CEPT ECC
Electronic Communications Committee

ECC Report 188

Future Harmonised Use of 1452-1492 MHz in CEPT

approved February 2013

0 EXECUTIVE SUMMARY

The 1452-1492 MHz band has remained unused in most European countries for the past decade. Since 2002, the 1452-1479.5 MHz sub-band has been harmonised for Terrestrial Digital Audio Broadcasting systems (T-DAB) through the Maastricht, 2002 Special Arrangement. The arrangement was later revised in Constanţa, in 2007 [1]. Since 2003, the 1479.5-1492 MHz sub-band has been harmonised for Satellite Digital Audio Broadcasting (S-DAB) through the ECC/ DEC/(03)02 [2]. The 1452-1492 MHz is indifferently referenced to, in Europe, as the L-band, 1.4 GHz or 1.5 GHz.

Late 2010, CEPT decided to undertake a review of the use of the L-band with the aim to change the current situation and enable the use of those 40 MHz of prime spectrum for new services and applications that could bring substantial social and economic benefits for Europe. In December 2010, the ECC launched a questionnaire to CEPT administrations and industry in order to identify the current and potential candidate applications. In May 2011, the ECC established a Project Team to determine, based on an impact analysis, the most appropriate future use(s) of the 1452-1492 MHz band in CEPT.

In order to conduct the impact analysis, a number of criteria have been defined, namely 1) compatibility with the current regulatory framework, 2) possibility to share with other applications/uses, 3) extent (maximisation) of social and economic benefits, 4) timeframe for availability of equipment on a large scale and for application deployment - status of standardisation and 5) Potential for economy of scale (need and potential for harmonisation within and outside CEPT).

The candidate applications considered for the future use of the band were 1) Terrestrial Broadcasting, 2) Mobile Broadband, 3) Mobile Supplemental Downlink, 4) Satellite Digital Audio Broadcasting, 5) Program Making and Special Events, 6) Broadband Public Protection Disaster Relief for temporary and local use and 7) Broadband Direct Air to Ground Communication. The spectrum requirement of each candidate application has been determined.

An analysis of the candidate applications against the defined criteria was carried out. The regulatory options required for the deployment of the candidate applications have been defined. Three regulatory options were then retained for further analysis. A detailed methodology to conduct the impact analysis was developed and the impact analysis was conducted.

The conclusion is that the most appropriate regulatory framework for the future use of the 1452-1492 MHz band in CEPT is the harmonisation of this band for mobile broadband / mobile supplemental downlink[1], 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 will bring the highest benefits for CEPT, with those benefits being maximised when mobile supplemental downlink is deployed under this framework.

The implementation of this regulatory framework would consist of the following:

- The ECC will adopt an ECC Decision designating the band for Mobile/Fixed Communication Networks (MFCN) supplemental downlink and defining the Least Restrictive Technical Conditions with a harmonised band plan for the 1452-1492 MHz band, based on 8 blocks of 5 MHz with associated generic BEM and restricted BEM (for coexistence between uplink and downlink blocks).
- The ECC/DEC/(03)02 [2], which currently harmonises the sub-band 1479.5-1492 MHz for Satellite Digital Audio Broadcasting within CEPT, will be suppressed.

[1] Mobile Supplemental Downlink (Mobile SDL) is a feature within a mobile broadband system, which by means of base station transmitters in the network, is able to use unpaired spectrum to provide a supplemental downlink capacity to carry efficiently comprehensive text, voice, images, sound and video content in unicasting, multicasting and/or broadcasting mode to mobile devices. Mobile SDL uses a wider channel for the downlink than for the uplink, by bonding the usual downlink of the paired (FDD) mobile bands with a supplemental downlink channel(s).

- An administration wishing to implement terrestrial digital sound broadcasting networks in part of the 1452-1492 MHz may choose to do so using the MA02revCO07 Arrangement and its possible Plan modifications [1].
- The MA02revCO07 Agreement will be retained for cross-border coordination bilateral agreements in the sub-band 1452-1479.5 MHz, between Terrestrial Broadcasting (for countries wishing to deploy terrestrial broadcasting in part of the band) and mobile services similar to the framework developed by CEPT for the 800 MHz band with GE06 and ECC/DEC [3].
- CEPT should consider proposing an agenda item at the next WRC to introduce pfd limits to be included in Article 21 of the RR [4]. The objective is to protect MFCN use within CEPT from harmful interference from satellite use outside CEPT[2];
- Mobile to mobile cross-border coordination in the band 1452-1492 MHz will be subject to an ECC Recommendation for bilateral agreements as for other mobile to mobile cross-border coordination in other bands.

[2] In the meantime, Administrations will have the possibility to register terrestrial stations of the SDL mobile service in the MIFR in order to ensure protection of MFCN from satellite interference through the ITU coordination procedure.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
BDA2GC	Broadband Direct-Air-to-Ground Communications
BEM	Block Edge Mask
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications Administrations
DAB	Digital Audio Broadcasting
DL	Down-Link
DVB	Digital Video Broadcasting
ECC	Electronic Communications Committee
ECN	Electronic Communications Networks
EU	European Union
FDD	Frequency Division Duplex
HSPA	High Speed Packet Access
ITU-R	International Telecommunication Union Radiocommunications
LTE	Long Term Evolution
LRTC	Least restrictive technical conditions
MA02revCO07	Maastricht, 2002, Special Arrangement, as revised in Constanţa, 2007
BPPDR	Broadband Public Protection and Disaster Relief
PMSE	Programme Making and Special Events
QoS	Quality of Service
S-DAB	Satellite Digital Audio Broadcasting
SDL	Supplemental Downlink
SDR	Satellite Digital Radio
T-DAB	Terrestrial Digital Audio Broadcasting
TDD	Time Division Duplex
UL	Up-Link
UMTS	Universal Mobile Telecommunications System

1 INTRODUCTION

This Report identifies and describes the most appropriate future harmonised use(s) of the band 1452-1492 MHz, also called L-band, 1.4 GHz or 1.5 GHz in CEPT.

Since 2002, the 1452-1479.5 MHz sub-band has been harmonised in CEPT for Terrestrial Audio Broadcasting systems through the Maastricht, 2002, Special Arrangement. The arrangement was later revised in Constanţa, in 2007 [1], to introduce additional flexibility in order to allow the deployment of terrestrial mobile multimedia systems on a national basis. In addition, the 1479.5-1492 MHz sub-band has been harmonised for satellite audio broadcasting (S-DAB) since 2003 through the ECC Decision (03)02 [2]. However, despite those harmonisation measures, the 1452-1492 MHz band has remained mostly unused for the past decade.

In late 2010, administrations and industry within CEPT have expressed interest in reviewing the utilisation of the band in order to ensure an efficient use of those 40 MHz of prime spectrum in Europe and to provide a considerable opportunity for the development of new applications. The ECC launched in December 2010 a questionnaire to determine the candidate applications for the future use of the band and in May 2011, a new Project Team was established to determine which future use of the 1452-1492 MHz band would be the most appropriate for CEPT, with the support of an impact analysis.

Section 2 of this ECC Report contains a description of the current regulatory framework for the band 1452-1492 MHz in CEPT and globally, as well as the current status and level of use of this band inside and outside CEPT.

In Section 3 the criteria for the impact analysis, are defined, namely 1) compatibility with the regulatory framework, 2) possibility to share with other applications/uses, 3) extent (maximisation) of social and economic benefits, 4) timeframe for availability of equipment on a large scale and for application deployment and 5) potential for harmonisation within and outside CEPT.

Section 4 provides descriptions of the candidate applications including their spectrum requirements namely:

1. Terrestrial Broadcasting;
2. Mobile Broadband;
3. Mobile Supplemental Downlink;
4. Satellite Digital Audio Broadcasting;
5. Program Making and Special Events;
6. Broadband Public Protection Disaster Relief for temporary and local use;
7. Broadband Direct Air to Ground Communications.

In Section 5, the candidate applications are assessed against the criteria.

Section 6 identifies and describes three regulatory options for harmonised implementations of candidate applications.

In Section 7 the regulatory options are assessed, graded and ranked by using an analysis methodology developed for the purpose of this work, taking into account the results of the analysis conducted in Section 5.

In the Conclusion the most appropriate regulatory framework for the harmonization of the band 1452-1492 MHz is provided.

This Report also includes a number of Annexes which cover in particular the current CEPT regulations and the ITU Radio Regulations applicable for the band 1452-1492 MHz, the status of this band in various countries inside and outside CEPT and detailed descriptions of the various technology standards for the candidate applications.

2 DESCRIPTION OF THE CONTEXT OF THE STUDY

2.1 REGULATION WITHIN CEPT

The ITU Radio Regulations allocate the band 1452-1492 MHz in Region 1 to the Fixed, Mobile (except aeronautical mobile), Broadcasting and Broadcasting Satellite Service on a co-primary basis. Several footnotes apply to the band. The details for this band extracted from Article 5 of the ITU Radio Regulations (including Region 2 and Region 3) are given in ANNEX 1.

According to footnote No. 5.342 the band 1 429-1 535 MHz is also allocated to the aeronautical mobile service on a primary basis exclusively for the purposes of aeronautical telemetry within the national territory in some CEPT countries.

According to footnote No. 5.345 the use of the band 1452-1492 MHz by both the broadcasting satellite service and the broadcasting service is limited to digital audio broadcasting. The band is subject to the provisions of Resolution 528 (Rev WRC-03) [4][2].

In CEPT, the Maastricht, 2002, Special Arrangement, as revised in Constanţa, in 2007 provides the technical and regulatory framework in order to facilitate the introduction of terrestrial mobile multimedia services (in addition to T-DAB) in the frequency band 1452 - 1479.5 MHz, Annex 1 to MA02revCO07 provides the Plan as agreed in 2007. The Plan can be modified in order to include new allotments using the procedures given in the MA02revCO07. In particular, MA02revCO07 [1] allows the implementation of mobile multimedia services through the envelop concept and the aggregation of blocks. These concepts were described in CEPT Report 18 [5] in response to the Mandate on EU harmonisation of the band 1452-1479.5 MHz (lower part of L-band) to allow flexible use by mobile multimedia technologies. Flexible spectrum usage may be subject to international coordination according to the provisions of MA02revCO07[1] (further details are provided in ANNEX 2:).

The ECC/DEC/(03)02 [2] designates the frequency band 1479.5-1492 MHz for use by satellite DAB systems. This Decision shall be reviewed inter alia on the basis of market demand at least every 10 years according to Decides 2 of ECC/DEC/(03)02 [2]. However, according to the ECC Rules of Procedure (art. 12.4.1), each Decision shall be reviewed on a regular basis, but not later than every five years.

2.2 DESCRIPTION OF THE CURRENT USE WITHIN CEPT

Sections 2.2.1and 2.2.2 provide general information about the use of the band 1452-1492 MHz in CEPT. ANNEX 3: provides additional details about the use of the band 1452-1492 MHz in some CEPT countries.

2.2.1 T-DAB and S-DAB

In most CEPT countries, the 1452-1492 MHz band is currently identified for the use by terrestrial and satellite digital audio broadcasting (T-DAB and S-DAB) applications.

Relating to T-DAB, most CEPT countries have one to three nation-wide T-DAB allotment coverages in the Plan with a bandwidth of 1.7 MHz (only a few countries currently possess in total three layers of Plan entries).

Relating to S-DAB, a review undertaken in July 2011 of the ITU-R database of satellite filings covering Europe showed that 7 CEPT administrations have 53 active requests for coordination which include the band 1479.5-1492 MHz over the arc 15°W to 55°E. Three of these have been notified. To date, none has been brought into use and resulted in the submission of Resolution 49 information.

None of the T-DAB and S-DAB usages have actually grown in the band to date as it has been shown by the Radio Spectrum Policy Group survey and Report on the future of digital audio broadcasting [6].

2.2.2 Other uses

There are some other systems in operation in few countries. In nine countries, the band is currently used by applications operated in services different from audio broadcasting: Fixed Service (6 countries), Mobile Service (3 countries), Ground and Wall probing Radar (1 country), Radio Astronomy (1 country), Aeronautical Mobile Service (aeronautical telemetry) (1 country). These uses are generally limited to sub-parts only of the 1452-1492 MHz band. Some of the countries indicated in their response to the ECC survey[3] carried out in December 2010 – January 2011 on the future use of the 1452-1492 MHz band that those mentioned different uses will continue until an already fixed date (1 country) or once digital radio will be implemented (2 countries) or until the band is used by multimedia services (1 country). One other country indicated that it had licensed the whole 1452-1492 MHz band for terrestrial applications under technology neutral technical conditions of usage (see ANNEX 3:).

2.3 CURRENT REGULATIONS AND USE OUTSIDE CEPT

Many countries are aligned with CEPT by allocating the 1452-1492 MHz band to digital audio broadcasting services. There are currently limited operational terrestrial digital audio broadcasting services. There are 2 satellites in operation in the 1452-1492 MHz band.

ANNEX 4: provides an overview of the use/regulations of the band 1452 – 1492 MHz in a number of countries outside from CEPT.

3 CRITERIA OF IMPACT ANALYSIS

- Compatibility with the current regulatory framework;
- Possibility to share with other applications/uses;
- Extent (maximisation) of social and economic benefits;
- Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation;
- Potential for economy of scale (need and potential for harmonisation within and outside CEPT).

The reference documents for this analysis are ECC Report 125 [7] and the internal ECC Report on Management of Impact Assessments in the ECC structure (Annex 13 to the Minutes of the 22nd ECC meeting, Vienna, 9th - 13th March 2009).

3.1 CRITERION 1: COMPATIBILITY WITH THE CURRENT REGULATORY FRAMEWORK

To evaluate if the application(s) under study is(are) compatible:

- with the Radio Regulations;
- with MA02revCO07 within 1452-1479.5 MHz [1];
- with ECC DEC(03)02 within 1479.5-1492 MHz [2].

3.2 CRITERION 2: POSSIBILITY TO SHARE WITH OTHER APPLICATIONS/USES

For each application it should be evaluated whether sharing with other applications is possible, based on the requirements, including spectrum requirements, of the relevant applications. If sharing is possible, the type of sharing should be indicated including whether through national flexibility or at CEPT level.

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[3] See FM(11)038 Rev2. http://www.ero.dk/764D6AAF-6354-49CD-B981-FA4B46AF493E.W5Doc?frames=no&frames=0

There are different ways for applications to share spectrum. Recommendation ITU-R SM.1132-2 [8] gives guidelines on the different possible dimensions of sharing:

- Frequency separation;
- Spatial separation;
- Time separation;
- Signal separation.

This ITU-R Recommendation [8] gives an extensive (non-exhaustive) list of detailed sharing possibilities, including channelling plans, band segmentation and geographical separation.

3.3 CRITERION 3: EXTENT (MAXIMISATION) OF SOCIAL AND ECONOMIC BENEFITS

The expected social (including public policy objectives) and economic benefits should be evaluated. This should be based on quantitative data where relevant. Where quantitative data is not available, a qualitative analysis of expected benefits and costs can be provided.

3.4 CRITERION 4: TIMEFRAME FOR AVAILABILITY OF EQUIPMENT ON A LARGE SCALE AND FOR APPLICATION DEPLOYMENT - STATUS OF STANDARDISATION

The timeframe of the availability of equipment on a large scale should be assessed. The status of standardisation, either existing, in preparation or planned should be assessed.

The timeline for application deployment and use should be assessed.

3.5 CRITERION 5: POTENTIAL FOR ECONOMY OF SCALE (NEED AND POTENTIAL FOR HARMONISATION WITHIN AND OUTSIDE CEPT)

For each application the size of the market shall be estimated taking into account the potential for CEPT wide or global harmonisation. The required level of harmonisation within and outside CEPT for each application should also be taken into account.

4 DESCRIPTION OF THE CANDIDATE APPLICATIONS, INCLUDING SPECTRUM NEEDS

The following candidate applications are considered:

1. Terrestrial broadcasting;
2. Mobile broadband;
3. Mobile Supplemental Down-Link (Mobile SDL);
4. Satellite Digital Audio Broadcasting (S-DAB);
5. Programme Making and Special Events (PMSE);
6. Broadband Public Protection and Disaster Relief (BPPDR) for temporary and local use;
7. Broadband Direct-Air-to-Ground Communications (BDA2GC).

4.1 APPLICATION ONE: TERRESTRIAL BROADCASTING

4.1.1 Description

Terrestrial broadcasting is a digital terrestrial system for distribution of audio and video content in a one-to-many mode to fixed, portable, handheld and mobile receivers. In many countries terrestrial broadcasting is one of the principal means for access to radio and TV services by the general public.

The main features of terrestrial radio and TV services are:

- Universal availability
  - coverage often exceeds 98% of the population;
  - delivery to secondary receivers;
  - support for services for people with disabilities.

- High QoS
  - predictable and consistent across the whole service area;
  - independent of the number of simultaneous viewers and listeners;
  - control over QoS.

- Efficiency
  - technically and cost efficient delivery to large audiences.

- Flexibility
  - possible delivery to fixed, portable and mobile reception conditions;
  - support to free-to-air reception or conditional access, or both;
  - supports public service as well as commercial broadcasting models;
  - coverage adapted to the service requirements (national, regional or local).

- Mass market platform
  - widely supported by manufacturers, network operators, broadcasters, regulators and the public.

- Competition
  - promotes competition even in those markets that are dominated by other delivery platforms.

Terrestrial broadcasting networks can be implemented by means of different systems, in particular the DAB and DVB families of standards and SDR, as indicated in Table 1: below:

Table 1: Examples of terrestrial broadcasting systems (see also ANNEX 5:)

System	Required block/channel bandwidth	Related standards, specifications and reports
T-DAB	1.7 MHz	ETSI – EN 300 401 ETSI – TR 101 496-3
T-DMB	1.7 MHz	ETSI – EN 300 401 ETSI – TS 102 428
DAB-IP	1.7 MHz	ETSI – EN 300 401 ETSI - ES 201 735
SDR (terrestrial deployment)	1.7 MHz	ETSI - TR 102 525 ETSI - TS 302 550 ETSI - TS 302 551-1 ETSI - TS 302 551-2
DVB-H	5, 6, 7 or 8 MHz	ETSI – TR 102 377
DVB-T2 (Base & Lite) DVB- NGH	1.7, 5, 6, 7, 8 and 10 MHz	ETSI – EN 302 755 ETSI – EN 303 105
DVB-SH (terrestrial component)	1.7, 5, 6, 7, 8 and 10 MHz	ETSI – EN 302 583 ETSI – TS 102 594

4.1.2 Justification

Demand for terrestrial broadcasting services both radio and TV is growing in most countries in CEPT. It is reflected in a growing number of radio and TV channels that have come on-air in the recent years[4] and in a growing viewing and listening time. In addition to national and international services there is an increasing demand for local broadcasting, in particular for local radio programmes.

While the FM radio is still the most popular radio platform, the capacity limits of band II have been reached in many countries and this constrains further developments. Digital radio has been introduced in a number of countries in the frequency band 174-240 MHz. However, this band may not be available in all countries and/or may not be sufficient to satisfy the future requirements, in particular for local radio services. This is why the L-band is important for the future development of digital radio in some countries.

The L-band will also facilitate the delivery of advanced multimedia services which are provided to the consumers in addition to the traditional radio and TV programmes.

Furthermore, there is a growing market demand for non-linear broadcasting services, both audio and video (e.g. time-shifted, personalised, on-demand, interactive and second screen services). L-Band is well suited for the provision of such non-linear services, in particular if terrestrial broadcasting is combined with wireless broadband technologies.

Joint initiatives between broadcasting and mobile industries are emerging that would enable further convergence in order to enable the full range of broadcasting and multimedia services in the future. The L-band offers an opportunity for implementation of such innovative approaches.

Finally, demand has been expressed for the deployment of the subscription-based radio services in the L-band on the basis of the above mentioned SDR specification. Implementation in Europe would require taking into account the variety of languages, cultural specificities and different coverage that compose the European countries. In this respect, the L band is adequate (see also sections 5.1.1 and 5.4.1) to anchor the deployment of national, independent subscription radio services. For instance, the existing regulation offers an option for any country to deploy subscription services according to individual needs, if and when required. This, in turn, would provide scope for further economies of scale through a harmonised use in Europe and for convergence with other services (notably with free-to-air radio).

It should be noted that broadcasting services in L-band have already been implemented in some European countries (see section 2.2.1 and ANNEX 3:).

4.1.3 Spectrum requirements

The spectrum requirement for terrestrial broadcasting applications is the frequency band 1452-1479.5 MHz which allows terrestrial broadcasting to be implemented in those countries where market demand exists.

4.2 APPLICATION TWO: MOBILE BROADBAND

4.2.1 Description

Mobile broadband is a terrestrial radio communication system that, by means of connected base stations and mobile station devices, is able of communicating in mobile situations in one or two directions providing various services and applications to end users, including mobile internet, e-entertainment, e-education, e-health and e-learning.

The trend in consumer devices with smartphones, tablets and dongles has changed the user behaviour in such a way that the traffic is becoming more IP based and asymmetric in terms of

[4] See for example: www.obs.coe.int/about/oea/pr/mavise_juin2011.html

download and upload ratio. Users download more data than they upload. Current spectrum allocations are usually symmetrical for the mobile broadband platform.

Mobile broadband applications could be provided by either FDD (frequency division duplex) with in-band or out-band pairing or TDD (time division duplex) systems. In case of FDD systems the maximum of 40 MHz potentially available in the L-band is considered not to be sufficient for a viable eco-system for in-band pairing.

Some examples of mobile broadband systems and their required bandwidths are provided in the table below. Which technology route to take will depend on a variety of factors depending on the operator, the availability of alternative spectrum, geography, demography and local conditions.

Table 2: Examples of mobile broadband standards (see also ANNEX 6:)

Standard	Required block/channel bandwidth	Related specifications
UMTS/HSPA+	5, 10 MHz (in-band carrier aggregation)	3GPP Release 6 to 8
LTE	5, 10, 15 and 20 MHz	3GPP Release 8 and 9
UMTS/HSPA+	5,10, 15, 20 MHz (carrier aggregation across bands)	3GPP Release 9, 10 and beyond
LTE-Advanced	1.4, 3, 5, 10 and 20 MHz (and higher values up to 100 MHz by carrier aggregation across bands)	3GPP Release 10 and beyond
WiMAX	5, 10 MHz	IEEE 802.16-2004 IEEE 802.16e-2005
CDMA revB	1.25, 5, 10, 15, 20 MHz (by carrier aggregation, up to 15 carriers)	3GPP2 C.S0024-B TIA/EIA/IS-856-B. Rev. B

4.2.2 Justification

Within few years, data services are expected to be accessed more often from smartphones than from desktop computers for the provision of a variety of bandwidth-intensive services (banking, shopping, multimedia content, education, social media, e-health). As a result, data traffic over mobile networks is expected to grow considerably in the coming years[5]. Spectrum availability for mobile broadband will therefore be key in order to cope with the consumers demand by expanding the network capacity and coverage.

The need for additional spectrum for mobile broadband is recognised at European level by both RSPG and CEPT[6].

The L-band is within the working range of the current cellular networks used by the mobile broadband systems which could have a positive impact on the equipment design and cost. The propagation characteristics of the band make it a good complement to frequency bands already available.

4.2.3 Spectrum requirements

Broadband mobile data services are currently deployed over 5 MHz and 10 MHz wide channels with UMTS/HSPA+ and over 10, 15 and 20 MHz wide channels with LTE. The market request for increased network download speed has led to the current deployment of systems operating over

[5] See Report ITU-R M.2243 [9].
[6] See Document RSCom 12-06 Spectrum assignments in EU-27 as of 1 January 2012 – an overview [10].

larger bandwidths (10 MHz, 20 MHz, 40 MHz, etc.) through the introduction of multi-carrier and multi-band aggregation. In this context, bandwidths lower than 5 MHz is not appropriate for significant improvement of speeds and user experience while bandwidths of 5, 10 MHz and more would appropriately complement carriers in other frequency bands. The attractiveness of 1452-1492 MHz band deployment for an operator is linked to the possibility of deploying a network for at least 10 MHz (TDD or in one direction in case of FDD) of capacity to make network investments justifiable.

The success of a frequency bands depends on the emergence of an eco-system, i.e. on a significant terminal market supporting the band. Such a market usually occurs when a band is harmonised on a large basis and when most operators have deployed networks in a band. At the opposite, if only one operator is using a specific technology/frequency band in a country, it would struggle to produce equipment. There are typically 3 or 4 Mobile Network Operators in European countries.

The band 1452-1492 MHz would be offering 40 MHz to augment the capacity of mobile broadband networks which is regarded to be a minimum amount of spectrum required, in particular assuming 3-4 operators within the band.

4.3 APPLICATION THREE: MOBILE SUPPLEMENTAL DOWNLINK

4.3.1 Description

Mobile Supplemental Downlink (Mobile SDL) is a feature within a mobile broadband system, which by means of base station transmitters in the network, is able to use unpaired spectrum to provide a supplemental downlink capacity to carry efficiently comprehensive text, voice, images, sound and video content in unicasting, multicasting and/or broadcasting mode to mobile devices.

Convergence is often referred to as a key technological evolution in the digital society, and the practical application is now materializing with the convergence of mobile broadband, fixed and broadcasting service offerings. The driving factor seems to be the requirement for rich multimedia and internet content carried to and from mobile devices. Multimedia content is consumed in various forms such as real time broadcast content, high definition audio/video streaming, podcasts, file casts, on-line gaming, social networking and apps downloading and is provided by a multitude of players under several different business models.

The data based traffic over mobile broadband networks is predicted to increase rapidly over the coming years driven by mobile multimedia usage with a particular evolution towards asymmetrical traffic and therefore an increasing demand for downlink capacity.

3G/4G mobile technologies have already evolved to support traffic asymmetry and the efficient delivery of mobile multimedia services (UMTS/HSPA 3GPP specification Release 9 and beyond, LTE-Advanced 3GPP specification Release 10 and beyond) with Mobile SDL using multi-bands and multi-carriers aggregation capabilities. As highlighted in Table 3:, UMTS/HSPA supports from 5 MHz to 40 MHz channel bandwidth aggregation and LTE-Advanced supports from 5 MHz to 100 MHz channel bandwidth aggregation in the downlink in multiple bands including the L-band.

LTE (3GPP specification Release 9 and beyond) also includes evolved Multimedia Broadcast and Multicast Services capabilities (eMBMS) which would enable to deliver rich mobile multimedia content to users using SDL spectrum in a flexible manner. It allows the mobile broadband network to switch dynamically from a unicasting to a broadcasting mode on a cell basis to very efficiently address users demand for live or on-demand content and other multimedia services.

Table 3: Mobile broadband standards supporting Mobile SDL (see also Annex 6)

Standard	Aggregated downlink Bandwidth	Related specifications
UMTS/HSPA+	Up to 40 MHz(using carrier aggregation across bands)	3GPP Release 9 and beyond
LTE-Advanced	Up to 100 MHz (using carrier aggregation across bands)	3GPP Release 10 and beyond
LTE eMBMS	Up to 20 MHz	3GPP Release 9 and beyond

A mobile broadband network implementing a Mobile SDL uses a wider channel for the downlink than for the uplink, by bonding the usual downlink of the paired mobile bands (800 MHz, 900 MHz, 1.8 GHz, 2.0 GHz, 2.6 GHz) with a supplemental downlink channel(s) as shown in Figure 1:.

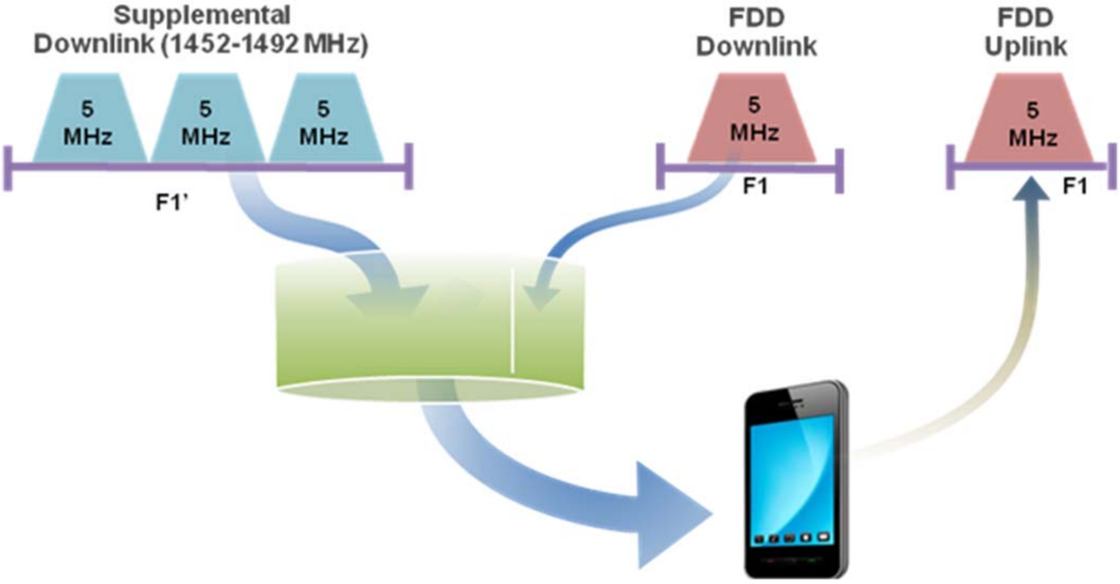

Figure 1: A Mobile Supplemental Downlink

4.3.2 Justification

The convergence of several service offerings (internet, broadcasting, and other multimedia based service offerings) on mobile devices, such as smartphones and tablets, is leading to an ever growing asymmetry of the overall mobile data traffic. Measurements in today's mobile networks clearly confirm the asymmetrical nature of the data traffic with consumers downloading considerably more than they upload data and multimedia content. The current usages of data services on smartphones will be more common than on desktop computers within few years. Smartphones and tablets, as well as laptops using dongles will drive usage of video and hence lead to considerable growth of the mobile data traffic.

A high proportion of this data traffic is already mobile multimedia. Moreover, multimedia is expected to account for a rising proportion of traffic in future. The downlink to uplink ratios seem likely to widen towards 10:1 in high-traffic areas, as the proportion of video traffic in networks grows. The use of the 1452-1492 MHz for Mobile SDL provides additional downlink capacity next to the bands used for mobile applications up to now, enables higher user data rates and supports a greater number of users, all of which will enhance the user experience and increase consumers demand for capacity (see ANNEX 6:).

The L-band is within the operational range of the current cellular spectrum used by mobile broadband systems and its implementation will have a marginal[7] impact on the equipment (base stations, chipsets, devices) design and cost. In addition, the L-band offers favourable propagation properties for coverage allowing consumers in urban, suburban as well as rural areas to cost efficiently access enhanced mobile services.

4.3.3 Spectrum requirements

Users in mobile networks are demanding increasingly higher peak data rates and enhanced quality of service. Operators are deploying next generation networks supporting larger bandwidth, typically 10 MHz, 15 MHz, 20 MHz, etc., to cope with these demands. In this context, and in order to support the requirement for significant increase of data speeds and user experience, access to bandwidths of 10 MHz, 15 MHz or 20 MHz etc. in the band 1452-1492 MHz is therefore required to appropriately supplement related deployments in other mobile bands from several mobile operators. In addition, interest of the band 1452-1492 MHz for Mobile SDL use by operators is linked to the opportunity of having access to a frequency block of at least 10 MHz for SDL deployments to make network investments justifiable. Notably, a one frequency block of 5 MHz per operator would not be sufficient to support advanced services such as higher definition video based multimedia content.

Furthermore, the success of a frequency band arrangement depends on the emergence of an eco-system with high equipment market penetration, including both base stations and devices, supporting usages in this band. This requires that the band is harmonised (in order to ensure its availability in a sufficient number of countries) and large enough (in order to accommodate multiple operators, which would through competition trigger growing demands). On the contrary, if the band is not harmonized in its entirety (less than 40 MHz) and only one operator would be able to use the band in a country, then such operator would struggle to find mass market cost efficient equipment. Therefore, the full 40 MHz in the band 1452-1492 MHz will accommodate multiple operators and therefore drive economy scale to the benefits of consumers.

Taking into account the need of at least 10 MHz per operator (see above) in a competition environment with several operators able to access the L-band and the requirement for economies of scale, in large bandwidth devices and infrastructure, a harmonised channelling arrangement for Mobile SDL across the whole band 1452-1492 MHz is deemed essential. Such a channelling arrangement should be designed for eight frequency blocks of 5 MHz each as usual for mobile bands (with the possibility to aggregate at least two adjacent blocks), subject to LRTC while enabling terrestrial UMTS/LTE SDL deployment i.e. base station to devices communication direction. A firm decision will convey a clear signal to the mobile broadband and broadcasting content industries on the availability of a sufficient harmonised capacity (40 MHz) for economically sustainable business cases in the L-band, still leaving the choice to administrations to potentially accommodate in part of the band any specific national need for other applications.

4.4 APPLICATION FOUR: SATELLITE DIGITAL AUDIO BROADCASTING (S-DAB)

4.4.1 Description

Satellite broadcasting is one of the principal means for access to thousands of radio and TV services by the general public in many countries across the globe. Satellites play a major role in ensuring complete coverage. In those cases, such offer complements the basic terrestrial offer, which may not be available everywhere. Alternatively, satellite can also offer new channels that are not available on terrestrial-only networks. As demonstrated by the digitisation of TV services, digital satellite can play an important role enabling the deployment of new digital technologies and services.

Where satellites are used in combination with complementary terrestrial networks, a “hybrid” system is created. Such a hybrid system consists of the satellite component and its associated terrestrial component(s). The complementary terrestrial networks can be used for the retransmission of content also available on the satellite (for instance to improve the reception quality in areas without line of

[7] See the study on the economic benefits of an SDL in 1452-1492 MHz (http://www.plumconsulting.co.uk/pdfs/Plum_June2011_Benefits_of_1.4GHz_spectrum_for_multimedia_services.pdf [11]

sight to the satellite, especially important in a mobile environment) and/or to provide access to additional content (e.g, local or on-demand content).

Satellite Digital Audio Broadcasting (S-DAB) is a satellite-enabled system for the digital broadcasting of a wide variety of audio content to fixed and mobile receivers (including portable, handheld and vehicular). S-DAB systems are expected to transport a mix of “subscription-based” and “free-to-air” services. Free-to-air services may be public services or commercial services for a large audience. A basic encryption could still be employed also in the case of free-to-air services in order to ensure copyright protection.

Three main modes of S-DAB operation can be distinguished:

- As a standalone satellite component (i.e, without complementary terrestrial component);
- As the satellite component of a hybrid solution with complementary terrestrial broadcasting networks operating in the spectrum used by the satellite across CEPT;
- As a standalone satellite component, complementing nationally licensed terrestrial broadcast networks.

The specific mode of operation (and content) may vary from country to country, depending on national regulations and the competitive situation. A hybrid service using the second mode of operation (operating in the 2.3 GHz band) has accumulated a significant number of subscribers in North America. A large proportion of new cars sold in North America are equipped with a satellite radio enabled receiver.

The main features of S-DAB services are:

- Universal availability
  - coverage up to 100% of the territory under line-of-sight conditions;
  - support for services for people with disabilities, where required.

- High QoS
  - predictable and consistent across the whole service area;
  - independent of the number of simultaneous viewers and listeners;
  - control over QoS.

- Efficiency
  - spectrally, technically and cost efficient delivery to large audiences.

- Flexibility
  - possible delivery to fixed, portable and mobile reception conditions;
  - support for free-to-air reception or conditional access, or both;
  - supports public service as well as commercial broadcasting models;
  - access adapted to the service requirements (international, national and regional).

- Mass-market platform
  - widely supported by manufacturers, satellite network operators, broadcasters and regulators.

- Competition
  - promotes competition even in those markets that are dominated by other delivery platforms.

S-DAB networks can be implemented by means of different technologies, in particular the DVB-SH and SDR standards families, as indicated in the table 4 below:

Table 4: Examples of satellite broadcasting technologies (see also ANNEX 5:)

Technology	Supported block/channel bandwidth	Related standards, specifications and reports
SDR	1.7-12.5 MHz	ETSI - TR 102 525 ETSI - TR 102 604 ETSI - TS 302 550-1-1 ETSI - TS 302 550-1-2 ETSI - TS 302 550-1-3
DVB-SH	1.7, 5, 6, 7 and 8 MHz	ETSI – EN 302 583 ETSI – TS 102 594 ETSI – TR 102 377

4.4.2 Justification

With demand for digital audio broadcasting services growing in some countries in CEPT, satellites can play a role in extending coverage and population reach of existing and new audio content. S-DAB could thus provide digital audio broadcasting solutions not only in countries where L-Band is important because of lack of alternative spectrum, but also as an enabler of new and innovative audio content offers.

Some demand has been expressed for the deployment of feature-rich free-to-air and subscription-based radio services. Implementation in Europe would require taking into account the variety of languages, cultural specificities and different coverage that compose the European countries. In this respect, the L-band is adequate to complement the deployment of national, independent subscription radio services. For instance, the existing regulation offers an option for any country to deploy subscription services according to individual needs, if and when required. This, in turn, would provide scope for further economies of scale through a harmonised use in Europe and for integration with other services (notably with free-to-air radio).

Furthermore, there is a growing market demand for non-linear broadcasting services (e.g. time-shifted, personalised, on-demand, interactive and second screen services). L-Band is well suited for the provision of such non-linear services. The L-band offers an opportunity for implementation of such innovative approaches.

The success of a frequency band depends on the emergence of an eco-system, i.e. on a significant terminal market supporting the band. Such a market usually occurs when a band is harmonised on a large basis and when sufficient operators and service providers have deployed networks and are offering affordable and attractive content and services in a band. At the opposite, if only few operators are using a specific technology or frequency band within CEPT, they may struggle to get affordable access to equipment.

SDR chipsets for the L-Band are already available, which could have a positive impact on the equipment design for S-DAB.

Furthermore, the propagation characteristics of the L-band are favourable for S-DAB.

4.4.3 Spectrum requirements

The spectrum requirements are primarily determined by the number of audio channels that are needed to create attractive content packages for different markets. Operations in the US, as well as comparable pay-TV benchmarks indicate that a minimum of about 50 - 60 channels are required per key national market in order to create a sufficiently diverse package. Taking into account different markets in Europe, the restrictions imposed by Resolution 528 (Rev.WRC-03) [4] with respect to S-

DAB in the band 1452-1492 MHz (effectively limiting S-DAB to the upper 25 MHz anywhere in the world, which would impact satellite transmissions in the direction of non-CEPT countries), and the ability to respond in a flexible manner to spectrum uses across CEPT, a harmonised channelling arrangement enabling S-DAB across the upper 25 MHz of the band 1452-1492 MHz is deemed essential. Technologies to be used for S-DAB are flexible enough to cope with existing or new harmonised band plans. The L-Band is the only frequency band below 3 GHz allocated to the broadcasting satellite service.

4.5 APPLICATION FIVE: PROGRAMME MAKING AND SPECIAL EVENTS (PMSE)

4.5.1 Description

The term Programme Making[8] and Special Events[9] applications (PMSE) is a widespread term gathering various radio applications used for SAP/SAB, ENG, SNG, OB in public or private events for perceived real-time presentation of audio visual information. The communication links are also used in the production of programmes, such as talk-back or personal monitoring of sound-track.

The definitions of SAP/SAB and ENG/OB are set out[10] as follows:

SAP: Services Ancillary to Program making (SAP) support the activities carried out in the making of "program", such as film making, advertisements, corporate videos, concerts, theatre and similar activities not initially meant for broadcasting to general public.

SAB: Services Ancillary to Broadcasting (SAB) support the activities of broadcasting industry carried out in the production of their program material.

ENG: Electronic News Gathering (ENG) is the collection of video and/or sound material by means of small, often hand-held wireless cameras and/or microphones with radio links to the news room and/or to the portable tape or other recorders.

SNG: Satellite News Gathering (SNG) is applications similar to ENG using satellite radio communication channels.

OB: Outside broadcasting (OB) is the temporary provision of programme making facilities at the location of on-going news, sport or other events, lasting from a few hours to several weeks. Mobile and/or portable radio links are required for wireless cameras or microphones at the OB location. Additionally, radio links may be required for temporary point to point connections between the OB vehicle, additional locations around it, and the studio.

Table 5: Technical terms of audio transmission systems that are part of PMSE

Application	Max bandwidth	Max e.r.p.
Wireless microphones and in-ear monitor systems	200 / 400 / 600 kHz [11] per link	50mW
Wireless conference and interpretation systems	20 MHz (in one block)	100mW

Wireless conference and interpretation systems are used in houses of parliament, courts, at banks and insurance companies, multipurpose halls, hotels, conference centres, industry meeting and discussion rooms as well as designed board rooms or historical meeting places that do not allow

[8] *Programme Making* includes the making of a programme for broadcast, the making of a film, presentation, advertisement or audio or video recordings, and the staging or performance of an entertainment, sporting or other public event.
[9] A *Special Event* is an occurrence of limited duration, typically between one day and a few weeks, which take place on specifically defined locations. Examples include large cultural, sport, entertainment, religious and other festivals, conferences and trade fairs. In the entertainment industry, theatrical productions may run for considerably longer.
[10] For further information see the ECC Report 002 [12]
[11] For further information see the EN 300 422 [13]

installations etc. These systems are very often combined with wireless microphone systems and in-ear monitor systems for those that lead through a presentation or discussion.

The current wireless microphone systems both analogue and digital deliver a resolution of 16 bit. This is almost CD quality. This is suitable for live presentations and the majority of all other productions. HD-Sound demands more: Studios already use for their productions 24 or 32 bit resolution and wish to use it direct from the wireless microphone too. Higher resolution means more dynamics for the listeners. ECC regulations are compatible with this demand through increasing the maximum allowed bandwidth from 200 kHz to 600 kHz. It can be seen by switching to the 24 bit resolution the required amount of spectrum for a given production doubles, for 32 bit resolution it triples.

Whereas in the past professional wireless microphone systems could not use bands above 1 GHz due to technical issues modern professional systems can operate above 1 GHz for certain applications.

4.5.2 Justification

Section 3.1 of ECC's Strategic Plan [14] mentions that the identification of appropriate frequency bands for PMSE is one of the main challenges of ECC to be solved within the next remaining three years due to the fact that, "in the course of implementing the digital dividend affected applications supporting programme making and special events (PMSE) are likely to be refarmed. Providing appropriate and sufficient resources to PMSE is crucial for that sector." This is also in line with the EU policy objective to support the creative and cultural activities. The ECC established a dedicated project team to address the spectrum requirements for PMSE. However, the mandate of that project team excluded the consideration of the band 1452-1492 MHz for the applications under its mandate until the final adoption of this Report on the L-band.

Already in 2007 the ETSI SRdoc TR 102 546 [15] requested access to the L-Band for the future development of PMSE. Besides that ETSI updated the spectrum mask above 1 GHz in the technical standard for audio PMSE (EN 300 422 [13]). Based on these ETSI statements manufacturers have invested already to provide technology for this range.

The necessary spectrum harmonisation of PMSE wireless production systems will require a long term effort from ECC and relevant CEPT Administrations at national level, but ECC has to face this challenge of coordinating the spectrum need of PMSE in Europe and as far as possible on a worldwide basis.

The L-Band could potentially be available to audio PMSE across Europe and beyond on a secondary basis. The density of users of audio PMSE applications in the currently available spectrum has risen in the course of implementing the digital dividend and as a result of the switch-over from analogue to digital TV. Future evolution of terrestrial digital TV may further limit the spectrum available for audio PMSE in the UHF band (e.g. simulcast of DVB-T and DVB-T2, HDTV, 3DTV) noting that PMSE is a secondary user and may only use gaps left by the TV transmitters.

At the same time the need for spectrum is increasing steadily because of the increasing demand for production quality, new audio formats and the growth of the number of concurrent PMSE users in a given event[12]. This may lead to the situation where peak spectrum demand will not be possible to satisfy within the exiting spectrum.

Some applications currently operating in the UHF band could be moved to the L-band, provided that they accept the related operational constraints. Man-made noise in the L-Band is lower than in the UHF range while the wave propagation characteristics in the L band are not as favourable.

[12] New audio formats require higher resolution, not compressed, from the microphones for storing the signals in highest resolution in order to be able to convert it according to the market needs. The current standard formats (mono or stereo) no longer fulfil the expectations of the listeners. Formats like 5.1 or 7.1 are common for today's productions. They need more equipment at the production frontend and more RF spectrum to transmit the increasing amount of signals. Audio 5.1 and 7.1 are intermediate steps to a real spatial sound experience for the people at home. The next step on the audio side is as format which offers a much more authentic 3D Audio experience.

4.5.3 Spectrum requirements

The amount of spectrum required to operate wireless microphones in a given event is not a linear function of the number of microphones, but more a geometrical or exponential function (see ANNEX 7:) For example, assuming devices compliant with standards EN 300 422 [13] and operating in the UHF band, the operation of 22 devices requires typically 20 MHz of spectrum, while the operation of 32 devices requires typically 40 MHz.

PMSE applications are successfully operating in interleaved spectrum alongside primary users and would benefit from having access on a secondary basis to the L-Band from 1452 to 1492 MHz.

4.6 APPLICATION SIX: BROADBAND PPDR FOR TEMPORARY AND LOCAL USE

4.6.1 Description

Public Protection and Disaster Relief (PPDR) radio communication systems are defined (by ITU-R) as:

Radio communications of Public Protection (PP) used by responsible agencies and organisations dealing with maintenance of law and order, protection of life and property, and emergency situations.

Radio communications of Disaster Relief (DR) used by agencies and organisations dealing with a serious disruption of the functioning of society, posing a significant, widespread threat to human life, health, property or the environment, whether caused by accident, nature or human activity, and whether developing suddenly or as a result of complex, long-term processes.

National narrowband PPDR networks using the TETRA or TETRAPOL technology are in operation in many European countries using the 390-395 MHz/380-385 MHz band harmonised for narrowband PPDR applications (ECC/DEC(08)05 [16]). Various studies and surveys have been made in an attempt to define the PPDR organisations future need of broadband applications. The users see a demand for a number of broadband applications in their future daily work, as well as in emergency crises situations. When translated to frequency bandwidth requirements, a minimum spectrum of 2 × 10 MHz below 1 GHz is believed to be necessary to cover the identified needs.

In addition to the identified need for permanent spectrum for broadband PPDR, studies done on the initiative of one administration [17] [18] show an additional need for spectrum for temporary use. In order to allow the PPDR applications for the usage of additional capacity to transmit real-time video of the site of operation or medical telemetry etc. it has been considered to provide these applications with an extension at the site of operation. The spectrum requirements for temporary and local usage are mainly driven by the need to address significant incidents where this additional capacity is required. The PPDR devices will need to be capable of operating in both the permanent and temporary spectrum bands. During temporary use for PPDR the spectrum will not be accessible to any other users. Appropriate mechanisms to ensure priority access for PPDR users to the temporary bands are to be defined.

4.6.2 Justification

Section 3.3[13] of ECC's Strategic Plan [14] mentions that, the overall demand for PPDR spectrum is one of the main challenges of ECC to be solved within the next remaining three years. Until now no other frequency band is designated for the use by broadband PPDR applications. The ECC established a dedicated project team to address the spectrum requirements for PPDR.

Some administrations identified the need for temporary and local PPDR networks with spectrum requirements outside those currently used for PPDR. The L-band could accommodate these needs.

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13 "ECC has received several request for addressing requirement for Public Safety and Security (PSS) wireless communication systems (e.g. from ETSI and from PSCE Forum). The safety and security community needs access to wideband and broadband services such as video and has specific requirements in terms of priority, availability or security. Spectrum harmonization of PSS wireless communication systems will require a long term effort from ECC and relevant CEPT Administrations at national level, but ECC has to face this challenge of facilitating public safety and security operations in Europe. CEPT ECC shall consider future requirements for access to spectrum for PPDR, the need for harmonization of use and shall identify resources accordingly."

The studies mentioned in 4.6.1 show that in case of significant incidents the following applications require higher capacity than that which can be provided by the permanent PPDR networks:

- local mobile data transfer;
- local high speed moving picture transfer;
- local infrared high speed moving picture transfer;
- local thermal imaging cameras;
- local operation surveillance;
- local unmanned remote controlled vehicles carrying surveillance cameras.

4.6.3 Spectrum requirements

Investigations undertaken by one CEPT country on high speed data communication demands and needs for PPDR and its possible realisation in the radio spectrum have been carried out in 2010 [17] and 2011 [18].

The calculations have been done on the basis of LTE - but not prejudging LTE or excluding any other standard at this point of time.

The needed bandwidth for temporary and local PPDR high speed data communications is 15 MHz as indicated in one of the above mentioned studies [17]. This requirement is primarily considered for a pan-European deployment.

4.7 APPLICATION SEVEN: BROADBAND DIRECT-AIR-TO-GROUND COMMUNICATIONS (BDA2GC)

4.7.1 Description

A broadband DA2GC system constitutes an application for various types of telecommunications services, such as internet access and mobile multimedia services. It aims to provide access to broadband communication services during continental flights on a Europe-wide basis. The overall end-to-end system architecture of the broadband DA2G communication system is illustrated in Figure 2:. The request for spectrum is related to the direct air-to-ground radio solution.

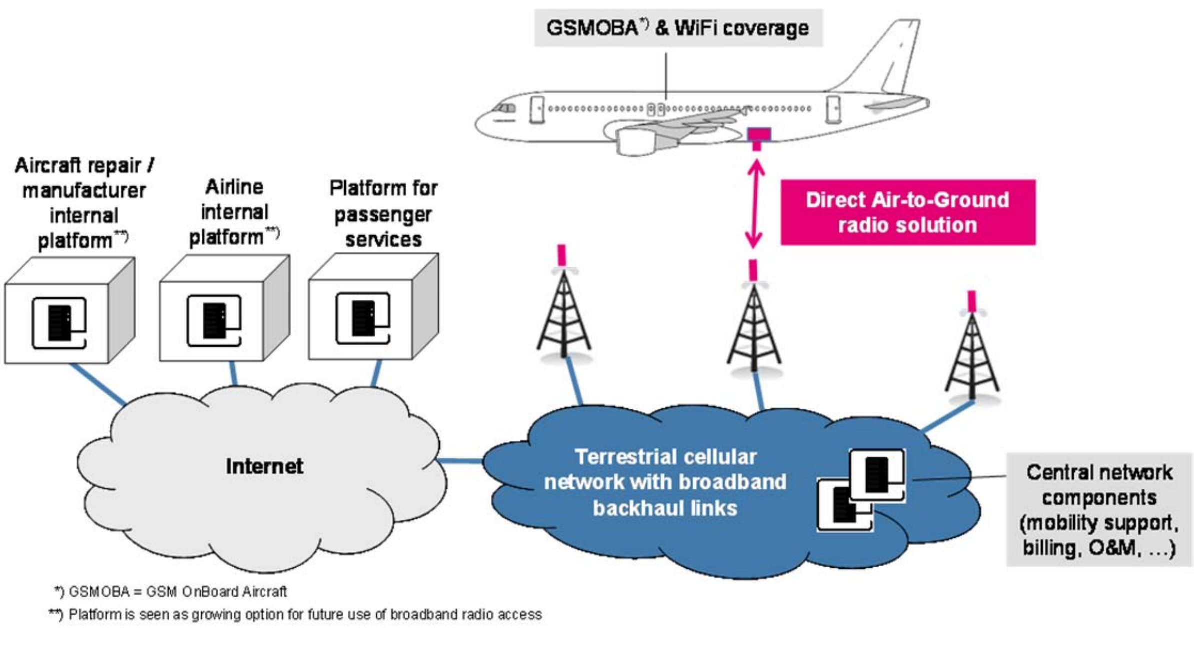

Figure 2: System architecture for broadband DA2G communication

The BDA2GC system under consideration in this Report is based on the 3GPP LTE (also called E-UTRA) standard (Rel. 8 or higher), as described in more detail in ETSI TR 103 054 [19]. The general characteristics of the DA2GC RF and digital baseband signals are also based on the LTE specification. To adapt the LTE system functionalities to the DA2GC link specifics, some modifications are required. In particular synchronisation algorithms as well as the maximum OBU Tx power are to be modified compared to terrestrial mobile radio usage in order to cope with high Doppler frequency shift caused by aircraft speed and large cell sizes. In addition the BS antenna adjustment has to be matched to cover typical aircraft altitudes between 3 and 12 km by up-tilt of vertical diagrams. Ongoing investigations will determine whether further modifications are required[14].

The main application field would be Air Passenger Communications (APC), e.g. WiFi or GSM based internet/company intranet access, data synchronisation and voice communication. In addition the system could also support Airline Administrative Communications services (AAC), e.g. flight data, crew scheduling and lodging information, aircraft supply requirements (catering etc.), miscellaneous crew information and requests for medical assistance. The envisaged broadband DA2GC system is not intended to be used for safety-relevant communications such as Air Traffic Control (ATC) and related services. It should also be noted that in continental US an Air to Ground system has been established with more than 1.300 commercial aircrafts equipped so far[15].

There are other proposals in Europe for BDA2GC systems to be used in ISM bands using different technologies (see also section 4.7.3).

4.7.2 Justification

Mobile customers expect to be connected everywhere, every time, with all kind of mobile devices. A terrestrial BDA2GC system in Europe is proposed to be an alternative to the already existing satellite based services. A number of European airlines have great interest to offer internet services to their flight passengers in their continental fleets as soon as possible. The costs for the aircraft installation and maintenance are key issues.

A forecast from Eurocontrol[16] published in October 2011 estimates 11.5 million movements according Instrument Flight Rules (IFR) in Europe in 2017. This is 21% more than in 2010. Studies on air passenger demand for on-board connectivity are currently not publicly available[17].

Currently, there is no spectrum designated for BDA2GC in Europe. In order to allow European citizens and airlines to derive social and economic benefits of the implementation of such a system, a spectrum designation on a Europe-wide basis would be necessary.

4.7.3 Spectrum requirements

The spectrum demand for the BDA2GC system is derived from a summary of relevant factors to be essential to cope with future capacity demand as well as from results achieved by system performance evaluations.

WG FM agreed that for BDA2GC paired spectrum of 2 x 10 MHz for FDD operation is considered necessary to cope with short- to medium-term demand. Unpaired spectrum for TDD operation (20 MHz) would also be an option, but system performance would slightly suffer due to guard time intervals required for large cell sizes. CEPT is looking to designate in total 20 MHz for BDA2GC[18].

The whole spectrum requirement of 2 x 10 MHz of paired spectrum for FDD or 20 MHz of unpaired spectrum for TDD operation or a part of it may be satisfied in the 1452-1492 MHz band.

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[14] A press release on trial flight: http://www.telekom.com/media/company/107626
[15] http://www.gogoair.com/gogo/cms/airlines.do; http://pr.gogoair.com/press-room/2012/03/gogo-installed-1500th-commercial-aircraft
[16] http://www.eurocontrol.int/statfor/public/subsite_homepage/homepage.html
[17] See document FM50(12)017_Air_passenger_survey_results at http://www.cept.org/ecc/groups/ecc/wg-fm/fm-50/client/meeting-documents; 2012; M5 – 6-9 March; Input documents
[18] See Minutes of the 73rd WG FM Meeting, FM(11)202_Minutes of 73WGFM_Lille_2011: The amount of spectrum for this radio application is considered independent from the number of system proposals.

5 ANALYSIS OF THE APPLICATIONS WITH RESPECT TO THE CRITERIA

5.1 CRITERION 1

The existing regulatory framework for the band 1452-1492 MHz consists of the ITU Radio Regulations, and at CEPT level the MA02revCO07 special arrangement [1] and ECC/DEC(03)02 [2]. In this section each application is checked against these three aspects of the framework.

In the context of this report, compliance with the Radio Regulations is understood to be compliance with Article No. 5 of the RR (including footnotes, as applicable). This is without prejudice to Article No. 4.4[19] of the RR [4].

There are three areas where an application can be compatible with the MA02revCO07 Special Arrangement [1]:

1. Use of the current Plan (Annex 1 contains the Plan as of 2007) designed for T-DAB. Applications other than terrestrial broadcasting, requiring a larger bandwidth than 1.7 MHz, will have little use of the current Plan.

2. Use of its Annex 2 frequency arrangement (envelope concept) and the procedures to aggregate channels of 1.7 MHz (see table 2 of Annex 2): all terrestrial applications with fixed transmitters or any station of any other radio communication service may use those procedures to aggregate 1.7 MHz contiguous channels to enable wider bandwidths (5 MHz, 10 MHz, etc.). The emissions masks proposed may need to be revised. However, if the whole band 1452-1492 MHz is proposed for harmonisation for technologies using carriers of (a multiple of) 5 MHz, a new channelling arrangement across the 40 MHz would need to be developed to enable the use of the band efficiently in its entirety.

3. Use of its Annex II for cross border coordination. The Ma02revCo07 procedure for cross-border coordination assumes that sharing and compatibility criteria for the services involved are known. Annex II provides such criteria for T-DAB and a set of other services that were considered at the Maastricht '02 planning meeting. No information is given for other candidate applications in the present ECC Report.

Nevertheless, administrations can use the Ma02revCo07 procedure to coordinate systems other than T-DAB. For such cases the provisions in Annex 2 require that '*the administrations concerned should develop appropriate sharing criteria by mutual agreement. When available, one could use the relevant ITU- R Recommendations or ERC and ECC Decisions and Recommendations*.'

In particular the coordination procedure to evaluate the field strength of mobile uplink and non fixed transmitters would need to be defined and agreed.

5.1.1 Compatibility of terrestrial broadcasting with the current regulatory framework

At ITU level, the 1452-1492 MHz band is allocated in Region 1 to the Broadcasting Service (sound) on a co-primary basis. Terrestrial broadcasting limited to audio broadcasting (RR footnote No. 5.345) is compliant with the Radio Regulations.

Terrestrial broadcasting (as described in section 4.1) is compatible with the MA02revCO07 special arrangement:

[19] "Administrations of the Member States shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations."

Table 6: Criterion 1 – Terrestrial broadcasting

Compatibility with MA02revCO07	Terrestrial Broadcasting
Compatibility with the current Plan	Yes
Compatibility with envelope concept	Yes
MA02 as a tool for cross-border coordination	Yes

The spectrum requirement for this application as described in section 4.1 does not cover the band designated in ECC/DEC(03)02 [2].

5.1.2 Mobile Broadband: compatibility with the current regulatory framework

As a mobile system, Mobile Broadband will operate under the Mobile Service allocation and is therefore compatible with Article 5 of Radio Regulations where the band 1452-1492 MHz is allocated to the Mobile Service on a co-primary basis.

The adoption of a band plan based on 5 MHz blocks for the introduction of technologies supporting the delivery of mobile broadband services in 1452-1492 MHz may stay compatible with the existing Maastricht special arrangement (MA02revCO07) [1].

The issue of compatibility with MA02revCO07 is summed up in the table below:

Table 7: Criterion 1 – Mobile broadband

Compatibility with MA02revCO07	Mobile Broadband
Compatibility with the current Plan	No
Compatibility with envelope concept	Mobile Broadband in the downlink could use aggregation of 1.7 MHz contiguous channels, but it would be suboptimal and the whole 40 MHz would not be used.
MA02 as a tool for cross-border coordination	Need to develop procedure for mobile transmitters

The ECC/DEC/(03)02 designates the frequency band 1479.5-1492 MHz for use by satellite digital audio broadcasting systems. Thus Mobile Broadband is not compatible with the ECC/DEC/(03)02 [2].

5.1.3 Mobile SDL: compatibility with the current regulatory framework

As a mobile system, Mobile SDL will operate under the Mobile Service allocation and is therefore compatible with Article 5 of Radio Regulations where the band 1452-1492 MHz is allocated to the Mobile Service on a co-primary basis.

The adoption of a band plan based on 5 MHz blocks for the introduction of technologies supporting the delivery of mobile broadband services in 1452-1492 MHz may stay compatible with the existing Maastricht special arrangement (MA02revCO07) [1].

The issue of compatibility with MA02revCO07 is summed up in the table below:

Table 8: Criterion 1 – Mobile SDL

Compatibility with MA02revCO07	Mobile SDL
Compatibility with the current Plan	No
Compatibility with envelope concept	Mobile Broadband in the downlink could use aggregation of 1.7 MHz contiguous channels, but it would be suboptimal and the whole 40 MHz would not be used.
MA02 as a tool for cross-border coordination	The procedure could be used as the transmitters are fixed

The ECC/DEC/(03)02 designates the frequency band 1479.5-1492 MHz for use by satellite digital audio broadcasting systems. Thus Mobile SDL is not compatible with the ECC/DEC/(03)02 [2].

5.1.4 S-DAB: compatibility with the current regulatory framework

At ITU level, the 1452-1492 MHz Band is allocated in Region 1 to the Broadcasting-Satellite Service (sound), on a co-primary basis. The ability to deploy Broadcasting-Satellite Services is limited to the upper 25 MHz of the band, in accordance with Resolution 528 (Rev. WRC-03) [4]. Satellite broadcasting limited to audio broadcasting (RR footnote No. 5.345) is compliant with the Radio Regulations.

The issue of compatibility with MA02revCO07 [1] is summed up in the table below:

Table 9: Criterion 1 – S-DAB

Compatibility with MA02revCO07	Satellite Broadcasting
Compatibility with the current Plan	No
Compatibility with envelope concept	No
MA02 as a tool for cross-border coordination	Not applicable, ITU coordination applies

Satellite broadcasting limited to audio is compatible with the ECC/DEC/(03)02 [2] and may be complemented by a terrestrial component in areas where satellite signal is not available (see *considering f* of the ECC/DEC/(03)02).

5.1.5 PMSE: compatibility with the current regulatory framework

PMSE is a mobile service according to the definition of the ITU Radio Regulation and as such is compliant to article 5 within the 1452-1492 MHz band.

The issue of compatibility with MA02revCO07 [1] is summed up in the table below:

Table 10: Criterion 1 – PMSE

Compatibility with MA02revCO07	PMSE
Compatibility with the current Plan	Can use the interleaved spectrum of the allotment plan as a secondary service
Compatibility with envelope concept	Yes, can fit several audio channels within a T-DAB channel (as a secondary service would not need to notify)
MA02 as a tool for cross-border	Not applicable; as a secondary service does not

Compatibility with MA02revCO07	PMSE
coordination	use the Maastricht agreement procedure

The ECC/DEC/(03)02 designates the frequency band 1479.5-1492 MHz for use by satellite digital audio broadcasting systems. PMSE is not compatible with the ECC/DEC/(03)02 [2]. However, the spectrum requirement for PMSE may not necessarily cover the band 1479.5-1492 MHz.

5.1.6 Broadband PPDR for temporary and local use: compatibility with the current regulatory framework

As a mobile system, PPDR will operate under the Mobile Service allocation and is therefore compatible with Article 5 of Radio Regulations where the band 1452-1492 MHz is allocated to the Mobile Service on a co-primary basis.

The adoption of a band plan based on 5 MHz blocks for the introduction of technologies supporting the delivery of mobile broadband services in 1452-1492 MHz may stay compatible with the existing Maastricht special arrangement (MA02revCO07) [1].

The issue of compatibility with MA02revCO07 is summed up in the table below:

Table 11: Criterion 1 – Broadband PPDR

Compatibility with MA02revCO07	PPDR
Compatibility with the current Plan	No
Compatibility with envelope concept	Mobile Broadband in the downlink could use aggregation of 1.7 MHz contiguous channels, but it would be suboptimal and the whole 40 MHz would not be used.
MA02 as a tool for cross-border coordination	Need to develop procedure for mobile transmitters

The ECC/DEC/(03)02 designates the frequency band 1479.5-1492 MHz for use by satellite digital audio broadcasting systems. Thus PPDR is not compatible with the ECC/DEC/(03)02 [2]. However, the spectrum requirement for PPDR may not necessarily cover the band 1479.5-1492 MHz.

5.1.7 BDA2GC: compatibility with the current regulatory framework

A ground station (base station) for a Broadband DA2GC system has to be considered as an “aeronautical station” according to provision No. 1.81 of ITU RR [4]. Therefore, BDA2GC is to be understood as aeronautical mobile service. As the band 1452-1492 MHz is currently allocated to the Mobile Service except aeronautical mobile in Region 1, BDA2GC is not compliant with current allocations in Article 5 of the Radio Regulations.

The issue of compatibility with MA02revCO07 [1] is summed up in the table below:

Table 12: Criterion 1 – BDA2GC

Compatibility with MA02revCO07	BDA2GC
Compatibility with the current Plan	No
Compatibility with envelope concept	Could use aggregation of 1.7 MHz contiguous channels in the forward link (ground to air), but it would be suboptimal and the whole 40 MHz would not be used. For the mobile transmitters (aircraft) appropriate procedure may need to be defined through mutual agreement.

Compatibility with MA02revCO07	BDA2GC
MA02 as a tool for cross-border coordination	Not applicable, CEPT wide service

As the ECC/DEC/(03)02 designates the frequency band 1479.5-1492 MHz for use by satellite digital audio broadcasting systems, BDA2GC is not compatible with this Decision [2]. However, the spectrum requirement for BDA2GC may not necessarily cover the band 1479.5-1492 MHz.

5.2 CRITERION 2

This criterion assesses the possibility for an application to share with another application. In this report it was considered that this would be best evaluated for each regulatory option and not individually at the application level. There is no reason to award points to two applications that could share the spectrum if there is no regulatory option that would actually allow the inclusion of these two applications. In section 6 of this report a methodology is proposed to take into account that some applications included within an given regulatory option may share the spectrum whether through band segmentation or through flexibility at national level.

5.3 CRITERION 3

This criterion assesses the extent of social and economic benefits. For this assessment it was decided to respect the following principles:

- Both qualitative and/or quantitative data can be used;
- The economic surplus is the quantitative measure to be used (net present value based on a 10 year period);
- Transparency in the inputs and on the methodology has to be ensured;
- The benefits should be specific to the L-band.

Accordingly the assessment was subdivided in four sub-criteria:

- Citizen/Consumer benefits (qualitative), more broadly this includes social benefits;
- Consumer surplus (quantitative), if available;
- Producer/industry benefits (qualitative);
- Producer surplus (quantitative), if available.

5.3.1 Terrestrial broadcasting

Table 13: Criterion 3 – Terrestrial broadcasting

	Terrestrial broadcasting
Consumer/citizen benefits	The availability of the L-band for terrestrial radio broadcasting would allow consumers to receive digital radio in addition to 174-240 MHz where available. In addition to that, consumer may enjoy access to a broad variety of local radio services. Additionally, the subscription model on which subscription radio is based creates an opportunity to differentiate from what is currently being offered by free-to-air commercial radio. In the field of music, as an example, commercial radios indeed tend to format their programming in order to best fit the expected music tastes of specific advertising audiences, that they are designed to target (specific age and gender, social class, etc.). Accordingly, subscription radio – by not being constrained by such advertising-driven formats – is positioned to provide commercial-free programmes complementary to existing free-to-air radio offerings in terms of content, and as such to contribute to extend national radio landscapes to the overall benefit of consumers. This complementary nature of free-to-air and subscription radio, both in terms of economic model and content, could favour the eventual development of convergent, multi-standard receivers enabling the reception of both services. By targeting national markets, subscription radio services are bound to engage in substantial marketing efforts to accompany their commercial rollout on a national basis, and could therefore play a positive role in the digitisation efforts of radio across Europe, through the dissemination of such convergent receivers, thereby contributing to enable European consumers access a variety of radio programmes in digital quality, throughout territories.
Consumer surplus (quantitative)	8.6 b€ (net present value) The net present value computed is valid for a system combining T-DAB and S-DAB. Therefore this value should be used as a combined value for two applications: T-DAB and S-DAB. In North America, subscription radio has attracted so far (end of 2011) more than 21 million subscribers. In Europe, dedicated market research conducted over the past decade (more than 15'000 respondents surveyed in total[20]) has evidenced the existence of an aggregated European market potential for commercial-free radio services that is comparable in size to the US' situation, with one adult out of five declaring to be "ready to subscribe" in Western Europe. Accordingly, the revenues generated by subscription radio over the first decade of commercial operation in the US have been used to estimate the NPV of revenues (in 2014) that could be created in Europe over the 2014-2023 timeframe (6.0 b€), using a 10% discount rate. An average elasticity of demand of 0.35 derived from price sensitivity data available from available market research is then used to calculate the consumer surplus value of 8.6 b€[21].
Producer/industry	The development of subscription radio services in Europe is positioned

[20] Conducted by IFOP-Gallup in 2002, Harris Interactive in 2005 and 2006, and by QualiQuanti in Sept 2009 – source RNP Forum
[21] See document FM50(12)INFO 007 for the details.

	Terrestrial broadcasting
benefits	to generate further industrial contracts to the direct benefit of the European economy, as some European procurement companies stand among worldwide leaders in a number of domains of interest to the deployment of subscription radio networks and services (terrestrial broadcast repeaters, deployment of conditional access receivers, core technologies, etc.).
Producer surplus (quantitative)	1.6 b€ (NPV) This net present value is valid for a combined system T-DAB and S-DAB. Therefore this value should be used as the combined value for two applications: T-DAB and S-DAB. As for the derivation of the consumer surplus, the US case is taken as a benchmark to estimate the producer surplus to be taken into account in this impact assessment analysis for Europe. In the US market, the producer surplus for subscription radio is assumed to at least equal over time the initial CAPEX investments that were incurred to startup the existing service, that were about $2 bn (1.6 b€).

5.3.2 Mobile Broadband

Table 14: Criterion 3 – Mobile broadband

	Mobile Broadband
Consumer/citizen benefits	The use of 1452-1492 MHz for Mobile Broadband will lead to a range of consumer/citizen benefits with: - additional mobile capacity, as additional spectrum will increase capacity - more affordable services, as more spectrum for mobile broadband will reduce the cost of the service and stimulate competition The demand for mobile broadband is expected to grow strongly over the next 10 years[22]. In Europe, mobile broadband traffic carried over mobile networks is forecasted to grow between 14 and 29 fold over the period 2010 to 2015.
Consumer surplus (quantitative)	The band specific quantitative analysis is not available for the mobile broadband application as described in this Report.
Producer/industry benefits	The harmonisation of the L-band for Mobile Broadband gives European operators and suppliers an early advantage in the development of mobile broadband services.
Producer surplus (quantitative)	The quantitative analysis is not available for the mobile broadband application which is described in this Report.

[22] See FM50(11)52

5.3.3 Mobile SDL

Table 15: Criterion 3 – Mobile SDL

	Mobile SDL
Consumer/citizen benefits	The use of 1452-1492 MHz for Mobile SDL will lead to a range of consumer/citizen benefits with: - enhanced mobile broadband services (faster download speeds, higher capacity) as carrier aggregation enables wider downlink spectrum - better user experience in rural areas (contribute towards achieving Digital Agenda target of 30 Mbps for all by 2020 at lower cost) - more affordable services, as more spectrum for mobile broadband will reduce the cost of the service and stimulate competition - innovative services, due to the availability of this new 'downlink pipe' especially well-suited for the delivery of mobile multimedia content There are a number of elements which, when taken together, suggest that demand for mobile broadband multimedia services is already significant and will grow over the next decade. Moreover, when this is coupled with the asymmetric nature of mobile broadband traffic, it demonstrates the existence of a market consumers' demand for Mobile SDL: - there is a trend towards personalisation, immediate and on the move use of the video-based content. A high proportion of mobile broadband is already multimedia traffic. Mobile video traffic exceeded 50 percent for the first time in 2011. Mobile video traffic was 52 percent of traffic by the end of 2011[23]. This is driven by the growing number of smart phones and tablets. - demand for mobile broadband is expected to grow strongly over the next 10 years[24]. In Europe, mobile broadband traffic carried over mobile networks is forecasted to grow between 14 and 29 fold over the period 2010 to 2015. - mobile users download much more data than they upload. The ratio of downlink to uplink traffic could rise to 10:1 over the next five years in high capacity areas, as the proportion of video traffic in the total mobile traffic grows[25].
Consumer surplus (quantitative)	28 b€ (Net Present Value) Deploying a Mobile SDL at 1452-1492 MHz will lead to faster download speeds, support for a greater number of users, better in-building coverage and enhanced services which will consequently increase consumers surplus, which was estimated at a net present value of 28 b€[26].This estimate is consistent with previous studies that estimate total surplus (consumer + producer) of mobile broadband services at values ranging from €0.51 to €7.01 per MHz per pop[27], with a number of studies clustering at the upper end of this range. These numbers would equate to a benefit of between €10 billion and €140 billion for the 1452-1492 MHz band for Europe.
Producer/industry benefits	Early adoption of Mobile SDL in 1452-1492 MHz will enable European businesses to better compete in global mobile services markets: The harmonisation of the L-band for Mobile SDL gives European

[23] *Global Mobile Data Traffic Forecast update, 2011-2016,* Cisco, February 2012.
[24] See FM50(11)52
[25] http://www.plumconsulting.co.uk/pdfs/Plum_June2011_Benefits_of_1.4 GHz_spectrum_for_multimedia_services.pdf [11]
[26] Detailed methodology and assumptions are provided in the document referenced in the previous footnote
[27] Per person

	Mobile SDL
	operators and suppliers an early advantage in the development of mobile multimedia services using a supplemental downlink. Implementation of the standard in Europe will open up new business opportunities in international markets, particularly for service providers that will be able to develop in advance new products and innovative business models tailored to Mobile SDL International adoption of the L-band for Mobile SDL will be of great benefit also to technology providers[28] in addition to European content and service providers.
Producer surplus (quantitative)	26 b€ (NPV) The producer surplus derived from the use of 1452-1492 MHz for Mobile SDL was estimated with the avoided costs model[29]. Deploying a L-band supplemental downlink rather than deploying additional base stations using their existing spectrum allows mobile operators to avoid significant cost to meet rising demand for mobile multimedia services.

5.3.4 S-DAB

Table 16: Criterion 3 – S-DAB

	S-DAB
Consumer/citizen benefits	The satellite digital audio broadcasting (S-DAB) application as presented in this report provides the social benefit of delivering satellite audio across a wide territory, for instance in countries where full digital radio coverage in 174-240 MHz would not be achievable or to provide additional or new audio programming for the benefit of citizens/consumers in those areas where no other, terrestrial, services are authorised and deployed. It should be noted that so far, satellite audio broadcasting (with harmonised use restricted to 12.5 MHz across CEPT), has not been a commercial success in Europe, which was one of the reasons to reconsider the harmonisation of the L-Band within CEPT.
Consumer surplus (quantitative)	See Terrestrial broadcasting above. This net present value is valid for a combined system T-DAB and S-DAB. Therefore this value should be used as the combined value for two applications: T-DAB and S-DAB.
Producer/industry benefits	The development of S-DAB in Europe is positioned to generate further industrial contracts to the direct benefit of the European economy, as some European procurement companies stand among worldwide leaders in a number of domains of interest to the deployment of S-DAB services (deployment of conditional access receivers, core technologies, satellite manufacturers and media companies, etc.).
Producer surplus (quantitative)	See Terrestrial broadcasting above. This net present value is valid for a combined system T-DAB and S-DAB. Therefore this value should be used as the combined value for two applications: T-DAB and S-DAB.

[28] Potential markets will exist in Europe and potentially in many countries outside Europe where the 1.4 GHz band can be made available for Mobile SDL (c.f. FM50(11)19). In addition, service providers will also have the opportunities in the US market for supplying innovative multimedia services as a Mobile SDL is planned there.

[29] The avoided costs model utilised as well as its key assumptions are detailed section 5 and in “Appendix C” of FM50(11)019.

5.3.5 PMSE

Table 17: Criterion 3 – PMSE

	PMSE
Consumer/citizen benefits	Use of the L-band offers the chance to switch to HD sound in production. It will secure the growth of the application as well as the demanded higher quality for productions[30]. In particular the L-Band will offer to the consumer real HD-sound content. This is especially important at live productions where there is no chance to install complex post production. This allows the development of new performance styles and genres. This will benefit the whole cultural and creative sector.
Consumer surplus (quantitative)	The quantitative analysis is not available
Producer/industry benefits	The possibility to use PMSE within the L-band will allow cost reduction and more flexibility for major cultural/media events that require a heavy use of PMSE. The saving from using increased capacity associated with the L-band can be a significant part of the production cost in average (e.g. shorter rent of a venue but also less staff and a greater flexibility when changes are necessary). It depends on the size and complexity of a production. In particular more complex large productions (such as musicals) can be performed. At the beginning of 2012 a total of 8900 TV channels were available in the EU and the candidate countries. At the end of 2011 approximately 612 have been already HD channels. 20 % are broadcasting sport followed by film (15%).[31] Developing HD-TV to a complete system it has be combined with HD-Sound to make it more vibrant. Viewers are sticking longer to “full” HD TV channels. HD sound will enable Commercial broadcasters to continue to compete for ad revenues. Enabling PMSE in the L-band will also support the expansion of the PMSE application (e.g. current annual growth of HD content in Germany is about 15%), and the demand for improved sound quality (HD-Sound). The new HD-Sound will change the equipment in the wireless production segment: as the studio equipment is already on HD level the wireless HD component will now fill up the missing gap. This will substantially stimulate the market for professional wireless production equipment.
Producer surplus (quantitative)	A detailed analysis was not available. However based on the following simplified assumptions : - limited access to the UHF band, - a new market is created for HD-sound microphones equivalent in value to the existing market (with a transition period reduced to zero), - the L-band is used across all CEPT countries, the following best effort estimation is provided. The average turnover of PMSE manufactures in Europe is around 280 M€ p.a. The new market for HD-sound microphones (when using the L-band) can be estimated to be about equivalent to the current turnover for PMSE manufacturers (280 M€ p.a.). Based on this estimation the 10 year NPV is: 1.9 b€

30 ETSI SRDoc TR 102 546 [15]

31 European Audiovisual Observatory, High Definition channels in Europe on the up, 2012, March 29th, http://www.obs.coe.int/about/oea/pr/mavise-miptv2012.html

5.3.6 Broadband PPDR for local and temporary use

Table 18: Criterion 3 – Broadband PPDR

	Broadband PPDR for local and temporary use
Consumer/citizen benefits	Reduced risk of loss of life Based on existing studies, reasoning is given that saving a life has a monetary value of at least 2 to 10 M€ per year, aside the obvious societal benefits. Enhanced PPDR communications protect and save lives in day to day usage and in disaster situations. Publicly available statistics suggest that better disaster preparedness has played a huge role in reducing loss of life over the past century, and will presumably continue to do so. Therefore it is reasonable to assume that these savings would be real and substantial. The following is an example to illustrate the consumer/citizen benefit. Case of the crash of an aircraft, on 13 January 1982[32]. The plane crashed just after take-off onto the 14th Street Bridge, which is the link between Washington, DC and the state of Virginia. The crash thus took place squarely at the point of intersection of the authority of the US government and of two US states. Attempts to rescue survivors were likely hampered by the lack of interoperable communications between the US Coast Guard, the National Park Service, and PPDR workers from Virginia and Washington, DC. Seventy-eight people died in that crash. Five people were successfully rescued, but many who otherwise might have survived the crash perished in the icy water of the Potomac River. Reduced risk of loss of property Statistics show a substantial *increase* in property damage due to disasters throughout the past century, despite improvements in preparedness. In any case, better PPDR communications result in more effective response, and thus in reduced risk to property. Productivity improvements for the PPDR activity PPDR providers should be able to achieve better protection at the same price, or comparable protection at a lower price. Reduced risk of injury or death for PPDR forces Improved tools reduce the personal risk for PPDR professionals.
Consumer surplus (quantitative)	4.7 b€. Formally, the following analysis represents a partial cost-benefit analysis. Some of the costs and benefits of the various options can be monetized, but others cannot. Consistent with standard practice for an impact analysis, the benefit is justified by any combination of lives saved, property loss avoided, gains in operational efficiency, and avoidance of loss of life of PPDR personnel. In a simple calculation, the net savings is €57 million per year in Germany (see WIK-Report p. 96). Germany represents nearly 9% of the CEPT population. In a ten-year period, the net saving is 6.3 b€ (€57,000,000 / 9 x 100 x 10 years). It is assumed that the population growth will be of about 5 % over the 10

[32] WIK-Report, German published version: http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/Studien/harmonisierung-ppdr-funkfrequenzen-deutschland-europa-weltweit,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf
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	Broadband PPDR for local and temporary use
	next years. Applying a discount rate of 10 % over the same period, the NPV is 4.7 b€. Given the estimation of €1,500 million per year of natural disaster damages, per year on average, based on the example of Germany, a fairly modest improvement in the effectiveness of response could easily exceed this threshold. Similarly, in light of the number of crimes per year and the societal cost per crime, improved effectiveness of crime prevention and deterrence (together with similar improvements for fire and emergency medical) is likely to exceed this threshold by a substantial margin.
Producer/industry benefits	1452-1492 MHz will support for a greater number of PPDR-users (fire-brigade, police etc.) and a better possibility for ad-hoc usage during a major event like a disaster. Deploying the 1452-1492 MHz spectrum allows PPDR networks to avoid significant cost to meet rising demand for local ad-hoc usage rather than deploying additional permanent base stations. These lower costs will result in lower prices for PPDR-Organizations (public costs paid mainly by tax-income). Reduced unit costs resulting from spectrum harmonisation and technical standardisation might mean that PPDR organisations can afford to equip more of their respective staff with relevant equipment. The development of terminal equipment operating in two frequency ranges (one for daily use the other for temporary use) on the basis of LTE represents an additional surplus for handset producers.
Producer surplus (quantitative)	The quantitative analysis is not available

5.3.7 BDA2GC

Table 19: Criterion 3 – BDA2GC

	BDA2GC
Consumer/citizen benefits	For the purpose of this assessment users of BDA2GC are understood as flight passengers (airlines are treated in the producer subsection). Due to the facts that: - Passengers want to be able to use the same applications in the air as on the ground in fixed and wireless networks, and especially the upcoming generation of digital natives is accustomed to be always online in social networks. - Subscribing Passengers would also benefit from the provision of additional services during flight, e.g. arrival-, transfer-, and airport- related information, In-flight Shopping, destination tourist information, weather forecasts, etc. - During their journeys business travellers require more and more to get informed by phone and/or by data exchange about relevant issues with impact to their commercial activities.

<table>
<tr><th></th><th>BDA2GC</th></tr>
<tr><td></td><td>The deployment of a pan-European DA2GC would provide the following benefits for flight passengers - in Europe:
- As an alternative service provision to satellite based communications, DA2GC by fostering competition, might benefit flight passengers.
- The technical implementation of DA2GC may lead to a provision of services at improved cost structures - including non-safety-relevant administrative communication services - and hence create a benefit to end customers and airlines resulting in higher and earlier service take-up.
- DA2GC avoids the round trip delay that is typical and unavoidable for geostationary satellite service provision and hence can provide low latency services.</td></tr>
<tr><td>Consumer surplus (quantitative)</td><td>The quantitative analysis is not available</td></tr>
<tr><td>Producer/industry benefits</td><td>European companies represent an important force in the aeronautical market. The European aircraft industry holds about 50% of the world market for aircraft manufacturing.
A timely introduction of a broadband DA2GC solution would not only increase Europe’s competitive position, but it could also bring Europe into a leading position in this market segment.
- Producer benefits would occur for the following market players:
- Equipment manufacturers from the sale of BDA2GC ground and aircraft equipment, additional in-flight systems and additional backhaul components.
- Aircraft manufacturers from additional revenue for the installation of airborne DA2G equipment.
- Airlines from additional income for in-flight services. Airlines are also expected to change their strategy particularly with respect to administrative services (AAC) in the future if a broadband link is available at lower cost compared to existing satellite systems for non-safety relevant applications, e.g. localised real-time weather information. Further, the costs for aircraft installations and maintenance are a key issue for airline companies. Given the fact the DA2GC equipment can be installed overnight on a plane is seen as an advantage by airline operators. In particular with regard to the aircraft antenna, a terrestrial solution has a clear advantage compared to existing satellite usage. Additionally, European airlines may choose a cheaper than satellite connectivity solution for their continental aircraft fleets.
- Content and service providers from additional customer demand.
- Network operators from revenues of additional telecommunications traffic.
Hereafter quantitative figures on air traffic increase, addressable market</td></tr>
</table>

	BDA2GC
	and equipment development are given: A forecast[33] estimates 11.5 million movements under Instrument Flight Rules (IFR) in Europe in 2017; 21% more than in 2010. About 66 % of the European air traffic - i.e. the main part of the airline business - consists of domestic or continental flights. The addressable market for BDA2GC in Europe is about 160 airlines with more than 4 500 aircraft expected in 2014 (without business aviation). A strong increase in percentage of aircraft fleet equipped with internet connectivity solutions is expected during the next years; approximately 50% of the world's fleet will have been equipped with Wi-Fi connectivity by 2020[34]. Requested data rates per customer (here per flight passenger) is expected to increase due to changes in service usability (higher percentage of video services, larger web page sizes because of more multimedia elements …) as the equipment applied is changing from classical voice-centric mobile phones and laptops for data services to smart phones and tablet PCs, simplifying especially the use of services on-board aircraft in spite of limited space. The deployment of BDA2GC in Europe is positioned to generate industrial contracts to the direct benefit of the European economy (e.g. jobs).
Producer surplus (quantitative)	591 million € (NPV **only** for equipment costs on-board aircraft, without installation, maintenance, etc. Other aspects are not covered due to lack of concrete figures.) Equipment costs (on-board aircraft, without installation) would be about 1/3 to ¼ compared to a Ku band satellite solution ($ 85,000 compared to $300,000 - $ 400,000; i.e. 68 T€ compared to 240 T € - 320 T€; i.e. saving of 172 T€ - 252 T€)[35]. Estimated number of aircraft in European continental fleets[36]: ▪ 2020: about 4500 ▪ 2025: about 5100 Equipped aircraft with BDA2GC[40]: ▪ 2020: 56% --> 2500 ▪ 2025: 60% --> 3000 Aircraft equipment savings in: ▪ 2020: 2500 x (172 T€ - 252 T€) = 430 - 630 million € ▪ 2025: 3000 x (172 T€ - 252 T€) = 516 - 756 million €

5.4 CRITERION 4

The aim of this criterion is to assess the timeframe of the availability of equipment on a large scale and the timeline for application deployment. The status of standardisation, either existing, in preparation or planned should also be assessed.

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[33] http://www.eurocontrol.int/statfor/public/subsite_homepage/homepage.html
[34] IMS research: http://imsresearch.com/news-events/press-template.php?pr_id=1981
[35] http://www.aircell.com/files/brochures/GettingYourBusinessAircraftOnline.pdf
[36] Estimations based on information publicly available:

- Boeing: Current Market Outlook 2011-2030: http://www.boeing.com/commercial/cmo/
- Airbus: Global Market Forecast 2011-2030: http://www.airbus.com/company/market/forecast/
- Eurocontrol: Long-term forecast - Flight movements 2010-2030: http://www.eurocontrol.int/documents/eurocontrol-long-term-forecast-flight-movements-2010-2030

To do this the criterion has been subdivided in 6 sub-criteria:

- Band designation;
- Technical conditions;
- Licensing;
- Standardisation;
- Equipment availability;
- Operational deployment.

Band designation corresponds to the moment when the regulatory framework was made available for incumbent applications or when a decision to allocate the band to a new application is made subsequent to this impact analysis work by CEPT. The timeframe for technical conditions corresponds to the moment when CEPT will have approved a set of new technical conditions in the case of new applications.

Licensing corresponds to the time needed for administrations to make the band available to a given application.

The standardisation sub-criterion gives a description of status of standardisation related to the application and projected efforts.

Equipment availability provides an assessment of the timeframe of large scale equipment availability.

Finally, operational deployment timeframe is estimated based on the previous sub-criteria.

5.4.1 Terrestrial broadcasting

Table 20: Criterion 4 – Terrestrial broadcasting

	Terrestrial broadcasting
Band designation	Existing now MA02revCO07
Technical conditions	Existing now MA02revCO07
Licensing	Licensing procedure could take up to 12 month, depending on national circumstances, in some countries the band is already licensed for Terrestrial broadcasting
Standardisation	Existing now (SDR family of standards and DAB/DAB+/DMB family of standards) Status of DAB/DAB+/DMB The most important ETSI specifications[37] are: ETSI EN 300 401: Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers ETSI TS 102 428: Digital Audio Broadcasting (DAB); DMB video service; User Application Specification ETSI TS 102 563: Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio Other technical standards are available in ANNEX 5:. ETSI's SDR (Satellite Digital Radio) standard stands among the possible technologies that may be used for the deployment of subscription radio services in the L band. As designed, the SDR standard enables the deployment of autonomous terrestrial radio networks, with a view to their possible extension to reach national coverage through companion

[37] A complete set of relevant specifications is available from ETSI as well as from the WorldDMB (http://www.worlddab.org/introduction_to_digital_broadcasting/standards_specs)

	Terrestrial broadcasting
	satellite components. It also enables the broadcast, within a same 1.7 MHz terrestrial multiplex, of different categories of independent broadcast services, e.g. enabling a mix of linear and non-linear audio services aimed to compose an offer. This standard is described in the following documentation: ETSI - TR 102 525: Functionalities, architecture and technologies ETSI - TS 102 550: Outer Physical Layer of the Radio Interface ETSI - TS 102 551: Inner Physical Layer of the Radio Part 1 (TS 102 551-1): Single carrier transmission Part 2 (TS 102 551-2): Multiple carrier transmission A number of European manufacturers have already developed broadcast and receiver equipment implementing the SDR standard, which are therefore ready for large scale production and deployment. These would include a series of digital radio receiver chipsets, as well as a range of digital radio broadcast tower transmitters. No further standardisation work is required before implementing terrestrial broadcasting services.
Equipment	Existing now. A number of receiver models have been developed and are potentially available on any market where the services are to be implemented. The receivers normally incorporate both the 174-240 MHz band and the L-band.
Operational deployment	Operational deployment can start in 2013. Depends on commercial opportunities, may vary from country to country, few existing operational deployments even though the regulatory framework is available.

5.4.2 Mobile Broadband

Table 21: Criterion 4 – Mobile broadband

	Mobile Broadband
Band designation	End of 2012. However, for the FDD out-band pairing option (i.e. pairing the band 1452-1492 MHz - in uplink or downlink - with 40 MHz in –uplink or downlink – in another band) this will require the designation of a new band to pair with the L-band. *(NB: FDD with out-band pairing is different than supplemental downlink)*
Technical conditions	In case of TDD, LRTC by the end of 2013. In the case of FDD in-band pairing, it has been concluded that the maximum of 40 MHz potentially available in the L-band is considered not to be sufficient for a viable eco-system for in-band pairing (see section 4.2.1) In case of FDD out-band pairing (i.e. pairing the band 1452-1492 MHz - in uplink or downlink - with 40 MHz in – uplink or downlink – in another band), the technical conditions development timeline will depend on the designation of 40 MHz in another band to pair with the L-band in an FDD mode. This is not foreseen to take place in CEPT under a realistic timeframe.
Licensing	Licensing procedure could take up to 24 months after band designation, depending on national circumstances (taking into account existing

	Mobile Broadband
	licenses) Taking into account that the band is already available in a number of countries, administrations can start licensing the band for mobile use as soon as the ECC Decision on LRTC is adopted and subject to their national market demand.
Standardisation	3GPP will have to develop LTE TDD standard specifications in the band 1452-1492 MHz as this band is today not specified for LTE TDD. This specification work by 3GPP can take approximately one year after a proposal is made by the industry to 3GPP. In the context of this study, the industry hasn't made such a proposal; this would suggest that the standard in the L-band might be completed in 2014 at the earliest.
Equipment	After the completion of the L-band LTE TDD standard, it would take a year or two to make the equipment available as industry interest hasn't been expressed in the context of this work. This would suggest equipment availability in 2015/2016.
Operational deployment	Operational deployment may start in 2015/2016.

5.4.3 Mobile SDL

Table 22: Criterion 4 – Mobile SDL

	Mobile SDL
Band designation	End of 2012
Technical conditions	LRTC by the end of 2013 This requires a Decision by the ECC defining the LRTC for the band 1452-1492 MHz, based on a harmonised band plan of 8 blocks of 5 MHz each with associated Block Edge Mask (BEM).
Licensing	Licensing procedure could take up to 24 months after band designation, depending on national circumstances (taking into account existing licenses). Taking into account that the band is already available in a number of countries, administrations can start licensing the band for mobile use as soon as the ECC Decision on LRTC is adopted and subject to their national market demand.
Standardisation	3 GPP standardisation for the band is expected to be completed by the end of 2013. The 3GPP specifications already contain almost all the capability that would be required to combine operation on the current European mobile paired FDD band with a SDL at 1452-1492 MHz. The key things those specifications would need to cover are the capability to aggregate downlink channels across bands (to create greater bandwidth). This is already supported in standards for UMTS from Release 9 (HSPA+) and for LTE from Release 10 (LTE-Advanced). Each specific band combination would be defined in 3GPP. Likewise channel management, power control, quality management and handover are all within the capability of the existing standards specifications. The Work Items (WI) for similar arrangements in the 700 MHz band in the USA have already been approved in the 3GPP (see RP-110435). The work on this WI is already on-going and is planned to be completed in September 2012. A new Work Item in 3GPP would be required for a 1452-1492 MHz SDL. However the current AT&T will cover the technical issues that will need to be addressed. Once a decision on the harmonised use of the band is taken by the CEPT/ECC end of 2012, a request can be made to 3GPP to undertake the necessary work to include the 1452-1492 MHz SDL in the specifications for HSPA+ from Release 9, as well as

	Mobile SDL
	for LTE from Release 10, i.e. the first LTE release which supports multiple carrier aggregation capabilities. This work will be undertaken in parallel to the development of the harmonised LRTC by the ECC similar to previous work undertaken (e.g. UMTS900, 3.4 GHz). Based on experience with progressing specifications in 3GPP for AT&T's WI, the 1452-1492 MHz WI could be completed by the end of 2013 in 3GPP.
Equipment	Chipsets are planned to become available in 2013 to enable commercial devices in 2014. Base stations are planned to be available in 2014. HSPA+ Release 9 (capable of supporting dual band and dual carrier) and LTE Release 10 (capable of supporting carrier aggregation) chipset solutions are already in the planning stage within the mobile broadband industry. Those chipsets are planned to become available in 2013 to enable commercial devices in 2014. This development would happen in parallel with the work in 3GPP. Adding requirements for an SDL in the band 1452-1492 MHz does not impact the timeline for availability of those Release 9 HSPA+ and Release 10 LTE capable chipsets since a solution of the former entirely leverages the architecture of the latter. RF band support is a Release-independent feature in 3GPP, hence the 1452-1492 MHz band can be supported by Release 9 HSPA+ and Release 10 LTE devices although the band 1452-1492 MHz numerology and conformance test specifications will be part of a later 3GPP release. In summary, the timeline for availability of chipsets with a 1452-1492 MHz SDL capability will depend primarily on the timeline for adoption by the ECC of the LRTC in the band. This would enable commercial devices in 2014, subject to the adoption by the ECC of the harmonized LRTC in the band in 2013.Manufacturers will design, test and build Base Stations and other network equipment supporting the 1452-1492 MHz band. It is expected that this process will take 12 months leading to availability of equipment in 2014, subject to the adoption by the ECC of the harmonized LRTC in the band in 2013.
Operational deployment	Operational deployment can start in 2014. The timeline shown below highlights the various interrelated regulatory and market steps for the deployment of Mobile SDL in the 1452-1492 MHz band starting in 2014 in Europe. 

5.4.4 S-DAB

Table 23: Criterion 4 – S-DAB

	S-DAB
Band designation	Existing for satellite audio broadcasting within 1479.5-1492 MHz, ECC/DEC/(03)02 [2]. Alternatively within the option of using the whole 1467-1492 MHz band the timeframe depends on the establishment of a possible new ECC Decision including a new regulatory framework enabling satellite audio broadcasting. It is possible that this process will be completed by the end of 2012.
Technical conditions	Assuming that S-DAB would be deployed under the existing framework there is no need for new technical conditions, If S-DAB want to use the whole 1467-1492 MHz band then the associated technical specifications and regulations would be available by the end of 2013.
Licensing	Satellite component is not subject to national licenses. However, operation of the satellite is subject to ITU filings.
Standardisation	Existing SDR or DVB-SH.
Equipment	A number of European manufacturers have already developed broadcast and receiver equipment using the SDR standard for the Terrestrial Broadcasting application which also supports the S-DAB application. For large scale S-DAB deployment, equipment supplies would have to be confirmed and ramped up. It is expected that this process will take at least 12 – 18 months.
Operational deployment	The existing AFRISTAR satellite (operating under the AFRIBSS satellite filing) is understood to have a projected end of life in 2014 that could be extended. Operational deployment of a new service before 2015 using the AFRISTAR satellite would require agreement with AFRISTAR operator. In terms of capacity, the technical assessment for a new satellite assumes 1.88 Mbps in 3.4 MHz (for 50 audio channels at 32 kbps, plus overhead) with a minimum EIRP of 62 dBW edge-of-coverage (ie, 65 dBW at the center of the beam), for reception under line-of-sight conditions. Assuming availability of up to 25 MHz of spectrum across Europe (i.e, 1,467 – 1,492 MHz) an L-band satellite (with a multi-beam antenna) could cover at least 8 - 10 different markets with dedicated packages (with some markets covering multiple countries). A new satellite supporting the 1467-1492 MHz band can be deployed and in commercial operation within approx. 28 – 32 months from order, i.e. in the second or third quarter of 2015 assuming a decision towards the end of 2012.

5.4.5 PMSE

Table 24: Criterion 4 – PMSE

	PMSE
Band designation	End of 2012
Technical conditions	LRTC by the end of 2013
Licensing	Up to 6 months after technical conditions are available, depending on national circumstances (some administrations have allocated PMSE on a secondary basis in parts of the 1452-1492 MHz band according to their national frequency allocation table)
Standardisation	The ETSI Standard EN 300 422 [13] for wireless microphones was published in 2008. For applications not included in EN 300 422 [13] such as audio conference systems (see section 4.5) standardisation work would be required and could take approximately one year. For the existing standard to comply with the new LRTC, standardisation work could be required and could take approximately one year after the completion of the new LRTC.
Equipment	PMSE wireless microphones devices for operation in the L-Band will be available 6 months after band licensing (if EN 300 422 does not need to be revised to take into account new LRTC). Research and development was done for the 1.8 GHz spectrum and devices are on the market. PMSE manufacturers have invested into the development of equipment noting that in some countries parts of the 1452-1492 MHz band have been authorised for PMSE on a secondary basis according to their national frequency allocation table. There is an existing SRDoc since Jan 2007 (TR 102546 [15]) requesting spectrum for PMSE.
Operational deployment	Operational deployment can start in 2014

5.4.6 Broadband PPDR for local and temporary use

Table 25: Criterion 4 –Broadband PPDR

	Broadband PPDR for local and temporary use
Band designation	End of 2012
Technical conditions	LRTC by the end of 2013
Licensing	Up to six month after LRTC are available, depending on national circumstances
Standardisation	Approximately by the end of 2013. Usually, if broadly supported by stakeholders, standardisation can take

	Broadband PPDR for local and temporary use
	24 to 36 month. Under the assumption that LTE technology will be used by PPDR for temporary and local use the basic technology is available already today. The on-going standardisation activities would be limited to the additional development of the PPDR safety requirements. This includes the adoption of already existing requirements (e.g. from TETRA standard) and its implementation into the existing LTE standard. Assuming an overall support by the parties concerned, this will take only a few months. 3GPP Group SA (Service Aspects) is currently discussing a proposal issued by the US and Canada to consider the implementation of PPDR requirements into a LTE standard. There seems consensus on the possibility but the focus of the discussions is on the direct mode and its impact to the public availability of mass market terminal equipment. The usage needs to be limited to PPDR forces only, since otherwise public terminal equipment, equipped with the same chipset, would be able to listen to the direct mode transmissions in the related local area.
Equipment	Would be available shortly after standardisation process. Once standardisation activities are completed, network and user equipment will have to be developed and deployed. The needed time will vary on the intention of the Administrations, their considerations on urgency and available money. A dedicated estimation is therefore hardly possible. The time until related terminal equipment and infrastructure is available, depends on the willingness of CEPT Administrations and industry to agree on an appropriate standardisation measure (e.g. within ETSI) and the time needed by stakeholders and industry to adopt the related measure. The choice of standardised equipment will enhance its availability from every manufacturer throughout Europe and minimise therefore time for deployment and provision. However, as of today, there is no agreement between CEPT administrations and in the industry on a standardisation measure, thus it is not possible to estimate when related equipment could be made available.
Operational deployment	Operational deployment can start in 2014. The operational availability of broadband ad hoc/temporary networks depends on national needs and public finance constraints.

5.4.7 BDA2GC

Table 26: Criterion 4 – BDA2GC

	BDA2GC
Band designation	After the conclusion of FM50 work and a decision by the ECC about the most appropriate future use of the band 1452-1492 MHz which is expected to happen in October 2012, at least one WRC (WRC 15) would be needed to change the Radio Regulations (suppression of “except aeronautical mobile”).
Technical conditions	LRTC by the end of 2013
Licensing	Licensing procedure could take up to 24 month after band designation taking into account that a pan-European authorisation is needed.

	BDA2GC
Standardisation	Based on 3GPP LTE standard: - Ground Station (GS) corresponds to eNodeB in 3GPP LTE specifications. - Aircraft Station (AS) corresponds to UE in 3GPP LTE specifications, with BDA2GC specific enhancements (increased power, Doppler shift compensation, etc.). - No need to develop a harmonised standard. The access network of the BDA2GC system consists of a terrestrial mobile radio access network. The baseline access technology is the 3GPP evolved packet system (E-UTRAN+EPC) that is already commercially available (Release 8, known as LTE), and higher releases, i.e. the ground station equipment is in conformity with 3GPP specifications. The RF unit would need to be adapted to the operational frequency. BDA2GC specific enhancements required correspond mainly to operational aspects, e.g. antenna up-tilt at the Ground Station (Base Station), and network management issues. These modifications of ground stations do not require standardisation efforts. The rollout of BDA2GC will start with about 200 to 250 ground stations, covering of the European area with higher density air traffic, followed by a successively development to enlarge coverage and density in very high traffic areas. In the final state, the ground network covering Europe will encompass 400 to 500 ground stations. The addressable market in Europe for the on-board unit is about 4500 commercial aircraft, and about the same number of business aircraft. For this number of aircraft stations no 3GPP standardisation activities are expected to take place.
Equipment	Adaptations of the ground components are expected to be completed ten months after spectrum licensing. The aircraft station acts as a mobile station (MS) in the BDA2GC system. Compared to a MS used in a usual mobile network, increased output power is required due to the higher path loss (larger cell sizes) in the BDA2GC network. Also improved synchronization features, e.g. to compensate the high Doppler shift, will be implemented. Time necessary for manufacturing the specific aircraft installation kits and for the corresponding type approval at aviation authorities is estimated to be about one and a half year. Aircraft assembly will take place during maintenance or overnight stop.
Operational deployment	Operational deployment can start in 2018. The build-up of the ground network is assumed to last about one year, but backhaul and site preparations could be started in parallel with the adaptations of the ground components. The service rollout with first aircraft can be expected about 18 months after spectrum licensing.

5.5 CRITERION 5

This criterion aims at assessing the potential for economy of scale of an application based on the need and potential within CEPT and the potential for take up outside CEPT. The following sub-criteria have accordingly been chosen:

- Need for CEPT harmonisation;
- Potential for CEPT harmonisation;
- Potential for take up outside CEPT.

The sub-criterion “need for harmonisation” within CEPT assesses whether an application needs to be implemented throughout the CEPT to be successful. However this sub-criterion has not been graded as it is not felt to be either an advantage or a disadvantage to need harmonisation within a band that has a strong theoretical potential for harmonisation.

The next sub-criterion, “potential for CEPT harmonisation” has been graded as low, medium and high. The grade low has been reserved for applications needing harmonisation within CEPT while the actual prospects for such harmonisation (basically the support from administrations) are low. The grade high has been reserved for the application showing the most potential for CEPT harmonisation. All other applications have received the grade “medium” (as an application that does not need harmonisation for successful implementation should not be heavily penalized if it has only modest prospects for harmonisation).

The sub-criterion “Potential for take up outside CEPT” assesses the prospects that the application (within the 1452-1492 MHz band) may be successful outside of CEPT. These prospects have been graded as low, medium and high.

5.5.1 Terrestrial broadcasting

Table 27: Criterion 5 – Terrestrial broadcasting

	Terrestrial broadcasting
Need for CEPT harmonisation	No The viability of subscription radio can today be contemplated in one country, however the current level of harmonisation in the L band provides clear paths for further economies of scales along with other possible service rollouts in Europe.
Potential for CEPT harmonisation	Medium Two countries have deployed this application although the possibility for CEPT wide harmonization already exists (another country is in the process of granting a subscription radio license). The existence of between one to three national coverage(s) per country in the MA02revCO07 Plan warrants an option for a country to deploy terrestrial digital radio according to individual needs, if and when required, thereby providing scope for harmonisation in CEPT.
Potential for take up outside CEPT	Low The L-band has been allocated to DAB services in numerous countries outside Europe and, as in Europe, DAB services have not been implemented in this band. Many countries (see section 2), are reconsidering the use of the L-band, which was originally set aside for terrestrial radio broadcasting.

5.5.2 Mobile broadband

Table 28: Criterion 5 – Mobile broadband

	Mobile broadband
Need for CEPT harmonisation	Yes It is important to harmonise a band plan with associated least restrictive technical conditions based on blocks of 5 MHz in order to enable the deployment and development of Mobile Broadband for CEPT. For the

	Mobile broadband
	success of Mobile Broadband, it is important that these harmonised technical conditions would be adopted in large geographic area/population in Europe so that economies of scale in consumer devices and infrastructure equipment production can be realised.
Potential for CEPT harmonisation	Medium The significant and growing market demand for Mobile Broadband lead to a strong potential for Mobile Broadband harmonisation and economies of scale to be realized in CEPT
Potential for take up outside CEPT	High Taking into account that mobile data services in general are a high priority of administrations worldwide, as demonstrated by the numerous 'national broadband plans', some countries globally are currently considering the future use of the 1452-1492 MHz band for mobile broadband to fulfil their broadband objectives and looking at Europe current activity. Hence if a European allocation for Mobile Broadband is adopted, there is the potential for this allocation to be taken up in these other countries.

5.5.3 Mobile-SDL

Table 29: Criterion 5 – Mobile SDL

	Mobile SDL
Need for CEPT harmonisation	Yes It is important to harmonise a band plan with associated least restrictive technical conditions based on blocks of 5 MHz (i.e. 8 blocks of 5 MHz) for downlink use i.e. base station transmission towards mobile in order to enable the deployment and development of Mobile SDL for CEPT. For the success of Mobile SDL, it is important that these harmonised technical conditions would be adopted in large geographic area/population in Europe so that economies of scale in consumer devices and infrastructure equipment production can be realised.
Potential for CEPT harmonisation	High The significant and growing market demand for mobile Broadband coupled with the highly asymmetric nature of the mobile traffic lead to a strong potential for Mobile SDL harmonisation and economies of scale to be realised in CEPT
Potential for take up outside CEPT	High Taking into account that mobile data services in general are a high priority of administrations worldwide, as demonstrated by the numerous 'national broadband plans', some countries globally are currently considering the future use of the 1452-1492 MHz band for mobile broadband to fulfil their broadband objectives and looking at Europe current activity. Hence if a European allocation for Mobile SDL is adopted, there is the potential for this allocation to be taken up in these other countries.

5.5.4 S-DAB

Table 30: Criterion 5 – S-DAB

	S-DAB
Need for CEPT harmonisation	Yes
Potential for CEPT harmonisation	Low The band 1479.5-1492 MHz has been harmonised in CEPT for the last 10 years (ECC DEC (03) 02) with no commercial services successfully emerging. However, interest from two CEPT administrations has been expressed to be able to implement such services (on a different regulatory basis so as not to block other uses in other countries) within CEPT.
Potential for take up outside CEPT	Low The 1452-1492 MHz L-Band is allocated to the Broadcasting-Satellite Service on a co-primary basis across the globe (with the exception of the US). However, the potential of the band for satellite audio broadcasting service has been tested with no commercial success recorded, despite the fact that the 1452-1492 MHz L-Band has been harmonised by the ITU for satellite audio broadcast for the past 20 years. As far as CEPT is aware, there is no new satellite project beyond the filings stage outside of CEPT.

5.5.5 PMSE

Table 31: Criterion 5 – PMSE

	PMSE
Need for CEPT harmonisation	No However, for the success of PMSE, it is important that the band be allocated in a large number of countries in Europe so that economies of scale in devices can be realised.
Potential for CEPT harmonisation	Medium
Potential for take up outside CEPT	Low At this time, limited likelihood of countries of other regions implementing this application.

5.5.6 Broadband PPDR for local and temporary use

Table 32: Criterion 5 – Broadband PPDR

	Broadband PPDR for local and temporary use
Need for CEPT harmonisation	No. However large take up of this application would facilitate interoperability of European PPDR networks. It would also assist the economies of scale and therefore the cost of equipment.
Potential for CEPT harmonisation	Medium
Potential for take up outside CEPT	Low E.g. in the US, the focus for PPDR spectrum is on the UHF bands.

5.5.7 BDA2GC

Table 33: Criterion 5 – BDA2GC

	BDA2GC
Need for CEPT harmonisation	Yes Network investment and deployment costs as well as aircraft equipment are high for BDA2GC, and the associated high technological and financial risks require economies of scale for such a system in the form of pan-European geographic coverage (which is a possibility within the L-band), so that they remain economically viable. In order to achieve a continental-wide coverage, a harmonised radio spectrum allocation is essential. In addition, a European harmonised authorisation is considered necessary to provide the regulatory certainty that network operators and airlines require to invest in a BDA2GC system.
Potential for CEPT harmonisation	Low This ranking is specific to the band 1452-1492 MHz.
Potential for take up outside CEPT	Low As the potential for CEPT harmonisation in the band 1452-1492 MHz is low, this band might not be chosen for BDA2GC elsewhere due to low economies of scale. BDA2GC is by its nature a solution for flight routes over land mass, i.e. coverage above ocean is very limited. A covered extension to Middle-East and North Africa could be considered, provided the same spectrum as in CEPT could be made available there. Deployment of BDA2GC also in other regions (in particular Asia with its high grow potential) within the same frequency band as in Europe would enable increased economies of scale for industries involved. In North America a DA2GC solution has already been deployed using spectrum in the 800 MHz range.

6 REGULATORY OPTIONS

This section provides considerations on the regulatory framework for the possible development of the applications described in section 3.

6.1 LEAST RESTRICTIVE TECHNICAL CONDITIONS

A technology and service neutral regulatory framework is implemented through the definition of Least Restrictive Technical Conditions (LRTCs) applicable to a band. The definition of LRTC allows to harmonise the technical conditions applicable to a band (and potentially enables equipment to benefit from economies of scale) while allowing flexibility at national level, as it is being done for instance for the 800 MHz spectrum (Digital Dividend).

The definition of LRTCs is based on the principle that they solely address the technical compatibility issues:

- Case of adjacent frequency interference within a given geographical area of operation (in band and out-of-band interference) [38]
- Case of co-frequency interference in adjacent geographical areas of operation

The development of LRTCs should consider, where necessary, existing international and/or regional agreements. The LRTC developed in CEPT were based so far on the consideration of the compatibility of adjacent frequency interference within a given geographical area of operation.

LRTC enables authorised users of the band to deploy any application, provided such deployment respects the technical conditions set out in the LRTC. This kind of regulatory regime provides clear conditions of co-existence for users of other frequency blocks in the same band as well as users in adjacent frequency bands. The emissions allowed at block/band edges are stable and well known over time. Operators and regulators also benefit from the maximum possible flexibility to determine the use(s) of the band.

6.1.1 ECC experience with LRTCs

The ECC has a significant experience in the development of LRTCs. LRTCs have been developed for several applications in several bands.

The CEPT Report 19 [20] studied the applicability of LRTCs and developed LRTCs applicable to frequency bands addressed in the context of WAPECS in a number of bands (in particular 3.4-3.8 GHz and 2500-2690 MHz). The report notes, inter alia, that coexistence between two WAPECS blocks using the same frequency in geographically separated areas can for instance be determined by the use of field strength, and that a frequency separation of 5 MHz is needed between an FDD uplink block or unsynchronised TDD block with another TDD block operating in the same geographical area.

The CEPT Report 30 [21] developed LRTCs for both Electronic Communication networks (ECNs), PMSE applications and low power applications in the band 790-862 MHz. It should be noted that the CEPT Report 30 [21] relied on studies and conclusions from the CEPT Report 23 [22] and CEPT Report 29 [23] which were studying the general coexistence issues in the band 470-862 MHz.

The CEPT Report 39 [24] developed LRTCs for Electronic Communication networks (ECNs) and low power applications in the 2 GHz bands (i.e. in the bands 1920-1980 MHz paired with 2110-2170 MHz as well as in the bands 1900-1920 MHz and 2010-2025 MHz).

The ECC Report 131 [25] studied the coexistence issues between terminals deployed under LRTCs in the band 2500-2690 MHz.

[38] The conditions given by the regulatory framework for the protection of the adjacent bands (below 1452 MHz and above 1492 MHz) has to be taken into account by the future use(s) of the band 1452-1492 MHz. This should be done in the definition process of the LRTC.

From the above Reports, it can be noted that:

- Block Edge Masks (BEMs) combined with a harmonised band plan are the preferred option, and the only option selected so far, to implement LRTCs, i.e. to control adjacent frequency interference (both within the band and at the edge of the band);
- CEPT Report 19 [20] indicated that the aggregate PFD model or field strength is suitable to address scenarios related to co-frequency compatibility in geographically different service areas. However, this has not been implemented up to now.
- Establishing LRTCs relies on the selection of a reference system (network scenario, receiver performance, etc). However, BEMs have been developed for high level groups gathering a large number of applications. It is likely that LRTCs for co-frequency sharing can be developed for such high level groups. This is detailed in the following section.

It is not the purpose of this Report to establish the technical details of appropriate LRTCs, however a general LRTC framework can be derived from past CEPT experience in developing BEMs.

CEPT has some experience in developing BEM, however, the practical experience relating to the implementation of this concept is still limited.

6.1.2 Possible sets of LRTC to be developed

By reviewing the applications under consideration, it can be established that the platforms that deliver those applications are satellite-based, terrestrial-based or airborne-based.

Table 34: Platform to deliver the applications under consideration

Candidate Application	Satellite (inc. Terrestrial Component)	Terrestrial	Airborne
Terrestrial Broadcasting		■	
Mobile Broadband		■	
Mobile SDL		■	
Satellite Digital Audio Broadcasting	■		
Programme Making and Special Events (PMSE)		■	
Broadband Public Protection and Disaster Relief (BPPDR) for temporary and local use		■	
Broadband Direct-Air-to-Ground Communications			■

The following sections provide an overview of the LRTCs to be considered in order to cover the applications under consideration in the framework of this Report. The merging of some of these LRTCs should be considered when practicable (for example the LRTC for the forward link of BDA2GC could be similar to the LRTC for one of the terrestrial applications).

6.1.2.1 Terrestrial Systems

The past CEPT studies on LRTCs have identified a number of cases where the development of BEMs is straightforward, while on the contrary identifying a number of cases that would require specific measures (e.g. restricted blocks, stringent BEMs). Such cases are in particular related to the adjacent frequency operation of FDD and TDD networks within the same geographical area.

This has led to the following classification of applications[39]:

- ECN's DL (including broadcast) to receivers with high directionality and/or high gain (e.g. fixed). For such applications, the corresponding target received field strength is low. None of the applications studied in this report are targeting this kind of deployment scenario.

- ECN's DL (including broadcast) to mobile receivers with low directionality and/or low gain (e.g. vehicular or handheld devices for on-the-move, nomadic or stationary use). For such applications, the corresponding target received field strength is high enough to enable reception at ground level to receivers with low gain antennas. This category includes terrestrial broadcasting, downlink of Mobile broadband, Mobile Supplemental Downlink and downlink of Public Protection and Disaster Relief.

- ECN's UL and low power applications (e.g. handheld devices for on-the-move, nomadic or stationary use). This category includes uplink of mobile broadband (if applicable), Programme Making and Special Events and uplink of Public Protection and Disaster Relief.

At this stage, only the second case and third case described above seem to be relevant for the studies undertaken in the framework of this Report.

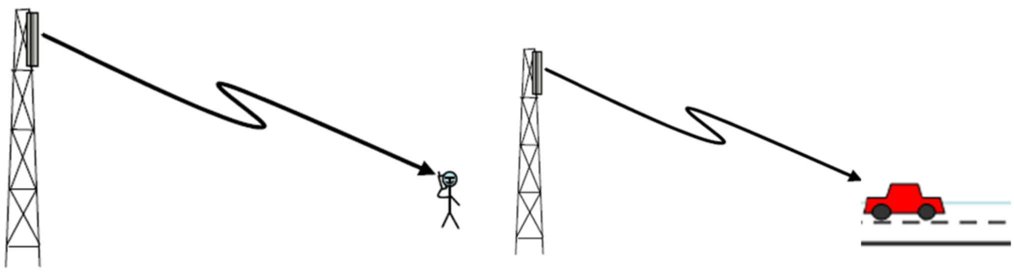

Figure 3: ECN's DL (including broadcast) to mobile receivers

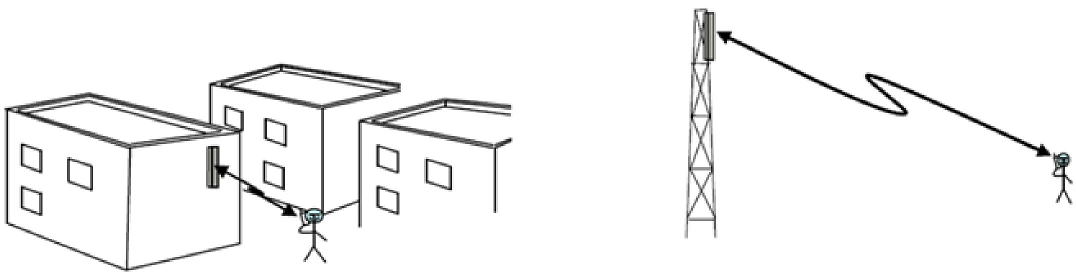

Figure 4: Duplex communications

In case of duplex communications, two sets of LRTCs are required:

- one for the DL and;
- one for the UL.

[39] The coexistence between high power broadcasting networks and low power ECNs has been studied in particular in the CEPT Report 23 [22], 29 [23] and 30 [21]. The main conclusions are that:

- The most difficult coexistence scenario is between ECNs UL and low power applications on one hand and broadcast to fixed receivers on the other hand and
- Coexistence between low power ECNs DL and high power broadcast networks is mainly governed by the reception mode of the broadcast transmission.

6.1.2.2 Satellite Digital Audio Broadcasting – (including terrestrial component)

Unlike some bands identified for satellite use, which are shared with other services, the band 1452 – 1492 MHz is not subject to any in-band pfd limits. In addition a CEPT Decision exists, at a purely regulatory level, that limits the use of satellite (in the ECC Decision ECC/DEC/(03)02) [2].

Satellite Digital Audio Broadcasting systems are referred to the band 1467-1492 MHz. If in-band pfd limits were applicable, these would be reflected in ITU-R RR Article 21, which is not the case today. However satellite use in the band 1452-1492 MHz is subject to out-of-band pfd limits. Here the limits, for emissions into adjacent bands from in-band emissions in 1452-1492 MHz, are detailed in Resolution 739 (Rev.WRC-07) [4].

Previous study work, in CEPT, had been carried out to address compatibility between S-DAB and T-DAB in adjacent bands (see ECC Report 161 [26]) and between S-DAB and PMSE (see ECC Report 121 [27]). New compatibility studies may have to be carried out depending on the outcome of the ECC work on the L-band and considering the information given in section 3.

In the development of the LRTC for the terrestrial component, similar approach as for the Terrestrial Systems should be considered, as appropriate.

One option would be to adopt the same channel raster as in the existing regulations (1.7 MHz).

6.1.2.3 BDA2GC

Compatibility studies between a BDA2GC system and a terrestrial cellular mobile system, both based on LTE technology, were performed for the band 3400-3600 MHz. The evaluations results state that in principle a LTE-based BDA2GC system can co-exist with a terrestrial mobile radio system with similar characteristics in the adjacent channel, in particular if FDD mode operations are considered for both systems. No additional guard band between the channel block edges is required in that case.

For TDD or mixed FDD/TDD mode operations the main problem to be solved is the decoupling of the antennas of the BDA2GC ground station and the terrestrial cellular mobile base station (eNodeB) which requires sufficient isolation in space and/or frequency. Therefore, it was concluded that frequency guard bands of about 5 MHz would be required when operating in different transmit directions in adjacent channels, as it applies also for the operation of different terrestrial cellular mobile networks within the same geographical area.

The conclusions drawn for the band 3400-3600 MHz would similarly apply also for the operation of BDA2GC adjacent to terrestrial cellular mobile networks the band 1452-1492 MHz.

Further compatibility studies may have to be carried out depending on the outcome of FM50 work with a view to developing LRTCs for BDA2GC if relevant, while noting the following:

- The BDA2GC reverse link (transmission from airplane, reception at ground station) requires higher transmission power than the uplink in terrestrial mobile systems, which indicates that BDA2GC LRTC would be different than for terrestrial systems LRTC which are typically based on an in-band power limitation. The maximum transmitter power for the BDA2GC-AS is 40 dBm TRP.
- The LRTC for the BDA2GC forward link have to be studied, taking into account that LRTC previously derived for the downlink of terrestrial systems all assume antenna down-tilt, whereas the BDA2GC forward link relies on the ground station antenna characteristic with special emphasis on the antenna up-tilt to achieve sky coverage.

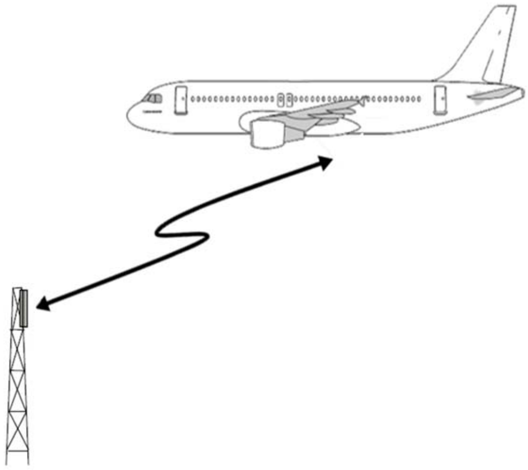

Figure 5: DA2GC

BDA2GC would require two sets of LRTCs, one for forward link (Ground-to-Air) and one for the reverse link (Air-to-Ground)

6.1.3 Reference systems

In order to establish compatibility criteria for systems operating in the band, it may be necessary to make some assumptions about likely systems in the band. The expression of minimum technical restrictions will be linked to a given set of assumptions generally identified through a market analysis.

For each band (or sub-band) one or more reference systems can be identified, based on the market analysis of most likely systems for that band (typically through research and consultation with interested parties).

LRTCs to date have consisted of the combination of:

- A harmonised band plan;
- Generic Block Edge Masks for adjacent frequency use (both within the band and at the band edges), enabling co-existence within a group of applications deployed in the same service area;
- Restricted Block Edge Masks for co-existence between groups of applications.

6.1.4 Initial considerations on LRTC for Terrestrial system

6.1.4.1 Possible Band plan(s)

It will be up to ECC to decide to retain parallel band plans or to select a preferred band plan and abrogate the MA02revCO07 [1] band plan. In the previous studies on the 800 MHz band, the preferred band plan was adopted in ECC/DEC/(09)03 [2] while the channelling arrangement from GE06 was maintained.

The adoption of 5 MHz block size has been used for the development of LRTCs in other bands. The 5 MHz band plan option is optimal for most terrestrial applications under consideration in 1452-1492 MHz. A 5 MHz plan uses efficiently the entire 40 MHz bandwidth and thus maximises spectrum availability.

A 1.7 MHz band plan based on MA02revCO07 [1] is optimal for T-DAB technologies. A 1.7 MHz plan uses a total bandwidth of 39.1 MHz. There is 0.9MHz unused and cannot accommodate most of applications based on broadband technologies.

A channel raster of 5.1 MHz (3x1.7 MHz) is considered in CEPT Report 18 [5]. However, it does not seem to be optimal for most of the applications under consideration. In addition, a band plan based on 5.1 MHz blocks will use a total of 35.7 MHz resulting in 4.3 MHz unused in the band 1452-1492 MHz.

Although, two candidate band plans are still under consideration, the final aim is to identify a single band plan in order to achieve harmonisation in CEPT to the maximum extent possible.

The band plan options for 1452-1492 MHz are illustrated in the figures below:

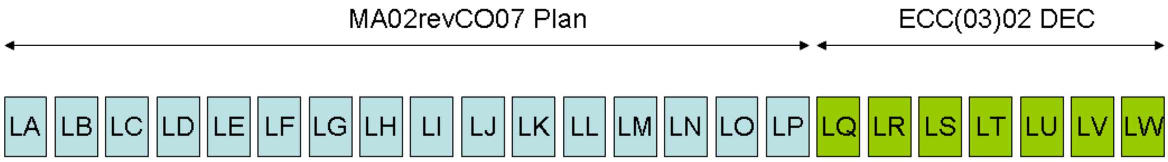

Figure 6: Band plan option A for 1452-1492 MHz band based on 1.7 MHz block size

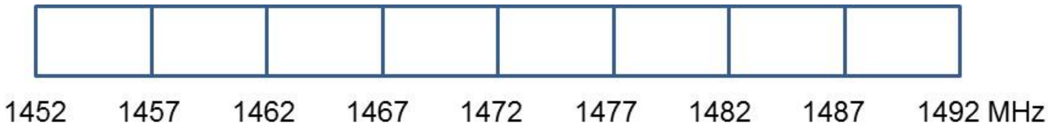

Figure 7: Band plan option B for 1452-1492 MHz band based on 5 MHz block size

6.1.4.2 Generic BEM

A generic BEM ensures coexistence between applications belonging to the same group of applications, i.e. ECNs DL vs ECNs DL and ECNs UL vs ECNs UL. In previous CEPT studies, such a generic BEM was typically derived from considerations of the Spectrum Emission Masks of the reference system for the group of applications.

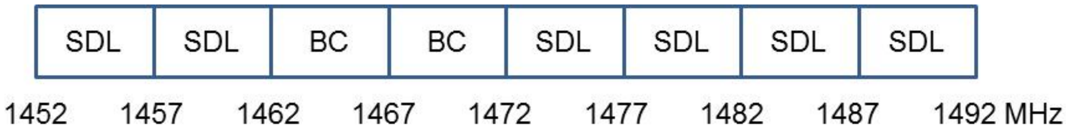

Figure 8: Example of mixed allocations between Mobile SDL and Broadcast (BC) at national level

In previous CEPT studies on the generic BEM for ECNs UL and low power applications, were implying a maximum in-band power, with no further constraints applied.

Appropriate CEPT reviews may be needed to verify these initial (as well as additional) considerations about the suitability of these candidate Generic BEMs.

6.1.4.3 Restricted BEM

The coexistence of ECNs DL and ECNs UL usually require the adoption of restricted blocks, on which restricted BEMs apply, as illustrated in Figure 9: below.

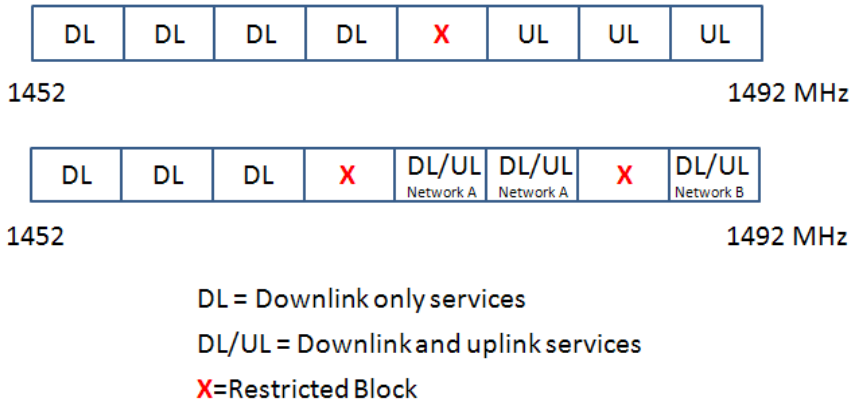

Figure 9: Example of mixed allocations between DL and DL/UL blocks, including resulting restricted blocks

This figure depicts illustrative examples. Requirements for restricted blocks have to be assessed on a case by case basis.

In such restricted blocks, the maximum in-band power is limited and the reception sensitivity may be degraded due to interference from adjacent DL blocks. The CEPT Reports 19 [20], 39 [24] and ECC Report 131 [25] have studied extensively these restricted blocks and provide an adequate corresponding regulatory framework.

6.2 PAN-EUROPEAN VS NATIONAL COVERAGE

The candidate applications can be classified based on their technical and regulatory requirement in two groups:

- Applications requiring the harmonisation and identification of spectrum for CEPT-wide use/coverage;
- Applications requiring the harmonisation and identification of spectrum for deployment at national level.

6.2.1 Applications requiring the harmonisation and identification of spectrum for CEPT-wide use/coverage

In general, the applications in this section either require the allocation of the band (or a sub-band) due to the service requirement, or will impact use of the band (or a sub-band) due to the inherent nature of their deployment which cannot be restricted to a single country.

6.2.1.1 Satellite Digital Audio Broadcasting– (including terrestrial component)

Satellite Digital Audio Broadcasting– (including terrestrial component) relies on a satellite component. Such satellite service provides naturally a Europe wide coverage in 1467-1492 MHz, i.e. the satellite beam cannot be shaped to cover a single country but covers multiple CEPT countries.

As a result, the decision from a CEPT country to allow satellite digital audio broadcasting– (including terrestrial component) within its border will directly result in signal covering also its neighbouring countries. In countries which decide not to protect on their territory the satellite broadcasting reception this signal is to be considered as interference. The terrestrial component can be deployed at national level.

6.2.1.2 BDA2GC

The objective of BDA2GC is to provide access to broadband communication services for air passengers during continental flights on a Europe-wide basis.

As such the implementation of BDA2GC in the band 1452-1492 MHz requires the harmonisation and identification of two 10 MHz FDD blocks or one 20 MHz TDD block within this band by ECC for pan-European use.

6.2.2 Applications requiring the harmonisation and identification of spectrum for deployment at national level

All terrestrial candidate applications can be deployed on a national basis, including Terrestrial Broadcasting, Mobile Broadband, Mobile SDL, BPPDR and PMSE. Fundamentally, this is due to the fact that the service area of a single base station (respectively access point) is much smaller than a country.

Issues that may arise at borders of countries which allocate a given sub-band to two different systems are solved through cross-border coordination between the involved countries; usually using ECC agreed recommendations and methodologies.

Despite the possibility to deploy the service on a national basis most of these systems require harmonisation at CEPT level, in particular of the band plan and the least restrictive technical conditions, in order to achieve economies of scale, ensure the availability of equipment, interoperability and roaming across CEPT countries. This is usually achieved through ECC Decision which harmonise the spectrum and in particular the band plan while maintaining the possibility to adapt to national requirements and needs. One typical example is the bands harmonised for the mobile services within CEPT, for which many countries may licence the whole band and some of them just a sub-band to take into account national requirements.

6.3 REGULATORY OPTIONS CONSIDERED

The following three regulatory options are considered based on the technical, spectrum and regulatory requirements of the candidate applications.

Regulatory Option 1[40] (No Change – baseline for the impact assessment): This option corresponds to the harmonised use of the band 1452-1492 MHz for terrestrial broadcasting (limited to 1452-1479,5 MHz) and S-DAB (limited to 1479.5-1492 MHz) in CEPT.

- The ECC will then maintain the harmonised band plan for the sub-band 1452-1479.5 MHz based on 1.7 MHz blocks and the MA02revCO07 Plan [1], optimising the use of the spectrum for terrestrial broadcasting in CEPT. PMSE can use this sub-band on a secondary basis.
- The ECC will also maintain the harmonisation of the band 1479.5-1492 MHz for S-DAB as per ECC/DEC/(03)02 Decision.

[40] "When identifying the possible options, ECC should generally start by considering the option of not changing the regulatory framework, either by not introducing regulation or by retaining existing regulation. This option – 'Do Nothing' will be the benchmark or base case against which other options will be judged even though it may not be always practical" see ECC Report 125 [7].

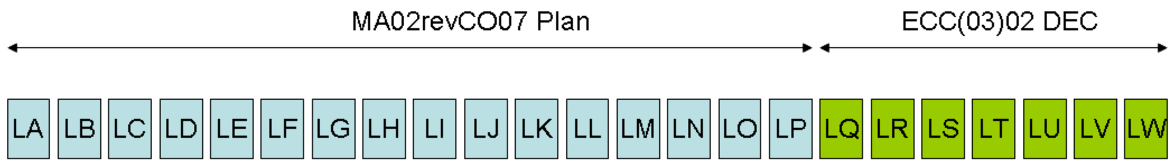

Figure 10: 1452-1479.5 MHz for terrestrial broadcasting and 1479.5-1492 MHz for satellite digital audio broadcasting

Regulatory Option 2: This option corresponds to the harmonised use of the band 1452-1492 MHz for Mobile Broadband / Mobile SDL in CEPT while allowing at the same time individual countries to adapt to national circumstances in part of the band for other terrestrial applications i.e. Terrestrial Broadcasting, PPDR (Broadband PPDR for temporary and local use) and PMSE (secondary basis).

- The ECC will adopt an ECC Decision designating the band for Mobile/Fixed Communication Networks (MFCN) and defining the Least Restrictive Technical Conditions with a harmonised band plan for the 1452-1492 MHz band, based on 8 blocks of 5 MHz with associated generic BEM and restricted BEM (for coexistence between uplink and downlink blocks).
- The MA02revCO07 [1] Special Arrangement should be retained for cross-border coordination bilateral agreements in the sub-band 1452-1479.5 MHz, between Terrestrial Broadcasting (for countries wishing to deploy terrestrial broadcasting in part of the band) and mobile services similar to the framework developed by CEPT for the 800 MHz band with GE06 and ECC/DEC(09)03 [3].
- An administration wishing to implement terrestrial digital sound broadcasting networks in part of the 1452-1492 MHz may choose to do so using the MA02revCO07 Special Arrangement and its possible Plan modifications.
- Mobile to mobile cross-border coordination in the band 1452-1492 MHz will be subject to an ECC Recommendation for bilateral agreements as for other mobile to mobile cross-border coordination in other bands. .
- The ECC/DEC/(03)02 Decision [2] will need to be suppressed.
- An agenda item to introduce pfd limits to be included in Article 21 of the RR should be submitted at the next WRC. The objective is to protect MFCN use within CEPT from harmful interference from satellite use outside CEPT[41];

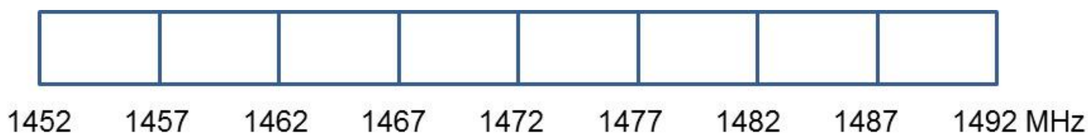

Figure 11: Harmonisation of 1452-1492 MHz for MFCN based on 5 MHz block size

Regulatory Option 3: This option corresponds to the harmonised use of 20 MHz in the band 1452-1492 MHz for Broadband Direct-Air-to-Ground Communication in CEPT while allowing individual countries to implement - according to national needs – other applications, if the spectrum requirements of those applications are satisfied in the remaining up to 20 MHz, subject to the necessary guard bands.

- The ECC will adopt an ECC Decision designating two 10 MHz FDD blocks or one 20 MHz TDD block for BDA2GC as illustrated in the following figures.

[41] In the meantime, Administrations will have the possibility to register terrestrial stations of the SDL mobile service in the MIFR in order to ensure protection of MFCN from satellite interference through the ITU coordination procedure.

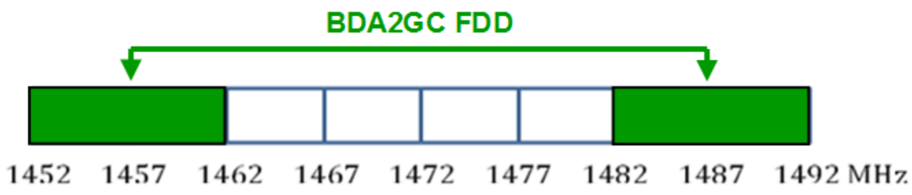

Figure 12: Harmonisation and designation of two 10 MHz FDD blocks to BDA2GC

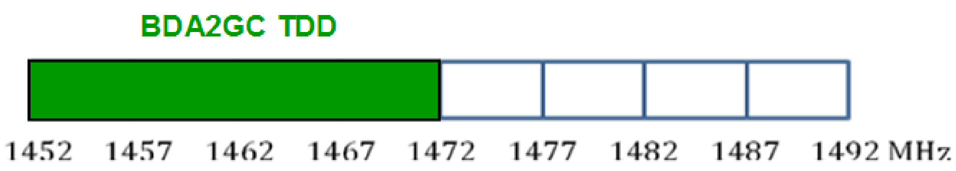

Figure 13: Example for harmonisation and designation of one 20 MHz TDD block to BDA2GC

- The ECC/DEC/(03)02 Decision [2] will need to be suppressed.
- The harmonisation on a European basis for BDA2GC may lead to a revision of the MA02revCO07 Special Arrangement in order to consider the stations already deployed or the entries in the frequency ranges designated for BDA2GC.
- Pursue the suppression in the RR of the exemption of Aeronautical Mobile Service in the band 1452-1492 MHz.
- Define the pfd limits to be included in Article 21 of the RR at the next WRC to protect BDA2GC use within CEPT from harmful interference from satellite use outside CEPT.

7 IMPACT ANALYSIS OF THE REGULATORY OPTIONS

This section considers the regulatory options for the future use of the band 1452-1492 MHz in CEPT as defined in section 6.3 to assess their benefits based on the criteria defined in section 3 and the analysis conducted in section 5. The aim of the impact analysis is to assess which regulatory option should be selected by CEPT for the future use of the 1452-1492 MHz band.

7.1 METHODOLOGY

The five criteria for the impact analysis are described and discussed for each application in Section 5. The way, in which the contributions from individual applications are combined into a single assessment of a regulatory option, differ from one criterion to another as detailed in the methodology provided below:

- Criteria 1 and 2 award points directly for the regulatory options (not for individual applications as supported by the regulatory option);
- Criterion 3 awards points for individual applications, which are summed appropriately for regulatory options;
- Criteria 4 and 5 award points for individual applications and the contributions to the regulatory option is the weighted sum of marks of each individual application.

Table 35: Reference Analysis Table

Priority	Maximum Points	No	Criterion	Result of the analysis	Points
High	3	3a	Consumer surplus		
	3	3b	Citizen/consumer benefits		
	2	3c	Producer surplus		
	1	3d	Producer/industry benefits		
	9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation		
	6	5a	Potential for CEPT harmonisation		
	5	5b	Potential for take-up of application outside CEPT		
Medium	6	2	Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)		
	2	1a	Compatibility with the Radio Regulations (Article 5)		
	2	1b	Compatibility with MA02revCO07		
Low	1	1c	Compatibility with ECC/DEC/(03)/02		

For the purpose of this impact analysis, the term main application is used to describe the most appropriate use of the L band for each regulatory option as described in section 6.3.

- For regulatory option 2, the analysis will have to be carried out separately for mobile supplemental downlink (SDL) (scenario 2-A) and mobile broadband (MBB) (scenario 2-B). This will result in two different scenarios under regulatory option 2.
- With regard to regulatory option 3, the analysis will have to be carried out separately for the scenarios where either broadband PPDR (scenario 3-A) or PMSE (scenario 3-B) is considered in the remaining part of the band, i.e. outside the spectrum identified for BDA2GC. This will result in two different scenarios under regulatory option 3.

It is important to note that the scenarios described above correspond to a simplification for the purpose of the impact analysis of the full regulatory options as described in Section 6.3.

7.2 APPLICATION OF THE CRITERIA

7.2.1 Criterion 1 - Compatibility with regulatory framework

This criterion awards points to regulatory options and scenarios (if more than one scenario is identified under a regulatory option).

Assessing criterion 1 for each application is not appropriate because some applications may be incompatible when combined in a specific regulatory option. For example:

- Terrestrial broadcasting is on its own compatible with ECC/DEC/(03)02 [2] when using the lower part of the band, while also
- BDA2GC is compatible with ECC/DEC/(03)02 [2] when using the lower part of the band.
- However, Terrestrial broadcasting and BDA2GC cannot be simultaneously compatible with ECC/DEC/(03)02 [2].

The impact of the exact positioning of application with regards to the entire band explains why the compatibility of an application with given regulatory regime can only be judged in the context of a complete regulatory option.

Sub-criterion 1a: Compatibility with the Radio Regulations (Article 5) [4]
This sub-criterion awards a maximum of 2 points.
2 points are awarded if the Regulatory Option is compatible with the Radio Regulations (Article 5).
0 point is awarded if the Regulatory Option is not compatible with the Radio Regulations (Article 5).

Sub-criterion 1b: Compatibility with MA02revCO07 [1]
This sub-criterion awards a maximum of 2 points.
2 points are awarded if the Regulatory Option is compatible with MA02revCO07.
0 point is awarded if the Regulatory Option is not compatible with MA02revCO07.

Sub-criterion 1c: Compatibility with ECC/DEC/(03)/02 [2]
This sub-criterion awards a maximum of 1 point.
1 point is awarded if the Regulatory Option is compatible with ECC/DEC/(03)/02.
0 point is awarded if the Regulatory Option is not compatible with ECC/DEC/(03)/02.

Table 36: Assessment of Criterion 1 for each Regulatory Option / Scenario

Regulatory Option / Scenario	Sub-criterion 1a	Sub-criterion 1b	Sub-criterion 1c
Regulatory Option 1	2	2	1
Regulatory Option 2 / Scenario A	2	2	0
Regulatory Option 2 / Scenario B	2	2	0
Regulatory Option 3 / Scenario A	0	0	0
Regulatory Option 3 / Scenario B	0	0	0

7.2.2 Criterion 2 - Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)

This criterion awards points to regulatory options and scenarios (if more than one scenario is identified under a regulatory option).

This criterion provides a measure of how much flexibility is available to a country on a national basis while achieving harmonisation through the regulatory option or scenario, if more than one case is identified under a regulatory option. This means it measures the number of applications among the 7 applications under consideration that are not considered as a main application, but can be deployed on a national basis.

This criterion awards a maximum of 6 points.

For Na applications that are not considered as main applications, Ns applications can be introduced on a national basis (only applications considered in the draft ECC Report should be taken into account).
The points awarded to each regulatory option are derived from the following formula:

$$\text{Awarded Points} = 6 \times Ns / Na$$

Ns, Na as well as the points awarded to each regulatory option / scenario are detailed in Table 37:.

Table 37: Main Applications and Applications on a National Basis for each Regulatory Option / Scenario

Regulatory Option / Scenario	Main (harmonized) applications	Other applications	Na	Applications on national basis	Ns	Points
Regulatory Option 1	TB S-DAB	MBB SDL PMSE PPDR BDA2GC	5	PMSE	1	1.2
Regulatory Option 2 / Scenario A	SDL	TB S-DAB MBB PMSE PPDR BDA2GC	6	TB PMSE PPDR	3	3
Regulatory Option 2 / Scenario B	MBB	TB S-DAB SDL PMSE PPDR BDA2GC	6	TB PMSE PPDR	3	3
Regulatory Option 3 / Scenario A	BDA2GC PPDR	TB S-DAB MBB SDL PMSE	5	PMSE TB (see Note 1)	2	2.4
Regulatory Option 3 / Scenario B	BDA2GC PMSE	TB S-DAB MBB SDL PPDR	5	PPDR TB (see Note 1)	2	2.4

Note 1: it is assumed that the deployment of TB on a national basis could be accommodated in the spectrum not identified for BDA2GC (20 MHz).

7.2.3 Criterion 3 - Extent (maximisation) of social and economic benefits

This criterion awards points to candidate applications (only to main applications).

Sub-criterion 3a: Consumer surplus

This sub-criterion awards a maximum of 3 points.

The points awarded to each application are derived from the following formula:

$$\text{Awarded Points} = 3 \times CS / CSmax$$

where CS is the consumer surplus of the specific application and CSmax is the maximum among the consumer surplus of all applications.

0 point is awarded to an application when no consumer surplus information is available.

The following table provides an overview of the results for the applications under consideration.

Table 38: Consumer Surplus of Candidate Applications

Application	Consumer Surplus	Points
TB + S-DAB	8.6 b€	0.9
MBB	N/A	0
SDL	28 b€	3
PMSE	N/A	0
PPDR	4.7 b€	0.5
BDA2GC	N/A	0

As can be seen from Table 38:, CSmax = 28 b€.

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario.

Table 39: Assessment of Criterion 3a for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	0.9
Regulatory Option 2 / Scenario A	3
Regulatory Option 2 / Scenario B	0
Regulatory Option 3 / Scenario A	0.5
Regulatory Option 3 / Scenario B	0

Sub-criterion 3b: Citizen/consumer benefits

This sub-criterion awards a maximum of 3 points.
Each application is awarded a grade, based on the analysis carried out in Section 5. Each grade awards a specific number of points:

- Very High (3 points)
- High (2 points)
- Medium (1 point)
- Low (0 point)

The following table provides an overview of the results for the applications under consideration.

Table 40: Citizen/Consumer Benefits

Application	Grade	Points
TB	Medium	1
MBB	High	2
SDL	Very High	3
S-DAB	Low	0
PMSE	Medium	1
PPDR	Very High	3
BDA2GC	Medium	1

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a} \times \frac{BW_a}{40\ MHz}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario and BW_a is the bandwidth allocated to application a.

Table 41: Assessment of Criterion 3b for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	0.7
Regulatory Option 2 / Scenario A	3
Regulatory Option 2 / Scenario B	2
Regulatory Option 3 / Scenario A	2
Regulatory Option 3 / Scenario B	1

Sub-criterion 3c: Producer surplus

This sub-criterion awards a maximum of 2 points.

The points awarded to each application are derived from the following formula:

Awarded Points = 2 x PS / PSmax

where PS is the producer surplus of the specific application and PSmax is the maximum among the producer surplus of all applications.

0 point is awarded to an application when no producer surplus information is available.

The following table provides an overview of the results for the applications under consideration.

Table 42: Producer Surplus of Candidate Applications

Application	Producer Surplus	Points
TB + S-DAB	1.6 b€	0.1
MBB	N/A	0
SDL	26 b€	2
PMSE	1.9 b€	0.1 (0.15)
PPDR	N/A	0
BDA2GC	0.591 b€	0 (0.05)

As can be seen from the Table 42:, PSmax = 26 b€.

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario.

Table 43: Assessment of Criterion 3c for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	0.1
Regulatory Option 2 / Scenario A	2
Regulatory Option 2 / Scenario B	0
Regulatory Option 3 / Scenario A	0
Regulatory Option 3 / Scenario B	0.2

Sub-criterion 3d: Producer/industry benefits

This sub-criterion awards a maximum of 1 point.

Each application is awarded a grade, based on the analysis carried out in Section 5. Each grade awards a specific number of points:

- High (1 point)
- Low (0 point)

The grades awarded to each application are provided in the table below.

Table 44: Producer/Industry Benefits

Application	Grade	Points
TB	High	1
MBB	Low	0
SDL	High	1
S-DAB	High	1
PMSE	High	1
PPDR	High	1
BDA2GC	High	1

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a} \times \frac{BW_a}{40\ MHz}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario and BW_a is the bandwidth allocated to application a.

Table 45: Assessment of criterion 3d for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	1
Regulatory Option 2 / Scenario A	1
Regulatory Option 2 / Scenario B	0
Regulatory Option 3 / Scenario A	1
Regulatory Option 3 / Scenario B	1

7.2.4 Criterion 4 - Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation

This criterion award points to candidate applications (only to main applications).

This criterion awards a maximum of 9 points.

The points awarded to each application are derived from the following formula:

$$Awarded\ Points_{application\ a} = 9 \times \left(1 - \frac{\Delta T_{application\ a}}{Max(\Delta T)}\right)$$

where

- $\Delta T_{\text{application a}}$ is the number of months between the date of operational deployment of application a and T_0.
- $Max(\Delta T)$ is the number of months between the latest date of operational deployment among all applications and T_0.
- T_0 is the date of "band designation" as defined in section 5.4 for the applications under consideration.

Table 46: Assessment of criterion 4 for each application

Application	T0	Date of Operational deployment (see section 4)	ΔT (months)	Points
TB	Mid 2002	2013	126	1
MBB	End of 2012	2015-2016	30	7.1
SDL	End of 2012	2014	18	7.9
S-DAB	2003	Q3 2015	141	0
PMSE	End of 2012	2014	18	7.9
PPDR	End of 2012	2014	18	7.9
BDA2GC	End of 2015	Q3 2017	18	7.9

This also indicates that
$Max(\Delta T) = 141$

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a} \times \frac{BW_a}{40\ MHz}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario and BW_a is the bandwidth allocated to application a.

Table 47: Assessment of Criterion 4 for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	0.7
Regulatory Option 2 / Scenario A	7.9
Regulatory Option 2 / Scenario B	7.1
Regulatory Option 3 / Scenario A	7.9
Regulatory Option 3 / Scenario B	7.9

7.2.5 Criterion 5 - Potential for harmonisation within and outside CEPT

This criterion awards points to candidate applications (only to main applications).

Sub-criterion 5a: Potential for CEPT harmonisation
This sub-criterion awards a maximum of 6 points, with the difference between maximum and minimum grade being 5 points.

Each application is awarded a grade, corresponding to the analysis carried out in Section 5. Each grade awards a specific number of points:

- High (6 points)
- Medium (4 point)
- Low (1 point).

The grades for each application are provided in Table 48:.

Table 48: Potential for CEPT harmonisation

Application	Grade	Points
TB	Medium	4
MBB	Medium	4
SDL	High	6
S-DAB	Low	1
PMSE	Medium	4
PPDR	Medium	4
BDA2GC	Low	1

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a} \times \frac{BW_a}{40\ MHz}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario and BW_a is the bandwidth allocated to application a.

Table 49: Assessment of Criterion 5a for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	3.1
Regulatory Option 2 / Scenario A	6
Regulatory Option 2 / Scenario B	4
Regulatory Option 3 / Scenario A	2.5
Regulatory Option 3 / Scenario B	2.5

Sub-criterion 5b: Potential for take-up of application outside CEPT

This sub-criterion awards a maximum of 5 points, with the difference between maximum and minimum grade being 4 points.

Each application is awarded a grade, corresponding to the analysis carried out in Section 5. Each grade awards a specific number of points:

- High (5 points)
- Medium (3 point)
- Low (1 point).

Table 50: Potential for Take-up of Application Outside CEPT

Application	Grade	Points
TB	Low	1
MBB	High	5
SDL	High	5
S-DAB	Low	1
PMSE	Low	1
PPDR	Low	1
BDA2GC	Low	1

The points awarded to each regulatory options / scenario are derived from the following formula:

$$Awarded\ Points_{Regulatory\ Option} = \sum_{a=1}^{nb\_applications} Awarded\ Points_{Application\ a} \times \frac{BW_a}{40\ MHz}$$

where $nb\_applications$ is the number of main applications for a specific regulatory option / scenario and BW_a is the bandwidth allocated to application a.

Table 51: Assessment of Criterion 5b for each Regulatory Option / Scenario

Regulatory Option / Scenario	Points
Regulatory Option 1	1
Regulatory Option 2 / Scenario A	5
Regulatory Option 2 / Scenario B	5
Regulatory Option 3 / Scenario A	1
Regulatory Option 3 / Scenario B	1

7.3 DETAILED REGULATORY OPTION (INCLUDING SCENARIOS) ASSESSMENT

This section provides an overview of the results based on the analyses given in section 7.2.

7.3.1 Regulatory option 1: T-DAB in 1452-1479.5 MHz and S-DAB in 1479.5-1492 MHz

Table 52: Assessment of Regulatory Option 1

Maximum Points	No	Criterion	Result of the assessment	Points
3	3a	Consumer surplus	8.6 b€	0.9
3	3b	Citizen/consumer benefits	Medium (TB)	0.7

Maximum Points	No	Criterion	Result of the assessment	Points
			Low (S-DAB)	
2	3c	Producer surplus	1.6 b€	0.1
1	3d	Producer/industry benefits	High (TB) High (S-DAB)	1
9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation	∆T=126 months (TB) ∆T=141 months (S-DAB)	0.7
6	5a	Potential for CEPT harmonisation	Medium (TB) Low (S-DAB)	3.1
5	5b	Potential for take-up of application outside CEPT	Low (TB) Low (S-DAB)	1
6	2	Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)	PMSE	1.2
2	1a	Compatibility with the Radio Regulations (Article 5)	Compatible	2
2	1b	Compatibility with MA02revCO07	Compatible	2
1	1c	Compatibility with ECC/DEC/(03)/02	Compatible	1

7.3.2 Scenario 2-A under regulatory option 2: Mobile supplemental downlink in 1452-1492 MHz

Table 53: Assessment of Regulatory Option 2 - Scenario 2-A

Maximum Points	No	Criterion	Result of the assessment	Points
3	3a	Consumer surplus	28 b€	3
3	3b	Citizen/consumer benefits	Very High	3
2	3c	Producer surplus	26 b€	2
1	3d	Producer/industry benefits	High	1
9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation	∆T=18 months	7.9
6	5a	Potential for CEPT harmonisation	High	6
5	5b	Potential for take-up of application outside CEPT	High	5
6	2	Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)	TB, PMSE and PPDR	3
2	1a	Compatibility with the Radio Regulations (Article 5)	Compatible	2
2	1b	Compatibility with MA02revCO07	Compatible	2
1	1c	Compatibility with ECC/DEC/(03)/02	Not compatible	0

7.3.3 Scenario 2-B under regulatory option 2: Mobile broadband in 1452-1492 MHz

Table 54: Assessment of Regulatory Option 2 - Scenario 2-B

Maximum Points	No	Criterion	Result of the assessment	Points
3	3a	Consumer surplus	N/A	0
3	3b	Citizen/consumer benefits	High	2
2	3c	Producer surplus	N/A	0
1	3d	Producer/industry benefits	Low	0
9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation	∆T=30 months	7.1
6	5a	Potential for CEPT harmonisation	Medium	4
5	5b	Potential for take-up of application outside CEPT	High	5
6	2	Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)	TB, PMSE and PPDR	3
2	1a	Compatibility with the Radio Regulations (Article 5)	Compatible	2
2	1b	Compatibility with MA02revCO07	Compatible	2
1	1c	Compatibility with ECC/DEC/(03)/02	Not compatible	0

7.3.4 Scenario 3-A under regulatory option 3: BDA2GC in 1452-1472 MHz and PPDR in 1472-1492 MHz

Table 55: Assessment of Regulatory Option 3 - Scenario 3-A

Maximum Points	No	Criterion	Result of the assessment	Points
3	3a	Consumer surplus	N/A (BDA2GC) 4.7 b€ (PPDR)	0.5
3	3b	Citizen/consumer benefits	Medium (BDA2GC) Very High (PPDR)	2
2	3c	Producer surplus	0.59 b€ (BDA2GC) N/A (PPDR)	0 (0.05)
1	3d	Producer/industry benefits	High (BDA2GC) High (PPDR)	1
9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation	∆T=18 months (BDA2GC) ∆T=18 months (PPDR)	7.9
6	5a	Potential for CEPT harmonisation	Low (BDA2GC) Medium (PPDR)	2.5
5	5b	Potential for take-up of application outside CEPT	Low (BDA2GC) Low (PMSE)	1
6	2	Possibility to share with other applications/uses (frequency, spatial,	PMSE and TB	2.4

Maximum Points	No	Criterion	Result of the assessment	Points
		time and/or signal separation)		
2	1a	Compatibility with the Radio Regulations (Article 5)	Not compatible	0
2	1b	Compatibility with MA02revCO07	Not compatible	0
1	1c	Compatibility with ECC/DEC/(03)/02	Not compatible	0

7.3.5 Scenario 3-B under regulatory option 3: BDA2GC in 1452-1472 MHz and PMSE in 1472-1492 MHz

Table 56: Assessment of Regulatory Option 3 - Scenario 3-B

Maximum Points	No	Criterion	Result of the assessment	Points
3	3a	Consumer surplus	N/A (BDA2GC) N/A (PMSE)	0
3	3b	Citizen/consumer benefits	Medium (BDA2GC) Medium (PMSE)	1
2	3c	Producer surplus	0.59 b€ (BDA2GC) 1.9 b€ (PMSE)	0.2
1	3d	Producer/industry benefits	High (BDA2GC) High (PMSE)	1
9	4	Timeframe for availability of equipment on a large scale and for application deployment - status of standardisation	∆T=18 months (BDA2GC) ∆T=18 months (PMSE)	7.9
6	5a	Potential for CEPT harmonisation	Low (BDA2GC) Medium (PMSE)	2.5
5	5b	Potential for take-up of application outside CEPT	Low (BDA2GC) Low PPDR)	1
6	2	Possibility to share with other applications/uses (frequency, spatial, time and/or signal separation)	PPDR and TB	2.4
2	1a	Compatibility with the Radio Regulations (Article 5)	Not compatible	0
2	1b	Compatibility with MA02revCO07	Not compatible	0
1	1c	Compatibility with ECC/DEC/(03)/02	Not compatible	0

7.3.6 Summary

The impact analysis provides clear insights about the classification of each regulatory option and identifies the most favourable regulatory option for the future harmonised use of the band 1452-1492 MHz in CEPT.

Table 57: Overview of the results

Regulatory Option / Scenario	Points
Regulatory Option 1	13.7
Regulatory Option 2 / Scenario 2-A	34.9
Regulatory Option 2 / Scenario 2-B	25.1
Regulatory Option 3 / Scenario 3-A	17.3
Regulatory Option 3 / Scenario 3-B	16

7.3.6.1 Comparative analysis of the scenarios under regulatory options 2 and 3

The comparative analysis of scenarios 2-A and 2-B under regulatory option 2 indicates that mobile supplemental downlink is a more appropriate use than mobile broadband.

The comparative analysis of scenarios 3-A and 3-B under regulatory option 3 with BDA2GC as the harmonized application, indicates that PPDR is a more appropriate use than PMSE as the complementing application.

7.3.6.2 Overall conclusion on the impact analysis of the regulatory options

The comparative analysis of all the regulatory options indicates that regulatory option 2 (see section 6.3), based on Mobile SDL (scenario 2-A - see section 7.1) is the most appropriate for CEPT.

8 CONCLUSION

The band 1452-1492 MHz has remained unused in most European countries for the past decade. CEPT therefore decided late 2010 to undertake a review of this band with the aim to use those 40 MHz of prime spectrum to enable the development of new services and applications which could bring substantial social and economic benefits for Europe. In order to achieve this objective, this ECC Report determines, with the support of an impact analysis, the most appropriate future harmonised use of the band 1452-1492 MHz.

A number of criteria have been defined to execute the impact analysis.

Those criteria are:

1. compatibility with the current regulatory framework;
2. possibility to share with other applications/uses;
3. extent (maximisation) of social and economic benefits;
4. timeframe for availability of equipment on a large scale and for application deployment - status of standardisation;
5. potential for economy of scale (need and potential for harmonisation within and outside CEPT).

The various candidate applications for the future use of the band 1452-1492 MHz in CEPT were identified based on the outcome of an ECC questionnaire that was submitted to CEPT administrations and to the industry before the start of the impact analysis. Those applications are: 1) Terrestrial Broadcasting, 2) Mobile Broadband, 3) Mobile Supplemental Downlink, 4) Satellite Digital Audio Broadcasting, 5) Program Making and Special Events, 6) Broadband Public Protection Disaster Relief for temporary and local use and 7) Broadband Direct Air to Ground Communication. The spectrum requirement of each application was also defined.

The next step was the analysis of all candidate applications against the above mentioned criteria. This was followed by the description of the regulatory options which were used for further assessment. A detailed methodology to conduct the impact analysis was then developed and the last step consisted in conducting the impact analysis per se with the aim to determine the most appropriate regulatory option.

Based on this work and the analysis of the three regulatory options, it is concluded that the most appropriate regulatory framework is the harmonisation of the band 1452-1492 MHz for mobile broadband / mobile supplemental downlink in CEPT, 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 will bring the highest benefits for CEPT, with those benefits being maximised when mobile supplemental downlink is deployed under this framework. The implementation of this regulatory framework would consist of the following:

- The ECC will adopt an ECC Decision designating the band for Mobile/Fixed Communication Networks (MFCN) supplemental downlink and defining the Least Restrictive Technical Conditions with a harmonised band plan for the 1452-1492 MHz band, based on 8 blocks of 5 MHz with associated generic BEM and restricted BEM (for coexistence between uplink and downlink blocks).

- The ECC/DEC/(03)02 Decision [2], which currently harmonises the sub-band 1479.5-1492 MHz for Satellite Digital Audio Broadcasting within CEPT, will be suppressed.

- An administration wishing to implement terrestrial digital sound broadcasting networks in part of the 1452-1492 MHz may choose to do so using the MA02revCO07 Special Arrangement [1] and its possible Plan modifications.

- The MA02revCO07 Special arrangement[1] will be retained for cross-border coordination bilateral agreements in the sub-band 1452-1479.5 MHz, between Terrestrial Broadcasting and mobile services similar to the framework developed by CEPT for the 800 MHz band with GE06 and ECC/DEC(09)03 [3].

- CEPT should consider to propose an agenda item at the next WRC to introduce pfd limits to be included in Article 21 of the RR. The objective is to protect MFCN use within CEPT from harmful interference from satellite use outside CEPT[42];

- Mobile to mobile cross-border coordination in the band 1452-1492 MHz will be subject to an ECC Recommendation for bilateral agreements as for other mobile to mobile cross-border coordination in other bands.

[42] In the meantime, Administrations will have the possibility to register terrestrial stations of the SDL mobile service in the MIFR in order to ensure protection of MFCN from satellite interference through the ITU coordination procedure.

ANNEX 1: EXTRACT OF THE RADIO REGULATIONS ARTICLE 5 FOR 1452-1492 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
1 452-1 492 FIXED MOBILE except aeronautical mobile BROADCASTING 5.345 BROADCASTING-SATELLITE 5.208B 5.345 5.341 5.342	**1 452-1 492** FIXED MOBILE 5.343 BROADCASTING 5.345 BROADCASTING-SATELLITE 5.208B 5.345 5.341 5.344	

5.208B[43] In the bands:

137-138 MHz,
387-390 MHz,
400.15-401 MHz,
1 452-1 492 MHz,
1 525-1 610 MHz,
1 613.8-1 626.5 MHz,
2 655-2 690 MHz,
21.4-22 GHz,
Resolution **739 (Rev.WRC-07)** applies. (WRC-07)

5.341 In the bands 1400-1727 MHz, 101-120 GHz and 197-220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extra-terrestrial origin.

5.342 *Additional allocation:* in Armenia, Azerbaijan, Belarus, the Russian Federation, Uzbekistan, Kyrgyzstan and Ukraine, the band 1 429-1 535 MHz, and in Bulgaria the band 1 525-1 535 MHz, are also allocated to the aeronautical mobile service on a primary basis exclusively for the purposes of aeronautical telemetry within the national territory. As of 1 April 2007, the use of the band 1452-1492 MHz is subject to agreement between the administrations concerned. (WRC-12)

5.343 In Region 2, the use of the band 1435-1535 MHz by the aeronautical mobile service for telemetry has priority over other uses by the mobile service.

5.344 *Alternative allocation:* in the United States, the band 1452-1525 MHz is allocated to the fixed and mobile services on a primary basis (see also No. 5.343).

5.345 Use of the band 1452-1492 MHz by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)** [44]

[43] This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.
[44] *Note by the* Secretariat*:* This Resolution was revised by WRC-03.

ANNEX 2: FLEXIBILITY IN MA02REVCO07 SPECIAL ARRANGEMENT (1452-1479.5 MHz)

A2.1 INTRODUCTION

MA02 Special Arrangement was reviewed in 2007 in order to allow for more flexibility and to allow the deployment of terrestrial mobile multimedia in the framework of MA02revCO07[1].

Flexibility built-in in MA02revCO07 enables the national administrations to take the approach that best suits their national requirements. The range of possibilities includes the introduction of:

- T-DAB or enhanced radio services in accordance with the Ma02revCO07 Plan,
- other terrestrial mobile multimedia systems that are compatible with the Plan by application of the envelope concept,
- terrestrial mobile multimedia systems that require larger bandwidth than 1.7 MHz (e.g. 5 MHz) by aggregating T-DAB frequency blocks,
- any combination of the above.

A2.2 CHANNEL RASTER AND BANDWIDTH

The associated frequency plan to the MA02revCO07 Arrangement [1] contains 16 x 1.7 MHz T-DAB blocks. The following table provides the list of T-DAB blocks included in the Plan.

Table 58: List of T-DAB blocks in MA02revCO07 Special Arrangement

T-DAB block number	Centre frequency (MHz)	Frequency range (MHz)
LA	1452.960	1452.192 - 1453.728
LB	1454.672	1453.904 - 1455.440
LC	1456.384	1455.616 - 1457.152
LD	1458.096	1457.328 - 1458.864
LE	1459.808	1459.040 - 1460.576
LF	1461.520	1460.752 - 1462.288
LG	1463.232	1462.464 - 1464.000
LH	1464.944	1464.176 - 1465.712
LI	1466.656	1465.888 - 1467.424
LJ	1468.368	1467.600 - 1469.136
LK	1470.080	1469.312 - 1470.848
LL	1471.792	1471.024 - 1472.560
LM	1473.504	1472.736 - 1474.272
LN	1475.216	1474.448 - 1475.984
LO	1476.928	1476.160 - 1477.696
LP	1478.640	1477.872 - 1479.408

A2.3 ENVELOP CONCEPT

The envelop concept and the possibility to use T-DAB Plan entries for terrestrial mobile multimedia was introduced in the MA02revCO07 through Article 2.4:

“

2.4 The T-DAB Plan entries may be used for terrestrial mobile multimedia services with characteristics that may be different from those appearing in the Plan but within the envelope of their T-DAB Plan entry or aggregate entries under the provisions of the Special Arrangement, and that their administrations agree that any such use will be afforded protection to the levels defined by the interfering field strengths as arising from their Plan entries, taking into account any relevant bilateral agreements.

”

A2.4 AGGREGATION OF T-DAB BLOCKS

Beyond the envelop concept, MA02revCO07 also includes regulatory provisions to add flexibility to the Plan to allow a different uses of T-DAB plan entries and the possibilities to operate systems requiring a bandwidth larger than 1.7 MHz. The possibility to aggregate T-DAB blocks is reflected in a number of sections of the Arrangement which mentions the aggregated case and in particular in Annex 2 – section 5.3 which provides a spectrum mask for two aggregated T-DAB frequency blocks.

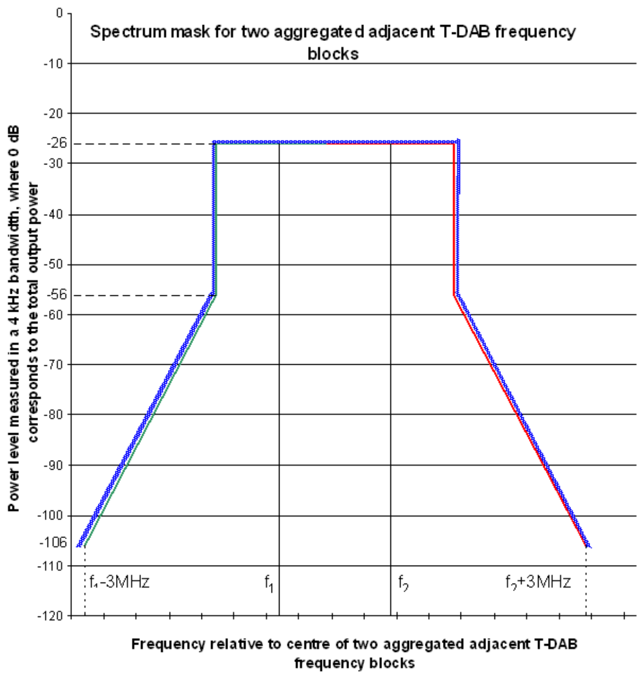

Figure 14: Example of Aggregation of 2 x 1.7 MHz T-DAB blocks

The Arrangement further enables the aggregation of any number of contiguous 1.7 MHz blocks over a given area. In order to introduce terrestrial mobile multimedia services according to paragraph 2.4 of the Special Arrangement, the following provisions apply:

Paragraph 6.1.2

“

6.1.2 Services brought into use under the terms of paragraph 2.4 shall not cause more interference nor claim more protection than the relevant T-DAB allotments in the Plan. Systems with a bandwidth greater than one single T-DAB frequency block may be brought into operation by aggregating contiguous T-DAB frequency blocks which appear in the Plan under the conditions given in Annex 2.

“

Annex 2, Section 2.3.3:
"

If a system is to be brought into operation in accordance with paragraph 6.1.2 the radiated signal between the edges shall not exceed the limit as defined by the blue line in Figure 3 (example of two aggregated T-DAB frequency blocks). Case 1 or Case 2 masks may be applied independently at either band edge of aggregated T-DAB frequency blocks.
"

The figure Figure 15:below shows an example of how 3 x 1.7 MHz blocks could be aggregated into a 5.1 MHz block allowing for 5 MHz based technology to be deployed.

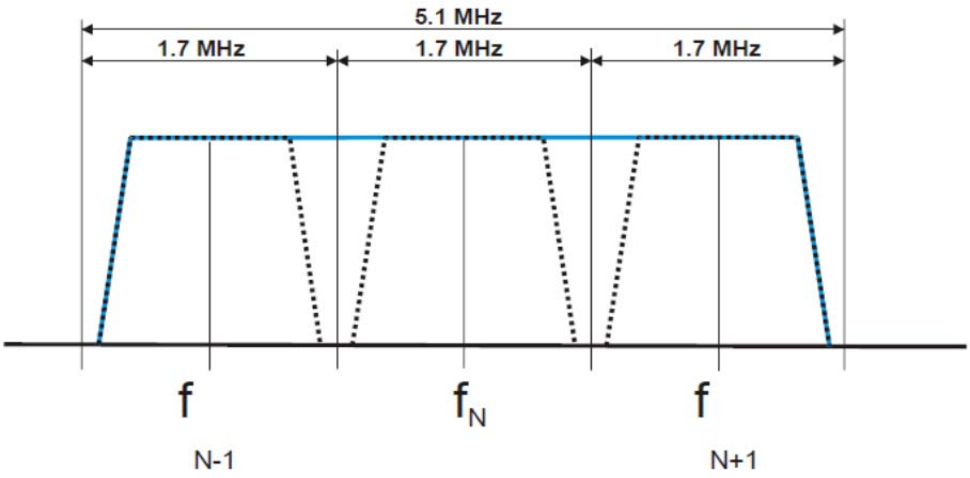

Figure 15: Example of aggregation of 3 T-DAB blocks aggregated into a 5.1MHz block (from CEPT Report 18)

The following figure indicates an example on how the 1.7 MHz blocks could be aggregated into 5.1 MHz blocks allowing the deployment of 5 MHz based technology.

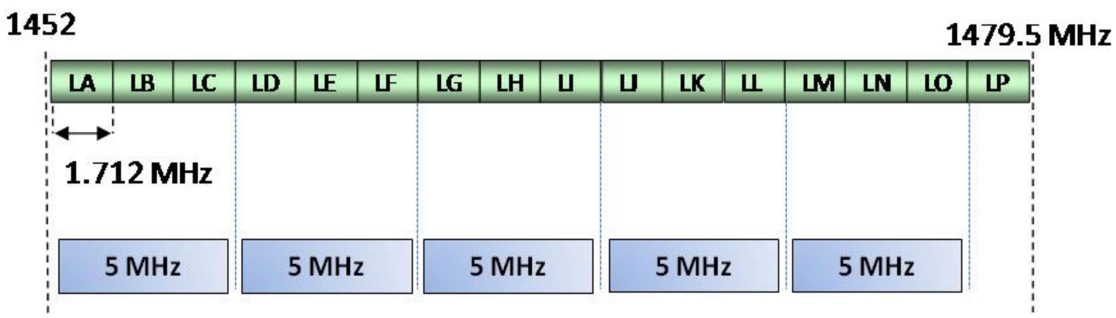

Figure 16: One potential Frequency raster for block aggregation in the band 1452-1479.5 MHz, as depicted in CEPT Report 18

Systems with a bandwidth greater than one single T-DAB frequency block may be brought into operation by aggregating contiguous T-DAB frequency blocks which appear in the Plan under the conditions given in Annex 2 to the Special Arrangement. The Special Arrangement also allows for the aggregation of contiguous blocks operated toward the same area.

A2.5 EXISTENCE OF CONTIGUOUS FREQUENCY BLOCKS OVER A GIVEN AREA IN THE PLAN

Administrations may choose to aggregate over a given area contiguous blocks in order to allow for the deployment of systems with a bandwidth greater than one single T-DAB frequency block in this area. The following table provides an overview of the number of Allotments per country (August 2011).

Table 59: Overview of the allotments in the Plan (August 2011)

Country	Allotment in Part 1[45]	Allotment in Part 2[46]	Allotment in Part 2sup[47]	Total
Albania	0	2	0	2
Austria	11	43	0	54
Belgium	6	11	0	17
Bosnia & Herzegovina	0	2	0	2
Bulgaria	8	14	0	22
Croatia	11	22	0	33
Czech Republic	1	26	1	28
Denmark	0	41	0	41
Estonia	4	4	0	8
Finland	0	21	0	21
France	134	67	0	201
Germany	108	112	0	220
Greece	4	60	0	64
Hungary	8	22	0	30
Ireland	0	31	0	31
Italy	21	193	0	214
Latvia	4	7	0	11
Liechtenstein	2	1	0	3
Lithuania	5	40	0	45
Luxemburg	1	1	0	2
FYR of Macedonia	0	2	0	2
Malta	0	1	0	1
Moldova	0	26	0	26
Monaco	2	0	0	2
The Netherlands	1	141	0	142
Norway	1	83	0	84
Poland	49	16	0	65
Portugal	14	60	0	74
Romania	11	48	0	59
San Marino	1	1	0	2

[45] Part 1 contains T-DAB allotments transferred from the original WI95 Plan in the 1.5 GHz band.
[46] Part 2 contains the allotments originating at the MA02 planning conference.
[47] Part2sup contains the allotments for which the coordination was completed after the publication of MA02revCO07 [1].

Country	Allotment in Part 1[45]	Allotment in Part 2[46]	Allotment in Part 2sup[47]	Total
Slovak Republic	1	16	12	29
Slovenia	8	9	0	17
Spain	19	342	0	361
Sweden	0	93	0	93
Switzerland	33	17	0	50
Turkey	6	5	0	11
Ukraine	25	58	0	83
United Kingdom	1	276	0	277

Administrations that would choose this aggregation method would need to introduce new entries in the Plan as there are very few locations with three frequency adjacent blocks in a given area within the Plan as of August 2011 according to the assessment below.

Analysis of the MA02 revCO07 Plan shows that there are very few geographical areas with two or three contiguous T-DAB blocks. This outcome results from the fact that only a few countries currently possess in total three layers of Plan entries, neither national nor regional (i.e. within certain geographical areas).

The Plan was originally established in 1995 at Wiesbaden (WI95) and provided two T-DAB layers on the basis of national requirements either in the 1452-1467 MHz band (see Figure 17:and Figure 18: and/or VHF. At Maastricht 2002 one additional T-DAB layer was planned in the 1452-1479.5 MHz band (see Figure 19:). Furthermore, a new Special Arrangement was established, namely the MA02 Special Arrangement. Following the two planning conferences WI95 and MA02:

- a few countries have three T-DAB layers in the 1.5 GHz band and no T-DAB in VHF;
- most countries have two T-DAB layers in the 1.5 GHz band and one VHF layer;
- only some countries have one T-DAB layer in the 1.5 GHz band and two VHF layers.

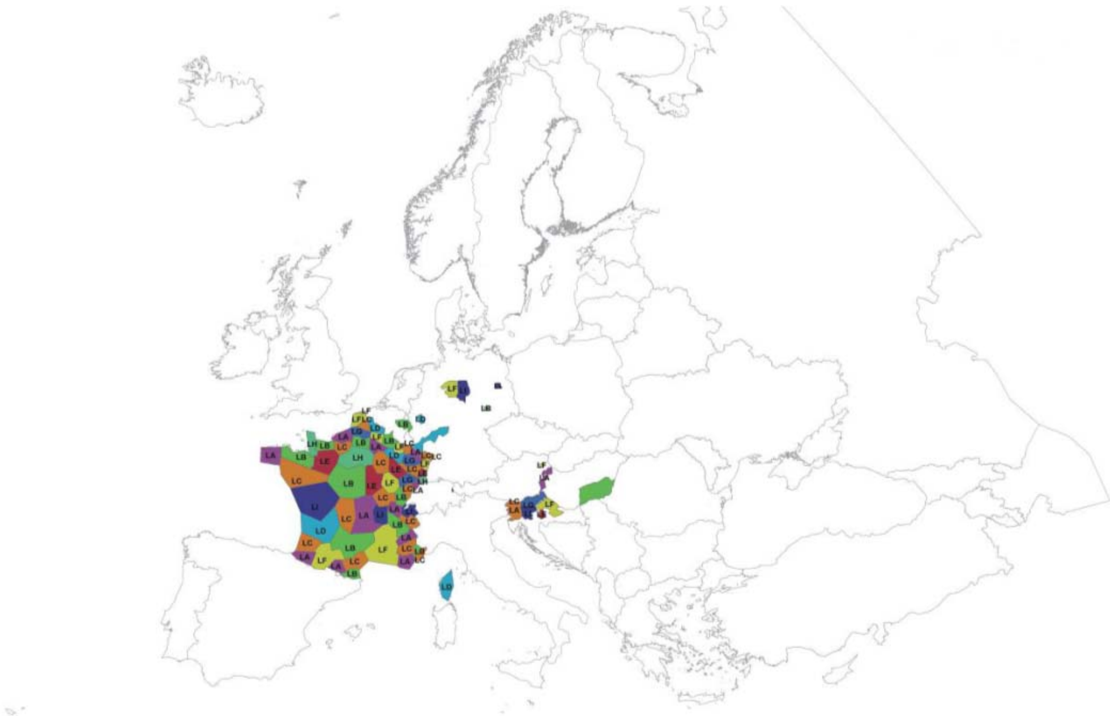

Figure 17: T-DAB layer 1 in the 1.5 GHz band originating from WI95 (2007)

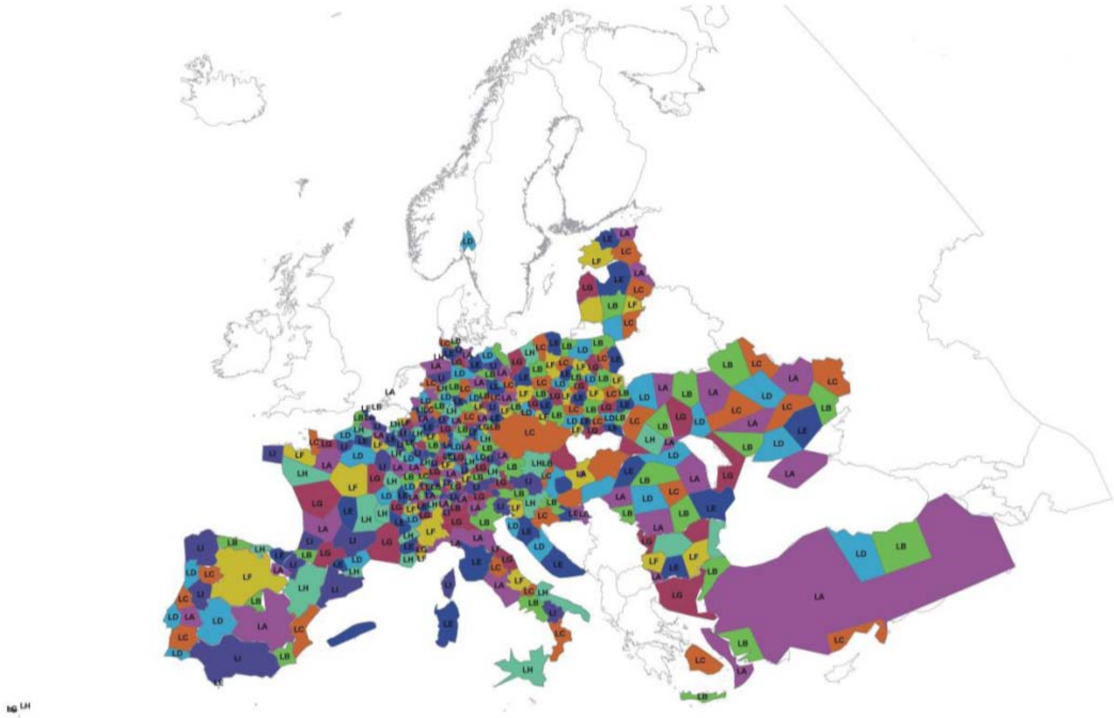

Figure 18: T-DAB layer 2 in the 1.5 GHz band originating from WI95 (2007)

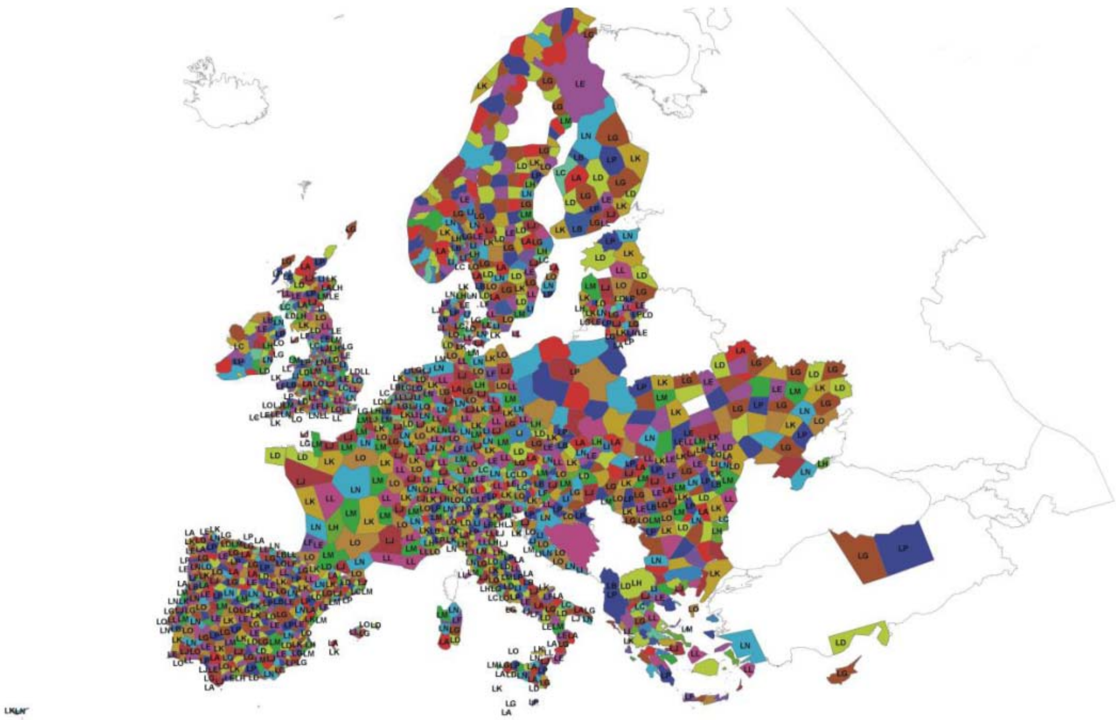

Figure 19: T-DAB layer 3 in the 1.5 GHz band originating from MA02revCO07 (2007)

A2.6 POTENTIAL ADDITION OF CONTIGUOUS BLOCKS IN A GIVEN AREA

The MA02revCO07 contains procedures for the addition or modification of an allotment (Annex 4, section 3 of the MA02revCO07) which enables addition of new contiguous blocks in a given area. Co-ordination is necessary if a new allotment would:

a. cause field strengths greater than or equal to 38 dB(μV/m) at the boundary of any other administration; or,
b. with regard to any other services, cause field strengths greater than or equal to the maximum allowable interfering field strengths at the boundary of any other administration.

No coordination is required where the above limits are not exceeded. In practice, this corresponds to those parts of a country which are separated from the boundary of each neighbouring administration by a certain distance. This distance depends on:

- the reference network (see section 5 – Annex 2 - of the Special Arrangement) associated with a particular allotment;
- the type of service to be provided;
- the existence of other services in the neighbouring administration and
- the type of propagation path (Land, Cold Sea, Warm Sea or mixed) between the boundary of the new allotment and the boundary of each neighbouring administration

Table 60: Typical reference network separation distances used when developing the Plan (based on Recommendation ITU-R P.370-7) for compatibility between T-DAB allotments operating on the same block

		Reference network 1 (L-RN1) receiving interference	Reference network 2 (L-RN2) receiving interference	Reference network 3 (L-RN3) receiving interference
Maximum permissible co-block interfering field strength (dBμV/m)		41 dBμV/m	43 dBμV/m	45 dBμV/m
Reference network 1 (L-RN1) as interferer	Land	50 km	44 km	38 km
	Cold sea	314 km	290 km	269 km
	Warm sea	434 km	392 km	350 km
Reference network 2 (L-RN2) as interferer	Land	39 km	34 km	30 km
	Cold sea	341 km	318 km	297 km
	Warm sea	466 km	426 km	386 km
Reference network 3 (L-RN3) as interferer	Land	23 km	20 km	17 km
	Cold sea	292 km	272 km	255 km
	Warm sea	388 km	348 km	313 km

For the conversion of an existing allotment into one or more assignments the co-ordination and notification procedures described in Article 6 are to be applied.

A2.7 REQUEST FOR COORDINATION RECEIVED BY THE ECO

The follow up of the request of coordination is available at http://cept.org/ecc/topics/broadcasting/t-dab/ma02revco07-special-arrangement/ma02revco07-t-dab-plan-circular-letters, where the Circular Letters published by the Office are available.

In total, seven Circular Letters have been published by the Office since May 2007. Among them, only two contained requests for new allotments.

In Circular Letter 013, the Slovak Republic requested the coordination of several new allotments. Among them, it can be seen that 8 sets of them were for 3 contiguous channels operated over the same area. 5 sets of 3 contiguous channels operated over the same area are contained in Part2sup.

In Circular Letter 018, the Czech Republic requested the coordination of a new allotment. However, a brief analysis shows that this will not result in a set of 3 contiguous channels operated over the same area.

A2.8 MATERIAL COMPLEMENTING THE ARRANGEMENT

MA02revCO07 was agreed in 2007 in order to provide the technical and regulatory framework to facilitate the introduction of terrestrial mobile multimedia services in the frequency band 1452-1479.5 MHz and to introduce more flexibility. At the time not all the information relating to possible systems to be deployed in this band was available. However the MA02revCO07 [1] provides the possibility to also consider other radio systems and their characteristics when addressing sharing between those and T-DAB and for coordination among administrations using complementary ECC deliverables:

“Where no information concerning protection ratios for other services suffering interference from T-DAB has been supplied to the Planning Meeting, the administrations concerned should develop appropriate sharing criteria by mutual agreement. When available one could use the relevant ITU-R Recommendations or ERC and ECC Decisions and Recommendations.“

and

“ Where no information concerning protection ratios for T-DAB suffering interference from other services has been supplied to the Planning Meeting, the administrations concerned should develop appropriate sharing criteria by mutual agreement. When available, one could use the relevant ITU-R Recommendations or ERC and ECC Decisions and Recommendations,”

ANNEX 3: 1452-1479.5 MHz BAND UTILISATION IN SOME CEPT COUNTRIES (UPDATED INFORMATION COMPARED TO THE ECC SURVEY CONDUCTED IN DECEMBER 2010 – JANUARY 2011)

Czech Republic

Administration of the Czech Republic has issued, on public tender basis, a number of licences for terrestrial digital broadcasting services based on Eureka 147 technology in the 1452-1479.5 MHz Band. Nine licences for particular regions and thirteen metropolitan licences will expire in 2021. Four T-DAB transmitters are already in regular operation.

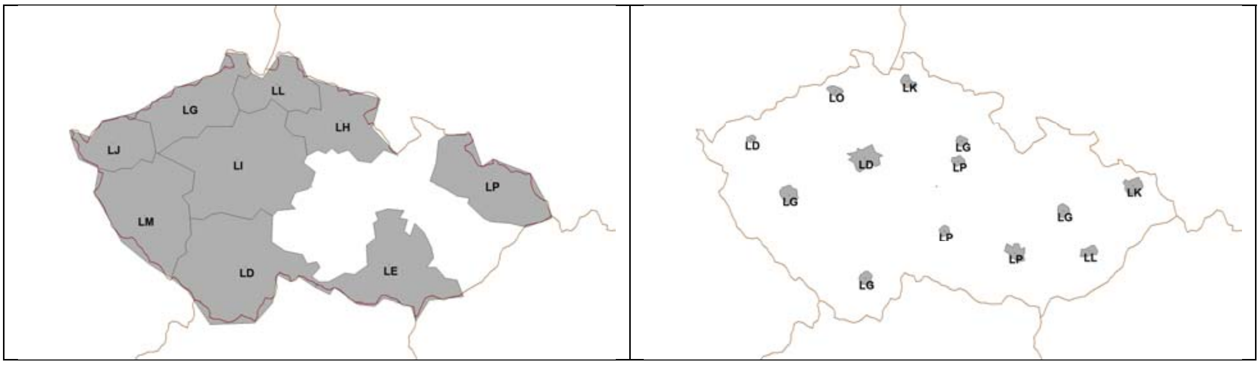

Figure 20: Terrestrial Broadcasting Service in the Czech Republic

France

France intends to use part of the 1452-1492 MHz for terrestrial digital radio (broadcasting) in the short term, and the other part for Mobile Supplemental Downlink (SDL). There is an ongoing call for tender in France for terrestrial radio services within part of the band 1452-1479.5 MHz, with rights based on the MA02revCO07 Special Arrangement. Two candidates have submitted their candidature. It is expected that the process will lead to the granting of a national authorisation to one digital radio distributor in 2012 with frequencies based on the existing allotments of the MA02revCO07 Plan, allowing the services to be on air by 2013 (67 allotments, forming 1 nationwide layer). On June 26th 2012, ARCEP (the telecom regulator) authorised Orange France to use the band 1484-1492 MHz to conduct a 18 month SDL trial in Toulouse area (two sites), in partnership with Ericsson and Qualcomm.

The Netherlands

The Netherlands issued one license within the 1452-1479.5 MHz band. This license was awarded based on rights out of the MA02revCO07 Special Arrangement:

- 117 area’s, containing 141 allotments, forming 1 nationwide layer;
- The license is technology neutral, transmissions should fit within the T-DAB spectrum mask;
- The license is granted on 16-02-2009 and will end on 15-02-2024;
- There is a roll-out obligation for 16 area’s by 16-02-2012 and 94 area’s by 16-02-2015;
- Not fulfilling the roll-out obligation can be a reason to withdraw the license. No roll out was reported up to now.

According to the national frequency plan of The Netherlands, the band 1452-1479.5 MHz has to be used for digital broadcasting.

Sweden

According to the national frequency plan the identified possible usage in 1452-1479.5 MHz is T-DAB and in 1479.5-1492 MHz is S-DAB. However, there are no licenses issued for T-DAB, no satellite is covering Sweden (S-DAB) and the identifications are to be reviewed. The entire 1452-1492 MHz may therefore be available for new licenses for terrestrial applications under least restrictive technical conditions during 2013.

The United Kingdom

The whole 1452-1492 MHz band is licensed until 2023 (renewable) for terrestrial applications under technology neutral technical conditions of usage.

ANNEX 4: OVERVIEW OF THE USE/REGULATIONS OF THE BAND 1452-1492 MHz IN A NUMBER OF COUNTRIES OUTSIDE FROM CEPT

Table 61: Use/Regulations of the band 1452-1492 MHz in a number of countries outside from CEPT

Country	Primary Services	Secondary Services	Note
Australia	Fixed, Mobile, Broadcasting, Broadcasting Satellite		http://www.acma.gov.au/WEB/STANDARD/pc=PC_2713 ACMA is consulting on the planning for mobile broadband within the 1.5 GHz mobile band (http://www.acma.gov.au/WEB/STANDARD/pc=PC_410368).
Brazil	Fixed, Mobile, Broadcasting, Broadcasting Satellite		www.anatel.gov.br
Canada	Broadcast (T and S) Fixed	Mobile	http://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/spectallocation-08.pdf/$FILE/spectallocation-08.pdf Industry Canada consulted on the adoption of 'a spectrum utilization policy allowing for flexible use of the spectrum to support a variety of services and technologies for subscription broadcasting, multimedia, fixed and mobile broadband applications.' http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09751.html#band1452a
China	Fixed, Broadcasting, Broadcasting Satellite		http://files.radioscanner.ru/bands/files/document76/castoti_kitaa_2005.pdf
Hong Kong	Fixed		http://www.ofta.gov.hk/en/freq-spec/freq-allocations.pdf
India	Fixed, Mobile, Broadcasting, Broadcasting Satellite		NFAP 2011: http://210.212.79.13/nfap-2011.asp Footnote IND 53 of the 2011 National Frequency Allocation Plan specifies that 'The requirement of spectrum in the frequency band 1427-1535 MHz may be considered for experimental/ trial/ pilot-study purposes for indigenously developed technologies for point-to-point backhaul and point-to-multipoint access systems.
Japan	1452-1453 MHz: Fixed and Mobile 1453-1475.9 MHz: Mobile 1475.9-1492 MHz: Fixed and Mobile		http://www.tele.soumu.go.jp/e/adm/freq/search/share/plan.htm
Kenya	Broadcasting, Broadcasting Satellite		http://www.cck.go.ke/licensing/downloads/Kenya_TOFA_2008_Edition.pdf
Pakistan	Fixed, Mobile, Broadcasting, Broadcasting Satellite		http://www.pta.gov.pk/media/Pakistan_Table_of_Frequency_Allocations.pdf
South Korea	Fixed and Mobile		http://rapa.or.kr/frequency/english/3_Korean_Allocations_Tables.pdf

Country	Primary Services	Secondary Services	Note
United States	Mobile (aeronautical telemetry) - aviation		http://www.ntia.doc.gov/osmhome/allochrt.html

A4.1 ADDITIONAL INFORMATION

- In Canada, Industry Canada's '*Consultation on the Spectrum Allocations and Spectrum Utilization Policies for the Frequency Range 1435-1525 MHz (L-Band)*' (http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09751.html) considered that "with the convergence of fixed, broadcasting and mobile services over digital wireless platforms, a regulatory approach promoting flexible use of spectrum is increasingly important […]. Several countries that initially considered the band 1452-1492 MHz for DAB services have recently begun to re-farm the spectrum for a range of broadcasting and multimedia applications within the international regulations and allocations […]. The prospect of a wide range of services in the band 1452-1492 MHz being allowed by industrialized countries in Europe and elsewhere further underlines the risk for Canada of pursuing only the conventional DAB service in this band. Consequently, the current allotment plan developed for the DAB implementation may not be appropriate given the new technologies that could be deployed in this band. Broadband wireless technologies, which support multimedia applications, are developed based on a 5 MHz channel width". The department proposed to "adopt a spectrum utilization policy allowing for flexible use of the spectrum to support a variety of services and technologies for subscription broadcasting, multimedia, fixed and mobile broadband applications." […] to streamline the Canadian frequency allocations in the band 1452-1492 MHz and to give full flexibility and priority to terrestrial services [… and] to elevate the status of mobile service to co-primary with broadcasting and fixed services in the band 1452-1492 MHz".

- In Africa, CRASA, which groups together the 14 Southern African Development Community (SADC) countries, highlighted in its latest *Frequency Allocation Plan (FAP)* (www.crasa.org/download.php?doc=doc_pub_eng64.pdf), its framework for the harmonisation across SADC on the use of the radio frequency spectrum, that: "T-DAB in the 1452-1492 MHz to be reconsidered: whereas this band was used for testing of T-DAB it was felt by the majority that this allocation is no longer required. The use of this band in the future should be further investigated and clarified."

- In Mexico, the report of a public consultation covering a wide range of issues contains a proposal to use 1452-1492 MHz for mobile broadband and make a reference to CEPT work on SDL. See section 13.8, p 78-79 at http://www.cft.gob.mx:8080/portal/wp-content/uploads/2012/11/Reporte-ConsultaV6.pdf

ANNEX 5: BROADCASTING STANDARDS

A5.1 TERRESTRIAL BROADCASTING

T-DAB / T-DMB

Terrestrial Broadcasting using the Eureka 147 family of standards (T-DAB)

The DAB system is a sound broadcasting system intended to supersede the existing analogue amplitude and frequency modulation systems.

It has been designed for terrestrial and satellite as well as for hybrid and mixed delivery.

It is now in regular service in many European countries and throughout the world.

DAB and DAB+ offer an identical consumer experience centred on radio, with text, slideshow, EPG and other multimedia features. DAB offers eight to ten radio services within a 1.5 MHz multiplex whilst DAB+ (using HE AACv2) can accommodate up to 20–30 radio services in the same spectrum. DMB is primarily a mobile TV platform, sharing the same multiplex and carrier structure as DAB, but it can be used for a visual radio service with similar multimedia properties to DAB and DAB+.

Single frequency networks are commonly built to provide wide area coverage with great spectrum efficiency. Multi-frequency networks, allowing more localised content, are also provided with comprehensive service following mechanisms to allow mobile and handheld receivers to retune automatically when travelling between coverage areas.

DAB, DAB+, DMB-radio and DMB-tv services may all be present in the same DAB multiplex.

Typical services carried by a DAB multiplex are:

- Audio programs
- Video programs
- Slideshow (SL)
- Dynamic text (DL)
- Traffic information (TPEG)
- Multimedia object delivery

DAB-IP

The use of IP tunnelling provides DAB with a mechanism for the adaptation of Internet services to DAB and is also a key component for DAB services using two-way interaction with personal DAB as specified in TS 101 736. The use of IP tunnelling enables the use of IP as a common network layer protocol, end-to-end, for DAB data services. The IP tunnelling through DAB is unidirectional. The tunnel is created from the packet mode encoder on the transmitting side, to the packet mode decoder on the receiving side, of the DAB system.

This system, commonly called DAB-IP, can provide data services including mobile television, to handheld devices. When coupled with a return channel it allows the downlink of multimedia services.

The benefits of the DAB family of standards:

- Easy programme selection
- Improved reception
- Programme-associated data
- Information services
- Targeted music or data services
- Wide choice of receivers
- Lower transmission costs for broadcasters

DVB-H

DVB-H is a technical specification for the transmission of digital TV to handheld receivers such as mobile telephones and PDAs. Published as a formal standard (EN 203 204) by ETSI in November 2004, it is a physical layer specification designed to enable the efficient delivery of IP-encapsulated data over terrestrial networks. The creation of DVB-H, which is closely related to DVB-T, also entailed modifications of some other DVB standards dealing with data broadcasting, Service Information, etc. It can be used as a bearer in conjunction with the DVB-IPDC systems layer specifications or alternatively with the OMA BCAST specifications.

In March 2008 the European Commission endorsed DVB-H as the recommended standard for mobile TV in Europe, recommending EU member states to encourage its implementation. However, commercial deployment has not been successful. ..

DVB-T2 - Base

DVB-T2 is the follow-up system of the digital terrestrial transmission (DTT) system DVB-T. It offers higher efficiency, robustness and flexibility. It introduces the latest modulation and coding techniques to enable highly efficient use of the terrestrial spectrum for the delivery of audio, video and data services to fixed, portable and mobile devices. These new techniques make DVB-T2 much more efficient than previous DTT systems. Possible bandwidths for the DVB-T2 operation are 1.7, 5, 6, 7, 8 and 10 MHz.

As with its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal. Just like DVB-T, DVB-T2 also offers a range of different modes, making it a very flexible standard. Several options are available in areas such as the number of carriers, guard interval sizes and pilot signals, so that the overheads can be optimised for any target transmission channel.

An important new element of DVB-T2 are Multiple Physical Layer Pipes (MPLP) which allow separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (e.g. in-door or roof-top antenna). It also allows transmissions to be tailored such that a receiver can save power by decoding only a single service rather than the whole multiplex of services. Furthermore Future Extension Frames (FEF) allows the standard to be compatibly enhanced in the future. FEF are basically placeholders for new services which are not supported by the already existing receiver population. An existing receiver will detect the FEF and not decode its content. New receivers may access the FEF and provide additional services.

DVB-T2-Lite

DVB-T2-Lite is the first additional transmission frame type making use of the FEF approach. It is an additional profile that was introduced in July 2011 to even better support mobile as well as portable TV and also to allow for cost-reduced implementation. The new profile is defined as a subset that adds two additional LDPC code rates to the main DVB-T2 specification. Since only elements relevant for mobile and portable reception have been included in the DVB-T2-Lite subset and the data rate is restricted to 4 Mbit/s per PLP, the implementation complexity has been reduced by 50%. The FEF mechanism allows that

DVB-T2-Lite and DVB-T2-Base can be transmitted in a same RF channel.

DVB-NGH

DVB-NGH is a successor of DVB-H and is based on DVB-T2 specification. It includes a number of additional techniques to improve mobile and portable reception of broadcast services, including Multiple-Input-Multiple-Output (MIMO) and Time frequency Slicing (TFS) with a single tuner, non-uniform constellations, extended LDPC codes for low code rates, more efficient time interleaving, and very robust signaling. It also includes a hybrid profile that enables a combination of terrestrial and satellite transmission. In addition to the latest modulation and coding techniques DVB-NGH provides additional operational flexibility where each service stream can be associated with a specific set of parameters.

A5.2 SDR

ETSI's SDR standard is a transmission standard (see also section 3.5.) that has been developed for the provision of high quality and high availability digital radio and associated data services to wireless receivers. The standard foresees the deployment of terrestrial and satellite broadcast networks, which may be combined to form "hybrid" systems.

The standard specifies the L band as the main candidate band for its deployment. In this band, terrestrial SDR networks (1.7 MHz carrier bandwidth) can be rolled out:

- in the 1452-1579.5 MHz sub band, in compliance with the MA02revCO07 Arrangement [1] (envelope concept), and/or
- in the 1479.5-1492 MHz sub band, in compliance with the ECC/DEC/(03)02 [2] S-DAB Decision, as part of an SDR hybrid system (see also section 3.5)

Its flexibility enables to mix in a same carrier independent (with different QoS as necessary), linear and non-linear services and free-to-air as well as conditional access (subscription) services.

Today, the SDR standard is contemplated for the deployment of subscription radio services in Europe.

A5.3 DVB-H

DVB-SH is a hybrid satellite/terrestrial system that allows the use of a satellite to achieve coverage of large regions or even a whole country. DVB-SH is a transmission system standard designed to deliver video, audio and data services to vehicles and handheld devices. In areas where direct reception of the satellite signal is not possible, a terrestrial gap filler can be used seamlessly to provide coverage. It is designed to use frequencies below 3 GHz. The system and waveform specifications have been published as ETSI standards (TS 102 584, TS 102 585 and EN 302 583).

ANNEX 6: MOBILE BROADBAND AND MOBILE SUPPLEMENTAL DOWNLINK STANDARDS

The 3GPP has been producing the Technical Specifications and Technical Reports for the technologies that support mobile broadband since 1998. The success of 3GPP technologies is easily understandable when acknowledging that the number of UMTS subscriptions has passed the 1 billion mark in January 2012[48].

While 3GPP technologies were focusing solely on 5 MHz bandwidth until the release 8 of the 3GPP standards, the 3GPP has become the focal point for mobile systems beyond 3G by standardising technologies supporting increasing bandwidth. From 3GPP Release 10 onwards, 3GPP is compliant with the latest ITU-R requirements for IMT-Advanced 'Systems beyond 3G'. The standard now allows for operation at peak speeds of 100 Mbit/s for high mobility and 1 Gbit/s for low mobility communication.

The 3GPP technologies (HSPA+ and LTE) have also evolved to support very large bandwidth through the aggregation of carriers across bands. This concurrent dual/multiple band operation is available from the release 9 of HSPA and release 10 of LTE onwards. An overview of the support of wide bandwidth and interband carrier aggregation is provided in the Figure 21: below.

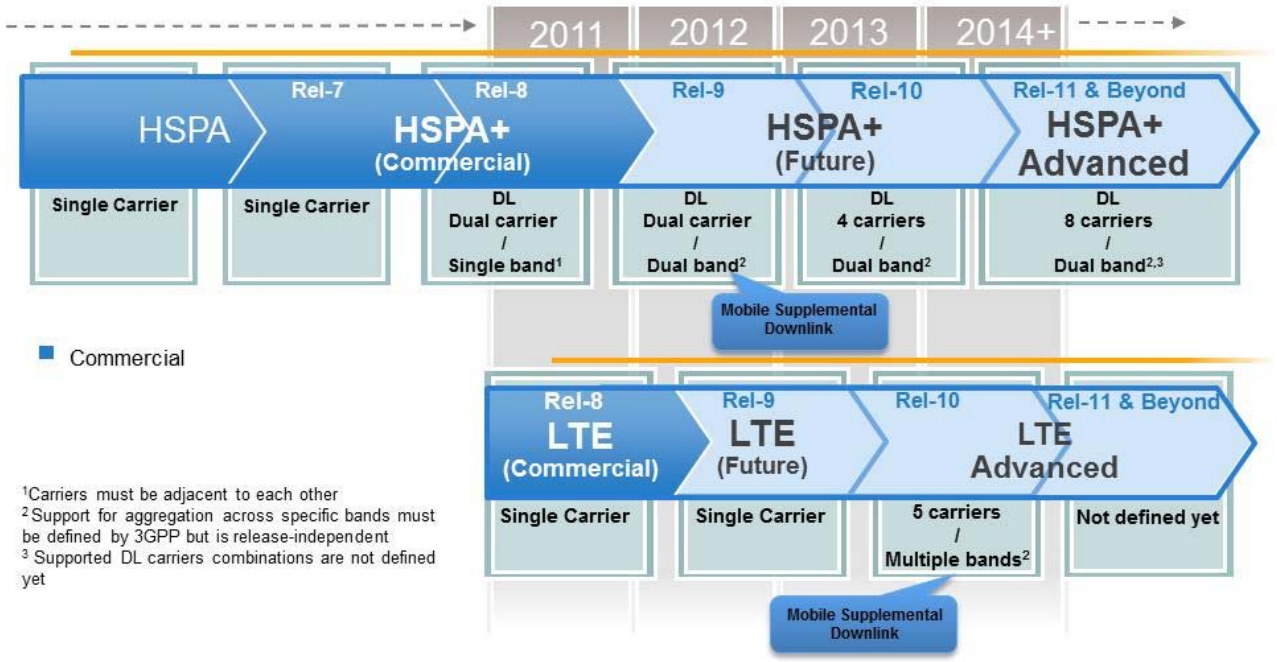

Figure 21: Support for increased bandwidth and inter-band carrier aggregation in 3GPP standards[49]

[48] Source: UMTS Forum
[49] Source: Qualcomm

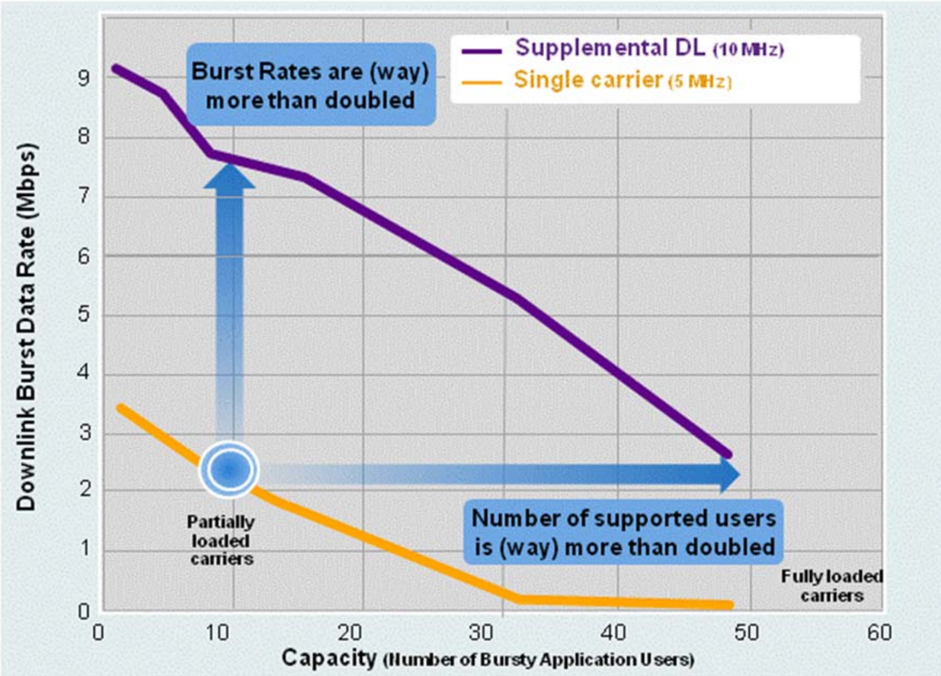

Figure 22: Results of simulation of performance of an L-band Supplemental Downlink (SDL) for bursty applications (see [11])

ANNEX 7: TECHNICAL INFORMATION ON PMSE

The question that is asked frequently: how many links can operate in parallel in the L-Band, in the range 1452-1492 MHz?

Any production has to be free of interference to find pleased listeners. One source of interference is caused by intermodulation which is generated in any wireless system when it operates in close proximity of other systems. As intermodulation can be calculated the system design takes care of the effect and uses only reliable frequencies which guarantee no unwanted noise in the audio signal.

The following graph shows a typical arrangement of carriers in a multichannel system of wireless microphones:

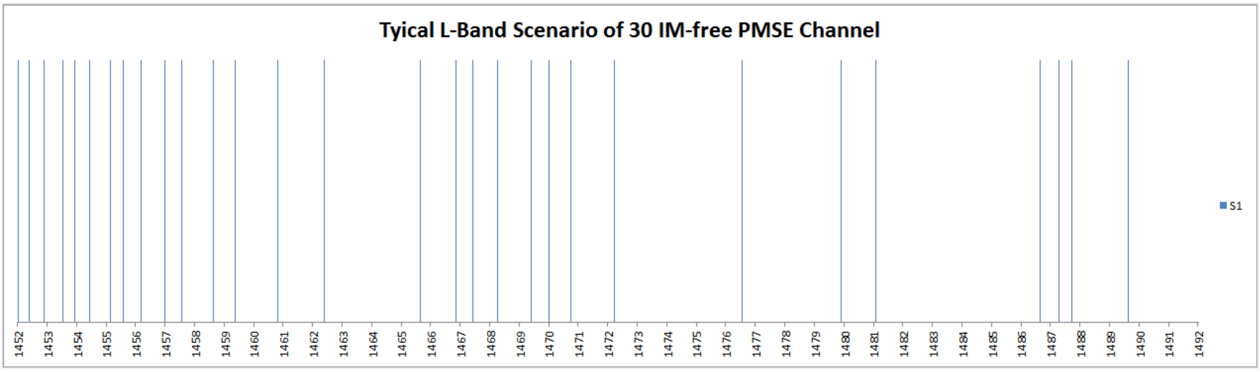

Figure 23: Typical arrangement of carriers in a multichannel system of wireless microphones

It can be seen that thirty carriers of this system are arranged in non-regular spacing.

A venue usually consists of different locations in which different events take place in parallel: in a conference centre there are different halls and rooms with different events using wireless equipment, same in hotels with their meeting facilities, in universities with their lecture halls, in entertainment centres with their various stages, also in exhibition halls with the booths of the exhibitors last not least at political and sport events where several ENG Teams operate in parallel in different areas.

All these events in one venue have one thing in common: they are separated by walls of by a certain distance. Separation by room, house walls or ceilings usually gives a signal attenuation of more than 15dB in addition to the path loss. Taking this into account the intermodulation of the system shown above will be very low in the neighbour room or neighbour venue. This allows taking the same set of frequencies for the neighbour venue, but shifting all the frequencies by the same amount. Optimising this process will deliver the following result and will give the answer to the above asked question “how many links can operate in parallel in the L-Band:

224 links can operate in parallel in one venue.

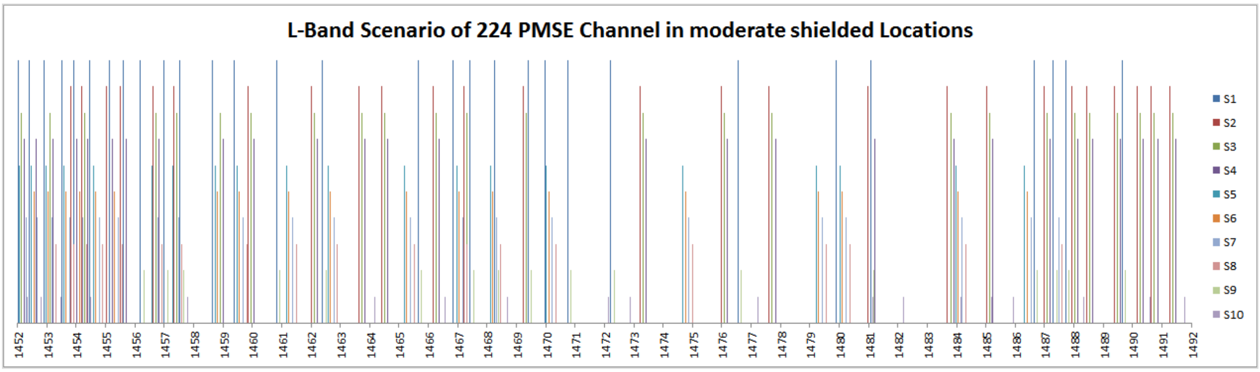

Figure 24: L-band scenario of 224 PMSE channels in moderately shielded locations

The calculation result shown above was done for standard equipment.

As shown in the graph above these locations a named S1, S2, S3 etc. The colours assigned to these locations can be found in the graph that shows the frequencies in the L-Band from left to right. By shifting the frequencies to higher ones there will come the point where one of these frequencies exceeds the upper limit of the L-Band range. These frequencies have to be left out.

This is the reason why the 10 different venues shown on the right of the graph have a different set of frequencies for the use in that location: some venues have more, some fewer frequencies.

The carriers in the graph have different level. The one with the highest level is the venue which is the reference, from which one can look to the signals of the neighbour venues. The difference in level of the other locations indicates the attenuation the signals experience on the way to the reference location.

Each of the venues on its own have intermodulation free frequencies, but there is a risk of interference if the wanted carrier falls below the intermodulation frequency level of one of the venues. This can only happen if one of the wireless microphones leaves its venue. For high quality productions there is no alternative than intermodulation free arrangement of a set of frequencies as shown in the first graph.

It has to be mentioned that this scenario as described above will work outdoors only if the distances between the venues delivers a signal attenuation of more than 15dB.

The system as described above is proven by practical application in everyday operation in the UHF range – for the venues as named above. This is usually done by the professional frequency coordinator who takes all the important parameters into account.

It needs to be mentioned that the use of PMSE with extended bandwidth, 400 kHz or 600 kHz, will reduce the maximum number of wireless links that can be used in one venue and a mixed scenario.

ANNEX 8: LIST OF REFERENCE

[1] MA02revCO07: The Maastricht, 2002, Special Arrangement, as revised in Constanţa
[2] ECC/DEC/(03)02 on the designation of the frequency band 1479.5-1492 MHz for use by Satellite Digital Audio Broadcasting systems
[3] ECC/DEC/(09)03 on harmonised conditions for Mobile/Fixed Communications Networks (MFCN) operating in the band 790-862 MHz
[4] RR: Radio Regulations
[5] CEPT Report 18: EU harmonisation of the band 1452-1479.5 MHz (lower part of L-band) to allow flexible use by mobile multimedia technologies
[6] Radio Spectrum Policy Group survey and Report on the future of digital audio broadcasting: http://rspg.groups.eu.int/consultations/consultation_futradio/rspg10_349_annex.pdf
[7] ECC Report 125: Guidelines for the implementation of impact assessment in relation to spectrum matters
[8] Recommendation ITU-R SM.1132-2: General principles and methods for sharing between radiocommunication services or between radio stations
[9] Report ITU-R M.2243: Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications
[10] Document RSCom 12-06 Spectrum assignments in EU-27 as of 1 January 2012 – an overview
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[19] ETSI TR 103 054: System Reference Document; Broadband Direct-Air-to-Ground Communications operating in part of the frequency range from 790 MHz to 5 150 MHz
[20] CEPT Report 19 Least restrictive technical conditions for WAPECS frequency bands
[21] CEPT Report 30: The identification of common and minimal (least restrictive) technical conditions for 790 - 862 MHz for the digital dividend in the European Union.
[22] CEPT Report 23: Technical Options for the Use of a Harmonised Sub-Band in the Band 470 - 862 MHz for Fixed/Mobile Application (including Uplinks)
[23] CEPT Report 29: Guideline on cross border coordination issues between mobile services in one country and broadcasting services in another country
[24] CEPT Report 39: To develop least restrictive technical conditions for 2 GHz bands
[25] ECC Report131: Derivation of a BEM for TS in 2500-2690 MHz
[26] ECC Report 161: Additional Considerations relating to the L-band and the MA02revCO07
[27] ECC Report 121: Compatibility studies between Professional Wireless Microphone Systems (PWMS) and other services/systems in the L band