WiMAX Forum White Paper - Spectrum Opportunities below 1 GHz

August 2008

Executive Summary

This White Paper provides an analysis of spectrum opportunities for WiMAX™ technologies in bands below 1 GHz. It describes the recent regulatory developments in the bands below 1 GHz, focusing especially on the upper part of Ultra High Frequency (UHF) 470-862 MHz band, i.e. in the sub-band 698-862 MHz which may become available to Mobile Service applications in the next years, typically between 2008-2012.

After a short description of the interest of the UHF band below 1 GHz in terms of implementation of the WiMAX™ technology, the document provides a description of the current regulatory situation of this band and of its recent evolutions:

- OFDMA TDD WMAN is now an IMT technology included in Recommendation ITU-R M.1457;
- at international level, the results of the WRC-07 (Geneva, 2007, Oct 22nd -Nov 16th) are presented and discussed;
- at regional or national levels, on-going processes in several regions or countries are described. These analyses concentrate on North American countries, CEPT countries, and some Asian countries, where active processes have been initiated and more information is currently available.

As a result of this review, the document focuses on the UHF band 698-862 MHz, including:

- the band 698-806 MHz which is already partly available for commercial applications in North America and has been designated for IMT applications in Region 2 (including CALA countries, except Brazil) and in some countries of Region 3, including in particular China, India, Japan and Republic of Korea;
- The band 790-862 MHz which has been allocated where necessary to Mobile Service and identified for IMT at WRC-07 in Region 1 (Europe, Africa, Middle-East) and in Region 3 (Asia-Pacific area).

This would not prevent the possibility to explore other opportunities on a case-by-case basis including, for instance, other IMT spectrum below 1 GHz, TV-spectrum white areas (use of the so-called interleaved spectrum) or an expanded band resulting from local situations.

In addition WiMAX technology could provide solutions for vertical markets like for instance Public Safety and military applications. In several countries the Digital Dividend may also result in providing new spectrum resources for these applications in the UHF band.

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1 Introduction

There is currently a lack of spectral resources for the introduction of Broadband Wireless Access services in low density and remote areas. In these areas wireless technologies are the most valuable way to provide both basic services and added value broadband applications to the populations, provided that adequate frequency bands would be available to provide these applications and services at a reasonable cost.

For this type of application, bands above 2 GHz, for which profiles have been developed by the WiMAX Forum®, suffer from the comparison with lower frequency bands already available to other technologies, like cellular mobile technologies (e.g. 450 MHz; 900 MHz) or broadcasting technologies (e.g. 470-862 MHz), in terms of coverage which is of paramount importance in rural and remote areas.

Some countries already took initiatives to offer commercial and public safety wireless solutions in rural areas:

- in North America (USA, Canada) some parts of the UHF spectrum have been released, or are intended to be released, to allow the development of Broadband Wireless Access (BWA) solutions;
- in India there is a strong commitment from the Government and the Regulatory Authority (TRAI) to facilitate the deployment of Telecommunication infrastructure to bring services to customers in rural areas. In this context there is high level of interest from the Indian Government in opening part of the UHF band around 700 MHz to BWA solutions.

Other countries are concerned as well but with a delayed time frame, typically between 2010 and 2015, and have initiated a review of the use of the UHF band:

- The European Union has taken initiatives to cope with the so-called Digital Dividend (DD) which would result from the switchover from Analogue to Digital TV. Therefore the availability of spectrum for BWA applications below 1 GHz in Europe is strongly linked to the conclusions of these on-going initiatives, and in many cases may not be expected before the switchover has been completed.
- In Australia, Malaysia and Taiwan there may also be some possibilities that spectrum below 1 GHz may become available at mid or long term.
- In Brazil there are projects and studies on the possibility to use technologies like WiMAX™ for interactivity in association with Digital TV. These projects seem not to be in direct relationship with the implementation of International Mobile Telecommunications (IMT).
- SUBTEL, the Telecommunications Regulator of Chile, intends to conduct a Public Consultation on the use of the 700 MHz band in 2008.

All these initiatives resulted from consideration on possible usages of the spectrum which was expected to become available after transition from Analogue TV to Digital Terrestrial TV – the so-called Digital Dividend (DD) – which has resulted, or will result in clearing a part of the UHF Band 470-806 / 862 MHz.

Due to this interest for possible new uses in the UHF band, a lot of countries supported the identification of a part of the UHF band 470-862 MHz for IMT applications by the World Radiocommunications Conference-2007 (WRC-07) in October 2007.

These efforts were successful, and the WRC-07 identified for IMT:

- Sub-band 698-806 MHz in Region 2 (Americas) and some countries in Region 3 (Asia-Pacific)
- Sub-band 790-862 MHz in Region 1 (Europe; Middle East; Africa) and in Region 3

This identification is supported by new primary allocations to Mobile Service where such allocation did not yet exist.

This document aims to consider opportunities for WiMAX™ technology in **all feasible bands below 1 GHz,** and for all possible applications which could benefit from the use of the this technology, including Broadband Wireless Access (BWA) and vertical markets.

Nevertheless it concentrates on bands which could be made available during or at the completion of the switchover process from Analogue to Digital TV, i.e. mainly the UHF spectrum between 470 MHz and 862 MHz, and on BWA applications.

Other bands below 1 GHz (e.g. the 450-470 MHz band, now identified for IMT) may need to be promoted for using band-specific conditions, where opportunity for WiMAX technology to access them may appear, in some cases possibly at shorter term, but probably on a country by country basis.

In parallel to this study on the expected availability of the UHF band in different areas in the world, the WiMAX Forum is checking on market expectations, as well as on services and applications that could benefit from the use of the 700 MHz band, and is undertaking the definition of profiles in this band. The result of market investigations is contained in “WiMAX Forum® Position Paper for WiMAX™ Technology in the 700 MHz Band” [39].

2 BWA Services in UHF bands

2.1 Rationale to implement BWA in the UHF band

In rural areas, using WiMAX technology in bands below 1 GHz will optimize the deployment by maximizing the coverage which is the limiting factor in this type of environment. Bands below 1 GHz are very attractive for BWA:

- large coverage which makes them particularly suitable to cover rural and remote areas while minimising CAPEX;
- good characteristics for mobile propagation allowing convergence between Fixed, Nomadic, and Mobile access;

Rough estimations lead to a cell radius in rural areas of around 15-20 km assuming a basic configuration without enhanced features like Adaptive Antenna Systems (AAS). This radius could be increased by the implementation of such features.

Up to now bands below 1 GHz were generally not considered available for Wireless Access. A large part of them are dedicated to terrestrial broadcasting and second generation cellular systems. Switchover from analogue to digital terrestrial broadcasting could, for the same number of TV programmes and a similar level of quality, free a part of this spectrum. This is generally known as the Digital Dividend. Therefore the Digital Dividend is probably a unique opportunity for BWA applications to reach access to part of this spectrum.

Whatever the amount of spectrum freed by the Digital Dividend process, there are also in several countries areas where either a part of even the whole UHF Broadcasting spectrum would not be used for TV applications. This is particularly the case of sparsely populated areas, and this would also offer an opportunity, possibly at shorter term, to use this spectrum for other applications like Broadband Wireless Access.

From an operator point of view, deploying the same technology (WiMAX) in two different frequency bands according to the environment (for instance below 1 GHz in rural or remote areas and 2.5 GHz in suburban/urban environment will make a lot of sense in the same way that today GSM is often deployed in 900 MHz and 1800 MHz in line with the cell coverage needed (macro-cell or micro/pico cell) given the availability of dual band/multiband user equipment.

These low density areas include large areas in countries like Australia, Brazil, Canada, China, Indonesia, India, Russian Federation, and The United States of America.

In addition, in emerging markets of developing countries there may be a lack of wired telecommunications infrastructures even in suburban areas and in small/medium sized cities. Wireless solutions could provide an alternative to faster develop high quality access networks in these areas, in order to ensure in a first step the provision of widespread coverage. In countries like India this would represent a considerable amount of addressable population.

WiMAX technology can also have an important role in providing broadband services to those in shared accommodation where several people would need to share a single wired connection and there could be disagreements about who pays for what usage. Also people who are going to move rented residences frequently may not want to commit to a long term contract or repeatedly pay high initial connection charges each time they relocate. WiMAX technology in bands below 1GHz can serve these groups most effectively by providing widespread coverage, with good in-building coverage, with less transmission infrastructure

In conclusion, WiMAX™ technology in bands below 1 GHz could be a particularly attractive solution in:

- developing countries to cope with extended rural areas and lack of telecommunication infrastructure in suburban areas and small/medium cities, and to ensure global coverage of the country

- developed countries for rural and sparsely populated areas; and

In both cases, as a wireless technology it would provide the possibility to implement seamless connectivity and to provide fixed, nomadic and mobile applications at reasonable costs in these areas.

WiMAX technology in bands below 1 GHz could also be a particularly attractive solution for serving customers in shared or rented accommodation.

3 An overview of the global situation before WRC-07

The UHF band is used worldwide by Broadcasting Service for terrestrial radio and TV applications. This was reflected in the Radio Regulations where most of the spectrum from 470 MHz up to above 800 MHz is allocated primarily to the Broadcasting Service.

Table 1 is an extract of the 2004 version of the Radio Regulations (RR) Article 5 – Table of Frequency Allocations. Only primary or co-primary allocations appearing in the Table itself are reported[1].

<table>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="5">470-790
BROADCASTING</td><td>470-512
BROADCASTING
Fixed
Mobile</td><td rowspan="2">470-585
FIXED
MOBILE
BROADCASTING</td></tr>
<tr><td rowspan="2">512-608
BROADCASTING</td></tr>
<tr><td rowspan="3">585-610
FIXED
MOBILE
BROADCASTING
RADIONAVIGATION</td></tr>
<tr><td rowspan="2">608-614
RADIO ASTRONOMY
Mobile Satellite except Aeronautical mobile satellite (Earth-to-space)</td></tr>
<tr><td rowspan="2">610-890
FIXED
MOBILE
BROADCASTING</td></tr>
<tr><td>614-806</td></tr>
</table>

[1] In addition to the primary allocations reported in Table 1, there are also primary allocations in specific countries by footnotes. There are also secondary allocations (including allocations to the Mobile Service) which are not reported here. It is generally recognised that it is generally unsatisfactory for applications like BWA or IMT to operate under such secondary allocations.

790-862 FIXED BROADCASTING	BROADCASTING Fixed Mobile	
	806-890 FIXED MOBILE BROADCASTING	

Table 1

Table of frequency allocations in band 470-862 MHz before WRC-07

(Excerpt from Radio Regulations Article 5 – Version 2004)

It can be noted that **in Region 3 the whole band 470-890 MHz was already allocated to Fixed and Mobile Services on a primary basis.**

The switchover to terrestrial Digital Radio and Digital TV will clear some part of the spectrum assigned to terrestrial analogue Radio and TV systems to other applications than those strictly necessary to replace current analogue services. This is what is generally called the "Digital Dividend". This represents an opportunity for applications like Broadband Wireless Access to obtain access to a part of this spectrum.

Some initiatives to allocate the spectrum resulting from the Digital Dividend have already been undertaken in some countries. Nevertheless progress is very different from country to country - from situations where precise assumptions have already been defined and are in a process of further refinement (like in the USA) to cases where no action has been undertaken for the time being.

The Radio Regulations have been updated by WRC-07. The provisions in the new version will generally enter into force from 1 January 2009. This update took into account the possible clearance of a part of the Broadcasting spectrum in the UHF band and, in order to give each country more flexibility in re-assigning the available spectrum, a new allocation to Mobile Service was introduced, where necessary, together with an identification for IMT systems, with some constraints for the protection of existing services.

Section 4 describes the outcome of the WRC-07 in more detail.

Section 5 of this document describes the situation in the different parts of the world. This situation results from a lot of initiatives, either at regional or at national level, which in several cases were initiated independently of WRC-07.

4 WRC-07 updates

4.1 Possible identification of new bands for IMT systems

The allocations in the frequency band 470-862 MHz were reviewed during WRC-07 (Geneva, 2008, 22nd 0ctober – 16th November) under the framework of Agenda Item 1.4 of WRC-07:

> "To consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account the results of ITU-R studies in accordance with Resolution 228 (Rev.WRC-03)".

This agenda item included the identification of new frequency bands for IMT systems. Several frequency bands were considered for a possible identification during WRC-07 preparatory work:

- **410-430 MHz**
- **450-470 MHz**
- **470-862 MHz**
- 2.3-2.4 GHz
- 3.4-4.2 GHz
- 4.4-4.99 GHz.

All changes to the Radio Regulations resulting from WRC-07 are reported in the Final Acts of the World Radiocommunication Conference (WRC-2007) [1].The present document focuses on bands below 1 GHz only.

4.2 Outcome of WRC-07 for Mobile Service and IMT in the UHF band

4.2.1 Band 410-430 MHz

This band was not identified for IMT.

4.2.2 Band 450-470 MHz

This band is now allocated to Mobile Service and identified for IMT worldwide.

Nevertheless, it will not be used for IMT in the USA, Canada (as officially declared by these two countries at the end of WRC-07), and in some European countries.

The identification of the band 450-470 MHz received strong support from African countries during WRC-07.

4.2.3 Band 470-862 MHz

The future status of this band was lengthily discussed before and during WRC-07. Most discussions concentrated on Region 1 countries, with European Conference of Postal and Telecommunications Administrations (CEPT) evolving from a global opposition to a global support for an allocation to the Mobile Service (MS), coupled with an identification to IMT in the upper part of the band, from 790 to 862 MHz.

- **Region 1 (Europe, Africa, Middle East)**

  - A primary allocation to the Mobile Service (except aeronautical Mobile) is introduced in the Table of Allocations for the band 790-862 MHz; the allocation will come into effect from 17 June 2015 and will be valid for all Region 1 countries;

  - The Mobile Service was already allocated prior to WRC-07 in some Region 1 countries listed in footnote N° 5.316; this allocation remains valid and is not subject to the 2015 limitation. As it was introduced before the starting of discussions on Digital Dividend, this allocation gives no clear view about the intention of these countries to use the band for IMT or not. Nevertheless some of these countries (Denmark; Finland; Norway; The United Kingdom and Sweden) were very active in supporting the allocation and identification process. On the contrary some other countries like Portugal had difficulties with the identification for IMT due to potential conflict with their assignments for Digital Terrestrial TV under GE-06 Agreement;

  - Some other countries have expressed the wish to have the possibility to implement the Mobile Service allocation prior to 2015, at the date of the entry into force of the revised Radio Regulations (version 2008). For these countries a primary allocation to the Mobile Service has been provided in a new footnote N°5.316A.

  - The band 790-862 MHz is identified for IMT (Footnote N° 5.317A)

- Therefore there are three categories of Region 1 countries:
  - Those with an allocation to the MS prior to WRC-07
  - Those with an allocation to the MS starting as soon as possible after WRC-07;
  - Those with an allocation to the MS starting on 2015.

The situation is summarised in Table N°2.

Region 1 represents a relatively complex case in terms of sharing with other co-primary services:

- the implementation of MS is subject to agreement under Article N° 9.21 with respect to the aeronautical radio-navigation service in countries mentioned in Footnote N° 5.312; this would affect especially countries like Poland and Lithuania for which agreement of the Russian Federation is required before using frequency assignments in the Mobile Service;
- the band 470-862 MHz was planned for Digital Terrestrial TV at Regional Radiocommunications Conference-2006 (RRC-06) and the use of stations of the Mobile Service is subject to the successful application of the procedures of the Geneva 2006 (GE-06) Agreement. This obligation could be leveraged for European Union countries provided they reach an agreement on a harmonised (or quasi-harmonised) band for Mobile Service and provided that it would be possible to modify by multilateral or bilateral agreement the provisions of GE-06 (for instance by decreasing the number of Digital TV (DTV) multiplexes and/or re-arranging of the frequencies for the remaining multiplexes). Nevertheless in any case the provisions of GE-06 will fully apply with countries implementing the GE-06 Agreement without modification.

The situation is summarised in Table 2.

MS allocation prior to WRC-07 (5.316)	MS allocation effective from 2009 (5.316A)	MS allocation starting 2015 (Table of Allocations)
Europe: Germany ; Bosnia and Herzegovina ; Croatia ; Denmark ; Finland ; Greece; Fyrom; Liechtenstein; Monaco; Montenegro; Norway; the Netherlands; Portugal; The United Kingdom; Serbia; Sweden; Switzerland Spain; France; Malta (830-862 MHz only)	**Europe:** Lithuania; Poland; Georgia (806-862 MHz) Spain; France; Malta (790-830 MHz)	**Europe:** Albania; Andorra; Armenia; Austria; Azerbaijan; Belarus; Belgium; Bulgaria; Cyprus; Czech Republic; Estonia; Hungary; Iceland; Ireland; Italia; Latvia; Luxembourg; Romania; Russian Federation; Moldova; San Marino; Slovak Republic; Slovenia; Turkey; Ukraine, Vatican City;

Africa: Burkina Faso; Cameroon; Ivory Coast; Libya; Kenya; Mali; Gabon (830-862 MHz)	**Africa:** Angola; Benin; Botswana; Congo (Rep of); Gambia; Ghana; Guinea; Lesotho; Malawi; Morocco; Mauritania; Mozambique; Namibia; Niger; Uganda; Rwanda; Senegal; Sudan; South Africa; Swaziland; Tanzania, Chad; Togo; Zambia; Zimbabwe Gabon (790-830 MHz)	**Africa:** Algeria; Burundi; Central African Rep; Comoros Islands; Congo (Dem Rep of); Djibouti; Ethiopia; Eritrea; Guinea Bissau; Equatorial Guinea; Liberia; Madagascar; Malawi; Mauritius; Nigeria; Sao Tome & Principe; Seychelles Islands; Sierra Leone; Tunisia;
Middle East: Saudi Arabia; Egypt (note); Israel; Jordan; Syria;	**Middle East:** Bahrain; Kuwait; Lebanon; Oman; Qatar; Yemen	**Middle East:** Iraq; United Emirates

Table 2

Outcome of WRC-07 for the Region 1 countries

Note to Table 2: Egypt is counted as part of the Middle East.

- **Region 2:**
  - In Region 2 the band 698-806 MHz has been allocated to Mobile Service on a primary basis, except in Brazil where the allocation remains secondary.
  - The parts of the band 698-960 MHz in Region 2 which are allocated to MS on a primary basis are identified for IMT. Therefore this identification is valid for the sub-band 698-806 MHz in the whole Region 2, except in Brazil.
- **Region 3:**
  - In Region 3 the band 470-890 MHz was already allocated to Mobile Service on a primary basis;
  - As a conclusion of WRC-07 the parts of the band 790-960 MHz which are allocated to the MS on a primary basis are now identified in full for use by IMT.
  - In addition the band, or portion of the band, 698-806 MHz is identified for use by IMT in nine Region 3 countries: China; Japan; Rep of Korea; India; New Zealand;

Philippines, Bangladesh, Papua New Guinea and Singapore. In China the use of IMT will not start until 2015.

4.3 Conclusions and remarks

- WRC-07 represents a significant progress for the recognition of the possibility for the Mobile Service and IMT to use a part of the UHF band; the Conference was able to identify significant part of the UHF band for Mobile use;

- Nevertheless the allocation to the Mobile Service just gives a right for the countries where this allocation has been made to use the band for Mobile Service with more flexibility and less constraints than without this allocation. This does not mean that these countries have an obligation to implement such usage. At least in some countries, it could be seen as a conservative measure that lets open any alternative for the decisions which will be taken later on the use of the available spectrum for the Digital Dividend (e.g. Mobile TV; High Definition TV (HDTV); Mobile; Public Safety, etc….);

- **Conditions for compatibility with other primary services in the band 790-862 MHz in Region 1 and 3 have still to be investigated. This is planned under Agenda Item 1.17 of WRC-11. A specific International Telecommunications Union (ITU) Group, the JTG 5/6 has been created to prepare for this agenda item.**

  > "to consider the results of sharing studies between the mobile service and other services in the band 790-862 MHz in Regions 1 and 3 in accordance with Resolution [COM4/13] to ensure the adequate protection of services to which this frequency band is allocated and take action as appropriate".

This item refers mainly to the Aeronautical Radio-navigation Service and to the Broadcasting Service (even if for this last case at least in Region 1 provisions of the GE-06 Agreement apply).
CEPT will undertake its own studies on this issue in order to contribute to WRC-11 and to determine which constraints apply to the introduction of IMT in the band 790-862 MHz.

- A radio interface based on WiMAX technology has been included within the set of IMT-2000 technologies during the Radio Assembly RA-07 (October 2007) under the designation of OFDMA TDD WMAN, and is now included in Recommendation ITU-R M.1457-7 [40]. This designation is frequency agnostic and thus relevant for operation in the bands below 1 GHz.

5 Regional Situation

5.1 North America (NA)

North America is the only region where in some countries plans to use the Broadcast spectrum during and after transition from analogue to digital TV are still well defined, or at least planned:

- choice of a part of the spectrum and of relevant channels;

- types of use already considered, or even defined.

In the USA and to a less extent in Canada, these scenarios were defined well in advance of WRC-07. Therefore the results of WRC-07 will not affect the situation in these countries, and the allocation to the Mobile Service and identification for IMT is useful mainly for Caribbean and Latin America (CALA) countries.

The situation in Canada and the United States of America is developed in sub-sections 5.1.1 and 5.1.2 respectively. No information was available from Mexico, as expressed in section 5.1.3. Then conclusions are proposed in section 5.1.4.

6 MHz wide TV channels are defined for the UHF band in USA and Canada.

5.1.1 Canada

There may be three market opportunities for WiMAX systems in bands below 1 GHz in the Broadcasting Band and possibly also in traditional Cellular bands.

5.1.1.1 Opportunities in Broadcasting Band

(1) WiMAX technology for broadband public safety communications (TV Channels 63-64 & 68-69 / 764-776 MHz & 794-806 MHz):

Following a Public Consultation [2], a moratorium on further assignments for broadcasting on TV channels 63/68 has been decided and broadcasting usage of channels 63 and 68 has been cleared [3] [5]. Designation of channels 63 and 68 for broadband emergency communications has been effective in 2007. Due to interoperability requirements [6], these interoperability channels are not technologically neutral. As cross-border operation between Canada and the USA is in place, the same technology will be used in both countries.

WiMAX could be one possible candidate technology even though, today, only narrow band and wide band are defined. The possibility to extend the application to broadband is there and, when this happens, the harmonization between the US and Canada should be maintained.

Industry Canada indicated they would consult again on designating channels 64 and 69 for public safety.

In August 2007 the Federal Communications Commission (FCC) issued a Second Report and Order (FCC-07-137) [19] to change its public safety frequency plan to accommodate a requirement for broadband systems in the US. Having in mind that previously the US and Canadian band plans were aligned and the technical rules for equipment characteristics were largely harmonised, Industry Canada has issued in January 2008 Notice No. SMSE-004-08 [9] in which a new consultation on the frequency plan for public safety in the band 700 MHz was announced. By this consultation Industry Canada is seeking if the use of the bands 770-776 MHz (channel 64) and 800-806 MHz (channel 69) should be harmonised with the United States.

(2) WiMAX technology for restricted 'infill' use in rural/remote areas UHF of channels 2-59 (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-746 MHz)

Use of the UHF band for broadcasting is very small in sparsely populated areas like Northern Canada. There are plans to use the unused channels for Wireless Access in these areas [5]. Taking into account the need to protect Broadcasting Service, this use could be **restricted to Fixed Wireless Access only.**

Taking into account the non scarcity of the resources in this case, spectrum is delivered to candidate operators on a first come-first served basis.

The licensing conditions for such usage in TV channels 21 to 51 (band 512- 698 MHz) are covered in [8], published March 2007. The main characteristics of the licenses in terms of spectrum usage will be:

- the assignment of 6 MHz blocks with upper and lower limits aligned with the limits of TV channels;
- the assignment of a maximum of two 6 MHz blocks to FDD systems, and of a maximum of one 6 MHz block to TDD systems;
- the definition of preferred channels: channels 43 (644-650 MHz); 35 (596-602 MHz); 34 (590-596 MHz) and 25 (536-542 MHz);
- the possibility to assign other channels within channels 21 to 51 (except channel 37 – 608-614 MHz) where necessary
- Within 400 km from the US border, authorization is provided on a no interference/no protection basis with respect to the Broadcast service in the United States
- Systems will only be authorized for applications at a minimum distance of 121 km from the Canada / US border.

(3) WIMAX technology for unrestricted use in 'digital dividend' UHF channels 52-69 (698 – 806 MHz, excluding emergency channels)

Fixed and Mobile Services have been raised a primary status in the Radio Regulations for Canada in frequency bands 470-512 MHz and 614-806 MHz by RR footnote 5.293.

Industry Canada intends to harmonize the use of television channels 60 to 69 (746 – 806MHz) with the United States, for public safety and commercial mobile usages. The band 746-806 MHz has already been allocated to Mobile Service in the Canadian Frequency Table [4]. Nevertheless the introduction of commercial mobile services in these channels is not yet scheduled.

Channels 52 – 59 (698-746 MHz) may also be subject to such introduction, as anticipated in footnote 5.293. Nevertheless this has not yet been translated into the Canadian Table.

It has also to be noted that, despite the request of the Wireless Access industry for a Fixed Service allocation, only Mobile Service allocation has been added in the Canadian Table. Therefore "it may not be possible to implement fixed and possibly, nomadic applications of BWA in the band 746-806 MHz".

In conclusion:

- there are short term opportunities for WiMAX technology in Canada, either for Public Safety in dedicated channels (as designated technology), or for fixed wireless access in the band 398-746 MHz in remote areas.
- at longer term there may be a possibility to implement WiMAX technology in the band 746-806 MHz, except in channels 63-64 and 68-69.

- with regard to the current allocations in [4], and also taking into account the possibility to use this band for FWA in remote areas, the use of the sub-band 698-746 MHz for service neutral BWA seems more problematic.

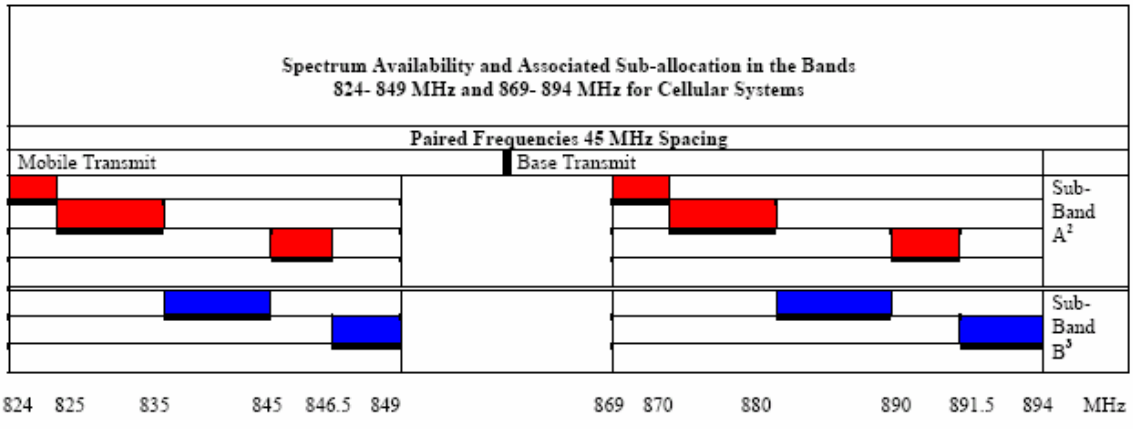
5.1.1.2 Opportunities in Mobile Cellular bands

Industry Canada published SRSP-503, Issue 6 (June 2003) "Technical Requirements for Cellular Radiotelephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz". [7]. This SRSP is technology neutral and supports analogue cellular systems and digital systems based on different technology platforms (e.g. TDMA, CDMA, GSM) as well as Cellular Digital Packet Data (CDPD). See Figure N° 1. New technologies can be introduced into cellular spectrum provided that the following provisions are observed:

- Out-of-band emission limits are specified in RSS-118, 128, 129 and 132
- Co-existence of systems operating in the same sub-bands
- Co-existence of systems operating in adjacent sub-bands.

Figure N° 1

Bands 824-849 MHz and 869-894 MHz in Canada



the legacy situation may in practice restrict the neutrality to FDD technologies only.

5.1.2 United States

5.1.2.1 The present situation

The FCC has identified Lower 700 MHz and Upper 700 MHz bands for Public Safety or commercial use, depending on the TV channel:

- Lower 700 MHz (L700) 698-746 MHz Channels 52 to 59
- Upper 700 MHz (U700) 746-806 MHz Channels 60 to –69

The equivalent of four TV channels, representing a total of 24 MHz, are identified for Public Safety in the Upper 700 MHz band [10]; [11]; [12]; [19]; [20].

The other parts of the 700 MHz Lower and Upper bands, except parts of them which are dedicated to guard band with Public Safety channels, are dedicated to commercial use. Some channels have been already assigned to operators prior to Auction 73 in January 2008.

A total of five 6 MHz channels remained available for auction in the Lower 700 MHz band. In the Upper 700 MHz band, a band of 22 MHz, divided in several blocks, was available.

This remaining spectrum has been subject in January 2008 to Auction 73.

The detailed repartition between commercial and public safety assignments, resulting from the Second Report and Order FCC 07-132[19] defining the services rules for the bands 698-746, 747-762 and 777-792 MHz and the subsequent Public Notice DA07-345 [20] from August 17, 2007, is presented in Figures 2 and 3 hereafter.

The main requirements for the use of the band, as summarised in FCC News from July 31, 2007, are presented below (extracts from FCC News, July 31, 2007).

700 MHz Band Plan

- Under the new band plan, additional 62 MHz of spectrum, divided into five spectrum blocks, have been auctioned for commercial uses in January 2008;.
- The commercial spectrum has been made available at auction in a mix of geographic area sizes, including Cellular Market Areas (CMAs), Economic Areas (EAs), and Regional Economic Area Groupings (REAGs);
- The 10 MHz Upper D Block will be licensed on a nationwide basis and will become part of a 700 MHz Public Safety/Private Partnership;
- Within the 24 MHz of public safety spectrum, the public safety wideband spectrum is being re-designated for broadband use to allow for nationwide interoperable broadband communications by public safety users;
- The public safety broadband spectrum is placed in a 10 MHz block at the bottom of this band and the existing public safety narrowband spectrum is consolidated in a 12 MHz block at the top of the band. Internal guard bands are placed in between the broadband and narrowband segments;
- There will be a single, nationwide license for the public safety broadband spectrum, assigned to a Public Safety Broadband Licensee, which will work with the adjacent commercial D Block licensee as part of the 700 MHz Public Safety/Private Partnership;
- The Public Safety Band is shifted by downward by one megahertz from 764-776/794-806 MHz to 763-775/793-805 MHz in order to protect public safety narrowband operations in the Canadian border areas;
- To accommodate the shift in the Public Safety Band, the Guard Band A Block is being relocated to a new location between the Upper C and D Blocks, and, to further protect the public safety narrowband operations from potential interference, the Guard Band B Block is being placed above the narrowband block at the top of the 700 MHz Band.

Public Safety/Private Partnership

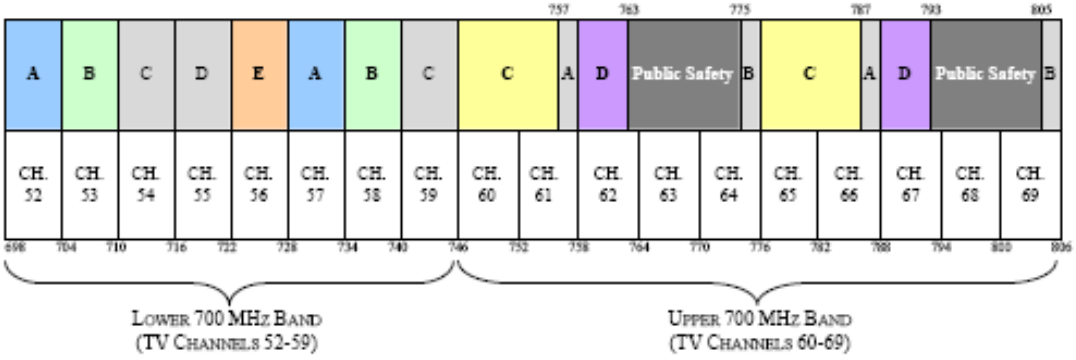
- The Upper D Block commercial licensee and the Public Safety Broadband Licensee will form a Public Safety/Private Partnership to develop a shared, nationwide interoperable network for both commercial and public safety users;

- The terms of the Partnership are governed both by FCC rules and by the details of the Network Sharing Agreement (NSA) to be negotiated by the Upper D Block commercial licensee and the Public Safety Broadband Licensee. The NSA is subject to FCC approval, and must contain certain provisions such as service fees and a detailed build-out schedule for the network.

Open Platform

- The licensees of the Upper 700 MHz Band C Block of spectrum will be required to provide a platform that is more open to devices and applications. This would allow consumers to use the handset of their choice and download and use the applications of their choice in this spectrum block, subject to certain reasonable network management conditions that allow the licensee to protect the network from harm

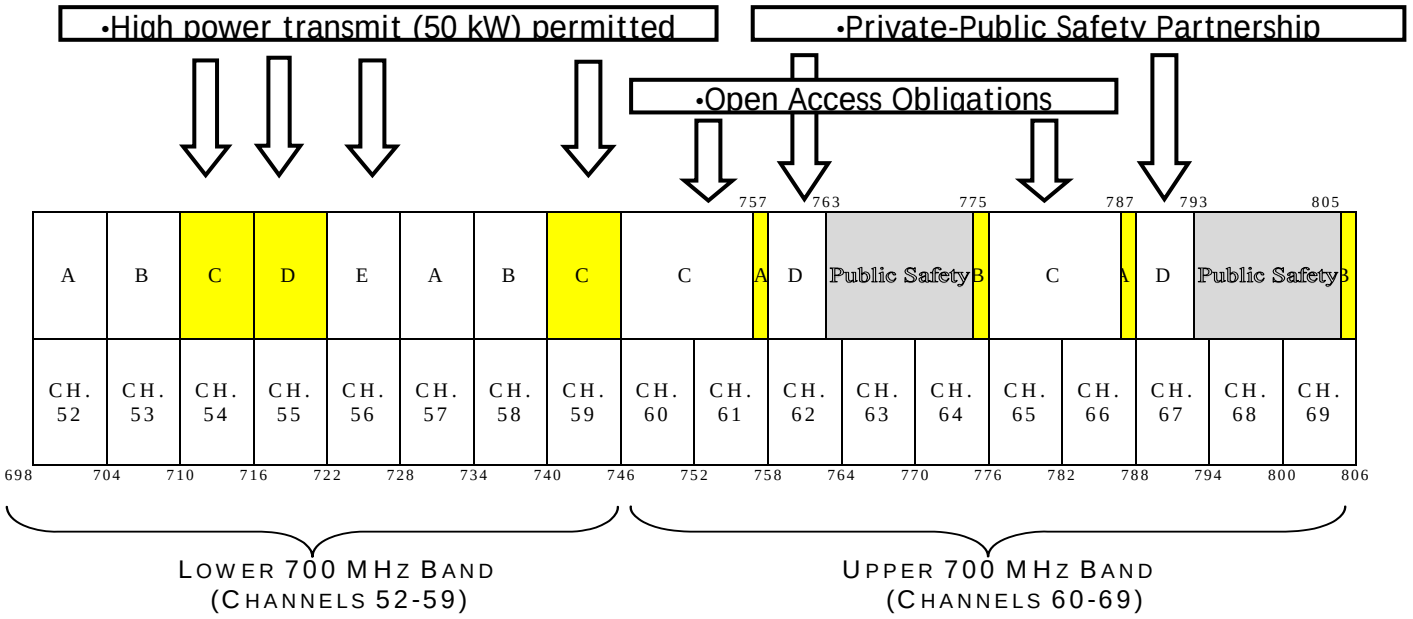
Figure N° 2
Revised 700 MHz plan for commercial services in the USA



Block	Frequencies (MHz)	Bandwidth	Pairing	Area Type	Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	EA	176
B	704-710, 734-740	12 MHz	2 x 6 MHz	CMA	734
C	710-716, 740-746	12 MHz	2 x 6 MHz	CMA	734
D	716-722	6 MHz	unpaired	EAG	6
E	722-728	6 MHz	unpaired	EA	176
C	746-757, 776-787	22 MHz	2 x 11 MHz	REAG	12
A	757-758, 787-788	2 MHz	2 x 1 MHz	MEA	52
D	758-763, 788-793	10 MHz	2 x 5 MHz	Nationwide	1 *
B	775-776, 805-806	2 MHz	2 x 1 MHz	MEA	52

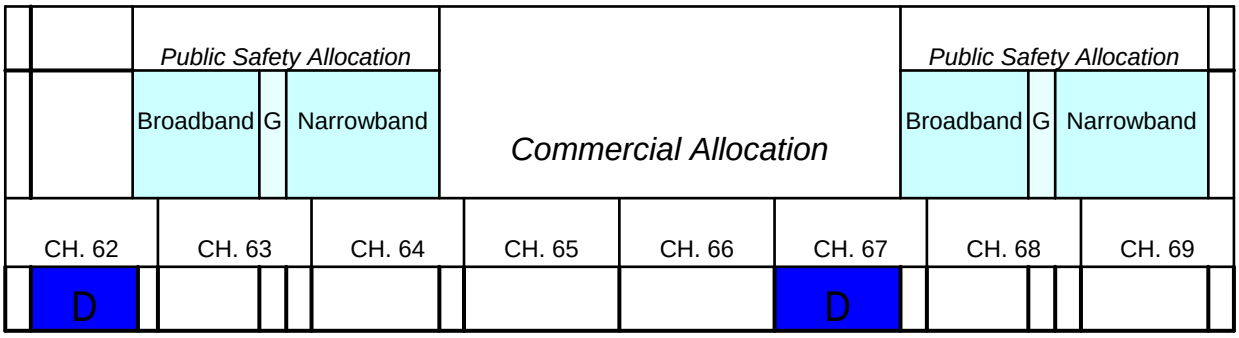
* Subject to conditions respecting a public/private partnership.

The blocks shaded above in gray (Lower 700 MHz Band C and D Blocks and Upper 700 MHz Band A and B Blocks) were auctioned prior to Auction 73.



Note: EA: Economic Area
EAG: Economic Area Grouping
CMA: Census metropolitan Area
MEA: Major Economic Area
REAG: Regional Economic Area Grouping

Figure N° 3
Revised 700 MHz plan for Public Safety services



The use of the 700 MHz in the US was subject to considerable amount of activity during the last years. The definitive rules for use of the parts of the band which had not been assigned before were established in August 2007. Detailed description of some aspects of his consultation process is provided in the next section.

5.1.2.2 FCC consultations on the 700 MHz band

The FCC launched several consultations in order to review the different aspects of the use of the UHF band for the introduction of commercial and public safety applications: [12]; [14]; [15]; [16]; [17]; [18].

In 2006 three NPRM processes and one Public Notice dealing with the use of the 700 MHz band were edited.

(a) proposals to modify the 700 MHz Public Safety spectrum in order to accommodate Broadband Communications (2006/03/17) [11];[12]

(b) proposals on possible modifications to the rules governing wireless licences in portions of the 700 MHz spectrum band (2006/08/03) [14]; [15]

(c) proposals on possible modifications to rules governing the 700 MHz guard band licensees (2006/09/08)

(d) projected schedule for proceeding on unlicensed operation in the TV Broadcast bands (2006/09/11)

In addition a proposal to share the “commercial” band in the Upper 700 MHz band between commercial and public safety applications has been issued. This is known as the “Cyren Call proposal”.

The use of the 700 MHz was finally fixed in mid-2007 after the FCC published a second Report and Order [19] and Public Notice [20]. These two documents defined the rules governing the blocks which had not been assigned before and the detailed rules for Option 73 on January 2008.

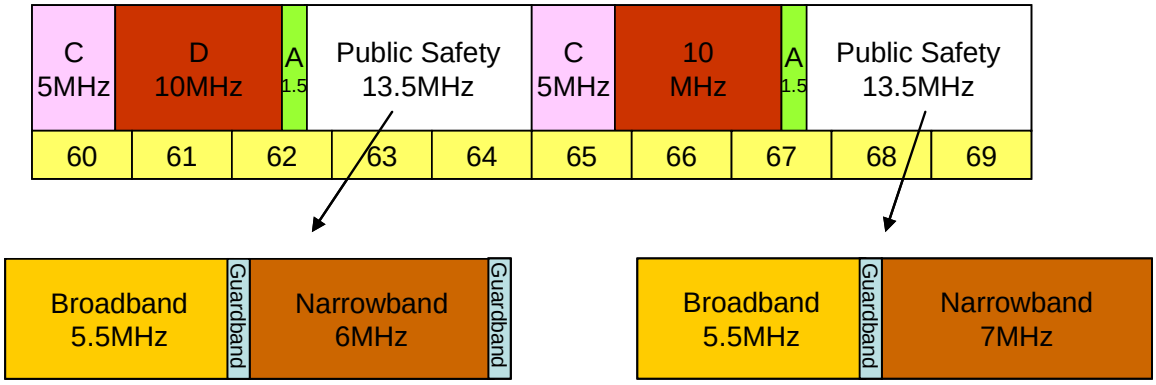
(a) Public Safety applications

The WiMAX Forum has developed Reply Comments to FCC supporting technology neutral approaches and proposals that expand rather than limit deployment options for public safety. More specifically the WiMAX Forum pointed out a proposal jointly filed by several companies (Access Spectrum, Columbia Capital, Intel and Pegasus Communications), which, from its point-of-view, provides the best opportunity for broadband deployment for public safety agencies. This proposal (called “the 4th proposal” in the WiMAX reply comment, and “optimisation plan“ by the authors):

- accommodates the greatest breadth of current and future technology choice;
- enables the greatest range of future applications by allocating the largest contiguous spectrum block;
- gives the greatest range of technology choices to the public safety regional planning committees in determining how to partition their bandwidth versus technology;
- facilitates potential future partnerships between public safety and commercial broadband applications through adjacent location of their contiguous spectrum blocks.

This proposal also proposes some refarming of the external guard band between Public Safety and Commercial spectrum (A blocks, narrowed from 2 to 1.5 MHz), which in principle is subject to the FCC inquiry (c).

Figure N° 4
"Optimisation Plan" or "4th proposal" proposed to the FCC



(b) Rules concerning licences in the 700 MHz band:

The consultation addressed several points of relevance either for the already auctioned spectrum, or for the parts which remain to be auctioned, inter alia:

the size of Service Areas: for not yet assigned spectrum service areas were defined as EAG (Economic Area Groupings); the FCC seeks comment on whether technology or commercial factors have changed since the original 700 MHz rules were established that would justify service area sizes other than EAGs, either larger (i.e. nationwide) or smaller (Cellular Market Areas);

- the size of spectrum blocks, including proposals on possible splitting or aggregation and size of the existing blocks;
- how to facilitate access to the spectrum (including the level of required service level
- the characteristics of the secondary market;
- the criteria for renewal (e.g. to clarify or modify the requirements and procedures of the renewal process for licenses in the 700 MHz band);
- the length of license terms
- the power limits (currently 1 kW ERP in Upper 700 MHz and 50 kW ERP in the Lower 700 MHz)

The FCC finally released a Second Report and Order on August 10, 2007 defining the service rules for the parts of the 700 MHz band not yet auctioned and then published a Public Notice on August 17, 2007 where the procedures and timing for the auctions were defined. Auctions for the remaining blocks took place on January 16, 2008. See a summary of this final proposal in Figures 2 and 3 above.

The Cyren Call proposal

It consists of establishing a Public Safety Broadband Trust (PSBT) to hold the license for the 30 MHz (6 5 MHz) commercial spectrum, and to share its use between public safety and commercial usage, with priority to public safety.

This would guarantee access to the spectrum to private sector entities that would agree to maintain the nationwide public safety next generation network. In return they would be allowed to sell excess capacity for commercial usages.

(c) Rules concerning guard band licenses in the band 700 MHz

See (a) above and [16].

(d) Use of white spaces

On May 2004 the FCC adopted a NPRM proposing to allow operation of unlicensed devices on TV channels that are unused at any given location. This public notice establishes a schedule for resolving outstanding issues in that proceeding so that unlicensed devices designed to operate on unused TV frequencies may be placed on the market with the completion of the DTV transition.

The Notice proposed to require that fixed unlicensed devices incorporate a geo-location method such as GPS or be professionally installed, and that they access a database to identify vacant channels at their location. It proposed to require that portable unlicensed devices operate only when they receive a control signal from a source such as an FM or TV station that identifies the vacant TV channels in that particular area. The Commission also sought comment on the use of spectrum sensing to identify vacant TV channels, but did not propose any specific technical requirements for devices that use spectrum sensing.

The record before the Commission does not contain sufficient information to adopt final technical rules for operation of unlicensed devices in the TV bands. Accordingly, the Office of Engineering and Technology is developing a First Report and Order and Further Notice of Proposed Rule Making that would make initial decisions and specific technical proposals necessary to adopt complete and final rules, taking into the account the comments received in response to the May 2004 Notice.

The Commission staff has developed the following schedule of actions in this proceeding [17]; [18].

Projected Date	Milestone

October 2006	Commission adopts a First Report and Order and Further Notice of Proposed Rule Making
December 2007	FCC Laboratory begins accepting applications for certification of unlicensed devices operating in the TV bands; certification will be granted at such time as the application has been reviewed and found to comply with the rules; certification will permit manufacture and shipment of products to distribution points

Therefore the rules for proceeding in TV Broadcast unused spectrum are still unclear.

It has to be noted that the situation in the USA is quite different from Canada: in this latter country there are areas where it is expected that spectrum will never be used for broadcasting applications. This is not the case in the USA where, even if spectrum is not currently used, it may change in the future. Then the spectrum may be unlicensed but additional features like listen before talk, etc. may be requested to protect possible future TV usages.

5.1.3 Mexico

No specific information is available for this country.

5.1.4 Conclusion: 0pportunities in the USA and Canada

There are clear commonalities in the USA and Canada situations.

In both cases the following applications are planned:

- Public Safety operation with some channels common to both countries;
- Dedication of channels for commercial use; even if Canada has not yet initiated concrete actions to free these channels as the USA did, same channels are targeted in both countries, ie channel range 52 to 67 (with exclusion of Public Safety channels 63-64) corresponding to the band 698-790 MHz, in both cases split in:
    - an Upper 700 MHz band : 746-790 MHz:
    - Lower 700 MHz band: 698-746 MHz
- Possible use of all the other TV channels where DTV is planned,
    - either on a licensed basis in Canada where there are no plans to use them in several areas with very dispersed population;
    - on an unlicensed basis in the USA, together with technical means to avoid interference, like positioning and spectrum sensing.

Therefore there are clear opportunities for the implementation of WiMAX technology in bands below 1 GHz in North America.

The main conclusions which would result for WiMAX technology from the consideration of the developments for the North American market are:

- **to focus in the band 698-806 MHz ;**
- **to be able to address both commercial and vertical markets like broadband public safety;**

The use for Public Access would require specific features like for instance the capability to manage emergency calls.

In addition there may be opportunities in the other broadcast channels, starting from Channel 2 (398 MHz), which could be used in some cases in both countries. Nevertheless the interest of these opportunities has to be considered with regard to:

- the additional features which need to be implemented for unlicensed use; are they compatible with developments in IEEE 802.16
- the additional cost which could result from a very large tuning range for equipment,
- Other considerations.

5.2 Europe

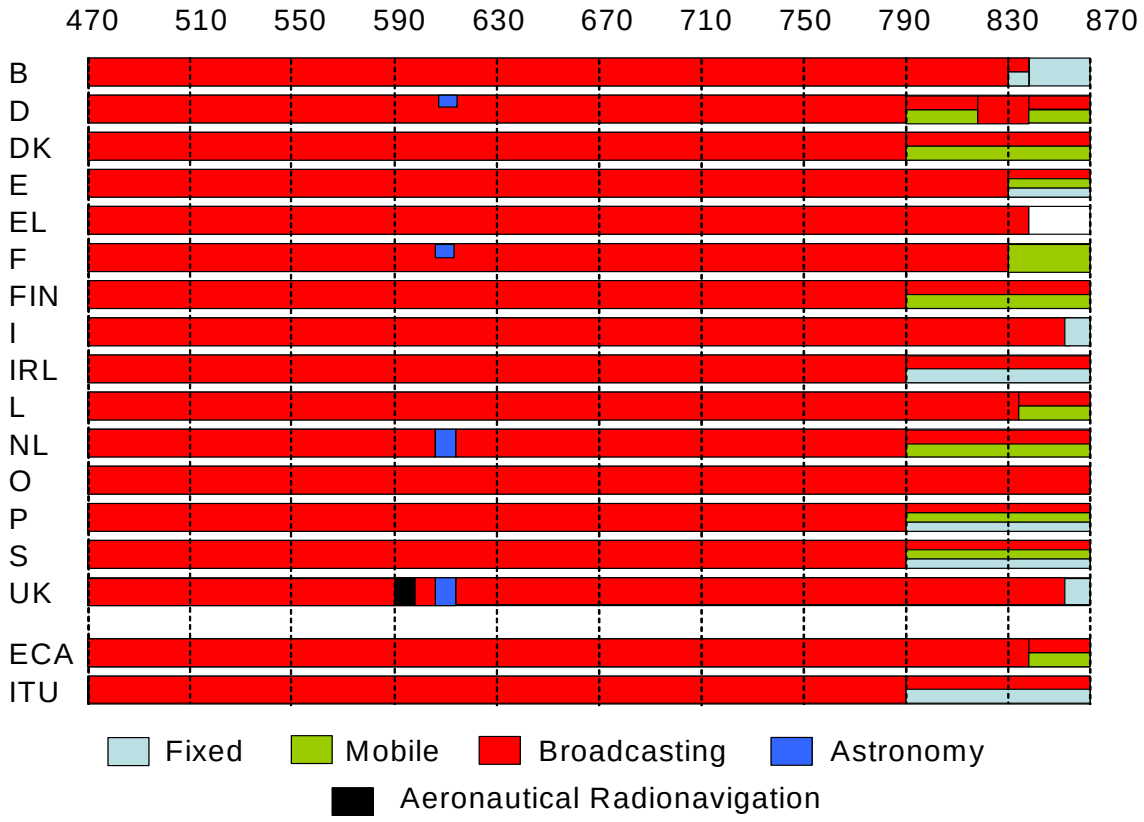
5.2.1 Introduction

The UHF band is widely used in Europe by Broadcast Services as could be seen for several Western European countries in Table 3, which describes frequency allocations in several Western Europe countries prior to WRC-07.

The currently recommended usages of the band at a European level are reported in the ECA (European Common Allocation) table contained in ERC Report 25 [43].

It appears from this table that spectrum from 470 MHz up to 790 MHz is currently generally for Analogue TV Broadcasting in each mentioned Western European country. Above this frequency usages are more specific of each country.

Table N° 3:
Current UHF Band Allocations in Western Europe



Europe is actively involved in the process of the transition from Analogue TV to Digital TV. Terrestrial Digital TV services have been already initiated in most European countries.

Nevertheless the planning for the completion of the switchover varies considerably from a country to another one, and, in each country, the process could be at very different steps in different geographical areas. Although the switchover is already achieved in some areas, full completion in CEPT is planned in 2012/2015 only, and in 2012 in European Union Member States.

CEPT proposed a date of 2012 to RRC-06, with the objective to obtain a date as close as possible to this targeted date. Africa initially proposed 2020 and Arab countries dates from 2012 to 2025. RRC-06 decided to retain a single date for all participants, and agreement was found on 2015.

Even if several European countries have reached a high degree of urbanisation, there are some opportunities for WiMAX technology in bands below 1 GHz:

- in Western Europe, in some countries with large area like France, Spain, Nordic countries, or in some parts of other countries (for instance Scotland in the UK);

- more generally in Eastern Europe, with a more important ratio of rural population and less deserved areas;
- the excellent properties of in-building penetration of the UHF band also provide opportunity for use in urban areas.

The discussions on Digital-TV implementation and possible Digital Dividend in Europe take place at three interacting levels:

- International level: RRC-06 / ITU-R;
- European level: European Commission; CEPT;
- National level.

(1) International level

Together with the other ITU-R Region 1 areas (Africa, Middle East) and Iran (belonging to Region 3), Europe was involved in Regional Radiocommunications Conferences 2004 & 2006 for the terrestrial Digital Radio and TV planning exercise.

This resulted in planning the whole bands 174-230 MHz (Band III) and 470-862 MHz (Bands IV and V) for these usages, as reflected in the Final Acts of RRC-06 [21], and in the Geneva-2006 Agreement [22] included in these Acts.

Nevertheless CEPT countries presented a European Common Proposal (ECP) [23] to RRC-06 allowing flexibility to introduce alternative terrestrial applications within the Plan.

In addition, CEPT countries signed an internal agreement [24] on flexibility taking into account the results of the Conference. It should be noted that at this stage these documents do not provide information on specific applications of the Dividend.

The band 470-862 MHz was also identified as one of the candidate bands at WRC-07 for the introduction of IMT solutions. CEPT preparation resulted in the preparation of a European Common Position (ECP) in favour of deferring this item to WRC-11, recognizing the possibility to check for earlier introduction through a European regional process. Nevertheless this position evolved during the Conference itself in the direction of the identification of the sub-band 790-862 MHz for IMT and its allocation to Mobile Service. The entry in force of these provisions are delayed to 2015 but possibility was let to specific countries for an earlier allocation / identification process.

Taking into account that completion of switchover in the EU is planned for 2012, Mobile Service may more likely start in 2012 but the date of 2015 was chosen consistently with the schedule planned in GE-06.

(2) European level

Up to now CEPT countries have not adopted a harmonised approach for the assignment of the digital dividend. It is sometimes even questioned if such a dividend exists. Nevertheless, for European Union Members the European Commission has taken an initiative to “harmonise” as far as possible the way by which Member States will consider this Dividend. This initiative resulted in “Radio Spectrum Policy Group (RSPG) Opinions” which then resulted in more concrete activities led by the European Commission in co-ordination with CEPT.

Parts of these activities will also be undertaken under another Commission initiative known as WAPECS (Wireless Access Policy for Electronic Communications Systems).

The European Commission has now provided Mandates to the CEPT to prepare Reports on both Digital Dividend and WAPECS.

The possible future usages of the band 470-862 MHz are under discussion within CEPT under these two Mandates.

In parallel the European Commission has recently published, on 13th November 2007 - together with a package for the revision of the European Regulatory Framework for Electronic Communications - a Communication to the European Parliament and the Council [30], in which a harmonised approach for the Digital Dividend in the EU is submitted to the political instances.

The document proposes a cluster approach, with basically three clusters, for DTV, Mobile TV and Mobile Communications respectively. Some freedom would be let to the Member States for the implementation of these clusters but it may be mandatory to implement each of them.

Mobile TV and Mobile Communications clusters would be submitted to some degree of soft harmonisation, where Member Sates would be free to reserve additional spectrum for national Digital Dividend within the DTV cluster – this may include Public Safety applications.

(3) National level

In each country a process has been undertaken to review and define the possibility for a Digital Dividend. This process is generally co-ordinated by high level political authorities. It is clear that the status of this process is very heterogeneous, from countries where basically nothing has been undertaken, to those where precise assumptions on DD amount have been provided.

See Table 5 for an overview of the different national approaches.

5.2.2 The Digital Dividend process

There are different possible interpretations of the term “Digital Dividend”, which is sometimes understood with different meanings. The final definition will probably include all usages which will not strictly result from the switchover from analogue to digital TV:

- Broadcasting applications like higher number of programmes, extended coverage areas, local television, HDTV, mobile or portable reception, data broadcasting, enhanced TV
- Electronic communications, like Mobile Telephony/ Broadband, Broadband Access, services ancillary to broadcasting, licence exempt applications
- Security uses, like military communications, Public Protection and Disaster Relief (PPDR)

With this definition, there will be some Digital Dividend in any case, but there is no guarantee that it would be made available to non-broadcasting applications.

5.2.2.1 Analogue to Digital TV switchover

At the end of the switchover process, the assignments or allotments to the different DTV multiplexes will in principle be those described in the Plan.

Nevertheless specific arrangements will need to be agreed between the different countries during the transition period to take into account the remaining analogue TV stations. Therefore assignments to a given multiplex during the transition period would not necessarily correspond to the frequencies finally assigned to it.

This will make difficult to implement on a broad basis the Digital Dividend during this transition period.

5.2.2.2 Candidate applications to the Dividend

Several applications have been identified as possible candidates for the use of the Digital Dividend, like for instance:

- DVB-T / HDTV: TV channels with standard quality and/or HDTV channels, local channels could be provided in addition to the amount of channels that can be offered by analogue TV ;
- DVB-H: several Broadcasters and Mobile Operators develop projects to deliver Mobile TV services.
- 3G rural: the UHF band is considered by several Mobile Operators and the UMTS Forum as a unique opportunity to ensure a global coverage for 3G solutions.
- WiMAX rural: this is analysed in this white paper;
- Public Safety: several government institutions and the public safety industry are considering the UHF band for these applications.

5.2.3 Outcome of the Regional Radiocommunications Conference-2006 (RRC-2006)

5.2.3.1 Outcome of RRC-06

RRC-06 has generally been considered successful, at least from its dedicated task point-of-view. The RRC-06 has planned the whole spectrum under its Mandate for Digital-Radio or Digital TV. Therefore the whole band 470-862 MHz is planned or Digital TV.

The result of this planning exercise is known as the Geneva-06 Agreement (GE-2006) [22].

5.2.3.2 How to implement flexibility in the GE-2006 Plan

A European Common Proposal (ECP) [23] prepared by CEPT as input to the Conference provides some ways to implement a flexible use in the Plan using an entry to the Plan.

The proposal is based on a spectral power density approach and ensures that alternative terrestrial applications could operate under the envelope of a digital broadcasting entry in the Plan provided it does not create more interference to, and does not claim more protection from the other entries in the Plan than would be afforded to the digital broadcasting assignment ., as precisely described in the relevant part of the ECP:

"EUR/7A6/1

The use of alternative terrestrial applications operating under the envelope of a digital broadcasting entry in the Plan is possible providing that:

- ***the peak power density in any 4 kHz shall not exceed the spectral power density in the same 4 kHz of the notified digital broadcasting assignment;***
- ***the alternative terrestrial application shall not claim more protection than would be afforded to the digital broadcasting assignment;***
- ***the application of the spectral power density approach shall only be based on notified digital broadcasting assignments."***

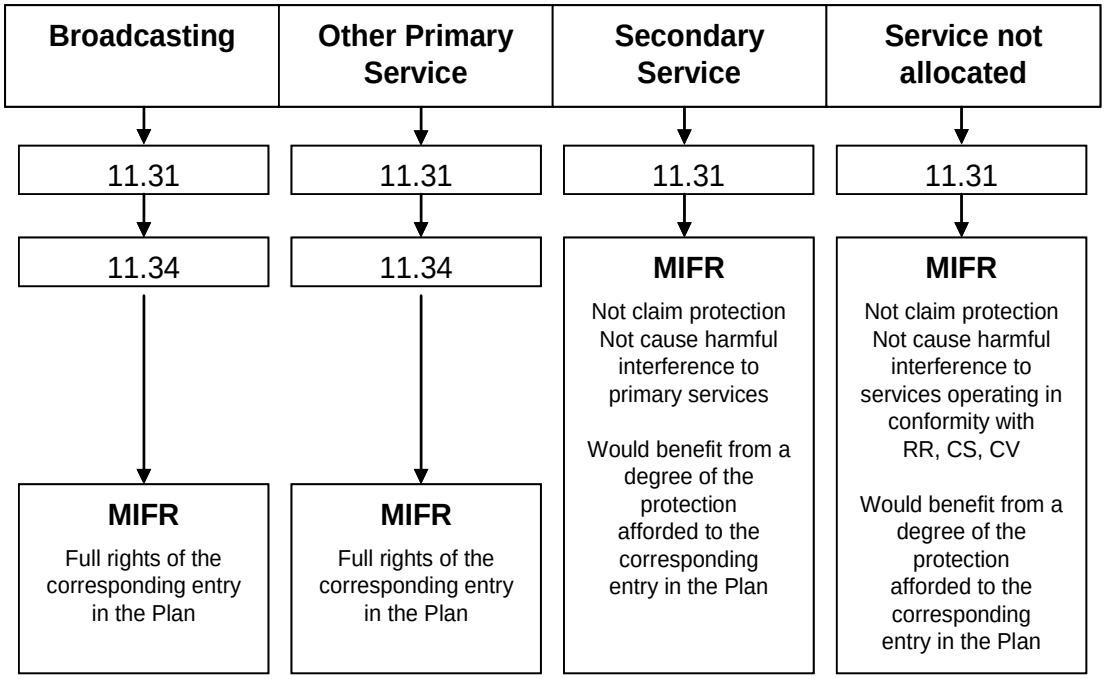
In principle this approach does not need further harmonisation between the different countries.

On this basis CEPT countries continued to check on flexibility issues in parallel discussions during RRC-06, in order to update the ECP and to take into account the outcomes of the Conference. This resulted in a document "Flexibility and the Transition Period at RRC-06" [23] which listed the different regulatory scenarios which could happen when implementing flexibility.

This is summarised in the following flow chart (Figure N° 5).

Figure N° 5

Flowchart of the regulatory procedures applicable for the use of entries in the Plan for other applications/systems



5.2.3.3 Limits of this approach

It appears to be difficult to implement with this approach applications requiring bi-directional transmission, and especially nomadic and mobile applications where the position of the terminals is not specified within the service area. The concept of mask to be fulfilled in any location outside the service area of a given operator is quite rigid, and may be quite impossible to implement for up-link transmissions of a Mobile/BWA operator.

In addition, taking into account that the frequencies assigned by the Plan to a given multiplex will in practice cover the whole frequency range (in practice the whole bands IV and V) it will impose, if alternative applications are simply substituted to unimplemented DTV multiplexes, equipment would have to implement the whole band 470-862 MHz as a tuning range.

Therefore this approach is certainly more adapted to applications coming from the Broadcasting world than to applications like Broadband Wireless Access or Cellular Mobile.

For this reason an alternative approach has been discussed within the Radio Spectrum Policy Group (RSPG) of the European Commission and resulted in the following proposal:

- Allocation in Region 1 to the Mobile Service (and possibly Fixed Service) with a primary status at WRC-07 in the whole 470-862 MHz band;
- Possible identification of sub-bands between WRC-07 and WRC-11, with the potential debate on possible identification of part or whole of this spectrum to IMT;
- Possibly proposal by CEPT of a new RRC (for instance in 2012) to review and modify the Plan for DTV assignments/allotments. This is a heavy process which may not be well considered by African and Arab countries which were also involved in RRC-06.

The two first points resulted in proposals for an ECP for the Agenda Item 1.4 of the WRC-07 in November 2007.

Nevertheless several CEPT Administrations were in practice very reluctant for such pro-active approach and proposed as an alternative to defer the decisions on an allocation to Mobile Service in the band 470-862 MHz to WRC-11, with only a WRC-07 Resolution for studies towards a primary allocation to Mobile Service as output of WRC-07. This more cautious approach finally received support from a majority of Administrations during the CEPT process for the preparation of WRC-07.

It was finally abandoned during the Conference itself, taking into account the more pro-active approach adopted by other regional organisations, like the Inter-American Telecommunication Commission (CITEL) and African Telecommunications Union (ATU), and it was finally possible to allocate to MS and to identify for IMT the sub-band 790-862 MHz, either starting on 2015, or sooner, depending on countries.

5.2.4 The European Commission initiatives

European Commission took several initiatives in the domain of spectrum which would affect directly the Digital Dividend. These initiatives were launched by either the RSPG or the Radio Spectrum Committee (RSC).

- The Wireless Access Policy for Electronic Communications Systems (**WAPECS**) initiative. Some frequency bands have been listed as potential WAPECS bands; the list includes all 2G/3G cellular mobile bands, BWA bands and Broadcasting band

470-862 MHz. The purpose of WAPECS includes to check how these bands could be made flexible in their use (from the point-of-view of technology and usage mode). The EU has requested by a Mandate the CEPT to provide a detailed report for each of the targeted bands. Electronic Communications Committee Working Group on Spectrum Engineering (ECC WG SE) created a Project Team ECC SE 42 to work on technical issues. This resulted in CEPT Report 19 [35], which, due to parallel activities on the UHF band in other CEPT Groups, just presented a summary of the on-going activity in the UHF band

- The RSPG activity on the **Digital Dividend:**
  - RSPG has adopted Opinions on "Spectrum implications of the switchover to digital broadcasting" (2004, Nov 23) [27] and "Spectrum for mobile multimedia services in the field of broadcasting" (mid-2006) [26]. This last opinion includes, but not exclusively, in its scope the broadcasting band below 1 GHz;
  - RSPG has adopted in October 2006 a draft Opinion on "EU spectrum policy implications of the Digital Dividend" [25] which will cover all potential applications of the Digital Dividend and recommend a coordinated approach between Member States. This could further result in the identification of specific piece of spectrum for the Digital Dividend. This draft Opinion was submitted to a Public Consultation up to mid-December 2006, with various responses from Telecommunications and Broadcasting Industries.

During the internal consultation made by RSPG towards Administrations some of them have identified the possibility to allow non-broadcasting applications within the Digital Dividend. Some Administrations have indicated discussions and/or consultations are on-going or planned.

- Following these results RSC has prepared a Mandate on the Digital Dividend to the CEPT. In response the CEPT has created a dedicated Group, ECC Task Group 4 (ECC TG4), which has for Mandate to take into consideration all aspects of the Digital Dividend and prepare a Report to the Commission.

In conclusion two Mandates are on-going which deal with the band 470-862 MHz:

- a Mandate on WAPECS
- a Mandate on the Digital Dividend

CEPT has prepared Reports in response to these Mandates. The deadline for these Reports was initially fixed to mid-2007 by the European Commission but some delay was finally agreed for some of them. In addition it is currently examined if further Mandates , would be given to achieve the considerable amount of relevant studies, and to reach consensual positions.

CEPT Report on WAPECS concentrated mainly on bands 3.4-3.8 GHz and 2.5-2.7 GHz. Due to the parallel work on Digital Dividend within ECC TG4, PT SE42 was not able to consider in details the UHF band in its response to the Mandate on WAPECS, but only indicated that the methodologies presented in the Report for the implementation of WAPECS would also apply to the UHF Band.

Further activity of PT SE42 on a possible continuation o the WAPECS Mandate, including studies for the UHF band may be decided, depending on Commission appreciation of the best way o implement the digital dividend and WAPECS applications in the UHF band.

ECC TG4 has prepared a first Report (Report A [31]) to the Commission focusing on the introduction of Mobile TV and on the possibility to dedicate a harmonised sub-band, taking into account the constraints resulting from Geneva 2006 (GE-06) Agreement. A second Report (Report B [32]) focusing on the introduction of Mobile technologies has also been prepared. This Report concluded on the following points:

- the definition of a specific sub-band for Mobile Service systems is possible;
- this sub-band should not be subject to mandatory harmonisation;
- this sub-band should be located at the upper part of the broadcasting UHF band and should include at least channels 62-69 (798-862 MHz)
- these conclusions shall not influence the choice by the ECC Conference Preparatory Group (CPG) of Option B2 (i.e. no allocation to the MS and no identification of a specific sub-band at WRC-07)

Examples of possible frequency arrangements in the band 790-862 MHz have been provided in a supplement to Report B [33] approved by ECC in December 2007. These examples illustrate different approaches that could be envisaged and also which solutions could be implemented to take into account that the band identified for Mobile Service applications may probably not be fully harmonised in Europe. Examples of these arrangements are provided in the supplement to Report B [33].

The definition of frequency arrangement will be undertaken by ECC PT1. The effective work will probably start at the next meeting in May 2008, and it is of high importance for WiMAX technology to actively contribute to this activity.

A third Report (Report C [34]) on White Spots is under preparation. White Spots could give the opportunity to use piece of spectrum below the “identified band” for non-broadcasting applications.

CEPT activities in relation with these two Mandates are described in Figure N° 6.

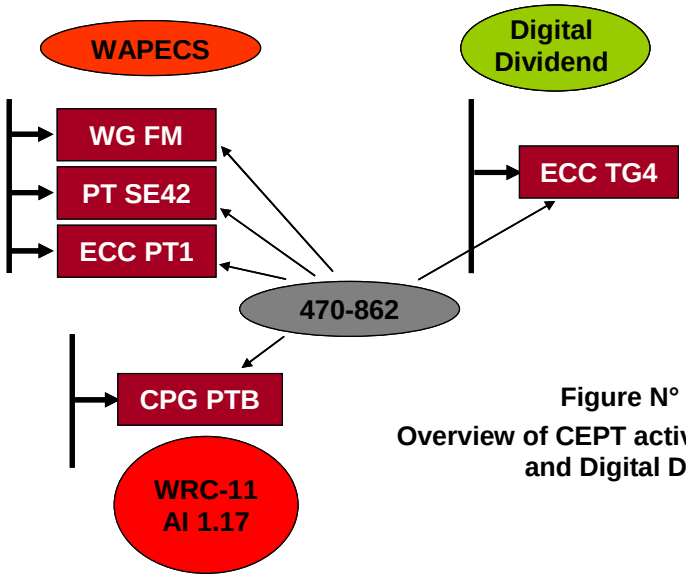


Figure N° 6
Overview of CEPT activities on WAPECs and Digital Dividend

5.2.5 EU Country by country overview

The following Table N° 5 summarizes the responses to the RSPG questionnaire by EU Member States' Administrations:

Table N° 5

National responses to RSPG internal questionnaire on Digital Dividend

AUT	No consultations till now. Discussions about possible strategies but no decisions.

CZE	National consultations on the Plan to transition from analogue to digital broadcasting are under way. Due to continuing uncertainty of the speed of the transition and lack of spectrum the discussion on the future non-broadcasting usage of a digital dividend is not on current agenda.

DNK	A workshop on possible future usage of the bands has been held. No decision has yet been taken with respect to alternative usage of the bands.

E	-

F	Under the auspices of ANFR, in the period September 2004-September 2005, ANFR Spectrum Review Consultative Committee (CRDS), which is opened to all stakeholders in France, has developed a report on the digital dividend which has been used to establish a strategic document on the issue, approved by the Board of ANFR on 15 November 2005. This document brings forward two scenarios (one under which the digital dividend is used essentially for broadcasting services, the other where it is shared with other electronic communication services), with no preference given to any of the two scenarios. On 5 May 2006, a Strategic Committee chaired by the Prime Minister and composed of the Minister of Media, the Minister of Industry, the Minister of Territory development and the chairmen of CSA and ARCEP, has been established in order to address the issues of Digital terrestrial television deployment, analogue switch-off and digital dividend. This Committee has started to proceed with wide consultations on these issues. According to a draft law on digital television due to pass through Parliament in the forthcoming months, the Committee would propose a National Plan for switchover, for adoption by the Government. This document will also determine general policy for the use of the digital dividend. The ARCEP organised on second-half of 2007 a Public Consultation and a Working Group on the possible uses of parts of the UHF band 470-862 MHz by Telecommunications. The Working Group was open to the Industry and Local Communities, and was also attended by Administrations like the Home Office and the MoD.

FIN	The Ministry of Communications has set a working group to study the matter. Final report is due by the end of the year.

G	Yes. Ofcom launched the Digital Dividend Review at the end of 2005. The project has examined the options arising from the release of UHF spectrum afforded by the digital switchover programme. Ofcom has consulted and issued a Statement in December 2007 Three awards (probably in 2009) are expected: - an auction primarily of the spectrum to be cleared of analogue TV - auctions of interleaved spectrum suitable but not reserved for local TV in some 25 locations; and A beauty contest primarily of the remaining interleaved spectrum with obligations toward users in the programme-making and special events sector. Further information on this project is available on the Ofcom website at the link below: http://www.ofcom.org.uk/radiocomms/ddr/

HNG	Not yet, planned during 2007

HOL	In the process of preparing the requirements for de RRC06, national consultations were organised with interested parties. In this process the issue of the digital dividend was included. The market broadly supported the use of the spectrum for digitalisation of the broadcast and the introduction of new / advanced broadcast applications.

I	No

IRL	Ireland was awaiting the outcome of RRC06 before holding a public consultation on the question of the digital Dividend. Currently consideration is being given to the use of the spectrum obtained at RRC06 and as part of that process a public consultation process will be considered.

LIE	There are no national consultations planned yet. A policy on the use of the "digital dividend" will be developed by the authority of Liechtenstein.

LTV	Not yet held. Term not defined

NOR	No national consultation planned.

POR	We are planning to hold a public consultation by the end of 2006 or in the beginning of 2007, at the latest.

ROU	We intend to hold a public consultation on the issue of the digital dividend in October 2006. We are now developing the issues and details for the questionnaire

S	No, but during the work with the report to the government, PTS held a seminar with interested parties. Also interested parties were interviewed by consultants during the work with the report and were invited to give their comments. The over-all message is that there seems to be a big demand for the frequencies, both from broadcasters and others.

SUI	There are no national consultations planned yet. A policy on the use of the "digital dividend" is under development at OFCOM

SVN	There were no national consultations on the issue of the digital dividend. It is difficult to say when such consultations will take place.

France

See above.

Germany and Italy up to now consider Digital Dividend within broadcasting applications. In Germany this results from a legal framework which could be overtaken only by EU legislation, which would take precedence over national rules.

United Kingdom

UK is for the time being the only European country having pre-identified the amount of spectrum available (112 MHz) for the Digital Dividend and the channels which should be devoted to it. See Figure 7. It could be questioned how this identification would/could be affected by the European Commission initiatives for a coordinated approach to the Digital Dividend.

A consultation [28] has been launched by the Office of Communications (Ofcom) of UK on 19th December 2006 up to 29th March 2007on the Digital Dividend and a statement [29] issued on 13 December 2007.

Figure N° 7:

Outline of band plan for 470-854 MHz

(Note: UK Broadcasting channels are 8 MHz wide)

21	22	23	24	25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64	65	66	67	68

	available spectrum from digital switch-over - these channels will become free for new uses
	Currently unavailable spectrum - 36 is radar; 38 is radio astronomy
	spectrum assigned to six DTT multiplexes, and resulting "interleaved" spectrum

Following this consultation, Ofcom prepared a Digital Dividend Review (DDR) [29], published in December 2007. Except for Public Safety applications, for which a beauty contest will be organised, Ofcom will not define the commercial applications which will be implemented in the released spectrum, and will let the decision to the market through the auction process.

5.2.6 Outside European Union

Russian Federation

Interest of operators for BWA spectrum in 700 MHz has been expressed; but no supportive actions are taking place.

Taking into account the use of the spectrum by aeronautical radio-navigation applications in Russia, it is highly unlikely that some part of the UHF band become available for mobile applications in the near future in Russia.

5.2.7 Summary of European activities

Digital Dividend in Europe is a mid-term issue but for which concrete activities have started end 2006.

Amongst the activities dealing with Digital Dividend, the following can be listed:

- preparation of ECPs on WRC-07 Agenda Item 1.4. This Agenda Item is dedicated to IMT and includes in its scope bands below 1 GHz for extended coverage. This is a useful tool to implement quickly a Mobile allocation in the band 470-862 MHz but this is in principle dedicated to IMT. This resulted in the identification of the band 790-862 MHz for IMT.
- RSPG has adopted Opinions on “Spectrum implications of the switchover to digital broadcasting” (2004, Nov 23) and “Spectrum for mobile multimedia services in the field of broadcasting” (mid-2006). This last opinion includes, but not exclusively, in its scope the broadcasting band below 1 GHz;
- RSPG has adopted in October 2006 an Opinion on “EU spectrum policy implications of the Digital Dividend” which covers all potential applications of the Digital Dividend and recommend a coordinated approach between Member States. This could further result in the identification of specific piece of spectrum for the Digital Dividend.
- These RSPG Opinions have resulted in Mandates to by the European Commission to the CEPT.
- CEPT activity in response to an European Commission Mandate on WAPECS: this activity has been initiated mid-2006 and continued up to -end-2007. Several bands below 1 GHz are listed as candidate WAPECS bands, including the 900 MHz band and the broadcasting band 470-862 MHz.
- CEPT activity in response to an European Commission Mandate on Digital Dividend. This resulted in three Reports, on Mobile TV, Mobile communications and White Spots respectively, respectively known as Reports A, B and C.

Following WRC-07, ECC will now concentrate on:

- **the definition of frequency arrangements** for Mobile systems; this activity is still at a very preliminary point, with some basic questions not yet concluded:
    - which arrangement with regard to duplex technologies?
    - which level of flexibility to implement to take into account possible national variations in amount of spectrum assigned to mobile communications?

This will be considered by **ECC Project Team 1 (PT1)**, starting effectively in May 2008.

- **Compatibility studies with other primary services in the band 790-862 MHz**: this will be undertaken under WRC-11 preparation by **CPG**;

- **Consider in more details how the implementation of Mobile communications in the band 790-862 MHz could be facilitated by re-arrangements of the assignments of GE-06**, and to what extent such re-arrangement would be possible?

This will be undertaken by ECC TG4.

5.3 Asia Pacific (APAC)

5.3.1 Overview

Country	Frequency band (MHz)	Allocation	Notes
Malaysia	614-806	FIXED MOBILE BROADCASTING	The frequency band 510-798 MHz is planned for DTTB service. Analogue Terrestrial Broadcasting Services phased out by 2015 Bnad 798-806 MHz for mobile use (to be confirmed)

Singapore	700		Doubtful that 700 MHz band be released for BWA

Taiwan	700		The 700 MHz could be allocated to BWA application in 2010
China	614-798		Proposed for IMT (contribution to ITU-R WP 8F)

5.3.2 Country by country analysis

Australia

The date of full achievement of the switchover was delayed from 2008 to 2012. At the date of May 2006 the Australian Government had no formal position on the future use of freed spectrum as a result of the digital switchover.

Nevertheless there may be long term opportunities for the Australian Communications and Media Authority (ACMA) to designate spectrum for BWA in the band. ACMA has stated in a consultation paper on Wireless Access Services that 520-820 MHz is a candidate for BWA services in the long term, due to timeframe for digital TV switchover. Note that there is no planned Digital Dividend at this time and the current digital TV plan does not provide large blocks of spectrum that would be suitable for BWA. The use of spectrum for BWA is being opposed by broadcasting interests.

China

At WRC-07China has identified the band 698-806 MHz, or part of it, for the Digital Dividend.

India

Following a Public Consultation BWA has been given a high priority in India and the Regulator TRAI announced its intention to recommend to assign spectrum to BWA in the 700

MHz band [36], in order to cope with the needs of rural India. This band is one of the four bands for which India announced such intention, together with 2.3 GHz, 2.5 GHz and 3.5 GHz.

Globally, at least 200 MHz of spectrum should be made available for BWA to accommodate growth requirement until 2007, and additional 100 MHz of spectrum should be earmarked by 2010:

- Spectrum in the 3.3 –3.4 GHz /3.4-3.6 GHz has already been identified;
- on grounds of non-availability in a short term time frame, no immediate action has been taken by the Authority for bands 2.3 GHz, 2.5 GHz and 700 MHz.

Nevertheless there is a strong political implication in the possibility to free some pieces of spectrum for rural access on the 700 MHz band:

"DoT should coordinate some part of 700 MHz spectrum for making it available for rural wireless networks in the near future." (Recommendation S.31 of the TRAI document).

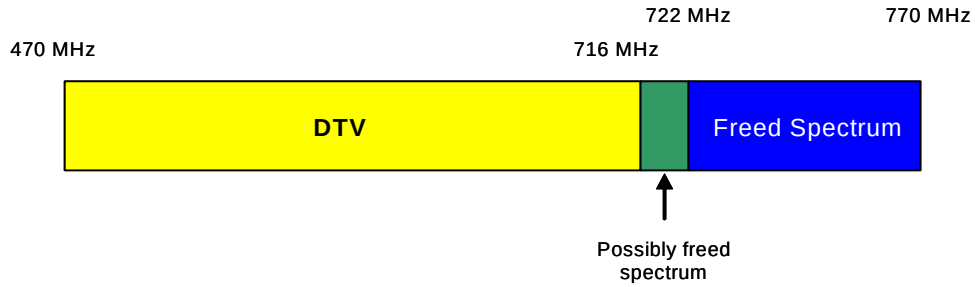
The November 2007 BWA Guideline issued by the Minister for Communications did not mention 700 MHz and focussed on the 2.3, 2.5, 3.3 and 3.4 to 3.6 GHz bands. Interest in the 700 MHz band continues, and national deliberations are underway for making available appropriate part of the band for WiMAX applications. In this context the following issues emerge:

- equipment availability in 700 MHz and time frame;
- roaming in different areas, especially between rural and urban areas, where different frequency bands might be deployed for WiMAX systems.

Japan

In Japan switch-off of Analogue TV is planned on July 2011. In March 2006 the Ministry of Internal Affairs and Communications (MIC) charged the technical subcommittee of Information and Communication telecommunications Council with the study of the technical requirements for effective use of frequency, including possible modifications of spectrum allocation and the frequency-sharing conditions with adjacent systems. The subcommittee will prepare an interim report by June 2007.

48 MHz of UHF spectrum (plus possibly 6 additional MHz) will be freed after switchover completion. This spectrum band extends from **722 MHz** (possibly 716 MHz) to **770 MHz**.



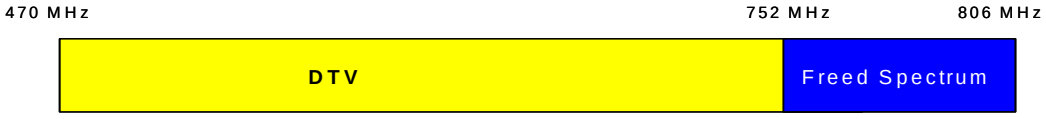
This is consistent with the identification of the band 698-806 MHz, or part of it, by Japan for IMT at WRC-07.

Recent information received from the WiMAX Forum local chapter indicated that MIC plans to allocate two frequency bands for terrestrial mobile communication services:

- 730-770 MHz, after July 25, 2011
- 905-958 MHz, after July 25, 2012

Korea

The date for the mandatory switch-off of Analogue TV will be defined after 2010.
The amount of freed spectrum after analogue switch-off is estimated at **54 MHz** in the UHF band, from **752 to 806 MHz**. The future use of the spectrum is not yet decided. This is also consistent with the Korean position at WRC-07.



Information for Japan and Korea is taken from an OECD Report [37].

Malaysia

The Malaysian Regulator (SKMM) announced in 2007 that digital TV would be deployed and analogue TV phased out in 2013. Consultation on the TV channel plan and Digital Dividend is expected in 2008.

Taïwan

In order to clean up the 700 MHz spectrum, government agencies have started inspecting current use of the spectrum:

- ITS and WiMAX IP surveillance are possible applications
- Combination of Public Safety and commercial operation adopted by FCC is also an option;
- Most of the 710-800 MHz spectrum remains reserved.

Other countries

There is currently no visibility on opportunities in other Asian countries; many have not yet considered the introduction of Digital TV.

5.4 Caribbean – Latin America (CALA)

A lot of countries in this area may have interest in allowing BWA markets below 1 GHz: large countries with relatively important rural population, and therefore the necessity to develop means to ensure coverage of these areas.

The band 470-806 MHz is generally used for TV Broadcasting, and there was up to very recent date no evidence that such introduction of BWA was planned.

Nevertheless things now seem to be moving:

- in a very recent Public Consultation on “Technological and Industrial Development of Wireless Communications Systems” [38] the Brazilian Ministry of Communications mentioned the development of project studies and prototypes based on WiMAX technology as a support for the interactive function of Digital TV. It was also mentioned that there are locations in the country that have channelling space; nevertheless it shall be mentioned that Brazil did not associate to the identification of the band 698-806 MHz by Region 2 countries for IMT. This could be considered as being not contradictory with these project studies

- Another opportunity for WiMAX technology in Latin America could come from the Specialised Mobile Radio (SMR) and Enhanced Specialised Mobile Radio (ESMR) Systems in the 800 MHz band. A SMR/ESMR Operator in several Latin America countries (Argentina, Brazil, Chile, Mexico, Peru) has expressed its interest for the WiMAX technology in bands 806-826 / 851-870 MHz).

- In Mexico, Argentina and Chile a process has already been initiated to re-assign the UHF television frequencies (470 MHz – 806 MHz). The Chilean regulator SUBTEL has announced its intention to make a Public Consultation on the UHF band in 2008.

Additional information was gathered from Mexico, Brazil, Colombia, Argentina, and Chile on status of bands between 450MHz and 869MHz. These bands are largely unused in the 5 countries listed with the exception of the 806-824MHz and 849-869MHz which are used by Nextel for iDEN services.

5.5 Middle East

Middle East countries including Iran were part of the RRC-04 and RRC-06.
They are not part of the agreement on flexibility signed by the CEPT countries.

Nevertheless several Middle East countries, mainly located in the Arabic peninsula have joined the list of countries which have identified the band 790-862 MHz for IMT at earlier stage, not waiting for the 2015 entry into force of the Mobile Service allocation in Region 1.

5.6 Africa

African countries were part of the RRC-04 and RRC-06.

They are not part of the agreement on flexibility signed by the CEPT countries, but their role in the identification of the band 790-862 MHz for IMT in Region 1 was very active. ATU was the only regional organisation in Region 1 which came to WRC-07 with a proposal for allocation to Mobile Service and identification for IMT of a part of the UHF band 470-862 MHz.

6 Conclusions

Conclusion on accessible frequencies for WiMAX technology

Two bands have been identified for the Mobile Service and IMT applications:

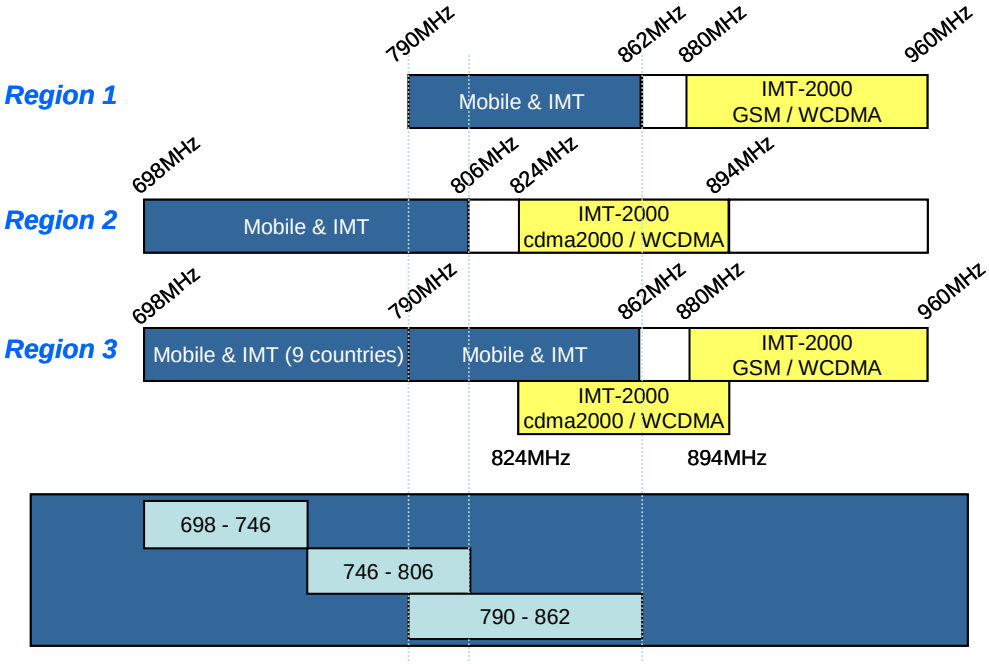
- the band 698-806 MHz, which was identified for long time for Advanced Wireless Services applications in the USA and is now identified for IMT in the whole Region é

(except Brazil) and in nine countries in Region 3, including China, India, Japan and South Korea.

- the band 790-862 MHz which has been identified for IMT in Region 1 and Region 3.

The bands identified for IMT in the frequency range 698-960 MHz in ITU Regions 1, 2 and 3 are summarized in Figure n° 8. The bands in yellow are already used for Mobile applications, and the actual technologies dedicated to these applications are reported. Nevertheless following the identification of OFDMA TDDWMAN as a IMT technology by RA-07, this does not preclude their use by WiMAX technology.

Figure N° 8
Bands accessible to WiMAX technology
in the frequency range 698-960 MHz



This diagram summarises the spectrum allocation by Region in the sub 1 GHz bands that could be used for WiMAX technology and should be considered by WiMAX Forum Working Groups when considering the development of new WiMAX Forum Profiles.

Other bands may be accessible to WiMAX technology on more specific conditions, for instance in White Spot spaces, or to address vertical markets like Public Safety or military applications.

Conclusion for Spectrum Planners

This paper has examined the considerable benefits that can accrue from having WiMAX networks deployed in IMT bands below 1 GHz. In some countries the spectrum may already be available, but in many it could only become available as part of a Digital Dividend resulting from the move to digital TV.

For spectrum planners this demonstrates the importance of planning their countries transition to digital TV in such a way as to create a Digital Dividend that provides blocks of spectrum that align with at least one of the three sub-bands identified above. This will maximise the benefits by providing spectrum that can be efficiently used for mobile or fixed/nomadic broadband wireless access including WiMAX technology.

7 Annex A - Acronyms

AAS	Adaptive Antenna System
ACMA	Australian Communications and Media Authority
ANFR	Agence Nationale des Fréquences (France)
APAC	Asia Pacific
ARCEP	Autorité de Régulation des Postes et Télécommunications Electroniques (France)
ATU	African Telecommunications Union
BWA	Broadband Wireless Access
CALA	Caribbean and Latin America
CDPD	Cellular Digital Packet Data
CEPT	European Conference of Postal and Telecommunications Administrations
CITEL	Inter-American Telecommunication Commission / Commission Interamericana de Telecomunicaciones
CMA	Census Metropolitan Area
CPG	Conference Preparatory Group
CSA	Conseil Supérieur de l'Audiovisuel (France)
DD	Digital Dividend
DDR	Digital Dividend Review
DTV	Digital TV
EA	Economic Area
EAG	Economic Area Grouping
ECC	Electronic Communications Committee (of CEPT)
ECP	European Common Proposal
ESMR	Enhanced Specialised Mobile Radio
FCC	Federal Communications Commission
GE-06	Geneva 2006 Agreement
HDTV	High Definition TV
IMT	International Mobile Telecommunications

ITS	Intelligent Transport System
ITU	International Telecommunications Union
MEA	Major Economic Area
MoD	Ministry of Defence
MS	Mobile Service
NSA	Network Sharing Agreement
OFCOM	Office des Communications (Switzerland)
Ofcom of UK	Office of Communications (UK)
OFDMA	Orthogonal Frequency Division Multiple Access
PPDR	Public Protection and Disaster Relief
PSBT	Public Safety Broadband Trust
PTS	Post and Telecom Agency (Sweden)
PT1	Project Team 1 (of CEPT ECC)
REAG	Regional Economic Area Group
RR	Radio Regulations
RRC-06	Regional Radiocommunications Conference-2006
RSC	Radio Spectrum Committee
RSPG	Radio Spectrum Policy Group
WG SE	Working Group Spectrum Engineering (of CEPT ECC)
SKMM	Telecommunications Regulator (Malaysia)
SMR	Specialised Mobile Radio
SUBTEL	Subsecretaria de Telecomunicaciones (Chile)
TDD	Time Duplex Division
TG4	Task Group 4 (of CEPT ECC)
TRAI	Telecommunications Regulatory Authority of India
UHF	Ultra High Frequency
WAPECS	Wireless Access Policy on Electronic Communications Systems
WMAN	Wireless Metropolitan Area Network
WRC	World Radiocommunications Conference

8 Annex B - References

[1] Final Acts of the World Radiocommunication Conference (WRC-2007);

[2] Notice No. DGTP-004-01 “Proposal to Introduce the Mobile Service on a Co-primary Basis with the Broadcasting Service in the Frequency Band 746-806 MHz”, Jun. 16/01

[3] SP-746 : Mobile Service Allocation Decision and Designation of Spectrum for Public Safety in the Frequency Band 746-806 MHz, October 2004

[4] Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2005 Edition, amended January 2006)

[5] RP-06 Issue 1: Policy for the Use of 700 MHz Systems for Public Safety Applications and Other Limited Use of Broadcasting Spectrum (June 2006)

[6] Notice No. SMSE-005-06: Consultation Paper on Public Safety Radio Interoperability Guidelines (June 2006)

[7] SRSP-503 Issue 6:Technical Requirements for Cellular Radiotelephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz (June 2003)

[8] CPC 2-1-24 “Licensing Procedure for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV channels 21 to 51)”

[9] Notice No. SMSE-004-08: “Proposed Revisions to the Frequency Plan for Public Safety in the Band 700 MHz”

[10] FCC News March 17, 2006: FCC seeks comment on proposals for modifying 700 MHz Public Safety Spectrum to accommodate Broadband Communications (WT Docket No. 96-86)

[11] Eighth Notice of Proposed Rulemaking in the matter of “The development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010”; adopted: March 17, 2006; released: March 21, 2006 (WT Docket No. 96-86).

[12] Ninth Notice of Proposed Rulemaking in the Matter of Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band & Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010 – PS Docket N°06-229; WT Docket N°96-86 ; released December 20, 2006

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[14] FCC News, August 3, 2006: FCC seeks comment on possible modifications to rules governing wireless licences in portions of the 700 MHz spectrum band (WT Docket No. 06-150; CC Docket No. 94-102; WT Docket No. 01-309)

[15] NPRM, 4th FNPRM, and 2nd FNPRM in the matter of Service Rules for the 698-746, 747-762 and 772-792 MHz bands; Revision of the Commission's Rules to ensure compatibility with enhanced 911 emergency calling systems; Section 68.4(a) of the Commission's Rules governing Hearing Aid-Compatible Telephones; adopted: August 3, 2006; released: August 10, 2006 (WT Docket No. 06-150; CC Docket No. 94-102; WT Docket No. 01-309)

[16] FCC News, September 8, 2006: FCC seeks comment on possible modifications to rules governing the 700 MHz guard band licensees (WT Dockets No. 06-169; 96-86)

[17] FCC Public Notice: OET announces projected schedule for proceeding on unlicensed operation in the TV broadcast bands; September 11 (ET Docket No. 04-186)

[18] NPRM in the matter of Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz band

[19] Second Report and Order FCC 07-137: Services Rules for the 698-746, 747-762 and 777-792 MHz bands; Adopted: July 31, 2007; Released: August 10, 2007

[20] FCC Public Notice DA07-3415 August 17, 2007: Auction of 700 MHz Band licences scheduled for January 16, 2008 – Comment sought on competitive bidding procedures for Auction 73; AU docket N° 07-157

[21] RRC-06 Final Acts

[22] Geneva-2006 Agreement (GE-2006)

[23] ECP on flexibility: Addendum 6 to Document 7-E (2006, 17th February)

[24] Final Document adopted by CEPT countries on flexibility

[25] RSPG Opinion on "EU Spectrum policy implications of the Digital Dividend"

[26] RSPG Opinion on "Spectrum for mobile multimedia services in the field of broadcasting"

[27] RSPG Opinion on "Spectrum implications of the switchover to Digital Broadcasting"

[28] Ofcom consultation on Digital Dividend (published 2006/12/19)

[29] Ofcom Digital Dividend Review – A statement on our approach to awarding the digital dividend

[30] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover

[31] ECC "Report A": Final Report from CEPT to the European Commission in response to the Mandate on compatibility issues between "cellular / low power transmitter" networks and "larger coverage / high power / tower" type of networks / Document ECC(07)050 Rev 2 Annex 12, 30 March 2007

[32] ECC “Report B”: Final Report from CEPT to the European Commission in response to the Mandate on „Technical feasibility of harmonising a sub-band of bands IV and V for fixed/mobile applications (including uplinks), minimising the impact on GE-06 / Document ECC(07)091 Final Annex 1, 19 July 2007

[33] CEPT Supplementary Report (to Report B) to ECC: “Technical options for the use of a harmonised sub-band in the band 470-862 MHz for Fixed / Mobile applications (including uplinks)” / Document ECC(07)116 Annex 14

[34] Working Document towards draft CEPT Report C to ECC: “A preliminary assessment of the feasibility of fitting new/future applications/services into non-harmonised spectrum of the Digital Dividend (namely the so-called “White Spots” between allotments)” / ECC TG4(08)142rev1, Feb 2008

[35] CEPT Report 19: Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS, December 2007.

[36] Telecom Regulatory Authority of India (TRAI): Recommendations on Allocation and pricing of spectrum for 3G and broadband wireless access services

[37] OECD Report “The Spectrum Dividend: Spectrum Management Issue”, OECD, Directorate for Science, Technology and Industry – Committee for Information, Computer and Communications Policies / Working Party on Telecommunications and Information Services Policies (October 2006).

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[41] Recommendation ITU-R M.1580-2: Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-2000;

[42] Recommendation ITU-R M.1581-2: Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-2000;

[43] ERC Report 25: The European Table of Frequency Allocations and Utilisations covering the Frequency Range 9 kHz to 275 GHz;

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The WiMAX Forum® is an industry-led, not-for-profit corporation formed to promote and certify the compatibility and interoperability of broadband wireless products using the IEEE 802.16 and ETSI HiperMAN wireless MAN specifications. The Forum's goal is to accelerate the introduction of these devices into the marketplace. WiMAX Forum Certified™ products will be interoperable and support Metropolitan Broadband Fixed, Nomadic and Mobile Applications.

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