REPORT ITU-R M.2079

Technical and operational information for identifying Spectrum for the terrestrial component of future development of IMT-2000 and IMT-Advanced*

(2006)

1 Introduction

To meet the ever increasing demands for mobile wireless communication and the expected higher data rates, as one of the initial steps, Recommendation ITU-R M.1645 defines the framework and overall objectives of the future development of IMT-2000 and IMT-Advanced. This framework is based on the global user and technology trends, including the needs of developing countries. Further ITU-R Recommendations will develop these concepts in more detail.

Based on Resolution 228 (Rev.WRC-03), WRC-03 established Agenda item 1.4 for the World Radiocommunication Conference 2007 (WRC-07) to consider frequency-related matters for the future development of IMT-2000 and IMT-Advanced. Resolution 228 (Rev.WRC-03) invites ITU-R to report, in time for WRC-07, on the results of studies on the spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and IMT-Advanced.

Based on the above situation, ITU-R has studied frequency-related matters for the future development of IMT-2000 and IMT-Advanced as follows:

a) **Report ITU-R M.2072**

User demand predictions in future systems such as the amount of traffic in the year 2010 onwards were considered as input for the calculation of required spectrum bandwidth for the future development of IMT-2000 and IMT-Advanced. Report ITU-R M.2072 addresses service and user demand issues of IMT-Advanced.

b) **Report ITU-R M.2074**

Studies in radio aspects are also indispensable for the calculation of required spectrum bandwidth and the determination of suitable frequency ranges, taking into account technical trends and predictions of the technical capabilities and characteristics in the year 2010 onwards. Report ITU-R M.2074 provides radio-related technical information which is relevant to the preparations of WRC-07 Agenda item 1.4. It describes technical matters related to radio aspects such as requirement for technical characteristics that are needed for the spectrum requirements calculations, values of the required radio parameters, spectrum efficiency values, and suitable spectrum range preference from a technical aspect. These matters are reflected in the process to calculate the required spectrum and to determine

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* For ease of use, this report uses the terminology proposed in draft Resolution ITU-R [IMT.NAME], which will be considered for adoption at the Radiocommunication Assembly 2007. It resolves:

– that the term “IMT-2000” encompasses also its enhancements and future developments;

– that the term “IMT-Advanced” be applied to those systems, system components, and related aspects that include new radio interface(s) that support the new capabilities of systems beyond IMT-2000; and

– that the term “IMT” be the root name that encompasses both IMT-2000 and IMT-Advanced collectively.

suitable frequency ranges for the future development of IMT-2000 and systems beyond IMT-2000 from the year 2010 onwards to fulfil the framework shown in Recommendation ITU-R M.1645.

c) **Report ITU-R M.2078**

ITU-R Report M.2078 addresses spectrum requirements for the future development of IMT-2000 and IMT-Advanced. The spectrum requirements were calculated with the spectrum calculation methodology defined in Recommendation ITU-R M.1768. In the spectrum calculation for the future development of IMT-2000 and IMT-Advanced new concepts are introduced including a mix of services, multiple complementary systems and radio access technique groups.

2 Scope

This Report provides useful information for administrations to consider when processing spectrum selection for the future development of IMT-2000 and IMT-Advanced in preparation for WRC-07. The selection process for candidate bands must consider compatibility, coordination and sharing with other primary services. To aid this process, the ITU-R evaluated suitable frequency ranges to fulfil the vision for the future development of IMT-2000 and IMT-Advanced.

The information contained in this Report is as follows:

a) A listing of related ITU-R Recommendations and Reports.

b) Background analysis on bands identified for IMT-2000 and the needs of developing and developed countries in relation to identifying possible world-wide spectrum for the future development of IMT-2000 and IMT-Advanced.

c) A summary of related technical and user demand predictions that influence spectrum requirements and the range of radio frequencies suitable for the future development of IMT-2000 and IMT-Advanced as further detailed in Reports ITU-R M.2072 and ITU-R M.2074.

d) A summary of estimated spectrum requirements for the future development of IMT-2000 and IMT-Advanced as outlined in Report ITU-R M.2078.

e) A summary of the investigation on current bands usage and sharing studies results.

f) The advantages and disadvantages of the candidate bands for possible candidate bands for the future development of IMT-2000 and IMT-Advanced.

g) Appendix 1 – Information document reflecting the views of Administrations related to candidate frequency ranges.

3 Related ITU-R Recommendations and Reports

Recommendations:

ITU-R M.687	International Mobile Telecommunications-2000 (IMT-2000)
ITU-R M.819	International Mobile Telecommunications-2000 (IMT-2000) for developing countries
ITU-R M.1457	Detailed specification of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)
ITU-R M.1645	Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000

ITU-R M.1768 Methodology for calculation of spectrum requirements for the future development of the terrestrial component of IMT-2000 and systems beyond IMT-2000

Reports:

ITU-R M.2023 Spectrum requirements for International Mobile Telecommunication-2000 (IMT-2000)

ITU-R M.2024 Summary of spectrum usage survey results

ITU-R M.2039 Characteristics of terrestrial IMT-2000 systems for frequency sharing/ interference analyses

ITU-R M.2072 World mobile telecommunication market forecast

ITU-R M.2074 Radio aspects for the terrestrial component of IMT-2000 and systems beyond IMT-2000

ITU-R M.2078 Spectrum requirements for the future development of IMT-2000 and IMT-Advanced

4 Background

4.1 IMT-2000 and IMT-Advanced

IMT-2000 systems are third generation mobile systems, which provide access to a wide range of telecommunication services, supported by the fixed telecommunication networks (e.g. PSTN/ISDN/IP), and to other services which are specific to mobile users.

Key features of IMT-2000 are:

– high degree of commonality of design worldwide;

– compatibility of services within IMT-2000 and with the fixed networks;

– high quality;

– small terminal suitable for worldwide use;

– worldwide roaming capability;

– capability for multimedia applications within a wide range of services and terminals.

The capabilities of IMT-2000 systems are being continuously enhanced in line with user demand and expectations and technology trends.

The specifications for IMT-2000, are defined in Recommendation ITU-R M.1457.

Recommendation ITU-R M.1645 defines the framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000. That framework is based on the global user and technology trends, including the needs of developing countries. Further ITU-R Recommendations will develop these concepts in more detail.

The ITU first identified spectrum for IMT-2000 at WARC-92, in No. 5.388 of the Radio Regulations (RR). WRC-2000 considered issues related to IMT-2000, resulting in the identification of additional spectrum for the terrestrial component of IMT-2000 in No. 5.317A and No. 5.384A. The spectrum identification for IMT-2000 at WRC-2000 was based on the total forecasted need for spectrum by the year 2010. Based on the above, the ITU identified 749 MHz of spectrum for use by IMT-2000 to include: 806-960 MHz (No. 5.317A, Resolution 224), 1 710-1 885 MHz and 2 500-2 690 MHz (No. 5.384A, Resolution 223), 1 885-2 025 MHz and 2 110-2 200 MHz (No. 5.388, Resolution 212). The pre-IMT-2000 and IMT-2000 systems in the above bands

continue to exist and have been evolving over time. However, the spectrum already identified for IMT-2000 may not be sufficient to meet the increasing demand for wireless communication, the expected higher data rates and the needs of developing countries.

WRC-03 approved Resolution 228 (Rev. WRC-03) and set an agenda item for WRC-07 to consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 and invited ITU-R to report, in time for WRC-07, on the results of studies on the spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and IMT-Advanced.

4.2 Needs of developing countries

It is widely acknowledged that the level of economic and social development as well as spectrum availability across administrations and regions varies. For the convenience of analysis, countries can be simply divided into two categories, developed countries and developing countries. Information and communications technologies (ICT), such as IMT-2000 and IMT-Advanced have the ability to improve lifestyles, social interactions and productivity. The international trend is to use telecommunications as a means to reduce social and economic differences by enabling entire populations, despite their location and resources, to have full coverage and access to telecommunication services. ICT are also being used to optimize and increase the efficient use of scarce resources, such as spectrum.

Advanced wireless technologies can offer developing countries new opportunities and services which take into account the fast growth of teledensity, the need to balance geographic and social distribution of services, increased coverage, and improved use of suitable spectrum. In the era of globalization, the telecommunications needs of developing countries or underserved areas are similar to the needs of developed countries. However, developing and developed countries have different considerations and requirements which are often due to economic and social factors. For example, developing countries have low levels of income per inhabitant, large population densities, vast rural areas and areas of difficult geographical terrain. Thus needs of developing countries include affordable pricing of mobile services and technical solutions that enable coverage of rural areas with varied terrain characteristics. Therefore developing and developed countries may require different frequency ranges and the different amounts of spectrum over various time frames, which should be taken into account when examining potential candidate bands.

4.3 Factors to consider in analyzing potential candidate bands

The following factors are relevant to choosing potential spectrum for the future development of IMT-2000 and IMT-Advanced:

a) the future development of IMT-2000 and IMT-Advanced are defined by a set of interdependent ITU-R Recommendations and Reports of which this Report is a part;

b) bands currently identified for IMT-2000 may be used by existing and future systems under current allocations, including 806-960 MHz (No. 5.317A, Resolution 224), 1 710-1 885 MHz and 2 500-2 690 MHz (No. 5.384A, Resolution 223), 1 885-2 025 MHz and 2 110-2 200 MHz (No. 5.388, Resolution 212);

c) WRC-07 will consider spectrum related issues for the future development of IMT-2000 and IMT-Advanced;

d) The time-frame in which the spectrum will be needed in the most countries;

e) evaluation of suitable frequency ranges including the advantages/disadvantages and the results of sharing studies;

f) consideration of spectrum and technical solutions that enable coverage of rural areas with varied terrain characteristics such as bands below those already identified for IMT-2000 in No. 5.317A and through the satellite component of IMT-2000.

5 General considerations

To investigate possible candidate bands for the future development of IMT-2000 and IMT-Advanced in order to satisfy WRC-07 agenda item 1.4 and Resolution 228 (Rev. WRC-03) the following technical factors should be considered:

– The steady and continuous evolution of IMT-2000, which is expected to support new applications, products and services with data rates up to approximately 30 Mbit/s under optimum signal and traffic conditions.

– Possible use of the frequencies below those already identified for IMT-2000.

– For IMT-Advanced there may be a requirement for a new radio interface(s) for the terrestrial component around the year 2010. ITU-R is considering new technologies, including the “new mobile access” and “new nomadic/local area wireless access” technologies:

  – new mobile access to handle low to high mobility applications with a wide range of supported target peak data rates of up to approximately 100 Mbit/s;

  – new nomadic/local area wireless access to handle low mobility applications with a wide range of supported peak data rates up to 1 Gbit/s.

Moreover, as mentioned in Recommendation ITU-R M.1645, various other complementary access technologies (e.g. WPAN, WLAN, Digital Broadcast, and FWA) could be used in conjunction with the future development of IMT-2000 and IMT-Advanced and should be considered when examining potential candidate bands since they may impact the spectrum and service usage.

5.1 General user demand trends

The services and user demands of the future development of IMT-2000 and IMT-Advanced are fully detailed in the Report ITU-R M.2072. In particular, § 5 of the Report discusses some of the many issues and types of services that can be considered when forecasting the user demand as far as 2020. Included is the need to define services based on parameters, such as segmentation (e.g. consumer or business, adult or youth). The Report also discusses the transmission speeds expected for future mobile communications systems based on the projected growth of data access speeds in mobile and fixed communication systems. As both high performance mobile terminals and rich content become available, transmission speeds tantamount to those of fixed systems are required. This is becoming a reality with IMT-2000 systems, which offer transmission speeds of several hundred kbit/s to Mbit/s.

Enhanced technical capabilities, a wider range of available services and breadth of applications will be progressively introduced as systems evolve to IMT-Advanced. The need to provide these new capabilities at high data rates with high mobility will need to be considered when choosing potential candidate bands.

5.2 Technical issues influencing spectrum range preferences

Report ITU-R M.2074 includes detailed analysis of some of the technical issues surrounding the spectrum range preferences for the future development of IMT-2000 and IMT-Advanced. Section 5.4 of the Report highlights the following issues:

– Target peak data rates.

– Target grade of mobility.
– Target coverage range with reasonable trade-off.
– The implications of frequency ranges on mobile device power consumption.
– The availability and feasibility of required RF components within the required time frame.
– Spectrum ranges influencing technology.
– Spectrum range preference.

In summary, Report ITU-R M.2074 states that the technical issues affecting frequency range preferences are primarily based on the requirements and target characteristics for the envisioned system. The high level requirements may result in several requirements or preferences on the possible frequency bands and spectrum ranges. For example, a new radio access system, covering the full range of capabilities of IMT-Advanced is envisaged to support a wide range of data rates according to economic and service demands in multi-user environments. There will be target peak data rates of up to approximately 100 Mbit/s for high mobility such as mobile access and up to approximately 1 Gbit/s for low mobility such as nomadic/local wireless access.

It may be possible to reach considerably higher overall spectrum efficiency than today's technologies, but even under the most optimistic assumptions discussed today and in favourable radio reception conditions, the 1 Gbit/s transmission rate may require bandwidth in the order of 100 MHz or more.

With respect to preferred frequency ranges for the future development of IMT-2000 and IMT-Advanced, Report ITU-R M.2074 suggests that the new spectrum for such new technologies that can fulfil the full range of requirements of the ITU for IMT-Advanced, including both the “new mobile access” and “new nomadic/local area wireless access” as they are presented in Recommendation ITU-R M.1645 should be identified below 6 GHz due to a number of technical reasons. In particular, bands below 5 GHz allow sufficient mobility and there is an acceptable trade-off between cost and full area coverage. Availability of required RF hardware components is seen as feasible in the required timeframe and mobile terminal complexity and power consumption could stay at an acceptable level. However, some administrations believe that some of this capacity can be met in bands above 6 GHz.

For technologies aiming at covering only one of the new capabilities envisioned by the future development of IMT-2000 and IMT-Advanced, such as the “new nomadic/local area wireless access,” the technical constraints may be different, possibly resulting in different preferences about the spectrum ranges.

For example, frequency ranges above 5 GHz may be considered for this purpose, including bands identified in RR 5.446A, though the coexistence studies between RLAN and IMT-Advanced nomadic radio interface have not been carried out.

Geographic coverage is especially important to developing countries because many people who do not at present have access to mobile communications live in parts of the world where the population density, teledensity, and/or income levels are low. The favourable propagation characteristics of the frequency bands below those identified for IMT-2000 and the associated coverage advantages should be considered for the deployment of cost effective systems for large areas with low user density or where there is no existing infrastructure, which is often the situation in developing countries. Specifically the frequency bands below those already identified for IMT-2000 offer longer-range radio wave propagation characteristics than higher frequency bands and therefore would allow operators to provide IMT-2000 network coverage with a reduced number of base station sites.

6 Estimated required spectrum bandwidths

The detailed study results of the estimated required spectrum bandwidths is described in § 8 of Report ITU-R M.2078 on spectrum requirements for the future development of IMT-2000 and IMT-Advanced.

The requirements were calculated with the spectrum calculation methodology defined in Recommendation ITU-R M.1768. In spectrum calculations for the future development of IMT, new concepts have been introduced including a mix of services, multiple complementary systems and radio access technique groups.

The specific spectrum requirements relevant to the scenario of large coverage areas with low teledensity have not been addressed.

7 Bands usage and sharing studies results

Based on proposals from individual countries on frequency bands which could be considered for the possible identification for the future development of IMT-2000 and IMT-Advanced, the usage and the preliminary sharing studies results for the bands below 5 GHz are found in Table 1. It is emphasized that it should not be concluded from this Table that these bands are candidate bands agreed for the future development of IMT-2000 and IMT-Advanced.

It should be noted that nomadic applications may be accommodated in the 5 GHz bands allocated to the mobile service at WRC-03, if such use is in accordance with RR No. 5.446A and Resolution 229 (WRC-03), and in other bands above 6 GHz. Identification specifically for nomadic application of IMT in the RR may not be necessary and bands above 5 GHz were not addressed in Table 1.

Information related to the band usage is based on materials provided either in written form or verbally by the membership of ITU-R but may not represent complete information. Moreover even if complete information on the existing spectrum utilisations is available that information in no way excludes the use of the band in future by the services to which the band is allocated in Article 5 of the RR.

In accordance with *resolves* 5 of Resolution 228 (Rev.WRC-03) Table 1 contains information on those bands considered and includes the information on the results of relevant sharing studies so far available.

TABLE 1

Candidate frequency ranges, band usage (including bands currently identified for IMT-2000), and results of sharing studies so far available for identifying spectrum for the terrestrial component of future development of IMT-2000 and IMT-Advanced

Frequency range (MHz)	Band usage	Sharing studies
410-430	This frequency band is allocated worldwide to the fixed, and mobile services on a co-primary basis, however these allocations are not the only service allocations within the band. In India, the band 410-430 MHz is being extensively used for variety of public and government applications. Part of this band is also allocated and being used for digital trunk radio and digital seismic telemetry. Utilisation in CEPT is for analogue and digital land mobile, PMR/PAMR for public safety and emergency networks in some countries. This band presents complex interlacing between PMR, PAMR and civil/governmental usage. In Japan, the band 381.3-420 MHz is used for digital airport radio, anti-disaster emergency radio telephones, public services by the national government, local governments and public institutions for transportation, and for miscellaneous services by private companies. In Japan, the band 381.3-420 MHz is used for unlicensed stations such as implantable medical data transmission equipment and medical telemeters. In Japan, the band 420-430MHz is used for unlicensed low-power stations such as radiophones, data transmission equipment and medical telemeters. In New Zealand the band 410-430 MHz is allocated to the fixed and mobile service. The band is heavily used by traditional commercial and public safety mobile applications, and narrowband fixed linking applications. Sri Lanka is considering the band 410-435 MHz which is allocated to mobile and fixed service. It is currently being analyzed for mobile and/or fixed systems, including CDMA2000.	For space applications and meteorology, Annex 1 of Recommendation ITU-R SA.1236 contains one approach to evaluate protection for fixed and mobile services while for remote sensing systems Annex 2 of Recommendation ITU-R RS.1260-1 provides information on the feasibility of sharing between active spaceborne sensors and other services in the range of 420-470 MHz (this Recommendation replaces Recommendation ITU-R SA.1260-1).

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Cameroon, Canada, Sri Lanka, Brazil and Venezuela, these bands are allocated to the fixed and mobile service. In Canada, in the band 406-430 MHz, in high density population areas, these bands is are heavily used by traditional commercial and public safety mobile services. In the United States of America, the 410-420 MHz band is allocated on a primary basis to the Federal Government for the fixed, mobile, and space research (space-to-space) services. The 420-430 MHz band is allocated on a primary basis to the Federal Government for the radiolocation service. In the USA, this band is used for ground, ship borne, and airborne long-range surveillance systems, as well as personnel location systems. Radars, which are used for national security, utilize this particular frequency band. These uses are essential for national security and public safety functions. The band, 420-450 MHz is utilized by amateur radio users on non-interference basis. The band 410-420 MHz is used for extra vehicular activity (EVA) communications by both Shuttle and International Space Station astronauts on a primary space research service. The Inter-American Telecommunication Commission – CITEL has recently approved Recommendation PCC.II/REC. 10 (V-05) on the “Use of the 410-430 MHz and 450-470 MHz bands for fixed and mobile services for digital communication particularly in low population density areas”. In Cameroon this band is allocated to the mobile and fixed service, some subscriber radio systems and private specialized mobile radio systems are operating in this band. In Slovenia, 410-430 MHz: currently: ending analogue PAMR, utilized for digital PMR/PAMR.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Mexico, the band 410-430 MHz is used for point-to-point/multipoint applications. In Venezuela the bands 410-430 MHz and 450-470 MHz are allocated to fixed and mobile services. In the Russian Federation the band 420-430 MHz is used for radar applications. In China, the band 410-425 MHz is being widely used for interphone service. The band 425-430 MHz is used for aeronautical radionavigation. In Australia the band 410-430 MHz is heavily used by the land mobile service in urban locations. In the 420-430 MHz band the use of the mobile service is limited to Commonwealth, State and Territory Government purposes.	
450-470	This frequency band is allocated worldwide to the fixed, and mobile services on a co-primary basis, however these allocations are not the only service allocations within the band. In India, the bands 450.5-457.5 paired with 460.5-467.5 MHz have been allocated for cellular mobile technologies especially in rural areas. However, major portion of the band 450-470 MHz is presently used for conventional point-to-point links and mobile applications for variety of commercial and public safety applications. Utilisation in CEPT is for analogue and digital land mobile, cellular networks in some countries, PMR/PAMR for public safety and emergency networks in some countries. This band presents complex interlacing between PMR, PAMR and civil/governmental usage. In Japan, the band 440-470 MHz is used for cargo/passenger transportation services including taxi, railway and bus radio, anti-disaster emergency radio telephones, and aural program transmission by broadcasters.	For space applications and meteorology, Annex 1 of Recommendation ITU-R SA.1236 contains one approach to evaluate protection for fixed and mobile services while for remote sensing systems Annex 2 of Recommendation ITU-R RS.1260-1 provides information on the feasibility of sharing between active spaceborne sensors and other services in the range of 420-470 MHz (this Recommendation replaces Recommendation ITU-R SA.1260-1). Sharing studies between radars in the radiolocation service in the 420-450 MHz band and IMT systems in the 450-470 MHz are being progressed within the ITU-R. Preliminary results indicate that sharing between systems in the 440-450 MHz band is feasible only with mitigation. Application of mitigation techniques to IMT systems and radars is currently being studied to reduce the separation distances for sharing between IMT systems and radiolocation radars.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Japan, the band 440-470 MHz is used for unlicensed low-power stations such as radiophones, data transmission equipment and medical telemeters. In New Zealand the band 450-470 MHz is allocated to the fixed and mobile service. The band is heavily used by traditional commercial and public safety mobile applications. In Cameroon, Canada, Indonesia, Sri Lanka, the United States of America and Venezuela, these bands are allocated to the fixed and mobile service. In Canada, in the band 450-470 MHz, in high density population areas, these bands are used by traditional commercial mobile, broadcast auxiliary and public safety mobile services. In Canada, 30 channels of 12.5 kHz around 462 MHz and 467 MHz are assigned to licence-exempt devices (Family Radio Service & General Mobile Radio Service). The Inter-American Telecommunication Commission – CITEL has recently approved the Recommendation PCC.II/REC. 10 (V-05) on the "Use of the 410-430 MHz and 450-470 MHz bands for fixed and mobile services for digital communication particularly in low population density areas". In the United States of America, the 450-470 MHz band is allocated on a primary basis to the fixed and mobile services for a wide variety of uses, including public safety applications. The types of systems in the band include: trunking-dispatch, conventional 2-way mobile systems, and some point to point, used for both analog and digital voice, data, and telemetry applications. Rural and urban local, state, regional, and nationwide networks are deployed in this band. This band is extensively used by a wide variety of users including: business, film and video production, forest products, electronic news gathering, manufacturers, medical, motor carrier, petroleum, power, public safety, railroad, relay press, special industrial, taxicab, telephone maintenance, etc.	Sharing studies between systems in the fixed service and non-IMT systems in the mobile service and IMT systems in the 450-470 MHz band are being progressed within the ITU-R. Preliminary results indicate that co-channel sharing between Fixed or non-IMT systems in the mobile service and IMT systems is problematic in most instances. Adoption of mitigation techniques between the IMT systems in the mobile service and systems in the fixed service or non-IMT systems in the mobile service may be required to enable sharing between the two types of systems. Sharing studies between broadcasting services in the 470-480 MHz band and the IMT systems in the mobile service in the 450-470 MHz are being progressed within ITU-R. Preliminary results indicate that sharing between IMT and broadcasting systems in adjacent bands is feasible with the use of mitigation techniques.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Cameroon this band allocated to mobile and fixed services, some subscriber radio systems and private specialized mobile radio systems are operating in this band. In Mexico the band 450-470 MHz is used for point-to-point/multipoint applications. In Venezuela, the band 450-470 MHz is allocated to the fixed and mobile services. In Vietnam, 450-470 MHz commercial CDMA2000 1x system is deployed. Band allocated to mobile and fixed services In RCC countries parts of this band are used by analogue public cellular NMT-450 networks, CDMA450 networks providing IMT-2000-like services, narrowband PMR systems, space operation service, Earth exploration-satellite service, radio relays which are being transferred to another band, and by other systems. In Norway, the bands 453-457.5/463-467.5 MHz are used for: CDMA2000. The rest of the band is used for PMR and maritime mobile services. In Sri Lanka the band 440-470 MHz is allocated to mobile and fixed service. Current applications in Indonesia at 450-470 MHz are for fixed and mobile services. Fixed service applications are used for radio point to point, land mobile services. For mobile services, Indonesia currently utilizes digital CDMA2000 450 MHz technology for national coverage. In China, a majority of 450-470 MHz band is used for interphone services and for wireless access technologies in rural areas. In Australia the band 450-470 MHz is heavily used by the land mobile service in urban locations.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
470-960	Portions of this frequency band contain allocations to the fixed and mobile services which are harmonized in large regions of the world, however these allocations are not homogenous across the three regions of the ITU and there are other co-primary allocations to other services, in particular the broadcasting service. The band 470-862 MHz is subject to replanning by the Regional Radiocommunication Conference 2006 for Region 1 and one country in Region 3. In the United States of America the 470-512 MHz band is allocated on a primary basis to the broadcasting and mobile services. The 512-608 MHz and 614-698 MHz bands are allocated on a primary basis to the broadcasting service. 470-862 MHz, utilisation in CEPT is for analogue and digital television broadcasting and services ancillary to programme making, and services ancillary to broadcasting. There is a primary allocation for mobile service in the upper part of this band in many countries especially for defence usage. In some European countries the band 645-862 MHz is also used for aeronautical radionavigation service. Within the European Union, the introduction of digital television is ongoing, and in a number of countries digital television has already been successfully introduced and in some countries spectrum has already been freed up. This is accomplished by introducing digital transmission in the currently used channel spacing. After a period during which both digital and analogue transmissions continue in parallel, the analogue TV is being switched off, which is making spectrum available for either additional TV or other services. Some countries have declared that analogue TV will be switched off before 2010 while it might stretch over an additional 10 years in some other countries. Initial deployment of mobile TVand HDTV networks in some countries is occurring.	Concerning the broadcasting service, sharing studies are currently being progressed initially from an IMT perspective to investigate sharing between IMT-2000 and systems beyond IMT-2000 applications and digital television broadcasting applications the band 470-862 MHz. Results of sharing studies presented to date based on low and medium power broadcasting transmitters show feasibilities for coexistence between IMT and broadcasting systems including DVB-T, DVB-H and ATSC with band segmentation, which may require frequency rearrangement also taking into account geographical separations. The feasibility is subject to a number of assumptions and limitations. The feasibility of sharing between IMT and high power broadcasting transmitters has not yet been fully studied. Sharing studies between Broadcasting services in the 470-480 MHz band and the IMT systems in the mobile service in the 450-470 MHz are being progressed within ITU-R. Preliminary results indicate that sharing between IMT and broadcasting systems in adjacent bands is feasible with the use of mitigation techniques.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In the Russian Federation the band is also used for: broadcasting satellite system (702-726 MHz and 742-766 MHz), tropospheric scatter radio-relay links (475-525 MHz and 575-625 MHz), radioastronomy (608-614 MHz), aeronautical radionavigation, limited to ground-based radiobeacons (862-960 MHz). The band 470-862 MHz is used for analogue TV stations with the plan to be switched to digital TV. However, the duration of the transitional period from analogue to digital TV can be hampered taking into account the large amount of analogue stations and current use of this band by other services. In India, the band 470-806 MHz is extensively used for analog TV broadcasting. This band is identified for introduction of digital terrestrial TV broadcasting and, during the transition period, both analog and digital TV transmissions will go in parallel. Complete transition from analog to digital terrestrial TV broadcasting is expected to take considerable time. New technologies such as Digital Video Broadcasting-Handheld (DVB-H) and Digital Multimedia Broadcasting (DMB) are also likely to be implemented. Parts of this band are also used extensively for conventional fixed and mobile services. In India, the bands 824-844 MHz paired with 869-889 MHz are presently allocated and used for CDMA based mobile telecom services. In India, the bands 890-915 MHz paired with 935-960 MHz are presently allocated and used for GSM based mobile telecom services. In Japan, the band 470-770MHz is used for television broadcasting. The use of the band 710-770 MHz for television broadcasting will be terminated by 24 July 2012. In Japan, the band 710-722MHz will be used for land mobile services and/or broadcasting services except television broadcasting from 25 July 2012 onward. In Japan, the band 722-770 MHz will be used for land mobile services from 25 July 2012 onward.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Japan, the band 770-806 MHz is used for broadcast auxiliary services (remote pick up units for TV broadcasting). In Japan, the bands 779-788 and 797-806 MHz are used for radio microphones. In Japan, the band 806-810 MHz is used for radio microphones (unlicensed low-power). In Japan, the bands 810-850, 860-901, 915-950 and 956-958 MHz are used for cellular phones. In Japan, the bands 836-838, 850-860, 891-893 and 905-915 MHz are used for MCA (multi-channel access). The use of 836-838 and 891-893 MHz for MCA is allowed only until 31 May 2007. In Japan, the bands 830-832 and 885-887 MHz are used for airport MCA. The use of 831.5-832 and 886.5-887 MHz by airport MCA is allowed only until 30 September 2007. In Japan, the bands 846-850 and 901-903 MHz are used for radio disaster prevention radio. The use of these bands by regional disaster prevention radio is allowed only until 31 May 2011. In Japan, the band 903-905 MHz is used for personal radio communications. In Japan, the band 950-956 MHz is used for RFID. In Japan, the band 958-960 MHz is used for broadcast auxiliary services (remote pick up units for TV broadcasting). In Japan, the band 806-960 MHz is also allocated to the terrestrial components of IMT-2000.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In New Zealand the band 470-502 MHz is allocated to the fixed and mobile services and heavily used by commercial and public-safety mobile applications. The band 502–806 MHz is allocated to the broadcasting service, managed under a property rights based spectrum management regime, and utilised for television, broadcasting. In New Zealand the band 806-960 MHz is allocated to the fixed and mobile services. The sub-bands 825–845 MHz, 870–890 MHz, 890-915 MHz and 935-960 MHz are managed under a property rights based spectrum management regime and utilised for cellular telephony applications (including IMT-2000). Other sub-bands in the 806-960 MHz range are utilised for commercial and public-safet mobile applications, and broad band fixed links in support of the broadcasting industry (studio-to-transmitter linking). In the United States of America the 470-512 MHz band is allocated on a primary basis to the broadcasting and mobile services. In the United States of America, the 608-614 MHz band is allocated on a primary basis to radio astronomy, is shared with low power biomedical telemetry devices, and is heavily used. Considering the importance of the broadcasting TV service in Brazil, and the need to implement the digital TV, the frequency bands 470-608 MHz and 614-806 MHz will be heavily used during the transition towards DTV. In Cameroon the 470-862 MHz band are planned for broadcasting services but currently sparsely used. In Mexico, the band 470-512 MHz is used for point-to-point/broadcasting applications.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In the United States of America the 698-806 MHz band is being transitioned from analogue to digital TV (DTV) freeing some spectrum formerly allocated to the broadcasting service for other uses. The 698-764 MHz and 776-794 MHz bands are allocated on a primary basis to the fixed, mobile, and broadcasting services. The 764-776 MHz and 794-806 MHz bands are allocated to the fixed and mobile services. The 764-776 MHz and 794-806 MHz bands are designated for the long term for public safety use. In Canada, the band 608-614 MHz is allocated to radioastronomy. In Canada, the band 470-806 MHz is allocated to broadcasting, process is underway to implement RR No. 5.293 to make the band above 746 MHz available exclusively to the mobile services, and to designate the sub-bands 764-776 MHz and 794-806 MHz exclusively for public safety use. In the United States of America the band 512-608 MHz and 614-698 MHz is used for broadcasting use, limited mobile use, radioastronomy sensitivity and critical medical care services. In the United States of America the 698-806 MHz band is being transitioned from analog to digital TV (DTV) freeing some spectrum formerly allocated to the broadcasting service for other uses. The 698-764 MHz and 776-794 MHz bands are allocated on a primary basis to the fixed, mobile, and broadcasting services. The 764-776 MHz and 794-806 MHz bands are allocated to the fixed and mobile services. The 764-776 MHz and 794-806 MHz bands are designated for public safety use for the long term.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In the United States of America the 806-894 MHz band is segmented into several primary allocations to the fixed and/or mobile services. The 806-824/851-869 MHz portion of the band is being restructured to enable public safety (which is currently utilizing 821-824/866-869 MHz) to move to 806-809/851-854 MHz. Similarly, enhanced mobile radio service (EMRS) will be relocated from 806-817/851-862 MHz to 817-824/862-869 MHz. The band 809-817/854-862 MHz will be allocated to the mobile service for public safety, non-cellularized special mobile radio service (SMR) and private land mobile for the long term. In the United States of America, Canada and Brazil the 824-849 and 869-894 MHz bands are allocated on a primary basis to the mobile service. In the United States of America, the 806-821/851-866 MHz band is allocated on a primary basis to the fixed and mobile services for a wide variety of uses, including public safety applications. In Canada, the band 806-824/851-866 MHz is used for commercial and public safety mobile services. In the Republic of Korea the band 752-806 MHz is temporarily used for digital television broadcasting and allocated to the mobile service. In CEPT, parts of the 862-960 MHz band are used for E-GSM (880-890 MHz/925-935 MHz) and GSM900 (890-915 MHz/935-960 MHz). In some CEPT countries GSM operators are authorised to migrate to IMT-2000. In China, the band 470-798 MHz is widely used for analog TV broadcasting. And 798-806 MHz is used for analog TV in specified cities. The Chinese administration plans to implement digital terrestrial TV broadcasting service in this band , however the transition from analog terrestrial TV broadcasting service to digital terrestrial TV broadcasting service may need a long period. Part of this band, 566-606 MHz, also has been allocated to fixed, mobile and aeronautical radionavigation service.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In China, 798-806 MHz paired with 843-851 MHz are used for relay systems. In China, 806-821 MHz paired with 851-866 MHz are used for trunk systems. In China, 821-824 MHz is used for narrow band communication system. In China, 824-825 MHz paired with 869-870 MHz are used for wireless data system. In China, 825-835 MHz paired with 870-880 MHz are used for CDMA cellular systems. In China, 885-890 MHz paired with 930-935 MHz are used for GSM-R cellular systems. 885-889 MHz paired with 930-934 MHz are also used for GSM public cellular systems. In China, 890-915 MHz paired with 935-960 MHz are used for GSM cellular systems. In China, these bands, 825-835 MHz / 870-880 MHz and 885-915 MHz/ 930-960 MHz currently allocated for public mobile systems are also allocated as FDD extension bands for future IMT-2000 communication systems in China. The spectrum that has been licensed for the existing operators for GSM and CDMA can continue to use. If the operators would like to migrate their existing systems to IMT-2000, must be approved by the administration.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Australia the 470-520 MHz band is heavily used by land mobile services in urban locations. The 520-820 MHz band *is extensively used by terrestrial analog and digital television services*. The band 820-960 MHz is heavily used by fixed and mobile services. In the sub-bands 825-845/ 870-890 MHz long-term (15-year) technology-flexible licences have been issued and are mainly used for mobile telephony applications (including IMT-2000) while in the sub-bands 890-915/935-960 MHz technology specific licences have been issued and are being used for the provision of GSM900 services. In Israel band usage is as follows: a) 806-824 MHz paired with 851-869 MHz are used for trunk systems, b) 825-835 MHz paired with 870-880 MHz are used for CDMA2000 cellular systems, c) 835-845 MHz paired with 880-890 MHz are used for TDMA cellular system are used for GSM cellular system.	
1 710-2025 and 2 110-2 200	This frequency band is allocated worldwide to the fixed, and mobile services on a co-primary basis, and is identified for IMT-2000, however these allocations are not the only service allocations within the band. In India, the band 1 710-1 885 MHz is used for variety of fixed and mobile applications by different private and Government agencies. This band has also been allocated and used for GSM based cellular mobile service. In India, 1 880-1 900 MHz and 1 900-1 910 MHz is allocated for micro cellular wireless access systems (fixed/mobile) in TDD mode including indigenous Cor-DECT systems. In India, the band 1 920-1 980 MHz paired with 2 110-2 170 MHz is allocated for implementation of IMT-2000. This band is used for variety of fixed and mobile applications by different agencies.	Recommendation ITU-R F.1334 contains the protection criteria for the fixed service sharing frequency bands between 1 and 3 GHz with the land mobile service.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In India, the band 2 010-2 025 MHz is allocated for implementation of IMT-2000 (TDD mode). This band is used for variety of fixed and mobile applications by different agencies. In India, the band 2 110-2 170 MHz paired with 1 920-1 980 MHz is allocated for implementation of IMT-2000. The band is used for some conventional point to point links. The requirement of space research (deep space), at specific locations, is also being met in accordance with the existing provisions. In India, the band 2 170-2 400 MHz is extensively used for variety of fixed and mobile applications by different agencies. In Japan, the bands 1 710-2 025 MHz and 2 110-2 200 MHz are identified for the use of the terrestrial components of IMT-2000. The band 2 010-2 025 MHz is used for IMT-2000 (TDD). The bands 1 749.9 1 784.9/ 1 844.9-1 879.9 MHz and 1 920-1 980/2 110-2 170 MHz are used for IMT-2000 (FDD). In Japan, the band 1 710-1 850 MHz is used for public services. In Japan, the band 1 884.5-1 919.6MHz is used for PHS. In New Zealand the 1 710-2 200 MHz frequency range is allocated predominantly to the mobile and fixed service, and managed under a property rights based spectrum management regime. The band 1 710-1 785 MHz paired with 1805–1880 MHz is utilised for the delivery of cellular telephony applications. The band 1 880–1 920 MHz is utilised for the delivery of mobile telephony applications (e.g. DECT, USA-PCS). The band 1 920–1 980 paired with 2 110–2 170 MHz is utilised for the delivery of IMT-2000 applications. The band 2 010–2 025 MHz is suitable for the delivery of IMT-2000 TDD applications. The band 2 025-2 110 MHz paired with 2 200-2 300 MHz is utilised for fixed wireless access applications and traditional fixed linking applications.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Canada, the bands 1 850-1 910 MHz paired with 1 930-1 990 MHz are licensed for personal communications services. These bands are defined for PCS use in North America. In Canada, a process is underway to make the bands 1 710-1 755 MHz paired with 2 110-2 155 MHz, 1 910-1 920 MHz paired with 1 990-2 000 MHz, 2 020-2 025 MHz and 2 155-2 180 MHz available for subscriber related radiocommunication services such as PCS, third generation cellular, IMT-2000, fixed wireless access, wireless multimedia, etc. In the United States of America the 1 710-1 755 MHz paired with 2 110-2 155 MHz is allocated to the fixed and mobile service for advanced wireless applications. The band 1 755-1 850 MHz is used for fixed and mobile services in addition the band 1 761-1 842 MHz is used for space operations. In CEPT, the bands as identified by No. 5.388 at WARC-92 for IMT-2000 have been licensed for IMT-2000/UMTS networks by at least 22 countries based on the channelling arrangement B1 of Recommendation ITU-R M.1036-2. The bands 1 710-1 785 MHz / 1 805–1 880 MHz are currently used for GSM1800. In some CEPT countries GSM operators are authorised to migrate to IMT-2000. In the Russian Federation the bands are also used for systems in fixed service: line-of-sight radio-relay systems in the whole bands and wireless access systems DECT (1 880-1 900 MHz), space research systems (2 110-2 120 MHz). In Brazil the bands 1 710-1 785 MHz and 1 805-1 880 MHz are allocated to the mobile service and parts of them are currently being used for GSM-1800. In China, 1 710-1 755 MHz paired with 1 805-1 850 MHz are used for GSM1800 cellular systems.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In China, 1785-1 805 MHz is used for SCDMA communication system. In China, 1 880-1 920 MHz, 2 010-2 025 MHz, 1 920-1 980 MHz and 2 110-2 170 MHz are allocated for IMT-2000. Among these bands, 1 880-1 920 MHz and 2 010-2 025 MHz are used for TDD, 1 920-1 980 MHz and 2 110-2 170 MHz are used for FDD. Additionally, 1 755-1 785 MHz and 1 850-1 880 MHz will be used for IMT-2000. 1 755-1 785 MHz paired with 1 850-1 880 MHz are used for FDD. In China, 1 710-1 755 MHz / 1 805-1 850 MHz is also allocated as FDD extension bands for future IMT-2000 communication systems. In Australia, the bands 1 710-1 785/1 805-1 880 MHz (restricted to the lower 15 MHz in regional areas), long-term (15-year) technology-flexible licences have been issued and are mainly used for mobile telephony applications (GSM1800), whilst in remote areas the bands are used for fixed point-to-point links. The band 1 880–1 900 MHz is utilised for the delivery of mobile telephony applications (e.g. DECT/PHS). In the 1 900-1 920 MHz band long-term (15-year) technology-flexible licences have been issued in capital cities and are mainly used for nomadic broadband wireless access services there are also a large number of broadband wireless access systems operating in regional and remote areas. In the bands 1 920-1 980 MHz/2 110-2 170 MHz (restricted to the upper 20 MHz in regional areas), long-term (15-year) technology-flexible licences have been issued and are mainly used for mobile telephony applications (including IMT-2000), whilst in remote areas the bands are used for fixed point-to-point links. In the 2 010-2 025 MHz band a process is underway to make the band available in capital city and regional areas via the auction of long-term (15-year) technology-flexible licences (predominant use is anticipated to be broadband wireless access services) whilst in remote areas the band may be used for the provision of broadband wireless access and fixed point-to-point link services.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
2 300-2 400	This frequency band is allocated worldwide to the fixed, and mobile services on a co-primary basis, however these allocations are not the only service allocations within the band. Utilisation in CEPT is for aeronautical telemetry, amateur, SAB/SAP, mobile applications, fixed radio links, defence systems in some countries, and radiolocation in some countries. In the Russian Federation this band is also used for wireless access systems. In Japan, the band 2 300-2 400 MHz is used for public service. In New Zealand, the band 2 300–2 400 MHz is allocated predominantly to the fixed and mobile services. The band is managed using a property rights based spectrum management regime. In Canada, the band 2 200-2 300 MHz and 2 360-2 400 MHz are for exclusive of the Government of Canada. In Canada, the band 2 305-2 320 MHz paired with 2 345-2 360 MHz were licensed for wireless communication services by auction in February 2004. In the Republic of Korea, the band 2 300-2 400 MHz is currently used for fixed services and mobile services, called WiBro. In India, the band 2 170-2 400 MHz is extensively used for variety of fixed and mobile applications by different agencies. In China, the band 2 300-2 400 MHz is identified for IMT-2000 TDD. This frequency band is also allocated to the radiolocation services on a primary basis. In Australia, long-term (15-year) technology-flexible licences have been issued for the 2 302-2 400 MHz band and can be used for the provision of broadband wireless access services.	Recommendation ITU-R F.1334 contains the protection criteria for the fixed service sharing frequency bands between 1 and 3 GHz with the land mobile service.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
2 500-2 690	This frequency band is allocated worldwide to the fixed, and mobile services on a co-primary basis, and is identified for IMT-2000, however these allocations are not the only service allocations within the band. In India, the frequency band 2 500-2 690 MHz is being used for satellite based BSS and MSS systems. A part of the band is also being used for terrestrial point-to-multi point systems by Internet Service Providers. In Japan, the bands 2 483.5-2 535 and 2 655-2 690 MHz are allocated to mobile satellite communications services. The bands 2 500-2 535 and 2 655-2 690 MHz are used for mobile satellite communications services. In Japan, the band 2 605-2 655 MHz is allocated for satellite sound broadcasting. The band 2 630-2 655 MHz is used for satellite sound broadcasting. In New Zealand, the band 2 500–2 690 MHz is allocated predominantly to the fixed service and utilised for itinerant fixed linking for television outside broadcast operations. In Canada, the band is currently allocated to fixed, mobile and broadcast services. Canada recently issued a policy identifying the process for the implementation of mobile service and a transition to a new band plan. CEPT has designated the band 2 500-2 690 MHz for terrestrial IMT-2000/UMTS services by January 2008, in accordance with the channelling arrangements C1 and C2 as agreed in the draft revision of Recommendation ITU-R M.1036-2. In the Russian Federation, the band is used for systems in fixed service: wireless access systems (2 500-2 700 MHz) and MMDS (2 500-2 700 MHz) and radar applications. In Indonesia, the band 2 520-2 670 MHz is used for the broadcasting satellite service. In China, 2 535-2 599 MHz is used for MMDS system.	Recommendation ITU-R F.1334 contains the protection criteria for the fixed service sharing frequency bands between 1 and 3 GHz with the land mobile service.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Australia, the band 2 500-2 690 MHz is currently used by nomadic fixed services for electronic news gathering (ENG) and television outside broadcast (TOB).	
2 700-2 900	This frequency band is allocated worldwide on a primary basis to the aeronautical radionavigation service. In Sweden and Norway, the current usage of the band 2 700-2 900 MHz is very limited. This frequency band is a major band for radiodetermination services, either radionavigation or radiolocation (see 5.423) and is currently heavily used in France for civil aviation, defence radars and meteorological purposes, all relating to safety of life and property. In particular, meteorological radar play a crucial role in the immediate meteorological and hydrological alert processes and represent the first line of defence against loss of life and property in flash flood events, such as in South of France, where severe weather conditions often occur and where most of these radars are deployed. Due to propagation conditions in this frequency band, this band is essential and same detection characteristics would not be retrieved in other radar bands. Concerning civil aviation radars in France, this band is the main band for primary radars. Such radars are now used for medium range detection and new deployments of primary radars will be made in this band. Moreover, primary radars which were previously using bands around 1.2 GHz are now progressively migrating into the band 2 700-2 900 MHz. Defence radars in France are also used for safety of flights. In India, this band is extensively used for variety of fixed and mobile applications by different agencies. In Japan, the band 2 700-3 000 MHz is used for miscellaneous radars (ASR, etc).	Recommendation ITU-R M.1461-1 provides guidance for determining the potential for interference between radars operating in the radiodetermination service and systems in other services while Recommendation M.1464 provides how to analyse between systems operating in the radiodetermination service and systems operating in other services. Recommendation M.2039 provides IMT-2000 parameters and interference criteria. Sharing studies are currently being progressed within the ITU-R to investigate sharing between ARNS and meteorological radars and IMT-2000 and beyond IMT-2000 systems in the 2 700-2 900 MHz band. Interference simulations between incumbent radars operating in the band 2 700-2 900 MHz and IMT-2000 systems show that interference will occur to ARNS and meteorological radars on a co-channel basis. Separation distances of greater than 100 km between radar and the nearest macro, micro, and pico IMT network to protect radar operation are shown to be necessary. Studies also show that carrier separations of 5 MHz to 15 MHz and IMT mitigation techniques of urban clutter protection and 30 dB front-end filters can be applied to reduce the required separation distances to 25-40 km for the macro base stations, and 1-5 km for micro and pico base stations. Analysis of interference from radars into IMT networks show that interference will be present even at distances of hundreds of kilometers. However, this interference may not seriously affect quality of service due to the radar's pulse characteristics and the error correcting features of the IMT devices.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	Within New Zealand, the band 2 700–2 900 MHz is allocated (under No. 4.4) to the fixed service and utilised for itinerant fixed linking for television outside broadcast operations. Additional allocations to the aeornautical radionavigation and radiolocation services are utilised for Government services. In the United States of America, the 2 700-3 400 MHz bands are used for radiolocation and radionavigation radars for the long term. In the United States of America, the 2 700-2 900 MHz band is allocated on a primary basis for aeronautical radionavigation, meteorological aids and radiolocation. In Canada, parts of CEPT and the United States of America the 2 700-2 900 MHz band is utilised for meteorological radar, radar, and navigation systems in the long term. In the Russian Federation, the band is also allocated to the radiolocation service on a primary basis and heavily used for aeronautical radionavigation systems and radar applications. In China, this band is used for radiolocation services. In Australia, the 2 700-2 900 MHz band is used for safety-of-life related aeronautical radionavigation systems. This is the band used for air traffic control radars for commercial and private aircraft movements, meteorological aids and radiolocation. In Australia, the 2 700-3 400 MHz bands are used for government radar applications.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
3 400-4 200	Portions of this frequency band contain primary allocations to the fixed service. Portions of this band contain primary allocations to the mobile. In Regions 2 and 3, in the band 3 400-3 600 MHz the radiolocation service is allocated on a primary basis. However, all administrations operating radiolocation systems in this band are urged to cease operations by 1985. Thereafter, administrations shall take all practicable steps to protect the fixed-satellite service and coordination requirements shall not be imposed on the fixed-satellite service. The fixed, mobile and radiolocation allocations are not necessarily worldwide, nor are they homogenous across this band. The primary mobile allocation is not worldwide, nor is it homogenous across this band. This band 3 400-4 200 MHz is allocated worldwide to the fixed-satellite service on a primary basis In Indonesia, this band is extensively used by the FSS and has provided vital telecommunications infrastructure to serve the archipelagic country that consist of 220 million people and seventeen thousand islands and also has been proven essential for recovering during natural disaster. The band 3 400-4 200 MHz is heavily used by FSS satellites for many essential telecommunication needs, and its use is constantly developing in Asia, the Pacific, Africa, the Arab States, parts of Europe and the Americas. It also provides essential inter-continental connectivity. This band is used, amongst other applications, for program distribution to cable head-ends and radio/TV broadcast stations, broadband communications, VSATs, SNG, weather data distribution to airlines and pilots, and position location and status for trucking fleets.	Recommendation ITU-R M.1465 contains the representative technical and operational characteristics of the radiolocation radars in the frequency band 3 100-3 700 MHz. Sharing studies are being progressed within the ITU-R between IMT-2000 and systems beyond IMT-2000 applications and the radiolocation service in the band 3 400-3 700 MHz. Preliminary studies between airborne radar and IMT have concluded that: – The required separation distance is approximately 360 km in some cases where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and airborne radar systems. – Using non-overlapping adjacent channel analysis only, the required separation distance is approximately 0 km, depending on the radar type and antenna type. Preliminary studies between shipborne radar and IMT have concluded that: – The required separation distance is approximately 45 km in some case where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and Shipborne radar systems. – Using non-overlapping adjacent channel analysis only, the required separation distance is less than 1 km, depending on the radar type and antenna type.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In addition to its long-standing use as the first commercial FSS band, the band 3 400-4 200 MHz continues to be chosen for high-availability links. The lower atmospheric absorption in this frequency enables high degree of reliability and wide and/or transcontinental coverage particularly in geographical areas with severe rain fade conditions.With required fade margins typically less than 2 dB, 4 GHz FSS links can provide the very highest point-to-point (radio) link availability at lowest cost. Due to the excellent fade characteristics, this band is favoured in regions where high rainfall makes higher bands unfeasible for reliable communications links. In developing countries, it is often the only choice for such links. There are currently more than 160 geostationary satellites operating in these bands, utilizing the entire FSS allocation in this part of the spectrum with global, regional and national coverages. Nearly two-thirds of all commercial satellites currently under construction will operate within the FSS allocation in this part of the spectrum. In addition, there are many satellites that operate predominantly in bands other than 3 400-4 200 MHz but use the 3 400-4 200 MHz band for their telemetry operations (telemetry, tracking and ranging). In Russia, Indonesia reported that they have currently licensed several thousand earth stations operating to satellites in this band. In India, the band 3 400-3 700 MHz is used by fixed-satellite service. In India, the band 3 700-4 200 MHz is extensively used for fixed-satellite service for variety of systems/applications. In Vietnam, the band 3 400-4 200 MHz is allocated to fixed-satellite service on a primary basis. This band will continue to be used extensively for FSS in the future. The 3.4-4.2 GHz band is currently heavily used by the fixed-satellite service (FSS) for downlinks in parts of Asia.	It is noted that for both airborne and shipborne scenarios that if interference mitigation measures are implemented at the IMT system, the required separation distances can be reduced and also that detailed sharing studies are underway and may be completed prior to WRC-07. Finally, it should also be noted that many areas to be observed by these radars are those over oceans or at high altitudes. Densely populated land areas where IMT traffic demand is high seldom coincide with the target of the observation areas of these radars. Sharing studies have been performed related to the possibility of IMT-2000 and beyond systems to be deployed in the band utilized by the FSS in the bands 3 400-4 200 MHz and 4 500-4 800 MHz. To provide protection of the FSS receive earth stations, some physical separation to the stations of the mobile terrestrial network is required. The magnitude of this separation distance depends on the parameters of the networks and the deployment of the two services. The magnitudes of these required distances to protect the FSS receive earth stations have been studied, taking account of the need to meet both short term and long term interference criteria requirements. Although the studies have differences in assumptions and methodologies and need to be continued to find convergence, they all show that ubiquitously deployed IMT-Advanced systems can not share in the same geographical area with FSS, when the FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, since no minimum separation can be guaranteed. Sharing may be feasible only when the receiving earth station is specific under the condition that the minimum required separation distance together with the criteria mutually agreed between the concerned administrations are observed.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In the band 3 400-3 600 MHz utilization in CEPT is for fixed links, fixed wireless access, systems (including nomadic applications), mobile applications and few satellite receiving earth stations. In the European Common Allocation (ECA) Table this band is allocated on a primary basis by footnote (in accordance with No.4.4 of the Radio Regulations), and refers the mobile allocation to services ancillary to programme making/services ancillary to broadcasting. In the band 3 600-3 800 MHz utilization in CEPT is for Fixed wireless access systems (including nomadic applications), medium/high capacity fixed links, and receiving earth stations in the FSS. In the band 3 800-4 200 MHz utilization in CEPT is for medium/high capacity fixed links, and receiving earth stations in the FSS . In the Russian Federation, the band is also used for systems in fixed service: line-of-sight radio-relay systems (3 400-3 900 MHz and 3 900-4 200 MHz with the transition to the band 3 600-4 200 MHz), wireless access systems (3 400-3 450 MHz and 3 500-3 550 MHz); space operation application (3 400-3 450 MHz) and radar applications (3 400-3 600 MHz). The band is heavily used for earth stations (3 400-4 200 MHz) including stations on board vessels (3 700-4 200 MHz) in fixed-satellite service.	The effect of use of terrain information on the reduction of the separation distance has been studied. Studies have also shown that the use of local terrain information will reduce the separation distance. The degree of this reduction will depend on the specific circumstances. However, the availability of reliable local terrain information has not been proven for all countries. Site shielding for FSS earth stations would mitigate interference from IMT Advanced systems. One study has shown that the use of multi-carrier schemes application as one of the possible mitigation techniques can reduce the protection distance range. The impact of other mitigation techniques such as narrow-beam transmission based on sectorized- or adaptive-beamforming antenna which could further improve the sharing situation needs to be further studied. The effectiveness of any mitigation technique is dependent on its application to individual site situations and can be applied only when FSS earth stations are confined to specific known locations. Further studies are necessary to determine the geographic circumstances which would permit the effective use of such techniques.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	For the last 15 years, besides the C-band (3 700-4 200 MHz) in the downlink, the Brazilian satellites also use an extended C-band (3 625-3 700 MHz) as it is not shared in Brazil with the fixed service and is suited to applications with multiple terminals such as VSATs. Presently, there are more than 8,000 earth stations pointing to one of the Brazilian satellites in standard C-band and 12 000 earth stations pointing to one of the non-Brazilian satellites that cover the country plus an equal number of earth stations in the 75 MHz extended C-band and around 20 million TVRO terminals scattered around the country. Two new Brazilian satellites using C-band are presently under construction so this band will be extensively used for at least twenty years. In New Zealand, the band 3 400–3 600 MHz is allocated predominantly to the fixed and radiolocation services, is managed under a property rights based spectrum management regime and utilsed for fixed wireless access applications. The band 3 600–4 200 MHz is allocated to the fixed and fixed-satellite services and utilized for coordinated fixed links and C-band satellite applications. In Canada, the band 3 475-3 650 MHz was licensed for fixed wireless access by auction in February 2004. The band 3 400-3 450 MHz is allocated to radiolocation for the exclusive use of the Government of Canada. In the United States of America, the 3 400-3 650 MHz band is allocated on a primary basis to the Federal Government for the radiolocation service and is used for high power airborne, shipboard and ground-based radars. In Brazil, the band 3 400-3 600 MHz is allocated to the fixed service BWA. In Japan, the band 3 400-3 600 MHz is allocated and used for the fixed and mobile services.	With respect to co-existence between ubiquitously deployed IMT Advanced and the ubiquitously deployed FS, it has been suggested that it will be unlikely that both services could be deployed within the same geographic area in the same country. However, deployment of IMT Advanced in one country and FS in a neighbouring country can be foreseen. With respect to interference from FSS into IMT Advanced, studies have provided a range of results, from interference criteria not being exceeded up to interference criteria being exceeded by 5 dB, depending on the assumptions (particularly the type of IMT-Advanced base station considered and the FSS space station EIRP density). Further studies are required, before WRC-07, to confirm these results by using agreed assumptions.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In Japan, the band 3.6-4.2 GHz is currently used for the fixed service and the fixed-satellite service, however this band has also been allocated to the mobile services to be used after 2010. The use of this band for the fixed services is allowed only until 30 November 2012. The 3.5 GHz (3 400-3 600 MHz) band is licensed in Venezuela for fixed wireless access applications. In the United States of America, the 3 600-3 650 MHz band is also allocated on a primary basis to the fixed-satellite service (space-to-Earth). In the United States of America, the 3 650-3 700 MHz band is allocated on a primary basis to the fixed, fixed-satellite and mobile services; the radiolocation service is allocated at 3 locations within the United States of America and on a non-interference basis for ship locations at least 44 nautical miles in off-shore ocean areas. In the United States of America, the 3 700-4 200 MHz band is allocated on a primary basis to the fixed and fixed-satellite (space-to-Earth) services. In Canada, the band 3 700-4 200 MHz is being heavily used by the fixed-satellite service in the space-to-Earth direction, with significant operations in both urban and rural areas. Satellite applications making use of this band include provision of communications services to remote communities. The use of spectrum by the fixed service (heavy route microwave) is for terrestrial links; aviation; meteorological; military and coast guard; and broadcast services. In the United States of America, the 3 700-4 200 MHz band is allocated on a primary basis to the fixed and fixed-satellite (space-to-Earth) services. The band is used extensively for terrestrial point-to-point or microwave systems, and for fixed-satellite earth stations, both domestic and international. It is also utilized by earth stations on vessels (ESVs) in and around United States of America ports. Critical public safety infrastructure is deployed in this band as well.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In the Republic of Korea, the band 3 400-3 500 MHz is allocated to the fixed and mobile services on a primary basis. In the Republic of Korea, the band 3 500-3 700 MHz is used for fixed service and fixed-satellite service but has also been allocated to mobile services on a primary basis. Traditionally, the C-band (downlink) mainly uses the frequency band 3.7~4.2 GHz. Because of the limitation of the orbit resource, In China, the frequency band for C-band has to extend to the lower bands, which could lead to the satellite's transponders working in the band of 3.4~3.7 GHz. The parts of this band, 3 400-3 430/3 500-3 530 MHz, are used for fixed wireless access services. 3 600-4 200 MHz band is used for microwave links. In Australia, the band 3 400-3 600 MHz is used for radiolocation and fixed services. In the sub-bands 3 425-3 492.5 and 3 542.5-3 575 MHz long term (15 year) technology-flexible licences have been issued in capital cities and regional areas only and are mainly used to provide fixed/broadband wireless access services. The 3 600-4 200 MHz band is used for fixed point-to-point link services and C-band satellite downlink services. The extended C-Band, i.e. below 3 700 MHz, is less extensively used for downlink services in Australia. In the United Arab Emirates, the band 3 400-4 200 MHz is heavily used by the fixed-satellite service and also used for feeder link operations between many already deployed space stations and their corresponding earth stations.	

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
4 400-4 990	This frequency band is allocated worldwide to the fixed, mobile and fixed satellite services on a primary basis, however these allocations are not the only service allocations within the band. The band 4 500-4 800 MHz, is part of the fixed-satellite service Plan (RR Appendix 30B). Appendix 30B is the subject of agenda item 1.10 of WRC-07 the outcome of that agenda item may have impact on the consideration of this frequency band for Agenda item 1.4. The fixed-satellite service Plan (RR Appendix 30B) is intended to preserve orbit/spectrum resources for future use, on an equitable basis among all country members of the ITU, and is of the utmost importance to developing countries that may not have the possibility to implement satellite systems in unplanned bands (that suffer more and more from congestion) in the short-and mid-terms. To safeguard the value of the allotted capacity in this Plan, it is important that administrations can implement this capacity at any time that they so wish without encountering interference or disruption. The Plan is important for inter-governmental systems such as RASCOM involving more than 50 African countries using and intending to implement satellite systems in the frequency band 4.5-4.8 GHz of Appendix 30B for their infrastructure telecommunication systems. In other developing countries, in particular those countries in which there is high rainfall rate, the above-mentioned frequency band is also used to provide their basic infrastructure telecommunication systems. In India, this band is extensively used for variety of fixed and mobile applications by different agencies. The frequency band 4 500-4 800 MHz band is extensively used by fixed-satellite service. In CEPT, the band 4 400-5 000 MHz is used for defence systems, mobile applications, and transhorizon links.	Recommendation ITU-R F.1706 – Protection criteria for point-to-point fixed wireless systems sharing the same frequency band with nomadic wireless access systems in the 4 to 6 GHz range. Recommendation ITU-R F.302 – Limitation of interference from trans-horizon radio-relay systems. Recommendation ITU-R F.698 – Preferred frequency bands for trans-horizon radio-relay systems. Recommendation ITU-R M.1465 contains the representative technical and operational characteristics of the radiolocation radars in the frequency band 3 100-3 700 MHz. Sharing studies are being progressed within the ITU-R between IMT-2000 and systems beyond IMT-2000 applications and the radiolocation service in the band 3 400-3 700 MHz. Preliminary studies between airborne radar and IMT have concluded that: – The required separation distance is approximately 360 km in some cases where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and airborne radar systems. – Using non-overlapping adjacent channel analysis only, the required separation distance is approximately 0 km, depending on the radar type and antenna type. Preliminary studies between shipborne radar and IMT have concluded that: – The required separation distance is approximately 45 km in some case where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and shipborne radar systems.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	In CEPT, the band 4 500-4 800 MHz is used for coordinated earth stations in FSS, defence systems, mobile applications, and transhorizon links. In CEPT, the band 4 800-4 990 MHz is used for defence systems, mobile applications, passive applications, and radioastronomy applications. The band 4 400-5 000 MHz is identified as a harmonised NATO band type 1 for fixed, tactical radio relay and mobile systems. In the Russian Federation, the band is also used for systems in fixed service: tropospheric scatter radio-relay links (4 435-4 555 MHz and 4 630-4 750 MHz), line-of-sight radio-relay systems (4 400-5 000 MHz), mobile systems (4 400-4 800 MHz), and radioastronomy (4 800-5 000 MHz). In New Zealand, the band 4 400-4 990 MHz is allocated to the fixed service and utilized for an extensive nationwide network of high-capacity fixed links. The band is allocated to the fixed-satellite service in accordance with the provisions Appendix 30B. This band is intensively used in Brazil for long distance links of the public switched telephone network. In the United States of America, the 4 400-4 940 MHz band is allocated on a primary basis to the fixed and mobile services. The 4 500-4 800 MHz band is also allocated to the fixed-satellite service (space-to-Earth) in accordance with the provisions of Appendix 30B.	– Using non-overlapping adjacent channel analysis only, the required separation distance is less than 1 km, depending on the radar type and antenna type. It is noted that for both airborne and shipborne scenarios that if interference mitigation measures are implemented at the IMT system, the required separation distances can be reduced and also that detailed sharing studies are underway and may be completed prior to WRC-07. Finally, it should also be noted that many areas to be observed by these radars are those over oceans or at high altitudes. Densely populated land areas where IMT traffic demand is high seldom coincide with the target of the observation areas of these radars. Sharing studies have been performed related to the possibility of IMT-2000 and beyond systems to be deployed in the band utilized by the fixed-satellite service (FSS) in the bands 3 400-4 200 MHz and 4 500-4 800 MHz. To provide protection of the FSS receive earth stations, some physical separation to the stations of the mobile terrestrial network is required. The magnitude of this separation distance depends on the parameters of the networks and the deployment of the two services. The magnitudes of these required distances to protect the FSS receive earth stations have been studied, taking account of the need to meet both short term and long term interference criteria requirements.

TABLE 1 (*cont.*)

Frequency range (MHz)	Band usage	Sharing studies
	4 400-4 990 MHz - In the United States of America, this band has a primary allocation to fixed and mobile services, except for a co-primary allocation to intercontinental FSS space-to-earth links between 4 500-4 800 MHz. Use of the 4 400-4 940 MHz band includes many datalinks and a number of unmanned air systems networks. Telemetry transmitters operate in this band. Systems in this band include deployable communications systems as well as fixed and tactical mobile radio relay networks. Troposcatter radio terminals are air or ground transportable radio terminals that provide secure digital long-haul radio trunking among major nodes of area common user system (ACUS) communications networks and interface with other ACUS systems, such as digital group multiplexers or various switching facilities. The terminals may be used in stand-alone applications as transmission links not associated with switching facilities. The terminals transmit and receive digital voice and other data by means of troposcatter. In the United States of America, the band 4 940-4 990 MHz band has been designated for public safety use to support new broadband applications such as high-speed digital technologies and wireless local area networks (WLANs) for incident scene management. The band will also support dispatch operations and vehicular/personal communications. There are no plans to change the use of the 4 940-4 990 MHz band in the United States of America. In Japan, the band 4.4-4.9 GHz is currently used for the fixed services, however, this band has also been allocated to the mobile services to be used after 2010. The use of this band for the fixed services is allowed only until 30 November 2012.	Although the studies have differences in assumptions and methodologies and need to be continued to find convergence, they all show that ubiquitously deployed IMT-Advanced systems can not share in the same geographical area with FSS, when the FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, since no minimum separation can be guaranteed. Sharing may be feasible only when the receiving earth station is specific under the condition that the minimum required separation distance together with the criteria mutually agreed between the concerned administrations are observed. The effect of use of terrain information on the reduction of the separation distance has been studied. Studies have also shown that the use of local terrain information will reduce the separation distance. The degree of this reduction will depend on the specific circumstances. However, the availability of reliable local terrain information has not been proven for all countries. Site shielding for FSS earth stations would mitigate interference from IMT Advanced systems. One study has shown that the use of multi-carrier schemes application as one of the possible mitigation techniques can reduce the protection distance range. The impact of other mitigation techniques such as narrow-beam transmission based on sectorized- or adaptive-beamforming antenna which could further improve the sharing situation needs to be further studied.

TABLE 1 (*end*)

Frequency range (MHz)	Band usage	Sharing studies
	In Canada, the bands 4 545-4 705 MHz and 4 735-4 895 MHz are used by fixed systems. In Canada, the mobile allocation is limited for use by the Government in the band 4 400-4 940 MHz, the band 4 500- 4 800 MHz is used around military bases. In Canada, the band 4 940-4 990 MHz was allocated to the mobile service in support of public safety applications. The bands 4 950-4 990 MHz and 4 990-5 000 MHz are allocated to radio-astronomy. In China, the frequency band 4 500-4 800 MHz band is extensively used by C-band fixed-satellite service. Among this frequency band, 4 400-4 990 MHz is also used for microwave links. In Australia, the 4 400-4 940 MHz band is heavily used for fixed and mobile government services. Australia is experiencing a significant growth in the wideband aeronautical mobile use of this band in the vicinity of high population density areas. In regional and remote areas Australia operates tropospheric scatter systems. Australia is currently reviewing the national use of the 4 940-4 990 MHz band for use by public protection and disaster relief (PPDR) organisations.	The effectiveness of any mitigation technique is dependent on its application to individual site situations and can be applied only when FSS earth stations are confined to specific known locations. Further studies are necessary to determine the geographic circumstances which would permit the effective use of such techniques. With respect to co-existence between ubiquitously deployed IMT Advanced and the ubiquitously deployed FS, it has been suggested that it will be unlikely that both services could be deployed within the same geographic area in the same country. However, deployment of IMT Advanced in one country and FS in a neighbouring country can be foreseen. With respect to interference from FSS into IMT Advanced, studies have provided a range of results, from interference criteria not being exceeded up to interference criteria being exceeded by 5 dB, depending on the assumptions (particularly the type of IMT-Advanced base station considered and the FSS space station EIRP density). Further studies are required, before WRC-07, to confirm these results by using agreed assumptions.

8 Advantages and disadvantages of candidate frequency bands

Introduction

Table 2 provides information and views from the administrations participating in ITU-R on the advantages and disadvantages of the various candidate bands being considered for the future development of IMT-2000 and IMT-Advanced in preparation for WRC-07. This table has been used as the basis for developing the summary of advantages and disadvantages which is included in the draft CPM report for WRC-07. It is to be noted that the table of advantages and disadvantages may be modified by the CPM to be held between 19th February and 2nd March 2007.

TABLE 2

410-430 MHz	
Advantages	**Disadantages**
The band is already allocated to the mobile service on a primary basis in all three ITU-R Regions. Lower frequencies have better propagation characteristics and allow building larger cells with significant coverage benefits and cost efficiencies recognizing it may also adversely impact antenna size or efficiency of terminal and base station. Some administrations have indicated that they are considering using this band for IMT.	The limited bandwidth of this frequency range may limit the capacity of the IMT networks. The band is heavily used in many countries by other land mobile services including PPDR particularly in densely populated areas, recognizing that some of these applications may be provided by IMT systems to resolve the congestion. Some administrations have indicated that they do not intend to deploy IMT in this band therefore global harmonization may not be possible.

450-470 MHz	
Advantages	**Disadvantages**
The band is already allocated to mobile service on a primary basis in all three ITU-R Regions. Lower frequencies have better propagation characteristics and allow building larger cells with significant coverage benefits and cost efficiencies recognizing it may also adversely impact antenna size or efficiency of terminal and base station. In some countries, IMT-2000 networks have already been deployed in this band and equipment is commercially available.	The limited bandwidth of this frequency range may limit the capacity of the IMT networks. The band is heavily used in many countries by other land mobile services including PPDR particularly in densely populated areas, recognizing that some of these applications may be provided by IMT systems to resolve the congestion. Some administrations have indicated that they do not intend to deploy IMT in this band therefore global harmonization may not be possible.

470-806/862 MHz	
Advantages	**Disadvantages**
In Region 3, the band is allocated to the mobile service on a co-primary basis. In several Region 2 countries, the bands 470-512 MHz and 614-806 MHz are allocated to the mobile service on a primary basis. Lower frequencies have better propagation characteristics and allow building larger cells with significant coverage benefits and cost efficiencies recognizing it may also adversely impact antenna size or efficiency of terminal and base station. The upper part of the band is close to other bands identified for IMT-2000 (i.e., 806-960 MHz). This may lead to reduced complexity of equipment. While the lower part 470-600 MHz have even better propagation characteristics. Introduction of digital broadcasting in portions of these bands may allow flexibility for the future consideration of other services (including mobile broadcast) after the analogue TV switchover. Using the same frequency band as the broadcasting service simplifies the integration of the two services in the terminal using the same antenna.	There is no primary mobile service allocation in Region 1, but in many Region 1 countries, the 470-806 MHz band is allocated to the mobile service on a secondary basis, per RR 5.296. In Region 2, the 470-512 MHz and 614-806 MHz bands are allocated to the mobile service on a secondary basis. Allocated to the broadcasting service in all three ITU-R Regions and on a co-primary basis in Region 3. In some countries, portions of the band are also allocated on a primary basis and/or used for other services (ie, radio astronomy, aeronautical radionavigation, PPDR, SAB/SAP …). In order to avoid poor terminal antenna performance, it may be necessary to identify harmonized sub-bands for IMT. Some reorganization of spectrum usage of broadcasting services in Region 1 may be needed. A guard band may be needed between mobile broadcast and IMT uplink services for converged terminal. Coexistence of cellular stations with high power/high site broadcast stations may result in adjacent channel interference and thus additional constraints. It may be difficult to define a harmonized channeling arrangement and, in Region 1, it should be congruent to the GE-06 plan, which is about to be implemented. In some administrations, portions of this band or the entire band cannot be made available for IMT-2000 or IMT-Advanced (e.g., due to an unspecified switch over date for analog TV stations), therefore global harmonization for this band would not be feasible.

2 300-2 400 MHz	
Advantages	**Disadvantages**
Allocated worldwide to the fixed, and mobile services on a co-primary basis. Resolution 223 recognized that some administrations are planning to use the band 2 300-2 400 MHz for IMT 2000. This band is near the bands already identified for IMT-2000 and would present similar propagation conditions.	Considering the IMT spectrum requirement and characteristics, this band may offer insufficient bandwidth. Some administrations are using or planning to use the frequency band 2 300-2 400 MHz for other applications (e.g., aeronautical telemetry, sound broadcasting satellite, non-mobile wireless broadband services …). It may restrain the use of it for IMT. Some administrations have indicated that they do not intend to deploy IMT in this band therefore global harmonization may not be possible.

2 700-2 900 MHz	
Advantages	**Disadvantages**
This band is near the bands already identified for IMT-2000, which may facilitate the use of the same antenna as in the band 2.5-2.69 GHz and would present similar propagation conditions. In some administrations only a limited number of radar systems are deployed in this band.	The band is not allocated to mobile service in any ITU Region. The band is allocated on a primary basis and used for aeronautical radionavigation, a safety of life service, in all three ITU-R Regions. Certain sharing studies conducted in the past have shown that the use of this band for IMT-2000 is not feasible. These analyses need to be updated. Present interference simulations between incumbent radars operating in the band 2 700-2 900 MHz and IMT-2000 systems show that interference will occur to ARNS and meteorological radars on a co-channel basis. Separation distances of greater than 100 km between radar and the nearest macro, micro, and pico IMT network to protect radar operation are shown to be necessary. Studies also show that carrier separations of 5 MHz to 15 MHz and IMT mitigation techniques of urban clutter protection and 30 dB front-end filters can be applied to reduce the required separation distances to 25-40 km for the macro base stations, and 1-5 km for micro and pico base stations. Analysis of interference from radars into IMT networks show that interference will be present even at distances of hundreds of kilometers. However, this interference may not seriously affect quality of service due to the radar's pulse characteristics and the error correcting features of the IMT devices. Some administrations have indicated that they do not intend to deploy IMT in this band therefore global harmonization may not be possible.

3 400-4 200 MHz	
Advantages	**Disadvantages**
In Regions 2 and 3, the band 3 500-4 200 MHz is allocated to the mobile service on a primary basis. The size of the band would accommodate IMT-Advanced systems which are envisaged with large bandwidth and would provide significant capacity. The use of this band may facilitate the convergence between cellular and broadband wireless access systems already deployed in the lower part of this band in some countries. In some administrations, FSS is not deployed in the sub-band 3.4-3.6 GHz. Smaller antenna size for terminals and base stations, which is favorable feature to implement multiple-antenna techniques enabling high spectrum efficiency. The band has relatively better propagation characteristics for mobile and in-building applications, in comparison with other higher frequency candidate bands. Some administrations have indicated that they are considering using this band for IMT.	In Regions 2 and 3 (except in countries identified in RR 5.432), the band 3 400-3 500 MHz is allocated for mobile service on a secondary basis only. In Region 1, the band 3 400-4 200 MHz is allocated for mobile service on a secondary basis only. In Regions 2 and 3, the band 3 400 to 4 200 MHz is allocated for fixed and fixed-satellite services on primary basis. There is extensive deployment of FSS earth stations in the band 3 625-4 200 MHz in all ITU Regions of the world, and in 3 400-3 625 MHz in ITU Regions 1 (except parts of Europe) and 3 (except parts of Asia). This band is important for FSS because atmospheric absorption is lower in this frequency band and enables high degree of reliability and wide coverage, particularly in geographical areas with severe rain fade conditions. The band has relatively poor propagation characteristics for mobile and in-building applications, in comparison with other lower frequency candidate bands. Ubiquitously deployed IMT-Advanced systems can not share in the same geographical area with FSS in the bands 3 400-4 200 MHz and 4 500-4 800 MHz, when the FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, since no minimum separation can be guaranteed. Sharing may be feasible only when the receiving earth station is specific under the condition that the minimum required separation distance together with the criteria mutually agreed between the concerned administrations are observed. The coordination between the mobile service including IMT-Advanced in one country and FSS receiving earth station(s) in other countries shall be carried out in accordance with relevant provisions of the Radio Regulations. Preliminary studies between airborne radar and IMT have concluded that: The required separation distance is approximately 360 km in some cases where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and airborne radar systems. Using non-overlapping adjacent channel analysis only, the required separation distance is approximately 0 km, depending on the radar type and antenna type.

3 400-4 200 MHz (*end*)	
Advantages	**Disadvantages**
	Preliminary studies between shipborne radar and IMT have concluded that: The required separation distance is approximately 45 km in some case where combined co-channel and adjacent channel analysis is conducted for the sharing between IMT and shipborne radar systems. Using non-overlapping adjacent channel analysis only, the required separation distance is less than 1 km, depending on the radar type and antenna type. It is noted that for both airborne and shipborne scenarios that if interference mitigation measures are implemented at the IMT system, the required separation distances can be reduced and also that detailed sharing studies are underway and may be completed prior to WRC-07. Finally, it should also be noted that many areas to be observed by these radars are those over oceans or at high altitudes. Densely populated land areas where IMT traffic demand is high seldom coincide with the target of the observation areas of these radars. The band 3 400-3 800 MHz is widely used in many countries for fixed broadband wireless access systems. This fact limits the spectrum in this band available for other systems. Some administrations have indicated that the entire band and some administrations have indicated portions of this band cannot be made available for IMT-2000 or IMT-Advanced, therefore global harmonization for this band may not be feasible.

4 400-5 000 MHz	
Advantages	**Disadvantages**
The band is already allocated for mobile service on primary basis in all three ITU-R Regions. The size of the band would accommodate IMT-Advanced systems which are envisaged with large bandwidth and would provide significant capacity.	The band 4 500-4 800 MHz is covered by the provisions of Appendix 30B (the fixed-satellite service plan) and is therefore intended to preserve orbit/spectrum resources for future use, on an equitable basis among all country members of the ITU, and in particular for developing countries.

4 400-5 000 MHz (*end*)	
Advantages	**Disadvantages**
Smaller antenna size for terminals and base stations, which is favorable feature to implement multiple-antenna techniques enabling high spectrum efficiency. Some administrations have indicated that they are considering using this band for IMT.	WRC-07 will review Appendix 30B (Agenda item 1.10) which is a very complex matter. In particular, it will consider the requirement of more than 25 countries which do not have any allotment in the plan due to the fact that their geographical situations is different from that prevailing when the plan was established and it will address the issue of coordination between the receiving earth stations and terrestrial services. Therefore, it is not possible to reliably decide on the matter until the outcome of WRC-07 is known. The band has the largest frequency-dependent propagation loss in comparison with other candidate bands. Due to the propagation characteristics, high mobility mobile applications in this band may be adversely affected in comparison with lower frequency bands. In some administrations, these bands have been identified for government services including aeronautical mobile. In some administrations, the band is intensively used for fixed services for long distance links. Portions of this band are also used by some administrations for the radioastromony stations. Some administrations have indicated that they do not intend to deploy IMT in this band therefore global harmonization may not be possible. The Plan is important for inter-governmental systems such as RASCOM involving more than 50 African countries using and intending to implement satellite systems in the frequency band 4.5-4.8 GHz of Appendix 30B for their infrastructure telecommunication systems. In other developing countries, in particular those countries in which there is high rainfall rate, the above-mentioned frequency band is also used to provide their basic infrastructure telecommunication systems. Ubiquitously deployed IMT-Advanced systems can not share in the same geographical area with FSS in the bands 3 400-4 200 MHz and 4 500-4 800 MHz, when the FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, since no minimum separation can be guaranteed. Sharing may be feasible only when the receiving earth station is specific under the condition that the minimum required separation distance together with the criteria mutually agreed between the concerned administrations are observed.

Appendix 1

Views of Administrations related to frequency ranges

The content of this Appendix is for reference use.

Administrations are invited to update their positions through submission of contributions to CPM-07 and/or WRC-07 with a view to updating this reference information and to take necessary action as appropriate.

The material contained herein reflects the information at the time of approval of the Report. It is further noted that the information might be changed, deleted, or added to in the future by Administrations.

The information below is based on inputs provided either in written form or verbally by the membership of ITU-R. The contents of this Appendix is incomplete since:

– the information contained therein consists only of the information provided through contributions on related topics;

– Administrations are not required to provide any information to the ITU-R Study Groups relating to spectrum utilisations.

410-430 MHz

Australia is currently reviewing the national use of the 406-430 MHz bands for existing and potential future terrestrial service applications, including IMT-2000 and IMT-Advanced with parts of the bands for use by Commonwealth, State and Territory Governments.

In India and Iran, the band 410-430 MHz is being extensively used for variety of public and government applications. Part of this band is also allocated and being used for digital trunk radio and digital seismic telemetry. In India, this band is not being considered for future development of IMT-2000 and systems beyond IMT-2000.

Cameroon, Sri Lanka, Brazil and Venezuela are analyzing these bands to be used for IMT-2000.

In the United States of America, this band is not now nor in the foreseeable future available for IMT-2000, the future development of IMT-2000, or systems beyond IMT-2000 in the United States of America.

In Cameroon, this band is currently being analyzed for mobile and/or fixed systems, including IMT-2000.

In Sri Lanka, this band is currently being analyzed for mobile and/or fixed systems, including CDMA2000.

In Venezuela, the following bands are being considered to be potentially used: 410-430 MHz and 450-470 MHz.

450-470 MHz

Vietnam and RCC countries consider this band as a potential band for IMT-2000.

Australia is currently reviewing the national use of the 450-470 MHz bands for existing and potential future terrestrial service applications, including IMT-2000 and IMT-Advanced. This band is identified by Australia as a potential band for global identification to IMT.

Cameroon, Indonesia, Sri Lanka and Venezuela are analyzing these bands to be used for IMT-2000.

In the United States of America, there are no plans to change the use of the 450–470 MHz band.

In Cameroon, this band is being analyzed for mobile and/or fixed systems, including IMT-2000.

In Venezuela, the following bands are being considered to be potentially used: 410-430 MHz and 450-470 MHz.

470-960 MHz

In Israel, the band 825-845 MHz paired with 870-890 MHz is planned for IMT-2000.

Australia is currently reviewing the national use of the 470-960 MHz bands for existing and potential future terrestrial service applications, including IMT-2000 and IMT-Advanced. Switch-off of analog television services in the band 520-820 MHz is targeted to commence in 2010-2012. No decisions have been made regarding use of this band beyond these dates (NOTE – In planning of digital television services Australia avoids, wherever practical, making assignments in the 806-820 MHz frequency range. However, 806-813 MHz digital licences have been issued at 18 sites). While the bands 890-915/ 935-960 MHz are presently used for nationwide 2G (GSM900) services, they may also be candidates for IMT-2000 and IMT-Advanced subject to migration of current 2G services and appropriate restructuring.

Cameroon, and Côte d'Ivoire are planning the band 470-600 MHz band for IMT systems.

Within Europe, the introduction of digital television is ongoing, and in a number of countries digital television has already been successfully introduced and spectrum has been freed up. This is accomplished by introducing digital transmission in the currently used channel spacing. A period is foreseen during which both digital and analogue transmissions will be in parallel. Some countries have declared that analogue TV will be switched off before 2010 while it might stretch over an additional 10 years in some other countries. That amount of spectrum can be made available for either additional TV or other services in the 470-862 MHz band after the closure of analogue broadcasting stations.

In India, the band 470-806 MHz is extensively used for analogue TV broadcasting. This band is identified for introduction of digital terrestrial TV broadcasting and, during the transition period, both analogue and digital TV transmissions will go in parallel. Complete transition from analogue to digital terrestrial TV broadcasting is expected to take considerable time. New technologies such as digital video broadcasting-handheld (DVB-H) and digital multimedia broadcasting (DMB) are also likely to be implemented. Parts of this band are also used extensively for conventional fixed and mobile services. In India, the band 470-806 MHz is not available for future development of IMT-2000 and systems beyond IMT-2000 in foreseeable future.

In India, the bands 824-844 MHz paired with 869-889 MHz are presently allocated and used for CDMA based mobile telecom services. In India, the bands 824-844 MHz paired with 869-889 MHz may be considered for transition to IMT-2000 and systems beyond IMT-2000.

In India, the bands 890-915 MHz paired with 935-960 MHz are presently allocated and used for GSM based mobile telecom services. In India, the bands 890-915 MHz paired with 935-960 MHz may be considered for transition to IMT-2000 and systems beyond IMT-2000.

In the Russian Federation and in Germany, the band 470-862 MHz is heavily used for broadcasting services and other services and is not considered as a candidate band for IMT.

In the United States of America, the 608-614 MHz band is not suitable for IMT-2000 and IMT-Advanced due to ubiquitous broadcasting use, limited mobile use, radio astronomy sensitivity and critical medical care services.

In the United States of America, the 698-806 MHz band is being transitioned from analog to digital TV (DTV) freeing some spectrum formerly allocated to the broadcasting service for other uses. As a result, large portions of this band could be made available for IMT-2000 and IMT-Advanced. The

764-776 MHz and 794-806 MHz bands are designated for public safety use, and there are no plans to change such use in the United States of America.

The Republic of Korea is studying rearranging the band 752-806 MHz for various applications.

CEPT has initiated the development of a new draft decision designating the GSM900 and GSM1800 frequency bands also for IMT-2000/ UMTS.

1 710-2025 & 2 110-2 200 MHz

Australia is currently reviewing the national use of the 1 725-1 785, 1 785-1 805, 1 820-1 880, 1 920-1 960 and 2 110-2 150 MHz bands for existing and potential future terrestrial service applications in regional areas.

In India, the band 1 710-1 885 MHz is used for variety of fixed and mobile applications by different private and Government agencies. This band has also been allocated and used for GSM based cellular mobile service. In India, a part of the band 1710-1885 MHz may be considered for transition to IMT-2000 and systems beyond IMT-2000.

In India, the band 1 920-1 980 MHz paired with 2 110-2 170 MHz is allocated for implementation of IMT-2000. This band is used for variety of fixed and mobile applications by different agencies. The band is used for some conventional point-to-point links. The requirement of space research (deep space), at specific locations, is also being met in accordance with the existing provisions. In India, the band 1 920-1 980 MHz paired with 2 110-2 170 MHz may be considered for future development of IMT-2000 and systems beyond IMT-2000.

In India, the band 2 010-2 025 MHz is allocated for implementation of IMT-2000 (TDD mode). This band is used for variety of fixed and mobile applications by different agencies. In India, the band 2 010-2 025 MHz is not available for future development of IMT-2000 and systems beyond IMT-2000.

CEPT has initiated the development of a new draft decision designating the GSM900 and GSM1800 frequency bands also for IMT-2000/ UMTS.

In India, the band 2 170-2 400 MHz is extensively used for variety of fixed and mobile applications by different agencies. Also, the frequency band 2 300-2 400 MHz is being considered for wireless broadband services. In India, the band 2 170-2 400 MHz are not being considered for future development of IMT-2000 and systems beyond IMT-2000.

2 300-2 400 MHz

In New Zealand, this band is being planned for BWA applications that may include IMT.

This band is identified by Australia as a potential band for global identification to IMT.

In India, the band 2 170-2 400 MHz is extensively used for variety of fixed and mobile applications by different agencies. Also, the frequency band 2 300-2 400 MHz is being considered for wireless broadband services. In India, the band 2 170-2 400 MHz are not being considered for future development of IMT-2000 and systems beyond IMT-2000.

2 500-2 690 MHz

Australia is currently reviewing the national use of the 2 500-2 690 MHz band for potential future terrestrial service applications including IMT-2000, ENG and BWA services.

In India, the frequency band 2 500-2 690 MHz is being used for satellite based BSS and MSS systems. A part of the band is also being used for terrestrial point-to-multi point systems by Internet service providers. India plans to use a portion of the band 2 500-2 690 MHz for satellite based mobile multimedia broadcasting systems further Wimax systems are also planned to be

implemented in portions of this band hence a part of the frequency band 2 500-2 690 MHz may be considered for future development of IMT-2000 and systems beyond IMT-2000.

In Indonesia, the band 2 520-2 670 MHz is being used and will be used in the foreseeable future for broadcasting satellite service.

Israel considers the band 2 500-2 690 MHz for IMT (BWA/UMTS applications).

2 700-2 900 MHz

In Australia, the use of 2 700-2 900 MHz and 2 900-3 400 MHz bands are not supported for IMT-2000 and systems beyond IMT-2000, since ITU studies have identified significant sharing difficulties with radars.

In Norway and Sweden, this band is under consideration for future development of IMT-2000 and systems beyond IMT-2000.

In India, this band is extensively used for variety of fixed and mobile applications by different agencies. In India, this band is not being considered for future development of IMT-2000 and systems beyond IMT-2000.

In Brazil, Germany, Canada, France, Russian Federation and the United States of America, the 2 700-2 900 MHz band is not now nor in the foreseeable future available for IMT-2000, the future development of IMT-2000, or systems beyond IMT-2000.

3 400-4 200 MHz

In the Republic of Korea, this band is considered to be used for the mobile services including IMT.

In Brazil, the 3 400-3 600 MHz band is being planned for BWA applications that may include IMT.

Israel considers the band 3 500-4 200 MHz for IMT/BWA applications.

Australia is currently reviewing the national use of the 3 575-3 710 and 3 710-4 200 MHz bands for existing and potential future terrestrial service applications, including IMT-2000 and IMT-Advanced.

In Vietnam and Indonesia, the 3 400-4 200 MHz band is not now nor in the foreseeable future available for IMT-2000, the future development of IMT-2000, or systems beyond IMT-2000. This band is extensively used for FSS.

In the Russian Federation and UAE, the band 3 400-4 200 MHz is continued to be used by fixed-satellite service and fixed service and is not considered as a candidate band for IMT.

In Japan and Sweden, this band is planned to be used for the mobile service including IMT.

In India, the band 3 400-3 700 MHz is used by fixed satellite service. In India, the band 3 400-3 700 MHz Wimax systems are also planned in this band hence this band is not being considered for future development of IMT-2000 and systems beyond IMT-2000 by India.

In India, the band 3 700-4 200 MHz is extensively used for fixed-satellite service for a variety of systems/applications. In India, the band 3 700-4 200 MHz is not being considered for future development of IMT-2000 and systems beyond IMT-2000.

In the United States of America, the 3 400-3 650 MHz band is not now nor in the foreseeable future available for IMT-2000, the future development of IMT-2000, or systems beyond IMT-2000.

The variety of services/uses, will require coordination with deployments of IMT-2000 and IMT-Advanced systems in the United States of America.

In the United States of America, due to the extensive use of the 3 600-4 200 MHz band by the fixed and fixed-satellite services, as well as the increased bandwidth requirements by these services, deployment of IMT-2000 systems and IMT-Advanced in this band could be significantly limited.

The band 3 400-4 200 MHz is heavily used by FSS satellites for many infrastructure telecommunication needs, and its use is constantly developing in Asia, the Pacific, Africa, the Arab States, parts of Europe and the Americas.

In CEPT, for the band 3 400-3 800 MHz, a draft ECC Decision on broadband wireless access is under preparation.

4 400-4 990 MHz

In the Republic of Korea, this band is considered to be used for the mobile services including IMT.

In the 4 500-4 800 MHz range is covered by the fixed-satellite service Plan (RR Appendix 30B) which is intended to preserve orbit/spectrum resources for future use, on an equitable basis among all country members of the ITU, and is of the utmost importance to developing countries that may not have the possibility to implement satellite systems in unplanned bands (that suffer more and more from congestion) in the short-and mid-terms.

In its recent review into ‘Strategies for wireless access services’, Australia did not consider the use of this band for future wireless access systems.

In Japan, the 4 400-4 900 MHz band is planned to be used for the mobile service including IMT.

In Iran, India, and the Russian Federation this band is extensively used for variety of fixed and mobile applications by different agencies. The frequency band 4 500-4 800 MHz band is extensively used by fixed satellite service. In Iran, India, and the Russian Federation, this band is not being considered for future development of IMT-2000 and systems beyond IMT-2000.

In many CEPT countries, the band 4 400-5 000 MHz is identified as a harmonised NATO band type 1 for fixed, tactical radio relay and mobile systems. Compatibility studies between IMT-Advanced and defence systems have to be carried out.

Because of the use of the 4 400-4 940 MHz band for other uses/services, this band is not now nor in the foreseeable future available in the United States of America for IMT-2000, or IMT-Advanced. As a result worldwide harmonization will not be possible.

In the United States of America, troposcatter radio terminals are air or ground transportable radio terminals that provide secure digital long-haul radio trunking among major nodes of area common user system (ACUS) communications networks and interface with other ACUS systems, such as digital group multiplexers or various switching facilities. The terminals may be used in stand-alone applications as transmission links not associated with switching facilities. The terminals transmit and receive digital voice and other data by means of troposcatter. Unacceptable impacts that result from a decrease in the bandwidth allocated to the fixed and mobile network system. Band segmentation and band sharing are not viable options. The recommendation is forwarded that the proposed encroachment of IMT-2000 systems into the 4 400-5 000 MHz band receive no additional consideration. The requirement for the allocated bandwidth has continually been evaluated and revalidated since the early-to-mid 1980s, and the priority for this requirement is expected to increase. The 4 400-5 000 MHz band was selected from consideration of the electromagnetic propagation characteristics of the band and from the availability of the amount of spectrum necessary to support operations. The amount of necessary spectrum is not available at other frequencies.