



**COUNCIL OF  
THE EUROPEAN UNION**

**Brussels, 4 September 2012**

**13377/12**

**TELECOM 152  
AUDIO 79  
MI 537**

**COVER NOTE**

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from: Secretary-General of the European Commission,  
signed by Mr Jordi AYET PUIGARNAU, Director

date of receipt: 3 September 2012

to: Mr Uwe CORSEPIUS, Secretary-General of the Council of the European  
Union

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No Cion doc.: COM(2012) 478 final

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Subject: Communication from the Commission to the European Parliament, the  
Council, the European Economic and Social Committee and the Committee of  
the Regions  
- Promoting the shared use of radio spectrum resources in the internal market

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Delegations will find attached Commission document COM(2012) 478 final.

Encl.: COM(2012) 478 final



EUROPEAN COMMISSION

Brussels, 3.9.2012  
COM(2012) 478 final

**COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN  
PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL  
COMMITTEE AND THE COMMITTEE OF THE REGIONS**

**Promoting the shared use of radio spectrum resources in the internal market**

(Text with EEA relevance)

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PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL  
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## 1. INTRODUCTION

The European Union is facing exponential growth in wireless data traffic. Wireless connectivity is becoming increasingly important in the economy. Industry sources predict that global mobile data traffic will increase 26% annually by 2015. By then, there will be 7.1 billion phones, tablets and other mobile devices that can connect to the Internet. Wireless broadband has become a ubiquitous internet access medium for citizens in Europe, and mobile network operators will have to meet growing user demand. Many other economic sectors beyond electronic communications should also benefit from wireless innovations and high-speed data applications that can improve productivity and ensure sustainable growth.

Meeting growing spectrum needs for wireless connectivity is constrained by lack of vacant spectrum and by the high price associated with re-allocating spectrum to new uses, in terms of cost, delays and the occasional need to switch off incumbent users. To satisfy growing demand, more efficient use and innovation are crucial. Within the next decade, technological progress may enable an increasing number of users to share simultaneous rights of access to a specific frequency band. However, the regulatory environment must allow this to happen.

Shared use of spectrum involves different users all enjoying the right to use a given frequency band in a variety of different relationships. This in effect makes additional spectrum resources available and lowers spectrum access hurdles for new users. A study conducted for the Commission shows that finding additional shared spectrum resources for wireless broadband could create significant net economic benefits for the EU. With an increase of between 200 to 400 MHz in shared access spectrum for wireless broadband, the scenarios evaluated in the study show a net increase in the value to the European economy of the order of several hundred billion Euros by 2020<sup>1</sup>.

As spectrum management is an essential pre-requisite for the digital single market, this initiative therefore contributes directly to meeting the objectives of the Europe 2020 strategy and, when implemented, could contribute to reinforcing the European economy. Reaping the full benefits of sharing spectrum requires not just the removal of current regulatory barriers to deploying innovative radio access technologies, but also the active facilitation of sharing. In line with the Radio Spectrum Policy Programme (RSPP)<sup>2</sup>, the Commission therefore seeks the broadest possible political endorsement of the proposed steps to foster the development of wireless innovations in the EU to ensure that the currently allocated spectrum is exploited to the fullest extent possible.

This Communication lays out the regulatory background, the drivers and enablers, and the challenges for more shared use of spectrum. Section 5 describes the proposed new approach to give incentives for and legal certainty to spectrum sharing. Section 6 proposes next steps to foster the shared use of spectrum in the internal market in unlicensed and licensed bands.

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<sup>1</sup> See: [Perspectives on the value of shared spectrum access](#), SCF Associates, February 2012 (SCF 2012).

<sup>2</sup> Decision 243/2012/EU of 14 March 2012, OJ L 81 of 21.3.2012, p. 7; Art. 4.1.

## 2. REGULATORY BACKGROUND

The EU regulatory framework for electronic communications<sup>3</sup> seeks to facilitate access to spectrum, based on the least onerous authorisation system possible. It favours the use of general authorisations, except where individual licences are clearly necessary, e.g. to ensure protection against harmful interference. It establishes the principles of efficient use and effective management of spectrum, as well as technology and service neutrality. The RSPD extends these principles to all relevant EU policy areas<sup>4</sup>. To enhance efficiency and flexibility, it requires Member States, in cooperation with the Commission, to foster, where appropriate, the collective use and shared use of spectrum<sup>5</sup>.

Corresponding to the Union policy objective of allocating sufficient and appropriate spectrum in a timely manner and to best meet the increasing demand for wireless broadband, the RSPD aims to identify at least 1200 MHz by 2015 as well as to facilitate access to spectrum through general authorisations<sup>6</sup>. Spectrum sharing approaches, e.g. radio local area networks (RLANs), small cell base stations and mesh networks are explicitly referred to<sup>7</sup>. The RSPD also requires the Commission, in cooperation with Member States, to assess the possibility of extending the allocation of unlicensed spectrum for wireless access systems<sup>8</sup>. Meeting these objectives requires solutions adapted to the different authorisation situations. In addition to licence-exempt bands and exclusively licensed bands, there are also bands where a number of users have licences, i.e. where the rights of use are not exclusive.

Finally, the RSPD establishes a *spectrum inventory* inter alia to identify spectrum-sharing opportunities<sup>9</sup>. In implementing these actions, the Commission shall ensure that the rights enshrined in the EU Charter of Fundamental Rights are respected<sup>10</sup>.

## 3. DRIVERS AND ENABLERS FOR THE SHARED USE OF SPECTRUM

The *shared use of spectrum* refers to situations in which a number of independent users and/or devices are allowed to access the same range of frequencies under certain conditions. As illustrated by the following three examples, stakeholders are increasingly turning to emerging sharing possibilities to meet growing demands for wireless connectivity. To maximise the benefits of efficient spectrum use, it is necessary to support this trend, while ensuring that there is no deterioration in the quality of services provided.

### 3.1. Wireless broadband

Wi-Fi networks are the best known examples of how European citizens and businesses currently share spectrum. Operating in harmonised bands for RLAN<sup>11</sup>, wireless broadband

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<sup>3</sup> Directive 2009/140/EC, OJ L 337, 18.12.2009, p. 37, and Art. 5.1 and 5.2 5th par. of Directive 2002/20/EC, OJ L 108, 24.4.2002, p. 21, as amended in 2009.

<sup>4</sup> RSPD Art. 2 and 3.

<sup>5</sup> RSPD Art. 4.1.

<sup>6</sup> RSPD Art. 3 (b) and (g).

<sup>7</sup> In cellular networks (e.g. UMTS, LTE or WiMAX) so-called pico- or femtocells are used for data off-loading within or outside licensed frequencies, RSPD Art. 6.10.

<sup>8</sup> RSPD Art. 6.7.

<sup>9</sup> RSPD Art. 9.1(b).

<sup>10</sup> Commission Communication 'Strategy for the effective application of the Charter of Fundamental Rights by the EU' COM(2010) 573.

infrastructures based on Wi-Fi technologies already support affordable and easily accessible internet connections in some Member States. This stimulates the development of online services to realise the growth potential and development of new and innovative business solutions in Europe<sup>12</sup>.

More than half of all smartphone traffic appears to be routed over Wi-Fi networks, and this nomadic traffic is growing 4-6 times faster than mobile traffic. Global sales of Wi-Fi-enabled equipment should have reached 3.5 billion units by 2014<sup>13</sup>. Mobile network operators are also relying on the same licence-exempt RLAN frequencies for data off-loading to increase network capacity, improve coverage in buildings and save costs.

Operators who have exclusive licences can also increase efficiencies in their respective mobile networks with the common use of frequencies in specific geographical areas. In 2011, the Radio Spectrum Policy Group (RSPG) concluded that spectrum sharing could promote more efficient use of resources, provided that competition implications are carefully considered and that the necessary sharing agreements are allowed in all Member States<sup>14</sup>.

Shared use of licensed or licence-exempt wireless broadband frequencies enables cost savings for mobile network operators, affordable internet connectivity and infrastructure sharing possibilities.

### 3.2. The wireless-connected society

Growing wireless connectivity needs emerge not just from wireless broadband but also from applications e.g. smart meters/grids or machine-to-machine (M2M) communications. Currently, about 80% of new wireless technologies covered by the European Telecommunications Standards Institute (ETSI) are developed to operate in licence-exempt shared bands<sup>15</sup>. Such innovations provide benefits in numerous ways, for example through home automation applications based on wireless sensors that can increase the sustainability of the EU citizens' daily lives — e.g. by switching off lights when we are not at home or regulating air-conditioning systems according to temperature.

The European Conference of Postal and Telecommunications Administrations (CEPT) recently found that e.g. in the harmonised 863-870 MHz licence-exempt band alone, at least 40 million wireless devices (including remote controls, alarms and sensors) are sold annually in Europe<sup>16</sup>. These so-called *Short Range Devices* (SRD)<sup>17</sup> also make businesses more efficient by reducing costs and increasing productivity, for example with RFID systems in logistics and retail applications.

All such Internet of Things (IoT) applications operate in harmonised licence-exempt bands. The value of these bands is significant, because they are freely accessible by any device that

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<sup>11</sup> The 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5725 MHz bands.

<sup>12</sup> Commission Communication 'a coherent framework for building trust in the digital single market for e-commerce and online services' COM(2011) 942.

<sup>13</sup> SCF 2012.

<sup>14</sup> RSPG11-374.

<sup>15</sup> SCF 2012.

<sup>16</sup> Draft ECC Report 182.

<sup>17</sup> Decision 2006/771/EC.

complies with relevant spectrum access rules to avoid interference without the need to obtain a spectrum licence.

However, SMEs and innovators, for whom such access is especially important, also have to ensure their technologies can cope with the potential of interference in shared bands where protection rights are not guaranteed by a national regulatory authority (NRA). Wireless innovations are therefore not only enablers for spectrum sharing, but also become drivers for more shared use, as demonstrated by emerging sharing arrangements<sup>18</sup>.

The trend towards a connected society demonstrates the added value of low spectrum access barriers in licence-exempt shared bands as the breeding ground for wireless innovation that stimulates the development and deployment of more resilient wireless technologies.

### 3.3. Research and innovative technologies

Exploiting the full benefits of spectrum sharing requires dedicated research into dynamic spectrum access, as supported by the 7<sup>th</sup> Framework Programme (FP7), with projects addressing technologies that foster cognitive radio, dynamic spectrum sharing and spectrum aggregation<sup>19</sup>. Since the beginning of FP7, about €50 million have been invested under each two-year work-programme for spectrum-related research.

These projects have led to progressive advances. Dynamic spectrum sharing is already included in current standards for RLANs at 5 GHz to allow sharing with radars. Cognitive radio technologies offer services in coexistence with TV transmitters, the primary service in the UHF band, by using location-based information to determine unused spectrum in and between broadcasting frequency bands (so-called ‘white spaces’). Trials in Germany, Slovakia and the UK show this approach is nearing practical deployment.

The Commission is supporting this trend by issuing a standardisation mandate to harmonise access to location-based information for these technologies through geo-location databases<sup>20</sup>. To enable the development and use of such technologies in Europe, the mandate identifies areas where standards are needed to foster compliance with EU and national legislation on the placing on the market and the use of radio equipment, in particular with the R&TTE Directive<sup>21</sup>.

While focusing on creating economies of scale for first deployments, the importance of using ‘white spaces’ is not limited to a specific band. More can be done to exploit cognitive radio technologies, for instance, by sensing other spectrum users. Research is also underway to create self-organising networks that will aim to minimise cross-interference between small cell base stations in future generations of wireless broadband technology.

Research has enabled access to spectrum to be opened up on a shared basis while ensuring that primary services are protected. Cognitive radio technologies are developing today with

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<sup>18</sup> e.g. in the bands 870-876 MHz and 915-921 MHz.

<sup>19</sup> e.g. SAPHYRE, CogEU, Sacra, OneFit, Faramir, E3, Socrates, Walter, NEWCOM++, NetWorks, Samurai, EUWB, Ucells, CROWN.

<sup>20</sup> Standardisation mandate to CEN, CENELEC and ETSI for Reconfigurable Radio Systems (RRS).

<sup>21</sup> Directive 1999/5/EC, OJ L 91, 7.4.1999, p. 10.

the support of mandates for harmonised standards and trials in European research projects. More progress can be expected in the area of sensing and use of small cell base stations.

#### 4. CHALLENGES ON THE PATH TO MORE SHARED USE OF SPECTRUM

As the examples in the previous section demonstrate, the radio spectrum is an extremely valuable and finite natural resource that can be re-used more efficiently with advances in technology. In 2011, the RSPG noted the high demand for shared use and found: ‘there is a need to progress further on appropriate regulatory mechanisms in regard to sharing of spectrum’<sup>22</sup>.

The key challenge for NRAs is to find appropriate ways to authorise *shared spectrum access* to a band, i.e. to allow two or more users to use the same frequency range under a defined sharing arrangement. To date, users sharing licence-exempt bands, such as SRDs, have no rights to be protected against harmful interference, while users sharing frequencies on the basis of individual licences may benefit from regulatory guarantees in this regard. To progress further, NRAs need to address the following challenges.

##### 4.1. Managing harmful interference to remove uncertainty

Ensuring co-existence between different applications in the same range of frequencies is essential for exploiting sharing opportunities. Applications should not interfere with each other to the point of degrading their functions seriously. Acceptable levels of interference and appropriate mitigation strategies must be defined between users or set out in regulatory conditions for shared access to a band.

Interference mitigation can be achieved through reliable sharing arrangements based on clear, effective sharing rules and conditions in a band, creating certainty for both incumbent and prospective users.

Moreover, transparent assumptions in initial compatibility studies and clear protection rights for primary users, including the enforcement of agreed levels of interference mitigation, are important to increase the predictability and mutual acceptance of sharing arrangements.

##### 4.2. Creating sufficient incentives and safeguards for all interested parties

Balancing the impact on the incumbent and the usage constraints on any additional user is a challenge. While incumbents must be reassured that additional users will abide by sharing rules, there may also be costs for the incumbent in ensuring a good quality of service for new users, e.g. mitigation technologies or more resilient receivers.

Sharing needs to offer advantages for all users. Incumbent users, who are either subject to spectrum pricing or need to deploy improved technologies to enable additional users to have access under attractive sharing arrangements, may seek financial compensation.

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<sup>22</sup> RSPG11-392.



It will also be necessary to ensure that sharing arrangements between users do not adversely affect competition (in compliance with the provisions of the Treaty<sup>23</sup>), and to take into account the impact of sharing possibilities on the design of future spectrum assignment procedures in Member States.

### **4.3. Capacity of licence-exempt bands**

Since users in licence-exempt bands do not benefit from any regulatory protection regarding congestion, it is not clear whether existing shared bands have enough capacity — e.g. can the current RLAN bands accommodate the growth of both private broadband access and mobile data traffic off-loading? To objectively establish congestion forecasts and improve the reliability of sharing arrangements in these bands for all users, NRAs could benefit from monitoring usage.

A new generation of RLAN equipment (known as 802.11ac), expected to be on the market by the end of 2012, could approach the user speeds of fixed line networks. While depending on existing RLAN spectrum at 5 GHz, such developments will require very broad frequency channels that are currently limited in number.

Given current patterns of Wi-Fi usage, including by mobile operators for data off-loading, consideration should also be given as to whether more unlicensed ‘fixed wireless’ spectrum should be identified as part of the search for broadband spectrum or as a complementary common resource.

#### **Fostering more shared use of spectrum requires:**

- Engaging mutual responsibility of users over acceptable limits of interference and appropriate mitigation strategies;
- Providing legal certainty on applicable rules and conditions, enforcement procedures as well as transparency about compatibility assumptions and protection rights;
- Incentivising investments in improved technologies beneficial for incumbents and additional users, while safeguarding and fostering competition;
- Identifying broad frequency channels for RLAN development as well as providing congestion forecasts to increase the predictability and reliability of the most important shared bands;
- Ensuring that any transition from exclusive rights of use to shared use enhances competition from additional users and in particular does not create undue competitive advantages for current or future right-holders.

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<sup>23</sup> As further elaborated in the EU Guidelines on horizontal cooperation agreements, OJ C 11, 14.1.2011, p. 1.

## 5. TOWARDS A COMMON FRAMEWORK FOR SHARED SPECTRUM ACCESS IN EUROPE

To the extent that emerging wireless technologies are increasingly able to ‘smartly’ cooperate with each other to avoid mutual interference, NRAs need appropriate means to enable suitable sharing arrangements and to foster the shared use of spectrum resources. The Commission therefore proposes to develop two additional tools to provide more spectrum access opportunities for innovative technologies and to incentivise greater and more efficient use of existing spectrum resources:

- (1) An EU approach to identify beneficial sharing opportunities in harmonised or non-harmonised bands; and
- (2) Shared spectrum access rights as regulatory tools to authorise licensed sharing possibilities with guaranteed levels of protection against interference.

### 5.1. Identifying beneficial sharing opportunities

Across the internal market **beneficial sharing opportunities (BSO)** can be identified, in both licensed and licence-exempt frequency bands, wherever the combined net socio-economic benefit of multiple applications sharing a band is greater than the net socio-economic benefit of a single application, taking into account additional costs resulting from shared use<sup>24</sup>.

Identifying BSOs in a specific band requires transparency about the sharing arrangement that would be applicable, in particular (i) the *sharing conditions*, i.e. the technical parameters defined by a NRA that determine the access hierarchy in a shared band<sup>25</sup>; and (ii) the *sharing rules*, i.e. the common usage provisions that allow sharing, which either could be mandated by a NRA or defined by users on the basis of standards, common protocols, or sharing agreements which comply with competition law<sup>26</sup>.

In order to foster wireless innovation and to stimulate the identification of BSOs, stakeholders need the possibility to apply to the relevant NRA, based on a transparent process, for the right to use spectrum bands on a shared basis. Any such *BSO applicant* would have to demonstrate the capability to share a band without unduly compromising the incumbent’s right to use the frequencies.

To leverage the economies of scale of the internal market to incentivise investments, the EU needs to define a process for identifying BSOs in order to ensure a coherent and consistent application across all Member States when they come to address individual cases. Applied either in harmonised or non-harmonised bands, such a process could include the following key elements:

- A harmonised timeline;

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<sup>24</sup> A beneficial sharing opportunity (BSO) can be calculated based on the following formula: *net benefit of application A < (net benefit of application A+B+C ...) - (cost of sharing)*. Such assessment could be done prior or after refarming a spectrum band.

<sup>25</sup> i.e. whether users share a band on the basis of a primary-secondary relationship or among equals.

<sup>26</sup> Either static *co-existence rules* for all users of a band or *dynamic cooperation rules* which determine spectrum access for one user according to use of the same band by another user, apply.

- An opportunity for negotiation between the applicant and the incumbent, in which the NRA would act as a mediator, to clarify the terms of the BSO, including (i) the instruments to prevent the deterioration of quality of service and (ii) the distribution of sharing costs (if any);
- The examination of socio-economic benefits would inter alia need to take into account (i) the conditions under which existing assignments were made, including costs incurred, and (ii) the legitimate expectations of the incumbent right holders as well as BSO applicants. Also relevant are (iii) the dynamic effects that BSOs could have on competition, as well as on investment incentives for incumbents and potential newcomers respectively, in the context of convergent technologies;
- The means for the NRA to approve a BSO and to ensure greater shared use of spectrum in order to achieve the most effective use of spectrum possible, in accordance with applicable EU and national law. Where appropriate, and taking into account existing rights, this could include the possibility to apply measures such as incentive fees at the level of the identified socio-economic opportunity cost;
- The provision of information at the EU level on BSO applications and on the outcome of the subsequent national processes, as well as the possibility of assessing BSOs in the context of the spectrum inventory and identifying BSOs suitable for application across the internal market.

To the extent that technological advances enable more *beneficial sharing opportunities* (BSO) in the internal market, it is necessary to promote investment and encourage spectrum users to make better use of their spectrum assets by defining, in close cooperation with the Member States, a process and key criteria at EU level to identify BSOs (e.g. in a Recommendation).

## 5.2. Authorising licensed shared spectrum access

Once a BSO in a specific band is identified and approved, it can result in a *sharing dividend* of additional shared spectrum resources, if NRAs have the appropriate tools to authorise shared spectrum access. Such authorisations should be granted in accordance with applicable EU and national law, in particular articles 3, 5, 6, 7, 13 and 14 of the Authorisation Directive<sup>27</sup> and taking into account the existing rights of the incumbent.

To facilitate the identification of BSOs with market-based incentives, *spectrum sharing contracts* could serve as legally-binding agreements that enable incumbents and BSO applicants to define their respective rights and obligations, i.e. sharing technologies and/or costs. To facilitate such contracts, NRAs could be entrusted to act as impartial technical advisers and to register the terms of such agreements. Such contracts could be necessary to modify existing usage rights on the national level in agreement with the incumbent.

Incumbent rights holders could benefit from the mutual reassurance of an appropriate sharing contract by proposing BSOs, e.g. public entities could offer access to spectrum capacities to commercial operators in return for co-funding of network infrastructures for broadband public protection and disaster relief (PPDR) applications.

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<sup>27</sup> Directive 2002/20/EC, OJ L 108, 24.4.2002, p. 21, as amended in 2009.

If innovators can compare sharing opportunities in a competitive internal market, economic incentives would encourage proposals for sharing contracts based on innovative technologies and foster the co-existence of technology standards.

Moreover, enabling users to negotiate an appropriate degree of protection against harmful interference and to conclude sharing contracts would make it possible to find BSOs based on actual spectrum usage. This would be an improvement on traditional technical compatibility studies based on statistical spectrum sharing models.

In order to provide the contracting parties with regulatory guarantees to justify the necessary investments, NRAs would need to be able to grant **shared spectrum access rights (SSAR)** based on sharing contracts that are legally binding to all users of a particular range of frequencies.

SSARs could therefore become an additional tool for NRAs to authorise shared spectrum access in bands where a BSO has been identified and approved, for example, with individual licences for the additional users.

The RSPG recently highlighted that a licensed shared access (LSA) approach would provide additional users with spectrum access rights and guaranteed quality of service. It concluded that this would allow ‘incumbents to continue to use the spectrum while also providing spectrum capacities to other users’<sup>28</sup>.

*Spectrum sharing contracts* provide users with legal certainty while creating market-based incentives, including financial compensation, to identify more BSOs in the internal market, if NRAs grant *shared spectrum access rights* to additional users of a frequency band.

## 6. NEXT STEPS

To foster the development of wireless innovations in the EU, it is necessary to continuously improve the opportunities for harmonised spectrum access in both licence-exempt bands and licensed spectrum and to establish new tools for more shared use of radio spectrum resources in the internal market. The Commission therefore proposes to take the following steps:

(1) Identify BSOs in both licensed and licence-exempt frequency bands by:

- Developing, in cooperation with Member States, a coherent and consistent process to identify BSOs as well as criteria for assessing BSO applications submitted at national level in accordance with applicable EU and national law and taking into account the key elements mentioned in section 5.1;
- Using data collected through the inventory established by the RSPP;
- Enabling the development and deployment of White Space Devices based on harmonised standards for geo-location databases to be drawn up in response to the forthcoming Commission Mandate. The lower part of the UHF band (in particular 470-698 MHz)

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<sup>28</sup> RSPG11-392.

should provide a pioneer sharing opportunity paving the way for use of this approach in other bands.

(2) Consider making sufficient licence-exempt spectrum, harmonised at EU level, available for wireless innovations by:

- Ensuring predictable and reliable sharing arrangements in SRD bands, while applying the principles of technology and service neutrality, through continued updates of Decision 2006/771/EC;
- Studying and measuring the present capacity and potential congestion of the 2.4 and 5 GHz bands for data off-loading;
- Depending on the outcome of technical sharing studies and of the impact in the market, considering the designation of additional harmonised licence-exempt spectrum for RLAN services (Wi-Fi) at 5 GHz through a revision of Decision 2005/513/EC;

(3) Define, in cooperation with Member States, a common path towards enabling more sharing possibilities, based on contractual agreements between users by:

- Recommending a common format for SSAR, a common terminology for documenting sharing conditions and sharing rules and best practices in shared access authorisations to facilitate contracts, including competition aspects;
- Organising a public consultation to identify user needs and best practices for sharing contracts as well as possible standardisation needs to support the uptake of innovative solutions;
- Developing guidelines for safeguarding efficient use of spectrum and fostering competition based on sharing contracts between users operating in the markets.