CEPT Report 52

Report from CEPT to the European Commission in response to the Mandate "To undertake studies on the harmonised technical conditions for the 1900-1920 MHz and 2010-2025 MHz frequency bands ("Unpaired terrestrial 2 GHz bands") in the EU"

Report approved on 6 March 2015 by the ECC

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0 EXECUTIVE SUMMARY

This CEPT Report has been developed within European Conference of Postal and Telecommunications Administrations (CEPT) in the framework of the EC mandate to assess and identify alternative uses of the unpaired terrestrial 2 GHz frequency bands (1900-1920 MHz and 2010-2025 MHz) other than for the provision of mobile electronic communications services through terrestrial cellular networks (as introduced by the UMTS Decision of 1999[1]) as well as develop relevant least restrictive technical conditions for spectrum use.

Background

The European Commission considered that there is no viable harmonisation option for mobile broadband services using the unpaired terrestrial 2 GHz spectrum that would avoid an unacceptable impact on current licences. An alternative harmonisation option outside the current framework of licence conditions would have to be pursued, which would be likely to imply change or revocation of existing authorisations.

Therefore, CEPT was mandated to undertake the following tasks:

1. Assess and identify suitable uses other than mobile electronic communications services delivered through terrestrial cellular networks and define the common minimal (least restrictive) technical conditions that would apply to them in these bands. These conditions should be sufficient to avoid interference with services or radio applications in adjacent bands, ensure coexistence with other services or radio applications in the same band, and facilitate cross-border coordination, also at the EU outer borders;

2. In performing task (1), consider the following non-ECS uses in line with the priorities of the RSPP: broadband PPDR, PMSE, short-range devices and DECT. This is without prejudice to the consideration of alternative uses for electronic communications services in line with EU spectrum policy objectives, such as Broadband Direct-Air-To-Ground Communications;

3. In performing task (1) as specified by task (2) and given the limited temporal or geographical scope of one or more of the radio applications under consideration, assess and justify the possibility of spectrum sharing amongst the radio applications under consideration and, if necessary, develop common technical sharing conditions which may include inter alia spectrum access rules, channelling arrangements or power emission limits that are sufficiently precise for the development of EU-wide equipment.

As presented in section 2.2 (Current authorisations and uses of the unpaired 2 GHz bands), there are licences in force in Europe in both unpaired 2 GHz bands. Some of the licences were awarded after spectrum auction processes and, as a result, considerable auction prices were achieved. In some countries, a licence repeal process might be possible in case of continued non-implementation, whereas in other countries this will not be possible due to specific conditions and obligations which are part of the licence (e.g. coverage obligations are interpreted in some cases as fulfilled when providing services via other spectrum where the same licensee has also a licence and for which the network is implemented). Other options for making the spectrum available for new usage need to be considered (e.g. liberalisation, transfer).

Harmonisation possibilities

After performing the analysis described in this CEPT Report, the following harmonisation possibilities were obtained:

Broadband DA2GC: A Broadband DA2GC system constitutes what is effectively a backhaul application to support various types of telecommunications services on board aircraft, such as internet access and mobile multimedia services (described in section 3.1). It aims to provide access to broadband communication services during continental flights on a Europe-wide basis. Currently, there is no spectrum designated for Broadband DA2GC in Europe. To allow European citizens and airlines to profit from the social and economic

[1] Decision 128/1999/EC [8] of the European Parliament and of the Council of 14 December 1998 on the coordinated introduction of a third-generation mobile and wireless communications system (UMTS) in the Community

benefits of the implementation of such a radio application (intended to provide broadband connectivity between the aircraft and a terrestrial based network), a harmonised spectrum designation within CEPT would be necessary. In order for the system to be commercially viable, it would need to have the potential to provide a solution across Europe.

PMSE: With respect to video PMSE (section 3.2), it is considered that there is a need for these services to be coordinated to avoid harmful interference and therefore an individual authorisation regime is appropriate for implementation by national administrations. In particular, it has to be noted that the use of each channel is decided for an event by the regulatory authority and according to assumptions taken into account during compatibility studies (see ECC Report 220), each channel is considered to be used by only one video link in a given area to avoid interference between PMSE users.

SRD: Concerning SRD applications (section 3.3), no allocations are required for SRD to operate in a specific frequency band (SRD typically operate on a non-interference and non-protection basis). Any upcoming request from industry would be taken into account at any time but preferably, after a primary usage is identified.

DECT: Regarding the proposal for DECT as set out in section 3.4, if realised under application-neutral and technology-neutral principles (see CEPT Report 014 [1] and CEPT Report 044 [2]) using general authorisation (exemption from individual licence), this can also be regarded as a new spectrum opportunity for SRD usage (meaning DECT authorised as SRD in these frequencies), provided that suitable spectrum access rules are followed.

Taking into account that no allocation is required for the two previous type of application, SRD/DECT are subject to a soft harmonisation in the ERC/REC 70-03 and therefore, it is not proposed to introduce a Commission implementing decision in this part of the spectrum for DECT/SRD. In addition, further complementary studies may be required in the future when the primary applications will be identified.

Ad hoc PPDR: A harmonised solution for ad-hoc PPDR network uses above 1 GHz is under consideration, which includes, for some countries, PPDR broadband air-to-ground applications (section 3.5). Cross-border coordination is needed for PPDR broadband air-to-ground applications. Broadband PPDR temporary additional capacity (also known as “hot-spot” or “local area” networks) could provide additional local coverage at the scene of the incident in order to provide the necessary communication facilities to PPDR users in addition to those provided through the Wide Area network (WAN) or where the WAN radiocommunications are limited or not available. This additional capacity may be provided by ad-hoc networks or other means (such as additional temporary base stations of the WAN) and are supposed to have high capacity and support PPDR users with low mobility. Ad-hoc networks may operate in the same (i.e. in a form of an ad-hoc micro-cell deployed at the event’s scene) as well as in a different frequency band.

PMSE use described in section 3.2 (Programme Making and Special Events) and ad-hoc PPDR use identified in section 3.5 (Public Protection and Disaster Relief) are further explored with the view of band sharing, since the same technologies / equipment may be used and the same technical framework might apply to both applications.

Consolidation of options

It is suggested placing the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands proposed for further study in the EC Mandate (as detailed in ANNEX 1:) into 3 defined categories:

- Direct air to ground communications;
- Video links and cordless cameras (PMSE / ad-hoc PPDR);
- Applications under general authorisation (DECT / SRD).

The objective of proceeding with these 3 categories is to take advantage of the synergies between the above identified uses by sharing the same technical framework to foster a more efficient use of spectrum and future innovation.

Stakeholders' views and support

Stakeholders' views were sought on the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands in accordance with the EC Mandate to CEPT "To undertake studies on the harmonised technical conditions for the 1900-1920 MHz and 2010-2025 MHz frequency bands ("Unpaired terrestrial 2 GHz bands") in the EU", as well as on the above 3 categories. This was done through a Call for Inputs carried out at the end of 2013. A summary of the responses to the Call for Inputs, as well as the responses received during the consultation period, are presented in ANNEX 2:.

A high level of support was expressed in the responses to the Call for Inputs for placing the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands (as proposed for further study in the EC Mandate) into the above three categories, although it became visible from the contributions that it was desirable to further investigate and clarify the technical characteristics and usage conditions for specific candidate applications during the development of the final CEPT Report.

Compatibility

Compatibility for the three usage categories, DA2GC, VLCC and DECT/SRD, with existing services/applications in the bands adjacent to the unpaired 2 GHz bands, as well as the sharing possibilities between the three usage categories, were studied. The least restrictive technical conditions for the three usage categories, which have been used as a basis for the technical studies, by taking into account sharing possibilities as far as possible, were considered.

Further consolidation of options

Studies have been carried out with regard to the candidate applications as described in the EC Mandate by considering various scenarios. The results of all these studies are provided in detail in other CEPT deliverables (ECC Report 209 [27] and ECC Report 220 [29]). The potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz could in theory be combined in various ways, either in one or in both unpaired bands, resulting in a considerable number of options. Due to the high level of complexity, and even the infeasibility of some of those options, the investigations proceeded on the basis of two scenarios, as shown in Figures 1 to 4 and described in section 5, This is also a result of the responses to the 'Call for Inputs'. Relevant compatibility and sharing aspects have been taken into account with regard to these two scenarios, which provide the possibility of spectrum sharing amongst radio applications as required in Task 3 of the Mandate. Therefore there was no need to complete all other studies which are not in line with the two selected scenarios.

Harmonisation possibilities and conclusions

Harmonisation possibilities were considered.

The conclusions from the analysis that was carried out reflect the conditions and restrictions that are to be observed in order to implement either one or the other scenarios that were studied. In both scenarios, shown below, which were considered within the aim of this CEPT Report, the three usage categories DA2GC, VLCC and DECT/SRD can be accommodated, although there are effectively different outcomes for each scenario.

Scenario 1

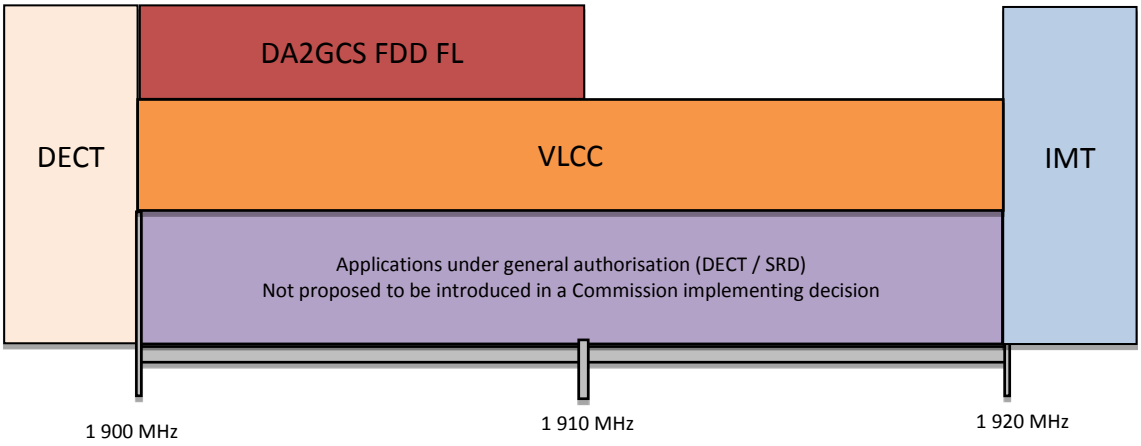

Figure 1: Scenario 1, lower band (DA2GCS FDD (forward link), VLCC, DECT / SRD)

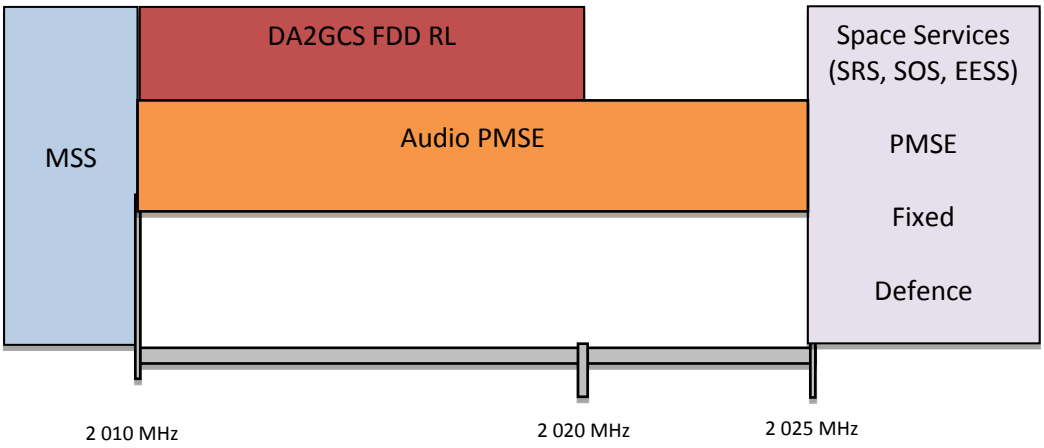

Figure 2: Scenario 1, upper band (DA2GCS FDD (reverse link), VLCC)

Note: Audio PMSE: in case of VLCC, the Broadband DA2GC system cannot be authorised

Scenario 2

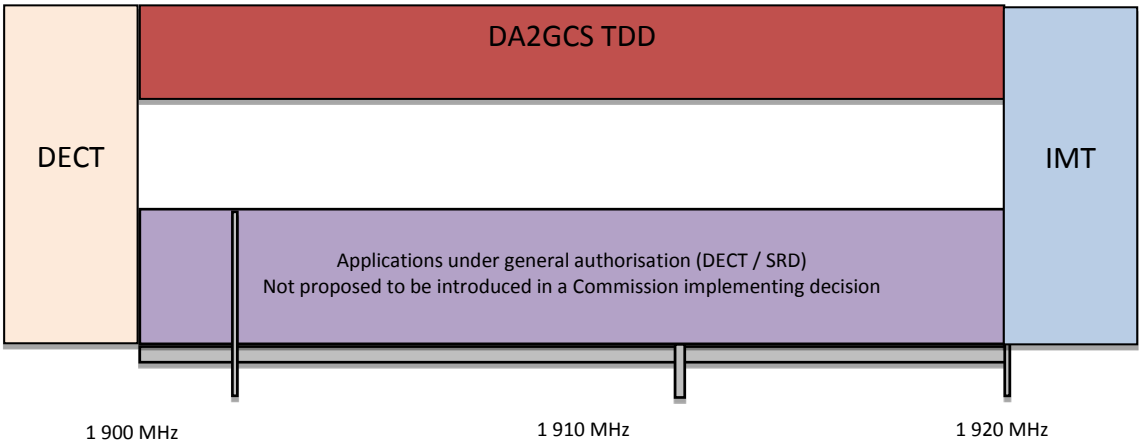

Figure 3: Scenario 2, lower band (DA2GCS TDD, DECT / SRD)

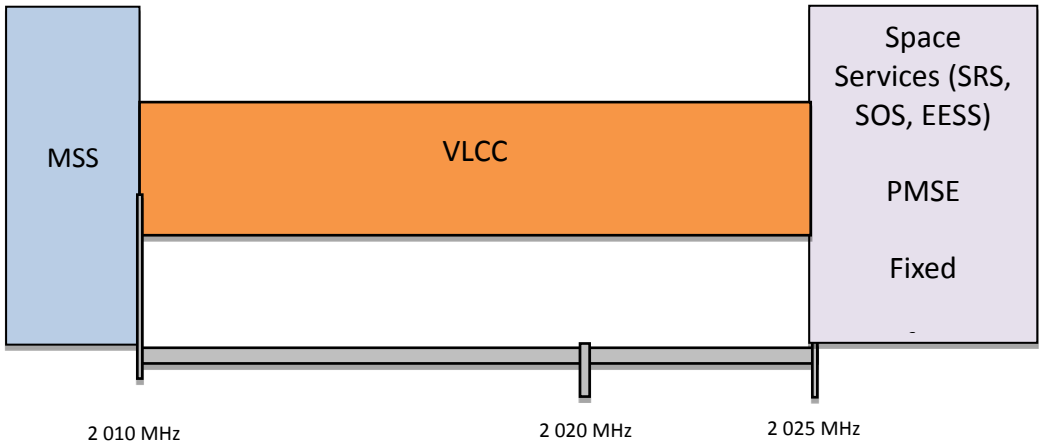

Figure 4: Scenario 2, upper band (VLCC)

CEPT agreed to further develop ECC/DEC/(15)02 [48] on Broadband DA2GC in the unpaired 2 GHz bands by only considering scenario 2 as reflected in this Report. As a result only the TDD DA2GC technical solution within the frequency band 1900-1920 MHz will be addressed. This is on the basis of the particular technical considerations, as this scenario eases the sharing with VLCC in the frequency band 2010-2025 MHz.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AS	Aircraft Station
CAA	Civil Aviation Administration
CCL	Cordless Camera Link
CEPT	European Conference of Postal and Telecommunications Administrations
CDMA	Code Division Multiple Access
DA2GC	Direct-Air-to-Ground Communications
DECT	Digital Enhanced Cordless Telecommunications
EC	European Commission
ECA	European Common Allocation
ECC	Electronic Communications Committee
ECO	European Communications Office
ECS	Electronic Communications Services
EESS	Earth Exploration-Satellite Service
EFIS	ECO Frequency Information System
ERC	European Radio Committee (superseded by ECC)
ESOMPs	Earth Stations On Mobile Platforms
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communication Commission
FDD	Frequency Division Duplex
FL	Forward Link
FS	Fixed Service
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GS	Ground Station
GSMOBA	GSM On-board Aircraft
IMT	International Mobile Telecommunications
LTE	Long Term Evolution
MSS	Mobile Satellite Service
MVL	Mobile Video Links
NTFA	National Table of Frequency Allocations
OFDMA	Orthogonal Frequency Division Multiple Access
OPEX	Operating Expenses
PHS	Personal Handyphone System
PMSE	Programme Making and Special Events
PPDR	Public Protection and Disaster Relief
PVL	Portable Video Link
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RL	Reverse Link
RSC	Radio Spectrum Committee
RSPG	Radio Spectrum Policy Group

RSPP	Radio Spectrum Policy Programme
R&TTE	Radio Equipment and Telecommunications Terminal Equipment
SAB/SAP	Services Ancillary to Broadcasting / Services Ancillary to Programme making
SOS	Space Operation Service
SRD	Short Range Devices
SRDoc	ETSI System Reference Document
SRS	Space Research Service
TDD	Time Division Duplex
TRR	Tactical Radio Relay
UHF	Ultra High Frequencies
ULE	Ultra Low Energy
UMTS	Universal Mobile Telecommunications System
VLCC	Video links and cordless cameras
WAN	Wireless Area Networks
WG FM	Working Group Frequency Management
WLL	Wireless Local Loop
WRC	World Radiocommunication Conference

1 INTRODUCTION

The use of the unpaired terrestrial 2 GHz frequency bands, 1900-1920 MHz and 2010-2025 MHz, was established within CEPT for IMT-2000/UMTS more than 10 years ago. These frequency bands, originally planned for TDD use, were later harmonised to allow greater flexibility in the use of the bands 1900-1920 MHz and 2010-2025 MHz for either TDD or FDD uplink (to be paired with another band). This harmonisation, as part of a process of making available spectrum for future mobile telecommunications systems within CEPT, has been the basis of a number of authorisations that have been granted for the bands 1900-1920 MHz and 2010-2025 MHz.

CEPT analysed the usage of the unpaired terrestrial 2 GHz bands and came to the conclusion that those bands were mostly unused. In summary, the band 1900-1920 MHz, although licensed in many countries, remained largely unused, and the use of frequencies in the band 2010-2025 MHz had only been authorised in few countries.

The pairing of 1900/1905-1920 MHz with 2090/2095-2110 MHz, as well as an internal pairing of 1900-1920 MHz with 2010-2025 MHz (limiting the pairing to 2x15 MHz), or even external pairing, were investigated within CEPT for cellular mobile mass market applications but considered inappropriate. Increased complexity (additional bands) in User Equipment (UE) design compared to very limited benefits for the cellular mobile community led to lack of support from Industry.

Thus, further investigations were considered as needed to develop a suitable ECC framework for those bands, focusing on alternative uses in the unpaired sub-bands (1900-1920 MHz and 2010-2025 MHz) other than for the provision of mobile electronic communications services through terrestrial cellular networks.

At the end of 2012, CEPT was mandated to assess and identify alternative uses of the unpaired terrestrial 2 GHz frequency bands (1900-1920 MHz and 2010-2025 MHz) other than for the provision of mobile electronic communications services through terrestrial cellular networks (as introduced by the UMTS Decision) as well as to develop least restrictive technical conditions for their deployment while ensuring co-existence with the electronic communications services in the paired 2 GHz spectrum.

This Report gives an overview of CEPT investigations on alternative uses of bands 1900-1920 MHz and 2010-2025 MHz, other than for the provision of mobile electronic communications services through terrestrial cellular networks, as follows:

- Section 2 supplies background information within and outside CEPT;
- Section 3 describes alternative uses, including its spectrum requirements;
- Section 4 examines compatibility with existing services/applications in the bands adjacent to the unpaired 2 GHz bands;
- Section 5 presents possibilities for co-channel and adjacent channel coexistence within the unpaired 2 GHz bands;
- Section 6 indicates common minimal (least restrictive) technical conditions, in particular spectrum access rules, channelling arrangements or power emission limits;
- Section 7 provides an insight on harmonisation possibilities;
- Section 8 contains conclusions.

2 BACKGROUND INFORMATION

2.1 CURRENT REGULATORY FRAMEWORK IN CEPT

The bands 1885-2025 MHz and 2110-2170 MHz were identified for International Mobile Telecommunications – 2000 (IMT-2000) in the World Administrative Radiocommunications Conference held in 1992 (WARC-92) through footnote 5.388 of the Radio Regulations (RR). These bands include the satellite component of IMT-2000.

Within the IMT-2000 family, the Universal Mobile Telecommunications Systems (UMTS) terrestrial radio access (UTRA) has been developed with 2 modes of operation (http://www.itu.int/osg/spu/ni/3G/technology/#Cellular Standards for the Third Generation); a Frequency Division Duplex (FDD) mode and a Time Division Duplex (TDD) mode. The FDD mode provides efficient operation in many UMTS environments, providing wide area coverage and full mobility applications. The TDD mode however may allow operators flexibility in network deployment and support traffic asymmetry in an efficient way.

In 1997, CEPT identified in ERC/DEC/(97)07 [5] the core frequency bands for UMTS in Europe. This Decision designated 155 MHz of spectrum to terrestrial UMTS applications with an additional 60 MHz for UMTS satellite services. In Europe, the 15 MHz spectrum at 1885-1900 MHz identified by WARC-92 for IMT-2000 was not designated for UMTS in ERC/DEC/(97)07 [5] due to current usage of this band by Digital Enhanced Cordless Telecommunications (DECT). The Decision required that administrations make available at least 2x40 MHz from within these bands by 2002.

Decision 128/1999/EC [8] of the European Parliament and the Council, dated 14 December 1998, on the coordinated introduction of a third-generation mobile and wireless communications system (UMTS) in the Community, came into force at the begin of 1999 with the aim to facilitate the rapid and coordinated introduction of compatible UMTS networks and services in the Community on the basis of internal market principles and in accordance with commercial demand.

In November 1999, ERC adopted Decision ERC/DEC/(99)25 [3], on the harmonised utilisation of spectrum for terrestrial UMTS operating within the bands 1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz. This Decision requested that, subject to market demand, administrations make provisions to allow the operation of UMTS self-provided applications in a self-coordinating mode in the frequency band 2010-2020 MHz It also indicated that the designation of this band for UMTS self-provided applications may be reviewed two years after the date of entry into force.

In response to Mandate 1 of the European Commission to CEPT, ERC/DEC/(00)01 [4] extended ERC/DEC/(97)07 [5] to require that administrations make available the entire 155 MHz of terrestrial spectrum for UMTS and other systems included in the IMT-2000 family by 1 January 2002, subject to geographical spread market demand and national licensing schemes.

More than five years after the entry into force of ERC/DEC/(99)25 [3], it has become clear that the anticipated market for UMTS self-provided applications has not materialised. It was also noted that there was a desire amongst some administrations and operators to allow greater flexibility in the use of the bands 1900-1920 MHz and 2010-2025 MHz, with the choice between FDD uplink and TDD mode being made subject to market demand on a national basis. In December 2004 the European Union sent a liaison statement to CEPT highlighting the results of a questionnaire to Member States on use of the band 2010-2025 MHz, indicating "… that there does not seem to be any interest for self-provided applications which are currently foreseen in the band 2010-2020 MHz…".

In 2006 a new ECC Decision, ECC/DEC/(06)01 [6], *on the harmonised utilisation of spectrum for terrestrial IMT-2000/UMTS systems operating within the bands 1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz*, came into force, aiming at facilitating efficiency in utilisation of the IMT-2000/UMTS bands across CEPT by identifying a common approach to spectrum planning. It entered into force on 24 March 2006 and addressed initially both paired (1920-1980 MHz and 2110-2170 MHz) and unpaired (1900-1920 MHz and 2010-2025 MHz) frequency bands. In addition, it replaced the earlier Decisions ERC/DEC/(97)07 [5], ERC/DEC/(99)25 [3] and ERC/DEC/(00)01 [4], consolidating and updating their provisions, removing references to self-provided applications operating in self coordinating mode, and allowing flexibility between FDD uplink and TDD modes of operation in the bands 1900-1920 MHz and 2010-2025 MHz. The values used in Annex 1 of

Decision ECC/DEC/(06)01 [6] have been based on the inter-service compatibility studies from ERC Report 65 [13], and intra-service carrier spacing studies undertaken within ETSI SMG02.

ECC conducted in 2010-2011 a review of this ECC/DEC/(06)01 [6] taking into account the information on the practical implementation and authorisations in force. During the revision process, CEPT has come to the conclusion that the unpaired 2 GHz bands were mostly unused and there was absence of equipment from manufacturers; the band 1900-1920 MHz, although licensed in many countries, remained largely unused, and the use of frequencies in the band 2010-2025 MHz had only been authorised in few countries. Frequency arrangements for the unpaired 2 GHz bands have been removed from the revision of ECC/DEC/(06)01 [6] and it was concluded that further investigations were needed to develop a suitable ECC framework for those bands.

The European Common Allocations Table (ECA) [14] of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz, in its latest version from March 2013, includes for the bands 1900-1930 MHz and 2010-2025 MHz the MOBILE service and the Fixed service (secondary status in the ECA). The ECA already indicates that CEPT is investigating alternative usage for the unpaired 2 GHz bands.

2.2 CURRENT AUTHORISATIONS AND USES OF THE UNPAIRED 2 GHz BANDS

Currently, all or parts of the frequency band 1900-1920 MHz is licensed to mobile operators for the provision of electronic communications services in 33 CEPT countries, whereby the licences are mainly limited to UMTS/IMT-2000 TDD technology. On the other hand, the frequency band 2010-2025 MHz, or parts of it, is licensed to mobile operators in 14 CEPT countries for the provision of electronic communications services, mainly limited to UMTS/IMT-2000 TDD technology and in some cases in a technology-neutral way. Existing licences in the unpaired 2 GHz bands have been awarded on an exclusive basis in some countries. In addition, some administrations use the band 2010-2025 MHz for short-term licences, in particular for PMSE video links and cordless cameras. Annex 3 shows the current authorisations in the bands 1900-1920 MHz and 2010-2025 MHz and the corresponding duration.

The mobile licences (UMTS TDD) in force on the unpaired 2 GHz bands are not in use in Europe, noting also that the lack of interest of mobile operators for spectrum in the unpaired terrestrial 2 GHz band has been demonstrated during the auctions in some CEPT countries in 2011. The duration of those licences vary from country to country, from 2014 - 2029 (or even unlimited duration, in United Kingdom).In addition it has to be mentioned that some licences have already been surrendered in a number of countries.

Some of the licences were awarded through spectrum auction processes and, as a result, considerable auction prices were achieved. In some countries, a licence repeal process might be possible in case of continued non-implementation, whereas in other countries this will not be possible due to specific conditions and obligations which are part of the licence (e.g. in some countries, coverage obligations are considered as fulfilled when providing services via other spectrum where the same licensee has also a licence and for which the network is implemented).Other options for making the spectrum available for new usage need to be considered (e.g. liberalisation, transfer, interim licence conditions for new licensee until the end of the existing licence duration(s)). Liberalisation frameworks would permit incumbent licensees in many of these countries to enable alternative service deployment, but the frameworks in some countries would or may maintain restrictions with regard to technology or use. A number of administrations may not be in a position to withdraw the existing licences and may seek agreements between the existing licence holder and possible new service operator(s). Possible use of the 2 GHz unpaired bands for PMSE video links and cordless cameras was proposed in CEPT Report 051 [36]. According to the results of a CEPT questionnaire on authorisation issues regarding the candidate bands for Broadband Direct-Air-to-Ground Communications (DA2GC) in 2013, the prospects for change of use through liberalisation appear in general promising for the 2 GHz unpaired bands, whereby the precise liberalisation framework may need to be found by the individual administration. It may be helpful to describe more in detail the options for a precise liberalisation framework in accordance with the needs of the new foreseen spectrum usages (e.g. pan-European service coverage in case of DA2GC, or progressive introduction as licenses expire in case of PMSE) and to set up a common European implementation schedule for future harmonised and efficient use of the 2 GHz unpaired bands. The difficulties related to current regulations and possible options for a liberalisation framework are described in the present Report from CEPT, which details the work undertaken and presents final results under this Mandate.

Updated information on the current status of individual authorisations in force on the unpaired 2 GHz bands can be found in ECO Report 03 [9] (http://www.cept.org/eco/deliverables/eco-reports) and EFIS (http://www.efis.dk/).

2.3 CURRENT USE AND REGULATORY FRAMEWORK OUTSIDE CEPT

The following information has been collected on the current use and regulatory framework outside of CEPT as shown in Table 1.

Table 1: Current Use and Regulatory Framework in Countries outside of the CEPT

	1900-1920 MHz	2010-2025 MHz
Australia	Mobile telephony – licence expiry 2017 Capital cities only – 3G and BWA services. Regional and remote areas only – BWA. Review initiated.	Mobile telephony – licence expiry 2017 Capital cities only – 3G and BWA services. Regional and remote areas only – BWA. Review initiated
Canada	1850-2000 FIXED MOBILE 5.384A 5.388A 5.388 5.389B C35: In the band 1850-1990 MHz, stations of the mobile service have priority over those of the fixed service with displacement of fixed assignments governed by the appropriate spectrum utilisation policy.	2020-2025 FIXED MOBILE 5.388 C37: The designation of the band 2 020-2 025 MHz for Advanced Wireless Services may be the subject of a future public consultation.
China	1880-1920MHz is allocated for IMT TDD system. In 1880-1900MHz, commercially deployed TD-SCDMA and TD-LTE networks are available by one Chinese operator (China Mobile). 1900-1920MHz may be used for commercial TD-LTE network in the future when the band will be freed.	2010-2025MHz is allocated for IMT TDD system. Currently it is used for commercial TD-SCDMA network by one Chinese operator (China Mobile)
CITEL	DECT usage is allowed in many countries administered by CITEL, within the frequency band 1910-1930 MHz allocated in: Argentina Bahamas Bolivia Brazil Chile Colombia Costa Rica Dominican Republic El Salvador Equador Honduras Mexico Panama Paraguay Peru Uruguay	
Africa CRASA CRASA groups together the 14 Southern African Development Community	1 900-1 920 MHz FWA IMT (terrestrial)	IMT (terrestrial) (2010-2025 MHz) TDD

	1900-1920 MHz	2010-2025 MHz
(SADC) countries		
India	1900-1910 MHz paired with 1980-1990 MHz may be considered for cellular systems	2010-2025 MHz (TDD mode)
Japan	1885-1980 MHz J99 FIXED Commercial Telecommunications Service (Fixed Wireless Access Communications in 1900MHz) The band 1885-2025MHz is intended for use by IMT-2000. Such use does not preclude the use of these bands by other services to which they are allocated (see also PHS-Personal Handyphone System – a cordless telephony system) The band 1893 – 1906 MHz is used by DECT in Japan (sharing the band with PHS)	2010-2025 J99 MOBILE J99A J99B Commercial Telecommunications Service (Portable Radio Communications) An assignment to the Portable Radio Communications is subject to Annex 7-3. The bands 1885-1980MHz, 2010-2025MHz may be used by high altitude platform stations as base stations to provide IMT-2000.
United States	1850-2000 FIXED MOBILE RF Devices (Part 15) Personal Communications (Part 24) Fixed Microwave (Part 101) 1980-2010 MHz NG177 NG177 In the bands 1990-2000 MHz and 2020-2025 MHz, where the receipt date of the initial application for facilities in the fixed and mobile services was prior to June 27, 2000, said facilities shall operate on a primary basis and all later-applied-for facilities shall operate on a secondary basis to any service licensed pursuant to the allocation adopted in FCC 03-16, 68 FR 11986, March 13, 2003 (“Advanced Wireless Services”). Not later than December 9, 2013, all such facilities in the bands 1990-2000 MHz and 2020-2025 MHz shall operate on a secondary basis to Advanced Wireless Services.	2000-2020 MHz FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) Satellite Communications (Part 25) 2020-2025 MHz FIXED MOBILE NG177

From Figure 5 it can be concluded that there is an extensive use by PHS services outside of Europe.

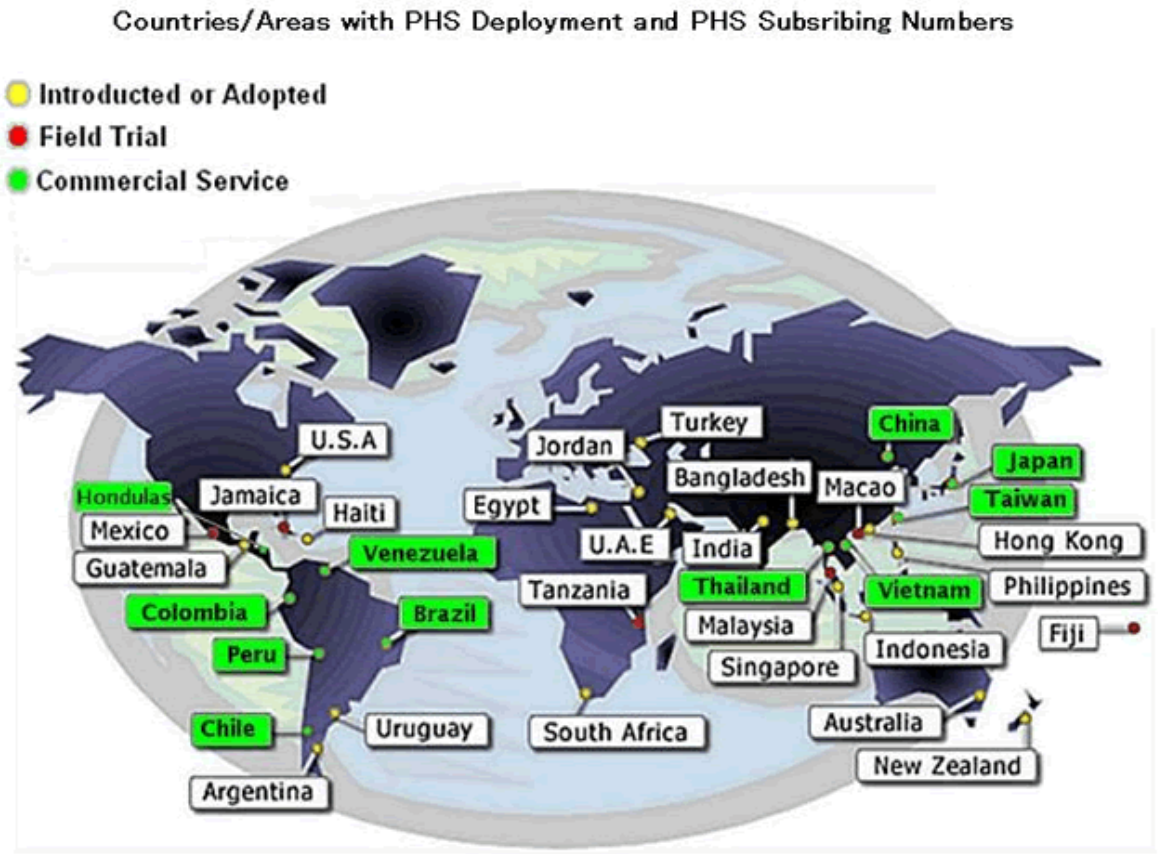

Figure 5: PHS Deployment

Table 2: Frequency bands usable for PHS

Country/Area	Frequency Band
Asia	
Bangladesh	1895.0 - 1915.0
China	1900.0 - 1920.0
India	1880.0 - 1900.0
Indonesia	1895.0 - 1918.1
Japan	1884.5 - 1919.6
Philippines	1908.0 - 1918.0
Singapore	1895.0 - 1906.1
Taiwan	1905.0 - 1915.0
Thailand	1900.0 - 1918.1
Vietnam	1895.0 - 1900.0
Pacific	
Australia	1880.0 - 1900.0
New Zealand	1895 - 1920
Middle East & Africa	
Cameroon	1905.0 - 1920.0
Ethiopia	1905.0 - 1925.0
Mali	1885.0 - 1930.0
Swaziland	1895.0 - 1905.2
U. A. E.	1895.0 - 1905.0
North America	
USA	1880.0 - 1910.0 1915.0 -1920.0
Latin America	
Argentina	1880.0 - 1910.0(mobile) 1910.0 - 1930.0(fixed)
Brazil	1880.0 - 1900.0
Chile	1880.0 - 1910.0(mobile) 1910.0 - 1930.0(fixed)
Columbia	1880.0 - 1910.0(mobile) 1910.0 - 1930.0(fixed)
Costa Rica (Fixed)	1910.0 - 1930.0(fixed)
Guatemala	1910.0 - 1918.0
Haiti	1910.0-1930.0
Honduras (Mobile)	1880.0 - 1910.0(mobile) 1910.0 - 1930.0(fixed)
Uruguay	1910.0 - 1930.0

PHS services range from digital walky-talky to cordless telephony, WLL and local FWA (up to about 10 km distance), private as well as public PHS services.

http://www.phsmou.org/resources/PHSGuidebook_4th.pdf

By October 2006, the PHS service had as many as 93 million subscribers in about 600 cities in China. PHS was officially closed by end 2009, some PHS users continue to use PHS phones, operators do not maintain anymore the installed PHS systems. The public PHS service in Taiwan is estimated to have at least 2 million subscribers.

2.4 PREVIOUS STUDIES ON THE UNPAIRED 2 GHz BANDS

CEPT Report 039 [11] has been the most recent work on the Unpaired 2 GHz frequency bands and was prepared by CEPT in response to the Mandate from the European Commission, issued in June 2009, relating to the 2 GHz bands (1900-1980/2010-2025/2110-2170 MHz).. This CEPT Report 039 [11] was based on the work carried out in ERC Report 065 [13], by considering developments in characteristics of systems operating in adjacent bands and by considering technology-neutral approach to allow technologies other than UMTS to be deployed. It was found that the conclusions of ERC Report 065 [13] remain valid. In the CEPT Report 39 [11], the least restrictive technical conditions for both 2 GHz FDD and TDD bands have been defined. In order to protect the commercial 2GHz FDD UMTS system, TDD blocks in 1900-1920 MHz in-band transmit powers were limited from 20 dBm to 43 dBm.

Available studies identified are ERC Report 64 [12] (Sharing between UMTS and existing fixed services) and ERC Report 65 [13] (Adjacent band compatibility between UMTS and other 2 GHz services), both addressing the bands 1900-1920 MHz and 2010-2025 MHz. These reports have been agreed in 1999 in the context of the designation of the bands for UMTS.

In addition, CEPT Report 019 [10] was prepared in response to the EC Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS. The Final Report was issued on 21 December 2007, with editorial revisions made on 17 March 2008 and 30 October 2008.

2.5 IDENTIFICATION OF ALTERNATIVE USES FOR BOTH UNPAIRED 2 GHz BANDS

CEPT had investigated, in the past three years before the EC Mandate was issued, many usage scenarios for the frequency bands 1900-1920 MHz and 2010-2025 MHz, in view of finding a suitable solution for the currently unused unpaired 2 GHz bands. The following options were considered and duly investigated:

- the pairing of 1900-1920 MHz and 2010-2025 MHz (between themselves or with others frequency bands) for IMT;
- the potential use of the unpaired band by low power applications;
- the identification of alternative uses for 1900-1920 MHz and 2010-2025 MHz bands.

The following alternative uses for the unpaired 2 GHz bands were considered the most suitable solutions, as a result of the CEPT investigation:

1. Use (parts of) the bands 1900-1920 MHz and/or 2010-2025 MHz to satisfy the spectrum demand of 20 MHz TDD or 2x10 MHz FDD for **Broadband DA2GC**.

The following options / combinations of bands for Broadband DA2GC would be possible:

- Use of the band 1900-1920 MHz for TDD Broadband DA2GC (guard bands may be required);
- Pair 10 MHz within the band 1900-1920 MHz with 10 MHz within the band 2010-2025 MHz for **FDD Broadband DA2GC** (guard bands may be required), and use the remaining 15 MHz within 1900-1920 MHz and 2020-2025 MHz for **video links and/or other SRDs** (guard bands may be required);
- Pairing of the bands 1900-1920 MHz and 2010-2025 MHz, from a cellular mobile point of view (mass market), was studied for UMTS technology. Increased complexity (additional bands) in User Equipment (UE) design compared to very limited economic benefits for the cellular mobile community led to lack of support from Industry. The situation was considered different for Broadband DA2GC, due to equipment dedicated to these two bands only;

2. Use of the entire 1900-1920 MHz and/or 2010-2025 MHz band for **PMSE** (in particular, video links); **several PMSE use cases have been identified;**

3. Use of both bands for **SRDs** (e.g.: among those applications requiring spectrum in the 2.4 GHz band); it has been noted that studies would first require the knowledge and identification of the future primary service use(s) in the bands;

4. To make spectrum in the band 1900-1920 MHz available for DECT, which is adjacent to the 1880-1900 MHz band (the “DECT” band).

5. **Ad-hoc Broadband PPDR** network; some use cases could be technically identical with identified PMSE use cases such as for wireless camera usage.

Any of the above alternative uses for the unpaired 2 GHz spectrum were considered to need further assessment in view of identifying the corresponding relevant technical conditions.

The future use of the unpaired 2 GHz bands could in some cases, be considered on a band-sharing basis (depending on the applications to be considered, geographical separation may be required to avoid interference).

It was as well be noted that harmonisation for alternative uses could be hampered by existing individual authorisations in force in some countries.

3 ALTERNATIVE USES INCLUDING SPECTRUM REQUIREMENTS

In order to respond to the request of the EC mandate, the following alternative uses are considered under this section:

1. Broadband Direct Air to Ground Communications (DA2GC);
2. Programme Making and Special Events (PMSE);
3. Short Range Devices (SRD);
4. Digital Enhanced Cordless Telecommunications (DECT);
5. Public Protection and Disaster Relief (PPDR).

It should also be noted that for these radio applications frequency bands other than the unpaired 2 GHz bands are also under consideration or have already been designated on CEPT level.

As described in section 3.6, synergies are identified so far for PMSE and ad hoc PPDR usages (use of the same technical framework and equipment) as well as for DECT and SRD usages (both candidates are seeking an allocation under a general authorisation regime). There may be a possibility of having a common set of technical parameters to enable equitable spectrum access.

3.1 BROADBAND DIRECT AIR TO GROUND COMMUNICATIONS

Several ECC Reports were under development within CEPT/ECC describing frequency management related and compatibility/sharing issues, see also sections 4 and 5:

- ECC Report 214 on Broadband Direct-Air-to-Ground Communications (DA2GC) [26],
- ECC Report 209 on compatibility/sharing studies related to Broadband Direct-Air-to-Ground Communications (DA2GC) in the frequency bands 1900-1920 MHz / 2010-2025 MHz and services/applications in the adjacent bands [27],
- ECC Report 220 on the compatibility and sharing studies of DA2GC, PMSE video links, SRD and DECT in the 2 GHz unpaired bands [29].

Additionally, as other frequency bands - especially 5855-5875 MHz - have also been studied for Broadband DA2GC, ECC Report 210 on Compatibility/sharing studies related to Broadband Direct-Air-to-Ground Communications (DA2GC) in the frequency bands 5855-5875 MHz, 2400-2483.5 MHz and 3400-3600 MHz [28] was developed.

The outcome of the evaluation of other frequency bands below 6 GHz, which were considered as less suitable than the unpaired 2 GHz bands or than the band 5855-5875 MHz, is also provided in ECC Report 214 [26]. In addition, ECC Report 214 [26] also came to the conclusion that a short term solution for Broadband DA2GC (by end of 2017) could not be realised in a frequency band above 6 GHz.

3.1.1 Introduction

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 request for spectrum is related to the direct-air-to-ground radio solution. The connection with the flight passengers' user terminals on-board aircraft is to be realised by already available fixed or Wi-Fi-based on-board connectivity network and/or via GSMOBA and in the future possibly also via UMTS and/or LTE.

The main application field would be Air Passenger Communications (APC). In addition, a Broadband DA2GC system could also support Airline Administrative Communications services (AAC) and thus improving aircraft

operation, resulting in particular in reduced OPEX for the airlines. Safety-relevant communications such as Air Traffic Control (ATC) and related services are not intended to be covered.

European Airlines are following the CEPT activities on Broadband DA2GC. So far, Lufthansa / Swiss / Austrian airlines, KLM / Air France, Air Berlin and British Airways have sent letters to CEPT showing their interest in a solution for Broadband DA2GC in Europe.

European companies represent an important force in the aeronautical market. The European aircraft industry holds about 50% of the world market for aircraft manufacturing. In the field of Air Passenger Communications services, however, Europe has room for improvements when compared to other parts of the world.

In North America, an air–to-ground system has been established in the duplex bands 849-851 MHz and 894-896 MHz, since the year 2008, with more than 2 000 commercial aircraft and 6 300 business aircraft equipped so far. An extension of the spectrum in the order of 2x1 MHz is going to be realised in the near future. In addition, the FCC is considering a new proposed rulemaking for DA2GC at 14.0-14.5 GHz (sharing with the FSS uplink whereby DA2GC Ground Stations (GS) avoid transmissions into the geostationary arc).

China is currently testing CDMA EV-DO to cover all of China's air routes. The industry is also studying the use of the fourth-generation mobile communications standard LTE, which provides higher download speeds, for route coverage. Trials for DA2GC are underway under the direction of CAA China and other Chinese Government entities to operate in 1785-1805 MHz band (20 MHz total bandwidth for DA2GC) and using TD-LTE technology. China Telecom had 17 base stations completed as of early 2012. Under the plan, China will construct up to a thousand surface-to-air base stations in the next few years. China's Civil Aviation Air-Ground Broadband Communications System will cover all routes of the major domestic airlines.

For the purpose of the present document, the following definitions apply:

Table 3: Definitions for Broadband DA2GC according to ECC Report 214

Term	Definition
Aircraft Station (AS)	Equipment which is installed on-board aircraft providing the radio, control and telecommunication functionalities for broadband DA2G communication
Broadband	“Broadband” in this context refers to a service providing data rates between several hundred kbit/s up to several Mbit/s per end-user, depending on the traffic load within a communication cell
Direct-Air-to-Ground Communications	Direct radio link between an Aircraft Station (AS) and a Ground Station (GS)
Forward Link (FL)	Within the DA2GC system the link from the Ground Station (GS) to the Aircraft Station (AS)
Ground Station (GS)	Equipment which is installed on the ground providing the radio, control and telecommunication functionalities for DA2GC
Reverse Link (RL)	Within the DA2GC system the link from the Aircraft Station (AS) to the Ground Station (GS)

3.1.2 Motivation for Broadband DA2GC

Mobile customers expect to be connected everywhere, every time, with all kind of mobile devices. This includes the provision of broadband services on-board aircraft and European airlines have great interest to offer internet services to their flight passengers in their continental fleets as soon as possible.

The connection link between the aircraft and the ground can be established either via satellites or by means of Direct-Air-to-Ground Communications (DA2GC). For future broadband services, it can be foreseen that the service provision via satellite will be conducted by using Ka-band satellite capacity and a considerable number of Ka-Band satellites are already put into operation or under procurement. Satellite operators also

consider mobile platforms such as aircraft and vessels as a considerable part of the addressable market and the ECC has recently adopted and published new ECC/DEC/(13)01 [7] supporting Earth Stations on Mobile Platforms (ESOMP). Ka-band satellite as well as DA2GC can therefore be seen as technical solutions in competition. On the other side, both solutions could also complement each other.

The establishment of a regulatory environment for Broadband DA2GC across Europe would provide ample benefits for the users - i.e. airline companies and flight passengers - in Europe:

- As an alternative service provision which by fostering competition might lead to a lower cost for the airlines and for the flight passengers;
- The technical implementation of DA2GC and also the stimulus of competition 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;
- The costs for aircraft installations and maintenance are a key issue for airline companies. Given the fact, airline operators see the DA2GC equipment can be installed overnight to a plane as an advantage. In particular, with regard to the aircraft antenna, a terrestrial solution has a clear advantage compared to existing satellite usage.

A further motivation arises from the expected growth of the air traffic. A forecast from Eurocontrol[2] published in October 2011 estimates 11.5 million movements under Instrument Flight Rules (IFR) in Europe in 2017. This is 21% more than in 2010.

About 66% of the European air traffic consists of domestic or continental flights, i.e. the main part of the airline business. The addressable market in Europe for DA2GC consisted of about 160 airlines with more than 4500 aircraft in 2014 (without business aviation). In general, a strong increase in percentage of aircraft fleet equipped with internet connectivity solutions is expected during the next years. According to a market research[3], approximately 50% of the world's fleet will have been equipped with Wi-Fi connectivity by 2020.

The introduction of Broadband DA2GC would not only increase Europe's competitive position, but it could also bring Europe into a leading position in this market segment. Studies on air passenger demand for on-board connectivity are currently not publicly available.

The introduction of Broadband DA2GC providing mobile services would contribute to the development of the internal market and enhance competition by increasing the availability of pan-European services and end-to-end connectivity as well as encouraging efficient investment. DA2GC constitutes an innovative alternative platform for various types of pan-European telecommunications services provided to aircraft passengers.

The provision of broadband services including also all kinds of transportation sectors is a declared goal under the European Digital Agenda 2020 plans.

Broadband DA2GC provide such services without the round trip delay that is a feature in the competing geostationary satellite service solutions. In addition, these networks can provide services to airplanes by using aircraft antennas that are considerably efficient in terms of weight, size, aircraft installation costs and air drag considerations when compared to satellite antennas on-board aircraft.

[2] http://www.eurocontrol.int/statfor
[3] from http://imsresearch.com

3.1.3 Spectrum demand for Broadband DA2GC

The spectrum demand for Broadband DA2GC 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.

Statistical traffic evaluations show that there is an average number of more than 26 aircrafts simultaneously within one cell with coverage radius of 100 km in high air traffic areas which are concentrated in Western/Central Europe (mainly Germany, France, Benelux, Switzerland, Austria, United Kingdom, Northern Spain and Northern Italy). It has to be mentioned that there are also areas at the edge of the flight zones, where the cells have only a low traffic density in the range of 1 - 2 aircraft simultaneously, but the spectrum demand for Broadband DA2GC has to be adapted for the high traffic areas. The approach used assumes that about 60% of the fleets are covered.

Based on the calculations, which have been carried out and accepted within ECC, paired spectrum of up to 2x10 MHz for FDD operation or 20 MHz for TDD operation is agreed to be necessary to cope with short- to medium-term demand. The amount of spectrum released could be done on a step-by-step process, e.g. by allocating the spectrum in smaller blocks on a national basis. This could be a methodology for facilitating a time plan for a common European harmonisation.

The implementation and operation of more than one European Broadband DA2GC system in the same frequency band (either in the unpaired 2 GHz bands, in the 5.8 GHz band or in the 2 GHz MSS band with CGC) was considered as unlikely. Therefore intra-service sharing studies (e.g. for 2 Broadband DA2GC systems in the unpaired 2 GHz bands) were not carried out. However, by looking at the results of the compatibility and sharing studies it appears that co-channel operation of different Broadband DA2GC systems would not be possible in the same geographical area. Even in the case of different systems in adjacent frequency blocks (in the same geographical area) a guard band in between seems to be necessary if TDD is considered. No aggregate effect with regard to other radio applications, i.e. adjacent to the unpaired 2 GHz bands, may occur.

As mentioned earlier, the roll-out of a European wide Broadband DA2GC system may be facilitated by releasing the spectrum using a step by step process. Cross-border coordination amongst European countries is considered an issue that can be addressed with normal bilateral/multilateral coordination procedures. In addition, it is considered that there will be no legacy systems (i.e. UMTS/TDD) in operation to coordinate with. Coordination with services within bands (e.g. PMSE) or in adjacent bands - either within a country or between neighbouring countries - is expected to be based on the results of the compatibility studies.

The results of the compatibility and sharing studies provide also a basis for cross-border coordination at the outer European borders, such as separation distances between DA2GC GS and other radio stations in the neighbouring country or for appropriate measures for the AS (e.g. power reduction over relevant countries without a DA2GC service). Although the situation - i.e. non-utilisation of the spectrum - outside of CEPT in ITU Region 1 is most likely similar because of the current IMT identification of the unpaired 2 GHz bands, such coordination would also support that a pan-European DA2GC service would not be subject to operational restrictions at border areas in the future.

3.1.4 Compatibility/sharing scenarios for DA2GC in the 2 GHz unpaired bands

A number of different compatibility/sharing scenarios with other radio services/applications were considered for the implementation of Broadband DA2GC within the 2 GHz unpaired bands. In addition, the possibility to put the DA2GC FL as well as the DA2GC RL within either band was also subject for the studies. All these compatibility/sharing scenarios are illustrated in Figure 6 to Figure 9.

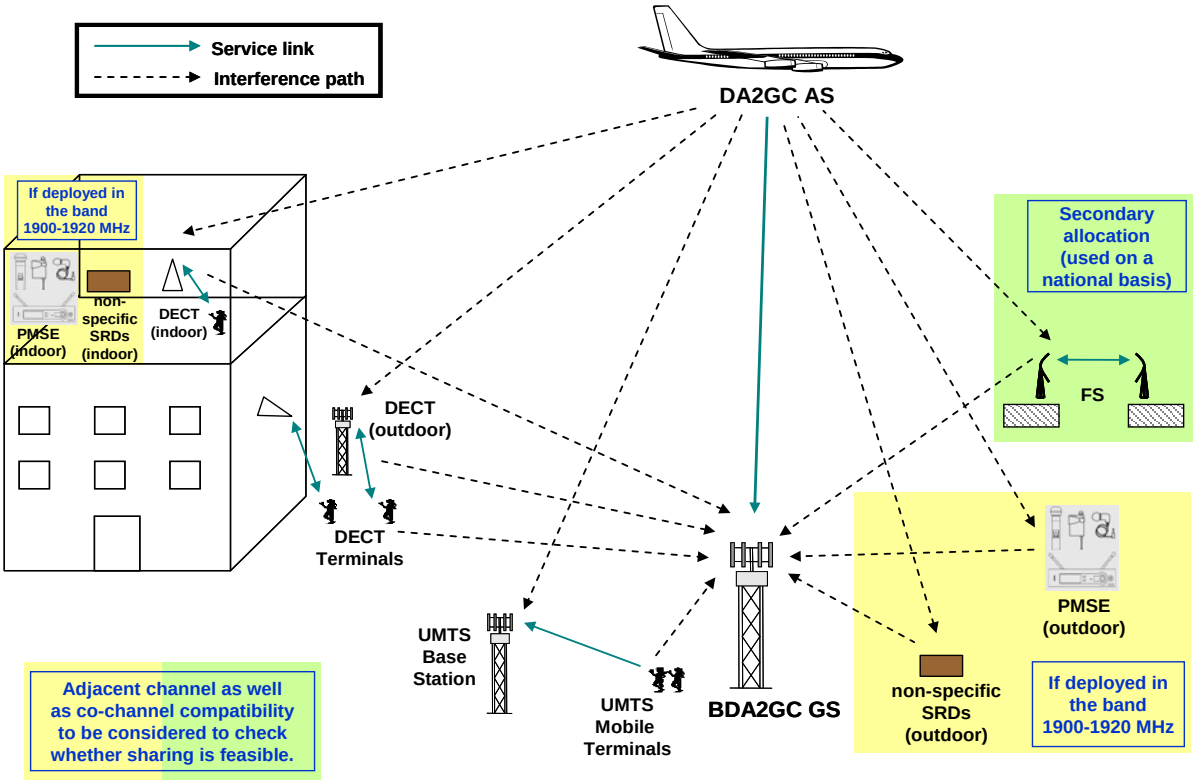

Figure 6: Compatibility/sharing scenarios for BDA2GC RL in the frequency band 1900-1920 MHz

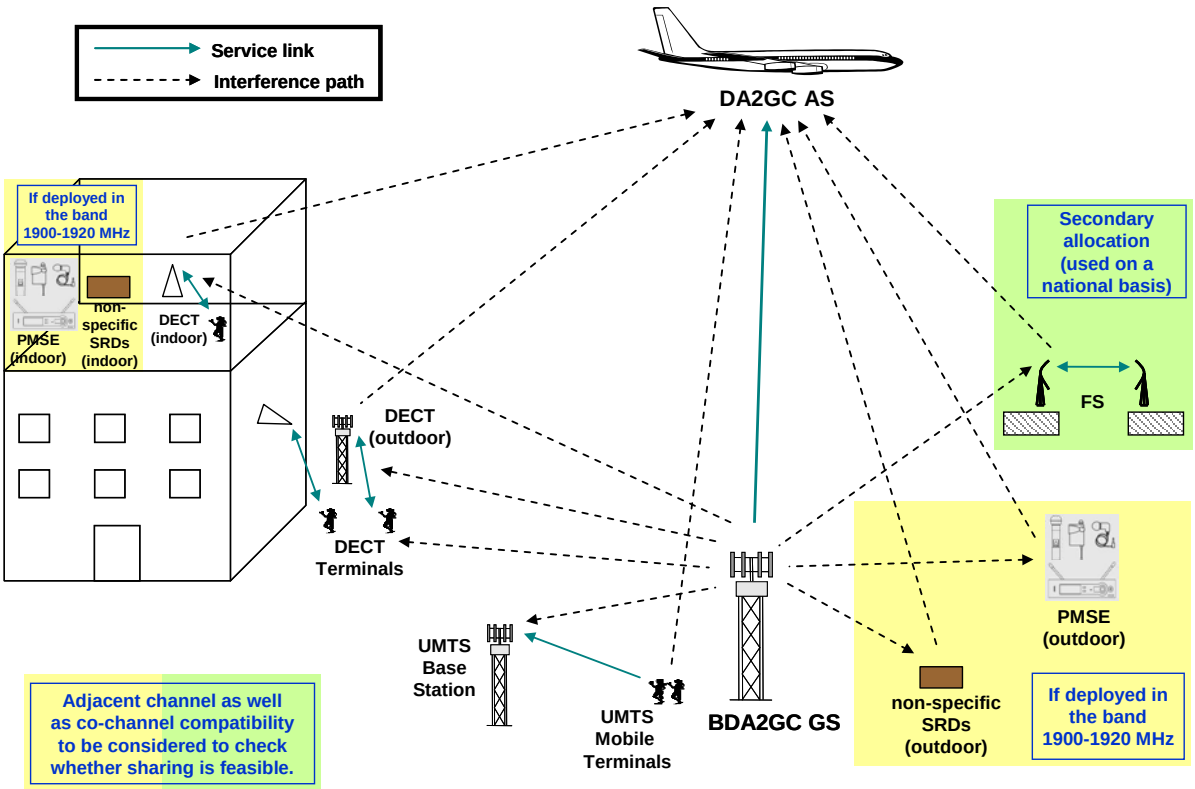

Figure 7: Compatibility/sharing scenarios for BDA2GC FL in the frequency band 1900-1920 MHz

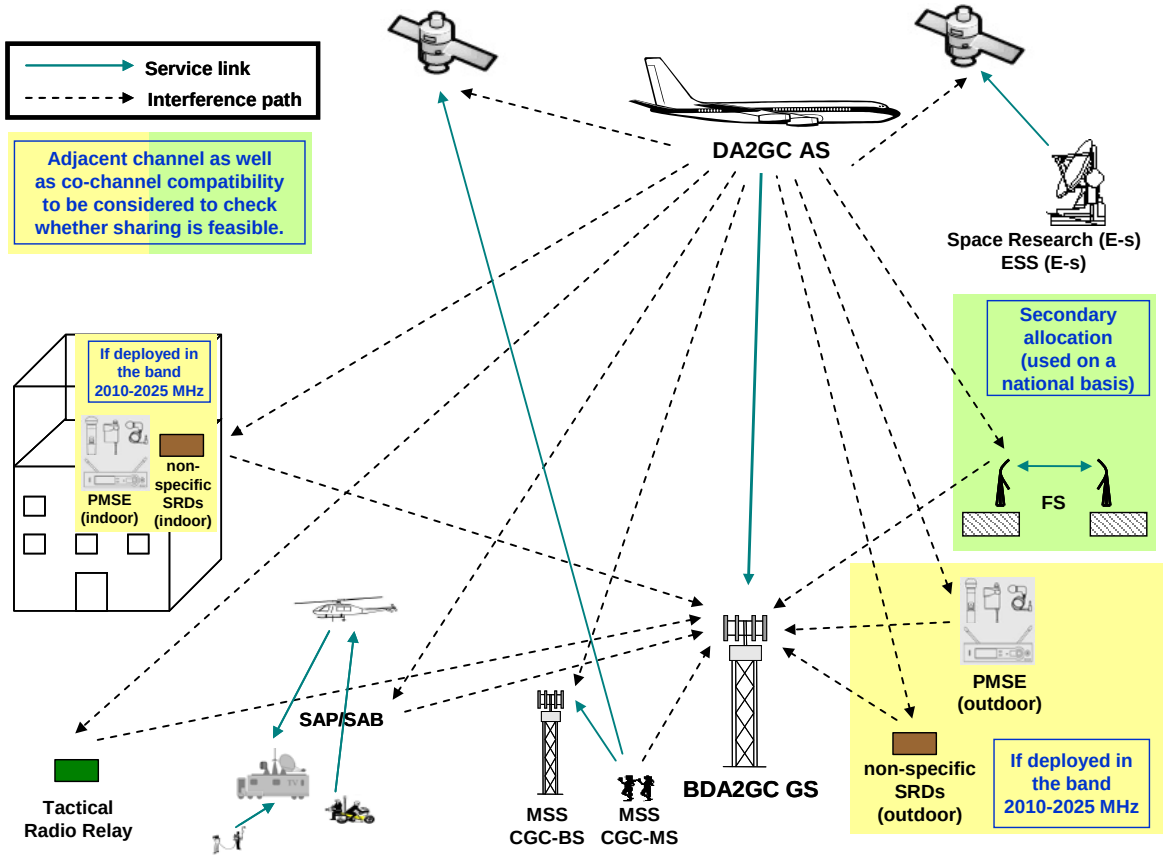

Figure 8: Compatibility/sharing scenarios for DA2GC RL in the frequency band 2010-2025 MHz

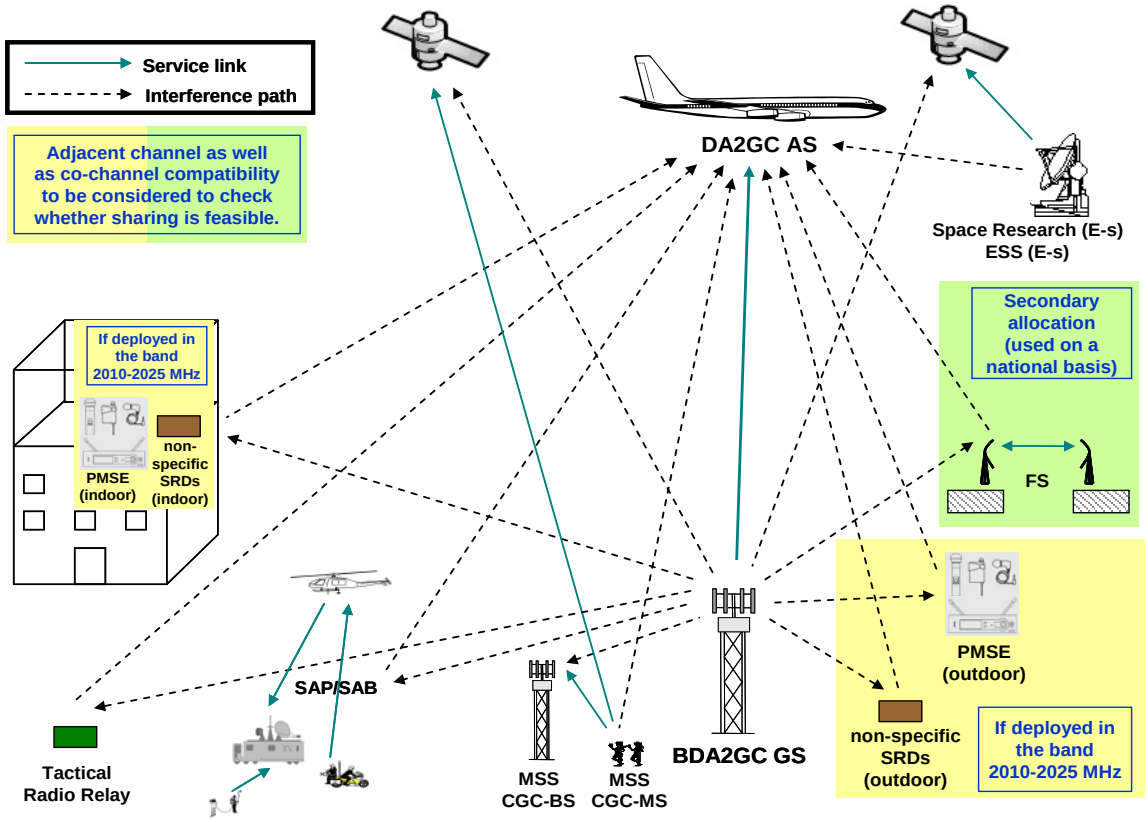

Figure 9: Compatibility/sharing scenarios for DA2GC FL in the frequency band 2010-2025 MHz

The following three options were considered as the preferred ones as a result of the compatibility studies between Broadband DA2GC and existing services adjacent to the unpaired 2 GHz bands:

- For an FDD system according to ETSI TR 103 054 [31], frequency bands: 1900-1910 MHz (FL) and 2010-2020 MHz (RL); ANNEX 4: presents the corresponding regulatory parameters;
- For a TDD system according to ETSI TR 101 599 [32], frequency band: 1900-1920 MHz; ANNEX 4: presents the corresponding regulatory parameters;
- For a TDD system according to ETSI TR 103 108 [33], frequency band: 1900-1920 MHz; ANNEX 4: presents the corresponding regulatory parameters.

It should be noted that the two Broadband DA2GC TDD systems mentioned above are also under consideration for operation in the 5.855-5.875 GHz band[4]. During the Call for Inputs, none of the respondents has indicated a preference for a DA2GC TDD solution in the 2010-2025 MHz band. The 2010-2025 MHz band can only provide up to 15 MHz for DA2GC using TDD, although it is seen as technically possible to operate such a system also within less than 20 MHz. The possibility for a DA2GC TDD system in the frequency band 2010-2025 MHz was not considered due to a decision taken during the preparation of the present report.

3.1.5 Typical performance expectations for Broadband DA2GC

The performance metrics as described below should be considered as typical performance to be expected independently of the technical solution / of the duplex mode.

Table 4: Typical performance metrics for Broadband DA2GC according to ECC Report 214

Metric	
Broadband DA2GC	"Broadband" in this context refers to a service providing data rates between several hundred kbit/s up to several Mbit/s per end-user, depending on the traffic load within a communication cell
Availability of the service (average target)	99%
Latency	Less than 100 ms (compared to e.g. geostationary satellite solutions which are typically in the area of 500 ms)
Data rate for one aircraft link	Typically 15 Mbit/s in either direction
Operational system efficiency	Typically between 1.5 and 3 bit/s/Hz

The end-to-end Quality of Service for a DA2GC system (link between the GS and the AS) depends not only on the characteristics of the chosen technology but also on the network configuration (spectrum efficiency of the system). E.g. it depends on number/density of GS, frequency band (2 GHz / 5.8 GHz), mitigation measures (to ensure coexistence with other radio applications), antennas (SISO, MIMO, different polarisations, adaptive beam forming antennas), link budget, number of aircrafts within a sector / beam.

The QoS for the end-user in the aircraft additionally depends on the configuration of the on-board system and on the number of users on board aircraft.

3.2 PROGRAMME MAKING AND SPECIAL EVENTS

The term Programme Making[5] and Special Events[6] applications (PMSE) describes radio applications used for SAP/SAB, ENG/OB and applications used in meetings, conferences, cultural and education activities, trade fairs, local entertainment, sport, religious and other public or private events for perceived real-time presentation of audio visual information.

[4] ECC/DEC/(15)03 [49].
[5] 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.
[6] 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.

The definitions of SAP/SAB and ENG/OB are set out[7] as follows:

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

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

The definitions of SAP and SAB are not necessarily mutually exclusive. Therefore, they are often used together as "SAP/SAB" to refer generally to the whole variety of services to transmit sound and video material over the radio links.

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 newsroom and/or to the portable tape or other recorders.

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.

The definitions of ENG and OB are not mutually exclusive and certain operations could equally well reside in either or both categories. Therefore, it has been a long practice within the CEPT to consider all types of such operations under the combined term "ENG/OB". It is also understood that ENG/OB refers to terrestrial radiocommunication services, as opposed to SNG/OB term, which refers to similar applications but over the satellite radiocommunication channels.

PMSE covers a wide variety of applications. Those most suitable for the unpaired 2 GHz bands consist of wireless cameras and mobile video links.

Video PMSE is used in a wide variety of programme production and film making, from daily news events with a single camera, through sporting events such as football which typically uses two or three wireless cameras, to more major productions, both studio based and outdoor which may require many cameras, mobile and airborne links to produce.

Figure 10: Cordless Camera for Sports Coverage

Typically, these services are allocated spectrum in blocks of 10 MHz bandwidth. The neighbouring band 2025-2110 MHz is already used in at least 19 CEPT countries for such PMSE applications on a shared basis, and is identified on a tuning range basis in ERC/REC 25-10 [17] (see also ERC Report 38 [19]). The

[7] For further information see the ECC Report 204 [18].

term “tuning range” for PMSE refers to a range of frequencies over which radio equipment is envisaged to be capable of operating. The availability of spectrum for PMSE use in a given country is dependent on the sharing conditions (frequency, power and time domain) with the primary users of the spectrum at any given location.

The successful use of video PMSE (as with other radio services) is dependent upon a range of factors which contribute to the link budget. The 2-3 GHz range provides the best conditions for many applications, including airborne and mobile use. The physical size of 2 GHz antennas and the attractive propagation characteristics, including using reflections from surrounding objects, allow successful capture of high quality images for mobile use, for example a camera operator running along the touchlines at a football match, or sitting on a motorbike following a road race. This frequency range is effective even in partially obstructed propagation paths, such as ground to air links obstructed by trees.

Due to a number of changes to the allocation of spectrum in the 2-3 GHz range, this frequency range is becoming more limited for use by PMSE. ERC/REC 25-10 [17] identifies 575 MHz of spectrum in the 2-3 GHz range (2025-2110 MHz, 2200-2690 MHz) as tuning range for PMSE. However, recent allocations to services with which PMSE cannot share (e.g. in the 2.5-2.69 GHz band and potentially within the 2.3-2.4 GHz band depending on future studies within CEPT) has resulted in a significant reduction of available spectrum for PMSE. The requirements for spectrum in the 2-3 GHz range remains, and with the advent of increased HD and UHD production, additional requirements may be foreseen. Several candidate bands within an extended tuning range for possible future use for cordless cameras and video links are under consideration (CEPT Report 051 [36]), but the majority are at higher frequencies up to 8.5 GHz which cannot provide non-line-of-sight operation, essential for coverage of many live events.

The 2010-2025 MHz band is directly adjacent to the 2025-2110 MHz band that is already part of the tuning range for video PMSE applications. Existing video PMSE equipment is already capable of tuning to this range; indeed, in some CEPT administrations, this band is already used on a temporary basis for PMSE. However, the 1900-1920 MHz band does not fall within the tuning range of PMSE equipment, and modifications would be required to existing and future equipment in order to access the band. As such, the 2010-2025 MHz band has a higher immediate potential for wider use within CEPT countries for video PMSE than the 1900-1920 MHz band.

3.3 SHORT RANGE DEVICES

Based on the requests from ETSI set out in five ETSI System Reference Documents for SRD applications, CEPT developed ECC Report 189 [30] on future spectrum demand for Short Range Devices in the UHF frequency bands 870-876/ 915-921 MHz (UHF roadmap). This includes spectrum demands raised by ETSI for generic SRD, UHF RFID, Home Automation & Sub Metering, automotive SRD, Smart Meters and Smart Grids, Metropolitan Mesh Machine Networks (M3N) applications, Alarm and Social Alarm systems and Assistive Listening Devices. At the same time, no demand request has been received for the unpaired 2 GHz band.

The propagation characteristics of 2 GHz is not as good for many applications, e.g. smart metering/ smart grids, compared with the spectrum considered in the on-going investigations under the UHF roadmap for which, as referred above, five ETSI System Reference Documents had been received, expressing proposals for utilizing the 870-876 MHz and 915-921 MHz frequency bands. It can be concluded from investigations that frequencies around 2 GHz are sub-optimal for installations in basements in urban and suburban areas (e.g. only around 20% of all smart meters could be reached according to an extensive study presented to SRD/MG by the University of Dortmund which was commissioned by German authorities). The UK Department of Energy and Climate Change also provided statements in support of a solution below 1 GHz as under the on-going investigations.

On the other side, examples where 2 GHz can be used by SRD are e.g. industrial automation, some alarm systems, machine-to-machine (M2M). For industrial automation applications, CEPT is currently investigating also the 5725-5875 MHz frequency range.

Many SRD applications such as RFID or wireless applications in industry are looking for frequency opportunities, which could also be used in other regions. The USA and Japan as well as other countries have provisions for applications under general authorisation in this or nearby part of the spectrum. However, the prospects for global harmonisation in the 800/900 MHz look better due to the presence of the 902-928

MHz ISM-band in Region 2 and this aspect is very important for some market sectors such wireless solutions used at machines, aircraft, automotive, RFID.

In addition, it should be noted that the particularity of SRD application is that none allocation are required to operate in a frequency band. This means that an upcoming request from industry would be taken into account at any time but preferably, when a primary user will be identified.

Regarding the proposal for DECT as set out in section 3.4, if this is realised under application-neutral and technology-neutral principles (see CEPT Report 014 [1] and CEPT Report 044 [2]) using general authorisation, it can also be regarded as a new spectrum opportunity for SRD usage, provided that suitable spectrum access rules are followed (see section 3.6 on Synergies between the proposed short list of selected use). The DECT proposal and the SRD approach are identical with regard to equal and non-exclusive access to spectrum under exemption from individual authorisation, in a spectrum compatible way with other possible usage that could be under individual authorisations, e.g. a DA2GC ground network.

Apart from the DECT system reference document, there is no ETSI System Reference Document under preparation in ETSI at the moment nor an industry request for SRD applications, making a proposal for usage in the 2 GHz Unpaired bands. The technical parameters of the ETSI System Reference Document for DECT are proposed to be used for compatibility studies. CEPT is aware of other technologies with similar technical parameters and spectrum access mechanism, e.g. draft IEEE 802.11ah (both approaches with 250 mW e.i.r.p., 1 MHz channel bandwidth, and dynamic channel/frequency selection spectrum access mechanism). The proponents of the technology 802.11ah have approached the CEPT with the request for identifying a spectrum opportunity (ETSI TR 103 245 [47]).

CEPT recommends that the principles set out in CEPT Report 014 [1] and CEPT Report 044 [2] for technology-neutral and application-neutral license-exempt regulations should apply for the DECT proposal. This does however not ensure that other standards will be developed with similar (or equivalent) medium access mechanism, and able to compete with DECT in the same spectrum.

A proposal to consider metering (smart metering, smart grids and smart cities) in the unpaired bands was presented during the Call for Inputs, taking note that the needed frequency ranges are dependent on a country's geography and the average construction of houses and buildings. It is as well referred that a number of bands proposed for metering, such as the 870-876 MHz, are not available in a substantial number of countries.

In line with the SRD strategy set out in CEPT Report 014 [1], CEPT Report 043 [40] and CEPT Report 044 [2] for metering applications, as well as the recent RSPG Report on Sectoral Needs, metering devices should be covered by a non-specific SRD regulatory approach. This request is therefore already included in the DECT/SRD usage category (see section 3.6).

3.4 DIGITAL ENHANCED CORDLESS TELECOMMUNICATIONS

Digital Enhanced Cordless Telecommunications (DECT) is a general radio access technology for wireless telecommunications, for cell radii ranging from a few meters to several kilometres, depending on application and environment. The DECT technology provides a comprehensive set of protocols, which provide the flexibility to interwork between numerous different applications and networks. The base standard EN 300 175-1 to 8 [16] specifies a high capacity TDMA/TDD radio interface supporting symmetric and asymmetric connections, connection oriented and connectionless data transport and provides security and confidentiality services. The mandatory instant Dynamic Channel Selection (iDCS) messages and procedures provide effective co-existence of uncoordinated private and public systems on the common designated DECT frequency band and avoid any need for traditional frequency planning.

In 1989, CEPT agreed ERC Recommendation T/R 22-02 [20] that designated the band 1880-1900 MHz for DECT (abrogated in the meantime). In 1991, Council of the European Communities adopted a Directive[8] that required member states to designate 1880-1900 MHz for DECT and to ensure that any services remaining in this band do not interfere with any DECT systems that may be established according to commercial demand. CEPT developed then two decisions on DECT:

[8] Council Directive on the frequency band to be designated for the coordinated introduction of digital European cordless telecommunications (DECT) into the Community (91/287/EEC) (Annex 1 to ERC/DEC/(94)03) [21].

- ERC/DEC/(94)03 [21] on the frequency band to be designated for the coordinated introduction of the Digital European Cordless Telecommunications system;

- ERC/DEC/(98)22 [22] on Exemption from Individual Licensing of DECT equipment, except fixed parts which provide for public access (Amended 8 November 2013).

The current regulation does not restrict the scope of DECT applications (e.g. audio, video).

3.4.1 Reasons for proposing additional spectrum for DECT

DECT technology has over 820 million of accumulated devices since its introduction in the market. The accumulated number of DECT devices grows at a ratio of around 100 M devices per year. This is far more than initially expected and is supported by only 20 MHz of allocation. While the operation of the technology is currently successful, it appears prudent to assign additional bandwidth for further expansion of the technology.

DECT was initially primary a 3.1 kHz telephony service conveyed over radio links. Recent new developments such as DECT New Generation now also offer wideband 7 kHz voice transmission, a super-wideband 14 kHz service, different data services and video surveillance. While these technological advances are well received, because they are reflecting the general trend towards multimedia devices, they are also requiring a lot more bandwidth.

DECT based softphones are one of the technologies in use as a telephony solution in the business market, which is increasing in all regions worldwide with annual growth figures >10%. By the year 2017, the Global Industry Analysts (GIA) group project market adoption of 2.9 million units (GIA online, 2011). This steady migration from traditional desk based telephones does result in users adopting new device solutions for their audio connectivity. The headset is now a prime audio device chosen by softphones users as PCs are not shipped with the traditional handset that a desk based hard phone would be supplied with. Whether it be in a contact centre environment or office environment, the use of PC based telephony which delivers wideband audio is leading to behaviour change within these organisations. Users equipped with headsets that deliver enhanced (wideband) audio may use the same devices to stream music from their connected PCs. Therefore, such users who may not be on an active telephony call may still be in a wideband audio media link between telephony calls.

DECT technology is used in wireless headsets solutions. Many large Enterprises recognise the benefits that these wireless devices bring and promote deployment of them within their businesses for their office users as well as for their more traditionally contact centre users. Such large enterprises may occupy single buildings with staff levels in excess of 500 users, each one requiring a wireless device. Within city business areas, adjacent large organisations may also seek to use the same wireless technology.

As DECT is a very reliable and cost effective system, new applications are being developed using this technology. One new feature of DECT is the ‘Ultra Low Energy’ (ULE) operation mode, which has been developed during 2012. This allows battery operated devices to work for up to 10 years without changing the battery. The ULE mode, together with the other DECT properties, makes this technology a candidate for use in M2M applications, such as home automation applications, which will increase the number of DECT terminals massively. This ULE mode can also operate in the current DECT spectrum. The combined effect of successful softphone adoption, wideband telephony, music at work and deployment of wireless devices is causing already today density issues within the existing spectrum available leading to deployments being affected or restricted. In addition, new services are starting to be deployed such as video applications and data applications like home control. An investigation will be necessary to provide more specific data on the spectrum requirements.

3.4.2 What are the specific advantages of the band 1900-1920 MHz

Most technical documents are already available. The carrier numbers and positions for the use of DECT in the 1900-1920 MHz band are already defined (see annex F of ETSI EN 300 175-2 [16]) as consequence of the IMT allocation. The Harmonised standard for DECT over this band is already available as part of the IMT-2000 set. It is the ETSI EN 301 908-10 [15] (latest release, v4.1.1).

Immediate product implementation is possible from the technical point of view. It should be noted that the frequencies 1900-1930 MHz are already in use by DECT in non-EU countries and that are already products (> 100 million of devices) in operation over these frequencies. Near all DECT chipset and RF parts vendors

are already providing components compatible with the proposed new allocation. There is no other band where the DECT extension is as simple and immediate. This, combined with the proposed license-exempt regime, will make possible the real usage of the band by the public in the very short term.

A designation within the adjacent band 1900-1920 MHz to DECT will provide a single continuous block of up to 40 MHz. This, in combination with the use of already defined HLM (High Level Modulation - up to 64 QAM) would make possible the introduction of additional broadband services via DECT. This would make also possible the further evolution of the standard towards OFDMA. A maximum bitrate of 1Gbit/sec is theoretically achievable over the combined 40 MHz block using already proposed evolutions of the standard.

If a contiguous designation is given for the DECT technology, two additional RF carriers can be obtained by avoiding guard spaces.

3.4.3 Possible way forward for implementation of DECT in 1900-1920 MHz

It is understood that the DECT proposal is made on an application-neutral basis and can also be considered for a technology-neutral approach using general authorisation (exemption from individual licence).

It should be noted that the request in ETSI TR 103 149 [34] does not include the requirement for DECT to access spectrum exclusively, e.g. as a pre-requisite to ensure high quality of service. Therefore, the status of DECT in a possible extension band would be different compared to the current exclusivity of accessing spectrum in the range 1880-1900 MHz.

DECT use cases are primarily indoor but not exclusively. Therefore, an indoor restriction in the band 1900-1920 MHz may be an option for consideration, although not the preferred one. Outdoor usage is possible under the current regulations in the band 1880-1900 MHz.

3.5 PUBLIC PROTECTION AND DISASTER RELIEF

Within CEPT, the Unpaired 2 GHz bands (1900-1920 MHz and 2010-2025 MHz) are under discussion as a candidate for a harmonised solution above 1 GHz for ad-hoc PPDR network uses including, for some countries, PPDR broadband air-to-ground applications. Broadband PPDR temporary additional capacity (also known as “hot-spot” or “local area” networks) are supposed to provide additional local coverage at the scene of the incident in order to provide the necessary communication facilities to PPDR users in addition to those provided through the Wide Area network (WAN) or where the WAN radiocommunications are limited or not available. This additional capacity may be provided by Ad-hoc networks or other means (such as additional temporary base stations of the WAN) and are supposed to have high capacity and support PPDR users with low mobility. Ad-hoc networks may operate in the same (i.e. in a form of an ad-hoc micro-cell deployed at the event’s scene) as well as in a different frequency band.

PPDR organisations may also have requirements for broadband air-to-ground applications to support PPDR operations. These typically involve a video stream being relayed from a camera mounted on an airborne platform to a monitoring station on the ground. The requirements for broadband air-to-ground PPDR spectrum within CEPT have not been evaluated in detail in ECC Report 199 [23]. However, some countries have provided a national estimate of their broadband air-to-ground spectrum needs. Based on this information, a realistic estimate for airborne PPDR is under investigation. For broadband air-to-ground usage, also cross-border coordination needs to be studied.

Possible synergies between these applications and PMSE use described in section 3.2 (Programme Making and Special Events) are further explored, since the same technologies / equipment may be used and the same technical framework might apply.

3.6 SYNERGIES BETWEEN THE PROPOSED SHORT LIST OF SELECTED USE

- **Applications under general authorisation (DECT / SRD)**

  DECT and SRD are candidates to use the spectrum under a general authorisation regime. There may be a possibility of having a common set of technical parameters to enable equal spectrum access.

The possibility of operating under general authorisation enables DECT extension as well as application and technology-neutral access to spectrum in line with principles set out in CEPT Report 014 [1] and CEPT Report 044 [2] (SRD strategy and principles).

During the Call for Inputs, the responding administrations clearly indicated that DECT should operate under a generic SRD regulation on a shared basis with other technology on a non-protected non-interfered basis. Spectrum access techniques should be mutually compatible and frequency segmentation amongst such applications should be avoided. It is important that the regulation also in practice provides an opportunity for alternative technologies to use the spectrum so that a competitive market is created.

Once defined with appropriate mitigation techniques and restrictions, DA2GC could share the spectrum with DECT/SRD, the later to be introduced on a non-protection and non-interference basis without affecting the DA2GC systems, as an optimised scenario.

- **Video Links and Cordless Cameras (VLCC - PMSE / ad-hoc PPDR)**

The same technical framework and equipment, i.e. temporary video links and cordless cameras (VLCC), may be foreseen for both PMSE and some ad-hoc PPDR applications and therefore there may be a possibility of having a common set of technical parameters for spectrum access. It is assumed that coordination and the associated usage demand will be dealt with on a national level. It should be noted that video applications, such as surveillance cameras, operating under general authorisation regime, are not included in this usage category.

The 2010-2025 MHz band is directly adjacent to the 2025-2110 MHz band that is already part of the tuning range for video PMSE applications, and indeed 2010-2015 MHz is already included in the available frequencies for video PMSE in certain CEPT countries. Extending the tuning range for video links and cordless cameras into the unpaired 2 GHz bands would allow opportunities for both PMSE and ad-hoc PPDR usage.

For ad-hoc PPDR, other frequency options are also under discussion in CEPT.

The unpaired 2GHz bands may ultimately offer only a small amount of available spectrum for ad-hoc PPDR and practical difficulties of sharing with PMSE are envisaged in unplanned event situations. Technology issues may also arise due to the different trends towards using DVB-based technology in the PMSE community for video links and LTE-based technologies for BB-PPDR solutions. The amount of support expressed for ad-hoc PPDR solutions in the Call for Inputs has been very limited. Nevertheless, the bundling of video links and cordless cameras under a co-ordinated approach leaves the door open for dedicated ad-hoc PPDR broadband applications in the 2 GHz unpaired bands under the same technical environment.

During the Call for Inputs, all PMSE proponents indicated that they do not consider that PMSE can share with unlicensed applications such as DECT/SRD. Usage of these license-free devices in the same band where essential PMSE professional services are being deployed impairs the error free use of these professional services. This notion has also been provided by the one response from a PPDR solutions provider.

Within the VLCC category, coordination between PMSE and ad-hoc PPDR is essential for an optimised scenario between those two uses of the proposed shortlist, in order to profit from the synergies between them. The UK's experience on such a coordination process, currently in place, is presented below:

> For a number of major events the supply of spectrum allocated for PMSE is not sufficient to meet the demands of the event itself, e.g. British Grand Prix, Open golf Championship, National events etc. In these circumstances, it is necessary to source additional spectrum from alternative bands and users. In the United Kingdom it is common to source and coordinate additional spectrum for PMSE from the PPDR services.
>
> An example of this is wireless camera use in the band 2302-2380 MHz that is currently allocated to PPDR. For peak demand events where PMSE spectrum demand cannot be met from that allocated to PMSE access to 2302-2380 MHz is often arranged in order to supplement the PMSE core bands.

In addition, there are some circumstances where PPDR may require supplementary spectrum and there are arrangements in place whereby PPDR services can coordinate access to spectrum allocated to PMSE.

The UK's experience shows that the need for supplementary spectrum for PMSE or PPDR does not generally occur for the same event i.e. when there is excessive demand for PMSE spectrum at an event PPDR interest is low and vice versa. If this is not the case a significant effort is put in to coordinating and accommodating the conflicting requirements. Should an emergency occur at an event where PMSE is utilising PPDR spectrum it is our view that the event itself would be unlikely to continue and spectrum would revert back to PPDR.

It is highlighted that PMSE can only access PPDR spectrum where use for PPDR is intermittent in both location and time thereby affording PMSE the opportunity to interleave with PPDR use. Similarly, PPDR access to PMSE spectrum is for applications that are specific to a particular time and location so can be coordinated with PMSE requirements. In the event that the unpaired 2 GHz spectrum was made available for 'always on, everywhere' use by PPDR there would be no opportunity for PMSE to share access.

– **Conclusions**

Due to the synergies between DECT and SRD and between video PMSE and certain ad-hoc PPDR applications, the shortlist indicated in the EC Mandate, composed of five potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands (DA2GC, PMSE, PPDR, DECT and SRD), is considered to be adequately studied by using three usage categories as presented in the following Figure 11.

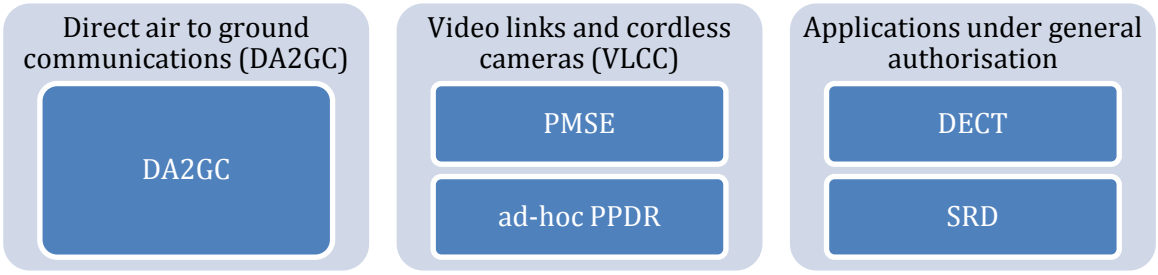

Figure 11: Synergies amongst the proposed short list of selected use

As a result, the compatibility / sharing scenarios that are being studied within the aim of the outline of the response to the Commission consider as a basis the three usage categories set out in Figure 11.

4 COMPATIBILITY WITH EXISTING SERVICES/APPLICATIONS IN THE BANDS ADJACENT TO THE UNPAIRED 2 GHz BANDS

For the three usage categories, DA2GC, VLCC and DECT/SRD, adjacent spectrum compatibility is important with the radio services and applications in the adjacent bands.

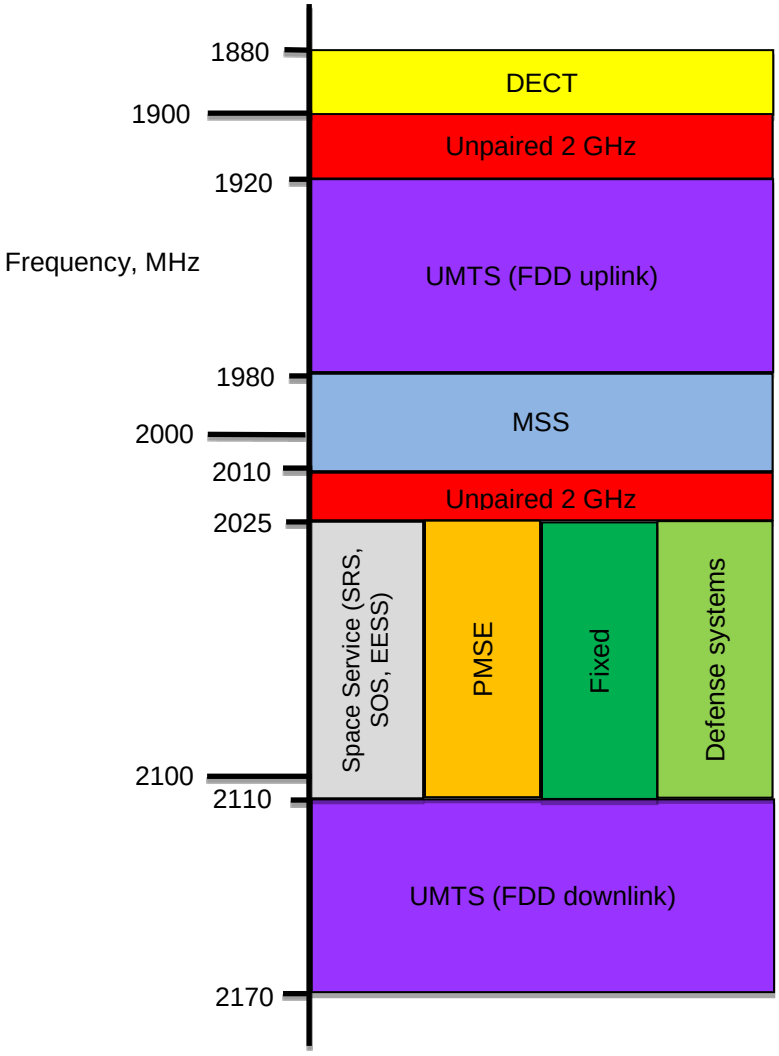

Figure 12: Adjacent band usage

4.1 DA2GC

The following results have been achieved by studying three different system proposals (ETSI TR 103 054 [31], ETSI TR 101 599 [32] and ETSI TR 103 108 [33]). Unless otherwise stated in the following sections, the results are applicable for all three systems proposals. Detailed descriptions of all relevant compatibility aspects are described in ECC Report 209 [27] on Compatibility/sharing studies related to Broadband Direct-Air-to-Ground Communications (DA2GC) in the frequency bands 1900-1920 MHz / 2010-2025 MHz and services/applications in the adjacent bands [27]. For DA2GC a FDD solution as well as a TDD solution has been studied.

4.1.1 1900-1920 MHz

Compatibility between Broadband DA2GC and DECT below 1900 MHz

Results of compatibility between DA2GC Reverse Link (RL) and DECT:
There will be no negative impact from DA2GC emissions on DECT systems below 1900 MHz. There is only a very low risk for any performance degradation of the DA2GC RL reception (i.e., at the GS) operation caused by DECT stations.

Results of compatibility between DA2GC Forward Link (FL) and DECT:
The implementation of a DA2GC FL in the band 1900-1920 MHz would have no negative impact on DECT operations in the adjacent band below 1900 MHz. The interference impact of DECT stations on DA2GC FL reception (i.e., at the AS) is not considered critical.

Compatibility between Broadband DA2GC and UMTS above 1920 MHz

Results of compatibility between DA2GC Reverse Link (RL) and UMTS:
The worst case link evaluations have shown that there will be no negative impact on UMTS FDD UL. There is a very low risk for any performance degradation of the DA2GC RL reception (i.e., at the GS) operation caused by UMTS User Equipment (UE).

Results of Compatibility between DA2GC Forward Link (FL) and UMTS:
Studies performed within the framework of the ECC Report 209 indicate that the UMTS base station receiving system will suffer from interference generated by the operation of the DA2GC Ground Station (GS) in the adjacent band (1900-1910 MHz) without mitigation techniques.

This case represents the most critical case for integration of the DA2GC FL in the lower 2 GHz unpaired band, as the transmission is in the opposite direction compared to UMTS and therefore corresponds to a similar case as applying UMTS (and/or LTE) TDD and FDD (or TDD) systems in adjacent channels (see also CEPT Report 39).

Based on the results of compatibility studies included in ECC Report 209, to keep the impact from DA2GC GS emissions at a UMTS BS (Base Station) low, appropriate separation distances between the DA2GC Ground Station (GS) and the UMTS BS (up to several kilometres) and/or a guard band between Broadband DA2GC below 1920 MHz and UMTS above 1920 MHz, as well as careful radio network planning for DA2GC in combination with site coordination with UMTS operators, are .required. The appropriate mitigation techniques (e.g. separation distance, size of a guard band, power reduction and the need for extended filtering) will be dependent upon the DA2GC system characteristics.

The interference impact of UMTS UEs on the DA2GC FL reception (i.e., at the AS) is not considered critical.

4.1.2 2010-2025 MHz

The following results have been achieved by studying the system proposal in ETSI TR 103 054 [31]. For the system proposal in ETSI TR 101 599 [32] studies were made on the compatibility with space services. No studies were made in this band for the system proposal in ETSI TR 103 108 [33].

Compatibility between Broadband DA2GC and MSS below 2010 MHz

Results of compatibility between Broadband DA2GC and MSS satellite receiver:
The DA2GC RL can be implemented in the upper 2GHz unpaired band without any degradation on the MSS satellite reception (independent on the positioning of the DA2GC carrier frequency between 2015 MHz and 2020 MHz).

Results of compatibility between Broadband DA2GC and MSS CGC BS and UT:
Wideband and narrowband User Terminals (UTs) as well as CGC Base Stations have been considered. Interference from high gain MSS UTs may occur at the AS receiver at low aircraft altitudes (3 km). No interferences from AS transmitters are expected at the CGC BS receiver. Separation distances are required between DA2GC GS and MSS CGC BS. Because of the very low density of MSS UTs the probability for interferences at the DA2GC system is negligible.

Compatibility between Broadband DA2GC and space services above 2025 MHz*

*Space Services encompass the Space Research Service, the Space Operation Service and the Earth Exploration Satellite Service. Studies have been carried out for SRS as the worst case scenario. Therefore there is no need to carry out additional studies with SOS and EESS.

Results of compatibility between DA2GC RL and space services:
The DA2GC RL in the band 2010-2025 MHz would cause no harmful interference into space station receivers of the Space Services operating in the adjacent band above 2025 MHz.

Concerning the impact of SRS Earth stations on DA2GC GS, a maximum separation distance of around 50 km might be required in rural areas. Taking into account real situations, in particular SRS Earth Station surrounding and terrain as well as the SRS Earth Station azimuth, the necessary separation distances between those stations will be less. Taking further into account the quite low number of SRS Earth Stations and DA2GC GS it is not expected to be difficult finding locations for DA2GC GS in the 2010-2025 MHz band.

Compatibility between Broadband DA2GC and the Fixed Service above 2025 MHz

Results of compatibility between Broadband DA2GC and FS (civil and military):
For the DA2GC system the two different alternatives for the realization of RL and FL in the band 2010-2025 MHz were taken into account. No interferences are expected between DA2GC AS and FS stations in case the DA2GC carrier frequency is at 2015 MHz. Separation distances are required between DA2GC GS and FS stations to achieve compatibility. Also for military FS stations (TRR) this is considered as manageable because of the temporary usage.

Compatibility between Broadband DA2GC and PMSE above 2025 MHz

Results of compatibility between DA2GC RL and PMSE:
Studies carried out have indicated that some impact is to be expected to PMSE in the adjacent channel to the DA2GC system. However, taking into account the frequency separation when implementing Broadband DA2GC according to scenario 1 (see section 5) and further mitigation measures such as adaptive scheduling at the DA2GC AS, no impact on PMSE operation is to be expected.

Studies carried out in ECC Report 220 [29] have indicated the need for separation distances for PMSE operations around DA2GC GS. For adjacent channel operation these distances are 1.5 km maximum assuming the PMSE Tx antenna directed towards the DA2GC GS Rx antenna in rural area. Thus, taking into account the frequency separation when implementing Broadband DA2GC according to scenario 1, and the low penetration of DA2GC GS, no real impact from PMSE operation above 2025 MHz on DA2GC GS is expected.

4.2 VLCC

4.2.1 1900-1920 MHz

Compatibility between VLCC and DECT below 1900 MHz

No compatibility studies have been conducted. This may be attributed to the low interest from the PMSE community in usage of the 1900-1920 MHz band for VLCC applications. This band falls outside the tuning range of current PMSE equipment thus necessitating costs for the development or modification of equipment to tune to one or possibly two channels, with the likelihood of restrictions in availability to provide sharing with DA2GC..

Compatibility between VLCC and MFCN above 1920 MHz

This scenario has been carried out and reported in ECC Report 220 [29]. The study is based on typical statistical situation of MFCN user equipment and the conclusion shows that the compatibility may be ensured by using appropriate mitigation techniques such as separation distance, guard band or reducing the maximum typical e.i.r.p of PMSE equipment. Only Cordless Camera Links and Mobile Video Links seem to be able to coexist with adjacent MFCN systems.

However, it should be noted that taking into account the high density deployment of MFCN networks above 1920 MHz, such mitigation techniques may be difficult to apply in practice.

Due to very low density of video PMSE using the same channel at the same place and at the same time, further investigations may be required in order to define the most suitable value of this maximum radiated power. In addition, it is underlined that PMSE devices are licensed equipment and usually, the use of each channel is decided for an event by the regulatory authority. This process will lead to restrict the use of each channel by one video link in a given area to avoid interferences between PMSE users.

Finally, as mentioned in section 4.2.1.1 of this report, the usage of the 1900-1920 MHz band for VLCC applications is not the preferred solution due to the fact that this band falls outside the tuning range of current PMSE equipment thus necessitating costs for the development or modification of equipment to tune to one or possibly two channels, with the likelihood of restrictions in availability to provide sharing with DA2GC.

4.2.2 2010-2025 MHz

Compatibility between VLCC and MSS below 2010 MHz

No compatibility studies have been conducted. However, it should be noted that PMSE use, including airborne use, is permitted in some CEPT countries without reported issues. This cannot be seen to be a guarantee that issues may not arise in future.

Compatibility between VLCC and services above 2025 MHz

Sharing between PMSE and other services (space services, fixed service) in the band 2025-2110 MHz is possible according to ERC/REC 25-10 [17] (including for air-to-ground applications). Similar provisions would apply to VLCC (the same technology as PMSE) for adjacent band operation.

4.3 DECT/SRD

DECT and SRD are both seeking to use spectrum, without coordination, under a general authorisation regime and usage restrictions to protect primary services.

4.3.1 1900-1920 MHz

Compatibility between DECT/SRD and DECT below 1900 MHz

In this case, the same technology is used above and below 1900 MHz (DECT core band in 1880-1900 MHz), therefore compatibility is achieved. SRD applications with duty cycle restriction are also considered to be compatible with the DECT core band.

Compatibility with MFCN above 1920 MHz

The ECC Report 220 [29] studies the impact of DECT devices on MFCN BS and shows that DECT devices can operate in the 1900-1920 MHz band. However DECT stations with directional antenna should not use DECT channels F20 and F21.

These considerations are also representative for other unlicensed applications such as SRDs with duty cycle and indoor usage restrictions. In addition, it has to be noted that based on the compatibility studies presented in ECC Report 207 for SRD operation in 863-870 MHz adjacent to MFCN UL below 862 MHz, it was concluded that some SRDs receivers may suffer interference from MFCN terminal OOB emission limits. This means that new SRD applications in 1900-1920 MHz should adapt their specifications in order to take into account the existing spectral environment.

4.3.2 2010-2025 MHz

This band is not requested for operation of DECT/SRD under a general authorisation regime.

5 POSSIBILITIES FOR CO-CHANNEL AND ADJACENT CHANNEL COEXISTENCE WITHIN THE UNPAIRED 2 GHz BANDS

The sharing possibilities between the three usage categories as shown in Figure 13 have been investigated. The frequency bands which will be designated for the DA2GC Forward Link (FL) and Return Link (RL) play a major role for the compatibility considerations with DECT / SRD and VLCC (PMSE / ad hoc PPDR and also impact the frequency arrangement for these applications.

The DECT / SRD applications are in principle uncoordinated and operate under a general authorisation regime. The nature of many considered SRD applications such as home/industry automation, smart metering, sensor networks are fixed installed devices. Therefore, this aspect restricts de facto the considered usage scenarios and facilitates sharing with other applications. It should also be noted that many DECT / SRD usage scenarios are based on dominant indoor usage.

PMSE usage can be coordinated. For ad-hoc, temporary PPDR usage, the temporary occurrence of interference at a location of a mission may be acceptable up to a defined level and geographical dimension. .

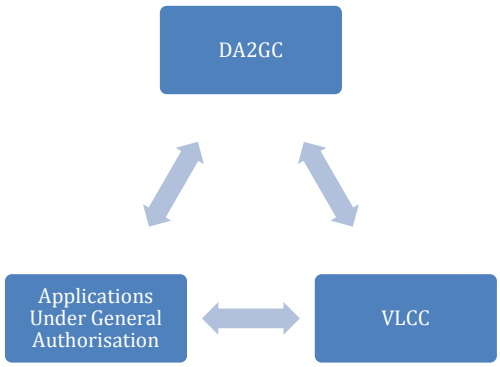

Figure 13: Sharing possibilities

The three usage categories indicated in Figure 13 could in theory be combined in various ways resulting in a considerable number of options to be studied. Due to the high level of complexity, and even the lack of feasibility, of some of those options, which could jeopardise the possibility to draw practical conclusions in this Report within the timeframe of the EC Mandate, it was decided to restrict the study to the two pragmatic scenarios presented in Figure 14 to Figure 17 in order to facilitate the completion of the CEPT response in the given schedule of the Mandate.

These two scenarios reflect preferences arising from the contributions to the Call for Inputs (details to be found in ANNEX 2:).

5.1 INTRODUCTION OF THE TWO INVESTIGATED SCENARIOS

- Concerning Broadband DA2GC, the following three options, which are based on the system descriptions included in the three ETSI System Reference Documents mentioned hereafter, were considered as the preferred ones, as a result of the compatibility studies between Broadband DA2GC and existing services adjacent to the unpaired 2 GHz bands (see ECC Report 209 [27] and ECC Report 214 [26]) :
  - For the FDD system described in ETSI TR 103 054 [31], the identified frequency arrangement could be between 1900 and 1910 MHz for the forward link and between 2010 and 2020 MHz for the reverse link;
  - For the two TDD systems described in ETSI TR 101 599 [32] and in ETSI TR 103 108 [33], the identified frequency band could be between 1900 and 1920 MHz.

It should be noted that these two options constitute the basis for the two investigated scenarios and therefore, these two options imply two different frequency arrangements.

- With regard to PMSE applications, scenario 1 suggests the opportunity to operate in the entire two bands (1900-1920 MHz / 2010-2025 MHz). However, VLCC applications cannot share in 2010-2025 MHz with the reverse link of FDD DA2GC system according to ECC Report 220. On the other hand, audio PMSE applications can share in 2010-2025 MHz with the reverse link of FDD DA2GC system with appropriate mitigation techniques. Furthermore, some operational restrictions are required in order to ensure full compatibility with the other candidate applications (see section 6). In addition, PMSE proponents responding to the Call for Inputs indicated that they do not consider that unlicensed applications such as DECT / SRD can co-exist with PMSE. Usage of these generally unlicensed devices (DECT / SRD) in the same band, where essentially professional services (PMSE) are being deployed, is considered undesirable/detrimental with regard to the QoS requirements of users of cordless cameras and other video links. This notion has also been provided by the one response from a PPDR solutions provider. Nevertheless, due to the following reasons, scenario 1 considers the introduction of VLCC and DECT / SRD in the band 1900-1920 MHz :

    - it is not foreseen to have co-located frequency use of the two usage categories VLCC and DECT / SRD;

    - there are some existing situations where VLCC and SRD co-exist (e.g. 2.4 GHz).

  The usage of the 1900-1920 MHz band for VLCC applications is not the preferred solution due to the fact that this band falls outside the tuning range of current PMSE equipment thus necessitating costs for the development or modification of equipment to tune to one or possibly two channels, with the likelihood of restrictions in availability to provide sharing with DA2GC.

  Scenario 2 offers the opportunity to VLCC to operate in the frequency band 2010-2025 MHz under the least restrictive operational conditions.

- So far, the PPDR stakeholders have not participated in the discussions of the unpaired 2 GHz bands and showed little interest in accommodating ad-hoc PPDR applications in the unpaired bands; however, as long as similar technologies are assumed for PMSE and ad-hoc PPDR , the VLCC usage category permits ad-hoc PPDR use when limited to cordless cameras, mobile and portable video links;

- No allocations are required for SRD to operate in a specific frequency band (SRDs typically operate on a non-interference and non-protection basis). An upcoming request from industry would be taken into account at any time but preferably, when a primary usage is identified. The principle for the applications under general authorisation category (DECT / SRD) should be to first place the radio services in the band (such as DA2GCS and PMSE / ad-hoc PPDR) and then investigate under which restrictions and use of mitigation techniques the use of unlicensed applications could be possible. According to compatibility studies, both scenarios offer the possibility to introduce DECT/SRD applications in the band 1900-1920 MHz. However, further complementary investigations are required for such applications under general authorisation.

Scenario 1

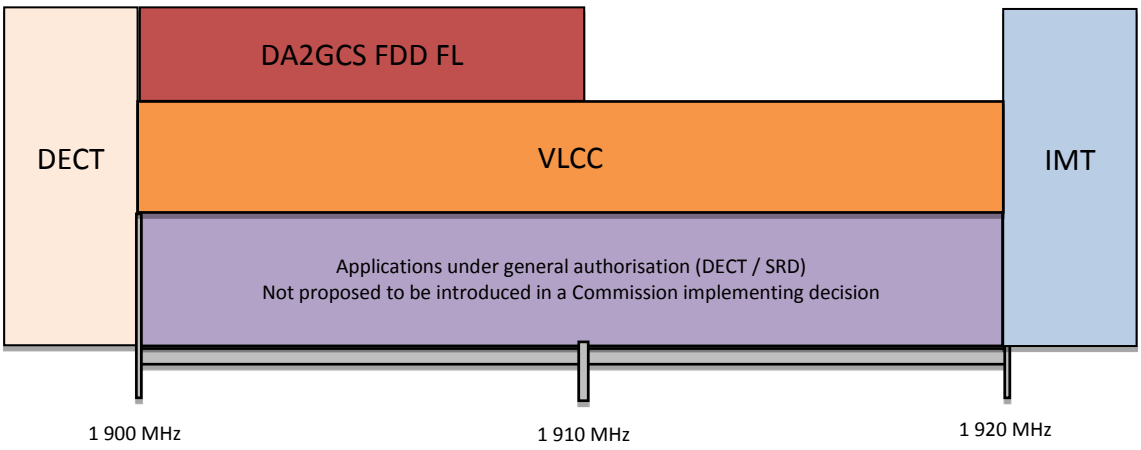

Figure 14: Scenario 1, lower band (DA2GCS FDD (forward link), VLCC, DECT / SRD)

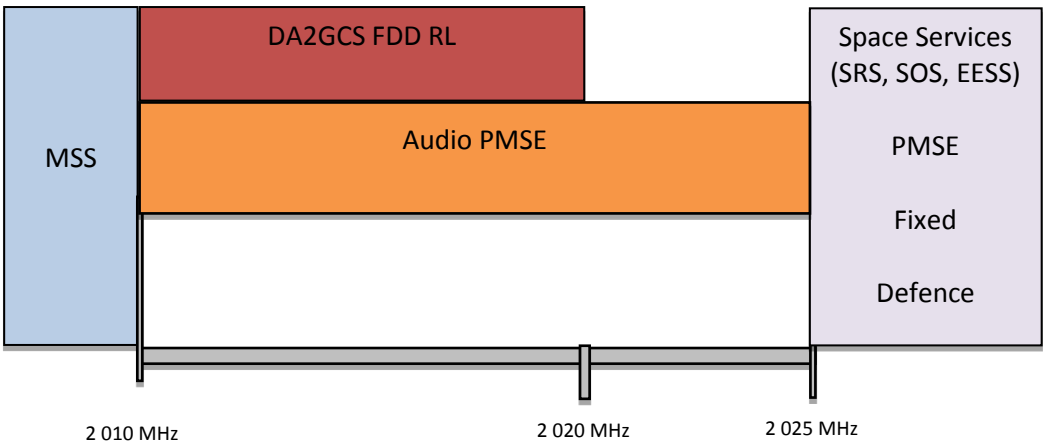

Figure 15: Scenario 1, upper band (DA2GCS FDD (reverse link), VLCC)

Note Audio PMSE: in case of VLCC, the Broadband DA2GC system cannot be authorised

For scenario 1, two alternatives are possible, depending on whether Broadband DA2GC or VLCC is afforded the higher priority.

When DA2CG is considered to be the priority, the following use of the bands can be made:

- The Broadband DA2GC system occupies the lower 10 MHz of each band in an FDD arrangement, with the forward link in the lower band with appropriate coordination measures, such as separation distances with MFCN base stations above 1920 MHz. This in turn dictates the restrictions required for VLCC usage. The studies conducted show that limited use of VLCC is possible, as follows: in the band 1900-1910 MHz for cordless cameras only; in the bands 1910-1920 MHz with certain separation distances for each VLCC application. No VLCC use is possible in the band 2010-2025 MHz, although audio PMSE applications with appropriate mitigation techniques are feasible.

- Considering the adjacent channel compatibility, the VLCC use in the band 1910-1920 MHz requires power limitations to mitigate interference into MFCN base stations (the power is already limited by the Broadband DA2GC in the band 1900-1910 MHz); the DA2GC authorisation may cause some interference to PMSE above 2025 MHz.

When VLCC is considered to be the priority, the following use of the bands can be made:

- VLCC would be feasible as follows: in the band 1900-1920 MHz with power limitations to mitigate interference into MFCN base stations; in the band 2010-2025 MHz under the same conditions as authorised for PMSE in the 2025-2110 MHz band. The Broadband DA2GC system cannot be authorised in the upper unpaired band because it would cause too much interference into VLCC in the band 2010-2025 MHz.

DECT/SRD usage in the band 1900-1920 MHz is possible with certain mitigation techniques and restrictions yet to be determined to protect the identified primary services.

Scenario 2

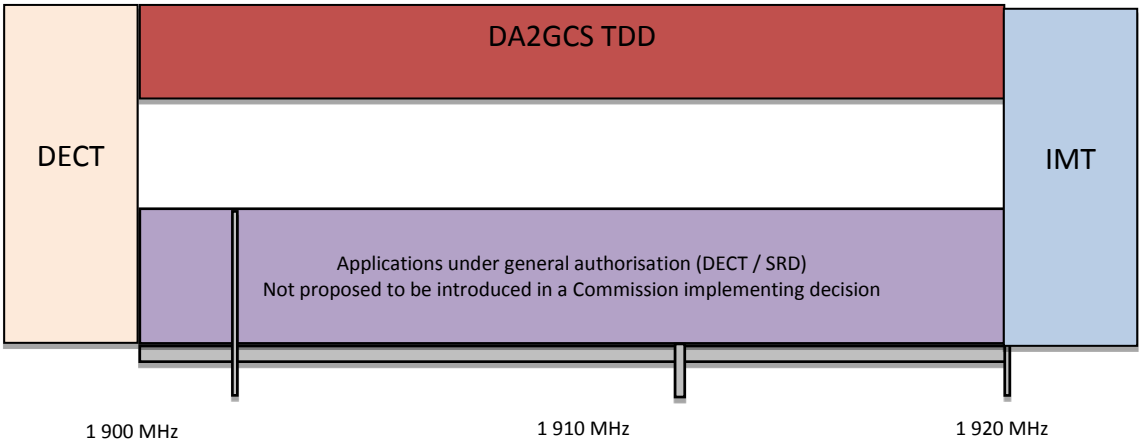

Figure 16: Scenario 2, lower band (DA2GCS TDD, DECT / SRD)

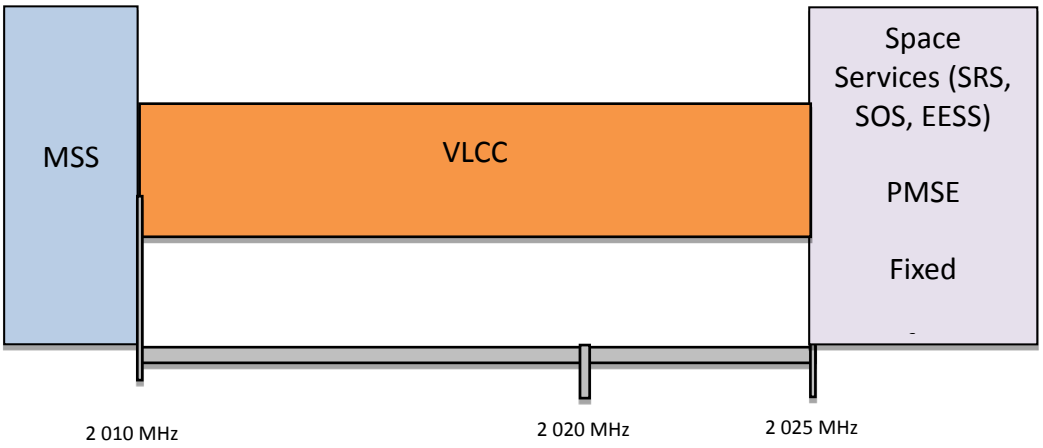

Figure 17: Scenario 2, upper band (VLCC)

For scenario 2, the usage categories DA2GC and VLCC are assigned to different bands.

- The Broadband DA2CG system is authorised and occupies the whole of the lower band in a TDD arrangement with appropriate coordination measures such as separation distances with MFCN base stations above 1920 MHz. VLCC is authorised in the band 2010-2025 MHz under the same conditions as authorised for PMSE in the 2025-2110 MHz band. DECT/SRD usage in the band 1900-1920 MHz is possible with certain mitigation techniques and restrictions yet to be determined.

5.2 COEXISTENCE BETWEEN EACH CANDIDATE APPLICATION

5.2.1 DA2GC and VLCC

DA2GC FDD and VLCC applications may share spectrum under scenario 1.

The following results have been achieved by studying the system proposal for DA2GC FDD described in ETSI TR 103 054 [31], since the two TDD DA2GC systems would only operate under scenario 2. For the studies, the same three usage scenarios of PMSE wireless video links have been selected as in ECC Report 172, Table 19 [43]. Detailed descriptions of all relevant sharing aspects are described in ECC Report 220 [29] on the compatibility and sharing studies of DA2GC, PMSE video links, SRD and DECT in the 2 GHz unpaired bands.

Co-frequency sharing

Co-channel operation of DA2GC FL and PMSE CCL would be feasible with appropriate separation distances and/or PMSE Rx antenna gain limitations.

Co-channel operation of DA2GC RL and PMSE (CCL, MVL and PVL) is not feasible due to the exceeding of the protection criterion of the PMSE Rx.

Co-channel operation of DA2GC (FDD Reverse link (2010-2020 MHz)) with audio PMSE applications, if deployed for indoor usage, could be feasible to some extent (see Annex 2 to the ECC Report 220 [29]).

Adjacent frequency sharing

Adjacent-channel operation of DA2GC FL and VLCC are considered feasible. Separation distances from DA2GC GS and appropriate mitigation techniques depending on the VLCC scenario, have to be applied.

Adjacent-channel operation of DA2GC RL and PMSE (CCL, MVL and PVL) is not feasible due to the exceeding of the protection criterion of the PMSE Rx.

5.2.2 DA2GC and DECT/SRD

DECT/SRD applications are investigated in scenario 1 as well as scenario 2 for applications under general authorisation in the frequency band 1900-1920 MHz. Studies have been conducted for DECT and other SRD applications which are considered under the “technical envelope” of the studies with the DECT key emission parameters.

The precise sharing conditions do also depend on the DA2GC system to be chosen with regard to some system dependent parameters such as DA2GC AS antenna sectorisation or antenna beamforming. For DECT/SRD indoor applications operating co-frequency with DA2GC, additional building attenuation as well as clutter attenuation as described in ITU-R Recommendation P.452-15 [25] and other mitigation techniques (e.g. power and density reduction) will facilitate sharing between DA2GC and DECT/SRD indoor applications.

Co-frequency sharing

DA2GC FL in 1900-1910 MHz sharing with DECT/SRD

In the case of an FDD arrangement for Broadband DA2GC, the most reasonable approach would be to allow only DECT/SRD indoor applications in the band used by the DA2GC (FL), i.e. within the sub-band 1900-1910 MHz.

Since potential aggregated co-channel interference from indoor DECT/SRD installations can degrade the DA2GC service, ECC Report 220 [29] considered a variety of indoor DECT/SRD applications and related expected usage densities. Sharing with low power and low density indoor SRD/DECT applications would be feasible. This conclusion is based on the considerations of the aggregated impact of unlicensed devices on the DA2GC AS receiver in ECC Report 220 [29], annex 3.

DA2GC TDD in 1900-1920 MHz sharing with DECT/SRD

In the case of a TDD arrangement for Broadband DA2GC, the most reasonable approach would be to allow only DECT/SRD indoor applications in the band used by the DA2GC. i.e. within the whole band 1900-1920 MHz since DECT/SRD equipment may disturb the DA2GC RL reception (i.e., at the GS), if they are placed near the GS with unobstructed line-of-sight path to the GS antenna.

Since potential aggregated co-channel interference from indoor DECT/SRD installations can degrade the DA2GC service (aggregated interference into the AS receiver), this needs to be investigated further and the precise sharing conditions do also depend on the DA2GC system to be chosen with regard to some system dependent parameters such as DA2GC AS antenna sectorisation or antenna beamforming. Power reduction as well as duty cycle restriction or other mitigations may decrease the probability of interference into the DA2GC AS receiver to acceptable levels.

Impact of DA2GC on DECT/SRD

DECT indoor station will be able to operate in the extension band 1900-1920 MHz in spite of potential interference from DA2GC GSs, because of the DECT error detection, dynamic channel selection and hand-over capabilities. This result is also considered representative for other unlicensed applications co-frequently sharing with DECT. The studies in ECC Report 220 [29] show also for the two DA2GC TDD approaches that the impact on indoor DECT/SRD equipment is negligible.

Adjacent channel operation:

Compatibility between DA2GC FL (1900-1910 MHz) and DECT/SRD devices operating in 1910-1920 MHz (same situation as with DECT in 1880-1900 MHz)

The interference impact of DECT stations operating on DA2GC FL reception (i.e., at the AS) is rated as uncritical due to high ACIR and sufficient path loss between both stations which would be increased in more realistic scenarios by typical usage of DECT in indoor environments and lower DECT station antenna gain.

The implementation of a DA2GC FL in the band 1900-1910 MHz (DA2GC scenario 1) would have no negative impact on DECT operations in the adjacent band below or DECT/SRD applications above 1910 MHz.

Concerning the impact from DECT/SRD devices operating above 1910 MHz, it is worth to note that the situation is similar to the DECT deployment below 1900 MHz for the DA2GC scenario 1 (DA2GC FL in 1900-1910 MHz). Careful consideration should be given to the adjacent frequency sharing impact with regard to the possibility of outdoor deployment of DECT/SRD in 1910-1920 MHz concerning the possibility of having a higher number of outdoor DECT/SRD equipment when comparing with the current outdoor DECT stations deployment density in 1880-1900 MHz.

Limitation to only indoor DECT/SRD applications, a channel guard separation, power reduction as well as duty cycle restriction or other mitigations may decrease the probability of interference into the DA2GC AS receiver to acceptable levels.

So far, it is concluded that operation of DA2GC FL and indoor DECT/SRD deployment in the adjacent band 1910-1920 MHz would be feasible with a power limitation and duty cycle restrictions for the DECT/SRDs.

5.2.3 DA2GC, VLCC and DECT/SRD

DA2GC, VLCC and DECT/SRD applications may need to share spectrum under scenario 1 (lower part (1900-1910 MHz) of the lower band); VLCC and DECT/SRD applications might need to share spectrum under scenario 1 (upper part (1910-1920 MHz) of the lower band).

No compatibility studies have been conducted. This may be attributed to the low interest from the PMSE community in usage of the 1900-1920 MHz band for VLCC applications. This band falls outside the tuning range of current PMSE equipment thus necessitating costs for the development or modification of equipment to tune to one or possibly two channels, with the likelihood of restrictions in availability to provide sharing with DA2GC. It should be noted that during the Call for Inputs, PMSE proponents indicated that they do not consider that PMSE can share with unlicensed applications such as DECT/SRD. This notion has also been provided by the one response from a PPDR solutions provider.

6 COMMON MINIMAL (LEAST RESTRICTIVE) TECHNICAL CONDITIONS

The least restrictive technical conditions for the three usage categories which have been used as a basis for the technical studies, by taking into account sharing possibilities as far as possible, are described below. Because the radio applications covered by these three categories are addressed in the EC Mandate, the exclusion of one of the applications or categories was considered as not appropriate.

6.1 BROADBAND DA2GC

The regulatory parameters which will be considered for a future Broadband DA2GC regulation in the 1900-1920 MHz are provided in Annex 4 of this Report. Annex 5 includes guidelines to ensure co-existence for DA2GC Ground Stations.

6.1.1 TECHNICAL AND OPERATIONAL CONDITIONS

In order to ensure the adequate protection of incumbent radio services and applications, the technical requirements for Broadband DA2GC systems, based on the results set out in ECC Report 209 [27] and ECC Report 210 [28], can be summarised briefly as follows.

General requirements

- DA2GC GS: e.i.r.p. limitations similar as for base stations for terrestrial cellular mobile networks;
- The minimum operational elevation angle of the DA2GC GC GS antenna main lobe is +5°.
- The minimum operational height above ground is 3000 metres for the DA2GC AS;
- Compliance with a relevant Harmonised European Standard or alternatively, compliance with equivalent technical specifications (to fulfil the essential requirements of art. 3(2) of the R&TTE Directive and, in the future, of the RE Directive);
- DA2GC AS has to be operated under the control of a network.
- For both systems, separation distances are required and should be carefully assessed taking into account the high density deployment of MFCN networks above 1920 MHz.

Requirements for the unpaired 2 GHz bands (FDD mode, 1900-1910 MHz / 2010-2020 MHz)

- Because of the need for separation distance, coordination is required for DA2GC GS operating in the frequency band 1900-1910 MHz with MFCN base stations receiving above 1920 MHz.
- To protect the DA2GC GS reception in the band 2010-2020 MHz coordination with FS, TRR and SRS earth stations is required.

Requirements for the unpaired 2 GHz bands (TDD mode)

- Because of the need for separation distance, coordination is required for DA2GC GS operating in the frequency band 1900-1920 MHz with MFCN base stations receiving above 1920 MHz.

Although three different system proposals have been studied, it has to be assumed from a commercial point of view that only one Broadband DA2GC system will be implemented in a specific frequency band. Therefore intra-sharing of different DA2GC systems in the same band has been considered as not relevant. Further information on the implementation is provided in ECC Report 214 [26].

6.2 VIDEO LINKS AND CORDLESS CAMERAS (PMSE/AD-HOC PPDR)

Use of spectrum for video links and cordless cameras is mainly on the basis of sharing with another service, so access to spectrum is predominantly authorised under local arrangements depending on the protection criteria agreed. These local arrangements can be configured to take account of a number of factors including the VLCC application, incumbent services and location. In the event that all or part of the unpaired 2 GHz bands are identified for use by VLCC and Broadband DA2GC on a shared basis, these local arrangements would need to consider the protection requirements of VLCC and Broadband DA2GC.

Given the respective technical parameters and compatibility scenarios a number of PMSE or ad-hoc PPDR video applications could utilise the unpaired 2 GHz bands:

- Cordless cameras;
- Portable video link/camera;
- Mobile video link/mobile camera.

In order to maximise the availability of non line of sight channels industry practice has tended to move higher powered links such as temporary point to point links to frequencies above 5 GHz. Consequently temporary point to point links are not considered a candidate application within the unpaired 2 GHz bands.

Video PMSE applications typically use digital modulation schemes on a 10 MHz channelling arrangement, although two or more channels may be combined in some situations to support higher data rates. The main difference between the applications noted above is the power required by the application, a cordless camera typically operates at relatively low power, -7 dBW e.i.r.p. through an omnidirectional antenna; a mobile video link may be up to 10 dBW e.i.r.p. from a directional antenna and a portable video link may be up to 16 dBW e.i.r.p. from a directional antenna. These scenarios lead to different technical conditions depending on the application being considered.

Based on the 10 MHz channelling arrangement for PMSE, the 1900-1920 MHz band would permit 2 × 10 MHz channels and the 2010-2025 MHz band would permit 1½ × 10 MHz channels, with the other half channel provided in the adjacent 2025-2110 MHz band, which is already widely used for video PMSE applications, being identified in the European Common Allocation table (ERC Report 25 [14]) for PMSE use and in ERC/REC 25-10 [17] as a recommended tuning range.

The basis for consideration of video links and cordless cameras should be made with the following technical criteria:

Table 5: Typical e.i.r.p. for VLCC

Type of Link	Typical e.i.r.p.
Cordless Camera	-7 dBW
Portable link	16 dBW
Mobile link	10 dBW

According to conclusions of ECC Report 220 [29], typical e.i.r.p mentioned in the Table 5 may be reduced for VLCC application operating in the band 1900-1920 MHz in order to ensure compatibility with MFCN application above 1920 MHz in some cases.

6.3 APPLICATIONS UNDER GENERAL AUTHORISATION (DECT/SRD)

It is essential for the effective use of DECT in the band 1900-1920 MHz, that the use of this band is always accessed as an extension to the DECT core band in 1880-1900 MHz.

Additional functionality can and may need to be added to the DECT instant dynamic channel selection procedures, to improve coexistence with non-DECT compatible technologies using the band 1900-1920 MHz. SRD applications using other technologies than DECT can co-.exist in the band 1900-1920 MHz because of the intended modification of the DECT dynamic channel selection rules as follows:

a. DECT only using the core band 1880-1900 MHz for RFP beacon transmissions;

b. Use the Least Interfered Channel within the entire 1880-1920 MHz for initial traffic bearer set up. If the setup is made on a channel within the extended band 1900-1920 MHz, and if the radio link is interfered, then the Least Interfered Channel selection for the intra-cell handover shall be limited to the DECT core band 1880-1900 MHz.

With this the quality mark of the DECT band can be preserved, because escape possibilities to the "interference free" 1880-1900 MHz are always available, when or if local and/or temporary severe interference would occur within the extension band 1900-1920 MHz.

This means that DECT will be able to utilise the capacity of all extended 20 MHz, and during the few occasions (locally and temporary) of severe interference, the equipment automatically limits itself to only use the interference free 10 carriers of the base band 1880-1900 MHz.

The following gives an overview on SRD typical parameters as used in recent studies in the ECC:

- ECC Report 182 [45] (863-870 MHz survey);
- ECC Report 189 [30] and ECC Report 200 [46] on new UHF frequency opportunities in the 870-876/915-921 MHz containing information on several SRD market sectors set out in five ETSI System Reference Documents;
- ECC Report 181 [44] on improving spectrum efficiency in SRD bands.

The studies provide the evidence that duty cycle restriction is the by far the dominant SRD mitigation technology in the market. It is also considered that the development of more sophisticated spectrum access technologies is not obvious due to the presence of the DECT DCS spectrum access technology and market participants would rather employ DECT spectrum access than developing more sophisticated spectrum access alternatives than the duty cycle restriction.

Typical SRD bandwidths are 200 kHz-600 kHz (as found for almost all applications in ECC Report 200 [46][46] and also ECC Report 182 [45]), although future studies with UHF SRD will also take into account 1 MHz bandwidth (ETSI is developing a System Reference Document for this purpose). This is well in line with the DECT channel bandwidth of 1 MHz and it can be proposed to limit the modulation bandwidth of unlicensed applications in the band 1900-1920 MHz to 1 MHz occupied bandwidth/ modulation bandwidth.

The assumption is that one could think about SRD applications and indoor use. For home automation, metering, alarms, IoT/M2M: these are all dominantly installed applications and indoor use/restriction may be enforceable.

It is proposed to limit the single SRD device duty cycle limit to 1% but for typical use taken into account for the aggregated impact on Broadband DA2GC as well as DECT devices, it is important to understand that for most applications the maximum equivalent needed transmit duty cycle is considerably lower (see for example Table 5 in CEPT Report 043 [40] based on duty cycle considerations in STF411 in ETSI). With this restriction, technology-neutral balance between DECT and other SRD technologies can be achieved.

It is further proposed to also limit DECT applications in their duty cycle. Due to the application of the modified DCS mechanism, this duty cycle restriction could potentially be a higher duty cycle. DECT applications needing higher transmit duty cycles or outdoor usage can still use the DECT coreband. It is understood that DECT equipment able to operate in the extension band always implements also the DECT coreband.

The considered main technical parameters proposed for SRD applications (including DECT) under general authorisation regime which were investigated in the compatibility studies can be set out as follows:

Table 6: Parameters considered for SRD (including DECT)

Application	Frequency Band	Power	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	Notes
SRD (including DECT and other applications using DCS or an equivalent mitigation technique)	1900-1920 MHz	≤ 250 mW total radiated power (≤ 1 W e.i.r.p. for directional antennas)	≤ 20% duty cycle and DCS	1 MHz	Tuning range und DCS (Dynamic Channel Selection) capability applied over the frequency range 1880-1920 MHz. Indoor only

Application	Frequency Band	Power	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	Notes
SRD	1900-1920 MHz	≤ 250 mW e.i.r.p.	≤ 1% duty cycle	≤ 200 kHz to 1 MHz	Indoor only

The parameters in the Table 6 above should not be understood as parameters for implementation in a regulatory approach but as parameters proposed by stakeholders for the compatibility studies which were performed.

Further considerations will be necessary to derive the precise technical parameters for implementation of a regulatory approach for DECT/SRD applications. The precise sharing conditions with Broadband DA2GC also depend on DA2GC system specific characteristics. The regulatory approach needs to be fine-tuned for the avoidance of harmful aggregated interference into DA2GC AS.

The proposal for the regulatory approach is to include these new entries in ERC/REC 70-03 [38]. This particular approach provides a good example of the CEPT use of 'soft harmonisation', where existing and new services remain protected to the extent that national administrations deem it necessary, yet providing the opportunity for the harmonised development of new unlicensed applications in the majority of European countries. Taking into account the current licenses for ECS in the band 1900-1920 MHz in many CEPT countries as shown in annex 3 and the fact that in many countries, not the whole band is covered by current licenses, limited implementations will also be possible.

The approach is as application-neutral and technology-neutral as much as possible and in line with the principles set out in CEPT Report 014 [1] and CEPT Report 044 [2]. In addition, the approach fulfils the expectations raised by administrations in ECC as well as during the call for inputs indicating that DECT should operate under an SRD regulation on a shared basis with other technologies. Spectrum access techniques are mutually compatible and frequency segmentation amongst such applications should be avoided. It is important that the regulation also in practice provides an opportunity for alternative technologies to use the spectrum so that a competitive market is created.

It is expected that the opening of this new opportunity for unlicensed applications may also trigger new technology developments and improvements as well as deployment developments in the initial years, making adaptions of the regulatory approach for unlicensed applications in the band 1900-1920 MHz quite likely. Also from this perspective, the approach in ERC/REC 70-03 [38] provides a flexible basis for needed adaptations in the future. This does also provide for the development of other SRD application spectrum access options such as LBT with adaptive frequency agility or DAA in the future, which may be added if so demanded, and after appropriate compatibility studies.

Finally, according to ECC Report 220 [29], DECT stations with directional antenna should not use DECT channels F20 and F21, in order to ensure coexistence with MFCN BS above 1920 MHz. The summary for DECT channels F11 to F19 and F20 to F21 is shown in Table 7 below.

Table 7: Summary of compatibility study (ECC Report 220) results between DECT and MFCN

DECT channels	F11 to F19	F20 and F21
DECT stations with omni-directional antenna	no restriction (26 dBm max e.i.r.p. as in ERC/DEC/(98)22)	
DECT stations with directional antenna	30 dBm max e.i.r.p.	not allowed

7 HARMONISATION POSSIBILITIES

As presented in section 2.2 (Current authorisations and uses of the unpaired 2 GHz bands), there are licenses in force in Europe in both unpaired 2 GHz bands. Some of the licenses were awarded after spectrum auction processes and, as a result, considerable auction prices were achieved. In some countries, a license repeal process might be possible in case of continued non-implementation, whereas in other countries this will not be possible due to specific conditions and obligations which are part of the license (e.g. coverage obligations are interpreted in some cases as fulfilled when providing services via other spectrum where the same licensee has also a license and for which the network is implemented). Other options for making the spectrum available for new usage need to be considered (e.g. liberalisation, transfer).

7.1 DA2GC

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. Currently, there is no spectrum designated for Broadband DA2GC in Europe. To allow European citizens and airlines to profit from the social and economic benefits of the implementation of such a radio application (intended to provide broadband connectivity between the aircraft and a terrestrial based network), a harmonised spectrum designation within CEPT would be necessary. In order for the system to be commercially viable, it would need to have the potential to provide a pan-European solution.

Network investment and deployment costs as well as aircraft equipment costs are high for Broadband DA2GCS, especially when considering the first rollout of Broadband DA2GCS. The implementation of such a system is only reasonable if a continuous and pan-European coverage were achieved, thus a harmonised radio spectrum designation and harmonised licensing conditions would be essential. In addition, a harmonised authorisation framework across Europe is considered necessary to provide the regulatory certainty that network operators and airlines require to invest in a Broadband DA2GCS.

Given the need for substantial financial investment, together with the requirement to protect other spectrum users, it is reasonable to envisage individual authorisation for the ground stations in Europe and that the aircraft stations are exempted from individual licensing. Free circulation and use is required for Aircraft Stations which are under the control of the DA2GC network. In addition, it is important that the chosen forms of regulation and licensing do not impose unreasonable restrictions on competition. The deployment of a European wide DA2GC network on a harmonised basis is urgent and a decision regarding spectrum and licensing conditions needs to be made quickly for a start of operation by end of 2017. Otherwise European airlines could only implement satellite solutions which may be more expensive. A short term solution for Broadband DA2GC (by end of 2017) could not be realised in a frequency band above 6 GHz. However, higher frequency bands can be considered in the future for next generation Broadband DA2GC systems.

The roll-out of a European wide Broadband DA2GC system will most likely be realised step by step. The timeframe will depend on the availability of the regulatory framework and then on the selection process and on commercial/financial decisions. Cross-border coordination amongst European countries is considered not to be an issue because the unpaired 2 GHz bands are not in use, although licences are issued in many CEPT Member States. Coordination with services in adjacent bands - either within a country or between neighbouring countries - is expected to be based on the results of the compatibility studies.

The European wide designation and timely implementation may also imply a harmonised selection and authorisation of a Broadband DA2GC system across Europe. For a successful launch of a Broadband DA2GC system, coordination of regulatory action across Europe would be highly advantageous. Differences in national selection procedures could create fragmentation of the internal market due to the divergent implementation of selection criteria, including the weighting of the criteria, or different timescales of the selection procedures. This would result in a patchwork of successful applicants selected in contradiction to the pan-European nature of DA2GC.

7.2 VLCC

With respect to PMSE, it is considered that there is a need for these services to be coordinated to avoid harmful interference and therefore an individual authorisation regime may be appropriate for implementation by national Administrations.

Based on the 10 MHz channelling arrangement for PMSE, the 1900-1920 MHz band would permit 2 × 10 MHz channels and the 2010-2025 MHz band would permit 1½ × 10 MHz channels, with the other half channel provided in the adjacent 2025-2110 MHz band, which is already widely used for video PMSE applications. , being identified in the European Common Allocation Table for PMSE use and in ERC/REC 25-10 [17]as a recommended tuning range.

PMSE use described in section 3.2 (Programme Making and Special Events) and ad-hoc PPDR use identified in section 3.5 (Public Protection and Disaster Relief) should further be explored since the same technologies may be used.

A harmonised solution for ad-hoc PPDR network uses above 1 GHz is under consideration, which includes, for some countries, PPDR broadband air-to-ground applications. Cross-border coordination is needed for PPDR broadband air-to-ground applications. Broadband PPDR temporary additional capacity (also known as “hot-spot” or “local area” networks) are supposed to provide additional local coverage at the scene of the incident in order to provide the necessary communication facilities to PPDR users in addition to those provided through the Wide Area network (WAN) or where the WAN radiocommunications are limited or not available. This additional capacity may be provided by Ad-hoc networks or other means (such as additional temporary base stations of the WAN) and are supposed to have high capacity and support PPDR users with low mobility. Ad-hoc networks may operate in the same (i.e. in a form of an ad-hoc micro-cell deployed at the event’s scene) as well as in a different frequency band.

7.3 DECT/SRD

Taking into account that no allocation is required, SRD/DECT are subject to a soft harmonisation in the ERC/REC 70-03 and therefore, it is not proposed to introduce a Commission implementing decision in this part of the spectrum for DECT/SRD. In addition, further complementary studies may be required in the future when the primary applications have been identified.

8 CONCLUSIONS

There are many interdependencies between all the possible applications that might use the unpaired 2 GHz bands under beneficial sharing arrangements and the priorities towards different services affect the outcomes. In order to provide some conclusions within the timeframe specified in the Mandate, a number of simplifications have been made. Firstly, the five candidate applications have been grouped into three usage categories: DA2GC, VLCC and DECT/SRD. Secondly, the possible arrangements of the usage categories have been simplified into two scenarios; effectively the difference being in the band usage of the Broadband DA2GC system. Both scenarios accommodated Broadband DA2GC, VLCC and DECT/SRD, although there are effectively different outcomes for each scenario.

Finally, for future harmonisation one preferable scenario was chosen – Scenario 2, as more effective scenario for implementation of all three usage categories: DA2GC based on TDD, VLCC and DECT/SRD.

For scenario 2, the usage categories DA2GC and VLCC are assigned to different bands.

The Broadband DA2CG system is authorised and can occupy the whole of the lower band in a TDD arrangement with appropriate coordination measures such as separation distances with MFCN base stations above 1920 MHz. VLCC is authorised in the band 2010-2025 MHz under the same conditions as authorised for PMSE in the 2025-2110 MHz band. DECT/SRD usage in the band 1900-1920 MHz is possible with certain mitigation techniques and restrictions yet to be determined.

ANNEX 1: EC MANDATE

MANDATE TO CEPT
TO UNDERTAKE STUDIES ON THE HARMONISED TECHNICAL CONDITIONS FOR THE 1900-1920 MHZ AND 2010-2025 MHZ FREQUENCY BANDS ("UNPAIRED TERRESTRIAL 2 GHZ BAND") IN THE EU

PURPOSE

The purpose of the UMTS Decision of 1999[9], which covered the frequency bands 1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz ('terrestrial 2 GHz band'), was to initiate the introduction of UMTS in the EU in a coherent manner. The UMTS Decision expired on 22 January 2003 and fulfilled its objectives. Any outstanding or related issues after 2003 such as on spectrum allocation, licensing or re-farming have been governed by the EU regulatory framework in electronic communications as well as the Radio Spectrum Decision 676/2002/EC since 2002.

Even if licences for the unpaired terrestrial 2 GHz band, comprising the TDD bands 1900-1920 MHz and 2010-2025 MHz, have been granted to mobile operators in the EU for many years, the proven lack of use of these bands (see document RSCOM12-05) necessitates new harmonisation measures in order to ensure effective and efficient spectrum use in line with the EU regulatory framework and the "use it or lose it" approach endorsed by the Commission to the extent possible under the existing regulatory framework.

Technical conditions for the provision of electronic communications services (ECS) in the unpaired terrestrial 2 GHz band have been developed under the initial Commission's Mandate to CEPT[10] in CEPT Report 39[11]. Unless demonstrated in the course of the work to be done under this Mandate that new technological developments in electronic communications should be taken into account, there is no need to revise those results. Therefore, this Mandate should cover as a priority uses not covered by CEPT Report 39, primarily non-ECS uses.

Therefore, the purpose of this Mandate is to assess and identify alternative uses of the unpaired terrestrial 2 GHz band other than for the provision of mobile electronic communications services (as introduced by the UMTS Decision) as well as develop relevant least restrictive technical conditions for spectrum use. The deliverables should aim at ensuring effective and efficient spectrum use by one or more applications while also exploiting the possibility of beneficial sharing arrangements between different applications.

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[9] Decision 128/1999/EC [8] of the European Parliament and of the Council of 14 December 1998 on the coordinated introduction of a third-generation mobile and wireless communications system (UMTS) in the Community

[10] Mandate to CEPT on the 2 GHz bands:
http://ec.europa.eu/information_society/policy/ecomm/radio_spectrum/_document_storage/mandates/2009mandate_2ghz.pdf

[11] Document RSCOM10-25

JUSTIFICATION

Pursuant to Article 4(2) of the Radio Spectrum Decision[12] the Commission may issue mandates to the CEPT for the development of technical implementing measures with a view to ensuring harmonised conditions for the availability and efficient use of radio spectrum necessary for the functioning of the internal market. Such mandates shall set the tasks to be performed and their timetable.

In response to the Mandate by the Commission, CEPT Report 39 lays down least restrictive harmonised technical conditions for use of the terrestrial 2 GHz band for the provision of two-way mobile electronic communications services. However, the technical conditions for the unpaired (TDD) bands impose significant restrictions regarding the amount of usable spectrum or the admissible transmit power levels in order to protect operations in adjacent frequency bands, mainly the FDD uplink band above 1920 MHz, from harmful interference.

Currently, the frequency band 1900-1920 MHz is licensed to mobile operators for the provision of electronic communications services in most EU Member States, whereby the licences are mainly limited to UMTS/IMT-2000 TDD technology[13]. On the other hand, the frequency band 2010-2025 MHz is licensed to mobile operators in just few Member States for the provision of electronic communications services, in some cases in a technology-neutral way. Both bands are not used in the EU. Recently, the lack of interest of mobile operators for spectrum in the unpaired terrestrial 2 GHz band has been demonstrated during the auctions in Italy and Portugal in 2011, where the 2010-2025 MHz band was put on offer but remained unsold.

Therefore, the effective and efficient use of the 1900-1920 MHz and 2010-2025 MHz frequency bands is handicapped by the lack of business interest of current rights' holders or other potential stakeholders from the mobile domain. This may be explained with the limited overall bandwidth of each of these bands and the coexistence limitations between multiple mobile networks[14], which reduce the number of independent mobile broadband operators in each band (operating on a channel of at least 10 MHz) to one or two. The lack of demand for unpaired 2 GHz spectrum has lead to the absence of equipment and an ecosystem. Therefore, the Commission considers that there is no viable harmonisation option within the mobile broadband context for both bands so that it becomes necessary to focus on alternative scenarios for the harmonised use of the unpaired terrestrial 2 GHz band that can justify demand and demonstrate socio-economic benefits.

In this regard, the principles and objectives set out by the Radio Spectrum Policy Programme (RSPP) must be duly taken into account, as well as the spectrum needs of specific Union policies[15] such as improving energy saving and efficiency, public protection and disaster relief (PPDR), the Internet of Things (IoT), programme making and special events (PMSE)[16] as well as for innovative applications that may have a major socio-economic impact and/or potential for investment.

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[12] Decision 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community, OJL 108 of 24.4.2002

[13] Only the licence conditions of operators in Austria (upon request), Germany, the Netherlands, and Sweden allow technology neutral use of the terrestrial 2 GHz band or parts thereof (see RSCOM12-05)

[14] As recognised in CEPT Report 039 [11]

[15] Article 8 of the RSPP

[16] In this regard, the Commission issued on 15 December 2011 a mandate to CEPT (RSCOM11-59) to identify suitable frequency bands for PMSE (still ongoing).

Furthermore, as a result of the public consultation of the Commission on the introduction of EU-wide technical harmonisation conditions for the terrestrial 2 GHz band (15 November 2011 - 28 January 2012)[17], a number of respondents proposed alternative uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands. These include broadband PPDR, DECT, Direct-Air-to-Ground Communications (DA2GC), PMSE (e.g. wireless cameras), short range devices (SRD), backhaul relay links of mobile networks, mobile IP services with quality-of-service management based on the IEEE 802.20 standard. Some of these proposals correspond to sectors or policies outside of wireless broadband, which have been identified by the RSPP as requiring special attention, and all are aligned with the RSPP's policies and objectives.

In view of the above, the Commission services have identified the following *shortlist* of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands to be given priority[18] in this Mandate:

(1) PPDR, most likely with preference to ad-hoc (non-permanent) PPDR networks.

(2) PMSE, preferably for use by wireless cameras.

(3) Short-range devices (SRD), preferably for improving energy saving and/or energy efficiency.

(4) DECT[19], preferably in the 1900-1920 MHz band.

(5) Broadband Direct Air-to-Ground Communications (BDA2GC), preferably in a paired spectrum arrangement.

The Commission notes that also other frequency bands are currently under investigation in CEPT for some of the radio applications above.

It can be assumed that some of the applications above being temporary or local in nature would not utilise exclusively the total available spectrum in the unpaired terrestrial 2 GHz band. Therefore, *shared use* between the different applications should be studied in order to ensure efficient spectrum use. In this regard, appropriate least restrictive technical conditions should be developed both for the identified specific application and for any possible sharing arrangement.

The Commission notes that the CEPT/ECC has already launched studies on the alternative use of the 1900-1920 MHz and 2010-2025 MHz frequency bands[20], which may contribute to timely deliverables in response to this Mandate.

Given the proven long-term lack of use of the unpaired 2 GHz spectrum under the current assignments and the foregoing RSC work before the adoption of the RSPP, this Mandate may be issued in advance of the outcome of the inventory process set up by the RSPP. The deliverables of this Mandate should be reflected in the EU spectrum inventory process.

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[17] See http://ec.europa.eu/information_society/policy/ecomm/radio_spectrum/get_involved/activities/index_en.htm#ongoing_consultations

[18] The order in this shortlist is chosen arbitrarily.

[19] Including innovative applications such as M2M

[20] Reported in documents FM(12)084 Annex 58 and ECC PT1(12)048

TASK ORDER AND SCHEDULE

CEPT is herewith mandated to undertake work to identify use(s) of the *unpaired terrestrial 2 GHz band* other than for the provision of mobile electronic communications services through terrestrial cellular networks pursuant to the UMTS Decision and the most appropriate technical criteria for spectrum use as well as, if appropriate, sharing arrangements between multiple applications, in order to meet EU spectrum policy objectives and foster economies of scale in the internal market.

In the work carried out under the Mandate, the overall policy objectives of the RSPP, such as effective and efficient spectrum use and the support for specific Union policies shall be given utmost consideration. In implementing this mandate, the CEPT shall, where relevant, take utmost account of EU law applicable and support the principles of service and technological neutrality, non-discrimination and proportionality insofar as technically possible. CEPT is also requested to collaborate actively with the European Telecommunications Standardisation Institute (ETSI) which develops harmonised standards for conformity under Directive 1999/5/EC.

CEPT is hereby mandated to undertake the following tasks:

(1) Assess and identify uses other than mobile electronic communications services delivered through terrestrial cellular networks and define the common minimal (least restrictive) technical conditions. These conditions should be sufficient to avoid interference with services or radio applications in adjacent bands, ensure co-existence with other services or radio applications in the same band, and facilitate cross-border coordination, also at the EU outer borders.

(2) In performing task (1), consider the following non-ECS uses in line with the priorities of the RSPP: broadband PPDR, PMSE, short-range devices and DECT[21]. This is without prejudice to the consideration of alternative uses for electronic communications services in line with EU spectrum policy objectives, such as Broadband Direct-Air-To-Ground Communications.

(3) In performing task (1) as specified by task (2) and given the limited temporal or geographical scope of one or more of the radio application under consideration, assess and justify the possibility of spectrum sharing amongst the radio applications under consideration and, if necessary, develop common technical sharing conditions which may include *inter alia* spectrum access rules, channelling arrangements or power emission limits that are sufficiently precise for the development of EU-wide equipment.

[21] DECT is considered to be an application with the potential to address the priority given to the Internet of Things set out in Article 8 of the RSPP.

CEPT should provide deliverables according to the following schedule:

Deliverable's schedule as specified in the EC Mandate

Delivery date	Deliverable	Subject
June 2013	Interim Report from CEPT to the Commission	Description of work undertaken and interim results under this Mandate.
November 2013[22]	Final Draft Report from CEPT to the Commission on selected use(s).	Description of work undertaken and final results under tasks (1) and (2) of this Mandate.
March 2014	Final Report from CEPT to the Commission on selected use(s), taking into account the outcome of the public consultation	Description of work undertaken and final results under tasks (1) and (2) of this Mandate taking into account the results of the public consultation
June 2014	Final Draft Report from CEPT to the Commission.	Description of work undertaken and final results under this Mandate.
November 2014	Final Report from CEPT to the Commission. taking into account the outcome of the public consultations	Description of work undertaken and final results under this Mandate taking into account the results of the public consultations

In addition, CEPT is requested to report on the progress of its work pursuant to this Mandate to all meetings of the Radio Spectrum Committee taking place during the course of the Mandate.

The Commission, with the assistance of the Radio Spectrum Committee and pursuant to the Radio Spectrum Decision, may consider applying the results of this mandate in the EU, pursuant to Article 4 of the Radio Spectrum Decision.

[22] Subject to subsequent public consultation

ANNEX 2: RESULTS OF THE CALL FOR INPUTS

The present Annex provides the results of the Call for Inputs on the outline of the response to the Commission in respect of the development of a CEPT response to the EC Mandate "To undertake studies on the harmonised technical conditions for the 1900-1920 MHz and 2010-2025 MHz frequency bands ('Unpaired terrestrial 2 GHz bands') in the EU".

Background

The present outline of the response to the Commission describes the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands in accordance with the EC Mandate to CEPT "To undertake studies on the harmonised technical conditions for the 1900-1920 MHz and 2010-2025 MHz frequency bands ("Unpaired terrestrial 2 GHz bands") in the EU".

The full range of source information has not been available to the extent that an ECC consultation in the formal sense could have been started at the ECC meeting in 5-8 November 2013. Therefore, the ECC decided instead to make a 'Call for Inputs' in order to gather relevant information from stakeholders in a timescale aligned with the requirements of the 'Unpaired terrestrial 2 GHz bands' Mandate. The consultation ended on 20th December 2013.

The following questions were put forward for consideration in addition to the outline of the response to the Commission on the shortlist of potential harmonised uses:

1. General questions

   a. **What is your view on the preferred scenarios / uses for the bands 1900-1920 MHz and 2010-2025 MHz as set out in the outline of the response to the Commission? Please, justify your answer by indicating the associated economic and other benefits of your preference.**

   b. In the outline of the response to the Commission it is suggested placing the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands, proposed for further study in the EC Mandate (as detailed in Annex 4), into 3 defined categories (see section 3.6 of the outline of the response to the Commission on Synergies between the proposed short list of selected use). **Do you agree with this approach? (Yes/No) If not please explain in detail why.**

2. DECT and SRD

   Two of the potential uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands proposed for study in the EC Mandate are DECT (1900-1920 MHz) and SRDs. Both uses would normally employ adequate mechanisms to access the spectrum equitably and operate under a general authorisation framework. The approach is application-neutral and technology-neutral as much as possible and in line with the principles set out in CEPT Report 14 and CEPT Report 44.

   Do you agree that SRD and DECT may be deployed and share the spectrum under a common technical and regulatory framework to foster a more efficient use of spectrum and future innovation? (Yes/No) If not, please indicate why.

3. PMSE and ad-hoc PPDR

   Two of the potential uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands proposed for study in the EC Mandate are PMSE and ad-hoc PPDR. Both proposed uses of the band are to provide temporary links both fixed and mobile (incl. airborne such as video links from/to helicopters or unmanned air vehicles), where these frequency bands would be included in an extended harmonised tuning range for video cameras and video links. The proposal in the

outline of the response to the Commission is that the same technical framework and same equipment can be used to meet the operational needs of both PMSE and PPDR users.

Do you agree that PMSE and ad-hoc PPDR show sufficient similarities to share the same technical framework to foster a more efficient use of spectrum and future innovation? (Yes/No). If not, please indicate why.-

Comments have been received from:

1. Deutsche Telekom
2. TriaGnoSys (affiliated to aircraft cabin manufacturer Zodiac Aerospace)
3. Riedel (provider of PMSE solutions)
4. NPO (Nederlandse Publieke Omroep; Netherlands Public Broadcasting)
5. Vislink (provider of PMSE solutions)
6. IRT (Institut für Rundfunktechnik) (research institute of the public broadcasters of Germany, Austria, and Switzerland)
7. France
8. DECT Forum
9. Sweden
10. Lufthansa Systems
11. Netherlands
12. Selex ES (inter-alia provider of PPDR solutions)
13. British Airways
14. Telefónica S.A.
15. Multi-operators' response from Bouygues Telecom, Orange, and SFR (Société Française de Radiotéléphone)
16. Germany
17. BT (British Telecommunications PLC)

All the comments are included in Annex 2 of Document FM(14)021 [35].

Some of the above entities and others provided as well comments to the present report during the public consultation (available in document FM(14)183 [24], with comment resolution), which were considered while preparing the final version of CEPT Report 52.

Summary of the responses

The table below includes an indicative overview of the support for applications (whereby some comments rather support the concept than specific applications, and some respondents may support different applications in different ranges).

Table 8: Support for the respective application

Application	Supported by number of responses
Broadband DA2GC	1, 2, 7, 10, 11, 13, 14, 16, 17
DECT	8, 11, 16
SRDs	9, 11, 16
PMSE	3, 4, 5, 6, 7, 11, 16
ad-hoc PPDR	12, 16
Other usage	11, 15

1. General questions

a. What is your view on the preferred scenarios / uses for the bands 1900-1920 MHz and 2010-2025 MHz as set out in the outline of the response to the Commission? Please, justify your answer by indicating the associated economic and other benefits of your preference.

DA2GCS:

Deutsche Telecom and TriaGnoSys expressed the support of a harmonised FDD solution in 1900-1910 MHz paired with 2010-2020 MHz. Telefonica also expressed their preference for an FDD solution for DA2GCS in the 2 GHz Unpaired Bands. Lufthansa Systems expressed the view that a TDD solution for DA2GCS in the 2 GHz Unpaired Bands should not be excluded from considerations, preferably for the 1900-1920 MHz band. BT also expressed their preference that the band 1900 – 1920 MHz is made available for DA2GC applications. No responder declared a preference for a DA2GCS TDD solution in the 2010-2025 MHz band.

France indicated that DA2GC could operate in the 2 GHz Unpaired Bands on a shared basis and the views expressed by other DA2GCS proponents go in the same direction, provided that coexistence conditions are clearly identified. Germany stated to support the preferred scenarios / uses as set out in the outline of the Call for Inputs. Netherlands stated that the unpaired band could partly be used for DA2CG. British airways expressed their support for a harmonised solution for DA2GCS without indicating a preferred technical solution. One of the two options defended by Lufthansa Systems points out the entire 20 MHz in the lower band to DA2GC for TDD usage leaving the 2010-2025 MHz for use by one or several of other applications.

Sweden finds it difficult to judge about economic benefits or other benefits that could be associated from an introduction of BDA2GC for a number of reasons expressed in the response. Generally a higher frequency band such as investigated by the FCC at the 14 GHz range would be preferred due to a lower opportunity cost. The Netherlands also indicated that economic benefits are not really clear yet but at least a reservation for this application may be advisable at higher frequencies.

PMSE:

Riedel, NPO, IRT, and Vislink expressed support for PMSE applications in the 2 GHz Unpaired Bands. The major benefits are seen in the slight expansion of the tuning range and preferable propagation conditions enabling non-line-of-sight video links compared to higher frequency ranges.

The four responding administrations also indicated to see the possibility for PMSE in the 2 GHz Unpaired Bands. Other responders such as DA2GCS proponents indicated to see sharing possibilities with PMSE applications.

DECT:

The DECT Forum expressed their view to make also available the 1900-1920 MHz band for DECT and refers to growth possibilities for higher rate data services, video surveillance and general home automation services, and especially M2M applications (for the latter one, an excerpt of the ETSI SRdoc has been provided).

Sweden does not predict a long-term growth of the DECT market, and estimates the benefits associated to a harmonisation of additional frequency spectrum are therefore limited.

SRD:

Sweden believes that with the right regulatory and technical conditions, an introduction of SRD in these bands potentially has a very high contribution to economic benefits in Europe.

France is of the view that based on appropriate mitigation techniques and restrictions, DA2GC could share with video applications, and an SRD regulation could also be introduced on a non-protection, non-interference basis without affecting the other services, as an optimised scenario.

The Netherlands proposed to consider metering (smart metering, smart grids and smart cities) in the unpaired bands, taking note that the needed frequency ranges are dependent on a country's geography and the average construction of houses and buildings. It is also referred that a number of bands proposed for metering, such as the 870-876 MHz, are not available in a substantial number of countries.

Other use, outside the indicated preferred scenarios/uses:

Two responses indicated other use, outside the indicated preferred scenario/uses:

Bouygues Telecom, Orange, and SFR stated that the current allocation of the unpaired terrestrial 2 GHz bands to the mobile network operators should remain as one of the possible alternatives. The main point of this contribution is to indicate the recent availability of mass-market handsets on the 2.1 GHz TDD bands. Such handsets are the same as those which also include the 2.3 GHz TDD band and the 2.6 GHz TDD band, in addition to all European FDD LTE bands. No statement was made with regard to the availability of network solutions in the unpaired bands (the main issue stated in the past has been the DL-emission limitations to be spectrum compatible with other applications in the adjacent spectrum).

This usage concept brought forward by the three operators may include TDD-FDD aggregation on hotspots and for M2M applications. The three operators are of the view that each potential harmonised use in the shortlist should be assessed against the use of the unpaired 2GHz bands for TDD-FDD aggregation on hotspots and for M2M. Telefonica mentioned the various licenses they hold in the 1920-1980 MHz/ 2110-2170 MHz across Europe and, in this context indicated that any solution in the 2 GHz Unpaired bands has to be spectrum compatible, i.e. protection of the adjacent services needs to be fulfilled.

The Netherlands introduced the view that radio amateur (satellite) use as well as wireless smart metering, smart grids and smart city networks should also be considered.

b. In the outline of the response to the Commission it is suggested placing the shortlist of potential harmonised uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands, proposed for further study in the EC Mandate (as detailed in Annex 1), into 3 defined categories (see section 3.6 of the outline of the response to the Commission on synergies between the proposed shortlist of selected use. **Do you agree with this approach? (Yes/No) If not please explain in detail why.**

From almost all responses, a high level of support has been expressed for the approach adopted by CEPT. Some responses indicate explicit possibilities or concerns that may need further investigations or refer to insufficient information:

- *Deutsche Telekom, TriaGnoSys see sharing of the DA2G forward link (ground-to-air) with PMSE cordless camera links is feasible under specific conditions. Such sharing feasibility is also expected to be valid for applications like SRD and DECT, in particular if low power, low duty cycle, DCS (Dynamic Channel Selection) and/or a restriction to in-house-only operation would apply for these applications.*
- *The need to be more precise on synergies, especially between PPDR and PMSE as well as on possibilities to coordinate ad hoc PPDR and PMSE usage.*
- *Telefonica supports the approach but needs also proper consideration of existing licenses and socio-economic studies detailing the synergies.*
- *DECT: precise usage should be further clarified, especially with regards to the handling of DECT video/video surveillance applications under the concept with the DECT/SRD and PMSE/ad-hoc PPDR categories.*
- *The DECT Forum expressed itself to be unable to support the common DECT/SRD approach due to lack of information on potential SRD usage.*

2. DECT and SRD

Two of the potential uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands proposed for study in the EC Mandate are DECT (1900-1920 MHz) and SRDs. Both uses would normally employ adequate mechanisms to access the spectrum equitably and operate under a general authorisation framework. The approach is application-neutral and technology-neutral as much as possible and in line with the principles set out in CEPT Report 14 and CEPT Report 44.

Do you agree that SRD and DECT may be deployed and share the spectrum under a common technical and regulatory framework to foster a more efficient use of spectrum and future innovation? (Yes/No) If not, please indicate why.

- *Several PMSE proponents indicate that they do not consider PMSE should share with unlicensed applications such as DECT/SRD. Usage of these licence-free devices in the same band where essential professional services (PMSE/PPDR) are being deployed impairs the error free use of these professional services. This notion has also been provided by the one response from a PPDR solutions provider.*
- *The responding administrations clearly indicated that DECT should operate under a generic SRD regulation on a shared basis with other technology on a non-protected non-interfered basis. Spectrum access techniques should be mutually compatible and frequency segmentation amongst such applications should be avoided. It is important that the regulation also in practice provide an opportunity for alternative technologies to use the spectrum so that a competitive market is created. SRD application spectrum access options (for sharing considerations) mentioned in the responses include low duty cycle and also LBT+AFA, DAA options.*

3. PMSE and ad-hoc PPDR

Two of the potential uses of the 1900-1920 MHz and 2010-2025 MHz frequency bands proposed for study in the EC Mandate are PMSE and ad-hoc PPDR. Both proposed uses of the band are to provide temporary links both fixed and mobile (incl. airborne such as video links from/to helicopters or unmanned air vehicles), where these frequency bands would be included in an extended harmonised tuning range for video cameras and video links. The proposal in the outline of the response to the Commission is that the same technical framework and same equipment can be used to meet the operational needs of both PMSE and PPDR users.

Do you agree that PMSE and ad-hoc PPDR show sufficient similarities to share the same technical framework to foster a more efficient use of spectrum and future innovation? (Yes/No). If not, please indicate why.

Two major concerns have been expressed concerning the PMSE/ ad-hoc PPDR sharing the same technical framework which seems to require additional discussions:

- *Several PMSE proponents indicated to support the categories/concept to use the same technical framework but also consider that PMSE/PPDR actual sharing might be difficult to achieve and coordination in certain situations (e.g. disaster spot) not being practicable. Others were more optimistic concerning this aspect and indicated that coordination and licensing conditions should be done on a national level.*
- *The need for more information, to support the on-going compatibility studies and also to clarify the precise PMSE/PPDR synergies was indicated. This may include DVB-T vs LTE considerations, 1-way/2-way communication needs and that PPDR does not only include video applications.*

Other uses suggested in the aim of the Call for Inputs

About **other uses** brought up in the Call for Inputs, the following is noted:

- *MOBILE*:

  In one contribution from three mobile operators, the desire to maintain the current allocation of the unpaired terrestrial 2 GHz bands to the mobile network operators is expressed as one of the possible alternatives. This usage concept brought forward by the three operators is meant to include TDD-FDD aggregation on hotspots and M2M applications. In addition, the three operators are of the view that each potential harmonised use in the shortlist should be assessed against the use of the unpaired 2GHz bands for TDD-FDD aggregation on hotspots and for M2M.

  On the other hand, it has to be noted that the purpose of the Mandate on the "Unpaired terrestrial 2 GHz bands" is to assess and identify alternative uses of the unpaired terrestrial 2 GHz band other than for the provision of mobile electronic communications services. Consequently, apart from the arguments presented, this option was considered to be out of the scope of this Mandate.

- *AMATEUR (SATELLITE)*:

  A proposal to consider the amateur (satellite) service use in the unpaired bands for cognitive radio experiments under controlled conditions was presented, under the argument that frequency use for the radio amateur service is currently under pressure.

  It can be seen from the RR Article 5 and the ECA Table that the amateur-satellite service always follows an amateur service allocation. As no amateur service allocation exists at the moment for the 2 GHz Unpaired Bands, it may be a long process to introduce such an allocation. Therefore, any activity within CEPT on this matter is considered to need sufficient support and a clear description of the demand, so as to conduct all necessary studies. It is as well to note that amateur-satellite service allocations already exist for the bands 1260-1270 MHz and 2400-2450 MHz, therefore it is suggested not to consider the proposed amateur-satellite usage in the 2 GHz Unpaired Bands.

ANNEX 3: CURRENT AUTHORISATIONS IN THE BANDS 1900-1920 MHz / 2010-2025 MHz

ECO Report 03 [9] on the licensing of mobile bands in CEPT includes in the version from 4 June 2014 the following information (information update indicated in brackets); complemented by the information recently received by ECO until 17 February 2015:

1. Andorra (January 2015)

1900-1920 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
vacant	1900-1920 MHz 2010-2025 MHz		

2. Austria (February 2014)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
Hutchison 3G Austria GmbH	1915.1 – 1920.1 MHz		Until Dec. 2020 tradeable
A1 Telekom Austria AG	1900.1 – 1910.1 MHz		Until Dec. 2020 tradeable
T-Mobile Austria GmbH	1910.1 – 1915.1 MHz 2019.9 – 2024.7 MHz		Until Dec. 2020 tradeable

3. Belgium (January 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration. tradability
Belgacom Mobile (Proximus)	1914.9-1920.3 MHz		15/03/2001-15/03/2021 Tradable
Mobistar	1909.9-1914.9 MHz		15/03/2001-15/03/2021 Tradable
KPN Group Belgium (Base)	1899.9-1904.9 MHz		15/03/2001-15/03/2021 Tradable

4. Belarus (not included yet in published ECO Report 03)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
vacant	1900-1920 MHz	UTRA TDD	Awaiting of a decision of State Commission for Radio Frequencies
vacant	2010-2025 MHz	UTRA TDD	Awaiting of a decision of State Commission for Radio Frequencies

5. Bosnia and Herzegovina (April 2013)

1900-1920 MHz/2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Telekomunikacije RS	1910 – 1915 MHz	UTRA TDD	01.04.2009. -31.03.2024, non-tradable

BH Telecom	1900 – 1905 MHz	UTRA TDD	01.04.2009. -31.03.2024, non-tradable
HT Mostar	1905 – 1910 MHz	UTRA TDD	01.04.2009. -31.03.2024, non-tradable

6. Bulgaria (March 2013)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Mobiltel EAD	2010-2015 MHz	UTRA TDD	25.04.2005 - 25.04.2025, transferable
Cosmo Bulgaria Mobile EAD	2020-2025 MHz	UTRA TDD	25.04.2005 - 25.04.2025, transferable
Bulgarian Telecommunications Company AD	2015-2020 MHz	UTRA TDD	25.04.2005 - 25.04.2025, transferable

7. Croatia (January 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
T-Mobile	1900 - 1905 MHz	TDD	OCT 2004 – OCT 2024, not tradable
Tele 2	1905 - 1910 MHz	TDD	DEC 2004 – DEC 2024,not tradable
VIPnet	1910 - 1915 MHz	TDD	OCT 2004 – OCT 2024,not tradable

8. Cyprus (February 2014)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
	No Assignments		

9. Czech Republic (February 2014)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability[x])
T–Mobile Czech Republic, a.s.	1910.1-1915.1 MHz	IMT/UMTS, TDD	22. 10. 2024, tradable

10. Denmark (March 2013)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
TDC A/S	1900-1905 MHz	TD SCDMA	Oct 2001 – Oct 2021, tradable
Telia Nättjanester Norden AB	1905-1910 MHz	TD SCDMA	Oct 2001 – Oct 2021, tradable
Telenor A/S	1910-1915 MHz	TD SCDMA	Dec 2005 – Oct 2021, tradable
HI3G Denmark ApS	1915-1920 MHz	TD SCDMA	Oct 2001 – Oct 2021, tradable

11. Estonia (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
EMT AS	1905.2-1910.0 MHz	TDD	08.10.2012 (the validity of licence shall be extended once a year) Tradable
Elisa Eesti AS...	1900.2-1905.0 MHz	TDD	17.01.2013 (the validity of licence shall be extended once a year) Tradable
Tele2 Eesti AS	1910.2-1915.0 MHz	TDD	27.01.2013 (the validity of licence shall be extended once a year) Tradable
ProGroup Holding OÜ	1915.2-1920.0 MHz	TDD	30.01.2017 Tradable

12. Finland (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
TeliaSonera Finland Corp.	1900.000 - 1904.800 MHz (Nationwide)	UTRA TDD	- 18.3.2019
DNA Ltd.	1905.000 - 1909.800 MHz (Nationwide except Provence of Åland)	UTRA TDD	- 18.3.2019
Elisa Corp.	1910.000 - 1914.800 MHz (Provence of Åland) 1915.000 - 1919.800 MHz (Nationwide except Provence of Åland)	UTRA TDD	- 18.3.2019 - 18.3.2019
Ålands Telekommunikation Ab	1915.000 - 1919.800 MHz (Provence of Åland)	UTRA TDD	- 18.3.2019

Note: in this table the term licence means a radio licence.

13. France (March 2013)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Bouygues Telecom	1900.1-1905.1 MHz	UMTS – TDD (not deployed)	12 December 2002 – 11 December 2022, SRU tradable
Orange France	1910.1-1915.1 MHz	UMTS – TDD (not deployed)	21 August 2001 – 20 August 2021, SRU tradable
Société Française du radiotéléphone	1915.1-1920.1 MHz	UMTS – TDD (not deployed)	21 August 2001 – 20 August 2021, SRU tradable

14. Georgia (June, 2010)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band	Technology in use (optional)	Licence duration, tradability
“Magticom” Ltd.	1910.000-1915.000 MHz	UMTS-TDD	November 2006 – November 2016 tradable
“Magticom” Ltd.	1915.000-1920.000 MHz	UMTS-TDD	September 2005 – September 2015, tradable
“Geocell” Ltd.	2010.000-2015.000 MHz	UMTS-TDD	June 2006 – June 2016 tradable

15. Germany (February 2014)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
Telefónica Germany	1900.1 – 1905.1 MHz		31 December 2025, not tradable
E-Plus	1905.1 – 1910.1 MHz		31 December 2020, not tradable
Telekom Deutschland	1910.1 – 1915.1 MHz		31 December 2020, not tradable
Vodafone D2	1915.1 – 1920.1 MHz		31 December 2020, not tradable
Telefónica Germany	2010.5 – 2024.7 MHz		31 December 2025, not tradable

16. Greece (January 2012)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration,
Cosmote	1905.1 – 1910.1 MHz	UMTS	05/08/2021, tradable
Wind	1910.1 – 1915.1 MHz	UMTS	05/08/2021, tradable
Vodafone	1915.1 – 1920.1 MHz	UMTS	05/08/2021, tradable

17. Hungary (August 2012)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Telenor	1905-1910 MHz	UTRA TDD	31 12 2019 Extendable 7.5 years Tradable with GSM1800 and UTRA FDD frequencies
Vodafone	1910-1915 MHz	UTRA TDD	31 12 2019 Extendable 7.5 years Tradable with UTRA FDD frequencies
Magyar Telekom Nyrt.	1915-1920 MHz	UTRA TDD	31 12 2019 Extendable 7.5 years Tradable with UTRA FDD frequencies

18. Iceland (January 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Nova ehf	1900-1905 MHz	TDD	30.3.2007-30.3.2022, not tradable
Síminn hf	1915-1920 MHz	TDD	30.3.2007-30.3.2022, not tradable
Og fjarskipti ehf	1910-1915 MHz	TDD	3.4.2007-3.4.2022, not tradable

19. Ireland (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Telefónica O_2 Communications (Ireland) Limited	1910 - 1915 MHx	UTRA TDD	October 2002 – October 2022 Tradable

20. Italy (March 2012)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
H3G	1900 - 1905 MHz	UMTS TDD	31 december 2021, tradable
VODAFONE	1905 - 1910 MHz	UMTS TDD	31 december 2021, tradable
TELECOM ITALIA	1910 - 1915 MHz	UMTS TDD	31 december 2021, tradable
WIND	1915 - 1920 MHz	UMTS TDD	31 december 2021, tradable

21. Latvia (March 2013)

1900-1920 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Bite Latvija	1900 - 1905 MHz	UMTS/IMT-2000/ TDD	June 2020. Not tradable
Tele2	1905 - 1910 MHz	UMTS/IMT-2000/ TDD	December 2017. Not tradable
Latvijas Mobilais Telefons (LMT)	1915 - 1920 MHz	UMTS/IMT-2000/ TDD	December 2017. Not tradable

22. Liechtenstein (March 2015)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
vacant	1900 - 1920 MHz 2010 - 2025 MHz		

23. Lithuania (January 2013)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
1900-1920 MHz / 2010-2025 MHz radio frequency bands are reserved. Permits are not issued.			

24. Luxembourg (March 2013)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Not assigned	1900 - 1920 MHz		Former UTRA TDD licence recently returned in 2013

25. Former Yugoslav Republic of Macedonia (April 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Not assigned	1910 - 1915 MHz		Former UTRA TDD licence recently returned in 2014

26. Malta (March 2014)

1900-1920 MHz / 2010-2025 MHz (paired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Vodafone Malta Ltd.	1909.9 - 1914.9 MHz	UTRA TDD	Aug. 05 – Aug. 20, not tradable
Mobisle Communications Ltd.	1914.9 - 1919.9 MHz	UTRA TDD	Aug. 05 – Aug. 20, not tradable
Melita Mobile Ltd.	1904.9 - 1909.9 MHz	UTRA TDD	Aug. 07 – Aug. 22, not tradable

27. Moldova (February 2011)

1900-1920 MHz and 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequency band licensed	Technology in use (optional)	Licence duration, tradability
Orange Moldova	1899.9 - 1904.9 MHz	UMTS TDD	August-2008 – August-2023, non-tradable
Moldcell	1914.9 - 1919.9 MHz	UMTS TDD	August-2008 – August-2023, non-tradable
Moldtelecom	1904.9 - 1909.9 MHz	UMTS TDD	December-2008 – December-2023, non-tradable

28. Montenegro (February 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Operator 1 (Promonte GSM)	1905 - 1910 MHz	UTRA TDD	13.04.2007. – 13.04.2022. / tradable if approved by the NRA
Operator 2 (T-Mobile Crna Gora)	1910 - 1915 MHz	UTRA TDD	11.04.2007. – 11.04.2022. / tradable if approved by the NRA
Operator 3 (MTEL)	1915 - 1920 MHz	UTRA TDD	21.04.2007. – 21.04.2022. / tradable if approved by the NRA

29. The Netherlands (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
KPN	1909.9 - 1914.9 MHz		Until Dec. 2016, tradable
T-mobile	1900 - 1909.9 MHz 2010 - 2024.7 MHz		Until Dec. 2016, tradable
Vodafone	1914.9 - 1920.3 MHz		Until Dec. 2016, tradable]

30. Norway (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
vacant	1900 - 1920 MHz	technology neutral	n.a.
Inquam Norway AS	2010 - 2025 MHz	technology neutral	31-12-2022, **tradable**

31. Poland (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
POLKOMTEL S.A.	1905.1 - 1910.1 MHz	UTRA TDD	20.12.2000 – 01.01.2023 tradable
Polska Telefonia Cyfrowa Sp. z o.o.	1910.1 - 1915.1 MHz	UTRA TDD	20.12.2000 – 01.01.2023 tradable
Polska Telefonia Komórkowa ”Centertel” Sp. z o.o.	1915.1 - 1920.1 MHz	UTRA TDD	20.12.2000 – 01.01.2023 tradable]
P4 Sp. z o.o.	1900.1 - 1905.1 MHz	UTRA TDD	Date 1 – 31.12.2023 tradable

32. Portugal (June 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability*
Not assigned	1900 - 1920 MHz	----------	--------
Not assigned	2010 - 2025 MHz	---------	--------

33. Romania (June 2007)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Licence start	Licence expiry (or duration)	Frequencies	Comments
Vodafone Romania	March 2005	March 2020	1909.9-1914.9 MHz	Not tradable
Orange Romania	March 2005	March 2020	1904.9-1909.9 MHz	Not tradable
RCS&RDS	January 2007	January 2022	1914.9-1919.9 MHz	Not tradable

* The rights of use of spectrum set out in the NTFA (National Table of Frequency Allocations) are transferable in accordance with the Law of Electronic Communications (http://www.anacom.pt/render.jsp?categoryId=97279#horizontalMenuArea) - See article nº 34 of Law no. 51/2011, of 13 September

34. Russian Federation (September 2010)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
OJSC «Megafon»	2010 - 2015 MHz	UTRA TDD	2017, not tradable
OJSC «Mobile TeleSystems»	2015 - 2020 MHz	UTRA TDD	2017, not tradable
OJSC «VimpelCom»	2020 - 2025 MHz	UTRA TDD	2017, not tradable

35. Serbia (March 2010)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
TELEKOM SRBIJA	1905 - 1910 MHz	UTRA TDD	28.07.2006. – 28.07.2016., non-tradable
TELENOR	1900 - 1905 MHz	UTRA TDD	31.08.2006. – 31.08.2016., non-tradable
VIP MOBILE	1910 - 1915 MHz	UTRA TDD	10.11.2006. – 10.11.2016., non-tradable

36. Slovak Republic (January 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Orange Slovensko, a.s.	1900 – 1905 MHz	TDD	19.07.2002 – 31.08.2026, Tradable
Slovak Telekom, a.s	1905 – 1910 MHz	TDD	16.07.2002 – 31.08.2026, Tradable
Telefónica Slovakia, s.r.o.	1910 - 1915 MHz	TDD	07.09.2006 – 07.09.2026 , Tradable

Note: This band is currently not in use.

37. Slovenia (June 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
TELEKOM SLOVENIJE	1900 - 1905 MHz	UMTS / TDD	06.09.2004 – 21.09.2021 Tradable
SI.MOBIL	1905 - 1910 MHz	UMTS / TDD	31.05.2014 – 21.09.2021 Tradable
T-2	1910 - 1915 MHz	UMTS / TDD	21.09.2006 – 21.09.2021 Tradable
SI.MOBIL	1915 - 1920 MHz	UMTS / TDD	21.09.2006 – 21.09.2021 Tradable
SI.MOBIL	2010 - 2025 MHz	UMTS / TDD	31.05.2014 – 21.09.2021 Tradable

38. Spain (February 2014)

1900-1920 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Orange	1900.1-1905.1 MHz	UMTS TDD	Apr-'00 / apr-'20 tradable
Vodafone	1905.1-1910.1 MHz	UMTS TDD	Apr-'00 / apr-'20 tradable
Telefónica	1910.1 – 1915.1 MHz	UMTS TDD	Apr-'00 / apr-'20 tradable
Xfera (Yoigo)	1915.1-1920.1 MHz	UMTS TDD	Apr-'00 / apr-'20 tradable

39. Sweden (March 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Svenska UMTS Licens AB (Tele2+TeliaSonera)	1905.0 -1910.0 MHz	Not deployed	16.12.2000 – 31.12.2025 tradable
HI3G Access AB	1910.0 – 1915.0 MHz	Not deployed	16.12.2000 – 31.12.2025 tradable
Telenor Sverige AB	1915.0 – 1920.0 MHz	Not deployed	16.12.2000 – 31.12.2025 tradable

40. Switzerland (February 2014)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Orange Networks SA	1905.5 – 1910.5 MHz	UTRA TDD	JAN 01 – DEC 16 Not Tradable
Sunrise Communications AG	1910.5 – 1915.5 MHz	UTRA TDD	JAN 01 – DEC 16 Not Tradable
Swisscom (Schweiz) AG	1915.5 – 1920.5 MHz	UTRA TDD	JAN 01 – DEC 16 Not Tradable
Not assigned	1900.5 – 1905.5 MHz 2010.0 – 2025.0 MHz		

41. Turkey (January 2010)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
VODAFONE	2010-2015 MHz	IMT/UMTS	30 April 2009-30 April 2029 Not tradable

42. Ukraine (March 2010)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Ukrtelecom	2015-2020 MHz	IMT-2000 CDMA UMTS/WCDMA	Dec 2005 – Dec 2020 Not tradable

43. United Kingdom (March 2013)

1900-1920 MHz / 2010-2025 MHz (unpaired frequency arrangement)

Operator	Frequencies	Technology in use (optional)	Licence duration, tradability
Telefónica UK Ltd	1909.9-1914.9 MHz	UTRA TDD	1/4/2000 – No expiration date; Tradable
Everything Everywhere Limited	1899.9-1904.9 MHz	UTRA TDD	1/4/2000 – No expiration date; Tradable
Everything Everywhere Limited	1904.9-1909.9 MHz	UTRA TDD	1/4/2000 – No expiration date; Tradable
Hutchison 3G UK Ltd.	1914.9 - 1920.0 MHz	UTRA TDD	1/4/2000 – No expiration date; Tradable

ANNEX 4: REGULATORY PARAMETERS (TECHNICAL AND OPERATIONAL REQUIREMENTS) FOR DA2GC SYSTEMS IN THE BAND 1900-1920 MHZ WITH TDD OPERATION MODE[23]

A DA2GC ground station may use multiple sector antennas with fixed azimuth and elevation patterns. For such a GS, a fixed elevation up-tilt is introduced to maximise reception at normal cruising altitudes of a commercial aircraft.

The aircraft station antenna may be based on an existing commercial aircraft antenna, which has been enhanced to support operation in the allocated frequency band, and so facilitates retrofit while not creating any additional drag for the aircraft.

A beamforming system can be implemented which uses advanced phased array and signal processing technology on the aircraft and at the ground station, to produce shaped and steerable beams. This enables dynamic beam pointing at both ends of the link such that the ground station and the aircraft mutually track each other. The use of beamforming helps to reduce co-channel interference and improves both the DA2GC link performance and its frequency sharing capabilities.

Power control is used in both directions, to maintain the required received power level at the GS and AS receivers.

ECC Reports 209, 214 and 220 provide detailed technical information.

Table 1: Main parameters for Ground Stations (GS)

Parameter	Value
Maximum channel bandwidth	20 MHz
Maximum e.i.r.p.	50 dBm/MHz
Minimum operational elevation angle of antenna main lobe	+5°
NOTE: The e.i.r.p. level in this table represents the maximum operational level at all times for a single beam, in the direction of the aircraft	

Table 2: Main parameters for Aircraft Stations (AS)

Parameter	Value
Maximum channel bandwidth	20 MHz
Maximum e.i.r.p. spectral density	34 dBm/MHz
Minimum ATPC (adaptive transmitter power control) range	10 dB
Minimum operational height above ground	3 000 m

For the protection of DECT systems below 1900 MHz and MFCN above 1920 MHz, the requirements for the out-of-block[24] e.i.r.p. limits for the DA2GC ground stations and aircraft stations in Table 3 shall apply.

[23] ECC/DEC/(15)02 Annex 1 [48].

[24] within this Annex, «block» is the 1900-1920 MHz frequency band

Table 3: Out-of-block e.i.r.p. limits for GS and AS

Frequency range of out-of-block emissions	Maximum out-of-block e.i.r.p. spectral density GS	Maximum out-of-block e.i.r.p. spectral density AS
1880 - 1900 MHz	-12 dBm/MHz	-3 dBm/MHz
1920 - 1980 MHz	-23 dBm/MHz	-3 dBm/MHz
The limits for the GS are specified for the entire hemisphere below the horizontal plane of any installation.		

Table 4: Other Co-existence requirements

Ground Station
Coordination with MFCN base stations operating in the 1920-1980 MHz band is required (See Annex 2 for guidelines).
See Annex 2 with guidelines for CEPT administrations to ensure co-existence with other services.

ANNEX 5: GUIDELINES FOR CEPT ADMINISTRATIONS TO ENSURE CO-EXISTENCE WITH OTHER SERVICES THAN BROADBAND DA2GC[25]

BACKGROUND

According to ECC Report 209, for most situations the calculated separation distance between DA2GC GS and MFCN BS in order to avoid interference will be less than 2 km for rural areas and 600 m for urban areas. These separation distances correspond to the limits in Table 3 of Annex 4, and in addition ECC Report 209 also assumes a case when the MFCN BS is at higher altitude than the DA2GC GS (10 m difference in height). Only in the situations where the MFCN BS is at a significantly higher altitude than the DA2GC GS there may be a need for greater separation distances.

Coordination and registration will be needed for the DA2GC GS. Co-location of DA2GC GS and MFCN BS is not possible.

This coordination would also support that a pan-European broadband DA2GC system would not be subject to operational restrictions at border areas in the future.

A broadband DA2GC system in the 1900-1920 MHz band is expected to be able to cover the whole European airspace with less than 500 GS (e.g. approx. number of DA2GC ground stations for Germany is 20, Italy - 25, France - 35 and Spain - 30). Thus the number of GS in each country to be coordinated with MFCN base stations being operated in the band adjacent to 1900-1920 MHz is rather low.

Based on the results of the compatibility studies included in ECC Report 209 relevant mitigation measures and careful radio network planning in combination with site coordination is required. Also Report ECC 209 concludes that a 10 MHz guard band would be sufficient to protect MFCN BS, i.e. that coordination is a priori needed with MFCN BS operating in 1920-1930 MHz.

GUIDELINES

Coordination with services in adjacent bands - either within a country or between neighbouring countries should be carried out.

These guidelines primarily relate to co-ordination within national boundaries. For the situation where stations are within the territories of different administrations, the use of these guidelines within bilateral agreements may help to expedite cross border co-ordination.

In deploying new stations, administrations and operators should be cognisant of the need to minimise constraints on other services and this should be ensured by the coordination process.

COORDINATION PRINCIPLES

Coordination of DA2GC GS with other stations should be carried out on a case-by-case basis, since no single separation distance, guard band or signal strength limit can be provided. This could be achieved based on similar principles to those which have been used for coordination between land mobile networks.

[25] ECC/DEC/(15)02 Annex 2 [48].

The following key principles related to the coordination between DA2GC GS and MFCN base stations should be considered at national level or between neighbouring countries in order to ensure co-existence:

1. Coordination is primarily about national implementation, local propagation conditions and national licensed use, which is best dealt with by national administrations;
2. The principle should be that the operator who introduces changes to his network has to trigger a coordination process (e.g. rollout of a new station or network modification);
3. The implementation of these guidelines is at the discretion of the national administrations to the extent this may help them;
4. Coordination processes and associated protection should only apply to registered/licensed spectrum users;
5. The coordination process should be both accurate and fast to enable all operators to efficiently plan spectrum utilisation and network deployments.

ANNEX 6: LIST OF REFERENCES

[1] CEPT Report 014 Report from CEPT to the European Commission in response to the Mandate to: Develop a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs)

[2] CEPT Report 044 In response to the EC Permanent Mandate on the ”Annual update of the technical annex of the Commission Decision on the technical harmonisation of radio spectrum for use by short range devices”

[3] ERC Decision (99)25 on the harmonised utilisation of spectrum for terrestrial Universal Mobile Telecommunications System (UMTS) operating within the bands 1900 - 1980 MHz, 2010 - 2025 MHz and 2110 - 2170 MHz

[4] ERC Decision (00)01 on the frequency bands for the introduction of terrestrial Universal Mobile Telecommunications System (UMTS)

[5] ERC Decision (97)07 on the frequency bands for the introduction of the Universal Mobile Telecommunications System (UMTS)

[6] ECC Decision (06)01 on the harmonised utilisation of spectrum for terrestrial IMT-2000/UMTS systems operating within the bands1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz

[7] ECC Decision (13)01 on the use, free circulation, and exemption from individual licensing of Earth stations on mobile platforms (ESOMPs) in the frequency bands available for use by uncoordinated FSS Earth stations within the ranges 17.3-20.2 GHz and 27.5-30.0 GHz

[8] Decision 128/1999/EC of the European Parliament and the Council, dated 14 December 1998, on the coordinated introduction of a third-generation mobile and wireless communications system (UMTS) in the Community

[9] ECO Report 03: The licensing of 'Mobile bands' in CEPT

[10] CEPT Report 019 Report from CEPT to the European Commission in response to EC Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS

[11] CEPT Report 039 Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for 2 GHz bands

[12] ERC Report 64 Sharing between UMTS and existing fixed services

[13] ERC Report 65 Adjacent band compatibility between UMTS and other 2 GHz services

[14] ERC Report 25 European Common Allocation Table

[15] ETSI EN 301 908-10 Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 10: Harmonised EN for IMT-2000, FDMA/TDMA (DECT) covering essential requirements of article 3.2 of the R&TTE Directive

[16] ETSI EN 300 175 (several parts): Digital Enhanced Cordless Telecommunications (DECT);Common Interface (CI)

[17] ERC Recommendation 25-10 on frequency ranges for the use of temporary terrestrial audio and video SAP/SAB links (incl. ENG/OB)

[18] ECC Report 204 Spectrum use and future requirements for PMSE

[19] ERC Report 38 Handbook on radio equipment and systems video links for ENG/OB use

[20] ERC Recommendation T/R 22-02 on frequency band to be designated for the European digital cordless telecommunication system (DECT)

[21] ERC Decision (94)03 on the frequency band to be designated for the coordinated introduction of the Digital European Cordless Telecommunications system

[22] ERC Decision (98)22 on Exemption from Individual Licensing of DECT equipment, except fixed parts which provide for public access (Corrected 30 March 2007); this decision is currently under revision in CEPT

[23] ECC Report 199 user requirements and spectrum needs for the future European broadband PPDR system (Wide Area Network)

[24] FM(14)183 Annex 1: Results of the PC of draft CEPT Report 52, Unpaired 2 GHz band

[25] ITU-R Recommendation P.452-15: Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz

[26] ECC Report 214 on Broadband Direct-Air-to-Ground Communications (DA2GC)

[27] ECC Report 209: Compatibility/sharing studies related to Broadband Direct-Air-to-Ground Communications (DA2GC) in the frequency bands 1900 – 1920 MHz / 2010 – 2025 MHz and services/applications in the adjacent bands

[28] ECC Report 210 on Compatibility/sharing studies related to Broadband Direct-Air-to-Ground Communications (DA2GC) in the frequency bands 5855-5875 MHz, 2400-2483.5 MHz and 3400 – 3600 MHz
[29] ECC Report 220 on the compatibility and sharing studies of DA2GC, PMSE video links, SRD and DECT in the 2 GHz unpaired bands (in public consultation)
[30] ECC Report 189: Future Spectrum Demand for Short Range Devices in the UHF Frequency Bands
[31] ETSI TR 103 054 V1.1.1 (2010-07), System Reference Document on Broadband Direct-Air-to-Ground Communications operating in part of the frequency range from 790 MHz to 5150 MHz; FM48(10)003
[32] ETSI TR 101 599 V1.1.3 (2012-09), System Reference Document on Broadband Direct-Air-to-Ground Communications System employing beamforming antennas, operating in the 2.4 GHz and 5.8 GHz bands; FM48(12)036
[33] ETSI TR 103 108 V1.1.1 (2013-07), System Reference Document on Broadband Direct-Air-to-Ground Communications System operating in the 5.855 GHz to 5.875 GHz band using 3G technology
[34] ETSI TR 103 149 V1.1.1 (2013-09): System Reference Document on DECT operating in the 1 900 MHz - 1 920 MHz band
[35] FM(14)021_ECO Summary of Consultation of the Call for Inputs for the 2 GHz Unpaired Bands
[36] CEPT Report 051 Technical conditions for ensuring the sustainable operation of cordless video-cameras
[37] ETSI TR 103 089: Digital Enhanced Cordless Telecommunications (DECT); DECT properties and radio parameters relevant for studies on compatibility with cellular technologies operating on frequency blocks adjacent to the DECT frequency band
[38] ERC Recommendation 70-03 Relating to the use of Short Range Devices (SRD)
[39] Draft IEEE 802.11ah: IEEE 802.11ah is an emerging standard that defines a WLAN system operating at sub 1 GHz license-exempt bands, with final approval slated for March 2016
[40] CEPT Report 043 To undertake technical studies on the efficient use of the harmonised 169.4-169.8125 MHz frequency band (169 MHz – Review Mandate
[41] ECC Report 096 Compatibility between UMTS 900/1800 and systems operating in adjacent bands
[42] ERC Recommendation 74-01 on Unwanted Emissions in the Spurious Domain
[43] ECC Report 172 on Broadband Wireless Systems Usage in 2300-2400 MHz
[44] ECC Report 181 on Improving spectrum efficiency in SRD bands
[45] ECC Report 182 on Survey about the use of the frequency band 863-870 MHz
[46] ECC Report 200 on Co-existence studies for proposed SRD and RFID applications in the frequency 870-876 MHz/915-921 MHz
[47] ETSI TR 103 245 V1.1.1 (2014-10): System Reference Document; Technical characteristics and spectrum requirements of wideband SRDs with advanced spectrum sharing capability for operation in the UHF 870 - 876 MHz and 915 - 921 MHz frequency bands
[48] ECC Decision (15)02 on the harmonised use of broadband Direct Air-to-Ground Communications (DA2GC) systems in the frequency band 1900-1920 MHz
[49] ECC Decision (15)03 on the harmonised use of broadband Direct Air-to-Ground Communications (DA2GC) systems in the frequency band 5855-5875 MHz