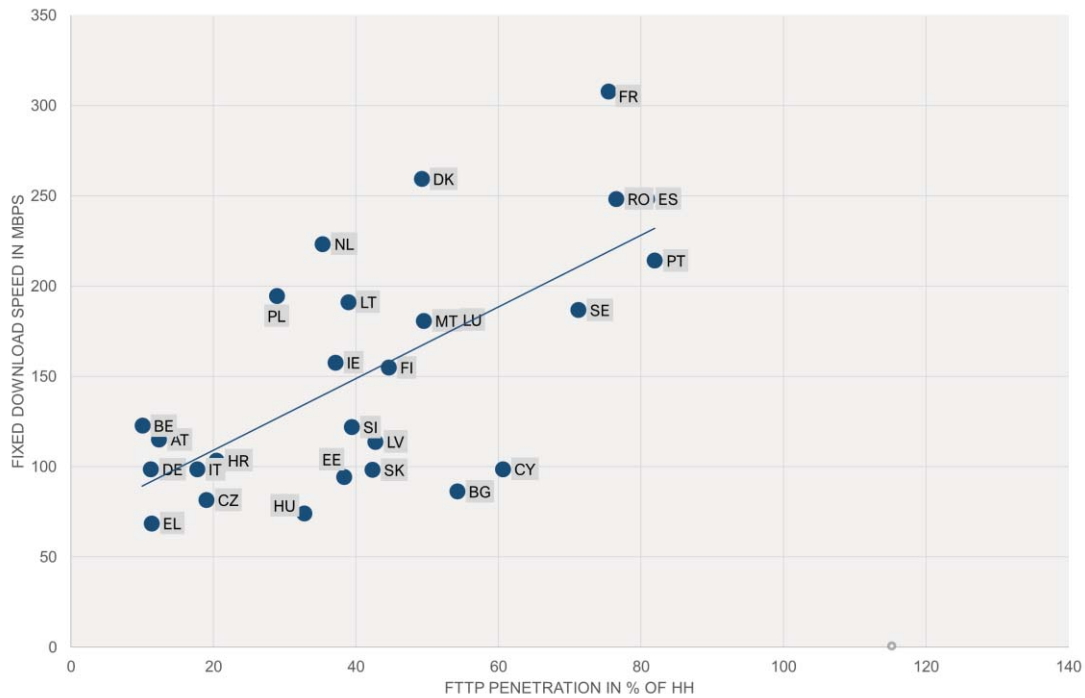
Effects of copper switch-off policies on outcomes

Copper switch-off should increase FTTH coverage by reducing penetration risk (low take-up) and strengthening the business case for FTTH investment. Financial investors have identified copper switch-off as the single most important policy for improving the viability of alternative FTTH deployment.

In areas already covered by FTTH, accelerating copper switch-off can directly boost FTTH take-up by requiring wholesale and retail customers on copper to migrate to fibre within a set timeframe. However, this only works if FTTH is available at the time of switch-off; otherwise, customers may have to rely on lower-performance technologies such as cable, FTTB/G.fast, FWA or mobile.

Higher FTTH take-up is also linked to higher average broadband speeds, since FTTH supports more advanced performance than other technologies. At the same time, safeguards are needed to ensure consumers are not forced to pay higher prices for equivalent services when moving from copper to fibre.

Figure A9 1-1: FTTP take-up in % of HH and median download speed (2024)



Source: WIK based on FTTH Council (2025)²⁰⁷ and Ookla (2025).²⁰⁸

A key problem is the lack of commercial incentives for copper network owners to deploy FTTH or switch-off copper networks in cases where they upgraded copper to FTTC. Therefore, options which require copper switch-off under conditions, where the switch off could be expected to be a reasonable response to the market situation and would result in improvements in consumer outcomes, are likely to be more effective in expanding FTTH deployment and take-up. Conversely, options which merely encourage copper switch-off or rely on market forces to achieve the migration to modern fibre lines are likely to be less effective.

Effects of access regulation on outcomes

The approach to access regulation influences FTTH coverage through infrastructure competition, in particular through the application of SMP regulation of physical infrastructure, which, as described in Annex 7, has been a key enabler for the deployment of fibre. This enables alternative fibre investors to use the incumbents' ducts and poles to

²⁰⁷ See FTTH Council (2025): FTTH/B Market Panorama in Europe, September 2024, <https://www.ftthcouncil.eu/resources/all-publications-and-assets/2358/european-ftth-b-market-panorama-2025> (last accessed on 14.07.2025).

²⁰⁸ See: OOKLA, Fixed broadband median download speeds as of April 2025 <https://www.speedtest.net/global-index>.

deploy their own fibre networks.²⁰⁹ In turn, increased FTTH coverage is linked to increased FTTH take-up.

In areas where extensive network duplication is not economically viable, access regulation also plays a vital role in promoting competition in retail broadband services for the ultimate benefit of end users.

The impact of access regulation on investment, choice, price and quality depends on how well it is targeted. This requires NRAs to proactively gather data, understand market dynamics, and adjust regulation as needed. The threshold for intervention is also key. Today, intervention is mainly based on SMP. NRAs may also apply Article 61(3) to require access to wiring up to the first distribution point (and sometimes beyond) when replicating such infrastructure would be economically inefficient or physically impractical.

The effects of regulation also depend on whether remedies are appropriately designed. In particular, to achieve competition in quality and price, it is necessary that the wholesale access products allow access seekers to make use of the full capabilities of the underlying infrastructure and differentiate their offers from those of the access provider. Effective retail competition in quality and price, linked to infrastructure competition or unbundling, is linked to higher availability and lower prices for high-speed broadband offers, which should lead to higher take-up in the absence of consumer inertia.

1.1.1.3. Option 1

Option 1 would set a non-binding 2030 target for copper switch-off across the EU. Past experience with similar non-binding tools—like the Digital Decade Policy Programme (DDPP) and the 2020 Connectivity Toolbox—shows that such approaches can help coordination but are generally not effective enough. For example, the DDPP already includes a 2030 Gigabit coverage target and requires national roadmaps, yet large differences in fibre rollout remain across the EU, with major gaps in countries such as Germany, Austria, Greece, and Czechia. In some cases, public funding and regulation even supported FTTC, working against the fibre goal. Likewise, the Connectivity Toolbox ultimately needed legal obligations under the Gigabit Infrastructure Act because voluntary guidance alone failed to deliver results.

Non-binding guidance has also failed to harmonise wholesale access products. Differences in specifications and limited support for competition persist despite EU-level guidance on VULA and BEREC's reports on Layer 2 wholesale access. Therefore, while legally mandated BEREC Guidelines on copper switch-off and wholesale products might help somewhat, they are unlikely to substantially change today's widely varying national practices.

²⁰⁹ The link between strong regulation of incumbent ducts and poles via SMP regulation has been identified in various studies, including the support study associated with the EECC Impact Assessment. Relevant early cases include France, Spain, Portugal. Countries such as the UK which adopted strong SMP PIA regulation at a later phase also subsequently saw an acceleration in FTTH deployment by alternative investors and a response from the incumbent. In certain countries with high FTTH coverage, use of utility or municipal duct infrastructure has also played an important role.

This option contains elements that should have a broadly positive effect on the management of copper switch-off processes and support for mapping and planning for the deployment of FTTH networks. Specifically, updating the VHCN definition to include fibre to the home (rather than being limited to the distribution point or terminating segment) should increase the focus of Member States on facilitating the deployment of fibre in-building and adopting the required standards to support these developments.

By updating the reference in the current Article 22 (geographic surveys) EECC to refer to FTTH rather than 100 Mbps, this option would improve the relevance of forecasts regarding the reach of Gigabit capable infrastructure, although the collection of data regarding planned VHCN deployments would remain optional. In this context it is worth noting that only 17 of the 24 Member States that provided information chose to collect data on a forward-looking basis, and only 9 chose to make use of that information to invite declarations regarding the deployment of broadband at speeds of more than 100 Mbps, despite the analysis of regulatory approaches taken and associated outcomes suggesting that such a measure could have been helpful in facilitating FTTH deployments and identifying gap areas while seeking to limit unviable network duplication.

The delinking of provisions on migration (Article 81) from SMP and linkage to ownership of copper networks under this option would enable greater utilisation of these measures by NRAs, supporting in the copper switch-off process. This is important, in view of the developments in some Member States to find no SMP in the copper segment of the wholesale local access market due to potential for substitution in this segment with mobile and/or fixed wireless broadband access.

Regarding access regulation, this option provides for stability in the regime regarding SMP regulation, which, was the preferred option amongst nearly all categories of stakeholder with the exception of some incumbents. The current regime requires NRAs to proactively conduct market reviews and act where required to address competition concerns via SMP regulation where not otherwise adequately addressed through commercial means or other provisions in the GIA or EECC. The EU-wide consistency and predictability ensured by this approach should support the continued investment and competition in FTTH networks that was achieved under the current regulatory framework.

However, a shortcoming of this option (as well as option 2) is that it may not be well suited to addressing situations involving tight oligopolies that would not give rise to competitive outcomes in the absence of ex ante regulation. However, as stated in Annex 11 (Evaluation Report), the oligopolistic markets have, so far been addressed either under the spectrum authorisation regime or under competition law. Furthermore, the SMP Guidelines, adopted in 2018, specifically focus on the joint SMP findings. The amendment to Article 61(3) to enable NRAs to apply it pro-actively up to the first distribution point would further improve the existing access regime, as it could encourage the use of Article 61(3) for the sharing of in-building fibre wiring, facilitating infrastructure competition for MDUs more widely across the EU (noting that only 7 NRAs have made use of Article 61(3) thus far). Although this is likely to apply only in limited cases, it could also potentially facilitate the use of Article 61(3) beyond in-building wiring in cases where fibre has been deployed in a manner that would allow access at an economically viable access point outside the building such as when point to point fibre deployments have been pursued. Option 2.

The requirement for Member States to develop, based on the input provided by NRAs, a Fibre Transition Plan will ensure a coordination at national level in supporting the deployment of fibre through concrete measures. This would also ensure that the coverage measures and the copper switch off measures are coordinated and complement each other. In particular, meeting the coverage objectives will facilitate meeting the requirements for the start of the CSO and therefore increase take up. The assessment of the NRA will inform the national authorities' decision to switch off the network and will also ensure that the other conditions and safeguards for the CSO are met. The scrutiny of the Commission will ensure consistency and coordination at EU level.

The requirement for Member States to ensure copper switch-off, under certain conditions, along with safeguards to protect competition and consumers, should accelerate FTTH deployment and copper switch-off. This approach supports the viability and expansion of FTTH investments and ensures consumers benefit from improved infrastructure availability, quality and reliability. With a legal requirement, Member States are more likely to take concrete steps to address fibre gaps through declarations, State Aid, and attention to technical aspects like in-building fibre wiring standardization.

A mandate for CSO will be a clear signal for investors and the market at large across the Union. It can incentivize alternative fibre investors to achieve 95% coverage and offer competitive retail and wholesale prices, facilitating a smooth consumer transition without additional charges. Additionally, the obligation for NRAs to analyse mass-market and enterprise connectivity related to CSO will address potential reductions in infrastructure competition. This will support fibre-based competition on best-practice wholesale product specifications defined at the EU level, fostering differentiation in quality and price.

This option would also provide a clear signal to consumers and business users as well as building-owners which have not yet upgraded their in-building wiring that migration will occur and that they should prepare for this outcome. This could accelerate the replacement of legacy equipment and connections relying on copper (in particular by businesses), and could encourage end-users to switch to fibre networks in advance of the deadline. Those (estimated at around 20%)²¹⁰ that may be resistant to switching, would also be migrated, subject to the legal requirements being met, thereby increasing take-up on FTTH networks and improving the business case.

Market analysis by the NRA with appropriate intervention at wholesale level where needed, coupled with requirements that CSO should only take place if it does not result in higher prices for similar services along with the right to connectivity at standard terms and conditions should limit the potential for price increases under this option and safeguard end-users.

Available data suggests that a mandatory transition from copper (incl. FTTC) to FTTH should result in end-users experiencing increased speeds and greater reliability for similar price. According to our price comparison in Member States with

²¹⁰ This estimate is derived from a questionnaire distributed to a representative set of stakeholders in June 2025.

high share of copper-based connections, the cheapest fibre-based offer is no more expensive than the cheapest copper-based offer.

Table A9 1-1: Price comparison – cheapest offers

Country	Copper	Fibre	Difference	Relative diff.
Austria	€ 16.74	€ 22.43	€ 5.69	34%
Belgium	€ 52.49	€ 35.44	-€ 17.05	-32%
Croatia	€ 27.96	€ 19.56	-€ 8.40	-30%
Czechia	€ 17.32	€ 15.47	-€ 1.85	-11%
Germany	€ 29.37	€ 35.41	€ 6.04	21%
Greece	€ 21.00	€ 24.99	€ 3.99	19%
Ireland	€ 34.47	€ 34.47	€ 0.00	0%
Italy	€ 26.66	€ 26.56	-€ 0.09	0%
Average				0%

Source: DG CNECT²¹¹

While the average price difference is 0%, the differences in member States range from -32% to +21% . Hereby, it should be noted that offers vary over time, and some depend on the location. The above table presents the situation in November 2025 and for random locations (when address is required). In some cases (e.g. Proximus and Telenet in Belgium, NOVA in Greece), operators offer the same product independent of technology and specify that the service is delivered over fibre, copper or cable depending on the address.

In terms of download speeds, the average difference of almost 600%, meaning the cheapest fibre-based product is six times faster than the cheapest copper one. Hereby, the speed advantage of fibre varies from -33% to 1150%.

Table A9 1-2: Download speed (Mbit/s)

Country	Copper	Fibre	Difference	Relative diff.
Austria	50	250	200	400%
Belgium	150	100	-50	-33%
Croatia	200	300	100	50%
Czechia	20	250	230	1150%
Germany	16	100	84	525%
Greece	24	300	276	1150%
Ireland	100	500	400	400%
Italy	200	2500	2300	1150%
Average				599%

²¹¹ Prices were collected (from 10 November to 17 November 2025) from the websites of the two largest fixed network operators. Installation and activation fees were included when calculating the average 24-month price.

Overall, based on our sample, fibre-based products are no more expensive than copper-based ones but offers superior speed and quality.

This finding is consistent with the fact that the cost of fibre-based broadband is not intrinsically higher than that of copper-based broadband. This is particularly the case when unviable duplication of infrastructure is removed via copper switch-off, thereby eliminating the demand-risk associated with parallel operation of copper and fibre. It is noteworthy that NRAs have been setting regulated prices for copper networks based on the cost structure of FTTH, as it is considered the most cost-effective technology.

The experience of countries such as France (see following chart) and Italy shows that when there is effective competition enabling differentiation on price and quality on fibre (via physical unbundling and IRU), charges for even very high bandwidths over fibre (Gigabit bandwidths) are similar to charges for broadband provided over copper at significant lower speeds.

Figure A9 1-2: Development of broadband prices in France (2012-2024)



Source: Arcep

Alongside the CSO obligation on copper network operators at the EU level, it is essential to plan a detailed migration and copper switch-off process. This option requires copper network operators that have not already done so to submit a CSO plan, providing clarity and transparency to investors in FTTH and access seekers. It ensures that NRAs take appropriate steps to oversee the CSO process, complying with EU law regarding deadlines, supporting competition and investment in FTTH networks, and protecting consumer welfare. In most countries that have progressed with CSO, NRAs have been involved in overseeing, implementing, and monitoring this process, setting conditions such as transparency obligations, coverage thresholds, alternative technologies identification, and notice periods. It encourages switch-off in areas where alternative investors have deployed fibre and requires Member States to determine which alternative technologies might be used in specific cases, such as rural areas where FTTH may not be viable for all households.

Regarding the **feasibility** of this option, it is important to note that, aside from the need to ensure widespread FTTH coverage, copper switch-off requires implementation at several layers.²¹²

According to the Study on Access Regulation, supporting the impact assessment, for example IT-processes have to be developed to implement the stop sell and switch-off by area (e.g. defined as area covered by a copper exchange or municipality). Information campaigns and procedures to inform end users also have to be planned and implemented.²¹³

In addition, copper switch-off means that critical safety devices still running on copper PSTN have to be migrated to alternative networks. Key services which belong to this category are intruder & fire alarms, stand-alone security alarms, telecare / medical alert, lift emergency autodiallers, miscellaneous monitoring services (fire panels, SCADA, building-management, traffic & ATM lines). It also impacts monitoring control systems used by the water, energy and transport industries.²¹⁴

There is no comprehensive data on the share of critical devices or monitoring systems using copper networks. In the context of a WIK study on copper migration and copper switch-off for the Gigabitforum in Germany, network operators and service providers interviewed were unanimous in their opinion that all the associated problems can be solved and have already been solved to a large extent in the migration from the PSTN to all IP.²¹⁵ It is also relevant to note that PSTN switch-off has progressed in many countries in advance of copper switch-off.²¹⁶

There is also evidence to suggest that upgrades to legacy equipment are being prioritised for operational reasons, and that maintaining such equipment could give rise to safety concerns. In contrast with that, the migration of consumers, businesses and government is

²¹² See for example experiences from the pilot projects in France and Germany. Strube Martins, S.; Neumann, K.-H.; Schwarz-Schilling, C. (2024): Final evaluation report on the copper migration and switch-off trial Deutsche Telekom (last accessed on 02.08.2025); Strube Martins, S. (2022): Kupfer-Glas-Migration in Frankreich und im Vereinigten Königreich (last accessed on 02.08.2025).

²¹³ See for example experiences from the pilot projects in France and Germany. Strube Martins, S.; Neumann, K.-H.; Schwarz-Schilling, C. (2024): Final evaluation report on the copper migration and switch-off trial Deutsche Telekom (last accessed on 02.08.2025); Strube Martins, S. (2022): Kupfer-Glas-Migration in Frankreich und im Vereinigten Königreich (last accessed on 02.08.2025).

²¹⁴ Frontier Economics (2023): Switching off the PSTN: Migrating from analogue to digital landlines, <https://www.bt.com/bt-plc/assets/documents/about-bt/all-ip/migrating-from-analogue-to-digital-landlines.pdf> (last accessed on 02.08.2025).

²¹⁵ Neumann, K.-H.; Plückebaum, T.; Strube Martins, S. and Schwarz-Schilling, C. (2021): Übergang von Kupfer- auf Glasfasernetze: Interessen, Spannungsfelder und mögliche Schnittmengen – Studie zur Erörterung im Gigabit-Forum, https://www.gigabitforum.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Breitband/Gigabitforum/WIK-Studie_Uebergang_Kupfer_Glasfaser.pdf?__blob=publicationFile&v=1 (last accessed on 09.10.2025).

²¹⁶ For example, in a 2020 study, WIK noted that a number of countries with limited FTTH coverage such as Germany and the UK nonetheless had targets for PSTN switch-off falling well before 2030. https://www.wik.org/fileadmin/Studien/2020/Copper_switch-off_whitepaper.pdf

linked with benefits as for example the take-up and use of a new generation of telecare services and energy savings.²¹⁷

With these factors in mind, it is assumed that the challenges related to the migration of critical services will be addressed. A mandatory CSO by a target date, subject to certain conditions, could have a positive effect by raising awareness of the technical challenges and ensure that the relevant planning and decision processes are initiated ahead of time.

Countries likely to be most affected by the CSO policies associated with this option are those lagging in FTTH deployment, with widespread FTTC deployments and a high proportion of FTTB coverage. These countries will experience pronounced positive effects from this option, although the benefits may be delayed beyond 2030 due to incomplete fibre coverage and other conditions. More specifically, an analysis of available data (which is however incomplete), regarding FTTH coverage, FTTB prevalence, focus on in-building fibre wiring and copper switch-off plans suggests that the status of compliance with the conditions requiring CSO will be as follows.

Full nationwide CSO by 2030 is expected to be possible in 15 countries (CY, DK, EE, FR, HR, IE, IT, LT, LU, MT, NL, PT, RO, SI and ES). In the remaining countries, in most cases, the majority of areas will meet the coverage and pricing condition by 2030 (while those which do not meet the pricing condition might do so in future if appropriate action is taken to promote competition on FTTH following a market analysis). Based on our analysis of available data, the following developments might be expected:²¹⁸

- In 5 countries (AT, CZ, DE, EL, BE) the conditions are unlikely to be met in 2030 for a significant number of areas representing at least 15% of

²¹⁷ Frontier Economics (2023): Switching off the PSTN: Migrating from analogue to digital landlines, <https://www.bt.com/bt-plc/assets/documents/about-bt/all-ip/migrating-from-analogue-to-digital-landlines.pdf> (last accessed on 02.08.2025).

²¹⁸ According to the BEREC progress report on managing copper network switch-off and the NRA survey conducted for the access study 9 countries (DK, FR, LU, MT, PT, RO, SE, ES and CY) are planning to switch-off copper by 2030 or earlier. 16 countries (AT, BG, CZ, DE, EE, EL, FI, HR, HU, IE, LV, LT, the NL, PL, SK and SI) have not set a target date. Estonia and Finland are already advanced in copper switch-off, although high proportions of FTTB in FI may affect copper switch-off readiness. 6 countries (BG, HU, IE, LT, NL, PL and SI) have a fibre coverage of at least 70%, which may limit the need for derogations if they succeed in accelerating FTTH deployment and addressing in-building fibre gaps. Italy has set a copper switch-off date but only with reference to the switch-off of copper exchanges enabling the continued provision of FTTC / VDSL. This means there would be decommissioning of the secondary copper network, but not the primary copper network. Under option 2, switch-off of the full copper network would then be required in Italy. FTTH coverage in Italy has grown significantly, and State Aid has been allocated to provide for near full coverage. Moreover, prices for fibre-based broadband are affordable. There is also a strong imperative to achieve copper switch-off in Italy as it is characterised by high levels of FTTC which has made customers reluctant to switch. Copper switch-off is therefore likely to be triggered across a high proportion of households in Italy in the event of a copper switch-off obligation. However, challenges may remain regarding connections in some areas, in particular less dense areas. Belgium has set a target date of 2035 and is lagging behind in fibre roll-out but copper is switched-off after 5 years at the latest when FTTH is available to customers in an area which means that the progress in copper switch-off will be directly related to FTTH roll-out. However, a further 6 countries (AT, CZ, DE, EL, LT and SK) are lagging behind in fibre roll-out and FTTH penetration (in % of broadband subscriptions). Of these, the situation is most critical in AT, CA, DE and EL.

households. Excessive pricing for fibre-based broadband may also need to be addressed.

- In 3 countries (LV, PL, SK) conditions may not be met for a smaller share of households (<15%) which are not served with fibre as of 2030.
- In 4 countries (BG, FI, HU, SE) conditions may not be met for in some areas for some MDUs due to the need to upgrade the wiring from copper to fibre and extra time may be required to complete this process.

As regards **effects of the CSO obligation envisaged under option 2 on coverage, speed and greenhouse gas emissions**, as illustrated in the game theoretic analysis (see below), when accompanied with measures under art 61(3) regarding in-building wiring (or access at other points if relevant), this option has the effect of providing an incentive for different operators (cable, incumbent, alternative fibre investor) to be first to deploy fibre in-building, creating a race to invest.

This should accelerate the pace of FTTH and maximise both speeds and environmental benefits. Examples of these effects can be seen in France, Spain and Portugal. However, operators would need to have access to the building to deploy in-building fibre, or otherwise, if they wish to maintain control/maintenance of the in-building wiring themselves, building owners would need to be obliged to make upgrades to legacy wiring within a given period. In addition, for the race to invest to materialise, alternative fibre investors would need equivalent access to ducts and poles as those available to the copper network owner. It would therefore be important for NRAs in countries which have limited FTTH coverage, to consider whether this could be fostered by improving conditions for ex-ante regulated access to physical infrastructure, in the context of market reviews associated with copper switch-off.

Table A9 1-3 Analysis of effects of options targeting FTTH/ CSO on FTTH / B deployment incentives for different categories of operator

	Obligation on copper owner i.e. incumbent to switch-off copper (twisted copper pair) in areas where 95% coverage FTTH by 2030 (derogation possible)
Scenario 1: Cable operator controls coax in-building in a given area.	Cable operator: Deploys FTTB if not already deployed to deter parallel FTTH deployment. May maintain coax in-building temporarily in situations where duplication of fibre is not viable. Then upgrades in-building to FTTH in order to trigger switch-off and transfer of customers from incumbent. Refuses wholesale access to in-building cabling. May alternatively offer bitstream access at excessive rates or refuse wholesale access to bitstream Incumbent: If duplication to building viable and if others have not reached the building first, seeks to deploy FTTH and switch-off copper. May face issues in accessing the building if the building owner is not required to give access. If duplication to building is not viable and/or the incumbent is not able to gain access to deploy fibre in-building, it may maintain

	existing copper network FTTC or deploy FTTB / G.fast and request derogation to 2035 Alternative fibre investor: If duplication to building viable and if others have not reached the building first, seeks to deploy FTTH to trigger a copper switch-off obligation on the incumbent to facilitate transfer of customers onto its network. If duplication to the building is not viable and / or it has issues in gaining access to deploy in-building fibre, no fibre deployment takes place.
Scenario 2: Building owner is responsible for in-building cabling. In-building cabling may in these cases involve coax in addition to twisted copper pairs	Cable operator: If duplication is viable, may race to seek access to building to upgrade in-building to FTTH in order to gain monopoly in-building and trigger switch-off. If duplication is not viable, and fibre not already deployed, cable operator deploys FTTB and uses access to coax in-building temporarily to limit viability for others to deploy FTTH. In time, may seek access to building to upgrade to FTTH in order to trigger switch-off and transfer of copper customers. Incumbent: If duplication is viable or if duplication is not viable but no other network is there yet, and access to building is possible, may race to seek access to building to upgrade in-building to FTTH to gain monopoly. Triggers switch-off with aim of transferring copper customers to its own fibre network. If access to building is challenging, and it is viable, may deploy FTTB and make use of in-building coax if has capability to do so (to limit potential for others to be there first). Derogation not relevant for incumbent in this case. Presumably it would voluntarily seek to decommission copper up to the building. Alternative fibre investor. If viable (i.e. no other fibre network there, or if there is fibre but duplication is viable), will race to gain access to building to upgrade in-building cabling to fibre to gain monopoly and trigger switch-off to transfer copper customers to its own network. If building access is difficult or if another actor is likely to be first and duplication is not possible, no investment. Building owner. May have incentive to upgrade in-building wiring to fibre in view of switch-off target, especially if it can gain financially from providing access to operators. Or may grant access to an operator to upgrade.
Scenario 3: Fibre gaps – incumbent may have FTTC / VDSL today, Likely high share of in-building copper	Cable operator: If present, and if access to building is possible, incentive to race to deploy FTTH in-building, benefit from in-building monopoly and trigger switch-off Incumbent. Incentive to race to deploy FTTH in-building, benefit from in-building monopoly and trigger switch-off (will seek to transfer to its own network)

	Alternative fibre investor. If access to building is possible, incentive to race to deploy FTTH in-building, benefit from in-building monopoly and trigger switch-off

Source: WIK-Consult

Effects of the updated access regulation

The requirement to gather data at regional level is likely to be positive, strengthening the quality of market analyses and ensuring that access regulation is appropriately targeted. Data gathering requirements encompassing data regarding dedicated connectivity as well as mass-market connectivity, could lead to a better understanding of the competitive dynamics of this market, and improved targeting of access regulation. Enabling NRAs to use Article 61(3) instead of SMP regulation in certain situations and to apply Article 61(3) beyond the first distribution point (including potentially to active access) on their own initiative should also be positive, and could potentially encourage additional use of this provision, which was a key driver behind the outcomes experienced in the French broadband market.

The requirement for the CSO process to be accompanied by a comprehensive and forward-looking market review with a view to ensuring that the transition is effectively managed in a manner which supports competition in a fibre environment, should ensure that, in the initial phase of the implementation of this option under the DNA, NRAs consider the use of Article 61(3) as described above as well as potentially adaptations to SMP regulation to reflect changes in market structure and technology following CSO. Such a market review should also ensure that NRAs reflect best practice wholesale specifications when determining what, if any, adaptations should be made to remedies in connection with the transition from copper to fibre.

Such a market review will also be needed to ensure that a smooth transition can be made between copper and fibre at the wholesale level, whether between different products on the former incumbents' network or between the former incumbent and a new fibre wholesale access provider. WIK considers that the threat of unviable fibre over-build (construction by the former incumbent in an area where an alternative fibre network has been deployed and only one fibre network is viable) is also likely to be heightened during the CSO process, as former incumbents seek to avoid transferring customers to an alternative fibre network.

In this context, it is relevant to note that, on a forward-looking basis, data, as well as theoretical models,²¹⁹ and responses by NRAs and stakeholders to the online survey issued by the WIK study team in Q2 2025 (following figure) suggest that on average, in an FTTH

²¹⁹ WIK (2023) for the EC "Investment and funding needs for the Digital Decade connectivity targets" shows that EUR 114 billion would be required to achieve full FTTH coverage taking into account FTTP coverage present in 2022. This assumed the deployment of only one FTTH network. Models by WIK prepared in the context of previous studies have highlighted that duplication in FTTH is likely to be economically viable only in very dense areas.

environment following CSO, more than 50% of households will be served with only one FTTH infrastructure.

Financial investors also observe that, to maintain viability in FTTH, it is necessary to limit duplication to the minimum with one noting that no more than around 20% households lie in areas where network duplication (i.e. two or more infrastructures) would be considered economically sustainable.²²⁰

The positive effects on competition, pricing on fibre networks and the take-up of higher speed broadband offers on fibre that have been assumed to be linked to this option, have been conditioned on the accompaniment of the copper switch-off process by a market analysis process and the associated imposition and/or amendment of remedies as needed (via Article 61(3) and/or SMP regulation applying to PIA, WLA and dedicated connectivity) to safeguard consumer and business interests.

However, while a market review timed around CSO should secure positive outcomes in the short term, this option may be associated with uncertainties in a longer-term horizon, in the event that there are no longer obligations for NRAs to periodically review connectivity markets.

It should be noted that the review of the RRM is not part of this process. In addition, even if the Commission were to amend the text of the DNA to make the issuance of this Recommendation merely optional (and not an obligation on the Commission as in the current text of the EEC), this would not automatically imply that the Commission would decide not to issue such a Recommendation any longer. However, WIK considers in its study that **if the RRM is made optional under this option and the Commission ultimately decides not to recommend markets for ex-ante regulation and no other mechanism is introduced requiring NRAs to periodically assess the market situation, this could result in an increase in Type II errors (a failure to tackle competition problems where they exist)**. Conversely, WIK considers that, in the event that an analysis is conducted, the EC could still issue a veto in the event that such a conclusion is not justified, avoiding over-regulation (addressing Type I errors). Action proposed by the NRA would also be subject to scrutiny by national courts.

In addition, according to WIK, the likely perception by NRAs and the financial markets that there is no longer a presumption that any market will be susceptible to ex ante regulation EU-wide in a full fibre environment. In turn, this may increase the perception

²²⁰ According to written responses to a supplementary questionnaire, network duplication is considered negatively by long term financial investors in fibre infrastructure. They consider that it is highly inefficient, leading to wasteful capital allocation and undermining the economic viability of fibre investments as well as contributing to emissions. The only exception is dense urban areas which may, in very rare cases, sustain limited network duplication, depending on local market conditions, especially population density, legacy infrastructure and investments predictability. One investor notes that the share of households where more than one fixed fibre network can be sustainably supported in the long term is likely to remain modest, under 20%. Another notes that overbuild in rural and suburban regions typically stems from incumbent players seeking to protect legacy market shares, not from sustainable infrastructure logic. Instead, duplication should be avoided and the focus should be on a shared, open access fibre model. One notes that in countries such as Sweden and Denmark where there are functioning wholesale access markets where customers have several ISP options and competitive FWA solutions there should be no overbuild stimulation at all.

of risk associated with broadband service providers relying on wholesale access, affecting investor sentiment. As alternative broadband operators already have a higher operator-specific WACC than incumbents as reported by Barclays in the Study on Finance and USO and as the majority of these providers are already failing to meet their cost of capital, deregulatory signals could further undermine the financial viability of these actors. These concerns have also been represented by stakeholders.

The above factors could lead to reduced levels of retail competition, which may in turn lead to higher prices for high-speed broadband, limiting take-up of Gigabit offers and reducing average broadband speeds. These effects are likely to be mitigated, as certain countries such as France have already implemented long-term regulatory solutions which support competitive FTTH markets on the basis of long-term agreements (IRUs), while others may continue to take the required action at a national level, and provide the additional analysis required to meet new requirements e.g. in relation to the three-criteria test. WIK considers that these problems could be addressed, in case the RRM is not maintained in its current form, by requiring NRAs to periodically analyse the geographic data they are required to gather and assess whether it indicates any competition problems on retail markets based on a modified greenfield approach (i.e. taking into account underlying infrastructure duplication and forward-looking expectations regarding replicability). If competition problems are identified, NRAs could be required to review the underlying wholesale markets in detail and pursue appropriate measures based on SMP and/or Article 61(3) in the event that other measures such as the GIA PIA would be insufficient to address the identified competition issues.

The establishment of **harmonised product specifications** for key wholesale products including FTTH unbundling, VULA, ethernet leased lines and Quality of Service parameters for business should also ensure that, in cases where regulation is applied, wholesale products will enable greater consistency in applying access regulation across the Union. Further to that the harmonised products should ensure differentiation in quality and price and hence contribute to higher degree of competition. The harmonization of access products coupled with well-targeted regulation including access to in-building wiring and potentially beyond should support greater take-up of Gigabit broadband and higher broadband speeds.

Evidence regarding the positive impacts of physical fibre unbundling on the availability of Gigabit offers at affordable prices, can be found in countries such as France and Italy. Evidence regarding the impact of EU-wide action to standardise wholesale products in a manner which boosts competition and innovation can also be seen from the impact on broadband deployment and speed of the 2000 Local Loop Unbundling Regulation. These impacts were quantified in a 2015 study of the impact of unbundling on UK broadband, which showed how this measure fostered broadband by stimulating competition in the upgrade of active equipment on passive unbundled loops.²²¹

²²¹ Mattia Nardotto, Tommaso Valletti, Frank Verbovenht (2015) [UNBUNDLING THE INCUMBENT: EVIDENCE FROM UK BROADBAND](#) - Nardotto - 2015 - Journal of the European Economic Association - Wiley Online Library.

VULA, “virtual unbundled local access” is a locally provided bitstream product (where the access provider retains full control of its connection). This product should mimic the functionality of “unbundling” in those situations where (due to technical reasons) physical unbundling is not feasible. VULA is used where there is no end-to-end connection which can be physically separated and rented.

VULA, in order to mimic unbundling should have the following features:

- ✓ occur locally (point of handover)
- ✓ be generic and provide access seekers with a transmission capacity which should support different types of services and is uncontended in practice;
- ✓ provide access seekers with sufficient control over the transmission network to allow for product differentiation and innovation
- ✓ be provided with pricing that facilitates its use in a similar manner to physical unbundling.

VULA is an access product created for regulatory purposes. Therefore, divergences in its applications have been observed. The aim of the harmonisation is to ensure that VULA products in the future contain the above-mentioned features.

It is important to note that the effects on innovation and speed of VULA at EU level are unlikely to match the effects on innovation of copper unbundled loops, due to point to multi-point fibre architectures which limit viability of unbundling and the intrinsic limitations of VULA compared with physical unbundling.²²² However, even if harmonised EU specifications mainly affect the specification of VULA, this should have positive impacts on competition in higher bandwidth broadband services.

Harmonisation of specifications for key wholesale products as well as attention to quality of service guarantees for businesses should also contribute to the development of competition in services for multi-site and multinational enterprises. This is important, noting that retail and wholesale market shares of incumbents in the supply of such business services are often higher than for residential customers, and competition may be limited by the lack of availability of wholesale access with appropriate service guarantees at all required locations.²²³ Stakeholders specialised in the provision of services to multi-national businesses confirm the value of this option in supporting cross-border service provision. Other stakeholders which are more focused on national service provision suggest that the impact of standardised wholesale characteristics on cross-border provision in multiple countries would be limited.

²²² Specifically, as a layer 2 bitstream product, VULA does not permit flexibility over the choice of active equipment, leaving this under the control of the access provider.

²²³ For example, analysis conducted in the context of the review of the RRM shows that in countries where NRAs have segmented the market for dedicated capacity by geography, incumbent market shares of 70% or more have been observed in the non-competitive zones for dedicated capacity. Limitations in competition have also been found e.g. in Spain in the provision of services to multi-site businesses.

1.1.1.4. Option 3

Option 3 involves a significant shift in the current approach regarding access regulation, with an emphasis on deregulation and reliance on existing measures regarding access to physical infrastructure (such as ducts and poles) under the GIA. This option was widely preferred by former incumbent operators participating in interviews and responding to the online survey issued for the purposes of this study.

This option would significantly simplify the existing regime, as it would imply the widescale removal of the existing access-related provisions. However, it is associated with a number of challenges which are likely to limit its effectiveness in achieving the Gigabit objectives or in securing harmonised outcomes.

A key negative aspect is that it would require a significant change from the regulatory approaches in place at the time when fibre investments were made. This is likely to create considerable uncertainty amongst investors, undermining confidence and potentially impacting the already fragile financial situation, in particular of alternative fibre investors and alternative broadband providers, which rely on wholesale access.

The changes envisaged under option 3 are likely to have negative impacts on fibre investment and take-up in two ways. Firstly, a shift away from SMP regulation of ducts and poles (which has been the primary mechanism used to support deployment by alternative investors) towards PIA regulation under the GIA would mean replacing a regime which relies on strict cost-orientation and non-discrimination, as advocated under the 2024 EC Gigabit Recommendation,²²⁴ with one in which access to telecom ducts (including those of the incumbent) would be subject to fair and reasonable pricing. In line with Article 3 of the GIA, various additional conditions, such as the impact of pricing of duct and pole access on the business case for VHCN of the access provider would need to be taken into account when setting wholesale charges. Wholesale prices would also be set in the context of case-by-case dispute resolution rather than established in a Reference Offer via a market review procedure. The differences in the pricing principles between the two regimes mean that the wholesale price of duct and pole access from the former incumbent would be likely to increase. This could deter further investments by alternative providers as well as putting into question the business case of alternative operators whose existing fibre deployments have been based on SMP regulated duct and pole access. This may have a widespread effect, noting that 17 of the 27 Member States currently mandate SMP duct and pole access and take-up of PIA under the GIA is significantly lower than SMP PIA²²⁵. The vast majority of respondents to the June-July 2025 stakeholder survey considered that duct and pole access was key for fibre deployment and favoured the inclusion in the DNA of duct and pole access regulation that goes beyond that permitted under the GIA. More than half of existing FTTH deployments to date have been made by

²²⁴ <https://digital-strategy.ec.europa.eu/en/library/recommendation-regulatory-promotion-gigabit-connectivity>.

²²⁵ SMP PIA has played a very significant role in supporting infrastructure competition in countries such as France, Spain, Portugal and Ireland. For example, in Spain in the second trimester 2024 117,000 km of SMP ducts were used by network operators. In contrast, available data suggests extensive use of BCRD PIA in just two countries – Italy and Slovakia.

alternative operators,²²⁶ many of whom are likely to have relied been on SMP duct and pole access. The majority of alternative fibre investors favour the retention of strong PIA measures under the DNA. They consider that an increase in the price of ducts and poles that are already being used by alternative investors could further tip an already challenging business case for these operators, expanding the profitability challenges that these operators already face.²²⁷

Negative impacts from this option would include significant limitations in the regulatory regime for access to fibre, likely to result in the worsening of access conditions for fibre in areas where competition would not be effective in the absence of regulated access.

In this context, it is worth noting that it is common practice for network operators controlling fibre networks to voluntarily offer wholesale access, including in areas served with a single fibre network, in order to maximise take-up on the network. This was confirmed by operators deploying fibre networks in the context of a questionnaire distributed for the Study on Access Regulation. Changing the threshold for intervention so that no access regulation can be applied if a network is “open”, would also provide incentives to continue the provision of such voluntary offers, or provide access in the event that this is not provided today.

However, access seekers in the replies to the questionnaires distributed in the context of Study on Access Regulation, highlighted that wholesale access will only have a meaningful effect on retail competition and consumer welfare (in circumstances where this is not secured via infrastructure competition) if the access provided allows access seekers to compete on quality and price. WIK considers that in the absence of more concrete and elaborated wholesale access obligations, including obligations to provide access at the passive layer or products having a similar level of flexibility, access providers which are not constrained by competitive forces are likely to offer bitstream services, set charges for higher bandwidth offers at a high level, and may (if they are vertically integrated) discriminate in favour of their own retail operations to maximise profits at both the wholesale and retail level. This risk was clearly highlighted by access seekers and is supported by the fact that access providers typically prefer to offer active access. Conversely, access seekers in particular in the mass-market, but also for large business sites and mobile backhaul, highlight the need for access to passive products or, in the absence of that, products allowing the differentiation of offers from that of the access providers.

²²⁶ Analysys Mason State of Digital Communications 2025 notes that challenger operators have achieved FTTH coverage levels of 52% in Europe, with cable operators providing coverage of 15%. “Leading” operators (likely incumbents) accounted for 49% coverage.

²²⁷ In a report by Barclays (Barclays. (2024). On the path to value creation, but not for all) covering 6 incumbents and 18 (mainly fixed and mobile vertically integrated) alternative operators, it can be seen that the ROCE of 4 out of the 6 incumbents (DT, Orange FR, TF Spain, KPN) exceeds the WACC provided by Barclays (whereas TI and BT are not recovering their WACC according to Barclays). For the alternative operators, where an operator-specific WACC has been provided by Barclays, in 12 of the 13 cases, the operators are not covering their WACC, as reported.

The restrictions on the circumstances in which access could be mandated along with the absence of standardised wholesale products would likely also worsen the existing fragmentation of offers.

Under this option, copper migration and possibly also copper switch-off may be accelerated in certain cases following the removal of restrictions e.g. regarding FTTH coverage and the availability of alternatives in the limited cases where FTTH is not available. However, experience suggests that accelerated switch-off would occur in areas where this was to the benefit of the copper incumbent i.e. where it has its own fibre access network.²²⁸ On the other hand, as with the status quo, the incumbent copper owner would not have any obligation or incentive to switch off its network in areas where an alternative provider has deployed fibre. This option is unlikely to produce any change either on the incumbents' plans and incentives to deploy fibre. In countries where FTTC is widespread, this would likely worsen the already fragile business case for alternative fibre providers, limiting investment incentives and restricting take-up. Withdrawing provisions which enable NRAs to oversee the copper switch-off process would also likely result in reduced transparency regarding incumbents' copper switch-off plans and may negatively impact also end-users.

1.1.1.5. Option 4

Option 4, which involves the replacement of the current SMP and Art 61(3) regime with an obligation on all operators to negotiate wholesale access would also significantly simplify the existing framework, as the majority of existing provisions could be removed.

A strict deadline for copper switch-off would eliminate uncertainties and the potential for delay inherent in the approaches to copper switch-off proposed in options 1 and 2. This would likely increase the incentives for Member States as well as operators to address coverage gaps and establish switch-off plans. This would likely result in an acceleration in FTTH deployment ahead of the switch-off deadline. However, the lack of flexibility over the deadline could lead to an over-use of public funding to address gaps that might otherwise be addressed via commercial means, and/or an outcome in which a material proportion of consumers are unserved with adequate fixed broadband offers at the moment when switch-off occurs, and would thus be forced to use alternative options such as the use of mobile broadband at a fixed location. This would have implications for the achievable bandwidths available for such customers.

According to the BEREC progress report on managing copper network switch-off and the NRA survey conducted for the Study on Access Regulation, 9 countries (DK, FR, LU, MT, PT, RO, SE, ES and CY) are planning to switch-off copper by 2030 or earlier. 16 countries (AT, BG, CZ, DE, EE, EL, FI, HR, HU, IE, LV, LT, the NL, PL, SK and SI) have not set a target date. Estonia and Finland are already advanced in copper switch-off. 6 countries (Bulgaria, Hungary, Ireland, Lithuania, the Netherlands, Poland and Slovenia) have a fibre coverage of at least 70% so that they might succeed in achieving the target date.

²²⁸ For example, in Finland the regulator did not set conditions for copper switch-off and the different regional SMP have proceeded to switch-off copper. Copper customers were migrated to fibre and mobile networks so that the share of copper in fixed retail broadband lines was 4% in 2024.

However, a further 7 countries (Austria, Belgium, Czechia, Germany, Greece, Latvia and Slovakia) are lagging behind in fibre roll-out and FTTH penetration (in % of broadband subscriptions) which means that in these countries there may be a need for additional public funding and customers will have to be migrated to other technologies or alternative cable/fibre networks (if available). However, there are countries where there is no or only limited coverage of cable such as CZ, HR, IT, EL, LV and SK.

In conclusion, it is expected that at least 9 countries (AT, CZ, DE, EL, HR, LV, SK, IT, BE) would need to address coverage gaps with public funding in order to meet the switch-off deadline with a transition to fibre or highly specified 5G FWA, or would need to rely on alternative technologies, including potentially mobile. Nevertheless, there will be a stronger impact on FTTH coverage and take-up than under option 2 resulting from the effort of copper network operators to comply with requirement.

As regards access regulation on physical infrastructure, the hard-wiring into legislation of the obligation for copper networks owners, which were previously found to have SMP to provide duct access on cost-oriented and non-discriminatory terms and conditions on an ongoing basis, would likely increase certainty for alternative fibre investors. This strengthening of the conditions to access incumbents' duct and pole infrastructure, could support additional fibre deployment by alternative investors, which could in turn foster a race to invest between incumbent and alternative fibre investors. This is likely to increase the pace of fibre deployment, leading to higher take-up of fibre.

Reliance on symmetric regulation for wholesale access to fibre would implicitly mean that access would be required in cases characterised by non-competitive oligopoly, thereby addressing a challenge that may persist in the other options under consideration. This could result in additional choice in fibre-based broadband services compared with the status quo or other options. However, as this option would apply fibre access obligations on all operators, it would be necessary (as is the case in the GIA) for such obligations to be less stringent than those applied based on SMP or on other findings relating to competitive concerns. For example, this may mean that common specifications for wholesale access products might focus on bitstream rather than physical and virtual unbundling and quality of service parameters for business. Meanwhile, wholesale prices would likely be set on the basis of a fair and reasonable test rather than cost-orientation, which may not be appropriate in situations where the access provider has the ability and incentive to set wholesale prices above the competitive level and is not adequately constrained from doing so. If applied in this way, access obligations are likely to be less effective than the status quo, as well as options 1 and 2 in supporting differentiated offers (including higher speeds) in situations where the market alone would not deliver competitive outcomes in the absence of ex ante regulation.

Reliance on case-by-case dispute resolution instead of a periodic market analysis procedure could also reduce the efficacy of measures regarding access regulation (by delaying their resolution and making the procedure more complex), in addition to increasing administrative costs and creating uncertainty. This would be likely to reduce the quality of competition compared with options 1 or 2. In addition, it should be noted that the shift in the threshold for access regulation from the current regime that is implied by this option carries the same downside regarding uncertainty and a lack of predictability as described in option 3.

1.1.2 Efficiency

Efficiency assessments involve a comparison of direct and indirect costs and benefits. As the direct benefits can be derived from the assessment of effectiveness, while indirect benefits are described in relation to economic, social and environmental impacts.

1.1.2.1. Administrative costs under the baseline

The main obligations in the EECC which give rise to costs to stakeholders and which are relevant to the Impact Assessment under the DNA are:

- **Data Collection (Article 22):** NRAs must gather and update geographical survey data every three years, detailing electronic communications networks' capabilities and quality of service. This data informs National Broadband Plans, coverage obligations, and State Aid. BEREC provides implementation guidelines.
- **Market Analysis (Article 64 & 67):** The Commission must adopt and update a Recommendation on relevant product and service markets. NRAs analyse these markets every five years or within three years of a Commission recommendation. If Significant Market Power (SMP) is found, NRAs impose obligations such as wholesale access, non-discrimination, price control, and transparency.
- **Network Decommissioning (Article 81):** SMP-designated undertakings must notify NRAs before decommissioning networks, including legacy copper networks. NRAs ensure a transparent timetable, appropriate notice periods, and availability of alternative products of comparable quality. Migration obligations may be withdrawn upon NRA confirmation of compliance.

The following table provides information about the number of FTEs currently involved in activities related to access regulation across the EU. Extrapolations from data provided by NRAs suggest that, out of a total FTEs employed in NRAs/ DSBs of approximately 9,500, around 725 FTEs are involved in access-related issues.

Table A9 1-4: FTEs involved in access related issues

	Total FTEs NRA /DSB	FTEs engaged in dispute resolution BCRD/GIA	FTEs engaged in market reviews	FTEs engaged in symmetric regulation	FTEs engaged in geographic survey's	FTEs engaged in dispute resolutions (Art. 26)
Total	5 238	59.2	185	26.5	118	41.1
Total responses	15	12	17	9	12	13
Average number of FTEs per NRA and topic	349.20	4.93	10.88	2.94	9.83	3.16
Total number of FTEs in the EU27 per Topic based on average	9 428.40	133.20	293.82	79.50	265.50	85.36

Source: WIK-Consult

According to the data provided by NRAs in the context of online survey Jan 2025, 34% of FTEs in NRAs are involved in market reviews and the imposition of access regulation on SMP operators. An average of 9% are involved in symmetric regulation (although this is likely to be skewed by figures in France and Croatia, which rely on these measures extensively). Meanwhile, a relatively high proportion (31%) of resources within NRAs are engaged in the preparation of geographic surveys (data gathering) in connection with Article 22²²⁹ and a further 10% in dispute resolution under Article 26 EECC.

If twice as many resources are deployed in the private sector in relation to access regulation, with a per FTE cost of EUR 95 400, total costs would be around EUR 207.5 million EU-wide.

1.1.2.2. Option 1

Option 1 involves relatively few new *mandated* actions on the part of Member States, ECN operators or NRAs. As such, while it provides guidance at EU level, it offers significant flexibility regarding the approach taken to copper switch-off, market analysis and the application of ex ante regulation and the choice of wholesale remedies. This means that the effect on costs resulting directly from the EU measure as opposed to national decisions, is likely to be relatively limited.

That said, aspects of this option which could result in additional **direct costs** resulting from EU legislation are:

- The requirement for Member States to produce FTTH and copper switch-off plans
- Requirement for national authorities to collect geographic data and assess progress regarding FTTH deployment and copper switch-off
- The requirement for BEREC to develop and adopt Guidelines on best practice wholesale products

Although Option 1 sets a target for copper switch-off of 2030, this is non-binding. This means that the ultimate decision on the CSO date will continue to lie with copper network owners. While national administrations themselves could decide to require copper switch-off under certain conditions, this would not result from obligations at EU level.

In large part, due to the non-binding nature of the provisions, this option is not associated with material **indirect costs and unintended effects**.

1.1.1.3. Option 2

Direct costs:

Option 2 includes additional mandatory elements, which could result in the following direct costs.

²²⁹ Additional resources might be involved in countries where other competent authorities have been given responsibility for geographic surveys under Art 22 EECC. However, this competence is understood to have been granted to the NRA in the majority of cases.

- Requirement for Member States to establish Fibre Deployment and and Copper switch-off plans
- Requirement for Member States to ensure the switch-off of copper networks by 2030 in areas where certain conditions are met, and thereafter on a rolling basis with a review mechanism in 2035.
- Requirement for copper network operators to develop copper switch-off plans and to submit such plans to the NRA
- Requirement for national regulatory authorities to collect geographic data and assess progress regarding FTTH deployment and copper switch-off. This would be unlikely to add significantly to costs as most NRAs already gather data on these aspects in the context of Article 22 EEC and data gathering for BEREC monitoring exercises. However, there would be an increased focus on data gathering relating specifically to copper switch-off and the frequency of data gathering is likely to increase, noting that Article 22 only requires data gathering every 3 years as a minimum.
- Requirement for national regulatory authorities to conduct a market review in relation to copper switch-off plans and expected implications for market dynamics. In connection with such an analysis, NRAs may also be required to mandate a requirement related to drop-cables in areas affected by copper switch-off. This review process and associated obligations is likely to require additional one-off resources in particular where this results in the need for a review earlier than the standard 5 years cycle and/or for markets that were previously deregulated. It can be expected that most NRAs would conduct a subsequent review at least within 5 years of the review associated with CSO. If the RRM is made optional under this option, then additional analysis may be needed regarding the 3 criteria test to support the continuation of regulation. However, any such additional costs are likely to be counteracted by savings linked to potential deregulation that may arise and/or the increased use of Article 61(3) on existing networks as an alternative to SMP, which may be more cost-efficient. The impact on recurring costs associated with market analysis under this option are thus assumed to be neutral.
- Requirement for Member States to review the situation in 2035 and inform the Commission accompanied by a Commission scrutiny.
- Requirement for EC in consultation with BEREC to adopt an Implementing Act to establish best practice specifications for wholesale access products, a requirement for NRAs and other competent authorities to take these into account when imposing wholesale access, and for operators to reflect the amended specifications in their wholesale offers
- Extension of the EC powers to include a veto on remedies (rather than just on SMP). This would be unlikely to add significantly to direct costs as a process already exists to express serious doubts regarding remedies. The existence of a veto power may however result in more cases being pursued in practice.

Direct costs associated with the above measures are **mostly administrative and included in the relevant table**. However, the requirement that Member States should ensure that copper network owners start switching off their networks in 2030 in areas where the

conditions are met, will trigger operational costs for copper network owners, and other affected ECN operators, as well as end-users related to the copper to fibre transition. It is important to note that, as all copper networks will eventually be replaced with fibre, such operational costs would be incurred regardless of any EU obligation. Moreover, in a number of countries (Belgium, Denmark, France, Luxembourg, Malta, Portugal, Romania, Sweden, Spain, Cyprus), this obligation will not entail any additional operational costs compared with the status quo, as CSO has been planned or is likely to take place by 2030.

However, for those countries which would not otherwise achieve CSO by 2030, an EU-wide requirement for Member States to achieve CSO by 2030 will result in operational migration costs being incurred earlier, and may mean that a higher proportion of end-users will be subject to forced migration than would otherwise be the case.

As situations vary and limited concrete information is available from literature or via stakeholder consultation, it is not possible to quantify the implementation costs associated with earlier copper switch-off and migration in the affected countries. However, the following information can be given. In this context, it is important to note that while there might be operational costs associated with an acceleration of the process (it is not clear that earlier implementation would affect the level of cost). Meanwhile, accelerating the process is also likely to result in cost savings (both capex and opex) and the release of cashflows from the sale of copper earlier than might otherwise occur. This is further explained below.

Implementation costs associated with copper switch-off

As an illustration, in the context of the WIK evaluation report on pilot projects for copper switch-off in Germany,²³⁰ the following cost categories were identified as being expenses linked to migration:

- Clarification of the initial data
- Interaction with end customers,
- Internal organisational process costs, including manual or IT costs for setting up IT solutions as part of the pilot for customer support and for ordering processes at the wholesale level (DSL transition product)
- Interim product in the migration process
- Cancellation of copper-based wholesale products,
- Wholesale charges (incl. infrastructure charges) for FTTH wholesale products,
- End devices at the end customer,
- Expenses for measures aimed at end customers as part of the pilot projects.

²³⁰ Strube Martins, S.; Neumann, K.-H.; Schwarz-Schilling, C. (2024): Final evaluation report on the copper migration and switch-off trial Deutsche Telekom, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Studien/2024/WIK_evaluation_report_pilot_copper_switch-off_Gigabit_Forum.pdf (last accessed at 08.10.2025).

Other possible cost categories that were not relevant or not identifiable in the pilot were not considered.

Other one-off implementation costs identified in a previous (2021) WIK study include²³¹

- Dismantling of collocation
- Establishment of new access points with collocation
- Dismantling of MSAN and street cabinets

From a regulatory perspective, attention will be needed to how these costs are allocated amongst different players in the context of access regulation.

Regarding values, it is not possible to provide an EU-wide or even a country-based estimate of the non-administrative costs associated with copper switch-off and migration, as there are many variables involved, and it would be necessary to understand the difference in cost relating only to the timing of migration.

Costs (and cost savings) associated with FTTH deployment

Option 2 does not mandate FTTH deployment or mandate CSO except in areas where FTTH coverage is high. Therefore, costs associated with FTTH deployment cannot be attributed to this option. However, it is relevant to note that this option is likely to incentivise faster and more extensive FTTH deployment and the provision of services at equivalent prices to reach the threshold that would trigger copper switch-off. This would particularly apply to alternative fibre investors or copper network owners that have fibre in a given area falling short of the coverage threshold, and would thus benefit financially from copper switch-off.

In practical terms, this option should result in a more rapid release of capex under commercial conditions than under the status quo to achieve full fibre coverage. As regards the amounts that may be released, according to a WIK study for the EC published in 2023, based on data from 2021, there was a remaining capex requirement of approximately EUR 114 billion to achieve 100% coverage of FTTH EU-wide, of which EUR 74 billion was estimated to be economically viable without subsidies in a situation of no network duplication (i.e. in the absence of parallel copper or fibre networks). This figure would be reduced to around EUR 108 billion of which around EUR 29 billion would be needed in subsidies if 5G FWA is used for the most remote households. This latter figure is more relevant when considering the 95% FTTH threshold that is proposed in the context of option 2. Moreover, if remodelled today, this figure would be significantly lower now as

²³¹ See Neumann, K.-H.; Plückebaum, T.; Strube Martins, S. and Schwarz-Schilling, C. (2021): Übergang von Kupfer- auf Glasfasernetze: Interessen, Spannungsfelder und mögliche Schnittmengen – Studie zur Erörterung im Gigabit-Forum, https://www.gigabitforum.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Breitband/Gigabitforum/WIK-Studie_Uebergang_Kupfer_Glasfaser.pdf?__blob=publicationFile&v=1 (last accessed on 09.10.2025).

since 2021, FTTP coverage has increased from 50% to 69% (in 2024), thereby reducing the size of the remaining investment need²³².

Importantly, noting that the costs and associated commercial viability estimated in the 2023 WIK study were based on a single network, without duplication, a CSO obligation would increase the percentage of households that would be viably served in the absence of State Aid compared with the status quo, where the continued presence of copper networks reduces take-up and therefore-profitability and economic viability of fibre networks. Option 2 should thus significantly limit the degree to which public funds are required to secure full FTTH coverage compared with the status quo. An update to the 2023 study and associated model would be required to estimate the precise level of savings in public funds associated with a CSO obligation.

Direct benefits via cost reductions and/or accelerated potential to realise cashflows

Reductions in total capex

It should be noted that a mandated switch-off, subject to conditions, which results in an earlier more time-compressed capex could reduce the total costs that would otherwise arise from sequential network upgrades and individual in-building fibre connections. In this context WIK has modelled the costs of sequential fibre roll-out with reference to the final drop and in-building infrastructure²³³ and also with reference to fibre roll-out step-by-step for copper to fibre migration, comparing the cost of deploying FTTC→FTTB / FTTC→FTTH / FTTB→FTTH, vs. deploying FTTH without intermediate steps.

Some estimates follow for the German market:

The results for a direct migration path from FTTN (fibre to the node) to FTTH PtP in Germany are total investments of 61 bn. EUR, or per home passed (HP) of EUR 1,379. For the actual sequential deployment of FTTN through FTTC and FTTB to FTTH PtP the investments sum up to EUR 114.8 billion and the stranded investment (i.e. investments that cannot be re-used in the context of eventual FTTH deployment) sums up to EUR 6.4 billion. This results in capex of EUR 2,741 per home passed. If the 3 migration steps were made after 42 months (3.5 years) each, the total time taken would be longer than 10.5 years.

²³² The precise figure cannot be calculated without an understanding of the level of FTTH coverage in different geographic areas in each EU Member State, as costs vary widely depending on national factors such as labour costs as well as on population density. However, it is important to note that option 2 is likely to incentivise both private (and where necessary public) investment to occur earlier and on a more widespread basis, but does not require such costs to be incurred

²³³ Wernick, C.; Knips, J.; Lachmann, R.; Strube Martins, S. (2024): Ursachen für die wachsende Schere zwischen FTTH Homes Passed und FTTH Homes Connected, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Diskus/2024/WIK_Diskussionsbeitrag_Nr_526.pdf and Plückebaum, T.; Ockenfels, M. (2020): Kosten und andere Hemmnisse der Migration von Kupfer- auf Glasfasernetze, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Diskus/2022/WIK_Diskussionsbeitrag_Nr_457.pdf (last accessed on 08.10.2025).

A longer path consisting of 5 steps with observable plausibility would involve starting again with FTTN, using next FTTC, then FTTS (fibre to the street) and proceeding towards FTTB PtMP, ending in FTTH PtP as before. Its investment sums up to EUR 128.3 billion, the accumulated stranded investment to EUR 20.3 billion and the investment per home passed to EUR 3 361. Not considered, but however relevant in some cases, are additional interim steps in the GPON architecture family for PtMP fibre topologies, causing additional investments into OLTs and ONUs, additional delay and potentially further stranded investment.

Migration path from FTTN to FTTH PtP	Invest total	add. total stranded investment	Invest total per home passed
direct	61.- bn. €	0.- €	1,379.- €
3 steps	114.8 bn. €	6.4 bn. €	2,741.- €
5 steps	128.3 bn. €	20.3 bn. €	3,361.- €

When FTTH involves the provision of fibre to MDUs, there is also a specific cost associated with in-building fibre wiring. Based on interviews conducted in the context of a research project, WIK assumes average costs of in-building wiring per dwelling (from the basement to the dwelling excl. of the drop-connection) of EUR 250-450,²³⁴ although some network operators indicate that the cost of in-building connections per dwelling amount to EUR 800. However, it is important to note that a simultaneous deployment of in-building fibre wiring as would be likely to occur in the context of a CSO obligation is significantly less costly than a sequential deployment, as may occur in the absence of such an obligation. WIK has modelled the cost of the sequential roll-out out of drop-connections compared with the immediate roll-out in one area and estimates that in Germany each percent of dwellings which have to be rolled-out when extending the network from homes passed to homes connected costs between EUR 69 and EUR 108 million.²³⁵ Thus a copper switch-off requirement which incentivises simultaneous deployment to all dwellings within a building is likely to imply reduced costs on average compared with sequential deployment.

²³⁴ See Neumann, K.-H., Strube Martins, S.; Schwarz-Schilling (2024): Kosten und Preise für den Zugang zur Glasfasergebäudeinfrastruktur, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Kurzstudien/2024/WIK_Kurzstudie_Kosten-und-Preise-Glasfaserinfrastruktur.pdf and Neumann, K.-H., Strube Martins, S.; Schwarz-Schilling, F. (2023): Gebäudeinterne Infrastruktur – ein notwendiger Schritt zur Entwicklung von FTTH, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Diskus/2023/WIK_Diskussionsbeitrag_Nr_499.pdf.

²³⁵ Based on the relation between homes passed and homes connected in 2024. See Wernick, C.; Knips, J.; Lachmann, M. R.; Strube Martins, S. (2024): Ursachen für die wachsende Schere zwischen FTTH Homes Passed und FTTH Homes Connected, https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Diskus/2024/WIK_Diskussionsbeitrag_Nr_526.pdf.

Reductions in operational cost

According to WIK's study on migration to fibre and CSO in the context of the Gigabitforum²³⁶, if a telecommunications company operates both an FTTC and an FTTH network in the same area, its operating costs are duplicated in part. FTTH has lower operating costs than the copper network. This is due to no electricity costs, more remote maintenance, fewer faults, and thus lower fault repair costs for FTTH. However, the relative repair costs (per case) are higher for FTTH than for FTTC.

In the interviews conducted for the Study on Access Regulation, supporting the impact assessment, one operator stated (comparatively and statically) a 30% lower level of operating costs for FTTH compared to the copper network. Estimates or figures from other operators of 50%-60% savings were considered significantly too high. According to calculations based on WIK's cost models, the operating costs of a fibre optic connection are in the range of EUR 10 to EUR 15 per line per year. In contrast, the BNetzA estimates operating costs for copper local loops to be more than EUR 15 per line per year.

Further insights on operational cost savings come from Verizon, which last year said it had upgraded 4.5 million circuits on its network from copper to fibre and converted 36 of its central office locations to all fibre. The conversion of those 36 central office locations, the company said, had resulted in operational savings of around USD 180 million.²³⁷

CSO will also allow for the sale of copper, thereby unlocking significant funds, potentially earlier than might otherwise have been possible. In this context, a recent report suggests that telecom groups globally are forecast to make more than USD 15 billion from the sale of copper over the next 15 years.²³⁸ More specific examples come from reports by BT which noted in 2024 that it had netted GBP 105 million from the sale of its surplus copper cables and expects to "recover up to 200,000 tonnes of copper – in line with customer migrations" by the 2030s.²³⁹ Meanwhile, Brazil's TelefónicaVivo hopes to raise as much as BRL 4.5 billion (EUR 711 million) by selling the physical assets underpinning its legacy fixed-line voice and broadband services.²⁴⁰

Regarding direct costs to consumers and businesses, migration from copper to fibre involves a migration from copper to fibre-based broadband services, and the potential deployment of a new connection (drop-wire) where this has not previously been deployed.

²³⁶ See Neumann, K.-H.; Plückebaum, T.; Strube Martins, S. and Schwarz-Schilling, C. (2021): Übergang von Kupfer- auf Glasfasernetze: Interessen, Spannungsfelder und mögliche Schnittmengen – Studie zur Erörterung im Gigabit-Forum, https://www.gigabitforum.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Breitband/Gigabitforum/WIK-Studie_Uebergang_Kupfer_Glasfaser.pdf?__blob=publicationFile&v=1 (last accessed at 09.10.2025).

²³⁷ <https://www.kearney.com/service/digital-analytics/article/a-blueprint-for-copper-decommissioning>.

²³⁸ Source: <https://www.ft.com/content/2e1cbcf8-67c3-48b1-94bf-66c344b155b8>.

²³⁹ <https://www.datacenterdynamics.com/en/news/bt-calls-for-uks-critical-national-infrastructure-to-shift-away-from-copper-networks/>.

²⁴⁰ <https://www.telcotitans.com/telefonicawatch/vivo-targets-700m-bonus-from-fixed-line-shutdown/9244.article#:~:text=Brazil's%20Telef%C3%B3nica%7CVivo%20hopes%20to,of%20acquisition%20over%20recent%20years.>

However, the safeguards provided in option 2 would mean that mandated CSO would not occur in areas where consumers would be charged more as a result of the migration.

Unintended costs

Option 2 limits unintended costs on end-users by ensuring that copper switch-off would only occur in cases where there is 95% FTTH coverage and prices to end-users for similar services would not be higher. It further ensures that consumers passed by the network have a right to be connected to the network as long as they pass within a certain distance that would be determined by the NRA (subject to possible right of refusal by the fibre network operator in case of disproportionality / impossibility of securing the connection). There could be unintended costs for those consumers which fall outside the 95% FTTH coverage. However, the possibility for national authorities to continuously review the situation and adopt appropriate remedies in terms of fibre deployment or of adopting alternative solutions, even in 2035, where the conditions are not met, would mitigate such risks.

In addition, provisions on universal service enable Member States to ensure universal availability meeting conditions for adequate broadband, in the event that the market would fail to deliver.

Given expected performance levels of new generation wireless and mobile technology as discussed in the Study on Finance and USO, it could be reasonably expected that mobile and wireless connections will allow similar performance to copper networks at the time of copper switch-off at similar prices. For example in Poland and Germany the least expensive double play offers with $\geq 100 < 200$ Mbps are based on LTE/5G, the least expensive $\geq 200 < 999$ Mbps double play offer in Poland is based on LTE/5G, the least expensive $\geq 100 < 200$ Mbps standalone offer in Romania, Slovakia and Sweden is based on LTE or 5G.

If this is not the case, and this results in digital exclusion, then Member States could step in to address the gap as explained above. Furthermore, any public expenditure needed to subsidise cost-effective wireless connections for the expected small proportion of households which may remain unserved with FTTH (anticipated at only 2% under option 2), is likely to be significantly lower than the public funds that will be saved as a result of extending the reach of commercially viable FTTH roll-out through copper switch-off. Direct costs in terms of subsidies needed to achieve high FTTH coverage while safeguarding broadband quality for users not passed by FTTH, are thus likely to be significantly lower under Option 2 than under the status quo.

Costs in relation to benefits

As regards assessing the benefits in relation to the costs copper switch-off as envisaged in Option 2 is likely to have significant impacts, in particular in certain countries, on the completion of connections along with the take-up of FTTH and on broadband speeds, without affecting prices. Improvements to the access regime to gather more precise market data, facilitate the use of Article 61(3), and to foster the implementation of best practice wholesale specifications should also have the effect of boosting competition on price and quality, resulting in take-up of higher speed broadband. Available academic literature suggests that this is likely to have significant and positive knock-on effects on GDP and reduce emissions associated with electronic communications.

1.1.1.4.Option 3

Option 3 would eliminate costs for operators and NRAs related to data gathering and market analysis under SMP regulation and Article 61(3). However, NRAs would still handle case-by-case dispute resolution, and the EC would review dispute results related to the “bottleneck” test. Evidence from countries like France, which have used dispute-led approaches, suggests this shift could increase costs and create delays due to the case-by-case nature of investigations. This option would reduce NRA oversight on copper switch-off, leading to cost savings for incumbents but potentially causing significant unintended costs for consumers, alternative investors, and broadband providers. Consumers might not be adequately served during copper switch-off, alternative investors could face processes favouring incumbents, and broadband providers might see deteriorated wholesale access conditions, further weakening their profitability. Only former incumbent operators believe the benefits of this option outweigh the costs.

1.1.1.5. Option 4

Option 4 would involve the following costs as a result of mandated measures.

- Requirement on copper network owners to establish copper switch-off plans and to make arrangements for the switch-off of copper networks by 2030.
- Requirement for Member States to establish FTTH coverage plans (as options 1 & 2)
- Requirement for NRAs to monitor fibre coverage by area
- Requirement for NRAs to collect forecasts and invite declarations in areas which are projected to be underserved
- Requirement for the EC or BEREC to provide guidelines on the terms and conditions for mandatory duct access
- Requirement for NRAs to settle disputes in relation to the obligation to make available wholesale access on fair and reasonable terms and conditions, including price
- Potential adoption by EC of Implementing Act establishing specifications for bitstream access, following consultation with BEREC

Option 4 would, like option 3 remove costs associated with data gathering and market analysis linked to the application of SMP regulation and Article 61(3), but would also (like option 3) involve a dispute resolution process. Moreover, unlike option 3, this would apply in a wide set of circumstances due to the symmetric access regulation associated with this option. Experience with the application of the BCRD dispute resolution process – which relates to only a limited set of wholesale products (i.e. access to ducts and poles). This would likely result in higher costs than the current market review process. Costs would also be spread across a broader base of operators, including potentially SMEs. All stakeholder groups with the exception of competent authorities responding to the survey consider that the costs of this option would outweigh the benefits

1.1.2. Comparison of direct (administrative) costs

An estimate of the direct FTEs associated with the application of the different options is provided in the following tables along with the status quo. The tables reflect, FTEs for competent authorities, FTEs for stakeholders and total FTEs. In making these assumptions, the following factors have been taken into account. All the calculations are provided by WIK-Consult in the context of the Study on Access Regulation, supporting the impact assessment.

- Regarding copper switch-off, a high proportion of Member States may already have experts devoted to addressing this topic, even amongst those which have not issued formal plans. For example, there are several activities ongoing in Germany on this subject, including pilot projects (costing 3.5 FTE per year according to an evaluation report²⁴¹) and discussions in a stakeholder forum, despite there being no plans announced by the incumbent and no decision from the NRA regarding conditions associated with copper switch-off. Additional costs for options advocating (Option 1) or requiring (Options 2 and 4) a CSO deadline are therefore associated with the expansion of these preparatory activities to those MS not already engaged in such activities and the extension of requirements e.g. to publish and monitor FTTH coverage and switch-off plans. It is assumed that under Option 1 (non-binding CSO) 4 additional FTEs would be involved on average in public authorities per Member State across the EU27. This would be increased to 7 additional FTEs per MS for Option 2 (which would allow an extended period, thus encompassing a timeframe in which resources would have been likely to be engaged under the status quo) and 10.5 for Option 4 (which would require accelerated CSO in 2030 without the potential for extension). This would be a one-off cost, spread over a limited number of years surrounding the CSO process.
- Regarding data gathering / geographic surveys under art 22, NRA questionnaires reveal that a significant amount of data is already gathered through this mechanism including data on coverage of specific technologies. Costs linked to additional data gathering requirements (in relation to Options 1, 2 and 4) therefore relate to the extension of data gathering to MS not already conducting such activities, and any extension in scope e.g. to gather data regarding forecasts, expand data gathering to better support the market analysis process (where this is not already the case) and potential to invite declarations for unserved areas. Options involving data gathering requirements (Option 1, 2 and 4) are anticipated to require set-up costs of 2FTE (centrally e.g. in the EC or BEREC) and 0,5 per NRA. As regards recurring costs, for option 1, it is assumed that the additional data gathering requirements would result in an uplift of 20% in resources associated with Art 22 geographic surveys for public authorities as well as for stakeholders compared with the status quo. This would increase to a 50% uplift for options 2 and 4 due to the additional requirements on reporting, and encouragement to make use of declarations to facilitate fibre deployment. While the expansion of Article 22 would be greatest under Option 4, with a requirement to make use of declarations, reporting focused on CSO would be concentrated in a narrower time period under this option.

²⁴¹ See:

https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Studien/2024/WIK_evaluation_report_pilot_copper_switch-off_Gigabit_Forum.pdf.

- The requirement to conduct a market review in relation to the copper switch-off process (option 2) is likely to result in increased one-off costs in countries which would need to conduct a market review earlier than the standard 5 year cycle or which would need to analyse markets (such as dedicated access) which may previously have been deregulated. One-off costs averaging 2 FTE per NRA have been assumed, although this is likely to be concentrated in affected countries. Options (potentially option 2), to the extent that they may involve the removal of an obligation for the EC to adopt a RRM without any requirement in law for NRAs to conduct a market analysis will result in widespread but relatively minor recurring cost increases arising from the requirement to conduct the 3 criteria test (which is not required today for market reviews of markets included in the RRM), in the event that no RRM is adopted. However, these cost increases are likely to be counterbalanced by cost reductions arising from the reduction in the number of market analyses conducted, leaving costs broadly similar.
- Options (option 3) which involve the removal of SMP regulation and limitation on symmetric regulation under Article 61(3) will continue to incur some recurring costs relating to Article 61(3) specifically regarding in-building wiring. In-building wiring obligations currently apply in 7 MS. It is assumed that this number will increase as FTTH deployment and connections expand. 50 FTE have been assumed EU-wide for this activity.
- Options (option 4) which remove SMP and symmetric regulation under Article 61(3) exception in-building wiring, but replace it with a regime subject to dispute resolution will have limited costs linked to SMP / 61(3) (assumed 50 FTE EU-wide as for option 2), but a significant increase in recurring costs associated with dispute resolution. Dispute resolution costs have been estimated by looking at costs associated with GIA dispute resolution (much of which relates to access conditions). This involved 133 FTE per annum based on data collected from DSBs and involves a single access product and associated information (Physical infrastructure / ducts and poles). It is assumed that there will be more disputes and therefore dispute-related costs in option 4 due to the obligations being applied on all operators than in option 3, where the scope of the access obligation is narrow.
- It is assumed that costs relating to the development of best practice wholesale access specifications will be proportionate to the complexity of the process, with higher costs linked to an EC Implementing Act (option 2) than BEREC guidelines (option 1 – where 2 FTE are assumed for 1 year + inputs from 0.5 FTE for each of the 27 MS), and higher costs linked to specifications for multiple wholesale products (included in options 1 & 2 compared with a single product (bitstream – option 4). It should be noted however that these are one-off costs, and are not likely to persist after 18-24 months. Additional one-off costs may be applicable to regulated firms in the event that wholesale specifications the introduction of or changes in the provision of wholesale products e.g., to provide additional flexibility in relation to a VULA product.
- From interviews conducted in the context of the IA associated with the EECC,²⁴² it is assumed that stakeholders as a group (mainly ECN and ECS providers) will

²⁴² <https://op.europa.eu/en/publication-detail/-/publication/ef401042-9a90-11e6-9bca-01aa75ed71a1>.

incur administrative costs of approximately double that applicable to the NRA, with more costs accruing to regulated firms e.g. in the context of SMP regulation then access seekers. These costs are linked to providing data and engaging with the NRA in the market analysis process and subsequent monitoring and enforcement proceedings.

- Costs have been derived from estimations regarding changes in FTE requirements on a one-off and recurring basis. The annual cost of an FTE has been calculated based on ISCO values of hourly earnings in 2022 + non-wage labour costs + 25% overhead, assuming that 50% of resources are ISCO 1 (legislators, senior officials and managers) and 50% are ISCO 2 (professionals), and that there are 250 working days per year each involving 8 hours of labour. The resulting annual cost for an FTE is EUR 95 400.
- These tables do not include costs incurred by end-users. These are likely to be substantial if they are required to bear the costs of fibre connections and/or the cost of upgrading legacy equipment. This is possible under option 4 (CSO without sustainability clause), but is precluded up to 2035 by the conditions linked to CSO under option 2.

Table A9 1-5: Estimated administrative costs (in FTE per year) to competent authorities

Option	FTTH and copper switch-off plans and implementation (one-off)	Data gathering under art 22, forecasts and declarations (one-off)	Data gathering under art 22, forecasts and declarations (recurring)	Market analysis, SMP and symmetric (art 61(3)) regulation one-off	Market analysis, SMP and symmetric (art 61(3)) regulation recurring	Best practice wholesale access specifications (one-off)	Dispute resolution in relation to EECC (recurring)
Option 0: Status quo	50		265		374	0	85
Option 1: Non-binding copper switch-off and limited updates to access regulation	108	15,5	318		374	15,5	85
Option 2: Conditional copper switch-off and updated access regulation	189	15,5	397,5	54	374	46,5	85
Option 3: Market driven copper switch-off and bottleneck-based access regulation	0	0	0		50	0	266

Option 4: Mandatory copper switch-off and symmetric regulation	283.5	15.5	397.5		50	15,5	532

Source: Study on Access Regulation

Table A9 1-6: Estimated administrative costs (in FTE per year) to stakeholders

Option	FTTH and copper switch-off plans and implementation (one-off)	Data gathering under art 22, forecasts and declarations (one-off)	Data gathering under art 22, forecasts and declarations (recurring)	Market analysis, SMP and symmetric (art 61(3)) regulation one-off	Market analysis, SMP and symmetric (art 61(3)) regulation recurring	Best practice wholesale access specifications (one-off)	Dispute resolution in relation to EECC (recurring)
Option 0: Status quo	100	0	530	0	748	0	170
Option 1: Non-binding copper switch-off and limited updates to access regulation	216	31	636	0	748	31	170
Option 2: Conditional copper switch-off and updated access regulation	378	31	795	108	748	93	170
Option 3: Market driven copper switch-off and bottleneck-based access regulation	0	0	0	0	100	0	532
Option 4: Mandatory copper switch-off and symmetric regulation	567	31	795	0	100	31	1 064

Source: Study on Access Regulation

Table A9 1-7: Total Estimated administrative costs (in FTE per year)

Option	FTTH and copper switch-off plans and implementation (one-off)	Data gathering under art 22, forecasts and declarations (one-off)	Data gathering under art 22, forecasts and declarations (recurring)	Market analysis, SMP and symmetric (art 61(3)) regulation one-off	Market analysis, SMP and symmetric (art 61(3)) regulation recurring	Best practice wholesale access specifications (one-off)	Dispute resolution in relation to EECC (recurring)
Option 0: Status quo	150	0	795	0	1 122	0	255
Option 1: Non-binding copper switch-off and limited updates to access regulation	324	46,5	954	0	1 122	46.5	255
Option 2: Conditional copper switch-off and updated access regulation	567	46,5	1 192.5	162	1 122	139.5	255

Option 3: Market driven copper switch-off and bottleneck-based access regulation	0	0	0	0	150	0	798
Option 4: Mandatory copper switch-off and symmetric regulation	850.5	46.5	1 192.5	0	150	46.5	1 596

Source: Study on Access Regulation

The following table shows the estimated change in one-off and recurring administrative costs taking costs for both public authorities and stakeholders into account. Option 1 is expected to be associated with a one-off cost of EUR 25 million, mainly associated with CSO and FTTH plans, as well as guidelines for the reporting of data and best practice wholesale products. One-off costs of around EUR 73 million are anticipated for option 2 linked to preparations for the mandatory switch-off of copper networks (as well as introduction of harmonised wholesale products) with slightly higher one-off costs for option 4 linked to intensified preparations for copper switch-off without the potential for extension beyond 2030. One-off cost savings of around EUR 14 million might be expected if it results in the removal of existing oversight mechanisms for copper switch-off, although this cannot be presumed. Regarding recurring costs, increases of 7% are expected for option 1 and 18% for option 2 (linked mainly to increased focus on data gathering), while an increase of 35% is expected for option 4 linked to the switch from ex ante regulation to the more resource-intensive process associated with dispute resolution. Cost savings of around 56% are expected from the removal of the market review framework under option 3 and its replacement with dispute resolution with a much narrower scope.

Table A9 1-8: Estimated change in one-off and recurring administrative costs

Option	One-off FTE (CSO + data + market review + wholesale products)	Change in one-off FTE	Change in one-off costs	Recurring FTE (Data gathering, market analysis, dispute resolution)	Change in recurring FTE	Change in recurring cost (EUR 000)	% Change in recurring cost
Option 0: Status quo	150	-	-	2.172	-	-	
Option 1: Non-binding copper switch-off and limited updates to access regulation	417	267	25 471 800	2.331	159	15.169	7%
Option 2: Conditional copper switch-off and updated access regulation	915	765	72 981 000	2.570	398	37.922	18%
Option 3: Market driven copper switch-off and bottleneck-based access regulation	-	- 150	- 14 310 000	948	- 1 224	- 116.770	-56%
Option 4: Mandatory copper switch-off and symmetric regulation	944	794	75 699 900	2.939	767	73.124	35%

Source: Study on Access Regulation

1.1.3 Impact on stakeholders

Impact on ECN operators

Relevant policies

Under option 2, the following provisions would impact ECN operators:

- From 2030, copper network owners (mainly former incumbents) that have not already done so would be expected to start switching off their networks in areas with at least 95% FTTH coverage. Where needed, operators must submit switch-off plans to the NRA.
- Geographic data: ECN operators must provide more granular geographic and technology-specific network data to the NRA or other competent authority.
- ECN operators must support the NRA in conducting any market analysis related to copper switch-off. This may involve additional work beyond the status quo if a new market review is triggered before the normal 5-year cycle.
- Wholesale product obligations: Where wholesale access obligations apply, operators would be expected to offer the standardised wholesale products listed in the DNA Annex.
- NRAs to make greater use of Article 61(3), including for access to in-building wiring and, in some cases, as an alternative to SMP WLA beyond the first distribution point.

Impacts of copper switch-off

Starting the copper switch-off process will entail some administrative and operational costs for copper network owners, as well as other ECN operators including broadband providers making use of wholesale offers and alternative fibre investors. However, as all copper networks will eventually be replaced with fibre, such operational costs would be incurred regardless of any EU obligation. The measure is changing only the timing of the migration.

As situations vary and limited concrete information is available from literature or via stakeholder consultation, it is not possible to quantify the implementation costs associated with earlier copper switch-off and migration in countries where the obligation may lead to earlier switch-off than would otherwise occur.

In this context, while there might be operational costs associated with an acceleration of the process, it is not clear to what extent (if at all) earlier implementation would affect the level of cost. Meanwhile, accelerating the process of FTTH deployment and reducing the timeframe for the parallel operation of copper and fibre is also likely to result in cost savings (both Capex and Opex) for ECN operators involved in the migration to fibre and (for copper network owners) the release of funds from the sale of copper earlier than might otherwise occur.

All the costs related to that option are discussed in detail in the previous chapter (Annex 9, p.1.1)

Distribution of costs and benefits amongst different operator types

The costs and benefits described above are likely to be attributed to different ECN operator types in the following ways:

Incumbent operators that have not widely deployed FTTH and are required to switch off copper earlier than planned may face additional administrative costs, including preparing CSO plans, supplying data, and engaging with NRAs. While precise incremental costs are unclear, copper owners in 18 Member States may need new or updated CSO plans. Assuming around 8 extra FTEs per affected Member State, this implies roughly 139 additional FTEs EU-wide (about EUR 13 million). If early market reviews are triggered, an estimated 54 extra FTEs (about EUR 5.2 million) may also be needed.

CSO implementation costs—system changes, operational adjustments, and consumer information campaigns—may be incurred earlier under option 2. Higher forced-migration rates could raise communication and customer-engagement costs. Some costs may ultimately be passed on to wholesale access seekers if fibre wholesale services continue.

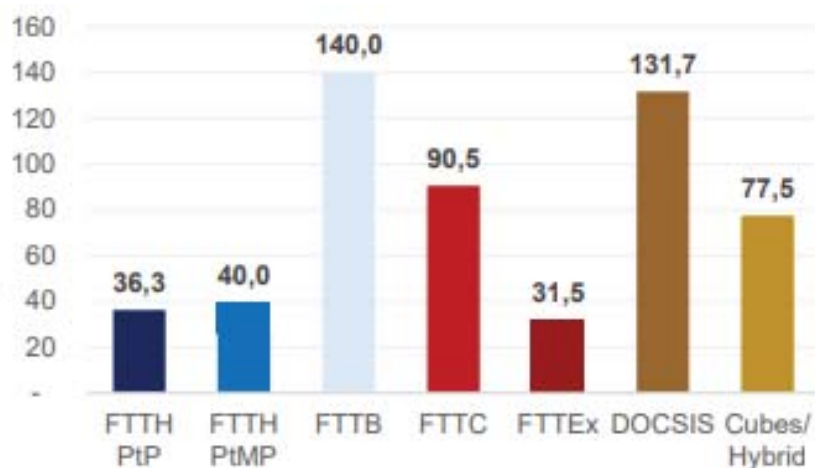
As regards indirect costs, earlier switch-off of copper networks which have been fully depreciated might affect profitability and ROCE of copper network owners. However, as noted in a WIK study for the German authorities,²⁴³ the impacts of CSO on profitability cannot be considered in isolation, and should also take into account profits incurred on a forward-looking basis over own-build or alternative fibre networks in the post-CSO environment. For example, even if a copper network owner has not deployed its own fibre network in a given area, if unbundled fibre is available on cost-oriented rates from an alternative provider, this should not in principle lead to reductions in profitability. It is also important to note that option 2 requires Member States to ensure that copper network owners switch off copper networks, while leaving the precise mechanism to the MS concerned. This might, if and where appropriate involve compensation, if considered appropriate.

Earlier copper switch-off could also accelerate financial gains from copper sales. Globally, operators are projected to generate over USD 15 billion from copper recovery over the next 15 years. For example, BT reported GBP 105 million from copper sales in 2024 and expects to recover up to 200 000 tonnes by the 2030s; Telefónica|Vivo aims to raise up to BRL 4.5 billion (EUR 711 million).

Finally, operational costs for FTTH are lower than for legacy networks due to reduced energy use and fewer faults. FTTH's superior energy efficiency relative to FTTC/FTTB is clear from the following diagram, which shows the average kWh of energy used per subscriber and year per technology in Austria.

²⁴³ See Lachmann, R.; Neumann, K.-H.; Wernick, C. (2025): Eine Modellanalyse zur Abschaltung des Kupfernetzes und zur Kupfer-Glas-Migration, p. 16, https://bmds.bund.de/fileadmin/BMDS/Dokumente/Studie_Modellanalyse_KGM.pdf (last accessed at 08.10.2025).

Figure A9 1-3: Average kWh per subscriber and year by technology in Austria



Source: https://www.rtr.at/TKP/aktuelles/veranstaltungen/veranstaltungen/veranstaltungen_2024/11122024/oekologische-effekte-des-glasfaserausbaus.de.html

Incumbent operators that have already invested widely in FTTH and plan to switch off copper by 2030 are likely to be largely unaffected; BEREC indicates this applies in 9 Member States. Others with substantial FTTH deployment but no concrete CSO plans may benefit from the obligation if it accelerates the removal of barriers to fibre rollout. The scale of these benefits depends on each operator's FTTH footprint relative to alternative fibre investors.

Alternative fibre investors without copper networks may face some administrative costs linked to CSO planning and contributing to Member States' FTTH deployment plans, though these would be far lower than those of copper network owners. If their resource needs amount to roughly half those of incumbents, this would imply about 70 extra FTEs (EUR 6.5 million) across the 18 Member States lacking CSO plans, plus around 27 FTEs (EUR 2.6 million) for participation in CSO-related market analyses.

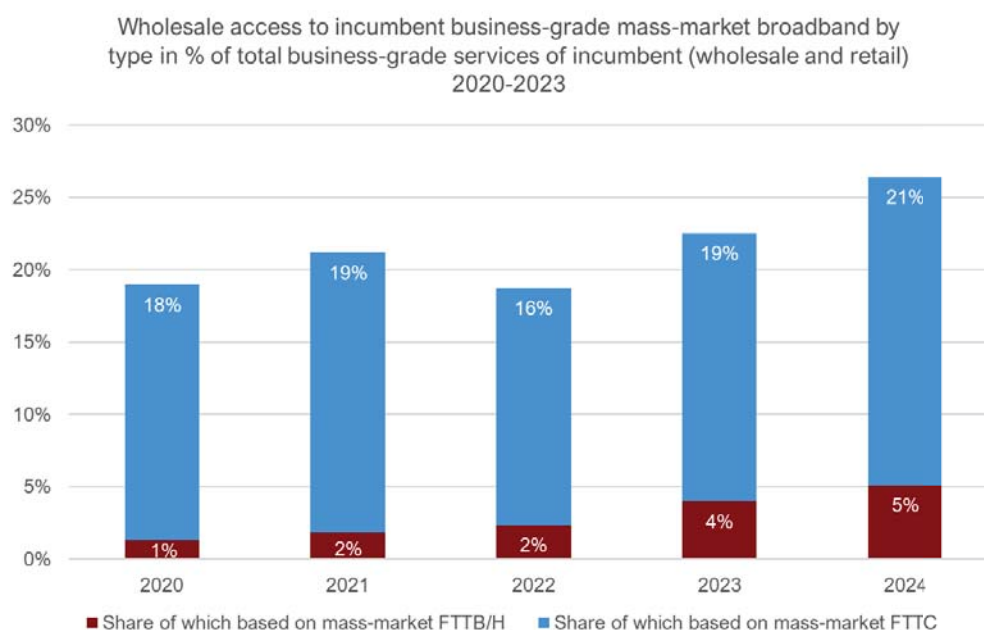
They will also need to ensure customers can be connected to their networks—e.g., deploying drop cables or in-building wiring—but these costs are generally passed on to end users through connection fees or monthly charges, and only arise where operators control in-building infrastructure. Unlike copper owners, they face no major additional operational costs from migration beyond switching and number portability.

Indirect effects are strongly positive. Alternative fibre investors stand to benefit most from CSO, as non-discriminatory switch-off would increase penetration on their networks, reduce risk, and improve profitability and ROCE. Many of these operators are currently highly leveraged and loss-making. Therefore, a binding CSO timetable would significantly improve investment certainty. Financial investors highlight that eliminating parallel copper networks enhances pricing dynamics, boosts take-up, strengthens long-term returns—especially in less dense areas—and improves valuations by providing more predictable cash flows.

Broadband service providers that depend on copper-based wholesale access may be negatively affected by the CSO obligation, as many still rely heavily on copper products in several Member States. They will face administrative costs linked to reviewing CSO plans and contributing to CSO-related market analyses to secure reasonable fibre wholesale terms. If their resource needs are roughly half those of copper network owners, this implies about 70 FTEs (EUR 6.5 million) for CSO planning and 27 FTEs (EUR 2.6 million) for market-analysis engagement across the EU. These providers will also incur implementation costs from system changes and customer communications. CSO mainly affects the timing of these costs, though they may rise if accelerated switch-off compresses resource needs or increases the volume of automatically migrated customers. Their dependence on copper is significant: copper and FTTC/VDSL still represent over half of all wholesale access supplied by incumbents to alternative operators. The greater degree of reliance on ADSL copper by access seekers compared with incumbents is also evident from data provided by NRAs which shows that for mass-market broadband services, as of 2023, 24% of total incumbent (wholesale and retail) copper (ADSL) lines were based on wholesale access. This compared with 14% of total incumbent (wholesale and retail) VDSL lines and 16% FTTH lines.

When considering the reliance of broadband service providers (altnets) on copper wholesale products, it is important to note that this applies not only to mass-market connections provided to consumers, but even more significantly to mass-market broadband connections provided with a business-grade SLA. This is illustrated in the following chart.

Figure A9 1-4: Wholesale access to incumbent business grade mass-market broadband by type in % of total business-grade services of incumbent (wholesale and retail) 2020-2023



Note: countries included here are Austria, Belgium, Bulgaria, Croatia, Ireland

Reliance by altnets on copper to serve business customers, is significantly greater than that of incumbents, although it is notable that as of 2023 38% of all non-dedicated business products from countries which reported such data, was provided on the basis of FTTC.

Indirect costs arise because broadband service providers will need to migrate copper customers to fibre networks, where wholesale conditions may be less favourable—particularly regarding pricing and service differentiation—unless regulatory safeguards are applied. Today, almost all wholesaled copper lines are physically unbundled, while only about 20% of fibre lines are, and copper and FTTC/VDSL products are often cost-oriented. By contrast, FTTH wholesale access is priced flexibly in many Member States.

As CSO removes copper-based competitive constraints, FTTH wholesale terms may worsen over time—especially where fibre becomes a monopoly or duopoly—unless NRAs intervene. Because wholesale-reliant broadband providers are generally less profitable than incumbents, any deterioration in wholesale conditions could disproportionately harm them. Providers that have co-invested in FTTH through regulated IRUs (available mainly in FR and IT) face lower risk.

Impacts of changes to access regulation

The additional cost associated with requirements to provide data to the NRA or other competent authority on a more granular level is likely to be relatively limited because (i) geographical surveys have already been implemented in the vast majority of member states, and some may already contain the necessary degree of detail, (ii) ECN operators should already have granular data available regarding the location and type of infrastructure for network planning purposes; (iii) the addition of data on the location of cables should be complementary to the mapping of existing physical infrastructure which is required for all ECN operators under the GIA; and (iv) most NRAs already require the provision of granular data in the context of periodic market analysis for the WLA market (regulated in 23 out of 27 MSs). Additional cost could be incurred by **ECN operators** to provide granular data regarding dedicated connections, as data gathered in the context of this study suggests that it was not collected by many NRAs (15 out of 27 did not provide detailed data regarding dedicated connectivity).

The additional resourcing needs relating to data gathering amongst ECN operators compared with the status quo could involve set-up costs of 4 FTE at EU level (to input into the development of guidelines) and 1 FTE per Member State amounting to total one-off costs around EUR 3 million. If recurring costs associated with data provision increase by 50% compared with the status quo this might require around 265 additional FTE EU-wide (approximately EUR 25 million), of which half may be attributable to incumbent operators and the remainder evenly split between alternative fibre investors and broadband service providers.

As regards benefits, if the resulting data is published, more stringent obligations regarding geographic data gathering could benefit ECN operators by providing evidence which could be used to support claims for intervention or deregulation in the context of market analyses.

Option 2 does not involve major s changes to the existing regime of access regulation. Specific one-off costs linked to the CSO-related market review have been covered under

the discussion of CSO. More generally, option 2 might lead to a more widespread imposition of access to in-building wiring under Article 61(3) which may entail some administrative inputs and implementation costs where not already applied (depending on decisions taken by the NRA), but contribute to substantial cost-savings for all operators deploying FTTH through sharing rather than duplication of in-building wiring in MDUs and office buildings. option 2 might also lead to Article 61(3) being used beyond the first distribution point for existing networks in some cases as an alternative to SMP WLA obligations. This should in principle give rise to administrative cost savings, as the Article 61(3) procedure should be more straightforward to apply than SMP in cases where there are multiple local monopolies. However, as the decision will remain with the NRA and the outcomes are uncertain, it is not possible to quantify such savings. The costs for the market analysis process will remain neutral for all parties involved under option 2.

While the effects would be delayed by the obligations to conduct market reviews associated with copper switch-off, it should be noted that there could be indirect effects in the event that the publication by the European Commission of the RRM, which lists relevant markets considered susceptible to ex ante regulation, becomes optional. This will result in indirect costs and benefits for **ECN operators** which will differ depending on the implications this has for specific operator groups that may have been (or might otherwise be) considered likely to be subject to ex ante regulation or may have relied on ex ante regulation to provide broadband services to end-users.

However, making the RRM optional does not guarantee that it will be removed (not adopted). The potential impacts discussed are hypothetical and depend on several factors, including NRAs actions. Therefore, the actual effects of a potential decision to make the RRM optional remain uncertain and contingent on future decisions and actions.

If the RRM is made optional this could be seen by financial markets as positive for **incumbent operators**, as these operators are currently subject to SMP designations and making the RRM optional will signal there may not be a perceived need for ongoing regulation in a fibre environment at EU level. This may raise expectations about the potential for deregulation of existing markets that are presumed to be susceptible to ex ante regulation. This effect is likely to be EU-wide due to the effect of the DNA in providing signals to the market and to NRAs, but is likely to be tempered by expectations about what NRAs may do at national level, which is likely to differ between the different countries.

Making the RRM optional could have mixed impacts on **alternative fibre investors**. On one hand, it could signal reduced NRA scrutiny of market power transferred to these operators post-copper switch-off in areas where incumbents did not deploy their own fibre networks. However, it could also decrease long-term certainty regarding wholesale access terms and limit focus on SMP regulation, including SMP PIA, which some investors rely on to deploy and sustain infrastructure. Deregulatory signals could undermine the market shares and positioning of alternative broadband service providers, detrimental to fibre investors reliant on them. The current proposal does not discuss the removal of the RRM. Even if it becomes optional, the impact on operators will be delayed until after 2035, as retail market analysis will act as a substitute for the RRM in the interim. In addition, the actions of NRAs need to be taken into account also in the long term.

Broadband service providers may face significant drawbacks if changes to the EECC make the RRM optional and there is a decision not to issue an RRM. This could reduce regulatory certainty in a fibre environment, signalling potential deregulation and increasing perceived risks. Higher risk perceptions could elevate their cost of capital, already higher due to project-based financing. The impact will vary by country based on existing access agreements and NRA proactivity. Overall, the risk for broadband service providers may increase, as they currently benefit from ex ante regulation in most Member States. However, for the reasons explained above many factors play a role in this context.

Standardised wholesale product

Under the preferred option, **all ECN operators** will face one-off administrative costs for developing standardized wholesale access product specifications for FTTH, QoS, and fixed wireless networks at the EU level and nationally (estimated at 93 FTE, ~ EUR 9 million). Incumbent operators will incur adaptation costs for wholesale specifications and interconnection points, but these may be recouped over time through charges for new wholesale products, including co-location and ordering system changes. Benefits could include faster infrastructure take-up due to competitive pricing and innovation.

For **incumbents** found to have SMP, mandating these specifications could increase market share, but may also lead to revenue loss if basic wholesale products replace more advanced ones. Alternative fibre investors would face similar costs and benefits, with additional potential gains from cross-border standardization.

Broadband service providers stand to benefit from product differentiation and innovation, though they will also incur adaptation costs. However, these benefits may be reduced if the focus on wholesale access regulation is limited. Overall, the impacts vary by market structure and the presence of SMP.

Table A9 1-9: Estimated costs and benefits to ECN operators linked to the preferred DNA option

		Incumbents		Alternative fibre investors		Broadband service providers	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Copper switch-off	Direct costs	CSO plan + contribution to FTTH plan where relevant Est 139 FTE (EUR 13 m) extra. CSO related market review 54 FTE ~EUR 5 m Migration costs (but would also be incurred in status quo).		CSO plan + contribution to FTTH plan where relevant Est 70 FTE (~EUR 6.5 m).. CSO related market review 27 FTE ~EUR 2.6 m		CSO plan + contribution to FTTH plan where relevant Est 70 FTE (~EUR 6,5 m). CSO related market review 27 FTE ~EUR 2.6 m Migration costs (but would also be incurred in status quo)	
	Indirect / unintended costs	For incumbents with high reliance on copper / limited FTTH, potential reductions in revenues and ROCE, but depends on replacement scenario incl. wholesale access conditions. Otherwise, limited negative effects				For altnets with high reliance on copper / limited FTTH, reductions in revenues and ROCE, but depends on replacement scenario incl. wholesale access conditions.	
	Direct benefits	Potential for accelerated sale of copper yielding significant revenues / cashflows		Increased penetration on FTTH networks			
	Indirect benefits	For incumbents which have deployed widespread FTTH, reduced barriers to switching, reducing Opex related to operating parallel networks For all incumbents – Reduced energy consumption and associated costs for operating fibre, reduced capital expenses associated with repairs over time		Increased revenues and ROCE		Reduced energy consumption / opex if able to access passive inputs or if benefits are passed on in wholesale offers	
Access regulation: Data gathering	Direct costs	Set-up of data gathering templates and processes est 15 FTE ~EUR 1.5 m	Increased data provision costs est 132 FTE extra (~EUR 12.6 m)	Set-up of data gathering templates and processes est 8 FTE ~EUR 0.7 m	Increased data provision costs Est 66 FTE extra (~EUR 6.3 m)	Set-up of data gathering templates and processes est 8 FTE ~EUR 0,7 m	Increased data provision costs est 66 FTE extra (~EUR 6,3 m)
	Indirect / unintended costs			Granular data gathering may highlight regional market power			
Access regulation: Potential increased use of Art 61(3) / Potential for RRM to be made optional	Direct costs		Likely no change (reduced number of reviews, but 3CT), although use of Art 61(3) beyond first distr point instead of WLA could reduce costs if used in cases of local monopoly		Likely no change (reduced number of reviews, but 3CT) although use of Art 61(3) beyond first distr point instead of WLA could reduce costs if used in cases of local monopoly		Likely no change (reduced number of reviews, but 3CT) although use of Art 61(3) beyond first distr point instead of WLA could reduce costs if used in cases of local monopoly

	Indirect / unintended costs	Greater incidence expected of legal challenge and associated cost in absence of RRM		Increased uncertainty regarding future approach to regulation Greater incidence expected of legal challenge and associated cost in absence of RRM		Deregulation signal likely to reduce valuations and increase cost of capital Greater incidence expected of legal challenge and associated cost in absence of RRM	
	Indirect benefits	Reduced costs / increased ease of deployment of FTTH if article 61(3) is applied more widely		Reduced costs / increased ease of deployment of FTTH if article 61(3) is applied more widely		Reduced costs / increased ease of deployment of FTTH if article 61(3) is applied more widely	
Access regulation: Harmonised wholesale products	Direct costs	Contribution to development of specifications est 46 FTE extra (~EUR 4.4 m) Product development and introduction – but added to wholesale charge		Contribution to development of specifications est 23 FTE extra (~EUR 2.2 m)		Contribution to development of specifications est 23 FTE extra (~EUR 2.2 m)	
	Indirect / unintended costs	Where standardised products applicable (subject to SMP finding), reduced scope to market active access -> reduced revenues and profits		Where standardised products applicable (subject to SMP finding), reduced scope to market active access -> reduced revenues and profits		Where standardised products applicable (subject to SMP finding), increased scope for price and quality differentiation -> increased profitability	

Source: WIK-Consult

National Regulatory Authorities (NRAs) and other competent authorities

Relevant policies

The preferred option has the following implications for NRAs and other competent authorities compared with the status quo:

- Requirement for NRAs to assess copper switch-off plans and to ensure that the process is handled effectively and in a manner that protects consumer welfare and preserves competition. Competent authorities will also engage in preparing FTTH plans and advise national governments in the context of copper switch-off.
- Requirement for NRAs or competent authorities to collect geographic data and assess progress regarding FTTH deployment and copper switch-off.
- Requirement to conduct a market analysis in the context of copper switch-off
- Possibility to consider application of Article 61(3) on own initiative. In the event that no RRM is adopted, removal of the existing requirement to analyse markets listed in the RRM, and a requirement to conduct the 3CT in addition to an SMP analysis for markets currently in the RRM. This may occur earlier, if markets are removed from the RRM.
- Requirement for EC in consultation with BEREC to adopt an Implementing Act to establish best practice specifications for wholesale access products, a requirement for NRAs and other competent authorities to take these into account when imposing wholesale access.

Copper switch-off

In relation to copper switch-off, SMP operators are already required to notify decommissioning plans to the NRA. The DNA is likely to affect the timing rather than the extent of NRAs' resourcing needs. In the nine countries planning CSO by 2030, few changes are expected.

Other countries may need more resources to oversee the transition to FTTH post-DNA implementation. Many Member States already have experts focused on this topic. For instance, Germany is engaged in various activities despite lacking formal plans. Additional costs will arise from expanding these activities to less-prepared Member States and extending requirements, such as reviewing switch-off plans, advising governments and accelerating FTTH deployment. Estimating precise costs is challenging without current resourcing data, but employing an additional 5 FTE per Member State (or 7-8 FTE in 18 Member States planning CSO before 2030) could require around 189 FTE, increasing resourcing needs by about EUR 13 million if 50 FTE are currently engaged in CSO support across the EU. Additionally, 54 FTE might be needed for market analyses related to CSO, costing around EUR 5 million.

The obligation to gather data at a more granular level will have limited resource implications in countries already collecting such data, based on the current code, but may increase the frequency of data gathering. Countries not currently collecting granular data will need additional resources, involving one-off costs to adapt data gathering systems and recurring increases in resources. Developing new guidelines at the EU level will also require resources. Set-up costs for new data gathering templates are estimated at 2 FTE at the EU level (e.g., in BEREC) and 0.5 FTE per NRA, totalling 15.5 FTE on a one-off basis, costing around EUR 1.5 million. A 50% increase in resources devoted to data gathering, based on current annual resources of around 265 FTE, would result in additional annual resourcing needs of 132.5 FTE, costing around EUR 12.6 million across the EU.

Changes to access regulation, with an increased focus on Article 61(3) for in-building wiring, may require additional resources. However, expanded use of Article 61(3) beyond the first distribution point could enable cost efficiencies, potentially balancing out the costs. If the RRM becomes optional, the need for ex ante regulation may decrease, reducing the number of market reviews over time. This could be counteracted by increased resources for conducting the 3CT for all markets and additional analysis triggered by regional data considerations. Overall, there is likely to be no change in resourcing and administrative costs associated with market reviews, but NRAs may face higher legal challenges and associated costs when they intervene.

For harmonized wholesale product specifications, set-up costs would be incurred by BEREC and contributing NRAs. This includes a one-off contribution of 2x3 FTEs over two years for developing BEREC guidelines and an additional 0.5 FTE per Member State over three years for national specifications. The total one-off resourcing need is estimated at around 46.5 FTE, costing approximately EUR 4.4 million.

Table A9 1-10: Estimated costs and benefits to NRAs and other competent authorities linked to the preferred DNA option

		NRAs and other competent authorities	
		One-off	Recurrent
Copper switch-off	Direct costs	139 FTE additional ~EUR 13.2 m for review of CSO plans 54 additional FTEs for CSO market review ~EUR 5.2 m	
	Indirect costs		
	Direct benefits		
	Indirect benefits		
Access regulation: Data gathering	Direct costs	15.5 FTE ~EUR 1.5 m for establishment of templates	132.5 FTE additional ~EUR 12.6 m
	Indirect costs		
	Direct benefits	More accurate data to input to geographic market analyses	
	Indirect benefits		
Access regulation: Extension of Article 61(3). Potential for RRM to be made optional	Direct costs	No change	No change although there could be cost savings if Art 61(3) is used instead of SMP WLA in cases of local monopoly
	Indirect costs	If RRM optional, reduced legal certainty / threat of legal challenge and associated costs Increased risk of under-regulation (but impacts mainly on ECN operators and end-users)	
	Direct benefits		
	Indirect benefits		
Access regulation: Harmonised wholesale products	Direct costs	46.5 additional to draft and implement ~EUR 4.4 m	Reduced associated costs with development of remedies
	Indirect costs		
	Direct benefits	Simplification / streamlining of process of defining remedies on ongoing basis	
	Indirect benefits		

Source: WIK-Consult

Consumers

Relevant policies

Consumers will be directly affected by the requirement for Member States to ensure that copper switch-off occurs in areas which have reached 95% coverage with FTTH and retail prices which allow equivalent services to be provided at no extra charge. In addition, consumers will be indirectly affected by changes to access regulation that influence choice, price and quality in broadband offers.

Copper switch-off

Regarding copper switch-off, as previously noted, the requirements under the DNA will affect the timing of a migration from copper to fibre that can be seen as inevitable. However, they will do so in a manner which seek to limit any negative impacts, and in particular the potential for increased costs, to consumers.

Regarding direct costs, copper switch-off and the associated FTTH deployment will require the deployment of in-building fibre wiring. In cases where this does not already exist in MDUs, this may involve costs for the deployment of such wiring, which may be met directly by consumers e.g. if it is the responsibility of the building owner, or indirectly, if the costs are met by ECN providers, but then passed onto consumers. Upgrades to fibre wiring are already required for major renovations under Article 10 GIA. However, accelerated fibre deployment under the DNA may also necessitate the accelerated deployment of in-building fibre in existing buildings. The manner in which these connection costs are passed on could be one important element addressed in the copper switch-off plan to be prepared by national authorities. Such costs can be minimised for example by adopting best practice standards and ensuring the sharing of wiring between multiple providers under Article 61(3). ECN operators could also commit to distributing connection costs over a longer period so that they do not impose an undue burden on consumers.

The preferred option seeks to ensure that all consumers passed by a fibre network within a given distance will have the right to connect at standard terms and conditions (which may be free if the connection is paid over time through the rental fee). The CSO requirement in the DNA should also make it more likely that connections are installed in parallel rather than sequentially. As discussed in relation to the impact on ECN operators, this should significantly reduce the total costs involved in installing connections, limiting the burden on consumers.

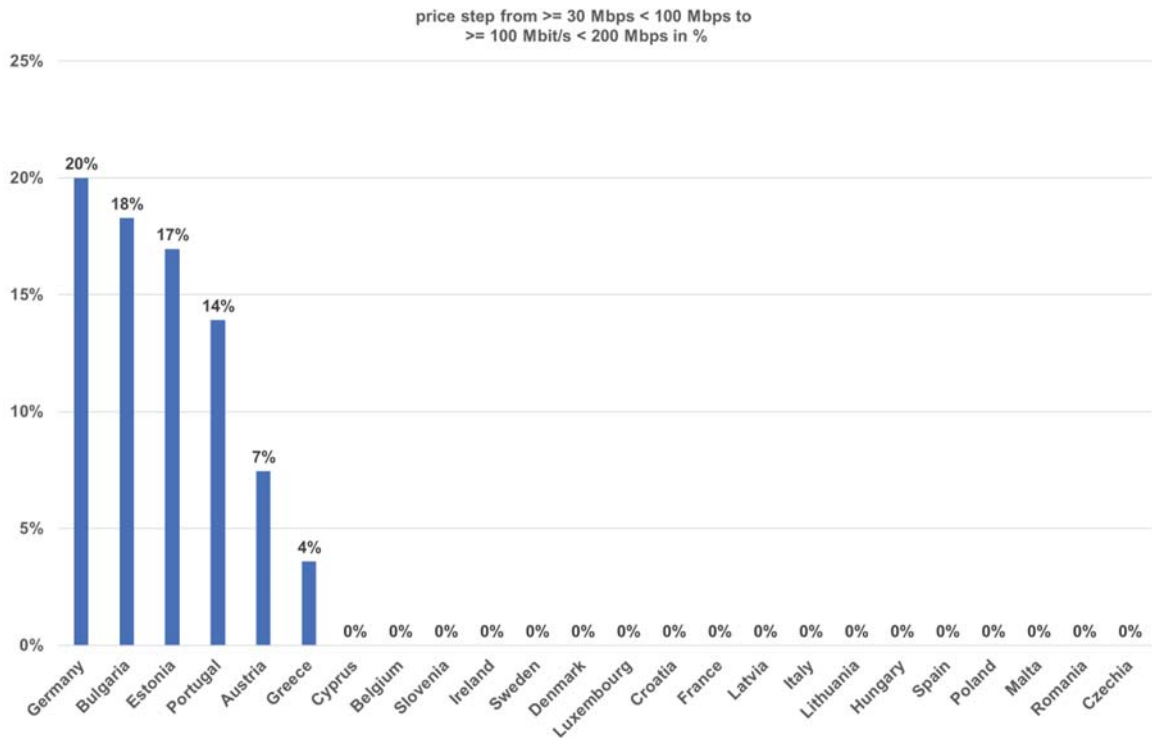
Regarding ongoing charges for fibre, the provisions in the DNA include provisions that switch-off should occur only if prices for equivalent services are not higher over the replacement infrastructure. This should ensure that consumers do not pay more for fibre-based broadband. In practice, evidence shows that significantly higher bandwidths over fibre are available at no extra charge to copper in the majority of Member States.

In fact, available data suggests that a mandatory transition from copper (incl. FTTC) to FTTH should result in end-users experiencing increased speeds and greater reliability for similar price. Recently published Empirica data shows (see figures below) that, as of 2023, in only 6 countries (DE, BG, EE, PT, AT, EL) would charges for an FTTH or cable connection of more than 100 Mbps be more expensive than an FTTC or ADSL connection at less than 100 Mbps for double and triple play including broadband and fixed telephony and TV in the case of a the triple play offer (the results are similar for standalone broadband).

Indeed, the presence of such a difference could prompt a review in these outlier countries of whether competition on fibre (including via access regulation where necessary) is sufficient to ensure that retail prices remain competitive following copper switch-off.

Evidence from the vast majority of other countries suggests that better quality connections should be available for no extra charge.

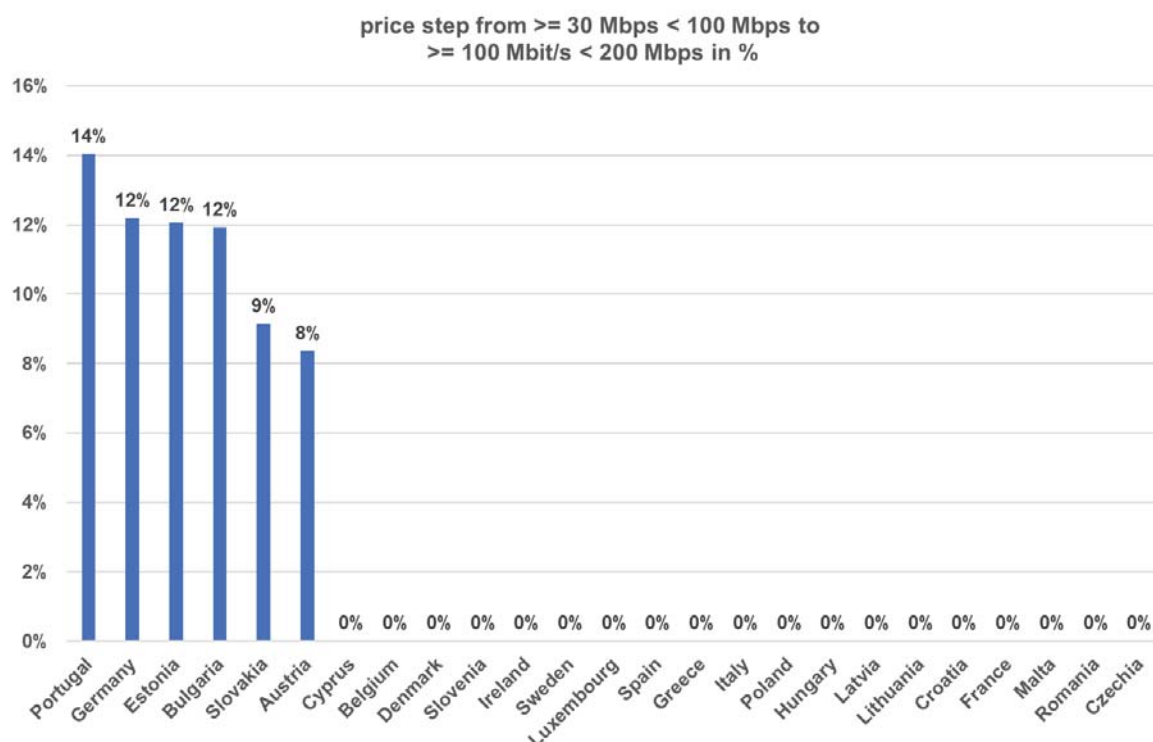
Figure A9 1-5: Double play pricing – difference between copper and cable or fibre-based connections from $\geq 30 < 100$ Mbps to ≥ 100 Mbps < 200 Mbps (internet and phone)



Note: The Netherlands and Slovakia excluded as least expensive offer based on xDSL. $\geq 100 < 200$ Mbps offers in Poland and Germany based on LTE/5G. No data was available for Finland.

Source: empirica (2025): Mobile and Fixed Broadband Prices in Europe 2023, Prices as of October 2023, least expensive fixed broadband offer.
<https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-price-europe-2023-insights-european-broadband-market>

Figure A9 1-6: Triple play pricing – difference between copper and cable or fibre-based connections from ≥ 30 Mbps < 100 Mbps to ≥ 100 Mbps < 200 Mbps (internet, phone and TV)



Note: Netherlands not included in this graph as prices referred to xDSL offer. No data was available for Finland. Germany and Estonia refer to cable.

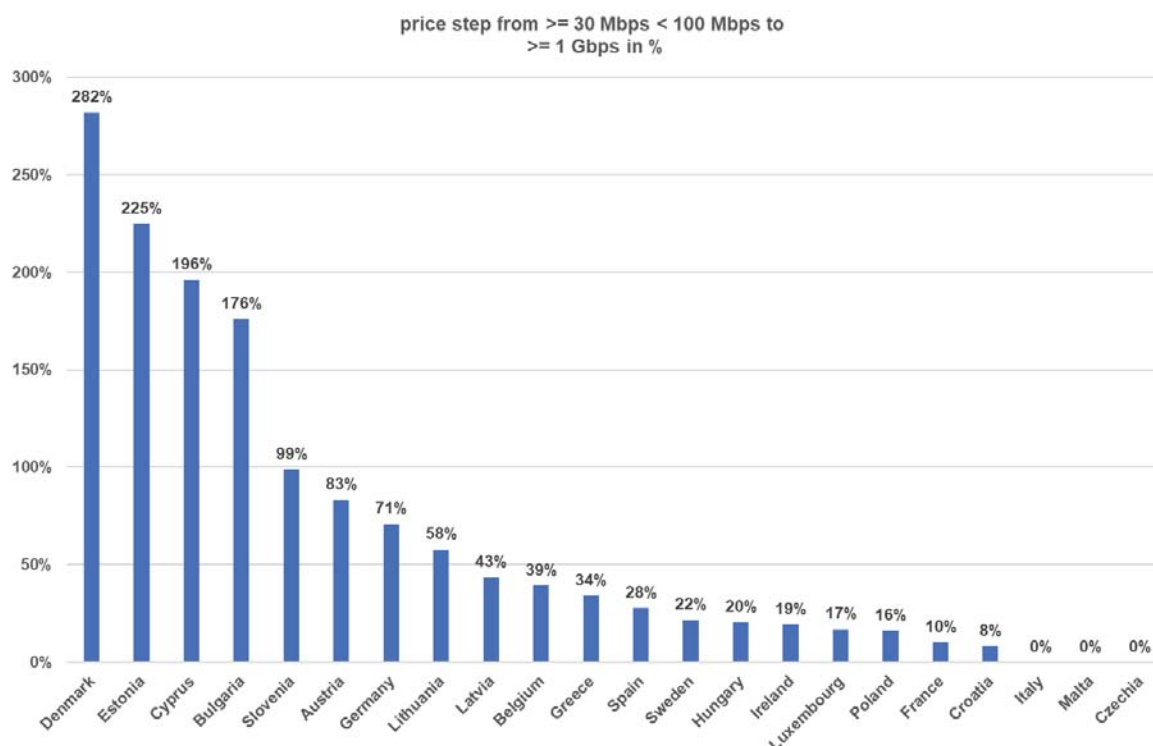
Source: empirica (2025): Mobile and Fixed Broadband Prices in Europe 2023, Prices as of October 2023, least expensive fixed broadband offer.

<https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-price-europe-2023-insights-european-broadband-market>

This finding is consistent with the fact that, when unviable duplication of infrastructure is removed via copper switch-off, thereby removing the demand-risk associated with parallel operation of copper and fibre which would otherwise increase the WACC, the cost of fibre-based broadband is not intrinsically higher than that of copper-based broadband. NRAs have for some time based charge controls on copper networks on the basis of bottom-up models in which costs are based on FTTH as the modern equivalent asset.

As can be seen from the following chart, the migration from low-speed copper to double and triple play offers with Gigabit speeds could be associated with considerable price increases in some countries. However, while the transfer to a fibre connection should provide additional options for consumers, there is no obligation for consumers to upgrade to Gigabit and incur these extra charges. Moreover, and importantly, the obligation under the preferred option for NRAs to conduct market reviews in connection with CSO could provide an opportunity for NRAs to address any barriers to competition (including inadequately specified wholesale products) that are preventing Gigabit speeds from being offered at competitive rates.

Figure A9 1-7: Double play pricing – difference between copper and cable or fibre-based connections from $\geq 30 < 100$ Mbps to ≥ 1 Gbps (internet and phone)



Note: The Netherlands, Poland, Portugal, Romania and Slovakia excluded as offer refers to bandwidth below 1 Gbps. No data was available for Finland. Germany and Estonia based on cable.

Source: empirica (2025): Mobile and Fixed Broadband Prices in Europe 2023, Prices as of October 2023, least expensive fixed broadband offer.

<https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-price-europe-2023-insights-european-broadband-market>

In summary, under the preferred option, the vast majority of consumers and businesses will benefit from higher speeds and reduced environmental impacts as well as reduced energy consumption compared with the status quo. Attention to the maintenance of competition during the copper to fibre migration along with legal safeguards should mean that consumers benefit from higher quality broadband at no additional cost. However, a limited proportion of consumers may need to switch to wireless and/or mobile solutions. There is evidence to suggest that in most cases, these wireless technologies already provide capabilities that are comparable to those available over copper. Thus, even consumers which are not served with FTTH should not be disadvantaged by copper switch-off. In the event that this is not the case, Member States could allow, following the 2035 review, the continued use of copper in residual areas where the deployment of fibre would not be viable or take action to secure an appropriate safety net via USO measures for those consumers who are not served with an FTTH network when copper is switched off to ensure an adequate internet access service.

Access regulation

Although they may not benefit directly from changes to access regulation, consumers should benefit from increased choice and quality on their fibre connections in situations where harmonised wholesale products are introduced. The wider scope of application of Article 61(3) which has been achieved very positive outcomes in countries such as France, could also help to support increased competition on fibre networks in countries where there are multiple local monopolies.

On the downside, in the event that there is no RRM and NRAs do not act proactively to ensure appropriate access regulation on fibre networks, consumers could face the risk of increased prices for broadband and constraints on quality. However, as explained also above, the review of the RRM is a separate process. In addition, a potential Commission decision to make the RRM optional in the text of the DNA does not automatically imply that there is a decision not to issue a RRM. NRAs in the vast majority of countries expect that, following copper switch-off, there will be only one FTTH network reaching the majority of households with a high proportion of duopoly, and very limited presence of three or more infrastructures. Financial investors note that network duplication should be minimised and enabled only in the densest areas, reaching around 20% of households. Therefore, NRAs will need to assess risks of exploitative pricing and limitations on quality and act as needed.

Assuming that it serves to ensure that NRAs address competition problems in broadband markets, the preferred option should increase take-up of Gigabit connectivity compared with the status quo, due to the combined effects of CSO on FTTH coverage and the development of harmonised wholesale product specifications which enable competition on quality. Projections suggest that in concrete terms consumers could benefit from increased broadband speeds (from 176 to 743 Mbit/s in 2035) under the preferred option, compared with speeds of 584Mbit/s in 2035 under the status quo.

Table: A9 1-11: Estimated costs and benefits to consumers linked to the preferred DNA option

		Consumers	
		One-off	Recurrent
Copper switch-off	Direct costs	In-building wiring (where not already deployed), but would also occur later under status quo – and could be minimised and distributed over time as part of the CSO process	None – as the conditions prevent CSO which would lead to higher prices
	Indirect costs	Disruption associated with migration. A limited % of consumers may need to be transitioned to FWA / mobile, but these often offer equivalent speeds to copper and (if not) action could be taken under CSO to support minimum quality guarantees	
	Direct benefits	Higher speeds and more reliable connections at no extra cost	
	Indirect benefits	Positive impacts on growth, jobs and sustainability	
Access regulation: Data gathering	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	N/A – although may affect outcomes of market analysis (see below)	
	Indirect benefits		
Access regulation: RRM made optional	Direct costs	N/A	
	Indirect costs	In the event that the RRM is made optional, there would be a risk of under-regulation / lack of targeting in regulation leading to reductions in competition and associated limitations in choice, quality and reasonable pricing. Under preferred option, some consumers needing Gigabit connections may not be served with such connections at an affordable price	
	Direct benefits	N/A	
	Indirect benefits	N/A	
Access regulation: Harmonised wholesale products	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	Where applied, potential for greater competition in quality (higher speeds for same price)	
	Indirect benefits		

Source: WIK-Consult

Large enterprises

Large enterprises will be directly affected by the obligation to switch off copper networks by 2030. In addition, enterprises will be indirectly affected by changes to access regulation that influence choice, price and quality in broadband offers.

Copper switch-off

Large enterprises will incur migration costs for copper-based leased lines, such as those used for alarms and elevators, to alternative technologies like fibre, wireless, or mobile connections. One-off costs include purchasing new equipment, while ongoing costs may involve differences in broadband pricing. These costs are inevitable but CSO obligations primarily affect their timing. The scale of changes needed is significant but data is limited. Network operators and service providers have successfully migrated from PSTN to all-IP, suggesting similar success for CSO. Delays in migration could lead to economic losses, as noted by BT Group, emphasizing the need for timely migration to avoid productivity and participation losses.

Enterprises will benefit from wider fibre connectivity, improved reliability, and quality of connections. However, dedicated connections offering multi-Gigabit symmetric capabilities will be crucial for advanced use cases, especially outside dense areas. Large enterprises will be more affected by gaps in FTTH availability, highlighting the importance of addressing dedicated connectivity in market reviews. Overall, CSO can raise awareness and ensure timely planning, addressing migration challenges without necessitating deadline extensions.

Access regulation

Large enterprises could benefit from NRAs gathering more granular data on fibre rings and point-to-point connections, and from harmonized wholesale specifications for Ethernet leased lines and business-grade QoS. However, they may be negatively impacted, in case of deregulation of the dedicated business connectivity market, if the market review process and remedies become optional if there is a removal of the RRM. Currently, only 15 out of 27 NRAs regulate the dedicated connectivity market, and many lack market information.

Table A9 1-12: Estimated costs and benefits to large enterprises linked to the preferred DNA option

		Consumers	
		One-off	Recurrent
Copper switch-off	Direct costs	In-building wiring (where not already deployed), costs associated with replacement of legacy analogue equipment but would also occur later under status quo	Equivalent service quality for the same price should be assured at least for mass-market grade connections. For business-grade connections (dedicated capacity) the market review requirement connected to CSO should seek to address any barriers to competition
	Indirect costs	Potential gaps in availability of dedicated capacity for critical applications Disruption associated with migration including replacement of analogue equipment.	
	Direct benefits	Greater availability of Gigabit-capable broadband. Higher quality connections for the same cost	
	Indirect benefits		
Access regulation: Data gathering	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	N/A – although may affect outcomes of market analysis (see below)	
	Indirect benefits		
Access regulation: RRM made optional	Direct costs	N/A	
	Indirect costs	In the event that the RRM is made optional, there would be a risk of under-regulation / lack of targeting in regulation leading to reductions in competition and associated limitations in choice, quality and reasonable pricing. This risk may be increased for dedicated capacity compared with mass-market, as there is already less data and attention given to this market	
	Direct benefits	N/A	
	Indirect benefits	N/A	
Access regulation: Harmonised wholesale products	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	Where applied, should increase availability of QoS guarantees for business and dedicated capacity	
	Indirect benefits		

SMEs

Affected SMEs include smaller telecom infrastructure and service providers as well as small and medium enterprises and smaller public sector bodies (such as GP surgeries, schools) in the wider economy.

SMEs in the telecom sector will be directly affected by both the obligation to switch off copper networks by 2030 as well as changes to access regulation.

SMEs in the wider economy will be directly affected by the obligation to switch off copper networks by 2030. In addition, such SMEs will be indirectly affected by changes to access regulation that influence choice, price and quality in broadband offers.

Copper switch-off

SMEs in the telecom sector are likely to be affected by copper switch-off because this category of actor is likely to include smaller ISPs which rely on wholesale access to offer retail services to end-users. Due to the small scale of these providers, such connections are likely to be on a rental basis rather than IRU and may include a high proportion of copper wholesale access lines, in certain countries. Copper switch-off will force such players to find alternative sources of access, and may impact profits and the ongoing viability of such actors, in particular if wholesale access options on fibre are not available on reasonable terms and conditions. The role of the market review to be conducted in the context of CSO will therefore be important in addressing reductions in competition arising from CSO that may be detrimental to these stakeholders. On the other hand, smaller players offering wireless services could benefit from new business in cases where copper switch-off leaves gaps in the availability of connections, which need to be addressed through alternative technologies.

SMEs in the wider economy will need to migrate existing copper-based leased lines, including those used for applications such as alarms, elevators, to alternative technologies. In some cases, for critical connections, dedicated fibre connections may be appropriate. In other cases wireless or mobile connections could be adequate. One-off migration costs may involve the purchase of new equipment, while ongoing costs may include differences in pricing associated with the broadband connections offered via alternative technologies. SMEs may be more affected by these migration challenges than large enterprises, as there may be a higher share of legacy equipment, although the precise proportion of SMEs affected is not known. While costs are inevitable during this migration process, they would also occur in the status quo. The main impact of the CSO obligations would be on the timing of those costs. SMEs are expected to reap significant benefits from copper switch-off, through the wider availability of FTTH connectivity, and associated improvements in reliability and quality of connections, which will support a wide range of applications. However, dedicated connections offering multi-Gigabit symmetric capabilities will be needed to support advanced use cases in the coming decades, for SMEs, and smaller public sector bodies as well as larger businesses, in particular where they seek to make use of services involving big data processing and two-way video communication. For SMEs to reap the benefits, it will therefore be important to ensure that such connections can be provided, in particular outside very dense areas, noting that SMEs and smaller public sector bodies are likely to be dispersed across the country. It should also be noted that businesses and public sector bodies in general including SMEs would be more affected than residential consumers by gaps that may be caused by requirements for copper switch-off in areas where there is no FTTH network available (and the potential for dedicated connectivity) for a portion of premises (even if less than 5%), because cable and wireless would not provide a substitute for critical use cases. The role of market reviews and associated access regulation in less dense areas is therefore particularly important to address the needs of SMEs based outside large cities.

Access regulation

SMEs could benefit indirectly from requirements for NRAs to gather data at a more granular level, if such data includes information about the reach and location of fibre rings and point to point fibre connections providing dedicated capacity as well as FTTH. They will also benefit from measures to include Ethernet leased lines and business grade QoS in a list of harmonised wholesale specifications at EU level. However, they are likely to be disproportionately negatively impacted compared with residential consumers in the event that RRM is removed. A lack of an RRM and / or associated guidance at EU level to require an examination of markets could also have the effect of reducing attention to business grade QoS in relation to “mass-market” products such as fibre unbundling and FTTH VULA.

Demand modelling based on evolutions in applications and the requirements of SMEs suggest that 50% of SMEs will require Gigabit connectivity by 2035, and many will require symmetric bandwidths. The preferred option could make a substantial contribution to ensuring that these needs are met.

Table A9 1-13: Estimated administrative costs to SMEs (in the wider market) linked to the preferred DNA option

		Consumers	
		One-off	Recurrent
Transition to fibre	Direct costs	In-building wiring (where not already deployed), costs associated with replacement of legacy analogue equipment but would also occur later under status quo. The limited right to connectivity under the preferred option should protect SMEs that others might be refused or charged excess fees for connection to the fibre network	CSO conditions should ensure that fibre-based access is available at no extra charge
	Indirect costs	Some SMEs may be forced to rely on FWA or mobile following CSO. Depending on specifications, this may not meet the requirements of business. Attention could be given to this issue in the context of USO, if needed. Potential gaps in availability of dedicated capacity for critical applications. Attention could be given to this issue in the context of the market review process Disruption associated with migration including replacement of analogue equipment.	
	Direct benefits	Greater availability of Gigabit-capable broadband, in areas where copper switch-off by 2030 would support the business case for FTTH deployment	
	Indirect benefits		
Access regulation: Data gathering	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	N/A – although may affect outcomes of market analysis (see below)	
	Indirect benefits		
Access regulation: RRM made optional	Direct costs	N/A	
	Indirect costs	Risk of type II errors (lack of intervention where it might be warranted) / lack of targeting in regulation leading to reductions in competition and associated limitations in choice, quality and reasonable pricing. This risk may be increased for dedicated capacity and mass-market with business-grade QoS compared with mass-market, as there is already less data and attention given to these markets. The gap between demand for Gigabit and take-up under this option may not be fully closed and is likely to be dependent on the approaches taken by individual NRAs	
	Direct benefits	N/A	
	Indirect benefits	N/A	
Access regulation: Harmonised wholesale products	Direct costs	N/A	
	Indirect costs	N/A	
	Direct benefits	Where applied, should increase availability of QoS guarantees for business and dedicated capacity	
	Indirect benefits		

1.2 Spectrum

The comparison of the Spectrum options from the perspective of Relevance and EU added value:

Relevance

The baseline is not well-suited to meet current and future investment needs in gigabit networks, 5G/6G, and next-generation infrastructure. It perpetuates regulatory fragmentation and uncertainty, discouraging large-scale deployment. **Option 1** is relevant as it introduces long-term licensing predictability and voluntary alignment tools. **Option 2** responds more closely to evolving needs, introducing renewal guarantees and placing investment sustainability at the centre of spectrum policy design encouraging 5G SA deployment and ensuring a solid bridge towards 6G in EU. Binding authorisation rules, mandatory spectrum sharing (without prejudice to competition law), and the removal of barriers to flexible spectrum access support new market entrants and business models. With a focus on coordinated timing of awards, this option promotes harmonised EU-wide 6G deployment in strategically important bands. **Option 3** is particularly relevant for addressing pan-European investment models, cross-border consolidation, future shared infrastructure, and strategic initiatives like the EU Digital Decade and the Connectivity Toolbox, by ensuring consistency, scalability, and long-term visibility. Indefinite license duration and harmonised award conditions promote consistency, scalability, and long-term certainty across Member States.

EU added value

The baseline leaves investment incentives and regulatory certainty entirely in the hands of Member States. **Option 1** demonstrates added value through voluntary tools that encourage convergence and partially reduce regulatory risk. **Option 2** achieves greater EU added value by embedding investment-related criteria into auction designs, thus promoting effective competition, and aligning spectrum policy with broader EU investment rules and goals (e.g. Digital Decade). The ability of the Commission to recommend binding authorisation conditions for private networks, support pro-security rules, and promote spectrum sharing strengthens the Union's capacity to support innovative and secure connectivity models. Coordinated EU and national roadmaps for spectrum awards ensure better synchronisation of high-value bands. **Option 3** provides the clearest added value in the long term, creating a harmonised investment environment that reduces transaction costs, increases cross-border consistency, and strengthens the EU's collective ability to deliver on infrastructure goals through stable spectrum governance. It enables fully scalable and predictable rollout conditions across the Union, thus possibly fostering cross-border consolidation and telcos obtaining scale in a potentially wider market. The short and medium term added value is instead less prominent due to the needed to very complex task to synchronise licence expiry dates and band-specific conditions to enable centralised auctioning, inefficiencies linked to the limited ability of operators to reallocate spectrum efficiently, slow change of market structure and related transition inefficiencies.

Conclusion: the options have the following main outcomes:

- Option 1: Limited benefits due to non-binding measures.
- Option 2: Boosting 5G and future 6G deployment through increased predictability, pro-investment spectrum authorisation and efficient use in the Single Market, incentivising cross-border provision of services and scale.
- Option 3: entails the highest costs with comparable outcomes. While it would have the benefit of facilitating cross-border consolidation it would represent a direct intervention in the market structure.

1.3 Authorisation

Relevance

The relevance of the **baseline scenario** for the current and future needs and the intervention objectives is low as it does not address the need to simplify rules and is not conducive to creation of more cross-border ECNs/ECSs. **Option 1** is more relevant than the baseline since it addresses the need of simplification and defragmentation of rules related to general authorisation, supports the broader competitiveness of the sector and the creation of cross-border services and networks. However, it is unlikely to fully meet stakeholder needs and stops short of addressing the regulatory gaps in access conditions for new satellite constellations, limiting its relevance for future-focused strategic goals such as space competitiveness, sovereignty and secure connectivity. **Option 2** is more relevant in addressing the need for simplification and full harmonisation and considers the emerging realities of more virtualised networks and more software-based innovative services. Problematic aspects from the point of view of stakeholders' areas (e.g. data retention, lawful interception) are also addressed (cooperation mechanism to ensure compliance with applicable conditions, including resulting from other acts than DNA, but still relevant for authorised DNA providers). EU satellite authorisation is also the most relevant to the emerging realities of the satellite sector and EU strategic needs. It positions the EU as a prominent and influential actor in the rapidly evolving space industry, and provides the strongest basis for the development and operation of sovereign, pan-European satellite infrastructure, and facilitates the enforcement of security and competition-related safeguards. It supports scalable, secure, and investment-friendly access to spectrum, particularly important in the context of the Union Secure Connectivity Programme and deployment of multi-orbit satellite systems. **Option 3** introducing the country of origin principle is the less relevant to current challenges, it requires mutual recognition and might incentivise forum shopping practices.

EU-added value

EU added value of the **baseline scenario** will continue as the current rules provide for reduced administrative burden for cross-border operators; however, for satellite authorisation, the fragmented approach undermines the EU's capacity to support pan-European satellite networks, enforce common conditions, or ensure strategic autonomy in space. **Option 1** produces a moderate EU added value for cross-border providers and new entrants, especially for SMEs, as it simplifies the relevant rules and procedures across all countries. However soft harmonisation will not fully address fragmentation, in all areas. Decision-making remains national and the role of the BEREC Office is limited to a limited one-stop-shop functionality, for the purposes of implementation and enforcement. **Option 2** brings high EU added value as full harmonisation could not be achieved by Member

States acting alone. Especially EU satellite authorisation significantly increases EU added value by reducing administrative burden for the industry and establishing a clear role for EU level governance (the Commission/Office/RSPG) in satellite spectrum selection, licensing and enforcement. It supports transparent market access and introduces a unified approach to handling scarcity and interference, protecting internal market integrity, promoting secure and competitive services, and ensure alignment with strategic objectives. It positions the EU as the primary actor for ensuring spectrum policies support secure, scalable, and strategically autonomous satellite communications. **Option 3** brings the lowest EU added value since it is based on a country-of-origin principle that increases national fragmentation and incentivises forum shopping practices, which are detrimental to the intervention objectives.

In **conclusion**, the options have the following main outcomes:

- Option 1 – has limited benefits due to partial harmonisation.
- Option 2 – facilitates compliance and removes excessive national requirements for general authorisation and offers the highest level of effectiveness considerably simplifying satellite authorisations.
- Option 3 – introduces the country-of-origin principle, but only for a subset of providers and risks/incentivise forum shopping practices in areas that cannot be fully harmonised such as national security.

Based on the above assessment option 2 is considered the preferred option.

1.4 Governance

The comparison of the Governance options from the perspective of Relevance and EU added value:

Relevance

The relevance of the EECC regulatory structure is likely to increase under **option 1** due to the Commission empowerment to make decisions on certain cross-border (spectrum) tasks. The BEREC Office would likely increase in effectiveness and hence relevance if it is enhanced to support BEREC and the RSPG on substance and administrative matters. However, this is somewhat diminished in this option (compared to option 2) as the RSPG and BEREC will remain without legal personality and cannot adopt binding decisions. Compared to the baseline and option 1, the relevance of **option 2** is potentially higher as it positions the Commission and BEREC to respond more effectively to new challenges and opportunities in relation to spectrum and cross-border tasks. However, as in option 1, RPSG would retain an advisory role, potentially limited gains in relevance compared to the baseline. In **option 3**, empowering the Commission to monitor certain cross-border tasks and empowering BEREC and RSPG to take decisions in this area may lead to an increase in relevance in this area compared to the baseline (although the impact will be smaller compared to under option 2, given the more limited competences granted to the Commission). The creation of the RSPG as a fully-fledged agency may increase the relevance of the latter, but the creation of two separate agencies (BEREC and RSPG) may limit the ability to respond quickly to emerging issues.

EU added value

The increased administrative and on the merit support provided by the BEREC Office under **option 1** could lead to more consistent regulatory outcomes across Member States, thereby further contributing to the completion of the single market in electronic communications as compared with the baseline scenario, where currently the support from the BEREC office is limited to administrative tasks. In particular, by empowering the Commission to adopt decisions on spectrum, option 1 will contribute to the establishment of the Single market and facilitate pan-EU provision of wireless services, including satellite services. **Option 2** would ensure that operators – in particular cross-border and satellite operators – benefit from centralised regulatory decisions that individual actions by Member States may not achieve. However, effectiveness and efficiency gains may be reduced by BEREC and the RSPG remaining separate entities, limiting also the EU added value of this option. Empowering the Commission to monitor certain cross-border tasks with BEREC and RSPG as independent agencies with decision-making powers in **option 3** could enhance EU added value by ensuring that spectrum policies are effectively implemented across Member States and cross-border issues are resolved in a consistent manner. However, the potential for duplication may limit the overall added value of this option.

In **conclusion**, the options have the following main outcomes:

- Option 1: ensures required outcomes with moderate cost increase while retaining the tested structure;
- Option 2: provides slightly better outcomes with higher costs;
- Option 3: entails the highest costs with lower outcomes.

Option 1 is considered to be the preferred option.

2. FURTHER BACKGROUND HOW THE ACTUAL IMPACTS WILL BE MONITORED AND MEASURED

2.1 Transition to fibre and access regulation

As regards transition to fibre and access regulation, the specific objectives are to increase FTTH coverage and take-up. The actual impacts of the legislative act will be evaluated based on relevant monitoring indicators, assessing its effectiveness in achieving its intended objectives. The evaluation will inform future decision-making and potential revisions to the legislation, ensuring its continued relevance and impact. The specific objectives will be monitored through the following indicators:

FTTH homes passed absolute and as % HH, FTTH homes connected, and take-up FTTH, with a target of 95% FTTH coverage by 2035 and 78% FTTH take-up as % HH by 2035, measured annually.

Prices for Gigabit broadband, take-up of Gigabit broadband as % total broadband, and HHI in Gigabit-capable broadband, with a target of 40% take-up of Gigabit broadband as % all BB by 2035, measured annually.

The operational objectives are, and how they will be monitored, are presented below.

Coverage of fibre is limited in some countries due to the persistence of copper and threat of unviable overbuild	Switch off copper networks by 2030 and no later than 2035
Some households passed by fibre are being refused connections	Provide a limited right to Gigabit connectivity for homes passed by fibre under specified conditions
Take-up of Gigabit broadband is lagging due to limits on competition in quality and price	Harmonise wholesale product specifications so that they are consistent and enable competition on quality and price
Market fragmentation including the regionalisation of networks is creating challenges for nationwide and pan-EU service delivery	
Wholesale access regulation is not always well targeted and granular data is not always available for mass-market and dedicated connections, There will be an even greater need for granular data gathering and associated market analyses during and following the switch-off of copper networks due to the reduced infrastructure competition that will arise in certain geographic areas and increased focus on fibre access.	
	Require regular data gathering at regional level and mandate NRAs to take this into account when reviewing markets

The table below shows how the specific and operational objectives will be monitored for transition to fibre:

	Objective	Indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target
Specific objectives	Foster FTTH coverage, connectivity and take-up	FTTH homes passed absolute and as % HH FTTH homes activated FTTH penetration	No. and % HH	EC	Annual	63% homes passed as % HH 37% FTTH penetration as % HH	95% FTTH coverage by 2035 78% FTTH penetration as % HH by 2035
	Boost Gigabit broadband take-up by promoting competition in very high speed services	Prices for Gigabit broadband Take-up of Gigabit broadband as % total broadband HHI in Gigabit-capable broadband	EUR (absolute and PPP) No. and % BB No.	EC	Annual	22% Gigabit as % fixed BB	40% take-up of Gigabit broadband as % all BB by 2035

Operational objectives	Switch off copper networks by 2030 and no later than 2035	Penetration of copper-based broadband including FTTC / VDSL, FTTB / G.fast	No. and % broadband	NRAs, EC	Annual	24% as % total HH	7% of HH by 2030, 0% by 2035
		Households served with copper based broadband including FTTC / VDSL, FTTB / G.fast	No and % HH	NRAs, EC	Annual	74.5% ADSL coverage (2024)	0% by 2030
	Harmonise wholesale product specifications so that they are consistent and enable competition on quality and price	Prices for and take-up of Gigabit broadband (as above)					
		Take-up of FTTH unbundling as % total connections and as % wholesale BB connections	No. and % total connections and % wholesale connections	NRAs, EC	Annual	See Study on Access Regulation. FTTH unbundling is 20% FTTH wholesale connections	30% by 2035
		Take-up of FTTH VULA as % total connections and % total wholesale BB connections	Present in country	NRAs			Available in all MS by 2030
		Availability of dedicated connectivity as % business premises					
		Availability of mass-market FTTH with business-grade QoS					
	Require regular data gathering at regional	Availability of data on FTTH, other Gigabit technologies,	Present in country	NRA / competent authority	Annual	Variable. 15 MS did not provide data on	Present in EU 27

	level and mandate to NRAs to take this into account when reviewing markets	copper, dedicated connectivity, at retail level and regional level at the infrastructure layer		Review by EC		enterprise connectivity to study team	
		Reviews conducted of retail markets for mass-market and enterprise connectivity based on data gathered	Present in country / notification to EC	NRA Review by EC	5 yearly (but rolling collection of number of reviews by EC)		Present in EU 27

2.2 Spectrum

Objective: Monitoring²⁴⁴ the impact of spectrum measures in ensuring high quality mobile networks to better serve end-users and enable quality-assured services requires a focus on the evolution towards “**real 5G**”, i.e. networks operating in **Standalone (SA) mode** with a native 5G Core (6G in the future) and sufficient spectrum resources. **SA coverage and availability and quality of service-quality of experience** are the defining step beyond NSA, unlocking the advanced performance and service capabilities expected from 5G and forming the foundation for 6G.

- **KPI 1:** The **core indicator** to measure this progress should be **Quality of Service and Quality of Experience**, measured through key metrics such as speed, latency, jitter, traffic share on mid-band and comparative SA vs. NSA performance.
- **5G SA coverage and availability**, expressed as the share of total 5G radio coverage and the measure of how often end-users get 5G SA.

²⁴⁴ To avoid creating additional reporting burdens, these indicators will be **implemented gradually**, building on the methodology for mapping QoS of 5G networks, currently being developed by the European Commission in collaboration with BEREC. In the interim, they could be **complemented by crowdsourced datasets and international benchmarks**, currently available on the market, until harmonised NRA reporting is fully established.

This monitoring framework should be grounded in **official data from Member States and NRAs** collected through *Connectivity (former Broadband) Coverage Europe Study 2025-2027*, ensuring regulatory credibility and comparability across the Union. These data will be **complemented, not replaced**, by international benchmarks (Ericsson, GSMA, GSA) and crowdsourced analytics (Ookla, OpenSignal, MedUX, Mozark, etc.) to validate trends and assess Europe’s positioning against global peers. Importantly, the framework **does not increase the reporting burden** for NRAs, as it builds on existing data flows and harmonised methodologies. This approach will allow the Commission to measure the **effectiveness of spectrum policy measures**, the **pace of 5G and 6G deployment** and the **real-world benefits delivered to EU citizens and businesses**, while supporting Europe’s ambition to lead globally in mobile connectivity. Together, these indicators make it possible to monitor the critical steps on Europe’s path towards the full capabilities of 5G, including advanced applications such as **vehicle-to-everything (V2X)**, **autonomous mobility** and **mission-critical services**.

Objective: Ensure a comprehensive assessment of spectrum measures and related investments, **additional supporting indicators** should be tracked.

These include:

- **KPI 1.1. 5G SA coverage and availability**, expressed as the share of total 5G radio coverage and the measure of how often end-users really get 5G SA in a daily usage
- **KPI 1.2. Mid-band population coverage** (percentage of population covered in the 3.4–3.8 GHz band), ensuring that deployment is measured where capacity and performance are meaningful.
- **KPI 1.2 Spectrum readiness** (MHz/pop, assigned in 5G mid-band and future 6G pioneer bands), directly reflecting impact of spectrum measures, regulatory preparedness and efficient spectrum use.
- **KPI 1.4 Quality of Service and Quality of Experience**, measured through key metrics such as speed, latency, jitter, traffic share on mid-band and comparative SA vs. NSA performance.

Objective: simplify access to spectrum and efficient use

KPI: Time to obtain spectrum authorisation: This indicator will evaluate if simplification measures reduce timing to access spectrum

KPI Number of Licenses with sharing conditions. This indicator will measure if spectrum rights promote a flexible and simplified use of spectrum.

KPI Amount of spectrum used by more than one user/category of user. The indicator will report if simplified measures facilitate access to spectrum e.g. by other actors.

2.3 Authorisation

General Authorisation – single ‘passport’

Objective	Indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target
To monitor the adoption and effectiveness of the simplified, fully harmonised general authorisation framework across the EU, by tracking how many providers utilize the cross-border notification system.	Number of providers using the cross-border general authorisation regime	The KPI counts the number of new cross-border providers (including those who want to expand their operations) that have successfully notified under the harmonised general authorisation regime in a Member State and are authorized to provide services in at least one	notifications database of the Member State of notification, coordination logs with other Member States, BEREC Office reports and GA Data Base.	Annual	0	Not quantified

		additional Member State.				

Satellite authorisation

Objective: increase pan-European network operation and service provision,

KPI. Number of pan-European satellite licensees

KPI Number of operators selected through a centralised selection procedure for satellite harmonised bands

KPI Time to complete satellite authorisation requirements

KPI Number of interference issues in the EU which have been timely and effectively addressed

KPI. Number of pan-European satellite licensees providing innovative services (e.g. D2D)

Objective: Alignment with ITU Radio Regulations to prevent and solve in a timely manner EU satellite interference

KPI: Average length of solving space interference complains in the EU

KPI number of enforcement procedures successful in ending interference issues

2.4 Governance

Currently BEREC is reporting annually on the key developments and market trends in the EU's electronic communications sector, putting focus on market dynamics and the development of EU public policies and regulatory practices. The report presents BEREC perspectives based on the collective expertise and knowledge of its members, and describes BEREC's own contribution to the development of the electronic communications sector in Europe. This report is submitted to the European Parliament, the Council, the Commission and the European Economic and Social Committee by 15 June each year.

The BEREC Office is also subject to annual reporting, preparing consolidated annual activity reports in accordance with Article 47 of Delegated Regulation (EU) No 1271/2013²⁴⁵, taking into account guidelines set by the Commission. The report and its assessment are submitted to the European Parliament, the Council, the Commission and the Court of Auditors by 1 July each.

The reporting obligations should be kept for both BEREC and BEREC Office. In line with the preferred option, the BEREC Office will be providing expert and administrative

²⁴⁵ Commission Delegated Regulation (EU) 2019/715 of 18 December 2018 on the framework financial regulation for the bodies set up under the TFEU and Euratom Treaty and referred to in Article 70 of Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council, OJ L 122, 10.5.2019, p. 1.

support to the RSPG and consequently, this part of its activities will be covered in the relevant reporting. In addition, RSPG should also be subject to reporting obligations.

Moreover, both BEREC and BEREC Office are subject to periodic evaluation. In particular, every five years the Commission shall carry out an evaluation to assess BEREC's and the BEREC Office's performance in relation to their objectives, mandate, tasks and location. The evaluation addresses the possible need to modify the structure or mandate of BEREC and the BEREC Office, and its financial implications.

The proposed KPI measures the **number and quality of BEREC, RSPG and BEREC Office outputs that directly contribute to single-market objectives**. These include deliverables that:

- Enhance harmonisation across Member States,
- Support consistent regulatory practices,
- Facilitate the effective functioning of the single market for connectivity,
- Implement or support EU-level procedures (e.g., satellite authorisation, spectrum coordination).

The proposed KPI has two components: quality and quantity of outputs.

Quality of outputs is assessed through:

- Impact (e.g., contribution to harmonisation or regulatory convergence),
- Uptake (e.g., extent to which NRAs rely on or implement the outputs),
- Regulatory relevance (e.g., alignment with evolving EU policy priorities),
- Quantity of relevant outputs is assessed by tracking the **volume** of outputs directly related to single-market completion, such as: BEREC guidelines,
- BEREC and RSPG opinions and consultations,
- Ex ante scrutiny of spectrum award procedures and market analyses,
- EU satellite authorisation procedures,
- Centralised selection procedures for harmonised satellite bands.

The proposed KPI is measured in intervals aligned with work programme and reporting cycles, with progress reviewed regularly by the BEREC Office, based on the data drawn from the Work Programme, internal monitoring, and post-adoption assessments. Examples of output indicators could be the following:

- Number of ex ante single market spectrum procedures and market analyses,
- Number of new EU satellite authorisation procedures,
- Number of centralised selection procedures for harmonised satellite bands,
- Number of BEREC/RSPG opinions and public consultations and their impact measured by stakeholders participation in the consultation process,
- Number of BEREC guidelines adopted and their up take measured by number of references in the decisions of the NRAs,
- Average case-handling time for resolving non-compliance with EU satellite authorisation or space-interference requirements,
- Number of successful enforcement actions resolving intra-EU interference issues.

3. BACKGROUND ON IMPACTS ON SPECTRUM INCLUDING FOR SATELLITE

This section draws from and includes excerpts of the study supporting this impact assessment which are relevant for understanding the impacts of the policy options.

3.1. Spectrum measures impact based on economic, environmental and societal benefits of 5G

3.1.1. Economic and sectorial impacts of 5G

In addition to boosting mobile broadband speeds for consumers, a key driver of economic benefits from 5G is expected to come from knock-on effects in other sectors resulting from 5G IoT applications. The text box below provides some illustrations of use cases which could benefit from the ultrafast speeds and low latency offered by 5G technology.

Table A9 3-1: Anticipated impacts of 5G by sector:

Healthcare. Both mobile and fixed ultrafast connectivity and minimum latency (<1ms) will critically enable instantaneous high-quality data transmission and processing. It will therefore increase the number of multi-sensors, biometric wearables²⁴⁶, and remote treatment opportunities and operations enhanced via AR/VR and automation.²⁴⁷ The latter might drastically improve resource management, drug reliability and treatment care²⁴⁸. 5G wearables can decrease cost by remote diagnosis and monitoring of patients.²⁴⁹ Healthcare applications using 5G are estimated to add USD 530 billion to global GDP by 2030.²⁵⁰

Manufacturing. This sector is expected to be highly affected by the 5G revolution and massive internet of things (IoT). Three main benefits expected are a) remote and automated quality control; b) higher working safety; c) productivity and operational effectiveness²⁵¹. The latter specifically benefits from Machine Learning applied to quality checks to prevent faults and reduce scrap costs²⁵². With a massive 5G deployment –it will be possible to achieve automated factory floors, human-to-robot collaboration and high skilled remote support through drones and AR/VR. Additionally, remote control and low latency will prevent a human worker from operating in dangerous situations as well as provide new tools for first aid²⁵³. It is forecasted that the number of connected IoT devices

²⁴⁶ Accenture “The Impact of 5G on the European Economy”, February 2021, page 46.

²⁴⁷ A. Moglia et al., “5G in Healthcare: From COVID-19 to Future Challenges,” in *IEEE Journal of Biomedical and Health Informatics*, vol. 26, no. 8, pp. 4187-4196, Aug. 2022, doi: 10.1109/JBHI.2022.3181205.

²⁴⁸ GSMA “Study on Socio-Economic Benefits of 5G Services Provided in mmWave Bands”, December 2018, page 45.

²⁴⁹ Devi, D. H., Duraisamy, K., Armghan, A., Alsharari, M., Aliqab, K., Sorathiya, V., Das, S., & Rashid, N. (2023). 5G Technology in Healthcare and Wearable Devices: A Review. *Sensors*, 23(5), 2519. <https://doi.org/10.3390/s23052519>.

²⁵⁰ PwC (2021): The global economic impact of 5G, available at: <https://www.pwc.com/gx/en/tmt/5g/global-economic-impact-5g.pdf>.

²⁵¹ World Economic Forum and PwC Report page 12.

²⁵² Accenture report page 29.

²⁵³ GSMA report page 53.

will reach 29.4 billion until 2030.²⁵⁴ McKinsey forecasted in 2020 that the manufacturing sector could generate between USD 400 to USD 650 billion of additional global GDP due to smart manufacturing based on 5G technologies.²⁵⁵ Other estimates by PwC state contributions of USD 134 billion until 2030.²⁵⁶

Automotive and transport. IoT ultrafast mobile data collection and elaboration might finally enhance autonomous driving at all levels – from exit-to-exit highway remote driving to self-driving cars. It would boost supply chain efficiency, increase elderly and mobility for people with disabilities, improve road safety, and transform public infrastructure. Connected vehicles could improve commute times and reduce pollution by optimizing routes²⁵⁷. Support devices like stolen vehicle tracking, massive media car infotainment, remote vehicle monitoring would become possible, enhancing vehicles life spans and their efficiency²⁵⁸. Until 2030, the total value stemming from connected-car business cases is estimated to be USD 550 billion starting from USD 64 billion in 2020. This equals a growth rate of 25 % per year.²⁵⁹

Energy and environment. Instant connectivity would enable smart grid implementation, significantly reducing energy consumption, operational costs via real-time remote monitoring and energy wastes. Smart grids might be applied to smart street lighting and residential smart meters²⁶⁰. Ultimately, IoT enhanced by applying monitoring drones, AR/VR tools and automated support would increase the reliability of the infrastructure and increase workers' safety²⁶¹. Smart utilities depending on 5G are predicted to add USD 330 billion to global GDP until 2030.²⁶² Ericsson estimates that the use of ICT can reduce interruption durations in the power grid, yielding a yearly increase in revenue of up to EUR 40 million for one Swedish operator.²⁶³

Agriculture. Accenture explored the application of 5G connectivity and highlighted three trajectories: a) pest and weed remote individuation and eradication using drones and AI, allowing targeted pesticides usage b) crops and livestock welfare and monitoring through

²⁵⁴ Noor-A-Rahim, M., John, J., Firyaguna, F., Sherazi, H. H. R., Kushch, S., Vijayan, A., O'Connell, E., Pesch, D., O'Flynn, B., O'Brien, W., Hayes, M., & Armstrong, E. (2023). Wireless Communications for Smart Manufacturing and Industrial IoT: Existing Technologies, 5G and Beyond. *Sensors*, 23(1), 73. <https://doi.org/10.3390/s23010073>.

²⁵⁵ McKinsey (2020): Smarter factories: How 5G can jump-start Industry 4.0, available at: <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-blog/smarter-factories-how-5g-can-jump-start-industry-40>.

²⁵⁶ PwC (2021): The global economic impact of 5G, available at: <https://www.pwc.com/gx/en/tmt/5g/global-economic-impact-5g.pdf>.

²⁵⁷ GSMA report page 47.

²⁵⁸ Analysys Mason report for Ericsson and Qualcomm "Costs and benefits of 5G geographical coverage in Europe", March 2021, page 48.

²⁵⁹ McKinsey (2022): The future of automotive computing: Cloud and edge, available at: <https://www.mckinsey.com/industries/semiconductors/our-insights/the-future-of-automotive-computing-cloud-and-edge>.

²⁶⁰ World Economic Forum and PwC Report page 18.

²⁶¹ Accenture report page 54.

²⁶² PwC (2021): The global economic impact of 5G, available at: <https://www.pwc.com/gx/en/tmt/5g/global-economic-impact-5g.pdf>

²⁶³ Ericsson (2020): Bringing 5G to power: Opportunities and challenges with connected power distribution grids, available at: <https://www.ericsson.com/4ac680/assets/local/reports-papers/industrylab/doc/bringing-5g-to-power---industrylab-report.pdf>.

sensors and drones c) connected and remotely controlled/automated equipment able to reduce human employment and increase sector's efficiency²⁶⁴. The GSMA estimates that 5G automated agricultural solutions could decrease water usage and needed human resources by 40 %.²⁶⁵

3.1.2. Economic impacts of 6G deployment

While quantification of economic effects has been possible for 4G and 5G technologies due to their commercial maturity and measurable deployment, it is not yet feasible to reliably quantify the potential impacts of 6G. The technology is still under development and has not been deployed at scale, meaning real-world data on adoption, performance, and impact on productivity or GDP is not available. As such, any forward-looking assessment of 6G's economic contribution must remain qualitative. Nonetheless, early standardisation efforts and research roadmaps indicate that 6G is expected to enable enhanced capabilities such as real-time distributed intelligence, ultra-low latency, integrated sensing and communication, and improved energy efficiency—all of which may generate cross-sectoral economic benefits similar or even superior to those observed for 5G.

In this context, spectrum-related measures such as early planning, timely authorisation, and cross-border coordination for 6G bands (particularly in the upper mid-band and sub-THz ranges) will be key to avoid delays in commercial rollout.²⁶⁶ The success of 6G spectrum awards will depend not only on the amount and quality of spectrum made available, but also on how auction conditions—such as duration, license flexibility, reserve prices, and obligations—are designed to support investment in a context of technological and commercial uncertainty²⁶⁷. Building on the lessons of 5G rollout, ensuring predictability and affordability in 6G spectrum awards will be critical to incentivise timely infrastructure deployment and long-term R&D commitments. Conversely, fragmented or misaligned spectrum strategies across Member States could hinder the creation of a harmonised EU-wide 6G market and delay the delivery of anticipated economic and societal benefits.

The first complete 6G standard (3GPP Release 21) is expected by 2028, with early commercial deployments starting around 2030²⁶⁸. EU-level spectrum decisions made between 2025–2028 will thus be crucial in shaping the conditions for early trials, industrial uptake, and large-scale 6G infrastructure investment.²⁶⁹ Timely and coordinated spectrum allocation will be necessary to support industrial research and early network planning, particularly for high-value vertical use cases. Without such preparation, there is a risk the EU could lag behind countries such as the US, China, South Korea and Japan, which have

²⁶⁴ *Ibid* page 63.

²⁶⁵ <https://www.gsma.com/5ghub/smartagri/>

²⁶⁶ RSPG (2024). Opinion on Spectrum Policy for Next-Generation Wireless Systems (6G). Available at: <https://rspg-spectrum.eu>.

²⁶⁷ LS Telcom, PolicyTracker & VVA (2023). Study on Assessing the Efficiency of Radio Spectrum Award Processes in the Member States. Available at: <https://op.europa.eu/en/publication-detail/-/publication/036d50f1-a1e2-11ed-b508-01aa75ed71a1>.

²⁶⁸ European Commission (2022). Strategic Roadmap Towards 6G for Europe. Available at: <https://digital-strategy.ec.europa.eu/en/policies/6g>.

²⁶⁹ CEPT/ECC (2024). CEPT Roadmap for 6G Spectrum. Available at: <https://cept.org/ecc>.

already launched national 6G strategies and spectrum planning initiative. A strategic and investment-friendly spectrum policy will therefore be indispensable to secure Europe's global competitiveness in next-generation mobile communications.

3.2. Satellite: The cost of legal and regulatory fragmentation of authorisation and spectrum assignment

This section will examine the key aspects of fragmentation within the satellite authorization domain. It will cover the fragmentation of satellite authorization itself, the regulatory efforts involved in satellite authorization, licensing, and monitoring, and, finally, the effects of delays in satellite authorizations

3.2.1. Satellite authorisation, licencing and monitoring efforts

There is significant and multi-layered fragmentation across EU Member States either for satellite spectrum and for ground stations licensing which include four main areas: the authorisation model, the procedural steps and decision time, the fees calculation and application, and the ancillary national obligations that are bundled with ground operations (security, lawful interception, data routing, emergency services, EMF and planning). In practice this means that the same earth/ground station can be subject to very different costs, lead times and compliance artefacts depending on where it is deployed, with the slowest or most onerous jurisdiction often dictating the overall rollout schedule and eroding the programme's Net Present Value, especially where services depend on a minimal set of operational sites, and a delay of one to three months in one jurisdiction can postpone revenue across multiple markets.

Fee structures and categories show great dispersion across Member States also. For pan-European provision of satellite D2D broadband services, according to some operators reporting Member States could impose on average one-off administrative cost for satellite authorisation (general and individual) reaching up from few thousands to EUR 110 000, plus annual administrative cost often between EUR 10 000 and EUR 50 000. In addition, the site authorisation for satellite ground stations could incur a one-off permit cost up to EUR 130 000, plus, annual administrative costs between EUR 5 000 and EUR 30 000. Further, some Member States also apply spectrum usage charges of EUR 1 000 to EUR 10 000 per site annually. Therefore, there is a considerable potential for reduction of administrative fees linked to the EU licencing procedure; however, the amount is difficult to assess as it depends on relevant projects and the location of ground components, for which annual costs can differ by tens of thousands of euros depending on the MS of location. Further, as part of the authorisation process, operators are required to conduct in-country testing in each Member State. This would necessitate at least 6 FTE dedicated to regulatory testing, the deployment of a temporary ground station/gateway (incurring CAPEX costs), approximately EUR 120 000 for gateway relocation, and the engineering resources needed for its movement and installation. In total, the indicative cost of meeting these requirements across all Member States is estimated at around EUR 3.2 million.

Regarding operator's staff it is involved in many activities, needed for licencing, testing, launch and operation of constellation. It is estimated that for securing spectrum authorisations (general authorisations, individual licensing and ground components) for a satellite constellation covering entire EU an operator needs 6 FTE centrally for assessing the scope and requirements to launch services across each Member States, including

working on spectrum assignments and additional further resources (approx. 1-2 FTE) per Member State to apply for spectrum authorisation. An operator needs to have technical teams in Member States tasked with carrying out the technical requirements necessary to demonstrate compliance with licensing requirements. These estimates may also include a minimum of additional 6 FTEs if Member States request in-country testing before the launch of satellite services

In order to gain a comprehensive understanding of the challenges associated with licensing and monitoring satellite authorizations, the Commission conducted a brief survey of NRAs and SMAs in support of this study. The 16 NRAs or SMAs that responded to date have all provided useful quantitative data on the number of Full Time Equivalent (FTE) staff working on these satellite aspects (see Figure A9 3-1).

Figure A9 3-1: NRA / SMA staff performing satellite authorisation, spectrum management, and enforcement (2025)

Authorisation & spectrum mgt	1,4	2,0	3,0	2,0	1,0	7,5	2,5	2,0	2,0	2,0	4,0	0,5	2,5	1,5	6,0	1,0	40,9	63,5
Monitoring and enforcement	-	-	3,0	-	1,0	3,0	1,5	5,0	2,0	1,0	1,0	0,5	1,0	1,0	2,0	-	22,0	34,2
Total:	1,4	2,0	6,0	2,0	2,0	10,5	4,0	7,0	4,0	3,0	5,0	1,0	3,5	2,5	8,0	1,0	62,9	97,6
Population (million)	9,20	11,90	6,44	0,98	5,99	49,08	5,64	68,64	3,87	5,44	58,93	0,57	36,50	10,75	10,59	5,42	289,94	450,40
Staff per million	0,15	0,17	0,93	2,04	0,33	0,21	0,71	0,10	1,03	0,55	0,08	1,75	0,10	0,23	0,76	0,18	0,22	0,22
																	Total MS	EU

Source: Authors' elaboration of the results of a survey conducted by the Commission in support of this study.

Based on the information provided and on an imperfect assumption that the number of FTEs needed is somewhat proportional to population, it was estimated that EU-wide 63,5 NRA/SMA FTEs are dealing with satellite authorisation and spectrum assignment today, and an additional 34,2 FTEs are dealing with enforcement, for a total of approximately 98 FTEs. This is however a rough estimate, first because the division of responsibilities between different Member State agencies and in some cases Ministries differ, and second because it was necessary to interpret the data (for instance where the NRA or SMA expressed the number of FTEs as a range).

Moreover, it is reasonable to expect an increasing number of satellite authorisation requests in the future, in particular for LEO constellations. According to the Detecon MSS Study (2025), around 9 000 LEO satellites were in operation worldwide at the beginning of 2025, and this number is expected to grow by at least a factor of six over the next decade, equivalent to roughly 60 000 operational LEO satellites by 2035 globally. This study also identifies around 25 global operators/LEO constellations with launched, planned or announced LEO satellites relevant in the coming years. These numbers will surely impact the FTEs needed to address these requests and ensure enforcement, monitoring and dealing with increasing harmful interferences.

Taking the staff size of the EU Member States dealing with satellite spectrum to be roughly 98 FTEs and adding 1.5 FTEs for the European Commission's current role, there are currently about 100 FTEs engaged in satellite authorisation and spectrum management across the EU. Under option 2, this number would be expected to decrease in NRA / SMA staffing needs, as much of the administrative work related to the assessment and issuance of authorisations would be centralised at EU level. However, Member States will still be responsible for monitoring, interference management and inspection tasks related to the ground components. At the same time, a progressive and moderate increase in resources would be required at the BEREC Office (up to 15 FTEs, approx. EUR 3.4 million annually,

for satellite authorisations depending on the number of requests) to handle the operational functions transferred from national authorities, and at the Commission, where staff would progressively grow from around 1.5 to 5 FTEs (approx. EUR 768 000 annually) to oversee and coordinate implementation. Overall, the net reduction can be assumed to amount to roughly 20% to 30%, corresponding to total staffing of about 70 to 80 FTEs. Assuming a burdened labour cost of EUR 95 400 annually, this would result in annual savings of approximately EUR 2 to 3 million annually. While such an adjustment would not occur instantaneously, it represents a realistic order of magnitude for the efficiency gains expectable over time once the system is established.

As regard the expected workload, lacking concrete data from the EU, data from the United States indicate that applications for space and earth stations have risen by factors of four and three respectively between 2015 and 2023, corresponding to compound annual growth rates of 19% and 15%. Since this growth in the EU is driven by similar factors as in the United States, mainly by the sharp rise in Low Earth Orbit constellation deployments, similar increases could occur in the EU. If such growth were to continue over the next five years, applications for ground stations could double and those for satellites increase by a factor of 2.4, while the labour required, and the associated budget increase would remain below this rate due to scale economies and progressive efficiency gains. Under business-as-usual conditions, a rough estimate suggests a potential increase in staffing of about one-third, but with the expected efficiency gains in staffing use resulting from the reform introducing EU level authorisation, overall staffing would likely remain close to today's level. The proposed EU-level authorisation regime could thus ensure that, at least over the next years, workload increases are absorbed without requiring additional administrative resources.

Probably to better address the growing volume and complexity of requests from New Space activities, the FCC created a distinct Space Bureau in 2023²⁷⁰.

The FCC has published an organisation chart for the 16 middle managers of the Space Bureau²⁷¹, a newly distinct team created in 2023²⁷², and there are 9 staff in satellite licensing division and 9 staff in earth station licensing division.²⁷³ The overall budget for the FCC shows a actual headcount for the Space Bureau just above 50 FTEs (see Table A9 3-1 below).

²⁷⁰ For more details on Space Bureau responsibilities see Study on Digital Single Market (DSM).

²⁷¹ FCC (n.d.). Space: <https://www.fcc.gov/space>.

²⁷² FCC (2023). FCC Space Bureau & Office of International Affairs to Launch Next Week: <https://docs.fcc.gov/public/attachments/DOC-392418A1.pdf>.

Table A9 3-2 FCC Space Bureau staff (2023-2026)

Year	FTEs	Budget (USD, thousands)
2023 (establishment year)	20	4 896
2024	56	12 780
2025 (requested from Congress)	54	12 696
2026 (requested from Congress)	51	12 705

Source: FCC (2024). 2025 Budget-in-Brief, DOC-401129A1, p. 11: <https://docs.fcc.gov/public/attachments/DOC-401129A1.pdf?ref=broadbandbreakfast.com>; FCC (2025). 2026 Budget Estimates to Congress, DOC-411718A1, p. 14: <https://docs.fcc.gov/public/attachments/DOC-411718A1.pdf>.

To put this in comparative context, the FCC has a total headcount of some 1,523 in 2024. At the same time, the FCC has a significantly greater burden than the typical EU NRA or SMA. The USA has more than 6,000 civilian satellites of all sizes, orbits and services, and almost 114,000 earth stations. By contrast, France (the EU Member State with the largest number of satellites) has only some 600 to 700 satellites – an order of magnitude less.

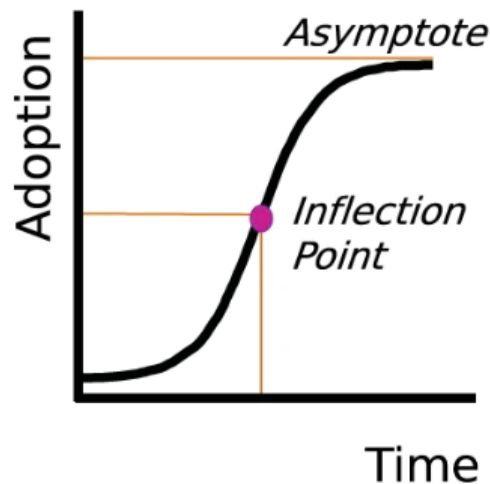
It is also important to bear in mind that the burden on a regulatory agency is driven not only by who performs the tasks, and which overall functions must be fulfilled, but also by how the tasks are to be accomplished. This is continuously evolving. For example, the FCC implemented new rules in August 2025 that seek to reduce the regulatory burden for satellite service providers and for the FCC itself. They simplify the process for Ground-Station-as-a-Service (GSaaS) operators to receive a baseline licence with a simple notification, without having to first identify a specific satellite point of communication. The FCC estimates that this change will eliminate half of all earth station modification applications. “The new rules streamline and expedite processes for space stations and earth stations, including removing many requirements to file license modification applications. The reforms expand the list of license modifications that do not require prior authorization, adopt a 30-day shot clock for most earth station renewal applications, and eliminate repetitive requests for special temporary authority for geostationary orbit satellites.”

3.2.2. *Effects of Delays in Satellite Authorizations*

This section evaluates the impacts of authorization delays. When the delay occurs at the point when the satellite communication service provider is first able to deliver the service, the immediate financial impact may be limited, since the customer base at that stage is small or possibly zero. However, this does not imply that the medium-term consequences are insignificant. When modelling the deployment of a new service, it is common to assume that customer adoption follows a sigmoid (logistic) curve (see Figure A9 3-2), which closely resembles exponential growth in the initial phases—before reaching the inflection point where market saturation begins²⁷⁴. The firm’s total revenue is roughly

proportional to the area under this adoption curve, representing the cumulative number of users multiplied by the duration of their usage. Therefore, if the delay in securing authorization and spectrum allocation causes the entire adoption curve to shift to the right, the negative effects could extend over many years, resulting in a substantial loss of potential revenue. In some cases, this revenue loss can be decisive, determining whether the business case is viable or no.

Figure A9 3-2: Adoption of new technologies and services is often modelled as a sigmoid logistics curve.



Source: Gregory Nemet, Jenna Greene, Finn Müller-Hansen, Jan C. Minx (2023). Dataset on the adoption of historical technologies informs the scale-up of emerging carbon dioxide removal measures, *Communications Earth & Environment*: <https://www.nature.com/articles/s43247-023-01056-1>.

Consumers also lose out if a satellite communication service provider lacks authorisation to deliver a service that it would otherwise be able to offer. If the satellite communication service provider is prohibited from offering the service, consumers cannot purchase or use it. This constitutes a different way of looking at the impact of a missing or delayed authorisation. The normal economic insight is that the gross loss of consumer surplus is at least as great as the price that the user would have otherwise paid for the service – if this were not the case, the service would not have been purchased.

The net loss of consumer surplus may be less in practice because a substitute service may, or may not, be available. The substitute service will generally be less attractive in terms of price/performance, otherwise it would have been preferred in the first place. So one should expect that there will always be a loss of surplus when a satellite communication service provider lacks authorisation to deliver its service, but the net loss of consumer surplus might be either more or less than the loss of revenue to the satellite communication service provider.

As an example one of the two EU Mobile Satellite Services provider in the 2GHz, faced considerable legal uncertainty and delays of several years in the authorisation process, which negatively affected its business case. Delays in accessing space spectrum caused by fragmented national authorization regimes can significantly hinder European competitiveness. To improve this situation, it is essential to streamline and harmonize the authorization processes across Member States. By adopting a more unified regulatory

framework for space spectrum access, Europe can enhance its competitiveness on the global stage. For instance, estimates²⁷⁵ for the space connectivity services to be delivered by the pan-European IRIS² constellation suggest full utilisation of all 33 satellites (O3b Classic and O3b mPOWER) by 2030. The projected investment up to 2030 is approximately EUR 1.8 billion, with peak annual spending of around EUR 400 million between 2027 and 2030. Once the constellation reaches full capacity, revenues are expected to exceed operating costs significantly, with an anticipated EBITDA margin of 55%. Based on this, annual revenues in 2030 could reach around EUR 600 million, equivalent to approximately EUR 50 million per month across the EU. This implies that a one-month delay in the provision of IRIS² services across the entire EU in 2030 could result in lost revenue of around EUR 50 million. Similarly, if services were unavailable in a single Member State for a month, the revenue loss would be roughly proportional to that Member State's share of the total EU revenue — calculated as a percentage of EUR 50 million.

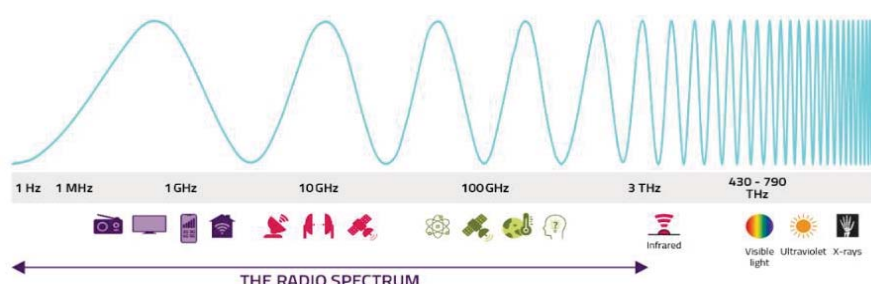
²⁷⁵ SES (2024), “SES & Spacelise sign IRIS2 concession contract”.

1. Radio Spectrum essentials and satellite spectrum

Radio Spectrum Decision 676/2002/EC defines radio spectrum as radio waves in frequencies between 9 kHz and 3000 GHz; radio waves are electromagnetic waves propagated in space without artificial guide²⁷⁶.

Contrary to the electromagnetic spectrum²⁷⁷, the radio spectrum does not exist independently; its existence depends on the electromagnetic waves that propagate without the need for artificial guidance. Thus, it is a virtual space, a physical reality that is used for the provision of services such as telecommunications: radio and television broadcasting, defence, emergency, transport, scientific research, etc.

Figure A10 1-1: Electromagnetic Spectrum



Source: Ofcom

Depending on the specific features of each wave, the waves are grouped into frequency ranges, forming what is known as radio spectrum bands, each of which takes in a set of consecutive bands of frequencies that share the same properties that affect speed coverage (signal reach and penetration), and capacity of services (bandwidth), to be provided in the band.

Figure A10 1-2: Low and High frequency band proprieties



Source: Cullen

International

²⁷⁶ Article 2 Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community.

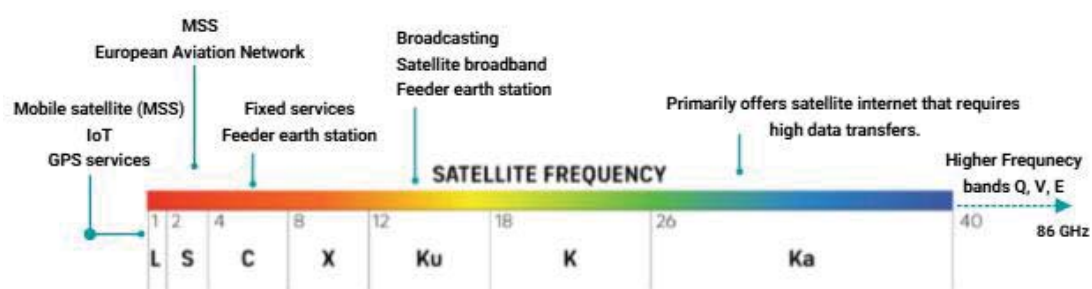
²⁷⁷ The electromagnetic spectrum is the range of all types of electromagnetic radiation, arranged according to their frequency. This includes Radio waves, infrared, ultraviolet, X-Rays, etc.

The radio spectrum is a finite resource— new frequencies can't be created. As demand for spectrum access continues to grow, this scarcity poses a significant challenge for both regulators and industry. While the total amount of spectrum remains fixed, advances in technology enable us to use it more efficiently, allowing for greater capacity and a wider range of applications. These improvements will play a crucial role in transforming how citizens live and work in the future.

To prevent interference between users, the generation and transmission of radio waves are rigorously regulated by national governments. These national efforts are coordinated on a global scale by the International Telecommunication Union (ITU) a specialised agency of the United Nations. Unlike terrestrial radio communications systems, the spectrum used for satellite communications requires a higher degree of international and national coordination because satellites operate across multiple countries and regions, often transmitting signals across national borders. This necessitates coordinated spectrum management to prevent interference and ensure smooth operations.

Satellite communications use various frequency bands which, because of their different properties, are suited to different service types, see Figure A10 1-3 below.

Figure A10 1-3: Satellite communications use spectrum across wide range of spectrum



Source: Cullen International

The lower bands (below 4 GHz), such as the EU MSS Band, enjoy good propagation characteristics but offer less bandwidth. These bands are generally used for voice and low data rate applications and are a hot spot for the deployment of D2D services (i.e. some newer smartphones offer D2D using spectrum allocated to MSS). The mid bands, such as the C-band (4–8 GHz), are mainly used for fixed satellite services and Earth station feeder links. Higher frequency bands offer more bandwidth but have less good propagation and are more sensitive to weather conditions. Popular new satellite constellations, including Starlink, Project Kuiper, and Eutelsat OneWeb, use high band spectrum, such as the Ku (12–18 GHz) and Ka (26–40 GHz) bands for fixed broadband, but its to be expected that they will move to lower bands in the future to provide D2D services.

2. Spectrum for 5G

The 5G pioneer bands 700MHz, 3.6GHz and 26GHz have different properties. For instance, the 700MHz band as a low-band (sub-1GHz) has limited speed but long range and coverage. Low-bands can travel far and penetrate buildings easily (indoor coverage). The 3.6GHz band belongs to the mid-band spectrum (1-6 GHz) and offers a good balance

between speed, coverage and capacity. Finally, the 26GHz is a high band (mmWave bands and above 24GHz), which provides very high speed (multi Gbit per second) but limited coverage as it does not travel so fast. These bands require many small cells placed close to each other to provide coverage.

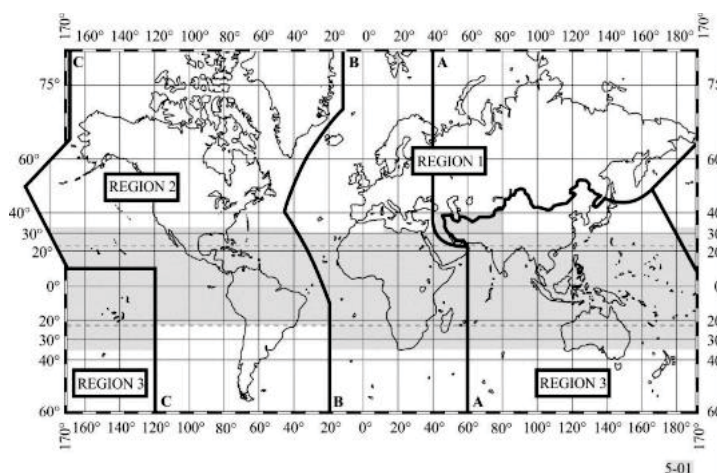
Considering that no single band can meet all 5G technical requirements well, operators need a combination of bands to effectively provide good quality 5G services. 5G SA will be deploying full 5G both at the radio and the core network, without relying on 4G LTE components. Similarly, the deployment of 6G will most probably have a progressive and evolutionary phased approach.

3. Spectrum governance

The International Telecommunication Union (ITU) plays a central role in spectrum management by coordinating the global use of the radio-frequency spectrum to ensure interference-free and equitable access. Specifically, the ITU:

- Prevents Interference: It establishes international regulations and procedures to minimize radio interference between countries and services.
- Allocates Frequency Bands: It defines and allocates frequency bands to different services (like broadcasting, mobile, satellite) on a global scale. For the purposes of coordination and international planning, the world has been divided into three large regions (Figure A10 1-4)

Figure A10 1-4. Regions of Frequency Allocation



: ITU

- Facilitates Coordination: It enables countries to coordinate spectrum use and resolve disputes related to spectrum assignments.
- Promotes equitable use of radio spectrum: As a UN specialized agency, the ITU ensures spectrum resources are shared fairly among all countries, supporting global connectivity and communication.

Besides the ITU role in spectrum management, States also cooperate at the regional level in spectrum management affairs (see Table below).

Table A10 1-1: Regional Bodies for Spectrum Regulation

ITU Region	Regional Body
Region 1 (Europe -Africa)	European Conference of Posts and Telecommunications (CEPT) African Telecommunications Union (ATU) Arab Spectrum Management Group (ASMG) Regional Commonwealth in the Field of Communications (RCC)
Region 2 (America)	Interamerican Telecommunications Commission (CITEL)
Region 3 (Asia-Pacific)	Asia-Pacific Telecommunity (APT)

a. Spectrum governance in the EU

In the European Union, radio spectrum policy is managed through a **multi-layered approach** (*cf.* the US in Annex 10) involving cooperation between the European Commission, regional bodies and national regulators.

- **European Commission.** The European Commission plays a key role in coordinating spectrum management to promote competition and ensure harmonized conditions for the availability and efficient use of radio spectrum. This coordination supports the effective functioning of the internal market across critical policy areas such as electronic communications, transport, and research and development (R&D). The governance model for radio spectrum policy in Europe is based on the Radio Spectrum Decision, which provides the powers of the Commission to harmonise the technical and operational conditions for the use of spectrum in the EU through comitology procedure, which involves the Radio Spectrum Committee (RSC). In addition, the European Commission is supported on strategic spectrum matters by a high-level advisory body known as the Radio Spectrum Policy Group (RSPG).
- **European Conference of Postal and Telecommunications Administrations (CEPT):** CEPT is a European regional organization where European countries collaborate on telecommunications matters. Pursuant to Article 4 of the Radio Spectrum Decision, the European Commission regularly issues mandates to the CEPT to study and develop harmonised technical and operational conditions for the provision of electronic communications services within specific radio frequency bands. The technical conditions proposed by CEPT are the preparatory work on which the Commission is basing its draft implementing Decisions that it submits to the RSC for approval, before adoption.
- **National Authorities with Spectrum competences (depending on the MS these can be National Regulatory Authorities (NRAs), or other Competent Authorities, i.e. Spectrum authorities).** Each Member State has its own authorities or group of authorities (NRA, Agency and Ministry), according to the national law, responsible for implementing spectrum management policies at the national level. These authorities monitor the use of spectrum, ensure legal compliance, carry out authorisation procedures (including competitive (auctions)

or comparative (beauty contests) selection procedures) and issue authorisations for spectrum use under the technical conditions set-up in the Commission Implementing Decisions and in line with the procedures of the EECC. In some Member States the NRA that is represented in BEREC does not have or has only partially spectrum competences. Under the EECC Article 5, where NRAs are not competent for spectrum management, they should at least provide advice regarding the market-shaping and competition elements of national processes related to the rights of use for radio spectrum for ECNS. Moreover, even where NRAs have extensive spectrum competences, often it is the relevant Ministries participate in the RSPG, given that the task of this high-level expert group is to advise the Commission and the co-legislators on spectrum policy. For these reasons, the composition of the RSPG is different than the one for BEREC.

b. Spectrum governance in the US

The US has a highly centralised governance based on two main bodies: the **Federal Communication Commission (FCC)** and the **National Telecommunications and Information Administration (NTIA)**²⁷⁸. Unlike the EU, where national governments and NRAs retain significant discretion over mobile licensing, satellite authorisations, coverage obligations, and authorisation processes, including auction design, US states have no role in spectrum management and only a limited role in mobile service regulation more broadly—. The FCC is an independent agency that is the exclusive regulator of non-Federal spectrum use, while the NTIA (under the Department of Commerce) is the sole agency responsible for authorising Federal spectrum use and is the President's principal advisor on telecommunications policies, coordinating and communicating the views of the Executive Government.

The US system is not without its own internal tensions—particularly between the FCC and NTIA— but the scale and coherence of its spectrum management regime stand in stark contrast to the EU's more fragmented landscape. Centralisation in the US yields clear economies of scale, as it allows the US to conduct large-scale, nationally coordinated spectrum auctions with uniform licensing conditions. This facilitates rapid deployment of new technologies such as 5G and supports cross-border service provision. U.S. operators benefit from a single licensing regime, uniform coverage mandates, and centralised interference management—allowing them to consolidate legal, engineering, and compliance functions. This reduces transaction costs and enables more efficient planning and investment.

The cooperation between FCC and NTIA was institutionally strengthened by a Memorandum of Understanding in 2022²⁷⁹, which formalized consultation and conflict-resolution mechanisms. Via this MoU there is an increased coordination between Federal spectrum management agencies to promote the efficient use of the radio spectrum in the public interest.

²⁷⁸ [see 2024 US national spectrum strategy implementation plan.](#)

²⁷⁹ [Memorandum of Understanding Between the FCC and NTIA | National Telecommunications and Information Administration.](#)

Further to these main bodies there are other entities which are regularly consulted by the main/lead organisations (NTIA and FCC) on spectrum management:

- **The Interagency Spectrum Advisory Council (ISAC)**, established by Presidential Memorandum, serves as the principal interagency forum for senior agency officials to advise NTIA on spectrum policy matters and to ensure that all decisions made by NTIA take into consideration the diverse missions of the Federal Government.
- **The Interdepartment Radio Advisory Committee (IRAC)** is used for any activity that falls within its purview, incorporating the interests of defense, security, and scientific agencies into spectrum policy
- **The Commerce Spectrum Management Advisory Committee (CSMAC)** represents the improved national framework for collaboration on spectrum policy envisioned in the US Spectrum Strategy that will be established to involve collaboration between non-Federal stakeholders and Federal agencies (i.e. transport), beginning after its creation, which is projected for September 2025.

Further indications about the human resources of the space section of FCC can be found in Annex 9.

4. Overview of the US mobile market

The mobile market in the US is a **highly concentrated** market dominated by three major nationwide players AT&T, Verizon and T-Mobile/Sprint who merged recently. These three service providers have networks that cover at least 95% of the U.S. population and at least 68% of U.S. road miles with their 4G LTE networks²⁸⁰. Further, there are many Mobile Virtual Network Operators (MVNOs)²⁸¹ who buy wholesale spectrum access from the three major carriers and resell these services to consumers. MVNOs offer retail competition but they heavily rely on the wholesale spectrum access from the big three. Given that they have no independent spectrum, they cannot replicate nationwide networks so they can only compete on pricing not on infrastructure.

At the same time, it should be noted that the different parts of the US communications market are becoming **increasingly interconnected**. For example, cable companies are expanding into mobile service through Mobile Virtual Network Operators (MVNOs) that can shift traffic onto Wi-Fi and mobile operators are starting to compete with traditional home internet providers through their 5G home broadband offerings. In addition, the FCC created the world's first "Supplemental Coverage from Space" (SCS) a hybrid terrestrial and satellite legal framework, which allows the use of advanced satellite technology to help terrestrial networks reach remote and underserved areas.

The structural concentration of the US mobile market is driven by the spectrum aggregation (spectrum holdings) and high barriers of entry. **Spectrum holdings** – i.e., the amount of radio-frequency spectrum licenses that mobile operators use to run their networks – are competitive factors that affect the US mobile market structure. In the US, the mobile operators AT&T, T-Mobile and Verizon together control the vast majority of

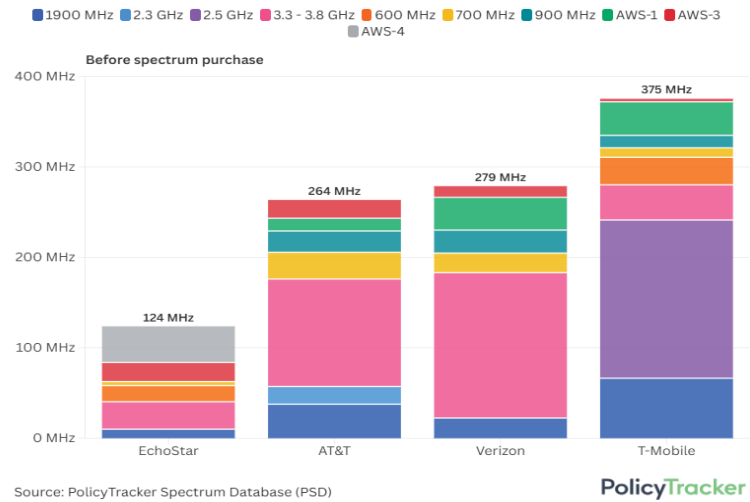
²⁸⁰ FCC Communications Marketplace Report [FCC-24-136A1.pdf](#).

²⁸¹ Two of the largest MVNOs are owned by cable providers who have entered the mobile wireless marketplace through these MVNO arrangements, and also have begun to deploy their own facilities-based networks.

the US terrestrial spectrum. These holdings create strong asymmetric advantages that prevent equal competition.

Table A10 1-2 below, indicates that in the US Low-band and Mid-band spectrum is dominated by T-Mobile, AT&T and Verizon. In summer 2025 Echostar sold to AT&T spectrum licenses in the 3.45 GHz and 600 MHz bands, a total of 50 MHz of nationwide spectrum, increasing the spectrum concentration in the US market.

Table A10 1-2: Spectrum assigned to US network operators, sorted by band



Source: PolicyTracker, 2025

In sum, the US market is characterised by concentration of spectrum holdings—more than 82%²⁸² of spectrum controlled by three operators—, an uneven distribution of valuable mid- and low-band spectrum, and the absence of a fully established fourth competitor, which indicate that the market functions more like a three-player oligopoly.

²⁸² 82% does not include the 50MHz spectrum sent from EchoStar to AT&T.

ANNEX 11: EVALUATION: REVIEW REPORT ON THE EECC AND RELATED ACTS

Please, find the Annex in a separate file.



EUROPEAN
COMMISSION

Brussels, 21.1.2026
SWD(2026) 13 final

PART 3/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on digital networks, amending Regulation (EU) 2015/2120, Directive 2002/58/EC and Decision No 676/2002/EC and repealing Regulation (EU) 2018/1971, Directive (EU) 2018/1972 and Decision No 243/2012/EU (Digital Networks Act)

{COM(2026) 16 final} - {SEC(2026) 14 final} - {SWD(2026) 14 final}

Annex 11 to the Impact Assessment: Evaluation – Review of the functioning of European Electronic Communications Code (EECC), BEREC Regulation, Open Internet Regulation, and certain aspects of the ePrivacy Directive

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1. INTRODUCTION

As a starting point, the European Electronic Communications Code (hereafter “EECC”)¹ article 122 requires the Commission to review the functioning of the EECC. Therefore, one aim of this review report is to assess the functioning of the EECC since its applicability as of 21 December 2020, in particular Articles 61(3), 76, 78 and 79.

In addition, Article 122(2) requires that the Commission shall review the scope of universal service in light of social, economic and technological developments. The aim of this report is also to review the scope of universal since the applicability of the current rules as of 21 December 2020.

Next, Article 122 (3) allows the Commission, taking utmost account of the opinion of the body of European Regulators for Electronic Communications (BEREC), to publish a report on the application of the general authorisation provisions, including on the possible conditions and to submit a legislative proposal to amend those provisions where it considers this to be necessary for the purpose of addressing obstacles to the proper functioning of the internal market.

Furthermore, Article 123 of the EECC requires that the Commission publishes a report on the application of end-user rights, taking utmost account of the BEREC opinion. The aim of this report is also to accomplish this.

Finally, in view of new challenges concerning the competitiveness of the sector, the need to deepen the Single Market for electronic communications as well as security and resilience of networks, the need for a major regulatory reform² has been identified. Therefore, this report includes a comprehensive review in light of the announced Commission initiative to propose a Digital Networks Act (DNA). Accordingly, this review of the entire EECC is conducted together with the review of the Regulation (EU) 2018/1971 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Agency for Support for BEREC (BEREC Office), and includes an assessment of the Regulation (EU) 2015/2120 on Open Internet Access (OIR), some telecom specific (number-related) aspects (Art. 7 on Itemised billing, Art. 8 on Presentation and Restriction of Calling and Connecting line identification and Art. 10 on the related exceptions, Art. 11 Automated calls forwarding and Art. 12 Public directories) of the Directive 2002/58/EC (ePrivacy Directive) and the Radio Spectrum Policy Programme³ (RSPP).

To ensure overall coherence of this report, the evaluation is organised separately by individual subject areas, and a summary is provided.

The sections on these subject areas cover a short evaluation carried out with available data and elaborates, where relevant, specifically on some of the evaluation criteria of effectiveness, efficiency, relevance, EU added value and coherence. To allow for easy reference, in chapter

¹ [Directive - 2018/1972 - EN - eecc - EUR-Lex.](#)

² See Draghi, M., The Draghi report: A competitiveness strategy for Europe (Part A), 2024 as well as Draghi, M., The Draghi report: In-depth analysis and recommendations (Part B), 2024, Letta, E., Much more than a market – Speed, Security, Solidarity Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens, 2024 and Niinistö, S., [Report: Safer Together – Strengthening Europe’s Civilian and Military Preparedness and Readiness](#) | European Commission.

³ Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme, Text with EEA relevance (OJ L 81, 21.3.2012, p. 7–17): [https://eur-lex.europa.eu/eli/dec/2012/243\(2\)/oj](https://eur-lex.europa.eu/eli/dec/2012/243(2)/oj).

5 on spectrum, the evaluation criteria are assessed for individual subject areas separately where necessary.

For these assessments, the European Commission (Commission/EC) gathered feedback from various sources, the main sources are listed in Annex I.

Stakeholders were consulted on the review and on the evaluation of the interventions together with the proposals for the DNA, for which the details are provided in Annex 2 of the Impact Assessment.

2. CONTEXT

The EECC, the BEREK Regulation, the OIR, the 2012 Radio Spectrum Policy Programme (RSPP)⁴, the Decision No 626/2008/EC (MSS Decision) and the ePrivacy Directive have not been significantly changed since December 2020. Legal, judicial and regulatory developments since December 2020 are outlined in the specific sections below where relevant.

The exploratory consultation of 2023⁵ and the feedback to the White Paper “How to master Europe’s digital infrastructure needs” of 2024 identified the following as the main technological developments impacting the connectivity sector: network virtualisation, artificial intelligence, open networks, edge cloud, low earth orbit satellite communications and next generation radio communications. Most respondents recognise the trend towards cloud- and software-based infrastructures and the need to significantly upgrade the network infrastructures. Many stakeholders underline the trend towards enabling data and AI centric applications. The diverse range and convergence of players in the broader ecosystem around digital networks is widely recognised, illustrated by partnerships between telecom suppliers and operators with cloud providers and content and application providers (CAPs). However, Internet and cloud players underline that general cloud services and telecom services remain technologically distinct. Some disagree on the concept of “convergence” between telecom and cloud services depicted in the White Paper.

Commercial/market developments:

Many operators that were previously present across several EU Member States have divested or rolled back certain of their operating units to focus on a smaller set of countries, to improve financial results and meet the expectations of investors. This includes, most recently Vodafone, Liberty Global, and BT Global Services (the former global business service unit of BT). The main aim in these divestments has been to focus on specific countries in which these operators have a stronger market position. Other operators are expanding to operate in more EU Member States e.g. Digi and Iliad, pursuing multi-country expansion strategies. The delayering of the telecom sector and the introduction of new players in the form of fibre netcos and towercos has tended to have a positive impact on investment in FTTH and towers for the provision of mobile services by improving transparency and offering the potential for higher take-up rates by aggregating demand. Certain incumbent operators have also opted for a legal, structural or functional separation of their business. With video streaming now dominating internet traffic, ISPs face increasing pressure to deliver high-quality content efficiently. Broadcasters transition to OTT as consumers shift from OTA (Over-the-air,

⁴ Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme, Text with EEA relevance (OJ L 81, 21.3.2012, p. 7–17) : [https://eur-lex.europa.eu/eli/dec/2012/243\(2\)/oj](https://eur-lex.europa.eu/eli/dec/2012/243(2)/oj).

⁵ <https://digital-strategy.ec.europa.eu/en/library/results-exploratory-consultation-future-electronic-communications-sector-and-its-infrastructure>.

including Cable TV and IPTV) to OTT (Over-the-top internet-based streaming). Beyond the challenge of bandwidth management, streaming represents also a major monetisation opportunity for ISPs. The synergy of connectivity and AI powers innovation like autonomous systems, smart cities, healthcare, and immersive virtual/augmented reality experiences. Applications such as automated driving or telemedicine run on advanced networks that will look increasingly like a computing continuum, ranging from chips and high-speed processors to connectivity, cloud, edge, software and AI. Technologies like AI and cloud computing converge with significantly enhanced connectivity needs.

3. OBJECTIVES AND SINGLE MARKET

3.1. Intervention logic

As to the EECC, at the time when the proposal had been made, the three primary objectives of promoting (1) competition, (2) the internal market, and (3) citizen interests, which were in place under Article 8 of the Framework Directive as well as the regulatory principles relative to investment and innovation were considered to remain valid and relevant⁶. The telecoms sector was generating more and more spillovers to the rest of the economy, becoming the foundation of modern, innovative economic systems and as well as of certain societal services, such as e-transport, e-government, e-health care and e-learning. This was considered to require appropriate networks to be rolled out at a sufficient scale and that Very High Capacity connectivity became accessible and affordable to all citizens and businesses. Such connectivity was recognised as the underlying driving force for the digital society and economy, underpinned by technological changes and evolving consumer and market demands. It appeared necessary that the objectives should be flanked by a novel connectivity objective, spelled out as: "Access and take-up by all European citizens and businesses of very high-capacity connectivity, both fixed and mobile, and interpersonal communications services, on the basis of affordable price and choice, enabled by effective and fair competition, by efficient investment with adequate returns, by innovation, by common rules and predictable regulatory approaches in the internal market and by the necessary sector-specific rules to safeguard the interests of citizens.

As to the BEREC Regulation and to RSPG, it was intended to ensure that the relevant regulatory functions were attributed to the different actors such as national regulatory authorities (NRAs), BEREC, RSPG or the European Commission and that the structure of BEREC is simplified in order to have a streamlined and efficient governance set-up.⁷

As to the Open Internet Regulation, the measures proposed were intended to lead to greater levels of innovation by lowering entry-market barriers and thus establishing a level playing field among providers of applications and services, while at the same time ensuring the highest protection for end-users and promoting the internet as an engine of innovation⁸.

As to the ePrivacy Directive (Directive 2002/58/EC)⁹, the latest amendments introduced in 2009 intended to mainly update the existing Directive 97/66/EC (i.e., preceding the GDPR)

⁶ See SWD(2016) 303 final, PART 1/3, p57 pp.

⁷ See SWD(2016) 303 final, PART 1/3, p62

⁸ See COM(2019) 203 final, p 12.

⁹ As amended by Directive 2009/136/EC of the European Parliament and of the Council of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on

on the processing of personal data and the protection of privacy in the telecommunications sector to take account of new services and technological developments. The aim was to cover all electronic communications services in a technology neutral fashion. A harmonised level of data protection in the electronic communications sector was an essential element for the functioning of the internal market in electronic communications services and networks. There was a need to provide subscribers and users with safeguards to protect their privacy in view of calling line and connected line identification services (CLI and COLI) and allowed access to blocked CLI information for emergency services and for tracing of malicious or nuisance calls. It was extended to new article on mobile location information. Among the other important consumers' rights introduced by the 2002 Directive was the subscribers' right and means to undo the forwarding of calls to their line and the subscribers' right to non-itemised bills.

3.2. Complexity and simplification potential, including observation on 'gold plating'

3.2.1. Complexity of and delays in the national transposition process

Member States were required to adopt and publish, by 21 December 2020, the laws, regulations and administrative provisions necessary to implement the EECC into their national law. However, the transposition of the EECC had been progressing rather slowly. Many Member States were late in complying with their implementation obligations. Only three Member States (EL, FI, HU) had complied with the transposition deadline of 21 December 2020. In February 2021, infringement procedures were opened against 24 Member States. By September 2021, only six of those had fully transposed and communicated the implementation. In April 2022, ten Member States (ES, HR, IE, LT, LV, PL, PT, RO, SE, SI) still had not complied with the transposition obligations and were referred to the Court of Justice of the European Union for their failure to fully transpose and communicate to the Commission the transposition measures. The transposition in all 27 Member States was completed in August 2024, with the official publication of the relevant Polish legislation. The significant delays accumulated by Ireland, Latvia, Poland, Portugal and Slovenia lead to judgements by the European Court of Justice which imposed significant fines¹⁰.

Transposition of many provisions of the EECC presented issues for some Member States. Only one in every seven Articles could be considered as not problematic and straightforward in all 27 Member States. The majority of Member States drafted completely new legislation. The remaining ten Member States amended their existing laws. In most cases, Member States provided a corresponding transposition of the EECC provisions (i.e. transposition of the meaning of the provision without given the exact verbatim expression). However, four Member States (CY, EL, IE, MT) seemed to use literal or almost literal transposition systematically for many EECC provisions. Also, transposition of certain provisions is more

cooperation between national authorities responsible for the enforcement of consumer protection laws (Directive 2009/136/EC). The 2009 intervention logic for the amendments of the 2002 e-Privacy Directive was based on the increased security breaches, and the lack of mandatory notification of security breaches resulting in users' personal data being lost or compromised. At that time, there were not sufficient measures available at Member State level to combat spam. It was not clear that the Directive also applies to public communications networks supporting data collection and identification devices (including contactless devices such as Radio Frequency Identification Devices). That's why, the relevant amendments were introduced by Directive 2009/136/EC.

¹⁰ Judgements in cases [C-439/22](#) (Ireland), [C-454/22](#) (Latvia), [C-452/22](#) (Poland), [C-449/22](#) (Portugal) and [C-457/22](#) (Slovenia),

often literal than others; in particular, about half of the Member States assessed have transposed the definitions of Art. 2 EEC in a literal or almost literal manner.

Several Member States accumulated political and administrative delays in the transposition process, which was mentioned by six countries (BE, EE, IE, IT, MT, RO). In Belgium the outgoing government acted as caretaker government and could not propose a bill as that could have prejudiced the policy of the future government. In addition, emission levels for electromagnetic fields had to be adapted to allow permit granting for 5G deployment in Brussels. In Estonia, the timeframe for the transposition remained a challenge procedurally, with the communication between national authorities and the legislator passing through the three readings of the Parliament being a time-consuming procedure. In Ireland, the transposition required primary legislation which resulted in a delay. Moreover, there was a Supreme Court decision during this period which set new standards for fair procedures and oral hearings in quasi-judicial administrative proceedings, which required the enforcement provisions to be redesigned. In Italy, the division of competences among different authorities presented significant challenges. The implementation of the EEC involved both the Communications Regulatory Authority (AGCOM) and the Ministry of Enterprises and Made in Italy (MIMIT), with additional input required from privacy authorities. As not all provisions of the EEC fell under the jurisdiction of a single authority, it often led to inefficiencies and delays, requiring protocols of understanding and extensive coordination between different entities. In Malta, a comprehensive implementation required extensive consultation with different stakeholders, allowing for reasonable timeframes to provide an informed input. While such challenges did not necessarily involve all stakeholders, the major authorised service providers required substantial time to provide their input to the legislative proposals envisaged in transposing the EEC. In turn, the Malta Communications Authority (MCA) and the Government required some time to evaluate the submissions made and to modify the original legislative proposals. In Romania, the process took longer than anticipated due to the unique aspects of the Romanian legal framework, which requires inter-institutional approvals. The extended timeline was also attributed to the inclusion of infrastructure development components in the legislation, which were not part of the EEC transposition.

This evidence confirms the overall complexity of the transposition of the EEC and sets out the significant delays accumulated by various Member States in completing the transposition process.

3.2.2. National rules in addition to transposition measures

Several Member States adopted national provisions which relate to EEC provisions but go beyond what would be strictly necessary for the completeness and conformity of the transposition. Such, accompanying provisions were identified in eight Member States were dispersed across various legal frameworks.

For example, Cyprus and Sweden had gone beyond the EEC requirements by implementing more frequent updates and broader information-gathering for their geographical surveys of broadband networks.

Furthermore, the EEC requires Member States to ensure that in the event of a significant threat to the security of public electronic communications networks or services, providers must inform potentially affected users about any protective measures or remedies available to them. Additionally, where appropriate, providers should also inform users about the nature of the threat itself. For example, Cyprus has adopted a provision that goes further by specifying that providers must also inform users about all possible ways to prevent such threats, including relevant costs associated with these measures. In Croatia, it is additionally

emphasised that operators must take appropriate and urgent measures at their own expense to prevent damage from security incidents, which adds a proactive element not explicitly stated in the EECC. The Maltese provision also includes the obligation to inform users about the threat itself where appropriate, ensuring that users are well-informed about potential risks.

3.3. Single Market

3.3.1. Harmonisation Aspects

There were several provisions introduced in the EECC to ensure harmonisation and strengthen the single market. The Significant Market Power (SMP) regime remains the key instrument for ex ante regulation. The detailed evaluation of the harmonisation of regulatory remedies under Article 32 EECC can be found in section 4.1. below. Several novelties were introduced by the EECC in relation to spectrum policy to strengthen its single market dimension. A detailed evaluation of the spectrum provisions, which are a key factor for fragmented national markets, can be found in chapter 5. Another important aspect limiting the development of the single market is the authorisation regime, which is today based on national procedures and conditions: general authorisation is covered in chapter 6. Other harmonisation aspects also contribute to the single market: standardisation is covered in section 3.5.3. Harmonisation of end user rights is addressed in chapter 8.

The EECC introduced specific requirements to support machine-to-machine/Internet of Things (M2M/IoT) pan-European services. Article 93(4) mandates Member States to make available a range of non-geographic numbers for extraterritorial use within the EU. BEREC was tasked to set up a database¹¹ with these number ranges. Not all Member States implemented this requirement, and 9 Member States did not notify such number ranges to BEREC database. Stakeholders that provide M2M services providers indicated that certain conditions attached to the right of use of number would not be relevant in such use cases: i.e. number portability, contract duration, reporting obligation in every Member State where the M2M/IoT service is deployed. Current obligations incumbent on cross-border service providers could be harmonised.

3.3.2. Open Internet Regulation

The second Report from the Commission to the European Parliament and the Council on the implementation of the open internet access provisions of Regulation (EU) 2015/2120 (Open Internet Regulation, OIR) of 2023¹² concluded that the principles enshrined in the Regulation are still fit for purpose and guarantee the appropriate balance between protection of end-users and technological development. Nevertheless, the Report mentioned that the interpretation of certain provisions is not sufficiently clear, especially considering the developments that took place in networking technologies since 2015, such as network slicing and virtualisation. During stakeholder consultations, some stakeholders have highlighted that there is not sufficient flexibility in the interpretation of the open internet provisions and accordingly not sufficient legal certainty for the introduction and provision of innovative differentiated and quality-optimised services.

¹¹ https://www.berec.europa.eu/en/tools/numbering-database-for-extra-territorial-use?language_content_entity=en.

¹² <https://digital-strategy.ec.europa.eu/en/library/second-report-implementation-regulation-open-internet-access>.

For example, until the rulings of the Court of Justice of the European Union which ruled that the so-called “Zero-Rating” offers are not compliant with the provisions of the OIR, this commercial practice was widely applied within the EU, although the approach of the national regulators vis-a-vis these offers varied. A diversified approach among the regulators, which subsequently got modified by the courts, had reduced the profitability of offers which had already been rolled out widely in the market and could no longer be offered.

Examples of categories of use cases that could benefit from more legal certainty which could lead to increases in expected profitability of roll-out are provided by the Camara project¹³: remote monitoring, surveillance and repairs services, digital payments, banking secure payment transactions, digital health monitoring services, connected vehicles, drones and navigation related services, connected smart meters, Industry 4.0 services (e.g. connected factories, supply chain services, like product shipping monitoring, inventory and warehouse management, smart factory production line (robotics), transport hubs, e.g. ports, airports (fleet and container tracking services, smart stadiums (e.g. live 5G connected cameras on field, security personnel communication), mission critical services like railway operations, public safety communications (PPDR), energy grids, disaster response or emergency medical services (EMS), Augmented Reality/Virtual Reality services, Network APIs (connectivity services with specific architecture): e.g. connectivity services in NaaS Platforms, Video Gaming, OTA (over-the-air) critical software updates for vehicles, OTA vehicle maintenance or professional broadcasting services (live event broadcasting, remote transmission of live broadcasting streams).

While it is maintained that the conclusions of the 2023 Report are still valid and the provisions of the Regulation are still fit for purpose and do not require major changes, it is suggested that, in order to address issues like the one on specialised services illustrated above, if BEREC guidance or, if considered necessary, the Commission’s Recommendation will not bring sufficient legal certainty, the Commission could be empowered to issue binding guidance in the form of implementing or delegated acts in instances where the market would benefit from more legal certainty.

3.4. General Objectives

The EECC consolidated and updated the previous EU Framework for Electronic Communications (adopted in 2002 and updated in 2009). It aimed at boosting connectivity and better protecting users by establishing forward-looking and simplified rules that facilitate the provision of very high-quality, secure, and affordable electronic communications services throughout Europe. While many of the measures in the EECC built on pre-existing measures present in the previous EU Framework for Electronic Communications, it added new elements that have required transposition and implementation within the Member States.

Under the EECC, NRAs and other competent authorities as well as BEREC, the Commission and the Member States shall pursue each of the following general objectives, which are not listed in order of priority:

- (a) promote connectivity and access to, and take-up of, very high-capacity networks, including fixed, mobile and wireless networks, by all citizens and businesses of the Union;

¹³ <https://camaraproject.org/>.

- (b) promote competition in the provision of electronic communications networks and associated facilities, including efficient infrastructure-based competition, and in the provision of electronic communications services and associated services;
- (c) contribute to the development of the internal market by removing remaining obstacles to, and facilitating convergent conditions for, investment in, and the provision of, electronic communications networks, electronic communications services, associated facilities and associated services, throughout the Union, by developing common rules and predictable regulatory approaches, by favouring the effective, efficient and coordinated use of radio spectrum, open innovation, the establishment and development of trans-European networks, the provision, availability and interoperability of pan-European services, and end-to-end connectivity;
- (d) promote the interests of the citizens of the Union, by ensuring connectivity and the widespread availability and take-up of very high capacity networks, including fixed, mobile and wireless networks, and of electronic communications services, by enabling maximum benefits in terms of choice, price and quality on the basis of effective competition, by maintaining the security of networks and services, by ensuring a high and common level of protection for end-users through the necessary sector-specific rules and by addressing the needs, such as affordable prices, of specific social groups, in particular end-users with disabilities, elderly end-users and end-users with special social needs, and choice and equivalent access for end-users with disabilities.

The EECC, therefore, introduced a **new general objective** (in addition to the previous objectives regarding competition, consumer protection and the internal market, see Article 3 EECC) **to promote connectivity and access to, and take-up of, very high-capacity networks**, including fixed, mobile and wireless networks, by all citizens and businesses of the Union. Increased emphasis was also given to the need to take into account the variety of conditions relating to infrastructure and competition in different geographic areas and the need to promote efficient investment and innovation in new and enhanced infrastructures.

As to maintaining security of networks and services, ex-Article 41 of the EECC, now integrated in Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union (NIS 2 Directive), provided that Member States should ensure that competent national regulatory authorities have powers to issue binding instructions, including regarding time limits for implementation and have the power to require information and security audits from providers. To follow up on the implementation of these obligations provided for in the EECC and, accordingly, to ensure the cybersecurity of 5G networks, Member States authorities adopted in January 2020 the 5G Toolbox¹⁴, endorsed by the European Council and the Commission. It contains a set of key measures to be taken by Member States. In particular, it sets out a thorough and objective process to assess risks and threats and identifies proportionate and non-discriminatory measures to mitigate and manage appropriately identified risks posed to the security of the network and services. The purpose of the toolbox is to guide Member States in the transposition and implementation of the relevant security provisions of the

¹⁴ NIS Cooperation Group, Cybersecurity of 5G networks - EU Toolbox of risk mitigating measures, 23 January 2020.

telecommunication regulatory framework (and currently in relation to Directive (EU) 2022/2555) in the area of 5G networks security. The EECC predates the EU's Green Deal and therefore does not systematically account for **environmental sustainability** considerations. There are two references to environmental protection in the EECC (Art. 44 on colocation and network sharing and Art. 57 on deployment and operation of small-area wireless access points). Some recitals also refer to compliance with environmental requirements (Recital 46), deploying networks in environmentally responsible way and improving facility sharing for environmental reasons (Recital 105), including spectrum sharing (Recital 106) and environmental security (Recital 94).

In June 2021, the Council and Parliament adopted legislation that enshrines sustainability objectives into Europe's first Climate Law¹⁵. Although the EECC does not itself specifically include general objectives relating to environmental sustainability, the telecom sector is subject to a variety of other legislation in this area. The EU environmental sustainability measures which apply to ICT include the Ecodesign Directive¹⁶ (covering energy consumption and labelling requirements for certain electronic goods), and Waste of Electrical and Electronic Equipment Directive¹⁷, which seeks to increase recycling of electronic equipment. In addition, the EC facilitated the development of voluntary Code of Conduct covering¹⁸ broadband equipment, 2024 Best Practice Guidelines on¹⁹ energy efficiency²⁰ and a forthcoming Code of Conduct for sustainable telecommunications networks²¹. Taxonomy establishes criteria under which companies can claim that their activities are "sustainable" for the purposes of establishing the degree to which an investment is environmentally sustainable (Art. 1 (1) Taxonomy Regulation).

An overview of the environmental measures impacting the ICT sector is shown in the following figure.²² This environmental sustainability overview and the figure below show that there is already existing legislation in place covering the electronic communications sector. However, there is still room to further streamline the reporting obligations under the horizontal acts and coordinate more the work of the various competent authorities involved in the environmental sustainability activities to facilitate the sector specific monitoring by the telecom regulators and BEREC and respectively, the compliance by the sector.

¹⁵ Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999, OJ L 243, 09.07.2021: <https://eur-lex.europa.eu/eli/reg/2021/1119/oj/eng>.

¹⁶ Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, OJ L 285, 31.10.2009: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0125>.

¹⁷ Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), OJ L 197, 24.07.2012: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02012L0019-20180704>.

¹⁸ [Publications; EU Code of Conduct on Energy Consumption of Broadband Equipment: Version 9.0 \(current version valid from 1.1.2024\)](#) and for Version 9.1 [Code of conduct on energy consumption of broadband equipment - Publications Office of the EU](#).

¹⁹ [2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency](#).

²⁰ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198, 22.06.2020: <https://eur-lex.europa.eu/eli/reg/2020/852/oj/eng>.

²¹ [Green and sustainable telecom networks - The Joint Research Centre: EU Science Hub](#).

²² Reference in Section 2.2.8 of the First Interim Report on Completing the DSM.

Figure 1: Figure on existing political frameworks and initiatives influencing the green digital transition



Compared to the strong emphasis put on competition, the EECC does not sufficiently account for competitiveness of the telecoms sector or of the EU industry at large. As widely recognised by stakeholders and set out in the Commission White Paper, the connectivity ecosystem is expanding driven by technological change, e.g. cloudification and AI. Competitiveness therefore becomes a very important element in view of the development of the AI continent²³.

As regards network rollout as basis for competitiveness, where VHCNs²⁴ including dark fibre are not widely available this can limit service quality and competition on 5G. It can also affect the bandwidths available to enterprises and thus their capacity to benefit from big data processing/AI as well as the development of future applications such as quantum communications. It is notable that some urban areas in the EU have achieved world-leading levels of innovation supported in part on the availability of a dark fibre network. The lack of networks supporting full innovation capabilities elsewhere could limit Europe's wider competitiveness in the global economy. Availability and take-up of future-proof connectivity provides a key input to European industry and is vital to enable societal participation in the digital economy as well as to drive European competitiveness.²⁵ Figures from available reports provide a mixed view of financial performance in the telecom sector, with differences between service types as well as countries, business models and operators with different degrees of scale and history. An overview is provided below. However, there has been a real term decline in revenues, with low ARPUs for mobile services. Fixed broadband revenues are significantly higher.²⁶ Further overview is provided below in the Coordinated spectrum policy.

²³ See [AI Continent Action Plan](#).

²⁴ 'Very High Capacity Networks' means either an electronic communications network which consists wholly of optical fibre elements at least up to the distribution point at the serving location, or an electronic communications network which is capable of delivering, under usual peak-time conditions, similar network performance in terms of available downlink and uplink bandwidth, resilience, error-related parameters, and latency and its variation; network performance can be considered similar regardless of whether the end-user experience varies due to the inherently different characteristics of the medium by which the network ultimately connects with the network termination point.

²⁵ See reference to the access study section 9.1.1.

²⁶ See reference to the finance study section 3.4 / 4.3.

In the current geopolitical context security and resilience of integrated electronic communications infrastructures (terrestrial, non-terrestrial such as satellite or submarine) have become an important concern which has not been addressed by the EECC, only partially and in a limited manner. Resilience under the EECC is considered mainly in the context of availability of services (voice communications services and internet access services) provided only over public electronic communications networks in the event of catastrophic network breakdown or in cases of force majeure (Art. 108 EECC). Not all EECC providers are subject to general authorisation conditions concerning public warnings, natural disasters or emergencies (Art. 110 EECC).

Nevertheless, resilience is also key for the integrity of networks irrespective of their purpose to avoid disruptions and ensure the uninterruptedness of communications. This could not be comprehensively addressed in the current framework. For example, submarine cable systems owned by content and application providers (CAPs) are considered as non-public ECNs and are not covered by the above-mentioned EECC requirements unless Member States decide at national level to subject such networks and non-public ECS to the general authorisation regime²⁷. Since international connectivity enhances and accelerates the competitiveness of the Union and its economy, and in a challenging and dynamic geopolitical context, it is important that resilience is equally ensured by all networks which provide crucial services for our economic activities, public safety, health and environment. Even when considering existing legal instruments addressing the physical or cyber resilience of infrastructures, not sufficient emphasis is given to the EU preparedness for crisis and to the role of NRAs and BEREC in enhancing the EU preparedness based on an EU networks' contingency plan.

3.4.1. Effectiveness

Within the wide spectrum of assessments, most stakeholders of all types consider that – overall – the EECC is currently achieving, or is on track to achieve, its core objectives. However, the Digital Decade report 2025 documents reveal differences in reaching various connectivity targets at EU level or, at the very least, in some Member States. VHCN and basic 5G roll-out is on track across the EU with some lagging only in some Member States²⁸. While many Member States are still lagging behind in mid-band 5G coverage that is necessary to ensure high quality 5G connectivity²⁹. Accordingly, some governments and a majority of industry stakeholders argued that the EECC missed out on the objectives of promoting connectivity and investment. An example of this shortcoming is the persisting urban-rural divide. According to the *State of the EU Digital Transformation in 2025: progress and horizontal recommendations*³⁰, the coverage of households by fixed VHCN in the EU-27 reached 82.5% in 2024, with a growth rate of 4.9%, while fibre coverage stood at 69.2% of households in 2024, marking an 8.4% annual increase, but rural deployment with fibre is only 58.8% in 2024. Incumbents, mobile operators as well as some alternative operators of broadband networks argue that the EECC does not strike the right balance between the

²⁷ Reference to Page 22, 2024 BEREC Report on the general authorisation and related frameworks for international submarine connectivity: "Non-public ECN and non-public ECS are subject to prior notification/registration under the general authorisation regime only in 4 MS".

²⁸ See [Spectrum](#) section 5.4.1. Figure **Error! Main Document Only.**: Total 5G household coverage.

²⁹ See [Spectrum](#) section 5.4.1. Figure **Error! Main Document Only.**: 5G coverage of households in the 3.6 GHz band Observatory Report 2025 | Shaping Europe's digital future.

³⁰ Reference to the State of the Digital Decade 2025 report: [State of the Digital Decade 2025 report | Shaping Europe's digital future](#).

objectives of facilitating investment, on the one hand, and the promotion of citizens' benefits and competition, on the other. This is in line with the emphasis by EU and national policies on the promotion of citizens' benefits and competition³¹.

Governments and industry stakeholders, such as incumbents, alternative operators, mobile operators, OTT providers agree that the EECC helped achieve/maintain effective competition in the market for electronic communications networks and services. There are multiple operators in each country on average 3-5 mobile operators and around 10 fixed operators, and even about 20 MVNOs in some Member States³². Stakeholders consider these numbers as signifying strong competition and sufficient to cover demand. Some positively noted the flexibility of the EECC, which allows NRAs to address market failures specific to their national markets and thus sustain competitive dynamics.

In terms of scaling up, incumbents and large mobile operators argued that the EECC failed to achieve its objective of effective competition because it is too much focused on market entry, blocking market exit, avoiding price increases fostering lower prices and discouraging investment resulting in fragmentation and a small user base per operator/provider. Consumer organisations are concerned that consumers would lose out on price, quality, and network deployment if there would have been more consolidation. There are some telcos active in several countries (e.g. Vodafone, Telefonica, Deutsche Telekom, Orange, Iliad, Digi). Furthermore there are regional operators present in more than one country (Telia, Telenor in northern Europe).

At the same time, the Significant Market Power (SMP) regime remains a central instrument for ex ante regulation as a guardian of competition both at infrastructure and service level in key access markets.

Overall, effective competition tends to be lower in some (national) markets (in particular for wholesale local access where more than 20 regulators still imposed remedies and wholesale dedicated capacity with 15 regulated markets) and for more advanced services. Competition in electronic communications in the EU is also shaped by external factors, such as technological developments and the presence of dominant non-EU hyperscalers that shape market demand.

On trade-offs between different regulatory objectives of the EECC, it shall be emphasised that most stakeholders either do not perceive any trade-offs or see them as a useful flexibility allowing to address the regulatory needs of a given national market³³.

Concerning potential addition of new objectives and especially, on the governance side, the evaluation results presented that BEREC should widen its focus beyond electronic communications to address emerging digital market issues that affect the telecommunication market. Network resilience and cybersecurity were mentioned as areas of particular importance in this regard. However, a potential issue is that not all NRAs may have competencies in these areas, and if some NRAs do and others do not have these competencies, it could reduce the representativeness of opinions by BEREC and ultimately could lead to reduced harmonisation.³⁴ This evaluation outcome shows that if expanding the policy

³¹ Reference to Section 3.1.2 of the Final 1st Interim Report on Completing the DSM.

³² Reference to Section 4.1.2.1 of the Final 1st Interim Report on Completing the DSM.

³³ Reference to 3.1.2 of the Final 1st Interim Report on Completing the DSM.

³⁴ Reference in Section 4.5.2 of the Final 1st Interim Report on Completing the DSM.

objectives there would be a need to overcome the divergence in regulatory competences to tackle effectively the newly emerging issues in the single market.

In view of the wide range of assessments, it will be important to balance any new proposals under the Commission's DNA initiative carefully, to address new challenges appropriately while preserving and expanding the benefits which have been achieved under the EECC.

3.4.2. Efficiency

The results of the study show that views are largely aligned between several governments and industry stakeholders on the administrative burden of the current legislation and the need to simplify the regulatory framework to achieve the regulatory objectives³⁵. The governments mention the simplification of regulation specifically to achieve the objective of the promotion of connectivity and investment. This applies in particular to the rules related to the deployment of VHCNs in high-cost deployment regions (e.g. rural or remote). Simplification can also achieve effective competitiveness because some EECC obligations (e.g. reporting obligations) do not differentiate between larger and smaller companies. It is also indicated that simplification and alignment of rules (related to general authorisation and end-user protection) may lead to greater harmonisation in some instances, thus contributing to the creation of the internal market³⁶.

3.4.3. Coherence

There is major agreement that there is no evidence of gaps in the coherence of the EECC objectives as such. Nevertheless, several stakeholders pinpointed a few specific issues of incoherence between the EECC, on the one hand, and Regulation (EU) 2022/1925 of the European Parliament and of the Council of 14 September 2022 on contestable and fair markets in the digital sector and amending Directives (EU) 2019/1937 and (EU) 2020/1828 (Digital Markets Act/DMA)³⁷, Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 October 2022 on a Single Market For Digital Services and amending Directive 2000/31/EC (Digital Services Act/DSA)³⁸ and Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive)³⁹, on the other.⁴⁰

³⁵ Reference to 4.1.2 of the Final 1st Interim Report on Completing the DSM.

³⁶ Reference to 4.1.2 of the Final 1st Interim Report on Completing the DSM.

³⁷ [Regulation - 2022/1925 - EN - EUR-Lex.](#)

³⁸ [Regulation - 2022/2065 - EN - DSA - EUR-Lex.](#)

³⁹ [Directive - 2022/2555 - EN - EUR-Lex.](#)

⁴⁰ Reference to Section 4.1.2 of the Final 1st Interim Report on Completing the DSM. Examples are related to the difference between the EECC and DMA for the thresholds of regulatory intervention concerning NI-ICS falling under both the EECC and under the DMA as a Core Platform Service. With regard to the DSA, a few stakeholders found issues with the EECC. In particular, the obligation to designate a single point of contact under Art. 11 DSA duplicates the activity notification under Art. 12 EECC. The former Art. 40 and 41 EECC had rules tailored to the security of electronic communications networks and services, while the NIS-2 Directive repealing these provisions apply to "network and information systems" that include both ICT networks and telecom networks.

Many stakeholders (including those who did not find any incoherence) pointed out that inconsistencies may emerge at the transposition and application stage, especially where different national authorities are responsible for the enforcement. All other digital legislations are new, and there is very limited experience with transposing and applying them, which might be the reason why so few instances of incoherence were reported. Therefore, many governments and industry stakeholders argue that the focus of the EU should be on guiding the transposition and application process. Several stakeholders also noted the need for more cooperation arrangements between different authorities⁴¹.

3.4.4. Relevance

There is broad agreement that the current EECC objectives remain relevant. Nevertheless, there were calls⁴² to improving implementation, ensuring better alignment with related legislation such as the NIS 2 Directive, DMA and the Regulation (EU) 2024/1309 of the European Parliament and of the Council of 29 April 2024 on measures to reduce the cost of deploying gigabit electronic communications networks, amending Regulation (EU) 2015/2120 and repealing Directive 2014/61/EU (Gigabit Infrastructure Act/ GIA)⁴³.

Although it seems there is certain interest in adding resilience as a possible new objective, there are nuances on what resilience means. Some stakeholders connected it to cybersecurity, while others explicitly stated that it was separate from security (i.e. network resilience as technical and organisational measures to meet risk-identified threats that can disrupt or break the operational continuity of electronic communications networks, including the international interconnection in case of cut off of power supply, man-made or natural catastrophes).

The views on including industrial competitiveness as a new objective in the DNA showed some tension between interested parties, with larger industry stakeholders (incumbents, mobile operators) supporting such new objective. The arguments in support were largely in line with the arguments from the Draghi report⁴⁴: the necessity to scale up, promote large investments, and ensure the global competitiveness of European companies. The review of the Horizontal Merger Guidelines is ongoing⁴⁵.

Although the EECC encompasses satellite communications networks and services and submarine cables, due to the recent technological advances, market developments and geopolitical challenges, the issues of competition, security, resilience and technological sovereignty regarding these networks came to the fore. While all stakeholders acknowledge the pertinence of satellites and submarine cables to EU's security, resilience and strategic autonomy/technological sovereignty, stakeholders have divergent views on whether these issues should be tackled under the EECC⁴⁶. Therefore, considerations about introduction of such new objectives should consider existing provisions in this regard in other instruments and complement them only where necessary.

⁴¹ Reference to Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁴² Reference in Section 4.1.5 of the Final 1st Interim Report on Completing the DSM.

⁴³ [Regulation - EU - 2024/1309 - EN - EUR-Lex](#).

⁴⁴ Draghi, M., The Draghi report: A competitiveness strategy for Europe (Part A), 2024 as well as Draghi, M., The Draghi report: In-depth analysis and recommendations (Part B), 2024.

⁴⁵ Reference in Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁴⁶ Reference in Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

3.4.5. EU added value

While the EECC provides a harmonised legal basis for electronic communications across the EU, the views on its meeting connectivity and investment objectives differ. Stakeholders broadly recognise the EECC's role in supporting gigabit rollout through longer licence durations, access regulation, and spectrum provisions, contributing to increasing VHCN and 5G coverage. However, still urban-rural divide persists: EU-wide 5G coverage stands at 94.3% in 2024 which is comparable to the 97% estimated coverage in the US and 95% in China and India. Rural 5G coverage in the EU and in the US are comparable with the EU at 79.6% and the US at 82%. Both regions have lower rural coverage compared to China (85.2% estimated) and India, which leads with 92.1% rural coverage. This gap is attributed to spectrum assignment delays, low rural investment returns, and planning barriers. European telecom operators also lag global peers in 5G Standalone availability, small cell deployment, and capital intensity. On the other hand, in view of stakeholders, consumer benefits under the EECC have generally improved, with wider service availability, better quality, and competitive pricing⁴⁷.

In view of the wide range of assessments, it will be important to balance any new proposals under the Commission's DNA initiative carefully, to address new challenges appropriately while catching up the delays in achieving the digital decade connectivity targets and at the same time, preserving and expanding the benefits which have been achieved under the EECC.

The evaluation, on the background of a challenging geopolitical dynamics and climate change, revealed the need for some rebalancing of objectives, in the sense of prioritising all dimensions of connectivity (investment, demand), including in green networks, to foster enhanced competitiveness for innovation in advanced infrastructures and services, and to strengthen infrastructure security and resilience. Given the rapid evolution of electronic communications services and their use, high level of consumer protection and competition remain important, while single market dimension of electronic communications needs to be reinforced.

3.5. Scope and level playing field

The EECC introduced an extension of the scope of legislation reflecting the considerable evolution of communication services and the technical means of their delivery resulting in the inclusion of the number-independent interpersonal communication services (NI-ICS). Interpersonal communications services that constitute a minor ancillary feature intrinsically linked to another service (e.g. chats in online games, comment sections on e-commerce websites) are excluded from the scope of the EECC. Like in the previous framework, the EECC does not cover the content of services delivered over electronic communications networks using ECS such as broadcasting content and financial services. The extended scope of ECS also covers transmission services used for the provision of machine-to-machine services which reflects the development of the Internet of Things and connected objects.

The extension of the scope of the legal framework aimed at greater levelling of the playing field between traditional telecom services which are number-based (NB-ICS) providers and NI-ICS providers. However, NI-ICS providers still enjoy a lighter regulatory regime⁴⁸. For instance, NI-ICS are explicitly exempted from the scope of the general authorisation regime

⁴⁷ Reference in Section 4.1.5 of the Final 1st Interim Report on Completing the DSM.

⁴⁸ Reference in Section 3.1.1 from the Final 1st Interim Report on Completing the DSM.

in Art. 12 EECC. Nevertheless, NI-ICS providers may be subject to some lighter EECC obligations like providing NRAs, other competent authorities and BEREC the information that may be necessary for the fulfilment of their tasks (Article 20 EECC), in the same way as NB-ICS providers.

Since the adoption of the EECC, the rapid evolution of technology has continued, and certain convergence trends have emerged gradually. As a result, the boundaries of ECN/S and cloud computing become increasingly blurring. In this regard, BEREC in its Report on Cloud and Edge Computing Services shares the view that the EECC scope (Art. 2 (4) on definitions) covers already cloud-based services such as NB-ICS (e.g., Amazon Connect) and NI-ICS (e.g., Microsoft Teams).⁴⁹ This could possibly encompass new edge computing services and cloud-based networks services for transport connectivity and network related capabilities which include conveyance of signals such as Network as a Service (NaaS).

As regards the interconnection, the EECC did not change the previous framework in terms of scope of involved undertakings and kept the right and, when requested by other undertakings under the general authorisation, the obligation to negotiate interconnection with each other, limited to providers of public ECNs only. Other providers of non-public ECNs providing backbone infrastructure/networks are not covered by the interconnection provisions. Given that NI-ICS are a type of ECS, the provisions on dispute resolution in the EECC, both at the retail and wholesale levels, apply to this category of players (Article 25 and 26 EECC). Compared to the previous framework, the dispute resolution provision is limited to disputes arising between providers with respect to their obligations under the EECC. In this context, Articles 60-61 EECC regulating interconnection are relevant. Article 60 EECC requires that operators of public ECNs, (not the non-public ECNs,) negotiate interconnection for providing services and offer access and interconnection on terms set by NRAs.

Furthermore, a CAP such as Liberty Global can be viewed as a public ECN provider because it serves substantial numbers of end-user customers but also as a CAP due to the provision of entertainment content. Similarly, certain activities of a company like Alphabet are considered content provision services (video streaming services) and do not fall under the EECC. Furthermore, even though Alphabet operates one of the largest IP-based networks in the world, because it does not provide network access to end-users in the EU, it also does not fall under the scope of Art. 60 as the network is not public⁵⁰.

NI-ICS are not, in principle, obliged by the EECC to make their services interoperable. However, such an obligation can be imposed when end-to-end connectivity between end-users is endangered due to a lack of sufficient interoperability, and only on NI-ICS with a significant level of coverage and user uptake. In this regard, Article 61(2)(c) EECC sets out the criteria under which interoperability could be mandated in relation to NI-ICS. The latter may be subject to both the EECC and DMA. The regimes of the two legislations can be considered complementary. The EECC aims to ensure competition in the markets for electronic communications, while the DMA ensures contestability and fairness in digital services markets by curbing the power of gatekeepers.⁵¹ Article 61 EECC empowers NRAs to

⁴⁹ BEREC Report on Cloud and Edge Computing Services - https://www.berec.europa.eu/system/files/2024-10/BoR%20%2824%29%20136_BEREC%20Report%20on%20Cloud%20and%20Edge%20Computing%20Services.pdf

⁵⁰ Reference to Section 3.1.1. in the Final 1st Interim Report on Completing the DSM.

⁵¹ See also BEREC (2021). Report on the interplay between the EECC and the EC's proposal for a Digital Markets Act concerning number-independent interpersonal communication services, BoR(21) 85:

impose obligations on service providers to ensure end-to-end connectivity and interoperability, particularly on those with SMP. NRAs may require access to infrastructure within buildings when replication is impractical. According to BEREC, there does not seem to be sufficient practice in enforcement of Art. 61(2)(c) EECC.⁵² However, the evaluation confirmed that the threshold for regulatory intervention under the EECC seemed to be higher than the one under the DMA⁵³.

Some EECC provisions pertaining to end-user rights also apply to NI-ICS e.g., information requirements including the contract summary (Art. 102 EECC), possibility to impose the requirement to contribute to financing the universal service by sharing the net cost of universal service obligations between providers of electronic communications networks and services (Art. 90 EECC)⁵⁴, non-discrimination (Art. 99 EECC), transparency obligations including information obligations related to quality of service under (Art. 103 EECC).

According to BEREC access to the European emergency communication number 112 is solely defined as an NB-ICS, in Articles 109(1) and 109(2) of the EECC. This has led to different views on whether equivalent access solutions under Article 109(5) could be provided by NI-ICS, potentially causing inconsistencies and challenges across Member States which undermines the effectiveness of the measure. However, in the event of major accidents or natural disasters, BEREC considers that operators must grant the continuous transmission of messages and notifications, taking all necessary measures to ensure uninterrupted access to all emergency service numbers and considering the increased use of NI-ICS.

To improve interoperability, freedom of choice for users and to encourage interconnectivity in the internal market, Article 39 EECC provides that the European Commission may request (and Member States may encourage) that standards be drawn up to ensure interoperability of services and end-to-end connectivity, among other aims. Furthermore, voluntary use of standards included in a list established by the Commission is to be encouraged by Member States. In the case that existing standards have not been adequately implemented so that interoperability of services in one or more Member States cannot be ensured, the EC, by means of including mandatory standards in the list, can make the implementation of such standards or specifications compulsory where this is strictly necessary to ensure interoperability and to improve freedom of choice for users. The list of voluntary standards had not been changed over the reporting period and is still considered to be relevant. The Commission has never used its competence to make the use of standards mandatory under this provisions which is still considered necessary as a measure of last resort.

The EECC security related articles (Art. 40 and Art. 41) were repealed by the NIS 2 Directive in October 2024. According to this directive and in terms of reporting obligations, the principle of country of destination applies only to public ECNs and to all ECS while the principle of the “country of main establishment” is applicable to all other digital entities in the scope of NIS 2 Directive. This implies obligations of public ECNs and of ECS to at least report to national authorities subject to national rules in 27 Member States in the event of significant cyber incidents. The study results confirm that different Member States still have

[https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_\(21\)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_\(final\).pdf](https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_(21)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_(final).pdf).

⁵² BEREC Report on Interoperability of NIICS - [BEREC](#).

⁵³ Reference to Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁵⁴ Reference to Section 5.2.5.1 of the draft WIK-Consult - EY Study on USO.

different approaches, regulations and standards related to the cybersecurity of electronic communications, which requires harmonisation⁵⁵.

3.5.1. Effectiveness

The extended EECC scope proved to be effective in terms of covered networks, but it also showed that the flexibility posed challenges in regulation. In this regard, the level of regulation remains differentiated which results in a fragmented approach and divergent solutions in addressing various issues effectively. For example, under the EECC, regulatory remedies for submarine cables owned by public ECNs providers include access obligations, transparency measures and price control⁵⁶. Submarine cable systems operated by content and application providers (CAPs) are considered as non-public networks and as a result, are subject to general authorisation regime only in 4 MS and the national legislation on access and interconnection does not apply to non-public ECNs in at least 16 MS⁵⁷.

Furthermore, regarding the effectiveness of the scope, a differentiated treatment in imposing NI-ICS' requirements was also observed. In this regard, in its submission to the European Commission's White Paper on "How to master Europe's digital infrastructure needs" published on 21 February 2024, BEREC declared some openness towards analysing the position of NI-ICS providers on the market⁵⁸.

In addition, the fact that some cloud-based services (e.g., NI-ICS) already fall also under the definition of Article 2 of the EECC and, thus, are at the same time ECN/S for certain types of services, requires their compliance with the electronic communications' regulatory framework preceded by identification of the applicable legal requirements for levelling the playing field. In this regard, a clear delineation with the EU cloud acquis is needed for ensuring coherence between the acts.

Concerning the functioning of relationships between various interconnecting networks, as quantitative data on effectiveness of competition is not available, for qualitative assessment we note polarised stakeholder positions, among others of those expressed in response to the White Paper. According to a certain number of stakeholders and BEREC in its 2024 Report on IP interconnection, the IP interconnection negotiations occur in a balanced setting, and

⁵⁵ Reference to Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁵⁶ Reference to Page 2 in the 2025 Draft BEREC Report on Submarine Cables Connectivity - [BoR \(25\) 85 Draft BEREC Report on Submarine cables connectivity in Europe.pdf](#). According to BEREC, the large majority of the submarine cables corresponds to purely domestic submarine cables (with all landing stations in the same country), while only 12% of them are part of an international cable system. Almost a third of the submarine cable systems are between 10 and 25 years old, and nearly a fifth of the domestic submarine cables analysed in this report benefitted from public funding (page 2 of the Draft Report). In addition, 14% of the submarine cable systems started operating over 35 years ago, which may impact the capacity of submarine cable systems in the near future. Regulatory approaches vary (Page 3 of the Draft Report): the report shows that six NRAs (HR, FR, EL, Iceland, PT and ES) have carried out a market analysis regarding or including domestic submarine cables leading to regulation of submarine cables with designation of an operator with significant market power (SMP). Over these six NRAs who regulate or have regulated submarine cables, four of them (Croatia, Greece, Iceland, Portugal) are still regulating this market, whereas the other two (FR and ES) stopped regulating it, respectively in 2017 and 2024.

⁵⁷ Reference to p. 23 of the [Draft BEREC Report on the general authorisation and related frameworks for international submarine connectivity](#).

⁵⁸ BEREC's input to the EC public consultation on the White Paper "How to master Europe's digital infrastructure needs?", BoR (24) 100_1, p20 https://www.berec.europa.eu/system/files/2024-07/BoR%20%2824%29%20100_1_%20BEREC%20Input_White%20Paper_final.pdf.

monitoring on a case-by-case basis proves that the current legal framework (consisting of civil law and competition law) and the EECC provisions on interconnection are effective. As examples are mentioned a few disputes occurred during 2020-2024 through litigation (e.g. Deutsche Telekom vs Meta; DAZN live-streaming)⁵⁹. BEREC focuses its conclusions on market developments without need of regulatory intervention. Other sources in 2025 (e.g., Cullen International June 2025⁶⁰) also describe that IP interconnection market balanced without regulatory intervention (few disputes in Europe where or regulator or court intervened). It quotes BEREC data indicating that traffic via on-net content delivery networks (CDNs) has increased more than traffic exchanged through peering and transit. In the similar vein, another source (German Monopolies Commission in 2023⁶¹) notes that there is a rebalancing of the bargaining power on the market: the importance of the large network operators is in decline as the data traffic in parts of the network is routed through networks built by CAPs (i.e. own core networks and on-net CDNs). The German Monopolies Commission observes more often settlement in the form of free peering agreements and that the number of connections via IP transit is decreasing.

On the other hand, another group of stakeholders, mainly big telecom operators, shares the view that the large asymmetry in bargaining power is compounded by the large scale of certain CAPs, which are much more powerful than any of the telecom incumbents, and that this leads to ISPs not getting fair conditions in IP peering agreements with CAPs. They claim that the lack of disputes reported by ISPs to NRAs or litigated in courts could be a proof of the legal framework not working. The EECC has been designed with traditional electronic communications in mind and does not adequately address all specific requirements of the broader digital sector⁶². Large operators also state that the current legal framework (mainly the OIR) weakens their bargaining position as ISPs, because it obliges them to comply with net neutrality rules and to carry all traffic in a neutral manner, irrespective of whether an agreement can be reached and the traffic is paid for. This is necessary to ensure that all end-users have access to, and can deliver, the content, services or applications of their choosing. CAPs generating large traffic are not under obligation to interconnect their private infrastructure (e.g. CDNs, data centres, undersea (submarine) cables) or negotiate an agreement. Their global reach allows large CAPs to re-route their traffic easily⁶³.

In contrast, as indicated in the Commission White Paper, and supported by most governments and industry stakeholders, the IP interconnection market in general works well. There have been very few known cases of intervention by regulatory authority or by court.⁶⁴ Accordingly, most NRAs state that, within their countries, they do not observe or receive reports/information on any disputes related to IP peering. These NRAs support the

⁵⁹ For details on the two disputes please see Annex I in BEREC Report on the IP Interconnection ecosystem, BoR(24) 93: https://www.berec.europa.eu/system/files/2024-06/BoR%20%2824%29%2093_draft%20BEREC%20Report%20on%20the%20IP-IC%20ecosystem_1.pdf.

⁶⁰ Cullen International June 2025 IP interconnection disputes (IP peering and IP transit).

⁶¹ [Monopolkommission \(2023\) Ein Beitrag von datenverkehrsintensiven Over-The-Top-\(OTT\)-Anbietern an den Netzausbaukosten ist abzulehnen!. 12. Policy Brief: https://www.monopolkommission.de/images/Policy_Brief/MK_Policy_Brief_12.pdf](https://www.monopolkommission.de/images/Policy_Brief/MK_Policy_Brief_12.pdf).

⁶² Reference in Section 4.1.2.5 of the Final 1st Interim Report on Completing the DSM.

⁶³ References in Section 4.1.2.5 of the 1st Interim Report on Completing the DSM.

⁶⁴ A few disputes occurred through litigation or NRA intervention (e.g. Deutsche Telekom vs Meta; DAZN live-streaming, Orange vs Cogent, Liberty Global/Ziggo; Telekomunikacja Polska (now Orange Poland), ANISP vs DIGI, etc.).

conclusions of the BEREC Report on the IP Interconnection ecosystem⁶⁵ and of the White Paper⁶⁶ that the ecosystem is driven by functioning market dynamics and the cooperative behaviour of market players. It is worth mentioning also other regulatory initiatives regarding IP interconnection. For example, in 2020 the Italian regulator (AGCOM) adopted general obligations, reference standards and the minimum set of functionalities that each operator must make available for the provision of VoIP/IP interconnection at national level⁶⁷.

While some stakeholders state that no quality-based services exist at the moment⁶⁸, the majority maintain that they are actually provided although still a few. For instance, new specifications such as 5G release 17 and CAMARA show that the sector is heavily committed to launch innovative services in the domain of quality-enhanced services, as mentioned in the section on the Open Internet Regulation.

3.5.2. Efficiency

Regarding IP interconnection and level playing field between ISPs and CAPs, the framework is not designed for the currently emerging broader connectivity ecosystem. Therefore, it can not be concluded that all potential issues can be addressed under the current legal framework. However, many stakeholders of different types (except telco providers) do not find any major inefficiencies in the current rules and do not experience any administrative burden. Telecom incumbents raised the lengthiness of court proceedings, which allegedly discourages more reliance on dispute resolution⁶⁹. Due to the lack of evidence and only a handful of known disputes, it is difficult to draw clear conclusions and assess whether cooperation among involved parties had been sufficiently facilitated by the current rules.

Moreover, the OIR provisions clearly affirm that internet access service providers shall not discriminate amongst internet traffic and shall enable the end-users to reach every internet end-point, irrespective of the content, application or service used. The OIR provisions also establish that internet access service providers cannot discriminate internet traffic based on commercial agreements. As mentioned above, the European Commission's 2023 report on the implementation of the OIR has concluded that these provisions are still fit for purpose and did not put forward any proposal for review or changes.

3.5.3. Coherence

As a part of the coherence evaluation, particular attention is paid to the main recent EU legislations related to digital infrastructures and services (i.e. external coherence), namely the Gigabit Infrastructure Act (GIA), the Digital Markets Act (DMA), Digital Services Act (DSA), Artificial Intelligence Act (AIA), Data Act and NIS 2 Directive. No incoherence has been identified within the EECC itself; therefore, the EECC is internally coherent, but there are issues related to the external coherence⁷⁰.

⁶⁵ https://www.berec.europa.eu/system/files/2025-01/BoR%20%2824%29%20177_BEREC%20Report%20on%20the%20IP-IC%20ecosystem_0.pdf.

⁶⁶ [White Paper - How to master Europe's digital infrastructure needs? | Shaping Europe's digital future.](#)

⁶⁷ Cullen International June 2025, IP interconnection disputes (IP peering and IP transit).

⁶⁸ Reference in Section 4.2.2 of the Final 1st Interim Report on Completing the DSM

⁶⁹ References in Sections 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁷⁰ Reference in Section 4.1.2 in the First 1st Interim Report on Completing the DSM.

In terms of coherence with other acts, the extension of scope does not necessarily lead to more rules for new providers because for instance, for certain categories of information society service providers in the EECC scope, the rules of Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services (INFOSOC Directive)⁷¹ apply. For instance, NI-ICS are not subject to the general authorisation regime under the EECC, and they comply with the INFOSOC and the eCommerce Directive rules.

On the other hand, the DSA was designed to cover intermediary services (i.e. mere conduit, cache or hosting services) that do not fall under the EECC. However, in practice, the distinction is not always easy, and the DSA gives some examples of services (e.g. Voice over IP, messaging services, web-based email, see Recital 28 DSA) that are within its scope, but are also NI-ICS in the sense of the EECC. Hence, as also requested by BEREC⁷², a clarification of the scope is necessary in this regard⁷³.

Regarding the lack of a level playing field in terms of services, many governments and industry stakeholders refer that “the legal framework shall provide for a level playing field for services that have the same functionality”. Stakeholders point out that, in the environment of technological convergence, both “traditional” and “non-traditional” service providers play an equally important and similar role in delivering digital communications but are subject to different sets of rules. For instance, NI-ICS are comparatively less regulated than NB-ICS, and NRAs' enforcement powers regarding them are weaker. If the DMA and DSA regimes are considered, stakeholders note that large CAPs are subject to EU-level rules and enforcement, which gives greater legal certainty when offering services across the EU. By contrast, electronic communications providers are subject to national rules and enforcement by individual NRAs in each Member State where they choose to offer services⁷⁴.

As for interconnecting networks, the role of NRAs in resolving potential IP interconnection disputes between ISPs and CAPs and in monitoring and data collecting related to the CAPs markets is also unclear, from the perspective of a few NRAs⁷⁵.

Regarding the interoperability between services, the requirement under Art. 61 (2) (c) EECC on NI-ICS providers, which reach a significant level of coverage and user uptake, to make their services interoperable can only be imposed where “end-to-end connectivity is endangered”. This appears to be a higher threshold than under Article 7 of the DMA⁷⁶.

Standardisation assessed from the level playing field angle, proves that efforts continue to move towards an all communication technologies (terrestrial/TN) and non-terrestrial/NTN) overarching network management architecture which would allow the provision of end-to-end (user to user) network connections or network slices using all NTN (high-altitude platform

⁷¹ [Directive - 2015/1535 - EN - EUR-Lex.](#)

⁷² See also BEREC (2021). Report on the interplay between the EECC and the EC's proposal for a Digital Markets Act concerning number-independent interpersonal communication services, BoR(21) 85: [https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_\(21\)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_\(final\).pdf](https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_(21)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_(final).pdf).

⁷³ References in Section 2.2.3 of the Final 1st Interim Report on Completing the DSM.

⁷⁴ Reference to Section 4.1.2 in the Final 1st Interim Report on Completing the DSM.

⁷⁵ Reference to Section 4.1.2 in the Final 1st Interim Report on Completing the DSM.

⁷⁶ Reference to Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

station/HAPS), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Geostationary orbit/GEO) and TN technologies according to their capabilities and characteristics, even if they are not operated by one firm, but by buying respective wholesale capacities and by interoperating the related communication platforms management systems over standardised interfaces. Such solution would allow for communication resilience in case of natural disasters or other damages at the best available capacity and quality resources and if the network access can be granted, or alternatives are still available⁷⁷.

3.5.4. Relevance

In terms of relevance of the EECC scope considering such technology trends as 6G, edge computing, advanced cloud services and AI, a great majority of governments, a consumer protection organisation and a minority of industry stakeholders (alternative providers, ISPs, MVNOs) do not think that an extension of the EECC scope is warranted in the face of the said technology trends. A smaller group of governments supported changes to the EECC without being specific in what exactly needs to change (most simply that the EU framework needs to change to create a forward-looking regulatory environment fostering innovation, promoting competitiveness, lowering entry barriers and administrative burden, and addressing potential challenges⁷⁸).

As said before, all stakeholders acknowledge the pertinence of satellites and submarine cables to EU's security, resilience and strategic autonomy, although stakeholders disagree on whether these issues should be tackled under the EECC. The Recommendation on secure and resilient submarine cable infrastructures⁷⁹ is a good example of acknowledgment of the issues and the EU should continue studying them, analyse the EU legal framework and identify other opportunities for EU-level specialised interventions (e.g. mapping; real-time monitoring; increasing EU-level funding for satellite and undersea infrastructures, for instance, through Connecting Europe Facility/CEF-Digital; joint repair and emergency capacities; restricted access to information about submarine cables; cross-body and cross-border cooperation for cybersecurity and resilience). Based on the findings, such measures can be included in the EU-wide policy on critical digital infrastructure that would cover terrestrial and non-terrestrial such as submarine infrastructures.⁸⁰

3.5.5. EU added value

The objectives and scope of the EECC, as also pointed out by many stakeholders, they have not significantly changed by comparison to the previous legal framework. Hence, some stakeholders stated that the EECC has not changed the situation but continued down the pathway laid down by previous legislation. Because of this, only a few benefits of added value were indicated.

⁷⁷ Reference to Section 2.1.10 on Network Convergence of the Final 1st Interim Report on Completing the DSM.

⁷⁸ Reference in Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁷⁹ Commission Recommendation (EU) 2024/779 of 26 February 2024 on Secure and Resilient Submarine Cable Infrastructures.

⁸⁰ Reference in Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

A few stakeholders also mentioned the value added of promoting a level playing field between small operators active in only one country and large international operators⁸¹.

For the standards part, the main evaluation findings describe that different Member States still have different approaches, regulations and standards related to the cybersecurity of electronic communications, which requires harmonisation.⁸²

In terms of networks and their interconnection based on the evaluation outcomes, it could be concluded that there have been a few legal challenges concerning networks and especially, on the topic of data traffic termination in national courts (e.g., Germany DT vs Meta⁸³). When such issues are taken to court by a party, the likelihood of lengthy procedures continuing for several years is high. These are disputes on commercial contracts and are not under the jurisdiction of the Commission. Therefore, at EU level, we could conclude that it would be useful to establish an ecosystem cooperation mechanism to monitor the market development and its impact on the competitive dynamics in the context of various dimensions of IP-networks and enhanced interaction with the national competent authorities and BEREC (e.g. resilience and redundancy, smooth functioning of IP networks, including if integrated with other types of networks, environmental sustainability etc.)

Regarding the evolution of services, the findings confirm that there is room for further extension of obligations to functionally equivalent services e.g., VoIP when justified by public interest (e.g., resilience preparedness for natural disasters and public warnings or emergency communications) and at the same time, avoiding overregulation by analysing carefully the effects of existing similar provisions in other acts. For coherence purposes, solutions should be also sought for facilitating compliance with other relatively recently adopted digital legislation.

The technological evolution and the gradual transition to IP networks revealed new challenges in terms of level playing field concerning consumer protection and tackling fraud. The scope of the EECC definition of ECS providers and the respective IP addressing systems used, the different services provided as well as the related e-privacy directive provisions signal some issues related to fraud which need special attention (details in the End-users' part).

4. ACCESS REGULATION

4.1. Harmonisation of regulatory remedies (Art 32)

Although NRAs have increasingly defined markets subject to regulation as regional or local and some NRAs decided to deregulate at national level,⁸⁴ the Significant Market Power (SMP) regime remained the key instrument for ex ante regulation⁸⁵, even if regulatory intervention can be envisaged outside of the SMP regime under the specific conditions set in

⁸¹ Reference in Section 4.3.6 of the Final 1st Interim Report on Completing the DSM.

⁸² Reference in Section 4.1.2 of the Final 1st Interim Report on Completing the DSM.

⁸³ For details on the two disputes please see Annex I in BEREC Report on the IP Interconnection ecosystem, BoR(24) 93: https://www.berec.europa.eu/system/files/2024-06/BoR%20%2824%29%2093_draft%20BEREC%20Report%20on%20the%20IP-IC%20ecosystem_1.pdf.

⁸⁴ Market 1 is not regulated in BU, RO, NL and AT. Market 2 is not regulated in BU, CZ, DK, EE, FI, LV, MT, NL, PL, RO, SK, SE.

⁸⁵ There is widespread use of SMP regulation (only 2 out of 27 NRAs do not apply it at all). This is mirrored in the large number of provisions that have been developed to guide the application of SMP regulation under the EECC.

Article 61 of the EEC through symmetric regulation⁸⁶. More specifically, a total of 23 NRAs indicated that they had found SMP in the market for wholesale local access at a fixed location (Market 1),⁸⁷ while in 15 countries SMP was found in the corresponding Market 2 – wholesale access for dedicated capacity.⁸⁸ 12 EU MS identified SMP in the former Market 3b - Wholesale Central Access market,⁸⁹ and 6 countries identified SMP in a separate market for Physical Infrastructure Access (PIA).⁹⁰ The following table provides an overview of SMP findings by market and country.

Table 4-1: SMP findings (at least part of the market)

	Separate PIA	Market 1	Market 2	Market 3b
Austria		No	Yes (partial)	No segmentation between WLA and WCA
Belgium		Yes	Yes	Yes
Bulgaria	Yes	No	No	No
Croatia		Yes (partial)	Yes	Yes (partial)
Cyprus		Yes	Yes	No
Czech Republic		Yes (partial)	No	No
Denmark		Yes (partial)	No	No segmentation between WLA and WCA
Estonia	Yes	Yes (partial)	No	Yes (partial)
Finland		Yes (partial)	No (court decision)	No
France	Yes	Yes	Yes	No
Germany		Yes	Yes	Yes (partial)
Greece		Yes	Yes	Yes
Hungary		Yes (partial) but withdrawal	Yes	Yes (partial) but withdrawal
Ireland	Yes	Yes	Yes (partial)	No
Italy		Yes (partial)	Yes (partial)	Yes (partial)
Latvia		Yes (partial)	No	Yes (partial)
Lithuania		Yes	Yes	Yes (partial)
Luxembourg		Yes	Yes	Yes
Malta		Yes but withdrawal	No	No
Netherlands		No	No	No segmentation between WLA and WCA
Poland		Yes (partial)	No	Yes (partial)

⁸⁶ In particular, Article 61(3) provides that access obligations can be imposed with respect to wiring and associated facilities inside buildings or up to the first concentration or distribution point where the replication of these network elements would be economically inefficient or physically impracticable; under strict conditions such obligations can be extended up to a point beyond. These provisions are applicable outside of the context of a market analysis, and irrespective of whether the undertaking concerned has been designated as having significant market power.

⁸⁷ EL, EE (partly), SK, SE, CY, LV (partly), LU, DK (partly), CZ (partly), DE, IT (partly), BE, HR (partly), MT, FR, IE, FI (partly), LT, LI, PT (partly), HU, PL (partly), SI. It should be noted however that there is no distinction between WLA and WCA in Austria, Denmark and Netherlands.

⁸⁸ EL, CY, LU, DE, IT (partly), BE, HR, AT (partly), FR, IE (partly), LT, ES, PT (partly), HU.

⁸⁹ EL, SK, LV, LU, IS, DE, SI, BE, HR, FI, LT, PL.

⁹⁰ EE, IE, LV, BG, FR and PT.

	Separate PIA	Market 1	Market 2	Market 3b
Portugal	Yes	Yes (partial)	Yes (partial)	No
Romania		No	No	No
Slovakia		Yes	No	Yes
Slovenia		Yes	Yes	Yes (partial)
Spain		No	Yes	Yes (partial)
Sweden		Yes	No	No

Under the SMP regime, regulatory intervention on a specific product and geographic market can be justified if proven that these markets are characterised by high barriers to entry and do not tend towards effective competition, and that competition law instruments are insufficient to tackle the identified competition problems (so called three criteria test under Article 67 EECC). An undertaking is deemed to have SMP, if, either individually or jointly with others, it enjoys a position equivalent to dominance, i.e. a position of economic strength, which gives it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers. Guidance on the market definition and SMP assessment has been provided in the 2018 SMP Guidelines⁹¹ and in the 2020 RRM⁹². Additionally, guidelines on the imposition of remedies are provided in the 2024 Gigabit Recommendation⁹³.

When the EECC became fully applicable on 21 December 2020, it introduced the promotion of connectivity, access to and take-up of VHCN as a new objective of the regulatory framework, alongside the promotion of competition, the development of the internal market and the interests of Union citizens. The market environment has also changed dramatically as a consequence of huge amounts of investments required to replace the copper local loop by fibre and the emergence of players other than the historic telecom incumbents that are deploying FTTH loops in certain geographic areas.

Specifically, as regards copper switch-off, operators with significant market power and subject to network access obligations must notify NRAs when they plan to decommission or replace their copper networks⁹⁴. The aim of the currently applicable regulation is to ensure that migrations from regulated networks are transparent with a clear timetable and adequate notice periods, do not harm competition or end-user rights and that alternative access products of comparable quality are available.

4.2. Market developments

Article 3 of the EECC provides that NRAs and other competent authorities should “promote regulatory predictability by ensuring a consistent regulatory approach over appropriate review periods”, “take due account of the variety of conditions relating to infrastructure, competition, the circumstances of end-users and in particular consumers in the various geographic areas”

⁹¹ Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services (2018/C 159/01).

⁹² Commission Recommendation (EU) 2020/2245 of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with the EECC (2020 Recommendation on Relevant Markets) (OJ L 439, 29.12.2020, p. 23-31).

⁹³ Commission Recommendation (EU) 2024/539 of 6 February 2024 on the regulatory promotion of gigabit connectivity (C/2024/523) (OJ L, 2024/539, 19.2.2024).

⁹⁴ See Article 81 EECC.

and “impose ex ante regulatory obligations only to the extent necessary to secure effective and sustainable competition in the interest of end-users and relax or lift such obligations as soon as that condition is fulfilled”.

A key trend in business models since the last review of the telecom framework and relevant market recommendation is the emergence of wholesale-only companies in both fixed (netcos) and mobile (towercos). The following diagram provides an overview of fibre netcos across the EU as of 2023



The **switch-off of legacy copper networks** is another development that is likely to influence market structures going forwards. While it is expected that the switch of copper networks will limit demand risk for FTTH on a market-wide basis, the way in which the copper switch-off is managed (and any associated conditions) may influence where the copper customers go. Subsequently, this will influence the business case for alternative fibre investors, as well as the possibility for alternative operators to provide broadband services via wholesale access to the incumbent's upgraded copper network. Copper switch-off, if managed in a way that allows incumbents to delay fibre roll-out and progressively migrate customers to its own fibre network alternative fibre providers in areas where only one FTTH network is viable, will increase market concentration at the infrastructure layer by replicating with fibre networks the same market situation already present in copper-based markets.

Technological trends

The physical components, topologies and transmission technologies associated with the access networks, determine the performance that can be achieved on an access network regarding capacity and quality. These factors can also affect the degree to which networks can be open to competition (allowing innovation by access seekers) as well as the degree to which they will be future proof, allowing for the expansion of capacity and quality to meet future needs. The EECC currently includes the objective to promote connectivity and access to, and take-up of, very high capacity networks (VHCN). BEREC has provided guidelines regarding the interpretation of this concept.⁹⁵ For fixed networks either a FTTB (Fibre to the building) should be provided (Criterion 1) or certain criteria regarding bandwidth and quality must be met (Criterion 3). The quality of the in-building connection is not considered.

Table below⁹⁶ provides an overview of the performance capabilities of fixed broadband access technologies⁹⁷:

Transmission technology	FTT...	Bandwidth down	Bandwidth up	No. of users	share of simultaneous users	Bandwidth effective down	Bandwidth effective up	Length limitation	individual/shared	symmetr./asymmetr.	VHCN BB	Standard	Maturity	ODF unbund.	VULA (L2)
Copper pair		[Gbps]	[Gbps]			[Gbps]	[Gbps]	[m]							
ADSL2+	FTTx/FTTC	0,01	0,004	1	1	0,01	0,01	2,600	i	a	n	2003	y	y	y
VDSL2	FTTx/FTTC	0,05	0,015	1	1	0,05	0,015	400	i	a	n	2006	y	y	y
VDSL2 Vectoring	FTTC	0,09	0,04	1	1	0,09	0,04	400	i	a	n	2010	y	n	y
VDSL2 Supervect.	FTTC	0,25	0,1	1	1	0,25	0,1	300	i	a	n	2015	y	n	y
G.fast	FTTS/dp	0,5	0,5	1	1	0,5	0,5	250	i	a/s	n	2014	y	n	y
XG.fast	FTTB	5	5	1	1	5	5	50	i	a/s	y	2016	y	n	y
HFC								*							
Docsis 3.0	fibre node	1,2	0,12	50	0,1	0,24	0,024	160.000	s	a	n	2006	y	n	n
Docsis 3.1	fibre node	10	1	50	0,1	2	0,2	160.000	s	a	?	2013	y	n	n
Docsis 4.0 (FD)	deep fibre	10	10	50	0,1	2	2	160.000	s	s	y	2021	+ 1 Y	n	?
Fibre															
GPON (PMP)	FTTH	2,5	1,25	30	0,1	0,8333	0,4167	20.000	s	a	y	2003	y	n	y
XG-PON	FTTH	10	2,5	30	0,1	3,3333	0,8333	40.000	s	a/s	y	2008	y	n	y
XGS-PON	FTTH	10	10	100	0,1	1	1	40.000	s	s	y	2015	y	n	y
TWDM GPON	FTTH	4 - 8 x 10	4 - 8 x 10	100	0,1	1	1	40.000	s	s	y	2013	y	4 - 8 Ops	y
MW-PON	FTTH	50	50	100	0,1	5	5	40000*	s	s	y	2024	y	n	y
DWDM GPON	FTTH	1,000 x 1	1,000 x 1	1	1	1	1	100.000	i	s	y	2020	+ 4 Y	y	y
Ethernet PtP	FTTH	n x 10,000	n x 10,000	1	1	10	10	80.000	i	s	y	1998	y	y	y
FWA															
LTE adv./ 4G	?	1	0,15	5	0,1	1	0,15	10.000	s	a	n	2022	y	n	y
5G	?	50	0,5	5	0,1	50	0,5	50 - 10.000	s	a	y	2022	y	n	y

The main access products are the following:

⁹⁵ [BOR \(20\) 165](#), section 3

⁹⁶ The table is based on several predecesing studies and updated to the state of the art, see also: Godlovitch, I.; Hocepić, C.; Lemstra, W.; Plückebaum, T.; Strube-Martins, S.; Kroon, P.; Lucidi, S.; Alexiadis, P.; Char, S.; Future electronic communications product and service markets subject to ex-ante regulation, European Commission Brüssel/ Luxemburg Juni 2019, <https://op.europa.eu/en/publication-detail/-/publication/7309fa31-b758-11ea-bb7a-01aa75ed71a1>.

⁹⁷ Column 1 names the transmission technologies. The lines for the technology descriptions are grouped per access line technology: copper pairs, Hybrid Fibre Coax (HFC), fibre, and Fixed Wireless Access (FWA). The FTT... abbreviations of column 3 enable the identification of technologies which meet criterion 1 (FTTB and FTTH). Column VHCN BB quality notes, if the criteria 1 or 3 are met or not. It can be seen in this context, that cable technologies of DOCSIS 3.1 or above and 5G FWA, could meet the VHCN quality criteria (depending on specification). Meanwhile, some older mass-market FTTH technologies such as GPON, while meeting the VHCN definition, may not be Gigabit capable.

Physical unbundling at ODF sites can only occur as an individual connection in access network topologies of the kind FTTH Point-to-Point (PtP) (see the last line in the fibre section of the table above) or in the old-fashioned copper FTTEEx topologies, where the fibres end in the local exchange (FTTEEx). Unbundling of PON is feasible, and is provided in certain cases e.g. by Fibercop in Italy, but requires multiple components.

When topologies are **shared** and thus physical unbundling is challenging, an alternative can be to provide **virtual unbundled local access (VULA)**⁹⁸. Its ideal characteristics have been defined in State Aid case⁹⁹, based on BEREC recommendations.¹⁰⁰ Common for all VULA approaches is the use of the Layer 2 Ethernet protocol, which allows for a higher degree of product definition freedom than a layer 3 Internet Protocol (IP).

There is one access network technology, hybrid fibre coax network (**HFC**), which does not support Ethernet based communication as a regular capability. Layer 2 communication in form of virtual Local Access Networks (vLAN) is only enabled if an additional optional feature of DOCSIS (3.0 – 4.0), called BSOD (Business services over DOCSIS), is implemented. These operators offer IP-based bitstream access, if at all.

5G or in future 6G radio transmission techniques can be used for fixed wireless access (FWA) services in directed antenna applications from the central mast to the individual fixed receiver locations, i.e. as substitutes for expensive and hard to approach fixed fibre access lines, even when deploying aerial constructions. The frequency bands in Europe for this use case are between 26 – 29 GHz, thus of high capacity, but of short range and require line of sight. The short range associated with these high frequencies can be overcome to some extent through directed and bundled outdoor antennas at both sides, central antenna mast and home. Thus far not all member states have deployed FWA to a significant degree.¹⁰¹ When deployed in a suitable manner, 5G FWA is a fixed network technology and could be capable of meeting the BEREC fixed network VHCN conditions.¹⁰² Its performance remains however below that of FTTH connections.

Overall, data shows that deployment and take-up of VHCNs is progressing across the EU (although at different rates in different countries) and that a choice of options is available for most end-users.

The graph below¹⁰³ shows that coverage in 11 MS exceeded 80%, with ES, RO and PT achieved the highest levels, while 8 MS have a fibre coverage between 70 and 80%. Another 4 have reached more than 50% of households, only 5 MS have a fibre coverage below 50%: AT, EL, CZ, DE and BE. Europe benefits from significantly higher FTTH coverage than the

⁹⁸ Virtual Unbundled Local Access.

⁹⁹ Plückebaum, T.; Godlovitch, I.; Assessment of the technicalities of VULA products in the context of a state aid investigation, Expert opinion, Version 2, EC, Brussels, March 2018, ISBN 978-92-79-79903-7, <http://ec.europa.eu/competition/publications/reports/kd0418126enn.pdf>.

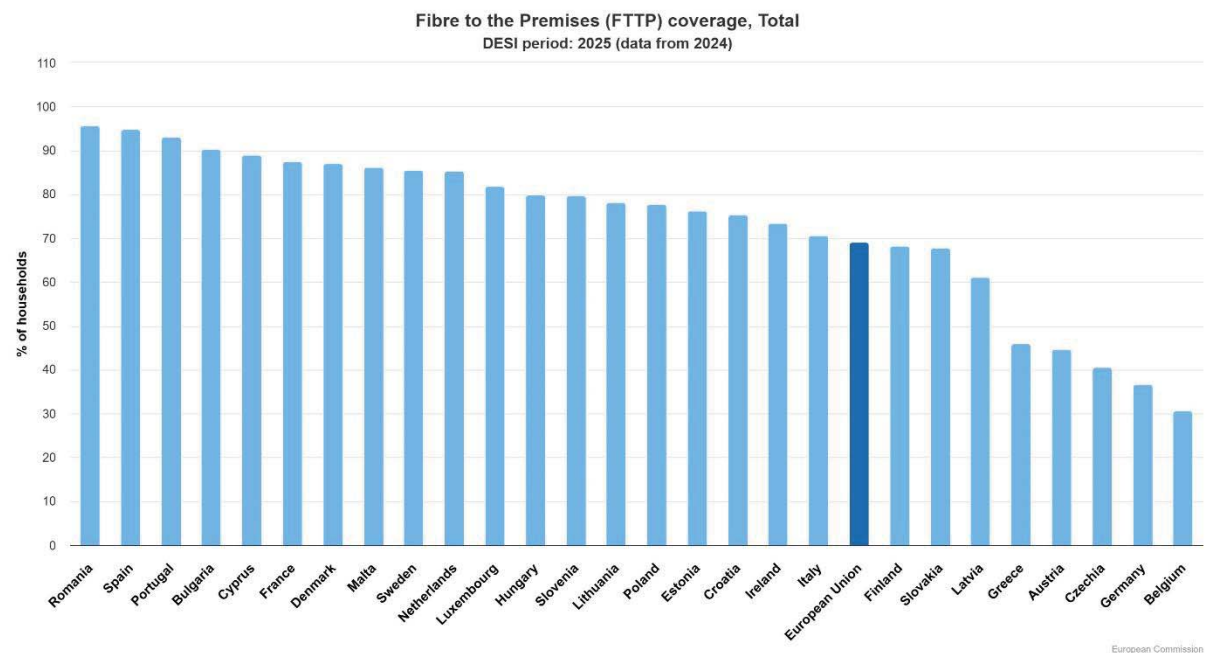
¹⁰⁰ Drafts and all documents incl. the original (BoR (15) 133) available at: <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-common-characteristics-of-layer-2-wholesale-access-products-in-the-european-union>.

¹⁰¹ In Italy FWA is part of the State aid solution for accessing the remaining connectionless homes in the Italia 1 Gig connectivity approach by the RFF funded state aid initiative. FWA there has to meet the fixed network VHCN quality conditions of fixed networks (BEREC Criterion 3).

¹⁰² BEREC Guidelines on VHC Networks, BoR (20) 165, <https://www.berec.europa.eu/en/document-categories/berec/regulatory-best-practices/guidelines/berec-guidelines-on-very-high-capacity-networks>.

¹⁰³ Source: Digital Decade DESI visualisation tool.

US, and according to figures provided by Analysys Mason for Connect Europe, bypassed South Korea at the end of 2024¹⁰⁴



Meanwhile, the data shows¹⁰⁵ that most European consumers have a choice of multiple providers of VHCN services, based on a combination of own infrastructure (in some cases supported by regulated duct access), services based on co-investment and services based on wholesale access. The following table, based on data provided by NRAs, shows the crucial role played by wholesale local access in supporting choice to consumers.

¹⁰⁴ State of Digital Communications 2025.

¹⁰⁵ The referenced “access study” is the currently unpublished supporting study “Review of Access Regulation under the European Electronic Communications Code and analysis of future Access policy in full fibre environment”. The possible confidentiality of the data from the NRAs is being checked.

Table: Role played by wholesale local access (“WLA”) in supporting consumer choice¹⁰⁶

	% HH able to receive given offers of number without WLA			% HH able to receive given offers of number with WLA		
	1+ VHC offers	2+	3+	1+ VHC offers	2+	3+
Austria	61%	19%	2%	79%	39,8%	61,4%
Belgium	95%	40%	< 5%	95%	95%	40%
France	42%	42%	41%	87%	86%	83%
Luxembourg	95%	85%				95%
Slovenia	87%	43%	13%	92%	79%	65%
Spain	87,10%	26,30%	0,50%	95,30%	95,30%	95,30%

4.3. Overview and evaluation of the access provisions

Wholesale access regulation¹⁰⁷ has been widely applied across the EU. Access regulation has supported the development of infrastructure-based competition (also via granting access to physical infrastructure) and choice in broadband services, including VHCN, for a high proportion of households in the EU. Meanwhile evidence of the effects of asymmetric (and some cases symmetric) wholesale local access regulation on the choice for consumers is also visible by looking at the proportion of retail broadband lines that have been provided on the basis of wholesale access, either directly resulting from regulation, or as a result of regulatory incentives or a continuation of practices that were triggered by regulation in the past¹⁰⁸.

The success of the EECC’s access rules would allow for further deregulation of markets and for some simplification of provisions which have not - or only scarcely - been used.

4.3.1. Effectiveness

Except for incumbent operators, which mostly favour a withdrawal of access regulation¹⁰⁹ in case of sustainable competition and focus only on limited bottlenecks, other stakeholders generally consider that the EECC access-related provisions have provided regulatory predictability and are well-understood by NRAs and the market. Alternative operators further observe that their existing investments (which amount to around one quarter of the FTTH

¹⁰⁶ Data from FR includes the role played by co-investment under symmetric regulation. Symmetric regulation of the fibre terminating segment in FR applies to around 90% of all households, and is based on the principle that, outside very dense urban areas, only one FTTH network is viable.

¹⁰⁷ Primarily based on SMP, but also symmetric regulation in the case of FR and HR.

¹⁰⁸ An analysis of the technologies used for the provision of wholesale access on incumbent operators’ networks shows that copper and FTTC-based wholesale access still accounts for more than 50% of wholesale connections sold by incumbents, despite accounting for only 26% of retail lines.

¹⁰⁹ Reference to the access study, section 4.3.1. and the results of the call for evidence (see Annex 2 of the Impact Assessment).

lines deployed in Europe¹¹⁰) were based on the existing regulatory regime, and these investments would be undermined in the event of changes.

An analysis of the approaches taken to access regulation under the EECC shows that NRAs have reflected in their market analysis and other regulatory decisions, factors which should serve to minimise ex ante regulation to that needed to support competition in the interests of end-users. In particular:

- NRAs have taken into account commercial agreements when considering whether ex ante access obligations are appropriate. Such considerations have led to deregulation or lighter touch regulation in several countries. Whereas Article 79 EECC was directly implemented only in three relevant markets¹¹¹, it also served as a point of orientation for those NRAs that decided to apply it *mutatis mutandis*¹¹²
- In line with Article 72 EECC, NRAs increasingly focused on passive infrastructure access (PIA) markets, either as a remedy for problems identified on wholesale local access or, where such markets are not regulated, as a reason to define separate markets for access to physical infrastructure and mandate access to those. This has contributed to downstream deregulation (reliance on PIA alone) in cases where it has supported competition at the level of active network infrastructure¹¹³.
- NRAs have increasingly defined markets subject to regulation as regional or local. As a result, there has been progressive removal of ex ante regulation (other than access to physical infrastructure) in wholesale local access and dedicated connectivity in many areas, in particular urban areas, where competition takes place. In many countries, regulation is limited to some geographic markets, often rural or less densely populated areas. This has ensured that regulation is adapted to specific conditions in the different geographic areas¹¹⁴. The NRAs in the EU Member States have conducted extensive geographical analyses to assess whether there is a need to define geographical markets.
 - In Denmark and Finland the segmentation is based on the network reach of local and regional network operators.

¹¹⁰ Reference to the access study section 4.3.1.

¹¹¹ Denmark (DK/2021/2346), where four (out of 17 proposed for regulation) regional operators offered commitments. DBA proposed to make the commitments binding, and to impose no additional obligations on the concerned operators, France (broadcasting – FR/2022/2365): TDF proposed a set of commitments, which were accepted by ARCEP and made binding for 5 years, Finland (broadcasting – FI/2022/2401): Digita's commitments accepted and made binding and complemented by additional remedy (cost orientation).

¹¹² Austrian wholesale broadband access market (case AT/2022/2389).

¹¹³ 17 Member States regulate PIA based on SMP, out of it: 6 countries (Bulgaria, Estonia, France, Ireland, Latvia, Portugal) have defined a separate PIA market and 11 countries (Belgium, Croatia, Cyprus, Germany, Greece, Italy, Lithuania, Poland, Slovakia, Slovenia, Spain) have imposed PIA as a remedy in market 1.

¹¹⁴ Out of the 12 Member States in which the NRA conducted a geographic segmentation of the WLA market and found SMP in a portion of the territory, 10 have distinguished between areas based on differing competitive conditions. In Croatia, the Czech Republic, Estonia, Ireland, Italy, Latvia, Poland and Spain the NRAs continue to regulate in the non-competitive areas. In Denmark and Finland geographic segmentation has been based on the network reach of local and regional network operators, leading to the designation of different operators with SMP in different areas.

- In Ireland, in a first step the market is segmented in two areas (intervention area IA NG area and commercial NG area) based on network reach of the network operators Eircom and NBI. The competitive conditions are assessed in a second step for each area.
 - In France, Hungary, Netherlands and Portugal the NRAs also combine the assessment of competitive conditions and the network reach of operators/market leaders in the geographical market analysis.
 - 16 NRAs use municipalities as a geographical unit. Other geographical units used are the modified exchange of Eircom (Ireland), the energy supply areas (Denmark), 6 digit postal code and concession areas (Hungary).
 - With reference to the rationale/methodology used to segment the market, the majority of NRAs combine criteria with reference to retail market share, minimum number of alternative operators and a threshold for the coverage of alternative operators (in sum or individually).
- In this respect, geographic surveys (under Article 22 EECC) provide an important input that should help national administrations and NRAs to understand to what extent there may be regions that are likely to be underserved with VHCN on a commercial basis, and which may therefore require State Aid to ensure adequate coverage. In areas where commercial deployment is envisaged, geographic surveys can also be used to understand to what extent infrastructure-based competition is present (or could emerge), data which is essential in defining geographic markets and tailoring SMP (or symmetric) regulation to reflect the competitive situation in the area concerned. Information about network technologies and spectrum use could also provide important insights regarding the quality of mobile services. NRAs could, therefore, use the provisions in Article 22 much more to address several issues related to achieving connectivity and accelerating copper switch-off. They could with this approach identify the areas which are relevant for state aid. Combined with analysis based on cost modelling, they could identify areas where duplication of networks is unviable and where infrastructure competition can be expected.
 - Many NRAs have refrained from imposing cost-orientation remedies when mandating access to FTTH¹¹⁵, and instead relied on pricing flexibility, sometimes coupled with Economic Replicability Test. Those which have nonetheless applied cost-orientation have noted that it has been justified based on an absence of sufficient competitive constraints.
 - Under Article 32(10) EECC NRAs, in exceptional circumstances, where that there is an urgent need to act, to safeguard competition it may immediately adopt proportionate and provisional measures (without the EU consultation process). As of 2020 only 11 interim measures were adopted by 6 NRAs¹¹⁶ and communicated to the Commission.
 - Furthermore, despite overall general effectiveness of the process which allowed the EU markets for electronic communication develop by removing part of high entry

¹¹⁵ Of the 23 countries which found SMP on market 1 (2020)/market 3a (2014), 11 apply cost orientation to **fibre-based wholesale products**. Depending on the results of the geographical market segmentation, this may apply only to non-competitive areas of the market.

¹¹⁶ BU, IT, HU – 1 measure each, EL – 2 measures, DE, HR – 3 measures each.

barriers and allowed greater tendency towards effective competition, several problems were identified. In particular:

- the Commission pointed in its comments letter to the fact that some market reviews are delayed¹¹⁷.
- a significant time gap was observed between the market review and the imposition of remedies (sometimes reaching three years). The Commission in a number of its comments letters¹¹⁸ stressed that significant time gap between the market review and the imposition of remedies, and the imposition of various remedies in piecemeal manner, undermines the goal of predictable regulation, as set out in Article 3(4) of the EECC.
- Data supporting the market analysis were not up-to-date (sometimes four years old)¹¹⁹;

As for symmetric regulation (Article 61 of the EECC), eight countries have applied symmetric access to in-building wiring¹²⁰. Of these, four countries (Cyprus, Greece, Italy and Poland) imposed symmetric access for in-building wiring only, while the other four (France, Spain, Portugal and Croatia) imposed symmetric access at the first distribution point with a possibility for this to lie outside the building. Access to in-building wiring typically refers to passive access.

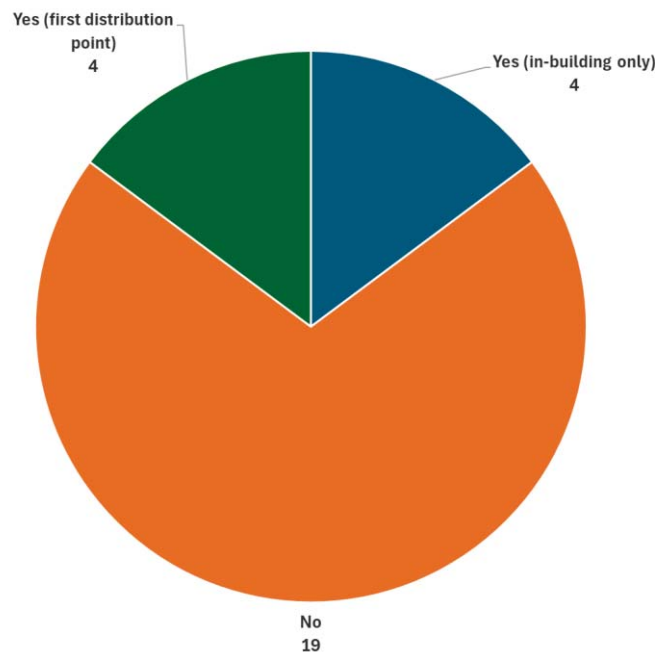
¹¹⁷ ES/2022/2361, MT/2024/2484, PL/2024/2528, DE/2024/2512.

¹¹⁸ E.g. DE/2018/2133, DE/2020/2258.

¹¹⁹ AT/2023/2446, DE/2024/2512.

¹²⁰ in accordance with Article 61 (3) EECC. Of these, four countries (Cyprus, Greece, Italy and Poland) impose symmetric access for in-building wiring only, while the other four (France, Spain, Portugal and Croatia) impose symmetric access at the first distribution point with a possibility for this to lie outside the building.

Figure 2: Application of symmetric regulation according to Art. 61 (3) EECC



Source: NRA online survey and Godlovitch, I. et al. (2023).¹²¹

Under Article 122 of the EECC, the Commission shall evaluate in particular the market implications of Article 61(3) and Articles 76, 78 and 79:

Symmetric regulation under Article 61(3) was designed, inter alia, to limit network duplication in areas where it is not viable by identifying a viable connection point for wholesale access and requiring the provision of access by any network operator that deploys in such an area. However symmetric regulation has only been used to limit FTTH duplication in areas where it is not viable in two Member States (France and Croatia). This may be in part because the provisions relating to symmetric regulation are *optional* (i.e. NRAs are not obliged to impose them but to react to “reasonable request”), whereas the requirement to conduct a market analysis of markets listed in the Relevant Market Recommendation as susceptible to ex ante regulation is, in principle, mandatory.

In addition, art 61(3) seems to place a focus on in-building wiring or access to the first concentration point (which is typically not a viable connection point when chosen by the operator concerned). This requires a high burden of proof for the imposition of passive access at this point for which there is limited elaboration or case law, and sets an even higher burden of proof to mandate access at a point “capable of hosting a sufficient number of end-user connections to be commercially viable for efficient access seekers”, with a further justification required to impose active access. Moreover, it makes only brief mention of the conditions that can be attached to access. This contrasts with the extensive menu of measures and obligations that may be linked to SMP regulation.

¹²¹ Godlovitch, I.; Knips, J.; Strube Martins, S.; Wernick, C.; Tenbrock, S.; Hoceplied, C. (2023): Study on the evolution of the competition dynamics of tower and access infrastructure companies not directly providing retail services, study for BEREC, BoR (23) 206, https://www.berec.europa.eu/system/files/2023-12/BoR%20%2823%29%20206_Rev1_Study_towernetco_PUBLIC_0.pdf (last accessed on 19.03.2025).

The limited use of symmetric regulation under Art 61(3) by other Member States could therefore be due, not only to the high burden of proof, but also to the fact that the weight of attention in the EECC (and the associated number of provisions) was rather towards SMP regulation. SMP regulation, in fact provides an alternative means of mandating wholesale access including to FTTH. Such wholesale access, however is based on the existing market power of an identified operator in a given area, rather than a prospective analysis of the potential (or otherwise) for networks to be viably duplicated in general.

Provisions in the EECC that can be said to have been particularly effective in minimising the overall burden of ex ante regulation are those which highlighted the need to prioritise civil engineering access where possible (**Article 72**) and to take into account different geographic conditions. The newly introduced option to make use of “commitments” instead of obligations to address SMP concerns (**Article 79**) has also been successfully used, albeit in a limited number of cases and has been supported by stakeholders interviewed by WIK.

The EECC acknowledged the positive role that can be played by commercial agreements including co-investment by requiring NRAs to consider the impact of such agreements on competitive dynamics, when they consider imposing SMP obligations. However, regarding co-investment under **Article 76**, there were no cases, in which the NRAs have formally applied this provision¹²².

Therefore, **Article 76 EECC** did not prove to be an efficient tool to incentivize SMP operators to share investments with (potential) competitors on a voluntary basis. The co-investment provisions in Art 76 EECC appeared complex, limiting their potential application. The provision, if applied, could potentially be counterproductive, as it would risk locking in customers to the SMP operators’ network, thereby reducing the potential customer base that would be needed to support the entry of infrastructure-based competitors¹²³. Therefore, Article 76 provisions should either be substantially revised or removed.

No NRA has mandated functional separation under **Article 77**. However voluntary legal or functional separation has been pursued in at least three countries¹²⁴ under Article 78.

As regards the effectiveness and relevance of **Article 80**, the possibility of lifting regulation does not seem to have been a key driver in either incentivising wholesale-only models or separation by former incumbents¹²⁵. The key driver for the emergence of wholesale only operators seem to have been rather investor expectations and business choices.

Article 80, indeed, offers regulatory relief (no strict price control). However, while NRAs and alternative telecom providers agree that there may be reduced incentives for wholesale-only undertakings to engage in anti-competitive behaviour, such as discrimination (in the absence of preferential agreements with retailers), they highlight that a risk of excessive pricing remains in cases where the wholesale-only operator keeps a SMP position¹²⁶.

¹²² Only in Italy country an SMP operator sought to make use of the new possibility offered by the Article 76 EECC. AGCOM, however, withdrew its notification once the SMP operator unilaterally changed its offer on an essential element (prices), thus requiring a new assessment by AGCOM. Later, AGCOM requested amendments of the offer and eventually, when the SMP operator did not implement them, rejected the offer as non-compliant with the EECC.

¹²³ WIK.

¹²⁴ Czechia (although this took place before the entry into force of the Code), Denmark, Italy.

¹²⁵ Only one NRA (DBA in Denmark) decided to regulate wholesale only operators.

¹²⁶ See. DK/2021/2346.

Part of stakeholders interviewed by WIK for the access study considered that specific provisions relating to wholesale only companies should be removed, leaving the analysis to be conducted in line with standard market analysis procedures. On the other hand, wholesale only providers argue that the existing provisions should remain but be clarified e.g. to allow the provision of services to business customers or to favour wholesale only companies which offer passive access. Meanwhile, former SMP operators which have engaged in separation consider that the conditions to be considered as wholesale only operators are too strict.

The EECC also requires, under **Article 122**, the Commission to review whether ex ante and other intervention powers pursuant to the EECC are sufficient to enable NRAs to address possible competition issues in the markets with an oligopolistic structure, and to ensure that competition in electronic communications markets continues to thrive to the benefit of end-users.

No recent cases have been confirmed in which joint SMP was found and access obligations applied in the context of ex ante regulation under the access provisions of the EECC. At the same time the number of draft measures, notified under Article 32 of the EECC, with collective dominance finding was very limited. In 2018 the Commission provided guidance on the interpretation and application of the joint SMP concept in the context of the SMP Guidelines of April 2018.¹²⁷ This was followed by a finding of joint SMP by the Dutch NRA ACM later in 2018, which was not vetoed by the Commission¹²⁸ under the review procedure for market analyses in force at that time (Article 7(3) Framework Directive). However, despite the Commission's absence of objection against the finding of joint SMP, the ACM's decision was subsequently annulled by the Dutch court.¹²⁹

In February 2022¹³⁰ and in March 2023¹³¹, the European Commission adopted the decisions requiring the Czech telecommunications regulator, CTU, to withdraw its proposed draft measures to regulate wholesale access to mobile networks in Czechia via a finding of joint SMP. A key factor was that other regulatory tools such as the enforcement of already imposed spectrum related obligations had the potential to solve the problems.¹³²

In turn, the Maltese regulator attempted to regulate the broadband access market with two local nationwide networks on the basis of single SMP findings and to regulate only one out of

¹²⁷ <https://digital-strategy.ec.europa.eu/en/library/communication-smp-guidelines>.

¹²⁸ Commission Decision C(2018) 5848 final of 30.8.2018 concerning Cases NL/2018/2099 and NL/2018/2100: Wholesale fixed access market in the Netherlands.

¹²⁹ <https://www.jdsupra.com/legalnews/highest-dutch-court-annuls-acm-s-joint-71679/>.

¹³⁰ [Commission closes its in-depth investigation on the proposed Czech regulation on mobile access market | Shaping Europe's digital future](#).

¹³¹ <https://digital-strategy.ec.europa.eu/en/news/commission-closes-its-depth-investigation-proposed-regulation-market-wholesale-access-mobile>.

¹³² In a 2023 study, see https://www.berec.europa.eu/system/files/2023-04/BoR%20%2823%29%2041%20Study%20on%20wholesale%20mobile%20connectivity%20trends%20and%20issues%20for%20emerging%20mobile%20technologies%20and%20deployments_final_0.pdf. WIK-Consult noted that the nature of MVNO obligations in spectrum licences might affect the degree to which an MVNO could differentiate its services from that of its host and thus its potential to provide competitive disruption. It noted that in the Czech case, the spectrum licence provides “prices must allow equally efficient operators to profitably operate on the downstream (retail) market”. The study noted in this context that “The fact that the spectrum licence MVNO obligations require wholesale prices to be set on the basis of an EEO margin-squeeze test in practice limits the potential for MVNOs to engage in price competition.”

two nationwide networks. After a thorough investigation, the Commission found that the Maltese regulator should take into account the role of the second operator with an alternative cable infrastructure and the competitive constraints it imposes. Therefore, the Commission has determined that the draft measure is not compatible with EU law and has issued a veto¹³³.

No other proposed cases involving joint SMP or oligopolistic markets have been notified.

Despite of small number of joint dominance cases under the SMP regime, **competitive concerns in oligopolistic markets** which involve a limited number of (most often two) significant players with similar market positions have been addressed in different ways, not all of which involve the traditional application of access-related measures under the EECC. The SMP Guidelines¹³⁴ adopted by the Commission set out the main principles and criteria for determining single SMP and joint SMP.

For example, in the Belgian market they were addressed through distinguishing separate markets for FTTx-based access and cable, while in the Dutch market, following the legal challenge to the NRA's proposed joint SMP finding, concerns were addressed via commitments, which were entered into following a market investigation under competition law. Meanwhile, proposals to apply SMP regulation in Czechia (mobile market) Malta (fixed broadband access market) to address refusal to supply by the incumbent operator, were withdrawn following a veto decision issued by the Commission. While in general, the EECC's provisions on the access regulation have contributed to supporting competitive outcomes, one issue of the access-related provisions concerns how to address uncompetitive oligopolies. The test of joint SMP is based on the competition law concept of joint dominance, as further detailed in the case-law of EU Courts starting from the *Airtours* judgement, which has set a higher level the required burden of proof. There are also different views among stakeholders, as to what extent the ex ante intervention into oligopolistic electronic communications market is needed.

While incumbent operators generally observe that one network is sufficient if wholesale access is provided and that the situation in which at least two players are present does not raise competition issues (and thus that the concept of joint SMP is not relevant), NRAs, consumer representatives, MVNOs and some alternative operators consider that it all depends on the behaviours and incentives of the oligopolistic operators. These stakeholders underline that the lack of cases is due mainly to the high burden of proof for joint SMP established by the case law and the difficulty faced by enforcers to prove a case.

As regards **Article 81** regulating copper switch-off, operators with significant market power and subject to network access obligations must notify NRAs when they plan to decommission or replace their copper networks¹³⁵. This ensures that migrations are transparent with a clear timetable and adequate notice periods, do not harm competition or end-user rights and that alternative access products of comparable quality are available. These requirements apply only to migrations of operators with SMP and had only limited practical relevance either because (i) the incumbents had not announced copper switch off plans, (ii) the conditions for copper switch off were set prior the entry into force of the EECC or (iii) copper markets were deregulated. Several Member States (e.g., Belgium, France, Spain, Italy and Portugal) have implemented copper switch-off conditions through their SMP market reviews, while others as

¹³³ C(2024) 1928 final.

¹³⁴ See points 46-49 and 51 of the SMP Guidelines.

¹³⁵ See Article 81 EECC.

Ireland have set a specific framework. More generally, this provision was not aimed and did not contribute in any fashion to accelerate the move from copper to fibre, as it only gave the means to regulators to govern the process for the switch off.

As regards the application of Article 32(10) EECC which allows NRAs, who are in position In exceptional circumstances, where a NRA considers that there is an urgent need to act, in order to safeguard competition and protect the interests of users, by way of derogation from the procedure set out in paragraphs 3 and 4, it may immediately adopt proportionate and provisional measures.

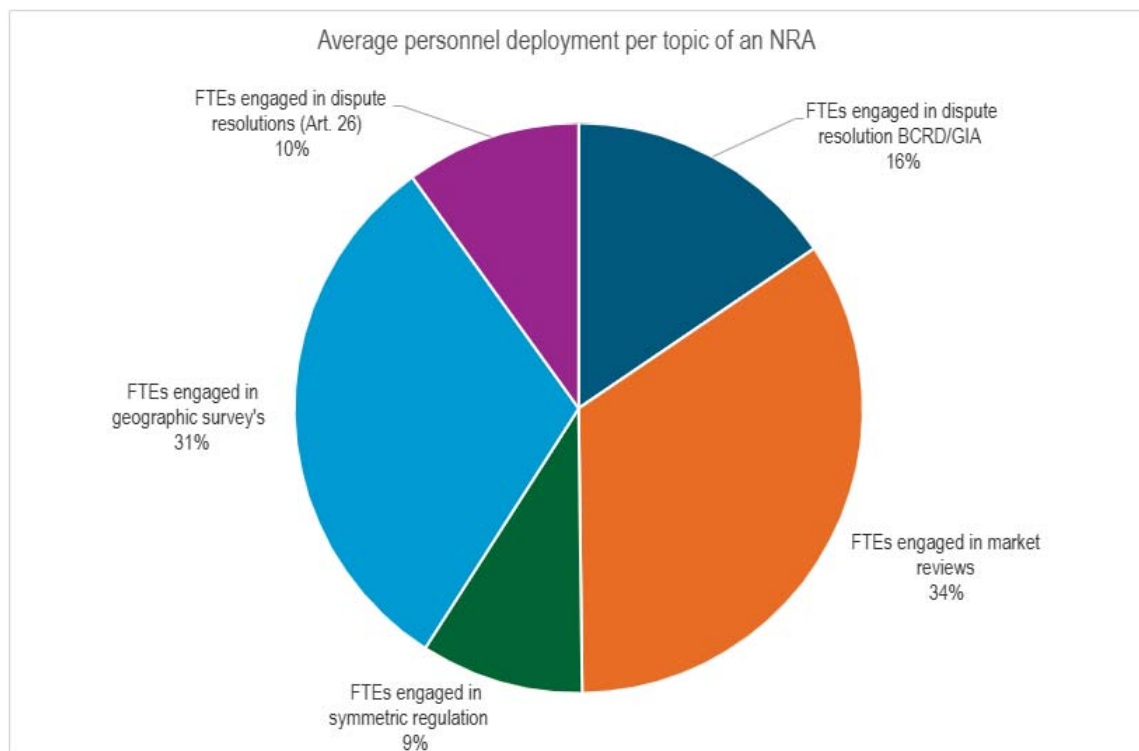
Furthermore, despite overall general effectiveness of the process which allowed the EU markets for electronic communication develop by removing part of high entry barriers and allowed greater tendency towards effective competition, several problems were identified. In particular, the significant time gap between the market review and the imposition of remedies (sometimes reaching three years), and imposition of various remedies, addressing identified competition problems in different manner in different markets and in piecemeal manner, undermines the goal of predictable regulation.

4.3.2. Efficiency

Data gathered from NRAs shows that the direct costs associated with the access regulation processes are relatively limited. As shown in the following table, extrapolations from data provided by NRAs suggest that, while the total Full Time Equivalent (FTEs) employed in NRAs/ Dispute Settlement Bodies (DSBs) was around 9,500, across Europe, only around 725 of these were involved in access-related issues. Likewise, the European Commission employs approx.. 15 FTEs for the tasks related to access regulation procedures. Under the assumption that twice as many resources are deployed in the private sector in relation to access regulation, with a similar per FTE cost of €60,000, total costs would be around €133m.

	Total FTEs NRA /DSB	FTEs engaged in dispute resolution BCRD/GIA	FTEs engaged in market reviews	FTEs engaged in symmetric regulation	FTEs engaged in geographic survey's	FTEs engaged in dispute resolutions (Art. 26)
Total	5238	59,2	185	26,5	118	41,1
Total responses	15	12	17	9	12	13
Average number of FTEs per NRA and topic	349,20	4,93	10,88	2,94	9,83	3,16
Total number of FTEs in the EU27 per Topic based on average	9428,40	133,20	293,82	79,50	265,50	85,36

The following chart shows that 34% of FTEs were involved in market reviews, with an average of 9% involved in symmetric regulation (although this is likely to be skewed by figures in France and Croatia, which rely on these measures extensively). Meanwhile, a relatively high proportion (31%) were engaged in geographic surveys and a further 10% in dispute resolution¹³⁶.



¹³⁶ Dispute resolution under the BCRD / GIA (not relevant to the assessment of the EECC access-related provisions) but interesting as a comparison accounted for 16% of the total FTE.

4.3.3. Coherence

The access-related provisions of the EECC are largely internally coherent, as they build upon a long tradition of economic regulation in the telecom sector based on findings of “significant market power”, while offering the possibility (pursued in only a small number of countries such as France and Croatia) to follow an approach based on symmetric regulation as an alternative to achieve the public policy objective of fostering the deployment of VHCN.

Some internal inconsistencies have become apparent in relation to provisions that were newly introduced in the EECC. In particular:

- The attempted application of Article 76 (co-investment) in the Italian market revealed that there can be tensions between this provision and the objective in Art 3 EECC that NRAs should promote efficient infrastructure-based competition. Specifically, in cases where co-investment relies on long-term commitments involving a high share of access lines, this could limit the potential for an alternative VHCN infrastructure to secure sufficient take-up and remain economically viable. This issue was considered by the Italian competition authority AGCM ((Autorità Garante della Concorrenza e del Mercato) as well as the NRA during their review of the proposed co-investment.
- The provision that civil engineering access can be mandated as a remedy even where not referenced in the market definition (Art 72) is only practicable in cases where SMP duct and pole access does not provide a core foundation for downstream competition. Where it does play a significant role, it has proved necessary to identify a separate and distinct market for PIA in order to allow the effects of this remedy on downstream competition to be considered in the market analysis and reflected e.g. through geographic segmentation.
- Provisions on wholesale only require operators to not have retail operations in retail markets for electronic communication services provided “to end-users in the Union”. However, for the purposes of a market analysis, only the provision of retail services in the geographic market concerned is relevant. Some stakeholders also question whether the provision in Art 80 limiting the application of regulatory obligations including price control on wholesale only companies is objectively justified and coherent with wider provisions in the EECC, noting that wholesale only companies may still have the ability and incentive to raise prices above the competitive level, if they enjoy a position of significant market power.
- Provisions regarding commitments have proven to be difficult to apply for SMP operators engaging in structural separation as the company engaging in separation cannot enter into commitments on behalf of a future separated entity. This may have limited their usefulness in providing assurances regarding the regulatory implications of separation for the companies concerned.

As regards external coherence, access regulation is based on the principles of EU competition law. Markets which are no longer subject to ex ante access regulation (based on a competition policy-based test), continue to remain subject to competition law. It is therefore coherent.

In the same vein, as regards external coherence with other legislative and soft law instruments, the provisions of the EECC overlap to a certain extent (but are not inconsistent with) provisions of the GIA. Areas of overlap include:

- Provisions on rights of access to public infrastructure under Art 3 GIA (including rooftops, street furniture). The GIA provisions overlap and extend beyond provisions

specifically relating to Small Area Wireless Access Points (SAWAP) under Art 57 EECC.

- Provisions on the processes to obtain Rights of Way and permits under Art 7-9 along with rights for access to public buildings and associated dispute resolution under the GIA could overlap and go beyond provisions regarding RoW in the EECC, in particular by introducing shorter timeframes and stipulating specific procedures for applications and dispute resolution around the terms of access.

Other aspects of the GIA have synergies with the EECC and do not conflict to any significant degree. These include:

- Provisions on access to ducts and poles under Art 3 GIA. These complement the potential (indeed encouragement in the context of the market review process) to mandate SMP PIA under the EECC by adding the potential for access to other physical infrastructure and may be considered as subsidiary to such provisions.¹³⁷ The requirement in the context of Art 3 GIA to take into account the impact on the business case when establishing prices for access to PIA further highlights the fact that these provisions do not substitute for SMP PIA, as they seek to reduce costs for and extend VHCN roll-out (and include measures which reduce the attractiveness of PIA and serve to limit VHCN duplication in this context), whereas SMP PIA obligations are focused on promoting, where possible, infrastructure competition by fostering the sharing of (largely historic) physical infrastructure deployed by SMP operators.
- Provisions to establish standards and obligations to deploy in-building infrastructure and fibre wiring (Art 8 GIA) complement obligations under art 61(3) EECC for owners of such infrastructure to provide access to in-building wiring. One point where there may be a **lack of coherence** however is that whereas Art 8 GIA refers to in-building fibre wiring specifically, Art 61(3) goes beyond these provisions to grant **access to wiring that could go beyond the in-building wiring** and extend to the first concentration or distribution point. **The focus on ensuring fibre wiring in-building in the GIA may also signal a need to review the case for excluding in-building wiring or other wireless connectivity from the definition of VHCN.**
- Provisions to grant access to in-building infrastructure under Art 9 GIA are understood to refer to in-building ducts and chambers and as such do not overlap but rather complement provisions in Art 61(3) that refer to access to wiring.
- Provisions in the GIA that refer to the development of Single Information Points (SIP) for existing physical infrastructure (Art 4 GIA) and planned civil works (Art 6 GIA), complement provisions in the EECC (Art 22) regarding geographic surveys. Specifically, whereas the GIA focuses on the location of physical infrastructure suitable for the deployment of VHCN, such as ducts, poles, towers and public buildings, Art 22 EECC focuses on networks deployed (existing and forecast) and can also be used to track the technologies used and associated quality as well as the number of networks deployed in specific locations.

¹³⁷ Art 1(2) GIA: If any provision of this Regulation conflicts with a provision of Directive 2002/77/EC, (EU) 2018/1972 or (EU) 2022/2555, the relevant provision of those Directives shall prevail, while Art 3(9) notes that Physical infrastructure which is already subject to access obligations imposed by NRAs pursuant to Directive (EU) 2018/1972 or resulting from the application of Union State aid rules shall not be subject to the obligations set out in paragraphs 1, 4, and 5 for as long as such access obligations are in place.

The EECC has adopted the Digital Decade Policy Programme (DDPP).¹³⁸ As such, it does not make reference to the specific objectives included in the DDPP such as the target that all end-users at a fixed location should be covered by a gigabit network up to the network termination point. The reference to “Very High Capacity Networks” in the EECC could be interpreted consistently with that target, as it is defined in the EECC to mean “an electronic communications network which consists wholly of optical fibre elements at least up to the distribution point at the serving location” or a network which offers equivalent capabilities.

Certain provisions in the EECC are however not consistent with the coverage targets in DDPP and therefore could be viewed as not internally coherent. Specifically, Art 22 regarding geographic surveys permits NRAs to designate areas where no undertaking or public authority has deployed or is planning to deploy “a very high capacity network or significantly upgrade or extend its network to a performance of at least 100 Mbps download speeds”. On the basis of this information, NRAs may invite undertaking to declare an intention to deploy VHCN or extend network performance to 100Mbit/s. As quality of service and bandwidths achievable over fibre networks improves, the reference to 100Mbit/s may become increasingly divorced from Europe’s aspirations regarding VHCN. Such a bandwidth may also over time depart from approaches taken to State Aid, which is likely to provide a vital contribution in closing the gap to achieving the DDPP targets. In this context, it should be noted that the 2023 Broadband Guidelines refer to Gigabit-capable networks.¹³⁹

4.3.4. Relevance

The consultation process under Article 32 EECC plays a key role in developing and implementing consistent market-based regulatory guidance to be applied by NRAs. The role of the publicly available Commission’s letters is not only to provide the assessment of individual cases but to promote consistent regulatory approach in the EU.

The Commission’s assessments in phase I can have a form of a “no comments” or “comments” letters. In case the notified draft measure may not be compatible with EU law, the Commission adopts and publishes its “serious doubts letter” which is the basis for a further in-depth investigation in phase II and is also a basis for stakeholders to submit their comments. Finally, the Commission can adopt a decision requiring an NRAs to withdraw its draft regulatory measure (veto decision) with respect to the market definition, the analysis of the three criteria test and SMP assessment. The Commission can also adopt a recommendation under Article 33 EECC which may affect the proposed remedies at the end of phase II assessment. The legal consequence of a veto decision is that the NRA must withdraw its notified draft regulatory measure and cannot adopt it. In case of a recommendation, the NRAs must provide reasons as to why they decide not to amend or withdraw their draft measures.

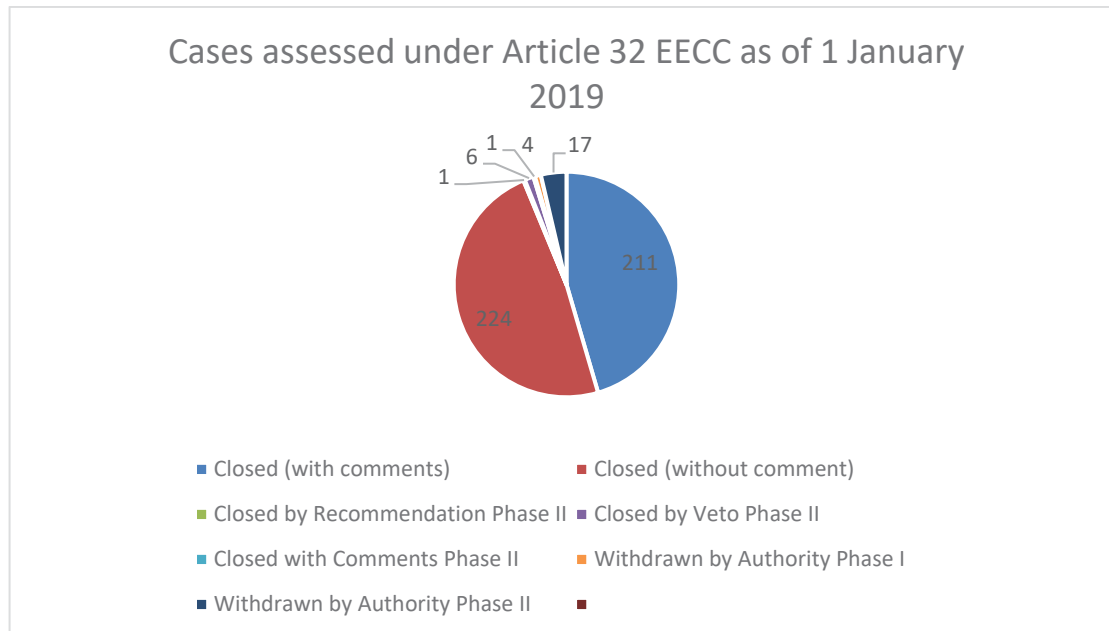
Despite the very short deadline (one month without any possibility of prolongation) for the assessment of legally and economically complex files, the Commission has responded to all the notified draft measures. The short EU consultation process does not, therefore, cause delays in the preparation and adoption of regulatory measures. In turn, it is instrumental in ensuring consistency in implementing ex ante regulation across the EU.

¹³⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32022D2481>.

¹³⁹ See points 56 and following
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52023XC0131%2801%29>.

In the vast majority of the cases, the Commission closed its assessment after one month by adopting a ‘no comments’ or ‘comment’ letter. Only a small fraction of cases required in-depth investigation during the Phase 2 investigation.

The number of cases, assessed after the adoption of the EECC i.e. after 1 January 2019, broken down by the outcome of the analysis are shown in the chart below:



Even if NRAs have increasingly defined markets subject to regulation as regional or local the access-related provisions remain relevant for the future. However, some streamlining could be considered (in particular in relation to some of the newly introduced measures i.e. access to civil engineering infrastructure (Article 72), regulatory commitments (Article 79) and wholesale-only (Article 80). Other measures, such as Article 76 (co-investment), Articles 77 and 78 (mandated and voluntary separation) that, as detailed in the previous sections, have proven to be of limited application and therefore relevance, could be removed in an effort of simplification.

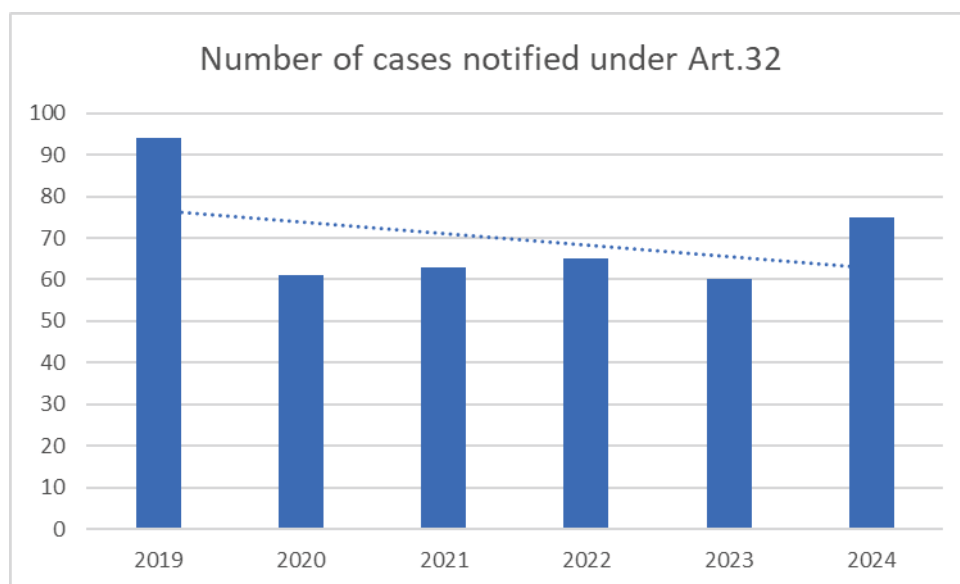
More generally, while measures are well adapted to addressing instances of significant market power including local monopolies, which may become more widespread in a post-copper world, the EECC asked also the Commission to carry out a review of the legal framework to assess its ability to address concerns related to oligopolies. As detailed in the previous sections, the number of cases regarding the oligopolistic markets, notified under Article 32 EECC was insignificant. The oligopolistic markets have, so far been addressed either under the spectrum authorisation regime or under competition law. Furthermore, the SMP Guidelines, adopted in 2018, specifically focus on the joint SMP findings.

4.3.5. EU added value

Under the EECC, the imposition of *ex ante* regulatory obligations on undertakings that have SMP on a specific market can be justified if proven that (i) these markets are characterised by high barriers to entry and (ii) do not tend towards effective competition, and that (iii) competition law instruments are insufficient to tackle the identified competition problems (this is the so-called the three criteria test).

EU consultations regarding draft regulatory decisions which aim at imposing ex-ante regulation, based on the SMP finding play a central role in the process. The draft regulatory measures must be always notified to the Commission, BEREC and other NRAs. The Commission has a power to require NRAs to withdraw their draft measures if the market definition and/or SMP assessment creates a barrier in the internal market or if there is lack of compatibility with Union law. Furthermore, the Commission can adopt recommendations with regard to the proposed remedies. Consistency of regulatory approaches taken by NRAs is of fundamental importance to avoiding distortions of the single market and to creating legal certainty for all investing undertakings. For this the Commission's publicly available assessments of the notified draft measures (including the so called comment letters or no comments letters) play a key role in guiding the NRAs' regulatory practices. EU consultations regarding draft regulatory decisions which aim at imposing ex ante regulation plays a central role in the process.

As indicated in the graph below, the number of notified cases is lower after 2019, in particular due to the removal of the markets for wholesale termination on fixed and mobile networks from the list of recommended markets (Article 76 EECC removed the risk of charging excessive prices by operators terminating the calls). However as of 2020 the number of cases notified annually was fairly stable. Despite slightly lower intensity of notifications in comparison with 2019, the complexity of the assessed cases increased. Indeed, the regulators and the Commission need to assess the markets for a more regional perspective with competitive and non-competitive areas. Moreover, regulatory obligations, in some cases are different to reflect variations of competitive conditions in the geographic areas.



There is a presumption that for the markets listed in the Recommendation on relevant markets¹⁴⁰, the three criteria test is met across the Union. However, an NRA may consider it appropriate, based on specific national circumstances, to conduct its own three criteria test on the wholesale markets in this Recommendation and notify its findings according to the consultation procedure set out in Article 32 of the EECC.

¹⁴⁰ Under Article 64 EECC the Commission is mandated to publish and regularly review its recommendations on relevant markets.

At the same time, NRAs should always carry out the three criteria test when they intend to regulate a market which is not listed in the Recommendation but which, in the light of specific national circumstances and having conducted an analysis of competition at retail level, could be susceptible to *ex ante* regulation.

An undertaking is deemed to have SMP, if, either individually or jointly with others, it enjoys a position equivalent to dominance, i.e. a position of economic strength, which gives it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers.

The NRAs should then impose obligations on SMP operators which are proportionate, justified and based on the nature of the problem identified, also with a view to achieving the objectives set out in Article 3 of the EECC. When assessing the proportionality of the obligations and conditions to be imposed, as when carrying out their market analysis, NRAs should take into account the different competitive conditions existing in the different areas within Member States.

Consistency of regulatory approaches taken by NRAs is of fundamental importance to avoiding distortions of the single market and to creating legal certainty for all investing undertakings.

The access-based provisions have, therefore, added considerable value compared with Member States acting alone. Specifically, pursuing a common ruleset based (in the vast majority of cases on SMP), has meant that common and well-understood principles could be applied across Europe, while ensuring that the regime was sufficiently flexible to address very different underlying market situations at national and local level. The use of common principles for access regulation has also enabled the progressive deregulation of telecom markets in areas where competition can be sustained in the absence of regulation.

5. SPECTRUM

5.1. Strategic Dimension of spectrum

Radio spectrum is of outmost strategic and geopolitical importance; it is essential to enable communication, drive economic growth and social prosperity, and support security and provision of mission critical services across various sectors. Spectrum has become a pre-requisite for EU's strategic autonomy and security, hence the need for its effective management and strategic and efficient utilisation.

The EECC and the previous framework were developed at a different geopolitical context and hence its strategic dimension had not been addressed. As a basic commodity, like electricity, it can also become a vulnerability. Spectrum supports vital services like critical communication, emergency communications, air traffic control, maritime navigation, and public security and safety networks. Today spectrum is weaponised in the context of armed and economic conflicts. It is not only used for operating drones and radars, but also for jamming and spoofing signals and disturbing key military and civil activities (from transport to banking).

The basic legal acts of the EU framework on spectrum management consists of the Radio Spectrum Decision¹⁴¹, the EECC and the Radio Spectrum Policy Programme.

¹⁴¹ Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision) (OJ L 108, 24/04/2002).

The Radio Spectrum Decision created an EU legal framework in order to ensure the coordination of policy approaches and harmonised conditions with regard to the availability and efficient use of the radio spectrum necessary for the establishment and functioning of the internal market in all EU policy areas not only for electronic communications but also for policies such as transport and research and development (R&D). It will not be incorporated in the DNA, as its scope is wider than the DNA since it covers all spectrum usages including uses not related to electronic communications and as it creates a technical harmonisation process for spectrum that is specifically addressed to the Member States.

5.2. Spectrum provisions in the EECC

The EECC defines a harmonised framework of objectives and principles for the strategic planning and coordination of the effective management and efficient allocation, assignment and effective use of radio spectrum for electronic communications. Spectrum policy is a shared competence between the Union and the Member States, therefore the EECC defines elements that competent authorities should consider while authorising radio spectrum at national level, both through general authorisation and individual rights of use. It also defines rules for strategic planning and coordination of spectrum use between Member States and means to address harmful interferences.

Several novelties were introduced by the EECC in the spectrum regulatory framework to strengthen its single market dimension. It created an integrated process of cross-border radio spectrum coordination between Member States. It introduced longer duration of spectrum usage rights for wireless broadband services to increase predictability and formalised the possibility to renew existing spectrum usage rights. It also formalised a peer review process to promote peer learning and convergence of the authorisation of spectrum usage rights. It set a coordinated timing of assignment for spectrum that was technically harmonised under the Radio Spectrum Decision¹⁴². Moreover, the EECC developed a basis for timely 5G deployment and network densification, by setting specific deadlines for the assignment of the 5G pioneer bands, facilitating access to radio local area networks and defining common criteria for the deployment and operation of small-area wireless access points

However, the effect of the improvements introduced by the EECC in 2018 has not been sufficient to fully exploit the potential of the single market in supporting effective and efficient spectrum policy and in ensuring EU leadership in mobile connectivity and advanced 5G deployment for citizens and businesses. Because of its voluntary nature, the peer review failed to align authorisation processes and conditions. Member States also chose different approaches in the case of duration of spectrum usage rights and conditions to renew them. All that failed in fostering regulatory predictability and investment capacity. Despite the binding deadlines imposed by law, delays in the assignment of 5G pioneer and other bands, due to exogenous (e.g. interference) but also endogenous reasons (e.g. delays or litigation) have also considerably slowed down deployment. The EECC has also not been fully effective in addressing harmful interferences between Member States and from third countries, due to limitations in the legal basis, therefore limiting the use of spectrum. Regulatory uncertainty further affected the limited attractiveness of the mobile sector for financial investors due to low profitability and significant investment required for acquiring spectrum and densifying networks.

¹⁴² Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision) (OJ L 108, 24/04/2002).

5.3. Radio Spectrum Policy Programme

The Radio Spectrum Policy Programme¹⁴³ (RSPP) dates to 2012 and sets out policy orientations and objectives for strategic spectrum planning and harmonisation, and actions for swift implementation of policy objectives. It applies to a broad range of EU policies that involve spectrum use such as electronic communications, research, technological development and space, transport, energy and audiovisual policies. While some RSPP general objectives are still valid and, based on RSPG opinion¹⁴⁴ and related public consultation¹⁴⁵, stakeholders see the RSPP merits as a strategic measure setting orientations, the EU policy, regulatory and technology context has changed considerably. Many RSPP actions were designed to support EU political priorities that are now either completed or outdated. Moreover, certain provisions have already been integrated in the EECC, as for example Article 5 on competition into Article 52 EECC and Article 10(2) on cross-border coordination with third countries into Article 28 EECC.

Based on previous evaluation Reports¹⁴⁶, studies¹⁴⁷ and stakeholder inputs (above mentioned RSPG opinion and related public consultation), we identified which actions included in the RSPP could be considered as completed and which provisions have become obsolete (including due to the substantive revision of spectrum rules brought about by the EECC). The analysis identified on the one hand which objectives and general principles of the RSPP remain relevant in the context of strategic policy needs and support of broader EU policy objectives, taking into account the current and future needs of key stakeholders. On the other hand, it specified which provisions have been taken over and further developed in the policy options of the Digital Network Act Impact Assessment (see Annex II for more details).

Objectives and general principles which remain relevant include:

- Authorisation principles to maximise flexibility and efficiency in spectrum use,
- fostering development of the internal market by promoting the emergence of future Union-wide digital services,

¹⁴³ Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme (OJ L 91, 21.3.2012, p. 7), <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012D0243>.

¹⁴⁴ RSPG Opinion on a Radio Spectrum Policy Programme (RSPP) (16 June 2021) https://radio-spectrum-policy-group.ec.europa.eu/document/download/00cfd520-efa9-48a1-bfec-d2980f511c3c_en?filename=RSPG21-033final-RSPG_Opinion_on_RSPP.pdf.

¹⁴⁵ Public consultation on the draft RSPG Opinion on a Radio Spectrum Policy Programme (RSPP) (https://radio-spectrum-policy-group.ec.europa.eu/consultations-0_en).

¹⁴⁶ Commission report on the implementation of the Radio Spectrum Policy Programme (COM(2014) 228 final) (22 April 2014), <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0228&rid=1> and Commission report on the Radio Spectrum Inventory (COM(2014) 536 final), 1 September 2014, <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52014DC0536>, the Commission's 2016 fitness check accompanying the Code legislative proposal- Commission Staff Working Document on Evaluation of the regulatory framework for electronic communications (SWD(2016) 313 final), 14 September 2016, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2016:0313:FIN:EN:PDF>.

¹⁴⁷ European Commission, Directorate-General for Communications Networks, Content and Technology, LS Telcom, PolicyTracker and VVA, Study on radio spectrum policy programme – Taking stock and discussing future scenarios – Executive summary, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2759/687724>.

- fostering the collective use of spectrum as well as shared use of spectrum within the limits imposed by competition law rules, assessing the justification and feasibility of extending the allocations of unlicensed spectrum,
- co-operation between Member States and the European Commission to allocate sufficient spectrum for wireless services, including in the unlicensed bands, as part of an evolving roadmap,
- promoting competition, innovation and investment,
- the need to avoid harmful interference,
- promoting technology and service neutrality in the rights of use of spectrum
- promoting spectrum harmonisation,
- upgrading networks to the most efficient technology in order to ensure that all citizens have access to advanced digital services including broadband in remote and sparsely populated areas,
- exploring the availability of sufficient spectrum for the provision of broadband satellite services enabling internet access,
- allocating sufficient and appropriate spectrum in a timely manner to support Union policy objectives and satisfying the increased wireless data traffic as part of an evolving spectrum roadmap,
- encouraging efficient management and use of spectrum, ensuring sufficient spectrum, harmonised where necessary, for specified uses including wireless broadband, provision of innovative audiovisual services like earth monitoring services and transport systems, safety of life services, Scientific services, PMSE, IoT services.

The RSPP also refers to certain aspects of international governance of spectrum that are still relevant such as the role of the Union in international negotiations relating to spectrum matters, such as for instance the recurrent World Radio Communications Conferences of the International Telecommunications Union and the role of the Union in assisting Member States with legal, political and technical support to resolve spectrum coordination issues with neighbouring third countries.

Annex II also identifies a set of key challenges moving forward, such as for example allocating sufficient and appropriate spectrum in a timely manner the need for greater focus on spectrum sharing and flexible licensing solutions, the need to support development of satellite communications. These challenges are further elaborated in the sections below evaluating the EU spectrum policy effectiveness, in particular in the sections on delays in 5G bands assignments, on effectiveness of spectrum sharing, transfer and leasing and on supporting satellite EU-wide connectivity.

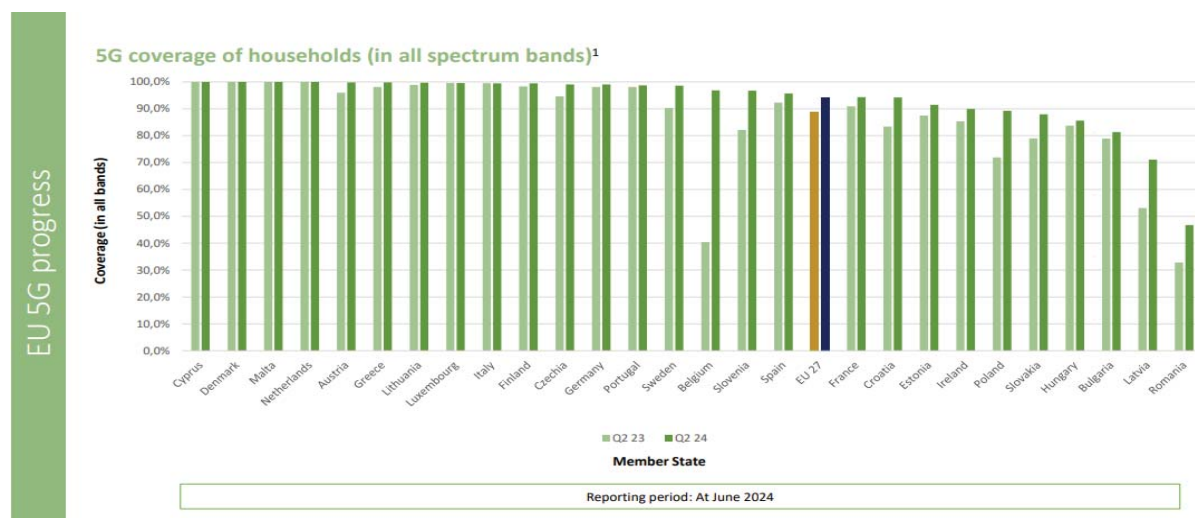
5.4. Effectiveness in promoting connectivity

Effectiveness is assessed with regard to promoting advanced 5G connectivity and ensuring investments and benefits for citizens.

5.4.1. 5G Connectivity achievements

While the **deadlines for the assignment of 5G pioneer bands**¹⁴⁸ and the RSPG's 5G Roadmap¹⁴⁹, sent a clear regulatory signal and helped define a common EU vision, they have not been successful in ensuring a coordinated timing of the 5G pioneer bands' assignment and promoting mobile and wireless connectivity by all citizens and business in the Union (Art. 3 EECC connectivity objective). While the single market delivered on **basic 5G coverage** and low mobile prices for consumers, that are generally significantly lower than in the US, both prices and basic coverage differ considerably between Member States due to inherently different market and regulatory landscapes¹⁵⁰. Average 5G household coverage by at least one basic 5G network across the EU reached 94.3% by the end of 2024¹⁵¹, behind South Korea (100%), Japan (99.2%), Norway and Iceland (99%), and the United States (97%)¹⁵², although with only 79.6% of households in rural areas being covered by 5G.

Figure 3: Total 5G households coverage- [5G Observatory Report 2025 | Shaping Europe's digital future](#)



¹⁴⁸ Aligned with the UHF Decision and supported by the 2016 5G Action Plan “Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 5G for Europe: An Action Plan”, European Commission, Brussels, 2016.

¹⁴⁹ Radio Spectrum Policy Group: Strategic Roadmap towards 5G for Europe: Spectrum related aspects for next-generation wireless systems (5G) and 5G implementation challenges Final progress report of RSPG Working Group 5G (2016-2019) on the Strategic Roadmap towards 5G for Europe to the RSPG Plenary, 2019.

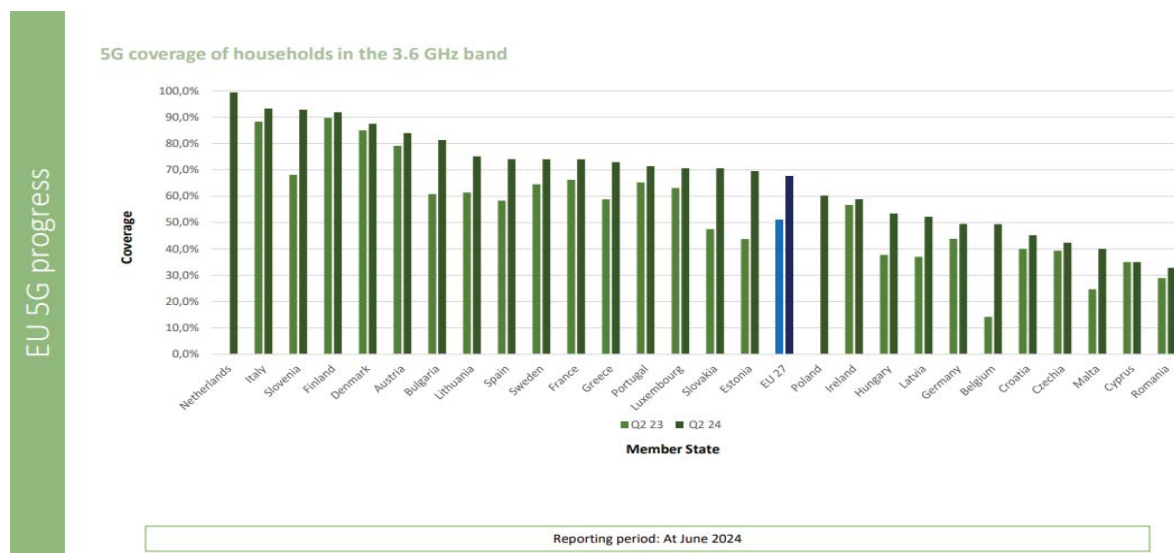
¹⁵⁰ Mobile broadband prices vary widely across the EU not only in nominal terms but also at price purchasing parity. See European Commission, Directorate-General for Communications Networks, Content and Technology, Mobile and fixed broadband prices in Europe.

¹⁵¹ [5G Observatory Report 2025 | Shaping Europe's digital future](#) In the majority of Member States household 5G coverage is reaching levels around or above 90%, with only Hungary, Bulgaria, Latvia and Romania lagging behind.

¹⁵² European Commission. (2025). Digital Decade 2025 – 5G Observatory Report. Directorate-General for Communications Networks, Content and Technology. Available at: <https://digital-strategy.ec.europa.eu/en/policies/5g-observatory-2025>.

5G deployment has not been even across the EU, in particular **coverage with the 3.6 GHz band**¹⁵³ and deployment of **5G standalone (SA) networks**. The EU average household coverage with the 3.6 GHz band was at around 67%, with 90% in Netherlands, Italy, Slovenia and Finland while it stood below 45% in Croatia, Czechia, Malta, Cyprus and Romania ¹⁵⁴. Moreover, only 26% of households in rural areas in the EU were covered by 5G using mid-band spectrum in 2024. 5G SA requires substantially higher investments and **is essential for industrial use relying on very-high reliability, security, low latency and higher throughput, and is a prerequisite to 6G deployment**. High-capacity networks, based on 5G SA, require high-band spectrum characterised by limited coverage and need for network densification. Article 57 EECC and the adoption of a Commission Regulation on a light deployment regime for small cells **aimed to boost high-capacity network deployment (5G and beyond)**. However, application of this regime remains limited and has not delivered any significant take-up compared with the US and Asia, as confirmed in surveys conducted by the Small Cell Forum (SCF).

Figure 4: 5G coverage of households in the 3.6 GHz band - [5G Observatory Report 2025 | Shaping Europe's digital future](#)

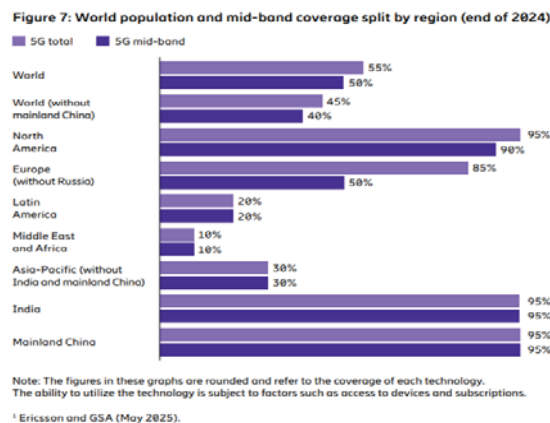


Ericsson data see Figure 5 on mid-band coverage that follow a different methodology and allow for an international comparison alarmingly confirm that Europe is lagging in mid-band coverage with 50% compared to 95% in India and China and 90% in the US.

¹⁵³ The 3,6 GHz band, together with the 700 MHz and the 26 GHz bands are the 5G pioneer bands. While the 700 MHz ensures wide coverage, the 3,6 GHz band is the “sweet spot” which strikes the best balance between speed capacity and coverage, is more accessible than mmW band, making it ideal for deploying 5G services to the general public and supporting the substantial data demands of dense urban areas and industry.

¹⁵⁴ 5G Observatory Report 2025 | Shaping Europe's digital future.

Figure 5: World population and mid-band coverage split per region (end of 2024¹⁵⁵)



Data from Connect Europe on 5G SA also confirm this finding: the EU lags considerably behind other major regions, marking the weakest performance in this advanced technology¹⁵⁶. The very low availability¹⁵⁷ of 5G SA in the EU (2%) compared to other global economies, China (80%), India (52%), and the USA (24%), is confirmed by Ookla's Speedtest® sample share.¹⁵⁸

The EC study¹⁵⁹ also confirms the limited use of mid-band spectrum in Europe, despite the widespread availability of this spectrum in most Member States as of 2022¹⁶⁰.

Article 57 EEC and the adoption of a Commission Regulation on a light deployment regime for small cells **aimed to boost high-capacity network deployment (5G and beyond)**. However, application of this regime remains limited and has not delivered any significant take-up compared with the US and Asia, as confirmed in surveys conducted by the Small Cell Forum (SCF).¹⁶¹

Use of mid-band and high band spectrum requires network densification. Operators indicate that they are hesitant to invest heavily in small cells given that, despite their potential to boost network capacity in dense urban areas, small cells face significant economic hurdles (high

¹⁵⁵ The Ericsson data are favoured compared to DESI data, to ensure comparability with performance of major economies, DESI data are instead presented in the Annex and include also data per MS.

¹⁵⁶ By the end of 2024, 5G SA coverage in North America reached 91%, in Asia-Pacific 45%, while Europe lagged at only 40%, despite the number of commercial 5G SA networks nearly doubling from 10 in 2023 to 19 in 2024. In Europe, Spain and Austria reported the highest proportions of 5G SA networks, with Germany and Greece following, although overall levels remain low. cf. Connect Europe (2025), State of Digital Communications, p. 5.

¹⁵⁷ Availability refers to the proportion of 5G connections that utilize 5G Standalone (SA) technology within the total number of 5G connections tested or sampled. It highlights the level of adoption and usage of 5G SA networks by users in various regions, as reflected in Ookla's Speedtest® data. This differs from coverage, which measures the percentage of the population or geographic area that has access to 5G SA networks, irrespective of actual usage.

¹⁵⁸ Ookla/ Omdia (2025), A Global Evaluation of Europe's Digital Competitiveness in 5G Standalone.

¹⁵⁹ Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

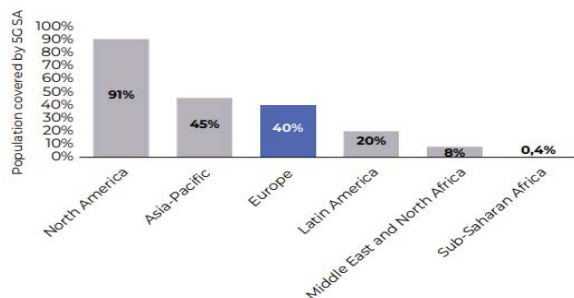
¹⁶⁰ BEREC (2023). Study on wholesale mobile connectivity, trends and issues for emerging mobile technologies and deployments, BoR(23) 41: <https://www.berec.europa.eu/en/document-categories/berec/reports/study-on-wholesale-mobile-connectivity-trends-and-issues-for-emerging-mobile-technologies-and-deployments>.

¹⁶¹ SCF (2024). SCF Market forecast report: <https://www.smallcellforum.org/docs/scf-market-forecast-report/>.

cost of equipment compared to small coverage area, complexity of deployment, permits) and they consider that until the regulatory framework and deployment economics improve, small cells might remain a secondary option.

Analysys Mason data also confirms low 5G standalone coverage in Europe, with values at around 40% compared to 90% in North America and 45% in Asia Pacific.

Figure 6: 5G SA coverage, by region, 3Q 2024, Source Analysys Mason, 2024



According to an EC study¹⁶², the lack of 5G SA-based connectivity, especially in mid-band frequencies enabling the use of bandwidth intensive services on mobile devices is the main cause for the lower take-up of innovative fully-fledged 5G services together with lack of availability of unlimited data packages as well as high prices in some countries, together with financial (profitability) challenges in particular for smaller operators, which impede their capacity to invest. These problems and the underlying drivers are further elaborated below. Moreover, a lack of demand or perceived willingness of consumers to pay for 5G and of enhanced mobile connectivity in general has also played a significant role.

Moreover, it appears that in Q4 2024, users in major EU cities still connected to 4G for 25% of the time on average, some cities lagged in 5G mid-band deployments and some 5G networks failed to deliver promised speed and advantages. See in Appendix II B MedUX - 5G QoE Benchmark in Europe: Drive Testing Report published at MWC25 (Q42024 data)¹⁶³.

From the consumer and business end-user perspectives, MedUX QoE data confirm the trend of EU lagging behind on high quality 5G (mid-band and standalone). While overall across EU states, 5G availability (any type of 5G) stood at 46.6% based on end user experience (5G devices only), deployments that rely specifically on the mid-band 3.4-3.8 GHz have now reached approximately 57.2% of this 46.6%, whereas 5G SA availability represents less than 2.5% (2.1%). See in Appendix II B MedUX – Status of 5G Quality and Experience in Europe, Report prepared for the EC (Q12025 data).

MedUX QoE data show that, despite wide 5G coverage on paper, users in many EU countries still rely predominantly on 4G. Across the EU27, average 5G usage (any type) stands at 46.6% among 5G-ready devices, meaning more than half of their traffic still flows over 4G or earlier technologies. This lags behind the US (74%), Thailand (57%), Switzerland (56%) and Norway (53%). Of the overall 5G deployments (when users are connected to 5G), usage of

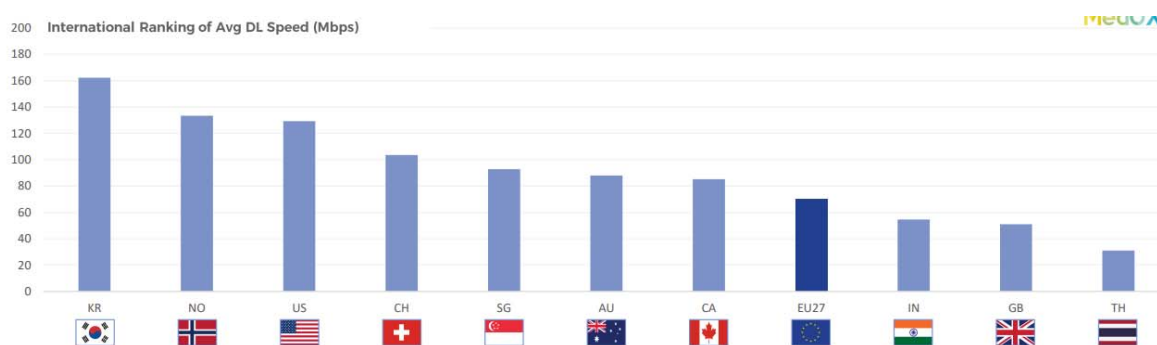
¹⁶² WIK-Consult. (2025). Financial Conditions, Demand and Investment Needs and Their Regulatory and Policy Implications, Including the Review of the Universal Service (Study for the European Commission).

¹⁶³ https://medux.com/blog/all-5g-networks-are-not-created-equal-unveiling-true-qoe-5g-europe-III?utm_source=chatgpt.com.

the mid-band 3.4–3.8 GHz has reached approximately 57.2% in the EU27, compared to 67.6% at the international level. However, on average across all technologies, end-users in the EU are connected to the mid-band only around 27.1% of the time. The deployment of 5G SA in Europe remains very limited. In the EU27, less than 2.5% of 5G connections are on SA, and when considering all access technologies, SA accounts for only 1.2% of usage. This reflects the fact that most European operators still operate in the 5G Non-Standalone (NSA) phase. By contrast, internationally, the situation is more advanced: 48.3% of 5G connections are already SA (vs 2.1% in EU27), and SA represents 20.5% of all access technologies. Certain markets are leading the global transition: India records 25% SA usage and the US 18%, positioning them far ahead of the EU average (1.2%), (considering all access technologies).

Average download speed performances in the fastest markets are led by South Korea (162.2 Mbps), followed by Norway (133.3 Mbps), the US (129.3 Mbps), and China (100 Mbps). In most markets, speeds exceed 85 Mbps. By contrast, the EU27 lags behind with an average of 69.9 Mbps - about 2.3 times slower than South Korea and slightly below the global average (70.4 Mbps). The UK and some Asian countries, such as India and Thailand, record even lower figures, with download speeds at or just below 50 Mbps.

Figure 7: International comparison of average download speed



The RSPG analysis confirms this trend¹⁶⁴ and recalls that the adoption of 5G SA is occurring slowly and unevenly among European MNOs and that European operators had been relatively hesitant in making the transformation to 5G SA compared to the US and Asia.

Despite EECC measures meant to ensure timely 5G deployment (cf. following section), delays in assignment of 5G pioneer bands, lack of demand, non-timely transposition of the EECC, slow national administrative processes and unresolved cross-border interference, together with low investment capacity have negatively affected the deployment and achievement of advanced 5G connectivity across the EU. Additionally, lack of market demand, particularly for the 26 GHz frequency band, further contributed to fragmented assignments.

Despite the launch of 5G in 2020, the uneven pace and quality of deployment, including low 5G SA core usage, show that the situation in the **EU is highly fragmented** and the EU is lagging behind other major economies. Hence, the EU intervention did not achieve the desired

¹⁶⁴ RSPG Opinion on 6G vision RSPG25-006 FINAL.

level of effectiveness within the envisaged timelines, negatively affecting overall 5G deployment.

The lack of investment in "full 5G" (including 5G SA using mid and high band spectrum) limits the quality of overall mobile services in EU, as well as the availability of quality-assured services that require high bandwidths and/or low latency, therefore affecting business innovation potential. Capex trends reported by Analysys Mason show that capex in 5G mobile plateaued at 20% of total European telecom capex in 2023, with capex in FTTH networks more than double this value.

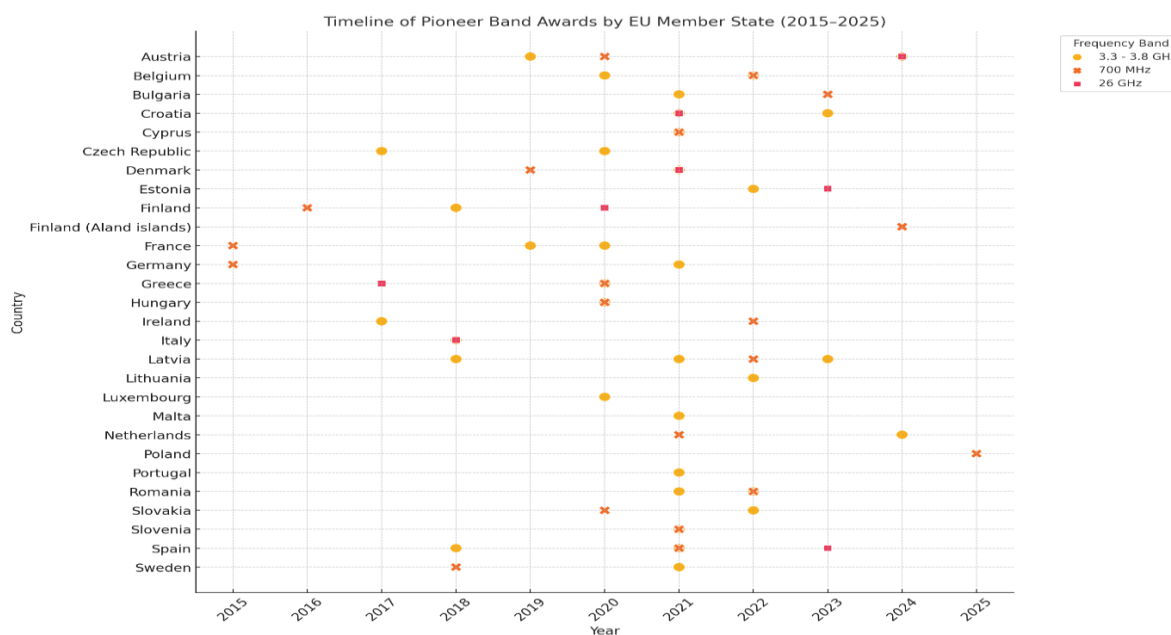
The Sections below will evaluate the likely causes of limited deployment of 5G SA, like delays in 5G pioneer band assignments, auction design and conditions (licence duration, coverage requirements, spectrum cost, market shaping measures) and availability of spectrum for industry/verticals.

5.4.2. Delays in 5G pioneer band assignment

The EECC aimed to ensure timely spectrum assignment to enable swift 5G roll-out by **imposing coordinated timing of assignment** for the use of two of the three pioneer spectrum bands for 5G (3.6 GHz frequency band and at least 1 GHz in the 26 GHz frequency band upon market demand, see Article 54) by 31 December 2020. For the third 5G pioneer band (700 MHz), the UHF Decision 2017/899/EU had set the deadline for the assignment **by 30 June 2020**. The EECC also set a general obligation to assign spectrum at the latest 30 months after the adoption of a harmonisation Decision (Article 53).

Although such legal deadlines could have had some accelerating effect on assignments of 5G pioneer bands, Member States finally accumulated **significant delays in the assignment** of all three 5G pioneer bands, and a large number (about half) of Member States has not met the overall deadline of 31 December 2020. The process for authorising 5G pioneer spectrum across the EU has been very long, spanning over 10 years and in 2025, and is still not yet completed (5 years after the overall deadline). The chart below underscores the fragmentation in spectrum policy implementation and rollout timelines across the EU for the three pioneer 5G bands between 2015 and 2025. The 700 MHz and 3.3–3.8 GHz frequency bands are more widely awarded contrarily to the 26 GHz frequency band reflecting the latter's more limited uptake to date.

Figure 8: Timeline of pioneer band awards by EU Member State (2015-2025)



Source: Policy Tracker (2025)

In particular, most national auctions for the 3.6 GHz frequency band (3.4-3.8 GHz) took place in a relatively long-time span, between 2017 and 2024, starting with early assignments in the Czech Republic and Ireland in 2017, complemented with additional assignment in 2018-2020 leading to overall 17 Member States (two of them only provisionally) respecting the 2020 legal deadline and ending with the most recent in the Netherlands in 2024. As for the 700 MHz frequency band, six Member States awarded it before the 30 June 2020 deadline, and another seven followed in the second half of 2020. Poland was the last Member State to complete the assignment process during 2025. The band has been assigned in all Member States except Malta where there is no market demand. As for the 26 GHz frequency band (24.25–27.5 GHz), by early 2025, only 12 Member States have assigned the band, while the remaining 17 consider that there is no market demand. Overall, the assignment of EU pioneer spectrum bands was at 75% ¹⁶⁵ on EU average in February 2025¹⁶⁶, mainly because of the 26 GHz frequency band. However, the 26 GHz band, remains pivotal for advancing innovative private networks and fostering overall technological innovation.

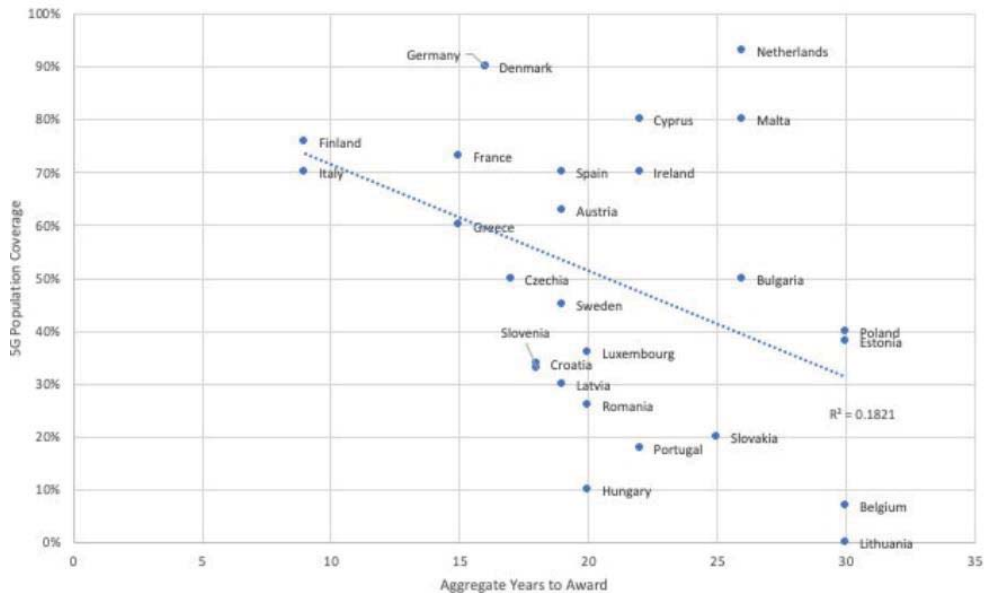
The delays in assignment were largely due to non-timely transposition of the EECC, slow national administrative process of spectrum assignment (partially due to the Covid-19 crisis), delays in freeing the bands from previous uses and, in certain cases, unresolved cross-border interference with non-EU countries or lack of market demand (in particular for the 26 GHz frequency band).

¹⁶⁵ The amount of spectrum assigned and ready for 5G use within the 5G pioneer bands. All three spectrum bands have an equal weight. 5gobservatory.eu, DESI indicators.

¹⁶⁶ [5G Observatory Report 2025 | Shaping Europe's digital future.](#)

According to an EC study¹⁶⁷, there is a strong correlation between time of 5G spectrum assignment and 5G deployment and 5G population coverage. Member States that assigned spectrum earlier have generally seen faster and broader 5G deployments and achieved high 5G population coverage faster than the late movers. Figure 9 shows strong negative correlation between the time taken to award 5G pioneer bands and 5G population coverage: almost 20% of the variation in 5G population coverage in the EU can be explained by the delay in awarding the three 5G pioneer bands.

Figure 9: 5G population coverage vs. years to awards, Source: Study on assessing the efficiency of radio spectrum award



While the 30 months authorisation deadline set by the EECC (Article 53) has been generally respected (e.g. with the revamped harmonisation of the 900 MHz and 1800 MHz frequency bands in 2022), it may, as a side effect, impose a constraint in the EU harmonisation process in cases of questionable market demand burdening the authorisation process, thus calling for more legal flexibility in the formulation of certain deadlines. This became evident during the harmonisation of the 42 GHz frequency band¹⁶⁸ where many Member States expressed concerns that the application of the 30 months authorisation deadline would impose considerable administrative burden in the persistent absence of market demand.

5.4.3. Spectrum for industry: verticals and private networks

The EECC does not contain measures facilitating development of private networks or harmonising conditions for local networks. However, EECC rules are flexible enough to allow for local 5G spectrum awards. Local networks are used primarily by **verticals** (e.g. transport, energy, manufacturing, mining, seaports) that have special needs as regards security, resilience, low latency and high-performance wireless connectivity. In general,

¹⁶⁷ Study on assessing the efficiency of radio spectrum award processes in the Member States, including the effects of applying the EECC Jan 2023, <https://digital-strategy.ec.europa.eu/en/library/study-assessing-efficiency-radio-spectrum-award-processes-member-states-including-effects-applying>.

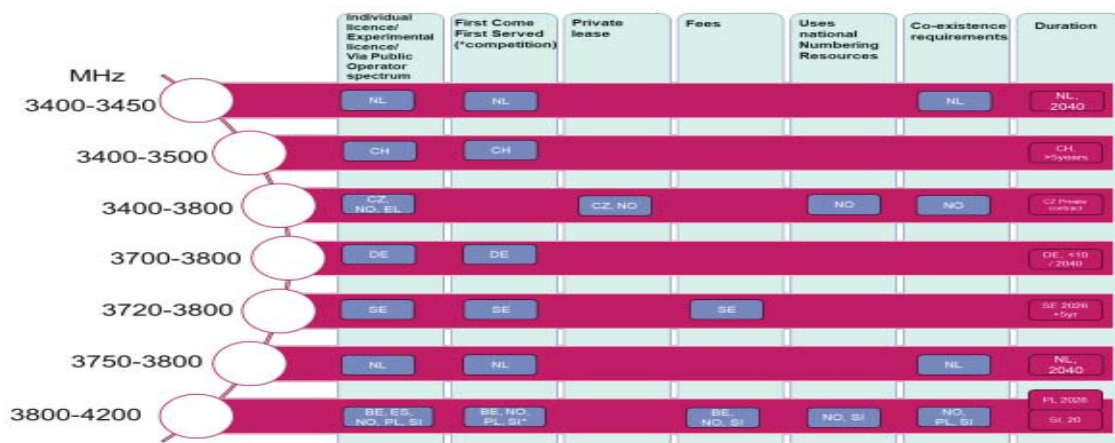
¹⁶⁸ Commission Implementing Decision (EU) 2024/1983 of 18 July 2024 on the harmonisation of the 40,5-43,5 GHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services in the Union.

spectrum for **private mobile networks** is made available on a licence-exempt basis where possible, or on a licensed basis through local assignments for private network use or can be leased from existing operators who hold exclusive usage rights.

Spectrum for local use has been made available in at least 13 Member States, yet in a fragmented way, i.e. in different frequency bands such as 2.3 GHz, 2.6 GHz, 3.6 GHz or 26 GHz and under different procedures (auction, most commonly on a first-come first-served basis) and conditions (price, duration of rights, between 5 and 20 years). Spectrum for intelligent transport systems (connected and automated mobility) in the 5.9 GHz frequency band has not been taken up also due to lack of consensus in the industry on the preferred technology to be used (cellular or Wi-Fi based).

Germany, Finland, Estonia, Spain, Latvia and Sweden have private networks also in the 26 GHz frequency band, Finland, Slovenia and Spain in the 2.3 GHz frequency band, Croatia and France in the 2.6 GHz frequency band. Belgium, Greece, Spain and Slovenia reported private networks, integrated in public networks and based on MNO spectrum. In Denmark, it is up to MNO's commercial consideration if it uses licenced spectrum for standalone private networks and for public integrated private networks. France has made the 3.8–4.0 GHz frequency band available for local licensing, with up to 100 MHz per site and has issued more than a dozen licenses since 2022. Belgium and Denmark have taken steps to open the 3.8–4.2 GHz frequency band for private networks, with similar initiatives underway in Spain. Slovenia has auctioned the 2.3 GHz frequency band for private networks targeting local administrations, while the Netherlands has issued local licenses across multiple frequency bands including 2.3 GHz, 3.5 GHz, and 3.7–3.8 GHz, catering to sector-specific connectivity demands. Overall, Germany has granted around 400 authorisations, Sweden 90, Spain 10 and Slovenia 1 private and 5 local licences.

Figure 10: Overview of private networks' information on 3400-4200 MHz – for illustrative purposes only Source: BoR(25) 33



Overall, despite being a core driver of 5G development, vertical sectors have shown slow adoption across the EU. Worldwide, 1489 private mobile network deployments have been identified, of which only 694 (47%) use 5G. In manufacturing—the leading sector for such networks—298 deployments were recorded, of which only 60% included 5G.169 In contrast,

¹⁶⁹ Global mobile Suppliers Association (GSA). (2024). Private Mobile Networks Summary Report – September 2024: <https://gsacom.com/paper/private-mobile-networks-september-2024/>.

Asia-Pacific countries like Japan and South Korea have advanced more quickly, driven by favourable policies and coordinated industrial strategies.

Systemic barriers help to explain the limited uptake. Spectrum access remains uneven, due to lack of spectrum sharing between public and private networks, with only a few Member States offering transparent and affordable local licensing regimes. Many companies—especially SMEs—face uncertainty on return on investment, given high costs of deployment, integration, and cybersecurity. The limited availability of skilled personnel and a still-nascent ecosystem of industrial-grade 5G devices (with fewer than 2% designed for robotics e.g.) further restrict adoption.¹⁷⁰

Moreover, unresolved legal and regulatory issues—such as data governance, service-level agreement frameworks for network slicing, and cross-border IoT regulation—have fragmented the investment landscape. Without coordinated regulatory reform, spectrum access facilitation, and vertical-specific integration support, Europe risks falling behind in realising the strategic benefits of **industrial 5G connectivity**.

5.4.4. Conditions of assignment (duration, coverage, price)

The EU legal framework entrusts Member States with carrying out most authorisation aspects of spectrum use in a context of shared competence. The EECC includes a number of requirements regarding duration of rights of use, coverage and quality of service and competition.

Duration of rights of use

Article 49 of the EECC introduced new requirements for minimum duration of rights of use. Member States must ensure 20 years of regulatory predictability through rights lasting a minimum of 15 years, with an option for a 5-year extension based on clear criteria related to spectrum utilisation and competition. An assessment before expiration determines if conditions are met for extension; if they are not, rights are reassigned through an open procedure.

First, it has to be noted that since the EECC's introduction in 2020, there has been a significant shift towards longer duration. The EC 2023 study¹⁷¹, shows that 92% of pioneer band licenses from 2020 onwards were for 15 years or more, compared to 77% before 2020. Between 2022 and 2025, 96% of the 23 awarded licenses in the EU were for 15 years or longer. Only Finland issued a 9-year license for the 700 MHz frequency band with a term shorter than 15 years (however, this was done before the EECC entered in force). These findings suggest that longer license terms have become more prevalent¹⁷².

However, the EECC's goal of ensuring 20-year predictability and enhancing investment certainty and business efficiency by supporting long-term planning has been only partially met. First, a number of auctions were conducted under the old rules, due to delays in EECC transposition, ignoring longer licence durations introduced by the EECC and rules on license renewals. This results in persistent sub-optimal licence durations and lack of renewal

¹⁷⁰ Global mobile Suppliers Association (GSA). (2024). Private Mobile Networks — Industry Focus: Manufacturing: <https://gsacom.com/paper/private-mobile-networks-september-2024/>.

¹⁷¹ Study on assessing the efficiency of radio spectrum award processes in the Member States, including the effects of applying the EECC, 2023, p.329.

¹⁷² Study on assessing the efficiency of radio spectrum award processes and Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

possibilities for spectrum which is currently in use by MNOs therefore still leaving untapped potential to enhance predictability. Second, many Member States still opted for the minimum solution allowed by the EECC, i.e. providing limited predictability (15+5) with less than half of the licences (46%) reaching 20 years or beyond. Overall, since 2010, out of 929 licenses lasting one year or longer, 650 (70%) were licensed under 20 years duration, while 279 (30%) were licensed for 20 years or longer (source: Policy Tracker 2025).

Moreover, operators are claiming that even the 20-year EECC licence duration is insufficient¹⁷³ and still represents a business continuity risk, negatively affects the investment return timescales and depreciation rates and is putting pressure on the mobile operators to cope with an investment horizon shorter than other communication technologies. Moreover, MNOs must sustain spectrum assignment cycles repeated in Europe approximately every seven years since 2000 (new and expiring licences).

Third, the guarantees for renewals are still considered insufficient to support long term investment planning, especially if compared to some other markets like the US, Australia, and New Zealand that typically grant for a first limited period of 10 to 20 year-licences, but with options for indefinite or recurrent renewal¹⁷⁴. For instance, FCC licenses typically are issued for a fixed (limited) period, but renewals are routine.

Finally, the criteria for renewal under article 49, are considered by the telcos too broad and fail to provide sufficient guarantees for renewal. They relate to the need to ensure the effective and efficient use of the radio spectrum concerned, to avoid harmful interference and protect public health against electromagnetic fields, or to fulfil general interest objectives related to ensuring safety of life, public order, public security or defence; and the need to ensure undistorted competition. Moreover, derogations from the standard framework are allowed for specific cases such as geographical limitations or experimental use. Additionally, Member States may synchronize expiry dates to effectively manage spectrum allocation.

In France, under the “New Deal Mobile” agreement between ARCEP and mobile operators, the latter were granted the renewal of their 900 MHz, 1 800 MHz, and 2 100 MHz spectrum licences free of charge, in return for binding commitments to significantly improve mobile coverage, particularly in rural and underserved areas.¹⁷⁵ Operators were required to deploy at least 5 000 new mobile sites in so-called “white zones” identified by local authorities, as well as upgrade existing sites to 4G. The agreement also included obligations to cover 10 000 specific locations (such as town centres, tourist areas, and major roads) with 4G within a set timeframe. To facilitate this deployment, operators were encouraged to share infrastructure, particularly in areas where individual investment would be economically unviable. ARCEP monitors compliance through a dedicated dashboard, and operators face penalties in case of non-compliance.

The German regulator BNetzA has opted to extend mobile licences in the 800 MHz, 1 800 MHz and 2.6 GHz frequency bands rather than re-auction them. These licences, due to expire at the end of 2025, will be prolonged for five years under the current award procedure. The

¹⁷³ For example, in its response to the EC’s Call for Evidence on the DNA, GSMA argued that moving towards indefinite licences — or at least extending licence terms to 40 years with tacit renewal conditions — would significantly support long-term network planning and deployment.

¹⁷⁴ Federal Communications Commission (FCC). Auction 107 – 3.7 GHz Band: <https://www.fcc.gov/auction/107>.

¹⁷⁵ Arcep (2022). Le New Deal Mobile: <https://www.arcep.fr/la-regulation/grands-dossiers-reseaux-mobiles/la-couverture-mobile-en-metropole/le-new-deal-mobile.html>.

aim is to align their expiry with later-ending licences and to prepare a larger pool of spectrum for future allocation. The extension will be accompanied by obligations for further mobile network rollout and measures to promote competition.

Lastly, Spain's Ministry for Digital Transformation and Public Service extended existing mobile operator spectrum licenses for an additional 10 years at no extra cost, effective from June 2024. This measure, part of revisions to the General Telecommunications Law, grants operators certainty for their 5G and future 6G deployments by extending license durations to 2040 and beyond. The extension applies to frequency bands like 800 MHz, 900 MHz, 1.8 GHz, 2.1 GHz, 2.6 GHz, and 3.5 GHz, and encourages investment in network upgrades and deployment.

According to GSMA Intelligence, assignments in frequency bands such as 900 MHz, 1 800 MHz and 2 100 MHz – widely used for 2G and 3G – are approaching expiry in more than 30 countries in 2025. In parallel, 61 network sunsets for 2G and 3G are planned in the same year.

According to a report by Aetha for Ericsson, out of the 32 countries studied (European Economic Area plus Switzerland and the UK), only two – Liechtenstein and the United Kingdom – do not have any spectrum licences expiring within the next 10 years (from 2002 onwards). The frequency bands with the highest number of upcoming expiries are 800 MHz, 900 MHz, 1 800 MHz, 2.1 GHz and 2.6 GHz. Among these, 800 MHz and 2.6 GHz are key 4G frequency bands, while 900 MHz and 2.1 GHz are typically used for 2G and 3G. In the longer term, however, all frequency bands are expected to be refarmed for 5G use.

For the above reasons, it is important for operators to have confidence that spectrum renewal processes will enable them to retain key spectrum at a price that is affordable in the long term, so that they can divert their energy and investments into deploying 5G and enhancing mobile network coverage.

Coverage requirements

When necessary to limit the number of rights of use, Article 55(2) EEC requires Member States to design a selection process and allows to follow additional objectives in relation to coverage, quality of service, efficient use of spectrum, and innovation and business development. Member States may attach to the spectrum rights conditions related to coverage and quality of service and to any commitment the holder of spectrum rights has taken in the process prior to the granting of the rights (Article 13 EEC and Annex I, Part D, 1 and 7).

Coverage obligations have become a widely adopted regulatory tool in EU spectrum auctions over the past decade, to promote equitable network deployment and reduce the digital divide, so that mobile operators who receive valuable spectrum rights invest in infrastructure rollouts aligned with public interest objectives—particularly in rural areas, underserved regions, and along critical transport routes. Nearly all EU Member States have included some coverage obligation into their 5G auction frameworks, even if the scope, ambition, and enforceability of these obligations vary significantly¹⁷⁶. The use of coverage obligations has remained relatively stable with only a few percentage points variation from 2020 onwards (coverage obligation - 85% before 2020 and 82% after 2020)¹⁷⁷. In a study published by OECD in 2022, it stands out

¹⁷⁶ Sörries, B., Franken, M., Baischew, D., & Lucidi, S. (2020). Einfluss von Versorgungsaufgaben auf die Mobilfunkabdeckung in der EU (WIK Diskussionsbeitrag Nr. 470). Bad Honnef: WIK Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste GmbH. Available at: https://www.wik.org/fileadmin/user_upload/Unternehmen/Veroeffentlichungen/Diskus/2022/WIK_Diskussionsbeitrag_Nr_470.pdf.

¹⁷⁷ Study on assessing the efficiency of radio spectrum award processes.

that nearly 49% of spectrum auctions between 2016–2021 included coverage obligations, rising to 73% for sub-1 GHz frequency bands, essential for rural deployment¹⁷⁸.

Two main types of coverage obligations emerged across Member States: “hard” or demanding obligations, and “soft” or flexible obligations. Hard obligations include quantitative, time-bound, and geographically specific requirements, designed to directly influence the investment strategies of mobile network operators, that may target population coverage (e.g. 90–98% in a defined timeframe), geographic reach (e.g. minimum number of municipalities), infrastructure milestones (e.g. motorway or railway coverage), or service-specific requirements (e.g. institutions like schools and hospitals). However, hard coverage obligations, applied in all spectrum lots in an auction may raise obstacles for certain business cases, such as that of wholesale only operators, which do not control the service provided to end-users, and to the development of efficient deployment methods, such as spectrum sharing.

France shows one of most prominent examples of this approach. Its 2020 auction for the 3.4–3.8 GHz frequency band included a multi-tiered obligation framework: deployment of 3,000 sites within two years, ramping up to 8 000 by 2024 and 10 500 by 2025; prioritisation of transport corridors; and mandatory upgrades of existing 4G sites to 5G. These obligations were complemented by a rural network sharing requirement to reduce duplication and improve cost efficiency. Similarly, Austria’s 2020 auction imposed binding obligations to cover 349 locations monitored by RTR. Operators were required to submit enforceable deployment plans. Germany also implemented hard obligations in both its 700 MHz and 3.6 GHz frequency bands. Each operator was required to achieve 98% population coverage by 2022, ensure continuous service along federal highways and key transport routes, and deliver high-performance benchmarks (e.g. 100 Mbps per user). These requirements were backed by strict enforcement clauses and regular reporting to the Bundesnetzagentur (BNetzA), ensuring compliance. Several Member States also set obligations in relation to coverage of roads, highways and railway lines, including defining coverage and quality of service targets by set deadlines; for example, the incumbent rights holders in Belgium should cover within two years, 98% of 15 major rail links with speeds of at least 10 Mbps.

In contrast, “soft” or flexible obligations were adopted in some Member States thanks to market maturity, or the desire to attract broader participation in auctions. These obligations often consisted of non-binding coverage goals, flexible timelines, or best-effort principles incorporated into broader national strategies but without enforceability through licence conditions.

Italy’s 2018 auction illustrates this model. Despite raising EUR 6.5 billion and awarding significant spectrum resources, including the 700 MHz and 26 GHz frequency bands, the coverage requirements were limited. Deployment concentrated in dense urban areas, with rural coverage progressing more slowly. Poland presents a similar case: while early spectrum plans included 5G rollout obligations, these were softened or removed following legal and political delays. When spectrum was finally awarded in mid-2023, the associated obligations lacked the detailed geographic and performance conditions found in countries like Germany or France.

In general, obligations to cover the most difficult-to-reach areas represent an important means to ensure investments, but also represent a significant additional cost associated with acquiring the spectrum licence which needs to be considered in the spectrum design and

¹⁷⁸ ECD (2022). Developments in Spectrum Management for Communication Services: <https://www.oecd-ilibrary.org/docserver/175e7ce5-en.pdf>.

pricing. Moreover, the existence of coverage and quality of service obligations in auction conditions could limit the possibility for wholesale only operators, such as tower operators, to bid for spectrum, unless the auction design considers this possibility. Investment commitments instead of coverage obligations have been used only in limited cases (e.g. Austria, France cf. *infra* under efficiency).

Other examples include a positive discrimination for new entrants allowing them more time to reach a certain coverage target; e.g. in Belgium, the new entrant has 7 more years to reach the railway coverage target.

Furthermore, for mid-wave bands which used to deliver capacity services within reduced coverage area, coverage obligations are not so extensive as in the frequency bands below 1 GHz; e.g. for 3.5 GHz, Member States generally required right holders to cover main populated areas (Austria, Bulgaria, Slovenia) or to activate a minimum number of base stations or sites (Czechia, Estonia, France, Latvia, Slovakia) by a set deadline or a combination thereof (Greece). Finland and Hungary only requested that the 3.5 GHz frequency band be used for the provision of services by a certain deadline (Hungary), and if not so, to be available for lease (Finland). The mm-wave bands are used for local use cases where a high capacity is needed. For example, for the 26 GHz frequency band, Member States have not specified any coverage obligation (Finland, Estonia, Greece, Italy, Spain) or requested only a minimum number of sites activation by defined deadline (Austria, Slovenia).

Auction designs that align spectrum awards with **long-term infrastructure goals** have proven more effective in promoting rapid deployment. Hybrid models, such as France's 2020 auction, balanced moderate spectrum costs with binding rollout obligations, linking licenses to transport corridor and municipal coverage targets, and achieving 5G availability in over half of municipalities within two years. Other regulators, such as those in Austria and Ireland, have explicitly set low reserve prices to avoid crowding out investment in network deployment. Moreover, Austria, attached coverage targets for underserved areas to its auction framework, demonstrating how tailored auction design can effectively channel investment toward rural connectivity.

Spectrum price

The EECC does not mandate a specific type of selection procedure in cases of limiting the number of rights of use. However, it outlines limited set of objectives that a competent authority may follow besides promoting competition when designing a selection procedure. These objectives include promotion of coverage or of efficient use of spectrum (Article 55(2) EECC) and common rules for setting spectrum fees, including reserved prices (Article 42 EECC).

Prevalently, price auctions were used by Member States for assigning spectrum for wireless broadband networks and services, including 5G; only recently more investment-oriented auctions were used, combining price and coverage commitments (see example of Austria above in the coverage obligations section). Prices have been relatively diversified as we can deduct from data presented in the efficiency section below. In several cases, spectrum segmentation and availability conditions artificially increased the resulting price of selections thereby hampering operators' investment capacity.

Relatively high spectrum prices have been particularly problematic due to the context in which mobile operators have been operating. The European mobile sector is currently facing relatively low profitability compared to other economies, prompting the need for pro-

investment measures in spectrum. European operators have spent significant amounts in spectrum, with approximately EUR 29 billion on 5G spectrum auctions, to be added to spectrum for 4G (total EUR 40 billion) and 3G (total EUR 109.7 million¹⁷⁹). Despite downward trends in absolute spectrum cost, the costs as proportion of recurring revenues have increased by more than 150% as a proportion of recurring revenue since 2014 (*infra* efficiency section).

Achieving the EU objectives with regards to high quality 5G deployment will require substantial investment¹⁸⁰, including in midband spectrum, estimated between EUR 25-30 billion, alongside expenditures on additional cell-sites and small cells¹⁸¹.

5.4.5. Mobile profitability and financial attractiveness

Profitability metrics, particularly mobile ARPUs (Average Revenue Per User), present a bleak picture for European operators: adjusted for purchasing power, they were among the lowest compared to international counterparts, just under EUR 15 per month in 2023. This contrasts significantly with regions like USA with ARPUs as high as EUR 41.70, allowing operators to invest a lot more in 5G SA networks (24% coverage against 2% in the EU) in a logic of “more for more” for users. For the GDP/capita adjusted figure, the US ARPU is still 67% higher at 24.9 EUR/month, and ARPUs in Japan, South Korea and China are all at least 33% higher than in the EU. The mobile ARPU in Europe experienced a steep fall of some 6% between 2022 and 2023, unlike other regions¹⁸². Figures from Connect Europe show that ARPUs in Europe are declining at a faster rate than in the other economies, having fallen 5.9% in 2022-3, compared to a fall of 3.5% in the USA and a rise of 2.2% in China. This trend is also evident in the analysis provided by Analysys Mason and other regulatory bodies, where ARPU levels in Europe hovered around €11 throughout 2024, only marginally above China’s figures.

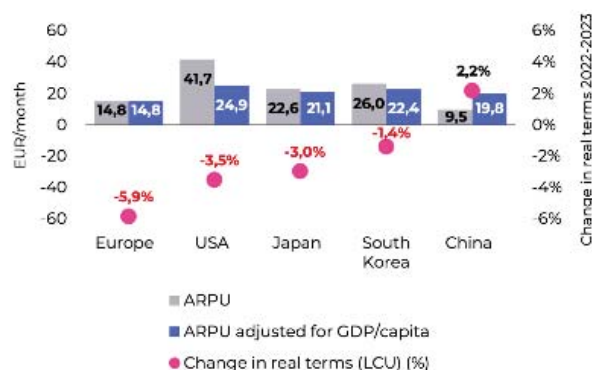
¹⁷⁹ Connect Europe, State of Digital Communications 2025.

¹⁸⁰ The mobile investment need for the provision of “full 5G services” has been estimated at EUR 33.5 billion by a Commission study and between EUR 26 billion and EUR 79 billion for main transport corridor connectivity to be covered mainly by private investments - WIK-Consult. (2023). Investment and Funding Needs for the Digital Decade Connectivity Targets. Study for the European Commission, <https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets>.

¹⁸¹ Connect Europe, State of digital communications, 2025, p. 87.

¹⁸² State of Digital Communications 2025 and USO Finance and Financial Condition Study.

Figure 11: Mobile ARPU comparison and real-term changes across global regions (2022–2023)



Source: Connect Europe, State of Digital Communications report 2025, p40

Limited revenue prospects and low or uncertain consumer willingness to pay for 5G reduce mobile network operators' (MNOs) incentives to deploy 5G Standalone (SA) using mid-band spectrum. Financial investors have also pointed out the high costs and demand uncertainties tied to 5G. In contrast, Fiber-to-the-Home (FTTH) has received a more favourable outlook, attracting substantial investment from long-term infrastructure funds¹⁸³. Capex trends reported by Analysys Mason show that capex in 5G mobile plateaued at 20% of total European telecom capex in 2023, with capex in FTTH networks more than double this value¹⁸⁴.

5.4.6. Market shaping measures

Article 52 EECC allows competent authorities to impose market shaping measures in spectrum authorisations to support or incentivise effective competition in electronic communications networks and services (ice). Market shaping measures have the potential to serve a more strategic approach by regulators to align spectrum management with broader connectivity, competition, and industrial policy objectives. However, as the EECC aimed at enhancing legal certainty, transparency and predictability for investment, the use of such measures is only allowed where necessary to maintain or achieve effective competition. The EECC therefore introduced the obligation for competent authorities to carry out a **forward-looking assessment** of market competitive conditions and likely effects on existing and future investments before applying such measures. However, the assessments carried out under the EECC have been of different quality and depth, there has been no control over their consistency and quality and their alignment with the forward-looking requirements, and no verification of the extent these met a certain burden of proof.

Nevertheless, Member States increasingly adopted market shaping measures to influence the structure and dynamics of national mobile markets, by supporting market entry, and to develop vertical use cases such as industrial automation, smart transport, and digital healthcare. The most frequent measure under Article 52(2) EECC was **spectrum caps and floors**. Spectrum caps are used to prevent a single operator from acquiring a disproportionate share of spectrum in a frequency band or across frequency bands, helping to ensure a level

¹⁸³ WIK-Consult. (2025). Financial Conditions, Demand and Investment Needs and Their Regulatory and Policy Implications, Including the Review of the Universal Service (Study for the European Commission).

¹⁸⁴ Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

playing field. However, Member States also used them to establish adequately equal spectrum holdings for all operators active on the national market, especially in the lower bands, or to protect the structure of the market, e.g. to avoid the exit of a small operator. Usually, spectrum caps were agnostic, but in some Member States tougher caps were applied to incumbent operators, such as in Austria in 700 MHz or in Czechia for 3.4-3.8 GHz. A few auctions were reserved to new entrants (in 2.1 GHz band in Cyprus). In a few Member States, certain bands were granted on condition of providing wholesale access to MVNO (Croatia, Czechia, France, Greece) or/and service providers (Croatia, Czechia, Germany – obligation to negotiate) or national roaming (Czechia, Greece). Spectrum floors, though less common, are intended to secure a minimum allocation for smaller or new operators¹⁸⁵. In Sweden and Ireland, this approach has improved the chances for smaller players to obtain spectrum and compete effectively.

Set-asides is another market-shaping tool that consists in reserving specific frequency blocks for entities outside the traditional mobile operator landscape, such as private industrial networks. Germany's 2019 decision to reserve 100 MHz in the 3.7–3.8 GHz frequency band enabled companies like BASF and Lufthansa to deploy their own 5G networks. Similarly, Poland and Netherlands earmarked parts of the 3.8–4.2 GHz frequency band for private use, although actual commercial uptake has so far been limited, due in part to regulatory and market readiness issues. **Local spectrum allocation** for verticals is another emerging trend that reserves spectrum for non-public networks—often in the 3.8–4.2 GHz or 26 GHz frequency bands—to support specific industrial use cases. While uptake has generally been slow due to complex licensing procedures and a still-developing ecosystem, this model has attracted interest in several EU countries, e.g. Poland and Latvia.

As to the assessment of the market shaping measures, GSMA study argues that private networks are growing equally in countries without set-asides, as in countries which have limited the availability of spectrum through a set-aside or sharing regime. Conversely, according to GSMA, limiting spectrum supply lowers quality of service and raises network costs. GSMA claims that the impact of 100 MHz set aside in 3.5 GHz is 24% lower download speed.¹⁸⁶

Additional mechanisms include **service-based competition obligations** and **reserve price structures**. To encourage MVNO access and enhance retail competition, some Member States included national roaming or wholesale access obligations in auction terms, e.g. in Czechia in 2020. Also auction pricing strategies can significantly shape outcomes: Italy's 2018 auction featured high reserve prices, driving revenues but possibly delaying investment. In contrast, France adopted lower reserve prices and flexible payment schedules to allow operators to invest more directly in network deployment. See below the table showing examples of market shaping measures used, and their impact.

¹⁸⁵ BEREC (Body of European Regulators for Electronic Communications). (2023). Study on Wholesale Mobile Connectivity: Trends and Issues for Emerging Mobile Technologies and Deployments (BoR (23) 41).

¹⁸⁶ Spectrum for Private and Local Networks, GSMA, 2025: <https://www.gsma.com/connectivity-for-good/spectrum/spectrum-forenterprise/>.

Figure 12: Examples and observed impact of market shaping measures in EU auctions

Country	Year	Market shaping measures	Observed impact
Germany	2019	- Spectrum caps in key bands- 100 MHz (3.7–3.8 GHz) reserved for industrial networks- MVNO access obligation - Ambitious coverage target: 98% of households and transport routes by 2022	- €6.55 billion raised, among the highest in EU- High prices criticised by operators- No new entrants- Stimulated industrial 5G use, but led to concerns about delayed investments
France	2020	- Staged deployment obligations (e.g. 3 000 sites by 2022) - Minimum quality of service commitments - Guaranteed spectrum blocks for those accepting obligations- Low reserve prices	- Moderate auction revenue- All four MNOs retained- Rapid rural 5G rollout- Over 80% population covered by mid-2023 (primarily via 700 MHz)- Balanced market outcomes with no exits
Italy	2018	- High reserve prices - No spectrum caps- Minimal rollout obligations	- €6.5 billion raised- Highest € per MHz/pop in the EU- No new entrants- Market structure unchanged- Investment delays reported
Poland	2020–2023	- Initially strong coverage and investment obligations- Auction delayed due to COVID-19 and legal-political hurdles - Later included set-asides for verticals (3.8–4.2 GHz)	- Spectrum awarded only in mid-2023- Regulatory uncertainty delayed 5G deployment- Low uptake of industrial spectrum- Concerns raised over investor confidence
Austria	2020	- Coverage obligations targeting 349 underserved communities - Rollout planning requirements - Wholesale access obligation	- Affordable auction outcome- Stimulated rural investment- All three MNOs remained active- Positively evaluated by regulators

Source: BEREC (2023). Study on Wholesale Mobile Connectivity: Trends and Issues for Emerging Mobile Technologies and Deployments (BoR (23) 41).

Spectrum reservations have been correlated with **high auction prices**. In this context, some operators expressed concerns¹⁸⁷ that these measures may have been misused at times, potentially creating artificial spectrum scarcity and increasing costs even in absence of problems in the retail market, which could negatively impact deployment and hinder the achievement of connectivity objectives.

For example, some argue that the reservation of spectrum for verticals in the 2019 auction for the 3.6 GHz frequency band in Germany led to a suboptimal outcome in terms of high prices. There were 4 MNOs interested in nationwide 3.5 GHz licences, while the reservation of 25% of the available spectrum for local licences, without any economic cost/ benefit analysis and justification increased spectrum scarcity and drove prices up. The auction generated €6.55 bn, as a combination of spectrum scarcity and aggressive bidding strategies inflated final prices. According to operators, the set aside caused auction prices to increase by around EUR 50 million per block. This means that public network operators had to pay around EUR 2.2 billion more for the amount of spectrum available, with all bidders ending up with less than

¹⁸⁷ Responses to the Call for Evidence on the Digital Network Act.

what they considered an optimal amount of spectrum in the band, due to the effect of spectrum-set aside. This increased cost is also likely to have a negative effect on network investment. Based on a Arthur D Little, Compass Lexecon study for Vodafone¹⁸⁸, the estimated consumer welfare loss was of EUR 6.2-15.6 billion (to 2040) due to higher prices and reduced network quality. Operators also regretted that in Italy only half of the 400 MHz available in the 3.6 GHz frequency band was made available in the 5G auction and further divided into four blocks (80/80/20/20), forcing two “winners” and two “losers”. Resulting scarcity in the auction drove prices up to EUR 4.35 billion – 6x typical benchmark averages. Moreover, 20 MHz is not technically sufficient to deploy quality 5G services as 80-100 MHz is needed to provide Gigabit speeds. Italy’s 2018 auction remains one of the most expensive examples, raising over EUR 6.5 billion, largely due to elevated reserve prices for 700 MHz and 3.7 GHz¹⁸⁹. Prices reached 0.35 EUR/MHz/pop—more than twice the EU average.

As to market structure and competition, despite measures such as spectrum set-asides for instance in Czechia, recent auctions have not led to sustainable entry of new mobile network operators (MNOs). This is a sign of a broader structural challenge: the economics of mobile networks increasingly favour a limited number of infrastructure players, as the cost of deploying each new generation of mobile technology (e.g. 5G and soon 6G) rises. In this context, it is likely that set-asides alone cannot compensate for the declining viability of infrastructure-based competition. Economic theory emphasizes the crucial balance between profitability, scale and investment.

5.4.7. Promoting advanced 5G

Though recognising the need to consider national specificities in conditions for spectrum assignment across the EU, we can conclude from the data presented above that the EECC has not been successful in establishing a pro-investment assignment framework and, partially as a result, the EU is lagging in high quality 5G deployment. Spectrum assignment conditions remained fragmented thus delaying the full realisation of benefits that might have been achieved through a more harmonized approach to incentivize investments across the EU while ensuring regulatory predictability. Assignments have not always used justified and well-designed market shaping measures and coverage obligations. Cost of spectrum has been excessive on account of high reserve prices and revenue-oriented auctions. Licence duration has not been sufficiently long to encourage more ambitious deployment of networks and advanced services offers, including cross border. Predictability has not increased sufficiently to improve the weak financial attractiveness of operators, also linked to low profitability of the mobile market in the EU.

5.5. EFFECTIVENESS IN PROMOTING DEVELOPMENT OF THE SINGLE MARKET

Effectiveness is analysed with respect to promoting the development of the Single Market

The sections below assess the effectiveness of the EU spectrum policy in contributing to the development of the Single Market by facilitating convergent conditions and developing

¹⁸⁸ <https://www.vodafone.com/content/dam/vodcom/files/public-policy/5g-report/an-industrial-5gspectrum-policy-for-europe.pdf>.

¹⁸⁹ BEREC (Body of European Regulators for Electronic Communications). (2023). Study on Wholesale Mobile Connectivity: Trends and Issues for Emerging Mobile Technologies and Deployments (BoR (23) 41). Available at: https://www.berec.europa.eu/system/files/2023-04/BoR%20%2823%29%2041%20Study%20on%20wholesale%20mobile%20connectivity%20trends%20and%20issues%20for%20emerging%20mobile%20technologies%20and%20deployments_final_0.pdf.

predictable regulatory approaches and by favouring the effective, efficient and coordinated use of radio spectrum (Art. 3, para (c)EECC - internal market objective). They look at measures related to the peer review mechanism, spectrum coordination and cross border interferences, measures aimed to incentivize spectrum sharing, transfer and leasing across the single market, the authorisation of satellite services and the provision of pan-European services.

5.5.1. Coordination/harmonisation of assignments - Peer review

The EECC aimed at enhancing convergence of spectrum policies and assignment conditions across the EU inter alia, through i) a **voluntary peer review/learning mechanism** and ii) a possibility to organise a **joint authorisation procedure**.

Voluntary peer review

Under Article 35 of the EECC, a competent authority may voluntarily ask other competent authorities to review its draft measure for the selection of assignees for EU harmonised spectrum, including through a Peer Review Forum with participation of BEREC experts experienced in forward looking assessment of market competitive conditions. The intention was not just to inform on future assignment procedures but mainly to achieve, through peer learning and assessment, more effective efficient and consistent selection methods, assignment conditions and market shaping measures.

The Council of EU in conclusions on the White Paper¹⁹⁰ recognised “*that the current peer review mechanism has proven to be valuable ...*” In its opinion to the White Paper¹⁹¹, the RSPG stated that “*the peer review has proven to be a valuable mechanism to share lessons learned and to engage in discussion between the Member States’ experts on awards. It helps understanding specific procedures based on national situations. This also serves as a tool for methodological harmonisation and to increase transparency between peers.*” At the same time, the RSPG acknowledged that “*there is room for enhancing the peer review mechanism further*”. The Council of EU recognised “*that the current peer review mechanism has proven to be valuable ...*”.

However, it is hard to assess/quantify the real added value of the current peer review mechanism. Firstly, it is a voluntary mechanism. Out of 30 draft measures notified to RSPG, only 10 cases led to voluntary Peer Review Forums and the RSPG never used its right under Article 35(2) to convene the Peer Review Forum on its own initiative. Furthermore, those assignment procedures which did raise criticism by market players have not even been subject to a peer review¹⁹². Secondly, there was no tangible follow up to the Peer Review Forums in the form of an RSPG opinion on the draft measure pursuant to Article 35(9) EECC on a notifying administration request or any other RSPG activity building on experience gained during the authorisation process. Thirdly, there was not sufficient investment of resources in the mechanism as not all Member States were represented or actively participated in the Forums. **Joint authorisation procedure**

¹⁹⁰ Council Conclusions on the White paper on “How to master Europe’s digital infrastructure needs?” (15861/24).

¹⁹¹ RSPG24-019 FINAL RSPG Opinion on “How to master Europe's digital infrastructure needs?”.

¹⁹² Auctions which have raised reactions from stakeholders, such as the Czech or German auctions, were not subject to the voluntary peer review under Article 35 EECC or not followed by a RSPG opinion or other form of RSPG action.

The EECC also established a joint authorisation procedure under Article 37 to allow several Member States to cooperate to grant spectrum usage rights through common conditions and procedure; however, as this is dependent on the voluntary initiative of the Member States, prospective users have not been able to require and rely on such coordination. To date, this joint procedure has never been used.

5.5.2. Harmful interference

Article 28 EECC provides for spectrum coordination among Member States to ensure that no Member State is prevented from using harmonised spectrum due to **cross-border interference in harmonised bands** and that cross-border coordination issues or interferences are solved between Member States and with third countries. Such interferences have a negative economic, and in certain cases social/cultural impact. The Commission relies on the RSPG, which may propose **coordinated solutions upon request by an affected Member State**, which may also request the Commission to adopt a decision if interference persists in harmonised bands. the RSPG good offices' involvement in cross border-interferences issues has brought significant added-value according to participants (see section on governance/RSPG).

The RSPG proactively engaged in solving cross-border issues in relation to use of the 700 MHz frequency band¹⁹³. It also adopted an opinion¹⁹⁴ with a coordinated solution for the 700 MHz frequency band on interference between Italy and Croatia. The RSPG mediation was also sought in coordination issues between Italy and France, and within Cyprus. However, the limitation of the scope of Article 28 to harmonised spectrum, thus excluding for instance FM radio, prevents adoption of appropriate measures regarding non harmonised spectrum which nevertheless has a high economic, cultural and social value and could solve issues such as between Italy and Slovenia, Croatia and France.

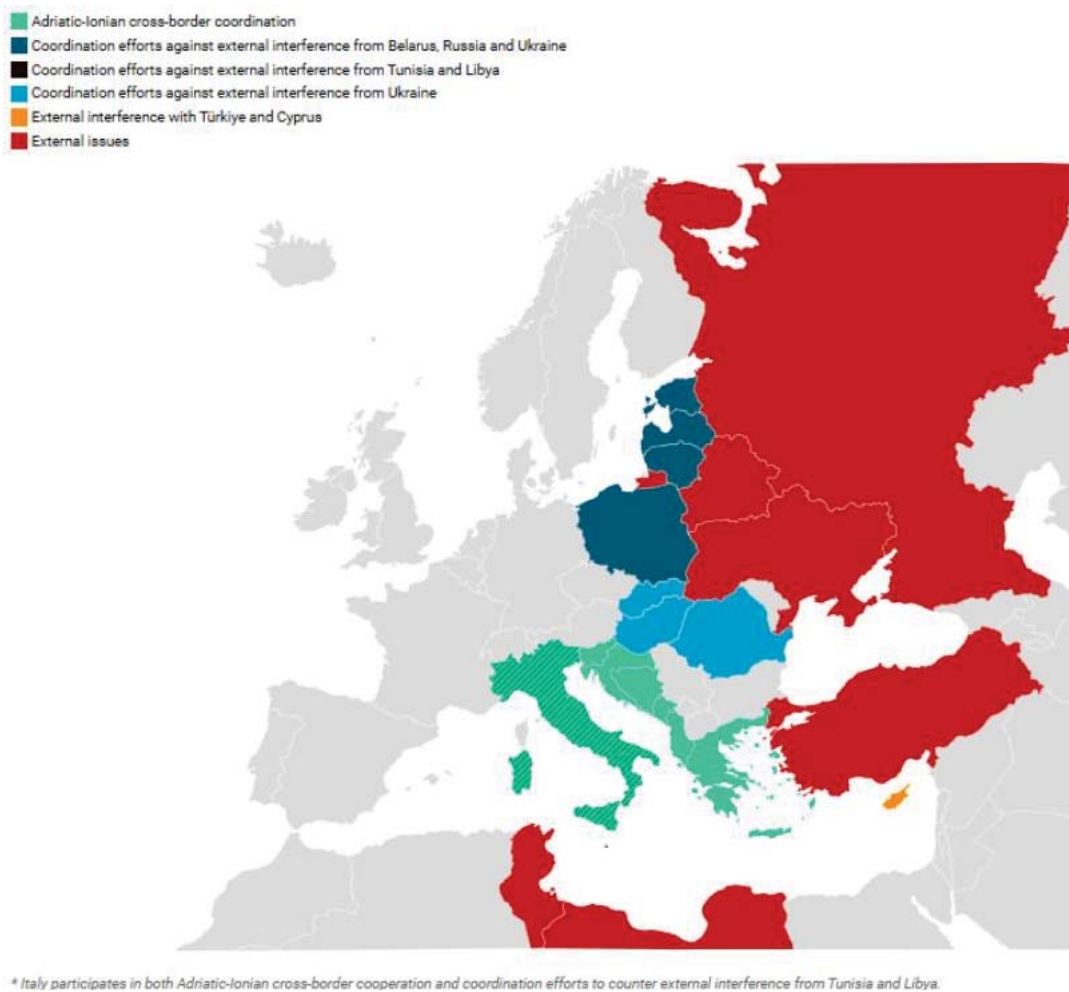
The **RSPG good offices framework** facilitated coordination negotiations between the Union and **third countries** including with Tunisia, Libya, Albania, Montenegro, North Macedonia, Moldova, Belarus, Russia and Ukraine¹⁹⁵. However, on cross-border coordination issues with third countries in general, the RSPG assistance has not been completely effective since the **RSPG lacks a legal basis to act** in the same way as with intra-EU cross border coordination. The support provided by the Union to Member States in case of interference caused by a third country would gain in effectiveness if Member States, acting altogether or with a particular push by EU action, could also intervene alongside the Commission.

¹⁹³ RSPG Report on the results of the RSPG "Good offices" for 700 MHz spectrum clearance and migration of broadcasting service below 694 MHz (RSPG18-042 FINAL).

¹⁹⁴ RSPG Opinion on the application of EECC Article 28(3) in relation to cross-border interference problems between Italy and Croatia in the UHF band (RSPG21-029 FINAL).

¹⁹⁵ See the RSPG Good Offices' progress reports to each RSPG Plenary.

Figure 13: Geographic distribution of cross-border harmful spectrum interference in Europe



Source: Own desk research based on information and notes from the European Commission

5.5.3. Spectrum sharing, transfer and leasing

The demand for radio frequency spectrum has been rapidly increasing due to the evolution from 4G to 5G, and eventually toward 6G. This trend is affecting all sectors—from telecom to transportation, healthcare, manufacturing, and beyond. Comparing to 4G, 5G brought 10x faster speeds, ultra-low latency and massive device connectivity, while 6G is expected to offer terabit-per-second speeds and support real-time, AI-driven, immersive experiences (e.g., holograms, extended reality). Combined with an explosion of the number of devices (smartphones, IoT, sensors, autonomous machines) and new applications emerging (Smart cities, Industry 4.0, autonomous vehicles, remote surgery, AR/VR, and metaverse), we can anticipate a **massive increase in spectrum bandwidth needs** beyond the electronic communications sector¹⁹⁶ and hence spectrum sharing continues to be important.

¹⁹⁶ According to GSMA European operators had to nearly double the average spectrum holdings assigned to them by country to bring 4G and 5G to consumers and on the other side by the controversy and competing demands for the sub-700 MHz band (by terrestrial broadcasting and mobile operators as well as by users of wireless microphones) and for the upper 6 GHz band (by various stakeholders including from the satellite, mobile and RLAN communities). Both frequency bands are considered as potentially last opportunities to access valuable spectrum in the low-band and mid-band range, respectively.

Spectrum sharing and leasing are supported under Articles 45, 46, 48, and 51 of the EECC. The EECC emphasizes that spectrum sharing, when complying with relevant competition law rules, can increase effective and efficient use of spectrum and facilitate the rapid deployment of mobile networks. However, these provisions are voluntarily applied and seldom used, and the framework lacks clear support for shared or local access models. In several prominent cases, agreements on spectrum sharing have been subject to competition law scrutiny.¹⁹⁷

In its 2021 Opinion on *Spectrum Sharing – Pioneer Initiatives and Bands*, the RSPG highlighted that spectrum sharing in the Union has so far been implemented in a rather static and conservative manner and called for further development — particularly to enhance the efficient use of radio spectrum and to promote innovation. The examples of spectrum sharing in the EU remain limited and fragmented. The RSPG recommended that the EC and Member States identify use cases requiring spectrum sharing and develop a proof-of-concept framework using ICT systems with innovative technologies, such as Artificial Intelligence/Machine Learning. Several regulators and industry bodies—such as BNetzA, ARCEP and GSMA—also emphasise the need for more dynamic spectrum management, including spectrum-sharing mechanisms like Licensed Shared Access and flexible licensing models for private or local networks. These tools are seen as essential to maximise efficiency, particularly in higher frequency bands (e.g. mmWave and future terahertz) where exclusive licences risk underuse.

The EECC allows spectrum licensees to transfer or lease their usage rights to third parties, to promote more efficient spectrum use and market flexibility. Under Article 51, such transfers or leases must be notified to NRAs, which may impose conditions or block transactions to prevent market distortion or inefficiencies. The process must be transparent, with transfers made public. Article 52 further enables regulators to attach conditions to spectrum rights that encourage effective use while maintaining technological and service neutrality. However, implementation is left to Member States, resulting in fragmented secondary market activity across the EU. Mechanisms such as Licensed Shared Access (LSA) and spectrum trading/leasing have seen limited uptake, often due to inconsistent national implementation and lack of centralised guidance.¹⁹⁸

The EC study indicates that there have been very few spectrum trades in Europe in the highest value sector (mobile). The study mentions two cases: a rearrangement of 1 800 MHz spectrum held by four operators in Slovakia in 1 800 MHz in 2022¹⁹⁹; and Proximus' purchase of 3.6 GHz spectrum from an existing operator in 2024.²⁰⁰ This contrasts sharply with Australia, where the Productivity Commission estimates the annual turnover of spectrum licences at 6%, similar to the commercial property market. In the United States, deals worth hundreds of millions of dollars are not unusual in the mobile market. For example, the biggest spectrum trade was in 2014 T-Mobile announced a mutual deal with Verizon Wireless estimated to be

¹⁹⁷ See [cerre_implementing_co-investment_and_network_sharing-26.05.2020.pdf](#).

¹⁹⁸ OECD (2022). Developments in Spectrum Management for Communication Services, pp. 20–22. <https://www.oecd-ilibrary.org/docserver/175e7ce5-en.pdf>.

¹⁹⁹ PolicyTracker (2022). Slovak operators agree 1800 MHz spectrum trade as regulator publishes 5G auction terms: <https://www.policytracker.com/slovak-operators-agree-on-1800-mhz-spectrum-trade-as-regulator-publishes-5g-auction-terms/>.

²⁰⁰ PolicyTracker (2024). Belgian MNO to buy spectrum from IT firm in rare voluntary trade: <https://www.policytracker.com/proximus-to-buy-spectrum-from-it-firm-in-rare-voluntary-trade/>.

worth USD 3.3 billion.²⁰¹ These are not takeovers of one company by another, but voluntary trades where only spectrum was sold or exchanged.

In Finland, **spectrum pooling** has been implemented to improve coverage and efficiency in sparsely populated areas, particularly through joint network deployments by mobile operators. In Italy, AGCOM introduced the “club use” model for the 26 GHz frequency band whereby five licensees each hold 200 MHz and may dynamically access up to 1 GHz of spectrum in areas not used by others, based on commercial agreements. While countries like the Netherlands and Finland have introduced flexible spectrum leasing models, others, such as Poland, maintain rigid frameworks that prevent optimal reallocation. This fragmentation led to inefficiencies, with an inexistent secondary spectrum trading market, with operators in some markets unable to lease unused spectrum due to restrictive national policies or adjust spectrum holdings to meet evolving demand.

According to the study, the main driver for very active spectrum trading markets in the US and elsewhere is the combination of national with local licences. While national mobile licences have been the norm in the EU, the experience from other parts of the world shows that trading is a viable policy option and could be more relevant in the future with the authorisation of higher band spectrum (e.g mid-band and mmW band spectrum) in a combination of national and regional/local way.

EECC rules on spectrum sharing, transfer, and leasing have not been effective in promoting efficient spectrum use, as evidenced by the inconsistent and limited utilisation of these models across the EU. Although some Member States adopted flexible leasing and sharing models, the lack of EU-wide coordination and support for shared or local access models caused underutilisation of spectrum, which is a concern as demand for wireless broadband increases with the arrival of 6G. The absence of a harmonized framework for secondary spectrum trading has further led to inefficiencies, with restrictive national policies inhibiting optimal spectrum reallocation. The divergences among Member States prevented the creation of a single market, resulting in a fragmented secondary market and inconsistent spectrum management in the EU.

The "use-it-or-lose-it" principle

The "use-it-or-lose-it" principle allows regulators to revoke or reassign spectrum if it remains unused, helping to prevent hoarding and promote efficiency. While the EECC does not mandate it, it allows national regulators to include such conditions as authorisation conditions. Implementation at EU level is hence uneven, with some Member States having incorporated such provisions into their regulatory frameworks, while others not.

Germany's Federal Network Agency (BNetzA) has included "use-it-or-lose-it" clauses in certain spectrum licenses, requiring licensees to meet specific rollout obligations within defined timeframes. Specifically, in the context of local broadband applications in the 3 700–3 800 MHz and 26 GHz frequency bands, BNetzA stipulates that spectrum assignments can be revoked if use of the spectrum has not commenced within one year of the assignment, or if the spectrum has not been used for its intended purpose for more than one year.

Outside the EU, the United Kingdom's communications regulator, Ofcom, has enforced adherence to spectrum license conditions on a "use-it-or-lose-it" basis, particularly in the context of mobile spectrum licenses. Furthermore, Canada and Australia apply clearer

²⁰¹ See RTE (2014). T-Mobile to buy Verizon Wireless spectrum in \$3.3 billion deal: <https://www.rte.ie/news/business/2014/0106/496244-t-mobile-sale>.

policies: Canada's 2024 reform enables reallocation in underserved areas, while Australia links licences to rollout obligations with penalties for non-compliance.

These approaches encourage efficiency, though overly strict enforcement may deter investment. A more harmonised EU application could improve spectrum use and accelerate reallocation.

5.5.4. Supporting satellite EU-wide connectivity

While the EU used to be strong in space and satellite connectivity, the EECC approach to satellite connectivity has not been successful to meet the evolving technology landscape and the needs of the single market for EU-wide secure connectivity.

Despite their inherent cross border nature, authorisation of satellite networks and services in the EECC is national. Although they may use the same network, with one or several satellites to provide services to several Member States, operators are obliged to notify under general authorisation to all Member States where they provide services and to respect nationally defined authorisation conditions. To use spectrum, they should also either respect nationally predefined conditions for unlicensed use of spectrum or request rights of use from every Member State where they intend to provide service.

Such fragmented regulatory framework does not facilitate scaling up through the EU wide provision of satellite services. In 2008, a specific procedure was created for the selection at EU level of operators using the 2 GHz Mobile Satellite Services (MSS) frequency band²⁰², to promote the provision of pan-EU satellite services in this band. After the EU selection in 2009, Member States issued authorisations to the two selected MSS operators for the use of radio spectrum, both for the satellite component and for any complementary ground components (CGC) mainly from 2011 onwards.

However, the types and conditions of authorisations issued considerably varied between Member States thereby partially undermining the harmonisation objective of the process. For CGCs, 24 Member States issued individual authorisations whereas 2 Member States used general authorisations. For the satellite spectrum, 20 Member States issued individual authorisations, in 4 of which with an integration of the CGC and spectrum authorisations, 2 used general authorisations, and 2 followed a hybrid approach.

While there are no specific provisions in the EECC on satellite spectrum assignment and authorisation, satellite communication networks and services fall within the scope of application of the EECC that is supposed to guarantee a degree of harmonisation. The provisions of the EECC relevant to general authorisation (Article 12 and following) and the provisions which concern the assignment of spectrum, under general authorisation (Article 46) or individual rights of use (Article 48) fully apply for the provision of satellite networks and the use of satellite spectrum. It is left to national authorities to decide how to authorise the use of spectrum for satellite networks and services; this varies from individual authorisation to the notification or registration of the provision of satellite services without reference to the specific spectrum bands used. Moreover, conditions and requirements attached to the provision of a satellite service differ between Member States: individual authorisations vary from 5 to 20 years for the space segment and from 5 to 10 years for ground stations. Moreover, it is often unclear whether general authorisations are associated with the fulfilment of certain requirements, even basic ones such as the respect of ITU-R

²⁰² EP and Council Decision 626/2008/EC.

Radio Regulations²⁰³. A recent EC study indicates that in the case of MSS authorization different licensing approaches created fragmentation, including wide variations in timescales for issuing a licence, different approaches to national coordination with existing services, different fees and different conditions attached to the licences; the list of country specific conditions is substantive and does not in every instance appear to be justified by national laws²⁰⁴.

Fragmented authorisation, lack of common requirements and of consistent authorisation conditions and enforcement encourages disrespect of the authorisation rules, regulatory forum shopping and weak enforcement mechanisms and allows large satellite constellations to defy rules to protect interference and guarantee access to the EU market. In recent years, the number of interference cases has increased. Some publicly available evidence of this can be found for example in the recent report of the Director of the ITU Bureau to the Radio Regulation Board²⁰⁵ in July 2025 where many cases are listed (see Appendix II on Radio Spectrum with information on cases of harmful interference concerning space services)

Data shows that the EU lacks sovereignty as regards satellite networks and services. Existing and planned constellations of thousands of satellites from third countries are occupying and will increasingly occupy orbit and spectrum resources, which are becoming more and more scarce. Based on the current number of satellites in Low Earth Orbit (LEO) (just under 9 000 as of February 2025), a recent EC study indicates that this number is expected to increase by at least a factor of six in the next decade. This will place increasing pressure on both shared and exclusive spectrum which mostly works on a “first come, first served” approach. With only 773 LEO satellites launched and 3.120 planned, the EU lags behind the USA (i.e. 7 633 launched, 33 397 planned) and China (i.e. 220 launched, 27 198 planned)²⁰⁶. In case of spectrum scarcity, a procedure to select operators at EU level for clearly cross border services will be necessary to ensure availability of spectrum across the EU. This shows the need for more unified EU-level coordination to streamline processes and improve satellite connectivity effectively.

5.5.5. Lack of Single Market for Spectrum

The EECC has not been effective in creating a single market for spectrum. Differentiated conditions across Member States persist and have led to limited predictability and inconsistencies that prevent a uniform regulatory framework throughout the EU. Deployment has been slow due to regulatory uncertainty. Problematic auctions have not been reviewed ex ante. The voluntary joint authorisation procedure allowing several Member States to cooperate to grant spectrum usage rights through common conditions and procedure has never been used since prospective users do not have a right to it. Regarding cross-border harmful interferences between Member States, the RSPG good offices’ involvement has not been fully

²⁰³ RSPG Opinion on the EU-level policy approach to satellite Direct-to-Device connectivity and related Single Market issues (RSPG25-020 FINAL)

²⁰⁴ Study on Mobile satellite services (MSS) in the 2 GHz band in the EU - Implementation of the current regulatory framework and an overview of the satellite connectivity market, July 2025, Detecon International GmbH.

²⁰⁵ https://www.itu.int/dms_ties/itu-r/md/25/rb25.2/c/R25-RRB25.2-C-0004!!PDF-E.pdf.

²⁰⁶ See Broadband Internet, D2D and IoT satellite constellations in terms of total number of launched and planned in Detecon International GmbH, Study on Mobile satellite services (MSS) in the 2 GHz band in the EU - Implementation of the current regulatory framework and an overview of the satellite connectivity market.

efficient, as it does not apply to non-harmonised frequency bands and has also not been completely effective on cross-border coordination issues with third countries where the EU and the RSPG has no legal basis to act in the same way as for intra-EU cross border coordination issues. Spectrum sharing is voluntary and has seldom been used and there has only been a limited and fragmented secondary trading market. For satellite services that have a clear cross-border potential, the authorisation framework is fragmented, as it relies on national authorisation, there are no minimum common authorisation conditions or requirements, and no common selection procedures except for the 2 GHz frequency band. Such fragmentation is not favourable to scaling up for the EU-wide provision of satellite services and may incentivise regulatory forum shopping.

5.6. Efficiency

5.6.1 Compliance, administrative cost

Evaluating the EECC efficiency on compliance and administrative costs, the EC study²⁰⁷ concludes that the costs for following spectrum management rules in the EECC are generally seen as fair and necessary by about 80% of stakeholders, aligning with the goals of efficient spectrum use and market competition. No major unfair costs were found, as most believe the expenses are justified by the goals of using spectrum efficiently, advancing technology, and encouraging market competition. However, fragmented spectrum policies, besides direct compliance costs, further add indirect costs, as operators must allocate extra resources to meet differing obligations across countries²⁰⁸. Streamlining these processes to reflect opportunity costs and economic impacts could enhance efficiency by reducing unnecessary burdens, allowing resources to be better utilized in accordance with the EECC objectives of ensuring adequate connectivity and fostering infrastructure competition.

Current compliance costs associated with spectrum management under the EECC consist of a mix of adjustment, administrative, and regulatory costs. NRAs and mobile operators incur adjustment costs related to spectrum refarming and policy adaptation. Spectrum refarming, though necessary to allow new technologies like 5G, involves significant planning and technical reconfiguration²⁰⁹. Broader institutional adaptation, including updating domestic legislation and enhancing administrative capacities, also add to costs, which vary substantially across Member States.

As to administrative costs, NRAs report varying levels of annual expenditure²¹⁰. While the peer review process under Article 35 EECC involves some administrative effort—such as the summarising and presentation of draft measures—the costs are widely considered manageable. Basic notifications to the RSPG Secretariat entail minimal burden, though costs

²⁰⁷ Study “Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

²⁰⁸ In France, Orange allocated extra resources to meet spectrum-sharing obligations, which are quite different from those in Spain and Germany, requiring separate technical adjustments and legal assessments for each market – see study “Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

²⁰⁹ For example, Croatia reported one-off costs of approximately €200 000 directly linked to the EECC obligation to assign 5G spectrum.

²¹⁰ Sweden, for instance, allocates approximately SEK 150 million annually to spectrum management, which includes administrative operations, monitoring, and licensing activities. By contrast, countries such as Greece and Latvia report relatively low compliance costs due to streamlined administrative practices and technology-neutral spectrum assignments.

increase when a Peer Review Forum is convened, requiring active participation by multiple Member States. These regulatory activities are typically financed by charges imposed on the industry, in line with Article 16 EECC. These charges fund administrative costs and are generally seen as proportionate by stakeholders. While significant, they are widely regarded as necessary for achieving the broader EECC objectives of efficient spectrum use, technological advancement, and market competition.

Beyond direct compliance costs, indirect and transaction-related costs are also notable under the current framework. Fragmentation in national licensing and spectrum-sharing regimes imposes additional burdens on operators. For instance, Orange allegedly needs to allocate separate legal and technical resources to comply with differing obligations in France, Spain, and Germany that increase the cost and complexity of delivering cross-border services. These inconsistencies prevent operators from fully benefiting from economies of scale and act as barriers to innovation and investment.

5.6.2. Spectrum cost

The EECC requires in Article 42 that Member States ensure that fees for radio spectrum use are set at a level which ensures efficient assignment and use of radio spectrum including by setting reserve prices as minimum fees based also on the value of possible alternative uses, taking into account costs linked to the conditions attached to the right of use and applying payment arrangements linked to the availability of spectrum. There is therefore a trade-off between spectrum cost and investment conditions: the higher the cost of spectrum, the lower the investment incentives.

High spectrum prices had a negative effect on deployment and investments GSMA econometric estimates²¹¹ show that spectrum cost **negatively impacts coverage, speeds** and services provided to end users: concretely a 10-percentage point (p.p.) higher spectrum cost to recurring revenue ratio decreased 4G and 5G coverage by up to 6 p. p. and decreased average speeds by up to 8%²¹². An Ericsson report also shows that spectrum costs account for some 7% of mobile service revenues across Europe. Since the total capital intensity of European mobile Communication Service Providers (CSPs) is around 18%, spectrum costs represent about 35-40% of their capital expenditures.²¹³ A GSMA report on global spectrum pricing²¹⁴ confirms that while spectrum needs have increased over the last decade, due to rapid growth in demand for mobile data and new use cases, the average revenue per MHz in Europe declined by 58% between 2014 and 2024. This reduction has not been fully reflected in spectrum prices, that have declined overall but not at a similar pace. While spectrum prices would normally respond to a decrease in its value in a market driven assignment process, GSMA claims that spectrum licences are often influenced by non-market factors such as regulatory intervention through high reserve prices or measures artificially increasing spectrum scarcity.

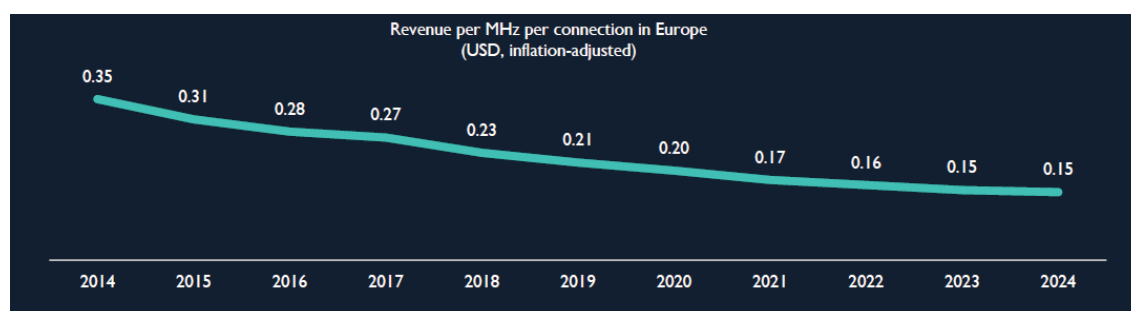
²¹¹ GSMA Global Spectrum Pricing 2025.

²¹² GSMA, "Global Spectrum Pricing report," Global Spectrum Pricing, GSMA, London, 2025, p. 10.

²¹³ Ingravallo, R., & Solomon, G. (2022). Spectrum Licence Renewals and Europe's Digital Future: <https://www.ericsson.com/en/blog/2022/12/spectrum-licence-renewals-europe>.

²¹⁴ GSMA Global Spectrum Pricing 2025.

Figure 14: Revenue per MHz per connection in Europe



Source: GSMA

Moreover, data show a **significant discrepancy in prices per MHz per population**. The table below shows the average spectrum prices (€/MHz/pop) for three 5G frequency bands—700 MHz, 3.3–3.8 GHz, and 26 GHz—across Member States: for 700 MHz from as low as €0.08 (Croatia, Estonia) to over €0.69 (France). For mid-band (3.3–3.8 GHz), prices vary widely—from under €0.01 (Romania, Bulgaria) to €0.38 in Italy—highlighting differing national auction strategies and demand levels. The 26 GHz frequency band shows the lowest values overall, with prices typically below 0.002 EUR/MHz/pop due to limited range and early market stage. Several entries are marked “incalculable” where license terms, population coverage, or price data were insufficiently defined.

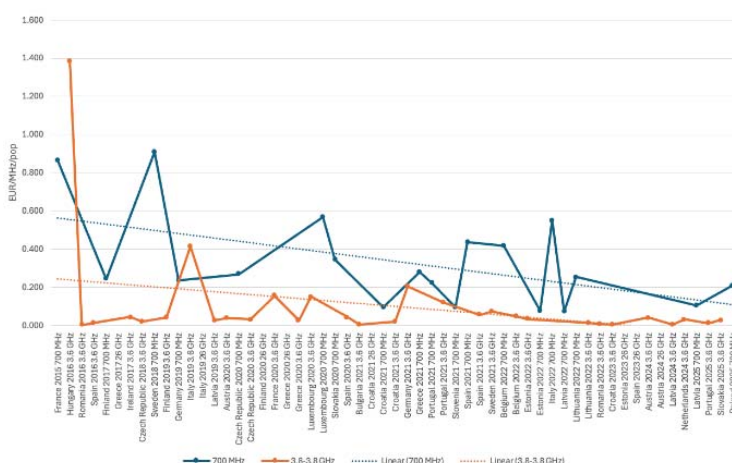
Figure 15: Average band prices in each award (€/MHz/pop)

Country	700 MHz	3.3 - 3.8 GHz	26 GHz
Croatia	0.0824	0.0093	0.0012
Latvia	0.095152	0.0689	Not awarded
Portugal	0.1864	0.0763	Not awarded
Germany	0.2005	0.1691	Not awarded
Finland	0.2008	0.0363	0.0016
Greece	0.2367	0.0242	0.0015
Czech Republic	0.2423	0.0289	Not awarded
Slovakia	0.2984	0.03007	Not awarded
Spain	0.3552	0.0461	0.000431
Luxembourg	0.4432	0.0878	Not awarded
Italy	0.5737	0.3823	0.0028
Sweden	0.6629	0.0567	Not awarded
France	0.6918	0.1328	Not awarded
Malta	Not awarded	0	Not awarded
Romania	Uncalculable	0.0073	Uncalculable
Bulgaria	Uncalculable	0.0075	Not awarded
Ireland	Uncalculable	0.0424	Not awarded
Netherlands	Uncalculable	0.03433	Not awarded
Austria	Uncalculable	0.034839	0.001344
Denmark	Uncalculable	Uncalculable	Uncalculable
Hungary	Uncalculable	Uncalculable	Not awarded
Cyprus	Uncalculable	Uncalculable	Not awarded
Slovenia	Uncalculable	Uncalculable	Uncalculable
Belgium	0.42294	0.050035	Not awarded
Estonia	0.077783	0.033805	0.001533

Country	700 MHz	3.3 - 3.8 GHz	26 GHz
Lithuania	0.256855	0.01489	Not awarded
Poland	0.22566	Not awarded	Not awarded

The Commission study²¹⁵ indicates that “high spectrum auction costs continue to be a major concern. High spectrum auction fees and divergent national pricing policies contribute to substantial opportunity costs. Despite some alignment in auction outcomes across the EU, Member States like Italy and Greece have recorded fees exceeding 20% of operator revenues. According to EC study, mid-band spectrum costs in Europe an average 14.5% of operator revenues—almost triple that of North America²¹⁶. Such pricing structures can reduce investment headroom for infrastructure deployment and delay network rollout. Industry stakeholders also argue that cumulative financial pressures could become even more pronounced during future rollouts of advanced technologies like 6G. If the EU market is functioning properly, the decline in revenues (see data on faster decline in EU mobile ARPU then in other economies) should mean that MNOs have less money to spend so they will pay less in spectrum auctions. The price of administrative assignments should also come down if administrations follow the changing financial fortunes of operators. 5G pioneer bands also show declining prices. The graph below analyses pricing in 700 MHz and 3.6 GHz that have been awarded in nearly all Member States, unlike 26 GHz.

Figure 16: Inflation adjusted price trends in EU awards of 700 MHz and 3.6 GHz 2015-2025

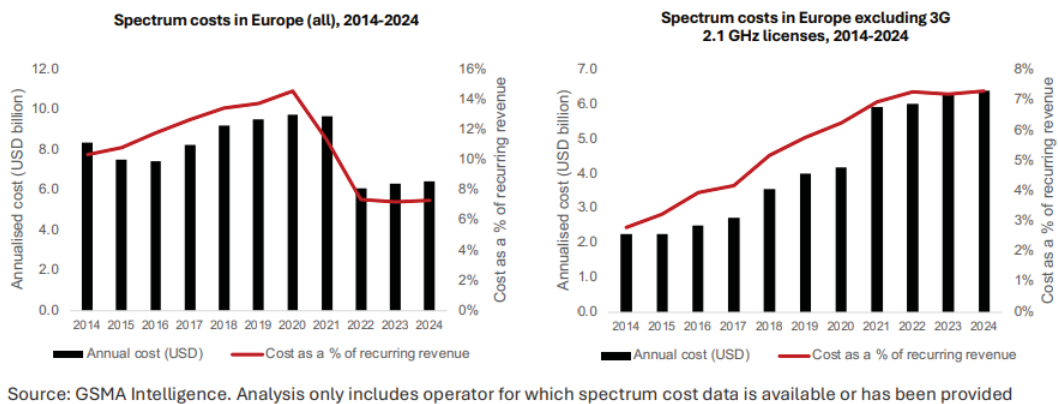


Source: PolicyTracker Spectrum Database 2025; figures adjusted for inflation with 2015 as the baseline using HICP figures from Eurostat <https://ec.europa.eu/eurostat/web/hicp/database>

²¹⁵ See section Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks”.

²¹⁶ Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks” reporting GSMA data.

On the other side GSMA is currently working on a spectrum pricing report and the preliminary analysis for Europe shows that spectrum costs have increased by more than 150% as a proportion of recurring revenue since 2014, when one excludes outlier 2.1 GHz prices for Germany and the UK:



Source: GSMA Intelligence. Analysis only includes operator for which spectrum cost data is available or has been provided GSMA

In a recent report, the GSMA²¹⁷ argues that the decline in spectrum prices has not sufficiently reflected MNOs falling revenues. The *Global Spectrum Pricing* report says aggregate spectrum costs now account for 7% of operator revenues, representing a 63% increase over the past decade. While admitting that spectrum prices have declined in the past 10 years, it stresses that these “were not sufficient to offset the build-up in the total cost of spectrum, largely driven by acquisition of the additional spectrum needed to deliver greater mobile data traffic and the launches of 4G and 5G networks”.²¹⁸ The report considers this issue globally rather than on an EU basis, pointing that, when measured in a different way²¹⁹, spectrum prices may be insufficiently responsive to changing market conditions.

GSMA supports some spectrum auction model examples, like for example the Austrian model²²⁰ where operators did not pay cash for licences but committed to infrastructure investments and coverage obligations. This “cashless” or “negative” auction approach aimed to accelerate mobile network expansion, especially in underserved rural areas. While this approach presents social and economic benefits it also brings challenges in monitoring and enforcing the investment commitments. With proper safeguards in place to ensure enforcement, Austria is now seen as a potential blueprint in seeking to balance digital inclusion goals with sustainable telecom investments.

²¹⁷ GSMA *Global Spectrum Pricing*(2025) <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/05/Global-Spectrum-Pricing-v2.pdf>.

²¹⁸ Ibid p8.

²¹⁹ The GSMA report also takes into account annual fees as well as award fees. See p27.

²²⁰ See *Austria-Spectrum-Licensing-Best-Practice* <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/Austria-Spectrum-Licensing-Best-Practice.pdf>.

5.6.3. Reserve prices for the 5G auctions

A 2017 study²²¹ showed that reserve prices are a key factor in determining the final price paid in spectrum auctions. Although many factors can influence auction prices, from wider economic trends to the strength of competition, high reserve prices can lead to nothing other than high final prices or unsold spectrum, while low reserve prices allow the auction to determine a market price. High reserve prices can therefore lead to final auction prices which exceed the economically sustainable market level and hinder investment in networks.

Art. 42 EEC is not specific about how administrations should determine reserve prices, requiring merely that spectrum fees should be “objectively justified, transparent, non-discriminatory and proportionate” and that setting reserve prices should have “regard to the value of those rights in their possible alternative uses.” The tendency of reserve prices becoming the final price may be a sign that procedures need to be tightened. One way of assessing whether auction prices have been set too high is to establish whether the auction closed without any competitive bidding i.e. the final auction price was the same as the reserve price. While this rough method does not capture all cases where the reserve price has been set too high, the table below of 5G auctions shows that 16% (6/37) closed at the reserve price.

Another way of assessing whether a reserve price is too high is to compare it to the average price for that band in the EU over the past 10 years. These are shown in the table below. The final column shows the reserve prices as a percentage of the EU average final price for that award. Taking the relative price into account suggests that the auctions in the last three rows in Spain Portugal and Romania in 2021 may have been reasonable, even though they closed at the reserve price. This is because the reserve prices were all below the average price for the respective bands. See Appendix II B for an analysis on How final auction prices differed from the reserve price in EU 5G auctions.

However, the Italian 700 MHz auction in 2018 raises concerns because the reserve was more than double the average price for that band and there was no competitive bidding. This suggests MNOs may have been forced to pay more than the market rate. The same is true of the Luxembourg 700 MHz award in 2020, although the reserve was a little less in relative terms. Similar concerns can be raised about the French 700 MHz in 2015 where the reserve was more than twice the band average price. There was a small amount of competitive bidding but the price level at which this occurred was likely inflated by the high reserve price.

In conclusion, most auctions seem to work well, demonstrating competitive bidding and a reasonable reserve price, but the design and pricing of a number of awards seems flawed. Two of these happened before the implementation of the EEC in 2020 – in France in 2015 and Italy in 2018 – but the Luxembourg auction occurred in the same year. We also note that the level of reserve prices seems to be moderating. From 2022 onwards no reserve price has been above the EU average final band price.

Table 2: Average final prices in EU spectrum awards 2015-2025

	Average final price for band (€/MHz/pop)
700 MHz	€0.2667
3.6 GHz	€0.0682
26 GHz	€0.0014

²²¹ Study on Spectrum Assignment in EU (2017) p97 <https://op.europa.eu/en/publication-detail/-/publication/2388b227-a978-11e7-837e-01aa75ed71a1/language-en>.

Telecom operators warn that high prices deviate funds from infrastructure investment, thus delaying network rollout. Several providers call for reforms, suggesting that spectrum fees should reflect opportunity costs and economic impact instead of focusing on revenue generation. On the other side they also caution that an EU-wide auction model might benefit large operators, hurting competition.

5.6.4. Cost of Peer review

It is difficult to estimate the costs related to a peer review. The current mandatory notification of the measure should not cause any excessive administrative costs, at least comparing to the organisation of the authorisation process, as it obliges the competent authority just to officially inform the RSPG Secretariat about a measure. If the notifying competent authority asks the Peer Review forum is convened, then it needs to contribute some time and efforts to prepare materials for the Peer Review forum, but it should not be more than what it already prepares for meetings to explain the process to the stakeholders or participants.

Over the course of 2021-2025, 12 Peer Review Forums were held. Seven National Competent Authorities (NCAs) indicated that they attended all meetings during this time, usually with 1-2 representatives (the number of representatives could not be linked to the size of the NCA). Only one mid-size NCA indicated that they attended with five persons on average. The average effort of participating in Peer Review Forum meetings depends on the number of NCA representatives attending, with an average of 30 hours per year per NRA. The effort is considerably higher if the NCA asked for a peer review of an auction, but due to the limited quantitative data obtained, it is impossible to calculate the extent of the additional effort in this case. The perceived added value by RSPG members is still relatively high, although the views show higher divergence than for other work strands²²². However, certain assignment procedures, which has raised criticism by market players, have not even been subject to a peer review.

Moreover, there is no legal obligation for the Commission the RSPG and the Competent authorities to devote resources in analysing the spectrum auctions measures, assess the evidence provided and develop an opinion. The process requires only limited information provided for the Peer Reviews Forums, with no possibility to request additional information, which de facto does not allow to undertake throughout analysis of the measure. It depends on the good will of the participants, and for this reason it has remained of limited utility in the most difficult cases. There is therefore a limited cost but also a very limited impact.

5.7. Coherence

The **spectrum regulatory framework** is made up of several legislative acts that pursue common objectives: the EECC works in combination with the provisions of the RSPP, the 2002 Radio Spectrum Decision²²³, the RSPG Commission Decision of 2019²²⁴ and the EU legal framework²²⁵ for MSS and the UHF Decision. The Commission harmonisation process

²²² See study: Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks”.

²²³ Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community.

²²⁴ COMMISSION DECISION of 11 June 2019 setting up the Radio Spectrum Policy Group and repealing Decision 2002/622/EC.

²²⁵ Commission Decision 2007/98/EC of 14 February 2007 on the harmonised use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile satellite services (MSS).

is supported by the CEPT and by the Radio Spectrum Committee, while the MSS process is supported by the Communication Committee (COCOM) and its specific MSS sub-group. The framework is also flanked by a large number of Commission Implementing Decisions on the EU-wide designation of various frequency bands under harmonised technical conditions as well as a Commission Implementing Regulation on a permit-free regime for small cells.

EECC spectrum measures versus RSPP: To a certain extent, the EECC duplicates the RSPP which under other aspects has now become obsolete and needs an overhaul in the light of technological, economic and policy developments²²⁶. The Radio Spectrum Policy Group (RSPG) also proposed a range of measures to update the RSPP and ensure it fosters the goals of the EU's Digital Decade and supports that objectives of the EECC.²²⁷ Stakeholders see the EECC as establishing clear legal rules for spectrum management, while the RSPP serves as a strategic planning tool, complementing the EECC by defining long-term spectrum policy goals. However, there is a strong view that the RSPP, which dates back to 2012, is outdated and should be revised to reflect technological advancements, particularly regarding 6G spectrum planning and the evolving digital landscape. Appendix II A to this Report presents the State of play of the implementation of the RSPP and of the proposed incorporation of relevant parts in the Digital Network Act.

EECC spectrum measures versus RSPG Decision: The work of the RSPG is central for the radio spectrum policy development in the EU and for any review of the regulatory framework. Established in 2002, the RSPG has been granted with new tasks by the EECC since 2019, such as related to the peer review. The RSPG Decision²²⁸ reflects a new RSPG status, i.e. it advises not only to the EC but also to European Parliament, the Council and Member States on issues related to spectrum policy, and new tasks related especially with the peer review, the cross-border coordination and preparation to World Radiocommunications Conferences.

The RSPG continues to issue reports and opinions on all crucial elements of EU spectrum policy, as for example recently the Opinion on satellite Direct-to-Device (D2D) connectivity and related Single Market issues and the report on the 6G Strategic Vision²²⁹, which are in

Decision No 626/2008/EC of the European Parliament and of the Council of 30 June 2008 on the selection and authorisation of systems providing mobile satellite services (MSS).

Commission Decision 2009/449/EC of 13 May 2009 on the selection of operators of pan-European systems providing mobile satellite services (MSS).

Commission Decision 2011/667/EC of 10 October 2011 on modalities for coordinated application of the rules on enforcement with regard to mobile satellite services (MSS) pursuant to Article 9(3) of Decision No 626/2008/EC of the European Parliament and of the Council (notified under document C(2011) 7001) (Text with EEA relevance) (2011/667/EU).

²²⁶ For details see VVA, PolicyTracker and LS Telecom (2024). Study on Radio Spectrum Policy Programme: taking stock and discussing future scenarios, study for DG CNECT: <https://digital-strategy.ec.europa.eu/en/library/study-radio-spectrum-policy-programme-taking-stock-and-discussing-future-scenarios>.

²²⁷ RSPG (2021). Opinion on a Radio Spectrum Policy Programme (RSPP), RSPG21-033 FINAL: https://radio-spectrum-policy-group.ec.europa.eu/document/download/00cfd520-efa9-48a1-bfec-d2980f511c3c_en?filename=RSPG21-033final-RSPG_Opinion_on_RSPP.pdf.

²²⁸ Commission Decision of 11 June 2019 setting up the Radio Spectrum Policy Group and repealing Decision 2002/622/EC (C/2019/4147).

²²⁹ RSPG (2025). 6G Strategic vision - RSPG Report, RSPG25-006 FINAL: https://radio-spectrum-policy-group.ec.europa.eu/document/download/89457260-ab6b-495a-9a10-437711cbe831_en?filename=RSPG25-006final-RSPG_Report_on_6G_strategic_vision.pdf. RSPG discussed the previously identified issues for timely 6G deployment in the EU, and set a particular focus on inter-service spectrum sharing as an indispensable mechanism to support innovation and efficient spectrum use. That Report studied the six usage

general welcomed by stakeholders and the assessment of the added value of RSPG work is high between the participating MS representatives²³⁰. For the RSPG deliverables to pursue broader EU benefit, it would be beneficial that the RSPG Secretariat, which is currently provided by the Commission, would evolve from offering only administrative and organisational support, to support the work of the group also on substance.

EECC versus spectrum measures in the EU framework for MSS: the MSS Decision sets specific provisions for the coordinated selection and assignment of spectrum for mobile satellite services in only one band, the 2 GHz band and acts as a ‘lex specialis’, with the EECC acting as ‘lex generalis’, i.e. regulating the issues which are not specified in the MSS Decision.

EECC spectrum measures versus ITU Regulations and international spectrum rules: The ITU-R Radio Regulations (RR) are an international treaty between the 194 ITU Member States on the use of the radio spectrum and coordination rules to provide access to it. The ITU-R RR deal with the allocation of spectrum bands to one or more radiocommunication services (e.g. broadcasting, mobile, fixed and various space services) and establishing regulatory, organisational and technical conditions to avoid cross-border or cross-service harmful interference. They do not mandate the actual implementation and spectrum use by a system or application. That is why an ITU Member State or a group of them (such as the EU) could decide to use different services or different conditions in a given spectrum band, however, taking into account sharing conditions and cross-border coordination requirements defined in the RR in order to protect the use of frequencies in other countries. Selected subset of the ITU-R RR is reviewed and, if necessary, revised every three to four years in the context of World Radiocommunications Conferences (WRC). At each WRC, there are certain agenda items with the EU relevance, i.e. they could affect EU law, policies or programmes, which could result in adopting or amending the technical harmonisation measures adopted under the Radio Spectrum Decision. An EU position for each WRC is set by the Council Decision pursuant to Article 218(9) TFEU.

As regards satellites, ITU-R RR introduce a multistage coordination and notification procedure—ranging from advanced publication to bringing satellite systems into use and recording them in the Master Register. ITU filings and coordination obligations fall solely on Member States, not the EU or other transnational bodies, limiting the feasibility of shared spectrum management models such as Licence Shared Access at the international level.

ITU-R RR by defining rules for avoidance of harmful interference are linked to one of the main principles of spectrum management under Article 45 EECC, which requires Member States, when applying the EECC, to comply with international law. ITU-R RR could be also linked to the authorisations as the EECC expressly allows Member States to attach to the spectrum rights of use technical and operational conditions necessary for avoidance of harmful interference.

The interplay between ITU obligations and national satellite licensing frameworks continues to require careful coordination within the EU, particularly where multiple operators seek

scenarios defined by the ITU-R and indicated possible frequency bands for 6G in the EU that will be further investigated in the preparation of a 6G spectrum roadmap. The 6G spectrum roadmap will be developed by the RSPG and address pioneer 6G bands, bands for the commercial launch and bands for vertical market.

²³⁰ See survey results presented in study: Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks”.

access to the same bands, such as the 2 GHz MSS band, and where pan-European solutions must still rely on filings by individual Member States.

EECC spectrum measures versus Space Act proposal – The adoption of the Space Act should not interfere with, but would, regarding satellite communications, be complementary to the regulation of radio spectrum under the EECC as the scope and objectives of these two acts are different. The Space Act is meant to regulate the safety, resilience and sustainability of space activities in the Union in the framework of Member States responsibilities under the Outer Space Treaty and related treaties, while the authorisation, use and management of radio spectrum are governed by the EECC and the Radio Spectrum Decision 676/2002/EC in the context of rules adopted in the context of the International Telecommunications Union rules.

5.8. Relevance

The EECC is seen by most stakeholders as a relevant and effective framework for EU spectrum policy, particularly for terrestrial services. However, several stakeholders highlighted shortcomings in addressing services with cross-border or pan-European scope, such as satellite communications. Several novelties were introduced by the EECC in the regulatory framework in relation to spectrum policy to strengthen its single market dimension. These include the establishment of a peer review process to promote consistency of the conditions attached to the selection and granting of spectrum usage rights, a spectrum coordination mechanism to avoid cross-border interference between Member States, longer duration of spectrum usage rights for the crucial bands to increase predictability, more coordination of spectrum assignments, facilitation of the access to radio local area networks all over the EU, and common EU criteria for the deployment and operation of small-area wireless access points. The regulatory improvements in spectrum policy introduced by the EECC ²³¹ went to the right direction, aimed at addressing persistent problems, however the agreed measures were not sufficient to fully exploit single market benefits, nor to sufficiently incentivise investments.

In the meantime, a new need emerged to address the quickly evolving satellite market and to better integrate the specific EU legal framework for MSS in the general framework. While the EECC focused on establishing harmonised rules for authorisation of spectrum mainly for terrestrial broadband network and services, including 5G, it has left the authorisation of satellite spectrum to national processes, despite of its inherent cross-border potential. This resulted in a very fragmented rules and conditions between Member States that do not allow the EU satellite operators to easily attain scale and offer cross-border services, especially satellite connectivity services, which have become crucial for providing connection to underserved and remote areas, enhancing resilience and enabling new technologies.²³² Spectrum for satellite use is harmonised and managed primarily at the international (ITU)

²³¹ Among novelties introduced in 2018 to the regulatory framework in relation to spectrum policy. the creation of a peer review process to ensure more convergence of the conditions attached to the selection and granting of spectrum usage rights, a spectrum coordination mechanism to avoid cross-border interference between Member States, the incorporation of international law on spectrum into EU law obligations, the harmonisation of the duration of spectrum usage rights as well as of the conditions for renewal of such rights, the coordination of spectrum assignments, the facilitation of the access to radio local area networks, and of the deployment and operation of small-area wireless access points and the reference to certain electromagnetic limits in view to the protection of human health.

²³² European Commission (2024). White Paper - How to master Europe's digital infrastructure needs?, COM(2024) 81: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024DC0081>.

level while the Member States authorise it in different ways for the provision of satellite services. Therefore, a common approach to satellite authorisation is necessary to improve and level the conditions for satellite operators to use radio spectrum across the EU. The RSPG adopted an Opinion on satellite Direct-to-Device (D2D) connectivity and related Single Market issues, in which it recognises the need to frame access to EU satellite market by setting common authorisation requirements and by establishing an appropriate coordinated enforcement mechanism, the ongoing work aims also at levelling the playing field with constellations from outside the EU.

5.9. EU added value

The EU spectrum framework has brought added value setting a vision for 5G deployment, encouraged early national preparations and supported harmonised spectrum planning. The early identification by the RSPG of the need for low (coverage in 700 MHz), mid (capacity in 3.5 GHz) and high (pioneering and innovation in 26 GHz) frequency bands for 5G proved to be the right recipe. The EU framework has laid the foundation for common technical conditions and harmonised band planning, supporting equipment interoperability and cost reduction. Thus the 700 MHz and 3.5 GHz frequency bands have been established as the core bands for 5G. Some Member States have also awarded, or by other means made the 26 GHz frequency band available. However, 5G rollout in the 26 GHz frequency band is not developing as anticipated in the EECC.

In the EU, spectrum is harmonised based on a successful European governance model that is unique in the world. The European model aims to coordinate contributions to international and European harmonisation initiatives and to leverage and act as a multiplier of EU positions for World Radiocommunication Conferences. In some instances, the model has been quite effective. The RSPG process leading to the EU position on WRC helped increasing the awareness among Member States at an early stage about the EU interest related with particular WRC agenda items and building trust and consensus about direction of related EU position. This contributed to the swift adoption of a Council Decision on WRC. Moreover, Member States were able to insert elements of EU position in the CEPT preparatory work, so that European Common Proposals when adopted by CEPT were supporting the EU position.

In areas such as regulatory predictability, cross-border coordination, market integration and investment outcomes however, the progress has been insufficient comparing to its objectives, initial ambition and EU needs. There remains huge untapped potential in providing investment predictability by coordinating authorisation procedures, as regards valuable spectrum for wireless broadband and satellite. Moreover, spectrum sharing and flexible licensing models, as enabled under Articles 45, 48, and 51 of the EECC underused in practice²³³. Mechanisms like Licensed Shared Access (LSA) and spectrum trading have seen limited uptake, largely due to inconsistent national implementation and a lack of centralised guidance.

An example of missed opportunity in terms of improved predictability is the low regulatory predictability stemming from the non-adoption of long licence durations. Most of the Member States opted for the minimum allowed in the EECC and only half (46%) of the 5G auctions opted for assigning spectrum for 20 years or beyond. This has not had the effect of enhancing

²³³ GSMA (2021). Effective Spectrum Licensing, p. 5. <https://www.gsma.com/spectrum/wp-content/uploads/2021/07/GSMA-Effective-Spectrum-Licensing.pdf> European Electronic Communications Code (Directive (EU) 2018/1972), Articles 45, 48, and 51.

investment certainty for operators and left EU markets far behind the US and Asia, where long licence terms and quasi automatic renewals are standard. This has significantly reduced the attractiveness of the EU mobile sector to financial investors and deprived operators from access to capital, thus delaying deployment.

Another example is the RSPG peer review mechanism which has been reduced to a peer learning process, without tangible impact. Participation has been limited, and Member States' engagement has been uneven. Strengthening participation in the peer review process could contribute to greater consistency across the EU. Moreover, cross-border coordination challenges—particularly with third countries—can undermine the coordinated timing of spectrum authorisation as envisaged under Article 53 of the EECC. Addressing these challenges requires the strategic use of existing tools, notably the RSPG “good offices” mechanism, which is however currently effective only for interference between Member States in harmonised bands. Despite these mechanisms, persistent interference from non-EU neighbours—particularly along the EU's eastern borders—continues to affect 5G deployment. While some cases have been resolved through coordination efforts, many remain unresolved, particularly in areas close to conflict zones or with high frequency congestion, it is a missed opportunity that the EU could not benefit from increased solidarity and a more systematic intervention of the RSPG also to tackle interferences from third countries.

Furthermore, there is at present no harmonised EU licensing framework simplifying cross-border spectrum use by establishing common procedures for authorisation, renewal, and compliance. There is therefore untapped Single Market potential to reduce administrative burden for operators needing licences in multiple Member States and to improve regulatory predictability—through uniform pro-investment licencing conditions, making the EU more attractive for investment.

As regards satellite, currently, most large satellite constellations are registered in the United States, where operators benefit from a single licensing process and clearer timelines. They then provide services in the EU, benefiting from the open skies framework and the general authorisation regime, even in some cases from the absence of any specific rule at national level (cf. RSPG D2D Report). The lack of an EU harmonised model with streamlined access to spectrum, especially for satellite services but also for future 6G networks, represents a barrier to the development of a strong EU satellite sector, the EU wide development of services and to related potential of enhancing EU resilience and security.

6. GENERAL AUTHORISATION

Under the EECC general authorisation, Member States may set *ex-ante* conditions for the provision of networks or services and for the use of spectrum or numbers and that there is currently some harmonisation, as there is a maximum list of those conditions (albeit very open) set by the sector-specific EU law i.e. EECC. Any provider that complies with these conditions may provide electronic communications networks or services and any control can take place only *ex-post*.

Pursuant to Article 122 (3) EECC, BEREC shall adopt, by 21 December 2021 and every three years thereafter, an Opinion on the national implementation and functioning of the General Authorisation (hereinafter: GA), and on their impact on the functioning of the internal market. The EECC was adopted in 2020 and since then, BEREC delivered two Opinions - in December 2021²³⁴ and in December 2024²³⁵.

²³⁴ BoR (21) 178, BEREC Opinion on the national implementation and functioning of the general authorisation,

According to the 2024 BEREC Opinion (see footnote 179), the EECC transposition shows that most of the Member States have a general authorisation system in place (except for Denmark not implementing a general authorisation regime) and France which has the system in place but does not require a notification), with the NRA being entrusted to manage the whole general authorisation (GA) scheme.

Article 12 EECC provides for the maximum amount of information that can be requested from notifying providers under general authorisation of electronic communications networks and services. Article 13 EECC on the related conditions that may be attached to the GA turns the list of the possibly applicable GA conditions in Annex I EECC into an exhaustive, maximum one and thus limiting the range of data that national authorities can ask notifying operators to provide. The maximum requirement that can be imposed on providers to enter the market is to submit a notification to the national competent authority (Germany and Sweden require only notifications).

In fulfilment of Art. 12 (4) EECC requirements about the minimal information required from providers for operating on the market, BEREC published guidelines for the notification template and established a GA database, a Union database of the notifications transmitted to the competent authorities by providers falling under the GA regime and subject to the notification requirement (EU register for authorised undertakings).

The majority of EU NRAs are responsible for implementing the relevant provisions related to the notifications and the rest of the tasks under Title 2, Chapter 2 EECC except for IT where a ministry is designated as a competent authority while the regulator (AGCOM) forwards the national notifications to BEREC. The BEREC database is maintained by the BEREC Office.

Although the harmonised BEREC notifications' template is used by more than half of the NRAs, being non mandatory, and according to BEREC's Opinion on the national implementation and functioning of the general authorisation²³⁶, and on their impact on the functioning of the internal market, pursuant to Article 122, paragraph 3 EECC, it seems that national adaptations are still possible, and especially, by the authorities which decided not to adapt their national notification form. Some regulators also opted for further simplifying BEREC notification requirements by setting aside certain fields (e.g., no distinction between a wholesale and retail level providers). This approach questions the EU added value of the measure and may have a dissuasive effect on cross-border operations.

The BEREC database was set up and running by December 2020. As of 18.11.2025, 25 171 country providers' notifications were submitted to the BEREC database. 23 299 notifications are for networks and 51 723 for services. Most NRAs upload the database monthly but there

and on their impact on the functioning of the internal market, pursuant to Article 122, paragraph 3 EECC, 9.12.2021, see: <https://www.berec.europa.eu/en/document-categories/berec/opinions/berec-opinion-on-the-nationalimplementation-and-functioning-of-the-general-authorisation-and-on-their-impact-on-the-functioning-of-theinternal-market-pursuant-to-article-122-paragraph-3-eecc>

²³⁵ BoR (21) 178, BEREC Opinion on the national implementation and functioning of the general authorisation, and on their impact on the functioning of the internal market, pursuant to Article 122, paragraph 3 EECC, 9.12.2021, see: <https://www.berec.europa.eu/en/document-categories/berec/opinions/berec-opinion-on-the-nationalimplementation-and-functioning-of-the-general-authorisation-and-on-their-impact-on-the-functioning-of-theinternal-market-pursuant-to-article-122-paragraph-3-eecc>.

²³⁶ https://www.berec.europa.eu/system/files/2024-12/BoR%20%2824%29%20190_BEREC%20Opinion%20on%20GA%20pursuant%20to%20Art%20122.pdf.

are also regulators that do it less regularly (e.g., every 3-4 months, once a year etc.). In addition, the course of the analysis of the functioning of the GA and its effects on the single market a 2024 BEREC Opinion (see footnote 179) draws the attention to the fact that authorised ECN/ECS providers have signalled divergencies in national notification experiences outside the EECC requirements which stem from either EU or national legislation and concern security, data protection, data retention requirements, the duty to notify the beginning of the activity in national language, the duty to have a national digital identity to run the online notification process, the duty to have national representatives to interact with national authorities etc. Despite falling outside its remit, BEREC in its 2024 Opinion (see footnote 179) also admits that all these requirements sometimes are very burdensome and constitute obstacles for completing the single market and enabling cross-border operations and activities.

6.1. Effectiveness

In its Opinion, BEREC confirms that the harmonised maximum requirements for the notifications under the GA have contributed to lowering obstacles to market entry, promoting market transparency and/or consistency in notification-related requirements across Europe. In general, the general authorisation regime has contributed to achieving the EECC objectives.

Industry stakeholders' assessment of the effectiveness of EECC provisions related to general authorisation is more nuanced. Industry stakeholders mostly agree that the EECC has been effective, even – in the words of one stakeholder – “world-wide best practice” in terms of direct one-off costs (if any) for the notification. Several industry stakeholders also point out that the effectiveness varies across Member States due to specifics of national implementation and application.²³⁷

Article 12 (1) EECC explicitly exempts NI-ICS from the general authorisation regime, but the flexibility provided by the Directive reveals different approaches regarding the types of networks or services to which the general authorisation applies. For example, submarine cable systems owned by CAPs are considered as non-public ECNs and Member States may decide at national level to subject such networks and non-public ECS to the general authorisation regime²³⁸. Regarding non-public ECNs and non-public ECS only 4 Member States require prior notification²³⁹. Conveyance of signal services such as transmission services used for M2M services are not always subject to general authorisation. Sometimes, this depends on whether there are contractual relationships with local businesses, or the connectivity component is not intrinsically linked with the IoT/Machine-to-machine service or product. A notification for such services is also not always required²⁴⁰.

The BEREC notification template was adopted fully by the majority of NRAs, which adds to effectiveness by “promoting market transparency and/or consistency in notification-related requirements” across the EU. The functioning of the current database revealed some issues

²³⁷ See Section 4.3.2 of the Final 1st Interim Report on Completing the DSM.

²³⁸ Reference to Page 22, 2024 BEREC Report on the general authorisation and related frameworks for international submarine connectivity: “Non-public ECN and non-public ECS are subject to prior notification/registration under the general authorisation regime only in 4 MS”.

²³⁹ [Draft BEREC Report on the general authorisation and related frameworks for international submarine connectivity](#).

²⁴⁰ Cullen Report on IoT/M2M roaming connectivity and local SIM profiles in European countries, dated 10 October 2024.

related to the identification of providers and treatment of duplicates, as the same undertaking is not unified when providing networks and services in more than one country. To avoid duplications and inconsistencies, further improvements are needed for cross-border providers of networks and services to ensure they notify only once according to a harmonised template. Concerning updates of the database, BEREC recommends maximum update intervals of 2 months to increase the reliability of the database.

The maximum list of harmonised conditions introduced by the general authorisation system and the harmonisation powers provided to BEREC as regards the notifications and the database, in general, functioned well because they limited to a certain extent the possibility for the Member States to impose additional conditions. However, the transposition revealed certain divergencies among Member States and allowed for NRAs to further develop the general authorisation conditions in secondary legislation or other administrative/regulatory decisions. The lack of a uniform approach led to incoherent application and revealed some limitations either for cross-border or smaller, national providers. Furthermore, there is no harmonised approach to all other applicable national rules and conditions relevant for the authorised ECN/ECS providers which do not stem from the EECC but are also part of other EU legislation. In this regard, some stakeholders share that divergent national rules on lawful interception present a market barrier for telecom operators causing legal uncertainty and possibly delaying the commencement of their activities or the launch of new services. This may undermine the objective of further harmonising general authorisation rules within the EU. Several industry associations (incumbents and mobile operators) stated that administrative charges for general authorisation/notification have never impeded entry into the EU electronic communications market²⁴¹.

6.2. Efficiency

All governments consider the cost for operators of compliance with Articles 12 and 16 EECC as necessary and proportionate to their objectives²⁴².

At the same time, a great majority of NRAs do not assess their own cost of compliance. Several NRAs state that their administrative fees are very low and have included the possibility to exempt smaller operators from them or otherwise adjust the fees (e.g. in one example, 0.2% of turnover²⁴³ and a minimum turnover threshold needs to be achieved for the fee to become due). A few NRAs mention that they neither levy any administrative charges nor change them for several years, having sufficient budget to cover their needs. This signifies that for some NRAs the costs of compliance are low, and consequently Articles 12 and 16 EECC can be considered efficient.

Many industry stakeholders find the cost of compliance with Articles 12 and 16 EECC reasonable and not significant but note differences in implementation between Member States that constitute an additional administrative burden. The procedural conditions of general authorisation also vary. Some countries require companies to have an address and establishment within their jurisdiction; others require digital identities²⁴⁴. In contrast to the governments, the consulted industry stakeholders found that some changes to the Annex I

²⁴¹ Reference in Section 4.3.2 of the Final 1st Interim Report on Completing the DSM.

²⁴² Reference to Section 4.3.3.1 Final 1st Interim Study Completing the DSM.

²⁴³ The fee of 0.2% turnover is applied in Bulgaria, Ireland and Latvia.

²⁴⁴ Reference in Section 4.3.3.1 of the Final 1st Interim Report on Completing the DSM

conditions are warranted to further simplify the authorisation process. Also, despite the BEREC Notification Template, the conditions required are very different in practice across different countries²⁴⁵.

Overall, many industry stakeholders find their reporting obligations under Arts. 20 and 21 EECC cumbersome and complex and ask for more harmonisation in this regard²⁴⁶.

This concerns following issues: duplication of requests for information (e.g. same or similar data is requested for statistical reporting and later for market analysis), different data and information requests by different NRAs for the same purposes without apparent reasons or justifications, different frequency of information requests, no difference in reporting obligations for smaller operators, which is more burdensome for them. However, the responding stakeholders have not quantified the additional administrative burden caused by these inefficiencies.

Overall, many industry stakeholders find their reporting obligations under Arts. 20 and 21 EECC cumbersome and complex and ask for more harmonisation in this regard.

6.3. Coherence

The national implementation of the EECC provisions on general authorisation is internally coherent but – according to industry stakeholders (incumbents and mobile operators) – lacks external coherence with national rules on cybersecurity, lawful interception, data retention and e-privacy, which often result from relevant EU legislations. This lack of coherence is noted specifically in relation to the conditions that may be attached to the general authorisation, according to Annex I EECC²⁴⁷.

In the area of cybersecurity, the diverging national rules seem to result from the differences in the transposition of the NIS 2 Directive. The said industry stakeholders suggest that further harmonisation and closer cooperation between Member States are necessary, for example, to define common security conditions for telecom operators. Some industry stakeholders consider that the lack of coherence between the general authorisation conditions related to cybersecurity, lawful interception, data retention and e-privacy leads to fragmentation and may prevent the achievement of the single market in electronic communications²⁴⁸.

6.4. Relevance

While all stakeholders agree that the current general authorisation regime under the EECC remains relevant, their views on what changes might be necessary are divided. Governments have not identified any further areas requiring harmonisation in the context of the general authorisation. By contrast, some governments warned against “over-harmonisation” that would limit the discretion of NRAs to adjust to the national circumstances.

Several industry stakeholders consider that the scope of application of the general authorisation regime must be expanded to include NI-ICS providers to level the playing field with providers of electronic communications services²⁴⁹. Currently, NI-ICS are required to

²⁴⁵ Reference in Section 4.3.3.2 in the Final 1st Interim Report on Completing the DSM.

²⁴⁶ Reference in Section 4.3.3.3 of the Final 1st Interim Report on Completing the DSM.

²⁴⁷ Reference in Section 4.3.4 of the Final 1st Interim Report on Completing the Single Market.

²⁴⁸ Reference in Section 4.3.4 of the Final 1st Interim Report on Completing the Single Market.

²⁴⁹ Reference in Section 4.3.5 of the Final 1st Interim Report on Completing the DSM.

notify only in several countries²⁵⁰ and this may pose challenges for instance, in the emergency communications and especially, for people with disabilities or in terms of VoIP services and the ability to address related issues (fraud, interconnection) in a harmonised way.

In its 2024 Opinion (see footnote 179), BEREC also signals the need for reflections around the suitability of expanding the scope of the GA framework to NI-ICS providers, other digital players, virtualised communications services or activities, also in the light of the EECC review (see reference in footnote 179). BEREC draws the attention to the need for reflection for expanding the scope to other players with a view to ensuring the same regulatory treatment in relation to the provision of the same services and relevant end-user protection guarantees in the usage of both NB-ICS and NI-ICS.

6.5. EU added value

Almost all governments and most industry stakeholders agree that the general authorisation regime under the EECC has brought added value beyond the TFEU guarantees of freedom of establishment and services provision. However, the extent of this added value has been differently assessed by stakeholders.

A few governments point out that the specific EECC contribution is marginal or non-existent because the general authorisation regime was introduced decades earlier.

Some stakeholders point out that the exemptions from administrative changes for small operators are not guaranteed, and they may experience disproportionate administrative burdens. Only a few NRAs mention the problem with operators not having an establishment in the country where they provide electronic communications services.

At the same time, the value added of the EECC general authorisation regime is not only in simplifying domestic and cross-border market entry, but also in providing the NRAs with sufficient information for carrying out monitoring compliance and supervision of operators under their jurisdictions, conducting enforcement activities and market reviews. Art. 12 EECC and the BEREC Notification Template specifically contribute to this added value.²⁵¹

The evaluation findings point out to the need for further harmonisation, update and simplification of the general authorisation regime and paving the way for facilitating the deployment of more virtualised and centrally managed electronic communications networks and software (cloud)-based electronic communications services in the EU.

7. UNIVERSAL SERVICE OBLIGATIONS

All Member States have transposed the EECC universal service provisions (**Articles 84 to 92**) that require and allow Member States to put in place obligations serving as a safety net and ensuring that all consumers have access at an affordable price to adequate internet access and voice communications services, including the most vulnerable in society as well as persons with disabilities and those in remote areas.

The universal service rules should be assessed in the context of the overall availability and affordability of adequate broadband and voice communications in the EU. In 2024, over 94% of EU households had internet access²⁵², although the availability of an internet connection at

²⁵⁰ Reference to 2.3.2.1 of the 2nd Interim Report on Completing the DSM.

²⁵¹ Reference in Section 4.3.6 of the Final 1st Interim Report on Completing DSM.

²⁵² https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h/default/table?lang=en.

home is significantly lower among persons with disabilities as opposed to those without disabilities²⁵³. Fixed broadband coverage (for download speed of minimum 30 Mbps) achieves 90% of households in almost all EU countries²⁵⁴. In nearly all Member States LTE-mobile coverage is close to 100%. Satellite coverage of households in almost all EU Member States is 100%. As regards affordability, according to ITU (2025²⁵⁵): *“The Europe region leads in broadband affordability, making connectivity accessible to all. In terms of affordability, Europe stands out as the region with the most affordable broadband services globally. Entry-level mobile-broadband services account for just 0.3 per cent of gross national income (GNI) per capita, compared to a global average of 1.1 per cent.”* The share of people in the EU that could not afford to have an internet connection has significantly declined over the last decade and was around 2.1% in 2024²⁵⁶. For those identified as being at risk of poverty, the share was higher, reaching over seven per cent (of people at risk of poverty) in 2022²⁵⁷.

Adequate broadband has been defined (**Article 84**) by 21 Member States, while six Member States have not yet done so or do not intend to²⁵⁸. Most countries have set a minimum download speed of 10 Mbps and few have set 30 Mbps. One Member State has defined 100 Mbps (Romania) maximum download speed²⁵⁹ which is the maximum so far. Where upload requirements are set, they range from one to five Mbps²⁶⁰. Sixteen Member States have requirements also for voice communications services²⁶¹. BEREC’s latest report²⁶² on best practices to support the defining of the adequate broadband access by Member States was published in March 2024.

Affordability measures (**Article 85**) can be imposed for consumers with a low income or special social needs. Member States take different approaches in determining the price of an affordable universal service (nationwide average, based on thresholds etc.)²⁶³. Due to the variety of measures, some of which are outside the universal service regime, the supporting study²⁶⁴ provides various figures on the affordability measures in Member States. There are

²⁵³ According to the Union of Equality, Strategy for the Rights of Persons with Disabilities 2021-2030 (2021), only 64.3% of persons with disabilities aged 16+ had an internet connection at home, compared to 87.9% of persons without disabilities.

²⁵⁴ Universal service supporting study. Forthcoming study “Financial conditions, demand and investment needs and their regulatory and policy implications including the review of the universal service”. The study collected data from 24 Member States.

²⁵⁵ ITU (2025): Measuring digital development State of digital development and trends in the Europe region: Challenges and opportunities, February 2025, page 1.

²⁵⁶ Eurostat, [ilc_mddu07a](#),

²⁵⁷ <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/edn-20230801-1>.

²⁵⁸ Data based on the universal service supporting study data gathering of 24 Member States, forthcoming

²⁵⁹ BEREC Report on Member States’ best practices to support the defining of adequate broadband internet access service, 7 March, 2024, BoR (24) 40.

²⁶⁰ Universal Service supporting study.

²⁶¹ Universal Service supporting study.

²⁶² BEREC Report on Member States’ best practices to support the defining of adequate broadband internet access service, 7 March, 2024, BoR (24) 40. <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-member-states-best-practices-to-support-the-defining-of-adequate-broadband-internet-access-service-0>.

²⁶³ Universal Service supporting study.

²⁶⁴ Universal Service supporting study.

legislative measures for consumers with low income for broadband/voice communications in around 15 Member States. Legislative measures for consumers with disabilities for broadband/voice communications and specific equipment and services exist in 15 Member States. Providers make voluntary offers for social tariffs in six Member States. Voluntary offers for consumers with disabilities exist in seven Member States.

Public funding is envisaged for financing the universal service unfair financial burden (Article 90) in nine Member States²⁶⁵. Seventeen Member States²⁶⁶ envisage to use an industry fund, of which five Member States²⁶⁷ intend to use both industry and public funding. Austria's industry funding model allows for contributions from non-traditional and independent communications service providers (NI-ICS). Eight Member States have defined how to assess an unfair burden. Only two of the Member States have reported actually paid compensation since 2021²⁶⁸.

Recent comprehensive figures of the cost of universal service obligations (USO) in Member States are not available. According to Cullen International data²⁶⁹, Member States' annual *net cost* calculations, where available, range between under 1 million euro to around 8,6 million euro.

A designation of a universal service provider (**Article 86**) has been imposed in nine Member States. Designation in certain service areas/regions only and case-by-case designation for individual request are also possible in three countries²⁷⁰. In Sweden, no service provider is obliged to provide universal service, but there is a state aid measure administered by PTS (the Swedish Post and Telecom Authority)²⁷¹.

Several Member States have made use of the options to extend the scope of universal service rules to other groups. For requesting an adequate broadband internet access, microenterprises are eligible in 14 Member States (MS), small enterprises are eligible in 13 MS, medium enterprises are eligible in 10 MS, not-for-profit organisations are eligible in 12 MS²⁷². Affordability applies also to microenterprises, SMEs and not-for-profit organisations in three Member States²⁷³.

7.1. Effectiveness

The EECC objectives (Art 3(2)) include “high and common level of protection for end-users”. This includes addressing the needs, such as affordable prices, of specific social groups, in particular end-users with disabilities, elderly end-users and end-users with special social

²⁶⁵ Czech Rep., Finland, Hungary, Latvia, Malta, Portugal, Romania, Slovenia, Sweden. Universal Service supporting study

²⁶⁶ Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, France, Germany, Greece, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia and Spain. Universal Service supporting study.

²⁶⁷ Malta, Portugal, Romania, Slovakia and Slovenia.

²⁶⁸ Universal Service supporting study.

²⁶⁹ Universal service obligation: designated providers and net cost. Cullen International data 3 March 2025.

²⁷⁰ Universal Service supporting study.

²⁷¹ BEREC Report BoR (24)40.

²⁷² Universal Service supporting study

²⁷³ BEREC Report on Member States' best practices to support the defining of adequate broadband internet access service. BoR(24)40, p. 27.

needs, and choice and equivalent access for end-users with disabilities. The three characteristics of the current universal service concept address affordability, accessibility (in universal service rules this includes also support to consumers with disabilities for terminal equipment, and specific equipment and specific services) and a possibility for Member States to address availability. A challenge to harmonisation is posed by the significant variation in implementation of the rules in Member States.

As regards the stakeholders' feedback on the assessment of universal services rules, the responses to the exploratory consultation (2023)²⁷⁴ were diverse and not conclusive on universal service. An equal number of respondents considered USO significantly or "not at all" useful to grant connectivity access to low-income consumers. Many respondents did not reply to the questions on universal service funding. Among those who replied, close to half of them indicated that the USO should continue to be funded by the public general budget, while the others considered that the USO should be funded by ECN providers. Companies (mainly ECN providers and broadcasters), business associations and almost all the responding public authorities expressed their support for maintaining the current financing model.

The feedback to the Commission's 2024 White Paper "How to master Europe's digital infrastructure needs?" (although there was no specific scenario proposed for the USO) highlighted that proper enforcement of current rules was missing; and therefore, focus should be on implementation and compliance of current rules. According to the feedback, some Member States have not created many internet connections under the universal service regime. The EECC already provides a framework for incentivising telcos to prioritise accessible connectivity and deployment of broadband to consumers in more remote regions. BEREC underlined in its answer that before introducing changes and imposing new universal service obligations it would be necessary to assess the economic impact on all actors, and that the current rules are future-proof. European Consumer Organisation BEUC highlighted that it is too early to conclude if changes to universal service financing model are needed²⁷⁵.

The Commission's 2025 Call for evidence on the Digital Networks Act highlighted universal service for protecting vulnerable end-users and re-focusing universal service obligation on affordability. In their feedback, most stakeholders acknowledged the need for the USO framework to flexibly accommodate varying regional needs and market conditions across Member States. Member States, NRAs and consumer organisations advocated for an inclusive and future-proof USO framework that supports digital inclusion, ensuring all citizens, particularly those in rural or underserved areas, have access to high-quality internet services. The majority of telecom operators argued that the market now provides a wide variety of offers to meet the needs of consumers and suggested that USO could be phased out. Public intervention, for example through voucher schemes, would be more efficient. The technologically neutral approach was emphasised.

Data on availability of adequate broadband on the different fixed, mobile (4G LTE and 5G) and satellite technologies show that the availability (**Article 86**) of adequate broadband <30 Mbps is already largely ensured in the Member States and not a significant issue in terms of coverage.²⁷⁶ The EECC underlines technological neutrality on provision of universal service.

²⁷⁴ <https://digital-strategy.ec.europa.eu/en/library/results-exploratory-consultation-future-electronic-communications-sector-and-its-infrastructure>.

²⁷⁵ https://www.beuc.eu/sites/default/files/publications/BEUC-X-2024-057_Mind_the_connectivity_gap_making_digital_infrastructure_work_for_consumers.pdf

²⁷⁶ Universal service supporting study

A technology or technical solution is not favoured over another for fulfilling the availability of adequate broadband requirement. The most efficient and effective technology is chosen, which makes the approach future-proof.

Given the widespread commercial roll-out of fixed and mobile networks capable of providing adequate broadband, availability does not seem to be a concern based on the quantitative figures. The availability of adequate broadband internet access service (as defined by the Member States) in almost all Member States²⁷⁷ is fulfilled by offers based on either commercial or publicly²⁷⁸ funded networks. Availability is also addressed through alternative public policy tools such as State Aid measures or financial instruments. Even where universal service providers were designated the actual number of imposed obligations was relatively low. Therefore, the supporting study argues that the benefits of the universal service regime as regards availability in the past (2021 to 2024) have been limited, however, the low number of requests does not necessarily indicate ineffectiveness of the availability rules that can be considered to be neutral in terms of effectiveness.

Measures to ensure affordability (**Article 85**) for consumers with low-income and special social needs differ significantly across Member States. The measures include various forms of support, such as vouchers, social tariffs and discounts. According to the universal service supporting study, ten Member States apply affordable broadband prices to all consumers, while 11 Member States limit measures to specific groups, notably users with low income or those with special social needs. Four Member States address affordability through the social welfare system. Eligibility definitions differ: some countries restrict affordability schemes to consumers, while in three countries eligibility is extended to microenterprises, SMEs and not-for-profit organisations.²⁷⁹

Member States have defined an affordable price for adequate broadband services, typically applying a uniform rate nationwide. The methodologies for determining what constitutes an affordable price vary and include, for example, affordability based on national market prices for products that meet only the minimum technical USO requirements, or use of income or expenditure-based benchmarks. In some Member States operators also provide voluntary offers for users with special social needs or low income²⁸⁰. Voluntary offers are available in some countries but lack regulatory oversight, leading to inconsistency. Lack of transparency and the complexity of procedures can be important barriers. While measures are in place, their practical impact seems limited due to low take-up, administrative burden, and lack of visibility or lack of proactive consumer service.

Member States have additional measures to support consumers with disabilities through the universal services regime (**Article 85(4)**). These include, for example, higher quality of service, free service and equipment support and measures outside universal service²⁸¹.

Stakeholders highlight the important role of competition in continuing to ensure affordable prices to consumers in the EU. Affordability remains a problem in rural areas or areas with limited competition, where prices can be high, especially in fibre-only areas. Some Member

²⁷⁷ Universal service supporting study

²⁷⁸ OMDIA (2024): Broadband Coverage in Europe 2023 - Mapping progress towards the coverage objectives of the Digital Decade, Final Report.

²⁷⁹ Universal service supporting study

²⁸⁰ Universal service supporting study

²⁸¹ Universal service supporting study

States have addressed these gaps through targeted public subsidies, such as the “conecta35.es” programme in Spain.

While market competition has generally kept broadband prices low across the EU, affordability issues persist in certain areas, making USO-based measures an important but limited safety net. The universal service supporting study also points out that the variable application of the provision may mean that not all consumers with difficulties have been addressed in all Member States.

Overall, the effectiveness of affordability measures for consumers with low income and special social needs seems to be low to neutral²⁸², while further data is needed to fully understand the implications of the affordability measures for consumers with disabilities.

Article 90 EECC allows Member States to finance universal service obligations through public funding, industry contributions, or both, following principles such as transparency and proportionality. However, it seems challenging to activate the funding in practice and according to the universal service supporting study, there is no conclusive evidence of net cost calculations to universal service providers of providing adequate broadband for internet access service. Relatively few Member States have designated universal service providers and even fewer have assessed an unfair burden. It is therefore not possible to assess the effectiveness of the measure as updated in the EECC. Also based on past experience, funding processes are seen as bureaucratic and costly, with risks of litigation particularly with industry funds. NRAs generally view the mechanisms as appropriate, but operators argue that universal service, as a public policy tool, should be state-funded.²⁸³ The practical use and demonstrated effectiveness of the costing and funding mechanism remain limited.

7.2. Efficiency

The number of end-users benefitting from the provision by a designated universal service provider seems to be relatively low compared to the resources it requires. There is limited data available, but considerable administrative costs can be incurred by public authorities, particularly where broadband access is provided on a case-by-case basis.²⁸⁴ The average annual administrative costs vary in Member States, however, the scope covered by the universal service schemes of the Member States differ, with some Member States treating social aspects separately from the universal service and the figures are thus not comparable. The costs stem from technical reviews required to assess the actual unavailability of broadband, coordination with operators, and the process of selecting and designating universal service providers. The efficiency of the mechanism for securing availability could thus be questioned due to the resources required for relatively limited outcomes in terms of new coverage or consumer uptake. Several industry stakeholders emphasize the high administrative cost of the regime, and the procedures can be very lengthy for consumers.

Most Member States have not set an affordable price and/or not all consumers are eligible²⁸⁵. The administrative costs linked to affordability provisions are generally low, as NRAs and ministries are not extensively engaged in designing or monitoring such schemes. The limited implementation also means that the benefits in terms of promoting internet take-up among

²⁸² Universal service supporting study

²⁸³ Universal service supporting study..

²⁸⁴ Universal service supporting study

²⁸⁵ Universal service supporting study

consumers with low income and special social needs are still minimal. The proportion of beneficiaries remains very small in most countries—ranging from negligible levels to a maximum of around 2.8% of the population.²⁸⁶ These figures do not allow for conclusions to be reached about the efficiency of the affordability provisions, as costs could outweigh benefits both in cases where there are objectively few concerns around affordability, as well as in cases where consumers with genuine needs have not been reached. These figures do not fully align with the broader population segments that report affordability as a barrier to internet adoption,²⁸⁷ suggesting a possible mismatch between policy objectives and implementation.

While most Member States have envisaged a specific financing regime to be applied, there has been limited actual use of the financing mechanism. As mentioned above, according to the universal service supporting study, since 2021 and until 2025, only two Member States reported that they have paid compensation in practice. This does not provide sufficient information to assess its efficiency. However, due to the design of the universal service costing and financing system (and from previous experience), it is reasonable to expect that there will be significant administrative costs if it becomes operational. The costs could be outweighed by the benefits in terms of beneficiaries of the regime²⁸⁸.

7.3. Relevance

The ubiquitous availability of basic broadband access in Europe is calling into question the relevance of the availability component of the universal service regime. The data shows that increasingly, at least at the level of safety net, technologies like mobile and satellite may provide a widespread solution. While there may be limited gaps regarding mobile coverage, satellite offers 100% coverage in most of the Member States. Over a longer time horizon, measures taken by Member States under the Digital Decade Policy Programme²⁸⁹ to achieve availability of Gigabit fixed connectivity and 5G to all households may raise the level of availability significantly above the quality thresholds that have currently been set for universal service internet access. This raises a question about the relevance of the availability rules in the universal service regime²⁹⁰.

There is a low number of requests for availability under the EECC provisions. However, the universal service regime principle as a safety net ensuring that all consumers are included in a fully developed digital society continues to be relevant and related to the Digital Decade targets. It should be noted that universal service may also appear less relevant where affordability of essential services, including connectivity, is addressed through the social welfare system and not within the sector specific universal service regime.

The objective of ensuring that adequate internet access is affordable and that consumers with a low income or special social needs can participate in the digital society remains relevant. However, as noted by the supporting study, this objective can also be addressed through other means.

²⁸⁶ Universal service supporting study

²⁸⁷ Universal service supporting study

²⁸⁸ Universal service supporting study.

²⁸⁹ Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030.

²⁹⁰ Universal service supporting study.

- First, affordability is often a competition issue and can be addressed through market regulation. Prices for broadband in the EU are some of the lowest globally due to consistently high levels of retail competition over the last decade. Operators report that the electronic communications sector has consequently become an outlier in terms of overall inflation in the last three years, showing a price deflationary trend in contrast to other sectors.²⁹¹
- Second, affordability for consumers with low incomes or special social needs is part of the social legislation and the social welfare system. For this reason, not all Member States apply sector specific universal service measures for these consumers. Nevertheless, in the event that these other measures are not sufficient to meet specific needs (in particular for those with low income, special social needs and consumers with disabilities), given the importance of digital inclusion to society, affordability provisions in the context of an updated EECC could be relevant going forwards²⁹².

The share of people in the EU that could not afford to have an internet connection has significantly declined over the last decade and was around 2.1% in 2024²⁹³. Data also shows that affordability for consumers with low income or special social needs remain a relevant problem in several Member States, especially in rural areas where only expensive technologies (e.g. satellite) may be available. The share of people in the EU that could not afford to have an internet connection is higher among people who are at risk of poverty (2024 Commission report on access to essential services²⁹⁴). It is also relevant to note that affordability (costs) is not necessarily the main reason why consumers without internet do not subscribe. Recent data is not available, but based on data from 2019, most common reasons were “not needed” and lack of skills, while the cost was the third most common reason why consumers without internet did not subscribe²⁹⁵.

The relatively small relevance of the universal service availability possibility can also be assessed in relation to the EU broadband state aid spending outside the universal service regime. Many Member States which do have a rural coverage gap have allocated state aid for the deployment of Gigabit-capable broadband. According to European Commission data, Member States spent €5.26bn on broadband state aid in 2023, representing a 69% increase compared to 2022²⁹⁶.

²⁹¹ Universal service supporting study.

²⁹² Universal service supporting study.

²⁹³ Eurostat - [ilc_mddu07a](#).

²⁹⁴ <https://op.europa.eu/en/publication-detail/-/publication/404ea31d-c715-11ee-95d9-01aa75ed71a1/language-en>. On risk of poverty, see Eurostat [In which EU regions are people at risk of poverty? - News articles - Eurostat](#)

²⁹⁵ Source: Eurostat, Households - reasons for not having internet access at home (2005-2019), https://ec.europa.eu/eurostat/databrowser/view/isoc_pibi_rni_custom_16270621/default/table?lang=en (last call: 15.04.2025).

²⁹⁶ European Commission. State aid Scoreboard 2024. https://competition-policy.ec.europa.eu/document/download/68225c70-5570-4e10-b983-53efde939d7f_en?filename=state_aid_scoreboard_note_2024.pdf.

7.4. Coherence

The services provided in Member States under the universal service regime constitute a Service of General Economic Interest (SGEI) within the meaning of Article 106(2) TFEU. Compensation may fall outside Article 107(1) TFEU if the Altmark criteria are fulfilled; otherwise, it constitutes State aid but can be declared compatible for example under the SGEI Decision or the SGEI Framework. This ensures full coherence between the universal service regime and the State aid framework.

Universal service is designed to encompass limited basic services. NRAs, when addressing availability of adequate broadband internet access services, take into account, inter alia, ongoing and planned commercial roll-outs, as well as pending roll-outs based on State aid measures or EU funding. Therefore, there should be no incoherence between State aid rules and universal service provisions, which do not target the same level of quality of service and complement other EU policies on investments in network roll-out. Most stakeholders agree that universal service is not an instrument for network roll-out of the “highest” quality in the market.²⁹⁷ It is also important to distinguish clearly between the universal service regime, under which Member States define a limited SGEI aimed at guaranteeing essential connectivity, and broadband State aid measures, which support the deployment of very high-capacity networks. These mechanisms serve different policy objectives and therefore do not lead to overlaps or inconsistencies under the State aid framework.

Affordability can also be covered by the social welfare system of the Member States. Several Member States report that affordability measures for consumers with low income and special social needs are covered by their social welfare system. In such cases, the flexibility of the EECC and its consideration of national circumstances ensures the coherence with national social welfare systems²⁹⁸ but do not provide for harmonised measures.

Social vouchers can also support broadband access for some specific categories of consumers and can be designed in line with State aid provisions as one alternative tool open to Member States to ensure that users have access to affordable broadband.

The European Accessibility Act (EAA)²⁹⁹ refers to and complements the EECC by setting forth additional accessibility requirements related to electronic communications services. EECC universal service rules set a requirement on support to consumers with disabilities. The scope of the EAA is complementary to the universal service provisions and it lays down concrete accessibility obligations as regards electronic communication services, imposing for instance that real time text is provided by electronic communication services in addition to voice communication and requesting the provision of total conversation in the cases where video is provided in addition to voice communication³⁰⁰. Moreover, the EAA sets forth mandatory accessibility requirements as regards access to emergency communications delivered by providers of electronic communication services, complementing the accessibility obligations laid down in Article 109 of the the ECC. The EAA also ensures that, when handling emergency communications to ‘112’, PSAP operators responding to those communications issue accessible responses, that persons with disabilities can perceive and

²⁹⁷ Universal service supporting study.

²⁹⁸ Universal service supporting study.

²⁹⁹ Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services.

³⁰⁰ Universal service supporting study

understand. The scope of the two acts is slightly different since the obligations of the EAA relate to electronic communication services with the exception of transmission services used for the provision of machine-to-machine services, whereas the EECC universal service regime relates to the provision of adequate broadband internet access and voice communication services.

The universal service supporting study assesses that the public funding mechanism for universal service is coherent but concludes that the industry funding mechanism may create artificial preference over other mechanisms funded via public funds and may be incoherent with the wider objectives of the EECC. According to the universal service supporting study, the funding for universal service policy should come from state resources rather than an industry fund, as the primary goal is to address market failures and social inequalities.

7.5. EU added value

The universal service regime is designed in a flexible way to allow Member States to implement it taking national circumstances into account due to the significant differences between the countries. The EU added value refers to the benefits provided by EU legislation. However, the national flexibility and divergence of the implementation of the rules limits the EU added value in terms of economies of scale and efficient administrative procedures³⁰¹.

That said, the USO regime has provided an important basis for the harmonisation of approaches that may otherwise have diverged to a significant degree. Before the entry into force of the EECC provisions on universal service broadband, nine Member States had already introduced a broadband universal service, with some degree of variability in the definition across those countries.³⁰² EECC rules provide limitations on the definition of adequate broadband as well as the minimum set of services set out in Annex V that provide a coordinated approach for the minimum bandwidth³⁰³. The EECC provides legal certainty and guidance on the costing (in EECC Annex VII) and financing of universal service.

While giving certain legal certainty, the availability provisions seem to have limited EU-added value since, for several reasons, notably because of commercial and publicly funded roll-out, the availability of adequate broadband (at universal service speeds) is widely ensured throughout the EU.³⁰⁴

8. End-user rights

In general terms, Europeans enjoy a high-level of end-user experience and protection in the electronic communications sector for choice, price and quality of services. The European electronic communications legislative framework (EECC) and the EU's competition policy ensure consumer choice and competitive markets. In 2024, over 94 per cent of EU households had an internet access³⁰⁵, up from 80 per cent in 2014. Nine in ten Europeans are also satisfied with the upload and download speed of their internet connection at home³⁰⁶. In global

³⁰¹ Universal service supporting study

³⁰² BEREC Report on Member States' best practices to support the defining of adequate broadband internet access service, 7 March, 2024, [BoR \(24\) 40](#).

³⁰³ Universal service supporting study.

³⁰⁴ Universal service supporting study.

³⁰⁵ Eurostat https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h/default/table?lang=en.

³⁰⁶ Special Eurobarometer 560. E-Communications and Digital Single Market. 2026.

comparison, Europe stands out as the region with the most affordable broadband services³⁰⁷. According to the Study on mobile and fixed broadband prices in Europe 2022³⁰⁸, in comparison, the EU27 region tends to offer the most affordable prices, particularly for Single Play offers below 999 Mbps. The EECC's end-user rights ensure solid consumer protection and empower consumers in aspects like changing providers, porting numbers or getting information on the quality of services. Nearly half of Europeans who have changed a service package provider have not experienced problems in doing so³⁰⁹. The European Consumer Organisation BEUC notes in its feedback to the Commission's Call for evidence on the Digital Networks Act in 2025³¹⁰ that the "EECCs end-user rights chapter provisions on switching, contract summaries, affordability, transparency and quality-of-service have proven essential for consumer empowerment and fair market functioning".

These findings are supported by the draft single market (DSM) supporting study³¹¹ that concludes that, overall, the majority of governmental and some industry stakeholders stated that the EECC did provide benefits to end-users. This indicates that the EECC reached its objective of promoting consumer choice, thanks to the provisions facilitating early termination of contracts, number portability and easy switching. This positive effect can also be observed in the data³¹² according to which both fibre coverage as well as 5G availability and subscriptions increased.

The sector-specific end-user rights provisions in **Articles 98-116** of the EECC complement general horizontal consumer protection rules, including the Directive 2011/83/EU on consumer rights, since there are sector-specific issues in the market which justify additional rules to protect end-users.

Article 123 of the EECC on "Specific review procedure on end-user rights" requires that the Commission, taking utmost account of the BEREC opinion, shall publish a report on the application of end-user rights and shall submit a legislative proposal to amend where necessary to ensure that the objectives set out in Article 3 of the EECC continue to be met.

The general objectives in Article 3 include promoting the interests of the citizens by enabling maximum benefits in terms of choice, price and quality on the basis of effective competition by ensuring high and common level of protection for end-users through the necessary sector-specific rules.

The BEREC Opinion on the market and technological developments and on their impact on the application of rights of end-users in the EECC was adopted by BEREC in December

³⁰⁷ ITU (2025): Measuring digital development State of digital development and trends in the Europe region: Challenges and opportunities, February 2025, page 1.

³⁰⁸ <https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-prices-europe-2022>; Study provides data on 2022 retail prices of fixed and mobile broadband offers for consumers in the EU27, the UK, Iceland, Norway, Japan, South Korea and the United States.

³⁰⁹ Special Eurobarometer 560. E-Communications and Digital Single Market. 2026.

³¹⁰ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14709-Digital-Networks-Act%20_en.

³¹¹ "DSM supporting study" refers to forthcoming supporting study "Study Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks".

³¹² The DSM supporting study 2025 section 4.1.2.

2024³¹³. The first BEREC opinion was adopted in 2021³¹⁴. The 2024 opinion considers the current end-user provisions to be *”future-proofed, ensuring that end-user rights are upheld despite ongoing developments in the electronic communications sector. In most cases, the framework’s robust structure allows it to adapt to new challenges and technological changes. However, there are some areas where improvements could be made to enhance its efficiency and end-user experience.”*

As of 21 December 2020, by virtue of the EECC definitions, the **ePrivacy Directive**³¹⁵ applies to public electronic communications networks, all electronic communications services, including number-independent interpersonal communications services. Given the technological evolution and the new challenges in this regard, the relevance of the current directive and to what extent it is fit for purpose is under consideration. Some telecom-specific/number-related provisions such as the presentation and restriction of the calling and connected line identification, and especially, for tracing malicious, nuisance or fraudulent calls, remain relevant but need to be updated, and taking also into account the evolution of networks and services (e.g., transition to all IP networks).

Article 4 of the Open Internet Regulation (EU) 2015/2120 (OIR) on transparency measures for ensuring open internet access, contains provisions that are complementary to the end-users rights in the EECC (Article 4 OIR establishes obligations for internet service access providers, while the EECC end-users provisions contain obligations for electronic communications service providers, except internet access service providers). As mentioned above, the European Commission’s report on the implementation of the OIR of 2023³¹⁶, concluded that the provisions of the Regulation, including Article 4, are still fit for purpose. In view of a possible simplification and streamlining of the electronic communications legal framework, Article 4 OIR could be merged with the rest of end-user rights provisions of the EECC, without substantial changes in the merit.

The Commission’s Call for evidence on the Digital Networks Act in 2025³¹⁷ showed that Member States, NRAs and consumer organisations support maintaining high-level of protection of consumers in the sector, while simplifying the rules where possible. Most operators and service providers called for simplification and removal of sector specific rules, where justified, in view of existing horizontal consumer law and for removal of protection in business-to-business transactions. However, many stakeholders, including several companies, agree on the necessity for sector-specific rules especially mentioning number portability and switching.

³¹³ <https://www.berec.europa.eu/en/all-documents/berec/opinions/berec-opinion-on-the-market-and-technological-developments-and-on-their-impact-on-the-application-of-rights-of-end-users-in-the-eecc-article-123>.

³¹⁴ BoR(21)177
https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/12/BoR_%2821%29_177_BEREC_Opinion_-_Art._123_EECC.pdf.

³¹⁵ [Directive - 2002/58 - EN - eprivacy directive - EUR-Lex](#).

³¹⁶ <https://digital-strategy.ec.europa.eu/en/library/second-report-implementation-regulation-open-internet-access>.

³¹⁷ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14709-Digital-Networks-Act%20_en.

8.1. Effectiveness

The evaluation of effectiveness of the EECC end-user rights considers how successfully the benefits in terms of choice, price and quality and high and common level of protection for end-users have been achieved. According to BEREC³¹⁸, most of the sector-specific consumer protection rules are fit for purpose and ensure the objectives of the EECC continue to be met. These findings indicate that the EECC reached several of its related objectives concerning end-user rights.

On broadband speeds, as mentioned above, compared to other countries around the globe, most end-users in the EU lose out in terms of median mobile broadband speed.³¹⁹ On fixed broadband median speeds the situation is only slightly better with most countries behind the US, South Korea and Japan.

The EECC opts for a maximum harmonisation approach (**Article 101**) for the applicability of the same rules across the Union. This aims to reduce single market barriers created by divergent implementation of rules and improve its functioning especially for cross-border providers. The effectiveness of this provision has been reduced by the possibilities included in various EECC end-user rights articles³²⁰ for national rules. These possibilities exist in several different paragraphs of the end-user rights articles. Member States have also widely used the possibilities. However, a distinction should be made between transposition *stricto sensu* – many Member States included the possibility to derogate in their transposition measures - and the effective use of the derogation³²¹. According to Commission's own analysis, the transposition of a future possibility to derogate has been done by 5 – 26 Member States (depending on the provision). According to BEREC collected data, 4 – 15 Member States of them have also effectively used the possibilities, based on a sample of 25 Member States³²².

In stakeholder feedback to the targeted survey, collected by the DSM supporting study³²³, some stakeholders (companies, business associations and a few NRAs) sought full harmonisation across the EU together with partial removal of EU level sector specific rules. The respondents mention that it would reduce administrative burden, lower compliance costs and enhance the delivery of cross-border services. The regulatory fragmentation of the consumer protection rules has been mentioned by industry stakeholders³²⁴ as a barrier to a Single Market for telecommunications preventing operating at scale or offering consistent cross-border services to business customers and increasing compliance costs. However, BEREC, in its 2024 opinion of Article 123 EECC, refers to Member States concerns of loss of

³¹⁸ BEREC Opinion [BoR\(24\)180](#) Figure 4, Figure 3.

³¹⁹ See [Speedtest Global Index – Internet Speed around the world – Speedtest Global Index](#), latest ranking from November 2025.

³²⁰ Articles 102(6), 102(7), 103(4), 105(1), 105(4), 105(6), 106(6) for NRAs to establish details, 107(5), 110(2), 115(2) and 115(3).

³²¹ DSM supporting study.

³²² BEREC Opinion BoR(24)180. Figure 7, covering 25 Member States.

³²³ Supporting study “Completing the Digital Single Market: Regulatory enablers for cross-border networks.”

³²⁴ Feedback on the Commission White Paper “How to master Europe’s digital infrastructure needs?” https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14168-White-Paper-How-to-master-Europes-digital-infrastructure-needs?_en and Connect Europe study “A simplification Agenda for European telecoms 2025”.

certain elements of consumer protection in full harmonisation and confirms that a certain level of flexibility remains necessary to achieve the objectives in EECC Article 3.

End-user rights **Article 102** “Information requirements for contracts” and related **Annex VIII** include provisions on the information requirements for contracts and sets the obligation on the contract summary template. The template was included in the Commission **Implementing Regulation (EU) 2019/2243**. The contract summary aims to identify the main elements of information for the benefit of end-users to make free and informed choices that contribute to the effective achievement of the general objectives in Article 3.

According to the DSM supporting study most industry stakeholders and many public sector stakeholders note that consumers are encountering an information overload when being presented with the contract and the supporting documents. They mention that there is too much information, and of a very technical nature. In its 2024 opinion, also BEREC notes the issue of information overload and that some NRAs have raised the issue of excessive information obligations. The European Consumer Organisation BEUC is in general inviting to consider an obligation to provide consumers with a summary of the General Terms and Conditions to help to partly counteract the asymmetry of knowledge created by the sheer volume of information that consumers are required to process.³²⁵

The **contract summary** obligation is scoped widely to electronic communications service providers, including number-independent services. According to BEREC³²⁶, the contract summary today is used as a tool to record the most important terms of the contract for the end-user to check before agreeing to them as well as for later reference. It has had a positive impact on the effectiveness. Furthermore, BEREC considers the contract summary an important element enabling end-users to make free and informed choices. The European Consumer organisation (BEUC) highlights that the EECC’s end-user rights chapter provisions on different aspects, including contract summaries, have proven essential for consumer empowerment and fair market functioning. These rules enable informed consumer choice³²⁷. According to DSM supporting study some stakeholders mention that the contract summary is already a step in the right direction, but some stakeholders note that consumers often receive the contract summary right before signing their contract and it cannot be effectively used to compare offers. The European Consumer Organisation BEUC mentions³²⁸ that its members report on certain operators failing to adequately provide their contract summaries with enough time in advance to consumers.

The EECC **Article 103** requires that NRAs ensure that end-users have access free of charge to at least one independent comparison tool. In its report in 2023³²⁹ BEREC reported on comparison tools. Comparison tools are implemented in different ways and only in one Member State it was possible to compare number-independent interpersonal communications services. There were also countries where the NRA certifies an independent provider. In 12 of

³²⁵ “Towards European Digital Fairness”. BEUC framing response paper for the REFIT consultation. https://www.beuc.eu/sites/default/files/publications/BEUC-X-2023-020_Consultation_paper_REFIT_consumer_law_digital_fairness.pdf.

³²⁶ BEREC Opinion [BoR\(24\)180](#).

³²⁷ [Feedback from: BEUC - The European Consumer Organisation](#).

³²⁸ BEUC response to the public consultation on the European Commission White paper “How to master Europe’s digital infrastructure needs?”. 2024.

³²⁹ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-comparison-tools-and-accreditation>.

the 15 countries where the tool was already implemented at the time of the BEREC report, the comparison tool can compare bundles. The main advantage of comparison tool is the possibility to compare prices and tariffs, while advertised speed is the criterion most frequently used by comparison tools. In most countries the certification regime for comparison tools was not yet in place. The main challenges faced in the implementation of the comparison tool were reported as the data collection, the design and testing of the algorithm used to order the offers, the definition of the requirements of the tool and its update and maintenance.

Some NRAs mentioned that the development of AI will affect the understanding and use of ECSs. The DSM supporting study mentions an absence of publicly available data on user engagement with NRA comparison tools or on their perceived usefulness, limiting the ability to assess their impact on consumer decision-making.

Information on the quality of service (QoS) (**Article 104** and **Annex X** in addition to requirements in Annex VIII), such as maximum download and upload speeds, supports consumer choice. According to Eurobarometer findings speed (together with pricing and bundle offers) is one of the most important factors for consumers when choosing an internet provider³³⁰.

BEREC adopted³³¹ QoS parameters of fixed networks and mobile networks in 2024. BEREC opinion on end-user rights³³² highlights the importance of quality-of-service parameters of the EECC that complement Article 4(1) of the Open Internet Regulation (EU) 2015/2120. Sixteen NRAs reported using the option under Article 104 of the EECC to require internet access and publicly available interpersonal communications service providers to publish information on service quality. While quality of service parameters rely on technical information, providing methodology and standards, this was viewed by some stakeholders as being more directly relevant to comparison by providers among themselves and for regulatory purposes rather than for the benefit of end-users.³³³ In its opinion, BEREC also notes the growing importance of comprehensive information on quality of service and mentions the value of having information regarding “quality of experience” that may have greater utility than QoS. According to the Eurobarometer findings, nine in ten Europeans are satisfied with the upload and download speed of their internet connection at home. Since 2020, the overall level of satisfaction has increased substantially for both types of speed.³³⁴

In general, BEREC³³⁵ assesses that the provision on end-user rights during the contract (**Article 105**) are effective. Most of the provisions³³⁶ of the article are scoped to all end-users. This raises issues on relevance of applicability to business-to-business relations discussed below.

³³⁰ Special Eurobarometer 560. E-Communications and Digital Single Market.2026

³³¹ BEREC Guidelines detailing Quality of Service Parameters of 7 March 2024, BoR (24) 42.

³³² [BoR\(24\) 180](#).

³³³ [BoR\(24\) 180](#).

³³⁴ Special Eurobarometer 560. E-Communications and Digital Single Market. 2026.

³³⁵ [BoR\(24\) 180](#).

³³⁶ Article 105(1) on maximum commitment period is scoped to consumers, microenterprises, small enterprises and not-for-profit organisations as specified in article 105(2).

The DSM supporting study refers to some stakeholder feedback about consistency with the case law of the European Court of Justice and ruling C-326/14³³⁷ (based on the rules preceding the EECC) that contract price increases resulting from indexation do not give the consumer the right to cancel the contract (as detailed in the ruling). In its opinion, BEREC highlights a concern relating to price increases during the contract. According to the Eurobarometer findings seven in ten Europeans (70%) have not been notified of an increase in price by their internet provider during their current contract³³⁸.

On contract duration, BEREC³³⁹ observed that for the most part Member States use provisions which mandate shorter (than 24 months) maximum contractual commitment periods on basis of **Article 105(1)**. According to Commission's own analysis, 13 Member States have made use of this option, setting periods between 6 – 12 months or a combination of 12-month and 24-month. Connect Europe study³⁴⁰ notes that Denmark imposes a six-month limit for consumers. Germany, similar to some other Member States (France, Croatia, Italy, the Netherlands and Poland,) apply legacy rules, originally introduced under the repealed Universal Service Directive, to maintain the availability of at least one 12-month contract option. Providers that wish to offer their services cross-border within the EU may find a disincentive in the different maximum periods of contract duration that some stakeholders see as excessive.

The rules on switching and number portability (**Article 106**) support end-users in benefiting from a competitive market. By decreasing the switching costs, the provisions stimulate competition in the telecom sector since they decrease the switching costs of the consumers³⁴¹. The Article is scoped to all end-users, but it has also been questioned³⁴² whether business customers should be protected and granted the receiver-led switching process.

In a poll done by Connect Europe among 9600 European adults (aged 18-64) in 2024, 44% of respondents mentioned that they switched mobile communications providers in the past 5 years. 39% of all respondents had already switched provider for fixed internet in the last five years. 58% of respondents find it simple and quick to switch telecom providers.³⁴³ The Eurobarometer shows that nearly six in ten Europeans (57%) have changed bundle service providers. Nearly half of Europeans (46%) who have changed service package provider have not experienced any problems.³⁴⁴ A stakeholder study³⁴⁵ mentions that competition and end-user empowerment has advanced significantly through switching rights. On this basis, the rules on provider switching and number portability appear to have been effective in achieving

³³⁷ Judgment of 26 November 2015. Verein für Konsumenteninformation v A1 Telekom Austria AG, Case C-326/14, EU:C:2015:782.

³³⁸ *Special Eurobarometer 560. E-Communications and Digital Single Market*. 2026

³³⁹ [BoR\(24\) 180](#) and Figure 7.

³⁴⁰ Connect Europe study “A simplification Agenda for European telecoms 2025”.

³⁴¹ Supporting study “Completing the Digital Single Market: Regulatory enablers for cross-border networks.”, forthcoming.

³⁴² [BoR\(24\) 180](#).

³⁴³ Connect Europe, *Europe's Digital Pulse Connectivity Trends and Consumer Insights*, 2024, https://connecteurope.org/sites/default/files/2024-10/Ipsos%20ConnectEurope%20Consumer%20survey_Report.pdf.

³⁴⁴ *Special Eurobarometer 560. E-Communications and Digital Single Market*. 2026.

³⁴⁵ Connect Europe study “A simplification Agenda for European telecoms 2025”.

the objectives of the EECC in terms of choice on the basis of effective competition. BEUC mentions that a member still reports lock-in measures that prevent consumers from easily switching operator for better offers on connectivity³⁴⁶. According to BEREC³⁴⁷ one of the most common complaints received by the NRAs is related to provider switching and number portability. In its opinion, BEREC highlights that the requirement to ensure there is a minimum (or no) service interruption during the switching process is a key requirement to achieve the objective to encourage end-users to compare. Furthermore, BEREC mentions that switching scenarios involving satellite operators and tying contractual commitments to devices provided by satellite operators should be studied more in detail.

The EECC **Article 106** on provider switching and number portability carried over Article 30 of the Universal Service Directive which already included that operators must port and activate numbers within the shortest possible time. The additional impact of the EECC in effectiveness is therefore not easy to assess. Evidence from some Member States³⁴⁸ shows continued increase in switching after the applicability of the EECC.

According to BEREC³⁴⁹, there's a growing trend of bundled services across the EU. The Eurobarometer findings show that over six in ten Europeans (64%) have subscribed to two or more services as part of a bundle with fixed internet access, mobile telephone and television channels being the most frequently included services. Most NRAs agreed that the provisions on bundled offers (**Article 107**) are effective. However, some issues were flagged by NRAs. For example, some found that Article 107 is unclear on the ability of end-users to terminate a bundled service when the service works well, but the mobile device (or another product in the bundle) does not, and legal remedies, such as warranties instituted by the rules of contracts for the sales of goods or for the supply of digital content, are inapplicable. According to BEREC, there are also questions about bundled contracts with separate minimal periods applicable to separate services.³⁵⁰

The supporting study points out that under the current definition,³⁵¹ an IoT device is considered terminal equipment, if it is connected directly or indirectly to a public communications network. If an IoT device is connected to a private communications network, it may be not seen as a terminal equipment.³⁵² This would result in Article 107(3) EECC not being applicable to the end-user contract that includes such an IoT device.³⁵³

³⁴⁶ BEUC response to the public consultation on the European Commission White Paper “How to master Europe’s digital infrastructure needs?”. 2024.

³⁴⁷ [BoR\(24\) 180](#)

³⁴⁸ DSM Supporting study.

³⁴⁹ [BoR\(24\) 180](#)

³⁵⁰ [BoR\(24\)180](#).

³⁵¹ Art. 2 Nr. 41 EECC in conjunction with Art. 1 point (1) of the Commission Directive 2008/63/EC of 20 June 2008 on competition in the markets in telecommunications terminal equipment, OJ L 162, 21.06.2008: <https://eur-lex.europa.eu/eli/dir/2008/63/oj/eng>.

³⁵² Even though private networks are not yet widespread and are only implemented by large companies, such as the Port of Rotterdam, Schiphol Airport Amsterdam, the relevance of said technologies will only increase with more future use cases of IoT such as fleet management, agriculture, etc. cf. BoR (23) 41.

³⁵³ For example, in DK car manufactures also fall under the term terminal equipment. This expanded definition can strengthen end-user rights.

On **Article 109**: the 2024 Report of the Commission to the European Parliament and Council on the implementation of the single European emergency number ‘112’³⁵⁴ highlights the continued implementation of packet switched technologies in Member States both in emergency communication services and Public Safety Answering Points (PSAP). This technological change is triggered by the broader trend of migration to 4/5G networks and 2/3G switch-off. The report indicates that the implementation of handset-derived caller location continued to improve in the EU. 25 Member States ensure that their PSAP system is AML enabled. However, only eight Member States confirmed that handset-derived location is available for roaming end-users. In addition, the report shows that end-users with disabilities do not yet benefit from fully equivalent means of access to emergency services, especially when roaming. When these end-users are not able to place a call to ‘112’, they have to rely on nationally fragmented solutions. However, this situation is expected to change as Member States are preparing their PSAP systems to handle and electronic communication service providers are preparing to deploy interoperable real time text by June 2025 in line with the requirements of the European Accessibility Act. The Delegated Regulation 444/2023 adopted under Art 109(8) further specifies caller location criteria parameters, equivalence requirements for end-users with disabilities and need to upgrade the PSAP system to packet switched technology.

As stated in the BEREC Opinion³⁵⁵ most of surveyed NRAs consider the Public Warning Systems (**Article 110**), Directory Enquiry Services (**Article 112**), Interoperability (**Article 113**), and ‘Must Carry’ Obligations (**Article 114**) to be clearly outlined in the EECC.

Article 110 of the EECC provides for the implementation of public warning systems (PWS) in mobile networks, that is Cell-broadcast or SMS based PWS. Currently 10 Member States did not notify the implementation of compliant PWS.

Article 112 on directory Enquiry Services requires that all providers of number-based interpersonal communications services meet all reasonable requests to make available directory enquiry services and directories, the relevant information in an agreed format, on terms which are fair, objective, cost-oriented and non-discriminatory. According to the DSM supporting study’s evaluation, some companies and business associations think that it should be completely removed. On the other hand, almost the same number of NRAs state that the current provisions should not be changed. The same opinion is shared by consumer protection associations and some companies as well as³⁵⁶. Given the divide in answers, it can be concluded that there is no solid evidence or arguments for introducing changes to this provision nor for maintaining it given the evolution of other functionally equivalent services. The consequences from the possibility for different treatment of end-users’ data in directories under the e-privacy Directive and in other functionally equivalent services under the GDPR should be assessed in updating the directory and directory enquiry services provisions.

On **Article 113** on interoperability of car radio, consumer radio receivers and consumer digital television equipment BEREC notes that the provisions are clearly outlined in the EECC, though several NRAs have reported challenges in implementation³⁵⁷. The single

³⁵⁴ <https://digital-strategy.ec.europa.eu/en/library/2024-report-implementation-eu-emergency-number-112>.

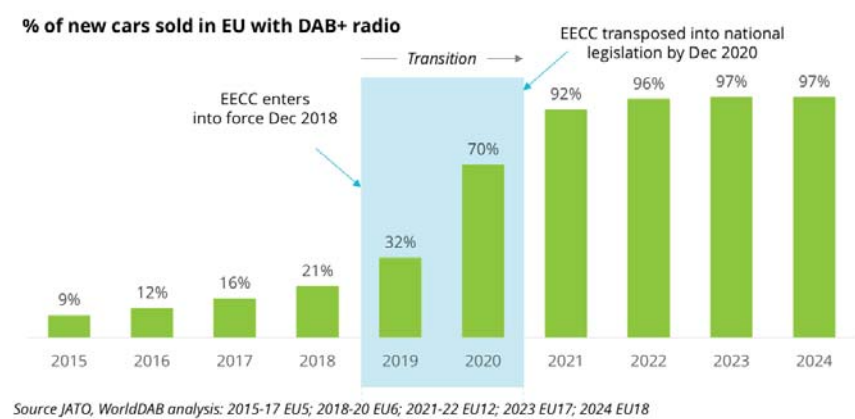
³⁵⁵ BoR(24) 180. <https://www.berec.europa.eu/en/all-documents/berec/opinions/berec-opinion-on-the-market-and-technological-developments-and-on-their-impact-on-the-application-of-rights-of-end-users-in-the-eecc-article-123>.

³⁵⁶ Reference to the DSM supporting study.

³⁵⁷ BoR(24) 180.

market supporting study noted that the measure of mandating all car radios integrated in new vehicles to be equipped with radios enabled to allow digital audio broadcasting/DAB+ reception has worked well. In 2018, when the new measure had been adopted as part of the EECC, only 21% of new cars were sold with a DAB+ radio. This figure rose to 70% in 2020, by which time the measure had to be transposed in all Member States and finally reached 97% in 2024.

Figure 17: % of new cars sold in selected EU countries³⁵⁸, 2015-2024



In 15 EU Member States 97% or more of cars are equipped with DAB+ radios.

Figure 18: % of new cars sold by 2024, per country

Country	% new cars with DAB standard	Country	% new cars with DAB standard
Romania	99%	Poland	97%
NL	99%	Croatia	97%
Belgium	99%	Czechia	97%
Denmark	99%	Sweden	97%
Portugal	99%	Hungary	97%
Spain	99%	Slovenia	97%
Slovakia	98%	Italy	96%*
France	98%	Germany	95%*
Austria	98%	Greece	92%*

Source JATO (EU18) , WorldDAB analysis. Note: * In Germany, for 4% of cars it was not known whether they had DAB or not. For Italy, the figure was 1% and, for Greece, 0%

The effectiveness of the measure has also contributed to more EU Member States being covered by DAB+ radio broadcast networks (the latest information is about launch in Estonia in September 2025 and in Luxembourg in November 2025) and to substantial increases in coverage of existing DAB+ networks in some other Member States (France and Spain). DAB+ broadcast networks are available in the vast majority of Member States, with an

358 2015-17: Denmark, France, Germany, Italy, Netherlands; 2018-202: same countries plus Belgium; 2023: same countries plus Austria, Czechia, Poland, Portugal, Spain, Sweden; 2024: same countries plus Slovenia.

increasing number of radio channels available³⁵⁹. Only in Belgium several regions have adopted requirements for consumer radio receivers other than car radios to include a DAB+ receiver, in accordance with Article 113(2) EECC³⁶⁰.

Art. 114 EECC leaves the possibility of imposing a reasonable must carry obligation to the discretion of Member States, in particular in relation to end-users with disabilities. The majority of respondents to the targeted survey (almost half of all NRAs, quite some companies, most consumer protection associations) find that there should be no change to the must carry obligations³⁶¹ which is a proof that the provision has confirmed its effectiveness and therefore, maintaining it seems a reasonable way forward.

8.2. Efficiency

As pointed already by the previous evaluation of the framework³⁶² the efficiency of the rules depends on the transposition by Member States that determine the costs and benefits for different stakeholders. The possibilities included in the framework for Member States to maintain or introduce divergent rules in several end-user rights provisions result in varying benefits for end-users and compliance costs for providers and makes an efficiency assessment difficult.

The single market supporting study highlights simplifying information provisions for efficiency. There is no clear conclusion whether the amount of information that an operator must provide under **Article 102** is efficient. Simplifications could be made, amongst which reducing duplications (overlaps with general consumer protection law), streamlining publication requirements and simplifying the language. Industry associations argued for decreasing the regulatory burden resulting from end-user provisions in the EECC, while one association also noted that changing the status quo will result in new costs. As regards the benefits of Article 102, BEREC³⁶³ considers that the current EECC provisions concerning the conclusion of contracts, the contract summary template (Article 102, Annex VIII) and the accompanying implementing act (Commission Implementing Regulation (EU) 2019/2243) are important elements of the regulatory framework enabling end-users to make free and informed choices based on complete, timely and understandable contractual information. BEUC³⁶⁴ highlights the benefits of the EECCs end-user rights chapter in general, including provisions on contract summaries, that have proven essential for consumer empowerment and fair market functioning. According to BEUC, these rules enable informed consumer choice and ensure minimum guarantees.

³⁵⁹ World DAB summit, 20 November 2025, see https://issuu.com/worldddb/docs/worlddab_summit_2025_brochure/3?ff

³⁶⁰ In the Walloon region, legislation has been adopted requiring that all radio receivers need to have a DAB+ receiver, with the exception of low-value receivers which do not have an alpha-numeric display. The Flanders region requires all equipment sold in Flanders intended for the reception of FM radio signals from a radio broadcaster to be able to receive digital radio signals. Exempted is equipment used by radio amateurs, smartphones and tablets. See Belgium | Countries | WorldDAB.

³⁶¹ Supporting study “Completing the Digital Single Market: Regulatory enablers for cross-border networks, forthcoming.

³⁶² Commission Staff working Document SWD(2016) 313. 14.9.2016.

³⁶³ [BoR\(24\) 180](#).

³⁶⁴ BEUC response to the Call for Evidence on the forthcoming Digital Networks Act (DNA). 2025.

The DSM supporting study gives an example of the efficiency of the **Article 113** on interoperability of car radio and consumer radio receivers and consumer digital television equipment. Although the provision is considered as effective, in terms of its efficiency, it could have some adverse effects, beyond increasing the cost for buyers of new cars because of the increasing take-up of alternatives like internet radio and Bluetooth speakers³⁶⁵. Based on the supporting study's evaluation findings, a potential simplification could be applied to this Article and in particular, the related Annex XI. This simplification would involve making the provision more technologically neutral. Doing so would help to avoid barriers to innovation and improve the efficiency of the regulation.

BEREC³⁶⁶ also explored potential ways to reduce the administrative burden on providers. Certain obligations **in Articles 105 to 107** may not serve a meaningful purpose for business customers (legal entities), which fall under the scope of the end-user definition.

Another aspect mentioned by stakeholders is the amount of information during the conclusion of contracts with end-users and possible inconsistencies between various pieces of European legislation related to user and consumer rights, for example regarding transparency obligations. Industry stakeholders mention in this context an increasing regulatory burden for European telecom operators over the past decade³⁶⁷.

8.3. Relevance

Sector-specific end-user protection rules are especially relevant for sector specific issues that are not covered in other EU legislation. The DSM supporting study concludes that there is consensus among government stakeholders that the EECC remains a relevant framework that protects and strengthens consumer rights. For example, contract termination and provider switching (**Articles 105-106**) are particularly relevant considering 5G, the copper switch-off and the provision of emergency services.

In its feedback, BEUC has highlighted a rise in consumer complaints, many originating in the electronic communications sector³⁶⁸. Those complaints concern issues such as unilateral price hikes or lower quality of service, and misleading marketing of offers to lock-in measures. Consumer organisations have also reported price hikes and too few competitive offers and multiple disparities across Member States between advertised offers and the actual service provided, especially regarding fibre to the home or 5G. According to the DSM supporting study's targeted consultation, a limited number of public sector stakeholders and several industry associations said that there should be no extension or change to the end-user rights or that these provisions should even be deleted to avoid redundancy since they are covered by horizontal legislation³⁶⁹.

The EECC **Article 103** requires that providers of internet access and interpersonal communications services publish information (detailed in EECC Annex IX), including description of the services offered, about their services. The targeted stakeholder consultation carried out by the DSM supporting study shows the continued relevance of this provision with

³⁶⁵ Reference in Section 4.6.3.2 of the Final 1st Interim Report on "Completing the Digital Single Market".

³⁶⁶ [BoR\(24\) 180](#).

³⁶⁷ Connect Europe study "A simplification Agenda for European telecoms 2025".

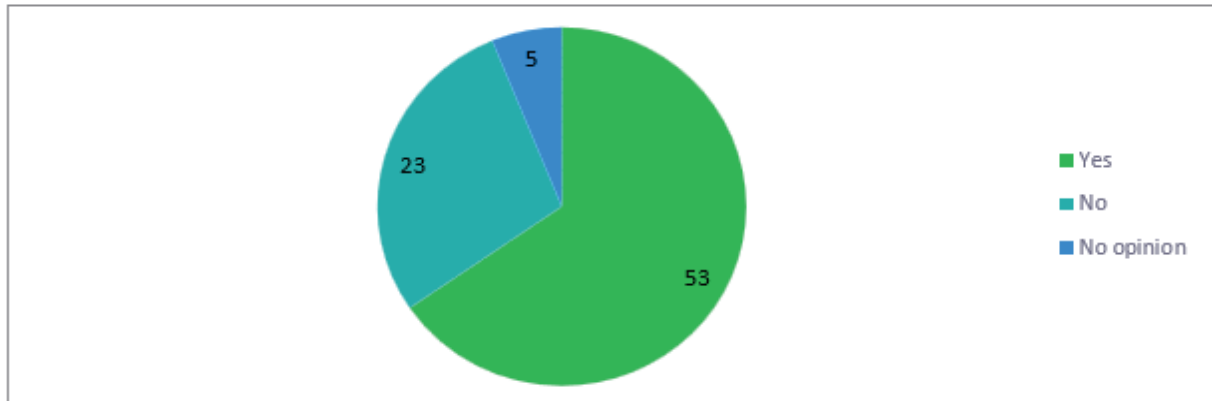
³⁶⁸ <https://www.beuc.eu/position-papers/mind-connectivity-gap-making-digital-infrastructure-work-consumers>.

³⁶⁹ DSM supporting study.

most respondents (53 out of 81 answers in total) finding the provision beneficial as shown in the figure below³⁷⁰.

Figure 19: Stakeholder views: Publication of information (e.g. description of offered services) by providers beneficial Y/N

Is the provision (Art. 103 and Annex IX EECC) requiring NRAs to ensure that providers of internet access and interpersonal communications services, which make their services subject to terms and conditions, publish certain related information beneficial?



Some business associations consulted in the context of the DSM supporting study believe that there are commercial clients who reap the benefits of end-user rights, even though they are not as vulnerable as consumers, for example, it could be questioned whether Articles 105(3) (notice period after automatic prolongation), 105(4) (rights of termination before end of contract), 105(6) (compensation before end of contract) should in general apply to all end-users.³⁷¹ The scope of end-user protection in electronic communications is wider than that of horizontal consumer legislation that applies to business-to-consumer commercial practices³⁷². BEREC³⁷³ noted that it was found that certain obligations may not serve a meaningful purpose for business customers (legal entities). One key observation was that the obligation in **Article 105(3)**, which requires providers to offer end-users the best tariff information at least annually, seems unnecessary for business customers with bespoke contracts. The lacking relevance of the obligation to give business end-users best tariff information is confirmed by the targeted stakeholder consultation carried out by the DSM supporting study. In the consultation many respondents argue for the removal of the extension of end-user protection to B2B relations (i.e. end-user protection should apply only to consumers). A stakeholder gave an example of the requirement to inform all end-users yearly about the most advantageous tariffs, which is irrelevant for "bespoke business such as the Large/Enterprise market" where no comparable tariffs exist.

³⁷⁰ Supporting study Annex 3 Survey results.

³⁷¹ Note that Art. 105(4,6) apply to end-users apart from transmission services used for machine-to-machine services for which those rights are exclusively applied to consumers, microenterprises, small enterprises or not-for-profit organisations.

³⁷² Alexiadis, P., Bourreau, M., Cave, M., De Streel, A., Feasey, R., Godlovitch, I., Manganelli, A., Monti, G., Shortall, T., Timmers, P., The Future of European Telecommunications: In-depth Analysis, p. 74-76, 2024.

³⁷³ BoR(24) 180.

An issue of increased relevance is the use of eSIMs in connected objects and the possibilities of switching. The eSIM market is significantly increasing³⁷⁴. Number porting of eSIMs is covered under **Article 106** EECC, and consumers should be easily able to port their numbers to other providers. However, manufacturers of devices i.e., mobile phones, tablets, IoT devices, etc. could limit specific eSIM profiles. BEREC noted³⁷⁵ that it might harm competition and lead to significantly higher prices for electronic communications services in devices reliant on eSIM-based connectivity if it is not possible to switch provider.

New issues of increasing relevance are the price indexation increases during the contract, which is an issue for possible further clarification of the rules in line with the horizontal consumer protection legislation³⁷⁶. According to BEREC, some NRAs have also observed that the additional facilities listed in **Annex VI** of the EECC (enabling Member States to *impose* on providers obligations such as to offer pre-payment and phased payment options) have become less relevant as they are increasingly provided voluntarily, on a commercial basis. The targeted stakeholder consultation carried out by the DSM supporting study asked whether the facilities referred to in Annex VI are beneficial to end-users. The views were divided, the results showed that around half of respondents (39 out of 75 answers in total) did not consider the facilities beneficial and around half of the respondents considered them beneficial or did not give an opinion. BEREC considered in its opinion appropriate to evaluate the possibility of making facilities such as cost control, itemised billing, and the deactivation of third-party billing mandatory.

BEREC³⁷⁷ considers that the contract summary (**Article 102**) is likely to have an increasingly important role to play for end-users, though its relevance for comparison has decreased. The development of artificial intelligence could also benefit the development of comparison tools.

Article 107 rules on bundled contracts remain highly relevant. According to the Eurobarometer³⁷⁸ over six in ten Europeans (64%) have subscribed to two or more services as part of a bundle with fixed internet access, mobile telephone subscriptions and television channels being the most frequently included services. The BEREC external Study on Communication Services for Businesses found that telecom and ICT bundling is widespread.³⁷⁹ In 2022 40-50% of 1,000 European business interviewed indicated that they subscribed to bundles of ECS and cloud storage and/or collaborative solutions. 30-40% of IT services are subscribed with an ECS bundle.

An increased reliance on NI-ICS for interpersonal communications has raised a question on re-evaluating the end-user rights for traditional electronic communications services and NI-ICS to reduce regulatory gaps and improve its relevance. Some industry associations are of the opinion that Articles 98-115 EECC provide a robust framework for traditional telecom

³⁷⁴ GSMA, 2024, eSIM Market China and Beyond, <https://www.gsma.com/solutions-and-impact/technologies/esim/wp-content/uploads/2024/07/GSMA-Welcome-and-eSIM-Market-China-and-Beyond.pdf?ref=mobimatter.com>.

³⁷⁵ BoR (24) 180

³⁷⁶ Council Directive 93/13/EEC on unfair terms in consumer contracts.

³⁷⁷ BEREC Opinion BoR(24)180.

³⁷⁸ Special Eurobarometer 560. E-Communications and Digital Single Market. 2026.

³⁷⁹ BoR (22) 184, interviewed 1,000 business users in various countries: DE, FR, PL, SP.

operators but are not projected well onto NI-ICS providers. Industry stakeholders pointed out that it might be necessary to extend **Article 109** EECC to include NI-ICS in the EECC³⁸⁰.

Concerning **Article 113** during the consultation period on the European Commission's Call for Evidence organised on the Digital Networks Act in July 2025, the provisions, in general, were assessed as relevant by the concerned stakeholders. Furthermore, some of them insist that all new vehicles of categories M and N placed on the EU market to be equipped with radio receivers supporting FM, DAB+, and IP radio. This ensures interoperability, allows seamless switching between platforms, and guarantees continued access to free-to-air radio across all environments. Furthermore, in times of crises, such as natural disasters or major emergencies, broadcast radio plays a critical role in keeping the public informed. When all else fails, broadcast radio is the only way for people to stay up to date with news and public safety alerts and recommendations. The recent power outage in Spain and Portugal highlighted the crucial role of radio. However, relevance should be assessed from more angles, including the nuanced views under the efficiency analysis in paragraph 8.2. of this Report. The role of radio broadcasting as a measure for disseminating public warning communications, complementary to those mandated by the EECC for providers of mobile number-based interpersonal communications services has so far been raised only by broadcasters and by car radio manufacturers.

The "must carry" obligation in **Article 114** had been justified by national circumstances which proves the relevance of such article³⁸¹. National factors, such as social, economic, and infrastructural conditions, can necessitate the application of "must carry" rules to ensure access to radio and television broadcast channels where this is necessary to meet general interest objectives such as media pluralism and cultural diversity³⁸².

As of increased relevance for end-user rights since 2021 BEREC³⁸³ mentions especially the continued growth and importance of data use in mobile communication, increase in demand for connectivity and high-capacity internet connections, the significant increase of fraudulent traffic and scams and the growth of usage of digital platforms. The most important technical developments were deployment of 5G, phase-out of 2G/3G and copper switch-off.

The consumer Trends Report 2024/25 EBA³⁸⁴ notes that payment fraud is one of the most relevant topics inside of the European Union. According to the Eurobarometer³⁸⁵ slightly under a fifth (19%, +6pp compared to results in 2020) of respondents reported receiving a call from an unknown number and being charged for it after answering or calling back, a slight increase since 2020. Since 2020, the share of respondents receiving this kind of calls has increased in 18 countries. Member States implement anti-fraud measures ordering operators to preventively block numbers or services rather than leave it to national authorities that are

³⁸⁰ Draft study "Completing the Digital Single Market".

³⁸¹ BoR(24) 180.

³⁸² The Court of Justice of the European Union has acknowledged that such national differences can justify the imposition of "must carry" obligations, provided they are proportionate and do not infringe on other fundamental rights. This highlights the need for a balanced and context-sensitive application of these rules, aligned with both regulatory principles and local needs. Case C-87/19.

³⁸³ BEREC Opinion BoR(24)180 Figure 4, Figure 3.

³⁸⁴ European Banking Authority, 2025, EBA Consumer Trends Report 2024/25, <https://www.eba.europa.eu/sites/default/files/2025-03/514b651f-091b-42d3-b738-1fae79264044/Consumer%20Trends%20Report%202024-2025.pdf>.

³⁸⁵ Special Eurobarometer 560. E-Communications and Digital Single Market. 2026.

enabled in Article 97(2) to issue orders after case-by-case analysis. These measures aim to balance e-privacy concerns with the need to fight the growing economic and societal impact of fraud schemes perpetrated through interpersonal communication services on end-users.

8.4. Coherence

One of the main coherence aspects of the EECC end-user rights is its alignment with horizontal Union consumer protection legislation. The Consumer Rights Directive (CRD)³⁸⁶ contains general consumer law rules on pre-contractual information, which link with the information requirements for contracts in **Article 102**. Stakeholders have asked³⁸⁷ for an improved alignment of the content of the pre-contractual information that needs to be provided, several industry associations suggesting deletion of what is covered by horizontal legislation.

BEREC's opinion points out that full harmonisation and its interactions (and sometimes clashes) with established interpretations in the areas of contract and consumer law at national level were identified as a concern. BEREC has also raised issues of coherence both internally and externally concerning the beneficiaries of the protection and the different applicability to all end-users, certain groups of end-users or only to consumers. On the rules on bundled offers (**Article 107**), BEREC observed some concern that there is a mismatch between the beneficiaries of the protections of **Article 106(1)** in a stand-alone situation and in a bundle situation, because of the formulation of **Article 107(4)** EECC that includes a possibility to waive all or parts of the provisions.

According to the DSM supporting study operators have mentioned concerns about potential overlap under the EECC Article 108 and the Directive on the resilience of critical entities³⁸⁸.

The EECC and Digital Services Act are considered largely complementary, but according to the DSM supporting study, the scoping to certain NI-ICS could be clarified.³⁸⁹

The Open Internet Regulation (OIR Regulation 2015/2120) and the EECC largely align, though some interplay issues have been mentioned.³⁹⁰ **Article 106** lays out provisions to facilitate provider switching, including for providers that offer internet access. On the other hand, OIR contains a broad baseline provision on the quality of access to internet service that is referred to in the context of the contract summary and Annex VIII.

³⁸⁶ Directive 2011/83/EU.

³⁸⁷ DSM supporting study.

³⁸⁸ Directive (EU) 2022/2557.

³⁸⁹ On the DMA, see BEREC (2021). Report on the interplay between the EECC and the EC's proposal for a Digital Markets Act concerning number-independent interpersonal communication services, BoR(21) 85: [https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_\(21\)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_\(final\).pdf](https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_(21)_85_Report_on_the_interplay_EECC-DMA_on_NI-ICS_-_Clean_(final).pdf).

³⁹⁰ European Commission: Directorate-General for Communications Networks, Content and Technology, ICF, Wik Consult, Godlovitch, I., Wiewiorra, L. et al., Study on the implementation of the open internet access provisions of Regulation 2015/2120, Publications Office of the European Union, 2023, <https://data.europa.eu/doi/10.2759/026383> discusses this incoherence, but also notes that such legal uncertainty has not yet been observed in the market.

The EECC and the Digital Content Directive³⁹¹ can be considered largely complementary though some interplay issues between the two instruments have been pointed out on terminating contracts regarding contract modifications³⁹².

The provisions of **Article 109** on emergency communications are coherent and complementary with other sectoral EU legislation, namely, the European Accessibility Act³⁹³ and eCall legislation³⁹⁴.

When assessing the coherence of the scope with other acts, several governments and industry stakeholders commented on the rules on personal data protection in electronic communications and found incoherence of the ePrivacy Directive with the GDPR and the EECC. A few stakeholders pointed out that, due to the repeal of the proposal for an ePrivacy Regulation, alternative solutions should be sought that align the rules for electronic communications with the GDPR. For instance, unsolicited communications, direct marketing, malicious calls, and cookies may already be sufficiently covered by the GDPR and do not require duplicate sectoral regulation. However, some sector-specific provisions remain necessary³⁹⁵.

8.5. EU added value

The added value of EU sector specific end-user protection rules in the electronic communications sector is two-fold³⁹⁶. It appears essential to continue to regulate key elements specific to the electronic communications market (such as switching and number portability) so that consumers can profit from competition. Second, consumer protection rules are part of the conditions that operators are obliged to comply with when providing electronic communications services and as such have a great impact on the conditions to do business and on the competition within the single market. In this latter context, full harmonisation has generated additional value. Harmonised end-user rules support also interoperability and cross-border services operating at scale, as highlighted by industry stakeholders³⁹⁷.

The principle of maximum harmonisation is set in the EECC **Article 101**. As discussed in the section on effectiveness, many Member States have used the EECC provisions that give Member States possibilities to introduce additional rules in various end-user rights articles³⁹⁸.

³⁹¹ Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services, OJ L 136, 22.05.2019: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019L0770>.

³⁹² See a discussion in: Karin Sein, What rules should apply to smart consumer goods?, 12 (2021) JIPITEC 169: <https://www.jipitec.eu/jipitec/article/view/305/298>.

³⁹³ Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services.

³⁹⁴ Commission Delegated Regulation 2024/1084.

³⁹⁵ DSM supporting study.

³⁹⁶ Discussion in the previous evaluation SWD(2016) 313. 14.9.2016. Evaluation of the regulatory framework for electronic communications.

³⁹⁷ Feedback on the Commission White Paper “How to master Europe’s digital infrastructure needs?” <https://www.ebu.ch/events/2025/10/channels-of-resilience?site=ebu#speakers-4fec4dae-952f-430a-876f-6611995916f0> and Connect Europe study “A simplification Agenda for European telecoms 2025”.

³⁹⁸ Figure 7. BEREC Opinion on the market and technological developments and on their impact on the application of rights of end-users in the EECC (Article 123). BoR(24)180.

This can present a risk of reducing the EU added value and fragmenting the overall market.³⁹⁹ On the other hand, several stakeholders noted that this allows for flexibility, taking national circumstances into account and having more tailored national rules where necessary.

According to the DSM supporting study, almost all public sector stakeholders agree that some provisions in the EECC provide added value beyond the horizontal rules that are in place. Overall, they note that the EECC provides stronger, sector-specific protection to ensure transparency, fair competition, and consumer rights in a rapidly evolving telecom market. Furthermore, the EECC harmonises the extension of certain protections beyond consumers, for example to micro and small enterprises and not-for-profit organisations meaning that also they are better protected throughout the EU. While some industry stakeholders mention the burden that some of the EECC provisions (e.g. contractual information or the added value of **Article 113**) place on operators, the need to ensure resilience of communication of public interest information and of public warnings in disaster situations and in case mobile communication networks are not working or are congested has been highlighted by public service broadcasters and EP parliamentarians⁴⁰⁰.

9. GOVERNANCE

The overall governance as it results in EECC involves the role of several actors, including the Commission, NRAs and other national competent authorities, as for example Spectrum Authorities, BEREC and BEREC Office, and RSPG, interacting among themselves and coordinating horizontally at national level or vertically between the national and the EU⁴⁰¹ level. The allocation of competences has been done according to different modalities, either listing the competences as for example Article 5 EECC on competences of NRAs or allocating specific tasks as for example to BEREC in Article 76 or Article 82 EECC regarding the guidelines. In other cases, the competences were allocated at the stage of transposition normally between competent Authorities and NRA.

9.1. Independence of NRAs

The EECC contains provisions on the functions and independence of the NRAs (Articles 5-11). The Directive provides high-level principles to which Member States need to abide to ensure that the NRAs have the necessary resources (both in terms of budget and staff) to execute their tasks. The Member States maintain a high level of discretion in the actual implementation of the provisions. The novelties introduced by the EECC compared to the previous legal framework relate mainly to strengthening the independence of personnel: the EECC has requirements not only for the dismissal but also for the appointment of the NRA head and members of the NRA board.

In its final report on the independence of NRAs⁴⁰², BEREC distinguished between an independence *de jure*, stemming from the actual provisions, and an independence *de facto*, which is influenced by other elements. EU-level legal provisions on NRA independence leave a lot of leeway for the Member States for their implementation in the national legislation. In

³⁹⁹ This phenomenon of derogations and the following detrimental effects that could arise by “gold-plating” is discussed by Letta, (2024), Much More than a Market, p. 125.

⁴⁰⁰ See <https://www.ebu.ch/video-talks/open/2025/10/channels-of-resilience>

⁴⁰¹ In some Member States, spectrum competences are split between ad hoc spectrum authorises, ministries and NRA. In some cases, NRAs present in BEREC, don't have nearly any competence in spectrum.

⁴⁰² Study on the NRA independence, BoR (22) 189.

addition, the practice of NRA independence (*de facto* independence) varies across countries, leading to even more diversity. As a result, although there is a harmonised *de jure* framework at the EU level, there is still a diversity of *de jure* and *de facto* independence at the national level.

In addition to the independence, Member State shall also ensure that NRAs have adequate financial and human resources to enable them to actively participate in and contribute to BEREC's goals of promoting greater regulatory coordination and consistency.

9.2. BEREC and BEREC Office

The evaluation of BEREC and BEREC Office according to the evaluation criteria (effectiveness, efficiency, coherence, EU added value, relevance) is contained in separate document entitled: Evaluation of BEREC and the BEREC Office. It is attached as Appendix III to this evaluation report.

9.3. Radio Spectrum Policy Group (RSPG)

The Radio Spectrum Policy Group (RSPG) is a Commission high-level advisory group established by ⁴⁰³ to support the Commission in the coordination of radio spectrum policy. Its members are high-level representatives responsible for strategic radio spectrum policy from Member States and, since 2023⁴⁰⁴, from EEA EFTA countries, and observers from the EU candidate countries, the CEPT and ETSI. The RSPG Secretariat is provided by the Commission.

With the entry into force of the EECC at the end of 2018, the RSPG role has been strengthened and tasks expanded to *inter alia* peer review of spectrum assignment procedures under Article 35 of the EECC and good offices to address any problem or dispute in relation to cross-border coordination under Article 28 of the EECC. Additionally, the RSPG assists the Commission in preparatory work for establishing the EU position for the World Radiocommunications Conferences (WRC) pursuant Article 218(9) TFEU. The RSPG also assists Member States and could, upon request, advise the Council and the European Parliament. New tasks were reflected in Commission Decision of 11 June 2019⁴⁰⁵.

Since the beginning of 2020, the RSPG adopted 15 opinions, including on three Commission's consultations, and 11 reports, including three annual reports on the Peer Reviews⁴⁰⁶. Besides its activities stemming from its biennial work programmes, the RSPG accepted all *ad hoc* Commission requests for an opinion, such as on the Mobile Satellite Services in the 2 GHz band.

The main areas addressed in deliverables were related to spectrum for future wireless connectivity, including 6G, spectrum sharing, future use of the UHF band, WRCs and their outcome, satellite connectivity, and climate change. The RSPG deliverables provided valuable

⁴⁰³ Commission Decision of 11 June 2019 setting up the Radio Spectrum Policy Group and repealing Decision 2002/622/EC (OJ C 196, 12.6.2019, p. 16).

⁴⁰⁴ Decision of the EEA Joint Committee No 63/2023 of 17 March 2023 amending Annex XI (Electronic communication, audiovisual services and information society) and Protocol 37 (containing the list provided for in Article 101) to the EEA Agreement [2023/2354].

⁴⁰⁵ Commission Decision of 11 June 2019 setting up the Radio Spectrum Policy Group and repealing Decision 2002/622/EC (OJ C 196, 12.6.2019, p. 16–21).

⁴⁰⁶ https://radio-spectrum-policy-group.ec.europa.eu/opinions-and-reports_en.

input for further EC considerations – for example the RSPG opinion on WRC-23 set a basis for the EU position at the WRC-23 established by a Council Decision – and are welcomed also by stakeholders. In general, all RSPG deliverables contributed to the development of the internal market and to support the development of a Union-level radio spectrum policy. However, as the RSPG adopts deliverables in general by consensus, at least on some sensitive issues, a fine balance needed to be struck between different national interests and the EU and national prerogatives, sometimes regrettably to the detriment of the broader EU benefit. Additionally, , in its Opinions, the RSPG’s tendency has been to focus mainly on technical issues when advising the EC on radio policy issues and to a lesser degree economic, political, cultural, strategic, health and social considerations⁴⁰⁷.

Since the entry into force of the EECC, Member States notified pursuant Article 35 of the EECC to the RSPG 30 draft measures for authorisation of EU harmonised spectrum, but only 10 Peer Review Forums were held. Notifications and Peer Review Forums “replaced” the RSPG peer review platform established in 2016 and authorisation workshops that served for peer learning on the authorisation procedures. In its opinion on the White paper “How to master Europe’s digital infrastructure needs”, the RSPG recognised the value of peer review mechanism for sharing of lessons learned and exchanging of views, leading to award harmonisation and increased transparency among peers. At the same time, the RSPG admitted the peer review could be enhanced. Indeed, due to the peer review’s voluntary nature, the lack of structure and obligation to devote resources and to conduct a thorough assessment of the notified measures, the peer review has been totally unsuccessful in influencing the design of authorisation procedures in a consistent manner in line with the objectives of the EECC for investment in high-capacity connectivity. There has been no tangible modification of authorisation conditions and market shaping elements following the peer review. Furthermore, experience shows that certain assignment procedures, which has raised criticism by market players, have not even been subject to a peer review.

Through its Good Offices subgroup, the RSPG proactively monitored cross-border coordination issues, including harmful interference, related to implementation of the 700 MHz band in the EU. It proposed a coordinated solution for an outstanding interference issue between two Member States pursuant to Article 28(3) of the EECC and together with the EC assisted Member States in cross-border coordination with the third countries. In this way it facilitated the 5G services deployment in the EU, and hence establishment of single market. However, the RSPG assistance falls short when it comes to cross-border coordination issues with third countries on general or, between Member States involving the non-EU harmonised spectrum (e.g. FM radio), as the RSPG simply does not have a legal basis and appropriate tools to act.

The RSPG played an important role in setting the EU position for the WRC-23 held in November and December 2023 through a well-established preparatory process. That process consists of identifying together with the EC items of the WRC agendas that might affect EU law, policies or programmes and then recommend for each of them the position that the EU should take at the WRCs. The draft Council Decision on WRC-23 proposed by the EC

⁴⁰⁷ Commission Decision of 11 June 2019 setting up the Radio Spectrum Policy Group and repealing Decision 2002/622/EC (OJ C 196, 12.6.2019, p. 16–21) recital 5) indicates that “The Group should further contribute to the development of a radio spectrum policy in the Union that takes into account not only technical parameters but also economic, political, cultural, strategic, health and social considerations, as well as the various potentially conflicting needs of radio spectrum users with a view to ensuring that a fair, non-discriminatory and proportionate balance is achieved”.

contained all items of the WRC-23 agenda identified by the RSPG as of the EU relevance⁴⁰⁸ and the EC relied very much on the RSPG recommendations when proposing draft EU positions for each of them. The RSPG recommendations⁴⁰⁹ proved useful for organising the EU coordination during the WRC-23. In its Report on the WRC-23⁴¹⁰, the RSPG did not just assess of the outcome compared to the initial EU positions but also provided very useful lessons learnt that will be used in the subsequent WRC cycles. Currently, the RSPG is working on an opinion for the WRC-27⁴¹¹. However, such a coordination phase of the Union's position does not exist when Member States participate at CEPT, where they co-develop technical harmonisation, which could have a significant impact at EU level.

The RSPG work is guided by biennial work programmes corresponding to the Chairperson's term of office. It is assisted by subgroups, created by the EC for implementation of topics outlined in a particular work programme, or ad hoc as a result of the EC request for an RSPG Opinion. On average, under each work programme, RSPG has 7 subgroups, with 3 of them being permanent (Good Offices, Peer Review and WRC); others are dissolved as soon as they fulfil their mandate. Generally, subgroups are open to the RSPG members and observers, except the Good Offices and Peer Review, and WRC subgroups, which are limited to RSPG members and to EU Member States respectively thus reflecting their more sensitive tasks. Subgroups' work is stirred by two co-chairs, from Member States of all sizes and different geographical parts of the EU. Under current work programme, the cochairs are coming one from DE, DK, FI, FR, HU, IE, IT, LT, MT, SE, SI and 3 from EL.

Since the beginning of the Covid-19 confinement, the RSPG has been meeting mainly in hybrid format and its subgroup in online format respectively. Only occasionally, the subgroups met also in the hybrid format, with a physical part taking place mainly in the EC premises in Brussels, to discuss more sensitive outstanding issues. These working arrangements of subgroups facilitated participation of experts, including of EC representatives, and thus exchanging of views and experiences and peer learning on the topics on interest among broader groups of experts. The number of subgroups' members is high (currently 45 and 100 members from 17 to 22 Member States), but not all are connecting to meetings and are actively engaged in subgroups' work. In general, big administrations can afford to be active in all subgroups, whereas small administrations only in the subgroups of their particular interest (such as Good Offices).

In general, the RSPG deliverables were adopted in the time frames foreseen in working programmes or in the EC requests for the opinion. Only in some rare, more sensitive cases, the subgroups needed a few more months to finalise work, but it was never carried to the new

⁴⁰⁸ RSPG Opinion on the ITU-R World Radiocommunication Conference 2023 (RSPG22-040 FINAL) https://radio-spectrum-policy-group.ec.europa.eu/document/download/61378c81-1e03-45a6-aa49-6190809ee3ed_en?filename=RSPG22-040final-RSPG_Final_Opinion_on_WRC23.pdf.

⁴⁰⁹ RSPG Opinion on EU coordination at ITU-R Radiocommunication Conferences (RSPG19-009 FINAL) https://radio-spectrum-policy-group.ec.europa.eu/document/download/cfb06e5c-1901-4d27-830a-ca800ecdfe84_en?filename=RSPG19-009final_RSPG_Opinion_EU-coordination.pdf.

⁴¹⁰ RSPG Report on the result of the ITU-R World Radiocommunication Conference 2023 (RSPG24-017 FINAL) https://radio-spectrum-policy-group.ec.europa.eu/document/download/3d8d393b-2067-48c4-98f9-b95f4d8ed960_en?filename=RSPG24-017final-RSPG_Report_%20WRC23.pdf.

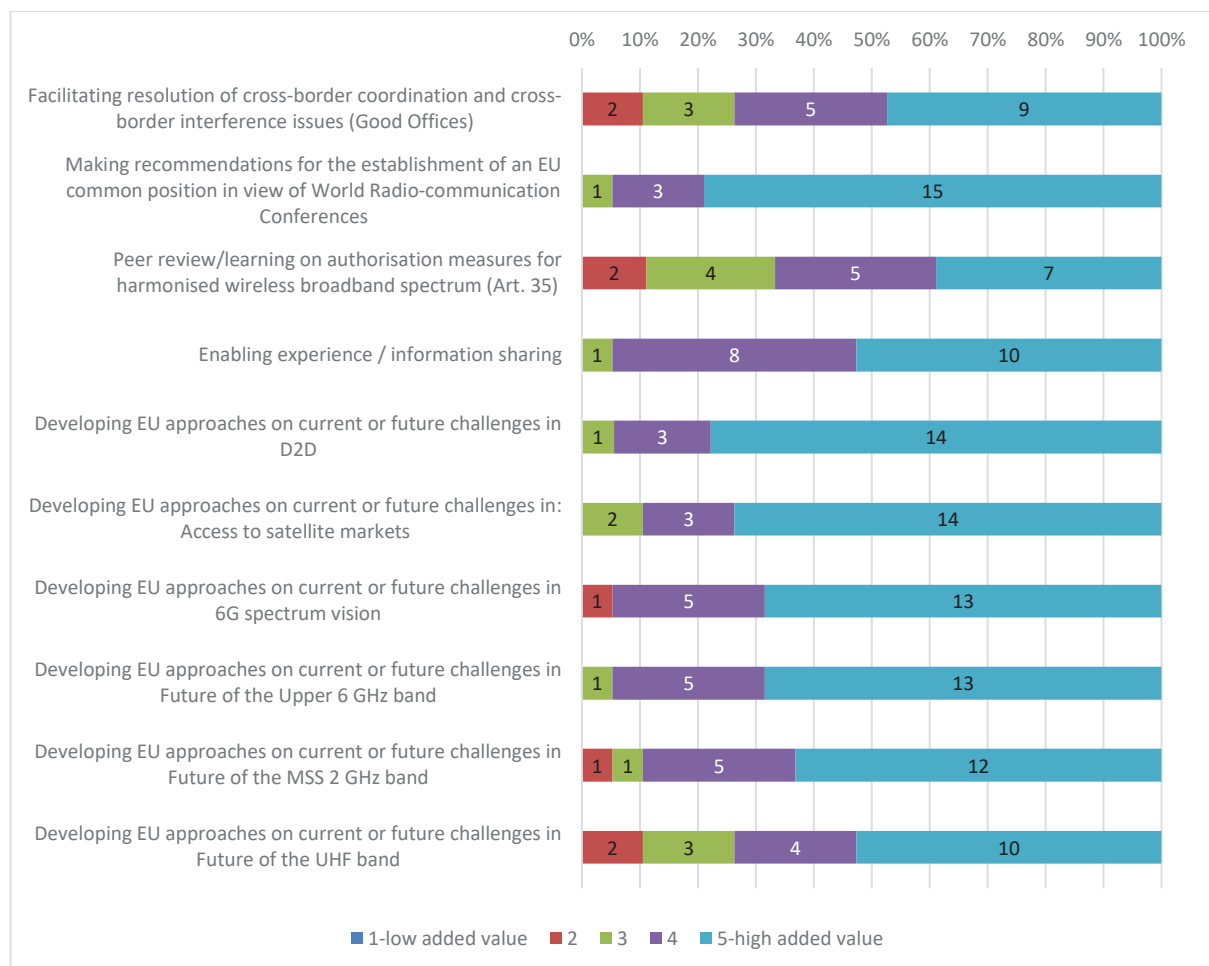
⁴¹¹ RSPG Interim Opinion on WRC-27 (RSPG25-022 FINAL) https://radio-spectrum-policy-group.ec.europa.eu/document/download/026c0088-c2ba-4c68-bebe-5019fbe2d38d_en?filename=RSPG25-022final-RSPG_Interim_Opinion-WRC27.pdf.

working cycle. When necessary, an extraordinary RSPG plenary meeting was organised⁴¹². A few RSPG deliverables were adopted through written procedure, such as the mandate to develop a 6G spectrum roadmap as an addendum of the Work programme 2024 and beyond.

During preparation of deliverables, the RSPG subgroups issued questionnaires targeted to Member States authorisations or to various stakeholders, or organised targeted hearings or workshops with broad range of stakeholders to collect evidence for substantiating their views. All deliverables, except the RSPG replies to the EC consultations and interim RSPG opinions on WRCs, were published for 6-weeks long public consultation before being adopted by the RSPG plenary.

All the RSPG workstream are considered to have a very high added value by participating Member States representatives as emerged from a survey conducted by the EC study⁴¹³ (see Figure 1). The highest added value was indicated to the development of the common position for the WRC, followed by approaches to D2D and access to satellite markets.

Figure 20: Spectrum competent authorities' assessment of added value of RSPG work



The RSPG, the BEREC and the BEREC Office signed in 2019 special working arrangements. BEREC experts are regularly invited and participate at the Peer Review Forums. In 2020, they issued a common Position Paper on spectrum-related EMF issues. However, there is not

⁴¹² https://radio-spectrum-policy-group.ec.europa.eu/extraordinary-rspg-plenary-09-december-2022_en.

⁴¹³ Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks

tangible cooperation beside those two examples of cooperation between the two groups, so RSPG deliverables might not be so holistic as one would expect and the cooperation with BEREC is insufficient. For example, some opinions which hinted to the need of further cooperation between BEREC and RSPG (e.g. D2D and access to satellite market) have not been further developed.

The RSPG Secretariat is provided by the Commission. It offers the RSPG, mainly an administrative support (e.g. organising the meetings on different levels, helping in organising hearings, managing documents, databases, preparing the steering documents), and legal support on the topics related to the RSPG functioning. For the RSPG deliverables to pursue broader EU benefit, it might be beneficial, if the RSPG Secretariat is involved more into substance too. Currently, this is impossible because of the lack of staff (around 1.5 FTEs) and the EC staff could represent at the same time the RSPG Secretariat and the EC experts.

Regarding the costs, 3 RSPG Plenary meetings are held per year - one of them might be online only, and hybrid format. For hybrid meetings, as they are taking place in the Commission's premises, costs are in a range of 10,000-15,000 euro per meeting, with a major part attributed to reimbursement of travel costs for one person per Member State, and a smaller part to costs of catering. There are no costs associated with the online only meetings. Subgroups are organised mainly in the online only format, as well as hearings. For occasional subgroup meetings in a hybrid format (about 5 times per year) and RSPG workshops (about 3 times per year) costs are lower than for the RSPG Plenary as the travel costs are not reimbursed and they were in the range from 900 euro (subgroup) to 4000 euro (workshop).

It is hard to assess costs per Member State for being involved in RSPG work as it depends on various factors. None of administration seems to have a special RSPG dedicated staff. The Commission is reimbursing travel costs for one person per delegation of a Member State only for RSPG Plenary meetings. Some Member States have special national arrangements to coordinate positions before each RSPG Plenary meeting, that could involve also consulting with stakeholders. It depends also on a degree of involvement of experts in the work of a subgroup – it is obvious that co-chairs should invest more efforts than other members of the subgroup, the workload could be shared among the members of a subgroup (such as drafting or assessing replies to a questionnaire).

Based on the EU study⁴¹⁴, the average number of hours that Member State devote per year to the specific activities is the following: around 60 hours and 250 hours for participation in RSPG plenary and sub-groups respectively, 90 hours of additional efforts for chairing sub groups, 30 hours for participating to peer reviews and 30 hours of additional effort if the Member State asks for a peer review of the auction.

Considering the limited cost, the current RSPG efficiently contributes to EU spectrum policy making with its opinions and reports and the preparation of the WRC and with the good offices activity. However, the RSPG effectiveness is reaching its limits. As indicated in the EC study⁴¹⁵, stakeholder see the merits in providing RSPG with more administrative support than is currently provided by the Commission. Such support could facilitate the work especially of RSPG subgroups, by taking over some preparatory and administrative work from the co-chairs. Such support would be even more pertinent, if in the future, the scope of RSPG tasks and responsibilities is increased.

⁴¹⁴ Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

⁴¹⁵ Study on Completing the Digital Single Market (DSM): Regulatory enablers for cross-border networks.

Overall, the coordination among authorities of Member States remains the core task in both entities, where pan-EU perspectives had been taken only to a limited extent, and there was no sufficiently strong boost to the completion of the single market. A lack of sufficient alignment of the organisation of workstreams and of the co-ordination of tasks prevented in several instances to achieve sufficient coherence in the governance of the sector.

10. LESSONS LEARNT AND CONCLUSIONS

The analysis above has shown that the EECC, through its objectives of promotion of connectivity and access to, and take-up of, very high-capacity networks, helped achieve/maintain effective competition in the market for electronic communications networks and services and protect the interests of the end users. However, the EECC, as a Directive leaves significant room for national divergence leading to fragmentation and therefore, the evaluation shows its limitations in achieving more single market. Furthermore, the evaluation revealed the need for some rebalancing of objectives, in the sense of prioritising all dimensions of connectivity (investment, demand), and considering the addition of new objectives of enhanced competitiveness for innovations in advanced infrastructures and services, and integration of infrastructures' security and resilience to the core objectives of the new framework.

Several pillars of EECC still remain relevant:

- The Significant Market Power (SMP) regime remains the key instrument for ex ante regulation. Ex-ante regulation is still an important tool to ensure that markets work well, and main tool used by NRAs. However, NRAs have increasingly defined markets subject to regulation as regional or local level and lower the intensity of ex ante regulation.
- Radio spectrum is of utmost strategic and geopolitical importance; it is essential to enable communication, drive economic growth and social prosperity, and support critical services across various sectors.
- The universal service obligations (USO) in the EECC are a safety net to ensure all consumers in the Union have affordable adequate internet and voice communications services, however the use of the USO by MS had decreased.
- The provisions on end-user rights are mostly still fit for purpose but in some respects could be simplified;

Access regulation is based on competition law principles and on transparent consultation mechanisms with the Commission as the guardian of the treaties, ensuring that the proposed regulations would not create a barrier to the internal market and are compatible with Union law. Such a system promotes regulatory predictability by ensuring a consistent regulatory approach.

The current framework is, in principle, well adapted to addressing instances of significant market power including local monopolies, which is relevant in full fibre environment in a post-copper world. The number of cases regarding the oligopolistic markets, notified under Article 32 EECC was very limited. Possible issues in oligopolistic markets have been addressed either under the spectrum authorisation regime or under competition law.

Moreover, as indicated in the report, there is a room for simplification of some key provisions that have either not been applied by regulators (Article 76 regarding co-investments, Article 77 regarding the imposition of functional separation) or were applied by some regulators but should be further simplified to enable their broader application (Article 61(3))

covering symmetric regulation, Article 79 covering regulatory commitments, Article 80 regulating wholesale-only networks).

As regards copper switch-off, Article 81 has had limited practical relevance primarily due to the lack of plans announced by incumbent operators and has not significantly contributed to accelerating the transition from copper to fibre networks. Instead, its primary purpose has been to provide NRAs with a framework to manage the switch-off process in a transparent and competitive manner, ensuring that migrations do not harm competition or end-user rights, and that alternative access products of comparable quality are available.

On **wireless connectivity**, although the EU spectrum policy framework has laid the foundation for coordinated 5G deployment through early harmonisation and binding deadlines for the assignment of spectrum, and has ensured competitive prices for end users, the EU is lagging in high quality 5G deployment compared to leading world economies with negative implications not only for consumers but also for EU's industrial competitiveness and innovation. The reasons are diverse: spectrum assignment conditions remain excessively fragmented and have not ensured consistent outcomes in terms of investments. Excessively high reserve prices, revenue-oriented auction designs, insufficiently long duration of licenses, unjustified market shaping measures, lack of flexibility and incentives to share spectrum and use it more efficiently have increased the cost of spectrum which combined with limited mobile revenues and lack of demand have negatively affected deployment.

The procedural tools of the EECC to help establish the single market for spectrum, and in particular the voluntary peer review of spectrum assignment procedures or the voluntary joint authorisation procedure allowing several Member States to cooperate to grant spectrum usage rights through common conditions and procedure have been ineffective to promote regulatory predictability and investment. As regards cross-border harmful interferences between Member States, the RSPG good offices' involvement has brought significant added-value according to participants but has not been fully efficient to address cross-border coordination issues with third countries or in non-harmonised bands. Overall lack of regulatory predictability and inefficient use of spectrum have affected the financial attractiveness of 5G investment projects.

For **satellite services** that have a clear cross-border potential, the failure to establish a Single Market is even more apparent. There are no minimum common authorisation conditions or requirements for satellite spectrum, and no common selection procedures except for the 2 GHz band, wide variations in timescales for issuing a license, different approaches to national coordination with existing services, different fees and different conditions attached to the licences. This fragmentation does not allow to leverage the strength of the internal market to ensure a level playing field in space and is not favourable to scaling up for the EU-wide provision of satellite services and allows for regulatory forum shopping. These barriers affect EU readiness for the Direct-to-Device challenge in a context where the EU risks being strategically dependent on foreign players for services crucial for its security and defence.

The evaluation findings on the **general authorisation provisions** pointed out to the need for further harmonisation, update and simplification of the general authorisation regime and paving the way for facilitating the deployment of more virtualised and centrally managed networks and software (cloud)-based electronic communications services in the EU.

The provisions on end-user rights are mostly still fit for purpose and there must be continued focus on their enforcement and implementation. At the same time, some updates and simplification could be beneficial for both end-users and service providers, for example, streamlining of contractual information (Article 102), as well as the harmonisation at EU level of some aspects, such as parameters on quality of services (Article 104)

As regards, **authorisation and objectives**, the fragmentation of rules, in particular the conditions under the general authorisation regime and for satellites combined with nationally diverging rules in the area of end-user protection as well as law enforcement, cyber-security or privacy, hampers companies from deploying pan-European innovative services. The evaluation revealed the need for some rebalancing of objectives, in the sense of prioritising all dimensions of connectivity (investment, demand), including in green networks and considering the addition of enhanced competitiveness for innovations in advanced infrastructures and services, and integration of infrastructures' security and resilience to the core objectives of the new framework.

As regards governance the assessment of BEREC and the BEREC Office and their contribution to the harmonised implementation of the EECC had been overall positive in particular as regards quality of BEREC guidelines and report, and overall supporting NRAs in reaching common approaches. Yet BEREC guidelines and exchanges of best practices were not sufficient to bring about the single market in the communication sector.

As markets, technology and broader digital ecosystem rapidly evolve BEREC's mandate should also evolve to encompass new tasks in e.g. digital markets, cybersecurity, spectrum, data, AI. Also, BEREC Office should be strengthened to increase its capacity to support BEREC also on substance, with aim to ensure better alignment with EU-level policies.

Similarly, the assessment of the contribution of the RSPG in spectrum policy is positive. Its deliverables related to spectrum for future wireless connectivity, including 6G, spectrum sharing, future use of the UHF band, WRCs and their outcome, satellite connectivity, and climate change have provided valuable input for further EC considerations. However, as the RSPG adopts deliverables in general by consensus, at least on some sensitive issues, a fine balance needed to be struck between different national interests and the EU and national prerogatives, sometimes regretfully to the detriment of the broader EU benefit. RSPG opinions tend to be too technical and not as political as its role of a high-level advisory group to the Commission would require. Moreover, several limitations have significantly limited its impact, such as the voluntary nature of the peer review, or the legal limitations to use its Good Offices mechanism to address interferences from third countries. Synergies between RSPG and BEREC work in technical, economic and overall policy dimensions have not been leveraged.

APPENDIX I SOURCES

1) National implementation reports from the NRAs (not available or carried out for the EECC, country reports for DD could be used to some extent) and BEREC:

2) The BEREC Opinions and reports:

BEREC Opinion on the national implementation and functioning of the general authorisation, and on their impact on the functioning of the internal market, pursuant to Article 122, paragraph 3 EECC⁴¹⁶.

BEREC Report on Member States' best practices to support the defining of adequate broadband internet access service⁴¹⁷ (2024).

BEREC Opinion on the market and technological developments and on their impact on the application of rights of end-users in the EECC (2021⁴¹⁸) and (2024⁴¹⁹).

BEREC report on interoperability of Number-Independent Interpersonal Communication Services (NI-ICS)⁴²⁰

3) The studies:

Ongoing studies

The objective of Study 1 on Completing the Digital Single Market (DSM) - Regulatory enablers for cross-border networks led by EY is to Develop and assess concrete policy options for the EECC review and the scenarios of the White Paper relevant for cross-border operation and the move towards a Single Market for digital networks and services. Relevant areas include Technology challenges and Convergence, Scope of the regulatory framework, Level Playing Field, Quality Based Services, Authorisation, Spectrum, Sustainability and Regulatory governance, as well as end-user protection.

Review of Access Regulation under the European Electronic Communications EECC and analysis of future Access policy in full fibre environment (Terms of reference⁴²¹) - Study 2, on Review of Access Regulation under the EECC and analysis of future Access policy in full fibre environment led by WIK, is **to i) to evaluate in particular**

⁴¹⁶ 2021: <https://www.berec.europa.eu/en/document-categories/berec/opinions/berec-opinion-on-the-national-implementation-and-functioning-of-the-general-authorisation-and-on-their-impact-on-the-functioning-of-the-internal-market-pursuant-to-article-122-paragraph-3-eecc>.

2024: <https://www.berec.europa.eu/en/all-documents/berec/opinions/berec-opinion-on-the-national-implementation-and-functioning-of-the-general-authorisation-and-on-their-impact-on-the-functioning-of-the-internal-market-pursuant-to-article-122-paragraph-3-eecc>.

⁴¹⁷ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-member-states-best-practices-to-support-the-defining-of-adequate-broadband-internet-access-service-0>.

⁴¹⁸ <https://www.berec.europa.eu/en/document-categories/berec/opinions/berec-opinion-on-the-market-and-technological-developments-and-on-their-impact-on-the-application-of-rights-of-end-users-in-the-eecc>.

⁴¹⁹ <https://www.berec.europa.eu/en/all-documents/berec/opinions/berec-opinion-on-the-market-and-technological-developments-and-on-their-impact-on-the-application-of-rights-of-end-users-in-the-eecc-article-123>.

⁴²⁰ [BEREC report on interoperability of NI-ICS](#).

⁴²¹ Internal link to Ares:
<https://webgate.ec.testa.eu/Ares/document/show.do?documentId=080166e5103da7a2&timestamp=1736846325599>.

the market and regulatory implications of key provisions of the EECC, including as a minimum Articles 61(3), 76, 78 and 79 regarding the access provisions concerning symmetric measures, co-investment, voluntary separation and commitments in relation as well with the objective of the EECC; ii) the assessment of the appropriateness of intervention powers to address oligopolistic market structures; iii) the assessment of the impact of symmetrical regulation; iv) the assessment, on a forward looking forward-looking basis, of the markets included in the current Recommendation on Relevant Markets and evaluation of other markets, if any, still warranting ex ante regulation at EU level; and v) assessment of the options set out in the White Paper in the field of access regulation. The study will also support the review of the Recommendation on relevant markets and possible guidance on Article 3 of the GIA Regulation.

Study 3 on financial conditions, demand and investment needs of the electronic communications sector and their regulatory and policy implications, including on the Universal Service also led by WIK aims at providing an estimate of the demand for very-high-capacity connectivity networks in EU Member States in the light of the Digital Decade 2030 targets and the evolution of households and industry's needs.

This study also aims at identifying financial and regulatory incentives and barriers for investment in the EU electronic communications sector as well as making an **assessment of the financial situation of the sector.**

Finally, it aims to assess whether the **scope of the Universal Service provisions** in the EECC needs to be changed or redefined in light of social, economic and technological developments, taking into account, inter alia, mobility and data rates in view of the prevailing technologies used by most end-users.

APPENDIX II – RADIO SPECTRUM (POLICY PROGRAMME) – ADDITIONAL INFORMATION ON SPECTRUM

APPENDIX II A. STATE OF PLAY OF THE IMPLEMENTATION OF THE RADIO SPECTRUM POLICY PROGRAMME AND PROPOSED INCORPORATION OF RELEVANT PARTS IN THE DIGITAL NETWORK ACT

This Annex addresses the current state of play of the implementation of the RSPP Decision⁴²² and assesses which aspects are completed or obsolete and which remain still relevant, to be integrated in the DNA. This was done through an examination of existing ⁴²³~~obj~~ and ⁴²⁴~~obj~~ which⁴²⁵, the Radio Spectrum Policy Group's (RSPG) 2021 opinion on the RSPP⁴²⁶ and the responses to the related public consultations⁴²⁷.

The analysis focused on a description of the current status of application of the RSPP Decision collected and identified the following:

what actions included in the RSPP Decision could be considered as completed,

what provisions of the RSPP Decision have become obsolete (including due to the substantive revision of spectrum rules brought about by the EECC) and

what objectives and general principles of the RSPP Decision remain relevant in the context of strategic policy needs and support of broader EU policy objectives, taking into account the current and future needs of key stakeholders.

In this analysis, completed actions are regarded as areas that designated bodies, such as the European Commission or Member States, have completed within the set timeframe. On the other hand, obsolete provisions refer to those that have become superseded or no longer useful. The third area assesses the relevance of the key objectives and general principles of the

⁴²² Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme (OJ L 91, 21.3.2012, p. 7), <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012D0243>.

⁴²³ Commission report on the implementation of the Radio Spectrum Policy Programme (COM(2014) 228 final) (22 April 2014), <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0228&rid=1> and Commission report on the Radio Spectrum Inventory (COM(2014) 536 final), 1 September 2014, <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52014DC0536>, the Commission's 2016 fitness check accompanying the Code legislative proposal- Commission Staff Working Document on Evaluation of the regulatory framework for electronic communications (SWD(2016) 313 final), 14 September 2016, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52016SC0313>

⁴²⁴ European Commission: Directorate-General for Communications Networks, Content and Technology, LS Telcom, PolicyTracker and VVA, Study on radio spectrum policy programme – Taking stock and discussing future scenarios – Executive summary, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2759/687724>

⁴²⁵ RSPG Opinion on the a Radio Spectrum Policy Programme (RSPP) (16 June 2021) https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-033final-RSPG_Opinion_on_RSPP.pdf.

⁴²⁷ Public consultation on the draft RSPG Opinion on a Radio Spectrum Policy Programme (RSPP) https://radio-spectrum-policy-group.ec.europa.eu/document/download/5d3a590a-c3a3-4aa9-abcd-536052e4e566_en?filename=PC_responses_RSPP_2021.zip and Targeted consultation on the 2030 Digital Compass: The European way for the Digital Decade, <https://digital-strategy.ec.europa.eu/en/targeted-consultation-2030-digital-compass-european-way-digital-decade>.

RSPP Decision in the current context. Section 2 identifies a key set of challenges that map the problems identified in the RSPP in Section 3.

In the course of this analysis, existing policy documents were reviewed, including relevant RSPG opinions and stakeholder consultation responses, and the principles of Tool #2 in the Commission's Better Regulation Toolbox, the Regulatory Fitness Programme (REFIT), were applied. The approach also considered the goals of simplification and burden reduction, in order to enhance the effectiveness of the policy document.

The chapter below summarises the findings of the analysis. The report acknowledges that assessing whether an action is obsolete is a rather qualitative process and therefore, the analysis is based on stakeholder views obtained through desk research and assessment of the strength of the argument in each case.

WHAT ACTIONS INCLUDED IN THE RSPP DECISION COULD BE CONSIDERED AS COMPLETED?

In addressing what actions defined in the RSPP Decision could be considered as completed, the study considered those actions which a designated body – such as the European Commission or Member States – must complete, usually within a set timeframe. Having reviewed the RSPP and its impact reports, the following actions are considered as complete:

Article 3 (b) RSPP Decision

Article 3 RSPP Decision outlines the policy objectives that Member States and the European Commission shall cooperate to support and achieve.

Article 3 (b) RSPP Decision highlights the importance of allocating:

“sufficient and appropriate spectrum in a timely manner to support Union policy objectives and to best meet the increasing demand for wireless data traffic, thereby allowing the development of commercial and public services, while taking into account important general interest objectives such as cultural diversity and media pluralism; to that end, every effort should be made to identify, based on the inventory established pursuant to Article 9, at least 1 200 MHz of suitable spectrum by 2015. That figure includes spectrum already in use”.

Article 3 (b) RSPP Decision recommends the identification of at least 1 200 MHz of suitable spectrum by 2015 to “support Union policy objectives” and to satisfy “the increasing demand for wireless data traffic”. In 2021, the RSPG estimated that there is “already more than 12 GHz of harmonised spectrum available for wireless services”⁴²⁸. Based on this information, the study considers this a completed action. The RSPG sees no need to define quantitative targets in a RSPP as it can “develop long-term spectrum availability plans including needs for harmonisation initiatives for key EU policy areas upon request”⁴²⁹.

However, allocating sufficient and appropriate spectrum in a timely manner to support Union policy objectives and to meet spectrum demand remains an important policy consideration. More than half of stakeholders consulted for this study agreed that updating the approach to

⁴²⁸ RSPG Opinion on a Radio Spectrum Policy Programme (RSPP), RSPG21-033 FINAL, 16 June 2021, p. 5 (https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-01/RSPG21-033final-RSPG_Opinion_on_RSPP.pdf).

⁴²⁹ Ibid.

establishing future spectrum needs was one of the most important issues related to revising the RSPP.⁴³⁰

Some stakeholders, such as the mobile industry body, the GSMA, and Telefonica, are more supportive of targets, both arguing that 5G needs an additional 1-2 GHz of new spectrum.⁴³¹ ECTA further argues for identifying new specific bands for licensing by a specific deadline, as was done in Article 6(4) RSPP Decision.⁴³²

Article 4 (7) RSPP Decision

Article 4 RSPP Decision is dedicated to the enhanced efficiency and flexibility of spectrum use.

Article 4 (7) RSPP Decision indicates:

“For electronic communications services, Member States shall, by 1 January 2013, adopt allocation and authorisation measures appropriate for the development of broadband services, in conformity with Directive 2002/20/EC, with the aim of achieving the highest possible capacity and broadband speeds”.

As the Authorisation Directive⁴³³ has already been transposed into national law, and in fact superseded by the 2018 EECC, this Article has in the literal sense been completed. Furthermore, in terms of fulfilling the policy goal, Member States have progressively followed objectives of enhanced efficiency and flexibility in spectrum use, further reinforced in Article 45(2)(f) EECC. The EECC also seeks to facilitate greater coordination of spectrum assignment across Europe, setting a deadline for making 5G bands available for use.⁴³⁴

Article 6 (2) RSPP Decision

This provision required Member States to make available the 3.4-3.8 GHz, 2.6 GHz, 900 MHz and 1800 MHz frequency bands under terms and conditions of Commission Decisions 2008/411/EC,⁴³⁵ 2008/477/EC,⁴³⁶ and 2009/766/EC,⁴³⁷ and carry out the authorisation

⁴³⁰ A representative sample of 26 stakeholders were surveyed for this study: more details are given in Annexes 2 and 3. When asked “What do you consider to be the most important issues or challenges in view to improve the current RSPP Decision?”, 14/26 interviewees agreed “updating the approach to establishing future spectrum needs” was one of the most important.

⁴³¹ GSMA and Telefonica responses in 2021 *Public consultation on the draft RSPG Opinion on a Radio Spectrum Policy Programme*.
(<https://circabc.europa.eu/ui/group/f5b44016-a8c5-4ef6-a0bf-bc8d357debcblibrary/fc40afef-626f-40ec-b1d0-874c69095f6a/details?download=true>).

⁴³² ECTA response in 2021 *Public consultation on the draft RSPG Opinion on a Radio Spectrum Policy Programme*.
(<https://circabc.europa.eu/ui/group/f5b44016-a8c5-4ef6-a0bf-bc8d357debcblibrary/fc40afef-626f-40ec-b1d0-874c69095f6a/details?download=true>).

⁴³³ Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services, OJ L 108, 24.4.2002, p. 21, no longer in force.

⁴³⁴ 3.6 GHz and 26 GHz: see Article 54 EECC.

⁴³⁵ Commission Decision 2008/411/EC of 21 May 2008 on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community, OJ L 144, 4.6.2008, p. 77.

⁴³⁶ Commission Decision 2008/477/EC of 13 June 2008 on the harmonisation of the 2500 - 2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community, OJ L 163, 24.6.2008, p. 37.

processes by the end of 2012. As detailed in European Communications Office Report 03,⁴³⁸ Member States have progressively implemented these harmonisation Decisions and this action has generally been completed.

However, as noted by the RSPG, assigned spectrum in harmonised EU bands varies by Member State. “These differences are resulting from various factors, in particular inter alia: the differences in national demands, in the characteristic of the band itself, in usages relative to public security and defence and in the need to protect existing services different from electronic communication”⁴³⁹. Furthermore, some Commission decisions referred to above have been amended, notably to account for revised technical conditions for band usage.

As regards the 3.4-3.8 GHz band, Article 54(1) EECC states that “By 31 December 2020, for terrestrial systems capable of providing wireless broadband services, Member States shall, where necessary in order to facilitate the roll-out of 5G, take all appropriate measures to:

reorganise and allow the use of sufficiently large blocks of the 3,4-3,8 GHz band”.

All Member States have now assigned this band for 5G.⁴⁴⁰

Article 6 (4) RSPP Decision

This provision required Member States to carry out the authorisation process in order to allow the use of 800 MHz for electronic communications services by the end of 2015. In addition, “If a Member State’s substantiated cross-border frequency coordination problems with one or more countries, including candidate or acceding countries, persist after 31 December 2015 and prevent the availability of the 800 MHz band, the Commission shall grant exceptional derogations on an annual basis until such problems are overcome”.

Despite the possibility for Member States to apply for derogations, the European Commission’s 2014 report on the implementation of the RSPP noted that “Delays in assigning the 800MHz band demonstrate the need for more nimble and flexible mechanisms for the harmonised timing of assignments throughout the Union or for categories of Member States based on the characteristics of the wireless broadband market, and for the harmonised duration of spectrum usage rights”.⁴⁴¹

Since then, the assignment of the 800 MHz band has been completed in all EU Member States.

Article 6 (5) first subparagraph RSPP Decision

This provision requires Member States and the European Commission to “continuously monitor the capacity requirements for wireless broadband services” and “report to the

⁴³⁷ Commission Decision 2009/766/EC of 16 October 2009 on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community, OJ L 274, 20.10.2009, p. 32.

⁴³⁸ <https://efis.cept.org/views2/report03.jsp>.

⁴³⁹ RSPG Opinion on the implementation of the current RSPP and its revision to address the next period, RSPG16-006 FINAL, 24 February 2016 (https://circabc.europa.eu/d/a/workspace/SpacesStore/4709f36a-f27b-4850-a19b-95df0154d5aa/RSPG16-006final_RSPP_opinion.pdf).

⁴⁴⁰ 27 Member States have assigned at least 50% of the targeted spectrum in this band. DESI 2025, figures at February 2025 - <https://digital-strategy.ec.europa.eu/en/policies/5g-observatory-2025>.

⁴⁴¹ Report from the Commission to the European parliament and the Council on the implementation of the Radio Spectrum Policy Programme (COM(2014) 228 final), 22 April 2014 (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0228&rid=1>).

European Parliament and the Council by 1 January 2015 on whether there is a need for action to harmonise additional frequency bands”. The European Commission delivered its report in September 2014, noting that “With the aim of using resources effectively, the Commission will continue to cooperate with the Member States both in collecting data that are already available at Member State level and in obtaining additional data on a targeted basis. In particular frequency bands relevant to the implementation of the RSPP will be targeted”.⁴⁴²

While this action has been completed, there is a continuing need to monitor the spectrum needed for wireless broadband services and constantly update targets to keep them up to date with technological progress and demand, e.g. in an evolving spectrum roadmap.

Previously conducted stakeholders survey showed considerable support for ensuring sufficient spectrum for wireless broadband as part of the RSPP review:

more than half regarded the updating of the approach to spectrum needs as a priority;

two thirds (18 out of 26) agreed that "ensuring that spectrum policy meets the requirements of the Digital Decade policy, in particular connectivity targets" was an important issue;

just under half (13 out of 26) supported the need for quantified spectrum targets;

one third (9 out of 26) agreed with identifying specific spectrum bands for 6G.

Article 9 (2) RSPP Decision

This provision required the implementing act for the setting up of a spectrum inventory to be adopted by 1 July 2013. This has been done but the usefulness of the spectrum inventory is now disputed, as discussed further below.

Article 15 RSPP Decision

Article 15 RSPP Decision specifies that, by “10 April 2014, the Commission shall report to the European Parliament and the Council on the activities developed and the measures adopted pursuant to this Decision. Member States shall provide the Commission with all information necessary for the purpose of reviewing the application of this Decision. By 31 December 2015, the Commission shall conduct a review of the application of this Decision”.

Regarding the reporting requirement, the European Commission’s report on the implementation of the Radio Spectrum Policy Programme⁴⁴³ was delivered on 22 April 2014. The review of the application of the RSPP was completed with the 2016 Fitness Check.⁴⁴⁴

WHAT PROVISIONS OF THE RSPP DECISION HAVE BECOME OBSOLETE?

This Section identifies provisions of the RSPP Decision which are obsolete in the sense of being no longer useful in their current formulation, archaic, superseded⁴⁴⁵ or obsolete in the

⁴⁴² Report from the Commission to the European parliament and the Council on the Radio Spectrum Inventory (COM(2014) 536 final), 1 September 2014 (<https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52014DC0536>).

⁴⁴³ Report from the Commission to the European parliament and the Council on the implementation of the Radio Spectrum Policy Programme (COM(2014) 228 final), 22 April 2014, (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0228&rid=1>).

⁴⁴⁴ Commission Staff Working Document, Regulatory Fitness and Performance Programme REFIT and the 10 Priorities of the Commission, SWD(2016) 400 final, 25 September 2016, (https://eur-lex.europa.eu/resource.html?uri=cellar:d2b78384-9b80-11e6-868c-01aa75ed71a1.0001.02/DOC_2&format=PDF).

⁴⁴⁵ <https://www.merriam-webster.com/dictionary/obsolete>.

sense of their functions having been transferred to other legislation. It is possible that an obsolete provision needs to be updated to reflect state-of-the-art developments. Determining whether an action is obsolete is a process which is subject to a more qualitative assessment than deciding whether an action is completed: the analysis is based on stakeholder views found via desk research and the strength of arguments in each case.

Article 2 (2) RSPP Decision

This provision refers to specific principles which apply in accordance with Articles 8a, 9, 9a and 9b of the Framework Directive.⁴⁴⁶ However, this Directive has been repealed and replaced with the EECC,⁴⁴⁷ so this Article is obsolete.

Article 3 (m) and Article 8 (2) RSPP Decision

The RSPP's environmental commitments, as listed in these two provisions, remain relevant but need an update in the light of the EU's European Green Deal policies. Article 3 (m) RSPP Decision lists as a policy objective reducing "the Union's carbon footprint by enhancing the technical efficiency and energy efficiency of wireless communication networks and equipment." Article 8 (2) RSPP Decision has the objective of conducting studies on "saving energy in the use of spectrum in order to contribute to a low-carbon policy" as well as making spectrum available for wireless technologies which can save energy in other networks such as water or electricity. This could be expanded to include the monitoring of progress towards EU environmental targets, as proposed by the RSPG.⁴⁴⁸

The European Commission policy options related to spectrum availability tackle the obsolescence of the current RSPP by requiring that spectrum is allocated to support not only the increasing demand for wireless communication but also environmental policy by:

ensuring that sufficient spectrum is made available to support technologies that promote environmentally efficient use of energy and a reduction of the environmental footprint;

envisioning that spectrum users would cooperate to develop their services and networks in such a way as to maximise environmental efficiency;

spectrum users reporting on their carbon emissions and actions taken to contribute to the achievement of the Union's environmental targets.

These elements will be integrated in the Commission proposal for the DNA.

Article 3 (c) and Article 6 (1) RSPP Decision

These provisions are obsolete in the sense that they make reference to the 2010 Digital Agenda for Europe⁴⁴⁹ target of access to broadband at speeds of not less than 30 Mbps for all EU citizens by 2020. This target has been superseded by new goals.

The 2016 Gigabit Society targets were for 2020 to make 5G connectivity available as a fully-fledged commercial service in at least one major city in each Member State, building on

⁴⁴⁶ Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services, OJ L 108, 24.04.2002, p33, no longer in force.

⁴⁴⁷ Article 125 EECC.

⁴⁴⁸ RSPG 2021 opinion on RSPP, section 6.2.

⁴⁴⁹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Digital Agenda for Europe, COM(2010) 245 of 19.05.2010 (<https://eur-lex.europa.eu/legal-content/en/ALL/?uri=celex%3A52010DC0245>).

commercial introduction in 2018 while a strategic objective set for 2025 targeted uninterrupted 5G coverage across all urban areas and all major terrestrial transport paths.⁴⁵⁰

Irrespective of whether these milestones have been achieved or not, they are obsolete because the new Digital Decade targets are to achieve by 2030 fixed line gigabit connectivity for all and that all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G.⁴⁵¹

These elements will be integrated in the Commission proposal for the DNA, in the sense that the DNA will be consistent with the EU policy objectives applicable at its adoption.

Article 4 (1) second paragraph RSPP Decision

This refers to the use of ‘white spaces’, a type of dynamic spectrum access (DSA) technology which has had limited application, whereas interest in DSA continues. Here the reference to white spaces is obsolete and could be replaced by DSA, which in any case includes white space technology. The policy options described in the DNA Impact assessment to promote spectrum sharing and flexible licensing, as a mandatory part of certain assignment procedures, aims at updating this obsolete provision in the RSPP Decision.

Article 5 RSPP Decision

Deleted with effect from 21 December 2020 (Article 125 EECC).

Article 6 (6) RSPP Decision

This provision urges the promotion of “broadband services using the 800 MHz band in remote and sparsely populated areas” while protecting programme making and special events (PMSE) users. While the provision of rural broadband is still an important policy goal, the emphasis on 800MHz has been superseded and a more modern formulation is likely to include bands like the 700MHz 5G pioneer band.

Article 6 (8) RSPP Decision

This provision, which allows for the transfer or leasing of rights of use of spectrum in harmonised bands, has been superseded by Article 51 EECC, which covers the same topic in greater detail. These elements will be integrated in the Commission proposal for the DNA.

Article 6 (10) RSPP Decision

This provision requires Member States and the European Commission to “examine the possibility of spreading the availability and use of picocells and femtocells”⁴⁵², as well as taking account of the benefits of wireless mesh networks. Both of these technologies are now

⁴⁵⁰ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society, COM(2016) 587 of 14.09.2016 (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0587>).

⁴⁵¹ Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, OJ L 323, 19.12.2022, p. 4: “all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technological neutrality”.

⁴⁵² Picocells and femto cells are wireless transmitters with a shorter range than the full power mobile base station. The latter has a range of up to about 10 km, while femtocells have a radius of up to 10 metres. Picocells can cover a radius of up to 200 metres (<https://commsbrief.com/small-cells-what-are-microcells-femtocells-and-picocells>).

widely used and adopted by operators in mobile and other networks where appropriate so this provision has been superseded.

Furthermore, the EECC incorporates a provision on small-area wireless access points, a categorisation which includes picocells and femtocells. Article 57 EECC stipulates that small-area wireless access points that meet defined characteristics shall not require town planning permits. This makes them easier to erect than macrocells, which usually do require planning permits. These elements will be integrated in the Commission proposal for the DNA and further updated to increase the efficient use of Radio Local Access Networks.

Article 9 RSPP Decision

Article 9 RSPP Decision provides for the setting up of an inventory covering uses of the spectrum between 400 MHz - 6 GHz. Its objective is to identify bands where spectrum efficiency can be improved, enable spectrum sharing and re-allocation opportunities and support the analysis of spectrum use. It requires Member States to collect the data and the European Commission to carry out an analysis of technology trends, future needs and demand for spectrum. To support this work, the Joint Research Centre (JRC) developed the Radio Spectrum Inventory (RSI) tool.

A key disadvantage of the current spectrum inventory is that it functions primarily as a static database⁴⁵³, without the capability to reflect real-time spectrum usage. This significantly limits its practical value—especially in contexts such as spectrum sharing, where accurate, real-time data on frequency occupancy is essential for ensuring efficient use and avoiding interference. The limited practical use⁴⁵⁴ of the inventory suggests it has not been effectively incorporated into spectrum management practices. Furthermore, its maintenance involves a high annual cost—estimated at around €100,000 by the JRC—despite its limited utilisation.

The RSPG has recommended that Article 9 of the current RSPP is not maintained. It described the inventory as “burdensome” for administrations and called for a more targeted approach focussing on “frequency bands identified by RSPG as potential bands for wireless broadband services or other strategic applications”.⁴⁵⁵ Desk research showed very limited support for continuing the inventory. Of the responses to the 2021 RSPG consultation on the RSPP, only the LoRa Alliance gave unqualified backing while United Wireless gave support to a revised inventory which concentrated efforts on wireless broadband frequencies. This is very similar to the approach advocated by the RSPG.⁴⁵⁶

Given these shortcomings, it would be more effective to phase out the current static inventory and replace it with a more dynamic and targeted database. A dynamic database—focused on specific frequency bands—would better identify underutilised spectrum and support more efficient spectrum use and sharing practices.

⁴⁵³ A static spectrum usage database is a type of database that contains fixed information entries, regarding the allocation, assignment, and utilization of radio frequency spectrum. Typically, the data is periodically updated but do not reflect real-time changes in spectrum usage.

⁴⁵⁴ Between 2019 and 2024, the tool has had very limited use. It was not accessed at all in 2021 and 2024, and in 2019 and 2020, usage remained below five accesses. In 2022, there were approximately 20 accesses, increasing to around 60 in 2023.

⁴⁵⁵ RSPG 2021 opinion on RSPP, p. 14.

⁴⁵⁶ 2021 RSPG consultation responses supporting the inventory by the LoRa Alliance and United Wireless. The latter in fact backs the RSPG proposal to concentrate efforts on wireless broadband frequencies. (<https://circabc.europa.eu/ui/group/f5b44016-a8c5-4ef6-a0bf-bc8d357debcbb/library/fc40afef-626f-40ec-b1d0-874c69095f6a/details?download=true>).

Such a dynamic inventory, could also contribute to the development and implementation of a spectrum roadmap to feed into Europe's 2030 Digital Decade's targets. 78.6% of respondents to the 2030 Digital Compass consultation (out of 56 participants) think that an evolving spectrum roadmap as a guiding but non-mandatory monitoring mechanism integrating input from a broad range of relevant stakeholders would increase the efficiency and effectiveness of spectrum management.

WHAT KEY OBJECTIVES AND GENERAL PRINCIPLES OF THE RSPP DECISION REMAIN RELEVANT?

The RSPP Decision contains many key objectives and general principles which remain relevant and which will be taken over and further developed in the policy options of the DNA Impact Assessment. These include:

applying the least onerous authorisation systems to maximise flexibility and efficiency in spectrum use (Article 2 (1) (a) RSPP Decision). This principle is extended and enhanced by the proposals to promote spectrum sharing and flexible licensing.

“fostering development of the internal market by promoting the emergence of future Union-wide digital services” (Article 2 (1) (b) RSPP Decision). The policy proposal on satellites explained in the policy options of the DNA Impact Assessment aims at helping to foster EU-wide digital services.

fostering “the collective use of spectrum as well as shared use of spectrum” (Article 4 (1) first subparagraph RSPP Decision) and promoting spectrum sharing (Article 9 (1) (b) and Article 9(1) (d) RSPP Decision).

assessing the “justification and feasibility of extending the allocations of unlicensed spectrum” (Article 6 (7) RSPP Decision). The policy proposal described in Section 6.2.3.2 proposes wide-ranging co-operation between Member States and the European Commission to allocate sufficient spectrum for wireless services, including in the unlicensed bands, as part of an evolving roadmap.

promoting competition, innovation and investment (Article 2 (1) (b), Article 2 (1) (c), Article 3 (f), Article 3 (i), Article 4 (4), and Article 9 (1) (d) RSPP Decision).

the need to avoid harmful interference: (Article 2 (1) (c), Article 2 (2) (c) and Article 3 (k) RSPP Decision).

promoting technology and service neutrality in the rights of use of spectrum (Article 2 (1) (e), Article 2 (2) (a) and Article 3 (f)) RSPP Decision).

promoting spectrum harmonisation (Article 2 (2) (b) and Article 4 (3) RSPP Decision).

upgrading networks to the most efficient technology (Article 6 (3) RSPP Decision).

in order to ensure that all citizens have access to advanced digital services including broadband in remote and sparsely populated areas, exploring “the availability of sufficient spectrum for the provision of broadband satellite services enabling internet access” (Article 6 (9) RSPP Decision) allocating sufficient and appropriate spectrum in a timely manner to support Union policy objectives and satisfying the increased wireless data traffic (Article 3 (b) RSPP Decision), as part of an evolving spectrum roadmap.

encouraging efficient management and use of spectrum (Article 3(a) RSPP Decision).

ensuring sufficient spectrum, harmonised where necessary, for specified uses including:

Wireless broadband (Article 6 RSPP Decision),

Satellite and terrestrial provision of innovative audiovisual services (Article 7 RSPP Decision). The satellite policy options described in Section 6.2.2.1 would benefit these new services,

Earth monitoring services and transport systems (Article 8 (1) RSPP Decision),

Safety of life services (Article 8 (3) RSPP Decision),

Scientific services (Article 8 (4) RSPP Decision),

PMSE (Article 8 (5) RSPP Decision),

IoT services (Article 8 (6) RSPP Decision).

The commitment to ensuring sufficient spectrum for specified services would be strengthened by the policy option concerning the establishment of an EU-level spectrum roadmap.

Article 10 (1) RSPP Decision, which sets out how international spectrum negotiations will be conducted if the subject matter falls within EU or Member State competences remains relevant as these negotiations will continue for the foreseeable future. From a substance point of view, this provision is not obsolete although it would have to be adapted to the 2017 European Court of Justice judgement confirming the EU's role in establishing common positions for ITU World Radio Conferences (WRC)⁴⁵⁷ and to the established practice illustrated by the recent Council Decisions based on Article 218(9) TFEU of 13 June 2019 for WRC 19 and of 12 September 2023^f for WRC 23.

Article 10 (2) RSPP Decision which relates to the EU, on request, assisting “Member States with legal, political and technical support to resolve spectrum coordination issues” with neighbouring third countries, is an ongoing issue and therefore still relevant.

Ensuring appropriate cooperation in spectrum matters between the European Commission (including the Joint Research Centre), Member States and CEPT (Article 11 RSPP Decision).

KEY RSPP CHALLENGES

The review of the reports which have assessed the RSPP, relevant RSPG opinions and relevant consultations,⁴⁵⁸ as well as stakeholder research carried out for the EC study, identifies a set of key challenges moving forward. On a top-level, these challenges are summarised below.

Allocating sufficient and appropriate spectrum in a timely manner

Allocating sufficient and appropriate spectrum in a timely manner to support Union policy objectives and to meet demand remains an important policy consideration. More than half of stakeholders questioned for a study agreed that updating the approach to establishing future spectrum needs was one of the most important issues related to revising the RSPP.⁴⁵⁹ The

⁴⁵⁷ European Commission v Council of the European Union, C-687/15, ECLI:EU:C:2017:803.

⁴⁵⁸ i.e. Commission's 2014 general report on the implementation of the RSPP, Commission's 2014 report on the spectrum inventory, Commission 2016 fitness check accompanying the Code legislative proposal, RSPG 2021 opinion on the RSPP, the 2021 targeted consultation on the 2030 Digital Compass, RSPG 2021 opinion on the targeted consultation on the 2030 Digital Compass, and the 2023 exploratory consultation on the future of the electronic communications sector and its infrastructure, RSPG 2023 opinion on the future of the electronic communications sector and its infrastructure,

⁴⁵⁹ A representative sample of 26 stakeholders were surveyed for this study: more details are given in Annexes 2 and 3. When asked “What do you consider to be the most important issues or challenges in view to improve

RSPG, in its 2021 opinion on the RSPP highlighted the need to make available EU harmonised spectrum to support the development of 6G and other technologies beyond 5G.⁴⁶⁰ Furthermore, the 2023 RSPG response to the European Commission’s exploratory consultation states that further work is needed to provide timely access to harmonised spectrum for verticals,⁴⁶¹ with the RSPG’s 2021 opinion on the RSPP saying there is a particular need for this to apply to the mmWave bands⁴⁶².

In this regard, the policy options of the DNA Impact Assessment propose that the Commission, together with the RSPG, develop an evolving roadmap of spectrum needs and that Member States develop national roadmaps which mirror such EU roadmap and adapt it to national circumstances, thus providing regulatory predictability to prospective spectrum users.

Greater focus on spectrum sharing and flexible licensing solutions

The assessment of the RSPP emphasised the need for a greater focus on spectrum sharing and flexible licensing solutions. The 2016 Fitness Check highlighted these as “key issues for the future”.⁴⁶³ In the same way, the more recent RSPG opinions (add sharing opinion and 6G vision) confirm this as a priority.

The RSPG 2021 opinion on the RSPP states that, to improve broadband connectivity, it is necessary to ensure availability of spectrum for WAS/RLAN applications and to use shared spectrum including innovative approaches such as automated shared spectrum solutions.⁴⁶⁴ It also recommends “enhancing flexibility in spectrum access by following the “use-it-or-share-it” principle, and to support the development of spectrum pooling and multi-tiered spectrum access approaches, including those assisted by geolocation databases or other ICT-based solutions.”⁴⁶⁵

Supporters of mixed authorisation models also emphasise the efficiency benefits. For example, in its response to the RSPG’s 2021 RSPP consultation, DIGITALEUROPE argues for ensuring “a timely, appropriate and balanced approach enabling access to additional licensed and licence-exempt spectrum to serve businesses and consumers, while working towards greater efficiency and intensity of use in existing and new bands.”⁴⁶⁶ In its report on 6G Strategic vision⁴⁶⁷ from February 2025, the RSPG recognised the enhanced need from spectrum sharing.

the current RSPP Decision?”, 14/26 interviewees agreed “updating the approach to establishing future spectrum needs” was one of the most important.

⁴⁶⁰ RSPG 2021 opinion on RSPP, p. 5.

⁴⁶¹ RSPG opinion on “The future of the electronic communications sector and its infrastructure”, RSPG23-016 FINAL, 11 May 2023, p. 4 ([https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-05/RSPG23-016final-RSPG Opinion on future of electronic networks and services.pdf](https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-05/RSPG23-016final-RSPG%20Opinion%20on%20future%20of%20electronic%20networks%20and%20services.pdf)).

⁴⁶² RSPG 2021 opinion on RSPP, p. 6.

⁴⁶³ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society, COM(2016) 587 of 14.09.2016, (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0587>)

⁴⁶⁴ RSPG 2021 opinion on RSPP, p. 6.

⁴⁶⁵ Ibid p3.

⁴⁶⁶ 2021 Public consultation on the draft RSPG Opinion on a Radio Spectrum Policy Programme.

⁴⁶⁷ RSPG25-006 FINAL report.

Supporting the development of satellite communications

In the assessments, there is a recognition that the commercial and technological developments are transforming the satellite sector in a time of changing national needs and the RSPP needs to support this. In its 2021 opinion on the RSPP, the RSPG considers that spectrum policy should support the development of “an innovative satellite system to achieve EU controlled connectivity and to provide governmental services with reliable, resilient and cost-effective satellite communications services.”⁴⁶⁸

More recently, the RSPG, in its Opinion on satellite Direct-to-Device connectivity and related Single Market issues⁴⁶⁹ from June 2025, recognised the fragmentation in the authorisation of the use of satellite service spectrum. It proposed to set in the EU law “common requirements” which should be applied by every MS granting access to its / EU market to the satellite operators active on the EU market. The RSPG also identified a need for a mechanism on the EU level for collective reaction on the EU level in the case of non-compliance to such requirements, if it cannot be resolved at national level.

Supporting efforts to prevent climate change

The need to ensure that spectrum is used for environmentally beneficial purposes was a theme in the assessments that have been reviewed. The current RSPP Decision mentions the need to procure and safeguard spectrum for monitoring the Earth’s atmosphere (Article 8 (1) RSPP Decision) as well as studying energy saving mechanisms and making frequencies available for applications such as smart grids (Article 8 (2) RSPP Decision).

In the stakeholder survey carried out for this study, a respondent from the utility sector argued that the goals of Article 8 (2) RSPP decision have yet to be achieved and they needed more support from spectrum policy to ensure the sector delivered its environmental potential.

The 2021 RSPG opinion on the RSPP argues that where there are EU initiatives to combat climate change, adequate spectrum needs to be made available under harmonised conditions to support this. However, where the need for spectrum is worldwide, such as for scientific services, this is best agreed upon through ITU processes.⁴⁷⁰

The 2021 RSPG opinion on the RSPP supports the goal of reducing the energy consumption of wireless networks. In terms of policy measures to achieve this, it supports voluntary measures taken by operators and urges that this is taken into account when funding research.⁴⁷¹

⁴⁶⁸ RSPG 2021 opinion on RSPP, p. 6.

⁴⁶⁹ RSP25-020 FINAL opinion.

⁴⁷⁰ Ibid p. 7-8.

⁴⁷¹ Ibid pp. 12 and 13.

APPENDIX II B. ADDITIONAL SUPPORTING DATA ON SPECIFIC TOPICS

Figure 21: MedUX - 5G QoE Benchmark in Europe: Drive Testing Report published at MWC25 (Q42024 data)

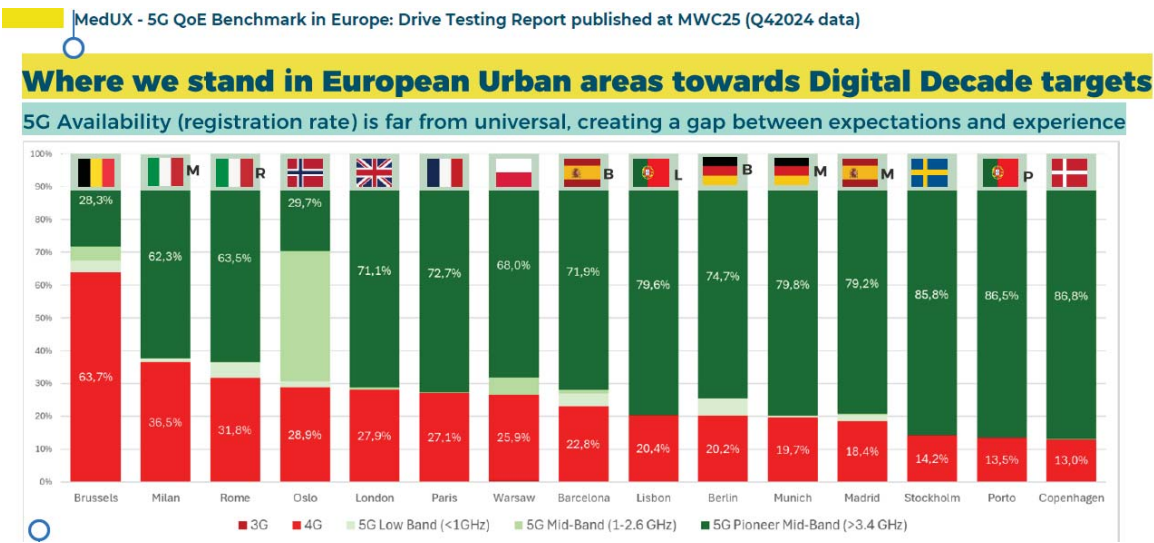


Figure 22: Status of 5G usage in Europe

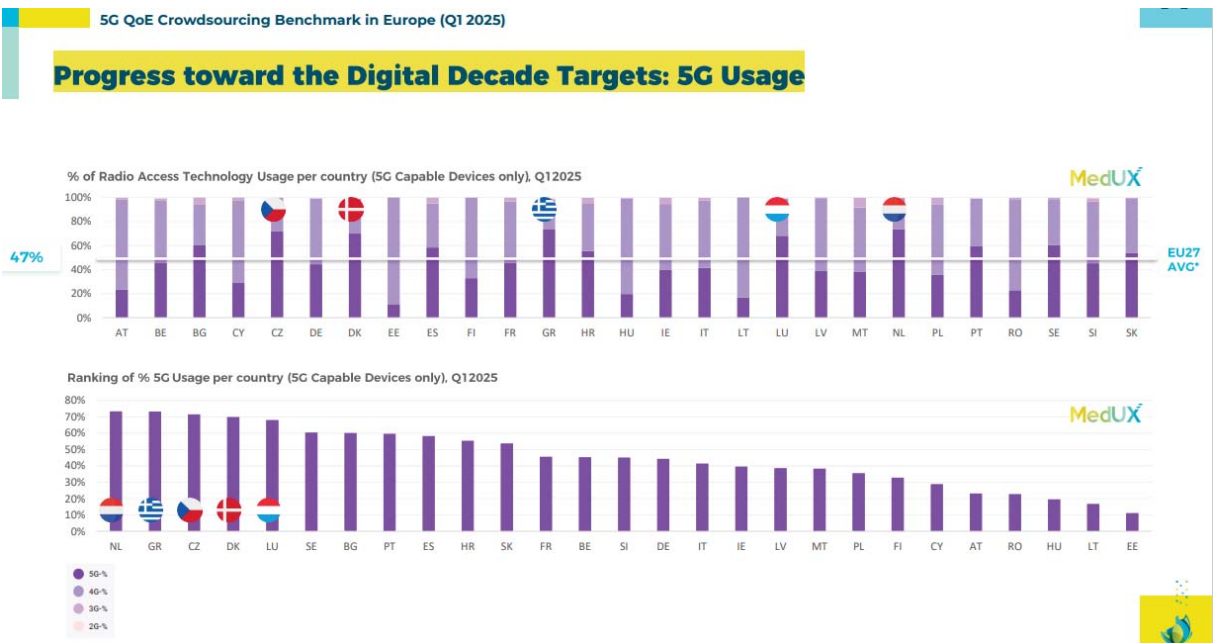


Figure 23 :International comparison of 5G usage

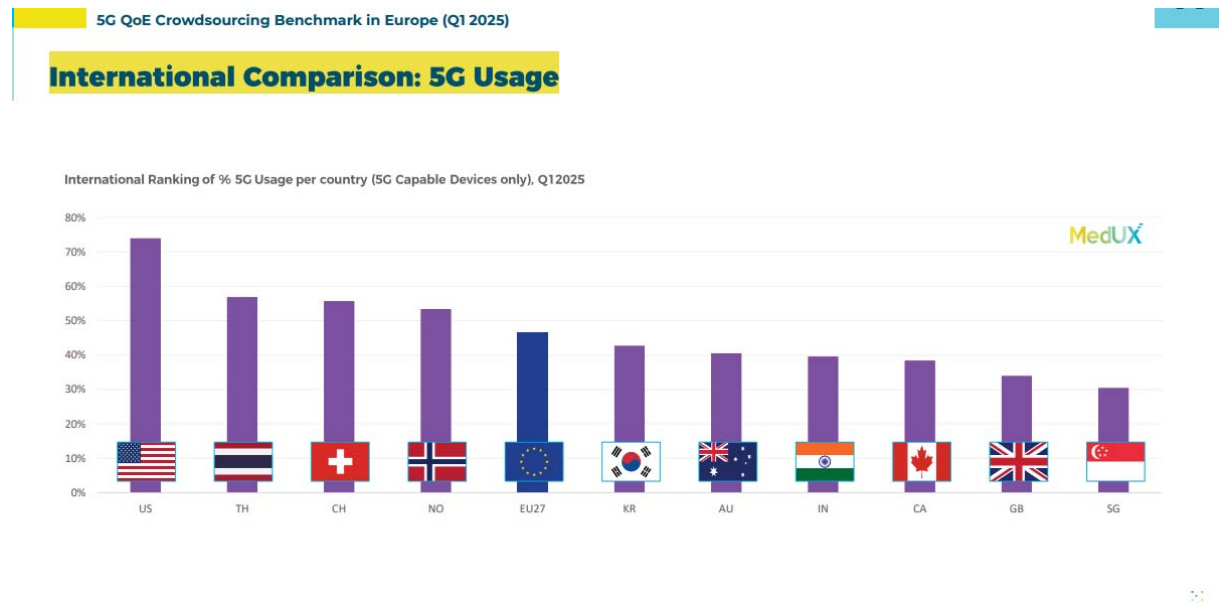


Figure 24: Status of 5G SA usage in Europe

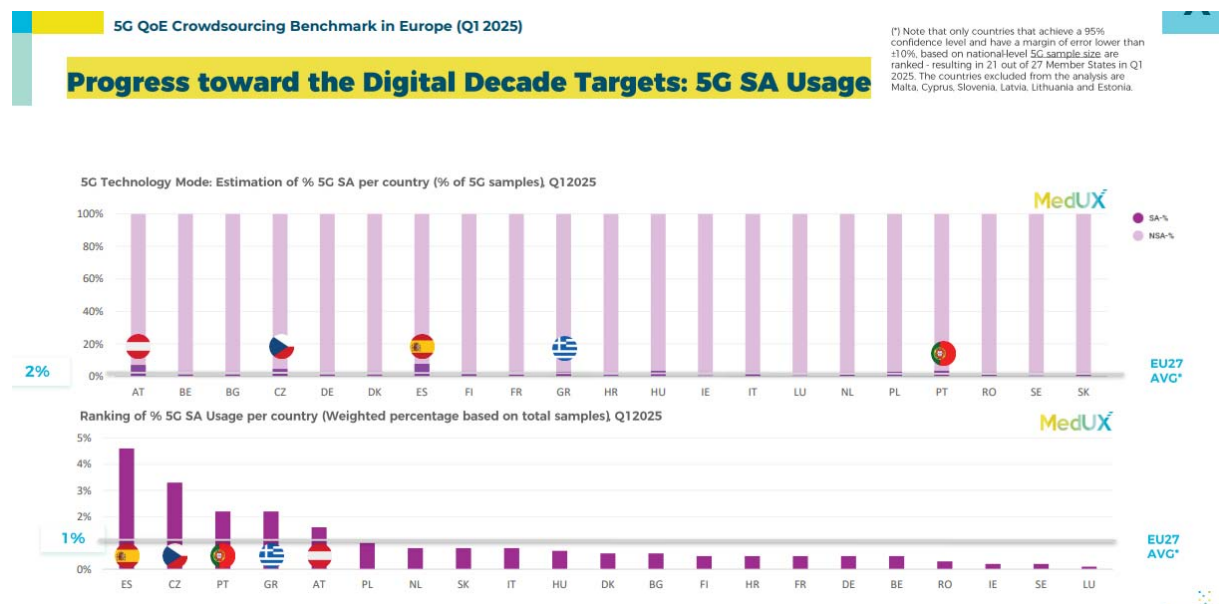


Figure 25: International comparison of 5G SA usage

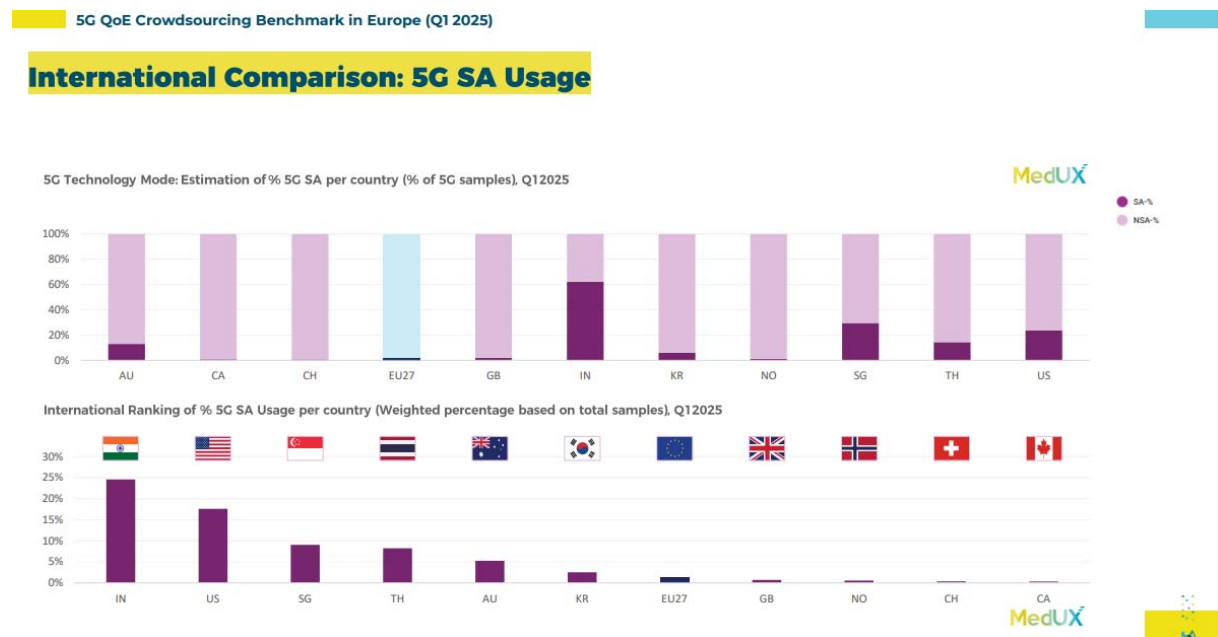


Figure 26: International comparison of average download speed

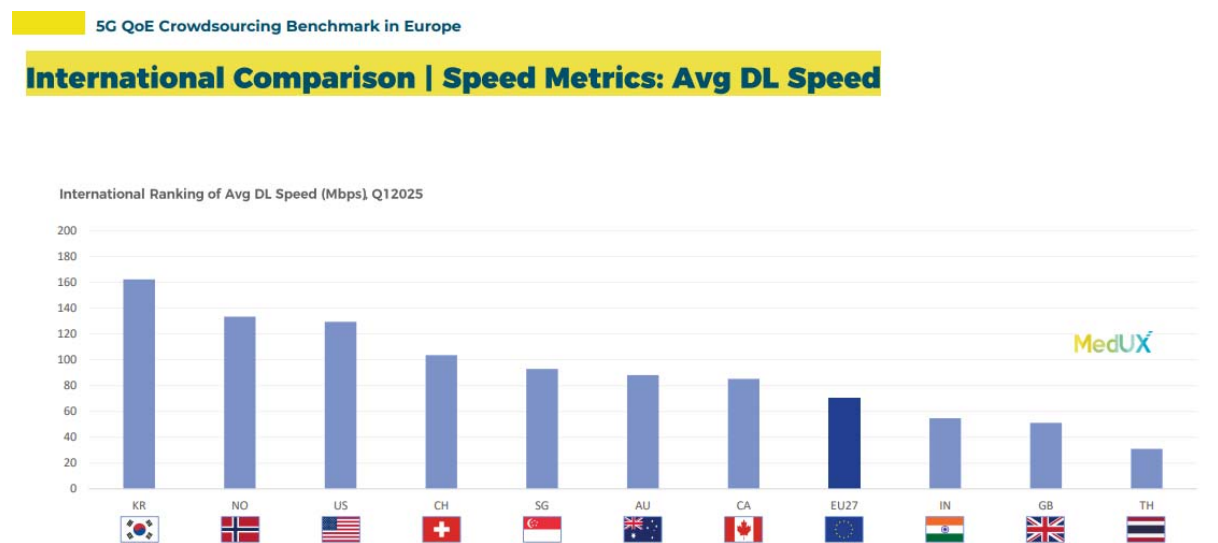


Table 1 – ITU Summary of cases of harmful interference concerning space services

TABLE 4-3
Summary of cases of harmful interference concerning space services

Period	Cases	For BR information (RR15.41)	For BR action/Request for assistance (RR15.42)	Affected service		
				Safety	Broadcasting	Other
06.2024	8	2	6	5	1	2
07.2024	9	3	6	4	0	5
08.2024	4	4	0	0	0	4
09.2024	9	7	2	4	0	5
10.2024	6	2	4	5	0	1
11.2024	9	8	1	1	0	8
12.2024	4	3	1	1	0	3
01.2025	4	2	2	0	0	4
02.2025	3	3	0	0	0	3
03.2025	5	4	1	1	0	4
04.2025	5	3	2	2	0	3
05.2025	24	21	3	8	0	16
Total	90	62	28	31	1	58

Source: Table 4-3 of the Report of the Director of the ITU Bureau to the Radio Regulation Board in July 2025

Table 2 How final auction prices differed from the reserve price in EU 5G auctions⁴⁷²

Award	Reserve as % of EU average band final price	Reserve as % of EU average band final price
Germany 3.6 GHz 2021	85.05	3%
Latvia 3.6 GHz 2018	26.10	4%
Sweden 700 MHz 2018	14.12	18%
Italy 3.6 GHz 2018	11.44	49%
Estonia 3.6 GHz 2022	9.79	5%
Ireland 3.6 GHz 2017	9.75	6%
Estonia 700 MHz 2022	8.85	3%
Austria 3.6 GHz 2024	8.52	6%
Czech Republic 3.6 GHz 2017	6.82	4%
Italy 26 GHz 2018	5.12	39%
Spain 3.6 GHz 2018	4.37	15%
Czech Republic 700 MHz 2020	4.19	22%
Portugal 3.6 GHz 2021	3.95	28%

⁴⁷² The table shows only those auctions where the reserve and final price data is available and can be calculated.

France 3.6 GHz 2020	3.05	64%
Germany 700 MHz 2015	2.22	34%
Latvia 700 MHz 2021	2.06	17%
Greece 700 MHz 2020	2.02	44%
Estonia 26 GHz 2023	1.88	55%
Luxembourg 3.6 GHz 2020	1.86	69%
Sweden 3.6 GHz 2021	1.29	65%
Spain 700 MHz 2021	1.25	107%
Finland 3.6 GHz 2018	1.20	44%
Czech Republic 3.6 GHz 2020	1.18	36%
Austria 26 GHz 2024	1.17	80%
France 700 MHz 2015	1.12	231%
Bulgaria 3.6 GHz 2021	1.12	10%
Croatia 700 MHz 2021	1.11	28%
Slovakia 700 MHz 2020	1.02	110%
Finland 700 MHz 2016	1.01	75%
Finland 26 GHz 2020	1.01	115%
Croatia 26 GHz 2021	1.01	90%
Italy 700 MHz 2018	1.00	215%
Greece 26 GHz 2020	1.00	110%
Luxembourg 700 MHz 2020	1.00	166%
Spain 3.6 GHz 2021	1.00	65%
Portugal 700 MHz 2021	1.00	70%
Romania 3.6 GHz 2021	1.00	11%

APPENDIX III EVALUATION OF BEREC AND THE BEREC OFFICE

1. INTRODUCTION

This report to the European Parliament, the Council and the Management Board outlines the Commission's findings of the evaluation of the performance of BEREC and the BEREC Office, in accordance with Article 48 of Regulation (EU) 2018/1971 of the European Parliament and of the Council of 11 December 2018 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Agency for Support for BEREC (BEREC Office) ¹, hereinafter the 'BEREC Regulation'. The accompanying staff working document contains more detailed evidence and analysis supporting these findings.

2. METHOD

The evaluation was carried out in compliance with the Commission Better Regulation Guidelines² and builds on the study supporting the evaluation of BEREC and the BEREC Office prepared for the Commission³. While in principle it encompassed the period from 2019 to 2023, most relevant developments until mid-2025 are also covered. This report assessed the performance of BEREC and the BEREC Office across the following evaluation criteria: effectiveness, efficiency, relevance, coherence, and EU value added.

The evaluation support study used several methods of data collection and analysis, including inter alia: desk research, document analysis, surveys for NRAs and for external stakeholders, as well as an interview programme with representatives from stakeholders categories.

In its evaluation, the Commission has also taken into consideration BEREC own initiative input to the Commission on the functioning of BEREC and the BEREC Office in view of the evaluation under Article 48 of the BEREC Regulation⁴.

3. BEREC AND BEREC OFFICE UNDER REGULATION (EU) 2018/1971

The Body of European Regulators for Electronic Communications as it exists today was established by the BEREC Regulation, together with the Agency for the Support for BEREC. They succeeded the original BEREC and its office, set up by Regulation (EC) No 1211/2009, as part of the 2009 telecoms reforms package, in order to ensure greater harmonisation of practices among the NRAs, promote an effective internal market in this sector, and act as an exclusive forum for cooperation among NRAs, and between the Commission and NRAs. In 2018, following the evaluation undertaken under Regulation (EC) No 1211/2009⁵, BEREC's role was further strengthened by the BEREC Regulation and by the EECC.

BEREC's mandate was notably expanded to issue several guidelines to facilitate the harmonised implementation of the EECC, as well as to establish and maintain specific databases, for instance on numbering and general authorisations.

The two-tier structure of BEREC and the BEREC Office was maintained in 2018 by the co-legislators, while the Commission had initially proposed in 2016 to expand BEREC on the model of a decentralised agency. As a result, only the BEREC Office, which succeeded the Office, is a decentralised EU Agency dedicated to delivering professional and administrative support to BEREC, the body gathering NRAs. The BEREC Office possesses a legal personality and maintains legal, administrative, and financial autonomy.

Like Member States, including NRAs, as well as the Commission and the Radio Spectrum Policy Group (RSPG), BEREC is pursuing the general objectives set out in Article 3 of the EECC, that is: promoting connectivity and access to very high capacity networks (VHCN);

promoting competition and efficient investment; contributing to the development of the internal market; promoting the interests of the citizens of the Union. The objective of promoting connectivity was added in the EECC as electronic communications were becoming essential for the economy and the society overall.

Additionally, BEREC must, according to Article 3 of the BEREC Regulation, ensure - in particular - a consistent implementation of the regulatory framework for electronic communications (EECC, Roaming Regulation⁷ and Open Internet Regulation⁸).

4. MAIN FINDINGS

4.1 Effectiveness

In general, over the period assessed, **BEREC** has been effective in delivering on its main objectives, i.e. promoting connectivity and access to VHCN; promoting competition and efficient investment; contributing to the development of the internal market; promoting the interests of the citizens of the Union (Article 3 EECC).

Under EECC BEREC has been tasked with elaboration of 11 guidelines⁹, on complex technical, economic and legal aspects, aiming to provide guidance to NRAs for more harmonised implementation of the EECC. BEREC devoted significant resources and expertise in elaboration of the guidelines, which in general are perceived as important guidance supporting NRAs common approaches. Yet those guidelines alone were not sufficient to create European single market in the communication sector, as the guidelines always adhere to the principle of NRAs flexibility. In this context, safeguarding BEREC and NRAs independence from political influences and from other stakeholders, has been and remains an important determinant of their effectiveness in implementing the regulatory framework.

During the period analysed, more complex and interrelated digital markets have led to the enactment of new rules in the digital ecosystem in recent years e.g., the Digital Services Act¹⁰, the Digital Markets Act¹¹, the Data Act¹² and Data Governance Act¹³ and the AI Act¹⁴. This resulted in new responsibilities assigned to competent authorities in these digital markets. However, in these new fields as well as in cybersecurity or spectrum, these new aspects are not always reflected in BEREC's mandate. Moreover, since these new responsibilities are not necessarily granted nationally to NRAs, BEREC cannot always rely on the experience of all of its members when implementing (new) tasks entrusted to it or, acting on its own initiative, providing advice or input on these new aspects. Therefore, better cooperation with competent authorities other than the NRAs in the field of electronic communications, as well as upskilling of the NRAs, are becoming even more important as digital regulation is extending beyond the traditional telecommunications sector. While more coordination and exchange of information between the NRAs and other competent authorities, or the direct involvement of the latter in the work of BEREC, would further improve its effectiveness, the above also prompts the question whether the scope of BEREC's tasks should not evolve, to keep up with these regulatory developments.

Moreover, as also recognised by BEREC and as indicated in the Commission's White Paper 'How to master Europe's digital infrastructure needs?' a virtualisation and softwarisation of electronic communications networks is ongoing, as well as a shifting of network functions to the cloud or the edge¹⁵. The convergence of electronic communications networks and services and cloud infrastructures does not only concern the infrastructure layer, but also the service operations. Furthermore, in the last years AI-based applications have profoundly changed the way of life and affected all economic sectors. It is important for BEREC to be able to respond to the convergence of the traditional telecoms market and the wider digital ecosystem to fulfil

its role, including the increasingly supranational scope of connectivity markets. Should the European dimension of the sector further develop, and with it, scope and objectives of regulatory framework, including regulatory issues such as authorisation, ensuring better functioning of broader connectivity eco system and very importantly resilience and sustainability broader and amore EU-focused governance setup should also be considered.

When it comes to **the BEREC Office**, generally speaking, it has been successfully providing support to BEREC, even during periods of increased workload or when having to adapt to significant global events, such as the Russia war of aggression on Ukraine. Nevertheless, the Commission shares the view of many NRAs that the BEREC Office should not only provide administrative support but also additional professional support and, in particular, play a more central role in data collection and analysis. This could be an important development in the BEREC Office's role, as demand for data analytics, and better understanding of technological trends and their determinants are essential for BEREC to fulfil its role, now and in the foreseeable future. Strengthening the BEREC Office so that it can support BEREC also on substance will allow BEREC deliverables to take more into account EU perspective and better align with EU-level policies.

4.2. Efficiency

BEREC is generally considered as an organisation with a clear and straightforward setup, governance and procedures, yet relatively flexible. Nevertheless, the frequent reliance on the bigger NRAs for leading BEREC working groups, the mentioned asymmetry in the NRAs' competences or their related limited knowledge in specific areas might challenge the representativeness of specific BEREC outputs. While the current mandate of the BEREC Office might not provide much margin of manoeuvre, requesting more content-related support from the BEREC Office could improve the situation.

Moreover, the number of BEREC Working Groups and the delineation of their tasks should be assessed to ensure that developments in the sector are addressed while avoiding possible overlaps or inconsistencies. Finally, as also raised by NRAs/BEREC, better coordination and planning with the EU institutions could enable more effective task delivery regarding ad hoc work requested from BEREC.

Being among the smallest EU agencies, **the BEREC Office** strives to provide support to BEREC as efficiently as possible within its budgetary constraints. The BEREC Office – and its Management Board – is, however, regularly deviating from the Commission's guidance on staff to recruit more colleagues. At the same time, there is currently a relatively high rate of staff turnover at the BEREC Office, mostly visible for external staff dealing with administrative tasks, and reportedly due, in part, to the location of the Agency. This turnover leads to continuity issues, including retaining knowledge.

The BEREC Office should address these issues in order to be more efficient. This could be done through reorganisation of functions inside the Agency, as well as closer collaboration with Commission services or other decentralised agencies. As a matter of fact, providing more content-related support e.g. on data analysis and report drafting, could make the overall balance between operational staff and administrative support staff more appropriate. This could make the BEREC Office a more attractive employer. Furthermore, the BEREC Office' IT tools could be further improved to make them more straightforward to use, and secure in view of persistent cybersecurity threats (both to the BEREC Office itself, in view of its location, as well as a compromise vector towards EU telecoms operators). In any event, it will be important that the BEREC Management Board addresses human and financial resources

issues in accordance with the overall framework for European agencies and uses the resources efficiently.

4.3. Coherence

More coordination and exchange of information at EU and/or national level, between the NRAs and other competent authorities, or the direct involvement of other competent authorities in BEREC's work for which NRAs are not all in charge at the national level, would also foster the coherence of certain BEREC outputs. In the Commission's view, BEREC should in any event adapt its outputs and expertise to relevant emerging topics such as AI, cybersecurity, and other digital matters, and very importantly sustainability and resilience of networks, which are addressed in different EU policies and legal instruments.

Specific reference should also be made to spectrum matters in this context. While a significant number of BEREC members are responsible for spectrum matters at national level, and both BEREC and the BEREC Office are addressing authorisation issues in a number of ways, they are involved in spectrum matters only in limited instances so far, such as via participation in RSPG peer reviews. Recent developments in the area of satellite-based applications particularly calls for strengthened involvement of BEREC and the BEREC Office in the field of spectrum, in view of inherently pan-European nature of satellite-based services.

4.4. EU added value

By bringing together expertise from 27 NRAs, **BEREC** plays a pivotal role in the implementation of the electronic communications' regulatory framework, in particular for the NRAs and the EU institutions.

At the same time, its contribution to fostering regulatory consistency, hence the internal market for electronic communications and end-users, should be further encouraged. In particular, BEREC could play a more active role in promoting a harmonised approach to the implementation of the European regulatory framework for electronic communications in line with Article 3 of the BEREC Regulation, notably through its guidelines. During the evaluation period, BEREC guidelines were instrumental in supporting the harmonisation of NRAs approaches but were not sufficient, among also many other factors not directly related to BEREC, to ultimately lead to the creation of European single market for communication. Nevertheless, while BEREC can adopt its opinions by simple majority, in practice it strives to achieve consensus/unanimity and common ground among all involved NRAs. In effect this significantly limits BEREC ability to act with focus on pan-European interests, as opposed to sometimes more conservative and 'naturally' more focused on local specificities, national views.

BEREC's opinions generally provide valuable inputs to the NRAs and the EU policy process. However, those issued on its own initiative and/or during inter-institutional negotiations could be better coordinated with the Commission and co-legislators to ensure their usefulness in the policymaking process. This would plead for finding the appropriate ways and timing for the Commission or other institutions to collect BEREC's views, and to clarify BEREC's current mandate to provide input in relation to the preparation of legislative proposals in the field of electronic communications.

Moreover, BEREC's expertise needs to be sustained, deepened and broadened, in view of the rapidly evolving electronic communications and digital markets, and this, despite any diverging powers of its members at national level. In that regard, in its response¹⁶ to the Call for Evidence BEREC states that it is keen to assume new institutional responsibilities in view

of further strengthening the single market dimension and broader digital policy perspective, while such expansion can also work well within its current two-tier structure. Further, BEREC stresses the need to clearly delineate the areas of responsibilities and accountability among various institutional actors, and acknowledges the growing need for structured cooperation with other EU-level bodies overseeing interrelated areas of digital policy, such as data governance, digital services, cybersecurity, and AI.

Finally, the increasing number of participants from third country NRAs, while helping to promote the EU electronic communication markets and exchange of views and learning from each other, implies reflecting on the respective roles, capacities to make decisions and organisation of BEREC work.

4.5. Relevance

Asymmetries in NRAs' competences in Member States may limit the relevance of **BEREC's** work for certain NRAs. This is prompting the question how BEREC could best '*contribute to the regulatory environment fit for the digital age in the run-up to 2030*', as BEREC puts it in its own input to the evaluation.

The current governance structure has been conceived for markets which are national in scope, and where *ex ante* regulation is the main tool in the regulatory toolbox. This is changing, since the European dimension of the sector has been developing, while competitive conditions have evolved. Also, greater potential to rely on symmetric rules means that the scope of *ex-ante* regulation, based on a regular review of national markets can be progressively reduced. Recent technological changes create various opportunities and challenges for the sector, as indicated in the Commission in the White Paper on digital infrastructure needs, and recent feedback in the Call for evidence accompanying the legislative process for the Digital Networks Act. The draft Strategy recognises the profound changes of the digital technologies and the intertwined/reciprocal nature of electronic communications and digital technologies (AI, data processing, virtualisation, cloud and edge computing). In order to ensure its relevance in the coming years BEREC identifies key priorities, which besides its current focus (connectivity, competition, end user interests), also put emphasis on environmental sustainability, cybersecurity and resilience.

The currently decentralised governance mechanism and the traditional setup of BEREC might not be sufficient and appropriate to cope with this evolution. Furthermore, the regulatory toolbox might need to be modernised to address the market and technological changes, with possible broader use of harmonised tools (for example access product) and its most rarely (if ever) used tools, such as resolution of cross-border aspects, may gain prominence. In this respect, and while BEREC's current tasks are mostly of an advisory nature, the question arises how the role and mandate of BEREC and the BEREC Office should possibly be strengthened and adapted to new responsibilities in the broader digital field.

The current setup also challenges the relevance of BEREC's work on digital markets for certain industry and consumer representatives. External stakeholders want to engage more with BEREC in virtual events or public consultations, often ask for more time to respond to consultations, and for more transparency on upcoming initiatives. In that regard during 2024 and 2025 BEREC has put significant emphasis on improving its effective communication with stakeholders, to ensure transparency, build trust and engage with stakeholders, ensuring that all its outputs remain relevant. This has been underlined as one of the aspects of strengthening BEREC capabilities in its draft Strategy 2026-2030, which aims to set BEREC priorities for the upcoming 5 years.¹⁷

5. CONCLUSION

This report, and its accompanying Staff Working Document, mainly look backwards, into the performance of BEREC and the BEREC Office over the period 2019-2023, while also taking into account main developments until August 2025. This report draws a number of lessons from this analysis, including on the mandate and the organisation of BEREC and the BEREC Office.

Overall, BEREC and the BEREC Office have proven to be quite effective in delivering on their main objectives. The contribution of independent NRAs, which share the same objectives, is essential in this respect.

However, the situation has been developing over the reporting period and continues to evolve significantly. More complex and interrelated digital markets have led to the enactment of new rules and new tasks granted to many BEREC members in e.g. digital markets, cybersecurity, spectrum, data, AI which are not always reflected in BEREC's mandate. This is increasing the asymmetry between NRAs' responsibilities at national level, as well as between NRAs' responsibilities and BEREC's mandate. Moreover, recent market and technological changes are creating opportunities and challenges for the sector, as indicated in the Commission's White Paper on digital infrastructure needs.

These developments are pleading for more coordination and exchange of information at national level or the direct involvement other competent authorities in the work of BEREC, which could improve its effectiveness. Moreover, changes occur in the electronic communications sector itself, with evolving competitive conditions and blurring delineation between different aspects of digital networks and electronic communication and digital services. These developments are calling for sustaining and broadening BEREC's role and expertise, as also recognised by BEREC itself, while underlining the need for clear delineation of new responsibilities and accountability of various institutional actors and preserving BEREC's and NRA's independence.