

Spectrum and Regulatory Considerations for IMT-2000 and Beyond

Including the Transition of Second Generation Systems to IMT-2000 and Beyond

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Outline

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Spectrum and Regulatory Objectives

Why is Spectrum so Important?

Despite being a scarce public resource....

- Globally, mobile phone users are overtaking fixed-line subscribers due to coverage, competition and convenience.
- Wireless-only homes are growing.
- There are far more mobile phones than PCs in the world.
- Mobile technologies are being utilized to foster various levels of global connectivity – from basic wireless local loop service to high speed mobile voice and/or data.
- *The demand for spectrum is growing exponentially!*
 - *However, the amount of spectrum available around the world is NOT! Thus new spectrum-based technologies must not only be widely available, affordable, and reliable; they must also use the spectrum efficiently while enabling a wide variety of fixed and mobile voice and data services.*

Spectrum Regulatory Objectives

- Advance spectrum reform by developing and implementing market-oriented allocation and assignment reform policies.
- Vigorously protect against harmful interference and enforce public safety-related rules.
 - Harmful interference between licensees using pre-IMT-2000 and IMT-2000 systems may be addressed by specific technical rules that seek to avoid harmful interference between operators on adjacent channels in the same area.
 - These technical rules include out-of-band emission limits, power flux density or field strength limits at the edge of the service areas or borders, guard-bands, and coordination requirements.
- Conduct effective and timely licensing activities that encourage efficient use of the spectrum.
- Provide adequate spectrum and improve interoperability for better public safety and commercial purposes.

<http://www.fcc.gov/spectrum/>

Additional Regulatory Objectives

- Ensuring Technology Neutrality
- Responsibility for Efficient Use of Radio Spectrum
- Promoting Consolidation with Existing Telecoms Infrastructure
- Defining Fixed Wireless vs. Limited Mobility
- Enabling Convergence



Role of Regulators – Very Crucial

Importance of Technology Neutrality

- **Spectrum availability dictates technology choice**
 - Appropriate spectrum enables innovative and different technology selection
 - Spectrum efficiency and 3G wireless broadband benefits should be leveraged
 - Economies of scale should be leveraged
- **No specification of technology**
 - Let the best business case win
 - Limited specification of spectrum allocation plans



Choice of Technologies Enables Cost-Effective Telecoms Access

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Convergence Licensing

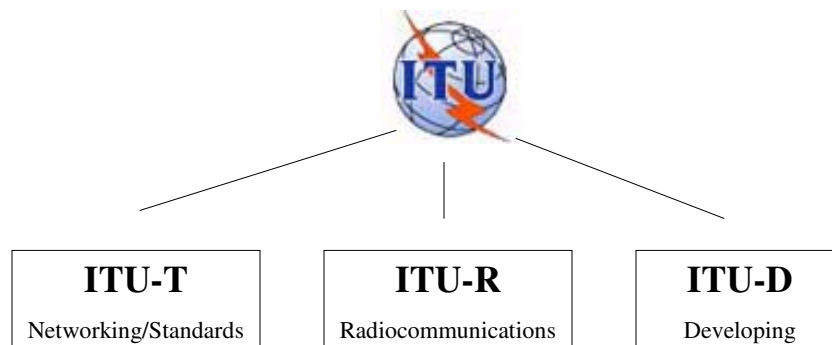
- **Convergence happening at the device level**
 - Licensing policy needs to address this reality
 - Allow carriers to offer fixed (e.g., WLL), mobile, data, broadcast services
- **Fixed → Limited Mobility → Full Mobility Convergence**
 - e.g. India's "Unified License" regime
 - Nigeria has also recently introduced four Unified Licenses into their market
- **Promote carriers in enabling different tiering of service plans**
- **Converged licenses possible at network facility, services, ISP, content layers**

Convergence Has Arrived

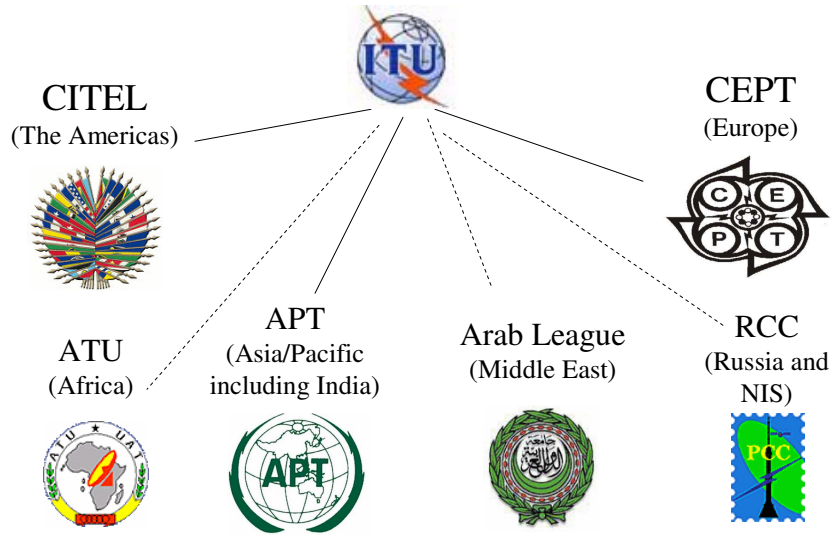
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IMT-2000 (3G) Technologies and Spectrum Issues

ITU Structure



ITU and Regional Organizations

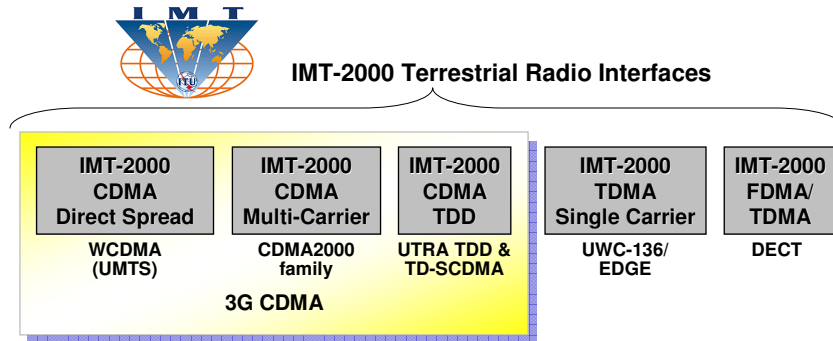


IMT-2000 Background

- **International Mobile Telecommunications-2000 (IMT-2000) is the global standard for third generation (3G) wireless communications, defined by a set of interdependent ITU Recommendations.**
- **IMT-2000 provides a framework for worldwide wireless access by linking the diverse systems of terrestrial and/or satellite based networks and takes advantage of the synergies between digital mobile telecommunications technologies and systems for fixed and mobile wireless access systems.**
- **The guidelines for evaluating the different radio interfaces were:**
 - 144 kbit/s (for vehicular high speed),
 - 384 kbit/s (for medium speed), and
 - 2048 kbit/s (for indoor, low speed)

IMT-2000 Radio Air Interfaces

The ITU approved five radio air interface standards and has identified multiple frequency bands for IMT-2000.



Although there are five terrestrial standards, most of the attention and energy in the industry has been toward the CDMA standards

IMT-2000 Spectrum – Background

The ITU has taken a lead role in the development and deployment of IMT-2000:

- Recommendation ITU-R M.1036-2 details the different bands identified for IMT-2000 and it continues to be updated.
- The ITU's World Radio Conferences in 1992 and 2000 identified several frequency bands for the deployment of IMT-2000 systems and services.
- This identification is not an allocation to a particular technology or set of technologies, nor is it an allocation to a new service.
- Instead, the identification is a recommendation to Administrations to consider using these frequencies for IMT-2000.

ITU-R Working Party 8F Scope

- WP 8F is responsible for the overall radio system aspects of IMT-2000 and beyond. It has the prime responsibility within ITU-R Study Group 8 for issues related to the terrestrial component of IMT-2000 and beyond.
- It is the lead group for the overall maintenance of existing and development of new Recommendations on IMT-2000 and beyond. This activity also involves liaison with ITU-T on network-related standardization activities of IMT-2000 and beyond, and with ITU-D in relation to the application of IMT-2000 in developing countries. Strong cooperative efforts with external organizations and defined standards development organisations (SDOs) are also maintained.
 - A key element is the consideration of the needs of developing countries and how IMT-2000 can appropriately be configured to meet those needs.
- IMT-2000, defined by a set of interdependent ITU Recommendations. International Mobile Telecommunications-2000, also known as the Third Generation Mobile Systems, fulfils the goal of making anywhere, anytime communications a reality.

Source: <http://www.itu.int/ITU-R/study-groups/rsg8/rwp8f/scope/index.html>

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IMT-2000 Spectrum – Identification by the ITU

IMT-2000 can operate in the frequency bands identified in the Radio Regulations (RR) as intended for use on a worldwide basis by administrations wishing to implement IMT-2000, as follows:

- **WARC-92 identified the bands:**
 - 1 885 - 2 025 MHz
 - 2 110 - 2 200 MHz
- **WRC-2000 identified the bands:**
 - 806 - 960 MHz
 - 1 710 - 1 885 MHz
 - 2 500 - 2 690 MHz



for possible use by IMT-2000 systems, noting (in accordance with RR No. 5.388) that identification of these bands does not establish priority in the RR and does not preclude use of the bands for any other services to which these bands are allocated. Also, some administrations may deploy IMT-2000 systems in bands other than those identified in the RR.

Source: Recommendation ITU-R M.1036-2, "Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications-2000 (IMT-2000) in the bands 806 - 960 MHz , 1 710-2 025 MHz, 2 110 - 2 200 MHz and 2 500 - 2 690 MHz"

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IMT-2000 Spectrum – Recommendation M.1036

“Frequency arrangements for implementation of the **terrestrial component** of International Mobile Telecommunications - 2000 (IMT-2000) in the bands 806 - 960 MHz , 1 710-2 025 MHz, 2 110 - 2 200 MHz and 2 500 - 2 690 MHz”

- **Recognizes that Administrations may implement IMT-2000 in *any* band allocated for the mobile service**
 - Today, IMT-2000 systems have been deployed in bands designated for mobile service for many years, such as the 450 MHz band, 800 MHz (cellular) and 1900 MHz band (PCS).
 - Also, 3GPP has introduced and completed technical specifications for deploying UMTS/WCDMA in the 900 MHz band which have been available since December 2005 (1).
 - ECC PTT1 is currently performing studies for operating in 1800 MHz
- **Encourages Administrations to allow existing pre-IMT-2000 systems (e.g. GSM, TDMA, cdmaOne,) to migrate to IMT-2000**
 - Example: the first commercial IMT-2000 systems were implemented by upgrading existing 1G and 2G cellular and PCS systems in the 450, 800, 1700 and 1900 MHz bands.

1: UMTS900 has been included in the Release 3 European harmonised standards (EN301908-xx by ETSI/TFES).

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Frequency Band Table of Allocations

Frequency Band	Specific Band Pairing	Common Names
800 MHz	824-849 / 869-894 MHz	800 MHz or cellular band
900 MHz	890 – 915 / 935 - 960 MHz	900 MHz or GSM 900
1700 MHz	1750-1780 / 1840-1870 MHz	Korean PCS band
1800 MHz or 1.8 GHz	1710-1785 / 1805-1880 MHz	DCS 1800 band
1900 MHz or 1.9 GHz	1850-1910 / 1930-1990 MHz	PCS band or PCS 1900
2 GHz	1920-1980 / 2110-2170 MHz	UMTS band

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World Radio Conference 2003



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WRC-2003 directed the ITU-R to report, in time for WRC-07, the results of studies on the spectrum requirements and potential frequency ranges suitable for the future development of IMT-2000 and systems beyond IMT-2000, taking into account:

- evolving user needs, including the growth in demand for IMT-2000 services;
- evolution of IMT-2000 and pre IMT-2000 systems through advances in technology;
- bands currently identified for IMT-2000;
- time-frame in which spectrum would be needed;
- period for migration from existing to future systems;
- potential use of frequencies below 806 MHz; inserted at request of developing countries who are looking the lower bands for deployment of IMT-2000 due to propagation characteristics especially in rural areas with low population density.

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World Radio Conference 2003 – Results

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The World Radio Conference 2003 (WRC-03) approved plans for the future development of IMT-2000, and created a new item for attention on IMT-2000 for WRC-07 (Agenda Item 1.4):

- “To consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account the results of ITU-R studies in accordance with Resolution 228.”
- Resolution 228 invites further studies of lower frequency bands for IMT-2000. Specifically, Resolution 228 invites ITU-R “to conduct regulatory and technical studies on the usage of frequencies below those identified for IMT-2000 in No. 5.317A for the future development of IMT-2000 and systems beyond IMT-2000”.
- **Several developing countries requested language to be included in the report for WRC-03 that encouraged the Conference to consider the benefits of using the bands below 600 MHz for IMT-2000 and consider the identification of these bands at WRC-07.**

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ITU-R Working Party 8F Activities

- ITU-R Working Party 8F is considering future spectrum requirements for IMT-2000 and IMT-Advanced. The study includes spectrum estimate and consideration of candidate bands for future identification at the next World Radiocommunication Conference in 2007.
- WP 8F is developing process to define IMT-Advanced. Preliminary plans are to complete this work in 2008 time frame. This work will have implications for deployment of systems in both new bands identified by WRC and current bands becoming available such as 2.5 GHz band.
- At the last meeting in May 2006, SWG Spectrum Bands and its various sub-working groups met continuously over seven days to address two principle work items:
 - the completion of the table of “potential candidate bands” for identification at WRC-07 in the Preliminary Draft New Report ITU-R M.[IMT.CANDI], and
 - to progress the work towards accommodating the advantages and disadvantages (in some sort of deliverable) of particular bands for the future development of IMT-2000 and IMT-Advanced

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Coverage Advantages of Lower Frequency Bands for IMT-2000 in Developing Countries

- Several developing countries, including Cameroon and Cote d'Ivoire, have indicated that they would like to explore the advantages of lower frequencies bands, such as the 450 MHz band, for the deployment of IMT-2000.
- Due to the favorable propagation characteristics of lower frequencies and their associated coverage benefits, there may be significant cost advantages associated with deploying a wireless system in the 450 MHz band.
- The 800 MHz and 900 MHz (cellular) bands offers both economies of scale and favorable propagation conditions.
- These cost advantages will be important considerations for developing countries, which may have several different frequency bands available, but may not have the resources to deploy nationwide systems in the higher frequency ranges identified by the ITU for IMT-2000.

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Importance of IMT-2000 for Developing Countries

Today, 3G technologies enable high capacity voice networks which translate into more affordable telephony services, but most importantly, they also provide ubiquitous broadband access.

- Means to achieve universal service and Internet access goals
- Diversification of the telecommunications services offering
- Provision of new advanced wireless services
- Factor of integration in the Information Society
- Development of connectivity
- Fast provision of voice and data services in underserved regions

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Considerations for In Band Transition to IMT-2000

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In Band Transition to IMT-2000

- In 2005, the ITU-D published a “GUIDELINES ON THE SMOOTH TRANSITION OF EXISTING MOBILE NETWORKS TO IMT-2000 FOR DEVELOPING COUNTRIES .”
- In this report, the importance of in band transition to IMT-2000 is emphasized.
 - “The adoption of flexible policies for the national allocation of the radio spectrum and for the choice of technologies provides market incentives for the development and deployment of advanced wireless services throughout the world. Regulators may wish to allow operators to transition their pre-IMT-2000 systems to IMT-2000 using their existing licensed spectrum, so that operators would not need to deploy these systems in new spectrum bands. This spectrum flexibility benefits operators by allowing them to spend capital resources on improving their system and can keep costs low.”^[1]
 - In some countries, system upgrades to IMT-2000 are taking place in the 800 MHz, 900 MHz, 1 800 MHz and 1 900 MHz bands. There are various possibilities to facilitate in-band transition. The regulators should evaluate these options carefully and select the one which best meets their needs.

^[1] Guidelines On The Smooth Transition Of Existing Mobile Networks To IMT-2000 For Developing Countries (GST); July 2005, ITU-D

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In Band Transition to IMT-2000

- One possibility to facilitate in band transition includes:
 - First, no regulatory limitations on the use of a particular technology in the existing mobile bands. Regulations and/or license conditions specifying the use of a particular technology or standard in the bands would have to be eliminated.
 - Second, service definitions may also have to be modified to accommodate the new flexibility. This can be achieved in the regulations or license authorizing mobile services (e.g., cellular, PCS or IMT-2000), by keeping the definition broad and non-specific. For example, the use of a broad definition has allowed existing pre-IMT-2000 operators in various countries to pursue in-band transition to IMT-2000 using whatever technology they choose.
- Alternatively, regulators can enhance the existing licenses and identify some preferred technologies in order to meet the demands of end users and operators.
 - For example, these preferred technologies might be the IMT-2000 family.
 - Given a choice from among the preferred technologies, the operators can still select the most appropriate technology from the set of technologies as well as the timing of the introduction of the new technology.

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In Band Transition to IMT-2000

- **Given the significant initial capital expenditures necessary to deploy entirely new IMT-2000 systems, operators are finding that upgrading networks in existing spectrum is a more economically viable option.**
 - Operators in Brazil, Canada, Japan, Korea, New Zealand and the United States are currently utilizing the 800 and/or 1900 MHz bands to offer IMT-2000 services by transitioning existing first and second generation systems to IMT-2000
 - Similarly, operators in Romania, Belarus, Russia, Uzbekistan and Sweden are upgrading existing systems in the 450 MHz band to IMT-2000
 - As mentioned previously, 3GPP has introduced and completed technical specifications for deploying UMTS/WCDMA at 900 MHz which have been available since December 2005 (3GPP TR 25.816 V7.0.0 (2005-12))
 - For offering the same service (data rates) the cell range of UMTS900 in rural area is about two times of that of 3G/UMTS in 2 GHz band
 - Draft Compatibility Study Report for UMTS Operating within GSM900 and GSM1800 Frequency Bands was finalised and approved by ECC PTT1 in January 2006

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In Band Transition to IMT-2000

- **Legal and Regulatory Considerations for the transition from GSM900 to UMTS900**
 - Decisions on spectrum aspects relating to the transition from 2G – 3G requires international coordination, mainly due to the risk of interference.
 - In CEPT and the EU the band 880-915 MHz / 925 -960 MHz is harmonised (as laid out in the GSM Directive) for GSM900 services and most of it is currently in use.
 - CEPT European Communications Committee (ECC) has several activities, where the issue of 900 MHz band for 3G/UMTS is under study, e.g. ECC-PT1 are performing studies for UMTS operating in 900 MHz and 1800 MHz bands
 - The issue whether or not the GSM Directive should be reviewed or replaced is dependent on varying legal interpretations.
 - A coordinated European / global approach to 3G/UMTS 900 is essential. It would allow e.g. economies of scale for equipment and services and improved frequency co-ordination on border areas between the countries and operators in question.

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Final Remarks

- Maximizing spectrum efficiency and providing a level playing field for competitors are key regulatory considerations
- The ITU approved five radio interfaces for 3G, and they are frequency agnostic
- The ITU has identified several frequency bands for 3G to aid spectrum harmonization
- There are various possibilities to facilitate in-band transition. Regulators should evaluate these options carefully and select the one which best meets their needs.
- Today, 3G technologies are providing ubiquitous broadband access

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Helpful Sources

General Technology and Market Information:

- www.3GToday.org
 - Sign up for Free Newsletter!
- www.cdg.org
- www.umts-forum.org
- www.450world.org/
- www.qualcomm.com
- www.outlook4mobility.com/main.htm
 - Sign up for Free Newsletter!

Regulatory:

- www.itu.int/home/
- www.fcc.gov/spectrum/
- www.fcc.gov/3G/
- www.ntia.doc.gov/ntiahome/threeq/

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THANK YOU FOR YOUR ATTENTION!

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