

No. 7

Report from the UMTS Forum

# **Report on Candidate Extension Bands for UMTS/IMT-2000 Terrestrial Component**



UMTS  
Forum

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**Report on Candidate Extension Bands  
for UMTS/IMT-2000 Terrestrial Component**

**UMTS Forum, March 1999  
2<sup>nd</sup> Edition**

This report is produced by the UMTS Forum, an association of telecommunications operators, manufacturers and regulators who are active both in Europe and other parts of the world and who share the vision of UMTS. UMTS will be a member of the IMT-2000 family of standards. UMTS will move mobile communications forward from where we are today into the Information Society of third generation services, and will deliver speech, data, pictures, graphics, video communication and other wideband information direct to people on the move.

The work to write the report has mainly been done in the Spectrum Aspects Group, a subgroup of the Forum. The main conclusions and recommendations in the report are supported by all operators and manufacturers of the UMTS Forum. The national administrations that are members of the UMTS Forum have participated in the discussions to gain an understanding of the industry views. The administrations cannot be bound by the detailed recommendations contained in this report.

The report is a major input towards the preparations for the World Radio Conference WRC-2000 and the decision making process on spectrum allocations for UMTS/IMT-2000 in a number of countries world-wide. It represents the consensus view on UMTS spectrum issues of the Forum members. It has been carefully developed and expanded over the past two year's life of the Forum and considers the spectrum vision and the spectrum demand. The report is written to be of interest to parties world-wide involved in the future development of the mobile telecommunications industry.

This report follows on from the first and sixth report of the UMTS Forum which dealt with a regulatory framework and spectrum aspects for UMTS [3, 6, 7]. Other outputs from the Forum cover areas of technical aspects [8], economic conditions [9], and licensing issues [7, 10]. In order to help regulators with the implementation of UMTS spectrum licensing, the Forum has issued a report on minimum spectrum demand [6, 11].

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## 0. EXECUTIVE SUMMARY

This Report gives the results of the work on extension bands that has been done within the Spectrum Aspect Group (SAG) of UMTS Forum providing an industry view on the suitability of these candidate bands for UMTS/IMT-2000 terrestrial component. It takes into account the interim results of the ongoing work in the relevant ERC [1] and ITU-R [2] groups.

In their efforts to identify additional spectrum for the UMTS/IMT-2000 terrestrial applications, Administrations call for justification and evidence to support the preparatory work for the ITU WRC-2000. As an European industry response, this Report summarises the relevant information on spectrum issues, lists the candidate extension bands and gives information on their current usage and benefits for 3<sup>rd</sup> generation applications. The report also explores examples of allocation scenarios in order to support the WRC-2000 decisions on the agenda item 1.6.

### The UMTS Forum believes that:

- Extension Bands must be allocated on a primary basis to the Mobile Service in Article S5 of the ITU Radio Regulations, preferably in all three ITU Regions. Action would be necessary at WRC-2000 to modify allocations with the aim to allow mobile services in these bands, where these do not currently exist.
- Extension Bands must be identified clearly for IMT-2000 applications, following the approach of the existing IMT-2000 “core bands” which are identified in Footnote S5.388. This approach allows a measure of flexibility for administrations. Action would be necessary at WRC-2000 to identify Extension bands for IMT-2000 terrestrial applications in a Footnote to Article S5.
- Extension Bands should need to be made available from year 2005 or later subject to market demand.

The timing of the requirement for additional spectrum within individual countries may differ and will depend on the development of the market in those countries. It has been calculated that administrations will need the full additional spectrum between 2005 and 2010.

- That not all countries will be able to offer access to all identified bands, or parts of such bands;
- That both additional paired bands and additional unpaired bands will be required.

**UMTS Forum Recommendations:**

**Recommendation N°1:** The objectives at WRC-2000 should be:

- to identify relatively large blocks of a minimum block size of 40 MHz, contiguous or as close as possible to the Core Band spectrum for IMT-2000 extension bands and
- to ensure these have primary Mobile Service allocation in all 3 ITU Regions and are identified for IMT-2000 applications on a similar basis to footnote S5.388<sup>1</sup>.

**Recommendation N°2:**

- The amount of additional spectrum to be identified for IMT-2000 should have the potential to satisfy needs of 187 MHz for areas with high traffic demand according to the current estimates.
- Both, paired and unpaired arrangements should be made possible.

**Recommendation N°3:**

The recommended additional IMT-2000 spectrum cannot be found in any single one of the candidate bands discussed in this report.

- The band 2520-2670 MHz should be identified globally for the terrestrial component of IMT-2000.
- The additional spectrum should be found preferably in only one other band, identified according to the principles discussed in this report. The identification of this band needs to be subject of additional studies.

**Recommendation N°4:**

- In addition to these new IMT-2000 bands, the UMTS Forum recommends to identify existing 2<sup>nd</sup> generation bands for IMT-2000 (880-915/925-960 MHz, 1710-1785/1805-1885 MHz). These bands could only be available for UMTS/IMT-2000 services in the longer term according to the market evolution.

<sup>1</sup> S5.388: The bands 1885-2025 MHz and 2110-2200 MHz are intended for use, on a world-wide basis, by administrations wishing to implement the future public land mobile telecommunication systems (FPLMTS). Such use does not preclude the use of these bands by other services to which the bands are allocated. The bands should be made available to FPLMTS in accordance with resolution 212 (Rev WRC-95).

## 0. RESUME

Ce rapport donne les résultats des travaux effectués sur les bandes d'extension dans le Groupe Aspects Fréquences (SAG) du Forum UMTS. Il fournit le point de vue du secteur concernant l'intérêt de ces bandes candidates pour la composante terrestre de l'UMTS/IMT-2000. Il tient compte des résultats intermédiaires du travail en cours des groupes spécialisés à l'ERC [1] et à l'UIT-R [2].

Dans leur effort d'identification du spectre supplémentaire destiné aux applications terrestres de l'UMTS/IMT-2000, les Administrations demandent des justifications et des arguments pour étayer les travaux préparatoires de la CMR-2000 de l'UIT. Ce rapport résume, en tant que réponse européenne du secteur, les informations pertinentes concernant le spectre, énumère les bandes candidates et fournit des informations sur leur utilisation actuelle et leurs avantages pour les applications de la 3<sup>e</sup> génération. Ce rapport examine également des exemples de scénarios d'allocation afin d'appuyer les décisions de la CMR-2000 sur le point 1.6 de l'ordre du jour.

Le Forum UMTS croit que :

- Des bandes d'extension doivent être attribuées sur une base primaire au Service Mobile dans l'article S5 du Règlement des Radiocommunications de l'UIT, de préférence dans les trois Régions de l'UIT.  
Il est nécessaire d'agir au niveau de la CMR-2000 pour modifier les allocations de fréquences avec l'objectif d'autoriser des services mobiles dans les bandes où ils n'existent pas encore actuellement.
- Des bandes d'extension doivent être clairement identifiées pour les applications IMT-2000, selon l'approche utilisée pour les bandes-cœur identifiées dans la note de bas de page S5.388.<sup>2</sup> Cette approche fournirait aux Administrations une certaine flexibilité.  
Une action à la CMR-2000 est nécessaire pour identifier les bandes d'extension dans une note de bas de page de l'article S5.
- Les bandes d'extension devront être disponibles en 2005 ou ultérieurement selon la demande du marché.

La demande de spectre supplémentaire peut varier dans le temps selon les pays et dépendra du développement du marché correspondant. Il a été calculé que les Administrations auront besoin de l'ensemble du spectre supplémentaire entre 2005 et 2010.

<sup>2</sup> Les bandes 1 885-2 025 MHz et 2 110-2 200 MHz sont destinées à être utilisées, à l'échelle mondiale, par les administrations qui souhaitent mettre en œuvre les télécommunications mobiles internationales-2000 (IMT-2000). Cette utilisation n'exclut pas l'utilisation de ces bandes par d'autres services auxquels elles sont attribuées. Les bandes devraient être mises à la disposition des IMT-2000 conformément aux dispositions de la résolution 212 (Rév.CMR-97).

- Tous les pays ne pourront pas offrir l'accès à toutes les bandes identifiées ou partie de ces bandes.
- Des bandes supplémentaires appairées et non appairées seront nécessaires.

### **Recommandations du Forum UMTS**

**Recommandation N°1:** Les objectifs de la CMR-2000 devraient être:

- d'identifier pour l'IMT-2000 des blocs d'extension relativement larges d'une taille minimale de 40 MHz, contigus ou aussi proches que possible de la bande-cœur et
- de s'assurer que ceux-ci seront attribués sur une base primaire au Service Mobiles dans les 3 Régions de l'UIT, et qu'ils seront identifiés pour des applications IMT-2000 sur une base similaire à la note de bas de page S5.388.

**Recommandation N°2:**

- Le spectre supplémentaire à identifier pour l'IMT-2000 devrait satisfaire le besoin de 187 MHz pour les zones à forte demande de trafic, selon les estimations actuelles.
- Des arrangements appairés et non appairés devront être rendus possibles.

**Recommandation N°3:**

La quantité recommandée de spectre supplémentaire pour l'IMT-2000 ne peut pas être trouvée dans une seule des bandes candidates citées dans ce rapport.

- La bande 2520-2670 MHz sera identifiée mondialement pour la composante terrestre de l'IMT-2000.
- Le spectre supplémentaire devrait être trouvé de préférence dans une seule autre bande, identifiée selon les principes discutés dans ce rapport. L'identification de cette bande doit faire l'objet d'études supplémentaires.

**Recommandation N°4:**

- En plus de ces nouvelles bandes IMT-2000, le Forum UMTS recommande d'identifier pour l'IMT-2000 les bandes existantes de deuxième génération (880-915/925-960 MHz, 1710-1785/1805-1885 MHz). Ces bandes ne devraient être disponibles pour les services UMTS/IMT-2000 qu'à long terme et ce, en fonction de l'évolution du marché.

## 0. RESUMEN EJECUTIVO

Este informe refleja los resultados del trabajo sobre bandas extendidas que ha sido realizado por el “Spectrum Aspects Group” (SAG) del UMTS Forum, proporcionando uno de los puntos de vista de la industria sobre la conveniencia de la candidatura de estas bandas como componentes terrestres del UMTS/IMT-2000. El informe tiene en cuenta los resultados internos de los trabajos que se están realizando en los grupos de ERC [1] y los grupos UIT-R [2] implicados.

En sus esfuerzos para identificar espectro adicional para las aplicaciones terrestres del UMTS/IMT-2000, las Administraciones piden justificación y datos para apoyar el trabajo preparatorio para el UIT CMR-2000. Como respuesta de la industria europea, este informe resume la información relacionada con temas de espectro, enumera las bandas extendidas candidatas, y proporciona información de su uso actual y las ventajas para las aplicaciones de tercera generación. El informe también explora ejemplos de escenarios de asignación para soportar las decisiones de la CMR-2000 en el punto 1.6 del orden del día.

El UMTS Forum cree que:

- Las bandas extendidas deben de asignarse principalmente a servicios móviles, como se recoge en el Artículo S5 de las Regulaciones de Radio de la UIT, preferiblemente en las tres regiones de la UIT.  
Sería necesario actuar en el IMT-2000 para modificar la asignación con el objetivo de permitir los servicios móviles en estas bandas, donde actualmente no existen.
- Las bandas extendidas deben identificarse claramente para aplicaciones IMT-2000, siguiendo el enfoque de las “bandas centrales” existentes para el IMT-2000 las cuales están identificadas en el pie de página S5.388. Este enfoque permite un cierto grado de flexibilidad a las Administraciones.  
Sería necesario tomar acciones en la CMR-2000 para identificar las bandas extendidas para aplicaciones terrestres IMT-2000 en un pie de página al Artículo S5.
- Sería necesario tener disponibles las bandas extendidas a partir del año 2005, o más tarde, en función de la demanda del mercado.

El momento para requerir espectro adicional en cada país de forma individual puede ser diferente y depender del desarrollo del mercado en dichos países. Las Administraciones han calculado que necesitarán la totalidad del espectro adicional entre el 2005 y el 2010.

- Que no todos los países podrán ofrecer acceso a todas las bandas identificadas, o a parte de ellas;
- Que se necesitarán ambas bandas adicionales, “pareadas” y “no pareadas”.

## **Recomendaciones del UMTS Forum:**

**Recomendación N°1:** Los objetivos en la CMR-2000 deberían ser:

- **identificar para las bandas extendidas de IMT-2000 grandes bloques con un tamaño mínimo de 40 MHz, contiguos o lo más cerca posible a la banda “central” del espectro 000 y**
- **asegurar que éstas tienen asignado principalmente servicios móviles en las tres regiones de la UIT y que están asociadas a las aplicaciones de IMT-2000 con un criterio similar al del pie de página S5.388<sup>3</sup>.**

**Recomendación N°2:**

- **La cantidad de espectro adicional que tiene que ser identificada por IMT-2000 debería de ser suficiente para satisfacer las necesidades de 187 MHz para áreas con alta demanda de tráfico de acuerdo a las actuales estimaciones.**
- **Ambos tipos de banda, “pareada” y “no pareada”, deberían ser posibles.**

**Recomendación N°3:**

El espectro IMT-2000 adicional recomendado no puede encontrarse en ninguna de las bandas candidatas discutidas en este informe.

- **La banda 2520-2670 MHz debería de ser identificada globalmente para la componente terrestre del IMT-2000.**
- **El espectro adicional debería de encontrarse preferentemente en una única banda, identificada de acuerdo a los principios discutidos en este informe. La identificación de esta banda requiere estudios adicionales.**

<sup>3</sup> S5.388: Las bandas 1885-2025 MHz y 2110-2200 MHz están pensadas para ser usadas en el ámbito mundial por las administraciones que deseen implantar los “futuros sistemas públicos de telecomunicaciones móviles terrestres” (“future public land mobile telecommunication systems” - FPLMTS). Dicha utilización no excluye el uso de estas bandas para otros servicios, en principio no asignados a estas bandas. Las bandas deberían pasar a estar disponibles para FPLMTS en virtud de la resolución 212 (Rev CMR-95).

**Recomendación N°4:**

- Además de estas nuevas bandas IMT-2000, el UMTS Forum recomienda identificar las bandas de 2ª generación existentes para el IMT-2000 (880-915/925-960 MHz, 1710-1785/1805-1885 MHz). Estas bandas podrían estar sólo disponibles para servicios de UMTS/IMT-2000 a largo plazo, de acuerdo con la evolución del mercado.

## 1. INTRODUCTION - SPECTRUM FOR UMTS/IMT-2000

It is widely recognised that UMTS/IMT-2000 should not be just an improved version of today's second generation mobile services but that it should be really a new concept, offering new and significant opportunities driven by data applications and market demand. This new concept had led to a higher spectrum demand as higher bit rate services need much wider bandwidths than 'traditional' voice applications.

A large part of the activity performed on UMTS/IMT-2000 in different international fora has been concentrated on the spectrum domain. Consolidation of spectrum requirement results is ongoing world-wide, taking into account geographic disparities and influences, market and traffic impacts as well as technical and system aspects.

A longer term strategic approach of UMTS/IMT-2000 spectrum aspects is necessary to prevent a possible spectrum shortfall during successful development of UMTS/IMT-2000. The UMTS Forum considers the securing of the additional spectrum for UMTS/IMT-2000 terrestrial mobile applications to be a major objective for the next WRC. Successful UMTS/IMT-2000 deployment will depend not only on the market needs and the technological progress but also on the timely availability of spectrum. The full potential of the 3rd generation networks could be realised only if the frequency allocations are appropriate.

Within the UMTS Forum, CEPT and ITU-R, studies to identify additional candidate bands for UMTS/IMT-2000 have been underway for some time. As part of co-operative activity with CEPT<sup>4</sup>, the UMTS Forum has already submitted its own views [1] on possible candidate bands into the CEPT debate in ERC Task Group 1 (TG1) and the ERC Conference Preparatory Group (CPG). At the ITU-R TG8/1 meeting in Jersey in November 1998, a draft text for the relevant sections of the ITU-R Report to the WRC-2000 Conference Preparatory Meeting (CPM) was prepared [2]. This text listed a number of candidate bands that were closely aligned with the options suggested by ERC TG1 and the UMTS Forum.

The list of candidate bands take into account the regulatory aspects and the UMTS Forum now sees important to provide an industry view on the suitability of these candidate bands. The Forum considerations include the background on existing usage, the advantages that each band offers to UMTS/IMT-2000, the potential availability of the band, the likely risks that this availability might not be realised in time combined with some implementation aspects. In addition the Forum believes that it is important to collate and fully understand information on the existing global, regional and national allocations in these bands in one document. A compendium of such

<sup>4</sup> The UMTS Forum and CEPT have signed a Co-operation Agreement that ensures a fully co-operative environment exists between regulators, operators and manufacturers in the development of requirements for UMTS/IMT-2000.

information, based on UMTS Forum members contributions where openly available, has therefore been compiled.

UMTS Forum SAG has decided to produce a complementary report focused on candidates bands, as listed by ITU-R TG 8/1, for IMT-2000 with the aim of supporting the ongoing work on this issue within ERC/TG1, ERC/CPG and ITU-R TG8/1. For the purpose of assisting administrations preparing WRC-2000 Agenda item 1.6 this report contributes useful information towards the decisions in May 2000 in Istanbul.

This report considers the whole issue with the view to determining the UMTS Forum position taking into account:

- the results of studies on characteristics, properties and current usage of candidate bands.
- the technical and operational issues related to sharing and co-ordination with other services that need to be co-ordinated within the CEPT.
- the conclusion on the possible world-wide and regional spectrum most appropriate to the needs of 3<sup>rd</sup> generation systems from an industry point of view.
- frequency planning aspects of the possible allocation scenarios.

## **1.1 ITU level situation**

### 1.1.1 WARC-92 initial allocation

WARC-92 - World Administrative Radiocommunications Conference – in the footnote No. S5.388 of the Radio Regulations has identified for IMT-2000, previously known as FPLMTS, the frequency bands 1885-2025 and 2110-2200 MHz i.e. a total of 230 MHz. This allocation was based on calculations done before WARC-92 which took into account speech and low data rate services as a major source of the traffic in Recommendation ITU-R M.687-2. Several more recent investigations [3, 4, 5] have shown that due to the tremendous growth of mobile communications and multimedia since 1992, the initial WARC-92 allocation would support only the initial introduction of UMTS/IMT-2000 systems. Because of the growth of both the number of users and the bandwidth they require, this initial spectrum will be insufficient to support further development.

The following ITU-R documents give more information concerning ITU-R level situation related to IMT-2000 spectrum aspects:

- **ITU-R Resolution 212** originated by WARC-92, revised by WRC-97, summarises the developmental, spectrum and regulatory issues pertinent to IMT-2000.
- **ITU-R Recommendation M.816** considers framework for a wide range of

services supported by IMT-2000.

- **ITU-R Recommendation M.[IMT.MTER]** describes a detailed methodology for the calculation of terrestrial spectrum requirements taking into account all new wide band services.
- **ITU-R Report M.[IMT.SPEC]** gives the total spectrum requirement for terrestrial mobile services in year 2010 applying the above mentioned methodology.

### 1.1.2 WRC-2000 agenda item 1.6 on additional spectrum needed for terrestrial IMT-2000

WRC-97 recognised the additional spectrum needs for IMT-2000 by including this issue as the Agenda Item 1.6 of the next WRC:

#### **Agenda Item 1.6: Issues related to IMT-2000**

**1.6.1 – review of spectrum and regulatory issues for advanced mobile applications in the context of IMT-2000, noting that there is an urgent need to provide more spectrum for the terrestrial component of such applications, and priority should be given to terrestrial mobile spectrum needs, and adjustments to the table of frequency allocations as necessary.**

**1.6.2 – identification of a global control channel to facilitate multimode terminal operation and world-wide roaming of IMT-2000.**

The UMTS Forum understands Agenda Item 1.6.1 text to mean that the WRC-2000 review will give priority to spectrum for the terrestrial component of IMT-2000 over that of the satellite component. The UMTS Forum fully supports this prioritisation, and the ideas developed within this report concentrate on a discussion of possible candidate bands for the terrestrial component.

## **1.2 CEPT situation**

### 1.2.1 ERC Decision on the introduction of UMTS (ERC/DEC/(97)07)

This Decision designates 155 MHz of spectrum to terrestrial UMTS applications with an additional 60 MHz for UMTS satellite services. In Europe, the 15 MHz spectrum at 1885-1900 MHz identified by WARC-92 for IMT-2000 is not designated for UMTS due to current usage of this band by DECT.

### 1.2.2 Draft ERC Decision on the harmonised utilisation of spectrum for terrestrial Universal Mobile Telecommunications System (UMTS) operating within the bands 1900-1980 MHz, 2100-2025 MHz and 2110-2170 MHz

CEPT/ERC/TG1 is currently producing an ERC Decision on UMTS frequency bands harmonised utilisation which purpose is to facilitate efficiency in utilisation of the UMTS bands across the CEPT by:

- identifying a common approach to spectrum planning,
- encompassing spectrum allocated on an exclusive basis for public licensed UMTS networks
- encompassing spectrum identified for shared use by license-exempt applications.

### 1.2.3 ERO/DSI III investigations

ERO is also supporting the work being done on UMTS in two ways:

- Firstly, ERO is conducting a study for the European Commission dealing with UMTS spectrum planning. The aims of the study are:
  1. To give an overview of the ongoing work at the European and world-wide level on UMTS spectrum issues;
  2. To provide detailed information about the current use of UMTS candidate bands and the plans of administrations in licensing spectrum;
  3. To provide information which has an impact on UMTS spectrum planning.

Especially the second aim is of relevance to this report.

- Secondly, the ERO is currently conducting a Detailed Spectrum Investigation phase III (DSI III), which covers the frequency range 862-3400 MHz and therefore includes UMTS. DSIs are conducted with a view to long term harmonisation of spectrum utilisation in Europe. The discussions on UMTS extension bands will be fully taken into account in DSI III.

### 1.2.4 TG1 preparation for WRC-2000

ERC/TG1 is leading the Conference preparation about IMT-2000 in CEPT. ERC/TG1 calculated the spectrum requirement for UMTS/IMT-2000 (see Table 1) and it has identified the European candidate bands for the extension bands. All the candidates are in the CPM list and they are pointed in chapter 2.3.

This favourable ERC context encourages the large investment necessary to launch UMTS/IMT-2000 systems and will contribute to their successful deployment in CEPT countries.

### **1.3 Previous UMTS Forum reports addressing spectrum issues**

#### 1.3.1 Regulatory framework, June 1997, UMTS Forum report #1

This Report reflects the first results of the work on spectrum issues done within the UMTS Forum concluding that:

- 582 MHz is the total spectrum demand for all mobile terrestrial applications in year 2010
- 187 MHz is the additional spectrum needed for UMTS/IMT-2000 terrestrial component in year 2010 to meet the UMTS market forecast.

UMTS Forum has developed also the UMTS spectrum vision with the concept of:

- Core Band (WARC-92 allocation as defined in ERC Decision (97)07)
- Extension Bands (global or regional/national basis)
- Refarming Bands (GSM 900 and 1800 allocations)

UMTS Forum has requested that the full 155 MHz in the UMTS Core Band shall be available by 2005 for terrestrial services.

#### 1.3.2 UMTS/IMT-2000 Spectrum, December 1998, UMTS Forum Report #6

This revised version of the above mentioned information confirms the predicted traffic level as well as spectrum requirement for UMTS/IMT-2000, and encourages the further work on extension bands.

#### 1.3.3 Mobile Market Study, March 1999, UMTS Report #8

The market forecasts from the UMTS Forum are specified in this document. They are based upon the detailed investigations for the total mobile market, made by the Analysys Intercai Group.

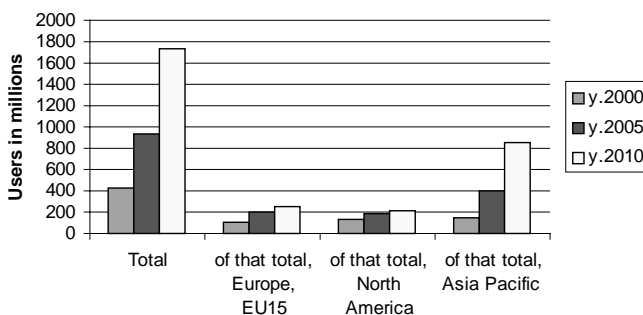
## 1.4 UMTS Forum's observations on world-wide spectrum aspects

### 1.4.1 World-wide mobile multimedia market

In its effort to locate additional spectrum for the UMTS/IMT-2000 extension bands Administrations call for justification and evidence to support the preparatory work for the ITU WRC-2000 agenda item 1.6. Accordingly, the UMTS Forum contributes the calculations and projections, based on methodologies which are extensively described in the Report #6, which may be reflected to assist the preparations.

The world market for mobile multimedia services was projected on the basis of the current status of market development compared to the European Union (EU). It may be interesting to note that markets outside the EU will dominate the world market. Asia Pacific regions will most likely be in a lead position in terms of users by the year 2010.

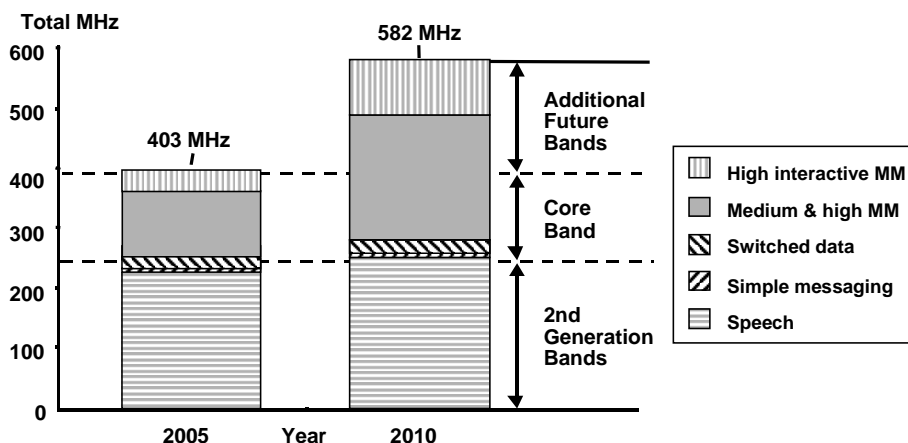
The information in figure 1 shows a high level of growth extending until at least the year 2010. Although less marked in the case of North America, the similarity of the trends, suggest that the requirements for additional spectrum will be broadly similar in most principal market areas.



**Figure 1 - The world-wide market forecast for the users of terrestrial mobile multimedia**

Regarding mobile traffic and capacity, particularly the expected enhancement of the telecommunications and the drive from multimedia and packet switched applications was considered. Based on this, amongst others, the Report #6 concludes that about 582 MHz will have to be identified for the highest traffic areas in the year 2010. The

requirement includes the bands currently designated for second generation systems and the UMTS/IMT-2000 core bands, plus new spectrum. This leaves a requirement of 187 MHz for additional spectrum in Europe.



**Figure 2 - Terrestrial spectrum estimates for the year 2005/2010 e.g. Western Europe (EU15)**

#### 1.4.2 Total spectrum estimates

The first estimates of the total spectrum requirement of 582 MHz for mobile terrestrial systems in year 2010 were done by UMTS Forum Spectrum Aspect Group in December 1997. The additional amount of the spectrum needed for UMTS/IMT-2000 to meet market needs was estimated to be 187 MHz in year 2010. These estimates were confirmed in Report #6 [3].

The methodology developed by the UMTS Forum has been adopted - with slight modifications - by CEPT Administrations within ERC/TG1 and presented to ITU-R/TG 8-1. On this basis ITU-R/TG 8-1 has elaborated a generic methodology which could also be used for other public mobile radio systems. This methodology is applicable to both circuit switched and packet switched traffic and can accommodate both symmetrical and asymmetrical services.

An ITU-R/TG8-1 common understanding of input assumptions as well as agreed projected traffic forecast have given the basis for the derivation of the initial results of a global spectrum estimate for UMTS/IMT-2000 terrestrial component. These results, which are in line with those given by UMTS Forum, are applicable to all Regions.

The UMTS Forum spectrum requirement calculated for terrestrial 3<sup>rd</sup> Generation services is based on:

- market forecast and penetration,
- potential user density in different environments,
- service and traffic characteristics and
- infrastructure and technical factors.

The details of the UMTS Forum spectrum calculations are given in Report #6 [3]

As of March 1999 the current total spectrum figures - quoted by main international bodies considering this issue - for the year 2010 are given in table 1.

	Total spectrum needs	Spectrum already identified for 2 <sup>nd</sup> & 3 <sup>rd</sup> Generation	Additional spectrum
UMTS Forum <sup>5</sup>	582 MHz <sup>6</sup>	395 MHz	187 MHz
Region 1 <sup>7</sup>	555 MHz	395 MHz	160 MHz
Region 2 <sup>7</sup>	390 MHz	230 MHz	160 MHz
Region 3 <sup>7</sup>	480 MHz	320 MHz	160 MHz
ITU-R (Draft) <sup>8</sup>			160 MHz

**Table 1: Summary of terrestrial spectrum requirements calculation**

On the assumption that the core band will provide up to 170 MHz for 3<sup>rd</sup> generation mobile, depending on existing regional allocation, a maximum additional 150 - 309 MHz would be required from 2005 to satisfy the projected market until year 2010. As much as possible of this additional spectrum must be harmonised on a global basis. The results presented in table 1 confirm the trends of spectrum requirement world-wide.

<sup>5</sup> Figures obtained from UMTS Forum Report 6, UMTS/IMT-2000 Spectrum - UMTS Forum ([www.fei.org.uk](http://www.fei.org.uk)), December 1998.

<sup>6</sup> 403 MHz in 2005

<sup>7</sup> Figures contained in Revision 1 to ITU Document 8-1/TEMP/140-E from 11 March 1999, Annex 1, IMT-2000 Spectrum Requirements

<sup>8</sup> ITU-R, Revision 2 to Document 8-1/TEMP/164-E from 18 March 1999 "Proposed Text for Section 1.1 of the Draft CPM Report to WRC-2000"; Task Group TG 8/1 Fortaleza, Brazil, 08 - 19 March 1999

## 2. CANDIDATES FOR UMTS/IMT-2000 EXTENSION BANDS

### 2.1 Basic principles influencing the choice of frequency bands

The vision for UMTS/IMT-2000 is a mobile communication environment that can deliver voice and high data rate digital services and multimedia services to a world-wide mass market. As such it will require spectrum allocations that are, as far as possible, harmonised on a global basis. If the full requirements cannot be met on a global basis, but good candidate bands are available on a regional basis, consideration could be given to achieving global harmonisation of these bands at a later stage (i.e. after 2010).

For a new band to be applicable to UMTS/IMT-2000 three important principles need to be addressed:

- The band in question must be allocated on a Primary basis to the Mobile Service, preferably in all three ITU Regions. Mobile Service allocations must therefore exist, or be introduced, into the frequency table in Article S5 of the ITU Radio Regulations. Action would be necessary at WRC-2000 to provide primary mobile allocations where these do not currently exist.
- The UMTS Forum believes that, in addition to having a Mobile Service allocation, the relevant band(s) would need to be identified as accessible to IMT-2000 applications. The approach used could follow the precedent set for the existing “core bands” which are identified for IMT-2000 in Footnote S5.388<sup>9</sup> to Article S5. This approach allows a measure of flexibility for administrations.
- The UMTS Forum also believes that any new band would need to be of minimum size in order that they are commercially viable from the industry and operator viewpoints. If handset and base station transceivers, antennas and filters need to have to be developed and deployed specially for a band, then this will only be worthwhile if that band embraces a certain minimum number of RF channels. This is particularly true if the new bands are not contiguous with existing UMTS/IMT-2000 allocations. Based on the assumption of 5 MHz wide channels, the UMTS Forum suggests that blocks of 40 MHz, at least 2x40 MHz of paired spectrum or 40 MHz of unpaired spectrum in each extension band, would be a viable minimum.

Furthermore, there are a number of wider principles that need to be considered when thinking about additional band, i.e.:

<sup>9</sup> S5.388: The bands 1885-2025 MHz and 2110-2200 MHz are intended for use, on a world-wide basis, by administrations wishing to implement the future public land mobile telecommunication systems (FPLMTS). Such use does not preclude the use of these bands by other services to which the bands are allocated. The bands should be made available to FPLMTS in accordance with resolution 212 (Rev WRC-95).

The total spectrum requirements that have been calculated by UMTS Forum, CEPT and ITU-R TG8/1 tend to be related to the requirements of the dense urban traffic areas of major cities, and that in some bands sharing on a geographical basis with other services in other areas may need to be explored;

- That the timing of the requirement for additional spectrum within individual countries may differ and will depend on the development of the market in those countries. It has been calculated that administrations will need the full additional spectrum between 2005 and 2010;
- That not all countries will be able to offer access to all identified bands, or all parts of such bands;
- That both additional paired bands and additional unpaired bands will be required.

Important considerations are the minimising of costs and the stimulation of competition in the supply of mobile services to this mass market. The industry (operators and manufacturers) believe these will best be achieved if UMTS spectrum is concentrated in as few separate frequency bands as possible, and with sufficient spectrum in each band to allow several competing operators to have allocations with broadly similar propagation characteristics and hence radio network costs.

It might be assumed that, where possible, preference should be given to options that permit contiguous spectrum. If this is not possible, then additional bands as close as possible to the existing core band would have advantages.

Whilst this is a perfectly valid assumption, it is worth considering the benefits of other frequency options. Propagation conditions are not the same at all frequencies. At the lower (UHF) frequencies, a greater range is possible for a given transmitter power, giving wider-area coverage, and signals more easily penetrate through vegetation, into buildings. The lower frequencies are also more able to maintain service over rough terrain. Therefore there may also be benefits in having access to some lower frequency allocations to allow UMTS/IMT-2000 to be made available in rural areas, difficult terrain and in the lower population areas where longer ranges and better signal penetration would be a clear advantage.

UMTS/IMT-2000 networks starting in, say, 2002-2005 will be rolled out in the 2GHz "core band", because that will be the available spectrum. The additional spectrum requirement is expected to arise as the peak demand in urban areas increases. It is unlikely that an operator could or would restructure his network (cell sizes, frequency reuse, antennas ...) in rural areas if he subsequently gained access to frequencies which have advantages in coverage in such areas. To take advantage of the benefits of lower frequencies for implementing UMTS/IMT-2000 in rural and/or developing areas, such frequencies would therefore need to be available at a fairly early stage. Nevertheless, not all countries will implement UMTS/IMT-2000 simultaneously, and the availability

of lower frequency extension bands could provide the key to a cost-effective and technically attractive deployment in developing countries and less populated areas where a 2 GHz roll-out is commercially unattractive.

## **2.2 A flexible approach to additional IMT-2000 spectrum**

In recognition of the general principles discussed above, it would seem that the objectives at WRC-2000 might be to identify a minimum number (say 2 or 3) of relatively large IMT-2000 extension bands (>100 MHz or so) and to ensure these have primary Mobile Service allocations, preferably in all 3 ITU Regions. These bands should be identified for IMT-2000 applications, on a similar but not necessarily identical basis to footnote S5.388.

National administrations could then organise on the national basis total IMT-2000 allocations in order to match their specific market needs from within the “core band” and the identified extension bands. Administrations would not necessarily need to make all the bands or all of any such bands available, so long as the required total was met from within the identified bands, and was made up from individual allocations of at least the minimum size suggested above.

This approach would offer administrations the advantages of flexibility in implementing IMT-2000 alongside existing services. It would provide clear guidance for industry by indicating, at an early stage, the frequency ranges within which equipment would need to operate. Finally it would give operators and investors confidence in the medium and long term growth potential of UMTS/IMT-2000.

As noted above, additional spectrum will be required for both the Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes of UMTS/IMT-2000, and in the former case due attention needs to be paid to the minimum duplex spacing requirements of low-cost terminals and base stations. Bands of less than about 100 MHz might be best suited to TDD unless it is possible to find a second similar band within an acceptable duplex range to form a pair. By default, the core band offers a duplex spacing 190 MHz, but it is recognised that flexibility in duplex arrangements might be attractive, and will be essential when considering the different extension bands. It is not therefore essential that a single duplex spacing be preserved for all future UMTS/IMT-2000 allocations.

## **2.3 The UMTS Forum analysis of each candidate extension band for UMTS/IMT-2000**

The purpose of this document is to bring together all of the relevant information on the global allocations for the possible candidate extension bands for UMTS/IMT-2000.

Studies in this report are based on previous results of the UMTS Forum reflection on Extension Bands [3] as well as ITU/R TG8-1 analysis [5].

The following bands were discussed within draft CPM text<sup>10</sup>:

- 470-806 MHz
- **806-960 MHz**
- 1429-1501 MHz
- **1710-1885 MHz**
- 2290-2300 MHz
- 2300-2400 MHz
- **2520-2670 MHz**
- 2700-2900 MHz

Complete information and analysis of the global allocations and indications of the current uses for the possible candidate extension bands for UMTS/IMT-2000 are given in Annex 1 which comprises:

- TG8/1 comments
- ITU-R Article S5 and Footnotes
- ERC Report 25 and Footnotes
- US Allocation and Footnotes
- Canadian Allocation and Footnotes
- Japanese Allocation and Footnotes
- Russian Allocation, Footnotes and Remarks

### 2.3.1 Analysis of the candidate band: **470-806 MHz**

#### **470-806 MHz**

##### **Background**

Replacement of the analogue broadcasting by digital television, with better spectrum efficiency, e.g. 3-4 programs per 8 MHz channel and improved frequency reuse, may offer the possibility to consider a part of this spectrum for UMTS/IMT-2000. Parts of the band are used also for other services and demand for these services are likely to continue.

<sup>10</sup> The bands indicated in bold are supported by CEPT

### Benefits of this band for UMTS/IMT-2000

- Potential for a longer range coverage would particular benefit rural areas, areas of low population density and developing countries. However a longer range can most effectively be realised on a FDD basis.
- Potential for a global mobile allocation.

### Availability and risks

Even if the introduction of DVB-T started recently in some countries, replacing of analogue TV might not be in the timeframe of UMTS-Extension since there are the risks that the introduction of DVB-T and the replacing of analogue TV may be delayed due to the acceptance by the customers.

Co-ordination of the analogue broadcasting plans is subject in Europe to the Stockholm agreements (1961). This have been complemented by the Chester agreements (1997) for digital television. Co-ordination is thus likely to be necessary between a country using analogue television in the band and another country using IMT-2000. It is necessary to change Stockholm/Chester agreements in order to introduce other systems in this band.

At the end of the coexistence period between analogue and digital TV services, the removing of analogue TV would make some spectrum available only if a rearrangement of TV assignments should occur. This might be a long process.

The band will be used for the introduction of DVB-T. A designation of a part of this spectrum for IMT-2000 will have an influence on the introduction scenario of DVB-T at all.

There are other services in the band which will remain. Sharing possibilities to be investigated or other spectrum to be identified for accommodating the corresponding requirement.

If this band is identified for IMT-2000, it is expected that operation of terrestrial television will continue in many countries, whereas operation of IMT-2000 will start in some other countries. This situation is likely to occur not only in a transitional phase. Co-ordination would then be necessary between digital and/or analogue television in one country and IMT-2000 in another one. Therefore several compatibility issues (e.g. guard bands) and cross border co-ordination need to be addressed.

A solution for UMTS (e.g. 2x40 MHz) must fit into the channel plan of the broadcasting service.

## UMTS Forum opinion:

- A minimum of 2x40 MHz is needed to utilise the benefits of this part of spectrum. 1x40 MHz is enough if it can be paired with 40 MHz within 806-862 MHz (2.3.2).

## 2.3.2 Analysis of the candidate band: 806-960 MHz

### 806-960 MHz

#### Background

Replacement of the analogue broadcasting by digital television (with better spectrum efficiency, e.g. 3-4 programs per 8 MHz channel, improved frequency reuse) in the band below 862 MHz may offer the possibility to consider a part of this spectrum for UMTS/IMT-2000. Parts of the band are used also for other services and demand for these services are likely to continue.

A large part of this band i.e. above 862 MHz is currently used extensively for existing mobile systems e.g. GSM900 (880-915/925-960 MHz) and could be refarmed in the longer term.

#### Benefits of this band for UMTS/IMT-2000

- Already a global mobile allocation
- Potential for a longer range coverage due to the more beneficial propagation conditions would in particular benefit rural areas, areas of low population density and developing countries. However a longer range can best be realised on an FDD basis.

#### Availability and risks

For the band 806-862 see also 470-806 MHz

The upper part of the broadcasting is used for the introduction of DVB-T in many countries. If the band is used for IMT-2000 the «new» DVB-T equipment has to be re-planned. Co-ordination of the analogue broadcasting plans is subject in Europe to the Stockholm agreements (1961). This have been complemented by the Chester agreements (1997) for digital television. Co-ordination is thus likely to be necessary between a country using analogue television in the band and another country using IMT-2000. It is necessary to change Stockholm/Chester agreements in order to introduce other systems in this band.

At the end of the co-existence period between analogue and digital TV services, the removing of analogue TV would make some spectrum available only if a re-

arrangement of TV assignments should occur. This might be a long process.

If a part of this band is selected for IMT-2000, then an evolution of the existing applications is necessary.

- If those existing applications are licensed mobile services, then there is a possibility to transfer to IMT-2000. Availability of this band for UMTS/IMT-2000 can only be made progressively in the longer term as existing use decreases.
- If those applications are non-mobile, sharing may be possible on a geographical basis.

Time-scales for availability of this band for IMT-2000 may differ.

Almost the whole band 806-960 MHz is used by second generation mobile systems in different regions of the world. There is therefore an opportunity to find bands that would be appropriate for IMT-2000. Since the availability is not the same in every country the whole band 806-960 MHz would be identified world-wide for IMT-2000 on the regional basis at the beginning but with the important potential to become a global allocation later.

The existing second generation allocations in different regions give the indication of the possible availability of 50-89 MHz of spectrum as follows:

- 50 MHz in Australia,
- 70 MHz in Europe,
- 80 MHz in US, 806-821/851-866 MHz and 824-849/869-894 MHz. Current use: US cellular. The lower part co-exists with the European proposal, too.
- 86 MHz in Canada,
- 89 MHz in Japan.

#### **UMTS Forum opinion:**

- **All this band should be identified at the ITU level for UMTS/IMT-2000.**
- **The GSM part of the whole band could be refarmed for 3<sup>rd</sup> generation applications only in the longer term (according to the market evolution) so this spectrum will not solve the additional spectrum issue. The identification of this spectrum will not decrease the total requirement for additional spectrum in Europe.**
- **1x40 MHz within 806-862 MHz would be useful, especially if it could be paired 40 MHz within the band 470-806 MHz (2.3.1)**

## 2.3.3 Analysis of the candidate band:1429-1501 MHz

1429-1501 MHz
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>In Japan, a large part of this band (1429-1453 MHz and 1477-1501 MHz) is currently used extensively for second generation system. In Japan, in the long term, there is a possibility to introduce IMT-2000.</li> </ul> <p>This band is used in other countries by some other services. In particular, 1452 – 1492 MHz, is allocated for satellites (SDAB) and terrestrial digital audio broadcasting (TDAB). A number of satellite systems are under co-ordination for implementation. A number of countries are planning terrestrial broadcasting in 1452-1492 MHz.</p>
<p><b>Benefits of this band for UMTS/IMT-2000</b></p> <p>The strong Japanese use of mobile applications in this band is considered as a good basis.</p>
<p><b>Availability and risks</b></p> <ul style="list-style-type: none"> <li>World-wide availability of this band is likely to be precluded by the aeronautical telemetry use in US and other countries as well as T-DAB and S-DAB allocations in CEPT countries. In Europe TDAB is subject to Wiesbaden arrangement (1995).</li> <li>Many countries have recently identified this band for non-IMT-2000 applications, and that investment is being done to implement these applications.</li> <li>72 MHz is not enough to support paired use, however elements of this band might support TDD use but only on a country basis.</li> <li>It is not an attractive proposal from the manufacturer point of view because of the T-DAB allocation in the middle of the band. It raises many problems (e.g. large guard bands, interference).</li> <li>UMTS Forum confirms ERC/TG1 position that this band is not suitable as an extension band 1.</li> </ul> <p><b><u>UMTS Forum opinion:</u></b></p> <p><b>This band could only be considered as extension band outside of Europe.</b></p>

### 2.3.4 Analysis of the candidate band: 1710-1885 MHz

1710-1885 MHz
<p><b>Background</b></p> <p>A large part of this band i.e. 1710-1785/1805-1880 MHz is currently used for existing mobile system e.g. GSM1800 in Europe and could be refarmed in the longer term.</p>
<p><b>Benefits of this band for UMTS/IMT-2000</b></p> <ul style="list-style-type: none"> <li>• It is already a global mobile allocation.</li> <li>• Close proximity to the Core Band.</li> <li>• Similar propagation characteristics to the Core Band.</li> </ul>
<p><b>Availability and risks</b></p> <p>Different band plans for cellular mobiles (PCS and GSM1800) are currently employed in different countries. Countries are likely to want to retain the same band plan for IMT-2000</p>
<p><b>UMTS Forum opinion:</b></p> <ul style="list-style-type: none"> <li>• All this band should be identified on the ITU level for UMTS/IMT-2000 but could be refarmed only in the longer term according to the market evolution.</li> <li>• This spectrum will not solve the additional spectrum issue. This portion of the spectrum will not decrease the whole demand of additional spectrum in Europe.</li> </ul>

### 2.3.5 Analysis of the candidate band: 2290-2300 MHz

2290-2300 MHz
<p><b>Background</b></p> <p>Fixed service and about 10 Earth stations world-wide for deep space research.</p>
<p><b>Benefits of this band for UMTS/IMT-2000</b></p> <ul style="list-style-type: none"> <li>• This portion of spectrum is adjacent to the 2300-2400 MHz band. It could be added to this band if it is available for UMTS/IMT-2000 or could be used as an additional band for licence exempt applications.</li> </ul>

## Availability and risks

- In some countries, this band is part of fixed service channel plan (ITU-R F.283) that already overlaps with IMT-2000 core band and will therefore be made available following migration of the fixed service, apart from the deep space stations.
- Studies in TG1 and TG8/1 to address protection of very sensitive Earth stations for deep space research have indicated that large separation distances, e.g. up 400 km, are required around 10 stations in the world (3 in Europe).
- Further studies about the possibility of compatibility and co-ordination (taking into account e.g. shielding) are needed.
- Good availability in Europe outside the co-ordination zones of the deep space stations.
- Some countries (e.g. US) have indicated that this band will not be available due to existing uses (space research and fixed services).
- It has been suggested to study the possibility to share with the space science services below 2290 MHz if the co-ordination distance is too large.

## UMTS Forum opinion:

### 10 MHz spectrum possible use:

- **alone<sup>10</sup> e.g. licence-exempt TDD band**
- **combined with the band 2300-2400 MHz (2.3.6)**

## 2.3.6 Analysis of the candidate band: 2300-2400 MHz

### 2300-2400 MHz

#### Background

Fixed service and aeronautical telemetry.

#### Benefits of this band for UMTS/IMT-2000

- Wide enough band for the additional band of UMTS/IMT-2000.
- Mobile allocation in all 3 Regions.

<sup>10</sup> A minimum block size of 40 MHz is applicable for public license use, however 10 MHz could be suitable for other types of systems.

### Availability and risks

- Some countries have indicated this spectrum could be made available.
- In some countries the aeronautical telemetry services are implemented but there are only a few transmitters. The aeronautical telemetry services need bands below 3GHz, their requirement is from 40 to 110 MHz and the harmonisation is suitable.
- Other systems like wireless cameras and ENG/OB operate in this band.
- Some difficulties are possible because of the other users (e.g. S-DAB is developed in US and could be spread, new military fixed links in some countries with a new equipment, radiolocation).
- In ERC/TG1 this band is no more considered as an European candidate.

### UMTS Forum opinion:

There are some uncertainties concerning the availability of this band in some European countries. Nevertheless, the UMTS Forum considers that the band should be studied as it could be a useful candidate band.

- Possibility to get at least 2x40 MHz
- Possibility to get as much as 2x110 MHz if 2290 MHz is paired with 2520-2670 MHz see 2.3.7).
- Possibility of a 100 MHz TDD band or 110 MHz if combined with 2290-2300 MHz.

### 2.3.7 Analysis of the candidate band: 2520-2670 MHz

#### **2520-2670 MHz**

#### **Background**

Fixed service, ENG/OB (Electronic News Gathering / Outside Broadcasting) and multipoint distribution applications.

#### **Benefits of this band for UMTS/IMT-2000**

- Allocation to Mobile Services in all Regions
- The band is wide enough to cover most of the forecast UMTS/IMT-2000 spectrum requirement.
- Might be paired with 2290-2300 MHz and 2300-2400 MHz (2.3.5 and 2.3.6) for even greater opportunities.

## Availability and risks

- In the US multipoint distribution applications are used. However, in Europe, such systems are only deployed in a few countries.
- Part of the band, 2520-2535 MHz/2655-2670 MHz, may be used for MSS in some countries, the same part can still be used for terrestrial services in other countries.
- Geographical sharing (urban/rural) might facilitate the transition or even enable, in the longer term, remaining operation of other services.

## UMTS Forum opinion:

This is the most probable candidate for additional band globally. The UMTS Forum recommends it as a prime candidate.

- 150 MHz, seems to be possible for most of CEPT Administrations starting from year 2008 or later subject to market demand, after phasing out of existing usage.
- It offers at least the following possibilities:
  - 150 MHz TDD band
  - 2x70 MHz paired (maximum, if duplex-separation allows)
  - 1x120 MHz is possible in 2535-2655 MHz (if the MSS allocation is left out) for TDD or FDD, 2x110 MHz could be possible if paired with 110 MHz within 2290-2400 MHz (2.3.5 and 2.3.6) or 2700-2900 MHz (2.3.8).

## 2.3.8 Analysis of the candidate band: 2700-2900 MHz

### 2700-2900 MHz

#### Background

Radar systems, Aeronautical radio-navigation systems and meteorological aids. CEPT is studying the current spectrum requirement of radars.

#### Benefits of this band for UMTS/IMT-2000

This band is wide enough to cover the forecast UMTS/IMT-2000 spectrum requirement.

### **Availability and risks**

- In some countries (e.g. Canada) a limited number of systems are deployed in this band
- On a world-wide basis usage for radio navigation and meteorological radars is expected to increase, making this band not available in all geographical areas for use for IMT-2000. For example in US this band is not suitable for IMT-2000 deployment.
- If studies in CEPT prove that radars can co-ordinate and use the spectrum more efficiently, some spectrum could be made available.

### **UMTS Forum opinion:**

**If the results of CEPT studies confirm the possibility for Europe to use this bands for UMTS/IMT-2000, it is assumed that in this case about 100 MHz could be available from this band. This gives the following possibilities:**

- **Maximum of 2x50 MHz FDD band (then there should be two block)**
- **2x100 MHz FDD band combining this band with 2290-2400 MHz (2.2.5 and 2.2.6) or 2520-2670 MHz (2.3.7).**
- **TDD band**

### **3. SCENARIOS FOR ADDITIONAL SPECTRUM ALLOCATION BY WRC-2000**

#### **3.1 Main requirements for the UMTS Forum recommended candidates for UMTS/IMT-2000 extension**

The following principles were taken into account when evaluating the suitability of the candidate bands:

- Important considerations are the minimising of costs and the stimulation of competition in supply of mobile services to this mass market. The industry believe these will best be achieved if UMTS spectrum is concentrated in as few separate frequency bands as possible. Preference should be given to options that permit contiguous spectrum. If not possible, then additional bands as close as possible to the existing core bands would have advantages.
- It is generally agreed that a considerable element of the cost of the mobile terminal is the RF part. So, the preferred band should be large enough to ensure feasible manufacturing of equipment, a number of narrow bands would lead to a MS which contains many radio parts. A minimum block of 40 MHz was considered to be needed to provide enough frequency band in a competitive environment.
- The bands under consideration in §2 are comprised between 470 MHz and 2.9 GHz. Operation at the lower end of this frequency range will increase the coverage and reduce the number of required sites in rural areas. Furthermore, at the lower range of these frequency bands reduce the “Doppler shift” and provide appropriate propagation conditions for fast moving mobiles. For propagation reasons, 3.4 GHz is considered to be an upper limit for a practicable and economically viable outdoor operation of UMTS/IMT-2000.
- It should be prepared to make both paired and unpaired bands available. The Frequency Division Duplex (FDD) mode of UMTS requires paired bands to operate, whereas the Time Division Duplex (TDD) mode can operate in unpaired bands. The FDD mode is expected to be more efficient for wide-area coverage, and the full benefits of lower frequency bands would be achieved with paired bands.
- The duplex separation is about 190 MHz in the UMTS/IMT-2000 core band while the duplex separation in the PCS bands is 80 MHz. The range of possible duplex separation and associated costs, in the year 2010, is not yet well defined, but this report will assume that separations between 60 and 245 MHz will be feasible, and indicates for each scenario which value is achieved.

- It is expected that guard bands will be necessary between UMTS/IMT-2000 and services operating in adjacent bands. These guard bands are expected to be limited in size, as they are for the core band of UMTS/IMT-2000 [6]. They are therefore considered here as negligible.
- Similarly, a guard band would be necessary in scenarios where the up- and down-link of UMTS/IMT-2000 are adjacent. The size of this guard band is not determined precisely at this time, and the possibility to identify adjacent bands for the up- and the down-link is retained. It is worth noting that this possibility could result in a limited loss of spectrum usage.

### 3.2 Examples of possible use of the candidate bands

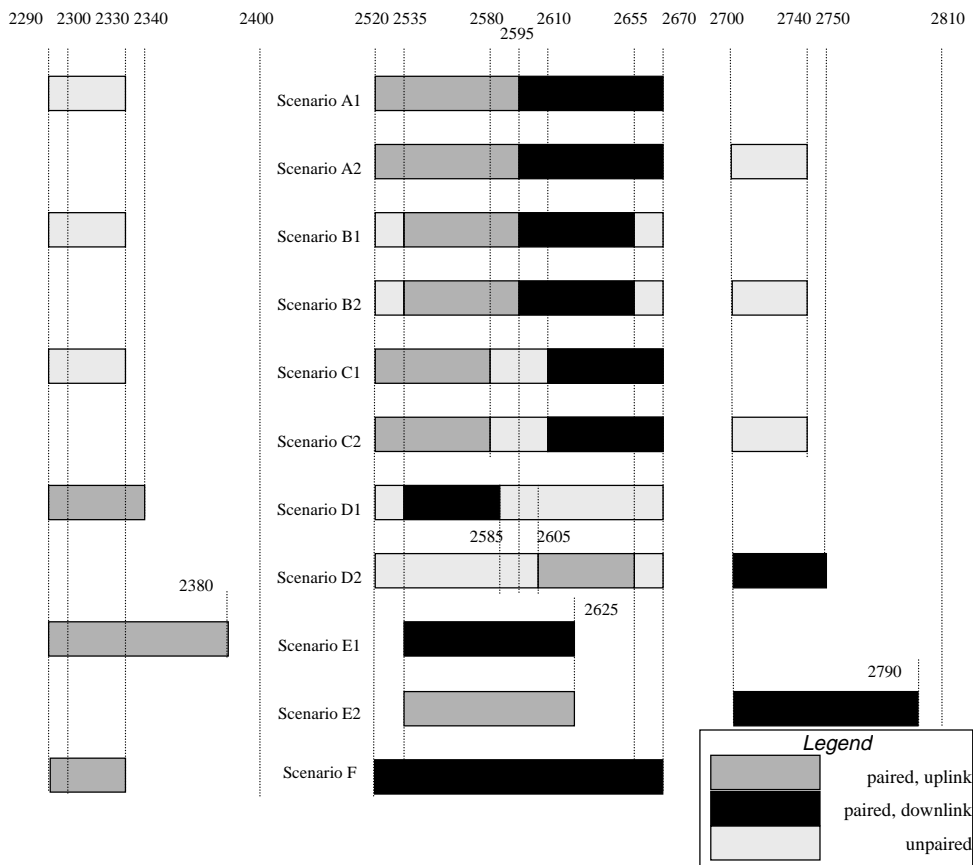
The principles defined in 3.1 have been applied to the bands identified in 2.3. Some scenarios are illustrated, but the whole range of possibilities is not fully investigated. Two categories of scenarios are investigated, depending on the number of frequency bands identified (2 or 3). Scenarios with more than three blocks would be less feasible according to 3.1.

Some of the bands listed in §2 are not considered here, because they are recommended to be used for refarming. The introduction of UMTS/IMT-2000 in 2<sup>nd</sup> Generation bands will occur at a later stage for extension bands on national/regional basis.

#### 3.2.1 Allocation scenarios using two spectrum blocks

On the basis on the principles defined in 3.1, the 2520-2670 MHz band (150 MHz wide) is a good candidate, and is seen as a prime candidate in Europe. This band alone is not sufficient to fulfil the 187 MHz requirement.

2x15 MHz within the bands 2520-2535 MHz/2655-2670 MHz, could be used for MSS in some parts of the world outside Europe. Figure 3 below presents different scenarios of allocation where this band is coupled with other portions of the candidate bands, to help and identify 190 MHz of additional spectrum.



**Figure 3 – Examples of possible frequency arrangements with two frequency blocks that could be studied.**

Table 2 presents the frequency blocks associated with these scenarios.

Scenario	Paired spectrum MHz	Duplex spacing (MHz)	Unpaired spectrum (MHz)	Notes
A	2 x 75	75	40	Up- and down-link are adjacent
B	2 x 60	60	70	Up- and down-link are adjacent Allows for use by MSS in other regions
C	2 x 60	90	70	
D1	2 x 50	245	100	Allows for use by MSS in other regions
D2	2 x 50	95	100	Allows for use by MSS in other regions
E1	2 x 90	245	-	
E2	2 x 90	165	-	
F	40/150		-	Asymmetry

**Table 2 – Frequency blocks related to the scenarios in Figure 3**  
(Maximum allocation that would be available)

Scenarios A, B, C and D are each split into two sub-scenarios where the 40 MHz additional requirement is found in other bands. It is apparent that if the whole band 2520-2670 MHz is identified for IMT-2000, the additional requirement can be accommodated in a reduced portion of other bands, thus enabling a continued operation of existing systems, and particular geographical sharing situations on a national basis.

Scenario E is split into 2 sub-scenarios where 2x90 MHz are found in 2 different bands: 2520-2670 MHz combined with an additional band above or below that band.

The UMTS Forum spectrum calculations [3] suggest that requirement for new spectrum could be asymmetric between the up-link and down-link. If this proves to be a case a scenario F would be needed to accommodate this asymmetry. Scenario F offers 150 MHz down-link in 2520-2670 MHz and 40 MHz up-link in an additional band.

Scenarios A and B identify paired bands that are adjacent. This could raise compatibility problems, in particular in the case of site sharing.

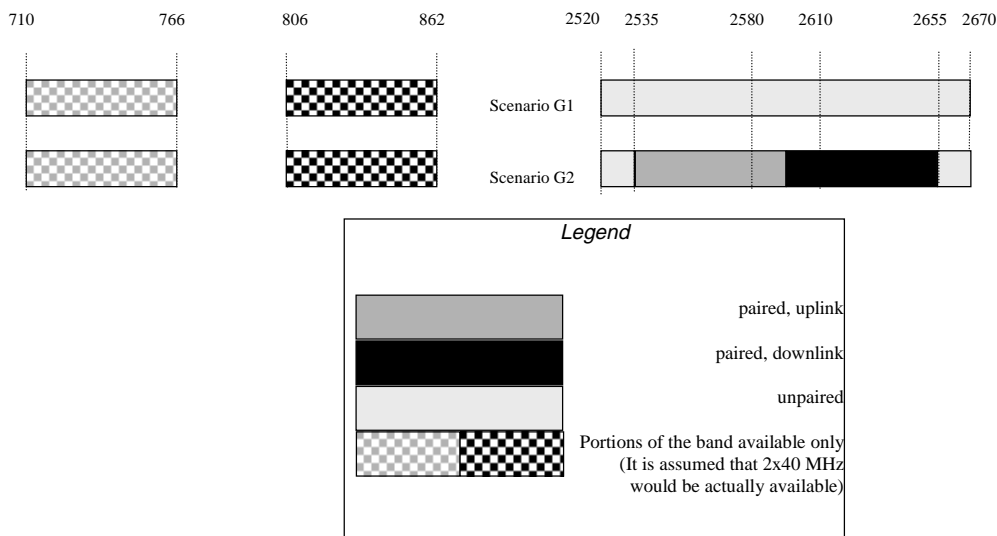
A fixed duplex distance between the up- and the down-link could be used world-wide in scenarios B and C, even in countries where the bands 2520-2535/2655-2670 MHz would be identified for MSS. However all scenarios can accommodate this national use if variable duplex distances are implemented.

## 3.2.2 Allocation scenarios using three spectrum blocks

The bands identified in 2.3.1 and 2.3.2 are of particular interest because they are already identified for the mobile service and are at lower frequencies. Propagation conditions are better than at 2 GHz, and therefore coverage is increased compared to the core band. To take benefit of this increased range, however, it is more suitable to use Frequency Division Duplex (FDD), and therefore paired frequencies would be preferred.

In scenarios G1, G2 the preferred CEPT band i.e. 2520-2670 MHz contributes the major part of the additional spectrum needed. This scenario takes also advantage of the benefits of lower frequencies for implementation of UMTS/IMT-2000 in rural areas, so it could provide the key to a cost-effective and technically attractive deployment in developing countries and less populated areas where a 2 GHz roll-out is commercially unattractive.

Figure 4 below presents different scenarios of allocation where these bands are identified together with other portions of the candidate bands, to help and identify 190 MHz of additional spectrum.



**Figure 4 – Examples of possible frequency arrangements with three frequency blocks that could be studied**

It is noted above that the current usage in bands identified in 2.3.1 and 2.3.2 is fragmented, and that a general identification of it would yield only a reduced amount of spectrum clearly available for UMTS/IMT-2000. It could be assumed that identification of 2x56 MHz, together with flexible pairing schemes, would result in the availability of 2x40 MHz.

Table 3 presents the frequency blocks associated with these scenarios.

Scenario	Paired spectrum MHz	Duplex spacing (MHz)	Unpaired spectrum (MHz)	Notes
G1	2 x 40	94	150	
G2	2 x 40	94	120	Allows for use by MSS in other regions

**Table 3 – Frequency blocks related to the scenarios in Figure 4**

The uplink band in scenarios G is identified as 710-766 MHz. This is an example of a particular location of this band, and other locations could be retained. This location, however, allows the operation of 5 video broadcasting channels in the band 766-806 MHz, and continued operation of some mobile services in the band 764-806 MHz.

In scenario G, two options for the use of the band 2520-2670 MHz are illustrated. However, different options as in scenarios A or B would be applicable as well with the same notes as in 3.1.1.

## **4. CONCLUSIONS**

It is expected that WRC-2000 will allocate an additional spectrum for IMT-2000 on a world-wide basis e.g. 187 MHz for Europe. It is extremely important that the biggest part of this additional spectrum for UMTS/IMT-2000 is identified to be harmonised from the beginning world-wide and some part to be harmonised on a regional basis with the potentiality to become harmonised world-wide after year 2010.

UMTS/IMT-2000 development in year 2010 requires a sufficient amount of the spectrum in the extension bands (WRC-2000 expected allocation) in addition to the Core Band (WARC-92 initial allocation).

The aim of this Report is to provide the industry's opinion on the allocation scenarios and the frequency planning aspects that would best suit its needs. They need to be balanced with the different constraints that are likely to apply to different countries. This Report is intended to contribute to the identification by WRC-2000 of the best possible choice taking into account the industry recommendations and constraints of the existing systems.

The list of scenarios is not exhaustive, and as time progresses, more information on a radio interface and on the bands listed in §2 and other bands might appear, to complement the picture that has been sketched in this report. However, the UMTS Forum recommends that the initial consideration on extension bands for UMTS/IMT-2000 be based on these scenarios, in addition to information that will be brought to the attention of Administrations via the CPM report.

National administrations could then organise on the national basis total IMT-2000 allocations in order to match their specific market needs from within the "core band" and the identified extension bands. Administrations would not necessarily need to make all the bands (or all of any such bands) available, so long as the required total was met from within the identified bands, and was made up from individual allocations of at least the minimum size suggested in this Report.

The UMTS Forum believes that:

- Extension Bands must be allocated on a primary basis to the Mobile Service in Article S5 of the ITU Radio Regulations, preferably in all three ITU Regions. Action would be necessary at WRC-2000 to modify allocations with the aim to allow mobile services in this band, where these do not currently exist.
- Extension Bands must be identified clearly for IMT-2000 applications, following the approach of the existing IMT-2000 "core bands" which are identified in Footnote S5.388. This approach allows a measure of flexibility for administrations.

Action would be necessary at WRC-2000 to identify Extension bands for IMT-2000 terrestrial applications in a Footnote to Article S5.

- Extension Bands should need to be made available from year 2005 or later subject to market demand. The timing of the requirement for additional spectrum within individual countries may differ and will depend on the development of the market in those countries. It has been calculated that administrations will need the full additional spectrum between 2005 and 2010.
- That not all countries will be able to offer access to all identified bands, or all parts of such bands;
- That both additional paired bands and additional unpaired bands will be required.

### **UMTS Forum Recommendations:**

**Recommendation N°1:** The objectives at WRC-2000 should be:

- to identify relatively large blocks of a minimum block size of 40 MHz, contiguous or as close as possible to the Core Band spectrum for IMT-2000 extension bands and
- to ensure these have primary Mobile Service allocation in all 3 ITU Regions and are identified for IMT-2000 applications on a similar basis to footnote S5.388<sup>11</sup>.

**Recommendation N°2:**

- The amount of additional spectrum to be identified for IMT-2000 should have the potential to satisfy needs of 187 MHz for areas with high traffic demand according to the current estimates.
- Both, paired and unpaired arrangements should be made possible.

<sup>11</sup> S5.388: The bands 1885-2025MHz and 2110-2200MHz are intended for use, on a worldwide basis, by administrations wishing to implement the future public land mobile telecommunication systems (FPLMTS). Such use does not preclude the use of these bands by other services to which the bands are allocated. The bands should be made available to FPLMTS in accordance with resolution 212 (Rev WRC-95).

**Recommendation N°3:**

The recommended additional IMT-2000 spectrum cannot be found in any single one of the candidate bands discussed in this report.

- **The band 2520-2670 MHz should be identified globally for the terrestrial component of IMT-2000.**
- **The additional spectrum should be found preferably in only one other band, identified according to the principles discussed in this report. The identification of this band needs to be subject of additional studies.**

**Recommendation N°4:**

- **In addition to these new IMT-2000 bands, the UMTS Forum recommends to identify existing 2<sup>nd</sup> generation bands for IMT-2000 (880-915/925-960 MHz, 1710-1785/1805-1885 MHz). These bands could only be available for UMTS/IMT-2000 services in the longer term according to the market evolution.**

## **5. REFERENCES**

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