

ITU-D Regional Development Forum for the Asia Pacific Region

“NGN and Broadband, Opportunities and Challenges”

Yogyakarta, Indonesia, 27 – 29 July 2009

Spectrum Management Mechanisms

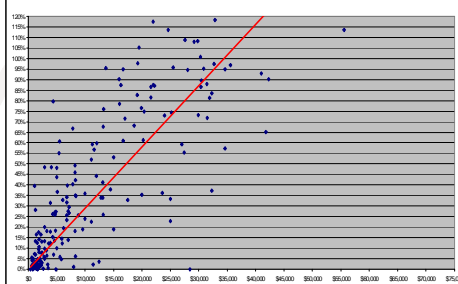
Bharat Bhatia
Regional Director, Asia
Motorola

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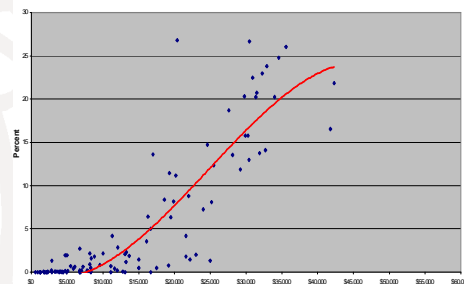
Broadband is not only key to bridging the Digital Divide

...Broadband is also the engine of economic growth

Per Country Mobile Penetration Rate vs GDP



Per Country Broadband Penetration Rate vs GDP



■ In the Emerging Markets

- ◆ 10% Mobile Penetration equates to US\$X of GDP
- ◆ 10% Internet Penetration equates to US\$1.25X of GDP
- ◆ 10% Broadband Penetration equates to US\$6.25X of GDP
- ◆ High Broadband Penetration Rates correlate to higher productivity and access to information which can have a causal relationship to increased country GDP.

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Spectrum Availability is crucial for success of Broadband

- ✓ Wireless is the preferred access method for broadband rollout in rural and urban areas
- ✓ Spectrum is the most critical resource expansion of Broadband in India
- ✓ More Spectrum is needed to support multiple technology choices
- ✓ More spectrum needed to support more traffic for new services and applications
- ✓ Digital dividend will help bridge the digital divide



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The Spectrum Conundrum

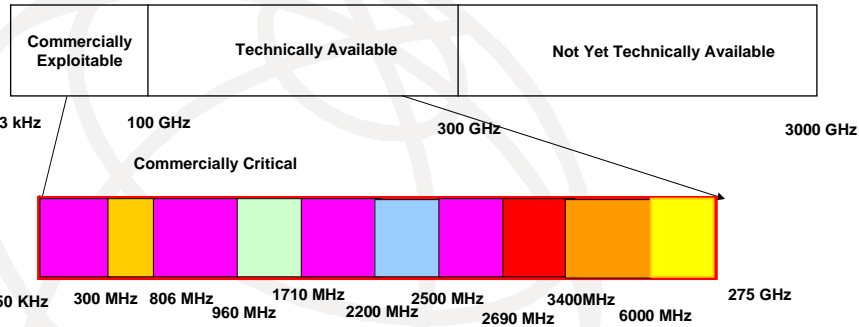
Conundrum - An intricate and difficult problem (Webster's)

- Capacity
 - ◆ **Increasing demand for data**
 - ◆ **Wireless a replacement for/competitor to wired services**
 - ◆ **Requires additional spectrum with wider bandwidths**
- Requirements increasing for almost all services
 - ◆ **Commercial, public safety, military, broadcast etc.**
 - ◆ **Competing for the same spectrum**
- Regulatory Environment
 - ◆ **Must keep pace with technology**
 - ◆ **Certainty with flexibility**
 - ◆ **Global Harmonization**
 - ◆ **Spectrum/technologies/technical rules**
 - ◆ **Need for creative approaches**

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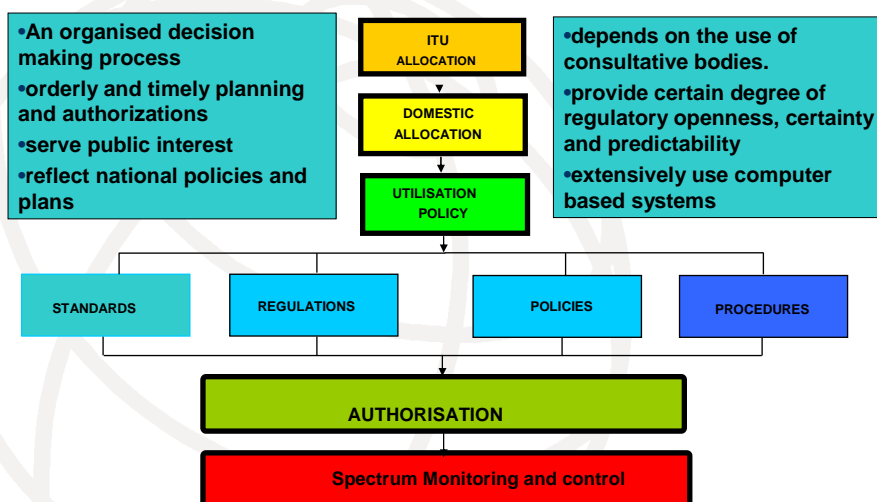
What Is The Radio Frequency Spectrum?



- ✓ The radio Frequency Spectrum (RFS) is a finite, global, natural resource that has the potential to provide significant economic, social and cultural benefit. It can not be stored for future use : Not used, it is wasted
- ✓ All countries have equal right of access to the RFS.
- ✓ The Radio waves, if not properly regulated have the potential to interfere with each other just as an unregulated traffic on an expressway.

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What is Spectrum Management (How to Regulate Air Waves)



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Objectives of ITU-R

- Global coordination of radiocommunications
 - ITU Radio Regulations
 - International Spectrum Management
 - Frequency Plans
- International focal point for standardization of wireless systems
 - ITU-R Recommendations are *de facto* Standards on:
 - spectrum management issues
 - radiocommunication system characteristics and operation

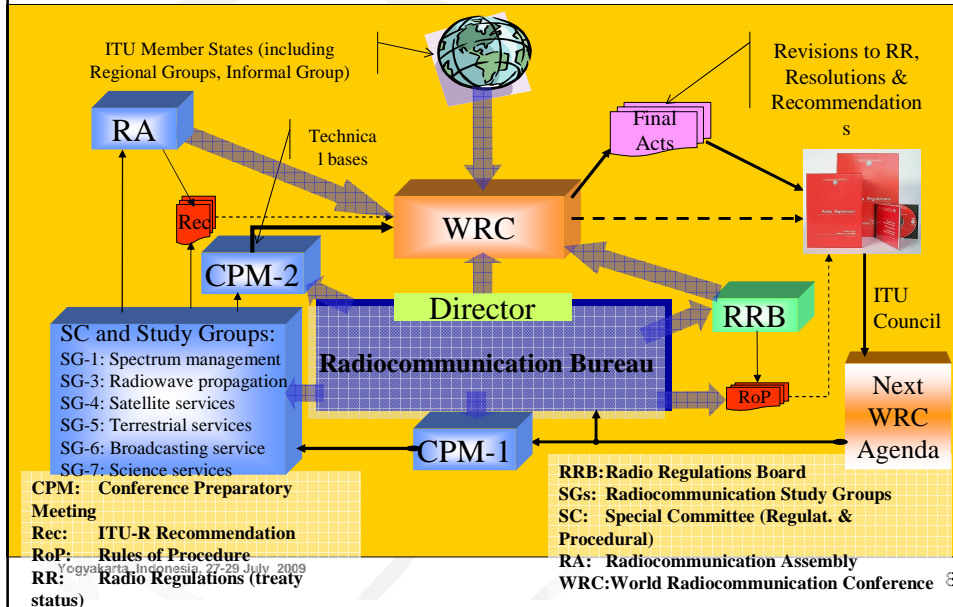


ITU-R
Radio
Regulations

Final
Acts of
WRC



Global Spectrum Management Process



Introduction to Spectrum Management - Definitions

■ Allocations

- Refers to assigning a "Service" to a range of usable spectrum divided in the frequency dimension into blocks or bands of frequencies; these frequency allocations determine the type of use allowed in the block or band of frequencies. E.g. the band 806-960 MHz is allocated to "Fixed" and "Mobile" services in Region 3 under the ITU-R Radio Regulations
- Allocations are Primary or Secondary-example below

International Frequency Allocation table

460-890 MHz (A4)		
Allocation to services		
Region 1	Region 2	Region 3
460-470	FIXED MOBILE 5.286 A A Meteorological-Satellite (space-to-Earth) 5.287 5.288 5.289 5.290	
470-790 BROADCASTING	470-512 BROADCASTING Fixed Mobile 5.292 5.293	470-585 FIXED MOBILE BROADCASTING 5.291 5.298

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Introduction to Spectrum Management - Definitions

■ Allotments

- In general, refers to a subdivision of particular service band (allocation) for a specific user and/or provider group within the service e.g. the band 890-915 paired with 935-960 MHz is allotted to GSM cellular Mobile Services under the National frequency allocation Plan of India.

■ Assignments

- An assignment is a grant of a license or permission for a specific entity or individual to operate a transmitter on a specific channel at a specific location under specified conditions
- In recent years and in certain services (e.g., cellular), the grant of authority has been expanded to include multiple channels covering a large geographic area employing multiple transmitter sites (area licensing)

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Introduction to Spectrum Management

- Allocation decisions take into account
 - ◆ public need and benefit considerations,
 - Dependence on wireless rather than wires .e.g. for mobile services
 - Number of people who will benefit from the service
 - Relative social and economic importance of the service, including safety of life and protection of property factors
 - Impact on existing wireless services in the proposed frequency band
 - ◆ technical considerations
 - Necessity of the service to use particular portions of the spectrum, including propagation characteristics and compatibility within and outside the selected frequency band
 - Amount of spectrum required
 - Relative amount of radio and other electrical interference likely to be encountered
 - Viability of the technology (i.e., whether the technology is proven and available, is on the forefront of development, or is not fully developed)
 - Operating characteristics of transmitters, including practical limitations on transmitter output power, ability to stay on frequency (stability) and ability to suppress out-of-band emissions

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Spectrum Management How to manage this scarce resource

“Command & Control”

- “Government knows best”
- “first come, first served”
- Low flexibility
- Pro “Government”

“License-free”

- “Nobody knows best”
- No Legal Protection
- Technical Protection
- High flexibility
- Pro- “Innovation”
- “Optimists”

“Property Rights”

- “Market knows best”
- Auctions
- Beauty Contests
- High flexibility
- Pro “Big Business”

Economists:
“maximise value”

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Engineers: “avoid interference”

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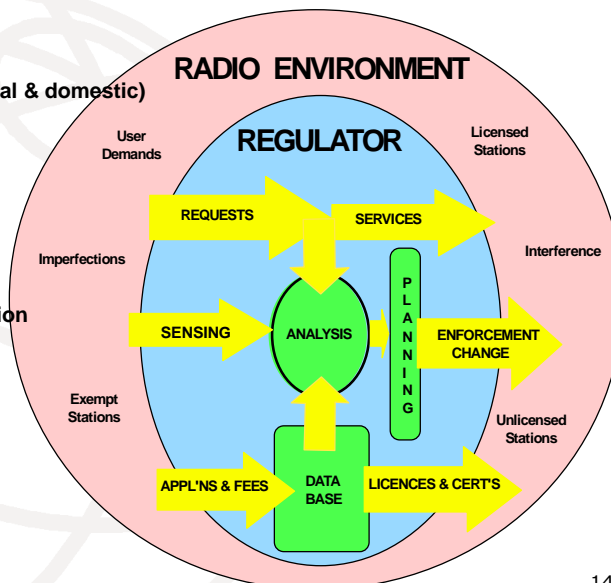
Impact of Technology Evolution on Spectrum management

<p>■ Classical Spectrum Regulation (circa 1930)</p> <ul style="list-style-type: none"> ◆ Built on the assumption of "dumb" radios ◆ Tightly regulated use to prevent interference ◆ Very limited provisions for reclaiming inefficiently used spectrum 	<p>■ New spectrum enabling technologies based on fast processing power and intelligent radios</p> <p>■ New technologies that are more tolerant towards interference and that make better use of available spectrum</p> <ul style="list-style-type: none"> ■ Spread spectrum ■ Agile radios ■ Software Defined Radio (SDR) ■ Cognitive Radios ■ Ultra-wideband (UWB) ■ OFDMA/MIMO ■ WiFi ■ Mesh networks 	<p>■ Demands for New Wireless Services</p> <ul style="list-style-type: none"> ◆ Advanced public Mobile Services ◆ IMT-Advanced ◆ WiMAX ◆ Other BWA ◆ Wireless LANS (WiFi) ◆ Public Safety (narrowband, wideband, Broadband) ◆ Satellite radio ◆ DTV
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New and Advanced technologies create new opportunities to use the RFS for greater benefit

National Spectrum Management Activities

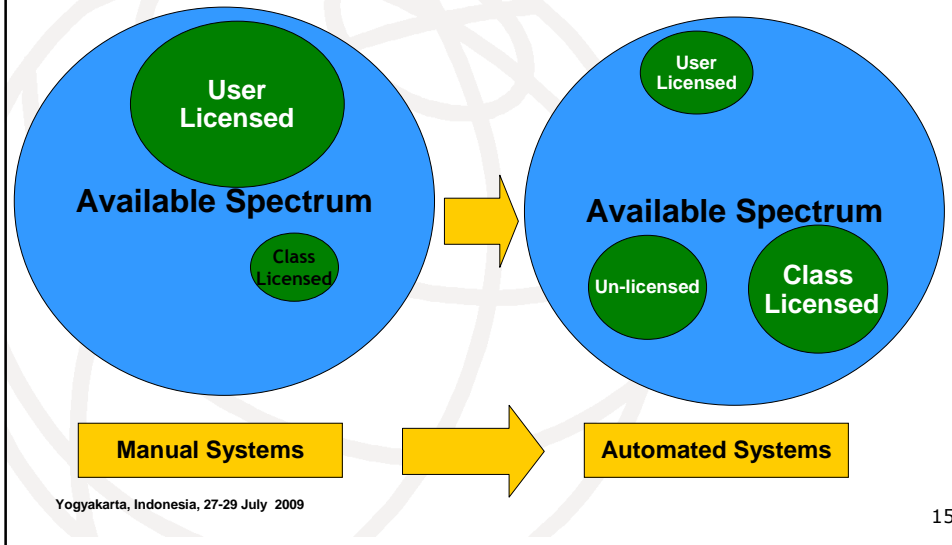
- **Spectrum Planning**
 - Regulations (international & domestic)
 - Policies, Procedures
 - Allocations, Band Plans
 - Standards
 - Engineering Studies
- **Authorisation**
 - Licensing, Certification
 - International Co-ordination
 - Record keeping
 - Financial control
- **Spectrum Control**
 - Monitoring
 - Inspecting
 - Educating
 - Enforcing



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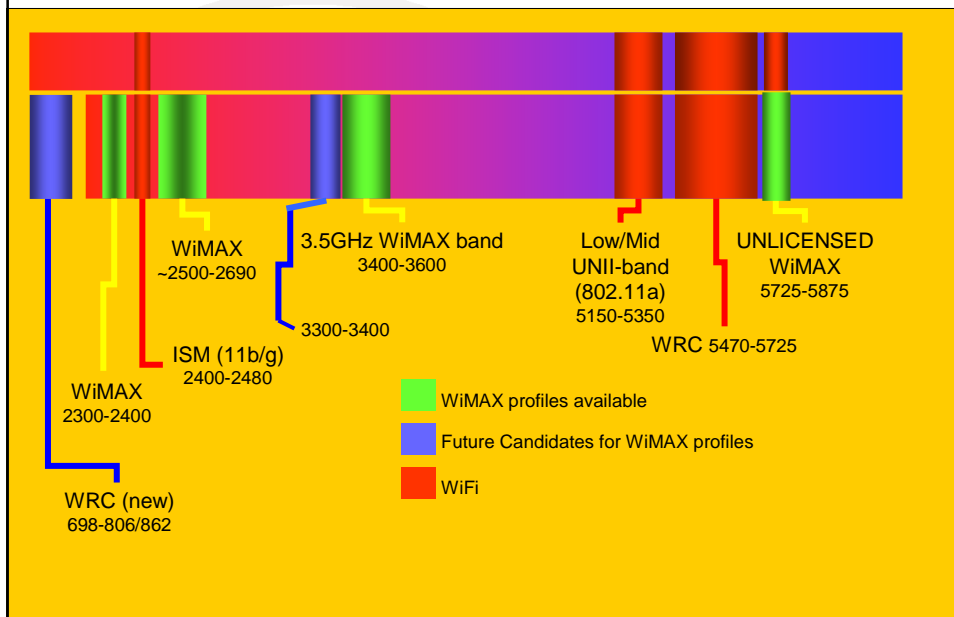
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Automated systems can greatly improve National Spectrum Management



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Frequency bands for BWA technologies

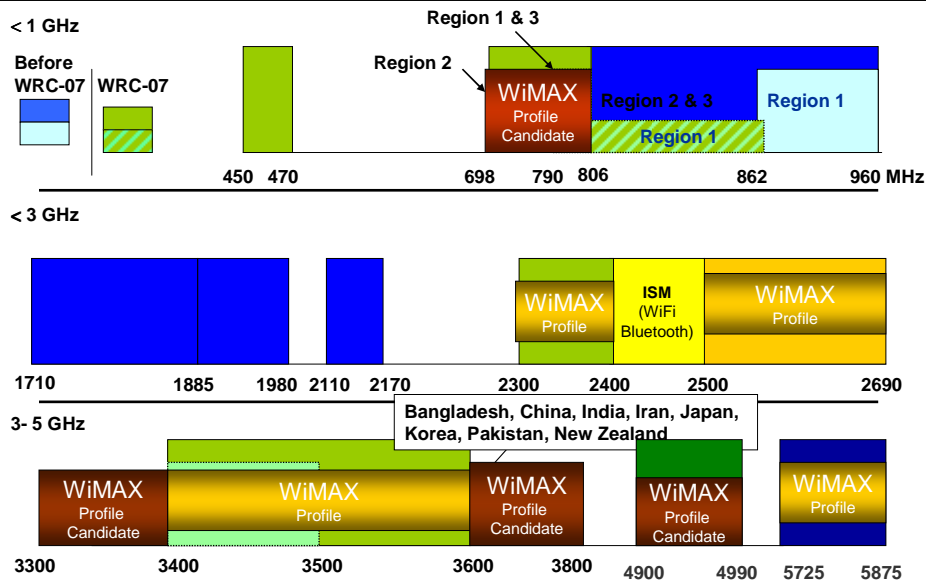


ITU recognised IEEE802.16e at WRC 2007

WiMax Became part of IMT

- ✓ **WRC/RA-07 recognised IP-OFDMA-WMAN as one of the IMT standards and thus gained access to ITU IMT bands.**
- ✓ **Current IMT bands are**
 - ✓ 1885-1980/2110-2170
 - ✓ 806-890, 1710-1885, 2500-2690
- ✓ **WRC-07 has decided new allocations to primary mobile service and identification for IMT in**

Global WiMAX & IMT Frequency Bands



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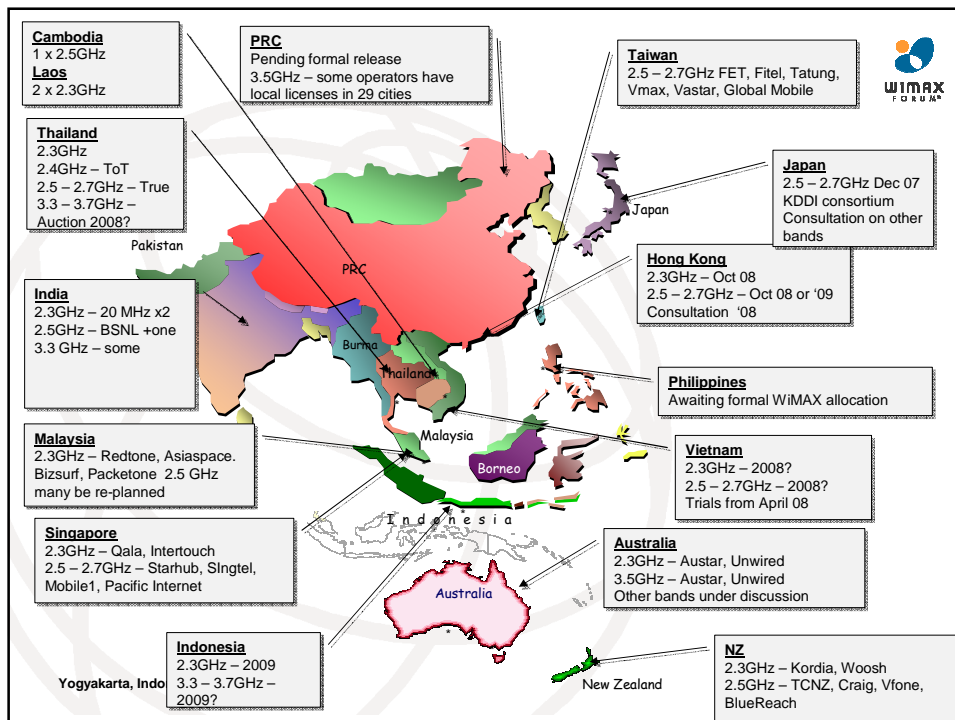
Spectrum by Region

2005 - 2008 Spectrum Focus



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2.5 GHz band is most critical band for BWA

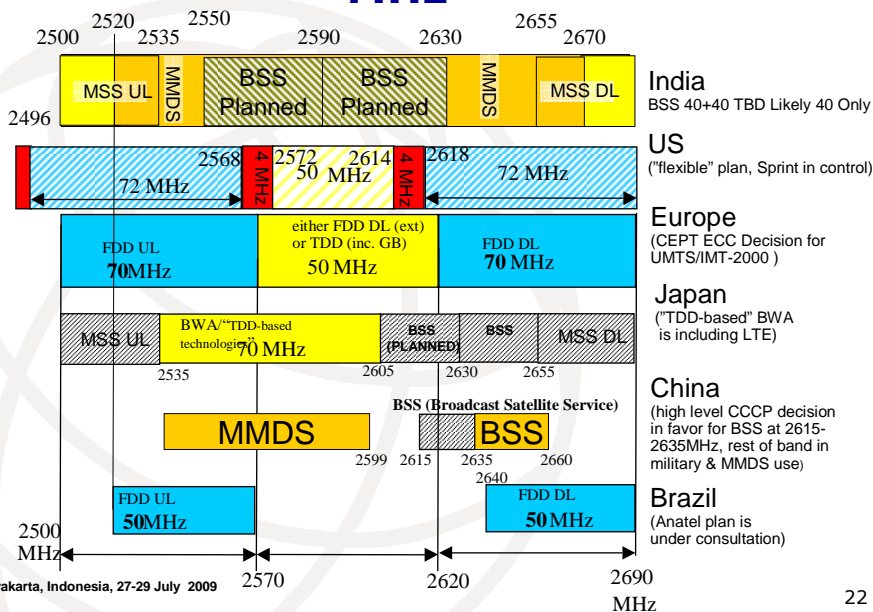
New Hard PFD limits agreed for protecting WiMAX in 2500-2690 MHz

- WRC-07 reviewed the technical, operational and regulatory provisions applicable to the use of the band 2 500-2 690 MHz by space services in order to protect the existing users and decided to set hard pfd limits on future satellite networks that will provide a stable radio environment for IMT networks
- WRC-07 decided to suppress MSS was in Regions 1 and 2; a limited number of MSS and FSS satellite networks were grandfathered.
- A co-ordination process will apply to areas within 1000 km of territories of India & Japan for MSS.
- The new pfd limits for MSS, BSS & FSS in 2.5 GHz are $X = -136$ and $Y = -125$ dB(W/m².MHz)
 - ◆ The new pfd limits to apply to all satellites notified by 14th Nov, 2007.

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Band plans in the band 2500-2690 MHz



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2500-2535 MHz: MSS in India New Regulations approved in WRC 2007

Allocation to services		
Region 1	Region 2	Region 3
2 500-2 520 FIXED MOD 5.410 MOBILE except aeronautical mobile 5.384A 5.405 5.412	2 500-2 520 FIXED MOD 5.410 FIXED-SATELLITE (space-to-Earth) 5.415 MOBILE except aeronautical mobile 5.384A 5.404	2 500-2 520 FIXED MOD 5.410 FIXED-SATELLITE (space-to-Earth) 5.415 MOBILE except aeronautical mobile 5.384A MOBILE-SATELLITE (space-to-Earth) 5.351A ADD 5.4A01 ADD 5.414 5.404 5.407 5.415A

5.4A01 In Japan and India, the use of the bands 2 500-2 520 MHz and 2 520-2 535 MHz, under No. 5.403, by a satellite network in the mobile-satellite service (space-to-Earth) is limited to operation within national boundaries and subject to the application of No. 9.11A. The following pfd values shall be used as a threshold for coordination under No. 9.11A, for all conditions and for all methods of modulation, in an area of 1 000 km around the territory of the administration notifying the mobile-satellite service network:

- 136 dB(W/(m² • MHz)) for 0° ≤ θ ≤ 5°
- 136 + 0.55 (θ - 5) dB(W/(m² • MHz)) for 5° < θ ≤ 25°
- 125 dB(W/(m² • MHz)) for 25° < θ ≤ 90°

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees. Outside this area Table 21 4 of Article 21 shall apply. Furthermore, the coordination thresholds in Table 5-2 of Annex 1 to Appendix 5 of the Radio Regulations (edition of 2004), in conjunction with the applicable provisions of Articles 9 and 11 associated with No. 9.11A, shall apply to systems for which complete technical data were received by the Radiocommunication Bureau by 14 Nov 2007 and that have been brought into use by that date. (WRC-07)

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TABLE 21-4 (WRC-07)

New hard pfd limits for space stations operating in the band 2500 – 2690 MHz

Frequency band	Service*	Limit in dB(W/m ²) for angles of arrival (θ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
...					
2 500-2 690 MHz 2 520-2 670 MHz 2 500-2 516.5 MHz (No. 5.404) 2 500-2 520 MHz 2 520-2 535 MHz (No. 5.403)	Fixed-satellite Broadcasting-satellite Radiodetermination-satellite Mobile-satellite Mobile-satellite (except aeronautical mobile-satellite)	-136 ²¹	-136 + 11/20(θ - 5) ²¹	-125 ²¹	1 MHz
...					

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ITU has identified 3400-3600 MHz also

Allocation to services		Region 3
<p>3 400-3 500 FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile ADD 5.BBB ADD 5.AAA1 Radiolocation 5.433 5.282 MOD 5.432</p>	<p>3 500-3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.433 5.435</p>	<p>3 400-3 500 FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile ADD 5.BBB ADD 5.AAA1 Radiolocation 5.433 5.282 MOD 5.432</p>
<p>3 600-4 200 FIXED FIXED-SATELLITE (space-to-Earth) Mobile</p>	<p>3 500-3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.433 5.435</p>	<p>3 600-3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.433 5.435</p>
<p>3 700-4 200 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile</p>	<p>3 700-4 200 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile</p>	<p>3 700-4 200 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile</p>

5.AAA1 identifies 3400-3500 MHz in Japan, Korea & Pakistan for IMT implementation; with regulatory provisions to protect FSS.
Note: Primary mobile allocation is already existing in these countries

5.AAA allocates 3400-3600 MHz to primary mobile service in specific countries and identifies the band for IMT implementation; with regulatory provisions to protect FSS

5.ZZZ allocates 3400-3500 MHz to primary mobile service in specific countries with no identification for the implementation of IMT

5.CCC identifies 3500-3600 MHz in China, Korea (Rep. of), India, Japan, New Zealand, Pakistan and French Overseas Departments and Communities for IMT implementation; with regulatory provisions to protect FSS

5.BBB allocates 3400-3500 MHz to primary mobile service in China, India, New Zealand, Singapore & French Overseas Departments and Communities and identifies the band for IMT implementation; with regulatory provisions to protect FSS.

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