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PART 2/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposalsl for

**a Directive of the European Parliament and of the Council establishing the European
Electronic Communications Code (Recast) and
a Regulation of the European Parliament and of the Council establishing the Body of
European Regulators for Electronic Communications**

{COM(2016) 590}
{COM(2016) 591}
{SWD(2016) 304}

ANNEXES

2.1 ANNEX 1 - Procedural Information

2.1.1 Identification;

This Staff Working Paper was prepared by Directorate B 'Electronic Communications Networks and Services' of Directorate General 'Communications Networks, Content and Technology'. The RWP reference of this initiative is 2016/CNECT/XX.

This Staff Working Paper is accompanied by the Fitness Check SWD for the current regulatory framework conducted in the context of the REFIT programme assessed not only in terms of achievement of the original goals, but also in view of potential simplification and reduction of the regulatory burden.

2.1.2 Organisation and chronology:

Several other services of the Commission with a policy interest in the review of the telecom framework have been associated in the development of this analysis. The Telecoms Framework Inter-Service Steering Group met for the first time on the 7 May 2015.

A second Telecoms Framework Inter-Service Steering Group meeting took place on 9 July 2015

A third Telecoms Framework Inter-Service Steering Group took place on 26 January 2016 .

A fourth Telecoms Framework Inter-Service Steering Group Impact Assessment Steering Group took place on 14 April 2016 to discuss a draft evaluation report and the problem definition of the IA. Comments were received by 21 April 2016.

A fifth Telecoms Framework Inter-Service Steering Group took place on 30 May 2016 to discuss the draft Impact Assessment

In the ISSG, chaired by SG, DG CONNECT, was flanked by DG DIGIT, DG COMP, DG JUST, DG GROW, DG ECFIN, DG FISMA, DG TAXUD, DG TRADE, DG RTD, DG JRC, DG SANTE, DG EMPL, DG EAC, DG NEAR, DG ENV, LS, DG REGIO, DG HOME, DG ENER, DG AGRI, DG MOVE, EUROSTAT, EPSC.

DG Connect also benefited from the support received by the JRC Information Society Unit for the assessment of the model elaborated for the IA support study *SMART 2015/0005* presented in section **Error! Reference source not found.** and Annex 5..In particular, the analysis carried out by JRC concluded that "*the consultants constructed a CGE model with a rich sectorial and geographical setup (8 sectors and 4 representative countries). Also, the policy considered in the analysis is entered into the CGE model through immediate costs are introduced in the form of (private and public) investments and public expenditures. In addition the sector TFP is adjusted following the estimated impacts from KPIs. This seems a fine way to capture the economic impacts from the policy considered*".

2.1.3 Regulatory Scrutiny Board

This staff working document will be discussed at the regulatory scrutiny board meeting of 7 July 2016.

2.1.4 Evidence

The options considered in this impact assessment were designed by taking into account the following main inputs:

- (i) the contributions to the Telecom Framework Review public consultation, a summary of which is attached in Annex 2 to this report.
- (ii) the BEREC opinion on the review of the regulatory framework released on 10 December 2015
- (iii) ³³⁵,

The three review studies (delivered together with this Impact Assessment report) are:

- (iv) *"Support for the preparation of the impact assessment accompanying the review of the regulatory framework for e-communications" (SMART 2015/0005)*
- (v) *Regulatory, in particular access, regimes for network investment models in Europe" (SMART 2015/0002)*
- (vi) *Substantive issues for review in the areas of market entry, management of scarce resources and general consumer issues" (SMART 2015/0003).*

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 July 2016 for SMART /002, by end of August for SMART 003 and by the end of September for SMART/005.

Other recent DG Connect studies in the field of Electronic communication:

- (vii) *"Review of the scope of universal service" (SMART 2014/11),*
- (viii) *"Study on future trends and business models in communications services and their regulatory impact" (SMART 2013/0019),*
- (ix) *"Identification and quantification of key socio-economic data for the strategic planning of 5G introduction in Europe" (SMART 2014/0008)*
- (x) *"Economic and Social Impact of repurposing the 700MHz band for wireless broadband services in the European Union" (SMART 2015/0010),*
- (xi) *'Costing the New Potential Connectivity Needs' (SMART 2015/0068)*
- (xii) *"Impact of Traffic Offloading and Technological Trends on the Demand for Wireless Broadband Spectrum" (SMART 2012/0015)28,*
- (xiii) *"Spectrum Policy. Analysis of Technology Trends, Future Needs and Demand for Spectrum in line with Article 9 of the RSPP" (SMART 2012/0005)27,*
- (xiv) *Survey and data gathering to support the Impact Assessment of a possible new legislative proposal concerning Directive 2010/13/EU (AVMSD) and in particular the provisions on media freedom, public interest and access for disabled people,*

The other relevant sources quoted in the document are indicated in the bibliography and range from academic papers to industry figures and estimates.

2.1.5 External expertise

The European Commission sought external expertise on the technical field as well as on the socio-economic impacts of the options presented above. The Commission contracted WIK-Consult, Ecorys

³³⁵ See; http://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/5577-berec-opinion-on-the-review-of-the-eu-electronic-communications-regulatory-framework

and VVA Europe to support the preparation of this impact assessment accompanying the review of the regulatory framework for e-communications. In the framework of the study an expert panel of top-level, globally recognised and reputable specialists (scholars, experts in the field). was organized to provide feedback on the preliminary conclusions reached by the consultants concerning the impact of planned changes to the e-communications framework.

A **high level expert panel** was held on 30 May 2016 conducted in the framework of study SMART 2015/0005. Participants were Prof. Joan Calzada, Prof. Frédéric Jenny, Prof. Brigitte Preissl, Prof. Luc Soete, Prof. Reza Tadayoni, Prof. William Webb, Prof. Brett Frischmann, Prof. Eli Noam. Experts profiles and a report of the discussion are presented in Annex 13.

In addition to the review and other studies quoted above also the following EC studies in the field of Electronic communication were considered

- *"Identification of the market of radio equipment operating in license-exempt frequency bands to assess medium and long-term spectrum usage densities" (SMART 2014/0012),*
- *"Eurobarometer household survey on eCommunications" - SMART 2014/0014,*
- *"Investigation into access and interoperability standards for the promotion of the internal market for electronic communications networks and services" (SMART 2014/0023) a study on the 'standardisation' of wholesale access products*
- *"Mapping of Broadband and Infrastructure Study" (SMART 2012/0022),*
- *"Mapping broadband infrastructures and services (phase II)" (SMART 2014/0016),*
- *"Impact of Traffic Offloading and Technological Trends on the Demand for Wireless Broadband Spectrum" (SMART 2012/0015)28,*
- *"Spectrum Policy. Analysis of Technology Trends, Future Needs and Demand for Spectrum in line with Article 9 of the RSPP" (SMART 2012/0005)27,*
- *"Study in support of the preparation of an impact assessment to accompany an EU initiative on reducing the costs of high-speed broadband passive infrastructure deployment" (SMART 2012/0013).*
- *"Steps towards a truly Internal Market for e-communications in the run-up to 2020" (SMART 2010/0016),336*
- *"Study on the socio-economic impact of bandwidth" (SMART 2010/0033),*
- *"Broadband coverage in Europe in 2013" Updated on an annual basis (SMART 2013/0054),*
- *"Broadband retail broadband access prices in 2013" Updated on an annual basis (SMART 2010/0038),*
- *"Challenges and Opportunities of Broadcast-Broadband Convergence and its Impact on Spectrum and Network Use" (SMART 2013/0014),*
- *"Use of commercial mobile networks and equipment for mission-critical high-speed broadband communications in specific sectors " (SMART 2013/0016),*
- *"Study in support of the preparation of an impact assessment to accompany an EU initiative on reducing the costs of high-speed broadband passive infrastructure deployment" (SMART 2012/0013).*

2.2 ANNEX 2 - Stakeholders and Public Consultation

2.2.1 The stakeholders engagement strategy

A continuous and active stakeholder engagement strategy was devised and followed for the evaluation and review of the regulatory framework for electronic communications networks and services. From the outset key ideas for evaluation and reform of the regulatory framework were outlined in a public roadmap³³⁷ that followed the Political Guidelines³³⁸ of the new Commission and the subsequent DSM

³³⁶ https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/final_report_internal_market_ecom.pdf,
http://europa.eu/rapid/press-release_IP-12-193_en.htm?locale=en

³³⁷ http://ec.europa.eu/smart-regulation/roadmaps/docs/2015_cnect_007_evaluation_elec_communication_networks_en.pdf

Communication³³⁹. The published roadmap explained what the Commission was considering, describing the scope of and outlining the main change drivers underpinning this initiative and announced further details of stakeholder consultation strategy. This fed into the subsequent consultation activities, ensued an inclusive process with all interested parties having an opportunity to contribute.

A dedicated 12 weeks open **public consultation** was launched on 11 September 2015 that gathered inputs for the evaluation process in order to assess the current rules and to seek views on possible adaptations to the framework in light of market and technological developments and thus contributing towards the DSM. The consultation document was both broad and detailed, eliciting extensive inputs from consumers, providers of electronic communications networks and services, national and EU operator associations, civil society organisations, broadcasters, technology providers, Internet and online service providers, undertakings relying on connectivity and wider digital economy players, national authorities at all levels, national regulators and other interested stakeholders. Inputs provided include stakeholders affected by the policy, those who have to implement it and those with a stated interest in the policy. The consultation gathered a total of 244 online replies from stakeholders in all Member States as well as from outside the Union.

On 11 November 2015, halfway through a public consultation process, **public hearing** was organised in Brussels as well as broadcasted online³⁴⁰. This offered an opportunity for in-depth discussions on issues outlined in the public consultation document, allowing for reasonable time to formulate and gather effective feedback from all relevant stakeholder groups, allowing the collection of all relevant evidence (comprising data/information) and views.

During the consultation process broad public events were combined with more targeted consultation. This in particular relate to a series of consultation events held with sector regulatory community that is entrusted with key supervisory and implementing tasks stemming from the regulatory framework. Following a series of such events and at the request of the Commission, BEREC provided an input to the evaluation and the review process and published its opinion in December 2015³⁴¹. In addition, the RSPG had provided its opinion on DSM and the Framework Review³⁴².

In parallel to the public consultation, and as part of such targeted consultation efforts, on 7 October 2015 the Commission convened a **dedicated meeting of e-Communications Administrations High Level Group**, comprising representatives of the relevant ministries. At this meeting national authorities shared their views and discussed challenges, focusing on the need to develop the fixed and wireless connectivity networks of the future and to drive take-up and innovative services across Europe.

As part of the evaluation process the Commission has also contracted a number of studies. Implementation of these studies encompassed public workshops that allowed stakeholders to comment and provide feedback to the ongoing evaluation work.

Several such public workshops took place that allowed cross checking of findings and verifying inputs and assumptions.

On 6 April 2016 was held in the Commission's premises a public workshop to validate the interim findings a study Smart 002/20015 conducted by WIK, IDATE and Deloitte on "regulatory, in particular access, regimes for network investments models in Europe" in the context of the

³³⁸ http://ec.europa.eu/priorities/publications/president-junckers-political-guidelines_en

³³⁹ http://europa.eu/rapid/press-release_IP-15-4919_en.htm

³⁴⁰ <https://webcast.ec.europa.eu/public-hearing>

³⁴¹ http://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/5577-berec-opinion-on-the-review-of-the-eu-electronic-communications-regulatory-framework

³⁴² http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG16-001-DSM_opinion.pdf

preparation of the regulatory framework for electronic communications networks and services. The workshop was attended by 60 external participants – not counting the team of consultants, from the main European industry associations of the sector, from the telecom industry, e.g. operators, service providers, vendors, business users, OTTs, banks and local governments, as well as representatives from BEREC and national regulatory authorities.

On 2 May 2016, a public workshop was held at Commission premises to validate the interim findings of a study conducted by WIK, CRIDS and Cullen on "Substantive issues for review in the areas of market entry, management of scarce resources and general end-user issues" (SMART 2015/003) in the context of preparing the review of the EU regulatory framework for electronic communications. The workshop was attended by around 100 external participants representing EU and national sectorial industry associations, electronic communications network operators and service providers, cable network operators, broadcasters, consumer interest associations, vendors, business users, as well as members of RSPG, Member States and National Regulatory Authorities.

In addition, the Commission responded positively to numerous requests to participate and update on the review progress at conferences, seminars and workshops, keeping open exchange with all stakeholders.

The consultation strategy followed by the Commission allowed the widest possible dissemination of information and allowing stakeholders for a reasonable time to formulate and gather effective feedback on all key elements of both the evaluation and the review process. This among other included problem identification, subsidiarity and the need for EU action, outlining possible policy response and anticipating impacts of such response. The consultation strategy followed ensured that both general principles and the five minimum standards were respected and met. The results of these consultation activities are summarised in the published synopsis report³⁴³ which is annexed to this report.

2.2.2 The outcome of the public consultation

The synoptic report summarising the main outcome of the public consultation carried out for the review of the telecoms framework has been published in April 2016.

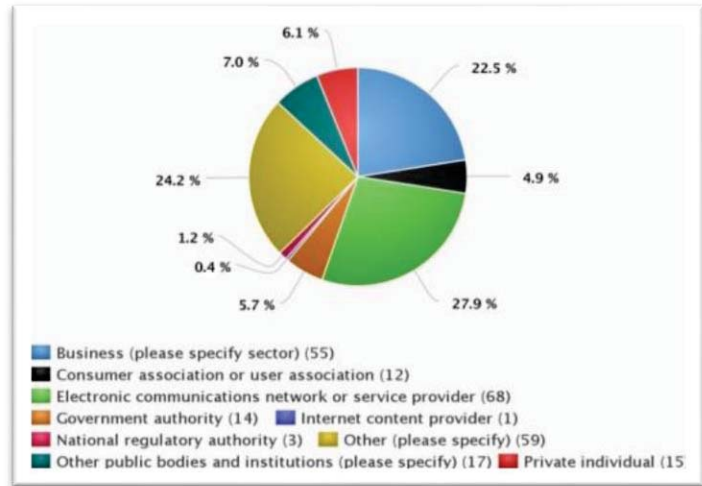
2.2.2.1 Introduction

The consultation on the regulatory framework for electronic communications networks and services was launched to gather input for the evaluation process in order to assess the current rules and to seek views on possible adaptations to the framework in light of market and technological developments, with the objective of contributing to the Digital Single Market Strategy.

The consultation targeted consumers, providers of electronic communications networks and services, national and EU operator associations, civil society organisations, broadcasters, technology providers, Internet and online service providers, undertakings relying on connectivity and wider digital economy players, national authorities at all levels, national regulators and other interested stakeholders. The consultation gathered a total of 244 online replies from stakeholders in all Member States as well as from outside the Union. The consultation elicited both consolidated contributions from umbrella organisations and individual contributions from various stakeholders.

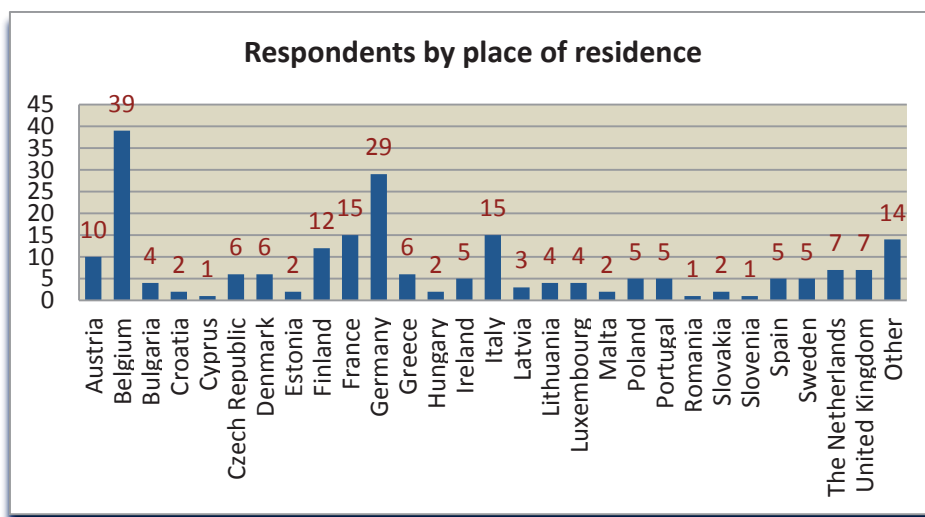
³⁴³ <https://ec.europa.eu/digital-single-market/en/news/full-synopsis-report-public-consultation-evaluation-and-review-regulatory-framework-electronic>

The participation of different stakeholder categories was overall balanced with stakeholders from the wider digital economy actively responding as well as consumer groups, public authorities and electronic communications networks and services providers. This includes stakeholders affected by the policy, those who have to implement it and those with a stated interest in the policy. Online contributions by public authorities (national administrations and sector regulators) were relatively fewer than the inputs of electronic communications network or service providers or wider digital economy market actors. Among stakeholders representing electronic communications networks and services providers, different clusters of economic actors with diverse economic power gave input – traditional/incumbent operators, alternative operators.



This report uses the above categorisation of stakeholders in presenting converging or differing views on issues addressed in the consultation. The contributions of the stakeholders who gave their consent to publication are available [online](#). This report also takes account of BEREC's³⁴⁴ input to the evaluation and the review process provided at the request of the Commission, the RSPG³⁴⁵ [opinion](#) on DSM and the Framework Review and some 20 other contributions received outside the online consultation as well as feedback received via the dedicated [public hearing](#) dedicated to this review. The BEREC opinion was published in December 2015, and can be found on this [website](#).

This analysis does not represent the official position of the Commission and its services and thus does not bind the Commission.



The input gathered corresponds to the objective of the consultation in both assessing the performance of the regulatory framework to date and also providing insights about possible adjustments in order to respond to market and technological advancements and prospective challenges.

³⁴⁴ Body of European Regulators for Electronic Communications

³⁴⁵ Radio Spectrum Policy Group

2.2.2.2 Analysis of responses

The analysis in subsequent sections of this report is based on inputs received by different stakeholder categories.

2.2.2.2.1 Objectives and overall performance

In terms of the *effectiveness*, it is acknowledged by most stakeholders (**consumer organisations, Member States, operators, regulators, other**) that while the framework has been successful in bringing more competition in the market and promoting the interests of EU citizens, it was less successful in promoting the internal market.

On the objective of achieving the internal market, most respondents indicated a moderate contribution. Alternative operators generally perceive the framework as having set the right environment for the internal market to develop. Conversely, several incumbents are rather negative on this point and also some small players point out that the provisions of the framework are not apt to foster cross-border deployments. Many respondents have stated that this objective has not been achieved owing to the lack of a consistent approach by NRAs (national regulatory authorities), with some of them being seen as more willing and ready to enforce framework provisions than others. Hence this objective can be considered as only partially achieved.

The framework's contribution to the objective of protecting the interest of European citizens is rated more positively. Most stakeholder groups (alternative operators, incumbents, others) consider that the framework has contributed moderately to citizens' rights and interest. **Alternative operators and small fibre operators** tend to attribute a more significant impact on EU citizens' interests, while **several incumbents** are rather negative on this point, considering that the interest of the European citizens has been promoted only to a certain extent, owing to the hurdles to investment in NGA allegedly caused by access regulation. **Some large operators** and entities wonder if the interest of citizens has been harmed by the focus on lower tariffs rather than on network quality. Finally, the sparse contributions by **private individuals** have a much more negative character, with 8 out of 12 pointing to little or no impact at all.

In terms of *efficiency* and whether the costs involved were reasonable, there was a somewhat negative perception. Larger operators (**incumbents and those with mobile arms**) consider that the administrative and regulatory costs borne have exceeded the results achieved. **Alternative operators** believe, on the contrary, that the benefits have exceeded the costs, underlining that competition, economical offers and several clear consumer benefits would not exist without the framework and that access regulation is necessary and proportionate. **Some alternative operators** underline the value of having a stable, predictable regulatory regime, whilst also highlighting some unnecessary costs: the costs of market analysis for termination markets where the outcome of the analysis in any event is stable, the cost of questionnaires, the overlap of tasks of public authorities, the lack of harmonisation in consumer regulation including data protection and data retention, of universal service obligations.

In terms of *relevance* of the framework and whether EU action is still necessary, the general perception is that framework is still necessary and there is a consensus amongst **incumbents and alternatives, large and small, consumer organisations, Alternative operators, consumer associations, wholesale operators** underline that competition cannot be maintained without ex ante regulation and that full duplication of network infrastructures is not realistic. Most **incumbents** argue for a simplified access regulation (limited to fixed infrastructures, with only one access product, based on commercial negotiations and dispute resolution rather than on ex ante cost orientation). Some **operators and equipment manufacturers** argue for a progressive transition to ex-post competition law. Many respondents groups support the relevance of the framework for network and service security.

In terms of *EU added value* and whether similar progress could have been achieved at national or regional levels, **most operators** highlighted the importance of competition for increasing choice and transparency, lowering prices and bolstering consumer rights. **Incumbents** acknowledged the role of the framework in liberalising monopolies. Many respondents highlighted a risk of fragmentation due to national implementing measures and of incoherence with other regulation and competition law. **Equipment vendors** in particular acknowledged the role of the framework in promoting competition. While the desire to deregulate in one form or another is present in almost all categories of contributors, albeit not equally, none of the contributions concludes that full repeal of the framework is warranted. Consumer protection rules and universal service were the subject of widely contradictory opinions from different stakeholder groups, with disabled user group noting that without the framework, many measures to facilitate a disabled person's access might not have happened. In terms of process, there were calls from some operators for a full harmonisation to address fragmentation.

Connectivity is the overall converging theme in many contributions across different stakeholder groups, with many suggesting that it should be a more prominent focal point in the revised framework. Including investment as one of the objectives, however, divides the respondents. In particular, **consumer organisations**, **alternative operators** and **regulators** fear that this could be seen as undermining the current competition objective. **Incumbents** and many **mobile operators** stress the increased need for connectivity and investment but diverge in the proposed solutions. Connectivity to the benefit of end-users as an overarching objective to which competition, internal market and investments provide the means, could be considered as a central theme supported by most stakeholder groups.

1.1. Network access regulation

Extensive inputs were received from all of the major fixed and converged fixed/mobile electronic communications providers active in the EU, whether they are former monopolies, small or large access seekers relying on their networks, or independent fixed infrastructure owners including cable and independent fibre networks.

Good connectivity is perceived as a necessary condition to achieve the Digital Single Market, with many respondents pointing to the need for policy measures and possible adjustments to current policy and regulatory tools to support the deployment of infrastructure in line with future needs.

2.2.2.2.2 Evaluation of the network access regulation

Amongst stakeholders from the industry, the positions expressed on network access and interconnection regulation, including the current SMP-based approach, can be divided in two blocks, with on the one hand operators whose business model predominantly relies on access (and who strongly support the current ex-ante regulatory approach) as well as broadcasters, and on the other hand the incumbents (who call for a reform of the regulatory regime in place). Cable operators are supportive of the role that the SMP regime has had to promote competition, but warn that overly aggressive regulation could hinder infrastructure deployment.

The main argument from alternative operators and their national and European trade associations is that regulated access and interconnection have driven competition, innovation and investment and that with the ongoing shift to NGA networks the needs for SMP-based regulated access to broadband networks will remain acute. In addition, they submit that the current regulatory approach provides NRAs with the right level of flexibility. Telecom users are also strongly in favour of the current access regulation, with the exception of one business users association which considers that the emphasis should be put on service competition rather than on the underlying infrastructure, and that the sharing of infrastructure should be emphasised.

On the other hand, incumbents consider that the access regime in general is a deterrent to investment in NGA networks, does not provide enough predictability, and is a burden for operators and regulatory authorities with high administrative costs. They claim in particular that promoting infrastructure investments by enabling competition downstream (first by the imposition of wholesale remedies and then by encouraging access seekers to gradually build their own infrastructure closer and closer to end customers), the so called "ladder of investment" approach, has failed, in particular when applied to NGAs, and that a lighter regime should be put in place with a focus only on situations where monopolistic conditions persist. The need to incentivize investment is raised by many incumbent operators. While many mobile operators also follow this line of thought, some of the mobile operators support the regulatory approach in place.

Regulators consider that the current approach drives investment. On the other hand, some responding Member States call in general for a pro-investment regulatory regime, estimating that the current ex-ante SMP-regulation is outdated and should be adapted, with some suggesting that it should enable NRAs to apply a more flexible approach for imposing symmetrical obligations of access to high-capacity networks.

With respect to the interconnection of voice, mobile operators and certain incumbents call for a phasing out of the ex-ante regime in place, arguing that the IP-based delivery of voice services is modifying market circumstances. MVNOs have an opposing view on the matter, on the ground that terminating networks will always remain a bottleneck. OTTs consider that interconnection rules are needed to avoid discrimination.

Many of the **access seekers** consider that the current rules were effective in addressing single dominance. This view is also shared by **consumer organisations** and part of the **regulatory community**. Those operators in principle agree with the existing scope of access remedies, while raising issues with its implementation in detail. On the other hand **incumbent operators** consider that the full set of access remedies is often imposed mechanically, without cost/benefits assessment and without regard to modulation according to actual problems identified. Intrusive access remedies, imposed at all levels of the "ladder of investment" hamper investments in modern networks. Moreover, the broad provisions concerning access regulation contained in the current framework allows NRAs to engage in product micro-management, business case design and steering market outcomes. This is said to cause significant delays in delivering new technologies and network upgrades.

2.2.2.2.3 Review of the network access regulation

The majority of **Member States/public authorities** that have responded highlight the positive effect that the implementation of the Framework has had on the market and the role of competition in promoting investments. However, there is an acceptance that updating the framework will be necessary, for reasons varying from promoting investment in next-generation infrastructures, responding to technological and market changes and diminishing administrative costs. Some Member States argue for flexibility in the application of incentives to meet future challenges at a national or sub-national level. **Access seekers** and some other operators also call for greater guidance to be given to NRAs to analyse sub-geographic markets to increase consistency. There are also calls from certain Member States, which perceive limits in dealing with oligopolistic market structures, for a greater role for symmetrical rules. **Regulators** broadly underline the achievements of the current system but argue that some flexibility may be needed, for instance by considering more prominently symmetrical obligations or by simplifying the regulatory approach to the termination rates markets.

Among **operators**, the responses of the two largest groups of stakeholders (incumbents on one side and access seekers on the other) correspond to the general lines of the two groups: the first advocating a de-regulatory push in the name of changed market dynamics and the risks involved in future investment plans, the second defending the link between competition and investments and calling for

a protection of access rights to legacy networks as well as to upgraded networks, where they fear that a deregulatory approach would lead to the loss of the welfare gains achieved so far by the regulatory framework. Those seeking further deregulation resist ideas that they fear may result in an increase of the regulatory burden, particularly in relation to regulatory measures that may lead to the continued regulation of markets even in the absence of proven market power. On the other hand, those that rely on regulation resist proposals that imply establishing a link between investment incentives and a lighter regulatory approach, as they fear that upgraded networks will become increasingly inaccessible and that broadband markets will become increasingly concentrated or even re-monopolised. In each case, however, the general approach is typically also accompanied by a recognition that regulated networks and their related markets have changed, leaving scope for adaptations.

In relation to the simplification of access products and focussing on key access points, **network owners** responded in favour of a drastic simplification to a single access product (if at all necessary), whereas **access seekers** insist on the importance of different access products to compete at the retail level. On the other hand, **access seekers** reject the idea that retail market considerations should be the focus of wholesale regulation, an idea that is strongly supported by **network owners**, who consider that continued wholesale regulation is not justified if retail markets are competitive.

In relation to different treatment of legacy copper networks (whether pure copper access networks or upgraded FttC networks with copper sub-loops) to incentivise upgrades, operators invoked the principle of technological neutrality and leaving the market to decide how to best meet demand. However, a number of contributors consider that copper-based solutions will not represent a credible alternative in the long term. **Investors** in FTTH solutions and some **access seekers** call for a recognition that the risk involved in rolling out fibre to the premises is higher than upgrading copper, so that regulatory incentives, if any, should not include FttC solutions. **Regulators** also propose the idea that any risks specific to a particular new investment network project should be considered if wholesale tariffs are subject to regulation, in order to allow the operator a reasonable rate of return on adequate capital employed.

Network owners request discretion to decide whether and how to continue to use copper assets (full copper loop or sub-loop), whereas **access seekers** request guarantees that physical access to copper networks will continue to be guaranteed. While a majority of respondents, including **regulators**, would not agree to mandating the switch-off of copper networks where fibre is present, they still see a role for regulators to manage the transition where switching off copper makes economic sense, with **copper networks owners** advocating minimal intervention, and others rather invoking public intervention to preserve competition (e.g. transitional migration regime).

With regard to co-investment models, many stakeholders can see the advantages of co-investment for increasing the reach of NGA networks, for example, in less densely populated areas. Their views however differ on the related regulatory regime. While **incumbents** favour co-investments on commercially negotiated terms, **access seekers** call for strict conditionality to ensure fairness and openness of the co-investment.

The responses overwhelmingly affirm the important role that civil engineering plays in the roll-out of NGA. Some **Member States** and a number of **infrastructure owners** don't see the need to further intervene to ensure access to civil engineering falling within the scope of the Cost Reduction Directive (2014/61/EU). However, **alternative operators** highlight the importance of detailed SMP obligations, beyond the general obligations in that directive. Furthermore, **incumbent operators** call for symmetrical access to in-house wiring.

There is broad alignment between **regulators**, **Member States** and many others that longer review periods (compared to the current mandatory three years) would be beneficial, particularly in stable markets such as termination rates.

Regarding measures aimed at facilitating the roll-out of high-speed networks in the most challenging areas, responses were cautious with regards to any first mover advantages (to operators that are willing to roll out next generation networks in challenge areas). **Access seekers** and **consumer associations** warned about the risk of re-monopolisation, whereas **network owners** challenged the proposition that a risk of strategic overbuild can be defined and distinguished from competition. Some **Member States** highlighted the need for local responses to sub-national competitive and investment challenges, indicating openness to consider approaches to incentivise first movers on a geographical basis, subject to suitable safeguards being built in. In supporting first mover incentives, **vendors** and wider digital economy players suggest a concession model, with some operators noting that in such a case regulators should be able to define a period in which the network operator is allowed to use its network exclusively. Most stakeholders agreed that any first mover advantage should be subject to safeguards against re-monopolisation. Wholesale-only models (which may counterbalance fears of re-monopolisation) found the support of **equipment vendors and smaller/fibre-only network operators**, but **operators in general and public authorities** disagree on whether such models would have a positive effect on investment.

On oligopolistic markets, on the basis of BEREC's recently adopted report, all respondent **regulators** and **some Member States** are calling for the widening/strengthening of regulatory powers to deal with new duopolies or oligopolies (where such market structures lead to sub-optimal market outcomes) albeit still with a high threshold for intervention. Some propose symmetrical regulation as a possible solution. Some alternative operators also raised concerns about the adequacy of approach under the current SMP test and guidelines to tackle joint dominance or "tight oligopoly" market structures. However, many operators warn of the risk of over-regulation if ex ante regulation tools are broadened, without a clear economic underpinning, to tackle oligopolistic conditions beyond the current joint dominance test, as set out in Annex II of the Access Directive and the SMP Guidelines, or beyond the current threshold for applying symmetrical rules.

2.2.2.2.4 Spectrum management and wireless connectivity

The importance of wireless connectivity and wireless broadband, and its link and complementarity to a very high capacity fixed connectivity is acknowledged in consultation responses. Industry is supportive of a more co-ordinated approach and looks for additional certainty in investment and possibilities to develop throughout the EU new wireless and mobile communications including 5G. Member States generally underline the achievements in the field of technical harmonisation, and the need for additional coordination to be bottom-up and voluntary; some of them call for a better balance between harmonisation and flexibility. There is widespread recognition of the importance of more flexible access and use of spectrum in the future from both operators and public authorities, although disagreeing about how to realise this.

2.2.2.2.5 Evaluation of the current rules on spectrum management

While a majority of respondents consider the current regime to have significantly contributed to promoting competition, almost half say it has only moderately achieved the aims of providing market operators with sufficient transparency and regulatory predictability, promoting citizens' interests and ensuring effective and efficient spectrum use. A third of respondents considered that the current regime had only a minor impact on keeping the administrative burden appropriate and on promoting the Internal Market.

A majority of respondents that spans public authorities, regulatory and trade bodies both in and outside the electronic communications sectors, MNOs, converged and satellite operators, user associations and vendors, consider the current regime to have contributed to harmonised conditions for the availability and efficient use of spectrum. Member States and regulators have in particular, been consistent supporters of this position. More reserved views are found among broadcasters and

other respondents, notably from the transport sector. The regime has been significantly more effective for new bands than for bands still requiring freeing.

There is a general perception among several respondents (converged operators, operator associations, vendors) that technical harmonisation has worked well and that the involved actors (RSPG, RSC/CEPT and the Commission) have delivered. Even those parties seeing little or no benefit from the existing regime (M(V)NOs, cable, converged operators, non-ECS associations) acknowledge the achievements in technical harmonisation, but stress persistent regulatory fragmentation. Points of criticism concern the ineffectiveness in addressing interference issues (transport) and ensuring usage efficiency.

As for the selection processes for limiting the number of rights of use, industry respondents, including operators and vendors, criticize a lack of consistency as well as sometimes unnecessary restrictions of usage rights. Some respondents recognise coherence of application in the sense of certain rules being widely used, while results still differ (converged operators, ECS associations). A majority of respondents (spanning ECS and non-ECS associations, M(V)NOs, converged operators and vendors) considered that the lack of coordination of selection methods and assignment conditions has impaired the development of electronic communications services. The authorisation methods most often mentioned as efficient for wireless broadband were auctions and general authorisations.

While respondents comprising broadcasters, mobile operators, associations of mobile and alternative operators, regulators and vendors consider that inclusion of spectrum provisions in several instruments should not per se impede their effective interpretation and/or implementation, several respondents including incumbent operators and some Member States nevertheless consider a single instrument to be potentially more effective, stressing the benefits of applying the same set of rules to all spectrum users, which is also supported by most vendors and operators/associations, subject to the rules being consistently applied.

2.2.2.2.6 Review of spectrum management rules

Regarding objectives and principles, **most economic actors and some Member States** seek more consistency in spectrum management to increase legal certainty and spectrum value, and to secure greater transparency and predictability for investment, in particular on licence durations, pricing and availability of spectrum. There is also large support from public authorities to remove barriers to access harmonised spectrum across the EU, in order to foster economies of scale for wireless innovations and to promote competition and investment, as well as to avoid cross-border service impairments. **Operators** also stress problems - in particular, late access to spectrum, high reserve prices, inefficient spectrum packaging, spectrum left idle and lack of long-term vision.

The majority of respondents consider that spectrum assignment procedures have a significant impact on structuring the mobile markets and their competitive landscape, e.g. number of operators, price, network investment, and consumer prices. Some (generally **large operators**) criticise the use of assignment measures as indirect means to ex ante regulate the market (through caps, reservations) without the associated objective criteria. Others (**vendors, some regulators**) also consider that additional factors such as regulatory conditions (e.g. access obligations for MVNOs) and historical national market development have a similar structuring impact.

Most responding **Member States, broadcasters and alternative operators associations** insisted on national specificities and are generally satisfied with the current framework. While public authorities could envisage limited coordination through common deadlines for making a band available or the common definition of certain general principles, many economic actors seek greater harmonisation of award methods and procedures (need and timing of spectrum release and selections, general principles and objectives, transparency, ex-ante competition assessment, reforming conditions, timing of advanced information to market participants, measures to promote use efficiency, spectrum

packaging) so as to enhance legal certainty, support investments, promote competition, provide more clarity to manufacturers and support economies of scale. **Member States** expressed much resistance regarding coordination of spectrum valuation and payment modalities, while many **operators** oppose fee disparities and excesses, and in general support greater coordination of assignment processes. Most **vendors** supported harmonisation for predictability and a robust end-to-end value chain, but warn that timetables alignment should not delay early movers.

Assignment conditions generally are considered as heavily impacting investment and business decisions, competition and the single market. Most **operators** agree on the need for more consistent binding assignment conditions to increase investment predictability, and in particular to support and ensure objective, transparent and non-discriminatory treatment of operators, transparency and alignment of timing and conditions of licence renewals, longer licence duration, flexibility to trade, lease or share, technology and service neutrality limits, refarming conditions, technical performance, use-it-or-lose-it clauses and interference mitigation before assignment decisions are taken. On the contrary, there is strong opposition to harmonise or even use wholesale access conditions from **operators** and to a certain extent to harmonisation of coverage obligations from **Member States**. For **broadcasters**, decisions on criteria and conditions should remain at national level to consider local specificities or media pluralism and cultural diversity. Some also insist on the need for compensation in case of refarming.

Member States reject full harmonisation but are open to a more common approach to spectrum management, some could accept a peer review of national assignment plans as well as a certain level of harmonisation or approximation of conditions and selection processes. A number of Member States expressed their desire to remain flexible to support early take-up of new technologies and to adequately balance harmonisation and flexibility in order to be able to adapt to market demand.

Most public and commercial respondents are calling for flexible or shared access to spectrum to meet future demand, in particular for 5G, preferably on a voluntary basis; **vendors** and **operators** insist on exclusive or licensed shared access for quality purposes. **Broadcasters** raise interference issues and thus urge for careful selection of compatible sharing usages; in addition, some point to their incapacity to at the same time compete for spectrum and meet cultural targets if flexibility is purely market-based.

On refarming, a large majority including operators, vendors and their associations as well as responding Member States and regulators seek further facilitation, notably on a voluntary basis except in cases of inefficient use. The large majority of operators, vendors and their associations consider that longer licence duration would be helpful in this regard. Most operators see a need to protect and give priority to existing users to safeguard investments or avoid interference, while a minority believes that appropriate spectrum pricing, trading and auctions can address this issue. When facilitating refarming, some seek a careful balance between flexibility and preservation of harmonisation.

With regard to facilitating deployment of denser networks, many respondents pointed to obstacles - lengthy permit process, high administrative fees for back-haul provision, inappropriate fee structure, lack of harmonisation of management of electromagnetic fields' emission - to the roll-out of small area access points needed for mobile services, while some **Member States** disagree. Many market actors and public authorities consider that a general authorisation regime would foster innovation and competition both for services and end-devices and should include access rights to public and private property to build a network. **Vendors** seek a common definition of small-area wireless access points and the harmonisation of technical characteristics about their design, deployment and operation.

While opinions are divided as to whether end-users should be entitled to share access to their Wi-Fi connections with others as a key prerequisite for the sustainable deployment of denser small cell networks in licence-exempt bands, many public authorities and private respondents supported the

deployment of commercial/municipal Wi-Fi networks in public premises, while seeking appropriate regulatory safeguards for a.o. liability or exposure to EMF. Some operators reject such idea as network roll-out could be facilitated via various forms of public-private partnerships, many stressed that any such public support should be technologically neutral.

With regard to public protection and disaster relief (PPDR), a majority of respondents reject the inclusion in licence conditions of obligations of service quality and resilience of network infrastructure to enable a dual use of commercial mobile networks for PPDR, as MNOs' individual business models do not combine easily with stringent PPDR requirements, and therefore should be on a voluntary commercial basis only and based on net neutrality rules. Some operators believe that providing PPDR services via commercial networks would be economically more efficient than funding a separate network for PPDR services.

2.2.2.3 Sector-specific regulation for communications services

2.2.2.3.1 Evaluation of the current sector specific regulation for electronic communications services

With regard to the effectiveness of the current regulatory framework in ensuring a high level of consumer protection, the clear majority of respondents (**Member States, telecom operators and their associations, broadcasters, vendors and OTT providers**) believe that the current framework contributed to effectively achieving the goal of ensuring a high level of consumer protection in the electronic communications sector across the EU. **Member States** noted that in general the framework had positive effects on the protection of consumer rights regarding traditional electronic communication services (ECS). In particular, provisions related to contracts and those facilitating change of provider (switching) have diminished unfair lock-in practices and ensure a high level of consumer protection. **Users and ECS/ECN associations**, as well as the majority of **operators** consider that the existing rules have delivered good outcomes and high levels of consumer satisfaction.

Many respondents, however, consider that the current regulatory framework has failed to deliver consumer protection with respect to emerging services, which are based on new technological developments and currently fall outside the remit of the sector-specific rules. Most responding **Member States** support specific requirements to be applied to all communications services irrespective of the provider ("traditional" telecom operators or "new" OTTs) in order to avoid risks of (a) insufficient customer protection, (b) a lack of clarity, and (c) confusion among consumers who might mistakenly believe that their communication is protected by sector-specific rules.

Some **telecom operators** think that the current provisions have become outdated with little substantial value for consumers, except for basic provisions on emergency services, number portability and interconnection and argue that competition in the sector would allow for the removal of regulation.

Regarding provisions constituting a particular administrative or operational burden, a majority of respondents (**mainly operators and their associations**) believe that there are administratively or operationally burdensome provisions. The biggest concerns are expressed regarding different and overlapping legal frameworks, e.g. Consumer Rights Directive (CRD); Universal Service Directive; Unfair Commercial Practices Directive. Some respondents argue that this leads to over-regulation, too detailed provisions, and inconsistency of rules. Some **alternative operators** consider the application of end-user protection rules to business customers as burdensome. According to other **incumbents and their subsidiaries** almost the entire Universal Service Directive is burdensome.

With regard to provisions to be repealed, the majority of respondents (mainly **telecom operators and their associations**, a few **broadcasters, vendors and OTTs and a Member State**) have identified certain sector-specific end-user rights' provisions, which they consider are no longer relevant. These include provisions such as contract rules which are covered by various other directives, in particular the CRD. Regarding the maximum contract duration, some **telecom operators** suggest either an

application of these rules also to OTT communications, or their abolition. One **telecom operator** suggests the repeal of Art. 34 USD as out-of-court dispute settlements are also addressed in the Directive on Consumer Alternative Dispute Resolution (ADR) and the Regulation on Consumer Online Dispute Resolution (ODR). Some **operators** suggest the repeal of the provisions on printed directories and public payphones. Some **Member States, mobile operator association, EU and national consumer associations and a trade union** have not identified any provision to be repealed.

With respect to provisions protecting disabled end-users, the USD contains specific requirements under the universal service obligation (USO) and regarding the equivalence in access and choice. The majority of the respondents (**telecom associations, telecom operators, users' associations, an association of users with disability, other NGOs, regulators and Member States**) found that the current regulatory framework has been effective in achieving these goals. Several **operators and NGOs** stated that the relevant Art. 23a is too weak ("Member States shall encourage"), it leaves too much discretion ("where appropriate") and does not contain financing provisions. They consider that it has therefore been only moderately effective in achieving the goals of providing equivalent access. As a consequence, an inconsistent diversity of approaches has developed across the EU.

Incumbent and larger operators raised the financing issue. Initiatives designed to improve accessibility of services to disabled people should be borne by the public authorities. If any contribution is required from the sector, it should be requested to all players, including OTTs, in proportion to their incomes and the number of users ("responsibility-sharing based on a proportionality principle").

With regard to the efficient implementation of number portability (NP) provisions, a large majority of respondents consider that the current NP provisions allow significantly or moderately for their efficient implementation. However, **operators** criticised the diversity of approaches, and of technical means put in place, in various Member States. In some Member States, there is no common database of ported numbers and in a few of them direct routing of ported calls is still not available. Some **operators and their associations** argued in favour of a receiving provider-led porting process. Some respondents stated that the current NP obligations are not well suited to new services such as M2M or IoT.

With regard to the relevance of 112 provisions to ensure an effective access to emergency services, a large majority of respondents agreed with the significant relevance of the scope and requirements of the current regulation of access to emergency services. **National authorities** are also in line with this trend. The **telecom industry** highlights the importance of reliable access to emergency services that, in view of the technical standards and legal arrangements in place today, can be provided today only through ECS.ECN/ECS argue that access to 112 obligations should be imposed on OTTs as well, if technically feasible. A large number of stakeholders consider that all the voice services perceived by the users as substitutive to the current PSTN voice service and which also give access to E.164 numbers should be subject to the same obligations regarding the access to emergency services. In the same vein **regulators** support an obligation on all communication services (including OTTs) that give access to numbers in the numbering plan.

As regards the effectiveness of network and service security rules in achieving their objectives, over half of all respondents (including several **Member States, most telecom operators** and some **vendors**) consider that the rules have been effective. A minority (one **Member State, a few telecom operators** and some **associations of operators**) found them ineffective. More than a third of the respondents (many incumbent and alternative telecom operators and associations, several ENISA-member national authorities) underlined the need to involve the complete Internet value chain (including OTT services, software and hardware).

2.2.2.3.2 Review of the sector specific rules for communications services

With regard to the scope of the future rules and the need for sector-specific regulation of communication services, the majority of respondents including **BEREC, Member States, several associations of broadcasters, of cable operators and of alternative operators, consumer associations, cable players and OTTs** note that there is still a need for sector-specific regulation of communications services as ECS have become an essential service in every person's life, crucial to ensuring a well-functioning society and economy. Therefore sector-specific rules are still considered necessary for sustainable competition, innovation, a healthy low concentration of providers' market power and also to guarantee that consumers can reap the benefits of such competition. Several areas were listed, where sector-specific regulation is still needed: retail Internet access services, numbering, end-user protection, universal service obligations, roaming and downstream availability and accessibility of a wide variety of audio-visual services etc. Nevertheless, several of those respondents prefer horizontal to sector-specific regulation wherever possible. A few of them, however, oppose the inclusion of OTTs within the scope of such rules, because there remain fundamental differences between the telecoms market and the market for Internet applications and content, and applying the same detailed sector-specific obligations would be a disproportionate burden for a highly dynamic industry sector.

Regarding the revision of the current ECS definition, **BEREC, several Member States, most operator associations, most incumbents, some cable players, all user associations and some broadcasters** consider that the current definition of ECS should be reviewed owing to the increasing uncertainty on the scope of the definition of ECS related to "conveyance of signals", the inconsistent regulatory obligations for similar services and the convergence of communications services. Several respondents emphasised that a future-proof definition needs to be end-user-centric, the key factor being substitutability from a customer perspective. Those opposing revision of the definition, (some **Member States, OTTs, software and equipment vendors, cable operators, some broadcasters and a few individuals**), argue that the concept of ECS has proven itself and changes may create regulatory, legal and investment uncertainty. According to some stakeholders, instead of including OTT services in the definition of ECS, the current regulatory requirements on traditional electronic communications providers should be loosened. In **OTTs'** view, if the definition is reviewed, the difference between Information Society Services and telecoms networks should be maintained.

The majority of respondents (some **Member States, operator associations, most incumbents and vendors**) are of the opinion that for consumers OTT services are a functional substitute for traditional ECS. The minority of respondents (some **Member States, a few operators, OTTs and consumer and user associations**) submit that OTT services are functionally different from ECS. The majority of respondents (**Member States, regulators, most incumbents, alternative operators, associations, trade unions, vendors**) are of the opinion that all functionally substitutable communications services should fall under a new common definition, but have significantly varying positions on the types of obligations that should apply to services falling within such a definition.

The minority of the respondents (**several Member States, NRAs, some associations, broadcasters, OTTs, a few cable and fixed players**) suggest maintaining the "conveyance of signals" criterion in the definition of ECS. For broadcasters that criterion helps in distinguishing telecommunications from audio-visual services. However, the majority of respondents (**several associations, most MNOs, most incumbents and few software and equipment vendors**) do not consider "conveyance of signals" as a necessary criterion. Rather, the lack of clarity in the ECS definition, when assessing whether services "consist wholly or mainly in the conveyance of signals", opens the door to different interpretations and inconsistencies. According to **BEREC**, it "is worthwhile to examine whether it is still an appropriate distinguishing factor."

With regard to the elements of the ECS definition related to transmission services in networks used for broadcasting, **all broadcasters and their associations, alternative operators and their**

associations, many fixed and converged fixed/mobile operators, an equipment vendor and private individuals advocate that these should continue to be considered as ECS. For **broadcasters**, excluding transmission services from the definition would mean that they are omitted entirely from the telecom framework, undermining important legal protections for broadcasting (e.g. transmission obligations). For some respondents "transmission services in networks used for broadcasting" should not be considered as ECS. They argue that in the light of the convergence of the legacy broadcasting transmission services and internet media services (including broadcasting), the transmission of the service is platform-based and no longer network-based and any reference to services provided on a network has to be eliminated.

With regard to a possible differentiation between managed and best-effort services in the ECS definition, the majority of respondents (**incumbents and alternative operators and their associations, vendors and broadcasters**) prefer no differentiation between *managed and best-effort* services in the ECS definition as such a differentiation would facilitate circumvention of the rules by opting for 'best effort provision' free of obligations. As to the question whether sector-specific regulation should be limited to Internet Access Service, there is almost no support for such reduction, with only a few exceptions.

Regarding the application of sector-specific provisions (end-user and other) to the IAS, **telecom operators, industry associations and vendors** agree that as a general rule only horizontal competition and consumer law should apply to internet access service and that, if any sector-specific provisions are needed, these should apply to all other digital services. Almost all **national authorities, user associations, OTTs, some broadcasters and IT service providers** see a need for further end-user rights in relation to IAS in addition to those included in the proposal for the Telecoms Single Market Regulation, although in many cases these stakeholders do not provide detailed arguments to explain this position.

On the issue of definition of communication services, a significant number of respondents (**incumbents and alternative operators**) emphasise that in an "all IP" environment network interconnection is to be distinguished from the interoperability of services as users would be tied to a single connectivity provider but not to a single communications service provider any more.

Some respondents do not believe that there is a need to apply the existing, as well as any further end-user rights, to communication services (some **Member States, a large number of mobile, fixed, and cable operators, and OTTs**). The main argument put forward by them is that horizontal regulation (consumer and data protection), together with competition-law tools, should suffice. Those who were in favour of having end-user rights applicable to communication services are mostly **Member States and consumer protection bodies**, while **alternative operators** suggested that full harmonisation is needed for contractual information, transparency measures, contract duration, switching, and bundles.

Several associations, most broadcasters, a few incumbents and converged fixed/mobile players consider that there are new sector-specific end-user protection issues that need to be addressed. Among the areas listed are: bundling of contracts and their impact on switching; communications contracts with subsidised equipment; continuity of service (telephone or internet) when switching; control of consumption; contract termination in case of the tacit extension of contracts; rights of the end-users when relocating; improved rules for end-users with disabilities, findability of public-interest content.

Finally, **regulators and others** indicated that some new end-user protection concerns can be anticipated in relation to services which are substitutable to traditional ECS, including access to emergency services, network resilience, cyber security and interoperability between different digital services, , transparency, protection of data confidentiality and privacy.

Trade unions, consumer organisations, vendors and directory services expressed support for specific rules with regard to voice services for end-users. These contributions highlighted the

importance of availability (call to emergency services, functionality during power outages and disasters) and the importance of voice quality as a distinctive characteristic. Some **mobile operators** considered voice-specific requirements still relevant, noting the need to ensure interconnection and access to emergency services, while others noted the importance of requirements such as data retention/lawful intercept. In general most **incumbent operators** would prefer horizontal regulation, while maintaining the possibility of a few specific requirements (such as emergency services) and consumer information was noted as safeguard measure. Directory service providers noted a risk that without a specific requirement (Art. 25 USD), operators might not provide them with subscriber information on a fair, objective, cost-oriented and non-discriminatory basis.

Half of the respondents (some **Member States, broadcasters, a few telecom operators and consumer protection bodies**) are of the view that providers of communication services as newly to be defined should potentially be subject to an SMP-based regulatory regime, if they can limit competition, based on a market analysis and consistent with the non-discrimination principle. Those disagreeing (some **Member States, associations of incumbents, alternative and mobile operators, vendors and OTTs**) highlighted the existing high level of competition, market dynamics and diversification of providers, and stated that competition law and horizontal consumer protection offer sufficient protection in this regard.

There is a majority support ranging from **national authorities to mobile operators and incumbents**, to extend the scope of the access obligations to emergency services to best-effort services. At the same time, it is recognized by all stakeholders that minimum quality of service should be ensured for emergency communications and best-effort communication cannot provide the end-to-end quality that managed services can. Some **operators** support imposition of a general obligation to give access to emergency services, adapted to the quality of service requirements that each type of services (managed vs. best-effort) can provide.

Regarding numbering resources and assigning numbers directly to M2M users, **most MNOs, including smaller ones**, highlight that this solution raises many implementation and security issues and risks of fraud, could exhaust national numbers, would endanger interoperability and end-to-end connectivity. There is a clear consensus that to cope with the numbering needs of M2M in the future, a clear framework for extra-territorial use of numbers is necessary to ensure sufficient numbering resources. A majority of respondents see a demand for over-the-air provisioning of SIM cards for M2M communications, and to a lesser extent for end-users' own devices later on. However, the idea of regulatory promotion of over-the-air provisioning is not supported, with the argument that it should be up to the markets to decide on specific technological options.

While there is a majority view that transmission obligations imposed on electronic network operators (must carry rules) and rules related to electronic programme guides should be adapted to new market and technological realities, there is sharp disagreement as to how such adaptation should be conceived. Extension of the current rules is supported by some **Member States** and most **broadcasters**, whereas most **telecom operators** are in favour of reducing the scope of the rules. **Public service broadcasters** consider that the future scope of rules should extend to interactive and non-linear services, should also cover hybrid TV signalling and should apply on a technologically neutral basis to all distributors of audio-visual content, not only to ECNs. Telecom **operators** call for a level playing field between broadcasters and online platforms and call for improving access to content rights. Some **cable and telecom operators** call for complete removal of must carry obligations or at least to limit them to the main/most essential general interest channels. **Commercial broadcasters, one telecom operator** and a citizen consider that the current provisions are adequate.

Media regulators and some **telecom and cable operators** consider that the presentation and the order on navigation interfaces is crucial for user choices of audio-visual content and that ensuring non-discrimination of general interest content is sufficient. **Public service broadcasters** consider that Member States should be competent to ensure 'findability' of general interest content on user

interfaces of significant networks and audio-visual platforms and that regulated EPGs should be included in new TV sets. A **pay-tv provider** considers that prominence of content could also be improved by better referencing/tagging of national and European offers. Several **telecom operators** point to the need for broadcasters to be obliged to make real-time signalling available, in order for EPGs to work satisfactorily.

2.2.2.4 The universal service regime

2.2.2.4.1 Evaluation of the current rules on universal service

The majority of **Member States and regulators** agree that universal service has been effective and efficient in safeguarding end users from the risk of social exclusion, while **most of the operators** see little or no impact and efficiency at all. Proponents of universal service argue that the availability of certain basic services increased and that services became affordable and accessible to all. Opponents claim that (1) the universal service regime has become outdated; (2) the high level of competition for fixed and mobile services ensures the affordability of tariffs and not the regulatory obligation; (3) the calculation of net costs have been fraught with controversy, challenges, and appeals; and (4) the overall administrative burden and regulatory uncertainty have been very high, for a regime which has not produced major benefits.

As for coherency with other rules, the majority of **Member States** agree that universal service has been coherent with other provisions of the framework and state aid, while most of the **operators** see little or no coherence at all.

The vast majority of **operators** consider that this review should be the opportunity to redefine or completely reconsider the universal service regime (including its financing), with many claiming that it has become obsolete. **Member States** mostly claim the need to maintain a universal service scheme, with flexibility at Member State level on funding and on broadband. **Regulators** support maintaining the status quo.

2.2.2.4.2 Review of the universal service rules

With regard to the scope of universal service most respondents consider that the current scope is outdated because it was shaped in a context of market liberalisation and since then market conditions have drastically evolved, with more competition and choice available to consumers.

There is a general acceptance among the respondents to exclude public payphones and comprehensive directories and directory enquiry services from the scope. Due to availability of mobile telephony and internet, there is no usage of or demand for public pay phones. **Regulators** acknowledge a decreasing demand/usage for public pay phones but argue that Member States should retain flexibility to include pay phones within the scope. As for directories, the availability of the same information through the internet is a further competitive alternative. However, some directory and local search providers underline that access to data risks being refused in the future, absent a universal service obligation guaranteeing access to directory enquiry services.

Concerning the provision of telephony services at a fixed location, **operators** mostly agree that this inclusion in the universal service scope is no longer necessary, because various types of players are providing voice services (mobile, VoIP) on a competitive basis while **regulators and Member States** mostly claim the opposite.

With regard to the inclusion of **broadband within the scope of universal service**, while most **operators and their associations** have no doubts about the positive impact of broadband on social and economic life, they claim that USO is not the right instrument to foster broadband deployment. In any case, if broadband were to be included in the US regime, it would have to be revised substantially.

Respondents supporting both in and out options (mostly **Member States and regulators**) submit that Member States should retain the flexibility to make the choice at national level.

Most **operators and their associations, several Member States and regulators** consider that broadband under universal service bears high risks of market distortions and cost inefficiencies. In particular, industry funding is considered too distortive. The risk of lowering incentives to invest, crowding-out effects, delays in network expansion and unpredictable large financial transfers between competitors (if industry funding is used) are considerable. Instead, an investment-friendly regulatory framework, lowering of deployment costs, demand stimulation, and well-designed public subsidy schemes targeted at cases of clear market failure (evaluated by an impact assessment) should be used for fostering broadband instead of USO. Many also highlight the need to promote competition and commercial investment via regulatory tools. The use of such other public policy measures should be based on timeliness (so as not to come in too early to disrupt or crowd out private investments), proportionality, non-discrimination and technological neutrality.

As to how broadband should be defined if included: those favouring the speed aspect (**consumer groups, several Member States, media players, operators**) consider it a simpler and more neutral parameter. **Media players** argue for sufficient speeds to deliver media content. Those favouring the criterion of the use of certain types of services (**ECS/N associations**) generally feel that it is more flexible, able to evolve with time, more technologically neutral and has a more direct link to social inclusion. Some players are wary of setting the speeds based on the average speeds used by the majority of the population, so that the speeds are not set at a high level. With regard to the list of essential services, most of the respondents agree that the list of services should be based on what is necessary for social (digital) inclusion, but they have varying views on what set services this would entail.

With regard to financing universal service, most **operators and associations** agree that the most appropriate and equitable way of financing the universal service, in particular in light of the possibility to include broadband within the universal service, would be through public funds. Broadband for all should be supported through general taxation since it is a general public interest goal that benefits society as a whole. The scope of universal service should be defined narrowly, representing only **a safety net** in a market-driven sector. Many **operators** state that industry funding, especially when limited to operators, is disproportionate. The use of public funds would have the advantage of limiting the risk of setting too high targets for the universal service and is the only way of ensuring that Member States properly weigh the needs against costs because of the need of reducing public expenditure and maximising public economic welfare. The high uncertainty of the right to compensation in the present universal service system and the difficult enforcement that led to numerous disputes/litigations are a considerable weakness to be eliminated.

Several actors considered a combination of public funding and industry funding acceptable with the **majority of respondents** however specifying that providers of on-line content, applications and services should contribute, given they are the biggest beneficiaries of access. **Broadcasters** warned against the redirection of resources from audio-visual content, innovative online services and digital skills activities to the financing of infrastructure, since availability of such content is an important determinant for the development of broadband networks.

According to **regulators**, the current funding mechanisms for USO remain relevant and that flexibility should be retained, allowing Member States to choose the appropriate mechanism.

Most market actors and regulators agree that universal service is not the right instrument to foster very high-capacity connectivity for public places. Market forces deliver these services and other public funding policies should be used because the service is of public interest. Only a small minority of respondents (**satellite operators**) agree that universal service should play a future role in to help realise public interest objectives, but this should be financed by public funds.

Most market actors, **Member States and consumer organisations** submit that obligations related to disabled end-users should be incorporated in horizontal law. Respondents stress that any obligations should apply equally to all market players. Through the broader implementation of the provisions of Article 23a of the Universal Service Directive, a wider choice of services and tariffs for disabled users could be achieved. According to **regulators**, specific provisions for disabled end users are already included in the national regulatory frameworks of many Member States. Measures in the Directives should continue to be flexible enough to adapt to the situation of each country.

2.2.2.5 Institutional set-up and governance

2.2.2.5.1 Evaluation of the current institutional set up and governance structure

The perception as regards NRAs' independence is generally positive, in particular those safeguards applicable to independent NRAs. This perception is supported by different kinds of stakeholders, in particular public and private, including **operators (mostly incumbents as well as some alternative operators and trade associations)**.

Just over half of the respondents consider that there is generally a sufficient degree of coherence in the application of the regulatory framework by the various institutional players (NRAs, BEREC, the European Commission). This idea was supported by **public authorities, especially regulators** and approximately **half of the operators**. Some operators propose to reduce the overlapping competences at EU and national level and to reduce and prioritise the objectives of the framework.

BEREC's role is positively perceived in relation to the Art.7 procedure, roaming, net neutrality, M2M communications and advice to EU Institutions. While more than half of respondents (including national regulators) considered that BEREC has achieved its main objective, a group of **incumbent operators**, on the contrary, considered that BEREC has not achieved its main objective, arguing that flexibility is overall favoured compared to harmonisation/consistency of application and that BEREC has a tendency to support over-regulation. Some **operators** stated that BEREC should be constituted as a supervisory authority independent from national interests or that it should be a proper EU regulatory authority with decision-making powers.

Some respondents submit that BEREC's current institutional set-up results in it opting for greater flexibility at national level or the lowest common denominator instead of focusing on a more consistent or harmonised approach for the single market, and therefore, BEREC's Positions and Guidelines are sometimes just descriptive documents and not a collective commitment or a development of best practice guidelines. Suggested proposals for addressing this include: allowing BEREC to make binding decisions, appointing board members for four years, establishing a Director appointed by the Board, more adequate funding, reassessment of the location of the BEREC Office, more consistent launch of consultations, longer consultation periods and introducing a two-stage consultation process on key policy matters. There were also calls for a stronger advisory role to the Commission, more pro-activeness, and improved transparency and stakeholders' involvement.

As regards consistency of market regulation, just over half of the respondents answered that the Art.7/7a process had been effective in achieving greater regulatory consistency, while a third were of the opinion that this process had little or no effect on consistency. In the first category of positive responses, there were many **alternative operators, FTTH-operators** and some **incumbents and MVNOs**. Also those **regulators and Member States** who responded were largely positive. With regards to areas which could be improved, many respondents who were generally positive suggested that the entire process could be streamlined, made less burdensome for all stakeholders and that the Commission's role vis-à-vis remedies (under Art.7a) should be strengthened, either by a veto power, or by a so-called double-lock veto (i.e. regulators would be required to withdraw the draft regulatory measures if BEREC agrees with the Commission's serious doubts).

Those who disagree, are mainly **incumbents** as well as some **individual respondents**. The main arguments brought forward for this view differ widely. On one hand, it is criticised that the current process does not lead to enough consistency. On the other hand, some respondents complained that the current system attempts a 'one-size-fits-all' approach not taking sufficient account of the need for different solutions in different Member States, i.e. not giving regulators enough discretion. **Regulators** challenged the need to ensure further regulatory consistency and the link between the lack of consistency and the current institutional set-up. **Regulators** state that access markets are intrinsically local and the nature of competition is not homogeneous either for supply or demand reasons.

As regards the current spectrum governance, the technical side of harmonisation is seen by most respondents to be working well with its aim of harmonising the least restrictive conditions. There is criticism of the present system's capability to bring the actual services into being in a coordinated and timely manner.

There is significant support for the role of RSPG in assisting and advising the Commission on radio spectrum policy issues, with some respondents promoting it for a status similar to BEREC. The interplay between national experts and the European format is seen to work well. In particular, vendors would like the RSPG deliberations to be more open to industry participation.

2.2.2.5.2 Review of the institutional set-up and governance structure

Institutional set-up for market regulation

Almost half of the respondents agree that the current institutional set-up at EU level should be revised in order better to ensure legal certainty and accountability. Respondents call for i) a clearer division of powers between the different institutions (to avoid overlapping), ii) making sure that institutions are accountable for their decisions (both politically and legally), iii) a high level of transparency in decision-making (improved stakeholders' involvement). The arguments brought forward for change, however, differed considerably. On the one hand, a group of mainly **incumbent** operators proposed more discretion for NRAs with a reduced role of the Commission (or BEREC), highlighting the need for taking account of national circumstances. On the other hand, a number of voices have called either for an increased role of the Commission to ensure consistency (through a veto for remedies, for example), or even the establishment of a pan-EU regulator. **The regulatory community** was of the view that there are benefits associated with all NRAs having a common toolkit and flexibility to determine which tools to use, in particular in view of the increasing complexity of the sector.

Amongst those who favoured a revision of the current institutional set-up, proposals differed from BEREC adopting a limited advisory or benchmarking role (giving opinions and giving assistance to NRAs where needed, providing timely technical guidance, etc.) to turning it into an EU regulatory authority with proper decision-making power. Some respondents called for strengthening BEREC's role within the Art.7 procedure and also for improving coordination rather than implementing institutional changes. Some **incumbents** and **alternative operators** submit that BEREC in its current form has shown a limited ability to act strategically and in the interest of EU competitiveness and, in particular, for the development of the single market. Further it was alleged that it does not contribute to the objectives of the framework in a satisfactory manner. Most respondents (**all types of operators and public bodies**) considered that the current EU consultation process can be streamlined. However, in the detail as to how this could be done the respondents vary considerably. Whilst some respondents call for more NRA discretion (and a less prominent role for the Commission), others ask for full harmonisation measures, at a minimum regarding the termination markets. In addition, a shift from *ex-ante* to *ex-post* control is proposed, rendering an Art.7 procedure less relevant. Among those who disagree (largely **alternative operators**), most argue that the current process is well-balanced and has proved effective.

Some **incumbents** advocate for dividing competence between EU and national levels, making BEREC redundant, arguing that stronger compliance or a more binding nature of BEREC guidance would not be appropriate. On the contrary, some **alternative** operators supported a stronger role of BEREC within the Art.7 procedure and the strengthening of its influence on the scope of remedies in case of a veto of the Commission. The sentiment as regards whether BEREC should be given more executive tasks or binding powers is generally negative (including the **majority of operators as well as public authorities**). Some respondents are concerned by the lack of accountability of BEREC because it has a *'de facto'* significant influence on national regulatory decisions and decisions by the Commission.

The majority of the respondents disagreed with the establishment of an EU Agency with regulatory decision-making powers for all the different areas (market regulation, EU spectrum management, end-user protection and other). Some respondents, mainly **operators**, recommended that an EU agency should be responsible for services of the EU single market or for issues such as consumer protection, content, service platforms, whilst NRAs should continue dealing with local issues (e.g. network access). As regards spectrum and numbering there was a call for more harmonisation, but there were divergent positions as to whether these issues should be dealt with by an EU agency.

The regulatory community expressed its view against further harmonisation and indicated that differences in regulatory approaches can be beneficial where they allow experimentation and innovation (leading to the discovery of new best practices). Respondents were divided as to whether a common EU approach would add value in addressing the differences in the regulatory approach chosen by NRAs for individual markets in similar circumstances. **The regulatory community** also notes that, in the wider digital ecosystem, it is particularly important to adopt a “light touch” regulatory approach so as not to undermine investment and innovation. In principle, there could be more room for co-regulation and self-regulation mechanisms. According to **regulators**, while this kind of innovative and “softer” approach to regulation can be effective, where it is pursued it will be important that its details are defined “bottom-up”, through the direct involvement of the affected stakeholders.

Consumer associations called for caution and considered that co-regulation and self-regulation should only be used on very specific issues and under strict conditions, such as: strong independent governance of the self-regulatory scheme, oversight and enforcement across the sector, and the presence of effective sanctions in cases of non-compliance.

As regards BEREC and the BEREC Office, almost half of the respondents had identified provisions in the framework which in their opinion should be revised. Proposals put forward include longer or extendable mandates for the BEREC Chair, relocation of the BEREC Office and definition of the role of BEREC in drafting Recommendations. Some **national regulators** considered that the governance structure is satisfactory but suggested a number of proposals for the mandate (consultation by the Commission on legislative initiatives, new responsibilities as regards connectivity objectives, more involvement in the area of spectrum through the exchange of best practices in the design of auctions and beauty contests and monitoring of coverage and QoS), deliverables (binding acts in limited circumstances, reinforced data collection) and functioning (simplification of the role of the Management Committee, establishment of an office in Brussels).

Consumer and civil society organisations referred to the need for better collaboration of BEREC with consumer organisations, civil society organisations and individual operators in addition to operators' associations as well as with other bodies/agencies such as ERGA and ENISA. The **regulatory community** has also identified the need to strengthen the cooperation with other networks of regulators established in adjacent economic sectors.

There is overall support for strengthening NRAs' independence, in particular by ensuring i) complete separation between ownership of providers and regulatory tasks, ii) political independence in particular in cases of restructuring, iii) control of adequate human and financial resources and iv) no political appointment of Board members. **Alternative operators** stated that NRAs' independence may also be affected when sector-specific NRAs are merged with other authorities. Respondents favoured that the powers of NRAs are extended to areas such as State Aid, consumer protection and coordination of spectrum policies. **The regulatory community** stressed the need of aligning the minimum competences (including end-user protection) of NRAs to those of BEREC.

A clear majority of respondents considered that NRAs should have a role in mapping areas of investment deficit or infrastructure presence because they are vested with the necessary powers to access relevant information and have the necessary expertise, as well as independence. Those opposed to such a role contested as a matter of principle any public interference with investment. There is strong support to a revision of the framework to better accommodate the role of NRAs regarding state aid, notably i) identification of target areas, ii) setting access price and access obligations, iii) ensuring better coherence between state aid and ex-ante regulation and iv) resolution of disputes. A few respondents propose that the role of NRAs regarding mapping of infrastructures or setting target areas must be limited to provide technical assistance to the relevant competent authorities or to being consulted.

Most **operators** indicated the need to revise several aspects of the general authorisation conditions, strictly interlinked with some general substantive choices on the scope and extent of regulation on ECNS (level playing field), in order not to hinder the cross-border provision of electronic communications services and networks. Several operators suggested a specific lighter regime for some categories of services (best efforts OTT, business services, small cross-border providers) in order to reduce cross-border obstacles. Other suggestions included the harmonisation of Mobile Network Codes conditions, reducing the scope of national discretion in setting the conditions attached to rights of use, and a common notification template.

The principle according to which established and non-established operators should be subject to the same rules in the country of provision was stressed by several respondents. The extension of notification requirements to OTTs as well as the harmonisation of a notification template and administrative simplification (online submission, single language version, one-stop-shop, harmonisation of categories of services) were suggested, in particular by business users and **cross-border providers**.

On numbering, most respondents do not consider it necessary to allocate more executive powers to BEREC, in particular since numbering is a national competence and existing harmonisation at CEPT/ITU/COCOM level seems to be working. On the contrary, some **operators** did not exclude the power to grant pan-EU numbers for specific services (M2M).

Institutional set-up for spectrum management

With regard to spectrum governance, in order to serve the future wireless connectivity needs of the EU, a common EU approach to governing spectrum access was welcomed by respondents in order to enable technologies to be used seamlessly, but respect for spectrum as a national asset is required. Delays in availability of spectrum and fragmentation between conditions of use in different Member States were noted. Some respondents promoted a stronger role of the Commission. Some respondents disagreed and stressed the national character of spectrum policy.

As regards spectrum management, **the regulatory community** encompassing both BEREC and RSPG was of the view that the EU already benefits from substantial coordination and harmonisation processes, and no further EU-level coordination procedures are necessary. However, RSPG showed openness to a peer-review mechanism as regards spectrum assignment.

As regards the need for binding guidance on certain aspects of assignment procedures and conditions, there was a split between **regulators** and (mainly) **broadcasters** that preferred a national approach and telecoms operators that supported a certain level of binding guidance. Most respondents supported the Commission issuing Recommendations (Art.19 FD) on assignment conditions and/or procedural aspects, often qualifying it with basing any Recommendation on an RSPG/RSC process. The majority of respondents supported the idea of establishing a mechanism similar to that set by Article 4 of the Radio Spectrum Decision for certain key assignment parameters, at times pointing out the need to choose between this process and the one under Art.19 FD.

There is little demand for mandatory **pan-EU or regional assignments**. Most respondents questioned the need for EU-wide licences. A preponderance of answers viewed assignment as a national matter. Any wider geographical scope should involve the Member States with some respondents viewing it as a Council matter.

2.3 ANNEX 3 - Discarded options

The following annex presents the options discarded that were not assessed in terms of impacts and provides a rationale of the reason why they were not retained. The topics included below are further investigated in the IA support study, SMART 2015/0005.

2.3.1 Access regulation

- **Full deregulation of telecoms networks;** Full deregulation of telecoms networks similar to the system that applied following market liberalisation in New Zealand and now applies in the US. This option was considered in light of the fact that when it was first introduced, it was envisaged that the framework would enable a gradual roll-back of regulation with eventual reliance on competition law. However, a full deregulation was discarded due to the disruption it would bring to the industry (although option 4 describes a sunset-clause scenario).
- **Regulation of non-collusive oligopolies on the basis of a unilateral effects test similar to the one used under the European Merger control regulation.** This approach has been considered by some NRAs and new entrants in the market as an alternative to the finding of joint SMP, or ‘joint dominance’, as a basis for imposing regulatory remedies to redress market failures on oligopolistic markets. It should be kept in mind that oligopolistic market structures in network industries are likely, and in certain cases efficient, market outcomes. They are also the result of the market liberalisation over the past twenty years. It is thus far not clear on what economic grounds such an additional concept could be identified, and the merger-specific concept of unilateral effects is not adequate. BEREC has raised this issue, but has recognised that the underlying economic assessment approach is not yet clear. As criteria for such a new intervention threshold are difficult to establish and therefore the risk of overregulation and further regulatory fragmentation increases, it does not seem appropriate to increase the regulatory burden by deviating from the current significant market power test.

Any competition concerns that may arise could be alleviated by facilitating alternative infrastructure roll-out through symmetric access for strictly non-replicable assets and by providing long enough transitional periods when regulation is removed. Furthermore, the **future revision of the current guidelines on market analysis and the assessment of significant market power (SMP guidelines)** is intended to bring more clarity on the criteria for the finding of joint dominance, based on the experience with the Article 7 case practice and relevant jurisprudence, which would assist NRAs to identify joint dominance. For this purpose, the present SMP Guidelines need to be reviewed in line with the developments of EU law, with the aim of further clarifying the tools for the correct application of this concept in the electronic communications sector.

The experience in applying the principle of collective dominance by NRAs is limited. Since 2002, less than ten cases proposing a joint SMP finding have been notified to the Commission (out of more than 1,800 notifications in total), primarily in mobile origination markets (Market 15 of the 2003 Recommendation on Relevant Markets). The reasons for this could be manifold and will be explored when SMP guidelines will be reviewed.

- **Mandatory structural separation of former monopolies; this option would entail a mandatory breakdown of the incumbent telecom operator.** Under this option a structurally separate operator supplies dark fibre on a wholesale –only basis and cannot compete on services. The ownership of the two operators would then be distinct. The model would follow the

experiences being developed in New Zealand³⁴⁶, Australia or Singapore. The current regulatory framework already contains a procedure for exceptional measures, potentially beyond voluntary separation. Thus, on the basis of the Access Directive, structural separation is a remedy which is already available to NRAs. The concrete legal basis, would be Art. 8(3) for forms of separation going beyond the functional separation foreseen in Art. 13a. Although this measure has been advocated by a number of competitive and fibre operators in the public consultation, a mandatory structural separation would impinge on the existing ownership rights and it was decided not to pursue this option as a central part of the EU-level policy prescriptions. The proportionality of such a measure would be put into question by the fact that voluntary separation is already promoted by the measures described in chapter 4.

- **Mandatory copper switch off.** This option was discussed because competitive pressure from legacy copper networks can be considered as one of the barriers to NGA deployment. Some MS have trialled copper switch-off and operators have already announced the de-commissioning of local exchanges and copper network switch-off in order transfer their customers base to their NGA platform only. To date, however, no copper switch-off was mandated in any MS. Network owners strongly opposed it in the public consultation the mandatory nature of such a move which would cause disruption in network management. A mandatory copper switch-off was judged as not feasible for proportionality and legal reasons, but a clearer and more predicable mechanism can be provided to the incumbents who decide to switch off copper network, as envisaged under option 3 for access.
- **Explicitly reducing legacy copper access charges** with the aim of incentivising incumbents to deploy FTTH/B and switch-off the copper network. This strategy to accelerate the deployment of fibre by regulated incumbents was proposed by alternative operators during the course of the development of the 2013 Recommendation on cost methodologies and non-discrimination and not retained.³⁴⁷ This option was rejected on the basis that it could make copper-based access relatively more attractive compared with fibre-based access (to both access-seekers and consumers), and therefore impede investment in and the migration to higher speed offers, which would ultimately provide better quality, social and economic benefits.
- **Remove the special competences for the Commission to recommend and ultimately mandate ECNS standards and to rely fully on the mechanisms established for general ICT standardisation.** The instruments provided by ECNS legislation have been used very carefully by the Commission since the last amendment of the Framework Directive in 2009. There have been no changes to the list of voluntary standards and there have been no standards mandated. The Commission has only issued a mandate to ETSI in the area of emergency call location. It had therefore to be considered to remove the special competences of the Commission related to ECNS standards. However a November 2011 study conducted for the EC ³⁴⁸ identified substantial benefits from greater standardisation of solutions within the EU. While this could in principle be achieved under the mechanisms established for general ICT standardisation³⁴⁹, the possibility to encourage and ultimately mandate the use of ECNS standards could help fostering the process. The ongoing work in the area of emergency call location might also benefit from the possibility – once the work is finished and a standard has been established - to encourage its use. Furthermore, the second impact assessment interim report by WIK/Ecorys³⁵⁰, explains that voluntary standardisation may not be sufficient in the area of wholesale products used for business access products, in particular when provided cross-border. It would therefore appear not to be

³⁴⁶ In Australia and New Zealand structural separation has been imposed in combination with massive public investment.

³⁴⁷ A discussion of this point can be found in section 6.1.2.2. of the IA accompanying that recommendation http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/swd_2013_0329_en.pdf

³⁴⁸ Ecorys/TNO/TU Delft (2011) ‘Steps towards a truly internal market for electronic communications’ <https://ec.europa.eu/digital-agenda/en/news/steps-towards-truly-internal-market>

³⁴⁹ Regulation 1025/2012 EC on European Standardisation, see <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:316:0012:0033:EN:PDF>

³⁵⁰ Annexed to this document, p35, the importance of standardisation in this area is also highlighted on p40 and p97.

appropriate to remove the special Commission competences in the area of ECNS standards. Moreover, technical adaptations to the current provisions can be used to ensure that BEREC expertise can be relied upon when the Commission issues mandates to European standardisation organisations (ESOs) and to clarify the details of the procedure which would apply before the Commission makes the use of a specific ECNS standard mandatory.

2.3.2 *Spectrum*

Several options have been envisaged or have been suggested by a few respondents to the public consultation but will not be further considered at this stage .

- **Full harmonisation**, in the directive on all aspects of spectrum assignment, and especially of the method to determine and/or collect spectrum fees; fee determination and collection has always been considered as a national regalian competence. Therefore in regard to these elements coordination should be limited to the main criteria used by MS when determining and collecting fees and avoid revenue maximisation being used as the primary objective and criterion. Implementing measures would be more suitable to enhance coordination in the definition of these and other key spectrum assignments elements.
- **Creation of a single EU spectrum license** which would be granted by an EU body be it the Commission or an agency. Besides the fact that this would only be justified in case of truly pan-European services relying on spectrum (which to date have not emerged except for satellites), it would be very difficult to create from a legal point of view and the principle has proven to be politically unacceptable; even the implementation of a coordinated solution which required similar national licenses to be granted to commonly selected applicants by the MS themselves has been very difficult to put in place (see MSS case).
- **Grant delegated powers to the Commission** to further define harmonised conditions for assignment of spectrum: as these are national competence, MS would possibly be less keen to accept such a procedure and would possibly prefer the use of implementing decisions through comitology. Moreover delegated acts are not always suitable from a substance point of view.

2.3.3 *Universal Service*

Connectivity to a network at all locations: This option is to enhance the focus of universal service on individual end- users and to provide connectivity to a network in all locations (by contrast to the current provision at a fixed location, which may be restricted to user's primary location or residence). This option is discarded because the expected deployment cost to deliver connectivity at all locations were much higher than the cost to deliver connectivity at the end-user's primary location or residence. The universal service cost needs to be kept at what is necessary to achieve a minimum safety net, with other tools being prioritised to enlarge both fixed and mobile coverage.

- **Terminate the universal service regime:** Taking into account the current social, economic and technological developments, this option suggests terminating universal service completely. This option could be accompanied by the introduction of horizontal accessibility obligations on all providers to ensure equivalence of access and choice for disabled users. This option is discarded because universal service is still considered a valid concept by most stakeholders (i.e. MS, NRAs, consumer organisations and most of industry players) and there are identifiable affordability needs for the most vulnerable sections of the population even under competitive market conditions, which can be met at limited cost.
- **Provision of very high-capacity broadband networks in public areas and places of specific public interest as an addition to Options 3 and 4:** As an additional measure to Options 3-4, it has been suggested providing very high-capacity broadband networks in public areas and places of specific public interest such as schools, universities, libraries, education centres, digital community centres, research centres, health care centres and town halls. Such provision under USO would apply when private and other public investments do not deliver, and would be financed from public

funds due to its general social benefits. This option is discarded because there are other EU and national policies supporting NGA deployment in such specific places (for instance, ERDF, GÉANT) and because USO cannot be considered a suitable instrument to foster high capacity connectivity by comparison to private investment, PPP or other public policy instruments (e.g. public procurement for public-service needs).

- **Changing the national financing regime in addition to other financing options under options 3-4:** In addition to other approaches, this option suggests establishing a system administered at EU level which would permit contributions to be distributed across MS. This would allow to bridge digital divide between less developed and more developed broadband areas. The providers established in one MS only may be targeted more effectively. This option is discarded because it requires significant changes to the institutional setup (i.e. delegating powers to the existing entity or creation of a new entity for administration of the financial scheme at the EU level) that might be difficult to achieve. Also, the suggested processing of the financing requests will result in a heavy administrative burden.
- **Changing the financing regime in addition to other financing options under Options 3-4 by setting national user levies:** In addition to other approaches, this option suggests setting national user levies via direct surcharge on user invoice. This could also be another option for a social solidarity scheme within the context and rationale of universal service where broadband were to be included in universal service. While this approach should be relatively simple to manage, any approach that targets subscribers directly elevates the retail price and risks both undercharging and overcharging and impeding broader digital take-up.

2.3.4 Services and end-user protection options

2.3.4.1 Services

- **No sector-specific regulation for services in the future:** This option would consist in abolishing provisions related to services from the Regulatory Framework. As a consequence of this measure, there would not exist any sector-specific consumer protection that is not desirable given the highly technical nature of telecommunications services. General consumer protection rules would not suffice to protect consumers sufficiently in all respects.

2.3.4.2 Numbering

- **Adapting the EU framework on numbering to address the competition issue on the M2M market, and creating (E.164 and E.212) European numbering ranges to promote a single market for M2M:** This option would complement the option 3 under numbering. A European numbering solution could provide the additional numbering resources necessary for M2M in Europe, with M2M-adapted and common requirements, and a country-agnostic use within Europe adapted to cross-border operating M2M applications. However past experience with ETNS and the results of the public consultation did not reveal a preference for a European numbering range. Therefore this option is not pursued at this stage. However, building on the current provisions of the framework with regard to further harmonisation of specific numbers or numbering ranges a mechanism is foreseen which allows for introducing a common EU-level numbering space in the future in case extra-territorial use of national numbering resources is not sufficient to meet the increasing demand.

2.3.4.3 Must carry and findability

- **Extending the scope of must carry obligations to OTT services.** This option would extend the scope of operators on which must carry obligations could be imposed to OTT providers. In case broadcasters, and more generally any content provider would provide their content via OTT services, net neutrality provisions (in particular Art 3(1) and 3(3) of Regulation (EU) 2015/2120) ensure that broadcasters as end users of Internet access services can distribute

their content to their viewers without discrimination. It is therefore not necessary to extend the potential scope of must carry rules to OTT services.

- **Extending the scope of EPG obligations and introduce regulatory safeguards to improve findability.** This option would extend the scope of existing EPG access and presentational obligations by modifying the definition of an EPG, which could include services and facilities providing access to on-demand content and recommendation engines. It would be envisaged to define at EU level the scope of possible measures under national law. Online viewing will continue to grow and larger PSBs will have little difficulty in finding a prominent place in app stores as well as on equipment installed at consumer premises or hand-held equipment. Regional and local PSB will have more difficulty in this respect. Cooperation with larger PSBs to carry niche content in their apps (possibly imposed by national governments) is a possible solution. In addition, niche content providers can develop alternative routes to gain exposure via social media strategies. Extending EPG obligations would not impose a great additional burden on OTT platforms as many of the essential platforms (like app stores and streaming platforms like YouTube and Daily Motion) include content of public interest in their current navigation facilities anyway. MS have already the possibility under national legislation to introduce prominence obligations on online service providers.³⁵¹ So far, MS have not made use of this possibility and the public consultation on the ECNS review has not revealed any concrete concepts how such obligations could be conceived.

The considerations outlined above (platforms already provide navigation facilities + lack of action at national level) put into question whether such obligations would be necessary and could achieve their intended purpose. It would therefore appear to be premature to define at EU level the scope of possible measures under national law and the option has therefore been discarded at an early stage of the analysis.

2.3.5 Institutional governance

- Commission powers to regulate markets directly

This option would mean the transfer of powers from national level (NRAs) to EU level (Commission). This option was discarded at an early stage as, even though it would likely serve to increase consistency, it does not meet political feasibility, the subsidiarity requirements and the need to build some flexibility into the system to efficiently ensure that national circumstances can be adequately addressed and taken into account.

- Not having an EU agency at all: substituting the BEREC Office by secretarial support functions to the Board of regulators to be provided by the Commission

This option, which is currently used for other EU bodies --- COCOM, RSPG or ERPG – could help in avoiding the application of the detailed set of rules that applies to all EU agencies (financial, staff/implementing rules, procurement, reporting, etc.) to a small organisation such as the BEREC Office. However, it was discarded as these difficulties could also be overcome by the option of establishing an EU agency carrying out certain regulatory tasks (not only a support function) with the additional benefit of ensuring more autonomy.

Moreover, the political feasibility of this option is not guaranteed as the European Parliament in its DSM report has called the Commission to ensure that a more efficient institutional framework is in place by strengthening the role, capacity and decisions of BEREC in order to achieve consistent application of the regulatory framework. In particular, the need to improve the financial and human resources and further enhance the governance structure of BEREC was highlighted.

³⁵¹ See Commission Staff working document AVMSD impact assessment, p.52

- Merging BEREC with the European Network and Information Security Agency (ENISA)

In 2007 the Commission proposed the establishment of a new agency building on the telecoms advisory group ERG and taking over the functions carried out at the time by ENISA. The option of following a similar approach with the current proposal, in particular in view of the discussions of the Inter-Institutional Working Group on decentralised agencies' resources³⁵², was considered. There are, however, several reasons which would not make it a feasible option at this stage, in particular the fact the two bodies have become in the meantime well established organisations with increasingly growing mandates (see e.g. Regulation (EU) 2015/2120 and current proposal for BEREC tasks and the tasks assigned to ENISA, which has time definite mandate, in the Directive 2016/1148/EU on security of network and information systems) which are not overlapping. Moreover, the nature of the tasks that BEREC and ENISA would carry out are rather different in terms of the intensity of human and financial resources needed and the type of relationship needed with stakeholders (ENISA counts with a Permanent Stakeholders Group). Therefore, only minimum synergies (in the area of administrative and budgetary matters, not specifically related to ENISA) could be expected to be derived from a merger scenario.

Although the two agencies fall under the remit of DG CONECT and could be considered by some that the tasks of BEREC and ENISA are related, contents-wise the two domains of cyber-security and telecoms are different. Telecoms is an important infrastructure but ENISA deals with any network infrastructure (not only the public ones that fall within BEREC remit) and any hardware and software (that are outside BEREC remit). In particular, ENISA advises on cybersecurity in energy networks, aviation networks, financial networks, health networks, etc.

Additionally, there are significant disadvantages to that option, as the representatives at Management Board level are different: telecoms NRAs for BEREC and predominantly representatives from ministries (telecoms, defence ministry, prime minister's office) or national agencies/offices focused on cyber security or information security for ENISA³⁵³. Also the consideration of the need to align the BEREC/BEREC Office structure with the 2012 Common Approach makes it difficult at this stage to consider, in addition to the significant governance changes needed, a possible merger with other existing agencies.

The possible disconnection of the proposal for a BEREC Regulation from the proposal for a European Communications Code would not ensure the achievement of the goals foreseen in the telecoms review. The institutional proposals derived from the analysis carried out in the relevant substance areas and it is pretty much interlinked (the current BEREC structure is not suitable for the new tasks in the enlarged mandate – not sufficient resources, no voting rights for Commission, limited role for the Administrative Manager, etc.). It is a package which not only concerns BEREC but other institutional elements (NRAs, other competent authorities, RSPG, COCOM, Commission powers, etc.), thus it could not be addressed in isolation or be delayed.

2.4 ANNEX 4 - Who is affected by the preferred options and specific impacts on stakeholders

This annex describes the practical implications of the preferred options identified in the Impact Assessment for the Review of the Framework for electronic communications for representative groups likely to be directly or indirectly affected by the legislation including electronic communication network and service providers, Over-the-Top players, SMEs and consumers, Ministries, National Regulatory Authorities and Spectrum Management Authorities.

For each stakeholder group, we discuss the relevant impacts of the preferred options, the key obligations that will need to be fulfilled and when these might need to be fulfilled in order to comply

³⁵² Analytical fiche n°3: Efficiency gains and synergies.

³⁵³ Only for two Member States a representative of telecoms NRA is the representative at ENISA Management Board.

with obligations under the revised framework. Wherever possible, we also indicate potential costs that may be incurred in meeting those obligations.

The opportunities and challenges presented by the proposed revisions to the electronic communications framework are described in the following table.

It is envisaged that consumers and SMEs will be the greatest beneficiaries of reforms to the electronic communications framework. These stakeholders will benefit from greater availability and choice in very high speed fixed and mobile connectivity, as well as an increased focus on the affordability of broadband and measures enabling them to defray the costs for newly installed fibre connections. Consumers and SMEs will also benefit from an extension in privacy and security protections for OTT services and improved switching for broadband bundles. Multi-national businesses should also benefit from more consistent standards for high quality connectivity cross-border.

Although they will need to meet tighter privacy and security standards, new (including European) players in the OTT and IoT space should also benefit from improved broadband connectivity as well as provisions, such as maximum harmonisation of consumer protection rules and cross-border number utilisation which should foster the scaling up of service provision across the EU.

The package includes several measures which should benefit electronic communication network providers which intend to invest in high speed networks. Such investors should benefit from increased attention to duct access and symmetric access to non-replicable assets such as in-building wiring – which are core elements facilitating the deployment of high speed networks. They should also benefit from the potential to defray connection costs over a longer period. Finally, the revisions to the Directive will explicitly recognise the important role that wholesale only models and co-investment play in supporting sustainable competition in the market. Such models will be subject to lighter touch regulatory controls. Incumbent operators which have been subject to tight regulatory controls on wholesale access, may also receive regulatory relief in areas where there is effective competition or where they make genuine co-investment offers.

Electronic communication network providers of all kinds should benefit from the increased certainty and reduced administrative costs associated with longer periods between market reviews (of 5 rather than 3 years except where there are material differences in the market situation). However, in countries which do not yet pursue such strategies, there may be additional effort required to submit mapping data to the NRA (to enable the geographic targeting of regulation) – and for operators with SMP to make duct access operational and adapt product specifications for business access to meet standardised requirements (following a suitable period).

The proposed revisions to the framework entail measures to increase reliance on general authorisations for spectrum, speed up spectrum assignment and foster consistency in assignment and core licence conditions. These provisions are broadly beneficial to electronic communication network providers and should reduce costs, improve spectrum availability and facilitate multi-national operations and service provision.

Operators offering broadband Internet access will need to meet more stringent requirements relating to transparency and quality of service. However, they will benefit from a streamlining of the rules applying to other electronic communication services. All operators should also benefit from a planned removal of redundant universal service obligations and switch away from sectorial levies which should reduce the regulatory burden on designated universal service providers and more widely reduce administrative cost.

Member States should benefit from the greater broadband diffusion, consumer trust and associated economic benefits associated with the preferred policy options. It is also possible, but not assured, that streamlining of regulatory approaches (such as the consolidation of mapping responsibilities) could

save costs at a national level. However, where not already the case, Ministries will need to ensure adequate resourcing and empowerment of NRAs, and the introduction of a minimum remit for independent National Regulatory Authorities may require a transfer of certain responsibilities in a few member states.

NRAs will benefit from the changes in a number of ways. Their independence and empowerment will be reinforced, and certain NRAs would benefit from an expanded remit concerning consumer protection and/or market-shaping aspects of spectrum. Burdens from market analyses should be reduced by extending the period between reviews. NRAs will also play a more formal and decisive role in an enhanced BEREC. However, NRAs will also need to conduct more geographically targeted reviews, and will need to ensure they have adequate expertise to take on a more extensive remit in relation to infrastructure, investment and quality of service mapping, as well as ensuring that regulation is adapted to support infrastructure competition (if not already the case).

Table 1 - Summary stakeholder impacts

		Opportunities	Challenges
Incumbent fixed and mobile telecommunication operators	<ul style="list-style-type: none"> ✓ More geographically targeted access regulation ✓ Lighter regulation in presence of co-investment or wholesale only business models ✓ Savings from less frequent market reviews ✓ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up ✓ Faster access to spectrum, greater regulatory certainty concerning spectrum assignments and more consistent usage conditions ✓ Lower spectrum access cost and regulatory burdens in bands subject to general authorisation ✓ Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings ✓ Elimination of redundant USO obligations and abolition of sectoral funding leading to reduced administrative cost and financial burden 	<ul style="list-style-type: none"> ✗ Requirement to supply infrastructure/investment mapping data for market reviews and operationalise duct access (where not already applied) ✗ Greater (commercial) pressure to invest in infrastructure due to additional infrastructure competition ✗ Need to standardise business wholesale products (given due notice) ✗ Further obligations concerning Internet access (to aid transparency QoS and switching) 	
Alternative fixed and mobile telecommunication operators	<ul style="list-style-type: none"> ✓ Operational duct access, co-investment and wholesale only incentives support more sustainable competition ✓ Standardised business wholesale products foster cross-border entry and competition ✓ Savings from less frequent market reviews ✓ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up ✓ Faster access to spectrum, greater regulatory certainty concerning spectrum assignment and more consistent usage conditions ✓ Lower spectrum access cost and regulatory burdens in bands subject to general authorisation ✓ Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings ✓ Abolition of sectoral USO funding leading to reduced financial burden 	<ul style="list-style-type: none"> ✗ Less regulation of short-term fixed access rental ✗ Greater pressure to invest or co-invest in own NGA infrastructure ✗ Requirement to supply infrastructure/investment mapping data (where not already the case) ✗ Further obligations concerning Internet access (to aid transparency QoS and switching) 	
Alternative (cable and fibre) infrastructure	<ul style="list-style-type: none"> ✓ Greater focus on infrastructure competition and regulatory targeting supports commercial flexibility 	<ul style="list-style-type: none"> ✗ Requirement to supply infrastructure/investment mapping data (where not already the case) 	

<p>investors</p>	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Operational duct access may support network expansion <input checked="" type="checkbox"/> Measures to extend contract duration for connections in challenge areas, as well as regulatory support for wholesale only models, are likely to benefit municipal and regional fibre investors <input checked="" type="checkbox"/> Savings from less frequent market reviews <input checked="" type="checkbox"/> Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up <input checked="" type="checkbox"/> Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings <input checked="" type="checkbox"/> Abolition of sectorial USO funding leading to reduced financial burden 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Greater use of symmetric obligations for non-replicable assets (where not already the case) <input checked="" type="checkbox"/> Further obligations concerning Internet access (to aid transparency QoS and switching)
<p>OTT and IoT providers</p>	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Greater availability and quality of fixed and mobile bandwidth supports OTT and IoT service delivery and innovation <input checked="" type="checkbox"/> Reduced barriers to entry and expansion for OTT and IoT firms due to maximum consumer protection harmonisation, and provisions to foster cross-border use of numbers <input checked="" type="checkbox"/> Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Switching and portability procedures currently existing for EC(N)S need to be implemented by OTTs that interconnect with E.164 <input checked="" type="checkbox"/> Privacy and security obligations need to be implemented by all OTTs <input checked="" type="checkbox"/> OTT that interconnect with E.164 potentially subject to levies for administration of regulatory authority
<p>SMEs</p>	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Greater availability of and choice in very high bandwidth connectivity with continued choice and value in basic broadband <input checked="" type="checkbox"/> Improved affordability for fibre connections through defraying connection charge <input checked="" type="checkbox"/> Potential to connect business sites cross-border boosted through standardised wholesale offers <input checked="" type="checkbox"/> Reduced barriers to entry and expansion for smaller OTT and IoT firms due to maximum consumer protection harmonisation, and provisions to foster cross-border use of numbers <input checked="" type="checkbox"/> Lower cost of access to spectrum (through greater use of general authorisations and best practice in assignment conditions) leading to greater access for smaller electronic communication companies <input checked="" type="checkbox"/> Greater predictability and trust amongst SMEs as users of ECS and OTT, improved transparency concerning IAS 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Smaller electronic communication providers may be less well placed to invest or co-invest in infrastructure <input checked="" type="checkbox"/> Potential new obligations and NRA contributions for small OTT in relation to E.164 interconnection, privacy and security

	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Reduced USO contributions for small suppliers (where previously captured) <input checked="" type="checkbox"/> Increased ease of engagement, reduced administrative burdens due to converged governance 	
Consumers	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Greater access to and choice in high quality broadband connectivity <input checked="" type="checkbox"/> Improved affordability for fibre connections through defraying connection charge <input checked="" type="checkbox"/> Greater availability and innovation in services relying on 5G and future generation wireless technologies <input checked="" type="checkbox"/> Accelerated fast mobile broadband <input checked="" type="checkbox"/> Greater predictability and trust amongst users of ECS and OTT due to extended privacy and security measures <input checked="" type="checkbox"/> Increased ease of switching in relation to bundled offers <input checked="" type="checkbox"/> Greater end-to-end connectivity and access to emergency services when using OTT interconnecting with E164 <input checked="" type="checkbox"/> Improved transparency concerning IAS <input checked="" type="checkbox"/> Potentially improved access to affordable broadband 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Potentially less detailed obligations on some ECS, but practical implications limited since consumer protection would be covered by horizontal rules or addressed through competitive markets
Member States	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Streamlining of regulatory approaches and governance at national and EU level should drive synergies and may enable cost savings <input checked="" type="checkbox"/> The proposed changes should support the diffusion of fixed and mobile connectivity, thereby supporting economic development and social welfare 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Ministries will need to ensure adequate resourcing and empowerment of NRAs (where not already the case), and governance changes may require a transfer of certain responsibilities in some member states
NRAs	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> NRAs will see a reinforcement of independence and empowerment as well as a harmonisation of their remit to provide a more converged regulatory approach (for example in relation to consumer protection and broadband mapping (including for state aid and broadband cost reduction)) <input checked="" type="checkbox"/> NRAs will play a more formal and decisive role in EU policy-making through the enhanced BEREC <input checked="" type="checkbox"/> NRAs will benefit from a longer period between market reviews reducing administrative costs and enabling longer-term decision making 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> NRAs not already pursuing such strategies will need to ensure competence in mapping, ensure the effective operationalization of measures to ensure infrastructure competition in broadband, support the deployment of broadband in challenge areas and provide standardised solutions for business access

2.4.1 Implications for telecommunications network operators and service providers

2.4.1.1 Access Provisions

Under the preferred option for access (Option 3 NGA+), telecommunication network operators and service providers will be affected by adaptations to the market analysis process. This may affect telecommunications operators differently depending on whether they are incumbent operators, which are subject to SMP obligations, alternative operators which may rely to a degree on regulated wholesale access, or other competitive operators making use of their own network infrastructure.

2.4.1.1.1 Access provisions and operators subject to SMP obligations

Economic impacts

Incumbent operators which are today typically subject to SMP regulatory obligations are expected to benefit from better motivated, more targeted and, in some instances, less onerous regulatory obligations resulting from a requirement for NRAs to place greater focus on retail market failure prior to intervention and from more granular geographic market analyses which may result in deregulation in some areas. Incumbents may also benefit from greater flexibility (for example in price setting) and reduced costs resulting from potential reduction on regulatory access obligations in cases where they propose adequate co-investment or commercial offers, or where they pursue voluntary structural separation.

The preferred option is also expected to increase commercial incentives on incumbent operators to invest in upgrading networks in order both to protect their market share and to compensate for the loss of wholesale revenues in a more competitive environment, as well as to benefit from the proposed lighter regulatory treatment for new upgraded networks. As a result, it is expected that following transposition and implementation of the legal provisions, CAPEX intensity amongst incumbent operators in countries which have not already undertaken significant network upgrades to VHC connectivity may increase.

Administrative impacts

Changes to the market review process are likely to result in certain administrative requirements, as well as change in the nature of access obligations resulting from a shift in focus towards infrastructure based competition (in countries where this is not already the case). Specifically, in the early stage, immediately following the adoption of a revised framework and during an estimated period thereafter of around 3-5 years, incumbents in countries which are not already subject to such obligations may have the additional requirements to submit infrastructure coverage data and plans concerning infrastructure deployment to support mapping by the NRA.

It should be noted that such obligations are only incremental to the data collection exercises that already exist or are planned in many member states, as described in the study (SMART 2012/0022) on the mapping of broadband and infrastructures,³⁵⁴ and (when combined with planned guidance in this area) should ideally serve to streamline and bring some coherence between data collection for market analysis purposes and the transparency obligations that exist in what may currently be viewed as separate exercises. For example, the Cost Reduction Directive already includes obligations to provide information concerning civil works to be performed in the next 6 months (Article 6 Directive 2014/61/EU) – relevant for investment mapping, while reporting obligations are already undertaken to undertake investment mapping in the context of State Aid schemes for broadband.

³⁵⁴ See Table 5-1 <https://ec.europa.eu/digital-single-market/en/news/mapping-broadband-and-infrastructure-study-smart-20120022>

Measures to operationalise duct access and symmetric obligations aimed at sharing non-replicable assets

The greater focus on infrastructure competition in the framework is likely to result (for those Member States not already pursuing such strategies) in a shift towards passive access and greater attention to symmetric obligations concerning non-replicable assets. This may require incumbents to provide information on availability of duct access, and potentially automated systems to support ordering, provisioning and repair, in cases where duct access is feasible and would be proportionate, but is not already fully operational. For incumbents in countries where such obligations are not yet fully effective the operationalization of duct access could result in one-off costs as well as ongoing costs associated with maintaining an online database for duct access availability and meeting access requests (if not already incurred).³⁵⁵

Moreover, administrative costs from the operationalization of duct and symmetric access may be offset if these obligations result in infrastructure competition, which enables the relaxation or removal of downstream asymmetric (SMP) access obligations.

Standardised wholesale offers for business

Incumbents may also be affected by requirements to move towards standardised wholesale offers for business access, in areas where such access is required.³⁵⁶ The study SMART 2014/0023³⁵⁷ assessed the impact of such a requirement, and concluded that while (some not readily quantifiable) costs may be incurred in adapting product offers, systems and processes, these could be mitigated by a phased introduction of the obligation, permitting these changes to be introduced during a refresh of systems. NRAs could determine the timing of such a required change subject to national circumstances, but for the benefits to be realised introduction should be subject to a deadline, which could be determined in Implementing Guidelines associated with the revised Framework.

Extension of market review period

Another planned change to the market review process is a reduction in the frequency of market reviews, which would be required every 5 years rather than every 3, with the potential for an interim review if needed in light of changed market circumstances. This change should in principle reduce the administrative burden involved in supplying market and operational data to the NRA and preparing information for cost modelling purposes. However, these cost savings are unlikely to be significant in the context of sector revenues, and it is possible that this change could negatively impact incumbent operators if it results in obligations being in place for longer than under the current cycle (although the reverse is also possible, in cases where regulatory obligations are withheld, for example on newly installed infrastructure in the presence of reasonable co-investment offers).

2.4.1.1.2 Access provisions and Alternative operators

It is anticipated that the increased focus on measures to boost infrastructure competition and foster investment is likely to impact the business models of alternative operators, supporting a

³⁵⁵ However, it should be noted that duct access and symmetric obligations are already operational in several member states including Portugal, Spain and France, while there are ongoing initiatives to operationalise duct access in countries such as the UK, which should be complete before the framework review comes into effect. See for instance Feb 2016 Ofcom Digital Communications Review Statement <http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/>

³⁵⁶ For example, where there is no prospect of effective infrastructure-based competition

³⁵⁷ Investigation into access and interoperability standards for the promotion of the internal market for electronic communications <https://ec.europa.eu/digital-single-market/en/news/investigation-access-and-interoperability-standards-promotion-internal-market-electronic>

move to more self-sustaining models based on investment, co-investment and/or longer term remedies or commercial solutions.

As this model is likely to involving upfront commitments, this may entail greater initial capital expenditures for these alternative operators, which would be offset in subsequent years by lower operational expenditures as business models shift from rental towards investment, co-investment or risk sharing arrangements. Engagement in infrastructure build or long-term agreements is likely to provide greater predictability for alternative operators than the current short-term arrangements, although it will also entail greater upfront risks.

In turn, as and when alternative operators invest in their own VHC infrastructure they may be subject to obligations to provide data concerning existing and planned fibre deployment as part of the expanded mapping process. They may also be subject to symmetric obligations for the sharing of in-building wiring or wiring up the first distribution point, in countries which do not already pursue such approaches, although it should be noted that such obligations are already operational under the existing framework in some countries³⁵⁸.

Precise cost impacts on alternative operators willing to invest in own infrastructure resulting from changes to the framework are difficult to estimate. However, the expectation is that the greater focus on infrastructure-based competition in NGA and VHC may result in different (more capex-intensive) business models for entrants, rather than increased costs overall.

As regards the standardisation of wholesale offers for business end users, changes to incumbent systems may also imply a need for adjustments to access-seekers' ordering and repair processes and systems, which could be made after a suitable period determined by the NRA as discussed above. On the other hand, standardised offers should lower barriers to expansion for operators which do not have nation-wide coverage in specific countries.

Finally, alternative operators which currently make use of wholesale access would, like incumbent operators, also benefit from reduced administrative costs associated with longer market review periods, although these administrative savings are not expected to be very significant as compared to other categories of costs and savings considered in this chapter.

2.4.1.1.3 Access provisions and other competitive operators

Cable operators and regional fibre investors are unlikely to be significantly impacted by the proposed changes to the market analysis process. Nonetheless, these operators are expected to benefit from an enhanced focus in the framework on infrastructure competition and more geographically targeted regulation. Specifically, they may be able to exploit operational duct access and symmetric measures to expand their existing footprint, and they may also benefit indirectly from the possible relaxation of SMP obligations in certain areas where infrastructure competition emerges, if this results in greater potential for pricing flexibility and tailoring of products and bundles to specific customer groups for the market as a whole.

Regional fibre investors including municipal investors may also benefit from specific provisions within the NGA+ option which aim to identify underserved areas that may offer deployment opportunities for this operator group, as well as benefiting from measures which are designed to hold operators to account as regards their investment declarations as made in the context of the geographical surveys conducted by the NRAs.

³⁵⁸ Symmetric obligations on in-building wiring and terminating segments on all operators are possible under the current Framework and are already operational and in place in countries such as Spain, France and Portugal. Furthermore, under the cost reduction directive, any owner or user of in-building physical infrastructure should meet reasonable requests for access in view of deploying high-speed electronic communications networks.

On the other hand, VHC networks built by these operators may become subject to symmetric obligations as regards sharing of in-building wiring or the non-replicable terminating segment, which will entail additional cost. However, it should be noted that in several countries, these rules are already in place, and it is envisaged under proposed revisions to the framework that operators could be exempted from such obligations if they operate wholesale only business models.

Like other operators they would benefit from reduced administrative costs resulting from extended market review periods, but may need to supply additional information in order to facilitate infrastructure mapping by the NRA, in those countries which have not already pursued such procedures.

2.4.1.2 Spectrum provisions

The preferred spectrum option emphasises the need to prepare Europe for the future deployment of 5G and to speed up access to spectrum resources. The preferred spectrum option (Option 3: binding criteria) introduces (amongst other provisions) common criteria for most relevant elements of spectrum assignments such as for example timing of awards, license duration and coverage, a greater focus on general authorisations versus individual licenses and provisions to facilitate the deployment of small cells and Wi-Fi. These provisions affect network and services providers in terms of speed and access to spectrum resources across the Single Market and the cost of such access. Under the preferred option these common criteria would be binding on Member States.

2.4.1.2.1 Common assignment criteria and licence conditions

Mobile Network Operators (MNOs) are some of the main users of spectrum and they will therefore be affected by common assignment criteria and obligations attached to rights of use (e.g. license duration, spectrum caps, timing of assignment, methods for determining coverage obligations, etc.). The nature of the impact will depend on the specific decisions taken at EU level which are not specified in the option and are subject to negotiation.

However, it is already clear that under the preferred option, compared with the baseline, all mobile network operators will be subject to more consistent conditions to access and use spectrum resources across the Single Market. This will likely generate greater regulatory certainty and foster the development of a level playing field across the EU. For instance, if the regulatory framework specifies that e.g. spectrum auctions should reflect a due balance of overall spectrum objectives, this should bring greater consistency in the conditions that will govern spectrum assignment across the Union.

2.4.1.2.2 Greater focus on general authorisations over individual licenses

A greater focus on general authorisations is likely to significantly reduce access costs to spectrum resources thus making spectrum available to smaller companies which cannot afford purchasing exclusive access under individual licenses e.g. in an auction.

Operators who are already present in multiple countries would benefit because they could have access to the same frequencies all over Europe, with similar conditions. Such a system would rapidly speed time to market, as there would be no decisions needed (either at national or EU level) on which operator obtains which spectrum. Furthermore, consistency of usage conditions could be improved (e.g. if a harmonised EU band plan was agreed to) and costs would be reduced compared with traditional assignments.

2.4.1.3 Universal service provisions

The preferred option with regard to universal service is Option 3 (incremental adaptation to trends with the focus on broadband affordability). This option foresees exclusion of payphones and accessory services from the universal service scope at the EU level. The universal service scope shall cover PATS and affordable broadband at least at a fixed location meaning that Member States may introduce affordability measures also by mobile (connection at least at a fixed location) at the national level. At the EU level, broadband can be defined by referring to certain services to be accessible via the connection (web-browsing, eGovernment, VoIP etc.). This option would ensure only the *affordability* of broadband (i.e. affordable retail pricing measures), that shall be ensured at least at a fixed location, thus allowing Member States the possibility to include affordability measures by mobile, while its availability shall be further promoted by other policy tools (incentives to private investment, state aid, etc.). Availability of broadband can be ensured only at a fixed location. Minimum harmonisation would be applied at EU level, such that Member States could enhance the basic services baskets. Member States may also decide, in exceptional circumstances, to support availability of broadband additionally to its affordability. The preferred financing option is through general budget as a more equitable, fair and least distortive way of funding of the provision of universal service.

ECS providers are likely to benefit from the revision of universal service according to Option 3 as it will likely reduce the uncertainty and administrative and financial burden on them. For instance, they will not be obliged to provide pay phones that are considered redundant and largely function at loss. Financing through public funds is easier to implement so that it will lessen administrative costs and will contribute to a fairer distribution of costs and benefits of the universal service provision among all market participants with less distortion to competition.

2.4.1.4 Provisions relating to electronic communications services

The preferred option regarding services (option 4) reduces, for services other than the IAS, the burden relative to a number of USD obligations for ECS providers regarding contractual rights, transparency, quality of services (QoS) monitoring, and out-of-court dispute resolutions. Additional costs might be attached to the role that access network providers might have in the standards that enable the routing of emergency calls from OTTs to numbers in the PSTN network. Option 4 also introduces a number of new obligations for ECN providers applying to IAS regarding transparency, QoS, and switching to other providers (including facilitated switching process). The preferred option regarding numbering saves telecom operators from inefficiencies in relation to extra-territorial use of numbers. The option on must carry/EPG does not impact on telecommunications network and service providers.

2.4.1.4.1 Reductions in obligations regarding ECS

In relation to overlapping consumer protection provisions, telecom operators will be relieved from unnecessary administrative and compliance costs regarding contractual rights, transparency, quality of services (QoS) monitoring, and out-of-court dispute resolutions. It is however not possible to estimate the overall costs for telecom operators of complying to potentially redundant rules.

In a survey among telecom operators organised in the context of this impact assessment, telecom operators indicate having to incur higher compliance costs resulting from existence of the rules that overlap with horizontal rules and/or rules having become redundant due to market forces. The overlapping information requirements create additional burdens for businesses that have to check all sets of requirements for any small or national differences and engage with two different sets of regulators in relation to enforcement. Activities that drive administrative burden and are related to complying with sector specific obligations regarding contractual terms and transparency are (amongst others):

- Activities related to regulatory/legal discussions with authorities on the terms of obligations;
- Activities related to assuring proper implementation of elaborate guidelines for marketing and sales (including specific provisions in contracts, in scripts for sales, in supporting IT, etc.);
- Other activities involved with assuring internal compliance with regulation;
- The need to inform customers about the corresponding regulatory provisions have the effect of making sales activities more lengthy and complex;
- Similarly, discussions with suppliers and partners (device suppliers, resellers) are made complex and imbalanced by the constraints on contracts terms;
- Activities involved with in potential litigations;
- Public Affairs involved in potential public controversies relating to the compliance with the rule.

In addition, specific resources may be dedicated to answering questions and to regularly updating online information in order to comply with transparency obligations. Telecom operators found it difficult to provide robust calculations of all compliance costs.

2.4.1.4.2 Introduction of new obligations regarding IAS

The reduction in enforcement and compliance costs regarding ECS will partially be undone by the additional obligations applying to IAS regarding transparency (related to consumption monitoring and comparison tools), QoS (reporting and, when criteria are not met, fines/compensation/termination of contracts), and switching (facilitated switching process).

2.4.1.4.3 Changes with regards to extra-territorial use of numbers.

Compared to the base scenario a number of management complexities and implementation costs may be prevented, such as: “*Network testing, functional testing, billing verification, table updates (in switches, STPs, HLRs, billing systems, etc.) [which] would need to be performed by the operator and each of its roaming partners.*”³⁵⁹ More streamlined extraterritorial usage would allow operators to gain efficiency by benefiting from economies of scale granted by the Single Market. Thus operators can provide cross border services without the need to change numbers., and can enter new markets without requesting a block of numbers in that country. At the same time, current bilateral arrangements for extraterritorial use (resulting in an equally burdensome costs for operators and roaming partners) may be replaced by a more harmonised governance structure that is much less burdensome on operators. This may require a possible extension of the activities (and costs) of BEREC as well as costs related to coordination with CEPT. However, these costs are likely much lower than the costs of the currently required multiple bilateral agreements between NRAs and telecom providers.

2.4.1.5 Governance provisions

The preferred option for Governance (option 3) involves the alignment of the remit of Regulatory Authorities at national level, as well as the extension of BEREC’s remit to encompass responsibility for market-shaping aspects of spectrum assignment and to take certain normative powers in relation to developing implementing guidelines (which would be adopted by the Commission) as well as playing a deciding role in enabling a Commission ‘decision’ in relation to case by case assessment of remedies (under an expanded article 7a process). BEREC would also perform the peer review of national spectrum assignment procedures.

This consolidation of responsibilities for market-shaping measures in fixed and mobile networks as well as service regulation is likely to have a positive impact especially for those electronic

³⁵⁹ http://www.attglobalpolicy.com/wp-content/uploads/2014/06/ATT-Comments_BEREC-M2M-Project-Team-19-June-2014.pdf

communication network and service providers, which are converged and/or operate or aspire to operate cross-border. Converged regulatory responsibilities should lead to more coherent decisions, while greater consistency at EU level may enable cross-border suppliers to achieve cost savings from reduced regulatory variation.

Notwithstanding these potential benefits to electronic communication operators however, increased consistency which reduces barriers to access or service provision between member states, may pose competition challenges for operators which currently have a strong position in national markets.³⁶⁰

2.4.1.6 Overview table

The following table summarises the changes obligations per subject area and associated practical implications and costs.

³⁶⁰ For example, in the context of interviews for SMART 2015/0002 and SMART 2014/0023, multi-national business end-users claimed that incumbent operators aimed to protect national markets. Additional cross-border competition from OTT players might also pose a challenge to the service revenues of traditional electronic communication providers.

Table 2 - Practical implications of preferred options for telecommunication network and service providers

	Changed obligations	Practical implications	Costs
Access	<ul style="list-style-type: none"> - Longer market review periods - Requirement to demonstrate retail failure - Infrastructure mapping - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for non-imposition of access obligations on new high capacity networks deployed on the basis of an open co-investment offer - Standardised wholesale remedies for business end users 	<ul style="list-style-type: none"> - Reduced admin burden for market reviews due to longer periods, focus on commercial rather than regulatory solutions, but increased burden in some countries for mapping, duct access, greater focus on symmetric rules for non-replicable assets - Requirement to standardise specifications (and potentially certain systems) for wholesale products designed for business 	<ul style="list-style-type: none"> - Potential savings from less frequent market reviews ~€28m - Other costs e.g. mapping difficult to quantify and vary depending on whether rules are already in place - Standardised wholesale products may involve set-up costs if/where they require changes to systems and processes, but these costs could be mitigated by phased introduction. Operational costs for multi-national providers should be reduced
Spectrum	<ul style="list-style-type: none"> - Harmonised assignment criteria and licence conditions (e.g. license duration) in all markets - Greater use of general authorisations rather than individual licenses 	<ul style="list-style-type: none"> - More consistency across the Single market - Greater regulatory certainty - Definition of coverage that is better suited to a wireless environment (e.g. not based on households but based on share of time the service is available) - Faster access to spectrum - More efficient use of spectrum 	<ul style="list-style-type: none"> - Lower cost of access to spectrum leading to greater access for smaller companies - Reduction in administrative costs associated with assignment procedures
Services numbering and	<ol style="list-style-type: none"> 1. Less obligations regarding ECS: <ul style="list-style-type: none"> • Transparency • Contractual rights • QoS • Dispute resolution 2. More obligations regarding IAS 	<p>A number of activities/resources can be downsized as a result of 1), such as: Regulatory affairs, Legal advice, Customer Care, IT-Resources, Product development, Product lifecycle management, Terms and conditions</p>	<p>1) and 2) lead to a net relief of administrative burden.</p> <p>No information on the monetary implications of 3).</p>

	<ul style="list-style-type: none"> • Transparency • QoS • Switching <p>3. Different arrangements for extra-territorial use of numbers</p>	<p>management, Billing.</p> <p>A number of activities resources will be re-introduced as a consequence of 2)</p> <p>Compared to the base scenario inefficient bilateral agreements on extra-territorial use of numbers are replaced by a more efficient system.</p> <p>A number of management complexities and implementation costs relate to roaming may be prevented.</p>	
USO	<p>Affordability measures for broadband at least at a fixed location</p> <p>Abolition of sectorial funding, instead financing through public funding</p>	<p>Reduced administrative burden due to clearer and easier to implement funding mechanism</p> <p>Reduced financial burden due to exclusion of redundant services at the EU level and introduction of public funding</p>	<p>Reduced administrative costs</p> <p>Potential cost savings due to exclusion of pay phones and accessory services for EU-28 – (pay phones alone – 1 bn euro annually)</p> <p>Cost of affordable broadband at a fixed location – from 147 mln euro to 436 mln euro per annum for EU-28</p>
Governance	<ul style="list-style-type: none"> - Merged institutional structure covering access, services and aspects of spectrum at national and EU level - BEREC to take prime responsibility for the drafting of implementing guidelines 	<ul style="list-style-type: none"> - Greater policy alignment - Increased institutional alignment on fixed and mobile regulation and consumer protection 	<ul style="list-style-type: none"> - Coherence in regulatory responsibilities should benefit converged players while greater EU consistency should reduce administrative costs, especially for cross-border providers, but may increase cross-border entry and service competition, challenging the service revenues of traditional players

2.4.2 *OTT providers and non-telco*

2.4.2.1 Access and spectrum

Changes to access and spectrum rules do not entail any changes to obligations for OTT providers. However, as for other sectors of the economy, but likely to an even greater degree, OTT providers will benefit indirectly if the preferred options lead to greater deployment of fixed and wireless network and technology and greater take-up among consumers across the Single Market.

Similarly, greater coordination of spectrum assignments under the preferred option does not directly affect users in industries that might develop 5G applications and services. However, if this option leads to successful and fast deployment of 5G in Europe it will constitute a significant growth opportunity in some sectors (e.g. automotive, transport, health, utilities, and others) and for consumers who benefit from the resulting innovations by way of greater safety, energy efficiency, and environmental sustainability, etc.). In addition, a greater focus on general authorisations could put spectrum resources within the reach of operators who are not at present able to purchase exclusive access.

In terms of other current spectrum users such as broadcasters, the preferred option does not have any direct impact since it focuses on assignment criteria and usage conditions for the provision of electronic communication services other than broadcasting rather than on allocations of spectrum bands. Of course, future deployment of 5G will affect all current spectrum users - both in terms of spectrum demand and supply, as well as in terms of optimal allocation of spectrum to different uses. These considerations go beyond the assignment criteria and usage conditions in the preferred option.

2.4.2.2 Universal service

The adoption of Option 3 for universal service will reduce the number of unconnected households and improve access to a number of enhanced communications services. Due to these developments, OTT providers are likely to benefit from the inclusion of affordable broadband in the universal service scope as they can make better use of the increased connectivity and reach a larger pool of users.

2.4.2.3 Electronic communication services

The preferred option regarding services (option 4) introduces additional administrative burden for OTT providers that use numbering resources as they will be subject to additional sector regulation. All communications services providers (regardless of the technology used, this includes OTTs) will experience an increased administrative burden in relation to complying with rules on security and privacy. The preferred option regarding numbering does not impose additional administrative burden on OTTs/IoT. OTTs may, however, have easier access to numbering ranges. The option on must carry/EPG does not impact on OTTs.

The ERG 2007 guidelines indicate that NRAs may subject OTT voice services that interconnect with the number regime to certain obligations. However, these guidelines are not binding and SMART 2013/0019 concludes that many NRAs do not follow these guidelines in practice. Under option 4, the obligations become binding and will have to be enforced by NRA's for all OTT services that make use of the numbering regime (i.e. including OTT messaging services). As such, compared to the baseline, the administrative burden may increase for OTT providers that use numbering resources as they will now be subject to the same regulation. Most of the obligations and costs (except those related to accessing emergency services) would be associated only with paying customers, as direct

revenues³⁶¹ largely relate to customers paying for interconnecting with the numbering plan. There is no quantitative information available on the size of the impact.

OTT services that make use of numbers (like Skype, Viber, or Google Voice) will be subject to the same obligations with regards to interoperability, end-to-end connectivity, and number portability. Since interconnection with the numbering regime is already part of the respective service, the obligation to provide interoperability and end-to-end connectivity will have little to no impact on current business models of the respective OTTs. With regards to portability (and associated activities to facilitate the switching process) it is not clear to what extent OTTs are currently de facto subjected to obligations. Following the ERG 2007 guidelines they could be, but in practice they are often not³⁶². Under option 4, it becomes explicitly clear that OTTs will have to be subjected to portability obligations and this may have an impact on compliance costs, but we don't have information on the size of this effect.

In addition, Article 12 and 13 of the Authorisation Directive would also apply to respective OTTs, which implies that NRAs may levy administrative charges. While following the ERG 2007 guidelines, NRAs could already impose such levies on OTTs that interconnect with the numbering regime, in practice this is not the case. The financial burden differs per Member State, but the size is relatively small. For example, in Italy the charges under Article 12 may add up to a maximum of 0.2% of turnover³⁶³. For a mobile operator with an annual ARPU of 250 to 400 EUR, this boils down to an average annual burden of €0.65 per paying customer.

Finally, OTTs would also be obliged to provide access to PSAPs, as far as this is technically feasible. In some Member States (such as the Denmark, Finland and UK) such functionality is already enabled³⁶⁴ in other Member States this is currently not the case. There is no information available on the size of the costs.

All OTTs (regardless of the technology used) will experience an increased administrative burden in relation to complying with rules on security and privacy and this may imply that some of the current OTT business models may need to evolve. It cannot be expected from past experience that the costs would be unreasonable compared to the benefits.

2.4.2.4 Governance

The preferred Governance option (option 3) envisages that the responsibilities of all NRAs would be aligned with that of BEREC, and would therefore cover inter alia issues relating to sector specific consumer protection. Alignment of governance mechanisms as well as maximum harmonisation and greater co-ordination at EU level is likely to benefit OTT players which frequently operate in a multi-national or even global environment.

2.4.2.5 Overview table

The following table provides an overview of the practical implications of the preferred options on OTT players and other non-telco users of electronic communication networks.

³⁶¹ not accounting for the indirect revenues as a result of e.g. integration in the wider MS Office suite in the case of Skype In / Out

³⁶² SMART 2013/0019 and additional interviews with NRAs in relation to this study.

³⁶³ As indicated in the answers to the consultation by an Italian telecom operator

Table 3 - Summary of impacts on OTT

	Changed obligations	Practical implications	Costs
Access	Na	Na	na
Spectrum	Na	Na	na
USO	Na	Na	na
Services and numbering	<p>For E.164 OTTs</p> <ul style="list-style-type: none"> - Interoperability - Interconnections - Portability - Access to emergency services <p>For all OTTs</p> <ul style="list-style-type: none"> - Privacy & security - 	<p>Interoperability and interconnection are currently already in place.</p> <p>switching and portability procedures currently existing for EC(N)S need to be implemented by OTTs that interconnect with E.164</p> <p>Privacy and security obligations need to be implemented by all OTTs</p>	<p>Extended obligations may entail some additional costs. No detailed estimate possible</p>
NRA financing	OTT potentially captured within levies for financing NRAs, where relevant	Additional administrative obligations and costs	Costs for NRA financing likely to vary by member state, but experience suggests limited. No detailed estimate possible
Governance	Alignment of responsibility for sectoral service regulation	May affect relevant bodies for engagement in certain MS	Streamlining of consumer protection responsibilities and increased EU-level guidance should allow reduced engagement cost

2.4.3 SMEs

2.4.3.1 Access and SMEs

Micro enterprises and smaller enterprises outside central business districts (including small businesses in rural areas) are likely to be important beneficiaries of strategies which boost the widespread deployment of fibre, as these organisations may today be under-served compared with larger corporations which may already have fibre connectivity installed to their premises. For example, the UK NRA Ofcom found in the context of research conducted in 2015³⁶⁵ that a significant minority of SMEs had had less favourable experiences with broadband, including a lack of widespread superfast broadband availability, a concentrated retail market structure, and dissatisfaction in relation to quality of service.

In addition to potentially benefiting from the installation of higher speed broadband, small businesses should benefit from a choice in high speed offers either as a result of infrastructure competition or otherwise through co-investment or regulated access (in the absence of co-investment offers). Competition in standard broadband services via regulated access will also remain. Small businesses which have or aspire to multi-national operations should also benefit from measures to ensure consistent product and service specifications, which should increase competition in the provision of cross-border services in addition to supporting seamless service characteristics.³⁶⁶

The preferred option for access envisages that payments for newly installed very high capacity connections in rural areas (which might not otherwise be economic) could be defrayed over a longer period than 24 months,³⁶⁷ while maintaining the current rules for contract duration for service contracts. This could support affordability of VHC connections for SMEs that may not be able to pay high costs up front. It is not envisaged that the potential for longer term payments for the installation, would impact customers' rights as regards switching service providers.

Finally, the provisions on mapping of quality of infrastructure, will have a positive effect on SMEs, as they entail the publication of this data. Businesses will therefore be able to gauge in advance the status of connectivity (by means of line-specific tests and not by headline speed) in a given area. This will be useful for instance when setting up a new business or relocate an existing one.

There are few electronic communication network providers that could be characterised as SMEs with fewer than 250 employees, as the capital and resources required to install and operate networks mean that most providers are larger in scale. However, smaller players may exist, for example in the installation of regional networks or the provision of targeted electronic communication services, and certain providers with scale across the EU such as suppliers of business communications, may nonetheless operate at small scale in individual national markets. These providers would in principle be subject to the same rules as other electronic communication providers with attendant advantages and costs as described in section **Error! Reference source not found.** except that, as today, NRAs are required to ensure that obligations are '*proportionate* and justified' in light of the objectives.³⁶⁸ More specifically, smaller regional fibre investors are likely to benefit from an increased focus on infrastructure competition, while business providers (which may have small scale in individual countries) will benefit from standardised wholesale offers. Smaller alternative operators serving the mass market which rely primarily on regulated access will be able to continue to offer competitive broadband services at standard speeds (on the basis of regulated wholesale access in cases where SMP persists). However, they may be less well placed to invest or co-invest in their own VHC network infrastructure than larger scale players.

³⁶⁵ <http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/sme/bb-for-smes.pdf>

³⁶⁶ The impacts of consistent wholesale offers are described in more detail in SMART 2014/0024

³⁶⁷ The currently allowed period under Article 30(5) Universal service and User Rights Directive

³⁶⁸ Article 8 Access Directive

Smaller OTT players are not directly affected by network access obligations, but would benefit from the additional capacity that may result from the focus on supporting infrastructure deployment.

2.4.3.2 Spectrum and SMEs

Under the preferred spectrum option, a greater focus on general authorisations over individual licenses has the potential to open up spectrum resources to smaller companies which are not at present able to purchase exclusive access. In addition, many of the end-user businesses which will benefit from accelerated access to spectrum and introduction of 5G will be smaller companies. By opening access to spectrum resources and accelerating 4G and 5G coverage across the Digital Single Market, the preferred spectrum option will facilitate innovation and entrepreneurship which benefits primarily (though not only) start-ups and smaller companies. For instance, there might be companies aiming to bring innovative new applications to market that rely on 5G availability and reliability in sectors such as utilities, automotive and transportation or e-health.

2.4.3.3 Universal service and SMEs

There are likely to be few implications of the universal service option on SMEs as the proposals aim specifically to target broadband affordability for remote or vulnerable consumers. However, affordable broadband home connections may also support the development of self-employment and micro-organisations.

2.4.3.4 Services and SMEs

The preferred option as regards services creates more equality in regulatory treatment as obligations on security and privacy would now apply to all types of communication services (telecom and OTT), regardless of how they are provided. There may be some costs to smaller OTT providers which would need to meet extended obligations (which are difficult to quantify). However, the changes would also provide greater regulatory certainty for all players, as well as increased trust for SMEs as end-users of OTT services, potentially thereby supporting increased take-up of OTT services including European OTT start-ups.

A further important benefit which is especially relevant to OTT start-ups is the proposal to apply full harmonisation for sectorial consumer protection rules. This should reduce barriers for scaling up in Europe (by reducing regulatory heterogeneity) to the benefit of start-ups entering as new players shaping the IoT value chain. As users of communication services, SMEs are not covered by horizontal consumer protection rules, yet they still enjoy a certain degree of protection through competitive markets. Furthermore, SMEs in new digital value chains (e.g. IoT) enjoy more trust and predictability as regards the scope of the Regulatory Framework, contributing to confidence in future planning and investment. SMEs in all sectors will be more inclined to embrace IoT applications and services as these can now be purchased at lower prices and higher quality (including better guarantees for being always and everywhere online). This will give more room for innovations by SMEs within the IoT value chain as well as in other sectors.

2.4.3.5 Governance and SMEs

Changes to Governance will not impact SMEs directly, but may benefit cross-border operations for smaller businesses supplying and using electronic communications services by ensuring consistent application of the rules and by requiring interaction with fewer interlocutors.

2.4.3.6 Overview table

The following table summarises the changes obligations per subject area and associated practical implications and costs.

Table 4 - Practical implications of preferred options for SMEs

	Changed obligations	Practical implications	Costs
Access	<ul style="list-style-type: none"> - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for longer contract duration for connectivity - Obligations for the publication of broadband QoS data - Standardised wholesale remedies for business end users 	<ul style="list-style-type: none"> - Greater access to and choice in high quality broadband connectivity - Improved affordability for fibre connections through defraying connection charge - Better availability and competition in cross-border business connectivity (also benefiting providers) - Greater transparency on line quality - Smaller electronic communication providers may be less well placed to invest or co-invest in infrastructure 	<ul style="list-style-type: none"> - na
Spectrum	<ul style="list-style-type: none"> - Faster access to spectrum - Greater use of general authorisations rather than individual licenses 	<ul style="list-style-type: none"> - Lower cost and improved potential for smaller firms to access spectrum - Facilitate innovation and entrepreneurship amongst services relying on 5G and future generation wireless technologies 	<ul style="list-style-type: none"> - na
Services numbering and	<ul style="list-style-type: none"> - Clarity with regards to the scope of the Regulatory Framework - More equivalence in approach to ECS and OTT providers offering ostensibly equivalent services - Maximum harmonisation: - Less obligations regarding ECS: <ul style="list-style-type: none"> • Transparency • Contractual rights • QoS • Dispute resolution - More obligations regarding IAS 	<ul style="list-style-type: none"> - For SMEs as customers <ul style="list-style-type: none"> - Greater predictability and trust amongst SMEs as users of ECS and OTT - Improved transparency, affordability and quality concerning IAS - Less barriers to embrace new digital applications and services (notably IoT). - The reduction in sector specific obligations (regarding ECS) 	<ul style="list-style-type: none"> - Extended OTT obligations and potential contribution to NRA financing may imply some cost increases for SME suppliers – level difficult to estimate - Max harmonisation for consumer protection should reduce compliance costs

	<ul style="list-style-type: none"> • Transparency • QoS • Switching <p>- Potential contribution to NRA admin costs</p> <p>- Clearer and Improved arrangements for extra-territorial use of numbers</p>	<p>may impact negatively on SMEs since equivalent horizontal obligations only apply to consumers. However, SMEs will enjoy protection through competitive markets.</p> <p>For SMEs as suppliers</p> <ul style="list-style-type: none"> - Increased consistency and reduced barriers to cross-border provision - Potential contribution to NRA (but may be subject to threshold) - Potential new obligations (in relation to E.164 interconnection, as well as privacy and security) 	
USO	Sectorial contributions excluded for broadband USO	Reduced contributions for SMEs as suppliers	<ul style="list-style-type: none"> - Potentially reduced costs for SME suppliers in member states which applied sectorial financing
Governance	- Alignment of responsibility for consumer protection and market-shaping spectrum regulation	Increased coherence in fixed, mobile and service regulation, greater consistency	<ul style="list-style-type: none"> - Greater consistency may reduce administrative cost for multi-national companies

2.4.4 Consumers

2.4.4.1 Access and consumers

Consumers in countries and areas currently lacking infrastructure competition (including rural areas) are likely to be the main beneficiaries of measures to support the deployment of VHC networks. This may lead to the availability of broadband services with significantly higher quality than is available today. In addition, consumers will benefit from a continuation of the degree of competition in existing broadband services (as access obligations offering quality levels equivalent to those prior to new infrastructure deployment will remain). This is unlikely to alter the current pricing dynamics for broadband currently experienced in Europe.

From experience in countries such as France and Portugal, it is also expected that consumers will benefit from competition in high speed offers and affordable prices resulting from infrastructure competition or co-investment in very high capacity infrastructure. In cases where infrastructure competition or co-investment does not materialise as expected, such choice can and should also be preserved through regulated wholesale access. Experience from countries which have pursued a similar approach to that advocated in the preferred option, including France, Spain and Portugal, suggests that pricing for VHC broadband is likely to be reasonable.³⁶⁹

Affordable prices for VHC broadband are likely to be supported not only by competition in the provision of high bandwidth services, but also as a result of continued support for competition in copper-based networks, which is likely to result in 'anchor' prices for standard speeds, which constrain the levels offered for higher speeds. Econometric analysis in the context of SMART 2015/0002 also tend to confirm that access regulation for standard broadband (through local loop unbundling) can have an influence on prices for NGA and VHC broadband, which in turn support take-up.³⁷⁰

The preferred option for access envisages to enable the cost of the (network) connection to be defrayed over a longer period than the current contract duration (24 month) while maintaining the current rules for contract duration for service contracts.³⁷¹ This could support affordability of VHC connections for customers that may not be able to pay high costs up front. It is not envisaged that the potential for longer term payments for the installation, would impact consumers' rights as regards switching service providers.

Finally, the provisions on mapping of quality of infrastructure, will have a positive effect on consumers, as they foresee the publication of these data. Consumers and businesses will therefore be enabled to know in advance the status of connectivity (by means of line-specific tests and not by headline speed) in a given area. This will be useful for instance when setting up a new business or relocate an existing one or when moving to a new house with additional effects in terms of house prices, repopulation, relocation of economic activity which in turn will drive more demand for connectivity.

2.4.4.2 Spectrum and consumers

While the spectrum options do not directly impact on end-consumers /citizens, greater and faster 4G and 5G coverage will enable consumers across the Single Market to benefit from advanced wireless data services and innovative applications resulting in particular from the deployment of 5G. These applications are likely to cover sectors as diverse as e-health, automotive / transportation and utilities, all of which potentially affect a large share of EU citizens. In addition, common methods for determining coverage obligations and improved connectivity across the DSM will contribute to

³⁶⁹ See SMART 2015/0002

³⁷⁰ See SMART 2015/0002 – also discussed in interim presentation slides http://www.wik.org/fileadmin/Konferenzbeitraege/2016/Public_Workshop_April/Public_Workshop_slide_presentation.pdf

³⁷¹ Article 30(5) Universal service and User Rights Directive

reducing social inequalities (e.g. by fostering digital inclusion). Finally, the introduction of 5G services is likely to create a significant number of jobs (estimated at 2.39m across the EU)

2.4.4.3 Universal service and consumers

The preferred option for universal service is likely to have positive implications for end-users (and particularly consumers) by reducing the number of unconnected households (currently 20% to 30% of households), especially in rural and remote areas, where cost is the main reason for not subscribing. This would allow for an improved access to essential e-services (eGovernment, VoIP, ebanking etc) and would enhance citizens' social participation and their exercise of fundamental rights, for instance right to information, right to conduct business and right to education. For vulnerable groups of consumers (those on low incomes, elderly, those that are less mobile or less able to leave home due to carer responsibilities), affordable broadband is likely to reduce social isolation, improve sense of community and promote social inclusion.

2.4.4.4 Services and consumers

Suggested measures focussing on potential bundling related lock-in problems and other measures supporting transparency and switching will support end-users' protection and freedom of choice which will have a positive impact in terms of affordability and/or quality for the end-user. People with a preference for privacy, confidentiality and/or security are more likely to be included in participating in popular and innovative communication networks. The options for consumers to reach PSAPs (when technically possible) will increase, however, while only a few OTTs seek to interconnect with the numbering regime, the impact is limited.

Although the number of rules dealing with sector specific consumer protection would reduce, this would not be at the expense of consumer protection. Rules are abolished only if respective consumer issues are sufficiently protected by horizontal rules and/or if they are sufficiently protected by competitive constraints imposed on market players.

2.4.4.5 Governance and consumers

Changes to governance will not impact consumers directly, although consumers will indirectly benefit from greater connectivity, cross-border entry and competition that may result from more effective co-ordination at EU level.

2.4.4.6 Overview table

Table 5 - Practical implications of preferred options for consumers

	Changed obligations	Practical implications	Costs
Access	<ul style="list-style-type: none"> - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for longer contract duration for connectivity - Obligations to publish QoS mapping data 	<ul style="list-style-type: none"> - Greater access to and choice in high quality broadband connectivity - Improved affordability for fibre connections through defraying connection charge - Greater transparency over quality of service 	<ul style="list-style-type: none"> - na
Spectrum	<ul style="list-style-type: none"> - Faster access to spectrum - Greater use of general authorisations rather than individual licenses 	<ul style="list-style-type: none"> - Greater availability and innovation in services relying on 5G and future generation wireless technologies - Accelerated fast mobile broadband 	<ul style="list-style-type: none"> - na
Services and numbering	<ul style="list-style-type: none"> - Equivalence in approach to ECS and OTT providers offering ostensibly equivalent services - Measures to reduce bundling-related lock-in - Interoperability, emergency service access and portability requirements for OTT interconnecting with E164 - Less obligations regarding ECS, but More obligations regarding IAS <ul style="list-style-type: none"> • Transparency • QoS • Switching 	<ul style="list-style-type: none"> - Greater predictability and trust amongst users of ECS and OTT due to extended privacy and security measures - Increased ease of switching in relation to bundled offers - Greater end-to-end connectivity and access to emergency services when using OTT interconnecting with E164 - Improved transparency concerning IAS - Potentially less detailed obligations on some ECS, but practical implications limited since consumer protection would be covered by horizontal rules or addressed through competitive markets. - a positive impact in terms of affordability and/or quality for the end-user 	<ul style="list-style-type: none"> - na

USO	- Focus on broadband affordability at least at a fixed location	-Potentially improved access to affordable broadband	na
Governance	- Alignment of responsibility for sectoral service regulation	- Increased ease of engagement, reduced administrative burdens	- na

2.4.5 Member States' authorities

2.4.5.1 MS and Governance

The proposed changes to the EU framework for electronic communications would require transposition into national legislation, and will entail certain changes to the institutional set-up in countries which do not already implement the revised structures and procedures as well as changes at EU level. Specifically, at national level, NRAs remit would be subject to minimum harmonisation (to cover inter alia market-shaping spectrum assignment issues and sector specific regulation in areas such as consumer protection). Likewise, at EU level the preferred option would give BEREC an expanded remit for market-shaping aspects of spectrum assignment and services alongside access, as well as increased responsibilities including responsibility for developing implementing guidelines and an enhanced role in the article 7a process on remedies as well as a peer review role on market-shaping aspects of spectrum assignments. These changes may have the following implications for member states' responsibilities and budget.

Taking into account factors which may reduce costs as well as those which increase them, the preferred option is projected to result in costs which are similar to the status quo (see discussion in the detailed chapter on Governance in SMART 2015/0005). However, in a scenario where the projected efficiencies are only partially achieved, the preferred option could entail additional costs of around €5.5m across the EU, with costs varying for different countries. The implications of the adapted governance structure on member states' responsibilities and budget are described in more detail below.

2.4.5.1.1 National level

An important change at national level will be the allocation of responsibilities in the field of consumer protection and spectrum awards design under the framework to those NRAs³⁷² which do not currently have such responsibilities. This affects a subset of member states.³⁷³ If it entails a transfer of responsibilities for existing tasks, cost implications may not be significant.

The preferred option also entails a requirement to ensure appropriate resourcing for NRAs both to conduct their duties at a national level, and contribute to the expanded remit of BEREC.

Additional expenses are expected to vary between member states, depending on the current resourcing available to the NRAs, but across the EU overall additional expenses for the resourcing of NRAs are expected to be minimal.

Based on an additional 20FTE from NRAs across the EU contributing to BEREC (in addition to the current estimated 49FTE),³⁷⁴ and a 50% increase in contributions from national authorities³⁷⁵ to EU spectrum co-ordination (concerning the design of auctions and market-shaping measures), the increased cost to NRAs for BEREC contribution is estimated at €2m in the EU 28 under the preferred option.

Certain NRAs may also need greater resourcing in order to adequately perform duties such as market analyses under the revised framework including the proposed requirement for infrastructure mapping.

³⁷² Independent National Regulatory Authorities within the meaning of article 3 Framework Directive

³⁷³ According to data from Cullen, NRAs in Denmark, Estonia, Latvia, Malta, Poland and Spain do not currently have responsibility for consumer protection, while NRAs in Netherlands, Spain, Cyprus and to some extent Slovakia and Portugal do not have primary responsibility concerning regulatory aspects of spectrum management

³⁷⁴ Based on BEREC interview

³⁷⁵ Today contributions are made to the RSPG by various bodies at national level, but would under the revised framework proposals be made by NRAs as regards spectrum auction design and market-shaping measures

However, as elaborated in the detailed analysis of impacts resulting from changes to the access regime conducted under SMART 2015/0005, the additional mapping obligations are only incremental to the advanced mapping initiatives that already exist in many Member States. Such mapping processes may already have been developed for market analysis purposes, for the implementation of transparency measures required under the Cost Reduction Directive (such as advance notification of civil works) and to meet reporting obligations for identification of white areas through investment mapping before notification of State Aid schemes. Indeed, it would be recommended for those national administrations which have not already done so, to streamline these ‘mapping’ processes under the remit of NRAs, which should ensure that the assessments are coherent, and may ultimately reduce complexity and cost.

Other policy approaches such as extended market review periods and standardised wholesale specifications for certain products with EU-level relevance, could also be expected to reduce costs for NRAs on average.

Moreover, the introduction of greater co-ordination concerning certain aspects of spectrum assignment, may result in reduced resourcing requirements for the management of spectrum resulting in a reduced overall national burden associated with regulation of the electronic communication sector at national level.

If costs for the application of non-spectrum aspects of regulation are broadly stable (taking into account positive and negative factors), but spectrum-related resourcing could be reduced by an average of 1FTE per member state due to greater co-ordination, the average estimated reduction in national costs for application of the electronic communication framework as a whole would be around €2.6m per annum across 28 Member States, but not necessarily equally distributed, since resourcing levels vary widely.

2.4.5.1.2 EU level

As regards EU co-ordination, the reinforcement of BEREC’s responsibilities and its structure to conform with the 2012 Common Approach will entail increased annual costs of an estimated €7m compared with the status quo. This increased cost could be met from the EU budget³⁷⁶. The preferred option bundle may also entail increased resourcing requirements for the Commission (especially relating to the proposed spectrum assignments peer review) with an estimated budgetary implication of around €0.6m.

At EU level, Ministries would continue to play a role in comitology bodies such as COCOM.

2.4.5.2 MS and Services

In general, sector specific rules would be followed by the NRA and the attribution of horizontal rules would be at national discretion. Some Member States might opt to give all consumer questions relevant for a sector to the sector specific regulator. Options with regards to numbering and with regards to must carry/EPG do not require actions from ministries, besides transposing new rules (regarding the assignment of MNCs to non-MVNOs, and regarding extra-territorial use of national numbers) into national law.

2.4.5.3 MS and Universal service

Adoption of Option 3 for universal service will have slight implications for ministries of some Member States where ministries share the relevant competences with NRAs (for instance, in Austria,

³⁷⁶ Some EU agencies are partly financed by fees but no specific tasks carried out by BEREC which could be subject to a fee paid by the beneficiaries of those tasks have been identified.

Estonia, Finland, France, Italy and Greece). In such countries, there will be new requirements with regard to the definition of the scope of universal service and universal service obligations at the national level, because Option 3 foresees only PATS and affordable broadband for the scope. Yet, depending on the national distribution of competences, ministries may retain the task of defining broadband at the national level (for example, by reference to specific communications services) as well as to assess affordability. Nevertheless, flexibility of Member States will be preserved due to a minimum harmonization at the EU level, i.e. the accessible communications services basket can be enhanced at the national level and broadband affordability can be expanded to at least at a fixed location. In addition, if a need is demonstrated at national level, Member States would have the possibility to include the availability component in the universal service obligation and to maintain services, which are currently part of USO at the respective national level (i.e. payphones and accessory services). There is a further limitation of discretion of Member States as regards the choice between different financing options, if public funding (as opposed to optional funding from the industry) is mandated at the EU level.

2.4.5.4 Overview table

An overview of the impacts for member states is shown in the following table.

Table 6 - Practical implications for Member States

	Obligations	Steps to be taken	Costs
Access	<ul style="list-style-type: none"> - Extension of market review periods, more detailed reviews (including mapping), harmonised wholesale specifications - BEREC to develop Implementing guidelines on adapted market analysis process and standardised wholesale products 	<ul style="list-style-type: none"> - Ensure adequate resourcing of NRAs to conduct market analyses and contribute to BEREC 	<p>Increased costs of ~€2m (+20FTE across EU28) to support NRAs in contributing to BEREC, some increased costs also to ensure effective NRA resourcing where not currently the case, but may be balanced by potential for reduced costs from extended market reviews</p>
Spectrum	<ul style="list-style-type: none"> - EC to adopt implementing Decisions subject to RSPG input and comitology - BEREC to play role in peer review of spectrum assignment 	<ul style="list-style-type: none"> - Ensure adequate resourcing of NRAs to contribute to BEREC/ RSPG 	<p>Some additional costs to support spectrum co-ordination (see governance), but overall potential saving of approx. €2.6m across EU28 for ECS spectrum management if co-ordination reduces resourcing requirement (by IFTE) at national level</p>
Services and numbering	<ul style="list-style-type: none"> - In general, sector specific rules would be followed by the NRA and the attribution of horizontal rules would be at national discretion. Some MS might opt to give all consumer questions relevant for a sector to the sector specific regulator 	<ul style="list-style-type: none"> - Ensure adequate resourcing of NRAs 	<ul style="list-style-type: none"> - Limited impact as the responsibilities of NRAs in enforcing current sector specific obligations can be downsized as a result of the preferred option.
USO	<ul style="list-style-type: none"> - Defining the scope of functional internet access - Implementing affordable universal service 	<p>NRAs already have significant responsibilities on technical implementation of universal service, only a (slight) adjustment of them will be necessary</p>	<p>The overall cost of specifically attributing certain US implementation responsibilities to NRA is likely to be neutral</p>
Governance	<ul style="list-style-type: none"> - Harmonised minimum remit for NRAs to include consumer protection and market shaping aspects of spectrum - Expanded remit for BEREC to encompass consumer protection, spectrum and alignment of structure with Common Approach - Peer review process for spectrum (involving BEREC, EC) 	<ul style="list-style-type: none"> - Transfer responsibilities for consumer protection and market shaping aspects of spectrum to NRAs (where not already lying with independent NRA) - Potential increased contribution to BEREC and EC costs 	<p>Removal of sectorial funding possibility</p> <p>Cost of transferring responsibilities between national authorities may be limited</p> <p>Estimated increased costs of reinforced EU co-ordination ~€4.4m for enhanced BEREC, and ~€0.6m for Commission (although potential national savings from spectrum co-ordination described above)</p>

2.4.6 National regulatory authorities (NRAs) and spectrum regulatory authorities (SRAs)

Under the preferred option bundle, NRAs will have full responsibility for implementation of regulatory rules under the EU framework for electronic communications including those associated with consumer protection and market-shaping aspects of spectrum assignment. This will entail an expanded remit and associated resources for those NRAs which do not already have these responsibilities.³⁷⁷ NRAs will also need to make additional contributions to the output of an enlarged BEREC. This may have the following practical implications.

2.4.6.1 NRAs and Access regulation

As regards implementation of the framework at a national level, the market analysis process will be adapted to include infrastructure mapping, greater consideration of duct access and clarifications in relation to the application of symmetric obligations, as well as co-investment and other commercial arrangements, prior to mandating obligations for access on the basis of SMP. NRAs can already adapt market analysis processes on a voluntary basis to reflect this approach, but will be obliged to follow this approach in the reviews subsequent to the adoption of the revised EU framework for electronic communications. These additional considerations – and especially mapping and the potential greater focus on duct access and symmetric remedies may imply additional effort and resource for those NRAs which have not already undertaken such analysis, especially in the first review process following the application of the revised framework. However, many NRAs or regional authorities already conduct mapping assessments thereby reducing the additional burden entailed by such an obligation (see SMART 2015/0002 and section 2 (access) of the detailed Impact Assessment, while the required effort in relation to duct access and symmetric remedies should be reduced in subsequent reviews.

The preferred option also provides a role for NRAs in identifying ‘challenge’ areas, holding operators accountable for the provision of misleading information concerning their deployment plans. This may result in greater engagement by NRAs with the process of broadband state aid allocation, which also involves the identification of areas in which NGA deployment is unlikely.

However, in addition to measures which may increase resourcing requirements for certain NRAs, there are measures which are likely to reduce the effort needed. Market reviews will be required only every 5 years as opposed to 3 years as currently,³⁷⁸ and the introduction of standardised wholesale remedies for example in relation to business access, will avoid duplicate processes for the specification of new wholesale remedies, and simplify the imposition of remedies (in cases where such remedies would be appropriate).

NRAs will need to be effectively resourced not only to fulfil their national functions under the electronic communications framework, but to contribute to an expanded BEREC, which will have responsibility for the development of implementing guidelines as regards issues such as infrastructure mapping and the development of standardised wholesale offers to support business communications. NRAs would also contribute via BEREC to an updated article 7a process whereby a Commission veto on remedies would be possible in circumstances where BEREC agrees.

Some of the changed requirements are likely to result in increased budgetary and resourcing requirements for a subset of NRAs. These include obligations to ensure adequate resourcing, responsibility for market shaping aspects of spectrum and consumer protection (where not already the

³⁷⁷According to data from Cullen, NRAs in Denmark, Estonia, Latvia, Malta, Poland and Spain do not currently have responsibility for consumer protection, while NRAs in Netherlands, Spain, Cyprus and to some extent Slovakia and Portugal do not have primary responsibility concerning regulatory aspects of spectrum management

³⁷⁸The 2014 Recommendation on Relevant Markets susceptible to ex ante regulation also involves two fewer markets than the previous 2007 Recommendation, which should also entail reduced effort as the markets removed from the list are progressively deregulated

case), and the requirement to conduct robust mapping exercises in relation to market analyses (where not already the case). Additional contribution to BEREC would also need to be resourced.

However, many NRAs already have sufficient resourcing, scope and undertake detailed mapping, and as discussed there are other aspects of the preferred package that may result in cost savings. Cost implications for changes to NRA duties under the preferred option (excluding spectrum) may therefore be considered neutral on average, although with variations amongst member states.

2.4.6.2 NRAs and Spectrum

In terms of the preferred spectrum option, NRAs would also need to have sufficient resources to deal with the spectrum assignment selection processes and the related peer review and to engage with BEREC accordingly. However, increased co-ordination of certain aspects of spectrum assignments at EU level, may allow for cost savings in spectrum management to be made at national level. For example, an estimated €2.6m could be saved across the EU, if greater spectrum co-ordination permitted a reduction in spectrum management staffing of 1 FTE per member state.

2.4.6.3 NRAs and Electronic Communication Services

Under the preferred option, NRAs indicate that the impact on enforcement costs for consumer protection is not a major issue. Abolishing the rules that overlap with horizontal rules would not bring any savings in terms of the enforcement costs; either because they are currently already enforced by competent authorities or because MS may decide to give responsibility for enforcing horizontal rules to the NRA. Moreover, while NRAs may reduce a number of activities related to transparency and QoS monitoring in relation to ECS, a number of these activities need to be re-introduced to enforce similar type of obligations imposed on IAS.

The obligations imposed on OTTs that provide communications services with regards to security and privacy may require additional activities to guide OTTs in implementing obligations (which may include legal enforcement activities). While OTT business models are EU-wide it may require coordination of activities at BEREC. The preferred option as regards numbering makes current procedures with regard to extra-territorial use of numbers much more efficient. This may require an increase of activities as it may lead to more applications for extra-territorial use of numbers. Moreover, the ability of non-M(V)NOs to apply for MNCs may also require more resources for NRAs. With regards to must carry and EPG, there is no impact on NRAs.

2.4.6.4 NRAs and Universal service

NRAs will be responsible for monitoring the national market evolution of functional internet access and voice communications. NRAs will also continue to keep the tasks related to assessing the possible unfair burden from the universal service provision and the calculation of the net costs.

An overview of the implications for NRAs is shown in the following table.

Table 7 - Practical implications for NRAs/SRAs

	Obligations	Steps to be taken	Costs
Access	<ul style="list-style-type: none"> - Longer market review periods, requirement to demonstrate retail failure - Infrastructure mapping - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Standardised wholesale remedies for business 	<ul style="list-style-type: none"> - Implement revised market analysis process in market reviews following application of the framework to be conducted on 5 yearly basis. - Conduct infrastructure mapping exercises (where not already implemented) - Investigate and where appropriate apply measures to make duct access and symmetric access to non-replicable assets effective - Include additional assessment e.g. of co-investment, commercial offers, prior to imposition of any additional SMP remedies - Implement standardised wholesale solutions (after adoption and following suitable period) 	<p>Difficult to precisely estimate and likely to vary between NRAs as some may already comply with the spirit of the preferred option, while others require further resourcing in order to do so.</p> <p>Given balance between positive and negative cost impacts, overall impact may be neutral</p>
Spectrum	<ul style="list-style-type: none"> - Negotiate assignment criteria and usage obligations which would form part of EC implementing decisions - Adopt system promoting general authorisations over individual licenses 	<ul style="list-style-type: none"> - Take on new responsibilities and provide necessary resources - Engage with spectrum advisory board 	<ul style="list-style-type: none"> - Greater EU co-ordination in spectrum assignment processes and licence conditions requires additional engagement with RSPG but may allow cost savings estimated at ~€2.6m based on reduction of IFTE per SMA on average - Transfer of certain spectrum competences to NRAs in countries where not already the case considered cost neutral

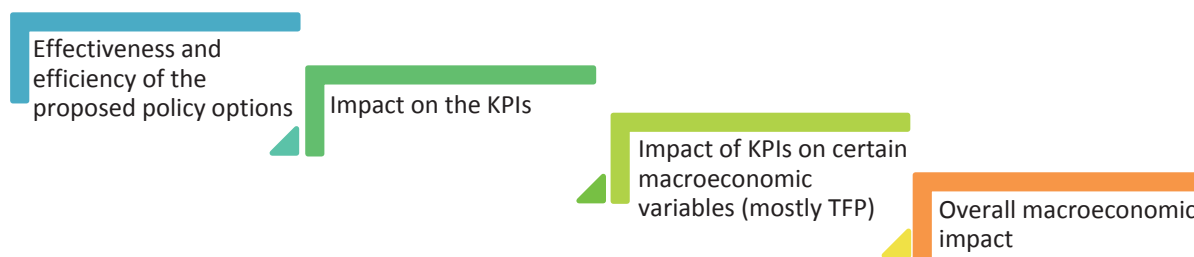
<p>Services and numbering</p>	<ol style="list-style-type: none"> 1. Enforcement of obligations on IAS and ECS 2. Assist OTTs in implementing security and privacy obligations 3. Enforcement of new OTT obligations 4. Operationalise new (more efficient procedures) regarding roaming and extra-territorial use 5. Clear possibility to assign numbers to non-M(V)NOs 	<ol style="list-style-type: none"> 1. Adapt activities in enforcement of some IAS and ECS obligations 2. Interact with OTTs, coordinate with BEREC, legal challenges. 3. Integrate enforcement of OTT obligations into current operations 4. Intensify cooperation between NRA's as the relevance of cross border aspects may increase 5. Increase resources as number of applications may increase 	<ul style="list-style-type: none"> • Net impact of 1 and 2 is likely zero • Impact of 2 is mostly during a brief transition period following implementation of option 3. It requires coordination with other NRAs and may involve legal challenges. • Impact of 4 is negligible • 4 and 5 may require some additional resources because increased efficiency may lead to an increase of the number of applications (where the current nr of applications is close to zero)
<p>USO</p>	<ul style="list-style-type: none"> - Monitoring market evolution - Net-cost calculation 	<p>NRAs already have significant responsibilities on technical implementation of universal service, only a (slight) adjustment of them will be necessary</p> <ul style="list-style-type: none"> - Contribute to expanded BEREC and RSPG responsibilities 	<p>The overall cost of specifically attributing certain US implementation responsibilities to NRA is likely to be neutral</p>
<p>Governance</p>	<ul style="list-style-type: none"> - BEREC to develop Implementing guidelines on adapted market analysis process and standardised wholesale products - EC to adopt implementing Decisions subject to RSPG input and comitology - Double-lock veto on draft SMP remedies under Article 7 - BEREC to play role in peer review of spectrum assignment 		<p>~€2m per year (for an additional 20FTE) contributing to BEREC (over current estimate of 39FTE) and some additional contribution to RSPG</p>

2.5 ANNEX 5 - Analytical models used in preparing the impact assessment.

2.5.1 Modelling the gains from intervention

The impact of the preferred policy options is estimated quantitatively using a mix of econometric and computable general equilibrium (CGE) techniques. The algorithm for performing the impact evaluation is presented very generally in the figure below. As a first step, the evaluated impact in terms of effectiveness and efficiency of the proposed policy measures is translated into quantitative (where possible) key performance indicators (KPIs).

To provide a link between the KPIs and the macroeconomic framework, econometric estimates of the effect of the indicators on certain macroeconomic variables are performed. These are complemented by other estimates, based on relevant economic literature. Finally, the evaluated impacts are fed into the CGE modelling framework as an input shock and the effects are multiplied and spread across the entire economy through the model system of equations. The impact is evaluated quantitatively by means of comparison of a baseline (largely extrapolation-based) and relevant alternative scenarios for the preferred policy options in each of the considered policy areas.



The choice of a CGE modelling framework for the estimation of the macroeconomic gains from intervening is justified by the suitability and widespread use of this type of models for evaluation of the impact of policy interventions. As the behaviour of various economic agents, such as consumers and different businesses, is explicitly modelled, this framework provides also estimations on the impact of the evaluated changes on different types of stakeholders, as well as the economy as a whole (through aggregate measures such as GDP or welfare). As the model is recursively-dynamic in its nature, it allows us to estimate also the transition paths for the macroeconomic variables, where, for the purposes of the current impact assessment, we have considered the cumulative impacts up to 2025.

2.5.2 Assumptions and limitations of the modelling approach

The modelling approach relies on the assumptions that the selected KPIs reflect sufficiently enough the expected developments in each policy area and that the estimated econometric relationship with the total factor productivity (TFP) will not change as a result of the implemented policies. The implementation of a CGE framework is also based on the following assumptions:

- No change in the input-output structure of the economies modelled. As already discussed, in the context of the current evaluation this implies that the estimated impacts are very conservative, where there is potential for higher benefits in case of disruptive technologies and innovations.
- Constant share of public investment with respect to the gross value added in the absence of policies

- Constant share of sectorial public investment with respect to the total capital expenditures of the government in the absence of policies
- Assumptions about important model parameters, which are presented in detail below in the current macroeconomic modelling annex. They are calibrated in order to ensure a plausible trajectory of the macroeconomic variables in the baseline.
- Also, in order to present estimates of the magnitude of the estimated impacts in nominal terms, we have also adopted the assumptions that in the baseline scenario annual GDP growth in the EU will be 2%, while employment will increase by 0.3% per annum and finally, that annual growth in gross fixed capital accumulation will be around 5%.

More generally, it is important to note that there are limitations on what can be estimated on the basis of the model. Specifically, we note that the implementation of the preferred policy options might have a significant boost on innovation and ultimately lead to disruptive growth. By their definition, however, such structural economic changes cannot be estimated ex ante. Therefore, the estimates presented below should be treated as a lower bound on what might be practically achievable in case the implemented policies facilitate the development and application of disruptive technologies with an important implications on a wide variety of businesses and, eventually, on the economy as a whole.

The achievement of a structurally different economic growth however will be strongly dependent on the ability of the business to absorb efficiently and effectively new technologies and benefit to the highest extent from the competitive advantages such technologies might provide. More generally, the impact of the proposed policies will be also contingent on the application of relevant innovation policies.

Finally, as a recommendation for an ex post impact assessment, a dynamic study of the behaviour of the various businesses at firm level before and after the introduction of the proposed policy changes in the e-communication regulatory framework and the respective legislative and institutional setups might provide useful insights. Also, if feasible, a large scale study with richer regional specifications might have high value added, as territorial variations might prove significant.

2.5.3 Impact of the proposed policy options on the KPIs

2.5.3.1 Access

The economic literature recognizes the positive effect of improved broadband access and uptake for achieving higher productivity and economic growth. Policy options in this domain relate to measures fostering the adaptation of the existing infrastructure to be 'fibre-ready' and provide stimulus for the development of the single market.

While the implementation of the policy options will be associated with significant CAPEX costs and transition periods, they should also lead to higher-speed broadband access and improved business and consumer climate.

2.5.3.2 Spectrum

As pointed out in the relevant section, spectrum has important implications on the deployment on mobile and fixed wireless networks, as well as on mobile competition, thus on the quality and prices of the services provided. Policy options, related to spectrum consist mainly of different degree of harmonization (more or less binding rules) of the regulatory framework on spectrum management, ranging from maintenance of the current status quo to full harmonization.

The enhanced harmonization of the spectrum regulations should lead eventually to higher speed due to realized economies of scale and investments and improved transparency and certainty for the end consumers.

It will, however, also lead to higher regulatory costs and various implementation-related expenditures. It will require a certain transition period and, in case of higher harmonization, will reduce the flexibility of the national authorities to conduct policies.

2.5.3.3 Services

Electronic communication services regulations need to be streamlined to level the playing field for all market participants, while ensuring the safe and continuous provision of the services. Various policy options are being considered, related mainly to identification of redundant regulations and/ or extension of some of the existing rules to all market participants and specification of the role of the National Regulatory Authorities and of BEREC.

The implementation of the envisaged measures might cause some additional administrative costs but should in the end promote competition in the sector and, at the same time improve the business climate through optimized regulation. In the end consumers are expected to benefit from higher quality and more securely provided e-communication services.

The problem with the must carry and EPG is also related to the provision of e-com services. However, the regulation of the access of public service broadcasters to online platforms falls out of the E-communication regulation and will not be considered in the current impact assessment.

2.5.3.4 Numbering

The problem with the numbering is closely related to the observed trend of expansion of the M2M applications and possible negative implications of solutions implemented only at national level. The policy options considered are related to the establishment of a common basis for extra-territorial use of national numbers throughout the entire EU and the use of M2M across borders.

Implementation costs for some of the policy options considered might be significant, but they should eventually lead to a boom in the development of M2M applications and, thus of innovations and economic growth.

2.5.3.5 Universal Services

Universal services have important social impacts and therefore it is essential to ensure that their scope and coverage is aligned with the societal and technological developments. The policy options considered in this respect comprise of exclusion of certain services from the US scope, which have become redundant (payphones, directories and directory enquiry services), inclusion of broadband affordability and, possibly, availability and, thirdly, adjustments in the pool of US contributors.

Optimizations in the scope of the universal services and contributors will enhance efficiency and effectiveness in the provision of these services, leading possible to lower financial burden for the contributors and better alignment of the US with the current technological, societal and economic developments in the EU.

2.5.4 *Impact of the KPIs on some macroeconomic variables*

The literature review of the impact of the various policy areas considered under this study, shows a multitude of studies assessing the effect from broadband access and uptake and some evidences on the impact of 4G on economic growth, productivity and employment. Estimations of the macroeconomic impact of high-speed broadband are however still limited in number and scope.

As can be inferred from the introductory section to this annex, the approach followed consists of estimation of the impact mainly on total factor productivity (TFP) and predominantly the effect from it to the other macroeconomic variables through the CGE model. To this end, we have constructed a two-

factor productivity function, where economic growth is explained by the contribution of capital (public and private) and labour (skilled and unskilled). Contrary to the typical estimation of the TFP as a residual in the production function, we have adopted the approach, used in GSMA and Deloitte (2012)³⁷⁹, where Stochastic Frontier Analysis (SFA) is used to proxy total factor productivity as a measure of efficiency. The main advantage of this approach to TFP estimation is that it allows for decomposition of the TFP into two analytically useful components: 1. technical progress over time and 2. different efficiency levels, measured as deviations of the respective economies from the (maximum achievable) production frontier.³⁸⁰ The results of the SFA estimation are given below.

As a first step, TFP was estimated by regressing GDP in volumes against the two typical production factors – capital (*CAP*) and labour (*EMPL*), respectively measured as cumulative investments, assuming a 10% depreciation rate, and employment. The remaining variables take into account the economic crisis after 2008 (dummy variable *dCRISIS*), evolution of the GDP in time (*Time*), i.e. technical progress, a constant (Intercept) and country fixed effects. The parameter $\Gamma \in [0,1]$ estimates the proportion of total residual variance, which is attributed to inefficiencies. Meanwhile σ^2_{sq} measures the sum of the variances in the error components (inefficiency and statistical noise).³⁸¹

Variable	Estimate	Significance	Variable	Estimate	Significance
(Intercept)	3.37	***	FI	0.07	*
log(CAP)	0.09	*	FR	-0.10	
log(EM)	0.97	***	HR	-0.83	***
dCRISIS	-0.03	***	HU	-0.89	***
sigmaSq	0.00	**	IE	0.27	***
Gamma	0.80	***	IT	-0.24	**
Time	0.13	***	LT	-0.78	***
BE	0.09	***	LU	1.04	***
BG	-1.62	***	LV	-0.87	***
CY	-0.24	.	PL	-0.98	***
CZ	-0.72	***	PT	-0.63	***
DE	-0.26	*	RO	-1.35	***
DK	0.22	***	SE	0.13	***
EE	-0.72	***	SI	-0.46	***
EL	-0.39	***	SK	-0.68	***
ES	-0.35	***	UK	-0.22	*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

The results indicate much bigger elasticity of output to labour (0.97) as compared to capital (0.09) and show returns to scale, which are close to constant (the sum of the coefficients in front of capital and labour inputs is 1.06). If estimated only on the subset of Eurostat data for 2000-2007, the elasticities of output to capital and labour are much more balanced, standing respectively at 0.45 and 0.46. The estimation results show a positive time trend in national income with an elasticity of 13% and the downturn from 2008 is estimated to provide a negative contribution to GDP of around 3%.

³⁷⁹ GSMA and Deloitte, 2012, "What Is the Impact of Mobile Telephony on Economic Growth?", Report prepared for the GSM Association, available at: <http://www.gsma.com/publicpolicy/wp-content/uploads/2012/11/gsma-deloitte-impact-mobile-telephony-economic-growth.pdf>.

³⁸⁰ The method and data used are described more in length below in the chapter devoted to the Elaboration of the methodology.

³⁸¹ Technically, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $= \sigma_u^2 / \sigma^2$, where are the variances in the assumed distributions of the inefficiency (u) and statistical noise (v) components in the error term.

The mean efficiency for the dataset, including 28 EU MS in the period between 2000 and 2015 stands at 0.88, where fixed effects are calculated negative mostly for the converging economies (highest for Bulgaria and Romania) and positive for the highest income countries in the EU – Luxembourg and Denmark, but also for Ireland.

Once efficiencies are estimated, they are used as proxy for the total factor productivity and are regressed against:

- Heritage index of economic freedom $heritage_{rt}$, which is mostly used as a proxy of the regulation effectiveness and efficiency and, more generally of the business and consumer climate.
- 4G mobile broadband coverage (as % of all households) mbb_ltecov_{rt}
- Average broadband connection speed $speed_{rt}$

Finally, as no data for Croatia was available for the speed of connection, it was excluded from the estimation panel.

Variable	Estimate ³⁸²	Significance	Variable	Estimate	Significance
log(heritage)	0.225	***	HU	-1.176	
log(mbb_ltecov)	0.003	**	IE	-1.210	
log(speed)	0.021	***	IT	-1.099	
AT	-1.169		LT	-1.285	
BE	-1.166		LU	-1.187	
BG	-1.207		LV	-1.253	
CY	-1.142		MT	-1.160	
CZ	-1.216		NL	-1.191	
DE	-1.174		PL	-1.212	
DK	-1.193		PT	-1.153	
EE	-1.234		RO	-1.263	
EL	-1.091		SE	-1.200	
ES	-1.153		SI	-1.163	
FI	-1.179		SK	-1.224	
FR	-1.137		UK	-1.191	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The estimation results indicate significant impact of economic freedom of the total factor productivity (elasticity of 0.225), including also important governance aspects. Higher broadband speed and expansion of the LTE mobile broadband also turned out to be statistically significant, though their coefficients are much lower - 0.021 and 0.003 respectively.

³⁸² The country fixed effects are all negative due to the lack of constant in the equation specification.

In addition to the results for the entire economies, sectorial production functions were also estimated. As sectorial breakdowns for Croatia were not available on the Eurostat website, it was excluded from the panel. The table below summarizes the results of the estimates performed for the seven sectorial aggregates that are incorporated in the CGE model for estimation of the macroeconomic impact³⁸³.

Variable (in logs)	TOTAL		AGR		LOWMAN		HIGHMAN		ENERGY	
heritage	0.225	** *	0.300		0.058		-0.163	*	0.107	
mbb_ltecov	0.003	**	0.001		0.005	**	0.003	**	-0.006	
speed	0.021	** *	- 0.078	** *	0.032	** *	0.035	** *	-0.136	** *

Variable (in logs)	TRANS		TELECOM		ECOM		SER	
heritage	0.0000002		-0.123		-0.412	*	0.141	.
mbb_ltecov	- 0.0000000 4	**	-0.020		0.012	** *	0.003	*
speed	-0.0000009	** *	-0.139		0.072	** *	0.012	**

Sector abbreviations: AGR – agriculture, LOWMAN - low-tech manufacturing, HIGHMAN - high-tech manufacturing, ENERGY - energy sector, TRANS - transport, TELECOM - telecommunications, ECOM - other electronic communication-related services, SER - Other services.³⁸⁴

Based on these estimates, we have assumed the following coefficients for the impacts in the CGE model, taking into account both the statistical significance of the coefficients and the logics behind the estimates. The table below summarizes the elasticities of the total factor productivity to the KPIs, used for the subsequent estimations:

Variable (in logs)	AGR	LOWMAN	HIGHMAN	ENERGY	TRANS	TELECOM	ECOM	SER
heritage	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225
mbb_ltecov	0.003	0.005	0.003	- 0.0000000 4	- 0.0000000 4	0.003	0.012	0.003
speed	0.021	0.032	0.035	- 0.0000009	- 0.0000009	0.072	0.072	0.021

³⁸³ Estimates in grey are not statistically significant.

³⁸⁴ The definition of the sectors is discussed in length in the section, describing the structure of the CGE model.

As estimated, the impacts of connection speed and 4G mobile broadband coverage on the sectorial total factor productivity is higher in the e-communication services (ECOM and TELECOM) and manufacturing and much less – in transport and energy sectors.

2.5.5 *Overall macroeconomic, social and environmental impacts*

Having established a link from the policy options, through the KPIs to some macroeconomic variables and parameters allows us to perform an overall macroeconomic impact assessment. To this end, we have constructed a CGE model, which is run for the three modelled economies (Germany, Czech Republic and Bulgaria), selected based on a cluster analysis, taking into account the digital and economic development and the size of the economies.

Each of these three economies is inhabited with a government, eight production sectors and a single representative household, maximizing its utility from consumption, skilled and unskilled labour and savings, given its budget constraint. The economic sectors comprise of agriculture, low-tech manufacturing, high-tech manufacturing, energy, transport, telecommunications, other electronic communication-related services and other services. Each of them maximizes its profit, based on its production technology. The government is formalized through its budget constraint. The link with the foreign sector is made through the invest-savings balance. Armington and constant elasticity of transformation aggregation functions are used to determine the quantity and relative price of the imports and exports.

The model is static in its essence, as all optimizing agents choose their optimal values only for the current period. However, the model features also some transitional dynamics, defined through the capital accumulation equation and an equation for total factor productivity growth.

The quantitative modelling approach can be schematically presented as in Figure 1. The next Figure 2 presents an overview of the impact mechanisms of the preferred policy options. To simulate the impact of the preferred policy options on the economy, shocks to the TFP have been introduced. Their magnitude is estimated based on the expected size and timing of the of the respective KPIs and their identified econometric relationship with TFP. Most of the shocks were introduced in 2020 and had impact already in 2021. Exceptions include accelerated fibre scenario, where impacts begin to be felt in 2019 as market analysis processes are voluntarily adapted in anticipation of the modification of the electronic communications framework and the 5G spectrum scenario, where impacts are not experienced before 2021, on the expectation that 5G technologies will not be ready for service before that date.

Figure 1 - Overview of the quantitative modelling framework

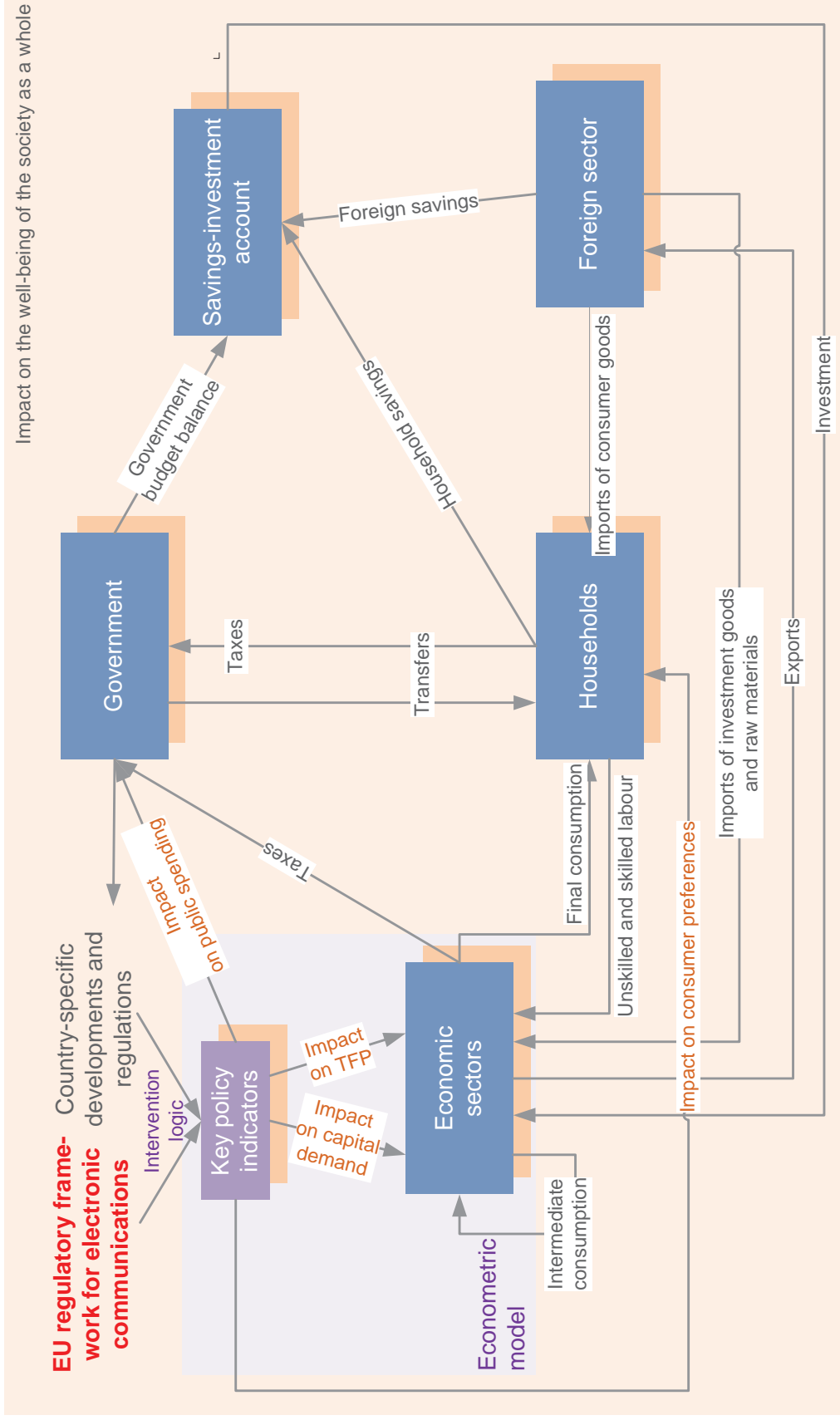
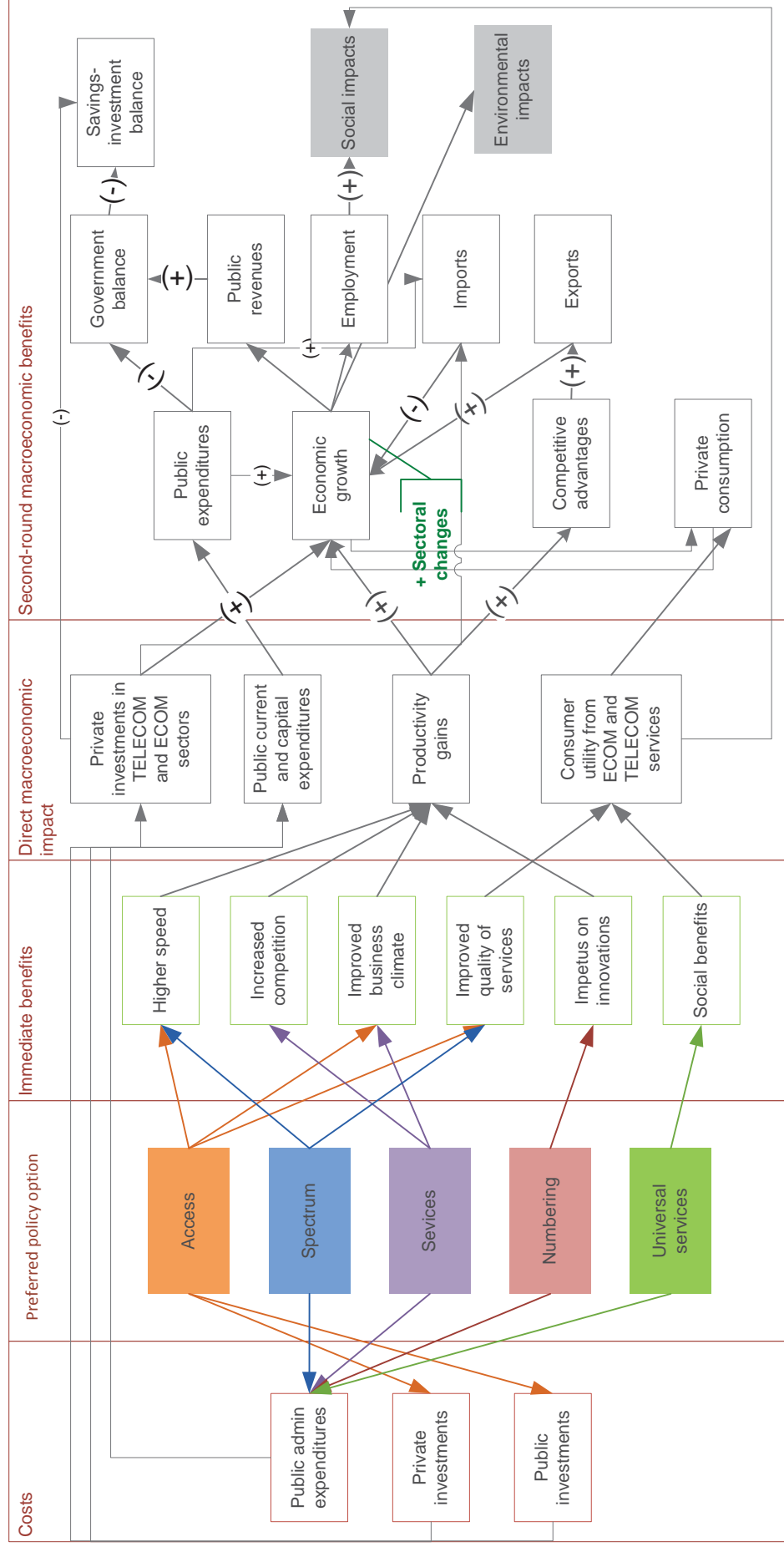


Figure 2 - Overview of the impact mechanisms of the preferred policy options.

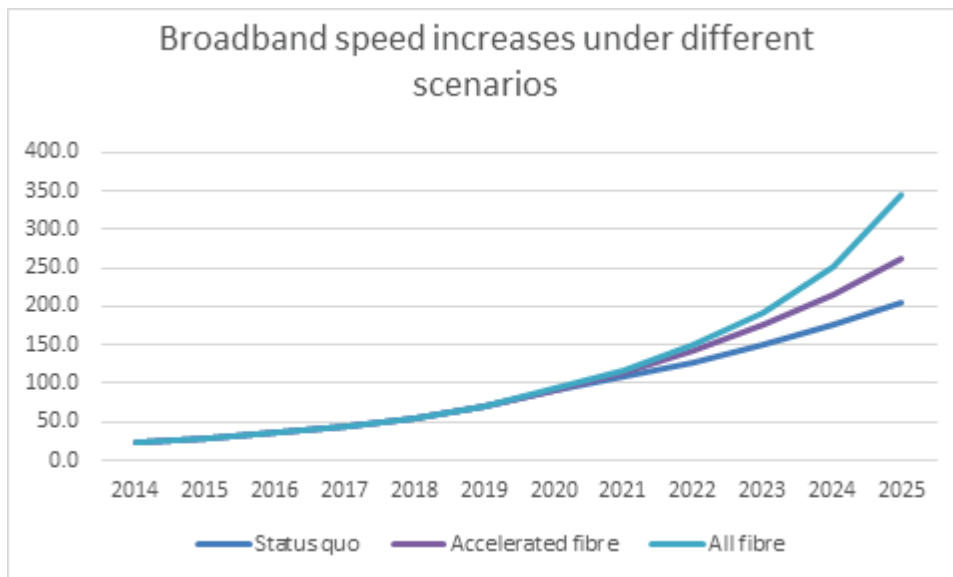


2.5.6 Simulation results, based on the preferred policy scenarios

Access

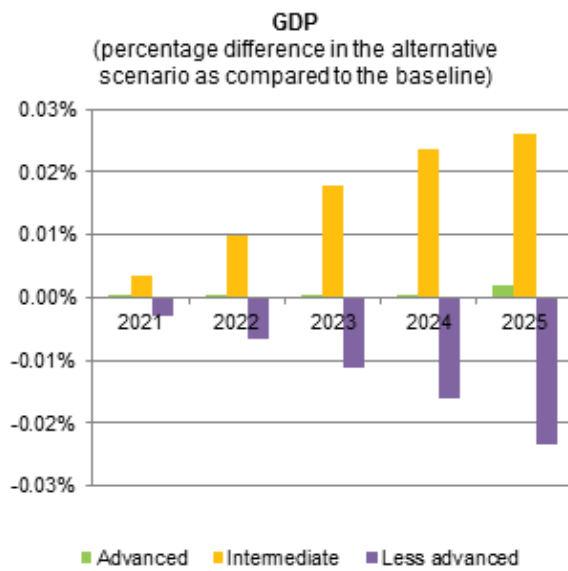
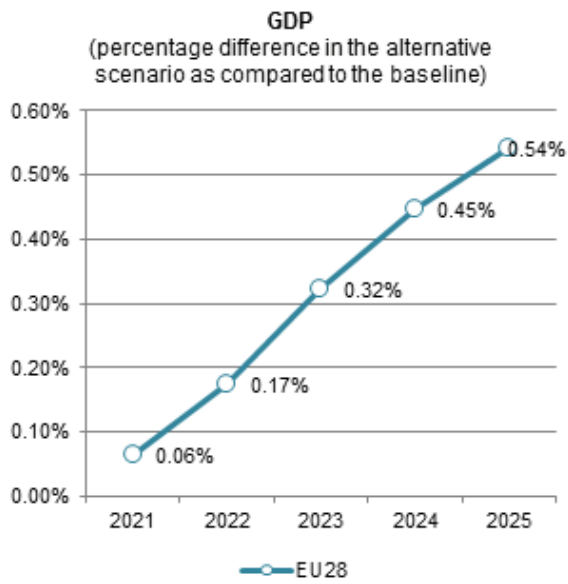
The impacts on broadband download speed from the implementation of the preferred policy options with respect to access are summarized in Figure 3 below:

Figure 3 – Broadband speed increases under different scenarios



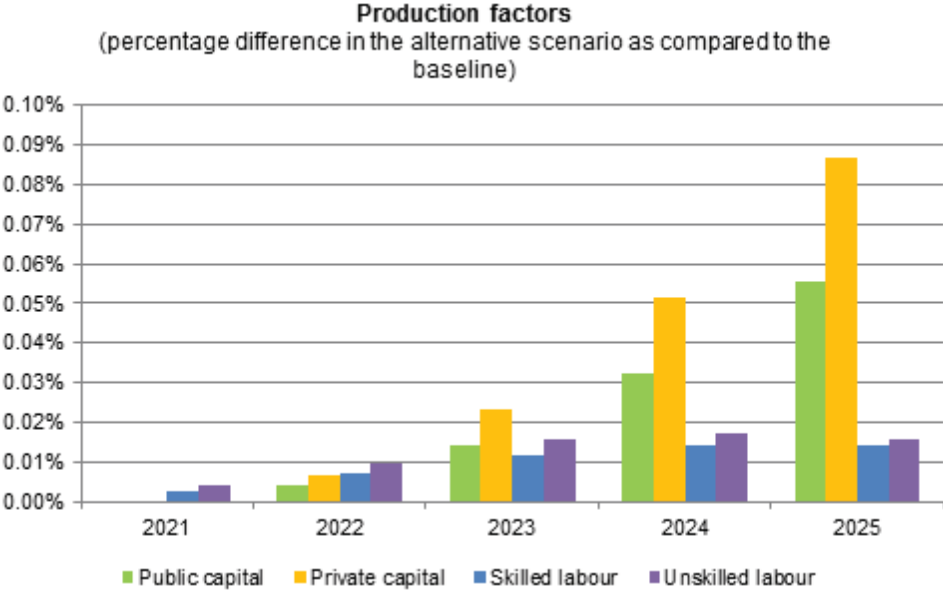
Under both alternative policy scenarios, connection speed growth is expected to exceed that of the baseline, respectively by an average of 3 percentage points in the accelerated fibre scenario and twice higher in the all fibre scenario. In the accelerated growth scenario deviations in connection speed growth amount to 6 p.p. in 2025. In the all fibre scenario, the gap in growth increases to 22 p.p. by 2025.

In the **accelerated fibre scenario**, the impact on GDP is expected to be positive by 0.06% already in 2021 and deepen to 0.54% by 2025. The impact will not be evenly spread across all EU economies. Specifically, the middle group of countries will benefit most from the proposed policy changes, while the group of less economically and digitally advanced economies is expected to gain slightly less than the average from the increase in average connection speed.



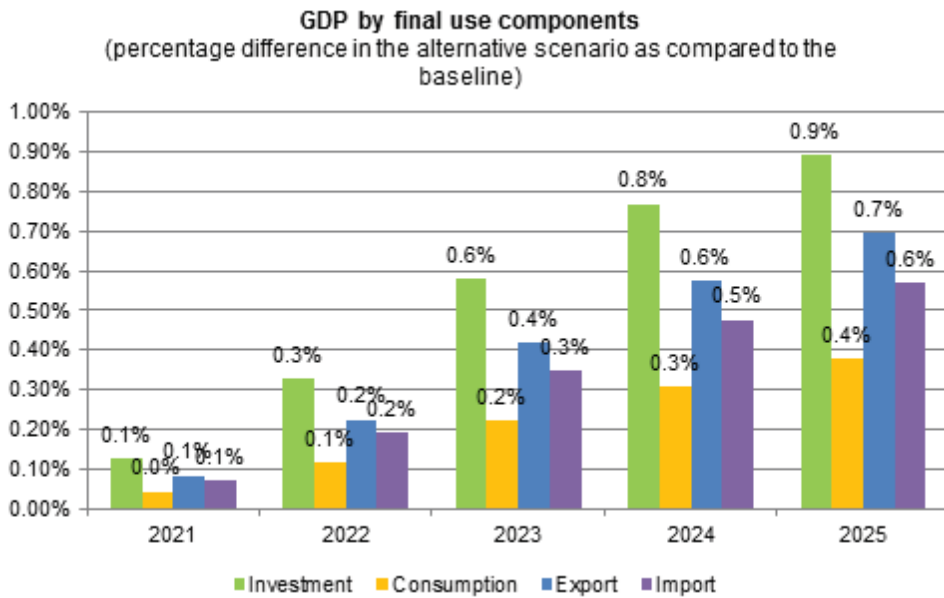
From the supply side, private capital increases are expected to have the highest contribution to economic growth, while the increases in labour will be modest (around 0.01%). Generally, employment is expected to decline somewhat in the TELECOM sector, and, as this sector uses skilled labour more intensively, overall growth in skilled labour is projected to be marginally lower as compared to the unskilled labour. In the less digitally advanced economies the replacement of the labour factor with higher productivity is expected to be more intensive and therefore in these economies the overall employment growth will be marginal as employment is expected to decline slightly also in the manufacturing sectors.

Figure 4 – Production factors



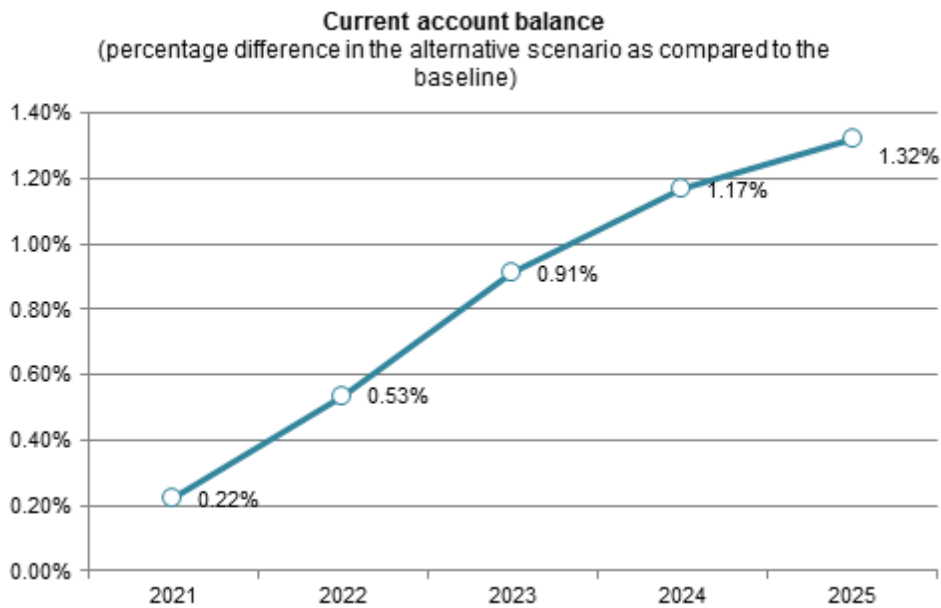
In terms of GDP composition by final use components, expectedly the highest deviation in the alternative scenario as compared to the baseline will be recorded in investments, as they are typically more volatile and respond more quickly to positive economic developments. In 2025 the cumulative deviation of investments against the baseline will amount to 0.9%.

Figure 5 – GDP by final use components



In contrast, consumption growth will be much more moderate - the deviation will amount to 0.4% in 2025. With respect to the external sector, exports will increase faster than imports and thus the current account will improve.

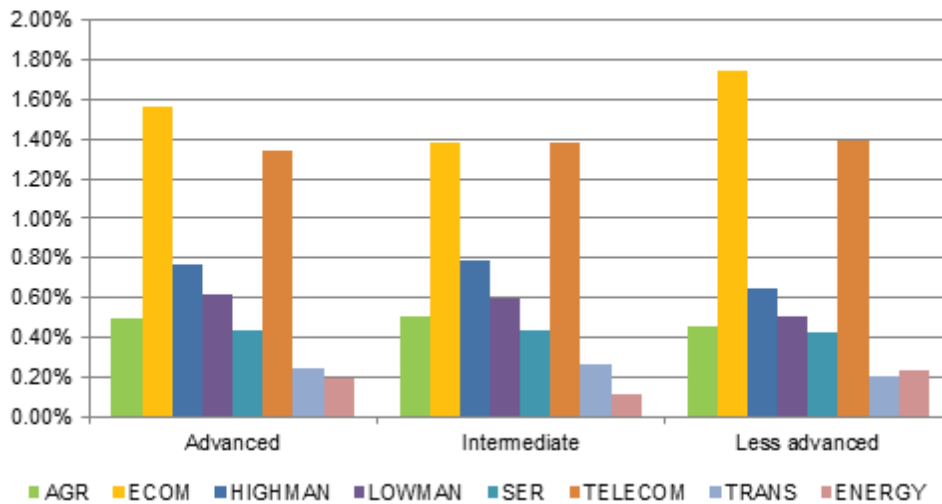
Figure 6 – Current account balance, % GDP



As the largest impact from higher broadband connection speed was estimated in the electronic communication sectors, they also exhibit the highest growth in value added, where other e-com services increases slightly more than telecom due to the very low share of the former in total gross value added. Manufacturing is also expected to benefit largely from higher connection speed, while the impact on transport and energy will be much lower, around 0.2% in 2025, thus contributing to the achievement of greener and more sustainable economic development.

Figure 7 – Gross value added by sectors in 2025

Gross value added by sectors in 2025
(percentage difference in the alternative scenario as compared to the baseline)



With respect to other important macroeconomic variables, relative prices of the e-communication sectors are expected to decline, thus exercising downward pressure on inflation.

Finally, it should be noted that the realization of the preferred policy options is also associated with some costs. For access policies, it has been estimated that the achievement of the accelerated fibre scenario is associated with a need for investment of EUR 92 bn for EU 28. If we assume that half of it is covered with public resources and financed through foreign borrowing and if it is divided equally in the years between 2018 and 2020, than this public spending is estimated to have an initial positive impact on GDP of around 0.1% from the demand side. However it will also imply worsening of the government budget balance and the external balances of the EU member states. This public spending is not expected to have a significant long-term impact on employment or consumption. In the much more ambitious scenario, where a total of EUR 200 bn is to be invested, the impacts are similar only scaled up around 2 times.

In case all investment costs are covered out of public resources, GDP grows by around 0.22% in 2018-2020, but afterwards budget and consumption restrictions induce small declines of GDP as compared to the baseline scenario. In the initial years of public investment, it also induces private capital formation, where the latter increases by 0.2% and 0.3% respectively in 2019 and 2020 as compared to the baseline.

In the **all fibre scenario**, macroeconomic developments are largely the same, only scaled upwards. The deviation in GDP from the baseline in 2025 will be as high as 0.95%, fuelled by larger investment by 1.5% and 0.7% expansion in consumption as compared to the baseline. Meanwhile, higher exports as compared to imports will determine the improvement in the current account balances. In this scenario, employment in the less advanced economies in the EU is already expected to decline on the account of lower job creation in the e-communication and manufacturing sectors.

Table 8 - Percentage deviations in the all fibre scenario as compared to the baseline in the main macroeconomic variables.

	2021	2022	2023	2024	2025
GDP	0.07%	0.23%	0.45%	0.67%	0.95%
Public capital	0.00%	0.00%	0.02%	0.04%	0.08%
Private capital	0.00%	0.01%	0.03%	0.07%	0.12%
Skilled labour	0.00%	0.01%	0.02%	0.02%	0.02%
Unskilled labour	0.00%	0.01%	0.02%	0.03%	0.02%
Investment	0.15%	0.43%	0.80%	1.15%	1.54%
Consumption	0.05%	0.16%	0.31%	0.46%	0.67%
Export	0.10%	0.30%	0.58%	0.87%	1.23%
Import	0.08%	0.25%	0.48%	0.72%	1.00%
Current account	0.26%	0.71%	1.27%	1.78%	2.39%

Table 9 - Percentage deviations in the all fibre scenario as compared to the baseline in the gross value added in 2025.

Gross value added	Advanced	Intermediate	Less advanced
AGR	0.87%	0.88%	0.80%
ECOM	2.81%	2.46%	3.14%
HIGHMAN	1.36%	1.39%	1.15%
LOWMAN	1.08%	1.04%	0.88%
SER	0.77%	0.77%	0.74%
TELECOM	2.39%	2.47%	2.49%
TRANS	0.43%	0.45%	0.34%
ENERGY	0.32%	0.18%	0.39%

Spectrum

The impacts from the implementation of the preferred policy options with respect to enhanced mobile broadband aspects of 5G³⁸⁵ are summarized in the table below:

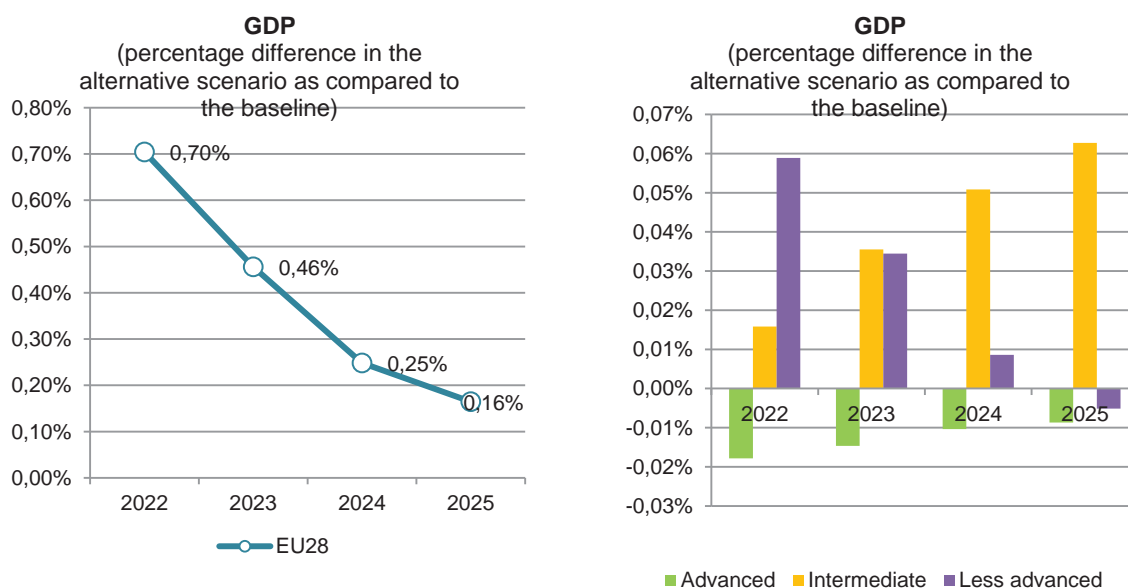
Table 10 – Impact from the preferred policy option

Year	EU eMBB 5G Coverage under baseline	Estimated eMBB 5G coverage under Option 3
2021	8.3	70.0
2022	27.0	93.3
2023	59.1	100.0
2024	79.4	100.0
2025	85.9	100.0
2026	89.0	100.0
2027	92.0	100.0
2028	95.0	100.0

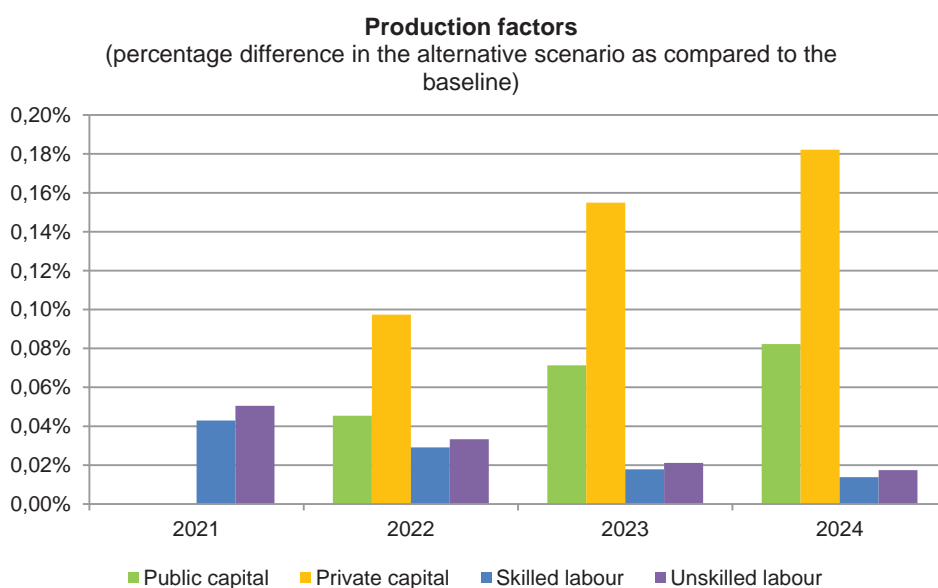
³⁸⁵ 5G as a network of networks will consist in different scenarios (i) enhanced mobile broadband (eMBB) (ii) massive machine-to-machine communications (very dense networks) and (iii) ultra-reliable and low latency networks. The coverage requirements of two specificities of 5G networks ie density and latency, will not reach 70% of EU population by 2020. However, as the economic gains are modelled on the gains assessed from LTE, a comparison with eMBB is considered to be more relevant. Other aspects of 5G which support IoT may in turn unlock further disruptive growth opportunities as discussed in the overview to the study

2029	98.0	100.0
2030	100.0	100.0

In the 'no change' policy scenario full eMBB coverage will be achieved only in 2030, while under Option 3, a 100% coverage might be expected to be established in only 4 years (from 2020 up to 2023). If we assume that the impact on total factor productivity from eMBB aspects of 5G will be of the same magnitude as that of 4G, then it will have an effect on GDP of 0.16% in 2025. The impact will be highest in 2021, when almost 3/4 of the eMBB coverage will be realized. In terms of variations between EU countries the intermediate and less economically and digitally advanced countries are expected to benefit more from enhanced mobile broadband.

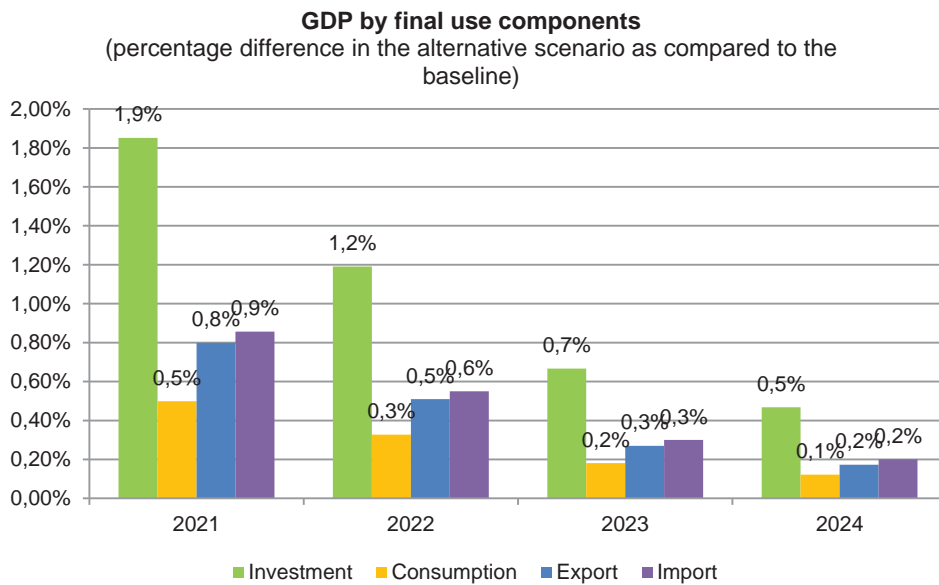


Similar to the simulations, based on access policies, faster coverage will have an important impact on capital and a marginally positive effect on employment.

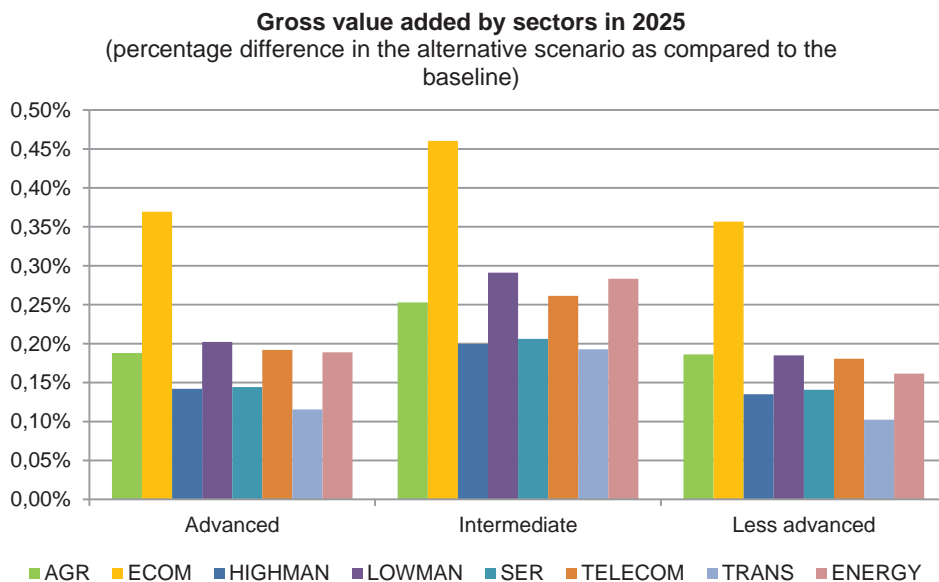


Again, gross fixed capital formation will expand most, by 1.9% in 2021 and 0.5% in 2025, while consumption dynamics will be much smoother. In contrast to the access scenarios, in this

spectrum-related scenario import will grow slightly faster than export, leading to a nearly balanced external sector.



E-communication sectors again will benefit most from higher eMBB coverage, this time followed by low-tech manufacturing and the production of electricity, thermal energy and gas.



Services – efficiency gains

The policy options in this area will have positive impact mainly on regulatory efficiency and effectiveness in the electronic communication sectors. However the magnitude of this impact is not directly quantitatively measurable. In order to overcome this difficulty, we have used the

results of a study by Haidar (2012)³⁸⁶, which indicates that impact of a more significant regulatory reform on the growth rate of GDP per capita is 0.15% on average. We have assumed that such an impact will be channelled through improved TFP in the e-communication sectors and by means of iterations estimated that an average increase in GDP growth rate of 0.15 percentage points is associated with a 4% annual increase in TFP in the TELECOM and ECOM sectors, starting from 2020.

Under this scenario, GDP is expected to be by 0.74% higher than the baseline in 2025. However, this scenario will be associated with somewhat lower investment (or postponed consumption) at the expense of higher current consumption growth. Due to the fact that services policies will have direct impact on the TFP in the e-communication sectors only, it is associated with higher increases in skilled labour.

Table 11 - Percentage deviations in the services scenario as compared to the baseline in the main macroeconomic variables.

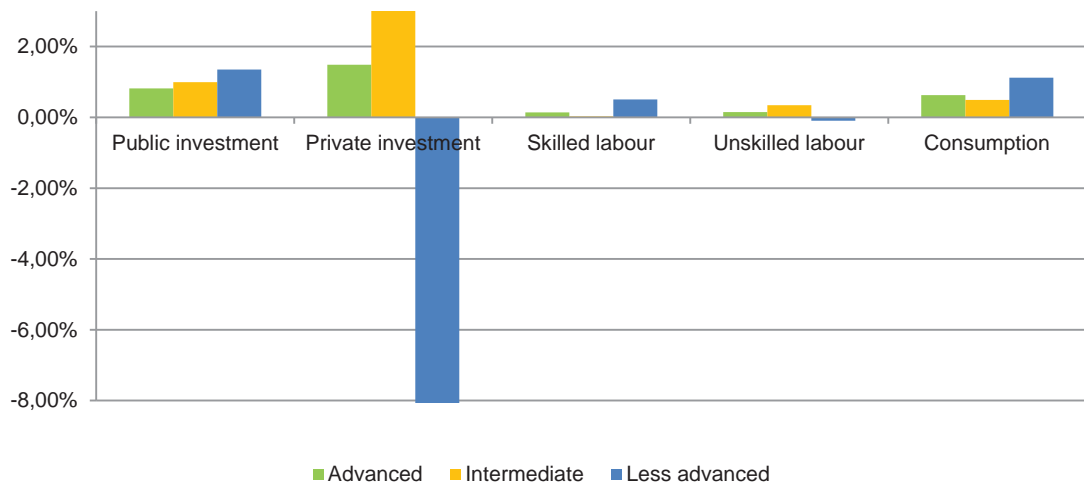
	2021	2022	2023	2024	2025
GDP	0.13%	0.27%	0.42%	0.57%	0.74%
Public capital	0.00%	0.01%	0.03%	0.07%	0.11%
Private capital	0.00%	0.01%	0.01%	0.01%	-0.02%
Skilled labour	0.01%	0.04%	0.08%	0.14%	0.20%
Unskilled labour	0.04%	0.07%	0.09%	0.11%	0.13%
Investment	0.20%	0.30%	0.29%	0.12%	-0.30%
Consumption	0.12%	0.25%	0.40%	0.55%	0.70%
Export	0.12%	0.26%	0.43%	0.63%	0.87%
Import	0.08%	0.16%	0.24%	0.29%	0.31%
Current account, % GDP (ppt)	0.02	0.07	0.14	0.25	0.40

The variation in the responses of the EU MS economies is larger in this scenario as well. The groups of less economically and digitally advanced economies, in particular, stands out as this scenario estimates a relatively higher increase in public investment in these economies, crowding out private investment. Also, in this cluster of EU MS the expansion in skilled labour is expected to outweigh significantly that of the unskilled labour.

Table 12 - Percentage deviations in the services scenario as compared to the baseline in investment, labour and consumption by clusters of EU Member States in 2025.

³⁸⁶ Haidar J. I. (2012) "The impact of business regulatory reforms on economic growth", *Journal of The Japanese and International Economies*, 26 (2012), pp. 285-307.

Investment, labour and consumption by types of EU economies in 2025
(percentage difference in the alternative scenario as compared to the baseline)



2.5.6.1 Cumulative impact

Generally, for all assessed scenarios GDP is expected to increase compared with the baseline, with an anticipated **GDP uplift of 0.16% in 2025 for spectrum policies** compared with the baseline and a **GDP uplift of 0.54% for access policies** based on the more conservative ‘accelerated fibre’ scenario.

The cumulative impact up to 2025 is expected to be significant due to the expected supply side impacts, which are built up over time. More positive economic developments will have a significant impact on investment, while the effects on consumption will be more moderate, along with the life-cycle hypothesis for consumption smoothing. In the access scenarios the effects are larger for the intermediate and the most economically and digitally advanced economies in the EU, which have the potential to capitalize best the benefits from applying the preferred policy options, and for the least advanced economies in the EU, which start from a lower base. In the spectrum scenario, intermediate economies are expected to perform better against the remaining EU countries, as 5G will most probably induce more investments both in the e-communication sectors and manufacturing.

We also find **some positive employment impacts from access and spectrum policies (around 0.02% higher than the baseline)**, while the efficiency gains potentially driven by reforms fostering **digital services, might result in increases in employment of up to 0.15%** compared to status quo.

Table 13 - Impact of assessed scenarios on GDP, consumption, investment and employment

	GDP		Consumption		Investment		Employment	
	2021	2025	2021	2025	2021	2025	2021	2025
Accelerated fibre								
Advanced	0.06%	0.54%	0.04%	0.38%	0.14%	1.11%	0.00%	0.03%
Intermediate	0.07%	0.57%	0.04%	0.35%	0.12%	0.66%	0.01%	0.02%
Less advanced	0.06%	0.52%	0.04%	0.40%	0.08%	0.22%	0.00%	-0.03%
EU28	0.06%	0.54%	0.04%	0.38%	0.13%	0.89%	0.00%	0.01%
All fibre								
Advanced	0.08%	0.96%	0.05%	0.66%	0.16%	1.92%	0.00%	0.04%
Intermediate	0.08%	1.00%	0.04%	0.62%	0.14%	1.09%	0.01%	0.03%
Less advanced	0.07%	0.91%	0.05%	0.71%	0.10%	0.34%	0.00%	-0.05%
EU28	0.07%	0.95%	0.05%	0.67%	0.15%	1.54%	0.00%	0.02%
Services-efficiency gains								
Advanced	0.11%	0.62%	0.10%	0.63%	0.30%	1.38%	0.02%	0.14%
Intermediate	0.11%	0.67%	0.05%	0.49%	0.62%	3.06%	0.01%	0.21%
Less advanced	0.22%	1.25%	0.23%	1.12%	-0.44%	-8.80%	0.06%	0.16%
EU28	0.13%	0.74%	0.12%	0.70%	0.20%	-0.30%	0.02%	0.15%
Spectrum								
Advanced	0.00%	0.16%	0.00%	0.12%	0.00%	0.48%	0.00%	0.01%
Intermediate	0.00%	0.23%	0.00%	0.14%	0.00%	0.74%	0.00%	0.04%
Less advanced	0.00%	0.16%	0.00%	0.12%	0.00%	0.24%	0.00%	0.01%
EU28	0.00%	0.16%	0.00%	0.12%	0.00%	0.47%	0.00%	0.02%
Cumulative								
Advanced	0.17%	1.32%	0.14%	1.13%	0.44%	2.91%	0.02%	0.18%
Intermediate	0.17%	1.46%	0.09%	1.00%	0.73%	4.33%	0.02%	0.26%
Less advanced	0.28%	1.93%	0.28%	1.66%	-0.36%	-8.62%	0.06%	0.13%
EU28	0.19%	1.45%	0.16%	1.22%	0.33%	0.96%	0.03%	0.18%

Source: Ecorys

2.5.7 Earlier literature on modelling e-communications and ICT

Overall, the economic literature acknowledges that e-communications and ICT are an important driver of growth in the long-run, mainly through higher productivity. EC White paper on "Growth, competitiveness, employment: The challenges and ways forward into the 21st century"³⁸⁷ and US International Trade Commission study on the "Global competitiveness of U.S. Advanced Technology Manufacturing Industries"³⁸⁸ already in the early 1990s draw attention to the development of the information society as a key driver of growth and competitiveness. Later studies, such as a study by OECD on "Globalization of Services and Jobs"³⁸⁹ and an UN paper from 2007³⁹⁰ also indicate that efficient IT has become crucial infrastructure for improvement of the tradability of certain services and for long-term economic development.

Recently, there has been a multitude of studies, which either estimate the trends in the development in e-communication services or the socio-economic benefits from higher connectivity. The first group of studies incorporates either the construction of some measures of digitalization or other indexes for IT readiness or use, like the 2013 "Global Information Technology Report 2013: Growth and Jobs in a Hyperconnected World", edited by Beñat

³⁸⁷ http://europa.eu/documentation/official-docs/white-papers/pdf/growth_wp_com_93_700_parts_a_b.pdf

³⁸⁸ <https://www.usitc.gov/publications/332/pub2434.pdf>

³⁸⁹ <http://www.oecd.org/site/tadicite/50287724.pdf>

³⁹⁰ United Nations, 2007, "Technology, globalization, and international competitiveness: Challenges for developing countries" in Industrial Development for the 21st Century", http://www.un.org/esa/sustdev/publications/industrial_development/full_report.pdf

Bilbao-Osorio, Soumitra Dutta and Bruno Lanvin³⁹¹, or some market analysis, such as the Telco 2015 report³⁹².

The aforementioned 2013 Global Information Technology Report, in addition to the provision of various measures of technological readiness and digitalization, also identifies a significant favourable impact of digitalization of GDP per capita and for curbing unemployment. Sectorial impacts in the same paper show profound and accelerating effects of digitalization, which lead to modification of the business models and lower barriers to entry, enhanced communication and service provision to customers, optimization of the production process and streamlined operations of the companies. The Global IT report from 2013 also provides evidence of the 3G penetration on economic growth, as well as on the social and economic impacts the electronic healthcare records.

Based on the above-mentioned studies, there is a general acknowledgement of the fact that the development of electronic communication services has a significant positive impact on trade, productivity and GDP. More specifically, the economic literature outlines the following impacts of the enhanced use of e-communications:

- **Human capital.** The impact is channelled through two mechanisms: 1. an enhanced use of e-communications would require more skilled labour and 2. the use of e-communications makes information more easily available and favours more flexible and distance learning.
- **Labour mobility, business costs and environment.** The use of video conferences or other means of distance communication enables individuals to work from distance and reduces both operating costs for the respective businesses and the traffic in the transport network.
- **Disintermediation and reduced transaction costs.** The use of e-communications allows for shortening the supply chain in the provision of a large number of goods and services.
- **Social benefits,** like connection of excluded regions (e.g. rural regions) and gaining collective power (e.g. by using social media). However the effect on employment is not always unambiguous: sometimes technological progress might lead to less intensive use of labour or facilitate outsourcing to countries with cheaper labour.
- Introduction of **new products and services.**
- With the use of e-communications **more time becomes available** for leisure or work.
- E-communications **fosters innovation.**

With respect to the methodological approach to the estimation of the social, economic and environmental impact of various policies, affecting the e-communication sector, there is a multitude of modelling alternatives. Recently applied methods include mostly econometric modelling, but also computable general equilibrium (CGE) models and even dynamic stochastic general equilibrium (DSGE) models.³⁹³

³⁹¹ http://www3.weforum.org/docs/WEF_GITR_Report_2013.pdf

³⁹² Telco 2015: Five Telling Years, Four future Scenarios, IBM, <http://public.dhe.ibm.com/common/ssi/ecm/gb/en/gbe03304usen/GBE03304USEN.PDF>

³⁹³ DSGEs have become a popular tool for economic modelling, but they are still limited to a highly stylized representation of the economy due to the challenges related to their numerical solution. Taking into account the need to design a multi-sector model for the implementation of the current impact assessment, the development of a large-scale DSGE model will be too ambitious within the scope of this project.

2.5.8 Econometric modelling

Examples of the **econometric modelling** approach are:

- Czernich et al. (2009)³⁹⁴ specifying a production function, assuming that increased use of broadband services has a positive impact of the total factor productivity in the economy. In their estimations, however, they use instrumental variables to control for the broadband penetration already achieved. Thus, an increase in the broadband penetration rate by 10 p.p is estimated to contribute to annual GDP growth per capita by 0.9-1.5 p.p. It should, however, be taken into account that the results of this study cannot be directly used in our work, as they relate more to increased coverage, rather than to higher speed access. Nonetheless, this study could be useful from a methodological point of view.
- Spiezia (2012)³⁹⁵ constructs a production function, where three types of ICT investment are incorporated: computer, software and communication. It is then estimated econometrically for 26 industries and 18 OECD countries for the period between 1995 and 2007. ICT investments are found to contribute to economic growth by 0.4-1 % per annum.
- Oliner et al. (2007)³⁹⁶ and Jorgenson et al. (2008)³⁹⁷ providing an estimation of the impact of information technologies for the productivity increases in the US by including both IT and intangible capital in a growth accounting framework.
- Regeneris' investigation, performed in 2012 for UK's largest communication services supplier BT also provides econometric evidence on the impact of increased broadband speed on welfare (measured by the gross value added) and employment due to enhanced business performance, new business creation and better home working opportunities.
- Mölleryd's³⁹⁸ paper builds on a model used for estimation of the social and economic benefits from the development of an open, operator-neutral fibre network in Stockholm. It provides useful estimates of the benefits of high-speed broadband on economic growth and firms productivity. The study also finds evidence that high-speed broadband networks can potentially substitute some transport services, create employment opportunities and even provide more efficient home care services.

2.5.8.1 DSGE modelling

Seeking to account for more general macroeconomic effects from the reforms, related to the digital agenda of the EU, Lorenzani and Varga (2014)³⁹⁹ augment the EC **dynamic general equilibrium model** QUEST III. The estimated policies include competition and investment-enhancing policies in the radio spectrum, enhancement of the professional e-skills, deepening of the e-Commerce and increased fixed broadband take-up. They find a positive impact of over 1% on long-term economic growth of the reforms that have already been implemented and potential for additional 2.1% in case the Digital Agenda for Europe targets are achieved.

³⁹⁴ Czernich, N., O. Falck, T. Kretschmer and L. Woessmann (2009), "Broadband Infrastructure and Economic Growth", CESifo Working Paper, No. 2861, Munich

³⁹⁵ Spiezia V. (2012) "ICT investments and productivity: Measuring the contribution of ICTs to growth", OECD Journal: Economic Studies, vol. 2012/1.

³⁹⁶ Oliner, S. D., D.E. Sichel and K.J. Stiroh (2007), "Explaining a Productive Decade", *Brookings Papers on Economic Activity*, 1, 81-151.

³⁹⁷ Jorgenson, D. W., M.S. Ho and K.J. Stiroh (2008), "A Retrospective Look at the US Productivity Growth Resurgence", *Journal of Economic Perspectives*, 22(1), 3-24.

³⁹⁸ Mölleryd G., 2015, "Development of High Speed Networks and the Role of Municipal Networks", *OECD Science, Technology and Innovation Policy Papers No. 26*, OECD.

³⁹⁹ Lorenzani D. and J. Varga (2014) "The Economic Impact of Digital Structural Reforms", EC economic papers 529/September 014.

2.5.8.2 CGE modelling

CGE models are less frequently used to study the economic, social and environmental impact of electronic communications but they present a number of advantages in case multiple countries or multiple sectors need to be incorporated. As a most recent example of this type of modelling, Christensen (2015)⁴⁰⁰ presents a multi-country, multi sector dynamic computable general equilibrium model, where ICT and R&D are imbedded in the production function.

Khorshid and El-Sadek (2012)⁴⁰¹ also develop a CGE model with a focus on the ICT sector for Egypt, where they base their estimations on a social accounting matrix, which aim is to capture the impact of the ICT on the other economic sectors, as well as on the labour and capital demand and on the income distribution. As a result, they provide estimates of the impact from four policies – 1. Measures to increase ICT investment, 2. Policies, specifically targeted to achieve growth in the ICT sector, 3. National training, reorientation and capacity building program leading to an enhanced factor productivity and labour efficiency in the economy as a whole based on advanced ICT and 4. Foreign exchange policy to promote ICT exports to the outside world.

Finally, Moon et al. (2000)⁴⁰² use the ORANI-F model, calibrated to the Korean economy, but rather than estimating the impact of ICT, they only make projections on the structure of the Korean economy by sectors and draw implications about the development of the ICT sector in terms of growth, export share, composition by subsectors, etc. However, this study has the merit of providing a reference classification of the ICT activities.

2.5.9 Elaboration of the methodology

2.5.9.1 Estimation of the production function with stochastic frontier analysis

If we take into account that the production function is defined as the function, which transforms given inputs into the maximum output quantity, then the actual output will be either at the production possibility frontier or below it. Therefore, the output can be estimated as a function of the production function, taking into account also possible inefficiency and stochastic shocks⁴⁰³:

$$\ln Y = \ln f(x) - u + \epsilon, \quad u \geq 0$$

(SFA1)

where Y is the output, $f(x)$ is the production function, where the input x is an argument, $u \geq 0$ are inefficiencies and ϵ is the error term. The latter equation is equivalent to

$$Y = f(x) \cdot e^{-u} \cdot e^{\epsilon}$$

(SFA2)

and allows us to define the following measure of output-oriented technical efficiency:

$$TE = \frac{Y}{f(x) \cdot e^{\epsilon}} = \frac{f(x) \cdot e^{-u} \cdot e^{\epsilon}}{f(x) \cdot e^{\epsilon}} = e^{-u}$$

(SFA3)

⁴⁰⁰ Christensen M.A. (2015), "A CGE Model with ICT and R&D-driven Endogenous Growth: A Detailed Model Description", *Joint Research Centre technical reports*, Report EUR 27548 EN.

⁴⁰¹ Khorshid M. and A. El-Sadek (2012) "A Multi-sector ICT Economy Interaction Model for Egypt: The Path to Information Society", International Conference on Policy Modeling 2012.

⁴⁰² Moon S-W, Y. Kim and D-P. Hong (2000), " The Economic Importance of the Information and Communications Technology (ICT) Industry in Korea: A CGE Approach", presented at the 3rd Annual Conference on Global Economic Analysis.

⁴⁰³ Meeusen, W. and J. van den Broeck, 1977, "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error", *International Economic Review* 18:435-444. Aigner, D., C. Lovell and P. Schmidt, 1977, "Formulation and Estimation of Stochastic Frontier Production Function Models", *Journal of Econometrics* 6:21-37.

We have estimated the above econometric model by maximum likelihood estimator with time-varying efficiencies, available in package 'frontier' under the R software. The error term follows a normal distribution with zero mean and constant variance and the inefficiencies u are assumed to be independently distributed according to a positive half-normal distribution:

$$\epsilon \sim N(0, \sigma_\epsilon^2)$$

$$u \sim N^+(\mu, \sigma_u^2)$$

These standard assumptions ensure that the distribution of $-u + \epsilon$ is skewed to the left so that the difference between actual and optimal production $\ln(Y) - \ln(f(x))$ stays negative.

Based on a dataset for the 28 EU economies⁴⁰⁴, we have estimated a production function, relating GDP to capital and labour:

$$\ln(Y_{rt}) = \alpha_0 + \alpha_1 \cdot \ln(L_{rt}) + \alpha_2 \cdot \ln(K_{rt}) + \alpha_{3,r} \cdot \text{Country}_r + \alpha_4 \cdot \text{DCRISIS}_t + t + \epsilon_{rt},$$

(SFA4)

where Y_t stands for GDP in constant 2010 prices of country r in period t ($t \in [2000, 2015]$), L_{rt} is employment, Country capture the fixed effects for each of the EU28 MS and $d\text{CRISIS}_t$ is added to account for the economic crisis, starting from 2008 onwards. The capital K_{rt} is defined as:

$$K_{rt} = 3 \cdot Y_{r1995} \cdot \sum_{i=0}^{t-1995} (1 - \nu)^i + \sum_{i=0}^{t-1-1995} (1 - \nu)^i I_{ri}, \quad t \in [1996, 2015]$$

(SFA5)

Assuming a depreciation rate $\nu = 0.1$, the assumption of the capital-to-GDP ratio in the base 1995 year becomes irrelevant from 2005 onwards.

As a second step we then regress the derived efficiency terms against the Heritage Index of Economic Freedom and variables, related to the development of the e-communication services in the EU:

$$\ln(\text{EFF}_{rt}) = \beta_1 \cdot \ln(\text{heritage}_{rt}) + \beta_2 \cdot \ln(\text{mbb_ltecov}_{rt}) + \beta_3 \cdot \ln(\text{DOWNSPEED}_{rt}) + \beta_{4,r} \cdot \text{Country}_r + v_{rt},$$

(SFA6)

In the above formula, heritage_{rt} stands for the Heritage Index⁴⁰⁵, intended to measure the developments in terms of rule of law, size of the government, regulatory efficiency and openness of the economy as key contributors to total factor productivity. Among others it can also be used as a proxy to measure of the effectiveness and efficiency of the regulation.

The variable DOWNSPEED_{rt} measures the average download speed. Finally, the impact of the 4G mobile broadband coverage (as % of all households) mbb_ltecov_{rt} also proved to be statistically significant.

In the estimation of the impact of e-communications on the total factor productivity we also tested specifications including other key variables from the Digital Agenda Database⁴⁰⁶, such as the Herfindahl-Hirschman Index on broadband competition, investments in the telecom sector, market share of leading operator (in % of active SIM cards) and share of the individuals interacting online with public authorities in the past 12 months. They however proved either

⁴⁰⁴ Eurostat, National Accounts (ESA2010) statistics.

⁴⁰⁵ <http://www.heritage.org/index/>

⁴⁰⁶ https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators

statistically insignificant, or had the wrong sign. These problems are largely due to the short time series available for most of the considered indicators, covering post-2008 crisis period, when unsteady GDP growth rates and, at the same time, significant improvements in digital agenda indicators were observed. Attempts to add other variables to control for the crisis were largely not very successful either.

2.5.9.2 C.2. Cluster analysis for the selection of representative economies

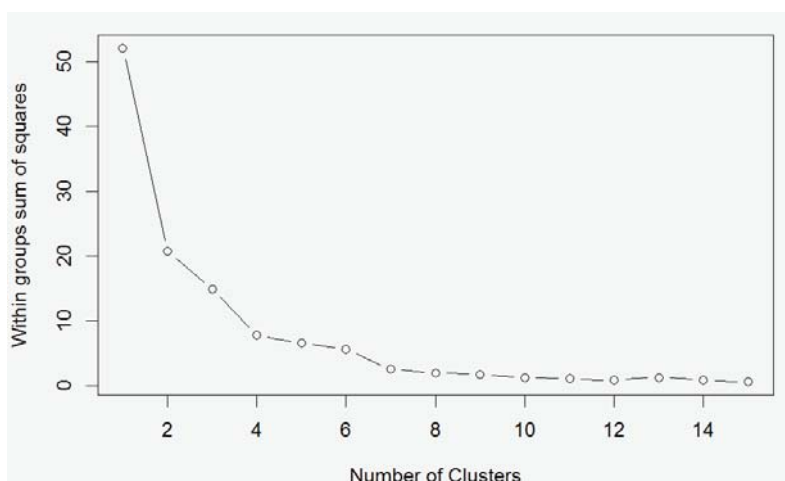
The model features a regional breakdown to allow for assessment of the impact of the proposed policy options not only for the EU as a whole, but also taking into account the differences between the EU MS in terms of digitalization, overall economic development and size of the economy.

As inclusion of all 28 EU MS economies increases exponentially the dimension of the model, we decided to cluster the EU countries according to the dimensions, mentioned in the previous paragraph and select a single representative economy from each of the identified clusters.

The variables, which were used to identify each cluster, are the following:

- The Digital Economy and Society Index (DESI), compiled by the EC
- Gross domestic product

The number of clusters was set to 6, based on the so called elbow method – number of clusters is plotted against the percentage of variance explained (see the figure below).



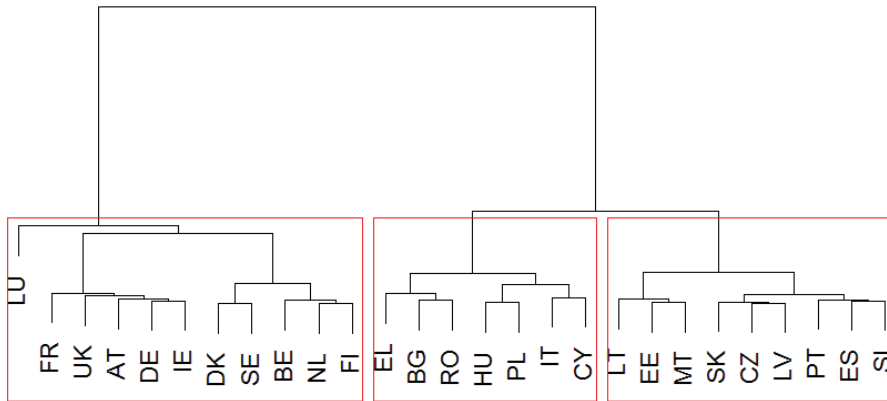
The number of clusters to be used is selected based on two criteria:

1. Keep the number of clusters as small as possible
2. Choose the number of clusters so that adding another cluster does not improve the explanation of the differences significantly.

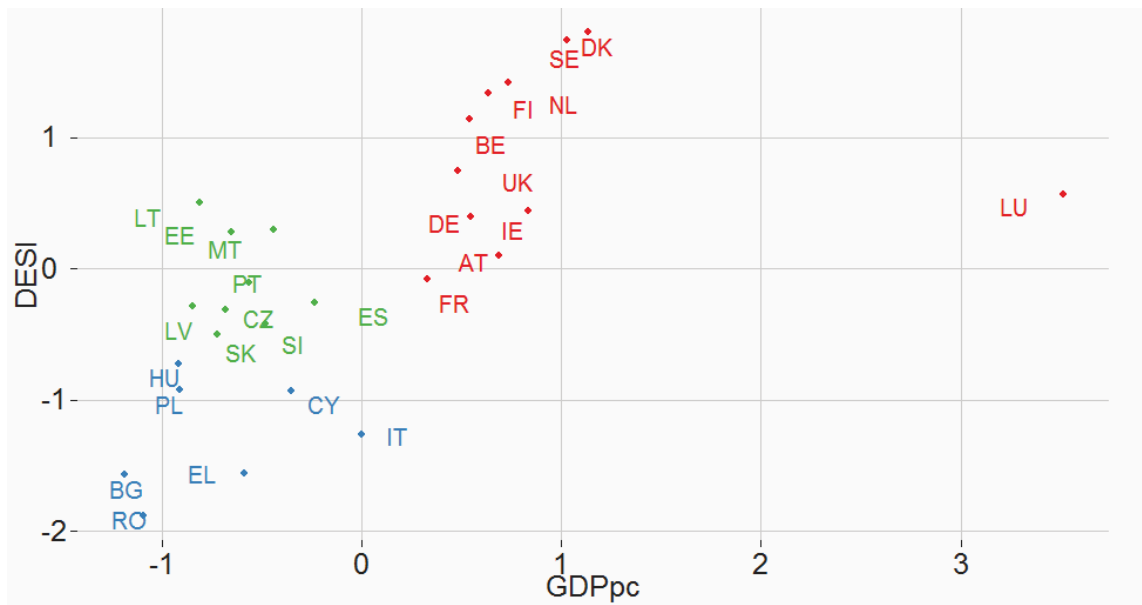
Based on the above figure, we had to select either 4 clusters, but the grouping of the countries into 4 distinctive clusters resulted in a separate group, consisting of Luxembourg alone. So, for efficiency reasons, we resorted to 3 clusters.

The clusters were selected with the Ward method for hierarchical cluster analysis, based on minimization of the within-cluster variances. As a result the following clusters were identified:

Cluster Dendrogram



To obtain a better idea of the groups of countries, employed in the model, we have depicted each of the countries along the clustering criteria, where colour codes were introduced to distinguish the six clusters.



Generally, one can identify a group of 11 countries (LU, DK, SE, FI, NL, BE, UK, DE, IE, AT, FR), which have very developed economies and rate very high in terms of digital development. The second cluster consists of the largest share of the countries, which joined the EU in 2004. They are slightly worse in terms of digitalization and economic development – LT, EE, MT, PT, CZ, LV, SK, SI. The group of the least developed countries in terms of economy and digitalization consists of Bulgaria, Romania, Greece, Cyprus, Italy, Hungary and Poland.

Based on the identified clusters of countries, we have selected the following three representative economies modelled in the CGE framework:

- Germany
- Czech Republic
- Bulgaria

They are viewed as 'typical' representatives of their groups, where no special economic or political circumstances have been observed in the past years.

2.5.9.3 C.3. Computable general equilibrium model: outline

We model an economy, which consists of the three representative regions/ countries, selected as a result of the cluster analysis, and rest-of-the-world, where eight types of products are being produced using private and public capital, unskilled and skilled labour.

Each **economic sector** operates under perfect competition, maximizing its profit, subject to its production technology. The sectorial production functions are defined as Constant elasticity of substitution (CES) production functions. They take as production factors private and public capital KPR and KPU , skilled labour H and unskilled labour N .

$$\max_{L_{jrt}, H_{jrt}, KPR_{jrt}, KPU_{jrt}} (PVA_{jrt} \cdot VA_{jrt} - PN_{rt} \cdot N_{jrt} - PH_{rt} \cdot H_{jrt} - PKPR_{rt} \cdot KPR_{jrt} - PKPU_{rt} \cdot KPU_{jrt}) \quad (\text{CGE1})$$

s.t.

$$VA_{jrt} = \sigma_{jrt}^{VA} \left(\beta_{jr}^{VA} \cdot L_{jrt}^{v_{jr}^{VA}} + (1 - \beta_{jr}^{VA}) \cdot K_{jrt}^{v_{jr}^{VA}} \right)^{\frac{1}{v_{jr}^{VA}}} \quad (\text{CGE2})$$

$$N_{jrt} \geq 0, \quad H_{jrt} \geq 0, \quad KPR_{jrt} \geq 0, \quad KPU_{jrt} \geq 0$$

where j , r and t represent respectively the j -th economic sector, r -th region and t -th time period. In other words, we have unconstrained maximization problem and a definition of the value added VA_{jrt} :

$$\max_{L_{jrt}, H_{jrt}, KPR_{jrt}, KPU_{jrt}} \left(PVA_{jrt} \cdot \sigma_{jrt}^{VA} \left(\beta_{jr}^{VA} \cdot L_{jrt}^{v_{jr}^{VA}} + (1 - \beta_{jr}^{VA}) \cdot K_{jrt}^{v_{jr}^{VA}} \right)^{\frac{1}{v_{jr}^{VA}}} - PN_{rt} \cdot N_{jrt} - PH_{rt} \cdot H_{jrt} - PKPR_{rt} \cdot KPR_{jrt} - PKPU_{rt} \cdot KPU_{jrt} \right) \quad (\text{CGE3})$$

The **household** derives utility from final consumption C_{irt} and savings S_{rt} and disutility – from the two types of labour N_{jrt} and H_{jrt} . The introduction of labour as a control variable in the household problem (i.e. endogenous labour supply) allows for modelling the link between technological progress and labour supply.

$$\max_{C_{irt}, N_{jrt}, H_{jrt}, S_{rt}} \left(\sum_i \theta_{ir} \cdot \ln C_{irt} - \sum_j \xi_j \frac{N_{jrt}^{\rho+1}}{\rho+1} - \sum_j \pi_j \frac{H_{jrt}^{\rho+1}}{\rho+1} + \kappa \cdot \ln S_{rt} \right) \quad (\text{CGE4})$$

s.t.

$$\sum_i P_{irt} \cdot C_{irt} = (1 - td_r) \sum_j (PN_{jrt} \cdot N_{jrt} + PH_{jrt} \cdot H_{jrt} + PKPR_{jrt} \cdot KPR_{jrt}) + ror * A_{rt} + tr_r - S_{rt} \quad (\text{CGE5})$$

$$C_{irt} \geq 0, \quad N_{jrt} \geq 0, \quad H_{jrt} \geq 0,$$

The **government** revenues consist of receipts from direct and indirect taxes, interest on its assets⁴⁰⁷ and income from public capital. It spends on government consumption, transfers to the households and capital expenditures. The difference between government revenues and expenditures constitutes the government budget balance:

$$\begin{aligned}
 BB_{rt} &= R_{rt} - G_{rt} = \\
 & ttd_r \cdot \sum_j (PN_{jrt} \cdot N_{jrt} + PH_{jrt} \cdot H_{jrt} + PKPR_{jrt} \cdot KPR_{jrt}) + \\
 & \sum_i \tau_{ir} \cdot \frac{P_{irt}}{(1+\tau_{ir})} \cdot Q_{irt} + \sum_j PKPU_{jrt} \cdot KPU_{jrt} + ror * AG_{rt} - \\
 & \left(\sum_i cg_{irt} \cdot P_{irt} + tr_{rt} + KE_{rt} \right)
 \end{aligned} \tag{CGE6}$$

For the **foreign sector**, we have adopted the Armington assumption, which contradicts the conventional Heckscher and Ohlin foreign trade theory, but provides explanation on the following facts:

- many commodities are imported and exported from a single country simultaneously;
- even at the most disaggregated level, most countries produce in all product categories and thus specialization in a single product, for which the country has comparative advantage, is not possible;
- the assumption takes into account the different substitution elasticities between the commodities, produced in the country and the imported ones and therefore allows for estimation of the changes in the relative prices of the imported goods and services.

To apply the Armington assumption, a composite product Q_{irt} is defined, which quantity is determined as a CES function of the quantity produced in the country for the domestic market QD_{irt} and imports QM_{idt} .

$$Q_{irt} = e_i \left(\beta_i \cdot QM_{irt}^{-\sigma_i} + (1 - \beta_i) \cdot QD_{irt}^{-\sigma_i} \right)^{-1/\sigma_i} \tag{CGE7}$$

where e_i is a scale parameter, β_i measures the share of imports and σ_i is an exponent, which is equal to $\frac{1}{\text{elasticity of substitution}} - 1$. It is constrained to satisfy $-1 < \sigma_i < \infty$ to ensure that the respective isoquant is convex, i.e. that we have a decreasing technical rate of substitution.

The domestic prices, respectively are determined by calculation of the optimal ratio between imported and domestically produced goods and services:

$$\frac{QM_{irt}}{QD_{irt}} = \left(\frac{PD_{irt}}{pm_{it}} \cdot \frac{\beta_i}{1-\beta_i} \right)^{1/1+\sigma_i} \tag{CGE8}$$

In a similar manner the substitution between the products, produced for the domestic market and for exports is described through a constant elasticity of transformation function (CET). The CET is almost identical to the above CES function, defined for the combination of domestically produced and imported commodities, with the exception of the elasticities of substitution, which are no longer negative.

⁴⁰⁷ Is government assets are positive, then it receives interest, if not – it pays interest on its debt.

$$QP_i = f_i(\eta_i \cdot QE_i^{\gamma_i} + (1 - \eta_i) \cdot QD_i^{\gamma_i})^{1/\gamma_i}$$

(CGE9)

Here $-1 < \gamma_i < \infty$ to ensure a concave isoquant.

Again, the optimal relationship between exports and products for the domestic market is calculated:

$$\frac{QE_i}{QD_i} = \left(\frac{pe_i}{PD_i} \cdot \frac{1-\eta_i}{\eta_i} \right)^{1/\gamma_i-1}$$

(CGE10)

To complete the external sector, foreign savings FS_{rt} are estimated as the difference between foreign sector revenues from imports and interest on its assets and incurred expenditures from exports, where p is an index for the respective external trade partners.

$$\sum_i \sum_p PE_{it} \cdot QE_{iprt} + FS_{rt} = \sum_i \sum_p PM_{it} \cdot QM_{iprt} + ror * AF_{rt}$$

(CGE11)

We also specify the usual equalities between total quantity supplied and used, defining the link between the make and use tables in the national accounts:

$$Total\ quantity\ supplied = Q_{irt} =$$

$$Total\ quantity\ used = \sum_j IC_{jrt} + C_{irt} + cg_{irt} + ID_{irt} + QE_{irt} + QT_{irt}$$

(CGE12)

and savings equals investment:

$$\overline{PK}_{rt} \cdot II_{jrt} = \frac{K_{jrt}}{\sum_j K_{jrt}} (S_{rt} + KE_{rt} + BB_{rt} + FS_{rt} - ror * (A_{rt} + AF_{rt} + AG_{rt}) - \sum_i P_{irt} \cdot Z_{irt} - DUMMY_{rt})$$

(CGE13)

where $DUMMY_{rt}$ is a dummy variable, added to ensure that the system of equations becomes functionally independent (which is not the case otherwise, due to Walras law). To close the model, an additional equation for each region is defined by normalizing the prices to the overall price level in the respective region:

$$plevel_{rt} = \sum_i w_{ir} \cdot P_{irt}$$

(CGE14)

As specified, the model is static in its nature, as all agents optimize only in the current period t and not over the entire time horizon of the simulations. However, the model allows also for transitional analysis by incorporating a capital and asset accumulation equations and constant growth of total factor productivity to capture some of dynamic in changes to the "state of the world":

$$KKPU_{jrt+1} = (1 - \delta) \cdot KKPU_{jrt} + IPU_{jrt}$$

$$KKPR_{jrt+1} = (1 - \delta) \cdot KKPR_{jrt} + IPR_{jrt}$$

$$\sigma_{jrt+1}^{VA} = (1 + \gamma A_t) \cdot \sigma_{jrt}^{VA}$$

$$A_{rt+1} = (1 + \text{ror}_r) \cdot S_{rt}$$

$$AF_{rt+1} = (1 + \text{ror}_r) \cdot FS_{rt}$$

$$AG_{rt+1} = (1 + \text{ror}_r) \cdot BB_{rt}$$

Sectorial disaggregation

In the selection of the disaggregation by economic sectors, we largely follow Christensen (2015). The classification of the low-tech and high-tech manufacturing sectors is made following the Eurostat classification⁴⁰⁸. In addition to this division of the manufacturing activities, we also specify the telecom, energy, transport and other e-com activities separately due to their importance for the impact assessment. Thus the economic sectors covered include:

1. Agriculture
2. Low-tech manufacturing
3. High-tech manufacturing
4. Energy sector
5. Transport
6. Telecommunications
7. E-communication services
8. Other services.

Skill disaggregation of labour

As specified the sectors use labour with very different qualification. If we assume the ILO classification based on occupations⁴⁰⁹, where the occupations are mapped by skill, using the following transition key:

ISCO-08 major groups	Skill level (from 1 to 4, where 4 is the highest)
1 Managers	3 + 4
2 Professionals	4
3 Technicians and Associate Professionals	3
4 Clerical Support Workers	2
5 Services and Sales Workers	2
6 Skilled Agricultural, Forestry and Fishery Workers	2
7 Craft and Related Trades Workers	2
8 Plant and Machine Operators and Assemblers	2
9 Elementary Occupations	1
0 Armed Forces Occupations	1 + 2 + 4

For the modelling purposes, we have grouped skill levels 1 and 2 into unskilled labour and skill levels 3 and 4 into skilled labour. In this way over 4/5 of the labour employed in agriculture and transport are unskilled. The share of unskilled labour in low-tech manufacturing and services is respectively around 2/3 and 1/2 and for the telecommunications and other e-communication services – between 1/4 and 1/3.

⁴⁰⁸ http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

⁴⁰⁹ International Labour Office, 2012, "International Standard Classification of Occupations ISCO-08", Geneva, available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf

2.5.9.5 C.3.2. Data sources and transformations

The inputs to the model consist of three major types: statistical data, estimates of some of the parameters for the model, based on identified relevant studies and information on the policy options considered, based on the input from the EC and a review of the development of the relevant legislative and institutional framework.

In order to perform simulations with the specified model, it is calibrated with some representative data about the groups of countries identified in the cluster analysis (described in the next section). The latter, together with the envisaged econometric estimations of particular parameters, also require detailed data about the e-communications services sector. Additionally, data on the main socio-economic variables has been collected.

Below, a list of all used sources of information is provided. Data for the econometric estimations was used in logarithms.

Data	Source	Used for
Supply-use tables for all EU MS economies	Eurostat, Supply, Use and Input-Output tables	Construction of the social accounting matrices for the CGE model.
Main revenues and expenditure aggregates for the government	Eurostat, Annual government finance statistics	Construction of the social accounting matrices for the CGE model.
GDP and components by final use, income and production accounts (including by economic sectors), employment population and per capita	Eurostat, National accounts	Econometric estimations of the impact of the KPIs SAM and parameters calibrations for the CGE model Cluster analysis
Employment by occupation and economic activity	Eurostat, Detailed annual LFS statistics on employment	Estimation of the skilled and unskilled labour supply in the CGE model
Exports and imports by trading partners and commodities	Eurostat, EU trade since 1988 by SITC	Construction of the social accounting matrices for the CGE model.
Data on KPIs, related to the e-communications	EC Digital Agenda Key indicators dataset	Econometric estimations of the impact of the KPIs.
Heritage index	Heritage foundation webpage: http://www.heritage.org/index/explore	Econometric estimations of the impact of the KPIs.
Data on DESI index		Cluster analysis for the identification of the regions in the CGE model

2.5.9.6 C.3.3. Calibration

The majority of the parameters are calculated from the social accounting matrices, constructed for the implementation of the computable general equilibrium model, respectively for Germany, Czech Republic and Bulgaria. They are computed backwards, so as to reproduce some of the equations in the model for the base year, taking the variable values as given.

Another big group of parameters are also calibrated based of historical data for the respective economies. Finally, there is also a group of parameters, which are set, based on economic literature review. The model proved robust with respect to most of them with the exception of the elasticities in the Armington and CET aggregation functions (elQ_{jr} and $elQP_{jr}$). They were adjusted to achieve a better reproduction of the baseline trajectories.

Parameter	Setting of the value
$elVA_{jr}$	0.99 (i.e. practically corresponds to Cobb-Douglas function)
elL_{jr}	0.99 (i.e. practically corresponds to Cobb-Douglas function)
elK_{jr}	0.99 (i.e. practically corresponds to Cobb-Douglas function)
elQ_{jr}	0.20, adjusted to reproduce plausible economic development trajectory in the baseline
$elQP_{jr}$	0.20, adjusted to reproduce plausible economic development trajectory in the baseline
β_{jrt}^{VA}	Calculated values of the share of labour in gross value added (SAM)
β_{jrt}^L	Calculated values of the share of unskilled labour in total labour (SAM)
β_{jrt}^K	Calculated values of the share of public capital in total capital (SAM)
β_{jrt}^Q	Calculated from equation (QMQR) in the base year (SAM)
β_{jrt}^{QP}	Calculated from equation (QEQR) in the base year (SAM)
v_{jrt}^{VA}	$(elVA_{jr} - 1) / elVA_{jr}$
v_{jrt}^L	$(elL_{jr} - 1) / elL_{jr}$
v_{jrt}^K	$(elK_{jr} - 1) / elK_{jr}$
v_{jrt}^Q	$(elQ_{jr} - 1) / elQ_{jr}$
v_{jrt}^{QP}	$(elQP_{jr} - 1) / elQP_{jr}$
σ_{jrt}^L	Calculated from equation (LAGGR) in the base year (SAM)
σ_{jrt}^K	Calculated from equation (KAGGR) in the base year (SAM)
σ_{jrt}^Q	Calculated from equation (QAGGR) in the base year (SAM)
σ_{jrt}^{QP}	Calculated from equation (QPAGGR) in the base year (SAM)

η_{jrt}^L	Calculated from data on employment by occupation and economic activity (from 2008 onwards, NACE Rev. 2) from Eurostat
η_{ijrt}^{IC}	Calculated from equation (ICSH) in the base year (SAM)
η_{jrt}^{VA}	Calculated from equation (VASH) in the base year (SAM)
η_{jrt}^{QP}	Calculated from equation (QPSH) in the base year (SAM)
η_{ii1rt}^{QT}	Calculated from equation (QTEQ) in the base year (SAM)
η_{rt}^{KE}	Calculated from equation (KEEQ) in the base year (SAM)
η_{irt}^{ID}	Calculated from equation (IDEM) in the base year (SAM)
η_{jrt}^{IPU}	Calculated from equation (IPUSH) in the base year (SAM)
η_{rt}^{FS}	Set as the share of current account in GDP in the base year
η_{rt}^{BB}	Set as the share of consolidated government budget balance in GDP in the base year
η_{rt}^S	Set as the share of savings in GDP in the base year, adjusted to reproduce plausible economic development trajectory in the baseline
utk_r	Calculated to reproduce a plausible economic development trajectory in the baseline
td_r	Calculated from the SAM as a ratio between revenues from direct taxes and the respective tax base
τ_{ir}	Calculated from the SAM as a ratio between revenues from indirect taxes and the respective tax base
δ_r	0.025
θ_{ir}	Calculated from equation (HCONS) in the base year (SAM)
w_{ir}	Calculated as the share of consumption of product I in total consumption in the base year (SAM)
ξ_{jr}	Calculated from equation (NSUP) in the base year (SAM)
π_{jr}	Calculated from equation (HSUP) in the base year (SAM)
ρ_r	2.3436, based on Mandelman and Zlate (2011) ⁴¹⁰
κ_r	1 (the parameter has a scaling effect and simulations with different values did not show impact on the results)
ι_r	Calculated from equation (IbarEQ) in the base year (SAM)
ror_r	Set at very low levels, in line with the current trend of very low interest rates
$plevel$	Calculated from equation (PNORM) in the base year (SAM)
zv_{ir}	Calculated from the respective use tables in the base year

2.5.10 List of abbreviations and equations in the CGE model

2.5.10.1 List of indices

Abbreviation	Definition
j	sectors
i	products
r	regions
t	time periods

⁴¹⁰ Mandelman F. and A. Zlate (2011), "Immigration, Remittances and Business Cycles", Federal Reserve Bank of Atlanta.

2.5.10.2 List of parameters

Abbreviation	Definition
$eIVA_{jr}$	Elasticity of substitution in the CES production function
eLL_{jr}	Elasticity of substitution in the labour aggregation function
eLK_{jr}	Elasticity of substitution in the capital aggregation function
eIQ_{jr}	Elasticity of import substitution (Armington)
$eIQP_{jr}$	Elasticity of transformation
β_{jrt}^{VA}	Share of value-added to labour in activity j
β_{jrt}^L	Share parameter in the labour aggregation function
β_{jrt}^K	Share parameter in the capital aggregation function
β_{jrt}^Q	Share parameter in the composite supply Armington function for i
β_{jrt}^{QP}	Transformation function share parameter for i
v_{jrt}^{VA}	Exponent parameter for the production function
v_{jrt}^L	Exponent in the labour aggregation function
v_{jrt}^K	Exponent in the capital aggregation function
v_{jrt}^Q	Exponent in the composite supply Armington function for i
v_{jrt}^{QP}	Transformation function exponent for i
σ_{jrt}^L	Shift parameter in the labour aggregation function
σ_{jrt}^K	Shift parameter in the capital aggregation function
σ_{jrt}^Q	Shift parameter in the composite supply Armington function for i
σ_{jrt}^{QP}	Transformation function shift parameter for i
η_{jrt}^L	Share of unskilled labour in total labour supply
η_{ijrt}^{IC}	Quantity of i as intermediate input per unit of output of j
η_{jrt}^{VA}	Value added per unit of output of j
η_{jirt}^{QP}	Yield of commodity i per unit of activity j
η_{ii1rt}^{QT}	Quantity of commodity i as trade input per unit of i1 produced and sold domestically
η_{rt}^{KE}	Share of public investments in GDP
η_{irt}^{ID}	Share of investment demand for product i in total investment
η_{jrt}^{IPU}	Share of public investment in sector j
η_{rt}^{FS}	Share of foreign savings to GDP
η_{rt}^{BB}	Share of budget balance to GDP

η_{rt}^S	Share of private savings to GDP
utk_r	Capital utilization rate
td_r	Implicit direct tax rate
τ_{ir}	Implicit indirect tax rate
δ_r	Depreciation of capital
θ_{ir}	Share of commodity i in the consumption of household
w_{ir}	Weight of commodity i in the CPI
ξ_{jr}	Weight to disutility from unskilled labour in hhd utility function
π_{jr}	Weight to disutility from skilled labour in hhd utility function
ρ_r	1 over Frisch elasticity of labour
κ_r	Weight of utility to savings in the hhd utility function
ι_r	Shift parameter in the investment aggregation function
ror_r	Rate of return
$plevel_r$	Consumer prices level in the base year
zv_{ir}	Change in stocks in value terms (for the base year calibration)

2.5.10.3 List of variables

Abbreviation	Definition
Endogenous variables	
σ_{jrt}^{VA}	Total factor productivity in the production function for activity j
VA_{jrt}	Value added in sector j
PVA_{jrt}	Value-added price of activity j
N_{jrt}	Quantity of unskilled labour demanded by activity j
H_{jrt}	Quantity of skilled labour demanded by activity j
L_{jrt}	Total labour employed in activity j
KPU_{jrt}	Quantity of public capital demanded by activity j
KPR_{jrt}	Quantity of private capital demanded by activity j
K_{jrt}	Quantity of capital demanded by activity j
PN_{jrt}	Price of non-skilled labour in activity j
PH_{jrt}	Price of skilled labour in activity j
$PKPU_{jrt}$	Price of public capital in sector j
$PKPR_{jrt}$	Price of private capital in sector j
IC_{ijrt}	Intermediate consumption of product i in activity j
QA_{jrt}	Gross output in activity j
PA_{jrt}	Price of gross output in activity j
QP_{jirt}	Quantity of product i produced domestically
QPT_{jirt}	Total quantity of commodity i produced domestically
PPT_{irt}	Price of total quantity of commodity i produced domestically
QD_{irt}	Quantity sold domestically of domestic product i
PD_{irt}	Domestic price of domestic output i
PDD_{irt}	Domestic price of domestic output i including trade and transport margins
QT_{irt}	Quantity of commodity demanded as trade and transport margin
P_{irt}	Composite price of product i
Q_{irt}	Composite supply of product i at domestic market
QM_{irt}	Imports of product i
QE_{irt}	Exports of product i
C_{irt}	Consumption of commodity i by household
S_{rt}	Household savings
I_{rt}	Total investment demand
ID_{irt}	Investment demand for product i
Z_{irt}	Change in stocks of product i
PK_{rt}	Composite investment goods price
II_{jrt}	Sectoral investment
IPU_{jrt}	Public investment in activity j

Abbreviation	Definition
IPR_{jrt}	Private investment in activity j
$KKPU_{jrt}$	Total public capital stock in sector j
$KKPR_{jrt}$	Total private capital stock in sector j
A_{rt}	Private cumulative assets
AF_{rt}	Foreign cumulative assets
AG_{rt}	Government cumulative assets
KE_{rt}	Government capital expenditures
R_{rt}	Government revenues
G_{rt}	Government expenditures
BB_{rt}	Budget balance
FS_{rt}	Foreign savings
$DUMMY_{rt}$	Walras variable (zero at equilibrium)
Exogenous variables	
tr_{rt}	Transfers from the government to the household
cg_{irt}	Government consumption of i
pm_{irt}	Import price of product i
pe_{irt}	Export price of product i

2.5.10.4 Complete list of model equations

Production function

$$VA_{jrt} = \sigma_{jrt}^{VA} \left(\beta_{jrt}^{VA} \cdot L_{jrt}^{v_{jrt}^{VA}} + (1 - \beta_{jrt}^{VA}) \cdot K_{jrt}^{v_{jrt}^{VA}} \right)^{\frac{1}{v_{jrt}^{VA}}} \quad (\text{PRODF})$$

First-order conditions for the producer optimization problem

$$L_{jrt} = \sigma_{jrt}^L \left(\beta_{jrt}^L \cdot N_{jrt}^{v_{jrt}^L} + (1 - \beta_{jrt}^L) \cdot H_{jrt}^{v_{jrt}^L} \right)^{\frac{1}{v_{jrt}^L}} \quad (\text{LAGGR})$$

$$K_{jrt} = \sigma_{jrt}^K \left(\beta_{jrt}^K \cdot KPU_{jrt}^{v_{jrt}^K} + (1 - \beta_{jrt}^K) \cdot KPR_{jrt}^{v_{jrt}^K} \right)^{\frac{1}{v_{jrt}^K}} \quad (\text{KAGGR})$$

$$PN_{rt} \cdot N_{jrt}^{1-v_{jrt}^L} = \frac{\beta_{jrt}^{VA} \cdot \beta_{jrt}^L \cdot PVA_{jrt} \cdot VA_{jrt} \cdot L_{jrt}^{v_{jrt}^{VA}}}{\left(\beta_{jrt}^{VA} \cdot L_{jrt}^{v_{jrt}^{VA}} + (1 - \beta_{jrt}^{VA}) \cdot K_{jrt}^{v_{jrt}^{VA}} \right) \cdot \left(\beta_{jrt}^L \cdot N_{jrt}^{v_{jrt}^L} + (1 - \beta_{jrt}^L) \cdot H_{jrt}^{v_{jrt}^L} \right)} \quad (\text{NDEM})$$

$$PH_{rt} \cdot H_{jrt}^{1-v_{jrt}^L} = \frac{\beta_{jrt}^{VA} \cdot (1 - \beta_{jrt}^L) \cdot PVA_{jrt} \cdot VA_{jrt} \cdot L_{jrt}^{v_{jrt}^{VA}}}{\left(\beta_{jrt}^{VA} \cdot L_{jrt}^{v_{jrt}^{VA}} + (1 - \beta_{jrt}^{VA}) \cdot K_{jrt}^{v_{jrt}^{VA}} \right) \cdot \left(\beta_{jrt}^L \cdot N_{jrt}^{v_{jrt}^L} + (1 - \beta_{jrt}^L) \cdot H_{jrt}^{v_{jrt}^L} \right)} \quad (\text{HDEM})$$

$$PKPU_{rt} \cdot KPU_{jrt}^{1-v_{jrt}^L} = \frac{(1 - \beta_{jrt}^{VA}) \cdot \beta_{jrt}^K \cdot PVA_{jrt} \cdot VA_{jrt} \cdot K_{jrt}^{v_{jrt}^{VA}}}{\left(\beta_{jrt}^{VA} \cdot L_{jrt}^{v_{jrt}^{VA}} + (1 - \beta_{jrt}^{VA}) \cdot K_{jrt}^{v_{jrt}^{VA}} \right) \cdot \left(\beta_{jrt}^K \cdot KPU_{jrt}^{v_{jrt}^K} + (1 - \beta_{jrt}^K) \cdot KPR_{jrt}^{v_{jrt}^K} \right)} \quad (\text{KPUDEM})$$

$$PKPR_{rt} \cdot KPR_{jrt}^{1-v_{jrt}^L} = \frac{(1 - \beta_{jrt}^{VA}) \cdot (1 - \beta_{jrt}^K) \cdot PVA_{jrt} \cdot VA_{jrt} \cdot K_{jrt}^{v_{jrt}^{VA}}}{\left(\beta_{jrt}^{VA} \cdot L_{jrt}^{v_{jrt}^{VA}} + (1 - \beta_{jrt}^{VA}) \cdot K_{jrt}^{v_{jrt}^{VA}} \right) \cdot \left(\beta_{jrt}^K \cdot KPU_{jrt}^{v_{jrt}^K} + (1 - \beta_{jrt}^K) \cdot KPR_{jrt}^{v_{jrt}^K} \right)} \quad (\text{KPRDEM})$$

Leontief aggregation of intermediate consumption and value added

$$IC_{ijrt} = \eta_{ijrt}^{IC} \cdot QA_{jrt} \quad (\text{ICSH})$$

$$VA_{jrt} = \eta_{jrt}^{VA} \cdot QA_{jrt} \quad (\text{VASH})$$

$$PA_{jrt} \cdot QA_{jrt} = \sum_i \frac{\eta_{ijrt}^{IC}}{\sum_i \eta_{ijrt}^{IC}} \cdot P_{irt} \cdot \sum_i IC_{ijrt} + PVA_{jrt} \cdot VA_{jrt} \quad (\text{QAVAL})$$

Transformation of activity into output

$$QP_{jirt} = \eta_{jir}^{QP} \cdot QA_{jrt} \quad (\text{QPSH})$$

$$PA_{jrt} = \sum_i \eta_{jir}^{QP} \cdot PPT_{irt} \quad (\text{PAEQ})$$

$$QPT_{irt} = \sum_j QP_{jirt} \quad (\text{QPTEQ})$$

$$PDD_{irt} = PD_{irt} + \sum_{i'} \eta_{i'rt}^{QT} \cdot P_{i'rt}$$

$$PPT_{irt} \cdot QPT_{irt} = PD_{irt} \cdot QD_{irt} + PE_{it} \cdot QE_{irt} \quad (\text{QPTVAL})$$

$$\frac{P_{irt} \cdot Q_{irt}}{(1+\tau_{irt})} = PDD_{irt} \cdot QD_{irt} + PM_{it} \cdot QM_{irt} \quad (\text{QVAL})$$

$$QT_{irt} = \sum_{i'} \eta_{i'rt}^{QT} \cdot QD_{i'rt} \quad (\text{QTEQ})$$

Armington function for domestic-import aggregation

$$Q_{irt} = \sigma^Q_i \left(\beta^Q_i \cdot \overline{QM}_{irt}^{-\nu^Q_i} + (1 - \beta^Q_i) \cdot QD_{irt}^{-\nu^Q_i} \right)^{-1/\nu^Q_i} \quad (\text{QAGGR})$$

$$\frac{\overline{QM}_{irt}}{QD_{irt}} = \left(\frac{PDD_{irt}}{PM_{it}} \cdot \frac{\beta^Q_i}{1-\beta^Q_i} \right)^{1/(1+\nu^Q_i)} \quad (\text{QMQD})$$

Constant elasticity of transformation function for the domestic-export aggregation

$$QPT_{irt} = \sigma^{QP}_i \left(\beta^{QP}_i \cdot \overline{QE}_{irt}^{\nu^{QP}_i} + (1 - \beta^{QP}_i) \cdot QD_{irt}^{\nu^{QP}_i} \right)^{1/\nu^{QP}_i} \quad (\text{QPAGGR})$$

$$\frac{\overline{QE}_{irt}}{QD_{irt}} = \left(\frac{PE_{it}}{PD_{irt}} \cdot \frac{1-\beta^{QP}_i}{\beta^{QP}_i} \right)^{1/(\nu^{QP}_i-1)} \quad (\text{QEQD})$$

First-order conditions in the household optimization problem

$$\sum_i P_{irt} \cdot C_{irt} = (1 - td_r) \sum_j (PN_{jrt} \cdot N_{jrt} + PH_{jrt} \cdot H_{jrt} + PKPR_{jrt} \cdot KPR_{jrt}) + ror \cdot A_{rt} + tr_r - S_{rt} \quad (\text{HBUDG})$$

$$C_{irt} \cdot P_{irt} \cdot \kappa = \theta_{ir} \cdot S_{rt} \quad (\text{HCONS})$$

$$\xi_j \cdot N_{jrt}^\rho \cdot S = \kappa \cdot (1 - td_r) \cdot PN_{jrt} \quad (\text{NSUP})$$

$$\pi_j \cdot H_{jrt}^\rho \cdot S = \kappa \cdot (1 - td_r) \cdot PH_{jrt} \quad (\text{HSUP})$$

Government equations

$$KE_{rt} = \eta_r^{KE} \cdot \sum_j PVA_{jrt} \cdot VA_{jrt} \quad (\text{KEEQ})$$

$$R_{rt} = td_r \cdot \sum_j (PN_{jrt} \cdot N_{jrt} + PH_{jrt} \cdot H_{jrt} + PKPR_{jrt} \cdot KPR_{jrt}) + \sum_i \tau_{ir} \cdot \frac{P_{irt}}{(1+\tau_{ir})} \cdot Q_{irt} + \sum_j PKPU_{jrt} \cdot KPU_{jrt} + ror \cdot AG_{rt} \quad (\text{REQ})$$

$$G_{rt} = \sum_i cg_{irt} \cdot P_{irt} + tr_r + KE_{rt} \quad (\text{GEQ})$$

$$BB_{rt} = R_{rt} - G_{rt} \quad (\text{BBEQ})$$

Capital and investment equations

$$ID_{irt} = \eta_{ir}^{ID} \cdot \bar{I}_{rt} \quad (\text{IDEM})$$

$$\bar{I}_{rt} = \iota_r \cdot \prod_i ID_{irt} \eta_{ir}^{ID} \quad (\text{IbarEQ})$$

$$\bar{PK}_{rt} = \sum_i \eta_{ir}^{ID} \cdot P_{irt} \quad (\text{PKEQ})$$

$$IPU_{jrt} = \eta_r^{IPU} \cdot KE_{rt} \quad (\text{IPUSH})$$

$$II_{jrt} = IPU_{jrt} + IPR_{jrt} \quad (\text{IPREQ})$$

$$KPU_{jrt} = utk \cdot KKPU_{jrt} \quad (\text{KPUEQ})$$

$$KPR_{jrt} = utk \cdot KKPR_{jrt} \quad (\text{KPREQ})$$

Recursive dynamic equations

$$KKPU_{jrt+1} = (1 - \delta) \cdot KKPU_{jrt} + IPU_{jrt} \quad (\text{KKPUDYN})$$

$$KKPR_{jrt+1} = (1 - \delta) \cdot KKPR_{jrt} + IPR_{jrt} \quad (\text{KKPRDYN})$$

$$\sigma_{jrt+1}^{VA} = (1 + \gamma A_t) \cdot \sigma_{jrt}^{VA} \quad (\text{TFPDYN})$$

$$A_{rt+1} = (1 + ror_r) \cdot A_{rt} + S_{rt} \quad (\text{ADYN})$$

$$AF_{rt+1} = (1 + ror_r) \cdot AF_{rt} + FS_{rt} \quad (\text{AFDYN})$$

$$AG_{rt+1} = (1 + ror_r) \cdot AG_{rt} + BB_{rt} \quad (\text{AGDYN})$$

Foreign sector balance

$$\sum_i \sum_p PE_{it} \cdot QE_{iprt} + FS_{rt} = \sum_i \sum_p PM_{it} \cdot QM_{iprt} + ror \cdot AF_{rt} \quad (\text{FSEQ})$$

Savings-investment balance

$$\overline{PK}_{rt} \cdot II_{jrt} = \frac{K_{jrt}}{\sum_j K_{jrt}} (S_{rt} + KE_{rt} + BB_{rt} + FS_{rt} - ror * (A_{rt} + AF_{rt} + AG_{rt}) - \sum_i P_{irt} \cdot Z_{irt} - DUMMY_{rt}) \quad (\text{IIEQ})$$

Product market clearance

$$Q_{irt} = \sum_j IC_{ijrt} + C_{irt} + cg_{irt} + ID_{irt} + Z_{irt} + QT_{irt} \quad (\text{PRODMKT})$$

Additional equation due to Walras law of functional dependence

$$plevel_{rt} = \sum_i w_{ir} \cdot P_{irt} \quad (\text{PNORM})$$



Brussels, 14.9.2016
SWD(2016) 303 final

PART 3/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposals for

**a Directive of the European Parliament and of the Council establishing the European
Electronic Communications Code (Recast) and
a Regulation of the European Parliament and of the Council establishing the Body of
European Regulators for Electronic Communications**

{COM(2016) 590}

{COM(2016) 591}

{SWD(2016) 304}

6.6 ANNEX 6 - Data and problem evidence

1.3.1 Introduction

Europe's Digital Progress Report provides an overview of the progress made by MS in digitalisation. It also details the policy responses by MS to address the specific challenges that face them.

The Commission adopted the DSM Strategy for Europe⁴¹¹ in May 2015, which identified that Europe has the potential to lead in the global digital economy, but that fragmentation and barriers that do not exist in the single market are holding back the EU. It estimated that bringing down these barriers could contribute an additional EUR 415 billion to European GDP. The digital economy could expand markets and provide better services at better prices, offer more choice and create employment. The DSM could create opportunities for new start-ups and provide an environment for businesses to grow and benefit from a market of over 500 million consumers.

The Commission therefore announced a series of measures to be taken at EU level to:

- improve access for consumers and businesses to online goods and services across Europe;
- create the right conditions for digital networks and services to flourish; and
- maximise the growth potential of the European digital economy.

The delivery rhythm of the announced measures has been brisk.

Already on 6 May 2015, the Commission launched a competition sector inquiry into eCommerce relating to the online trade of goods and the online provision of services. More than 1300 companies responded before the end of 2015. A first set of very preliminary results has been published on 18 March 2016, showing that geo-blocking is widespread in the EU. This is partly due to unilateral decisions by companies not to sell abroad but also contractual barriers set up by companies preventing consumers from shopping online across EU borders.

On 9 December 2015, the Commission presented a proposal for Directive on contracts for the supply of digital content⁴¹² as well as a proposal for a Directive on certain aspects concerning contracts for the online and other distance sales of goods⁴¹³. The aim of these proposals is to remove barriers due to contract law differences. In addition, for the supply of digital content, once adopted, the Directive should set out clear and specific rights for consumers. Indeed, there is currently a clear gap in EU legislation in the area of defective digital content, as most MS do not have any legislation in place to protect consumers in the case of defective digital content.

On the same day, the Commission proposed a Regulation on the cross-border portability of online content services in the internal market⁴¹⁴ to allow people to travel with their online content. In other words, this Regulation should ensure that Europeans who have purchased films, series, sports broadcasts, games or e-books online can access them when they travel within the EU.

At the same time, the Commission published an action plan to modernise EU copyright rules,⁴¹⁵ which should make EU copyright rules fit for the digital age. This 'political preview' will be translated into legislative proposals and policy initiatives that take into account responses to several public consultations.

⁴¹¹ COM(2015) 192.

⁴¹² COM(2015) 634.

⁴¹³ COM(2015) 635.

⁴¹⁴ COM(2015) 627.

⁴¹⁵ COM(2015) 626.

A set of measures to support and link up national initiatives for the digitisation of industry and related services across all sectors and to boost investment through strategic partnerships and networks was adopted by the Commission on 19 April 2016.⁴¹⁶ This package also contains concrete measures to speed up the standard setting process for ICT and an updated e-government action plan to modernise digital public services.

In addition to action at the European level, the DSM strategy recognised that such action needs to be complemented by actions taken at MS level, since a major part of policies which are essential for the development of the digital economy are formulated at a national level. Moreover, MS are at very different stages in the development of the digital economy; some, for example, the Nordic countries, are among the most advanced in the world, while others still have a lot of catching up to do. Therefore, both policy priorities and the impact of the DSM will differ significantly from Member State to Member State.

This report combines the quantitative evidence from the **Digital Economy and Society index (DESI)** with country-specific policy insights. It keeps track of the progress made in digitalisation in the MS and provides important feedback for policy-making at EU level. To enable a better comparison between MS, this report also develops a cross-country analysis for the main dimensions of DESI. This report will feed into the analysis of MS' economic and social challenges and the monitoring of national reform efforts carried out under the European Semester.

The report is structured in thematic chapters that examine one issue across all MS. The first section starts with connectivity, followed by human capital, before moving on to internet usage, the digitisation of industry and digital public service and finally R&D in ICT. This is followed by country chapters, each of which looks in the same order at the same issues, except for R&D, which is not covered at the level of MS.

1.3.2 *The state of play on connectivity and the telecom sector*

The Connectivity dimension of DESI looks at both the demand and the supply side of fixed and mobile broadband. Under fixed broadband it assesses the availability as well as the take-up of basic and high-speed NGA broadband and also considers the affordability of retail offers. On mobile broadband, the availability of radio spectrum and the take-up of mobile broadband are included.

On the fixed side, Luxembourg, the Netherlands and the UK are the strongest, and Poland, Romania, Slovakia and Bulgaria the weakest. NGA subscriptions are particularly advanced in Belgium, Romania, the Netherlands and Lithuania. As for mobile broadband, The Nordic countries (Finland, Sweden and Denmark) lead along with Estonia, while lowest figures were registered by Hungary, Greece and Portugal.

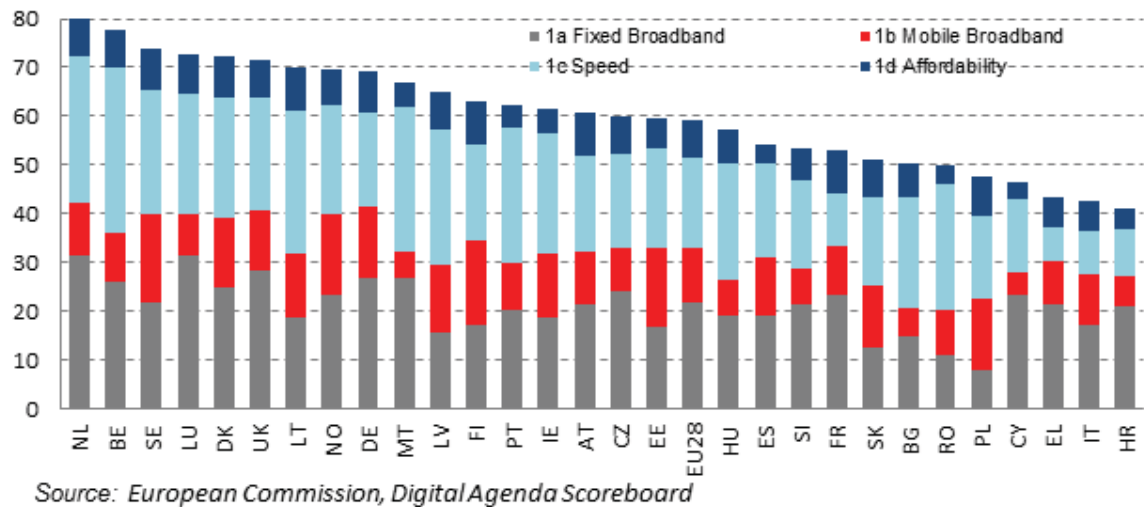
Table 1 - EU average of Connectivity Indicators in DESI 2016

DESI - Connectivity	
Fixed broadband coverage (% of homes)	97%
Fixed broadband take-up (% of homes)	72%
Mobile broadband take-up (subs per 100 people)	75
Spectrum (% of spectrum harmonised)	69%
NGA coverage (% of homes)	71%
Subscriptions to fast broadband (% of subscriptions)	30%

⁴¹⁶ COM(2016) 176, (COM(2016) 178, COM(2016) 179, COM(2016) 180.

Fixed broadband price (as a % of income)	1.3%
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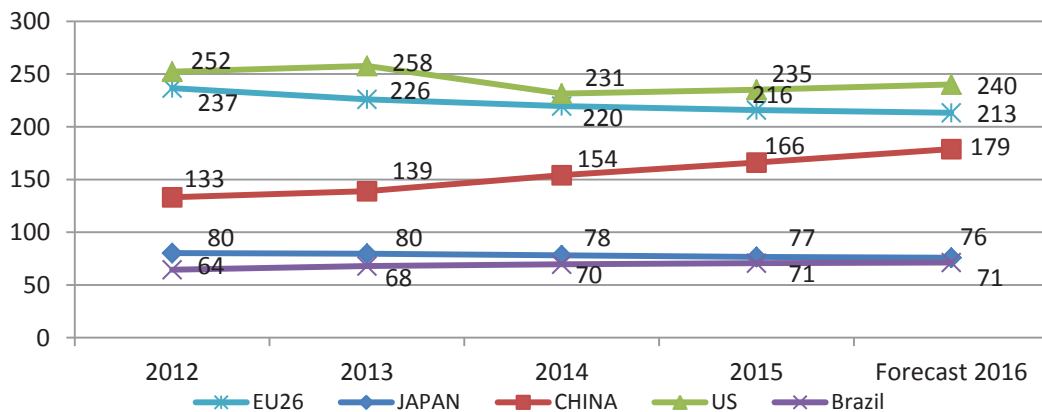
Figure 1 - Digital Economy and Society Index (DESI), Connectivity, 2016



Total telecom services revenues have declined by 10 % in Europe since 2012. EU telecom CAPEX has slightly increased in the same period.

Telecom operators in Europe generated less revenue than US operators. Revenues went down from EUR 237 bn in 2012 to EUR 213 bn in 2016 (forecasted) in Europe. At the same time, the US also reduced its figures from EUR 252 bn to EUR 240 bn, surpassing Europe despite its smaller population. There have been large increases in emerging markets, especially in China, where there is still relatively low take-up of telecom services⁴¹⁷.

Figure 2 - Total telecommunication services revenues per region, billion EUR, 2012-2016

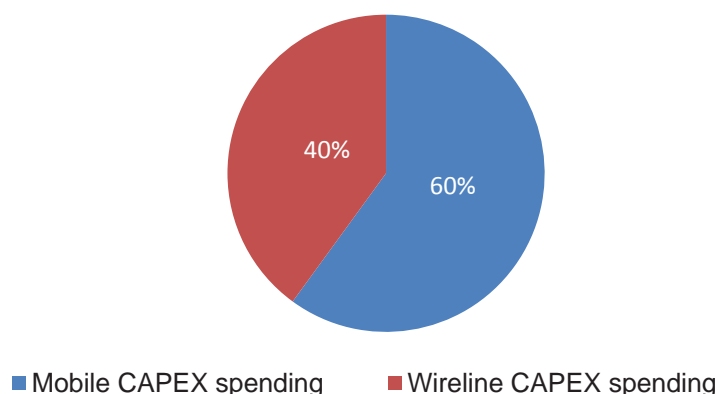


Source: 2015 EITO in collaboration with IDC

CAPEX figures remained stable over the last four years even though NGA coverage increased from 54 % to 71 %. Mobile CAPEX spending represented 60 % of total spending.

⁴¹⁷ Note: this analysis is based on detailed figures from 26 MS, which covered about 98 % of the total EU market (total telecom carrier services).

Figure 3 - Share of fixed and mobile CAPEX in Europe, 2015



Source: 2015 EITO in collaboration with IDC

Mobile voice and fixed voice revenues have decreased by over 25 % since 2012. Mobile data grew by 10 %, and will represent over a quarter of total telecom revenues at EU level in 2016.

The revenues of the telecommunications sector went down by 10 % between 2012 and 2016 (forecasted figure).

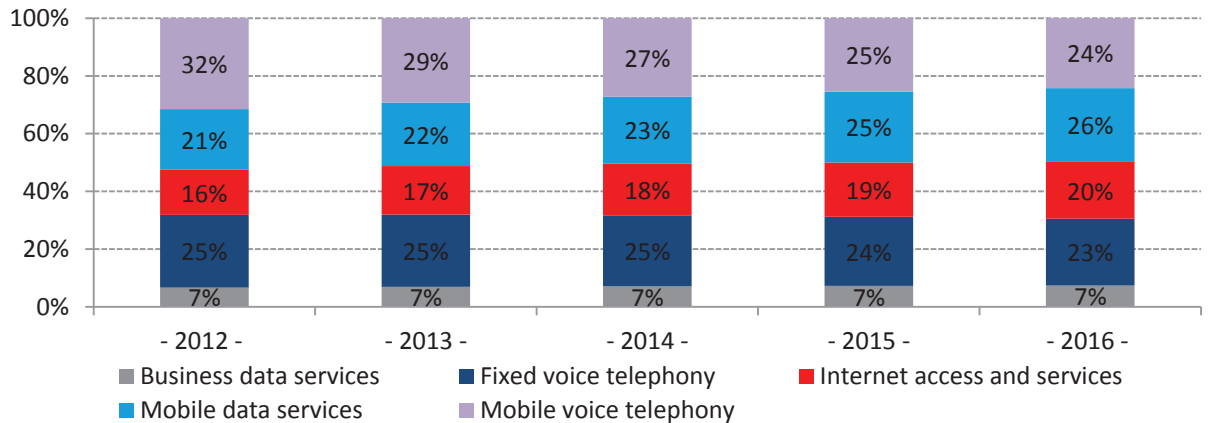
Telecommunications revenues (carrier services) by segment showed, how voice services (both fixed and mobile) lost importance. Fixed voice decreased by 17.2 %, while mobile by 30.8 %. Fixed and mobile voice services made up 57 % of total telecom revenues in 2012, but will only represent 47 % in 2016.

Table 2 - . Revenue growth rates, 2012-2016

Revenue growth rates 2012-2016	
Telecom carrier services	-10.0 %
Business data services	-0.8 %
Fixed voice telephony	-17.2 %
Internet access and services	13.1 %
Mobile data services	9.9 %
Mobile voice telephony	-30.8 %

By contrast, the growth in mobile data services (9.9 % between 2012 and 2016) is remarkable. Mobile data will represent over one quarter of total market revenue (26 %) in 2016. The growth in mobile data services could not, however, compensate for the major decline in voice. Revenue from fixed internet access went up by 13.1 % since 2012, whereas business data services decreased by almost 1 % between 2012 and the forecasted figure for 2016, representing solely 7 % of total telecom revenue.

Figure 4 - Total telecom carrier services revenues by segment, 2012-2016



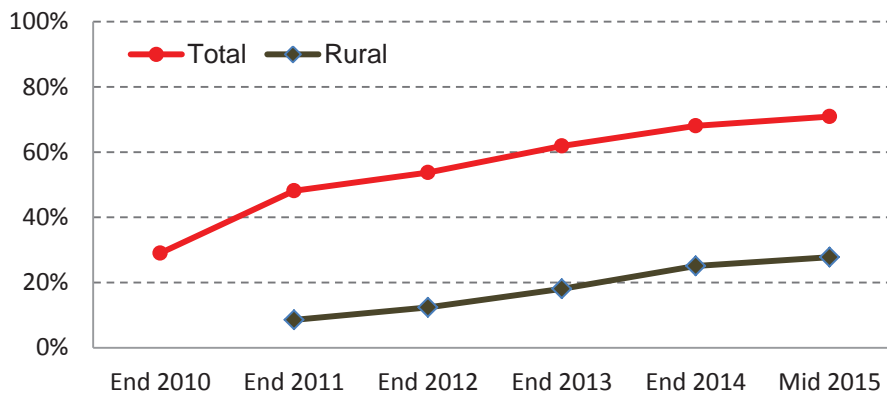
Source: 2015 [EITO](#) in collaboration with IDC

Coverage of next generation access (NGA) technologies continued to increase and reached 71 %. NGA deployments still focus mainly on urban areas, while only 28 % of rural homes are covered.

For the purpose of this report, next generation access includes VDSL, Cable Docsis 3.0 and FTTP. By mid-2015, Cable Docsis 3.0 had the largest NGA coverage at 44 %, followed by VDSL (41 %) and FTTP (21 %). Most of the upgrades in European cable networks had taken place by 2011, while VDSL coverage doubled in the last four years. There was remarkable progress also in FTTP growing from 10 % in 2011 to 21 % in 2015, but FTTP coverage is still low.

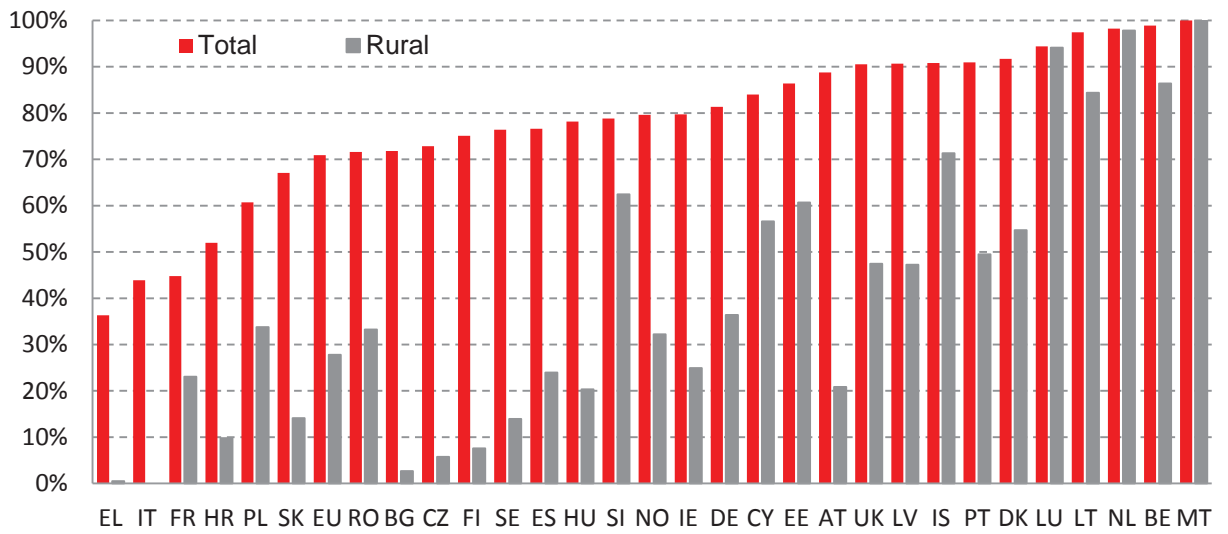
NGA networks are still very much limited to urban areas: only 28 % of rural homes are covered, mainly by VDSL.

Figure 5 - NGA broadband coverage in the EU, 2010-2015



Source: IHS, VVA and Point Topic

Figure 6 - Next generation access (FTTP, VDSL and Docsis 3.0 cable) coverage, June 2015

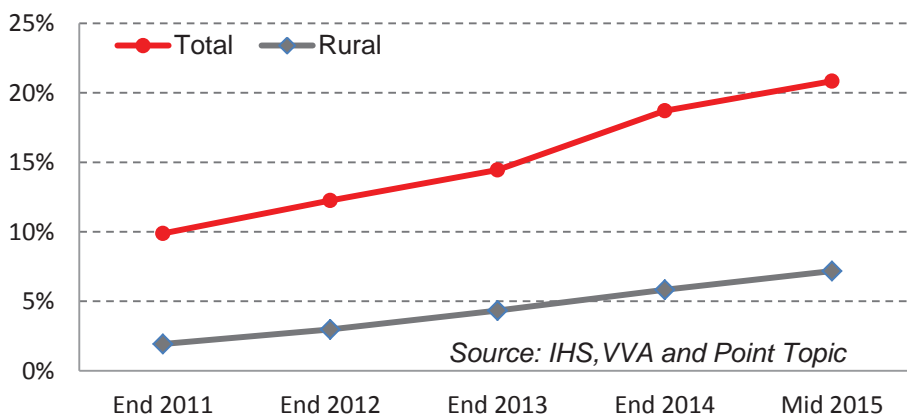


Source: IHS and VVA

Coverage of Fibre to the Premises (FTTP) grew from 10 % in 2011 to 21 % in 2015, while it remains a primarily urban technology. Lithuania, Latvia, Portugal and Estonia are the leaders in FTTP in Europe.

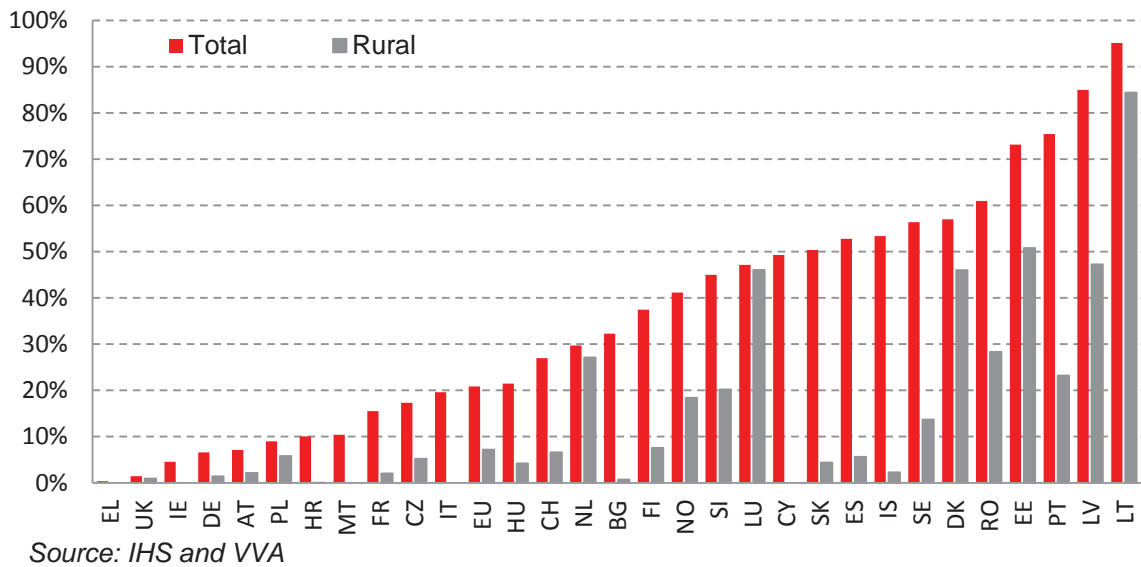
FTTP is catching up in Europe, as coverage for homes more than doubled since 2011. However, the FTTP footprint is still significantly lower than that of cable Docsis 3.0 and VDSL. In Estonia, Portugal, Latvia and Lithuania more than two thirds of homes can already subscribe to FTTP services, while in Greece, the UK, Ireland, Germany, Austria and Poland only less than 10 % can do so. FTTP services are available mainly in urban areas with the exception of Lithuania, Latvia, Estonia, Denmark and Luxembourg, where more than one in three rural homes can also have access to it.

Figure 7 - Fibre to the premises (FTTP) coverage in the EU, 2011-2015



Source: IHS, VVA and Point Topic

Figure 8 - Fibre to the premises (FTTP) coverage, June 2015



4G mobile broadband availability reached 86%, up from 27% three years ago. 4G has been commercially launched in all MS.

In 2015, deployments of 4G (LTE) continued: coverage went up from 79% of homes to 86% in six months. Nevertheless, 4G coverage is still substantially below that of 3G (HSPA). As of October 2015, 80% of Mobile Network Operators in the EU offered 4G services on LTE networks.

LTE is most widely developed in the Netherlands, Sweden and Denmark, while commercial 4G services were launched only last year in Bulgaria.

LTE deployments have focused so far mainly in urban areas, as only 36% of rural homes are covered. However, in sixteen MS, LTE is already available also in the majority of rural homes, with very high rates in Denmark, Sweden, Slovenia, Luxembourg and the Netherlands.

Figure 9 - Mobile broadband coverage in the EU, 2011-2015

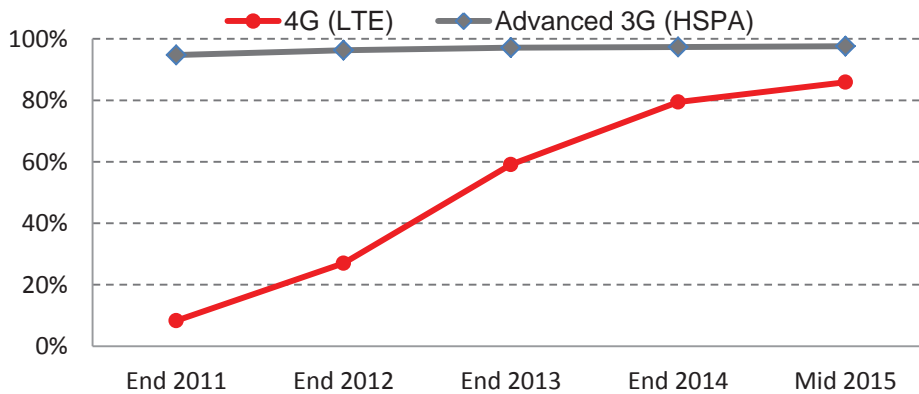
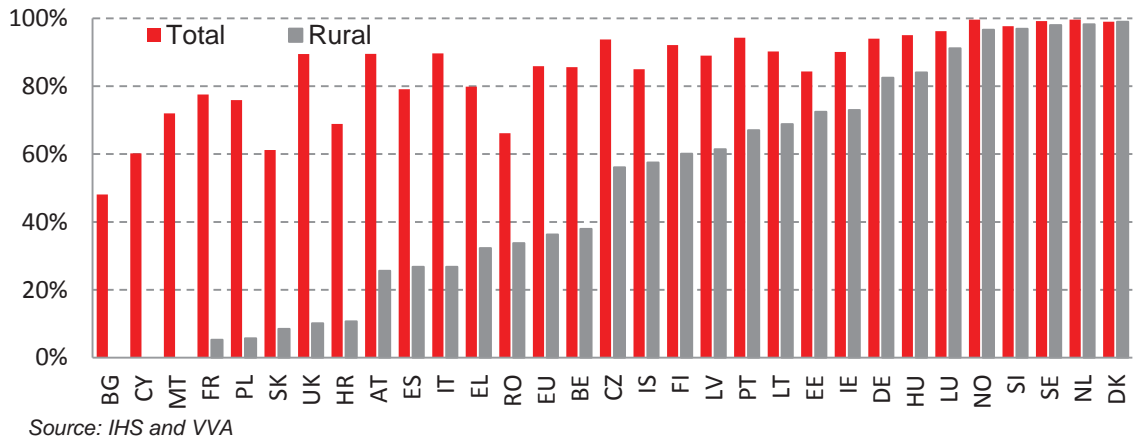


Figure 10 - 4G (LTE) coverage, June 2015



An estimated 8 % of European homes subscribe to ultrafast broadband (at least 100Mbps), up from 0.3 % five years ago. Romania, Sweden and Latvia are the most advanced in ultrafast broadband adoption.

The Digital Agenda for Europe set the objective that at least 50 % of homes should subscribe to ultrafast broadband by 2020. From June 2015, 49 % of homes are covered by networks capable of providing 100Mbps. As service offerings are emerging, take-up is growing sharply. The penetration is the highest in Romania, Sweden and Latvia. These three MS have a high coverage of FTTP. In Greece, Italy and Croatia take-up is low mainly due to the lack of superfast infrastructure, while in Cyprus and Malta, where the infrastructure is available for many homes, still mainly lower speed offers are purchased.

Figure 11 - Percentage of households with a fast broadband (at least 30Mbps) subscription at EU level, 2010-2015

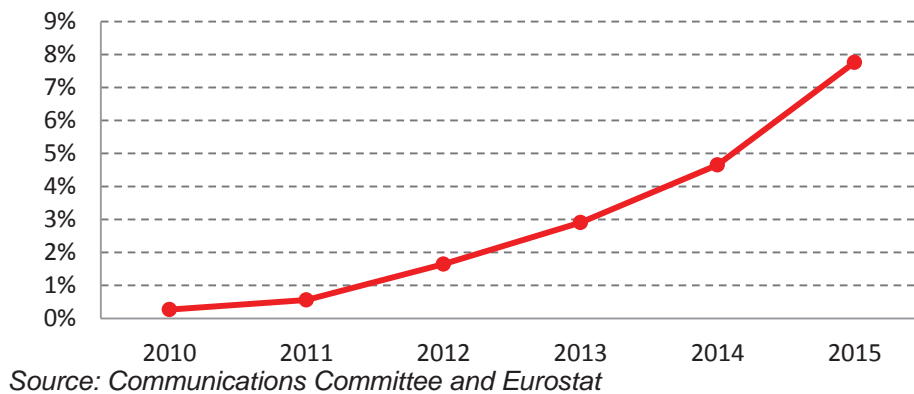
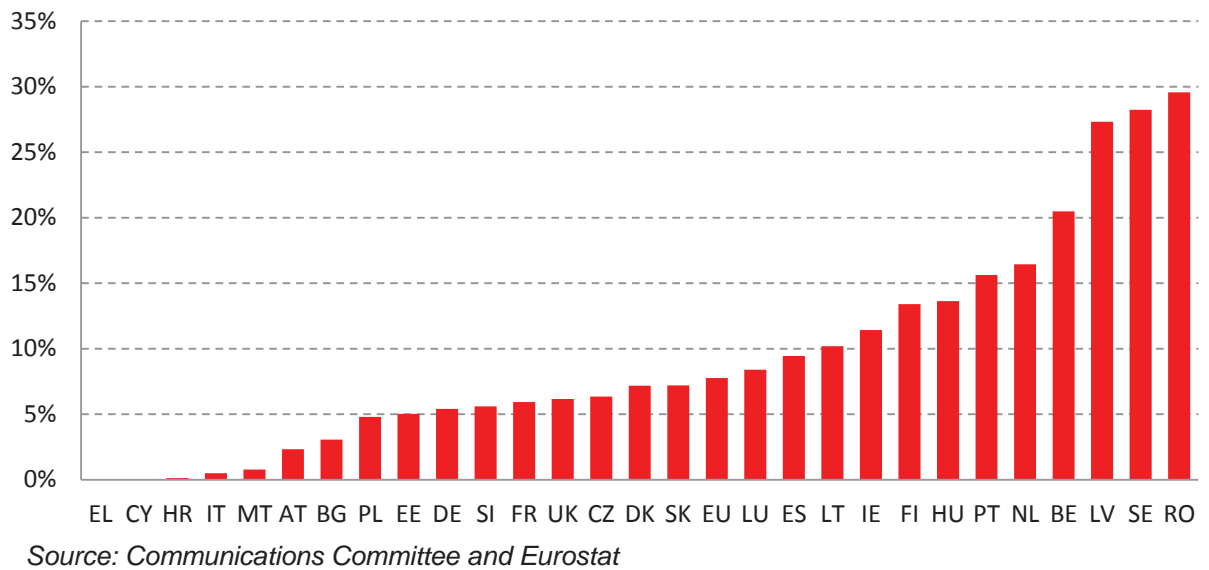
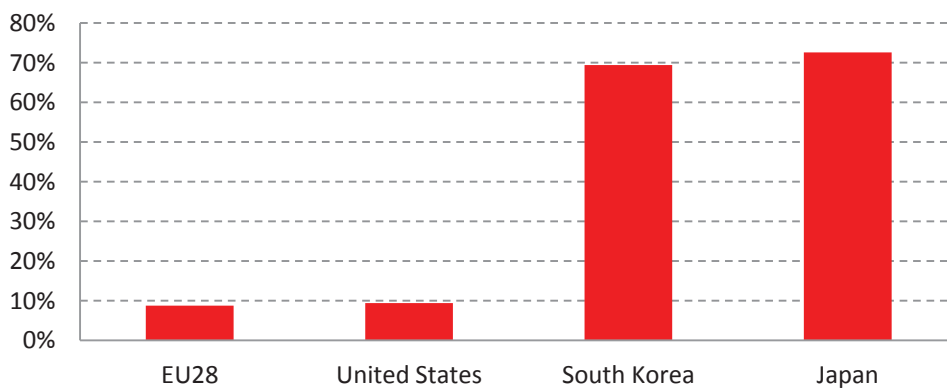


Figure 12 - Percentage of households with an ultrafast broadband (at least 100Mbps) subscription, July 2015



FTTH and FTTB together represent 9 % of EU broadband subscriptions up from 7 % a year ago. In these technologies, Europe is still very much lagging behind South Korea and Japan.

Figure 13- Share of fibre connections in total fixed broadband, July 2015

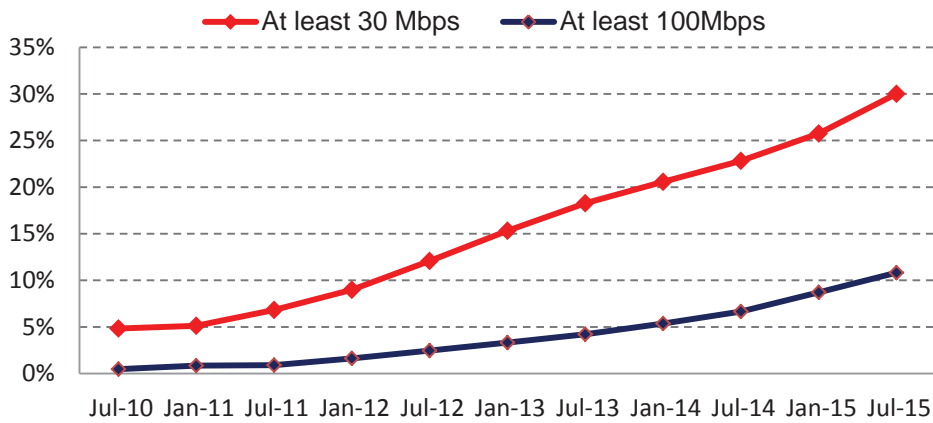


Fast and ultrafast broadband subscriptions grew by 36 % in 12 months. In Belgium, Latvia and Romania, the majority of subscriptions are at least 30 Mbps. Ultrafast (at least 100 Mbps) is most widespread in Belgium and Romania.

Despite the growth in fast and ultrafast subscriptions, they are still rare in the EU. In January 2015, only slightly more than one in four subscriptions were at least 30 Mbps and only 9 % were at least 100Mbps.

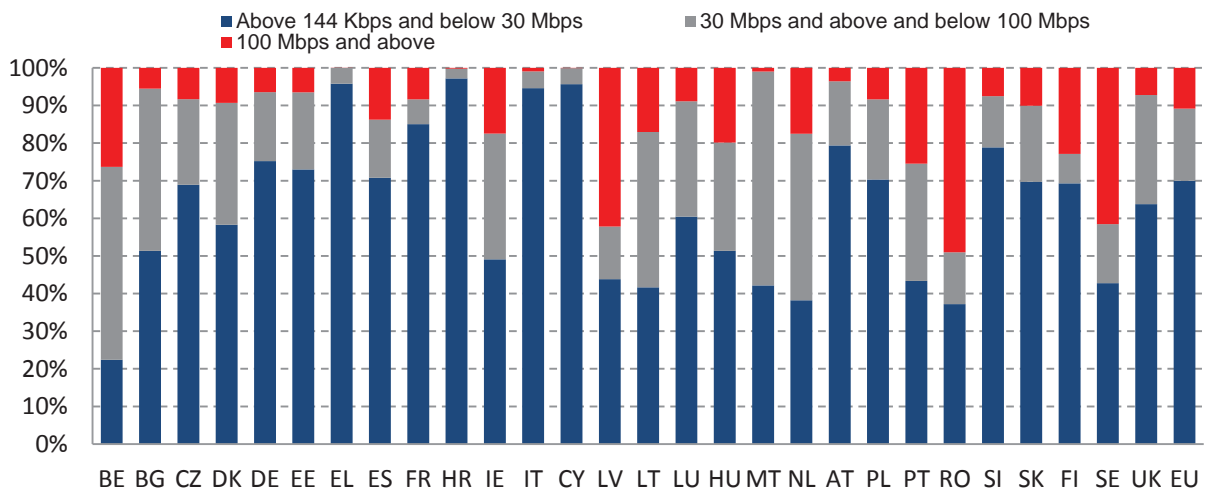
In Belgium, Romania, Malta, Latvia, Portugal, Lithuania, Ireland, the Netherlands and Sweden, more than 50 % are already at least 30Mbps, while the same ratio is less than 10 % in Italy, Greece, Cyprus and Croatia. In ultrafast (at least 100 Mbps), Sweden, Latvia and Romania are the most advanced with more than 40 % of subscriptions.

Figure 14 - Fixed broadband subscriptions by headline speed at EU level, 2008-2015



Source: Communications Committee

Figure 15 - Fixed broadband subscriptions by headline speed, July 2015



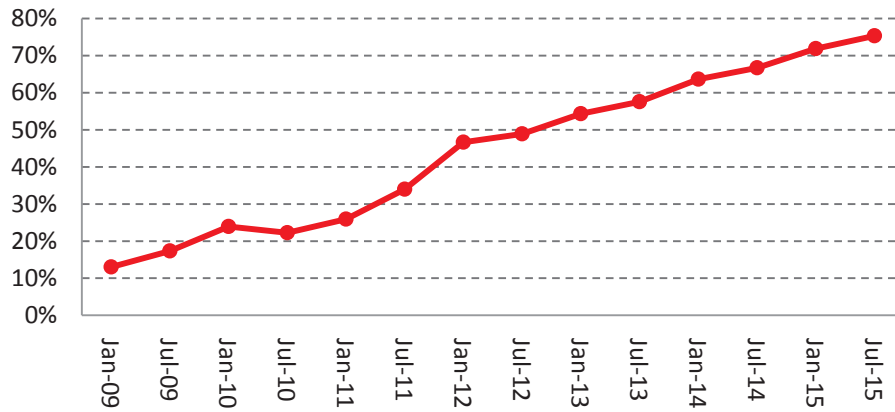
Source: Communications Committee

There are 75 active mobile broadband SIM cards per 100 people in the EU, up from 34 four years ago. The growth was linear over the last three years with over 40 million new subscriptions added every year.

Mobile broadband represents a fast growing segment of the broadband market. More than 60% of all active mobile SIM cards use mobile broadband.

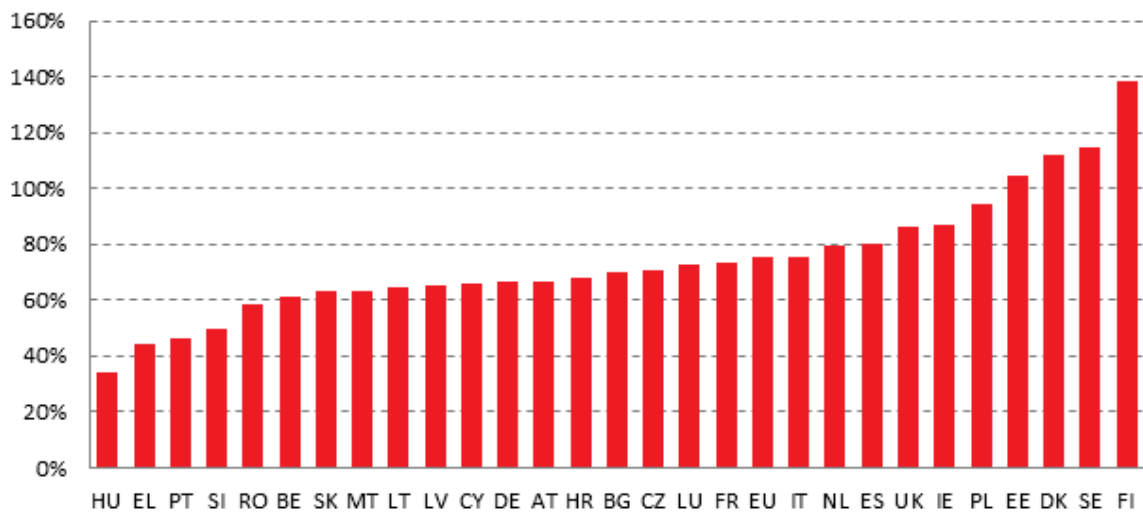
In the Nordic countries and Estonia, there are already more than 100 subscriptions per 100 people, while in Hungary, Greece, Portugal and Slovenia the take-up rate is still below 50%. Most of the mobile broadband subscriptions are used on smartphones rather than in tablets or notebooks.

Figure 16 - Mobile broadband penetration at EU level, January 2009 - July 2015



Source: Communications Committee

Figure 17 - Mobile broadband penetration at EU level, January 2009 - July 2015



Source: Communications Committee

Mobile broadband traffic: Tablets are expected to be the touchstone for mobile data traffic in 2020, exceeding smartphones and laptops in average usage. Mobile data traffic in 2020 is expected to be 6-fold higher than in 2015.

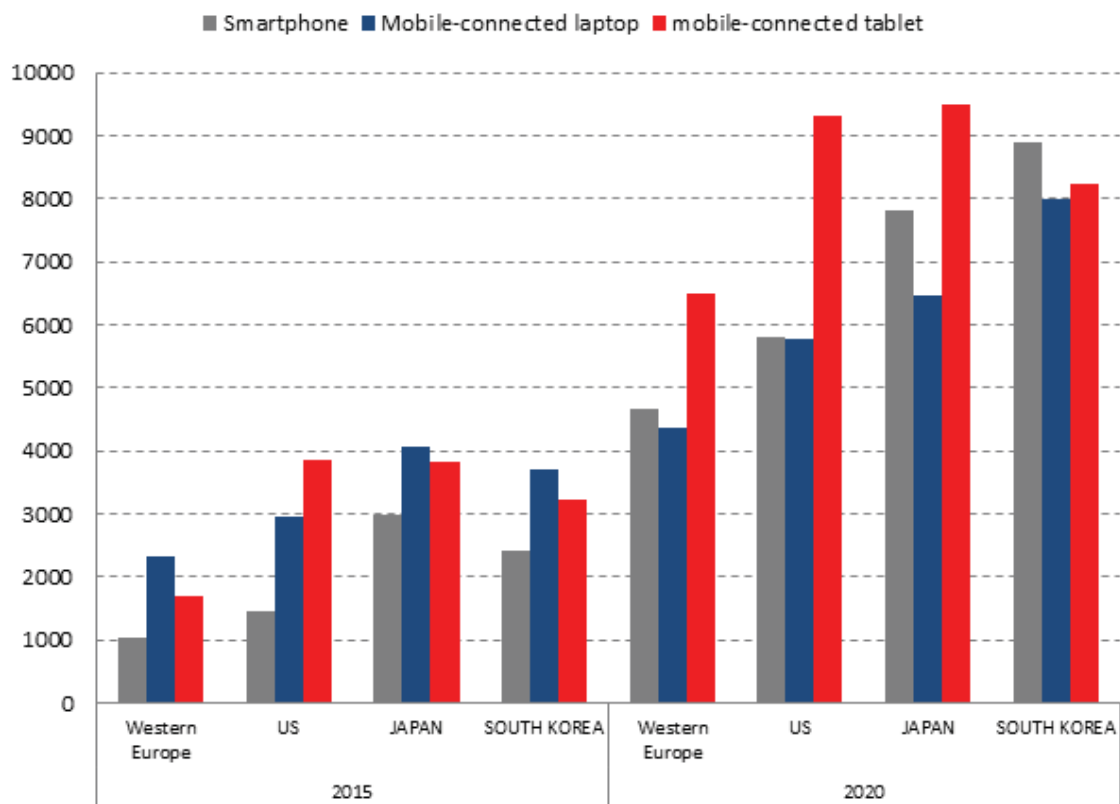
Mobile data traffic in Western Europe is expected to grow by 6-fold from 2015 until 2020, which represents a higher growth compared to the US (x6), South-Korea (x5) and Japan (x4). Indeed, mobile data traffic will grow 2 times faster than fixed IP traffic from 2015 to 2020.

The average smartphone user in Western Europe will generate 4.6 Gb of mobile data traffic per month in 2020, up by 353% from 2015. Laptop users will generate 4.4 Gb and tablets user more than 6GB.

Tablet devices in Europe will overtake mobile-connected laptops and smartphones in total data traffic. Currently, in Western Europe, tablets represent 33% of total mobile traffic. In 2020, their share will be 42%, while in South-Korea and Japan tablets will weigh less than 40% of total mobile traffic.

As for the US, tablets will represent 44% of total mobile traffic by 2020, with 9Gb per month per user, as opposed to 6Gb in the EU.

Figure 18 - Mobile data traffic per type of device and region, Megabytes per month, 2015 - 2020



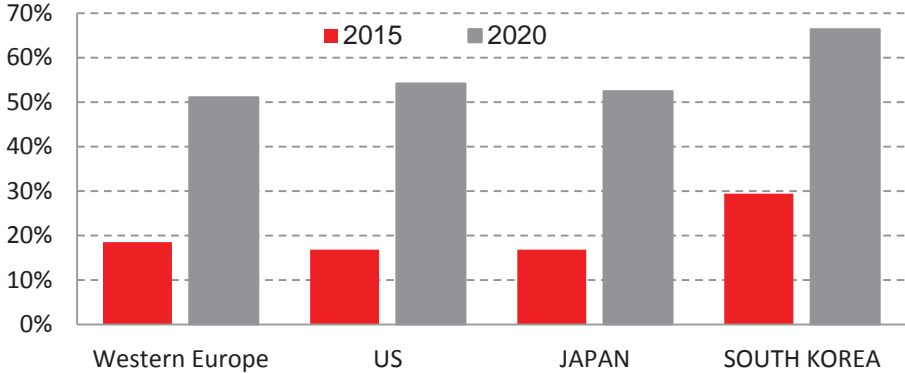
Source: Cisco, VNI Forecast Highlights

Machine-to-Machine communications: In Western Europe, M2M modules currently generate 3% of total mobile data traffic. By 2020, this figure will go up to 11.6%, while M2M modules will represent more than half of the total connected mobile devices in Western Europe.

Machine-to-Machine communications on mobile networks will continue to increase rapidly both in terms of traffic and the number of devices. M2M currently represents 19% of all connected mobile devices; this ratio is forecasted to go up to 51% by 2020 in Western Europe. M2M traffic will also expand, but will still take a relatively low share of total traffic on mobile networks (12%).

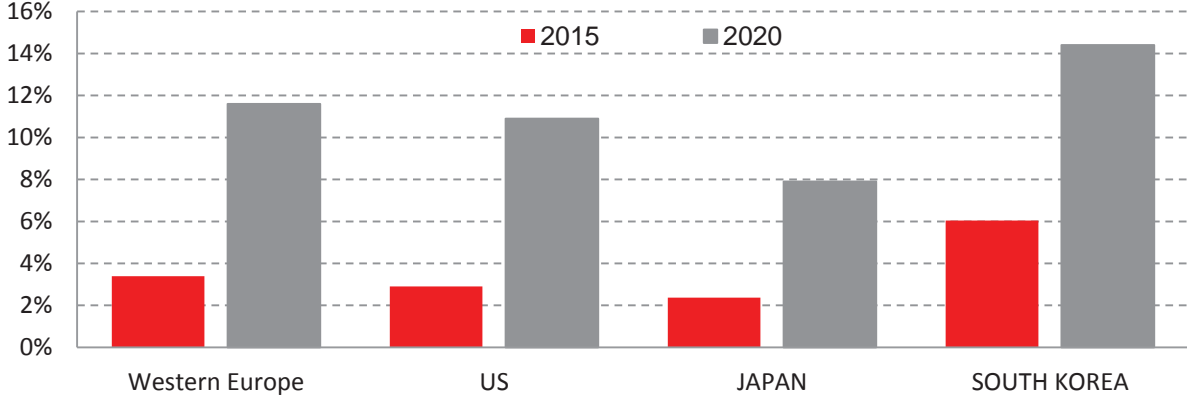
The US and Japan will show similar figures, while in South Korea both traffic and number of M2M devices will be significantly higher proportionally.

Figure 19 - Percentage of M2M modules of device connections by region, 2015 - 2020



Source: Cisco, VNI Forecast Highlights

Figure 20 - M2M traffic as a percentage of total mobile data traffic by region, 2015 - 2020



Source: Cisco, VNI Forecast Highlights

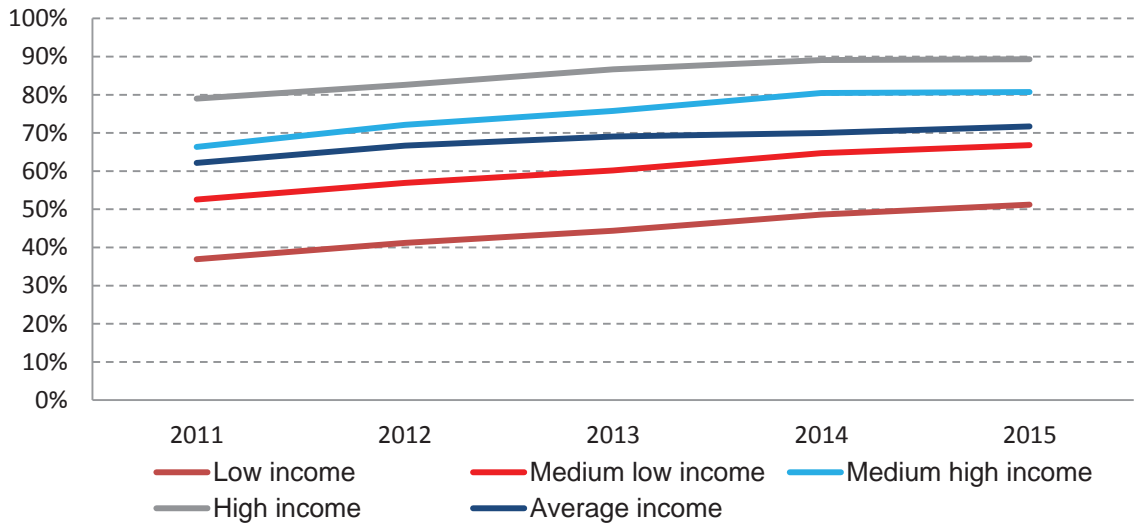
Broadband take-up tends to be lower in MS where the cost of broadband access accounts for a higher share of income, but the correlation is not strong. The lowest income quartile of the EU population has a significantly lower take-up rate.

Considering overall take-up, European average is 72 % of homes with Luxembourg, the Netherlands at the highest positions and Italy, Bulgaria and Poland lagging behind.

Statistics show that income plays an important role in subscription rates. The lowest income quartile has only 51 % take-up of fixed broadband as opposed to 89 % in the highest income quartile.

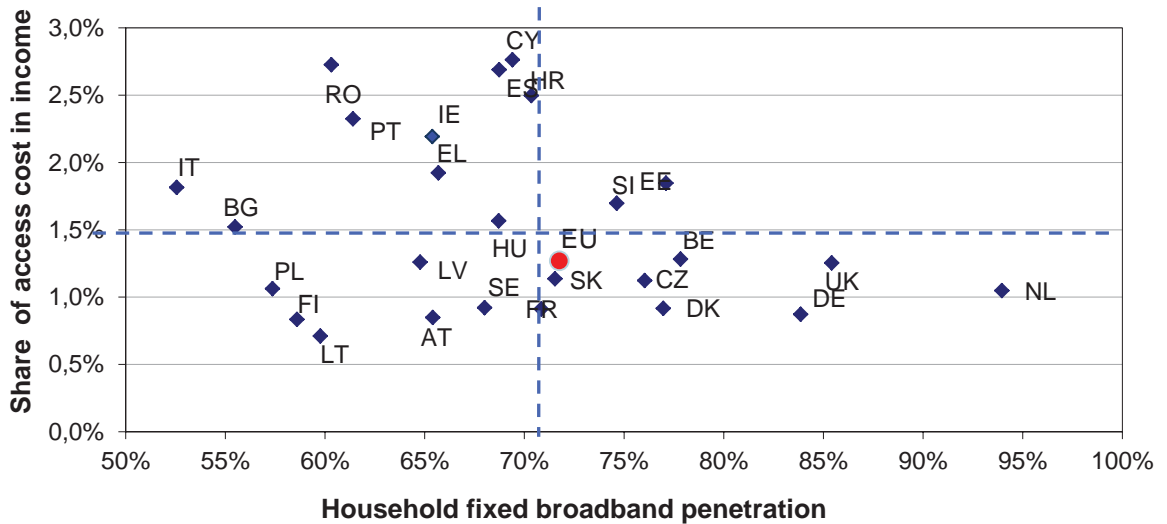
The lag in the lowest income quartile when compared with the national average is evident in Bulgaria, Romania, Hungary, Slovenia, Lithuania, Czech Republic, Croatia, Spain and Slovakia.

Figure 21 - Fixed broadband household penetration by income quartiles at EU level, 2011-2015



Source: Eurostat

Figure 22 - Household fixed broadband penetration and share of broadband access cost (standalone 12-30Mbps download) in disposable income, 2015⁴¹⁸



Source: Commission services based on Eurostat and Van Dijk

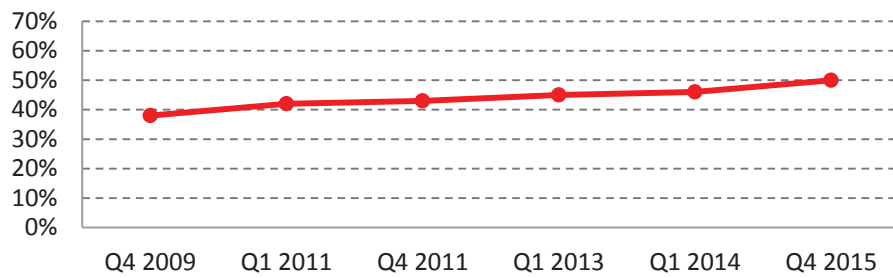
Half of all EU households subscribed to bundled communications services in 2015. 80 % of bundles include internet access. Fixed telephony + internet is the most popular type of bundle.

50 % of all EU households purchase bundled communications services, up from 38 % six years ago. The most popular bundle is fixed telephony + internet followed by ‘triple play’: fixed

⁴¹⁸ Data not available for Luxembourg and Malta.

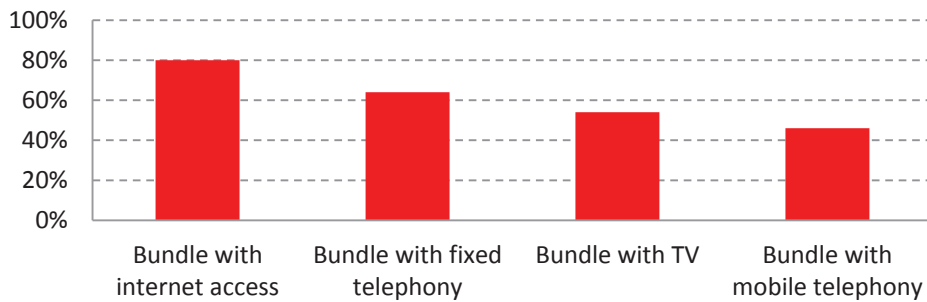
telephony + internet + TV. Internet access (either fixed or mobile) is present in 80 % of all service bundles, fixed telephony in 64 %, TV in 54 % and mobile telephony in 46 %.

Figure 23 - Percentage of households subscribing to bundled services at EU level, 2009-2015



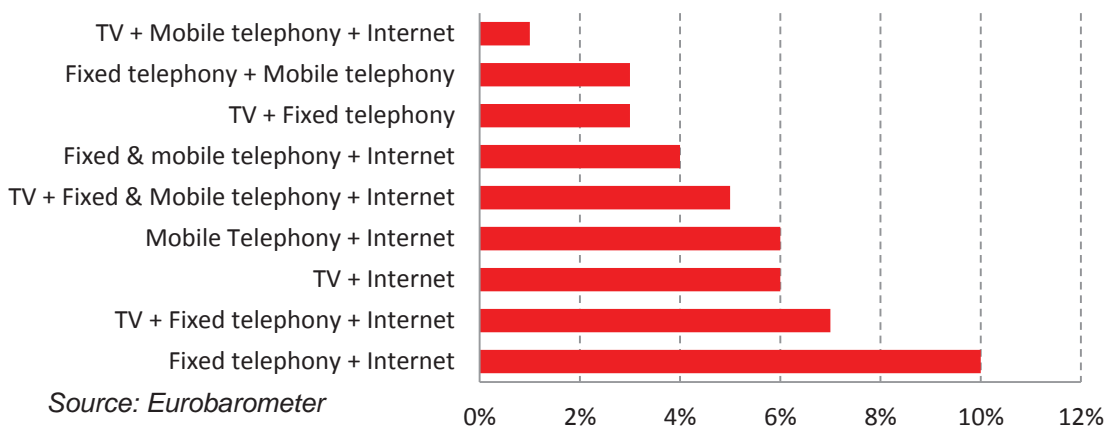
Source: Eurobarometer

Figure 24 - Popularity of different services in bundles at EU level, 2015



Source: Eurobarometer

Figure 25 - Popularity of different bundles (% homes with subscriptions) at EU level, 2015



Source: Eurobarometer

Prices of mobile voice+data plans vary greatly across Europe. In comparison with the US, the EU is cheaper for lower usage baskets, and more expensive for high-end packages.

Looking at the usage basket of 300 voice calls and 1GB data usage on handset, minimum prices range between €13 and €73 with an EU average of €31.

The cheapest countries are Estonia, Lithuania, Denmark and the UK with minimum prices below €15. At the same time, prices are very high (>€60) in Hungary, Malta and Greece.

The EU on average has much lower prices than the US for the 0.1GB+30 calls and the 0.5GB+100 calls baskets, however, on the 2GB+900 calls basket, the US is by close to 30% cheaper than the EU⁴¹⁹.

Figure 26 - Mobile broadband prices (EUR PPP) - handset use in the EU and the US, 2015

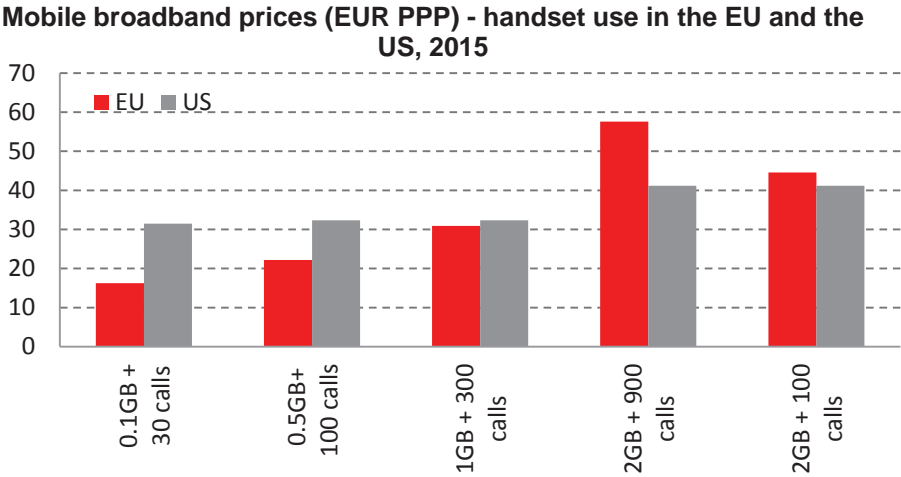
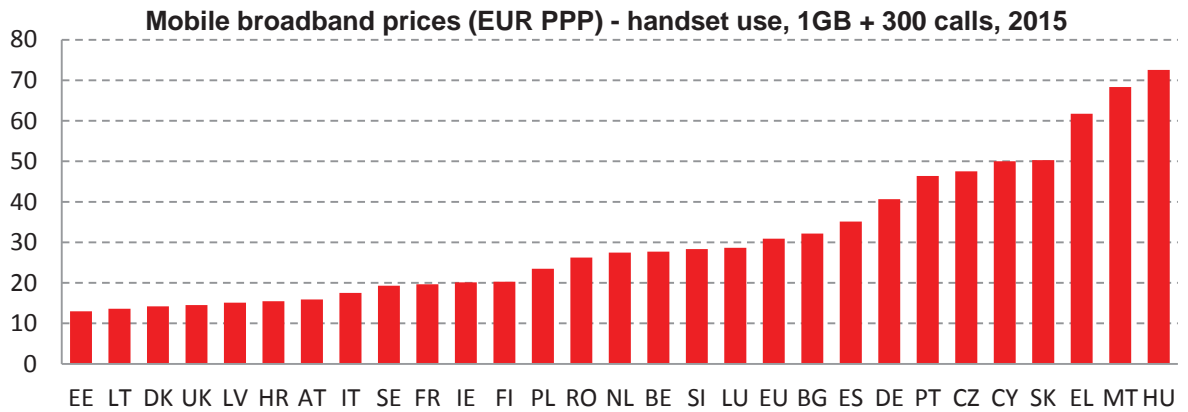


Figure 27 - Mobile broadband prices (EUR PPP) - handset use, 1GB + 300 calls, 2015

⁴¹⁹ Source: SMART 2014/0049 - Mobile Broadband prices (February 2015) <https://ec.europa.eu/digital-single-market/en/news/mobile-broadband-prices-february-2015>. This study was carried out for the European Commission by Van Dijk.



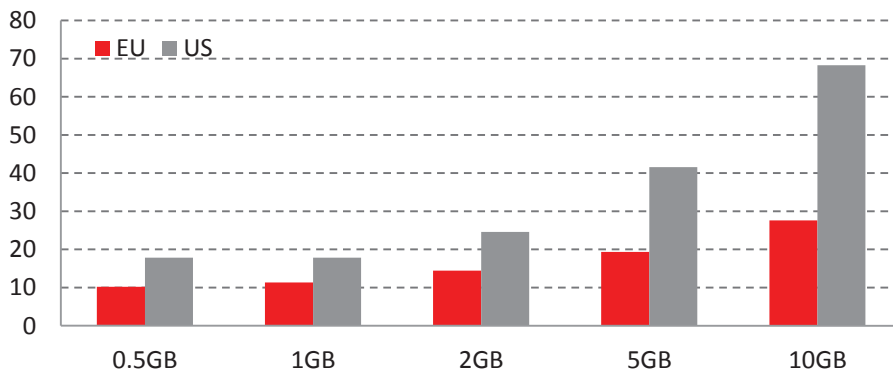
Prices of mobile broadband plans for laptops also show large differences across Europe. In comparison with the US, the EU is cheaper for all usage baskets.

Looking at 5GB data-only plans for laptops, minimum prices range between €10 and €46. The EU average (€19) is below the price of fixed standalone offers of 12-30Mbps.

The cheapest countries are Austria, Italy, Finland, Denmark and Poland with prices below €12. At the same time, prices are very high (>€30) in Cyprus, Spain, Czech Republic and Croatia.

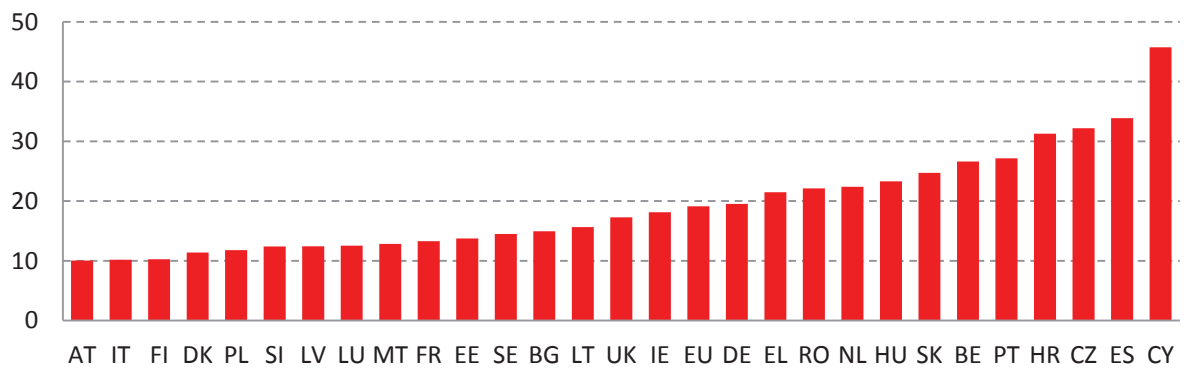
The EU on average has much lower prices than the US for all the laptop baskets⁴²⁰.

Figure 28 - Mobile broadband prices (EUR PPP) - laptop use in the EU and the US, 2015



⁴²⁰ Source: SMART 2014/0049 - Mobile Broadband prices (February 2015) <https://ec.europa.eu/digital-single-market/en/news/mobile-broadband-prices-february-2015>. This study was carried out for the European Commission by Van Dijk.

Figure 29 - Mobile broadband prices (EUR PPP) - laptop use, 5GB, 2015



1.3.3 *Technical annex on technologies and medium*

In the context of constantly increasing IP traffic, resources such as numbering or spectrum become more and more scarce. In spite of industrial development of more sophisticated and optimised solutions of spectrum usage for wireless data transmissions or of other transport media like copper or fibre, the laws of physics as currently understood are showing a clear unused capacity potential for certain technologies. Just comparing the fundamental properties of physical media available for future technologies which could appear over the air, copper or fibre, electrical signal speed is just two thirds of the speed of light. Fibre has an efficiency range of dozen of kilometres while copper G.fast is effective only over 250 m or so. More significantly, fibre theoretical capacity of frequency bandwidth is 50 000 GHz against 0.2 GHz for twisted copper.

Concerning broadband technologies we are observing on the one hand a tendency of boosting equipment around a copper pair or wireless path in order to use higher and higher spectrum in the fixed line or over the air over shorter and shorter distances; and on the other hand, evolution of optical devices in order to consume more and more of the unused already available spectrum of the fibre while keeping or improving the efficiency range.

As suggested by the SMART 2015/0005 support study, the continuous reliance on the existing copper-based infrastructure may hinder the development and take-up of certain applications if the most demanding scenario in terms of bandwidth needs materialises. The new concept of VHC takes into consideration a number of parameters in terms of quality of transmission (speeds, latency, jitter, etc.), that will define performance in a broader sense than understood today (with a current focus almost exclusively on download speeds).

Table 3 - Table of mediums and technologies

Medium	Technologies	Down/Upstream Rate ⁽¹⁾	Efficiency range ⁽¹⁾	Typical latency ⁽²⁾	Shared medium for last mile?	Frequency bandwidth ⁽³⁾	Infrastructure architecture	Suitability	Future of the technology
copper	Wired								
	ADSL, ADSL2, ADSL2+	24/1 Mbps	5 km	15-40 ms	no	0,0022 GHz	internet access by transmitting digital data over the wires of a local telephone network copper line terminates at telephone exchange (ADSL) or street cabinet (VDSL) - Vectoring: Elimination of cross talks for higher bandwidths - G.Fast: Frequency increase up to 2.12 MHz to achieve higher bandwidth	<ul style="list-style-type: none"> use of existing telephone infrastructure fast to install small efficiency range due to the line resistance of copper connection lines 	<ul style="list-style-type: none"> further speed and range improvements by enhancing and combining new DSL-based technologies (phantom mode, bonding, vectoring) bridge technology towards complete fibre optic cable infrastructure
	VDSL, VDSL2, Vectoring	100 / 40 Mbps	1 km	15-40 ms	no	0,017 GHz			
	G.Fast	500/500 Mbps	250 m	15-40 ms	no	0,212 GHz			
	CATV	200/100 Mbps ⁽⁴⁾	2-100 km ⁽²⁾	15-40 ms	yes	1 GHz	<ul style="list-style-type: none"> coaxial cable in streets and buildings; fibre at the feeder segments network extensions to provide backward channel functionality 	<ul style="list-style-type: none"> use of existing cable television infrastructure fast to install high transmission rates 	<ul style="list-style-type: none"> Further implementation of new standards (DOCSIS 3.1) will allow to provide higher bandwidth to end-users
fiber	Optical								
	p2p p2mp	1/1 Gbps (and more)	10-60 km	0.3 ms (5 μs per km)	no yes	50000 GHz	<ul style="list-style-type: none"> signal transmission via fibre distribution of signals by electrically powered network equipment or unpowered optical splitters 	<ul style="list-style-type: none"> highest bandwidth capacities high efficiency range high investment costs bandwidth depends on the transformation of the optical into electronic signals at the curb (FTTC), building (FTTB) or home (FTTH) 	<ul style="list-style-type: none"> next generation technology to meet future bandwidth demands
air	Wireless								
	LTE (Advanced)	100/30 (1000/30) Mbps ⁽⁵⁾	3-6 km	5-10 ms	yes	0.1 GHz	<ul style="list-style-type: none"> mobile devices send and receive radio signals with any number of cell site base stations fitted with microwave antennas sites connected to a cable communication network and switching system 	<ul style="list-style-type: none"> highly suitable for coverage of remote areas (esp. 800 MHz) quickly and easily implementable shared medium limited frequencies 	<ul style="list-style-type: none"> commercial deployment of new standards with additional features (5G) and provision of more frequency spectrum blocks (490 - 700 MHz) meets future needs of mobility and bandwidth accessing NGA- Services
	HSPA	42,2 / 5,76 Mbps	3 km	30-70 ms	yes	0.005 GHz			
	Satellite	20/6 Mbps	High	500-700 ms	yes	10 GHz		<ul style="list-style-type: none"> highly suitable for coverage of remote areas quickly and easily implementable run time latency asymmetrically 	<ul style="list-style-type: none"> 30 Mbps by 2020 based on next generation of high-throughput satellites
	Wi-Fi	300/300 Mbps	300 m	100 - 1000 ms	yes	0.005-0.160 GHz ⁽⁷⁾		<ul style="list-style-type: none"> inexpensive and proven quickly and easily implementable small efficiency range shared medium 	<ul style="list-style-type: none"> increased use of hotspots at central places
	WiMAX	4/4 Mbps	60 km	50 ms	yes	0.01 GHz			<ul style="list-style-type: none"> gets continually replaced by Wi-Fi and LTE

Legend:

1 Technical standard max.

2 Depends on amplification

3 Depends on the frequency spectrum used

4 EuroDOCSIS

5 Usual practical values depending on distance

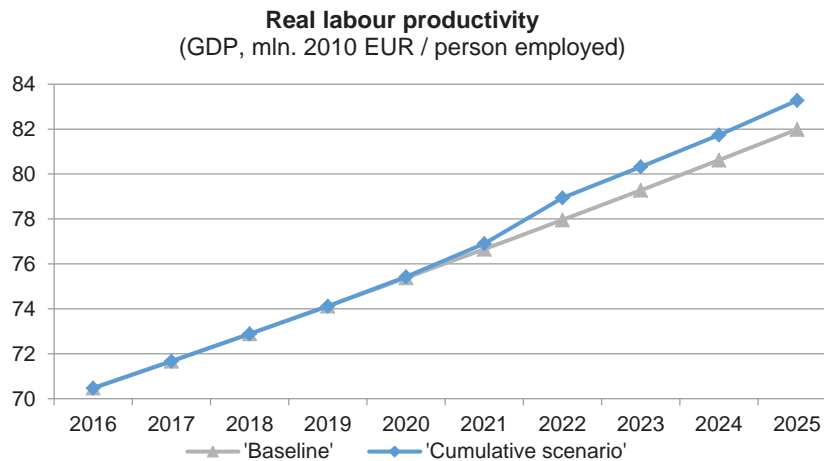
6 difference between the upper and lower usable frequencies for signals transmission

ANNEX 7 - Impact on competitiveness and innovation

1.4.1 Impact on competitiveness

The results of the CGE modelling also provide some indications as regards the implications of changes to the framework on labour productivity – one measure of EU competitiveness. In the cumulative scenario case, where preferred policy options are implemented in all areas, real labour productivity will exceed the baseline by an average of 1% for the period 2020-2025. This is equivalent to an average of 0.3 percentage points higher growth rate of productivity in the simulation scenario as compared to the baseline.

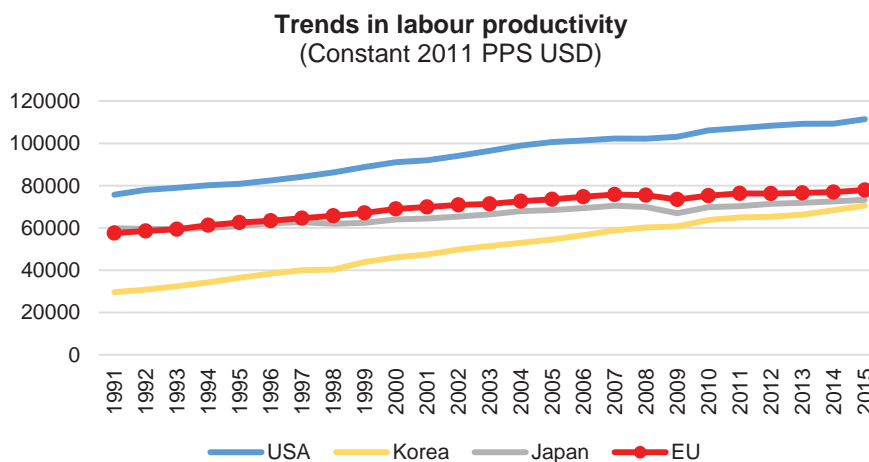
Figure 30 - Real labour productivity (preferred options vs status quo)



Source: Eurostat, own calculations

Viewed in international perspective, historically over the past quarter century labour productivity growth in EU has been lagging by an average of 0.4 percentage points as compared to the US and by 2.4 percentage points as compared to Korea (due its lower base). One can realistically expect productivity growth acceleration in the US and Korea in the forthcoming years as well. Despite this, the implementation of the considered policy changes should make a significant contribution towards boosting EU productivity, and potentially closing the gap.

Figure 31 - Trends in labour productivity – international comparisons



Source: World Bank, World Development Indicators database

1.4.2 Potential for disruptive change through innovation

The assumption underlying the CGE model is that clearer regulation of communication services and better connectivity will allow all sectors of the economy to operate more efficiently and realise higher total factor productivity rates.

In addition, the implementation of the preferred policy options might give a significant boost to innovation. Such innovation effects are particularly relevant in view of the fact that the review of the electronic communications framework could support the development and use of the ‘Internet of Things’ (IoT)⁴²¹ and digitalization of industry inter alia by fostering:

- More regulatory certainty for all players throughout the IoT value chain contributing to a better investment climate;
- Levelling barriers for scaling up in Europe (by reducing regulatory heterogeneity) to the benefit of start-ups entering as new players shaping the IoT value chain.
- Improving connectivity for SIM based M2M services;
- End-users confidence about security, privacy and confidentiality⁴²².
- Faster adoption of 5G; and
- A more ubiquitous roll-out of fibre networks to homes and lamp posts as to provide a backbone with the stability and low latency that is required by many IoT applications.

In turn, IoT implies an increased role for communication services in (and increased dependency on connectivity by) various industries, including automotive, agriculture, health, transport, etc. As such, policies which unlock the full potential of IoT and the digitization of industry could trigger a so-called “disruptive growth path”⁴²³.

It is not possible to estimate ex ante the impact of such structural economic changes on the basis of CGE modelling. Therefore, the CGE estimates should be treated as a lower bound. Assessing the impact of disruptive structure changes would require a case study approach examining how precisely production processes would change as a consequence of a progressing IoT. Such analysis has been done by McKinsey (2015) “The internet of things: mapping the value beyond the hype” which analyses a number of IoT use cases⁴²⁴ involving sectors that are key for EU competitiveness.

- IoT will particularly increase **productivity and innovation** in sectors that are considered essential for Europe’s **global competitiveness** (such as automotive⁴²⁵ and electrical

⁴²¹ BEREC (2016) and McKinsey (2015) identify a number of key enablers that contribute to unlocking the full potential of the IoT. Key enablers are optimal fixed and mobile connectivity (which is realised through policy measures with regards to access, spectrum and numbering), regulatory security for new players in the IoT value chain (which is realised by clarifying the scope of the RF) as well as end-users confidence about security, privacy and confidentiality.

⁴²² The reason, as explained by BEREC and McKinsey, is that new categories of risks are introduced by the Internet of Things. McKinsey argues that more devices means more opportunities for potential breaches and BEREC argues that “[d]ue to limited resources in terms of energy and computing power, [...] IoT devices may be vulnerable to cyber-attacks”. Furthermore, McKinsey argues that the impact of a data breach is much larger in the context of the IoT. “when IoT is used to control physical assets, whether water treatment plants or automobiles, the consequences associated with a breach in security extend beyond the unauthorized release of information—they could potentially cause physical harm”. BEREC concludes that “If users do not trust that their data is being handled appropriately there is a risk that they might restrict or completely opt out of its use and sharing, which could impede the successful development of IoT.”

⁴²³ See: “Information Technologies and Labour Market Disruptions - A Cross-Atlantic Dialogue” background document by the “interdisciplinary, cross-sector roundtable organised by the European Commission (DG Enterprise and Industry and DG Communication Networks, Content and Technology) in cooperation with The Conference Board and Cornell University ILR School” 3/11/2014, p. 11

⁴²⁴ Outside, Home, Human, Cities, Factories, Worksites, Offices, Retail, environments, and Vehicles,

⁴²⁵ BEREC BoR(16)39 as well as McKinsey (2015) identify automotive as key sector that will adopt IoT applications. At the same time, it is considered a strategic sector of the EU economy http://ec.europa.eu/growth/sectors/automotive/index_en.htm

engineering⁴²⁶). Realising the full potential of the IoT in Europe contributes to maintaining/strengthening that position. Not realising the full potential of the IoT in Europe may lead to other parts of the world overtaking that position.

- IoT will also increase **productivity and innovation** in as well as in agriculture⁴²⁷ which is an essential sector for the **regional competitiveness** of Europe's peripheral areas⁴²⁸.
- Furthermore, IoT contributes to **cost savings** in a wide variety of other sectors such as E-health, smart metering/grids, smart homes and cities, etc.

McKinsey estimates for the global economy that by 2025, the full potential of IoT amounts to approximately 3.9 to 11.1 trillion dollars per year (including consumer surplus). In terms of % of global GDP this amounts to 3.3% to 9.4% according to our own calculations.⁴²⁹ If Europe could realise a similar gain by fostering key IoT enablers, this would amount to an additional GDP of 0.56 and 1.59 trillion euros in the year 2025.⁴³⁰

The contributions to European competitiveness that could be made from the proposed changes to the EU regulatory framework are summarised in the following table.

⁴²⁶ Electrical engineering is a sector in which the EU is the global leader and which will benefit greatly from the ongoing growth in mobile devices see: http://ec.europa.eu/growth/sectors/electrical-engineering/index_en.htm

⁴²⁷ BEREK BoR(16)39 as well as McKinsey (2015) identify agriculture as key sector that will adopt IoT applications.

⁴²⁸ Thissen, van Oort, and Diodato (2013)

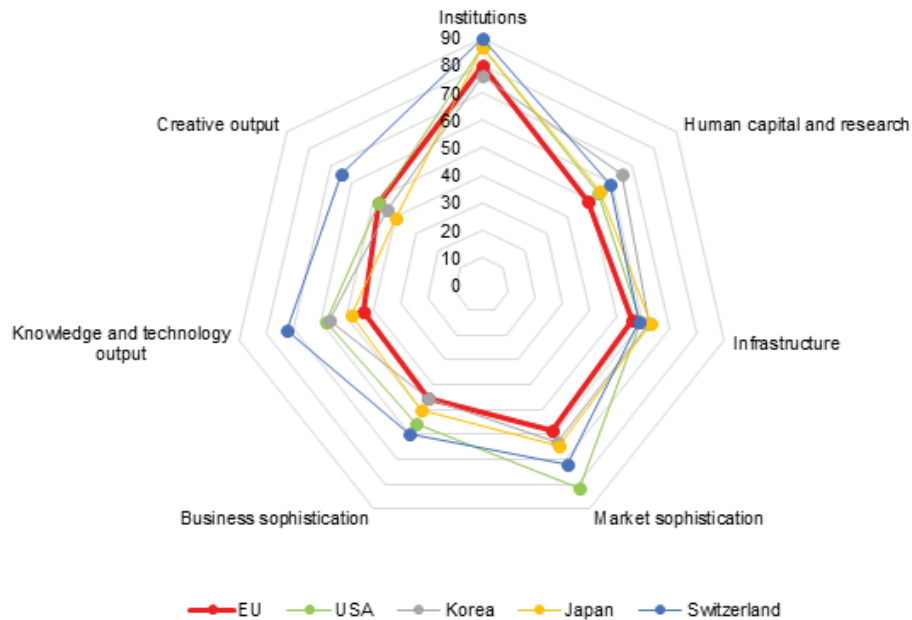
⁴²⁹ On the basis of data and forecasts provided by the Conference board, global GDP may grow from 88 trillion dollars in 2015 to 117 trillion dollars in 2025, not accounting for a disruptive boost like the IoT. As such, the IoT may create up to 3.3% to 9.4% additional income at global level by 2025. See <https://www.conference-board.org/data/economydatabase/index.cfm?id=27762> and <https://www.conference-board.org/data/globaloutlook/index.cfm?id=27451>

⁴³⁰ Assuming the EU economy has grown to 16.58 trillion euros by 2025 (based on forecasts by the Conference board). 0.33% of 16.58 trillion euros = 0.56 trillion euros. 9.4% of 16.58 trillion euros = 1.59 trillion euros

Table 4 - Overview of competitiveness impacts

	Access	Spectrum	Services
Cost competitiveness	High bandwidth connectivity supports the digitalisation of services, reducing cost and time to market. Standardising wholesale products used for business should also reduce costs and increase efficiency within cross-border organisations	The prevalence of general authorisations will make access to spectrum more affordable and lower administrative / regulatory costs. This is of particular benefit to smaller companies with more limited resources	The reduction of administrative burden and of regulatory heterogeneity realises cost savings for telecom operators.
International competitiveness	Access policies are likely to boost infrastructure deployment in Europe, closing the investment gap with other economies. Increased bandwidth is likely over time to support increased use of digital services and the attractiveness of the EU as a platform for technological and service development.	Device manufacturers will benefit from EU single market, offering significant scaling opportunities, and producing devices that are able to operate in “European” bands.	Less regulatory heterogeneity contributes to the realisation of a digital single market which facilitates a faster scale-up of European start-ups in the global digital economy.
Innovation competitiveness	The deployment of fibre to lampposts and homes supports 5G development, and new applications. A connected economy may also drive disruptive change in business processes	The prevalence of general authorisation will open up spectrum access to innovative services, faster roll-out of 4G/5G will foster development of new services based in Europe.	More clarity and equality throughout the value chain with regards to regulation reduces regulatory risk for new (small medium sized and large) players. This increases their willingness to invest and innovate

A key challenge however in realizing the benefits we have identified from innovations including those stemming from IoT is the capability of European businesses to leverage innovation. For example, comparing EU⁴³¹ innovation capacity and results against peer economies, according to the Global Innovation Index for 2015,⁴³² the EU seems to be lagging behind in terms of many aspects of innovation,⁴³³ although some countries within Europe including Finland, Sweden, Luxembourg, Denmark and Germany are reported to be relatively strong in making use of innovations specifically in ICT.



Source: Global innovation index, own calculations

If benefits are to be fully realized, this highlights the need for levelling up within Europe, not only in terms of supply-side policies for electronic communications including the regulatory environment, but also – importantly – on initiatives to support the absorption of new technologies within businesses of all sizes.

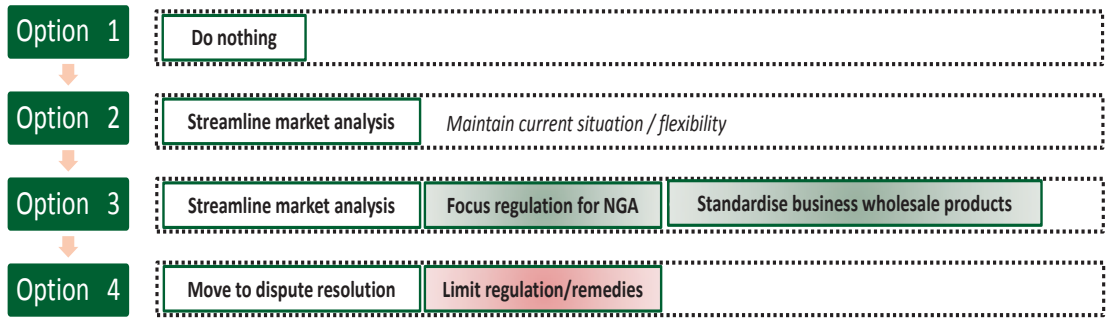
⁴³¹ EU figures are derived aggregating the member states scores, weighting them with the respective country population.

⁴³² The Global Innovation Index is an annual ranking of countries by their capacity for, and success in, innovation. It is published by INSEAD and the World Intellectual Property Organization, in partnership with other organisations and institutions. It is based on both subjective and objective data derived from several sources, including the International Telecommunication Union, the World Bank and the World Economic Forum.

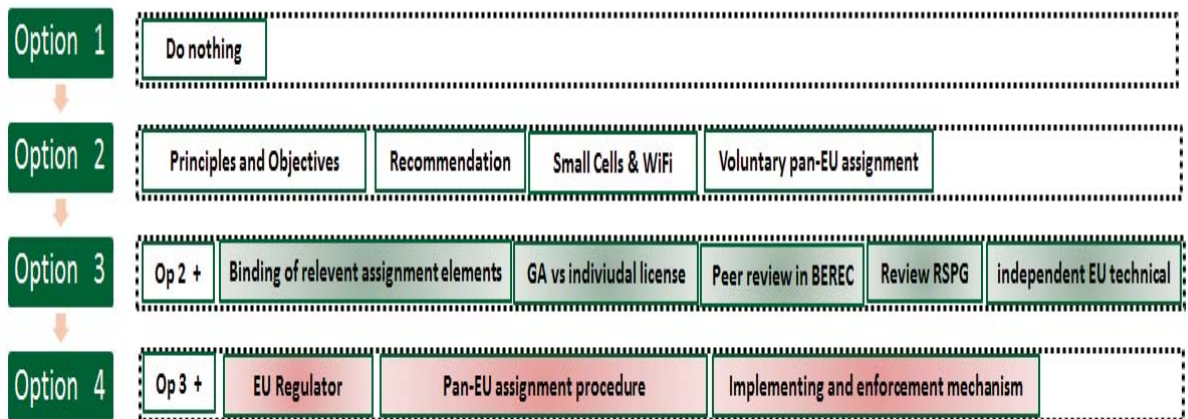
⁴³³ There are clear differences for the business sophistication pillar of the index, which includes knowledge workers and R&D activities performed in the business sector, links between the business sector and the academia and means of knowledge absorption. Another aspect where EU is performing relatively worse concerns indicators for ‘knowledge and technology’ including knowledge creation, diffusion and impact.

ANNEX 8 – Options diagrams

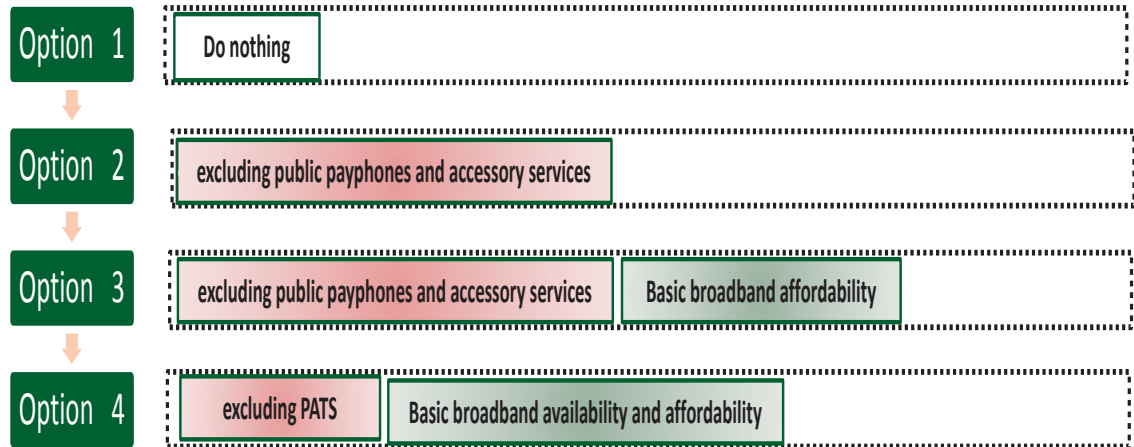
1.5.1 Access options



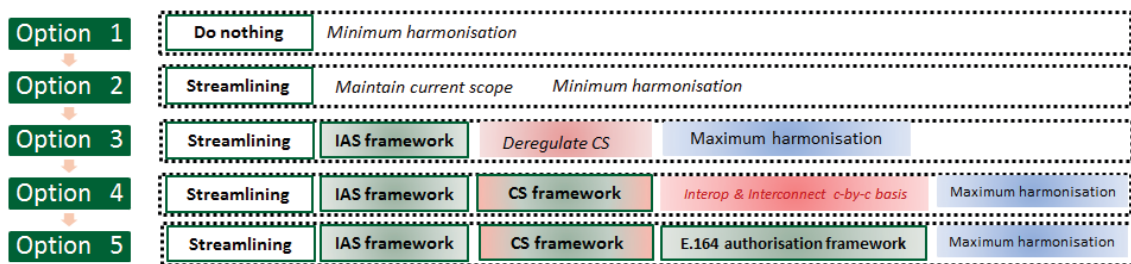
1.5.2 Spectrum options



1.5.3 USO options



1.5.4 Services options



Costs

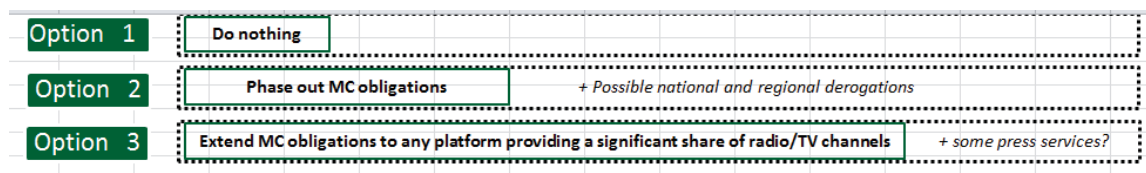
Green shaded: moderate enforcement, compliance and adjustment costs

Orange shaded: costs in terms of less privacy protection

Red shaded: high regulatory enforcement and compliance costs + increased regulatory risks

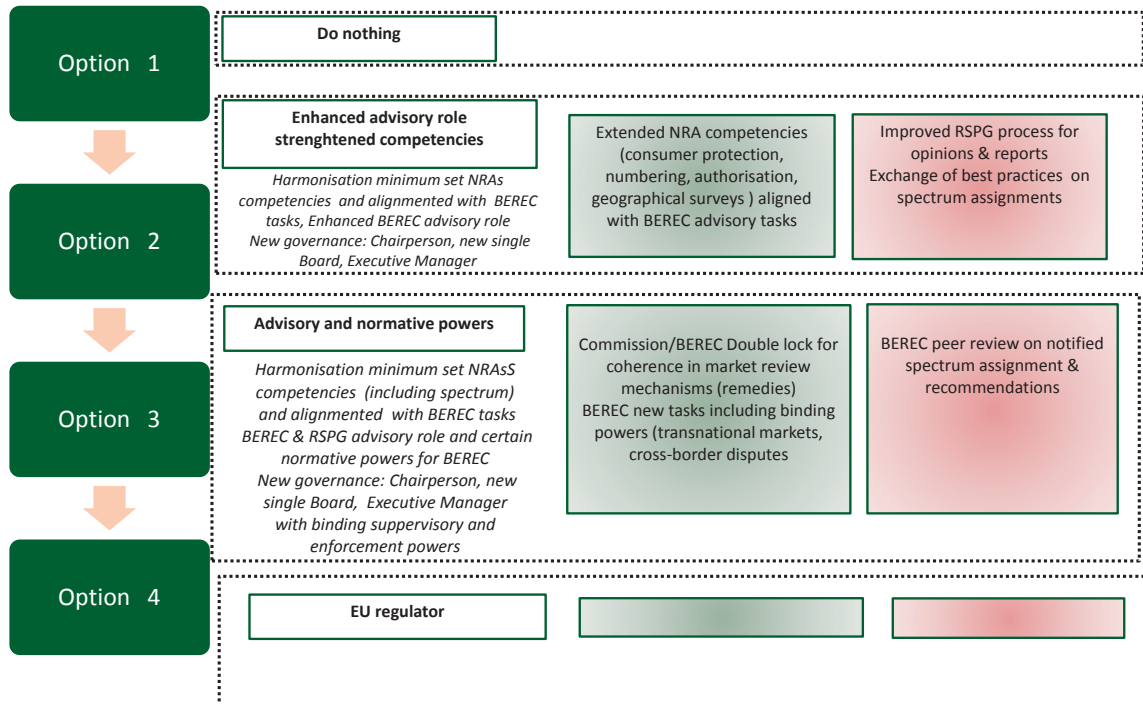
Blue shaded: costs of reduction in national flexibility

(size of which depends on heterogeneity of preferences and degree of harmonisation of horizontal rules)



Option 1	Do nothing		
Option 2	Streamlining	<i>Maintain current scope</i>	
Option 3	Adapt rules to the nascent M2M market	<i>E.212 numbers for M2M</i>	<i>Harmonised extra-territorial use of numbers</i>

1.5.5 Governance



ANNEX 9 - The connectivity strategy: a European Gigabit Society

This annex spells out the rationale behind the connectivity strategy for a European Gigabit Society by 2025. The Communication accompanying the review of the telecoms framework will introduce the policy context and the ambitions for Europe in the coming years. In this annex we review the process followed and the evidence underpinning the need for a Gigabit society.

1.6.1 *The public consultation on internet speeds and the new ambitions*

Adequate connectivity is a prerequisite to achieve a genuine DSM. This is why the DSM Strategy announced that the review of the Telecom Framework's focus would include "*incentivising investment in high speed broadband networks*". This is also why President Juncker and VP Katainen have made of telecommunications one of the priority areas for strategic investment under the regulation setting up the European Fund for Strategic Investment. DG CONNECT has then, over the last year, gathered evidence on Internet connectivity needs beyond 2020:

- We have held bilateral meetings not just with the telecom operators but also with various user sectors' representatives.
- We have analysed connectivity facts and figures in available publications and forecasts.
- We have carried out and analysed a full public consultation which focused on speed and quality of internet services.

Overall, the results of these various actions converge: the use of Internet services and applications will substantially increase for both fixed and mobile connectivity and there is a need to prepare now for higher speed (upload and download) and other features of quality of service (latency, resilience, etc.) beyond 2020. The findings of these various steps illustrate the need to:

1. Show greater ambition in terms of both average and maximal speed and other quality parameters beyond 2020, considering expected future developments and the time horizon for investment.
2. Ensure that policy, regulatory and financing instruments support an investment-friendly environment in line with such ambition.

These conclusions echo the call for a definition of Europe's connectivity ambition beyond 2020 from the participants - representatives of the industry, users and local and national public authorities - in the broadband roundtables that Commissioner Oettinger chaired in early 2015. These stakeholders called for defining long-term connectivity ambitions and for better rules and instruments to further deploy broadband infrastructure.

On the need to show greater and longer-term ambition and in line with the mandate given to Commissioner Oettinger by President Juncker to "set clear long-term strategic goals to offer legal certainty to the sector and create the right regulatory environment to foster investment and innovative businesses", **Commissioner Oettinger announced in March his ambition of connectivity for a European gigabit society by 2025**, to be based on 3 pillars:

- Gigabit connectivity for socio-economic drivers, starting with schools, hospitals, libraries, public administration and business centres.
- Future-proof ubiquitous connectivity to support all forms of mobility.
- Improved connectivity in rural areas.

While the DAE targets should remain valid up to 2020, the expected uses' evolution and technological developments as well as the time horizon for investment (investment cycles

needed for such broadband infrastructure projects run over 5-10 years) call for setting up now longer term objectives for 2025. A study is currently being conducted by the Commission Services to assess the feasibility of the three pillars announced by Commissioner Oettinger and come up with a preliminary estimate of the cost entailed.⁴³⁴

1.6.2 Connectivity and its importance

As mentioned in the main report and in the support studies, there are numerous studies showing that improved Broadband access is beneficial for the society. The positive impact ranges from purely economic GDP growth and unemployment decrease, through battling digital divide and improvement in innovativeness for business and increased employees skills to entertainment possibilities and wellbeing generated by e-health. EGovernment solutions decrease the costs of the local administration and the citizens are more willing to participate in community life (e.g. voting participation).

Czernich et al (2011)⁴³⁵ examined the wider effects of broadband on GDP per capita across the OECD countries, finding that a 10-percentage point increase in broadband penetration raises national annual per capita growth by 0.9-1.5 percentage points. EIB and IMIT⁴³⁶ study proves that higher Broadband speed has positive impact on GDP and it is greater in countries with lower income than countries with higher income. Katz et al. (2010)⁴³⁷ claims that Germany achieving both the broadband penetration and speed targets will create more than 960,000 additional jobs and output worth more than 170 billion euro. Rohman and Bohlin⁴³⁸ (2012) show that increasing the Broadband speed in the OECD countries stimulates GDP growth. The impacts depend on the broadband speed and the existing economic growth in particular country.

Studies conducted by De Stefano et al. (2014)⁴³⁹, Kandilov et al. (2011)⁴⁴⁰, Kim and Orazem (2012)⁴⁴¹, Whitacre et al. (2014a)⁴⁴² show that Broadband can increase the number of businesses – either because it increases firm entry, or because it helps with firms' survival. Akerman et al. (2015)⁴⁴³, Dettling (2013)⁴⁴⁴, Kolko (2012)⁴⁴⁵, Whitacre et al (2014b)⁴⁴⁶ show that Broadband can positively impact on local employment. Employment effects can vary across different types of areas, industries, and workers, with urban areas, service industries and skilled workers possibly benefiting more than rural areas, manufacturing industries and unskilled workers.

⁴³⁴ See SMART 2015/0068

⁴³⁵ Czernich N., Falck O., Kretschmer T., Woessmann L. (2011), Broadband Infrastructure and Economic Growth, *The Economic Journal* 121 (552) May 12, pp, 505-532

⁴³⁶ http://institute.eib.org/wp-content/uploads/2014/04/EIB_broadband-speed_120914.pdf

⁴³⁷ Katz, R. L., Vaterlaus, S., Zenhäusern, P. & Suter, S. (2010). The Impact of Broadband on Jobs and the German Economy. *Intereconomics*, 45 (1), 26-34

⁴³⁸ Rohman, I. and E. Bohlin (2012), Does broadband speed really matter as a driver of economic growth? Investigating OECD countries. *International Journal of Management and Network Economics*, 2012, vol.2, issue 4, pages 336-356

⁴³⁹ De Stefano, T., Kneller, R., Timmis, J., (2014), The (Fuzzy) Digital Divide: The Effect of Broadband Internet Use on UK Firm Performance. University of Nottingham Discussion Papers in Economics. Discussion Paper 14/06.

⁴⁴⁰ Kandilov, AMG, Kandilov, IT, Liu, X, Renkow, M., (2011), The Impact of Broadband on U.S. Agriculture: An Evaluation of the USDA Broadband Loan Program. Selected paper Prepared for Presentation at the Agricultural and Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting. Pittsburgh, Pennsylvania, July 24-26

⁴⁴¹ Kim, Y., Orazem, P., (2012), Broadband Internet and Firm Entry: Evidence from Rural Iowa. Iowa State University Working Paper No. 12026

⁴⁴² Whitacre, B., Gallardo, R., Strover, S., (2014a), Broadband's Contribution to Economic Growth in Rural Areas: Moving Towards a Causal Relationship. *Telecommunications Policy* 38, 1011-1023.

⁴⁴³ Akerman, A., Gaarder, I., Mogstad, M., (2015), The Skill Complementarity of Broadband Internet. *Quarterly Journal of Economics*.

⁴⁴⁴ Dettling, L.J., (2013), Broadband in the Labor Market: The Impact of Residential High Speed Internet on Married Women's Labor Force Participation. Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C.

⁴⁴⁵ Kolko, J., (2012), Broadband and Local Growth. *Journal of Urban Economics* 71, 100–113.

⁴⁴⁶ Whitacre, B., Gallardo, R., Strover, S., (2014b), Does Rural Broadband Impact Jobs and Income? Evidence from Spatial and First-Differenced Regressions. *The Annals of Regional Science* 53, 649-670.

Forzati and Mattsson (2012)⁴⁴⁷ show that increasing in the ratio of the population that lives within 353 metres of a fibre-connected premise contributes positively to job employment from 0%-0.2% after two and a half years. Atkinson et al (2009)⁴⁴⁸ proved that investment in broadband networks for USD 10 billion in one year generated about 498 thousand jobs in the USA.

Table 5 -Potential socio-economic impacts of broadband deployment in Rural, Remote and Sparsely populated areas

Domain	Impacted aspect	Examples of benefits in RRS areas by stakeholders ([B] business, [C] citizens)
Community building	Quality of life Social inclusion	Participation in social life reducing geographical distances (including politics, leisure activities, etc.) [C]. Interaction among citizens allowing for the participation of a larger set of stakeholders (including elderly people, minorities, people living in remote areas, etc.) [C].
Crime and public safety	Quality of life	Reduction of crime due to the deterrent of remote surveillance (e.g. safer small villages) [C]. Control of strategic assets/infrastructures located in areas not easily accessible (e.g. increasing security and response capacities to man-made damages or natural disasters) [B].
Education and skills	Competitiveness and innovation Employment Technological skills Social inclusion	Increase of productivity [B]. Increased contacts with research and innovation actors (i.e. universities and enterprises) allowing connections and technology transfer processes at distance [B]. Increase of competitiveness on the job market with skills alignment with those of the citizens of urban areas [C]. Creation of ICT professional competences as a side effect of deployment and management of broadband infrastructures [C]. Improvement in the ICT take-up (eServices, eCommerce, eGovernment) [C] [B]. Increase of education delivered in remote mode facilitating access to knowledge also by those having difficulties in accessing transport networks (from disabled people to people living in areas poorly covered by public transport services)[C].

⁴⁴⁷ Forzati and Mattsson (2012), The economic impact of broadband speed: Comparing between higher and lower income countries

⁴⁴⁸ Atkinson, R.T., Castro D., Ezell S.J. (2009), "The digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America", The Information Technology and Innovation Foundation (ITIF)

Economy	Employment	Selection and employment of workers at distance, accessing competences not available locally or located in areas not attractive for business [B]. Opportunity for workers to contribute remotely to specific ICT-based jobs [C].
	Growth	Creation of new ICT-based businesses [B]. Increase of the Total Factor Productivity of the areas [B]. Increased competitiveness of local firms in other sectors than ICT through the creation of new/innovative products and services [B].
	Competitiveness and innovation	Face-to-face communications worldwide, saving travels costs and time [B]. Access of remote technological services to increase firms' efficiency (i.e. cloud computing) while avoiding local physical installation of ICT equipment [B]. Implementation/adoption of logistic solutions addressed to increase firms' efficiency (i.e. monitoring of stocks) while avoiding traditional transport and logistics [B].
	Incremental cost saving	Direct access to global markets [B] and potential gaining of a market share through eCommerce solutions [B].
	Incremental revenues	
Environment	Incremental cost saving	Use of smart grids with energy efficiency benefits [B] [C]. Less physical travels, implying reduced CO2 emission and use of fuels and time [B] [C]. Adoption of remote control systems to prevent and mitigate natural disasters [C].
	Quality of life	
Equality and well-being	Employment	Job opportunities for disabled people or people not served by public transport means [C]. Education opportunities for disabled people or people not served by public transport means [C]. Connection opportunities with families/relatives displaced in different areas [C]. Connection opportunities through smartphones and tablets [B] [C]. Connection opportunities for disabled people or people not served by public transport means [C]. Opportunities to access information and data worldwide [B] [C]. Opportunities to save money from traditional telecommunications means (i.e. fixed lines) [B] [C]. Opportunities to access eCommerce and eGovernment services [B] [C].
	Technological skills	
	Quality of life	
	Social inclusion	
	Incremental cost saving	
Finance and wealth	Wealth	Valorisation of the value of an area reflected in increased prices for housing/business location [B] [C]. Opportunities to access financial services for disabled people, people not served by public transport means, and remotely located businesses [B] [C].
	Incremental cost saving	
Health care	Incremental cost saving	Reduction of costs for health consultations (for less critical pathologies) [C]. Digitalisation and automation of administrative procedures within public and private health systems [B] [C]. Monitoring of basic health conditions through mobile apps [C]. Monitoring of patients at distance without requiring hospitalisation (for less critical pathologies) [C].
	Quality of life	

Source: Linking the Digital Agenda to rural and sparsely populated areas to boost their growth potential – Committee of the Region Report (2016)

SMART 2015/0005 demonstrates the impact of speed (and therefore quality) of networks. It estimates that an annual increase of broadband speeds of 21% (associated with a scenario whereby projected ADSL connections were all replaced with FTTC/VDSL connections by 2025), would result in cumulative growth in GDP of 1.5% by 2025. A 28% annual increase in speed (as would be associated with a replacement by all broadband connections with fibre) would result in cumulative growth in GDP by 2025 of 5.1%.

According to Vodafone and Arthur D. Little the number of fields which could benefit from the high-speed connectivity is substantial:

Better Healthcare: Fibre networks will be crucial for Digital Health such as Remote patient monitoring, Remote care & rehabilitation, Professional operative consultations and Research (e.g. Next Generation Genome Sequencing). Patient services are being improved, healthcare is delivered in a more efficient way, more patients can be reached and benefit from specialists' attention and the cost of healthcare will ultimately be reduced. This sector still relies on antiquated infrastructure and many 'pre-Digital' working practices today.

Better Education: New educational tools and applications are being enabled by fibre networks such as immersive virtual reality training for professionals and remote interactive learning. Fibre networks will support increased digitalization within the classroom (e.g. to download content on tablets or laptops). This has allowed education to become more personalized, tailored to the need of each individual by student, increasing buy-in and motivation. Moreover, a larger network of students can be reached, teaching tasks distributed and education delivered in a more efficient way.

Increased Security: Monitoring public or private environments, recognizing suspicious activity and alerting security services can happen better and faster when fibre networks are in place. More and higher quality images can be captured (subject to privacy safeguards) and analysed whilst AI can recognize potentially dangerous situations and automatically trigger emergency response.

Positive Social impact: Fibre networks enable a range of new applications for entertainment, collaboration and social inclusion. Social relationships between people can be maintained regardless of distance, age or level of mobility, e.g. through high definition video streams or ambient presence.

Positive impact on Environment: Next Generation Smart Grid and Smart Mobility applications can be enabled by fibre networks and will have a positive impact on Energy consumption and CO2 emissions. Applications like Automated Energy Demand Response reduce the production and consumption, enabling more efficient use of renewables. Smart highways, Autonomous transportation and Smart traffic management tools – with core fibre networks – will lead to more efficient Mobility.

Increased Employment: New jobs are created to construct and set up the new fibre infrastructure. But more importantly, new applications and business models enabled by fibre networks appear and create new job opportunities, and the wider availability of such connectivity nationwide also distributes economic benefits and promotes modern commerce outside urban centres.

The benefits from the network and especially high-speed network are well documented but the value of benefits varies with the speed and scope of adoption, and in turn speed and scope of adoption depends on the quality of networks. This circularity renders decisions difficult, in particular for public investment.

1.6.3 Towards the Digital Single Market and new connectivity ambitions

The DSM Strategy stresses the importance of connectivity and ICT networks: they "provide the backbone for digital products and services which have the potential to support all aspects of our lives, and drive Europe's economic recovery"; the DSM "must be built on reliable, trustworthy, high-speed, affordable networks".

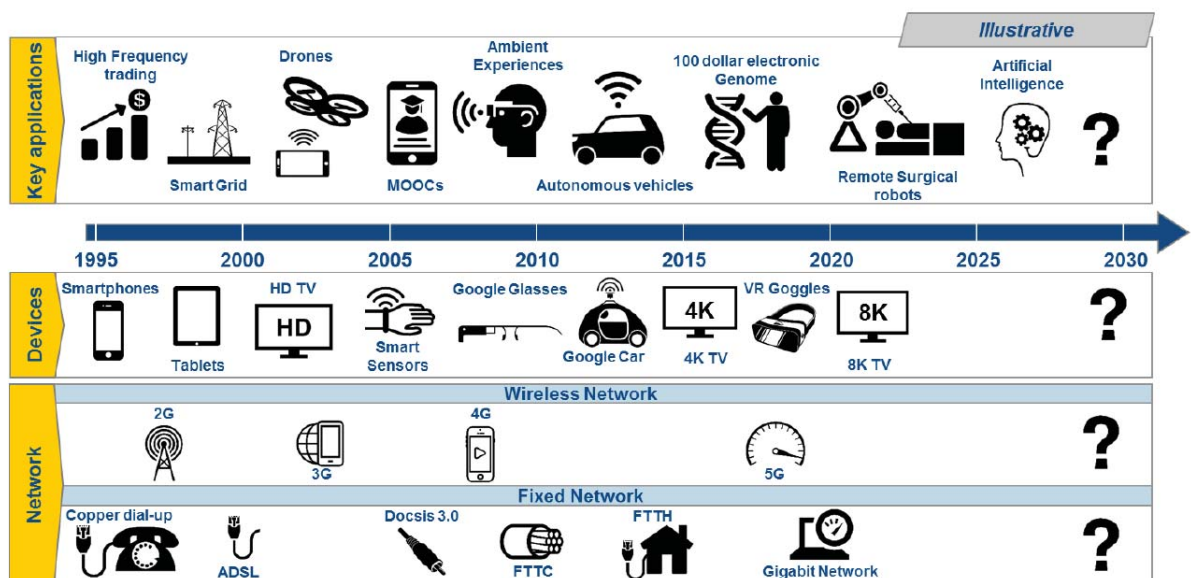
Adequate connectivity is a prerequisite to achieve a genuine DSM. This is why the DSM Strategy announced that the review of the Telecom Framework's focus would include "incentivising investment in high speed broadband networks". This is also why President Juncker and VP Katainen have made of digital networks one of the priority areas for strategic investment under the regulation setting up the European Fund for Strategic Investment.

The lag between policy, investment and its impact on the society implies that in order to ensure connectivity beyond 2020 the decisions have already to be taken. Europe's future economic success will stem from innovation and new business models that will make the most of digital networks – not just telecom infrastructure, but also cloud computing, Big Data, connected cars, the digitalisation of our industry, and so on. Hence, a supply driven approach would be in line with ensuring access to these new paradigms, even if demand may not follow immediately. Policy aiming at increasing European competitiveness and attractiveness for business will improve EU wealth and contribute to the well-being of all the citizens, stimulating jobs creation and decreasing unemployment.

1.6.4 Technological developments

Our review of global IP traffic, technological trends, user scenario forecasts and the infrastructure needs for key policy initiatives further reinforces the view that networks require a true generational shift in terms not only of download speed, but also in other quality aspects such as upload speed, low latency, reduced jitter and uninterrupted access. The figure below illustrates the technological development, which will require better networks.

Figure 32 – Key applications and technological developments

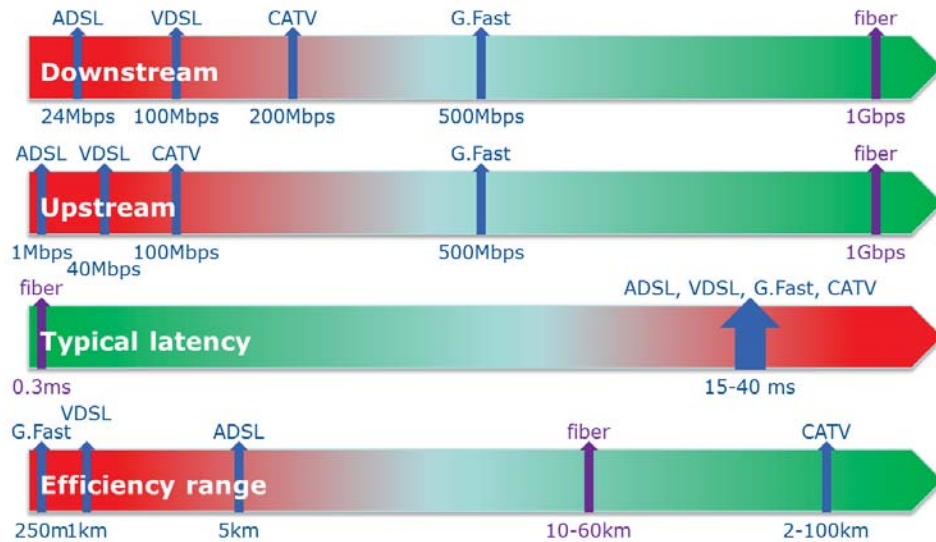


Source: ADL

As mentioned in annex 6, section 3, in the context of constantly increasing IP traffic, resources such as physical infrastructures, numbering or spectrum become more and more scarce.

Furthermore, copper-based infrastructures tend to have a much higher number of nodes and equipment as well as require a higher amount of electricity. This implies higher maintenance costs and longer down periods which represent obstacles to the efficient and reliable running of these critical infrastructures. The figure below illustrates the differences between technologies.

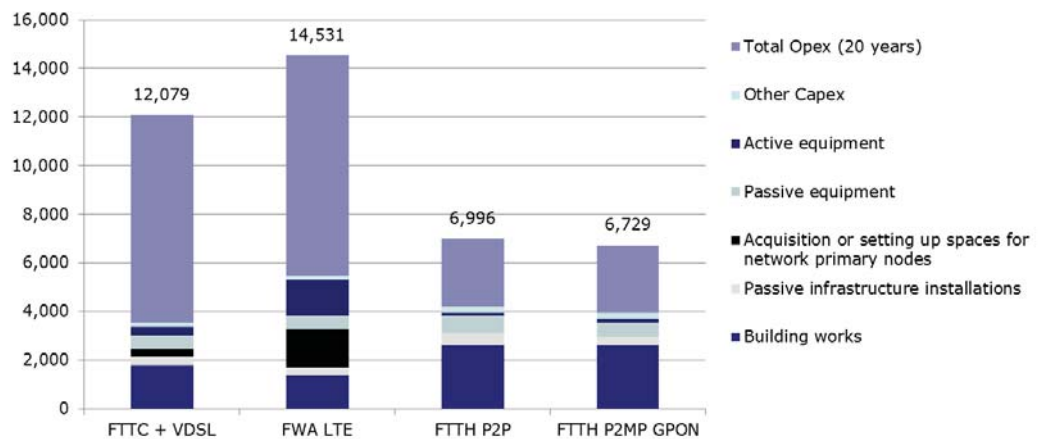
Figure 33 – Network features and speeds



Source: European Commission

Additionally, despite the higher initial expenditure in terms of CAPEX, the maintenance and operational costs OPEX are lower for fibre based technologies. The graph below is an example of a business case from OAN project Southern Primorska. The higher initial costs are offset after less than 3 years of operations assuming take-up of 50%.

Figure 34 – Cost scenarios for Southern Primorska region



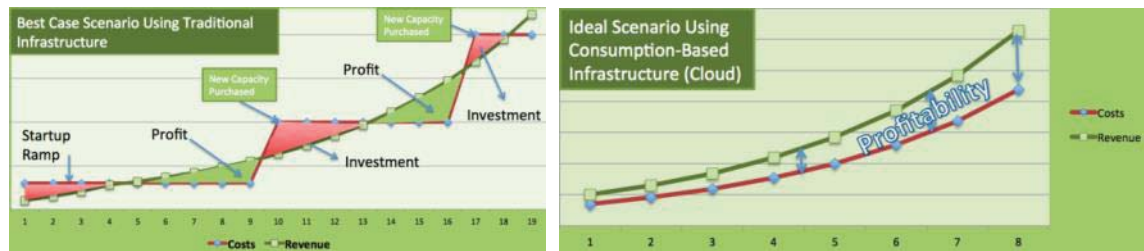
Source; European Commission elaboration on data from project Southern Primorska

Hence, the physical characteristics of certain media make them inherently better than other media for communication tasks. Extended reliance on the existing copper-based infrastructure is already today showing inefficiencies in terms of quality of transmission (speeds, latency, range, etc.), capacity, maintenance costs, energy and suitability, inflexibility to easily accommodate Software Defined Networks and the service innovation that this brings with them.

1.6.5 Some future developments

The cloud technology, also referred to as XaaS being X as a service, where X might mean Infrastructure, Software, Security, etc. becomes more and more popular. Investment in IT is usually costly and might generate additional costs in order to satisfy peak demands. Companies, which use cloud solutions only pay for capacity actually employed and do not need huge upfront investment (CAPEX). Below there are 2 graph illustrating the benefits from the cloud solutions – the left one represents a case, where a company invest in IT step by step and the right one the company, which benefits from the cloud.

Figure 35 – benefits from adopting a cloud solution



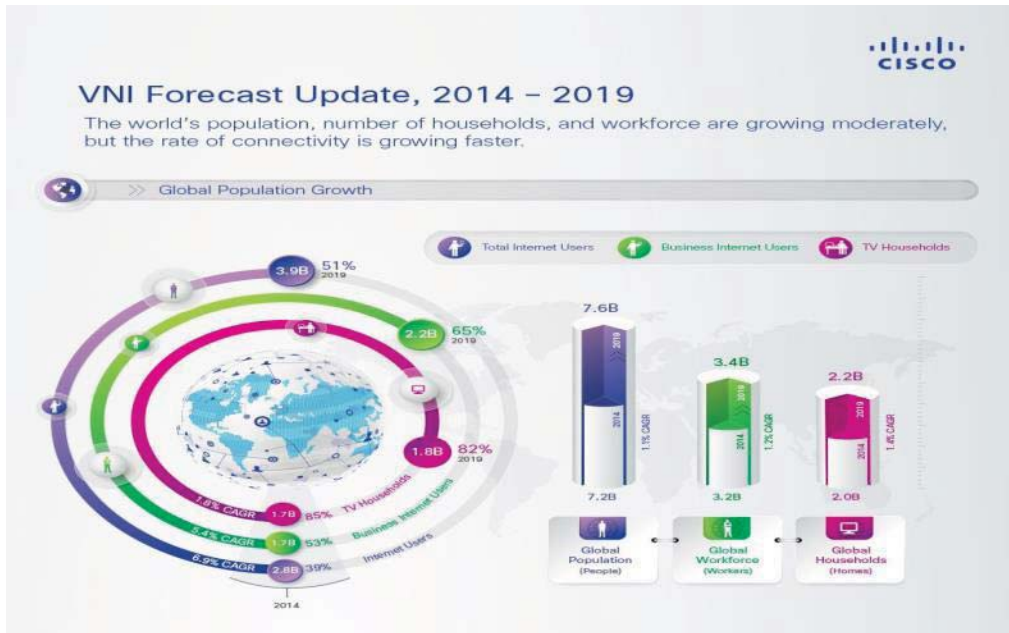
Source: *medium.com*

In order to benefit from the cloud the economic actors have to be connected – outsourcing IT capability requires excellent connectivity (both download and upload). Therefore for the connectivity is extremely important if Europe is supposed to get on the cutting edge of innovation by creating appropriate environment for the companies to optimize their costs. According to Cisco IP worldwide traffic will be growing very dynamically as the number of users and devices is fuelled by Internet of Things development.

Global IP traffic	2014	2019
Annual run rate	718.2 Exabytes	2.0 Zettabytes
Traffic per capita	8 GB	22 GB

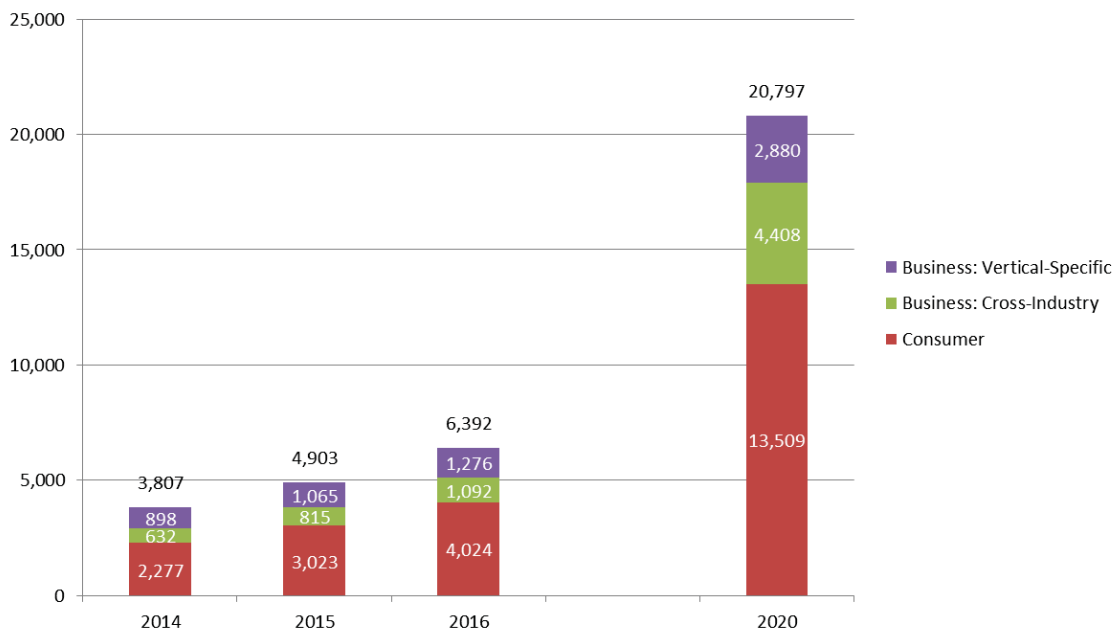
Globally, average IP traffic will reach 511 Tbps in 2019, and busy hour traffic will reach 1.7 Pbps. In 2019, the gigabyte equivalent of all movies ever made will cross Global IP networks every 2 minutes. Good connectivity will be key in order to ensure the wellbeing of the citizens.

Figure 36 – Cisco VNI forecasts



Penetration of Internet users, especially the business one will increase in the next 5 years and the trend will most likely continue till 2025.

Figure 37 - Internet of Things Units Installed Base by Category (Millions of Units)

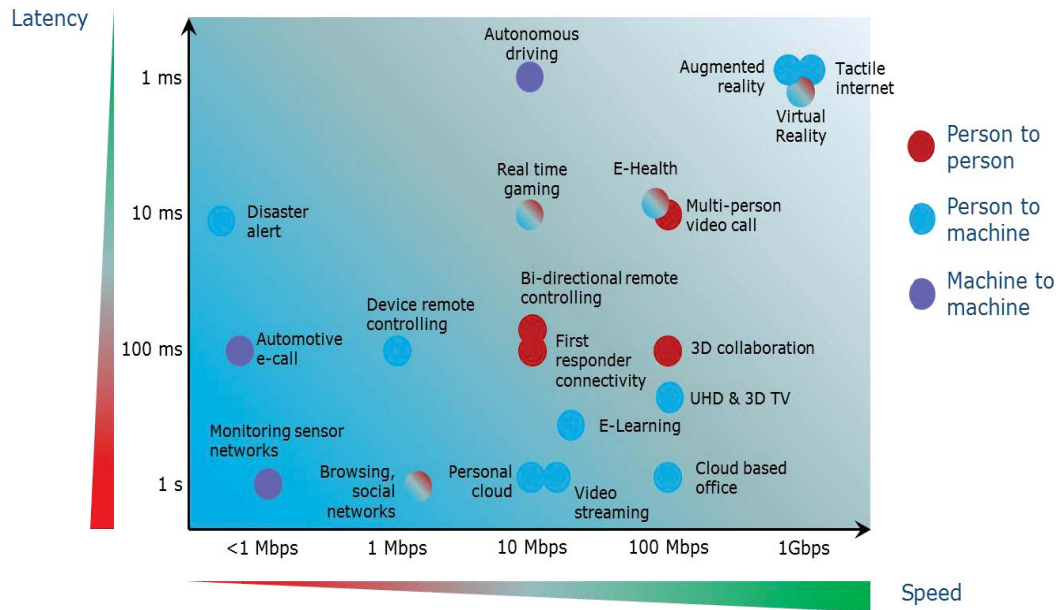


Source: Gartner (November 2015)

New applications requiring low latency and VHC internet access are emerging and will create the demand for better connectivity. Figure 38 illustrates that a number of applications will need latency around 1ms and bandwidth of 1Gbps by 2025. Of course, one has to consider that many of these application will be run in parallel, so that the bandwidth needed by households is cumulative.

Figure 38 – Latency and speed needed by applications and services

Need for speed and latency by applications and services



Source: Commission analysis based on GSMA and EIB

ANNEX 10 – Problem drivers

The present annex provides a more detailed description of the drivers included in section **Error! Reference source not found.** and of the evidence supporting them.

1.7.1 The lack of incentives to deploy networks in the absence of infrastructure competition or in rural areas

The rules governing the sector fell short of providing sufficient incentives and opportunities for the market-funded roll-out of NGA and especially VHC fixed and mobile networks. Moreover the deployment of wireless infrastructure was hampered by insufficient availability of a key resource i.e. spectrum.

The need for upgrades to legacy networks described under section **Error! Reference source not found.** raises questions of whether there are sufficient incentives to invest in the upgrade, and also which competitive model should be applied, as the unbundling of the copper local loop from the central office may become relatively less important because of the performance improvements on the basis of other technologies.⁴⁴⁹

The transition from copper-based networks towards fibre-based networks is gradually happening worldwide. In Europe, fibre is being deployed by a variety of operators in the access network to overlay or replace legacy copper lines or even parts of HFC co-axial networks. One of the main challenges for regulators today is to incentivise investment and support sustainable competitive models for newly constructed networks, at the same time guaranteeing the attained level of access to legacy networks until those become redundant. MS have followed different strategies with varying outcomes,⁴⁵⁰ and new broadband gaps have emerged in terms of coverage and take-up of NGA and VHC networks between countries in Europe, between Europe and international competitors⁴⁵¹ and between urban and rural households, which projections suggest may persist.

Deployment of VHC networks can be comparatively more expensive in near-term Capex than incremental upgrades of legacy copper infrastructures and demand for - VHC connectivity is very closely related to experience, hence requiring a supply-led ("build it and they will come") approach. Traditional network operators managing depreciated legacy infrastructures do not necessarily see the benefit of rolling out VHC broadband networks under these conditions, which in turn renders perceived business cases uncertain, especially in challenge areas that in any case can only support one network, such as rural areas.

Certain elements of the current regulatory framework, in the light of the most recent market developments could be improved to **foster deployment of VHC networks**, such as:

(i) Incumbent operators fear that they will be most likely price regulated, potentially on cost oriented basis if and where they deploy VHC networks, lowering their return on investment.

(ii) Insufficient regulatory predictability regarding access obligations on NGA networks (in particular pricing); due to short market review cycles, lack of sufficient focus on retail markets and the difficulty of enforcing consistency on the basis of non-binding recommendations, impacting network roll-out. Conversely for regulated operators, obligations to share on a non-

⁴⁴⁹ Local Loop Unbundling has been the main tool facilitating competitive stimulus. LLU volumes are already starting to decline in countries such as Germany, with the migration to next generation fibre networks, and several countries such as the Netherlands and Sweden have focused on fibre access..

⁴⁵⁰ See SMART 2015/0002 for a detailed analysis of regulatory strategies and outcomes

⁴⁵¹ Countries such as South Korea and Japan which placed significant emphasis early on FTTH are now clearly ahead of most (although not all) European countries as regards fast broadband as shown in section 1 above

discriminatory basis any new assets may take away some of the incentives, especially for the riskiest investments.

(iii) The lack of incentives for incumbents to co-invest; experience has shown that this is relatively unlikely to happen in local markets, unless a credible threat of roll-out by competitors is present or where the incumbent has responded to a policy push.

(iv) Likewise in areas where no NGA infrastructure is present the emergence of new local operators may be discouraged by the commercial threat posed by existing operators that have (non NGA) infrastructure in place.

(v) Lack of sufficient measures to support NGA deployment by alternative investors. By focusing regulatory model on SMP finding, the system perpetuates a model built at a time where only one network was deployed. It fails to take account of other operators and investment models, which could benefit from greater support.

The implementation of basic competition safeguards which could help climb the ladder of investment (e.g., access to civil engineering of SMP operators) can be made difficult if access to civil engineering as a remedy is made ineffective by lack of information (mapping) or unclear or uncertain conditions⁴⁵².

Further, while access regulation is a necessary condition for newcomers to enter the market, gain scale and ultimately replicate the network infrastructure, on the other hand regulated access at low prices has lower risks than full network build-out and thus may result in lower incentives for alternative operators to invest or co-invest.

Ubiquitous connectivity also requires efficient investment in the roll-out of very high quality networks fit for 5G technology, expected to drive business in the years to come. The architecture of 5G networks will be much denser than previous wireless networks (i.e. 3G and 4G) and thus a key challenge will be to adapt the licensing model accordingly, including by promoting license-exempt spectrum or adaptations to the model of exclusive licensing. It has to be noted that in addition to spectrum needs the 5G deployment needs also substantial fixed assets at its disposal.

Poor auction design or renewals conditions and uncoordinated releases as well as timeframe between allocation and assignment of spectrum have severely hindered the level and the quality of the roll-out of 4G networks and this cannot be repeated. Rapid access to spectrum under appropriate conditions is key for early 5G network deployment.

1.7.2 Inefficient allocation mechanism for public funding

Investment needs remain considerable: as mentioned in annex 14, more than EUR 92 billion were needed in 2014 to bring our digital infrastructures up to the DAE 2020 broadband targets standard and more might be needed beyond that date to ensure that Europe's infrastructure remains competitive.

Where the market cannot deliver on its own, public funding can contribute to the wide deployment of VHC broadband networks. In particular the European Structural and Investment Funds (ESIF) the Connecting Europe Facility and the European Fund for Strategic Investment can help plugging the gap. These financing tools provide grants, financial instruments (equity, debt, guarantees) and can be cumulated to contribute funding a given project. While grants are

⁴⁵² However, in France and Spain, as well as in Portugal, duct access was ultimately pursued as the main remedy for NGA under the SMP regime. Duct access SMP conditions were set in 2009 in France and Spain and complemented with symmetric obligations for in-building wiring and in the French case, access to fibre terminating segments outside areas in which the NRA considered that infrastructure competition could develop. The positive impacts of this policy are described in chapter 5.

mostly suited to plug gaps in market failure areas, financial instruments can reduce the risk profile in areas where a business case is present but remain underserved. However, one must be take into account that public support is a scarce resource and that it comes with significant constraints of legal, industrial and administrative nature; as an example OPEX is not included in grant funding, so the running costs fall on the network operator in any case.

However, the experience from the last programming period shows the trend that calls for tenders won by incumbents have typically resulted in copper enhancing solutions, while public support for VHC solutions has been more scarce.

The size of the tenders was also a problem, as it is very difficult for a new entrant to bid for large regions, while they might have a chance in smaller areas. Finally, the lack of a homogeneous network, infrastructure, **investment and quality of service mapping** by NRAs generates very different outcomes in terms of granularity of assessment and sometimes underestimates the amount of infrastructure present on the ground, diverting grants to area where a business case is possible. Also, the way the call for tenders are designed often ends up favouring the incumbent operator (size of the call, choice of direct support to operators instead of PPPs). The Commission is committed to make the most of the public funding leverage effect with a view to promote and unlock both public and private investment across Europe. This is all the more important as the public resources assigned to broadband infrastructure are limited, (EUR 6.4 billion for 2014-2020 are devoted to broadband by Structural Funds) as explained in more details in Annex 14 (section 1.11.1)

The Commission and the MS should strive to work together to ensure a maximization of available resources for the financing of the broadband deployment including developing an appropriate funding mix between grants and financial instruments.

1.7.3 Fragmented regulated and commercial offers for businesses across the EU

Geographic market integration, leading to larger demand, more competition (allocative efficiency), lower costs (technical efficiency) and better product and services offers for customers (qualitative efficiency), is impeded by artificial barriers to the expansion of markets beyond borders. In the EU, the effects of various types of artificial barriers can be felt with regard to possibilities of access seekers to avail for consistently regulated access inputs, in particular with a view to serving business customers on cross-border basis, and with regard to non-harmonised end-user protection requirements.

Inconsistency of regulatory intervention in electronic communications markets, which acts as a barrier to market integration, is largely driven by three factors. First, national regulatory authorities have under the current regulatory framework not the appropriate incentives to opt for a DSM-compatible solution when choosing the appropriate regulatory remedy to a competition problem identified in a market. Indeed, NRAs exercise their discretion resulting in divergent approaches, for instance, in the regulation of fibre networks, symmetric regulation, pricing methodologies etc..

Although the current framework allows for flexibility in applying its general principles to national circumstances, this does not mean that all regulatory solutions can achieve the objectives of the framework or that they can all achieve them in the best way. Secondly, the technological complexity of networks, and in particular their local access parts, multiply this (inconsistency) problem by rendering the design of the technical details and requirements of comparable regulated access products more difficult. For example an international company purchasing communication services in different jurisdictions would not be able to receive a homogeneous offer on crucial elements such as activation or repair time. Thirdly, the current system does not allow identifying transnational demand nor as a consequence require NRAs to adopt remedies accordingly. This would enable the provision of connectivity for business users. Fourthly, the consistency check procedure (so called "Article 7 procedure") as well as the

currently available "harmonisation procedures" (under Art.19 of the Framework Directive) would often not tackle the problem effectively, as such measures take too long to be implemented, leave too much room to national regulatory authorities to circumvent the outcome of the procedures and, thus, unnecessarily increase the lack of regulatory predictability.

Lack of consistency in regulatory responses to similar problems⁴⁵³ does not just affect cross-border operators, which have to adapt to different regulatory regimes and thus face greater internal market barriers. It also results in different levels of effectiveness of national regulatory regimes in fostering the best possible connectivity at affordable prices for end users. For example the implementation of VULA reference offers in different MS has resulted not only in different design outcomes, but also in different levels of take-up of this type of access products, which may be due to the attractiveness to access seekers in terms of quality. In other words, regulatory choices such as those regarding access obligations and the pricing of legacy networks have an impact on the investment decisions of operators. In this way, end users pay the consequences of inconsistent and potentially sub-optimal regulatory decisions, affecting retail markets.

1.7.4 Minimum harmonisation, differentiated rules

Over the past years, it has become apparent that the lack of consistency of telecoms regulation is – to a degree at least – the result of the institutional set-up and the way the various institutional players (i.e. mainly NRAs, BEREC and the EC) interact and can influence the regulatory outcome.

Whilst the EU Regulatory Framework had been designed with flexibility in mind in order to allow NRAs to take account of national circumstances, many differences in the national regulatory approaches cannot be sufficiently explained with varying national circumstances. This reasoning led to, for example, the Commission's recommendations in relation to costing methodologies (termination rates and costing and non- discrimination recommendations). The inconsistency witnessed is exacerbated by the fact that the procedural and institutional set-up currently in place appears to be ill equipped to ensure a more consistent approach in similar circumstances.

For example, in the area of spectrum, while harmonization of technical conditions for spectrum use contribute to a great extent to the creation of economies of scale for device and network equipment manufacturers, the subsequent uncoordinated releases of spectrum to operators prevent these economies to be realized in full as network deployment only happens on a patchy manner, thereby increasing manufacturer's development costs and the time to bring equipment to market. As investments decisions are increasingly made at global level, this phenomenon tends to discourage technology and equipment development in Europe to the advantage of other faster regions which will attract the investments.

Moreover, given that radio waves travel across national borders, the type of use of a frequency band in one MS has an impact on the type of use possible in neighbouring countries. In practice, if a MS uses a band for a specific type of application such as 5G before its neighbours who continue to emit with different technical parameters, interference problems could occur across borders⁴⁵⁴ – for example in bands below 1 GHz (i.e. 700MHz band). This problem would hence be particularly relevant in smaller MS or in MS where a large proportion of the population lives within reach of signal transmissions from neighbouring countries. In addition, the very fact that

⁴⁵³ In about 11% of all draft decisions subject to Art.7 notification the Commission has indicated that it may create a barrier to a single market or is contrary to EU law, or even if no formal decision has been issued by the Commission, the notifying NRA has withdrawn its notification.

⁴⁵⁴ Spectrum allocation and cross-sectoral interference issues fall out of the scope of this review. In particular, the work on managing interference between GSM (mobile) and GSM-R (mobile communications for railways) is addressed in several bodies (CEPT and/or ERA) as well as at a national level. Some MS have introduced financing schemes to encourage the installation of filters and new radio modules in the railway cabin radios.

there is only limited coordination of key determinants of market shaping inputs such as spectrum assignments across MS leads to more fragmented markets than necessary.

The current minimum harmonisation approach has also produced different outcomes and led to fragmentation in terms of consumer protection. In the field of contracts, for instance, this may be seen as a positive element, since NRAs can go beyond the minimum provisions of the Universal Service Directive where required. While the level of consumer protection - as measured by completeness of contracts, ease of comparing offers and extent of switching - is generally relatively high, the underlying measures are quite diverse. The diversity of national approaches creates a barrier to entry for pan-European operators active in multiple MS. The problem may be aggravated as MS may advance further and start developing their own measures in response to the previously identified problems.

1.7.5 Differentiated rules leading to uncertainty on spectrum assignment

Spectrum rules do not support optimal spectrum availability and deployment of mobile networks in Europe (regulatory failure).

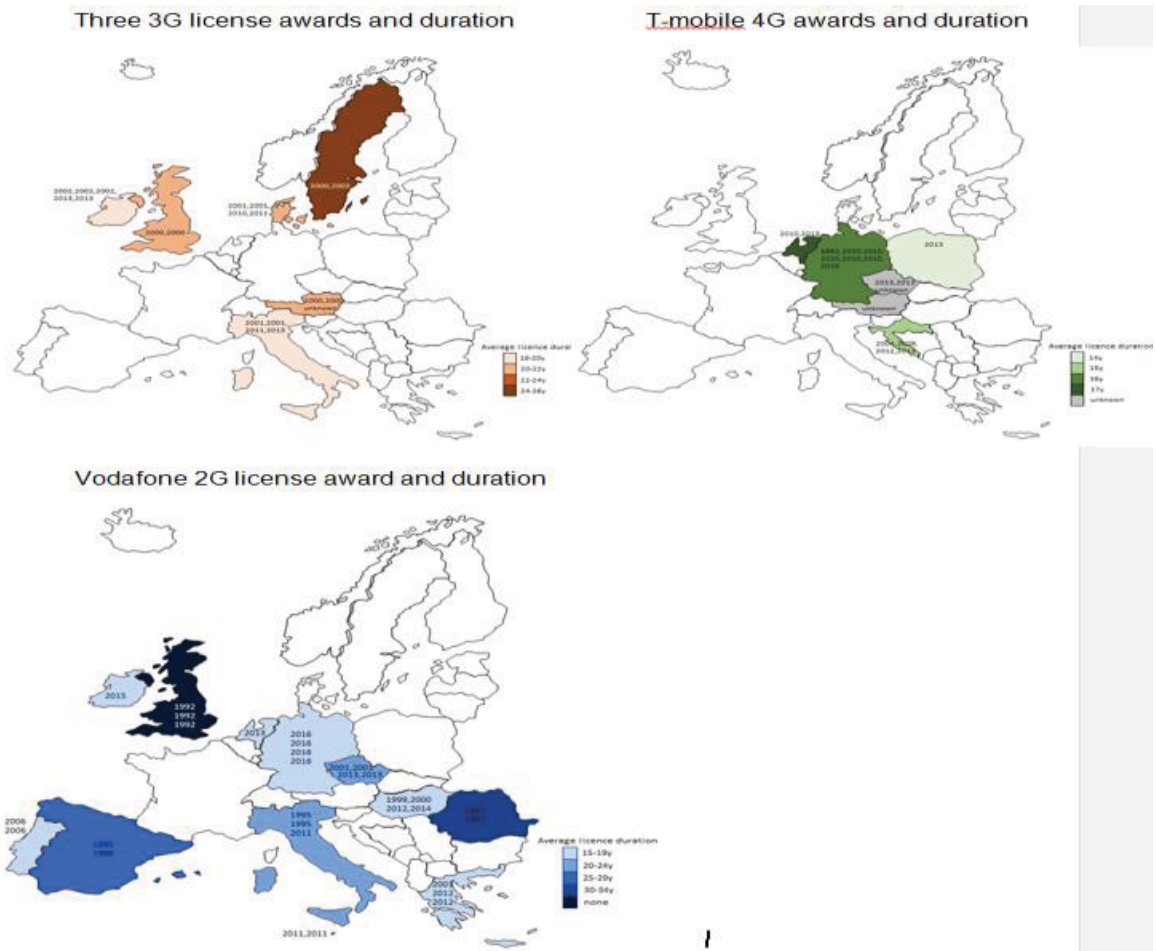
The timely availability of spectrum to the single market, is negatively influenced by

(i) the time gap between spectrum allocation (harmonised use and technical conditions) and actual assignment to operators, (ii) the uncoordinated timing of assignment of same bands throughout MS and (iii) the varying conditions which govern spectrum renewal.

The current regulatory framework has no mechanism in place to facilitate a more consistent approach let alone to enforce it and most attempts to coordinate the assignment of spectrum has been made on a piecemeal, limited and insufficiently efficient approach with the need to adopt a specific legislative measure each time a deadline has to be set for the assignment of a part of the spectrum (the 2012 Radio Spectrum Policy Programme for 800 MHz 4G, the 1998 UMTS decision for 3G, the pending proposal for a EP and Council Decision on 700 MHz). Moreover, spectrum policy is often guided by national policy objectives which often do not take sufficient account of common EU policy objectives such as the promotion of high quality communications networks and the single market.

The figures below show for three major operators the timing and duration of licenses awarded. The diagram clearly indicates that, even where licenses were awarded in neighbouring countries, these awards took place in different years and they cover different durations.

Figure 39 - Example of differences in timing and duration of licenses for major EU operators



Source: Wik Consult

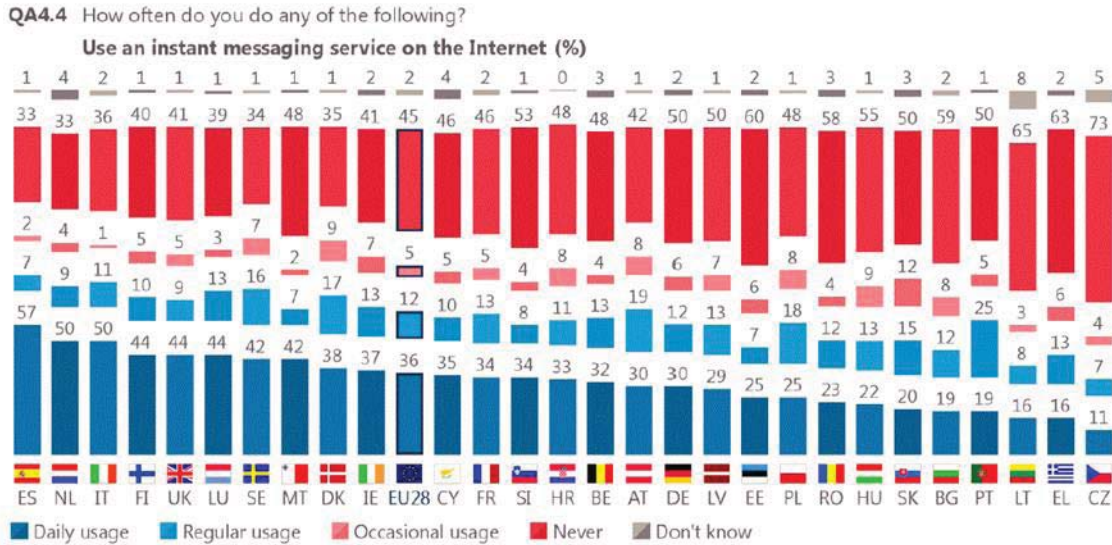
Furthermore, the existing spectrum governance structures focus on the harmonisation of technical parameters but may not allow for sufficient consistency of the timing of effective use of spectrum once allocated. Moreover, spectrum is assigned with varying conditions reflecting different (national) balances of the primary objectives underpinning the regulatory framework. This leads to disparate conditions where a national border bisects otherwise similar areas. The absence of consistent EU-wide objectives and criteria for spectrum assignment, as well as for changes to the conditions applicable to individual rights of use, at national level creates barriers to entry, hinders competition and reduces predictability for investors across Europe.

1.7.6 Technological and market changes

There have been significant changes in the telecommunications market since the last review that have affected the way in which end users communicate. The increasing coverage of wired and wireless broadband networks, coupled with the availability and affordability of consumer devices, have made consumers and businesses to rapidly adopt new communications services that rely on data and internet access services instead of traditional telephone services. The market has seen how in very few years new players have managed to compete with traditional telecom operators by offering a new set of communications applications over the internet.

Although there are still significant variations across Member States, overall European consumers have been very quick in adopting these new communications services. At the end of 2015, a significant number of citizens used instant messaging services, a relatively new service, several times per day compared to the users of e-mails or phone calls over a landline phone (30% vs. 27%). On average, 50% of Europeans use instant messaging services regularly, with 36% using them daily.

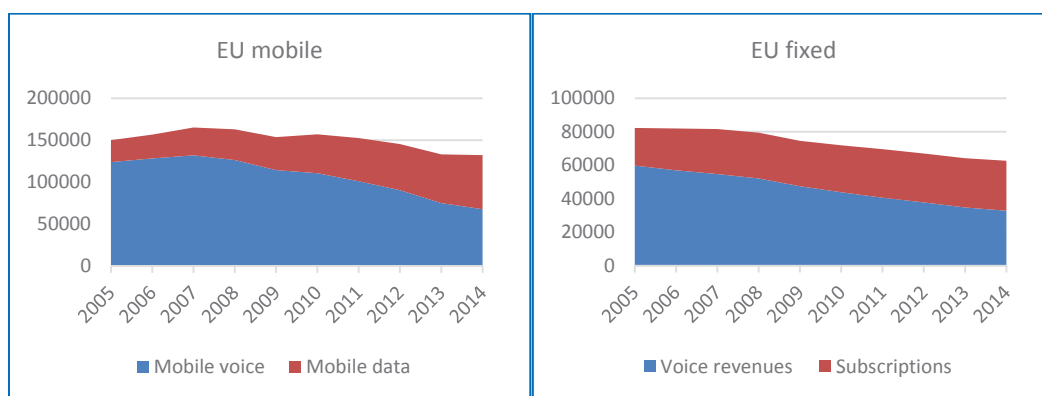
Figure 40 – Use of Instant Messaging in EU member States



Projections on future take-up of instant messaging simply confirm current trends. The volume of IP messaging, which was still negligible in 2010, exceeded the SMS volume only three years later and it is expected to further increase its predominant share of overall messaging traffic in the future. In 2014 alone instant messaging services on mobile phones would have carried more than twice the volume (50 billion versus 21 billion per day) of messages sent via a short messaging service (SMS).

With regards to revenues, it is estimated that between 2008 and 2014 fixed and mobile revenues declined in the EU by 19%. In both markets there has been a drop in traffic-related revenues. Taking into account also factors that are largely independent of the rise of OTT, such as revenue decrease due to regulatory intervention (by NRAs or by the EC, such as a decline in termination and roaming rates) or due to the global economic downturn, the study SMART 2013/0019 concludes that the rise of OTTs had no impact on fixed revenues, but did negatively impact mobile revenues.

Figure 41 - Mobile and Fixed revenues in the EU (million Euros)



As regards to the provision of wireless connectivity, the upcoming 5G technology revolution requires a fit for purpose spectrum management chain including allocation and assignment, since the way airwaves are regulated depends partly on the technologies used and services offered. Future users of dense 5G networks will need greater flexibility on both, access and use of spectrum but today, in the current framework, there are insufficient incentives for holders of rights to use spectrum efficiently in terms of technology and capacity.

There is consensus on the need to develop spectrum sharing to enable the 5G revolution. Today there is much focus in the use of individual often exclusive licenses (which are justified for some uses, e.g. mobile, to avoid interferences) but no sufficient incentives for secondary market for spectrum. In addition, it becomes clear that commercial operators are also using license exempt spectrum, notably for distributing Wi-Fi based connectivity from fixed infrastructures. **Barriers to spectrum entry** need to be lowered to stimulate innovation and new services.

1.7.7 Increasing adoption of bundles

In response to network convergence and increased competition, telecom operators have started to bundle different services like TV and Voice telephony to the internet access service. Moreover, given the convergence of fixed and mobile services, also mobile services (voice and data) are increasingly added to the bundle.

A bundle refers to a package of several different services sold together as a single plan: landline calling, Internet access, mobile services, pay-tv. In 2014 take up of broadband bundled products per total population was 46%, five points higher than the previous year, with an ever increasing number of triple and quadruple play products.

The growing take-up of bundled services can be seen in the figure below. Double play bundles are still most common, but triple and quadruple play bundles are gaining significance.

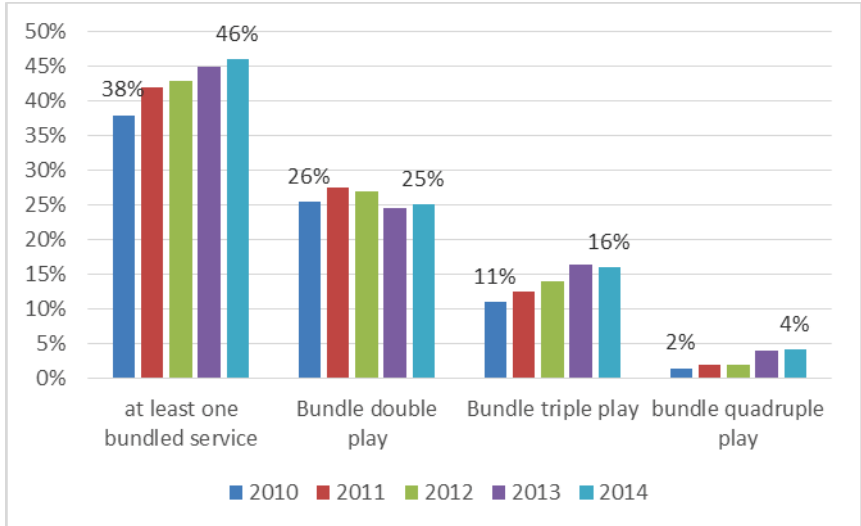


Figure 42 – Adoption of bundles in the EU, 2010-2014

At the end of 2015, 87% of households in the Netherlands and 78% in Malta had purchased bundles services, as had at least half of all households in 19 other Member States. Italy, the Czech Republic and in Lithuania were at the other end of the scale with 31%, 32% and 34% of households respectively. Since 2009 there has been an increase in the number of households subscribing to bundled products in all Member States, as shown in figure 68.

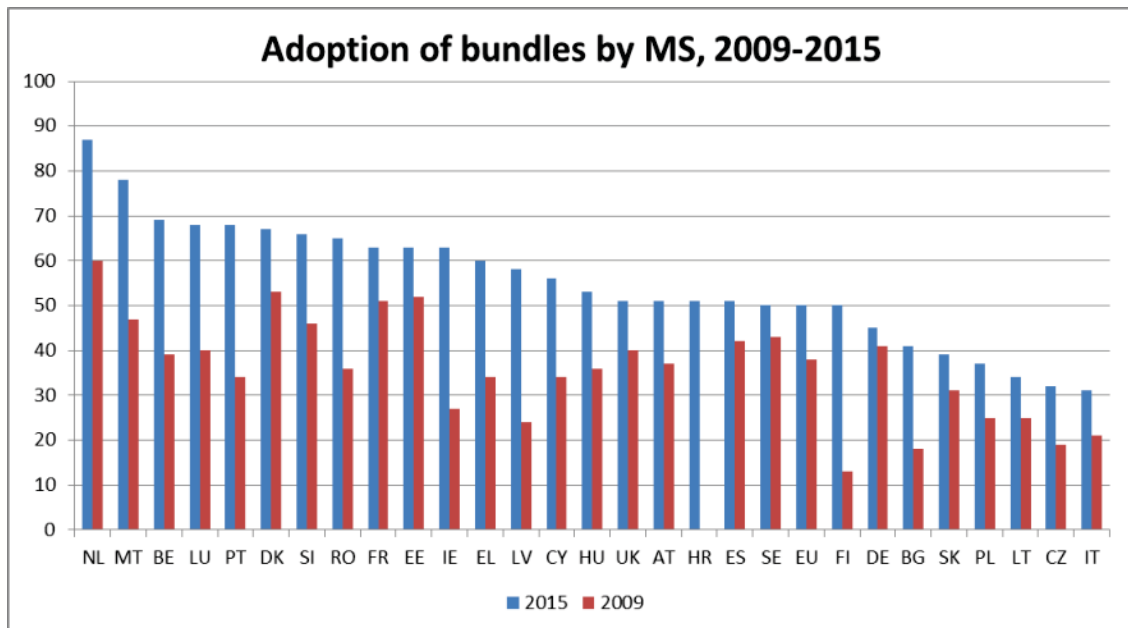


Figure 43 – Adoption of bundles per MS, 2009-2015

1.7.8 *Suboptimal design of market review cycles and Inconsistent remedies under current rules (art.7)*

This problem driver consists of insufficient legal certainty and regulatory predictability regarding access obligations on NGA networks due to short market review cycles, lack of sufficient focus on retail markets and the difficulty of enforcing consistency on the basis of non-binding recommendations, impacting network roll-out.

Provisions therefore need adjustments with a view to reducing the regulatory burden and make regulation more clear and certain. The current process of frequent market reviews and ex ante regulation has been reported in certain MS to cause little regulatory predictability and legal certainty, on top of being rather cumbersome. This is related on the one hand to the variety of (unranked) goals and remedies available to NGAs, but also to the relatively short regulatory cycles (every three years, significantly shorter than investment cycle), in particular when considered together with the associated appeals and court procedures. While regulation needs to move along with a fast changing sector, operators often stress the need for regulatory predictability.

It is also worth noting that the short cycle of market reviews, the lack of predictability and the litigation that may follow have a discouraging effect on institutional investors such as infrastructure funds, private equity and pension funds that may be willing to invest capital in the sector's network operators, especially on a long-term horizon. On the other hand, investors attracted by short-term gains and price arbitrage may be more attracted by a more volatile environment. The effects of this "adverse selection" problem may hamper infrastructure deployment which has is definition a long-term asset class, especially for operators which are smaller and more exposed to instability.

Whilst market fragmentation is not solely to blame on the regulatory set-up in the EU, it has become apparent over the past years, that the lack of consistency of telecoms regulation is – to a degree at least – the result of the institutional set-up and the way the various institutional players

(i.e. mainly the NRAs, BEREC and the Commission) interact and can influence the regulatory outcome⁴⁵⁵.

Whilst the EU Regulatory Framework had been designed with flexibility in mind in order to allow NRAs to take account of national circumstances, the Commission has repeatedly pointed out that many differences in the national regulatory approaches cannot be sufficiently explained with varying national circumstances. The inconsistency witnessed is exacerbated by the fact that the procedural and institutional set-up currently in place appears to be ill equipped to ensure a more consistent approach in similar circumstances⁴⁵⁶.

In particular increased consistency in market regulation and management of scarce resources would contribute greatly to a true Single Market. With regard to both areas, of course, there may be various sub-themes⁴⁵⁷, which would benefit more broadly from an institutional set-up that was geared more thoroughly towards ensuring consistency. Where the problem of inconsistency and fragmentation arises is exactly where the Commission does not have veto powers (and relies on the non-binding recommendations), i.e. on the remedy side.

First, concerning market regulation, one area, in relation to which a more consistent approach is particularly important, is the choice and design of access remedies. Unfortunately, it is especially in this area where there is the most notable divergence across the EU. Whilst competition still predominantly takes place at the national level, EU-wide consistency in designing access remedies is increasingly considered important. In addition to access remedies, fragmentation of other regulatory conditions (e.g. authorisation conditions) may also represent an obstacle to market entry and cross-border provision of services⁴⁵⁸.

1.7.9 Obsolete and redundant rules

A number of regulatory inefficiencies can be identified in the current regulatory setting, which are generating unnecessary compliance costs and discouraging investment. Given the technological and market changes described above, certain provisions of the framework might no longer be relevant or might have become superfluous.

This is the case for example for part of the Universal Service rules. The evolution of consumers' behaviour, the wide coverage and availability of mobile networks and services, and the provision by the market of comprehensive directories and directory enquiry services, which also experience strong competition from other (notably online) information sources, have eliminated or at least reduced the need for including certain universal service obligations, such as the phone directories and public pay telephones. These changes will require an adaptation of the Universal Service regime to remove outdated services. Moreover, with already nearly 100% standard fixed broadband coverage in the EU, universal service obligations regarding the availability of

⁴⁵⁵ See, for example, the [EP study](#) on "[How to Build a Ubiquitous EU Digital Society](#)", p. 100 where it is stated that "[...] the fact that Heads of NRAs are considered primarily to be motivated by a desire for self-determination, has led to some criticisms that BEREC delivers verdicts based on a 'lowest common denominator', or prioritises flexibility over consistency in the Single Market."

⁴⁵⁶ In particular, with regards to imposing remedies, the balance between achieving harmonisation in a flexible framework appears to have been tilted in favour of flexibility neglecting legitimate needs for consistency. For example, whilst remedies are imposed on operators by NRAs at the national level, the Commission and BEREC almost exclusively input through non-binding instruments in order to attempt to achieve EU-wide regulatory consistency on this level. In the past, this "soft law" approach has led to significant differences in some areas, clearly proving to be an obstacle for the development of a Single Market.

⁴⁵⁷ For example, issues surrounding the independence and funding of NRAs, the constitutional set-up of BEREC, the design of the EU consolidation process under Article 7, the Commission's powers to adopt harmonisation measures under Article 19, standardisation, rights of way, numbering, spectrum management, naming and addressing to name but a few.

⁴⁵⁸ The negative impact a fragmentation of conditions has on the provision of connectivity services has been widely reported by the [BEREC consultation on the cross-border obstacles to business services](#), and in [the EP study on the assessment of the EU Regulatory Framework](#) (p. 42 and 107).

functional internet access and telephone service are likely to become redundant in many MS in the future.

Further provisions might have become superfluous due to legislative developments in other regulation areas. Some of the sector-specific consumer protection rules (e.g. Article 20 and 34 Universal Service Directive) are examples of provisions that need to be reviewed in those respects to avoid that overlapping rules contribute to the unnecessary administrative burden.

Overlaps in legal frameworks on consumer protection are just one of the issues to be addressed in this review. Sector-specific rules aimed at providing a particular level of protection to users of ECS in areas such as data protection, privacy and security, freedom of choice and prevention of lock-in effects, transparency, quality and affordability and access to emergency numbers. These rules only apply to providers of ECS.

While in some case these rules applicable to consumers can be complementary, there are may be instances where overlaps between the different set of rules can occur⁴⁵⁹. For example the information requirements in the Consumer Rights Directive overlap with certain general provisions of Article 20 Universal Service Directive, while Article 34 Universal Service Directive on out-of-court dispute resolution is covered by the Directive on alternative dispute resolution for consumer disputes.

A specific situation may fall within the scope of two Directives or within the scope of specific provisions of these directives and create a circular cross reference. One example may be the priority provisions in Article 1(4) USD "*The provisions of this Directive concerning end-users' rights shall apply without prejudice to Community rules on consumer protection, in particular Directive-s 93/13/EEC and 97/7/EC, and national rules in conformity with Community law*" and Recital 11 of the CRD: "*this Directive should be without prejudice to Union provisions relating to specific sectors, such as [...] electronic communications*".

Another example is Art. 3 of ADR Directive, which states that "*if any provision of this Directive conflicts with a provision laid down in another Union legal act and relating to out-of-court redress procedures initiated by a consumer against a trader, the provision of this Directive shall prevail*".

This overlap results in a complex legal framework, with different consequences: the risk that it is not fully respected; penalties could be contradictory within MS; differences in implementation may also be due to an inconsistency among terminology; and these problems are compounded to the prejudice of the internal market when rules are based on minimum harmonisation.

⁴⁵⁹ See for a detailed analysis the SMART 2015/005

ANNEX 11 - 5G spectrum requirements for connected car (use case)

In the study on 'Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G' SMART 2014/0008 spectrum estimates within each sub-range are calculated by multiplying the number of devices by their respective occupancy of the spectrum in bps according to the scenario and multiplied by the assumed spectral efficiency of the technology used for each device type.

The different approaches of 100 per cent sharing (fully shared) versus 0 per cent sharing (exclusive licensing) have a very high impact on the total demand to support either type of operation. In a fully shared (100 per cent sharing) environment, the spectrum needed is equal to the total use case driven demand estimate. In an exclusive licencing environment however, the spectrum needed is equal to the total use case driven demand estimate multiplied by the number of operators in the environment. This approach is taken to understand the minimum and maximum spectrum requirement figures.

In the connected car example illustrated below is based on two very high data rate use types within the transport and automotive verticals, once the theoretical total (user driven) demand estimates is calculated, the spectrum needs are analysed based on the five different spectrum sharing scenarios. In doing so, this use case is intended to drive the spectrum requirements to an extreme level to understand the impact on spectrum in a very challenging environment.

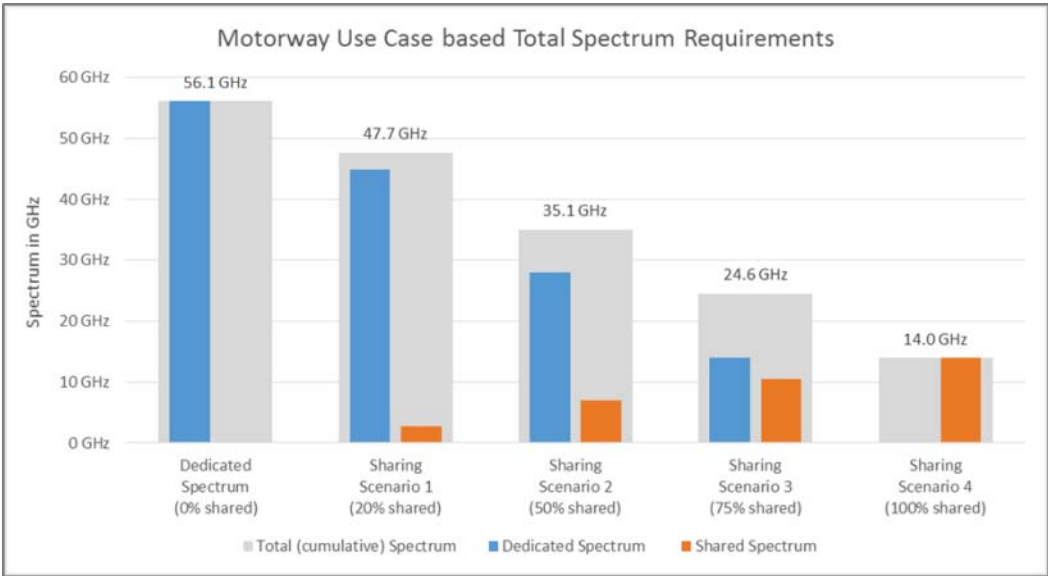
The table below shows how the total quantity of spectrum varies depending on the different sharing scenarios that may emerge by 2025.

Table 6 - Total spectrum requirements relative to percentage of spectrum sharing scenarios based on theoretical model

Spectrum sharing scenario	Total spectrum needed (GHz)
Scenario 1: 0% sharing	56.1
Scenario 2: 20% sharing	47.7
Scenario 3: 50% sharing	35.1
Scenario 4: 75% sharing	24.5
Scenario 5: 100% sharing	14.0

The figure shows the total spectrum requirements for each scenario split by the quantity of dedicated and shared spectrum in each case.

Figure 44 - Total spectrum requirements for motorway use case



All-exclusive case requires the largest quantity of spectrum (56.1 GHz) because each individual of the four-service provider (x4) requires approximately the same amount of spectrum estimated for the given scenario. The all (100 per cent) shared case has the lowest spectrum requirement with a total of 14.0 GHz of spectrum. If by 2025 full sharing is not possible then a mix of dedicated and MNO sharing with the 5G use cases (connected car, eHealth, transport and utilities) helps to minimise the total quantity of required spectrum compared to the all dedicated case.

The option of sharing spectrum becomes a benefit to service providers as the proportion of shared spectrum increases. Total required spectrum reduces however, for each frequency range where there is a limit to the quantity of available spectrum in each range. Therefore, this result shows that some sharing will be necessary in Sub-1 GHz band because MNOs will likely only have access to no more than 75 per cent of the spectrum in this sub-range by 2025 and therefore sharing with other operators and new MVNOs will be required to serve the users in this transport scenario below 1 GHz.

ANNEX 12 – Comparison of impacts by stakeholders

In this annex, we present the summary tables of impacts on different groups of stakeholders in; they were compiled under the supporting study to this IA on the basis of the public consultation, the interviews with stakeholders and workshops organised by the EC. As mentioned in section **Error! Reference source not found.** we pay specific attention to positive and negative impacts, direct and indirect on specific categories of stakeholders, including SMEs, as required by the SME test under the better regulation principles and public administrations. Although the impacts on stakeholders are addressed for all the options considered under each policy area, a wider attention is paid to the preferred option for each policy area. A more complete and narrative version is provided in SMART 2015/0005, chapters 1 to 5.

1.9.1.1 Access regulation

Table 7 - Summary stakeholder impacts – access options

	Option 1: Status quo	Option 2: Continuity and simplification	Option 3: Fibre-ready	Option 4: Reduction in scope of regulation
Consumers	Mixed – some may be well-served but existing gaps may remain	As option 1	Substantial benefits arising from higher broadband quality of service due to increased deployment and competition in very high speed broadband. Some market consolidation also possible, which may have positive as well as negative impacts on innovation and price	Negative – significant reductions in competition could be expected impacting pricing and service quality, although some further investment might be made
SMEs	Mixed – some may be well-served but existing gaps may remain	As option 1	Substantial benefits arising from higher broadband quality of service due to increased deployment and competition in very high speed broadband.	Negative – significant reductions in competition could be expected impacting pricing and service quality, although some further investment might be made
Larger and multi-national businesses	Negative – fragmentation would continue to impact cross-border connectivity	As option 1	Benefits from greater fibre availability (also reaching smaller sites, homeworkers) and consistent wholesale specifications, if SMP approach maintained for business access	Highly negative – significant reductions in competition and further cross-border fragmentation
Incumbents	Negative – existing regulatory burden and constraints would remain	Some benefits compared with status quo – more certainty, higher burden of proof for intervention, but may also facilitate functional separation	Mixed. Some benefits – potential lifting of sectoral regulation, but also tighter regulation of ducts, pressure to invest	Highly positive – significant reduction in regulatory burden and constraints and lessening of competition
Entrants	Mixed – continuation of access regulation positive, but no emphasis on supporting more sustainable competition. Therefore, practical application varies by	Some benefits compared with status quo – more certainty, greater potential for functional separation, but also higher burden of proof for intervention	Benefits for larger scale players able to invest and co-invest. Negative for smaller entrants relying on wholesale access	Highly negative – may undermine business viability

	country. Entrants vulnerable to technological and regulatory change.	- may reduce regulation			
Alternative fibre investors	Neutral for existing players, but no additional support for further investment	As option 1	As option 1	Positive – greater access to civil infrastructure, support for rural investments	Neutral if not reliant on incumbent SLU/duct access. Otherwise negative
Cable operators	Stability considered highly positive, although continued wholesale price regulation could undermine revenues	Benefits compared with status quo – more stability, higher burden of proof for intervention	As option 1	Mixed - Some benefits from potential lifting of wholesale price regulation, but also greater infrastructure competition and pressure to invest	Positive – reduced competition
Content and application providers	Mixed – existing bandwidth gaps would remain, but competition would continue to support take-up and protect vs discriminatory conduct	As option 1	As option 1	Positive – greater bandwidth availability, but risk in some markets of consolidation impacting competitive safeguards	Negative – likely to impede take-up of higher speed offers, and concentrate the market, raising risk of discriminatory conduct
Equipment manufacturers	Neutral to negative – no specific stimulus for investment by industry	Neutral to negative – no specific stimulus for investment by industry	Neutral to negative – no specific stimulus for investment by industry	Mixed – depending on business model/customer-base	Mixed – depending on business model/customer-base
NRAs	Mostly positive – retain existing flexibility. But several NRAs have raised concern over burden of 3 yearly review requirement + some NRAs raise concerns over independence and resourcing)	Positive – NRAs would benefit from continued flexibility, but with reduced market analysis administrative requirements and increased potential to implement functional separation. Under this option their resources and remit would also be strengthened	Positive – NRAs would benefit from continued flexibility, but with reduced market analysis administrative requirements and increased potential to implement functional separation. Under this option their resources and remit would also be strengthened	Mixed – NRAs would have more prescriptive requirements. Those not already pursuing mapping analysis and the operationalization of duct access may require additional resources to do so in the short term – although the admin burden may reduce longer term	Negative – NRAs would lose an important tool for the promotion of competition, while potentially facing an increased burden in dispute resolution
BEREC	Neutral	Positive – remit would be expanded and NRAs' competences would be aligned with BEREC's	Positive – remit would be expanded and NRAs' competences would be aligned with BEREC's	This option would entail the strengthening of BEREC Governance as well as additional responsibilities. Although BEREC's competence and influence would be expanded, NRAs would have less direct	Highly negative. BEREC would lose a significant portion of its current remit (concerning market analysis).

1.9.1.2 Spectrum

Table 8 - Summary stakeholder impacts – spectrum options

	Option 1: Status quo	Option 2: voluntary	Option 3: binding	Option 4: spectrum agency
End-users (consumers and business)	Negative – late and uncoordinated deployment of 5G and lack of action on recent 700 MHz auctions means businesses are unable to develop new services (e.g. in transport, automotive, healthcare, utilities etc.) and consumers (including businesses) don't benefit from innovative services	Mixed – while this option could be in place fast, there is a high risk that voluntary measures would not be taken-up by many MS, leaving the same results as under option 1	Positive – this option delivers a coordinated approach to spectrum assignment and usage across the EU including for 5G (though it may come too late to influence 700 MHz assignments)	Mixed – while this option sets up a governance structure to address the problem, the complexity of negotiating this set-up means it will come too late to influence 700 MHz auctions and will delay 5G deployment
SMEs	Negative – the impacts would not differ from those for other end-users	Mixed – the impacts would not differ from those for other end-users	Positive - the impacts would not differ from those of other end-users. Swift implementation of 5G would create opportunities for innovation and entrepreneurship which would benefit SMEs in particular. General authorisations could provide greater opportunities for SMEs to gain access to spectrum which is now only accessible to large companies with the financial power to purchase exclusive rights (e.g. MNOs, etc.)	Mixed - the impacts would not differ from those of other end-users. Swift implementation of 5G would create opportunities for innovation and entrepreneurship which would benefit SMEs in particular
MNOs	Negative – this option risks repeating the 4G scenario where Europe lagged behind other regions for	Mixed – while this option could be in place fast, there is a high risk that voluntary measures would not be	Positive – this option delivers a coordinated approach to spectrum assignment and usage across	Mixed – while this option sets up a governance structure to address the problem, the complexity of

Other spectrum users (e.g. broadcasters, PMSE, etc.)	5G with investment insufficient	taken-up by many MS, leaving the same results as under option 1	the EU including for 5G (though it may come too late to influence 700 MHz assignments)	negotiating might delay 5G deployment
	Nil – this option would continue the current set-up which engenders significant local variability, continued erosion of spectrum for some users and uncertainty about future spectrum availability	Nil - This option would likely not differ significantly from option 1	Uncertain - This option provides a greater level of regulatory certainty and consistency across MS, impacts on other spectrum users would depend on specific decisions taken by the peer review mechanism could ensure that local needs of different spectrum users continue to be fully taken into account.	Uncertain - This option provides the greatest level of regulatory certainty – impacts on other spectrum users would depend on specific decisions taken by the spectrum agency. There would be less scope for adaptation to local needs under this option.
Equipment manufacturers	Negative – this option repeats the 4G scenario (late & uncoordinated assignments) for 5G and therefore fails to provide legal certainty and it fails to capitalise on the size of the Single Market	Negative – this option risks repeating the 4G scenario for 5G and therefore fails to provide legal certainty and it fails to capitalise on the size of the Single Market	Positive – this option provides greater regulatory certainty and consistency to manufacturers providing them with incentives to invest now in order to serve the Single Market	Positive – this option provides greater regulatory certainty and consistency to manufacturers providing them with incentives to invest now in order to serve the Single Market

1.9.1.3 USO options

Table 9 - Summary of impacts on stakeholders – universal service options

	Option 1: Status quo (baseline)	Option 2: Light adjustment	Option 3: Broadband affordability	Option 4: Broadband availability
Consumers	Risk of social exclusion and of the deepening digital divide, support of redundant services	Risk of social exclusion and of the deepening digital divide	Connection of disadvantaged households, reduction of the risk of social exclusion, access to advanced services	As option 3, especially for rural and remote areas
SMEs	0	0	Support of self-employment and micro-organisation	As option 3
Larger and multi-national businesses	0	0	0	0
Incumbents	0	Alleviating the financial burden by narrowing the USO scope	Alleviating the financial and administrative burden by narrowing the scope and modernising the funding	As option 3; potentially increase or entrenchment of the market power
Entrants	Legal uncertainty with regard to financing	As option 1	More legal certainty with regard to financing	As option 3; potentially increase or entrenchment of incumbent's market power; distortion of price levels; more difficult market entry
Alternative fibre investors	0	0	Alleviating the financial and administrative burden	As option 3; distortion of competition and price levels; crowding out investments
Cable operators	0	0	As above	As above
Mobile/ wireless providers	0	0	Alleviating the financial and administrative burden; more equitable cost-benefit relation in the case affordable	As option 3

				mobile broadband	
Content and application providers	0	0	0	Improved channels for advanced communications services and greater audience	As option 3
NRAs	0		Less flexibility in the adjustment of the USO to national circumstances	Flexibility with regard to the national USO; no choice with regard to financing	As option 3

1.9.1.4 Services options

Table 10 - Summary stakeholder impacts – services options.

	Option 1: Status quo	Option 2:	Option 3:	Option 4:	Option 5:
Consumers	<p>A) Security and privacy issues remain.</p> <p>B) Looming risk to lock-in with multi-play bundles</p> <p>C) As OTT usage increases, there is an effective reduction of access to emergency numbers</p>	<p>A) 0</p> <p>B) Lower risk</p> <p>C) 0</p>	<p>A) More issues</p> <p>B) Unclear (iii)</p> <p>C) -</p>	<p>A) Fewer issues</p> <p>B) Lower risk</p> <p>C) +</p>	<p>A) Fewer issues</p> <p>B) Lower risk</p> <p>C) +</p>
Telco's	<p>D) Unequal regulatory treatment vis-à-vis OTTs remains.</p> <p>E) Compliance costs</p> <p>F) duplication of costs when operating in multiple countries</p>	<p>D) 0</p> <p>E) go down</p> <p>F) down (ii)</p>	<p>D) ++</p> <p>E) down less than in option 2 (i)</p> <p>F) market entry i.s.o. regulatory barriers (iv)</p>	<p>D) +</p> <p>E) go down less than in option 3 (i)</p> <p>F) same as 2</p>	<p>D) ++</p> <p>E) same as 4 (i)</p> <p>F) same as 2</p>
OTTs	<p>G) no compliance cost except some legal cases as to the scope of the RF</p>	<p>G) 0</p>	<p>G) reduced</p>	<p>G) new compliance costs</p>	<p>G1) New compliance costs</p>

					G2) regulatory risk (vii) G3) innovations(vii) D) clarity about scope K) go up (vii)
IoT Start-ups and SMEs	D) Low confidence in future planning and investments due to unclear scope of RF	I) 0	I) More clarity but more market risks (v) K) go up (vi)	I) clarity about scope K) 0 (i)	
NRAs	L) Enforcement costs	K) 0 (i)			
(i)	Reduction in compliance costs due to cancelling redundant rules are significant. Reduction of enforcement costs by NRAs are zero. From option 2 to 3 the number of obligations for ECS reduce, but new obligations for ECN arise. From 2 to 4 and 5, the reduction in obligations for ECS remain the same, but the number of obligations for ECN go up. Additional measures that impact on OTTs do not impact on Telco's				
(ii)	Streamlining reduces the dimensions for regulatory heterogeneity. While lack of clarity about the scope of the RF may lead to evolution of interpretations by MS and create new heterogeneity of rules, this would not affect Telco's but rather OTTs and IoTs.				
(iii)	Measures to reduce lock-in with multi-play service providers may be offset by relaxing obligations for interconnection and subsequent concentration of the market.				
(iv)	Relaxing obligations to interconnect may allow for the creation of market entry barriers as National Markets concentrate.				
(v)	IoT start-ups will have less uncertainty about rights and obligations and experience less duplication of costs when operating in multiple countries, however, Option 3 may introduce competition issues for number-based m2m service providers vis-à-vis large telco's.				
(vi)	Risk of more need for ex-post interventions in which NRAs may need to support CAs				
(vii)	Interconnection on the basis of "reasonable limitations of technical feasibility as well as cost limitations" gives rise to enforcement/implementation costs, uncertainty and risks for innovation				

1.9.1.5 Must carry and EPG obligations

Table 11 ---Summary stakeholder impacts – Must carry and EPG obligations

	Option 1: Status quo	Option 2: Phase out obligations	Option 3: Extend must carry obligations to OTT providers
Consumers	Positive, viewers continue to have access to PSB services via traditional TV networks	Negative, in some cases viewers may lose access to PSB services via traditional TV networks before OTT substitution is viable	Neutral compared to option 1: No impact on PSBs (neither small or large) or on the variety of content offered to (i.e. choice for) end-users. The abundance of online content could make it more difficult for some smaller PSBs to build a significant audience
Larger and multi-national commercial content providers	Neutral – market entry might continue to focus on the OTT area which has less regulatory constraints	Positive - market entry could include traditional TV networks to the extent that transmission capacity becomes available subsequent to discontinuation of must carry obligations	Neutral. No change in the possibilities to make content available compared to status quo as OTT providers already include PSB content.
PSBs, including at regional and local level	Positive, existing privileges would remain in place	Negative, appropriate transmission on traditional TV networks would have to be negotiated under market conditions.	Negative as concepts for proportionate and appropriate intervention in the OTT area do not currently exist. Positive effects are possible in the long terms, if such intervention can finally be successfully conceived.
ECNs	Neutral/positive – existing regulatory burdens and constraints would remain, but with a perspective that they will be removed gradually over time subsequent to national reviews of obligations.	Strongly positive - existing regulatory burdens and constraints would disappear by 2020-2025	Neutral – no change of existing burdens and constraints
OTT service providers which are not themselves content providers	Neutral – existing obligations do not relate to OTTs	Neutral – existing obligations do not relate to OTTs	Negative as concepts for proportionate and appropriate intervention in the OTT area do not currently exist.

1.9.1.6 Numbering options

Table 12 - Summary stakeholder impacts – Numbers.

	Option 1: Status quo	Option 2:	Option 3:
Consumers	A) Higher prices for IoT services B) Higher prices for IoT services	A) same as option 1 B) same as option 1	A) Lower prices D) Lower prices
IoT users (Industry 4.0)	C) Potential barriers for cross border use of applications D) Potential barrier for full integration into the IoT	C) same as option 1 D) same as option 1	E) Less risk F) Less barriers
IoT service providers (including SMEs)	E) Potential lock-in with connectivity providers, leading to high prices and lower quality F) potential bottlenecks in delivering reliable always and everywhere connected services (domestic and cross border) G) Less room for innovations of IoT	E) same as option 1 F) same as option 1	E) Less risk F) Less bottlenecks

	services		G) same as option 1	G) More room for innovations
Telco's	H) High prices and profits		H) same as option 1	H) lower prices, less profits
	I) growing administrative costs related to extra-territorial use of numbers		I) same as option 1	I) Lower administrative costs
NRAs	J) growing administrative costs related to facilitating the extra-territorial use of numbers		J) same as option 1	J) Lower administrative costs

1.9.1.7 Governance

Table 13 - Costs of institutional options per stakeholder

	Baseline (option 1)	Enhanced advisory role (option 2)	Advisory role + some normative powers (option 3)	EU regulator with implementation/enforce ment powers (option 4)
Bodies	Status quo (option 1)	Enhanced advisory role (option 2)	Advisory role + some normative powers (option 3)	EU regulator with implementation/enforce ment powers (option 4)
Commission	→	↑ (EU technical guidelines)	↑ Spectrum peer review	↑ Spectrum peer review
BEREC Agency	→	↑ (Additional advisory requirements + compliance with Common approach)	↑↑ (Enhanced technical guidance role + compliance with Common approach)	↑↑↑ (substantial additional resourcing required)
NRAs	→	↑↑ (effective resourcing, additional contribution to BEREC, mapping) ↓↓ Fewer market analyses, standardised specifications	↑↑ (effective resourcing, additional contribution to BEREC, mapping) ↓↓ Fewer market analyses, standardised specifications	↑ (additional contribution to BEREC) ↓↓ Fewer market analyses, some enforcement powers to EU
Spectrum authorities	→	↑ Increased contribution to RSPG	↑ Increased contribution to RSPG ↓ Greater EU guidance	↑ Increased contribution to RSPG ↓ ↓ Some enforcement powers to EU

A more analytical estimation of the costs is presented in SMART 2015/0005.

Table 14 – Summary of governance costs by option

Body	Option 1		Option 2		Option 3		Option 4	
	Status quo	Assumptions	Enhanced advisory role	Assumptions ²	Synergy + some normative powers	Assumptions ³	Synergy + some normative and supervision powers	Assumptions ⁴
Commission	€ 7.328.400	60FTE @€118,640pa (blended rate) + €210.000 missions	€ 7.921.600	Status quo + 5FTE to reflect additional implementation duties	€ 7.921.600	Status quo + 5FTE for spectrum article 7 process	€ 7.921.600	As option 3
BEREC Agency	€ 4.061.000	28FTE €137,714pa (= blended rate of €107,714 + additional est €30,000 pp overheads to reflect small scale) + €205,000 missions	€ 5.713.571	40FTE as opposed to 28FTE, assumptions as before	€ 8.467.857	60FTE as opposed to 28FTE, assumptions as before	€ 31.000.000	EBA cost
NRAs (excl spectrum)	€ 107.309.530	41FTE per NRA, blended cost for FTE €66,768pa, 40% mark-up for overheads	€ 103.103.146	Status quo + 5*10FTE for under-resourced NRAs + 10FTE for extra BEREC contribution. Cost savings on extended market review periods (est 15%). Cost increase associated with mapping assumed balanced by cost reductions through standardisation + reduced regulatory burden	€ 104.037.898	As option 2, but with additional contribution to BEREC.	€ 90.951.370	As option 3 but with reduction of 5FTE per NRA due to greater EU level rule-making and supervision
(of which BEREC contribution excl spectrum)	€ 4.580.285	49FTE based on BEREC estimate	€ 5.515.037	status quo +10FTE reflecting four additional guidance requirements per year	€ 6.449.789	Status quo + 20FTE reflecting additional contributions to draft implementing guidelines	€ 6.449.789	As option 3
RSPG support/office	€ 556.600	Based on 2.5 Clon FTE + €260,000 expenses	€ 556.600	Status quo	€ 556.600	Status quo	€ 0	Spectrum activities incorporated within BEREC
SMA	€ 83.753.779	32FTE per SMA blended cost €66,768pa, 40% mark-up	€ 83.886.802	Status quo + increased RSPG contribution (see below)	€ 81.269.496	Option 2 with saving of 1 FTE per SMA due to more standardised auction format	€ 73.417.579	As option 3 but with further reduction of 3FTE per SMA due to greater EU level rule-making and supervision (SMA in NRA)
(of which contribution to RSPG)	€ 266.045	Based on 14 WG mtgs per year, 10 participants and 5 days prep	€ 399.067	Status quo +50% to reflect increased advisory requirements	€ 399.067	As option 2	€ 399.067	As option 2
Total costs with synergies (best case)	€ 203.009.309		€ 201.181.719		€ 202.253.451		€ 203.290.549	
Total costs (EU co-ordination)	€ 16.792.330		€ 20.105.875		€ 23.794.913		€ 45.770.456	
Co-ordination as % total cost	8%		10%		12%		23%	
Total costs (no synergies)	€ 203.009.309		€ 210.996.615		€ 214.685.652		€ 234.043.890	
Total costs (average)	€ 203.009.309		€ 206.089.167		€ 208.469.552		€ 218.667.219	

ANNEX 13 - Report from the Expert Group meeting

On 30 May 2016, WIK-Consult GmbH, Ecorys Brussels N.V. and VVA Europe organised a high-level academic expert panel to support the Commission in the preparation of the Impact Assessment for the Review of the electronic communications framework.

The purpose of the expert panel was to provide feedback on the provisional conclusions reached by the consultants concerning the impact of planned changes to the e-communications framework. Prior to the meeting, the experts were provided with a programme for discussion, slide presentation and draft ‘overview’ of the consultant’s research findings.

This Annex presents details on participating experts, the agenda of the day with points for discussion, and the report as reviewed by the members of the expert group.

PARTICIPATING EXPERTS:

The members of the academic panel were selected in consultation with the Commission by virtue of their in-depth experience in issues relevant to the electronic communications sector, innovation and governance.

Joan Calzada is Associate Professor at the Department of Political Economy, Universitat de Barcelona, with expertise in theoretical and empirical industrial organization. His main research interests are the economic regulation of network industries, especially telecommunications, transportation, and water.

Brett Frischmann is Professor and co-Director of the Intellectual Property and Information Law program at Cardozo Law School in New York City. His expertise lies in intellectual property and Internet law, and in particular the relationships between infrastructural resources, property rights, commons, and spillovers. Professor Frischmann is a prolific author, whose articles have appeared in numerous leading academic journals. He has published important books, including the award winning ‘Infrastructure: The Social Value of Shared Resources’ (Oxford University Press, 2012).

Frederic Jenny is Professor of Economics at ESSEC Business School in Paris and a Chairman of the OECD Competition Committee. He has written extensively about trade, competition and economic development and his research areas concern the relationship between structure and performance in European countries and antitrust legislation in Europe.

Eli Noam is Professor of Economics and Finance at the Columbia Business School. His research focuses on strategy, management, and policy issues in telecommunications, computing, and electronic mass media. Noam has written numerous articles and books on subjects such as communications, information, public choice, public finance, and general regulation.

Dr **Brigitte Preissl** is Head of Knowledge Transfer in Economics at the German National Library of Economics in Hamburg. She has an extensive research record in the regulation of telecommunication markets, the economics of service innovation and national research systems.

Luc Soete is Professor of International Economic Relations at the School of Business and Economics, Maastricht University. His research covers a broad multi-disciplinary field which focuses on the nature, origin and determinants of innovation. Soete’s publications include topics on governance and institutions, ICT-enabled innovation as well as societal transformation.

Reza Tadayoni is Associate Professor at the Faculty of Engineering and Science, Aalborg University. His research field is media convergence. He has been contributed to a number of consultancy reports and studies for the Danish telecom and broadcast administration, EU and the World Bank. He has been actively involved in European COST networks, including COST A20 on 'The impact of the Internet on the mass media in Europe' and COST A16 on 'ICT and transnational communities'.

Professor **William Webb** is a Director at Webb Search Consulting and an expert on wireless technology and regulatory matters. As a former director of Ofcom, he performed a research across all areas of Ofcom's regulatory remit and led major reviews conducted by Ofcom including the Spectrum Framework Review, the development of Spectrum Usage Rights and most recently cognitive or white space policy.

The expert panel was introduced by Anthony Whelan, Director for Electronic Communications at the EC, DG Connect, and Chaired by Dr Iris Henseler-Unger, Managing Director of WIK. Each subject was briefly introduced by a member of the study team on the basis of the circulated slides. Pertinent questions were raised by the Chair, and the remainder of the session was devoted to comments from experts.

AGENDA: EXPERT PANEL

IMPACT ASSESSMENT FOR THE REVIEW OF THE FRAMEWORK FOR ELECTRONIC COMMUNICATIONS

30 May 2016

Berlaymont, Room 07/062, Rondpoint Schumann, Brussels

The EC is currently undertaking a review of the legislative framework applying to electronic communications. The impact of the review could be significant. Electronic communications is a strategic sector which directly constitutes €168.62bln of European value added and 1.06 million jobs (around 1.3% GDP and 0.47% of total employment in 2012), with a labour productivity per person of more than 144 thousand euros (the highest rate within the ICT sector)¹. The sector supports a wide range of other high-tech manufacturing and digital services (the ICT sector constitutes 4% GDP and 2.76% of EU jobs, with a labour productivity rate 44.45% higher than total labour productivity) as well as the economy as a whole.

The review comes at a crucial time for the digital economy. Consumer and business demand for bandwidth continues to expand, driven by the growth of connected devices, digital content services and cloud computing, as well as connected 'things', we are mid-way through an important cycle of investment in fixed infrastructure with the prospect of 5G to come, and business models in the telecom sector are changing to adapt to a con-verged, data-driven environment.

These developments highlight a new **ambition for ubiquitous and Very High Capacity connectivity**. At the same time, they have revealed shortcomings in the framework, highlighting the need for the Framework to be adapted to meet market and technological change in order to protect **consumer interests and enable competition to flourish across the single market**. Finally the review provides an opportunity to **achieve efficiencies** and see whether the complex processes and institutional framework in place today can be streamlined to reduce costs and bureaucracy.

In order to ensure that the changes to the framework are fit-for-purpose, in according the Better Regulation Guidelines, the Commission is conducting an Impact Assessment to gauge the economic, social and environmental effects of different options and assess how effective and

efficient they would be in achieving the objectives we have identified above. The Commission has engaged WIK-Consult, Ecorys and VVA Europe to support them in this exercise. **The purpose of the expert panel is to provide feedback on the provisional conclusions reached by the consultants concerning the impact of planned changes to the e-communications framework.** Details of the programme are shown overleaf.

Programme

Participants

Experts:	Prof. Joan Calzada, Dr. Frédéric Jenny, Prof. Brigitte Preissl Prof. Luc Soete Prof. Reza Tadayoni Prof. William Webb, Prof. Brett Frischmann, Prof. Eli Noam
Commission	Anthony Whelan, Reinald Krueger, Vesa Terava
Consultants	Dr Iris Henseler-Unger, Ilsa Godlovitch (WIK), Nicolai van Gorp (Ecorys), Pierre Hausemer (VVA), Iglia Vassileva (Ecorys), Tseven Gantumur (WIK)

Format **Roundtable.** The session is introduced by Anthony Whelan, Director for Electronic Communications at the EC, DG Connect, and Chaired by Dr Iris Henseler-Unger, Managing Director of WIK. Each subject is briefly introduced by a member of the study team on the basis of the circulated slides. Pertinent questions are raised by the Chair, and the remainder of the session is devoted to comments from experts.

Record **Minutes** will be taken of the panel proceedings and circulated following the workshop for comment and approval. The approved workshop minutes will be annexed to the final report under preparation by WIK, Ecorys and VVA.

09.30-10.00 Morning Coffee

10.00-10.30 Introduction and problem definition

Anthony Whelan EC

The context for the review

Identifying the core problems:

Gaps in high speed broadband deployment

Delays in LTE roll-out, perspective for 5G

The impact of market and technological developments

Redundant regulation

What should we seek to achieve?

10.30-12.40 Achieving ubiquitous high speed connectivity

Introduction by study team, debate

Approaches to access regulation to foster high speed broadband in urban and rural areas
Approaches to spectrum policy to accelerate deployment

12.40-13.40 Lunch

13.40-14.40 Protecting consumers and promoting competition and innovation in the single market

Introduction by study team, debate

Approaches to services policy
Need to adapt the concept of ‘electronic communications services’?
Relevance of the use of public resources (e.g. numbering resources) for sector-specific rights and obligations?
Which rules should apply to which communications services?
The role of universal service in securing access to connectivity

14.40-15.00 Break

15.00-16.00 Implications for institutional governance, jobs and growth

Introduction by study team, debate

Implications for institutional balance, role of NRAs, EC, BEREC and RSPG
How will achieving the objectives impact jobs and growth?

16.00-16.20 Concluding remarks and next steps

Anthony Whelan, EC

Draft report

The report included below needs approval by the expert group, which will be granted by the end of June 2016.

Access

The connectivity imperative is not an immediate short term problem (except in rural areas)...

The experts agreed concerning the need to foster better infrastructure in rural areas, where a potential digital divide still looms. There was some discussion over what the review of the framework should aim towards as regards objectives for connectivity overall and whether or not there should be an emphasis on very high speeds potentially delivered via fibre connections. One view was expressed that FTTH may not be necessary to fulfil many of today's domestic needs; even when considering multiscreen 4K TV content, copper is also able to realise sufficient speeds. Moreover, the maximum capacity of In-house Wi-Fi may act as a bottleneck, limiting the effectiveness of Very High speed Connectivity (VHC) unless this additional performance barrier is addressed. It follows that, from a short term perspective, the added value of VHC may not be so high in the eyes of consumers and this gives rise to uncertainty as to whether they would be willing to pay more for it. The impact of different technological solutions on cost and price should also be analysed.

...but it is a problem in a forward looking perspective and the Framework should be forward looking and supportive of innovation.

It was agreed that this short term perspective should be taken into consideration. However, some experts noted that the Framework should have a more forward looking perspective. Market demand for VHC may not be there today, but you still might want to have infrastructures in place so that the market can evolve. In this sense, one could say there are market failures related to connectivity in the form of externalities and spill overs (innovations) that are not incorporated in the current willingness to pay by consumers. As such, VHC is a legitimate objective in a forward looking perspective but probably it will not be feasible to roll out FTTH re all the way up to the homes across the entire Union by 2025; e.g. in some areas it may already suffice to roll out fibre to the lamppost (in order to operationalise 5G). However, when considering Europe's global competitiveness vis-à-vis other parts of the world, we may want to set even higher targets as it may not be enough to 'catch up' but rather to aim to 'leapfrog'.

Solutions might not always be regulatory and may have to involve public support

The experts noted the need to be clear about what were the market failures involved in the new context and highlighted that there may also be other market failures involved than market power, such as innovation externalities, resulting in social demand for infrastructure not being reflected in current private demand. It follows that regulatory tools to promote competition may not be sufficient and that public investments (eg by municipalities or via state aid) may be needed to complement regulatory tools. Other solutions discussed included as initiatives for aggregating local demand (as in Sweden) and/or to enable the cost of the (network) connection to be defrayed over a longer period than the current contract duration (24 month) while maintaining the current rules for contract duration for service contractst

Mapping is considered an important initiative. the role of sunk costs in different areas can be considered a market failure

The experts indicated that the impact assessment should clearly specify where infrastructure competition alone does not work to stimulate connectivity and choice, and where accordingly additional solutions are needed. One important market failure is the presence of sunk costs giving rise to economies of scale and market power. Regions differ in the scalability of investments and this problem may be more pressing in white areas than in black areas. However, black areas may experience other sources of market failure. Mapping is therefore important to clearly describe the size of these problems: what is the magnitude of white areas? What are the potential problems in black areas? What are options to improve existing infrastructure? What is the interaction between electronic communication framework and state aid framework in these different settings?

With respect to the proposal to standardize of wholesale products for business communications, one of the experts questioned whether product innovation may be

The trade-off between harmonization/standardisation and regulatory/commerc

negatively impacted as a result of harmonization of specifications. However, it was noted that the wholesale products such as bitstream were often the result of regulatory intervention from the NRA to mandate access, and therefore such products may be less likely to be subject to commercial innovation.

On the other hand, one of the experts noted that market failures may result from a lack of harmonization. An analogy was made that once national networks have formed (e.g. in the banking sector) which largely serve national demand, none of them will spontaneously embrace pan-EU network solutions that serve transnational demand but that may have some short-term costs. This argumentation would call for more harmonization and the consideration of options which are more radical such as moving to EU regulators.

Spectrum

Agreement on the preferred option

There was broad agreement among the experts that the spectrum analysis indeed shows that the preferred option would constitute a significant improvement over the status quo.

Need a definition of 5G

Several comments were made for the research team to consider in the final report. First of all, the experts agreed that the successful, fast and joint deployment of 5G is the key opportunity to be seized and the key challenge for spectrum policy to tackle. While it is not yet clear precisely what 5G actually entails, the experts suggested that an attempt should be made in the report to define what is meant by 5G and to identify its key components (i.e. securing pioneer 5G bands) that will generate the impacts that are described in the impact assessment. Not all aspects of 5G technology will materialize at the same time: some aspects such as e.g. mmWave technology are currently still very much “research projects” that are likely to generate impact only in the longer term. At the same time, other aspects, such as enhanced mobile broadband are likely to be available much earlier.

Facilitating scaling up is one of the key impacts to consider

Second, the experts agreed with the research team that the analysis should clearly highlight how scale (and the speed of scaling up) is becoming an ever more important imperative for economic operators, especially in network industries. The experts pointed out that a true digital single market across the EU, for which spectrum is an important input, is a key element to facilitate such scaling up in Europe, experts mentioned 862-870MHz that is particularly suitable for IoT applications. It is such scale economies that lead investors (e.g. device manufacturers) to consider Europe as a significant player on the global stage, in comparison with other large markets such as the US or China. For instance, device manufacturers need to consider which spectrum bands their technology should be able to operate in. For Europe to ensure that it drives such decisions, it needs to present itself as a single market that is as economically attractive as other major markets.

Distinguish between market structuring and policy aspects of assignments

Third, the panel discussed the difference between market structuring and public policy elements of spectrum assignments which should be acknowledged in the report. Market structuring elements include e.g. license duration, spectrum caps and other such elements. Public policy aspects refer to issues such as coverage obligations. It was noted that EU level intervention is likely to be most valuable

in the coordination of market structuring aspects, and in higher level framing of overall policy objectives.

Option 3 should be a stepping stone to a future more ambitious move toward a more consistent management of spectrum and possibly an EU regulator

Lastly, it was generally acknowledged that the preferred option would make a significant difference in terms of coordinating spectrum assignments in Europe. For the experts, the more far reaching Option 4 (an EU regulator) which is likely to lead to the biggest economic gains, is at the same time possibly less agile and efficient in adapting to local constraints and likely to meet opposition from Member States . A suggestion was made that the impact assessment should be used to show the cost of such opposition by Member States (i.e. the difference in impact between Option 4 and Option 3). There was consensus that Option 3 could eventually be seen as a stepping stone to a future gradual move towards a sustainable and more consistent management of spectrum in the EU, and possibly to the creation of an EU regulator.

Services

Is numbering a practical distinguishing feature?

It was noted that the description of the preferred option should more clearly specify that the reference to "numbers" means E.164 numbers and no other numbering resources such as IPV6 addresses. Furthermore, it may need to be further analysed whether making use of numbering resources is a relevant distinguishing feature for applying sectorial obligations to services and whether this distinction is practically applicable, although they did not elaborate on this point.

Regulatory heterogeneity is not a bad thing per se

Some experts noted that the analysis on regulatory heterogeneity and on the impacts from harmonisation focuses on the gains of harmonisation but not so much on the possible costs for consumers. They agreed that regulatory heterogeneity with regards to consumer protection leads to duplication costs, but questioned whether there are benefits to regulatory heterogeneity if consumer preferences differ. At the same time they agreed that certainty will be needed for the development of the M2M market. They agreed on the need to be transparent about the pros and cons of harmonisation.

What exactly do the measures with regards to bundles entail?

Questions were raised as to what exactly the option with regards to bundles entailed. There were some doubts about the effectiveness and practicality of offering consumers the ability to buy services separately. The issue is rather about the need to be clear on which rules apply to what services when a bundle contains services that fall within the scope of the regulatory framework and services that do not. Once this is solved one should look at how services should be provided and what protections are needed. Consequently there is a need for some reasoning as to how sector specific rules apply to the bundle.

While consumers may clearly benefit from bundling, there are also risks involved

Some experts recognised that bundling may create transparency problems as consumers may find it more difficult to compare bundles to stand-alone products. They noted that it is not always clear what is in the fine print and, in the end, a consumer may have chosen a product in which he/she is actually not better off and it is not clear what the costs of getting out of the bundle are. Another potential concern, due to the popularity of bundles among end-users, was that some operators may be hindered in replicating bundles because they do not have access to relevant wholesale products (e.g. in Spain some operators have trouble getting wholesale access to mobile). However, other experts stressed that bundles may have positive attributes, not least to promote competition, and are no longer considered negative for consumers. Consumers also gain from bundles in the form of reduced transaction cost and a reduction of occasions at which a choice has to be made (consumers don't like to make choices). Thus there is a need to go case by case

rather than taking a single approach on this area and improve transparency through comparison tools.

The RF may not be the right framework for dealing with privacy and security issues

One expert noted that the basis for extending privacy and security obligations to a wider set of communication services is not strong if it is only based on the observation that one third of respondents to a survey find it an issue (referring to a survey held in the context of SMART 2013/0019). Another expert recognised that privacy and security issues are important in relation to communication services (notably IoT services), but argued that the problem also applies to other types of OTTs and not just to OTTs providing communications services. He suggested that in the future IPv6 addresses will replace E.164 numbers and that privacy and security issues should be dealt with under horizontal rules.

Universal service

Flexibility of regulation at the national level

While acknowledging the benefits of allowing Member States flexibility, experts were interested to understand how a universal service (US) obligation for basic broadband would be defined if included, e.g. who determines what is the minimum bandwidth that should be guaranteed. They also inquired about the appropriateness of including mobile connection in the options in this day and age where mobile technologies are becoming much more important. It was explained that there is minimum harmonisation at the EU level so that Member states have options to define their understanding of US pursuant to the national circumstances (e.g. with regards to a minimum required bandwidth) and that mobile technologies are currently included as a technology that can potentially be used to realise broadband services at a fixed location. However, nomadic services as such are not currently included as a US.

Underline the distinction between the measures for affordability and availability of broadband

Experts noted that the problem analysis could make a clearer distinction between affordability and availability. While the preferred option aims at *affordability* (e.g. ensuring affordable prices for all end users, in particular for the most vulnerable), it was argued that *availability* is the real issue to be considered by the RF in general, including possibly by US. Affordability can be realized through social income related policies or subsidies. It was explained that under the preferred option broadband availability would be further promoted through other instruments (such as regulation, state aid or spectrum policy).

Differences between Member States may create complexity, but not necessarily create uncertainty

The analysis refers to “uncertainty” resulting from the fact that Member States have their own approach to assessing costs and unfair burden. It was questioned whether this causes “uncertainty”, or just “complexity”? It was explained that differences between Member States in the calculation of net cost and the notion of unfair burden makes it not always clear to operators entering the market what will be the net cost of US provision, whether it will be considered an unfair burden and whether they get any compensation, which may result in an uncertain market entry.

Governance

Centralisation is important for scaling up and spillovers to be generated

On the topic of governance, the expert panel reaffirmed some of the policy specific elements discussed on access, spectrum and services. There was agreement that localised governance may prevent cross-border markets from emerging. If this is the case, then it significantly strengthens the case for co-ordination at EU level

Administrative costs related to a particular set-up might not be easily reduced

Second, the experts pointed out that in estimating the costs of governance reform, it should be borne in mind that institutional costs are sticky and that any savings from reform (e.g. administrative costs) might take a long time to materialize. One expert observed that institutions often end up maintaining the problem they were created to solve.

Subsidiarity needs to be considered in light of the benefits of greater coordination

Third, one panel member challenged the team to consider subsidiarity in a different light (finding the most appropriate geographic level of intervention rather than one that necessarily places responsibility at the most local level). He posited that, in the context of a digital single market, there is a need to justify why a centralized, coordinated model of governance for electronic communications is not the right way forward. The European Research Cooperation (ERC) is an example where centralisation of the allocation of research grants has resulted in a much more efficient allocation of national research funds across EU researchers and also a more effective search for talent, since there are strong arguments for a larger scale when trying to identify high level expertise. It is a prime example of how the subsidiarity arguments (scale economies and spill-overs) are at play and where centralisation leads to more efficient outcomes. A similar centralized model of governance could be beneficial in the case of e.g. spectrum.

The institutional set up needs to be open to innovation

Finally, one panel member suggested that it is important to understand how the governance model facilitates (rather than acts as a block to) innovation. How can innovation (technological or regulatory) be introduced under a new institutional set-up, what are the key steps for new ideas to be introduced, for their merits to be considered, for them to be decided and then implemented and how open is this process. For example one of the benefits the preferred spectrum option is that it is open to this idea discovery process but puts in fewer blocking factors than other options.

Macroeconomic modelling

The analysis reflects existing production functions but not disruptive changes of production processes

The existing CGE analysis is a welcomed and well developed addition given the necessity to estimate future impact scenarios in a strongly quantitative way. But there are some limitations derived from the deterministic inclination of these models that should be noted.

The model is based on current productivity parameters, while structural changes might be expected as a result of the implementation of the preferred policy options together with a variety of factors. It should be noted that, ideally, the impacts should be analysed from a dynamic perspective, estimating the impact of changes in productivity as a result of both infrastructural and socio-economic factors, including organizational changes. This would require, among other things, that the analysis does not focus only on the horizontal comparison of industries, but also on the specifics of the production process throughout value chains and at the firm level. It is really important to understand how processes of production will change if policy strategies are to be rightly implemented.

Impacts may materialize with a lag

The analysis should account for the fact that it takes time to adopt changes, implement them and, finally, for them to have impact on the production process. Moreover, the analysis should recognize limits in the absorptive capacity of firms. Not all firms are instantly ready to jump to another production function. This has nothing to do with regulation, but with the potential to harvest the benefits of digitalization by industries. Such potential follows from the strategies that different

industries and organizations might adopt e.g. regarding cloud computing. The consultants confirmed that such lags have been accounted for in the model.

CGE modelling is limited in assessing the impact on comparative advantages vis-à-vis the ROW

The CGE model seems to assume that the European economy is operating independently of what happens in the rest of the world. While the current policy options take the broadband situation in the most innovative economies as a benchmark, we have to go beyond that and have a vision to be more innovative than others. For example, the model suggests that exports growth will exceed that of imports. If you want to keep comparative advantage or achieve it, then you have to go beyond the benchmark of access policy, spectrum policy and service policy. It was recognized that this is a general but accepted shortcoming of CGE modelling.

Regional models: potentially very promising but not achievable under the current IA

It would be interesting to see a disaggregated model at regional level, similar to the RHOMOLO model for example. Such models allow for analysing what would happen on the ground in different industrial hubs around Europe. It is recognised that such models are indeed very interesting but also require an extensive amount of resources and development time when done properly.

Materializing of impacts depends on complementary policies in the area of innovation and digital services

Finally, the experts note that the Regulatory Framework alone would not be enough to realise the preferred outcomes in terms of competitiveness of the EU economy. Infrastructure policies should be complemented with innovation policies and policy of digital services (in broader sense than just communication services). All these different policy fields should go together.

ANNEX 14 – The state of play and the EU dimension of connectivity

This annex integrates the problem definition section by describing in more detail (i) the obstacles to unconstrained connectivity identified in section **Error! Reference source not found.**, (ii) the EU dimension of the problem and (iii) including more elements of the baseline, to complement the ones included in section **Error! Reference source not found.**.

1.11.1 Costing the gap and the financial endowment of current initiatives

Some studies have tried to estimate the NGA broadband gap in Europe and to provide estimates about the cost to fill it. The best known of these studies is probably the one performed by the European Investment Bank in 2011. The study considers four scenarios for broadband deployment in Europe. The most **ambitious scenario foresees FTTH/B** roll-out throughout Europe and the gap was estimated at €221 billion⁴⁶⁰. The same scenario of 100% FTTH/B coverage was analysed by Analysis Mason in a study for DG CONNECT in 2012⁴⁶¹. The amount foreseen is similar (€250 billion, for deployment of FTTP-only, across Europe). The amount is reduced to €154 billion in case of high duct re-use. Analysis Mason also estimated the costs associated to a 100% FTTC deployment which are in the area of €50 billion. In case of high duct re-use, the cost would go down to €31 billion.

An internal estimate on the basis of the Analysis Mason study was also carried out by DG CONNECT in 2014 according to which Europe needed an additional EUR 34 billion in investment to reach the target of 100% coverage at 30 Mbps, and an additional EUR 92 billion to credibly enable reaching the 50% take-up target at 100 Mbps⁴⁶². These figures are already taking account of the amount that the private sector could be expected to invest⁴⁶³, and would leave part of the network unfit to serve a Gigabit society if substantial copper-based parts of the networks were to be durably maintained thereafter.

The **financial resources available** at the European level are certainly not sufficient to meet the challenge presented above. The allocation of **European Structural and Investment Funds** for high speed broadband networks experienced a sharp increase from EUR 2.7 billion in 2007-2013 to around EUR 6.4 billion for 2014-2020 (about EUR 5 billion ERDF and an estimated EUR 1.4 billion EAFRD)⁴⁶⁴. However, most of this investment is expected to be made in the form of grants rather than financial instruments so the leverage effect on public (national and/or regional co-funding) and private co-funding will not reach more than EUR 9-10 billion – falling far short from the needs to reach the EU targets for broadband coverage and take-up.

The **Connecting Europe Facility** (CEF) in the digital area is endowed with a limited budget of EUR 1 billion for the period 2014-2020 after the severe cuts it suffered in the Multiannual Financial Framework (MFF) negotiations from a proposed EUR 9.2 billion. EUR 150 million are allocated to broadband infrastructure, based on the provision of financial instruments via the

⁴⁶⁰ http://www.eib.europa.eu/attachments/efs/eibpapers/eibpapers_2011_v16_n02_en.pdf

⁴⁶¹ Analysis Mason, The socio-economic impact of bandwidth (2013).

⁴⁶² Based on a 75% coverage assumption.

⁴⁶³ According to the Digital Agenda Scoreboard, telecom (including fixed, integrated and mobile-only) CAPEX in Europe was € 43 bn in 2013. CAPEX figures remained relatively stable over the 2011-2014 years despite the fact that in the same period NGA coverage increased from 29% to 68%. In 2014, Mobile CAPEX spending represented 59% of total spending. However, this CAPEX is not only directed at modernising the network so that it is difficult to say how much private operators will invest in increasing coverage in the coming years.

⁴⁶⁴ An estimate as the Commission cannot differentiate between allocations foreseen in EAFRD for ICT and Broadband as this type of information is not requested by the regulation. However, additional information is requested and will be provided in the context of monitoring activities (in particular, monitoring will be done for "N° of operations", "Population benefiting from new or improved IT infrastructure" differentiating here between "Broadband" and "Other than broadband").

European Investment Bank (EIB). The broadband part of CEF is expected to mobilise around EUR 1 billion⁴⁶⁵.

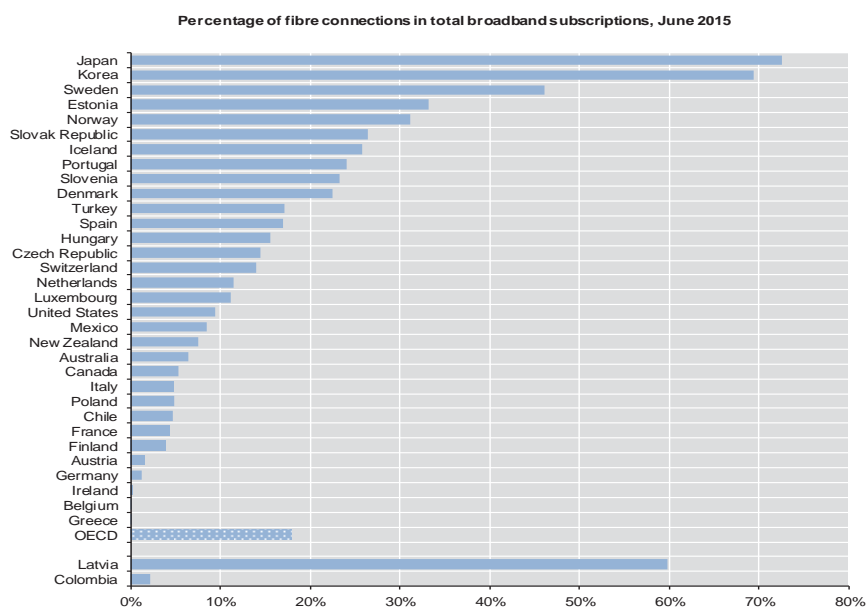
Finally, the European Fund for Strategic Investment (EFSI) does not have sectorial earmarking hence it is difficult to anticipate how much budget will be allocated to broadband infrastructure.

1.11.2 International comparisons

Affordable Gigabit connectivity has already been available as a consumer service in Japan,⁴⁶⁶ Singapore and Korea for some years, while in 2014 Korea's SK Telecom announced trials of 10Gbit/s.⁴⁶⁷ In Korea, the National Broadband Plan (Ultra Broadband Convergence Network⁴⁶⁸), already launched a 1 Gbps target in 2010.

Gigabit connectivity is also available to households and small businesses in US cities served by Google Fibre,⁴⁶⁹ and recent reports suggest that AT&T is responding to the competitive challenge with more widespread urban Gigabit deployments of its own.⁴⁷⁰ However, it is certainly not the case that all European countries are falling behind in a Gigabit society. As shown in the analysis carried out in SMART 2015/0002, Sweden or Estonia already today compare well with Japan on a range of NGA metrics (although Swedish fixed rural coverage remains relatively limited).

Figure 45 - % of FTTB connections on total subscriptions (OECD)



⁴⁶⁵ Under the pilot phase of the Europe 2020 Project Bond Initiative, the EIB and the Commission closed in July 2014 the first deal on a broadband project bond (in France – Axione is the beneficiary). The leverage factor foreseen for the broadband part of CEF is around 7x, so it is expected to mobilise around EUR 1 billion. This leverage was exceeded by the Axione deal which had a leverage factor of 14x.

⁴⁶⁶ KDDI launches GBit/s service 2008 <http://www.japantoday.com/category/technology/view/kddi-to-launch-1gbps-fiber-optic-service-in-oct>

⁴⁶⁷ SK Telecom showcases 10Gbit/s service <http://www.businesskorea.co.kr/english/news/ict/6789-100x-faster-internet-sk-broadband-offer-10-gbps-internet>

⁴⁶⁸ See:

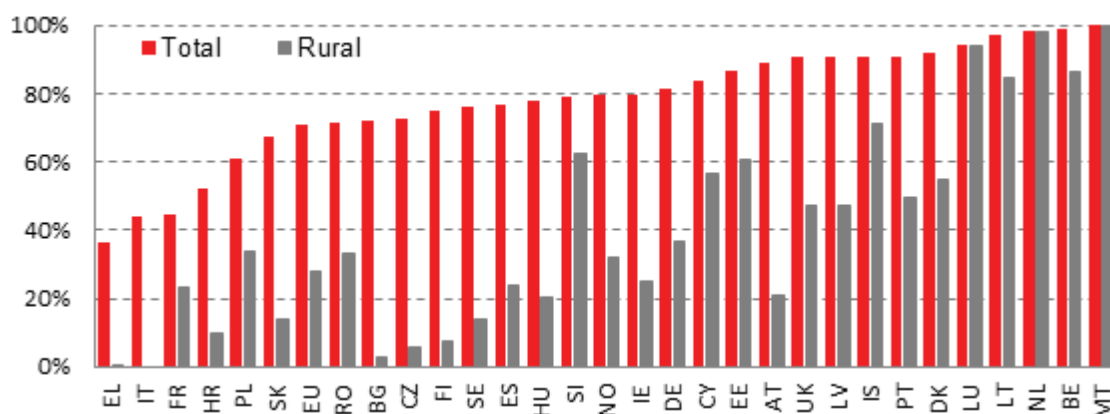
<http://www.unescap.org/sites/default/files/4.1%20Korean%20Broadband%20Policies%20and%20Recommendations.pdf>

⁴⁶⁹ <https://fiber.google.com/cities/kansascity/plans/>

⁴⁷⁰ See for example <http://www.latinpost.com/articles/101338/20151210/google-fiber-vs-att-gigapower-likely-to-win-gigabit-race-thanks-to-google.htm>

Several other EU countries, including Portugal, Spain, France, Romania and other MS, which benefit from an expanding FTTH/B footprint, albeit at different pace of deployment, may become Europe's leading countries for VHC connectivity in the years to come⁴⁷¹. However, large European countries which have so far been experiencing limited or incremental NGA deployment may lag behind European and global leaders on VHC broadband. illustrates the state of transition from copper to fibre, which is much more advanced in other large economies than in several large EU countries⁴⁷². Although the picture does not take into account the effect of cable subscriptions, it gives an idea of the different pace of this transition. Furthermore, rural NGA coverage has been increasing slowly in several countries such as Germany, France, Italy, Austria and Finland, raising the risk of a growing urban/rural digital divide as can be seen in .

Figure 46 – Next generation access (FTTP, VDSL and Docsis 3.0 cable) coverage, June 2015



Source: *IHS and VVA - Digital Scoreboard – Connectivity section*⁴⁷³

*Challenges to the regulatory framework*⁴⁷⁴

The evaluation has confirmed that the access-related provisions of the EU Framework have delivered in most Member States competition and market entry at least in standard broadband and other copper-based telecom services, resulting in greater choice and value for consumers, as also confirmed by the consultation⁴⁷⁵. The market shares of incumbents have fallen steadily on average across the EU reaching 41% of total subscriptions by July 2015 and average prices for broadband services in the EU have been historically low in comparison with international benchmarks such as the US or Canada for low data consumption patterns.⁴⁷⁶

Access of all citizens and businesses to high-quality networks at affordable price has become a prerequisite for Europe to reap the full benefits of the emerging digital economy. The existing framework was not primarily designed for, and could have not foreseen, the scale of the need to ensure the widespread availability of modern infrastructure (in rural as well as urban areas), to

⁴⁷¹ See SMART 2015/0005 and SMART 2015/0002

⁴⁷² Fibre subscriptions data includes FTTH, FTTP and FTTB and excludes FTTC. Some countries may have fibre but have not reported figures so they are not included in the chart.

⁴⁷³ Source: : <https://ec.europa.eu/digital-single-market/en/download-scoreboard-reports>

⁴⁷⁴ For further discussion regarding the contribution of the regulatory framework to network investment and service take up, please refer to the Evaluation of the regulatory framework for electronic communications SWD, in particular to the sections concerning the effectiveness of access regulation and spectrum regulation.

⁴⁷⁵ 86% of respondents to the Commission's consultation felt that the EU framework (and the access-related provisions specifically) have contributed either moderately or significantly to achieving the objective of competition. Consultation Q4b, Q19a

⁴⁷⁶ Source: Mobile Broadband prices (February 2015) <https://ec.europa.eu/digital-single-market/en/news/mobile-broadband-prices-february-2015>. This study was carried out for the European Commission by Van Dijk.

enable access to emerging applications and services - and to ensure that competition is fostered in an environment of technological change.

1.11.3 Towards a connectivity objective

The need for **Very High Capacity networks** stems by the analysis of the likely connectivity needs over the next ten years based on the current trends and comparing them with performance enhancements required from telecoms networks to meet these needs. While expressing an ambition for the future – especially in the fast changing and transformative digital sector – cannot be fully evidence based, the trends described below, as well as findings of the public consultation on "*needs for Internet speed and quality beyond 2020*", strongly support the conclusion that Europe needs unconstrained VHC connectivity for all. This growth will be underpinned by technological evolution (a comprehensive overview of the means and technological choices available for network deployment and their implication in terms of performance can be found in Annex 6.3., SMART 2015/0005 and SMART 2015/0002).

The evaluation clearly shows how regulatory choices under the framework can affect the connectivity outcome (section 7.2.3.). Moreover, work conducted for the Commission⁴⁷⁷ in support of the evaluation and review of the framework illustrates the impact that national regulatory choices can have on the deployment and upgrade of higher performance networks. The study presents how Spain, France and Portugal's NRAs have focused on stimulating entrants to '**climb the ladder**' to FTTH through a focus on duct access and in-building wiring in the absence of downstream remedies as well as by promoting co-investment models. These countries have seen developments in FTTH **infrastructure competition**, but these are largely limited to very dense areas. Market structures in these countries have tended to consolidate towards fewer fixed mobile integrated players. FTTH coverage has grown strongly in **Spain and Portugal, but more hesitantly until recently in France**. The feasibility of this model has depended on the characteristics of the existing networks, including the availability of ducts.

The main reason for both persistent capacity and coverage constraints, in particular outside urban areas, lies in the huge investments required to roll out very-high-capacity networks. While the 30 Mbps target for 2020 is likely to be largely reached on the basis of current trends, the uncertainty of adoption dynamics remains a key constraint to investment in VHC connectivity.

Despite progress in roll-out of NGA (> 30 Mbps), in the EU significantly fewer households, 49%, have access to networks of at least 100 Mbps, in contrast with Japan and South Korea where according to latest data, 73% and 69% of total broadband connections are fibre. In addition, connectivity in Europe is still overwhelmingly asymmetric, while upload speeds are increasingly important for services, such as cloud computing.

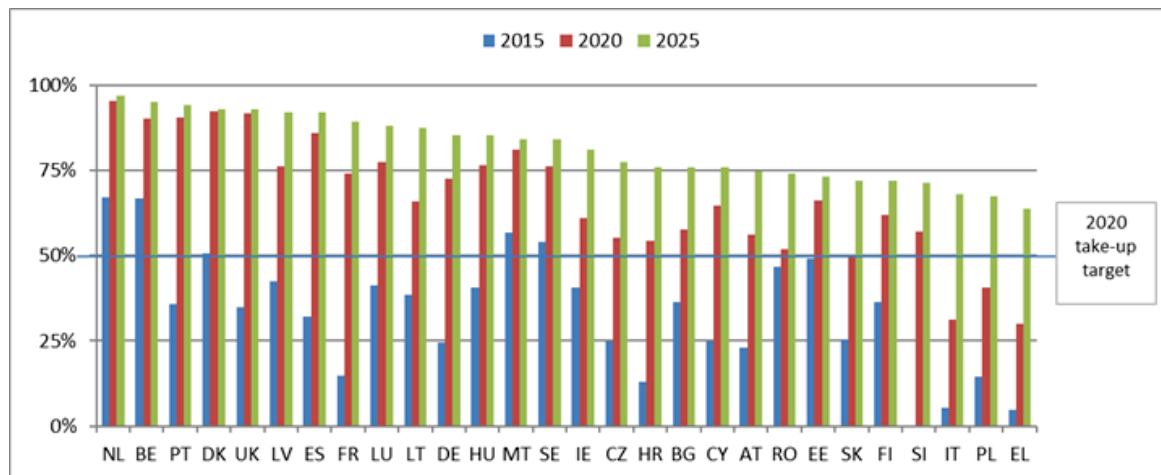
As of July 2015, 70% of European households have basic broadband subscriptions; only 30% of the households are subscribed to NGA above 30Mbps. The trend however, shows that Europeans are rapidly replacing their basic broadband connections with NGA: in 2013 the only 15% of European subscribed to NGA above 30Mbps, while 85% of subscriptions was to a basic broadband connections⁴⁷⁸. **Error! Reference source not found.** showed how dramatically the take-up rate of connection above 100 Mbps is progressing in countries where fibre networks are widely available. Take-up projections of NGA in a 5-10 year timeframe vary, and show significant differences across countries and technologies. For example, taking into account evolving coverage and propensity to take-up NGA, IDATE preliminarily projects that nearly half of households across the EU will take NGA technologies (FTTC, FTTH/B or Docsis 3.0 and

⁴⁷⁷ Regulatory, in particular access, regimes for network investment models in Europe (SMART 2015/0002)

⁴⁷⁸ Source; Digital Scoreboard: <https://ec.europa.eu/digital-single-market/en/connectivity>

successors) by 2020, and nearly two thirds by 2025. However, there are significant differences between countries as shown in the figure below.

Figure 47 - Projections for NGA (>30Mbps) take-up 2015-2025



Source: IDATE

As today not all NGA networks can deliver 100 Mbps, the picture above implies that without appropriate investment incentives, **Europe is likely to miss the target of having 50% take-up of 100 Mbps services by 2020.**

As reported in the evaluation on **stakeholders' views** (section 7.1.1.) some Member States, the European Telecommunications Network Operators' Association (ETNO) and the large majority of the incumbents go as far as suggesting, via the public consultation conducted in light of the review, that investment should be made an explicit objective, next to competition, given the significant network rollout and upgrade needs in the coming years. This would imply amending the framework; among others access regulation, to favour dynamic efficiency gains over static ones. In areas where infrastructure competition is not viable, competition would be "for the market" rather than "in the market". Many other stakeholders including alternative operators and consumer associations stress, on the other hand that competition would not survive outside the regulatory framework and that the latter should not favour investment at the expense of competition (and thereby also at the expense of the consumer outcomes that go along with competition).

However, the findings of the access study and the forecast summarised in section **Error! Reference source not found.** seem to show the legitimacy of the connectivity objective in the medium run.

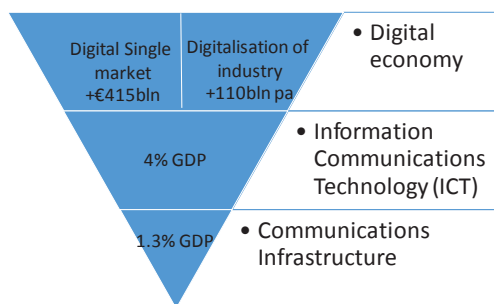
1.11.4 What is the EU dimension of the problem?

The state of play and the European dimension of the connectivity problem There is a particularly strong rationale for EU action in the context of the challenges of the DSM. Digital services (including calls, messaging and entertainment) are increasingly offered on a pan-European or even global basis. In turn, digital services for consumers and businesses rely on ubiquitous connectivity, in some cases requiring VHC and/or reliability. Connectivity is a vital enabler for the DSM⁴⁷⁹ and warrants an EU-wide response, even if network deployments are mainly local in

⁴⁷⁹ See EC Digital Single Market Communication May 2015 <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52015DC0192>

nature. The figure⁴⁸⁰ below gives an idea of the spillovers that are determined by communication infrastructures on the wider European economy.

Figure 48 – GDP contributions from the Digital economy



The limited connectivity available in Europe already today negatively affects EU citizens', businesses' and public authorities' capacity to produce, share and benefit from innovative digital products and services. Moreover, the competitiveness of the wider economy, not least of multinational companies based in the EU, is affected as high speed, high quality communications services and networks have an economic effect across all business sectors in Europe. As mentioned in section **Error! Reference source not found.**, it is important to take into account that **albeit networks are local in nature**, (and will probably get even more local in the future with the proliferation of small fibre operators such as in Sweden) the problem of **suboptimal investment is a European problem**, as even local networks are financed from international and cross-border capital markets. So despite the local nature of the networks, connectivity and investment have a clear internal market dimension and the review should strive to induce policies which are more favourable to investment without jeopardising the existing objectives.

According to the macroeconomic model elaborated for this study (see Section **Error! Reference source not found.** and Annex 5), if all the preferred options are pursued as a result of the review of the electronic communications framework, we expect expanded market-driven investment and consumption and a cumulative effect on growth of 1.45% and on employment of 0.18% in 2025, assuming that the reforms are implemented by 2020.

In general, digital technologies and ICT have been in the last twenty years an enabler for the emergence and the expansion of new business models such as the sharing economy, crowd-sourcing of ideas and solutions for large companies, mutualisation of software (SaaS), including in the cloud. Experience from the **harmonisation of approaches** to previous generation technologies and solutions, notably from the GSM Directive,⁴⁸¹ LLU Regulation,⁴⁸² and the Leased Line Directive⁴⁸³ suggests that clear and co-ordinated action at EU level to implement best practice in relation to connectivity can provide an important stimulus for deployment and take-up, raising the performance of the EU as a whole, compared with action that could be taken by MS individually. This is illustrated by Figure 49, which shows how broadband take-up in Europe expanded in the years following the adoption of the LLU Regulation in 2000, which applied best practice methods for broadband promotion (until then applied only in a few countries such as Germany) more widely across the EU.

Figure 49 - Broadband trends in Europe following the LLU Regulation (2000)

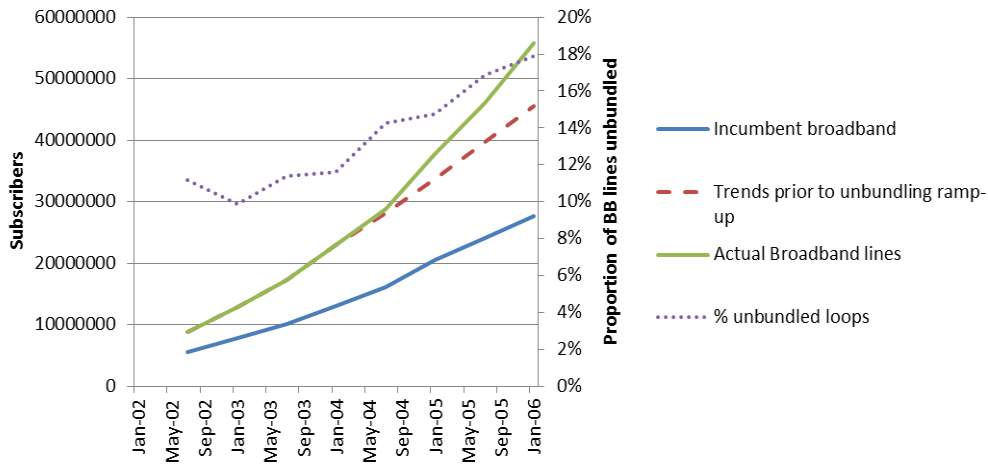
⁴⁸⁰ Source: SMART 2015/0005..

⁴⁸¹ Council Directive 87/372/EEC

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31987L0372:en:HTML>

⁴⁸² Regulation EC 2887/2000 <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32000R2887>

⁴⁸³ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31992L0044>



Source: WIK based on Cocom data (except 2002 – OECD) and extrapolations

The 2002 Framework generally enhanced the flexibility of market regulation to deal with different economic circumstances in the MS (via market definition and SMP identification), and the 2009 review enhanced technological and service neutrality in spectrum bands (in contrast to the approach of the GSM directive).

This has allowed for a much more flexible and sophisticated approach to regulation, which can take economically-based decisions on a case-by-case basis. Nevertheless there is still a clear need for a degree of EU-level steering to define bottlenecks and ultimately to meet common needs. This is recognised in the current framework through a level of flexibility which allows coping with new technological and market circumstances.

Several of the issues raised by the stakeholders and in the implementation experience involve cross-border challenges, such as numbering needs and roaming issues in relation to IoT, spectrum coordination and consumer protection, or businesses' need for seamless connectivity across multiple sites and countries. For example, the lack of European cross border coordination on the timing of allocation and assignment creates cross border interference problems and prevents services developing across the whole EU territory.

The heterogeneity in the implementation at national level of consumer protection as a result of different national legislation brought about by the current minimum harmonisation approach has impacted the effectiveness and efficiency of the rules and reflects the need for a coherent approach at EU level. Consistency in consumer protection standards across borders would avert further fragmentation along national lines and facilitate compliance for multi-territorial operations. Further harmonisation of end-user rights in the EU, coupled with deregulation where warranted, should thus result in a modernised set of consumer protections rules, providing higher confidence among end-users and making it easier for providers of communications services to comply with legislation and reducing unnecessary compliance costs.

1.11.5 Baseline analysis: how would the problem evolve without intervention

This section complements and deepens the analysis of the baseline presented in section **Error! Reference source not found.**

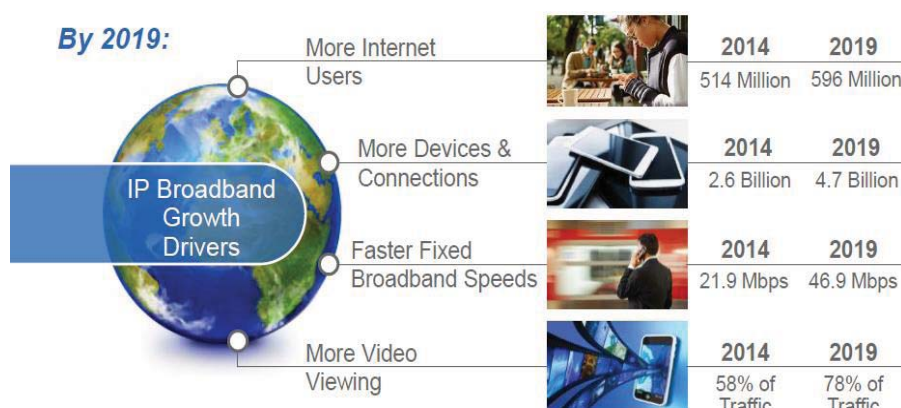
As mentioned therein, the existing framework has delivered more competition, better prices and choice for consumers, and spurred operators to invest in upgrading their networks at least in some areas. Today virtually all EU citizens have access to basic broadband networks (97% fixed

broadband connections according to the DESI index 2016⁴⁸⁴) and increasing numbers of citizens and businesses have access to networks (Next Generation Access – NGA- connectivity) allowing at least 30 Mbps download speed (70.9% NGA general coverage⁴⁸⁵ in EU according to DESI 2016 – see section 1.4.1 for more data). Only some countries, such as Malta, Lithuania, Belgium and the Netherlands, already enjoy nearly comprehensive coverage of NGA networks, in most of those cases probably mainly thanks to the competitive impulse provided by legacy cable networks, which could be upgraded at relatively low cost⁴⁸⁶. NGA coverage in countries which lack extensive cable has been slow to develop in many cases (Italy or Greece being emblematic). Moreover, a large part of the NGA coverage beyond the cable footprint in many countries (UK or Germany, for instance) has been achieved through only partial upgrades of the legacy copper loop (FTTC), rather than full upgrades (FTTH/B). As investigated in study SMART 2015/0002, the former approach may not be sufficient to cope with the data consumptions under the most ambitious scenario forecast.

A key development since the framework was originally conceived is that legacy telephone and cable (coaxial) networks, including the copper ‘local loops’, are in the process of being upgraded with fibre and other solutions which improve broadband performance.

In terms of demand, these enhancements are needed to enable customers to enjoy better quality in online services including online video and cloud applications, as well as enabling multi-screen viewing, which is becoming increasingly prevalent in European households with the proliferation of devices as illustrated in **Error! Reference source not found.** below.

Figure 50 - Europe IP Traffic and Service Adoption Drivers



Source: Cisco VNI Global IP Traffic forecast 2014-2019 – Europe includes Western Europe + CEE, excluding Russia

According to CISCO, Global IP traffic will increase threefold over the next 5 years. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of 21 percent from 2013 to 2018⁴⁸⁷. The widespread adoption of cloud services, the number of connected devices (IoT), the booming M2M industry, contribute to further increase the traffic load on communications networks. In

⁴⁸⁴ The Digital Economy and Society Index (DESI) is a composite index developed by the European Commission (DG CNECT) to assess the development of EU countries towards a digital economy and society. It aggregates a set of relevant indicators structured around 5 dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology and Digital Public Services. For more information about the DESI please refer to <http://ec.europa.eu/digital-agenda/en/digital-agenda-scoreboard>

⁴⁸⁵ NGA broadband coverage/availability (as a % of households) with Next Generation Access including the following technologies: FTTH, FTTB, Cable Docsis 3.0, VDSL and other superfast broadband (at least 30 Mbps download)

⁴⁸⁶ Several studies highlight the role played by cable in stimulating NGA deployments including SMART 2015/0002, WIK-Consult (2015) for Ofcom ‘Competition and Investment: analysing the drivers of superfast broadband’, and the EP (2013) study ‘Entertainment X.0 to boost broadband deployment’

⁴⁸⁷ Source: CISCO VNI index, see:

<http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html>

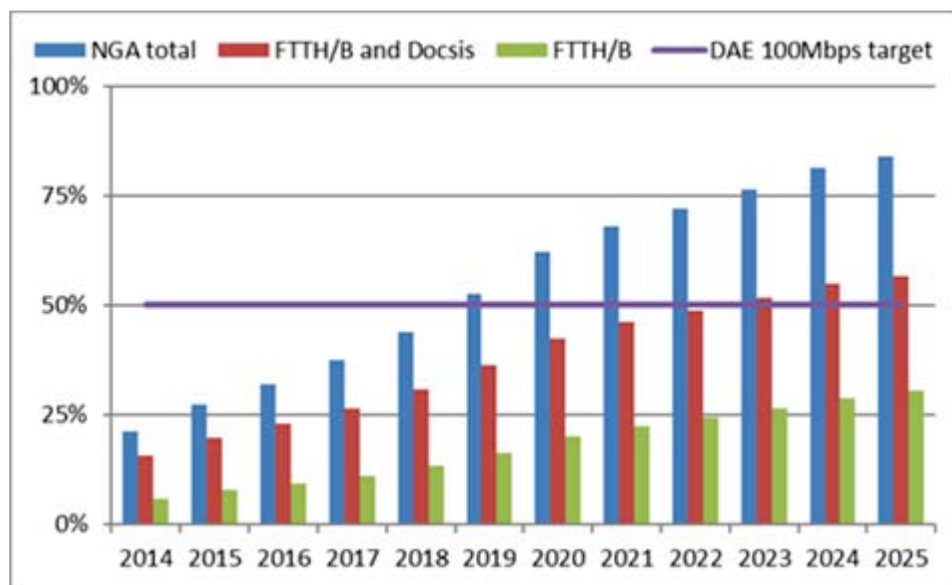
particular, as businesses and consumers exchange their data with the cloud, this will also lead to a **modified demand pattern for upload traffic**. Hence, while most of the traffic will still be in download, demand for upload will increase, as well as the need for lower latency for applications such as cloud computing and e-health, parameters included in the VHC concept.

The trends explained above increase the demand for capacity and certain quality characteristic of connectivity networks. There is an emerging consensus among industry players and investors that in the medium and long run connectivity providers, both fixed and mobile, will have to rely on (nearly) ubiquitous fibre infrastructures coming very close to users' premises, to support their business, especially considering the expected requirements of 5G.

Gigabit connectivity is also foreseen in projections by Deloitte⁴⁸⁸ as a requirement to meet the aggregate demand from **dozens of connected devices in a home**. This is becoming the norm in European households where several users consumer bandwidth from several devices at once. Deloitte further notes that “*demand for connectivity has evolved symbiotically: as faster speeds have become available, the range of applications supported has increased and the viable number of devices per person has steadily risen.*”

In terms of supply of NGA in commercially viable areas, forecasts from IDATE based on market intelligence (see figure below) suggest that upgrades to NGA and VHC networks will continue, but at a relatively gradual pace.

Figure 51 - Projected take-up of NGA by technology (to 2025)



Source: IDATE, SMART 2015/0002

IDATE projections suggest that by 2020 (see figure above), even under very optimistic assumptions (assuming FTTC/vDSL delivers 100Mbit/s in practice), around 16 countries may miss the DAE targets of 50% households taking up at least a 100 Mbps connection, and that within the 16 affected countries the target will be missed by around 25m households. Under a more conservative assumption, whereby only FTTH/B and cable are considered as reliably offering more than 100Mbit/s, the gap in meeting the target would amount to around **27m households**. In reality other advanced hybrid copper-based solutions may deliver the required speed provided the local loop is sufficiently short. Countries with limited historic cable competition such as Italy and Greece are included amongst those considered likely to miss the

⁴⁸⁸ Deloitte Technology, Media and Telecommunications Predictions 2016

targets, while countries which have been characterised by strong FTTC, coverage could fail to meet targets under the stricter assessment⁴⁸⁹.

This pace of development may be sufficient to meet the needs of some users, but is likely to limit the potential for more demanding users including small business and home office users and may not be sufficient to enable Europe to fully benefit from a connected economy and society. As explained in more detail in the support study SMART 2015/0005, chapter 1, the demand for data is booming and the scenarios considered are mostly rather conservative.

Concerning rural NGA deployment, existing regulatory practice and outcomes vary across the EU as shown in case studies for SMART 2015/0002. If the current varying practices remain, the current status of uneven rural deployment is likely to persist, resulting in patchy access in rural communities to broadband capable of reaping the benefits from the social and economic integration that digitisation may bring. This process is likely to have repercussions on public finances, especially if accompanied by ageing population. Challenge areas could in theory be addressed through public subsidies, but these are by no means sufficient. The costs of achieving DAE targets also in rural areas are exposed above in section 1.11.1.

An estimate of the connectivity problem in the future (2025 and beyond) can be inferred from asking (1) whether there is likely to be a gap between bandwidth demand and NGA deployed; (2) whether future demands can be met through incremental upgrades of existing copper and coax (cable) networks or only through FTTH/B; and (3) the extent to which future mobile technologies (5G) will be able to rely on fixed networks for backhaul and other data transmission needs. The size of Europe's bandwidth challenge can be seen most vividly by comparing where we are today with what would be needed to benefit from all aspects of a connected society in 2025 as assessed in more detail in SMART 2015/0002 and SMART 2015/005⁴⁹⁰.

According to Samknows, average download speeds achieved in Europe in 2014 were 24Mbit/s.⁴⁹¹ If investment in NGA technologies continues at its current levels, IDATE has projected that average download speeds would reach around 200Mbit/s- by 2025,⁴⁹² while upload speeds would reach around 90Mbit/s. Based on trends in video and cloud usage under the 'status quo', IDATE has also estimated that bandwidth use in the EU may expand from 62GB per line per month in 2025 to 298GB per line.⁴⁹³ This may seem significant, and for households used to experiencing restricted bandwidths,⁴⁹⁴ it may be appear enough.

As mentioned in section **Error! Reference source not found.**, there is evidence suggesting that in the telecom sector **demand responds to supply**,⁴⁹⁵ and that restricted download and upload

⁴⁸⁹ For additional deployment forecasts see , SMART 2015/0002.

⁴⁹⁰ In the context of the Expert Panel conducted under SMART 2015/005 – See Annex 13 for more detail, Prof. Brett Frischmann observed that current demand expressed by end-users may fail to reflect the innovation potential in the market, which could be unlocked through more performant infrastructure.

⁴⁹¹ Page 115 Samknows for EC Oct 2014 Quality of Broadband Services in the EU

⁴⁹² In the context of SMART 2015/0002 IDATE forecast likely uptake of NGA by technology to 2025 and based speeds and speed growth per technology on the basis of Samknows data. According to Akamai speed measurements, average speeds have been increasing by 16% per annum across a range of geographies. An alternative approach of extending this projection would result in speeds of around 150Mbit/s in 2025.

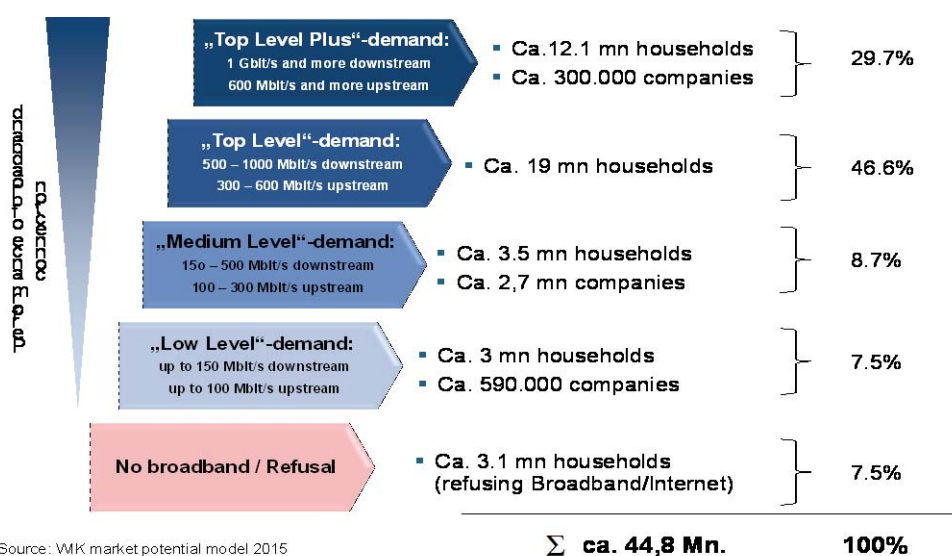
⁴⁹³ SMART 2015/0002

⁴⁹⁴ Many Internet users are already experiencing challenges with the bandwidth they have available. Almost four in ten respondents to the Eurobarometer survey of 2014 noted that they had experienced difficulties accessing online content or applications as a result of insufficient speed of download capacities.

⁴⁹⁵ Data from the UK regulator Ofcom for example suggests that download bandwidth consumption for NGA (FTTC and FTTP) networks was around two times higher than bandwidth consumption for non-NGA networks, with significantly higher use of upload capacity. This evidence of higher usage being associated with the availability of NGA is supported by the case study of Palaiseau in France, which has been the subject of a pilot trial for the switch-off of Orange copper customers and migration to FTTH networks. In this case it was observed that the average Internet traffic of Orange's broadband customers as well as their consumption of video-on-demand was multiplied by a factor of three. Importantly, this trial also resulted in fibre clients' usage of upload bandwidth being increased 8 times, due to changes in Internet usage and an increased usage of cloud-based services.

speeds may limit the types of usage and applications that might otherwise emerge. In Sweden, following an early boost by the central government, one out of every two municipalities is involved in fibre to the business and fibre to the home deployments. This has led to very high take-up: as of July 2015, 68% of the broadband connections in Sweden are NGA⁴⁹⁶, achieved predominantly through FTTH and FTTB connections. Where FTTH is widespread, the availability of fibre makes extending fibre to base stations far more feasible and efficient. This is well illustrated by the example of 4G in Stockholm where the world's first 4G deployment took place helped by the virtually 100% fibre coverage.⁴⁹⁷ If bandwidth needs are calculated on the basis of what might be required to run certain applications, a case study of the German market providing a forecast for 2025 suggests that an average user might require 150-500Mbit/s downstream with more than 100Mbit/s up, while high-end users including those running small or home offices might require 1Gbit/s in download and more than 600 Mbps in upload (see SMART 2015/0005). This bandwidth would be used not only for multi-screen ultra HD video, but also for applications such as cloud and e-health as well as for home working and small business needs.

Figure 52 - Model of market potential – Germany 2025



As shown in **Error! Reference source not found.** data rates required by the most demanding users could reach 1 Gbit/s or more on the downstream link by 2025, while a significant proportion of households and offices could demand download speeds of 500-1000Mbit/s and 300-600Mbit/s upstream by 2025. This scenario therefore sets the upper bounds for potential users (including business user) demands in the medium term – though it is worth noting that even a less ambitious scenario will need the fibre rollout to reach far deeper into most of the present networks.

On the subject of inconsistency in the implementation of the framework, there is evidence that without further direction at EU level, this problem is likely to persist and may worsen, in part because when new technologies and services emerge they lack the harmonisation that was historically required through EU legislation, and may not achieve adequate levels of harmonisation through voluntary standardisation alone. Concerns over the impact of fragmentation on business users, in particular multi-national ones, provide an example of the enduring nature of these problems and difficulties in using current tools to address them. Concerns over fragmentation in the market for business communications were first raised in a survey conducted by the predecessor to BEREC, the European Regulators Group (ERG) in

⁴⁹⁶ See annex 6.

⁴⁹⁷ Source: Vodafone's call for the Gigabit Society, Dec. 2015

2009,⁴⁹⁸ validated in a further survey published in 2013,⁴⁹⁹ and have subsequently been reaffirmed by business end-users in the context of studies for the EC in 2015⁵⁰⁰ and 2016.⁵⁰¹ Yet in an interview conducted in 2016 for SMART 2015/0002, INTUG observed that it still had concerns over the ability of business issues to be effectively addressed under the existing institutional set-up.

Concerning future generations of wholesale access products for residential customers and small business, the experience of a new product designed as a partial replacement for LLU on NGA networks, such as ‘VULA’ (Virtual Unbundled Local Access) or a WDM (Wavelength Division Multiplexing) based access product provides a warning that without efforts to apply a European ‘standard’ (as was created with ‘local loop unbundling’ on copper networks) any future technological upgrades in fixed access networks are likely to result in duplicate efforts to develop new wholesale access solutions and divergent implementations at national level. As seen with the past implementation of VULA, this may result in slow take-up of wholesale offers of future generations of fixed access infrastructure and therefore – especially in the early phase - reduced levels of choice for consumers in areas where competition cannot be delivered through infrastructure-based competition alone. In turn, this may dampen take-up of new technologies in the early deployment phase.⁵⁰²

Lastly, in view of the fact that the preparation by NRAs of market analysis often coincides with three year period between market reviews and results in delays of several years, the perpetuation of the existing three year market review cycle, is likely to result in insufficient time for the previous reviews to be confirmed and effectively implemented⁵⁰³ and their effects to be known. Additionally, the continued re-evaluation and re-calibration of regulation conflicts with the aim of many regulators to provide longer-term certainty and potentially long-term remedies⁵⁰⁴ in order to provide more durable solutions that offer greater certainty to operators and investors.

Overall we can state that **a no change scenario would lead to a persisting digital divide for citizens and SMEs**, sub-optimal economic development outcomes, sub-optimal allocation of capital, lack of consumer trust in digital services, lower take up of innovation and loss of competitiveness of EU industry. A review of studies on standard speed broadband suggests that an increase of 10% in standard broadband penetration could contribute between 0.25% to 1.38% to GDP growth.⁵⁰⁵ There is also a small, but expanding body of literature highlighting how the

⁴⁹⁸ ERG report on the regulation of access products necessary to deliver business connectivity services ERG (09) 51 http://berec.europa.eu/doc/publications/2009/erg_09_51_business_services_paper_final.pdf

⁴⁹⁹ WIK (2013) Business Communications, economic growth and the competitive challenge

⁵⁰⁰ SMART 2014/0023 Access and Interoperability standards for the promotion of the internal market for electronic communications

⁵⁰¹ SMART 2015/0002 access and investment

⁵⁰² Evidence from standard broadband suggests that unbundling played a role in accelerating take-up in the early deployment (but not later phase). It also had a positive impact on service quality. See unbundling the incumbent – evidence from UK broadband Nardotto, Valletti, Verboven (2015) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2505035. SMART 2014/0024 also shows how NGA take-up could have been accelerated if customers of entrants had been converted to NGA at the same rate as those of incumbents

⁵⁰³ This is especially true in the case of appealed decisions

⁵⁰⁴ Long-term discounts exceeding 3 years have been negotiated for wholesale FTTC/VDSL bitstream access in NL and Germany. In France, one amongst a number of justifications provided by ARCEP in interview for SMART 2015/0002 for pursuing symmetric rather than asymmetric regulation to address fibre bottlenecks was the need to provide a framework for longer term solutions (in this case on the basis of IRU)..

⁵⁰⁵ Among others: Crandall, R., Lehr, W., and Litan, R. (2007), The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data, *Issues in Economic Policy*, 6; Czernich, N., Falck, O., Kretschmer T., and Woessman, L. (2011), Broadband infrastructure and economic growth, *Economic Journal*, 121(552); Koutroumpis, P. (2009). The Economic Impact of Broadband on Growth: A Simultaneous Approach, *Telecommunications Policy*, 33; Qiang, C. Z., and Rossotto, C. M. (2009), Economic Impacts of Broadband, In *Information and Communications for Development 2009: Extending Reach and Increasing Impact*, 35–50. Washington, DC: World Bank.

effects of faster broadband through fibre connectivity could boost growth further and offer a new lease of life to rural communities⁵⁰⁶.

Promotion of the interests of end-users, including the provision of a safety-net through the universal service obligations, is another principal objective of the regulatory framework, as it ensures that consumers can participate in the digital society and fully reap the benefits of a competitive market. Overall the framework has been successful in safeguarding consumer protection, even when this is not fully translated in increased consumer satisfaction. Given the increasing role of connectivity and electronic communications services in today's European economy, it is important to continue protecting end users' interest.

Current rules on contracts content, duration and termination, transparency on tariffs, quality of service and other conditions, potential minimum quality of service requirements, switching and number portability have enabled consumers to take advantage of a competitive market.

Regarding switching, the number of porting transactions has increased, in particular in relation to mobile numbers, with switching rates above other subscription-based industries, even if certain practical implementation difficulties still affect consumers (e.g. loss of service during switching).

National rules have ensured transparency of information on services and prices by providers, including in some cases the provision of online tools comparing prices and services; rules on contract duration have been transposed so that the initial commitment period does not exceed 24 months, while also ensuring that providers offer users the possibility to subscribe to a contract with a maximum duration of 12 months; some Member States have adopted detailed rules regarding consumer protection safeguards in case of unilateral changes to contract conditions.

Despite the above, consumers still refer to issues related to transparency and quality of service, in particular with regards to the internet access service. This problem is especially acute when access to the internet service is bundled with other communications service, resulting in 24% of consumers not finding easy to compare prices of bundles, while evidence shows that an increasing number of consumers on most Member States opt for this service delivery mode.

The provisions on security and integrity of networks and services have contributed to strengthening the European telecom infrastructure's resilience and services availability across the EU. Yet effectiveness of the provisions is not complete and this would be related to the fact that security obligations cover only electronic communications providers.

As explained in the problem definition, only providers of traditional communication services have to comply with sector specific rules safeguarding end-user's interests. Providers of communications service over the internet (OTTs) are not subject to these sector-specific rights and obligations, even when their services are used by the end-users to cover the same or similar communications needs as the traditional electronic communications services.

Significant changes or further evolution of the problem are not foreseeable with regards to services and end-user protection, absent further intervention at EU level. Uncertainty about the scope of sector specific rights and obligations and gaps in consumer protection would persist, which would in turn lead to a further fragmentation of the internal market and impede adoption of new services.

Rules on universal service aim at providing a safety net ensuring that the most vulnerable in society as well as those in more remote areas can receive basic services. They cover both connectivity and service aspects, as well as the affordability of tariffs and accessibility for disabled users. The provisions permit financing of any 'net cost' of universal service obligations either through a levy on operators or through public funds, where such a net cost would

⁵⁰⁶ See for further studies SMART 005/2015

otherwise constitute an unfair burden to the designated Universal Service Obligation (USO) operator.

In the absence of intervention at EU level, Member States would likely take increasingly different approaches in universal service obligations by removing outdated services from the scope. Consistency and coherence of the universal service regime across Member States would reduce without a common approach towards the inclusion of broadband in the universal service scope. The sectorial financing mechanism would continue being a possibility for financing. The costs of financing the universal service obligation in the Member States would likely remain the same, depending on possible national approaches. Looking towards future challenges which could not be addressed in the absence of more consistent and effective intervention, the most immediate and significant new technological development is the introduction of 5G (planned for the early 2020s). Indeed, as an ongoing Commission study⁵⁰⁷ confirms, 5G is expected to deliver 1 gigabit per second simultaneously to, for instance, many workers on the same floor. In addition, it offers enhanced spectral efficiency, enhanced signalling efficiency and reduced latency compared to 4G. 5G is also expected to be a key enabler for M2M communications and the IoT.

The economic benefits of successful, fast and coordinated deployment of 5G across the EU are very significant and they have been estimated at 146bn EUR per year and the creation of 2.39m jobs⁵⁰⁸. These estimates only consider the most immediate impacts of a delay including the sectors that are most directly affected. It is likely that the full impacts of 5G would only materialise at a later stage and that they would affect many more sectors of the economy. Later deployment of 5G services would therefore also lead to delays in these ripple effects throughout the wider economy.

A failure to achieve a single market in electronic communications can in itself impose considerable costs. This is especially true for multi-national businesses, which require not only the availability of connections in disperse locations, but also uniform conditions for provisioning, repair and quality guarantees. In a 2013 study “Business communications, economic growth and the competitive challenge”, WIK estimated that the creation of a single market enabling the seamless provision of business communications services could lead to efficiency gains and boost productivity providing economic benefits of up to €90bn per annum over time.⁵⁰⁹

Meanwhile, a 2011 study conducted for the EC – steps towards a truly Internal Market for e-communications⁵¹⁰ – identified substantial benefits from greater ‘standardisation’ of solutions within the EU, including: (i) Advantages for multinational corporations – making Europe a more attractive location for headquarters, branch offices and production facilities; (ii) economies of scale for manufacturers of telecoms systems, which could benefit from a lesser need for customisation (iii) improvements in e-Health, e-Learning and business to business services. The authors concluded that increased standardisation could provide annual gains of 0.3%-0.45% GDP (€35bn-€55bn) and cautioned that failing to reach standardised solutions would affect future pan-European roll-out as well as the development of premium over-the-top-services. The study also examined the impact of harmonised ‘best practice’ in the promotion of competition in telecoms, and concluded that a fully-harmonised European approach could provide gains of 0.22% and 0.44% of GDP (€27bn - 55bn) by delivering lower prices, higher quality and greater investments.

⁵⁰⁷ SMART 2015/0003, Substantive issues for review: market entry, management of scarce resources, and general end-user issues

⁵⁰⁸ SMART 2014/0008, Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe

⁵⁰⁹ The gains are associated with a welfare gain from lower prices, efficiency gains from an improvement in ICT processes and productivity gains through a reorganisation of business processes

⁵¹⁰ Ecorys/TNO/TU Delft (2011) ‘Steps towards a truly internal market for electronic communications’ <https://ec.europa.eu/digital-agenda/en/news/steps-towards-truly-internal-market>

ANNEX 15 - Glossary and Bibliography

ADR: Alternative Dispute Resolution

ADSL: Asymmetric Digital Subscriber Line

ARPU: Average Revenue Per User

ARCEP: Autorité de régulation des communications électroniques et des postes

ASQ – Assured Service Quality

BCG: Boston Consulting Group

BEREC: Body of European Regulators

BEUC: Bureau Européen des Unions de Consommateurs (The European Consumer Organisation)

CAGR: Compound Annual Growth Rate

CAP: Content and Applications Provider

CAPEX: Capital expenditure

CEPT: European Conference of Post and Telecom Administrations

COCOM: Communications Committee

CRM: Customer Relationship Management

DAE: Digital Agenda for Europe

DESI: Digital Economy and Society Index

DG CNECT: European Commission Directorate General for Communications Networks, Content and Technology

DNS: Domain Name System

DSM: Digital Single Market

ECHR: European Charter of Human Rights

EC: European Commission

ECN: Electronic Communication Networks

ECNS: Electronic Communication Networks and Services

ECS: Electronic Communication Services

ECTA: European Competitive Telecommunications Association

EFIS: ECO (European Communication Office) Frequency Information System

eMBB: enhanced mobile broadband

EP: European Parliament

EPG: Electronic Programme Guide

ERA: European Railway Agency

ERP: Enterprise Resource Planning

ERT: European Round Table for Industrialists

ESIF: European Structural and Investment Funds

ETNO: European Telecommunications Network Operators' Association

ETNS: European Telephone Numbering Space

ETSI: European Telecommunications Standards Institute

EU: European Union

EUR: euro (currency)

FCC: U.S. Federal Communications Commission

FTE: Full Time Equivalent

FTTB: Fibre to the Building

FTTC: Fibre to the Cabinet

FTTH: Fibre to the Home

FTTP: Fibre to the Premises

FTTx: Fibre to the x

FWA: Fixed Wireless Access

FWD: Framework directive

GDP: Gross Domestic Product

GHz: Gigahertz

GPS: Global Positioning System

GPT: General Purpose Technology

GSM: Global System for Mobile Communications

GSMA: GSM Association

HFC: Hybrid Fibre Coaxial technology

HSPA: High Speed Packet Access

IA: Impact Assessment

IAS: Internet Access Services

IASG: Impact Assessment Steering Group

ICT: Information and Communications Technology

INTUG: International Telecommunications Users Group

IoT: Internet of Things

IP: Internet Protocol

IPR: Intellectual Property Rights

IPTV: Internet Protocol Television

ISP: Internet Service Provider

IT: Information Technology

ITRE: European Parliament Committee on Industry, Research and Energy

LLU: Local Loop Unbundling

LTE: Long Term Evolution

M2M: Machine-to-Machine

MEP: Member of the European Parliament

MHz: Megahertz

MNC: Mobile network code

MNO: Mobile Network Operators

MS: Member States

MSC/MNC: multi-site/multi-national corporations

MVNO: Mobile Virtual Network Operators

NFV: Network Function Virtualisation

NGA: Next Generation Access

NIS: Network and Information Security

NRA: National Regulation Authority

ODR: Online Dispute Resolution

OECD: Organisation for Economic Co-operation and Development

OTA: over-the-air-provisioning

OTTs: Over The Top players

P2P: Peer-to-Peer

PATS: Public Access Telephony Services

PSAP: Public Safety Answering Point

PSB: Public Service Broadcaster

PSTN: Public Switched Telephone Network

QoS: Quality of Service

R&D: Research & Development

RSC: Radio Spectrum Committee

RSPP: Radio Spectrum Policy Programme

RSPG: Radio Spectrum Policy Group

SDN: Software Defined Networks

SIM: Subscriber Identity Module

SMA: Spectrum Management Authority

SME: Small and Medium Enterprises

SMP: Significant Market Power

SMS: Short Message Service

TFEU: Treaty on the Functioning of the European Union

TTE Council: The **Transport, Telecommunications and Energy Council**

US: United States of America

USD: Universal Service Directive

USO: Universal Service Obligation

VAT: Value Added Tax

VHC: Very High Capacity

VDSL: Very-high-bit-rate digital subscriber line

VoD: Video on Demand

VoIP: Voice over Internet Protocol

VP: Vice-President

VULA: Virtual Unbundled Local Access

WDM: Wavelength Division Multiplexing

WLR: Wholesale Line Rental

4G: Fourth generation of mobile phone mobile communication technology standards

5G: Fifth generation of mobile phone mobile communication technology standards