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RADIO SPECTRUM POLICY GROUP

Report on Spectrum for Wireless Broadband and Broadcasting in the Frequency Range 400 MHz to 6 GHz

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Contents

1. INTRODUCTION AND SCOPE

This report has been developed by the RSPG in support of the RSPG Opinion on the strategic challenges facing Europe in addressing the growing demand for wireless broadband services[1]. The report examines in detail some of the frequency bands identified in the Opinion with high potential for supporting the introduction of wireless broadband services, highlighting issues which will need to be addressed in making those bands available.

The report reviews available market studies on trends for growth in demand for broadband and the increasing role being played by mobile data subscriptions in delivering broadband services. It then looks in detail at the results of a survey conducted by the RSPG in 2012 on the long-term spectrum requirements for digital terrestrial television (DTT) in the European Union. This is followed by a detailed analysis of key spectrum bands suitable for WBB as identified in the aforementioned Opinion.

2. BACKGROUND

The RSPP

The Radio Spectrum Policy Programme (RSPP)[2], adopted in March 2012, recognises that spectrum is a key public resource for essential sectors and services, including mobile, wireless broadband and satellite communications, television and radio broadcasting, etc. It notes that regulatory measures on spectrum have economic, safety, health, public interest, cultural, scientific, social, environmental and technical implications.

Article 3 of the RSPP states that Member States and the Commission shall cooperate in seeking, "to allocate sufficient and appropriate spectrum in a timely manner to support Union policy objectives and to best meet the increasing demand for wireless data traffic", make every effort "to identify … at least 1200 MHz of suitable spectrum by 2015." In order to find the 1200 MHz of spectrum, Article 9 provides for the establishment of an inventory of spectrum use in the frequency range between 400 MHz and 6 GHz. In an earlier Opinion[3] the RSPG advised the Commission, in the context of the RSPP, on the best processes for analysing spectrum demand and the elements that would need to be assessed in determining whether that spectrum is being used in an efficient way.

Article 7 of the RSPP states that in order to support the further development of innovative audiovisual media and other services to Union citizens, taking into account

[1] RSPG13-521: RSPG Opinion on Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband.
[2] Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme.
[3] RSPG12-408 (Final): RSPG Opinion on Review of Spectrum Use.

the economic and social benefits of a single digital market, Member States shall, in cooperation with the Commission, aim at ensuring there is sufficient spectrum available for satellite and terrestrial provision of such services, if the need is clearly substantiated.

RSPG Opinion on WBB

In June 2013, following public consultation, the RSPG adopted an Opinion ("the Opinion") on the strategic challenges facing Europe in addressing the growing demand for wireless broadband services[4]. In developing the Opinion the RSPG has reviewed the current allocations of spectrum in Europe within the frequency range from 400 MHz to 6 GHz and identified the steps which need to be taken (the roadmap) to make particular frequency bands available for wireless broadband.

An important element in developing the Opinion was the definition of the term 'wireless broadband' as this in turn determined which frequency bands and services would be of interest.

The Opinion concluded with 9 recommendations to the Commission including development of a strategic plan for the candidate bands identified within the range 400 MHz to 6 GHz[5], and with specific recommendations on the key bands within that range at 700 MHz, 1.5 GHz, 2.3 GHz, 3.8-4.2 GHz and 5 GHz.

The Opinion also recommended development of an overall policy for the UHF band in the frequency range 470-790 MHz, taking account of, in particular, the spectrum needs of the DTT platforms in the EU, the spectrum needs of PMSE, and the possible benefits arising from future convergent broadcasting mobile platforms to deliver linear media/audiovisual services and high-audience video and data to mobile devices (smartphones, tablets, etc.).

The spectrum needs of the DTT platforms in the EU are developed in section 5.1 below, including preliminary elements on broadcasting/mobile convergence.

The spectrum needs of PMSE will be addressed in the RSPG Report on Strategic Sectoral Spectrum Needs.

Relevant International Studies/Developments

At the time of producing this report studies were taking place in a number of international bodies of relevance to the topic of spectrum for wireless broadband. These include ITU study groups and CEPT working groups and project teams, all largely focused on preparations for the World Radiocommunication Conference in 2015 (WRC-15).

The agenda for WRC-15 includes the following items of relevance to wireless broadband:

[4] RSPG13-521: RSPG Opinion on Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband

[5] i.e., within the scope of the RSPP.

- (Agenda item 1.1) "*to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12)***";
- (Agenda item 1.2) *"to examine the results of ITU-R studies, in accordance with Resolution **232 (WRC-12)**, on the use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and take the appropriate measures.*"

Some other WRC-15 agenda items may also be relevant to spectrum requirements for WBB, e.g. Agenda Item 1.3 on PPDR

The CEPT Conference Preparatory Group (CPG) Project Team D will lead European preparations for WRC-15 agenda items 1.1 and 1.2. The CPG work will be further developed in order to have a European Common Proposal adopted on these agenda items in time for WRC-15.

CEPT has also decided to harmonise the technical conditions for the use of the frequency band 1452-1492 MHz by wireless broadband supplemental downlink (SDL), while allowing the possibility for administrations to use part of this band for other terrestrial usage such as broadcasting. It has also launched an initiative to develop an ECC Decision on implementation measures for Mobile/Fixed Communication Networks (MFCN) in the 2.3-2.4 GHz band and the need to review in particular how to reflect regulatory provisions for Licensed Shared Access (LSA) in the Decision facilitating the long-term incumbent use alongside wireless broadband. In addition, it can be noted that CEPT has already considered the possibility to migrate low capacity long range fixed links still operating in the region of 1400 MHz into frequency bands higher than 6 GHz.

Concerning cross-border coordination, a first assessment of the consequences on equitable access to spectrum, as defined in the GE06 Plan, of a new allocation to the mobile service below 790 MHz has been carried out. A proposed approach for coordination of the broadcasting service within Europe in such a case has been addressed in the RSPG Report 13-154[6].

The spectrum requirements for broadband PPDR are being addressed by the RSPG working group examining strategic sectoral spectrum needs, the final report of which should be available towards the end of 2013.

3. DEFINITION OF BROADBAND

Types of Broadband access

The Opinion avoided defining wireless broadband in terms of speed due to the acknowledged difficulties of finding consensus amongst stakeholders on that

[6] RSPG Report on proposed spectrum coordination approach for broadcasting in the case of a reallocation of the 700 MHz band.

approach. A study for the EU in 2008[7] noted that, "Definitions based on data transfer speed are not able to take into account the very fast evolution in technologies and uses. There is no definitive answer as the bandwidth required to run internet applications is continuously increasing and infrastructure standards are also continuously improving to face the growing demand. Such a definition can only be relative to a particular moment in time in a particular country." (emphasis added)

Instead, the Opinion observed that the types of wireless services involved in delivering broadband are key and it defined wireless broadband as high-speed wireless transmission of data which may be provided via:

- a fixed wireless service to devices in permanent locations, such as homes and offices or to nomadic users;
- a mobile broadband service with nearly ubiquitous connectivity to users on the move or who may be in temporary locations, such as coffee shops and train stations and may also be used in homes and offices; and
- depending on the characteristics of the satellite network, satellite broadband can service either mobile or fixed broadband users, or both.

This identification of the various means of delivering broadband informed the analysis in the Opinion of the amounts of spectrum which could be identified as already available/in use or with future potential to be made available for wireless broadband.

By way of background to the demand for wireless broadband, it is informative to consider some statistics on the growing demand for access to broadband via wireless platforms. As can be seen below the various forecasts all anticipate significant growth in mobile data traffic within the next 4 to 7 years although they are not always comparing like with like.

4. DELIVERY OF BROADBAND AND THE INCREASING DEMAND FOR WIRELESS BROADBAND

Statistics gathered by the OECD on wireless broadband show the increasing role being played by mobile data subscriptions in delivering broadband services.

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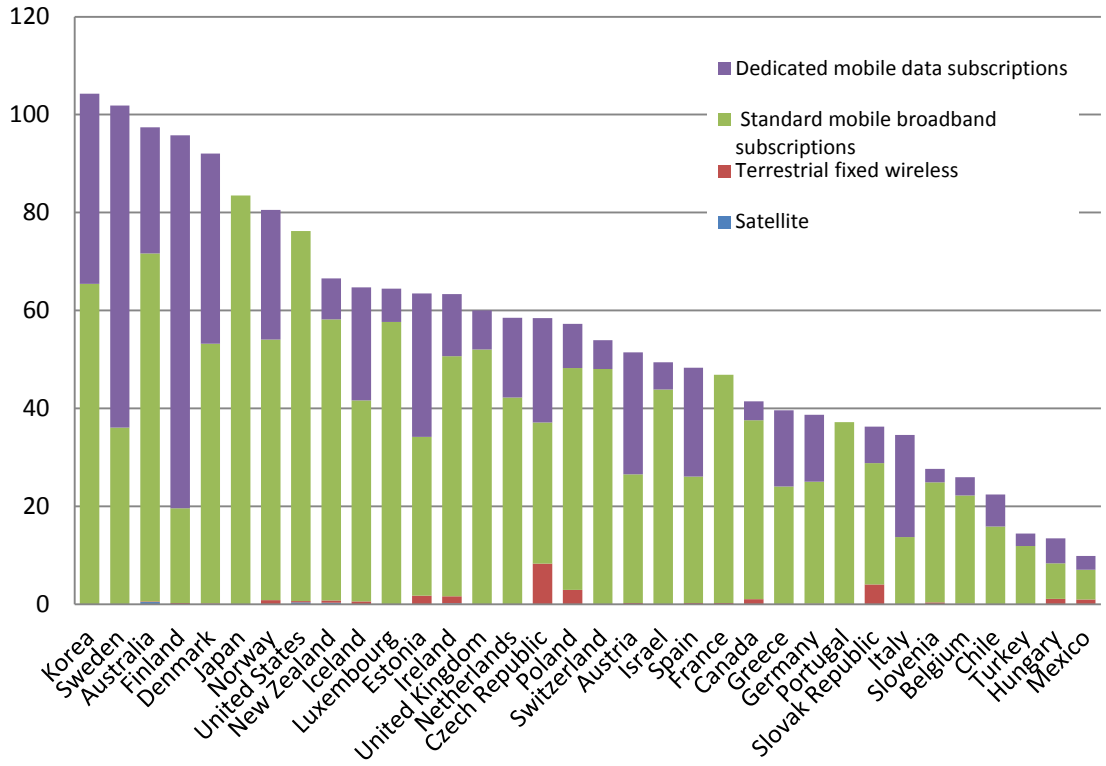


Note: Standard mobile broadband subscriptions may include dedicated mobile data subscriptions when breakdowns are not available.

Source: OECD

Figure 1: OECD wireless broadband subscriptions per 100 inhabitants, by technology, June 2012

Cisco's global mobile data traffic forecast makes the following estimates[8] of the growth in mobile data traffic:

- By 2017 it anticipates 1,384,072 TB per month of mobile data traffic in Western Europe and 844,887 TB per month in Central and Eastern Europe in the same timeframe with compound annual growth rates (CAGR) of 50% and 66 % respectively.
- 46% of total mobile data traffic will be offloaded in 2017 (Figure 2 below)

[8] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update 2012-2017

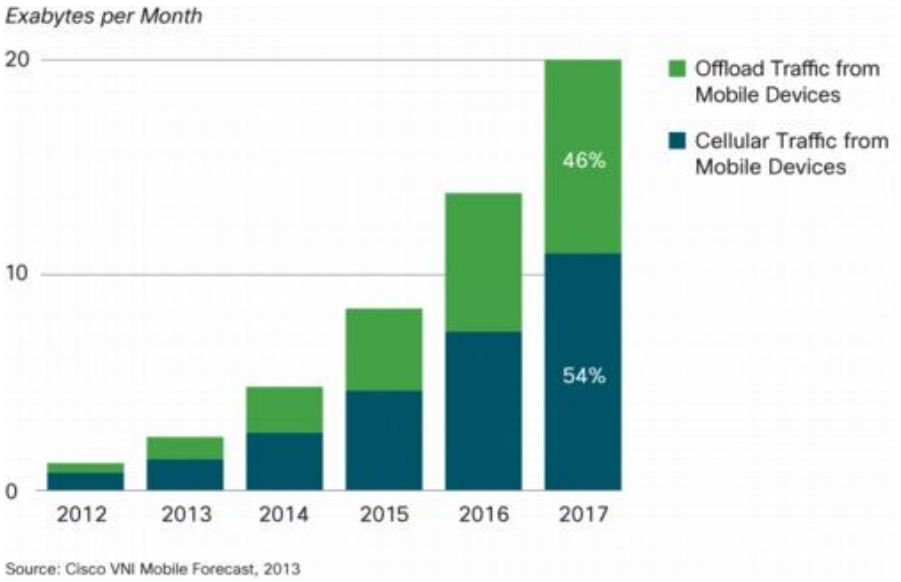
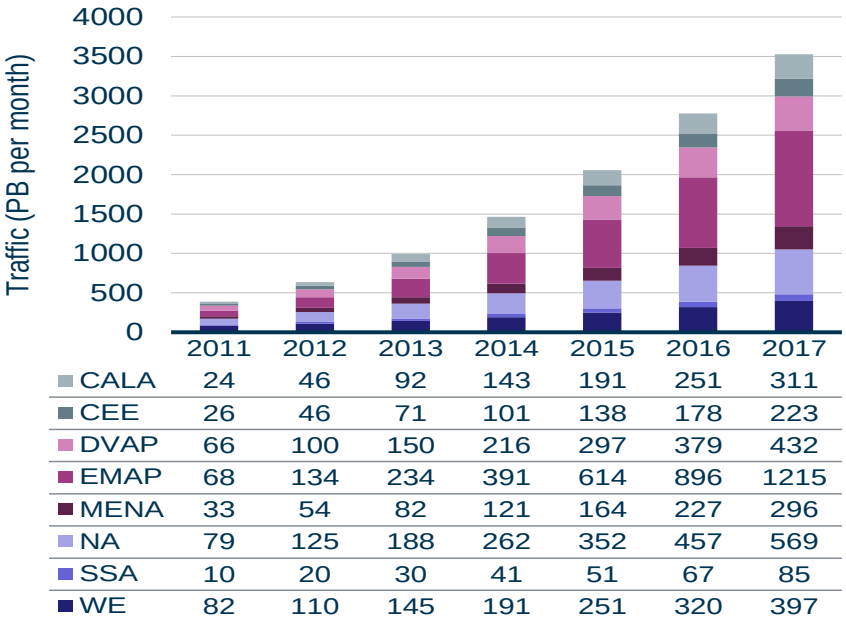


Figure 2: Total mobile data traffic offload 2012-2017

A more conservative estimate from Analysys Mason[9] anticipates wireless data traffic at 223 PB per month by 2017 for Central and Eastern Europe and 397 PB for Western Europe. (Figure 3 below)



	2011	2012	2013	2014	2015	2016	2017
CALA	24	46	92	143	191	251	311
CEE	26	46	71	101	138	178	223
DVAP	66	100	150	216	297	379	432
EMAP	68	134	234	391	614	896	1215
MENA	33	54	82	121	164	227	296
NA	79	125	188	262	352	457	569
SSA	10	20	30	41	51	67	85
WE	82	110	145	191	251	320	397

[Key to regions: CALA = Caribbean and Latin America; CEE = Central and Eastern Europe; DVAP = Developed Asia–Pacific; EMAP = Emerging Asia–Pacific; MENA = Middle East and North Africa; NA = North America; SSA = Sub-Saharan Africa; WE = Western Europe.

Figure 3: Wireless network traffic worldwide 2012–2017

[9] Analysys Mason Wireless network traffic worldwide: forecasts and analysis 2012–2017.

Underpinning these estimates Analysys Mason also analysed data traffic in 2011 showing overall that 59% of data traffic was carried over Wi-Fi and 41% was carried over cellular networks (Figure 4).

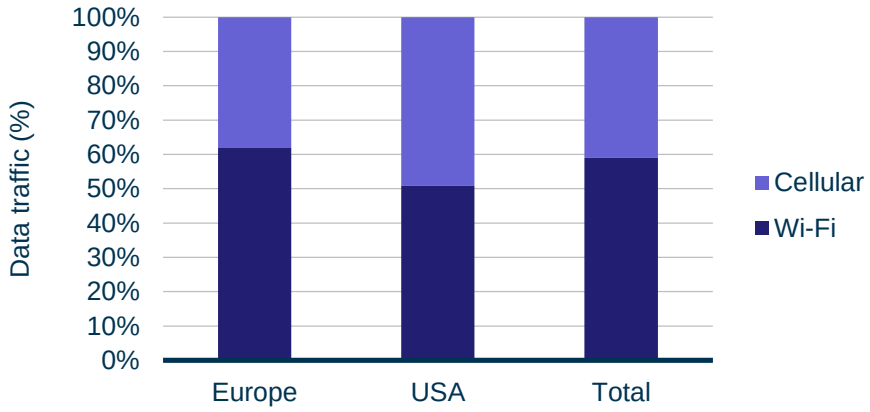


Figure 4: Traffic split between Wi-Fi and cellular, Europe (France, Germany, Spain, the UK) and the USA, September 2011.

An IDATE survey of May 2011[10] uses a range of sources to produce estimates of daily mobile traffic per Mobile BB subscription in a representative Western European country[11] of 294MB on average and 503MB for dongles only. It further estimates that by 2020 users of MBB subscriptions with high end smartphones and dongles will represent 31% of subscriptions and 63% of mobile traffic.

Conclusions on the growth in demand for wireless broadband

As can be seen from the examples quoted above forecasts of demand for wireless broadband vary significantly. Nevertheless the general consensus amongst forecasters is that huge growth in mobile data traffic is expected within the next 4 to 7 years with consequent increased demand for access to suitable spectrum to support this growth. Solutions are likely to include:

- higher capacity backhaul networks and with closer proximity to essential elements such as base stations;
- more dense radio access networks, e.g., smaller cells including pico- and femto-cells,
- use of LTE Advanced (including carrier aggregation techniques);
- more spectrum, both for capacity and coverage applications;
- increasing use of data offload (Wi-Fi, femto cells, etc), integrated mobile broadcast channels (broadcast of video content overlaid on a cellular network using broadcast technologies);
- satellite networks, e.g., mobile solutions such as the 2 GHz MSS bands or fixed-satellite provision directly to mobile base stations

[10] IDATE Mobile traffic forecasts 2010-2020.

[11] A representative Western European country is considered as a country with 50 million population in 2010 and 50.2 million by 2020, with 62.6 million mobile subscriptions in 2010 rising to 85.4 million subscriptions by 2020.

5. SURVEY ON THE LONG TERM SPECTRUM REQUIREMENTS FOR DTT IN THE EUROPEAN UNION – HIGH-LEVEL CONCLUSIONS

A questionnaire was issued in 2012 by the RSPG working group preparing the draft opinion on the future spectrum requirements for Wireless Broadband, focusing on issues specific to the future use of the 700 MHz band and on the evolution of the digital terrestrial platform (DTT) over the next decade (2012 – 2022). By the closing date for responding to the questionnaire of 28 September 2012 a total of 41 responses were received from 33 countries and 8 industry groups. A summary of the responses can be found at ANNEX 1

The future evolution of the DTT platform

The complementary nature of the different TV delivery platforms (DTT, ADSL, cable, satellite, etc.) within countries was then explored in the questionnaire. 66.7% of countries who responded agreed that the different TV delivery platforms were complementary to each other, while 100% of the industry groups agreed that the platforms were complementary. DTT provides the free-to-air, universal/near universal population coverage, whereas cable, ADSL, wireless broadband are mainly available in urban areas. DTT and satellite cover the areas where cable, ADSL and wireless broadband could not. Some countries and the industry groups/broadcasters believed that DTT also has an important role to play in providing a service, mainly linear content, to second and third television sets within a household.

The questionnaire sought views on how the DTT platform could evolve to be capable of delivering audio-visual services to mobile terminals as well as traditional TV delivery platform. Twelve countries were of the view that such an evolution could take place, while 13 countries said that a discussion on this subject was still underway. The countries who responded to the questionnaire were of the view that for mobile networks to be capable of delivering linear video content to both fixed and mobile terminals the main challenges were:

- the need to ensure sufficient backhaul capacity;
- a need for eMBMS devices;
- mobile networks not suited to delivering linear video content to a mass audience at same time; better suited to non-linear delivery;
- more spectrum needed in any case to support growing demand for mobile data services;
- new regulatory framework;
- large discrepancy between link budgets for fixed versus mobile networks.

Another important fact revealed by the questionnaire is that over half of countries within Europe have not yet concluded on their future requirements for DTT.

Of the 8 broadcasters/industry groups who replied, 7 were of the view that the DTT platform could evolve to be capable of delivering audio-visual services to mobile terminals. However, this was further qualified by these groups suggesting that a complementary solution is required as they believe that mobile networks will not become a viable alternative to DTT. It was their view that the two platforms should

be used in a complementary manner which would facilitate their evolution and enhance consumer experiences.

Convergence between terrestrial mobile and (evolved) DTT platforms
The questionnaire sought views on the possible convergence between terrestrial mobile and (evolved) DTT platforms, considering the consequences of mobile networks being capable of delivering linear video content to mobile terminals.

A majority of respondents considered it unlikely that mobile networks will evolve to deliver video content to mass audiences, primarily because of the increased demand for spectrum to support such a network capability, which many respondents considered inefficient. Views expressed included:

- it would require a paradigm shift in both the technology and the regulatory framework;
- IP based on-demand services may increase;
- there may be reduced spectrum for DTT;
- increased competition;
- new devices need to be developed;
- mobile networks may need to be upgraded;
- new business models may be required;
- new content/advertising opportunities could arise;
- more choice to consumers;
- more complex handsets would be required;
- access to more spectrum would be necessary;
- there would be increased mobile TV use.

Long-term DTT multiplex requirements
Views were sought on the number of DTT multiplexes expected to be required by countries in the long-term (beyond 2020). The responses were as follows:

Issue	Countries
Greater than 10 multiplexes required	4
Less than 10 multiplexes required	20
Number of multiplexes required still under discussion	7
No answer at this time	2

In the countries which indicated a requirement for more than 10 multiplexes, this included provision for regional/local based DTT services, with numbers ranging from 16 to 55 multiplexes (including national regional/local based DTT services). Of those countries expecting less than 10 national multiplexes, the average was 6 national multiplexes per country being required beyond 2020. The eight industry groups/broadcasters who replied to this question anticipated the number of multiplexes required would range in value from 6 to 40.

Summary
The questionnaire revealed the long-term spectrum requirements for television broadcasting in the European Union. The following are the general conclusions from the data received on the questionnaire:

(a) The long term spectrum need for broadcasting varies amongst European countries. However, several Member States are planning an increase in the number of programmes, a widespread expansion of HDTV, additional mobility and possible introduction of Ultra High Definition TV;
(b) The relative penetration of each platform for TV delivery is highly country dependent. However, most Member States consider that these platforms complement each other and most countries have stressed the importance of terrestrial TV for free-to-air services, for secondary TV sets, and that viability of DTV requires access to sufficient spectrum resource;
(c) Both broadcasting and mobile networks may complement each other in the provision of linear and non-linear audiovisual content to mobile terminals. However, for fixed reception, it is currently considered unlikely that mobile networks will evolve to deliver video content to mass audiences, primarily because of the increased demand for spectrum to support such a network capability, and which many considered inefficient.

6. DETAILED ANALYSIS OF KEY SPECTRUM BANDS SUITABLE FOR WBB

6.1 700 MHz band (694-790 MHz)

Current use of the 700 MHz band
The 700 MHz band is used in Europe for terrestrial television and PMSE. The frequency band 694-790 MHz represents 30% of the total remaining UHF TV spectrum. The impact of a reallocation of this spectrum for broadband will therefore potentially be significantly more important for terrestrial broadcasting than in the case of the 800 MHz band which was used in some countries for other services (i.e., defence). In addition, such a reallocation, which would take place after analogue switchover, could not appear as a share of the digital dividend between the broadcasting and mobile services but rather as a reduction of the capacity for broadcasting, which would require in many countries the implementation of new technologies (DVB-T2/HEVC) and would impact further developments of DTT services, such as the introduction of higher definition video services. This reallocation could have a financial impact for DTT viewers as they may have to again buy new equipment with no clear benefit this time in terms of enhanced television reception.

The UHF band is also heavily used for Programme Making and Special Event (PMSE) services, especially wireless microphones. PMSE services make use of the white spaces between the TV broadcasts. It is unlikely that such use can continue in the 700MHz sub-band if it is used for mobile broadband, except for the possible centre duplex gap arising from the mobile frequency plan. The amount of spectrum available for PMSE services was already diminished when making the 800 MHz band

available for mobile broadband. There is need to take account of the spectrum needs for PMSE services and to provide a solution for the continuation of PMSE services elsewhere in the UHF band or in other appropriate bands. An example could be the band 1492-1518 MHz which is currently being implemented for PMSE by CEPT working group FM.

Trends in the development of DTT and its implications for the UHF band

The outcome of the recent questionnaire as summarised in Section 5 reveals the future plans for the DTT platform within Europe. While the long-term spectrum need for broadcasting varies amongst European countries, over 75% of respondent countries have indicated plans to introduce new DTT multiplexes in the next 1 to 5 years. The services anticipated by such an expansion in national DTT platforms include an increase in the number of programme services, a widespread expansion of HDTV, interactive services, additional mobility and possible introduction of Ultra High Definition TV.

Having considered the spectrum requirements for DTT into the future (as revealed in the questionnaire), the challenge for the development of an EU policy on the 700 MHz band will be to address the variety of national situations in terms of digital terrestrial television services and the need for additional wireless broadband services. In recognition of that policy challenge the EC Radio Spectrum Committee recently adopted a mandate to CEPT for the development of technical conditions for the introduction of wireless broadband in the 700 MHz band[12]. The mandate to CEPT also includes a requirement to study the possibility of shared spectrum use with certain incumbent uses such as PMSE. In developing technical conditions and as part of the mandate, CEPT is required to ensure the deployment of wireless broadband services while also taking into account other priority areas of EU spectrum policy such as public protection and disaster relief (PPDR) and should ensure appropriate protection for incumbent uses, primarily broadcasting services and PMSE in spectrum below the 700 MHz band. The results of this mandate should also complement high-level deliverables of the RSPG, in particular the RSPG Opinions on wireless broadband and the definition of common policy objectives for WRC-15.

The future introduction of new DTT technologies (such as DVB-T2, HEVC) will enable an increase of spectrum efficiency and the provision of improved TV services. However, scenarios and timing for transitioning to these technologies are critical and very much country-dependent.

Timescales

In terms of timing, there is a disconnect between the consumer replacement/upgrade cycle of broadcast TV receiving equipment and the consumer replacement/upgrade cycle for computer equipment. Whilst consumers will easily upgrade software on a PC to display, read and edit improved (more efficient) formats for AV and data content, they are reluctant to replace broadcast receiving equipment at the rate of development of the technology. There is a relationship in each country with the duration of broadcasting licences, the timeline for the introduction of the new services for broadcasting, the implementation of more efficient broadcasting technologies, and the need to meet the targets set down nationally and at EU level in relation to delivery

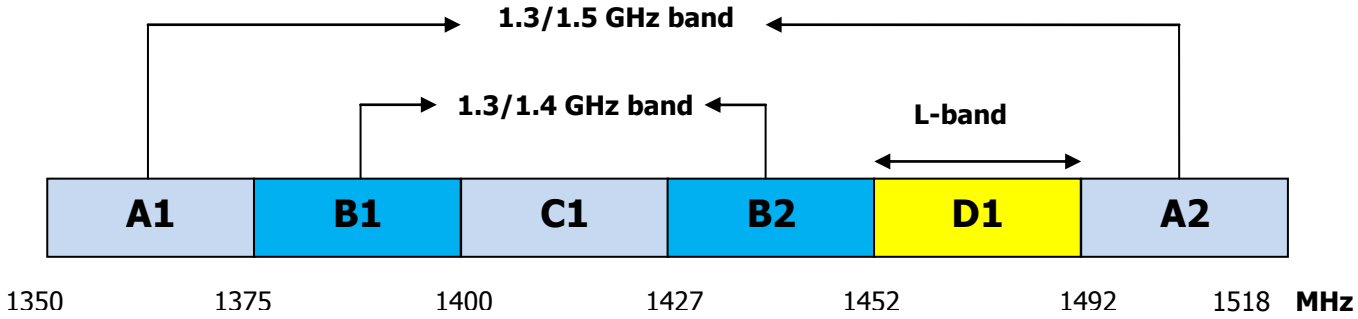
[12] See RSCOM12-37 rev3.

of broadband capacity. This also has to be considered in the context of potential cross-border frequency coordination difficulties, including taking into account the required time for cross-border coordination and modifications of the broadcasting assignments.

The recent questionnaire revealed that the majority (72.8%) of current national DTT licences expire over a broad time-scale – between 2016 and 2026, with the current DTT licences in 16 countries expiring between 2020 and 2023.

6.2 Frequency Bands in the range 1350 to 1518 MHz

For convenience in the following discussion the frequency bands of interest in the range 1350 to 1518 MHz have been labelled as shown in Figure 5 below.



A1 - 1350 – 1375 MHz, A2 – 1492 – 1518 MHz
B1 – 1375 – 1400 MHz, B2 – 1427 – 1452 MHz
C1 – 1400 – 1427 MHz, D1 – 1452 – 1492 MHz

Figure 5: Frequency Bands of interest in the range 1350 to 1518 MHz

Current allocations and use:
A1 and B1 are allocated to fixed, mobile and radiolocation services on a co-primary basis in ITU Region 1 only and the bands A2 and B2 are allocated globally to fixed and mobile services on a co-primary basis.

Currently, there is a measure of harmonisation in the bands A1 paired with A2 and B1 paired with B2 through CEPT Recommendation T/R 13-01[13], and the bands are used by a small number of radio link users for low capacity long distance communications. According to the ECC Report 173[14], the number of radio links remains limited. In addition to the radio link applications, these bands are also used for military radio applications including radiolocation in the bands A1 and B1. In some countries the band B2 is used for wireless camera applications.

[13] CEPT Recommendation T/R 13-01 (Montreux 1993, Revised Rottach-Egern, February 2010): Preferred channel arrangements for Fixed Service systems in the frequency range 1-2.3 GHz.

[14] Fixed Service in Europe: Current use and future trends post 2011 (March 2012).

Band C1 is a passive band currently allocated to the Earth Exploration-Satellite, Radio Astronomy and Space Research services on a co-primary basis, in which all emissions are prohibited in accordance with RR 5.340. Therefore, any wireless broadband services deployed in adjacent bands would need to limit unwanted emissions into the passive band to a level ensuring protection of passive services noting, as reflected in the RSPG Opinion 13-521, that ITU-R Resolution 750 addresses this issue.

Finally, the band D1 (1452- 1492 MHz) is allocated to the Fixed, Mobile and Broadcasting services on a co-primary basis. The lower part of the band, 1452 – 1479.5 MHz, has been harmonised for terrestrial digital audio broadcasting (T-DAB) through the Maastricht 2002 Special Arrangement (later revised in 2007 in Constanța). The upper part of the band, 1479.5 – 1492 MHz, was harmonised for satellite digital audio broadcasting(S-DAB) in 2003 through ECC Decision (03)02[15]. However, only a few countries have introduced digital sound broadcasting services using T-DAB or S-DAB in this band and, where these services have been introduced, take-up has been limited. Therefore, following an extensive review and studies of this band[16], CEPT ECC decided in September 2012 to develop an ECC Decision designating the band 1452- 1492 MHz for mobile/fixed communication networks (MFCN) supplemental downlink (SDL) and defining the Least Restrictive Technical Conditions with a harmonised band plan based on 8 blocks of 5 MHz each; The intention being to facilitate significant additional capacity for mobile networks. It should also allow individual countries to meet national requirements by, if necessary, using part of the band for terrestrial broadcasting and other terrestrial applications.

Potential constraints to be considered

Before the bands B1/B2 could be made available for use by WBB the following steps would need to be taken:

- refarming of tactical radio applications, e.g. into the frequency bands 2025-2070 MHz and 2200-2245 MHz (in line with NATO Joint Civil / Military Frequency Agreement);
- migration of radars, possibly to the lower frequency band (1300-1350/1375 MHz);migration of fixed links to higher frequency bands;
- protection of adjacent band services, in particular of the passive band C1 (1400-1427 MHz).

CEPT has recently consulted on the designation of the band 1492-1518 MHz for use by PMSE. One outcome is the need identified for studies on compatibility between radio microphone applications restricted to indoor use and other users in the band. This is also underlined by ECC Report 121[17], which already in 2008 concluded that

[15] ECC Decision of 17 October 2003 on the designation of the frequency band 1479.5-1492 MHz for use by Satellite Digital Audio Broadcasting systems.

[16] ECC Report 188 on the "Future Harmonised Use of 1452-1492 MHz in CEPT"

[17] ECC Report 121on "Compatibility studies between professional wireless microphone systems (PWMS) and other services/systems in the bands 1452-1492 MHz, 1492-1530 MHz, 1533-1559 MHz also considering the services/systems in the adjacent bands (below 1452 MHz and above 1559 MHz)"

compatibility between PMSE and the incumbent services is achieved by implementing mitigation techniques or restrictions.

CEPT studies
ECC Report 188 on the future harmonised use of the band 1452 – 1492 MHz (D1 in Figure 5 above) concluded that the most appropriate regulatory framework for the future use of the band in CEPT would be the harmonisation of this band for mobile broadband SDL, while allowing individual countries to adapt to specific national circumstances in part of the band for terrestrial broadcasting and other terrestrial applications. This regulatory framework should bring the highest benefits for CEPT countries when SDL is deployed under this framework. The ECC thus decided to designate the band for MFCN SDL. The ECC will also define least restrictive technical conditions with a harmonised band plan for this band, based on 8 blocks of 5 MHz with associated generic BEM.

CEPT is also currently studying (in the Spectrum Engineering Working Group) additional bands for low capacity long range fixed links in the frequency band between 3 – 15 GHz focussing on the 6 GHz and 10 GHz band, which could facilitate migration of fixed services operating in the L band.

As mentioned above, studies have also been proposed in respect of radio microphone applications in the bands 1492-1518 MHz and 1518-1525 MHz. Furthermore, in preparation for WRC-15 CEPT is studying the bands in the range 1350 to 1518 MHz, with the exception of band C1 (1400-1427 MHz), as potential candidates for IMT.

Suitability for WBB
The limited take up of services in bands B1/B2 and D1 make them suitable candidates for designation for use by wireless broadband services. Furthermore, the bands around 1500 MHz are covered by the 3GPP standards, which should facilitate the provision of LTE and LTE-Advanced equipment in these bands. However, existing services including fixed links and defence applications would have to be migrated to other bands.

The decision by the ECC to develop a harmonisation measure for the band 1452-1492 MHz, designating it for MFCN SDL, earmarks that band as an early candidate for WBB.

6.3 2300-2400 MHz band

Current allocations and use:
In Europe the band 2300 – 2400 MHz (2.3 GHz) is allocated to the Fixed and Mobile services on a co-primary basis, and to the Radiolocation and Amateur services on a secondary basis.

Use of the 2.3 GHz band varies throughout Europe. In some countries the band is extensively used for defence or security purposes including aeronautical telemetry in

accordance with ERC Recommendation 62-02[18] and CCTV. The band is still a core band for wireless cameras as part of SAP or SAB applications. SAP/SAB operates on a non-interference, non-protected basis and assignments of these services tend to be temporary in nature.

Potential constraints to be considered

The band is shared with aeronautical telemetry, SAB/SAP and CCTV/cordless camera security applications, which may limit its availability on a wider basis in some Member States. Long-term incumbent use of the band in the territory of those administrations that wish to maintain such use will also be a constraint.

CEPT studies

The Frequency Management Working Group, via project team FM 52, has been tasked with developing a draft ECC Decision, aimed at harmonising implementation measures for MFCN (including broadband wireless access systems) in the frequency band 2300-2400 MHz including;

- least restrictive technical conditions (LRTC), taking into account the existing standardisation framework and activities at the worldwide level, and an appropriate frequency arrangement;
- regulatory provisions based on Licensed Shared Access (LSA) to facilitate the long term incumbent use of the band in the territory of those administrations that wish to maintain such use.

FM52 is also developing a recommendation on cross-border coordination between MFCN, and, between MFCN network & other systems in the 2300-2400 MHz band.

Suitability for WBB

- ITU Radio Regulations footnote 5.384A[19], identifies the 2.3 GHz band for use by administrations wishing to implement International Mobile Telecommunications (IMT). Consequently, the band is already used for mobile broadband applications in several other parts of the world including US, China and India for example.
- The band is already standardised in 3GPP (Band 40)
- Given that the band is extensively used in other parts of the world, equipment is readily available.
- With potentially up to 100 MHz available the band would be ideal for WBB applications
- ETSI has developed a System Reference Document on the introduction of mobile broadband in 2300-2400 MHz under an LSA framework

[18] ERC Recommendation 62-02 on "Harmonised frequency band for civil and military airborne telemetry applications."

[19] ITU Radio Regulations, Article 5, footnote 5.384A: The bands, or portions of the bands, 1710 – 1885 MHz, 2300 – 2400 MHz and 2500 – 2690 MHz, are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution 223 (Rev. WRC-12). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC07).

6.4 3800 – 4200 MHz band

Current allocations and use:

The band 3800 – 4200 MHz is currently allocated on a co-primary basis to the Fixed and Fixed-Satellite services. In Europe the band is used for terrestrial fixed links, satellite earth stations of the Fixed-Satellite Service (FSS) (space-to-Earth), including the Galileo Data Dissemination Network (GDDN).

There are over170 geostationary orbit satellites worldwide operating in the band 3400 – 4200 MHz of which more than 50 provide services to Europe and interconnect Europe with other regions of the world. These satellites provide essential services (mainly governmental and security services) to consumers (NGO and non-NGO and IGO), the meteorological community, EUMETCAST and GEONETCAST, for public sector emergency applications[20]. They are also used by embassies and diplomatic missions due to the very high robustness of these frequencies towards atmospheric conditions around the world, and for feeder links for the GMDSS. .

Potential constraints to be considered

There is a greater concentration of Earth-stations using the band 3800-4200 MHz compared to the lower bands 3400-3600 MHz and 3600-3800 MHz. Sharing of frequencies between satellite and terrestrial services can be challenging, and it has been demonstrated that coexistence between ubiquitous FSS Earth stations and the Mobile service in the same geographical area is generally not viable, requiring large separation distances.

There is likely to be only limited possibilities for harmonisation of this band for wireless broadband at the global level due to diverse national situations although there is a co-primary allocation to the Mobile, except aeronautical mobile, service in Regions 2 and 3 and a secondary allocation to the Mobile service in Region 1.

CEPT studies

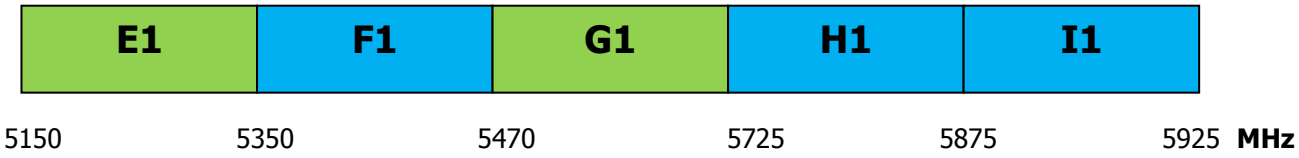
WRC-15 Agenda item 9.1.5, in the context of Resolution 154 (WRC-12), addresses the technical and regulatory actions required to support existing and future operation of FSS Earth-stations in the band 3400-4200 MHz as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in ITU Region 1. CPG Project Team B is following this issue.

Suitability for WBB

The band has potential to play a role in the provision of ECS by supporting the future capacity needs especially in urban hot-spots.

[20] For example, see www.emergency.lu)

6.5 5 GHz bands



E1 – 5150 – 5350 MHz, F1 - 5350 – 5470 MHz, G1 – 5470 – 5725 MHz
H1 – 5725 – 5875 MHz, I1 – 5875 – 5925 MHz

Figure 6: 5 GHz bands

Current allocations and use:

Band F1 is currently used for EESS active sensors (including Sentinel-1 and Sentinel-3 which are part of GMES), defence systems, position fixing, radiodetermination applications including shipborne and vessel traffic service (VTS) radar and weather radar applications.

Band E1 and G1 are currently used, among other applications, for RLANs in accordance with EC Decision 2005/513/EC as amended by Decision 2007/90/EC.

The current usage of the band H1 includes amateur, defence systems including frequency hopping radars, ISM, SRDs, radiodetermination applications, RTTT, weather radars, fixed links, FSS and some use of Broadband Fixed Wireless Access (BFWA). CEPT has also published a Recommendation[21] on use of the band for BFWA.

Band I1 is used for RTTT (ITS), FSS, fixed links, UWB and amateur service applications.

Potential constraints to be considered

The frequency bands 5350-5470 MHz and 5725-5925 MHz bands were not originally designated for use by RLANs in order to protect radio services such as the radiodetermination services and the EESS (active) service. Therefore, studies will be needed within ITU-R and CEPT to address all compatibility issues.

Other potential constraints include:

- Existing harmonised Wi-Fi standards need to be developed further
- May not be available in all Member States
- EC Decision 2008/671/EC on the harmonised use of radio spectrum in the band 5875-5905 MHz for safety related applications of Intelligent Transport Systems (ITS) is applicable.

[21] ECC Recommendation (06)04: Use of the band 5725-5875 MHz for Broadband Fixed Wireless Access (BFWA).

- Sharing the band I1 with FSS Earth stations and ITS may impose geographical constraints on usage and/or require intelligent mitigation techniques.
- Sharing the band F1 with EESS and radars, if feasible, is likely to lead to constraints on eirp of outdoor operations and use of cognitive sharing techniques;
- Sharing constraints in the band H1 to protect radars, FSS and RTTT.

CEPT studies

Within CEPT, WGFM is studying potential frequency bands for broadband direct-air-to-ground communications (DA2GC), intended to provide high performance broadband connectivity between aircraft and a terrestrial radio access network to be deployed in Europe. Among the bands under consideration is 5855-5875 MHz. However, to date no conclusions have been reached on the suitability of the band as a candidate for DA2GC.

In ITU-R sharing studies are underway in JTG 4-5-6-7 which is identifying potential frequency bands for IMT as required under Agenda item 1.1 of WRC-15. Bands identified for study include 5350-5 470 MHz and 5850-5925 MHz. CEPT CPG Project Team D is preparing European positions on these and other bands.

Suitability for WBB

- The existing 5GHz RLAN eco-system could be easily developed to encompass the new bands;
- Bands F1, H1 and I1 could be considered as providing additional spectrum for Wi-Fi applications;
- Designating the bands for WBB applications (Wi-Fi) would meet needs for data offload and indoor wireless connectivity;
- Additional spectrum for Wi-Fi applications could deliver greater speed and/or capacity for existing and new applications.

The FCC in the United States has initiated consideration of the bands 5350-5470 MHz and 5725-5925 MHz to enhance the amount of 5 GHz spectrum for RLAN/WIFI applications. If approved these blocks of spectrum would facilitate the implementation of wider channels and higher bit rates, reducing the likelihood of WiFi becoming a bottleneck for broadband communications.

7. CONCLUSIONS

A range of market forecasts, although varying in their estimates, all anticipate significant growth in demand for data traffic and the broadband services to support it in the next 4 to 5 years. This will largely be driven by the take up of smart devices including tablets and smart phones and the anticipated growth in machine-to-machine applications. A significant proportion of this broadband demand will be provided by wireless infrastructure including fixed, mobile and radio local area networks (WiFi).

The RSPG Opinion RSPG13-521[22], associated with this report, identified a range of frequency bands with potential for wireless broadband in the frequency range 400

[22] RSPG Opinion on Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband

MHz to 6 GHz. As can be seen from the Annex 1 to that Opinion there is already a substantial amount of spectrum available in the range 400 MHz to 6 GHz and already contributing to the RSPP target of at least 1200 MHz of spectrum for wireless broadband.

In the lower part of the range of interest, i.e., below 1000 MHz, the main issue for access to spectrum in the future is that of the impact on broadcasting services and in particular, whether coexistence between broadcasting and wireless broadband is viable, even desirable, and if so in what form it would be practicable.

Between 1000 MHz and 3000 MHz, there are future possibilities in the bands 1375-1400, 1427-1452 and 1452-1492 MHz. However, the first two bands are currently designated for use by defence systems and low capacity fixed links although, as acknowledged in the Opinion, such use is not extensive. There is some use of the band 1427-1452 MHz by wireless cameras. To facilitate WBB on a Europe-wide basis would require that such uses are migrated to another, most likely higher, band. The band 1452-1492 MHz is the subject of work in ECC (WGFM) to develop a harmonising Decision on use of the band as a supplemental downlink for MFCN.

The band 1880-1900 MHz, currently used by DECT systems, also has longer-term potential for WBB subject to a revision or replacement of the Council Directive on DECT[23].

The next band of interest is 2300-2400 MHz with an ecosystem already in place in some parts of the world but with limitations on its availability in some European countries.

Above 3000 MHz the spectrum tends to be more suitable for meeting capacity needs rather than coverage with medium term potential for WBB in 3800-4200 MHz, and the potential to achieve contiguous blocks of spectrum for Wi-Fi type applications in the 5 GHz range. In all cases, however, such potential is dependent on compatibility being achieved with the other services in those bands.

In nearly all of the bands under consideration for future wireless broadband applications there is likely to be some impact on incumbent services, either through sharing with the new service or through the need to be refarmed to another, inevitably higher, frequency band and the consequent costs incurred by such a move. When refarming in particular is being considered, the economic and social costs and benefits to both incumbent and new services will need to be evaluated, as outlined in the RSPG Opinion on Review of Spectrum Use[24].

[23] Council Directive of 3 June 1991 on the frequency band to be designated for the coordinated introduction of digital European cordless telecommunications (DECT) into the Community (91/287/EEC)

[24] RSPG12-408. Final RSPG Opinion on Review of Spectrum Use

ANNEX 1

Summary of responses to the Questionnaire on the long term spectrum requirements for television broadcasting in the European Union including the number of TV services, HDTV, interactive services, mobility requirements and the possible introduction of Ultra High Definition Television

I. Introduction

The questionnaire was prepared to facilitate the work of the sub-working group of Radio Spectrum Policy Group (RSPG) preparing the draft opinion on the future spectrum requirements for Wireless Broadband, specifically issues relative to the future of the 700 MHz frequency band (694 -790 MHz).

The 700MHz frequency band is currently used in Europe for terrestrial television and in many countries also for PMSE on secondary basis and represents approximately 30% of the total remaining UHF spectrum used by the television broadcasting. The impact of an exclusive reallocation of this spectrum to wireless broadband will therefore be significantly more important for the broadcasting service than in the case of the 800 MHz band.

The responses received to the questionnaire will contribute to the analysis of the RSPG on the future use of the 700 MHz as well as on the evolution of the digital terrestrial platform (DTT) over the next decade (2012 – 2022).

The questionnaire was circulated by the Secretariat of the RSPG on the 24 July 2012, the closing date for responses was the 28 September 2012.

This document gives a headline summary of the responses received to the questions asked in the DTT questionnaire.

II. Overview of Respondents who participated

Administrations	33
- of which are EU Member States	26
Industry Groups	8
Total Responses Received	41

Thanks to all who took time out to complete the questionnaire, a full list of participants can be found at section IV of this document.

III. Summary of Responses Received

Question 1

i) Please describe the DTT platform in your country, currently on-air, in following terms (please use the following format for your answers):

Some headline findings regarding the existing DTT networks of the countries who responded. Percentages used are as a percentage of the total number of administrations who responded of 33.

(a) number of national DTT networks

One or more national DTT networks in place	28	84.9%
Two or more national DTT networks in place	23	69.7%
Four or more national DTT networks in place	19	57.6%
Six or more national DTT networks in place	10	30.3%
Eight or more national DTT networks in place	5	15.2%
Greater than ten national DTT networks in place	1	3%
Countries whose national DTT services have yet to be rolled-out/launched	3	9.1%
Countries who have no DTT network	1	3%
Countries who have regional/local DTT networks only	1	3%

(b) number of regional/local DTT networks

One or more regional/local DTT networks in place	16	48.5%
Two or more regional/local DTT networks in place	9	27.3%
Four or more regional/local DTT networks in place	7	21.2%
Six or more regional/local DTT networks in place	6	18.2%
Eight or more regional/local DTT networks in place	3	9.1%
Greater than ten or more regional/local DTT networks in place	2	6.1%
Countries who have no or more regional/local DTT networks in place	17	51.5%

(c) DTT System

DVB-T only	25	75.8%
DVB-T plus DVB-T2	5	15.2%
DVB-T2 only	2	6.1%
DVB-H	3	9.1%

(d) Content Format

SD only	10	30.3%
SD plus HD	20	60.6%
HD only	0	0%

(e) Coverage obligations, reception availability

Countries with coverage obligations on one or more of their DTT multiplexes	27	81.8%
Countries with coverage obligations on one or more of their DTT multiplexes	3	9.1%
Countries where one or more of their DTT multiplexes is available on a Free-to-air basis only.	13	39.4%

Countries where one or more of their DTT multiplexes is available on a Free-to-air and pay-TV basis.	16	48.5%

(f) Spectrum Bands used by countries who have DTT currently on-air

UHF Band IV/V only	26	78.9%
UHF Band IV/V and VHF Band III	4	12.1%
VHF Band III only	0	0%

ii) Are there plans to deploy (a) additional DTT multiplexes and/or (b) foresee the launch of new services in the short term (1 – 5 years)?

(a) additional DTT multiplexes

Countries planning additional multiplexes	25	75.8%
- DTT system (DVB-T2)	16	48.5%
- DTT system (DVB-T)	13	39.4%
- DTT system, to be decided	5	15.2%
Content format planned – SD only	3	9.1%
Content format planned – SD plus HD	16	48.5%
Content format planned – HD only	6	18.2%
Content format planned – To be decided	5	15.2%
Countries not planning additional multiplexes	4	12.1%
Countries where decision on additional multiplexes to be taken	3	9.1
Countries planning to reduce the number of DTT multiplexes	1	3%

(b) foresee the launch of new services

Countries foreseeing additional services	25	75.8%
Countries foreseeing no additional services	2	6.1%
Countries where a decision on additional services to be made	4	12.1%
Expected content format – SD only	3	9.1%
Expected content format – SD plus HD	16	48.5%
Expected content format – HD only	7	21.2%
Reception availability – Free-to-air only	4	12.1%
Reception availability – Free-to-air plus pay-TV	7	21.2%
Reception availability – pay TV only	3	9.1%
Reception availability – to be decided	2	6.1%
Interactive Services	10	30.3%
VoD	7	21.1%
Ultra High Definition TV	5	15.2%
Other – 3D TV	5	15.2%

Other services being considered by those countries who selected ‘other’ include mobile services, mobile TV, multi-screen content, Hybrid/Integrated Broadband and Broadcasting (H/IBB).

iii) When do the existing DTT licenses in your country expire?

Expire 2013-2015	5	15.2%
Expire 2016-2019	8	24.2%
Expire 2020-2023	16	48.5%
Expire 2024-2027	9	27.3%
Expire at some point after 2027	3	9.1%
No answer given	2	6.1%
Expire 2016-2026	24	72.8%
Licence renewed annually	1	3%
Expires 2032	1	3%
Don't licence expiration, Government Policy decides	6	18.2%

Question 2
How do you foresee different means of reception (DTT, ADSL, Cable, satellite, etc) complementing each other?

Administrations

Foresee different means of complementing each other	22	66.7%
Do not foresee different means of complementing each other	7	21.2%
Didn't answer/unclear	4	12.1%

Industry Group/Broadcaster

Foresee different means of complementing each other	8	100%
Do not foresee different means of complementing each other	0	0%

Of those countries who believed that different means of reception (DTT, ADSL, Cable, Satellite, Wireless Broadband) were complementary.

In relation to the role of DTT, administrations and industry groups/broadcasters were of the view that it is an affordable option to provide near universal coverage within a country for free-to-air availability. There was also a general view expressed by some administrations and by industry groups/broadcasters that DTT plays a crucial role in delivering on the political, cultural and social aspects related to public service broadcasting (PSB), given the nature of PSB DTT being available on a free-to-air basis unconditionally and its universal/near universal population coverage.

Some administrations and industry groups/broadcasters were of the view that DTT, ADSL, Cable, Satellite, Wireless broadband were complimentary. DTT provides the free-to-air, universal/near universal population coverage, whereas Cable, ADSL, Wireless Broadband was mainly available in urban areas where the infrastructure supported it. DTT and Satellite cover the areas where cable, ADSL and wireless broadband could not.

Some countries and the industry groups/broadcasters believed that DTT has an important role to play in providing a service to second and third television sets within

a household, mainly linear content. Whereas satellite, cable and ADSL, where available, was used on the primary television set within the household, providing linear, non-linear content, as well as interactive services, VoD, where the infrastructure supported it.

Where countries believed that DTT, ADSL, Cable, Satellite, Wireless broadband were not complimentary, this was due to (a) the prominence of cable or satellite, or (b) that DTT, ADSL, Cable, Satellite, Wireless broadband operated in direct competition to within the country and were therefore not seen as complimentary to each other.

Question 3:

i) Do you think that the DTT platform in your country will evolve to being capable of delivering audio-visual services also to mobile terminals?

Administrations

Yes	12	36.4%
No	8	24.2%
Number of Administration where this still under discussion	13	39.4%

Industry Groups/Broadcasters

Yes	7	87.5%
No	0	0%
Still under discussion	1	12.5%

ii) If yes, what is the required evolution of the DTT network platform architecture? Please give details in relation to: -

a. the DTT network topology (whether there will be a need to migrate from high-power/ high- tower to low- power/ low- tower type of networks);

Administrations

Yes/Maybe	8	24.24%
No	5	15.15%
Didn't answer/under discussion/unclear	20	60.6%

Industry Groups/Broadcasters

Yes	0	0%
No	8	100%

b. to the use of MFN versus SFN networks to achieve the evolution, and

Administrations

MFN	1	3%
SFN	7	15.15%
Mixed MFN & SFN	2	6%
Didn't answer/under discussion/unclear	23	69.6%

Industry Groups/Broadcasters

MFN	0	0%
SFN	3	37.5%
Mixed MFN & SFN	5	62.5%

c. a possible migration to a new DTT system(e.g. to facilitate interactive services) and transmitting technologies (e.g., DVB-T2, DVB-T2 Lite, etc.).

Administrations

Possible migration to DVB-T2	6	3%
Possible migration to DVB-T2 Lite	1	15.15%
Both	4	6%
Didn't answer/under discussion/unclear	22	69.6%

Industry Groups/Broadcasters

Possible migration to DVB-T2	5	62.5%
Both	1	12.5%
Under discussion	2	25%

iii) Do you believe that a DTT platform evolving towards delivering audio-visual services also to mobile terminals may also be used by mobile operators to cope with:

a. the data traffic required to deliver linear video content (i.e., with mobile terminals including broadcasting tuners), and

b. certain non-linear content that could be pushed (and stored)?

Administrations

Yes	12	36.3%
No	4	12%
Didn't answer/under discussion/unclear	17	51%

Industry Groups/Broadcasters

Yes	6	75%
No	0	0%
Didn't answer/under discussion/unclear	2	25%

iv)What evolutions do you expect would be required for mobile networks to be capable of delivering linear video content ubiquitously to both fixed and mobile terminals?

Administrations

Complementary solution (both DTT and mobile networks co- existing together)	7	21%
Evolved mobile network (LTE Advanced)	7	21%
Evolved DTT network (DVB T2, DVB T2 Lite)	1	3%
Didn't answer/unclear/under discussion	18	54.5 %

Industry groups/Broadcasters

Complementary solution (both DTT and mobile networks co- existing together)	4	50%
Evolved mobile network (LTE Advanced)	0	0
Evolved DTT network (DVB T2, DVB T2 Lite)	0	0
Didn't answer/unclear/under discussion	4	50%

Some of the countries stated that for mobile networks to be capable of delivering linear video content to both fixed and mobile terminals the main challenges were:

- the need to ensure sufficient backhaul capacity;
- a need for eMBMS devices;
- the unsuitability of mobile networks to delivering linear video content to a mass audience at the same time; mobile networks were better suited to non-linear delivery;
- more spectrum needed in any case to support growing demand for mobile data services;
- new regulatory framework;
- large discrepancy between link budgets for fixed versus mobile networks.

Of those broadcasters who also suggested a complementary solution a number stated that mobile networks will not become a viable alternative to DTT, instead, the two platforms should be used in a complementary manner which would facilitate their evolution and enhance consumer experience. Furthermore, these respondents presented the following scenarios.

- For big screen, live and linear content, high quality and fixed reception, current DTT networks will remain and evolve to deliver enhanced services e.g. UHD, 3D, etc. Current DTT networks provide a near universal coverage and are optimized for this type of services. Delivery costs on DTT are low and independent of the number of concurrent users.
- For medium / small screen, linear and non-linear content, medium quality:
  - In the case of outdoor reception, a cooperative DTT-Mobile network arrangement would be the optimal approach.
  - In the case of indoor reception, where a vast majority (>80%) of media consumption takes place, innovative solutions such as WiFi offload, and femtocells are some of the possible solutions.
- For small screen, non-linear content, low quality and mobile reception, current mobile network topology seems the optimum infrastructure for low volumes.

v) Of a possible convergence between terrestrial mobile and (evolved) DTT platforms, what do you consider will be the consequences of mobile networks being capable of delivering linear video content to mobile terminals?

A majority of respondents considered it unlikely that mobile networks will evolve to deliver video content to mass audiences, primarily because of the increased demand for spectrum to support such a network capability, which many considered inefficient. Views expressed included:

- It would require a paradigm shift in both the technology and the regulatory framework
- IP based on demand services may increase
- That there may be reduced spectrum for DTT
- Increased competition
- New devices need to be developed
- Mobile network may need to be upgraded
- New business models may be required
- New content/advertising opportunities
- More choice to consumers
- More complex handset
- More spectrum demand
- Increased mobile TV use

Question 4:
i) How many DTT multiplexes do you expect will be needed in your country in the long-term (beyond 2020),

Countries expecting greater than 10 multiplexes required	4	12.1%
Countries expecting less than 10 multiplexes required	20	60.6%
Countries where number of multiplexes required still under discussion	7	21.2%
Countries offering no answer at this time	2	6.1%

In the countries who saw a requirement for more than 10 multiplexes, this included provision for regional/local based DTT services, with numbers ranging from 16 to 55 multiplexes (including national regional/local based DTT services). Of those countries expecting less than 10 national multiplexes the average was 6 national MUXs per country being required beyond 2020.

Of the eight industry groups/broadcasters who replied to this question, the number of multiplexes required ranged in value from 6 to 40.

ii) What services do you expect the DTT multiplexes to carry (assuming use of DVB-T2/HEVC)?

Administrations

SD	6	18.2%
HD	16	48.5%
UHD TV	21	63.2%
3D TV	14	42.4%
Interactive Services	7	21.2%
OTT/VoD	6	18.2%
Number of countries where this still under discussion	7	21.2%

Industry Groups/Broadcasters

SD	1	3%
HD	6	18.2%
UHD TV	7	21.2%
3D TV	5	15.2%
Interactive Services	3	9.1%

iii) What transition and migration paths do you anticipate will be required to achieve this long-term DTT goal for your country?

Administrations

Network migration from DVB-T to DVB-T2	17	51.5%
User equipment migration from DVB-T to DVBT2	14	42.4%
Number of countries where this still under discussion	13	39.4%

Industry Groups/Broadcasters

Network migration from DVB-T to DVB-T2	5	62.5%
User equipment migration from DVB-T to DVBT2	5	62.5%

Of those administrations, industry groups/broadcasters who offered an option about migration paths, some were of the view that cost would also be a factor which needed to be considered. Also, some administrations and industry groups/broadcasters were of the view that securing a frequency re-plan to release the 700 MHz would also be a factor in any migration path.

ANNEX 2

List of Questionnaire Respondents

(a) Administrations

Name of Administration	**EU Member State (Y/N)**
Austria	Y
Belgium	Y
Bulgaria	Y
Croatia	N
Cyprus	Y
Czech Republic	Y
Denmark	Y
Estonia	Y
Finland	Y
France	Y
Germany	Y
Greece	Y
Hungary	Y
Ireland	Y
Italy	Y
Latvia	Y
Liechtenstein	N
Lithuania	Y
Luxembourg	Y
Malta	Y
Montenegro	N
Netherlands	Y
Norway	N
Poland	Y
Portugal	Y
Serbia	N
Slovak Republic	Y
Slovenia	Y

Spain	Y
Sweden	Y
Switzerland	N
Turkey	N
United Kingdom	Y

(b) Industry Groups

Name of Industry Group/Broadcaster
Albertis Telecom
Association of European Radios (AER)
Broadcast Networks Europe (BNE)
European Broadcasters Union (EBU)
German Public Broadcasters (ARD-ZDF)
RAI
Media Broadcast GmbH Germany
TDF France
UK Multiplex Operators

ANNEX 3

GLOSSARY

ADSL	Asymmetric Digital Subscriber Line
CEPT	European Conference of Postal and Telecommunications Administrations
CPG	Conference Preparatory Group (of CEPT)
CCTV	Closed Circuit Television
DA2GC	Direct-Air-to-Ground Communications
DECT	Digital Enhanced Cordless Telecommunications
DTT	Digital Terrestrial Television
DTV	Digital Television
DVB-T	Digital Video Broadcasting — Terrestrial
DVB-T2	Digital Video Broadcasting – Second Generation Terrestrial
EC	European Commission
ECC	Electronic Communications Committee (of CEPT)
ECS	Electronic Communication Service
EESS	Earth Exploration Satellite Service
eMBMS	Multimedia Broadcast Multicast Services
ETSI	European Telecommunications Standards Institute
EU	European Union
EUMETCAST	European Organisation for the Exploitation of Meteorological Satellites
FCC	Federal Communications Commission
FSS	Fixed-Satellite Service
GDDN	Galileo Data Dissemination Network
GEONETCAST	Global Network of Satellite based Data Dissemination Systems
GMDSS	Global Maritime Distress and Safety System
GMES	Global Monitoring for Environment and Security
HD	High Definition (television)
HEVC	High Efficiency Video Coding
IGO	Inter-governmental Organisation
IMT	International Mobile Telecommunications
ITS	Intelligent Transport System
ITU-R	International Telecommunication Union Radiocommunication Sector
JTG 4-5-6-7	Joint Task Group 4-5-6-7 of the ITU-R
LRTC	Least Restrictive Technical Conditions
LSA	Licensed Shared Access
LTE	Long Term Evolution
MFCN	Mobile/Fixed Communication Networks
MFN	Multi-Frequency Network
NATO	North Atlantic Treaty Organization
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PB	Petabyte (10^{15} bytes)

PMSE	Programme Making and Special Events
PPDR	Public Protection and Disaster Relief
RLAN	Radio Local Area Network
RSPG	Radio Spectrum Policy Group
RSPP	Radio Spectrum Policy Programme
RTTT	Road Transport and Traffic Telematics
SAB	Services Ancillary to Broadcasting
SAP	Services Ancillary to Programme Making
SD	Standard Definition (television)
S-DAB	Satellite Digital Audio Broadcasting
SDL	Supplemental Downlink
SFN	Single Frequency Network
TB	Terabyte (10^{12} bytes)
T-DAB	Terrestrial Digital Audio Broadcasting
UHDTV	Ultra High Definition Television
UHF	Ultra High Frequency
UWB	Ultra- wideband
VHF	Very High Frequency
VTS	Vessel Traffic Service
WBB	Wireless Broadband
WG FM	Working Group Frequency Management (of CEPT)
WRC-15	World Radio Conference- 2015