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**FINAL RSPG OPINION**

**ON**

**REVIEW OF SPECTRUM USE**

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## **RSPG Opinion on Review of Spectrum Use**

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## **RSPG Opinion on Review of Spectrum Use**

### **I. Introduction**

Article 2 of the amended Commission Decision establishing a Radio Spectrum Policy Group states that, “*the RSPG shall assist and advise the Commission on radio spectrum policy issues, on coordination of policy approaches, on the preparation of multiannual radio spectrum policy programmes and, where appropriate, on harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the internal market*”. RSPG opinions should help in substantiating by qualitative and, wherever possible, quantitative indicators whether a European Union objective can be better achieved at EU level, taking into account the principle of subsidiarity<sup>1</sup>.

Article 8 of the Commission proposal for a Decision of the European Parliament and of the Council establishing a Radio Spectrum Policy Programme (RSPP) includes an inventory of existing uses and an analysis of technology trends, future needs and demand for spectrum. At the time of adopting this Opinion the draft Decision is still under negotiation. In recognition of the key role to be played by the RSPP multiannual radio spectrum policy programme in driving European spectrum management initiatives during the next 5 years, the RSPG Opinion on a radio spectrum policy programme<sup>2</sup> proposed that an essential part of the RSPP should be to “identify developing and potential future significant uses of spectrum taking into account demand and technology trends”. As stated in the Opinion the RSPG believes that, with a view to releasing more “new” spectrum, the EC should take into account an analysis of demand and technology trends to identify developing and potential future significant uses of spectrum. Consequently, the RSPG Work Programme<sup>3</sup> for 2011 includes developing an Opinion on “Review of Spectrum use”.

In this context, the RSPG has investigated the best processes for analysing spectrum demand, the impact of technology trends on such demand, the supply of spectrum that might meet increasing demand and the elements that would need to be assessed in determining whether that spectrum is being used in an efficient way.

While acknowledging the terminology used in the RSPP Decision with respect to the inventory of spectrum use, in particular Article 9, this Opinion uses the term “review of spectrum use” to encompass the supply (inventory of current usage), demand (for access to spectrum) and analysis of these two drivers including the assessment of efficient spectrum use.

### ***Structure of this Opinion***

This Opinion is structured as follows:

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<sup>1</sup> Article 5(3) of the Treaty on European Union and Article 5 of the Protocol 30 to the European Community Treaty.

<sup>2</sup> See RSPG10-330

[http://rspg.groups.eu.int/documents/documents/opinions/rspg10\\_330\\_rspp\\_opinion.pdf](http://rspg.groups.eu.int/documents/documents/opinions/rspg10_330_rspp_opinion.pdf)

<sup>3</sup> See RSPG10-346 [http://rspg.groups.eu.int/work\\_programme/index\\_en.htm](http://rspg.groups.eu.int/work_programme/index_en.htm).

- **Section II** sets out the background to this issue, including details of those key publications and policy initiatives that inform the work of this document. It also includes a diagram visualising the decision making process for radio spectrum harmonisation decisions arising from the RSPP;
- **Section III** describes what should be the objectives and methodology for the spectrum review under the RSPP Decision, once that decision has been adopted. Three key phases are identified of assessing the demand and supply of spectrum, followed by a review of the respective efficiencies of proposed uses of the spectrum in question;
- **Section IV** deals with the essential task of identifying the responsible entities which should contribute to a spectrum review;
- **Section V** discusses what is involved in assessing the demand for radio spectrum;
- **Section VI** addresses the task of identifying what spectrum may be available for new uses and provides advice to the EC and to Member States on how this could best be done;
- **Section VII** discusses how, having established the demand and potential supply of spectrum, the identification of frequency bands should then be made; and
- **Section VIII** considers some of the challenges to be faced in assessing the suitability of frequency bands for new services and applications; and
- **Section IX** sets out the Opinion of the RSPG.

## **II. Background**

### ***The RSPP***

The regulatory framework legislation for electronic communications<sup>4</sup> allows the Commission to submit a multi-annual Radio Spectrum Policy Programme (RSPP) to be adopted by the European Parliament and the Council of Ministers. According to Article 8a (3) of the Framework Directive, the RSPP should set out the policy orientations and objectives for the strategic planning and harmonisation of the use of radio spectrum in the Community. In accordance with Article 8a, the Commission is required to take utmost account of the opinion of RSPG in the formulation of the RSPP proposal.

Following a request from the European Commission in November 2009, the RSPG adopted an Opinion (RSPG10-330<sup>5</sup>) advising the Commission on the key elements to be addressed in a proposed RSPP for the period 2010 – 2015. Core elements of the RSPG Opinion were consolidated in Section IV of RSPG10-330 as the following Spectrum Policy objectives:

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<sup>4</sup> Directive 2009/140/EC of the European Parliament and of the Council

<sup>5</sup> See [http://rspg.ec.europa.eu/documents/documents/opinions/rspg10\\_330\\_rspp\\_opinion.pdf](http://rspg.ec.europa.eu/documents/documents/opinions/rspg10_330_rspp_opinion.pdf)

- a. identify developing and potential future significant uses of spectrum taking into account demand and technology trends;
- b. take all actions to designate and make available more 'new' spectrum and liberalise where possible, currently used spectrum under service- and technology-neutral regimes (i.e. WAPECS<sup>6</sup>);
- c. create appropriate regulatory mechanisms to foster more efficient use of spectrum, both for the commercial and public sector;
- d. ensure that competent national authorities, the European Commission, CEPT and ETSI work towards the same objectives, enhancing collaboration and cooperation to reach those objectives, and clearly defining their respective roles and responsibilities.

During the development of the RSPG Opinion a Spectrum Summit was organised jointly by the European Parliament and the Commission in Brussels in March 2010<sup>7</sup> involving representatives of the European Parliament, the Commission, the EC Member States, stakeholders from the telecommunications industry and users. The focus of the spectrum summit was on debating policy issues and objectives in preparation for the RSPP.

In September 2010, the EC published its proposal for a Decision of the European Parliament and of the Council establishing that first RSPP<sup>8</sup>.

### ***EU2020 vision and the Digital Agenda***

Europe 2020 is the EU's growth strategy for the coming decade. Its objective is for the EU to become a smart, sustainable and inclusive economy. The strategy restated the objective to bring basic broadband to all Europeans by 2013 and seeks to ensure that by 2020 all Europeans have access to much higher internet speeds of above 30 Mbps. The strategy comprises a number of flagship initiatives which include, for example, smart grids in the context of a 'resource efficient Europe' and the Digital Agenda. The Digital Agenda is Europe's strategy for a flourishing digital economy by 2020. The aim of the EC's Digital Agenda for Europe *is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications*<sup>9</sup>.

One of the key challenges highlighted in the Digital Agenda is that more needs to be done to ensure the roll-out and take-up of broadband for all, at increasing speeds, through both fixed and wireless technologies, and to facilitate investment in the new very fast open and competitive internet networks that will be the arteries of a future economy.

The Digital Agenda states that wireless (terrestrial and satellite) broadband can play a key role in ensuring coverage of all areas including remote and rural regions. It notes that a problem central to development of wireless broadband networks is access to radio spectrum. A forward-looking European spectrum policy should, while accommodating broadcasting,

<sup>6</sup> WAPECS – Wireless Access Policy for Electronic Communications Services

<sup>7</sup> See the discussion paper on the Spectrum Summit at [http://ec.europa.eu/information\\_society/policy/ecom/radio\\_spectrum/document\\_storage/rsp\\_p\\_summit/spectrum\\_summit\\_discussionpaper\\_0317.pdf](http://ec.europa.eu/information_society/policy/ecom/radio_spectrum/document_storage/rsp_p_summit/spectrum_summit_discussionpaper_0317.pdf)

<sup>8</sup> See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0471:FIN:EN:PDF>

<sup>9</sup> See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF>

promote efficient spectrum management, by mandating the use of certain digital dividend frequencies for wireless broadband by a fixed future date, by ensuring additional flexibility (also allowing spectrum trading) and by supporting competition and innovation.

### ***Other EU policies and principles***

The review of spectrum use should be done consistent with those policies and objectives set out in the text of the RSPP, once adopted. Spectrum use has an increasing influence on sustainable growth, competitiveness and productivity in the internal market, particularly in relation to important EU sectoral policies. Since suitable spectrum is scarce, priorities are needed to ensure that spectrum is allocated and used efficiently and effectively, taking into account EU policy objectives for electronic communications (telecommunications and broadcasting, terrestrial and space). Account should also be taken of the established goal of broadband for all, intelligent transport, research, public protection and disaster relief, Earth observation, civilian satellite navigation services (Galileo), environmental protection and the fight against global warming including smart grids and smart meters as mentioned in the RSPP Decision.

### ***CEPT process for designating spectrum to new applications***

For some decades CEPT has carried out reviews of spectrum use with the objective of identifying and designating appropriate frequency bands to services and applications in response to demands from its members and from the industry.

CEPT will continue to work on spectrum issues, either in cooperation with the EC in the frame of the RSPP and the Spectrum Decision 676/2002/CE or on its own work programme according to the process described hereafter.

In particular, the CEPT process will continue to be used outside of the RSPP and the EU framework for responding to the short-term demands. Under this process, industry demand is generally addressed to CEPT via ETSI. They have both agreed on a co-operation process between them as follows:

1. the process is normally started in an ETSI technical group in response to an demand from industry;
2. if there is a sharing or compatibility problem or when a new spectrum allocation is required, then the originating ETSI technical group generates a System Reference Document (SRdoc)<sup>10</sup> which is submitted to CEPT;
3. CEPT Working Group Frequency Management (WG FM) analyses the SRdoc and decides if it should lead to a new work item. The ECC Work Programme is modified accordingly;
4. if sharing or compatibility issues are identified, WG FM sends a request to Working Group Spectrum Engineering (WG SE) to perform the necessary sharing/compatibility studies; and
5. the ECC adopts and publishes relevant deliverables establishing a regulatory framework including spectrum designation, if appropriate, and which take the form of either an ECC Decision<sup>11</sup> or an ECC Recommendation.

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<sup>10</sup> According to the Working Procedures for ETSI, a 'System Reference Document' (SRdoc) should be produced for any new system, service or application requiring a change of the present frequency designation / utilisation within CEPT or a change in the present regulatory framework for the proposed band(s) regarding either intended or unwanted emissions

Cooperation between the EC and CEPT is undertaken in accordance with EC Decision 676/2002/EC and in particular through “mandates” from the EC to CEPT.

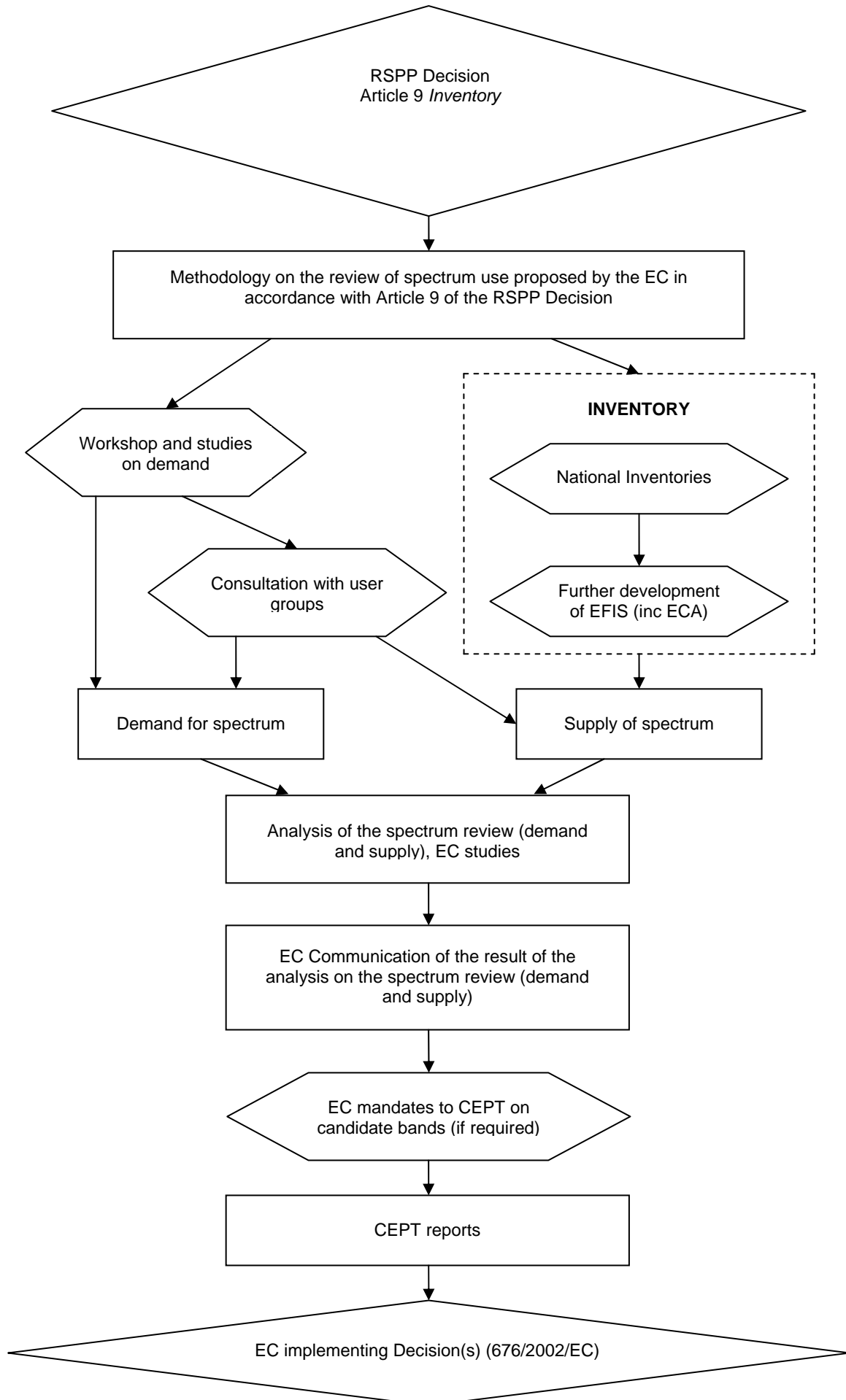
RSPG considers that the CEPT review process mentioned above should continue in those areas not covered by the RSPP Decision as well as the cooperation between the EC and CEPT under the Spectrum Decision.

***Context for the Opinion***

The following diagram visualises the decision making process for radio spectrum harmonisation decisions arising from the RSPP. This Opinion describes the objectives and methodology for the spectrum review within that process noting the difference in terminology between the RSPP and this Opinion as described in Section I, Introduction.

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<sup>11</sup> ECC Decisions are measures on significant harmonization matters. It is understood that all CEPT administrations should implement measures specified in ECC Decisions, except specially requested derogation cases





### III. Objectives and Methodology for the Spectrum Review

In working towards the development of a strategic plan for the use of the radio spectrum in support of the internal market and the Digital Agenda it is essential to identify demand for emerging technologies and applications for electronic communications and other specific Union policies based on feedback from stakeholders, administrations and analysis of market and technology trends in each relevant sector.

In principle, the review of spectrum use should fulfil the following objectives:

- i) it should provide visibility to decision makers on emerging spectrum needs for electronic communications services and other specific Union policies as described in the RSPP which would benefit citizens and industry and contribute to development of the internal market. This assessment could also allow a view of future demand for those services not covered in the above categories;( to be discussed as the EU review process should include all the spectrum needs);
- ii) it should provide as transparent view as possible of spectrum usage in frequency bands of interest across the EU ;
- iii) it should facilitate development of a long-term strategy on use of the spectrum resource for those services where future demand has been assessed, enabling access to spectrum for any new and innovative applications while ensuring suitable protection for existing uses; and
- iv) it should lead to more efficient use of spectrum. In particular, enhanced sharing and coexistence possibilities might help to satisfy emerging spectrum needs so as to avoid redistribution, i.e. the removal of spectrum assets from existing users. The actual and planned use by existing users will substantially influence the possibilities for sharing.

Carrying out a review of spectrum use across Europe will be a complex undertaking. Before embarking on a review, the importance of the contributions to be made by responsible entities, all sectoral interests (e.g. ECS, broadcasting, transport, military, public use of spectrum, environment, space, civil protection, energy, earth observation, etc.) should be considered. All stakeholders should be consulted in a transparent way on the elaboration of spectrum proposals, in particular those concerning new technologies. This should provide clarity and certainty to all stakeholders on how their positions will be treated and how decisions on the use of spectrum will be made.<sup>12</sup>

The spectrum review process could be divided into the following phases:

*a) Assessing the **demand for spectrum**:*

The demand phase will require collection and analysis of information on the current and future demands for spectrum based on analysis of developmental trends in technology and applications, and on policy objectives. The aim will be to identify those applications which are likely to drive a significant rise in spectrum demand in the timeframes covered by the RSPP and the Digital Agenda, i.e., where possible until at least 2020. This date is consistent

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<sup>12</sup> RSPG Opinion 10-330 on the Radio Spectrum Policy Programme, §22.

with the RSPP and with the policy objectives for Europe to be reached by 2020<sup>13</sup>. Responsible entities representing all interested sectors should be consulted during this phase<sup>14</sup>;

*a) Quantifying the supply of spectrum:*

In order to quantify how much spectrum is available it would be necessary to collect information from Administrations about the actual use of the frequency bands of interest in each Member State, including obligations on the use and/or the protection of spectrum in accordance with international agreements and treaties. This phase should help to identify the most suitable parts of the radio spectrum from which, assuming spectrum is or can be made available, such increased demands could be met. Responsible entities representing all interested sectors should also be consulted during this second phase;

*b) Reviewing efficiencies:*

Finally there should be a review of the respective efficiencies of the applications or proposals, taking account of the parameters discussed in Annex 2. It should be possible to draw several conclusions from the review of spectrum use, including whether future supply and demand can be balanced and where efficiencies can be made through harmonisation or refarming of spectrum.

It can be argued that the tasks should be done in this logical order; however the review of spectrum use (a key element of phase (b)) could also be done in advance of, or in parallel with, assessing the demand for spectrum, especially if the emphasis is to be placed on a specific frequency range. Such conclusions should be informed, not only by the usage information gathered in phase (b), but also by analysis of the socio-economic costs and benefits involved in changing how spectrum is used or is intended to be used.

#### **IV. Identifying the responsible entities which should contribute to the review**

According to phase a) as described in section III, assessing the demand for spectrum requires consultation of stakeholders in order to give them clarity and certainty on how their positions are treated and how spectrum decisions are made.<sup>15</sup>

In order to obtain accurate information on spectrum use from each stakeholder group of spectrum users it is necessary for the national administration to establish a good level of confidence with the stakeholders, and for the national administration to be aware of their needs, constraints and expectations. The benefit for the users should be that their priorities are clearly taken into account and the impact/cost of any change of spectrum use will be well considered.

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<sup>13</sup> See EC Communication entitled 'Europe 2020 - A strategy for smart, sustainable and inclusive growth', 3.3.2010, COM(2010) 2020 final.

<sup>14</sup> Ibid

<sup>15</sup> RSPG Opinion 10-330 on the Radio Spectrum Policy Programme, §22.

Spectrum is used by different groups of users for different services. Each group of users and each service has its own constraints and specific requirements and characteristics. The following user groups, including terrestrial and satellite users, have been identified:

- **ECS** (telecommunications and broadcasting, terrestrial and satellite, PMSE (SAP/SAB users));
- **Transport** (Road, Rail, Civil aviation, Maritime) ;
- **Scientific services** ((Earth exploration (data transmission, EESS (active and (passive)), space research, meteorology, Radio astronomy);
- **Emergency services** (including PPDR);
- **Defence**;
- **Amateur** (terrestrial and satellite)

Examples of responsible entities representing stakeholders are listed below. Please note that this list is not exhaustive and does not include, for example, many of the professional bodies representing sectors of industry.

<b>Domain</b>	<b>International Bodies</b>	<b>European Bodies</b>
<i>Civil Aviation</i>	ICAO	ECAC, EASA, Eurocontrol ICAO, European and North Atlantic Office ETSI
<i>Electronic Communications</i>	ITU	CEPT, ETSI, NRAs
<i>Broadcasting</i>	ITU	EBU, ETSI
<i>Defence</i>	NATO	EDA
<i>Space</i>	SFCG (informal)	ESA, EUMETSAT
<i>Interior</i>		LEWP (informal)
<i>Meteorology</i>	WMO	EUMETNET & EUMETSAT
<i>Maritime and waterways</i>	IMO (maritime)	RAINWAT (waterways), ETSI
<i>Radio astronomy</i>	URSI and ICSU	ESF & CRAF

## V. Assessing Demand for Spectrum

This section discusses what is involved in assessing the demand for radio spectrum including identifying, where appropriate, the entity primarily responsible for the assessment.

In assessing future demand for radio spectrum a range of sources of information should be considered in order to build up a comprehensive and realistic picture of that demand, including:

- current supply of spectrum for, and actual use by, a service or application demanding spectrum;
- reviews of trends in technology development;
- surveys and forecasts of demand in relevant markets, e.g., short range devices, broadband, multi-media;
- ITU-R studies;
- CEPT mandates (e.g., collection of information on usage of a frequency band);
- information provided by key market players that is already in the public domain (such as Company Reports or Annual Accounts);
- relevant EU Framework R&D programmes; and
- consultations, etc.

Workshops convened by appropriate bodies such as the EC and CEPT could be a useful means to gather information from administrations and stakeholders about spectrum demand and technology trends.

The main drivers of demand for radio spectrum will also need to be identified. The most likely drivers could include one or more of the following:

- innovation leading to new applications;
- new technologies (digitisation of more services, cognitive devices);
- important EU policy objectives<sup>16</sup>, including interoperability;
- user requirements, e.g., for mobility, faster speeds, higher bandwidths;
- other benefits of wireless versus wired applications, e.g., speed of deployment, cost, flexibility;
- potential benefits to citizens and consumers (social value, cultural value, economic benefits, etc.); and
- the general economic climate.

The ultimate focus of the spectrum review shall be to meet the requirements of the RSPP as adopted. Accordingly, it may be appropriate to classify the demand drivers into short-, medium- and long-term. Short and medium-term drivers of demand should be relatively easy to predict based on feedback from stakeholders, administrations and analysis of market and technology trends. Long-term drivers will be more difficult to predict due to the nature of technological and economic progress and are likely to be more general in nature.

The demand scenarios developed from the information sources identified above should then be verified against other developments including trends in European and global economies.

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<sup>16</sup> Examples of which may include PPDR, smart grids/smart meters, RFIDs, PMSE and transport (e.g., road, rail, air).

The fundamental role of a radiocommunication service is to carry information between or to users of the service. Demand for any new radiocommunication service may not be enough on its own to directly identify suitable frequency bands needed to operate it. However, operating requirements can be used to arrive at an estimate of a suitable frequency range.

Firstly, the geographical range of the proposed service must be identified. Where are the users of the service located? What is the estimated density (peak or average) of users in each area? Lower-frequency bands have better propagation characteristics, making them better suited to carrying signals over long distances and penetrating buildings, compared to higher frequency bands which tend towards line of sight communication and can support much higher bandwidths. For area coverage the lower frequency bands may have both a higher economic value because of the reduced cost of network deployment, and be more suitable for long-range services requiring mobility such as transport and military applications, which sometimes do not have any other alternative.

Secondly, the amount of information the service needs to carry is to be quantified. What is the dynamic profile of traffic carried by the service? How will the number of users or the traffic per user vary in future years? These questions help to identify the bandwidth required by the service.

Thirdly, different applications require different modes of communication, for example, radio and TV broadcasting involves distributing signals from a central source to a potentially unlimited number of receivers. Radars involve transmitting signals from a central source over a certain area. Point-to-point microwave networks, on the other hand, are made up of a series of uni- or bi-directional links connecting small numbers of fixed locations. The majority of electronic communications services are somewhere between those examples. The mode of communication and the topology of the required network are important factors in the identification of suitable frequency bands for new services.

In most cases, demand for a service is identified before the service becomes operational. Mobile communications operators, for example, gather statistics about user demand (such as those identified here) to estimate future network requirements.

### ***Responsible entity***

This 'demand' phase should be undertaken under the responsibility of the European Commission with the cooperation of national administrations and stakeholders. This should be done in a transparent manner so that national administrations and all stakeholders have a view on how their positions are treated and how the demand for spectrum is evaluated.

## **VI. Quantifying the Supply of Spectrum**

Undertaking the task of identifying what spectrum may be available for new uses and applications is likely to be a challenging task at the national level and even more so when done on a Europe-wide basis. Nevertheless, the aim of this Opinion is to provide advice to the EC and to Member States on how this could best be done.

An important point to be considered is that unless a programme of detailed technical field surveys is undertaken to determine what services are using which spectrum at what time, it is not possible to know *exactly* how spectrum is being used. Such a programme of spectrum monitoring would involve costs far beyond the utility of the information being gathered and are clearly not an option for determining how spectrum is being used, at least not on any significant scale. Accordingly, policy makers will need to use the most effective proxies to represent existing spectrum use. In general those proxies will be data on where and when spectrum is authorised for use under each Member State's licensing regime. Licence data will provide information on how users are permitted to use spectrum but not necessarily confirming precise details of the actual use of that spectrum.

For each band of interest, it could be useful to collect information on its occupancy. Occupancy or actual use is a decisive factor in assessing how spectrum could be used more effectively, either by introducing some type of shared use (taking into account current sharing methods and techniques) or through redistribution if information on actual use shows that the frequencies are not used at all.

However, it needs to be recognised that, in certain frequency bands, only limited information will be available to the spectrum review so, in such cases, it will not be possible to give an in-depth picture on the extent of spectrum use. This is likely to be the case where there is limited licensing information available (such as where there is a general authorisation regime in place) and,

- i) there is limited information on spectrum use that can be gathered from stakeholders, such as manufacturers or end users; or
- ii) the nature of the spectrum use is sufficiently sensitive on a commercial or security level such that more detailed information cannot be released.

In the first instance, and at its highest level, sources of information on spectrum usage should be identified at both the national level and at the European level. Immediate examples include national frequency allocation tables and national databases of frequency assignments, and the EFIS database including the ECA.

### ***National Databases***

National administrations in charge of spectrum management typically maintain databases on radio stations, frequency assignments and allotments and, in most bands, grant authorisations to operators for which they require varying levels of detailed information on spectrum use<sup>17</sup>. They also gather information on the use of spectrum when they are contributing to studies in certain frequency bands in ITU (e.g. for WRC preparations) or in CEPT (e.g. for WRC preparation at the European level, for CEPT-wide harmonisation projects or in response to an EC mandate).

This valuable information may be fairly widely distributed within an administration. It would be useful to ensure that the information is consolidated, made available as widely as possible and regularly updated.

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<sup>17</sup> One administration stated that in 2010 it started an inventory of spectrum use which will be completed by end 2011.

Currently, the most complete collection of information, including the national frequency tables of 37 European countries, is available in the EFIS database<sup>18</sup> maintained by ECO and as described below.

### ***European Common Allocation Table and EFIS***

The freely available European Common Allocation Table (ECA)<sup>19</sup> reflects European common frequency allocations for each frequency band throughout the radio spectrum, key applications within those bands, CEPT harmonisation measures (ECC/ERC Decisions, Recommendations) and relevant technical standards. CEPT member countries are expected to implement as many parts of the ECA Table as they are able. The Table is intended to be used as a source document by CEPT member countries for the development of Decisions, Recommendations, and European Common Proposals (ECPs) for future Radiocommunication Conferences of the ITU and as a reference document when developing national frequency allocation tables and national frequency usage plans.

In 2005, the European Commission issued a mandate to CEPT on the feasibility for EFIS, the freely available ECO Frequency Information System<sup>20</sup>, to develop into a European portal for spectrum information. EC Decision 2007/344/EC on harmonised availability of information regarding spectrum use within the European Community was published on the 16th of May 2007 and entered into force on 1st January 2008. In accordance with this EC Decision Member States shall input into EFIS information about the use of radio spectrum on their territory. It is an open database showing frequency allocations, usage, radio interface specifications and rights-of-use information on a national level for frequency bands for ECS where spectrum trading is allowed or where comparative or competitive selection procedures are used. Member States are mandated by EC Decision 2007/344/EC to use EFIS as a “common access point, in order to make comparable information regarding the use of spectrum in each Member State available to the public via the Internet”<sup>21</sup>. Article 3 of the Decision obliges Member States to update the information twice per year.

However, as has been noted by the Commission services in the Radio Spectrum Committee, the information that is actually provided to EFIS by Member States is incomplete. While allocations and designated applications are comprehensively uploaded, the information necessary to quantify the supply is not available in EFIS. At this stage, only a few Member States have provided comprehensive and reliable information on rights of use in EFIS. Furthermore, the information on rights of use is limited to only a few frequency bands, mostly those already used for electronic communications services and listed in the annex. There is no detailed information in EFIS regarding actual use which would allow an identification of what spectrum would be available for new uses and applications.

By the end of 2011 significant modifications were made to the EFIS tool including the integration of the ECA into the EFIS database. These improvements allow for the provision of information relating to potential future significant uses of spectrum, taking into account

<sup>18</sup> See <http://www.cept.org/eco/eco-tools-and-services/efis-eco-frequency-information-system/national-frequency-tables>.

<sup>19</sup> ERC Report 25: The European Table of Frequency Allocations and Applications in the Frequency Range 9 kHz to 3000 GHz.

<sup>20</sup> See <http://efis.dk>.

<sup>21</sup> Article 2 Commission Decision of 16 May 2007 on harmonised availability of information regarding spectrum use within the Community; see Official Journal of the European Union L 129/67, 17.05.2007.

demand and technology trends. In addition, all of this information is available in one IT system. Detailed spectrum information for a number of applications could also be filed in the radio interface data section of EFIS.

### ***Responsible entity***

The quantification of spectrum supply has to be done by National administrations taking into account the EFIS and ECA tables and the positions of stakeholders. They should compare the results of this phase in order to achieve a consolidated view with the assistance of the EC, possibly with a number of options. This could be undertaken either in a RSPG working group or in CEPT.

## **VII. Analysis of the spectrum review (demand and supply)**

Having established the spectrum demand and potential supply of spectrum the identification of frequency bands should then be made on the basis of the following information:

- investigate whether current allocations could meet the increased demand. This might involve an assessment as to whether these allocations could be used more efficiently by the respective service;
- where this is not the case, refer to the spectrum inventory (supply) and identify which alternative bands are technically suitable to meet the increased demand for the respective application (this will take into account co-channel, adjacent channel co-existence as well as constraints from ITU regulations), other international agreements and harmonisation opportunities;
- the possible sharing of spectrum under the LSA (licensed shared access) concept developed by RSPG in its draft report<sup>22</sup> submitted at the RSPG#26 on 16 November 2011, should be considered in order to minimise the impact on current users of spectrum and increase the number of candidate bands; and
- the difference in economic and social value of the competing services and the costs and impacts of moving the existing users in the band.

Part of this work could be done through European cooperation under the Radio Spectrum Decision 676/2002/EC, including mandates to CEPT.

In case refarming of a band is to be considered, the time frame for the exercise would depend on the specific frequency bands targeted, national circumstances and international developments such as at World Radiocommunication Conferences and issues such as costs of refarming, timeframes, etc.

### ***Responsible entity***

This analysis has to be done under the responsibility of the European Commission with the cooperation of national administration e.g. within the Radio Spectrum Committee.

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<sup>22</sup> RSPG11-392



## VIII. Some challenges in assessing the suitability of frequency bands for new services and applications

As an example of the workings of the process of making spectrum available for new applications during the last two decades, national administrations have worked within CEPT and with the EC in identifying and designating approximately 1 GHz of spectrum between 790 MHz and 3.8 GHz for mobile services (see Annex 1). Candidate bands were typically proposed by administrations and studied within CEPT, resulting in the designation of the most appropriate bands to respond to the needs of the mobile services. The process has worked efficiently to the benefit of European consumers and the European economy. However, finding new bands for any applications in the same frequency range is becoming more difficult due to the increased use of these bands. Nevertheless, the identification of candidate bands for a specific application could emerge from a spectrum review based on a demand and supply analysis.

The following is a list of some of the likely challenges which will need to be addressed in carrying out a review of spectrum use:

- the “inventory” in itself will not be sufficient to identify candidate bands for new applications. Demands and technology trends will also need to be assessed;
- the disparate “inventories” of all Member States must be pooled in one place. This is likely to be a significant challenge which should be addressed at the outset in order to ease the path to a successful outcome;
- there is no single criterion for the occupancy of frequency bands so, therefore, it may be difficult to make comparisons between bands and applications on the basis of occupancy alone;
- spectrum efficiency<sup>23</sup> metrics could be one tool in assessing the most efficient use of a frequency band. However, it should be noted that this is a complex task involving not just the relative technical efficiency of applications but also other factors including functional, social value and economic efficiency weighted according to their relative importance to users, the economy and society;
- it may be necessary to draw upon other tools in order to evaluate economic and social value of spectrum refarming and to facilitate objective comparisons between different bands and applications;
- a significant amount of information will be required to facilitate the estimation of socio-economic value<sup>24</sup>. Some of this information may only be available at the national level;
- an “spectrum review” is unlikely, in every band, to provide overly detailed information such as the location of stations or of mobile users;
- establishing geographical differences in the use of a frequency band, in particular between high-density population areas and rural areas;
- in order to provide confidence to current users regarding future spectrum developments it may be necessary to clarify refarming/migration solutions that could be used under certain conditions; and

<sup>23</sup> For a more detailed explanation of the concept of spectrum efficiency see Annex 2.

<sup>24</sup> See also the Joint RSPG/BEREC Report on the economic and social value of spectrum [ RSPG11-400]

- the volume of information to be provided by stakeholders to complete a review of spectrum use should remain proportionate and not impose an unnecessary burden on them.

During a spectrum review, issues of a sensitive or confidential nature, such as defence use of spectrum will need to be addressed. However, this is best done at the national level where the spectrum regulator will have (or is best placed to develop) the trust of the stakeholders involved and be able to reassure them that their issues will be treated in an appropriate manner. The importance of this should be recognised at all levels, including, for example, in the use of the EFIS database.

To deal with the potential challenges listed above it is essential that ground rules be established on issues such as measuring the occupancy of frequency bands.

### ***Implications of collecting data for the spectrum review***

Every European measure shall take account of the need for any burden, whether financial or administrative, falling upon the Union, national governments, regional or local authorities, economic operators and citizens, to be minimised and commensurate with the objective to be achieved. Therefore, this Opinion assesses the consequences of the elements of the review of spectrum. Some of the implications are listed below:

- amount of data;
- costs and man power;
- validation of data in view of the time scale and
- confidential information.

#### *Amount of data*

The amount of data which should be collected in implementing the review of spectrum use depends on the intended use of the data. Therefore, it is essential to clarify in detail exactly what information is required for the review of spectrum use. On this basis member states will be able to assess the likely costs and efforts to meet the requirements.

#### *Costs and man power*

The effort required by each member state will, to a large extent, depend on the format in which the required information is available. If the information is only available in paper form it is likely to take a lot of manpower, financial costs and time to convert it into a useful electronic format, e.g., Germany estimates that to convert all of its approximately 150,000 frequency licenses into electronic format will cost almost 1.5 million Euro and more than 6,300 man days (just for the “Right of use” information in the EFIS format).

#### *Validation of data in view of the time scale*

The validation of information about volumes and types of applications depends directly on the kind of application which is used in a frequency band. In cases of applications which have a high turnover in hardware, such as some short range devices the information may be out of date within a year. Therefore it is necessary to update such information twice a year or more often. In some cases this may increase the costs and efforts for the member states.

#### *Confidential information*

Protection of confidential information for both business and national security and defence purposes is a sensitive point. Commercial aspects are already treated under Article 8 of the Spectrum Decision<sup>25</sup>. For non commercial aspects in domains not included in the scope of the Spectrum Decision, mainly the security and defence domains, there is therefore a need to provide further explanations and recommendations.

Confidential data exists in relation to public security (e.g. PPDR – one of the high-priority policy objectives of the EC) - and the defence community. In most Member States, if not all, strict rules apply on confidentiality which establish several levels of confidential information and allow access to the related information only to duly authorised persons. Therefore not all information can be published in the framework of such a review.

It should be stressed that classification of information and designation of authorised persons to access confidential information remains a national responsibility and it is therefore undesirable and probably not possible to establish common rules within the spectrum review process.

As a consequence, RSPG recommends that access and use of confidential information should be treated at the national level under the national rules of each country, and those who are authorised to deal with such confidential information should only provide to the Commission either data which does not include confidential information or aggregated data using generic wording which does not include information of a confidential nature, as is currently done in EFIS. The RSPG recommends Member States to use the full range of terminology available in EFIS as appropriate to the level of confidentiality.

## IX. Responses to the consultation

A public consultation on a draft version of this Opinion was held from November 2011 until January 2012. Nine responses were submitted to the RSPG<sup>26</sup>. The RSPG is grateful to all

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<sup>25</sup> Article 8: Confidentiality:

1. Member States shall not disclose information covered by the obligation of business confidentiality, in particular information about undertakings, their business relations or their cost components.
2. Paragraph 1 shall be without prejudice to the right of relevant authorities to undertake disclosure where it is essential for the purposes of fulfilling their duties, in which case such disclosure shall be proportionate and shall have regard to the legitimate interests of undertakings in the protection of their business secrets.
3. Paragraph 1 shall not preclude publication of information on conditions linked to the granting of rights to use radio spectrum which does not include information of a confidential nature.

<sup>26</sup> Responses were received from the Aeronautical Spectrum and Frequency Consultation Group (ASFCCG), Digital Europe, European Broadcasting Union, GSMA Europe, Telefónica Group, Telecom Italia, TETRA and Critical Communications Association (TCCA), Association of Commercial Broadcasters and Audiovisual Services in Germany (VPRT) and Runder Tisch Amateurfunk (RTA).

respondents for their input. All responses can be found on the RSPG website at [http://rspg.groups.eu.int/consultations/responses\\_spectrum\\_review\\_111121/index\\_en.htm](http://rspg.groups.eu.int/consultations/responses_spectrum_review_111121/index_en.htm)

All respondents acknowledged the importance of an inventory of existing uses of spectrum and in general supported the advice in the Opinion on factors to be taken into account in conducting a review of spectrum use. Respondents confirmed their willingness to participate in the review process and asserted that they must be consulted in a transparent manner so that the interests of all stakeholders could be considered.

In relation to assessing demand for spectrum, respondents supported the identification of more spectrum for new and expanding applications such as mobile broadband. One respondent (Digital Europe) promoted extension of the allocation for RLANs in the 5 GHz band to foster RLAN development, as fixed traffic over Wi-Fi will grow at a Compound Annual Growth Rate of 35% in Europe in the period 2010 – 2015.

In relation to the suggestion that the LSA approach could be used, two opposing views were expressed: Digital Europe welcomed the proposal to use LSA and stated that LSA widens the opportunities of finding common ground; on the other hand Telefonica Group and Telecom Italia stated that “most services currently being provided over radio spectrum need individual rights to be granted in order to ensure an appropriate quality of service, thus limiting the scope for applying LSA”.

Most respondents commented that a balanced approach is needed to evaluate spectrum efficiency and agreed with the draft opinion that this could be a challenging process. Spectrum efficiency should include an analysis of how underused frequency bands can be better exploited. It should also include the cost factors for transition to more efficient technologies and the cost impact to users of the renewal of their equipment (VPRT, EBU). In particular, TCCA expressed concern over assessing social efficiency for those services whose main contribution to the society is normally not calculated on a financial scale. This respondent suggested that this issue could be resolved through a consultation process with relevant stakeholders.

Other points raised by respondents included:

- that the timeframe for the initial assessment of the demand should be significantly longer than the timeframe covered by the RSPP and the Commission should identify a timetable and review milestone to ensure that the review of spectrum use is revisited at an appropriate time (Telefónica); and
- that the spectrum inventory should not delay the ongoing harmonisation work that CEPT is undertaking and that any delay will be detrimental to European industry (Digital Europe).

## X. The Opinion of the RSPG

Once adopted, the multiannual Radio Spectrum Policy Programme (RSPP) set out the policy orientations and objectives for the strategic planning and harmonisation of the use of the radio spectrum in support of the internal market and the Digital Agenda for Europe. In developing such a plan a key element is the nature of the use of spectrum in the specified range, the identification of demand for emerging technologies and applications in all sectors, and the identification of the possible supply in support of demand for electronic communications and other specific Union policies. Without duplicating the current CEPT/ETSI process<sup>27</sup> the demand analysis should be based on feedback from stakeholders and administrations, and investigation of relevant trends in markets and technologies, and taking into account the current allocation of spectrum for and the actual use by a service/application demanding spectrum.

The assessment of the supply of spectrum (primarily based on the inventory of the use of spectrum with additional analysis) in frequency bands of interest shall logically accompany the analysis of demand for spectrum.

The purpose of this Opinion is to provide guidance to the European Commission on how a spectrum review could be undertaken. The RSPG is of the view that a spectrum review could be performed by dividing the overall task into two separate tasks: an assessment of spectrum demand and potential availability of spectrum. Additionally, in light of the demand and supply studies referenced in Section III, items a) and b), there should be a process of evaluating whether there is scope for improved efficiencies (Section III, item c)) noting the complexities identified in Annex 2 with the aim of determining the overall benefit to users, the economy and to society.

The RSPG considers that:

- i) a spectrum review should contain sufficient information to allow conclusions about future availability of spectrum to be drawn. Furthermore, information on supply of spectrum should be collected in a format consistent with EFIS to facilitate analysis and to limit the burden for the entities involved;
- ii) key sources of information are currently national databases and national entities managing spectrum. A more developed version of EFIS could become a key source depending on its future capability to illustrate actual availability and resources and capabilities of Member States to provide such information. Studies contracted by the European Commission could also be a key contribution and help to spread the administrative burden;
- iii) a common format needs to be agreed at EU level on the amount and detail of information to be provided by the Member States in order to provide accurate and exploitable information at EU level;
- iv) a mechanism for treating confidential and/or sensitive information should be employed in accordance with national rules to ensure that such requirements are taken into account;
- v) trends in development of technology and applications impacting on spectrum use should be assessed;

<sup>27</sup> <http://www.cept.org//files/1051/ECC/About%20ECC/ECC-ETSI/Standardisation%20process.pdf>

- vi) in order to carry out an effective review, trends in technology, applications and the associated spectrum demands should be classified into short-, medium- and long-term;
- vii) assessing the most efficient use of spectrum is a complex task involving not just the relative technical efficiency of applications but also other factors including functional, social value and economic efficiency;
- viii) proposed changes to spectrum use or sharing methods on spectrum use should take into account the economic and social value of each scenario at national and EU level as well as any refarming costs. In the latter case questions of timing for refarming and national financing issues should be considered; and
- ix) in reviewing the use of the radio spectrum, full account must be taken of the international radio regulatory regime pertaining to the frequency bands in question, including proposals for and outcomes from international or regional radio regulatory conferences.

The RSPG notes that:

- i) the Member States already possess within their national databases and other sources information required to assess spectrum supply;
- ii) information from national databases is uploaded twice yearly to the EFIS database;
- iii) although the EFIS database can be considered as a starting point from which to undertake a spectrum review, as it already contains valuable information in a relevant format, the level and the nature of information within EFIS should be improved; and
- iv) quantifying the supply of spectrum imposes a significant burden on Member States.

The RSPG recommends that:

1. as noted above, measures be undertaken to continue the development of the EFIS database resource supported by the appropriate regulatory framework (RSPP and EC Decision 676/2002) with the aim of providing comprehensive information on spectrum usage rights;
2. Member States should use the full range of terminology available in EFIS appropriate to the level of confidentiality;
3. access and use of confidential information should be treated at the national level under the national rules of each country, and those who are authorised to deal with such confidential information should only provide to the Commission either data which does not include confidential information or aggregated data using generic wording which does not include information of a confidential nature, as is currently done within EFIS;
4. in addressing the RSPP objectives the future demand for access to radio frequency spectrum to deliver sustainable economic and social benefits to Europe's citizens and consumers should be evaluated by the EC together with the Member States and where appropriate with the assistance of CEPT; the current CEPT/ETSI liaison process should be maintained for issues regarding spectrum demand not treated under the RSPP;
5. in order to facilitate the availability of similar spectrum information across the EU, the Commission should specify, pursuant to the procedures established in the

RSPP, which data should be submitted and which format and procedure should be used by the Member States. In doing so the Commission should take into account the resource limitations of national administrations and minimize them by, inter alia, providing supportive action, e.g. studies;

6. the activity on assessing spectrum demand should involve a number of elements as follows:
  - i) determination of the main drivers of demand for radio spectrum. This will involve analysis of developments in technology and applications in the short, medium and long term using the approach discussed in Section V above, including convening workshops to gather information on the demand and technology trends;
  - ii) the need for harmonisation, if any, should be identified;
  - iii) identification of the frequency bands most suitable to support those demands taking into account the guidance in Section VI above;
  - iv) identification of all relevant stakeholders in those frequency bands, including incumbents and potential new users;
  - v) initiation of dialogues with the stakeholders. Depending on the stakeholders and issues to be discussed, this should be done either at national level or EU level as appropriate. For example, discussions on confidential or sensitive issues such as defence use of spectrum may be best done at the national level;
  - vi) assessments of spectrum efficiency which should involve evaluation of the technical, functional and economic efficiencies and social value of applications weighted according to their relative importance to users, the economy and society (see Annex 2). Therefore, any assessment of spectrum efficiency should, at least, take all of these elements into account with the aim of determining the overall benefit to users, the economy and to society;
  - vii) evaluation should also be made of the impact on all affected users; and
  - viii) analysis and synthesis of the outcomes of the evaluations and dialogues into public consultation documents, followed by public workshops to discuss and develop proposals with all stakeholders.
  
7. following this process a final report(s) to the European Parliament and to the Council should be prepared and published by the Commission containing results of the review process for the supply of the frequency bands of interest which will form part of the overall Radio Spectrum Policy Programme. Any implementation measures related to this policy will then be undertaken in application of the EC Radio Spectrum Decision 676/2002, including the mandate process to CEPT.

## ANNEX 1

## Harmonised ECS Bands

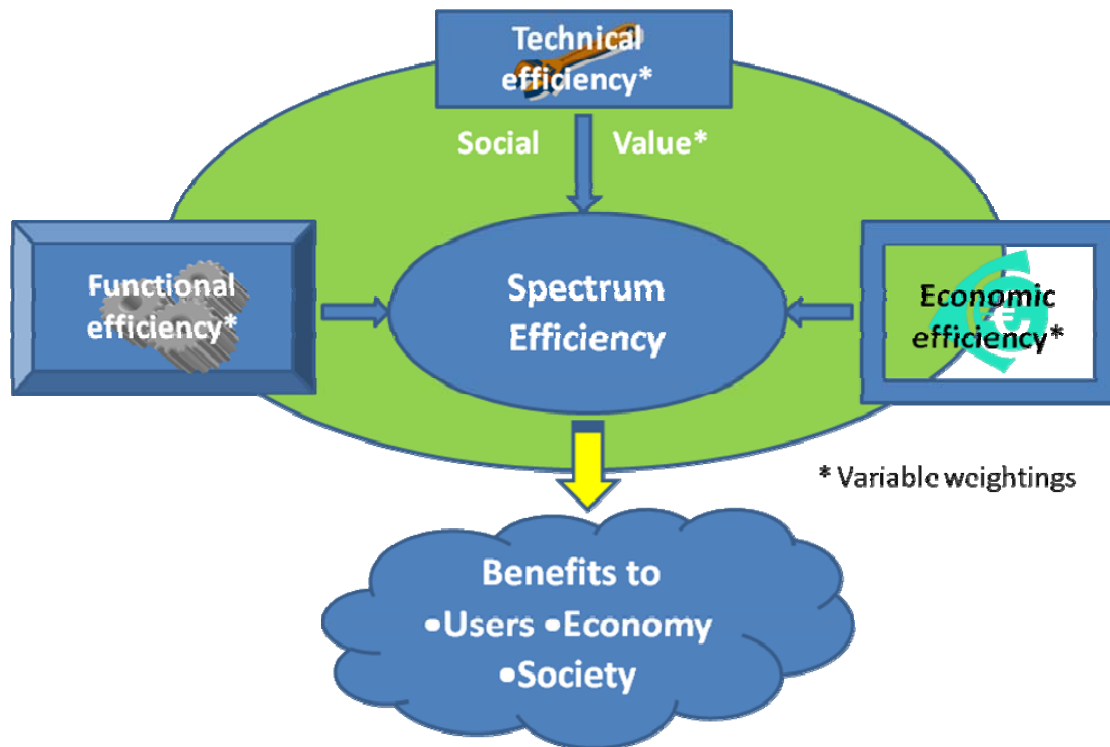
The bands that have been designated for harmonised ECS during the last two decades are shown in the following table:

Frequency Band	CEPT & EC Decision references	Year of designation	Amount of Spectrum
800 MHz	ECC/DEC/(09)03 Dec 2010/267/EU	2010/2015	2x30 MHz
900 MHz	Dir 87/372/EEC ERC/DEC/(94)01 ERC/DEC/(97)02 ECC/DEC/(06)13 Dir 2009/114/EC Dec 2009/766/EC	1987- 1994 - 1997	2x35 MHz
1800 MHz	ERC/DEC/(95)03 ECC/DEC/(06)13 Dec 2009/766/EC	1995	2x75 MHz
2100 MHz	ERC/DEC/(97)07 ERC/DEC/(99)25 ERC/DEC/(00)01 ECC/DEC/(06)01	1997 – 2000	155 MHz
2600 MHz	ECC/DEC/(02)06 ECC/DEC/(05)05 Dec 2008/477/EC	2002 - 2008	190 MHz
3600 MHz	ECC/DEC/(07)02 Dec 2008/411/EC	2007 – 2008	400MHz
<b>Total Amount of Spectrum</b>			<b>1025 MHz</b>



## Efficiency of spectrum use<sup>28</sup>

In looking at the supply side of spectrum the question of how efficiently a particular frequency or band of frequencies is being used may arise. In aiming to evaluate such a parameter ('spectrum efficiency') it should be recognised that it is not simply a technical parameter, e.g., b/s/Hz, b/s/Hz/km<sup>2</sup> or similar, that needs to be assessed but other factors have a significant role to play. These other factors may include functional (operational) efficiency, social value or economic efficiency. All of these factors will have differing importance (weightings) in the overall assessment of efficiency depending on the specific scenario being addressed. In evaluating spectrum efficiency the key objective should be to determine the overall benefit to society, which includes user interests, social value and the economy. This is illustrated in Figure 1.



**Figure 1. Evaluating spectrum efficiency**

The four key factors mentioned above can be explained as follows:

<sup>28</sup> With acknowledgement to "Measuring Spectrum Efficiency – The Art of Spectrum Utilisation Metrics" by John Burns, Aegis Systems Ltd.

*Technical efficiency*

This can only be defined for a certain frequency or frequency band in which it is necessary to evaluate the merit of different technologies within the same service or application. Evaluation of technical efficiency between different bands and different services or applications is not feasible. This is explained in the ITU Recommendation ITU-R SM.1046-2<sup>29</sup>. For mobile applications such as GSM and UMTS, it is typically defined by 3 parameters: bandwidth, frequency re-use and time or space. Bandwidth, in effect, is a measure of the information carrying capacity (e.g. b/s/Hz) of a system. Frequency re-use determines how many times a frequency can be used within a network over a geographical area without mutual interference. Typical examples include public mobile cellular networks with re-use (cell repeat frequency) factors of 4 for GSM technology and 1 for UMTS, the latter being the more efficient. It is also well known that frequencies can be shared in time, e.g., time-division multiple access (TDMA) or in geographic space, i.e., by physical separation of transmitters at such a distance that they do not mutually interfere with each other's service or in the power domain, through the adoption of opportune codes (CDMA). Recent technological advances that would increase capacity in a network, all other things being equal, could also be considered such as MIMO.

*Functional efficiency*

The ease of use and access to a service can be a key determinant of its importance to users. For example, reliability, speed of access, quality of service, security of communications, coverage, group calls and ease of use may be of prime importance to the emergency services in specifying or evaluating a radio system, whereas for a member of the public, cheap and convenient mobile communications with a roaming capability may be the most important elements. The possibility to use another media can also be a key determinant. For example, a backbone network may be either wired or wireless, each of which will of course incur different costs. On the other hand earth exploration can only be undertaken from space and needs spectrum. Thus, assessing functional efficiency may involve the use of subjective criteria such as measuring the value to society compared with consumer surplus (benefit derived from the service measured by the price the user would pay compared to the price paid for it) or alternative solutions.

*Economic efficiency*

In making choices between technologies or applications for a frequency band, it is appropriate to assess the economic costs and benefits of the respective contenders with the aim of determining which is the use with the highest net socio-economic benefit. Costs may arise from network infrastructure build or refarming an existing system to another frequency band. Economic benefits may arise from revenue generated by traffic carried on the network or through increased efficiency in operations or logistics. Economic efficiency can also be encouraged through market mechanisms such as auctions.

*Social value*

In making choices between technologies or applications for a frequency band, it is appropriate to assess the social value of such elements. This means that the benefits

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<sup>29</sup> Recommendation ITU-R SM.1046-2: [Definition of spectrum use and efficiency of a radio system.](#)

of the application or technology to society as a whole should be evaluated e.g., in terms of development, culture, research activity, environment, security and safety. The evaluation of the direct economic net benefit of these aspects may be difficult, but the evaluation of the social net benefits is often more difficult. Therefore striking a balance between, say, the economic and social value of an application can be quite challenging and in some cases such decisions may need to be made at the political level.

**Conclusions on spectrum efficiency**

Determining the most efficient use of spectrum is a complex process and may be quite challenging where elements such as the social value of an application or technology should be considered. It is not solely a matter of how technically efficient a particular application is, but a combination of that together with other factors, the most notable of which are functional and economic efficiency. Depending on the scenario under examination, these factors will have greater or lesser importance or weighting relative to each other. Therefore, any assessment of spectrum efficiency should, at least, take all of these elements into account with the aim of determining the overall benefit to users, the economy and to society.

## ANNEX 3

## Glossary

EASA	European Aviation Safety Agency
CEPT	Conference of European Postal and Telecommunications Administrations
CRAF	Committee on Radio Astronomy Frequencies
EBU	European Broadcasting Union
EC	European Commission
ECAC	European Civil Aviation Conference
ECS	Electronic communication services
EDA	European Defence Agency
EFIS	European Frequency Information System
ESA	European Space Agency
ESF	European Science Foundation
ETSI	European Telecommunications Standards Institute
EU	European Union
EUMETNET	Conference of the European National Meteorological Services,
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
ICAO	International Civil Aviation Organization
ICSU	International Council for Science
IMO	International Maritime Organisation
ITU	International Telecommunication Union
LEWP	Law Enforcement Working Party (of the Council of the European Union)
LSA	Licensed Shared Access
NATO	North Atlantic Treaty Organisation
PMSE	Programme Making and Special Events
PPDR	Public Protection and Disaster Relief
RAINWAT	Regional Arrangement concerning the Radiotelephone Service on Inland Waterways
RSPG	Radio Spectrum Policy Group
RSPP	Radio Spectrum Policy Programme
SAB	Services Ancillary to Broadcasting
SAP	Services Ancillary to Programme making
SFCG	Space Frequency Coordination Group
URSI	International Union of Radio Science
WAPECS	Wireless Access Policy for Electronic Communications Services