



# National Spectrum Management and Outcomes of RA-15, WRC-15 & CPM19-1

*Workshop on Spectrum Management: Economic Aspects*

*21 – 23 November 2016*

*Tehran, Iran*

*ITU Regional Office for Asia and the Pacific*

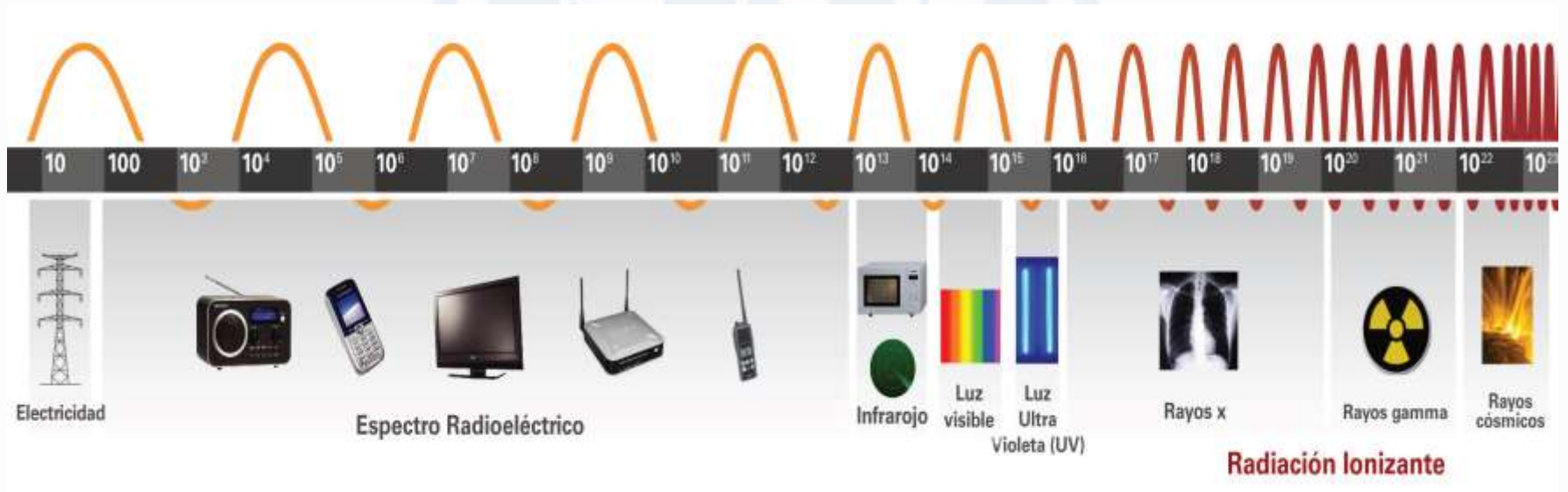
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# Radio-Electric Spectrum

- Portion of Electromagnetic Waves, used for Communications
- Artificial boundary, based on technologic development



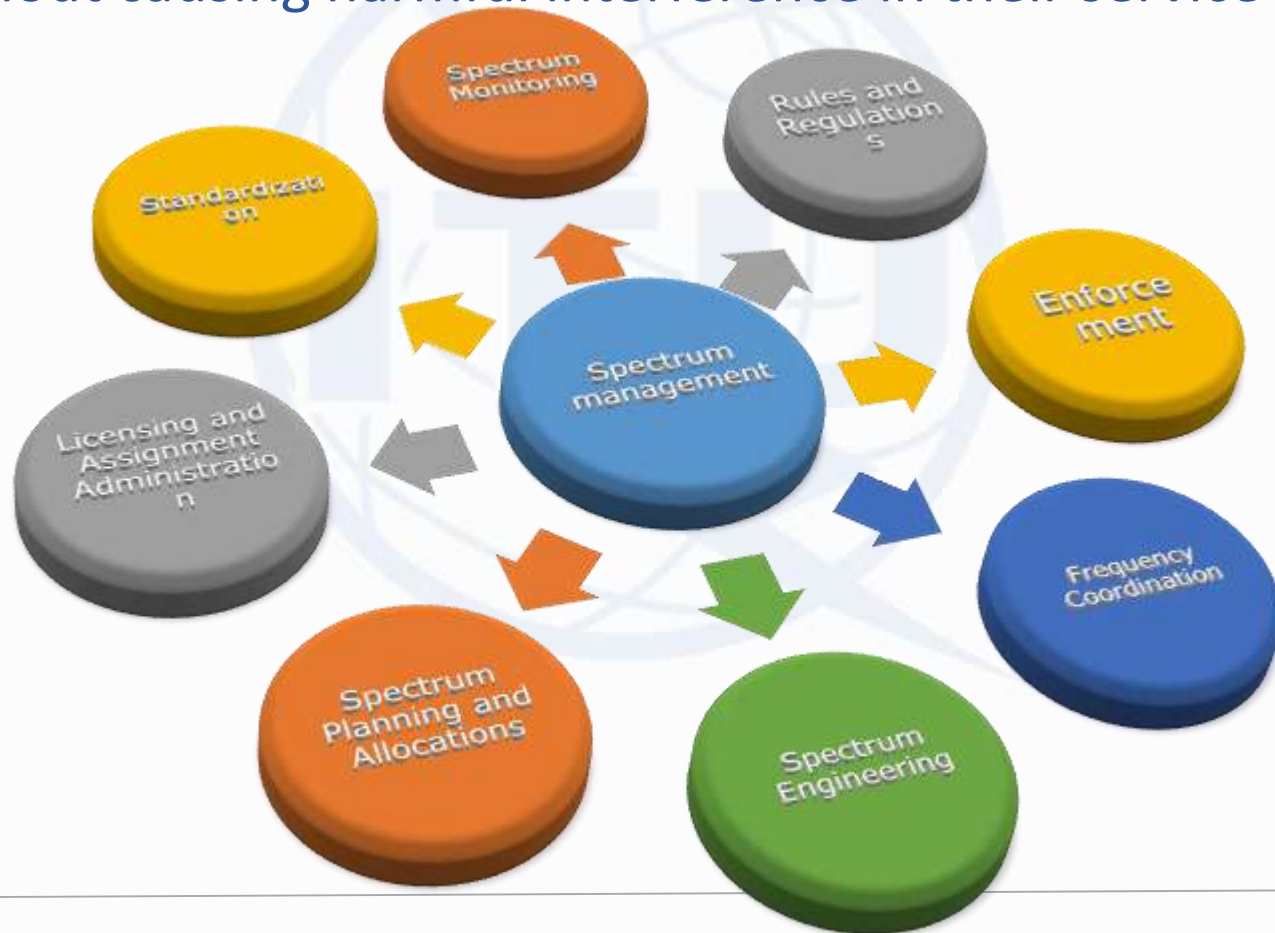


# What is RF Spectrum?

Features	Natural Resource			
	Spectrum	Land	Oil	Water
Is the resource varied?	<b>YES</b>	YES	Not very	Not very
Is it scarce?	<b>YES</b>	YES	YES	YES
Is it renewable?	<b>YES</b>	Partially	NO	YES
Can it be stored for later use?	<b>NO</b>	NO	YES	YES
Can it be exported?	<b>NO</b>	NO	YES	YES
Can it be traded?	<b>YES</b>	YES	YES	YES
Can it be made more productive?	<b>YES</b>	YES	YES	NO

# National Spectrum Management

Spectrum management is a combination of administrative and technical activities for efficient utilization of spectrum by users without causing harmful interference in their service area



# National SM Actions



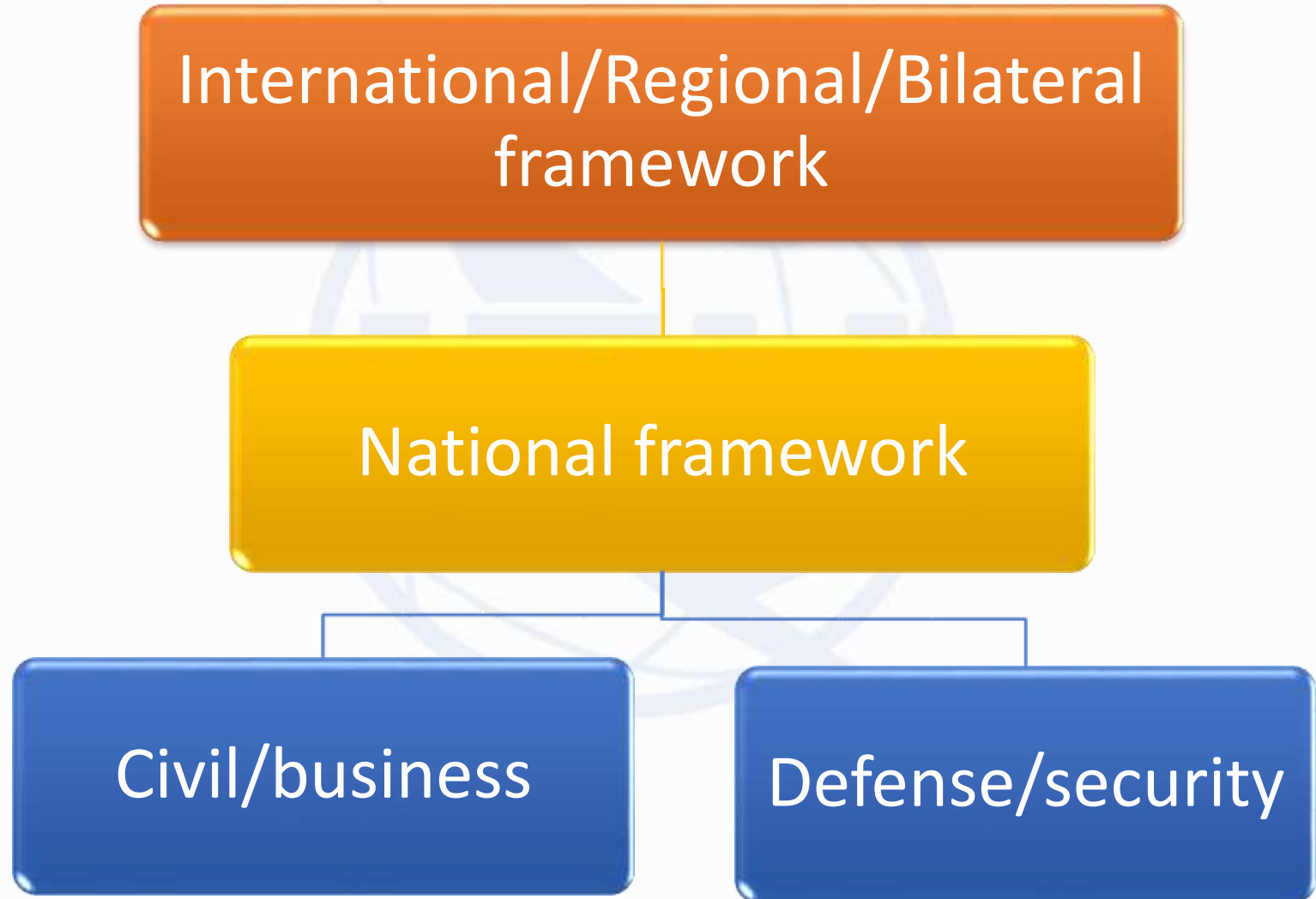
- **Planning:** *Defining the use of different bands*
    - provides direction and cohesion in support of policy formulation, and support future steps to achieve optimal spectrum use. Major trends and developments in technology and the needs of both current and future users of the frequency spectrum should be closely monitored and mapped.
  
  - **Licensing:** *Authorizing of emissions, and technical conditions*
    - Involves assigning specific frequencies to users, allotting certain frequency bands or sub-bands to specific users under certain specified conditions and in accordance with the national and international table of frequency allocations.
  
  - **Spectrum Engineering**
    - Involves the development of electromagnetic compatibility standards for equipment that emits or is susceptible to radio frequencies.
  
  - **Enforcement:** *Verifying the use of spectrum in conformity with licensing*
    - Involves the monitoring of the use of the radio spectrum and the implementation of measures to control unauthorized use
-

# Income from Spectrum Management



- **Fees collected :**
  - License application (not refundable);
  - License issuing, renewing and amendment;
  - Periodically (on monthly/annual basis) from spectrum users proportional with the occupied bandwidth, service type, used frequency, covered location, service area, time duration and etc.;
  - Penalties imposed in effect of breaching of regulation;
  - Type approval fee;
  - Special technical assistance;
  - Auction;
  
- **Spectrum management authority could earn much more money than its administrative needs if a suitable spectrum pricing regulation developed**
  
- **Roughly, spectrum fee should not be more than 3~5% of net revenue of licensee**

# International roles of SM



## Bilateral Agreements

Cross-border co-ordination by harmonizing the use of frequency spectrum.

develop means of resolving instances of unexpected harmful interference



## Regional co-ordination on spectrum Management

Exchange information and experiences to foster the harmonization of spectrum management rules

Facilitating efficient and flexible use of the spectrum

Coordinating the Use of Technical Standards across Regions

Managing interference by establishment of a common framework

Prepare common positions to be presented to regional, then global instances

# Regional Organizations



Name	Official website
APT - Télécommunauté Asie-Pacifique - Asia-Pacific Telecommunity - Telecomunidad Asia-Pacífico, BANGKOK, Thailand	<a href="http://www.apr.int">www.apr.int</a>
ASMG- Arab Spectrum Management Group	<a href="http://asmg.ae">http://asmg.ae</a>
ATU - Union africaine des télécommunications - African Telecommunications Union - Unión Africana de Telecomunicaciones, NAIROBI, Kenya	<a href="http://www.atu-uat.org">www.atu-uat.org</a>
CANTO - Association des entreprises nationales de télécommunications des Caraïbes - Caribbean Association of National Telecommunication Organizations - Asociación de Organizaciones Nacionales de Telecomunicaciones del Caribe, PORT OF SPAIN, Trinidad and Tobago	<a href="http://www.canto.org">www.canto.org</a>
CEPT - Conférence européenne des Administrations des postes et des télécommunications - European Conference of Postal and Telecommunications Administrations - Conferencia Europea de Administraciones de Correos y Telecomunicaciones, VALLETTA, Malta	<a href="http://www.cept.org">www.cept.org</a>
CITEL - Commission interaméricaine de télécommunications - Inter-American Telecommunication Commission - Comisión Interamericana de Telecomunicaciones, WASHINGTON, D.C., United States	<a href="http://www.citel.oas.org">www.citel.oas.org</a>
COMTELCA - Commission technique régionale des télécommunications - Telecommunications Regional Technical Commission - Comisión Técnica Regional de Telecomunicaciones, TEGUCIGALPA, M.D.C., Honduras	<a href="http://www.comtelca.org">www.comtelca.org</a>
COPTAC - Conférence des Postes et Télécommunications de l'Afrique centrale - Conference of Posts and Telecommunications of Central Africa - Conferencia de Correos y Telecomunicaciones de África Central, YAOUNDE, Cameroon	n/a
CTU - Union des télécommunications des Caraïbes - Caribbean Telecommunications Union - Unión de Telecomunicaciones del Caribe, PORT-OF-SPAIN, Trinidad and Tobago	<a href="http://www.ctu.int/">http://www.ctu.int/</a>
ETSI - Institut européen des normes de télécommunication - European Telecommunications Standards Institute - Instituto Europeo de Normas de Telecomunicaciones, SOPHIA ANTIPOLIS CEDEX, France	<a href="http://www.etsi.org">www.etsi.org</a>
LAS - Ligue des Etats Arabes - League of Arab States - Liga de los Estados Árabes, CAIRO, Egypt	<a href="http://www.arableagueonline.org">www.arableagueonline.org</a>
RCC - Communauté régionale des communications - Regional Commonwealth in the Field of Communications - Comunidad Regional de Comunicaciones, MOSCOW, Russian Federation	<a href="http://www.rcc.org.ru">www.rcc.org.ru</a>

# ITU at a Glance



## Specialized Agencies of the United Nations



WHO



ILO



UPU



ICAO



WMO



IMO



IAEA



THE WORLD BANK  
WB



UNWTO  
UNWTO



FAO



IFAD



UNIDO



WIPO



WFP



IMF



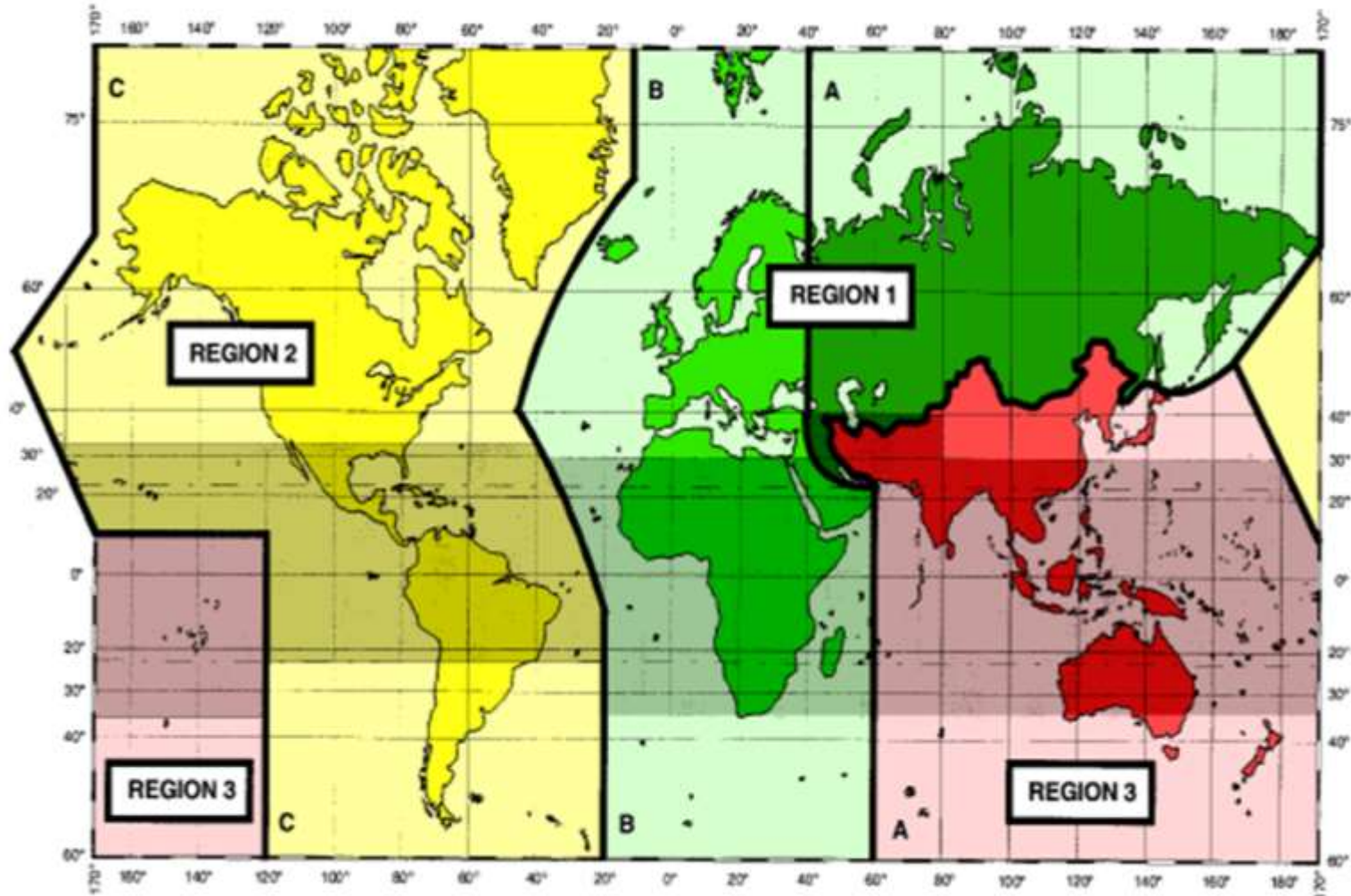
*Specialized UN agency with focus on  
Telecommunication / ICTs*

# ITU and Spectrum Management



- **The Radio Regulations govern the use of the radio-frequency spectrum and the geostationary satellite and non-geostationary-satellite orbits.**
- **Article 5 of the Radio Regulations deals with regulations for frequency allocation and contains the (international) Table of Frequency Allocations.**
- **The Table of Frequency Allocations reflects decisions made on the purpose or purposes to which particular frequencies will be put.**

# International Frequency Allocations

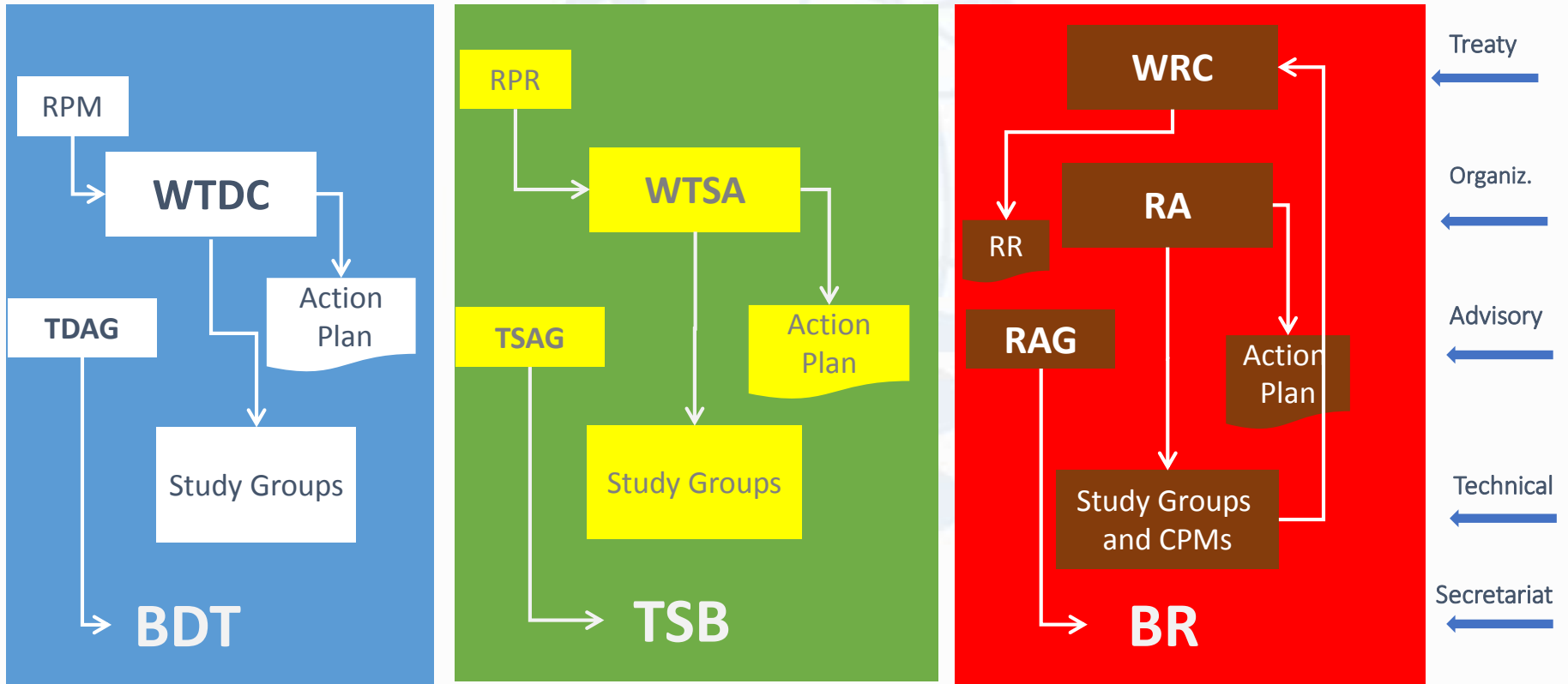


The shaded part represents the Tropical Zones as defined in Nos. 5.16 to 5.20 and 5.21



# ITU – Organization

## Membership Inputs





International Telecommunication Union

# RADIOCOMMUNICATION ASSEMBLY 2015

GENEVA, SWITZERLAND  
26 – 30 OCTOBER 2015



Organized by:



150 1865 2015

[www.itu.int/go/ITU-R/RA-15](http://www.itu.int/go/ITU-R/RA-15)

CENTRE INTERNATIONAL  
DE CONFÉRENCES  
GENÈVE





# Radio Assemblies

- **Radiocommunication Assemblies (RA) are responsible for the structure, programme and approval of radiocommunication studies**
  - Normally convened every three or four years and may be associated in time and place with World Radiocommunication Conferences (WRCs)
  
- **The Assemblies:**
  - **ASSIGN** conference preparatory work and other questions to the Study Groups;
  - **RESPOND** to other requests from ITU conferences;
  - **SUGGEST** suitable topics for the agenda of future WRCs;
  - **APPROVE** and issue ITU-R Recommendations and ITU-R Questions developed by the Study Groups;
  - **SET** the programme for Study Groups, and disband or establish Study Groups according to need.





# RA – 2015 Outcomes

- In addition reports from 6 BR SGs and information and Administrative documents from the secretariat, a total of **34** contributions were made to plenary before the start of the RA-15.
  
- **RA-15 agreed to**
  - **6** new resolutions
  - Modification to **30** existing resolutions
  - Suppressed **5** existing resolutions.
  - No change was made to **5** existing resolutions.

**441 registered Participants**



# RA – 2015 Outcomes

## ➤ **Category: Bridging Digital Divide**

- **New Resolution ITU-R 69:** *Development and deployment of international public telecommunications via satellite in developing countries*

## ➤ **Category: Spectrum Management**

- **Revision of Resolution ITU-R 40-3 - Worldwide databases of terrain height and surface features**

The resolution considers that the propagation predictions are improved by the inclusion of more detailed information on terrain heights and surface features and suitable digital maps. It encourages administrations and organizations involved in the production of terrain maps to make databases available as such availability of digital maps of terrain height and surface features would be of considerable benefit to developing countries in the planning of their existing and newly introduced services. Also resolved that **the further development of SMS4DC should also take into account.**

- **Revision of Res ITU-R 11-4:** *Further development of the spectrum management system for developing countries*
- **Revision of Res. ITU-R 22-3:** *Improvement of national radio spectrum management practices and techniques*



# RA – 2015 Outcomes

## ➤ **Category: Wireless Broadband**

- **Res. ITU-R 56-1: Naming for International Mobile Telecommunications**

Since ITU is the internationally recognized entity that has sole responsibility to define and to recommend the standards and frequency arrangements for IMT systems, with the collaboration of other organizations such as standard development organizations, universities, industry organizations and with partnership projects, forums, consortia and research collaborations, therefore the RA-15 debated especially on naming of IMT systems.

- *the existing term IMT-2000 continues to be relevant and should continue to be utilized;*
- *the existing term IMT-Advanced continues to be relevant and should continue to be utilized;*
- *However for systems, system components, and related aspects that include new radio interface(s) which support the new capabilities of systems beyond IMT-2000 and IMT-Advanced, the term “IMT-2020” be applied*
- *In addition it was resolved that the term “IMT” would be considered the root name that encompasses all of IMT-2000, IMT-Advanced and IMT-2020 collectively.*

## ➤ **Category: Accessibility for persons with disabilities**

- **New Resolution ITU-R 67: Telecommunication/ICT accessibility for persons with disabilities and persons with specific needs**

The proposal of new resolution from United Arab Emirates attempts to include this issue in the list of topics of common interest of all the three sectors in order to reach an integrated approach which is according to Resolution 191 of the Plenipotentiary Conference, Busan 2014 on Strategy for the Coordination of efforts among the three Sectors of the Union (ITU-R, ITU-T and ITU-D).

## ➤ **Category: Emergency Telecommunication, Disaster response and relief**

- **Suppression of Res. ITU-R 53-1: The use of radiocommunications in disaster response and relief**

The resolution was adopted in the past in order to serve a specific need to undertake studies and develop guidelines related to the management of radiocommunications in disaster prediction, detection, mitigation and relief collaboratively and cooperatively within ITU and with organizations external to the Union. This work was considered to have been accomplished in general and therefore the **resolution was suppressed with any remaining relevant matters consolidated in the ITU-R 55-1**

- **Revision of Res. ITU-R 55-1: ITU studies of disaster prediction, detection, mitigation and relief**

The resolution considers the importance of radiocommunication systems in assisting disaster management through techniques for early warning, prevention, mitigation and relief and also takes note of Resolution 34 (Rev. Dubai, 2014) of the World Telecommunication Development Conference, on the role of telecommunications/information and communication technologies in disaster preparedness, early warning, rescue, mitigation, relief and response. Based on the agreement of the delegations the resolution.



# RA – 2015 Outcomes

## ➤ **Category: Climate change and green ICTs**

- **Revision to Resolution ITU-R 60 - Reduction of energy consumption for environmental protection and mitigating climate change by use of ICT/radiocommunication technologies and systems**

The resolution considers that the issue of climate change is rapidly emerging as a global concern and requires global collaboration because climate change is one of the major factors causing emergency situations and natural disasters afflicting humankind.

## ➤ **Other resolutions and recommendations**

- **New Resolution ITU-R 66: Studies related to wireless systems and applications for the development of the Internet of Things (IoT)**

The resolution while recognizing that the IoT is a concept encompassing various platforms, applications, and technologies that are implemented under a number of radiocommunication services also notes that the implementation of the Internet of Things currently does not require specific regulatory provisions in the Radio Regulations.

- **Revision of Recommendation ITU-R M.1036-4: Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR)**

The revisions to this recommendation were debated at length and were finally agreed during the 5th plenary session of the RA-15. The recommendation provides guidance on the selection of transmitting and receiving frequency arrangements for the terrestrial component of IMT systems as well as the arrangements themselves, with a view to assisting administrations on spectrum-related technical issues relevant to the implementation and use of the terrestrial component of IMT in the bands identified in the RR. The frequency arrangements are recommended from the point of view of enabling the most effective and efficient use of the spectrum to deliver IMT services – while minimizing the impact on other systems or services in these bands – and facilitating the growth of IMT systems.

- **New Recommendation ITU-R M.[BSMS700] - Specific unwanted emission limit of IMT mobile stations operating in the frequency band 694-790 MHz to facilitate protection of existing services in Region 1 in the frequency band 470-694 MHz**

This Recommendation provides guidance to administrations on specific unwanted emission levels of IMT mobile stations operating in the frequency band 694-790 MHz in order to facilitate protection of existing services in the frequency band 470-694 MHz in Region 1. In essence the recommendation may be referred by Administration in using the 700 MHz band for IMT which is being under consideration by several ITU administrations which are also member of APT.

# ITU-R Study Groups



Study Group Number	Focus Area	Structure
SG – 1	Spectrum Management	<ul style="list-style-type: none"><li>▪ <a href="#">Working Party 1A (WP 1A) - Spectrum engineering techniques</a></li><li>▪ <a href="#">Working Party 1B (WP 1B) - Spectrum management methodologies and economic strategies</a></li><li>▪ <a href="#">Working Party 1C (WP 1C) - Spectrum monitoring</a></li></ul>
SG – 3	Radio Wave Propagation	<ul style="list-style-type: none"><li>▪ <a href="#">Working Party 3J (WP 3J) - Propagation fundamentals</a></li><li>▪ <a href="#">Working Party 3K (WP 3K) - Point-to-area propagation</a></li><li>▪ <a href="#">Working Party 3L (WP 3L) - Ionospheric propagation and radio noise</a></li><li>▪ <a href="#">Working Party 3M (WP 3M) - Point-to-point and Earth-space propagation</a></li></ul>
SG – 4	Satellite Services	<ul style="list-style-type: none"><li>▪ <a href="#">Working Party 4A (WP 4A) - Efficient orbit/spectrum utilization for FSS and BSS</a></li><li>▪ <a href="#">Working Party 4B (WP 4B) - Systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering</a></li><li>▪ <a href="#">Working Party 4C (WP 4C) - Efficient orbit/spectrum utilization for MSS and RDSS</a></li></ul>

# ITU-R Study Groups



Study Group Number	Focus Area	Structure
SG – 5	Terrestrial Services	<ul style="list-style-type: none"><li data-bbox="550 382 1862 486">▪ <a href="#">Working Party 5A (WP 5A) - Land mobile service above 30 MHz (excluding IMT); wireless access in the fixed service; amateur and amateur-satellite services</a></li><li data-bbox="550 534 1862 638">▪ <a href="#">Working Party 5B (WP 5B) - Maritime mobile service including Global Maritime Distress and Safety System (GMDSS); aeronautical mobile service and radiodetermination service</a></li><li data-bbox="550 685 1862 789">▪ <a href="#">Working Party 5C (WP 5C) - Fixed wireless systems; HF and other systems below 30 MHz in the fixed and land mobile services</a></li><li data-bbox="550 836 1108 868">▪ <a href="#">Working Party 5D (WP 5D) - IMT Systems</a></li><li data-bbox="550 915 1141 946">▪ <a href="#">Task Group 5/1 - WRC-19 Agenda item 1.13</a></li></ul>
SG – 6	Broadcasting Services	<ul style="list-style-type: none"><li data-bbox="550 1003 1360 1035">▪ <a href="#">Working Party 6A (WP 6A) - Terrestrial broadcasting delivery</a></li><li data-bbox="550 1082 1443 1113">▪ <a href="#">Working Party 6B (WP 6B) - Broadcast service assembly and access</a></li><li data-bbox="550 1160 1553 1192">▪ <a href="#">Working Party 6C (WP 6C) - Programme production and quality assessment</a></li></ul>
SG – 7	Science Services	<ul style="list-style-type: none"><li data-bbox="550 1246 1553 1278">▪ <a href="#">Working Party 7A (WP 7A) - Time signals and frequency standard emissions</a></li><li data-bbox="550 1325 1456 1356">▪ <a href="#">Working Party 7B (WP 7B) - Space radiocommunication applications</a></li><li data-bbox="550 1403 1257 1428">▪ <a href="#">Working Party 7C (WP 7C) - Remote sensing systems</a></li></ul>

# Task Group 5/1



## WRC-19 Agenda item 1.13

- The first session of the Conference Preparatory Meeting for WRC-19 (CPM19-1), invited Study Group 5 to establish a Task Group (TG 5/1) which will be the responsible group for WRC-19 agenda item 1.13

- Agenda item 1.13:

*“to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **238 (WRC-15)**”,*



# RA – 2015 Outcomes

- **List of All resolutions of RA-15**



- **List of New Questions for ITU-R Study Groups**







# World Radiocommunication Conference 2015 (WRC-15)

Geneva, Switzerland, 2-27 November 2015





# Purpose of ITU WRCs

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- **Create regulatory certainty for multi-million dollar industry which are now playing increasingly important role in the development of our societies.**
- **Global spectrum harmonization for important services including amongst other the fixed, satellite, mobile and broadcasting to generate economies of scale, roaming and interoperability**

**But achieving above requires consensus in order to achieve stable results. This consensus is attempted at WRC through time, efforts and patience of all the involved.**

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# WRC-15 (General Information)

- **3275** participants attended WRC-15, including:
  - **2780** participants from **162** Member States, and
  - **495** participants representing **130** other entities, including industry, which also attended as observers
  
- **678** Documents including **2888** proposals were submitted before WRC-15.
  - Two thirds (**66%**) of those were common proposals (either regional or multi-country).
  
- WRC-15 addressed over **40** topics related to frequency allocation and frequency sharing for the efficient use of spectrum and orbital resources.



# WRC-15 (General Information)

<b>Chairman of the Conference:</b>	<b>Mr Festus Yusufu Narai Daudu (Nigeria)</b>
<b>Vice-Chairmen of the Conference:</b>	Mr A. Jamieson (New Zealand) Mr Y. Al-Bulushi (Oman) Mr D. Obam (Kenya) Mrs D. Tomimura (Brazil) Mr A. Kühn (Germany) Mr N. Nikiforov (Russian Federation)
<b>Committee 1: (Steering)</b>	(Composed of the Chairman and Vice-Chairmen of the Conference and of the Chairmen and Vice-Chairmen of the Committees.)
<b>Committee 2: (Credentials)</b>	Chairman: Mr N. Meaney (Australia)
<b>Committee 3: (Budget Control)</b>	Chairman: Mr A. Kadirov (Uzbekistan)
<b>Committee 4: (Mainly Terrestrial Issues)</b> <b>Specified agenda items (a.i.)</b> 1.1 , 1.2, 1.3, 1.4, 1.5 (see Note), 1.15, 1.16, 1.17, 1.18, 3*, 5*, 9*, 9.1*, 9.2*, Global flight tracking	Chairman: Mr M. Fenton (UK)
<b>Committee 5: (mainly satellite issues)</b> <b>Specified agenda items</b> 1.6 (1.6.1, 1.6.2), 1.7, 1.8, 1.9 (1.9.1, 1.9.2), 1.10, 1.11, 1.12, 1.13, 1.14, 3*, 5*, 7, 9*, 9.1*, 9.2*, 9.3	Chairman: Mr K. Al Awadhi (UAE)
<b>Committee 6:</b> <b>Specified agenda items</b> 2, 3*, 4, 5*, 6, 8, 9*, 9.1*, 9.2*, 10	Chairman: Mrs A. Allison (USA)
<b>Committee 7: (Editorial)</b>	Chairman: Mr C. Rissone (France)



# Agenda for the WRC-15

(Resolution 807 (WRC-12))

*Items:*

*1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9.1, 1.9.2, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16,  
1.17, 1.18, 2, 4, 7, 9.1, 9.3 and 10*



# Description of Agenda Items as per

Agenda Item	Issues Covered	Chapter Number
<b>1.1, 1.2, 1.3, 1.4</b>	<b>Mobile and Amateur</b>	<b>1</b>
<b>1.11, 1.12, 1.13, 1.14</b>	<b>Science</b>	<b>2</b>
<b>1.5,1.15, 1.16, 1.17, 1.18</b>	<b>Aeronautical, Maritime and Radiolocation Issues</b>	<b>3</b>
<b>1.6, 1.7, 1.8 , 1.9 (1.9.1 and 1.9.2), 1.10</b>	<b>Satellite Services, FSS</b>	<b>4</b>
<b>7, 9 (9.1, 9.2, 9.3)</b>	<b>Satellite Regulatory Issues</b>	<b>5</b>
<b>2 (2.1 and 2.2), 4, 9, 10</b>	<b>General Issues</b>	<b>6</b>



# Summary of Key Outcomes of WRC -15







## Background

### • REQUIREMENTS TO

- Identify harmonized PPDR bands to benefit from economies of scale, interoperability, cross-border equipment circulation
- Review Res. 647 on emergency and disaster relief communication
- Ensure better protection of 406 – 406.1 MHz (Cospas-Sarsat)

## WRC-15 Results

- **Revision of Resolution 646** -> resulted in harmonization of PPDR bands and at the same time providing flexibility for administrations
- Encouragement to use harmonized bands, especially for broadband:
  - 694 – 894 MHz – on a global basis
  - 380-470 MHz – in Region 1
  - 406.1-430 MHz, 440-470 MHz and 4 940-4 990 MHz – in Region 3
- Administrations to use **Rec. ITU-R M.2015 for national planning**
- PPDR applications **must not cause unacceptable interference to services** to which these ranges are already allocated
- **Revision of Resolution 647** on emergency and disaster relief radiocommunications. Reinforcement of main ideas of this Resolution:
  - ITU-R to continue to maintain database on contact information of administrations and frequency bands (optional) relevant to disaster relief [www.itu.int/ITU-R/go/res647](http://www.itu.int/ITU-R/go/res647)
  - Administrations encouraged to submit information to the database
- **Protection of 406-406.1 MHz (MSS reception of Cospas-Sarsat):**
  - Requests not to assign frequencies to FS and MS in adjacent bands
  - " BR to organize additional monitoring programs on impact from systems in 405.9-406 MHz, 406.1-406.2 MHz
  - " administrations to take into account frequency drift of radiosondes above 405 MHz to avoid transmitting in the 406-406.1 MHz

# Outcomes of WRC-15

## Amateur & Maritime Mobile Service

(agenda Items 1.4, 1.15 and 1.16)





# Amateur Service

## Background

- Need for spectrum around 5 MHz band in addition to existing allocations at 3.5 MHz and 7 MHz to provide flexibility of HF operations in varying propagation conditions

## WRC-15 Results

- Secondary allocation to amateur service in **5 351.5-5 366.5** kHz subject to power limitations in No.5.133B:
  - maximum e.i.r.p.  $\leq 15\text{W}$  on a global basis
  - maximum e.i.r.p.  $\leq 20\text{W}$  and  $\leq 25\text{W}$  in some Region 2 countries listed in No.5.133B

## Implications

- contributes to flexibility and reliability of amateur communications in
- HF band -> **facilitating emergency and disaster relief operations**

# Maritime On-board communication



## Background

- Problem of congestion in on-board UHF communications since only 6 frequencies around 460 MHz were available for this purpose

## WRC-15 Results

- no new spectrum was allocated, but measures were adopted for more efficient usage of existing frequencies (in modified No. 5.287):
  - Introduction of new channeling arrangements of 6.25 kHz and 12.5 kHz through Rec. ITU-R M. 1174-3, while retaining 25 kHz channeling for analogue systems
- Recommendation to use new digital technologies, e.g. Digital coded squelch

## Implications

- provides more channels for on-board communications with the same amount of spectrum available, removes congestion

# Maritime AIS *(Automatic Identification Systems)*



## Background

- Development of new Automatic Identification System (AIS) applications, aimed at improving maritime communications and safety of navigation, required additional frequency resource

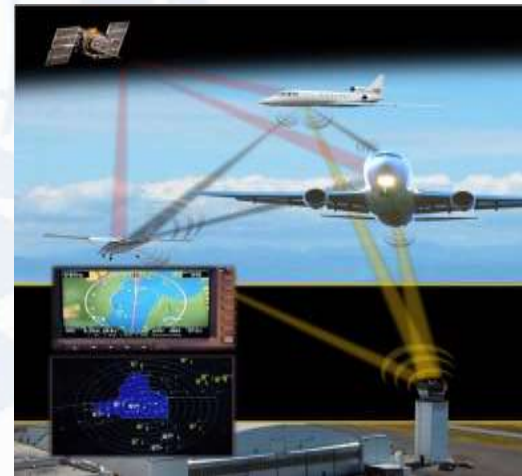
## WRC-15 Results

- Enabling application-specific messages in AP18 chan. 2027, 2028; protection AIS by prohibiting chan. 2078, 2019, 2079, 2020 for ships
- Identification of bands for terrestrial VHF Data Exchange System (VDES):  
**157.200–157.325/161.800–161.925 MHz in R1, 3 and 157.200–157.275 MHz /161.800 – 161.875 in some R 2 countries**
- Secondary allocation to uplink maritime mobile-satellite service in 161.9375–161.9625 MHz/161.9875–162.0125 MHz for satellite component of VDES; downlink will be considered at WRC-19
- VDES regional solution: identification of AP18 channels 80, 21, 81, 22, 82, 23 and 83 for digital systems in Regions 1 and 3

# Outcomes of WRC-15

## Aeronautical & Automotive Applications

(agenda Item 1.5, 1.17, 1.18 and Global Flight Tracking)





# Unmanned Aircraft Systems



## Background

- Rapid UAS development, future integration in conventional air traffic
- reliable terrestrial and satellite links are critical for controlling UAS
- Need for ensuring reliability of UAS links, given interference in FSS
- Need for protection of terrestrial services because placing FSS earth station on aircraft changes interference situation
- Need for taking decision in the absence of available ICAO standards
- WRC-12 made allocation to terrestrial component in 5 GHz, but satellite component still required frequencies due to limited AMSS spectrum and lack of operational AMSS systems

## WRC-15 Results

- Approval of No. 5.484B and Res. 155 [COM4/5] allowing the use of FSS assignments for UAS
- Designation of 8 bands for such usage. Total spectrum: Ku band: **970 MHz globally, 1520 MHz regionally**, Ka band: 1000 MHz globally
- FSS can be used only after development of related ICAO aeronautical standards and recommended practices (SARPs);
- Measures to avoid impact on terrestrial services and other FSS
- Requirement to UA ES to operate in existing interference environment
- Instructions to the Bureau: to identify a new class of stations for UAS, to examine Res. 155 to identify actions by administrations, not to process filings until all conditions are met, liaise with ICAO

## Implications

- Paves the way for commercial utilization of UAS after 2023



# Spectrum for WAIC *(Wireless Avionics Intra-Communications)*

## Background

- About 30% of electrical wires are candidates for wireless substitute
- **Example A380:** wire count 100 000; length 470 km; weight 5 700 kg
- need for spectrum for WAIC to replace cables that provides safety-related data in single aircraft (e.g. from sensors to cockpit)

## WRC-15 Results

- Allocation of **4 200-4 400 MHz** to AM(R)S reserved for WAIC
- Approval of Res. 424 [COM4/1]: Conditions For WAIC
  - Non-interference basis vs. aeronautical radio altimeters, obligation to comply with ICAO SARPs

## Implications

- Using approved wireless technology would make new generation of aircraft more reliable, light, less fuel consuming and environmentally friendly





# Global Flight Tracking

## Background

- Urgent Issue. Following disappearance of MH370, PP-14 adopted Resolution 185 and established additional AI on GFT
- Need for continuous aircraft surveillance; satellite tracking could complement terrestrial tracking, e.g. radars, HF communications, etc.
- Before WRC-15 terrestrial automatic dependent surveillance-broadcast (ADS-B) was available that could be extended to satellite reception

## WRC-15 Results

- Primary allocation of **1087.7-1092.3 MHz** for satellite reception ADS-B messages (5.328AA)
- Allocation conditions are in Resolution 425: i.e. ability operate in existing interference environment, compliance with ICAO standards

## Implications

- improves aircraft tracking through utilization of an existing technology; especially important for polar, oceanic, remote areas



# Automotive Applications

## Background

- Significant growth in the use of automotive radar systems that are critical for improving global road safety
- Increasing variety of applications e.g. adaptive cruise control, collision avoidance, blind spot detection, lane change assist, etc.
- Requirements for additional spectrum for such applications

## WRC-15 Results

- Worldwide primary allocation to the radiolocation service in the band **77.5-78 GHz**
  - Allocation is limited to short-range ground-based
  - Radar, including automotive radars. Parameters are in Recommendation ITU-R M.2057-0

## Implications

- **Provides harmonized and contiguous band 76 – 81 GHz** for radio location service including automotive applications. Allows radars to move from the **24 GHz band**, which had some compatibility problems

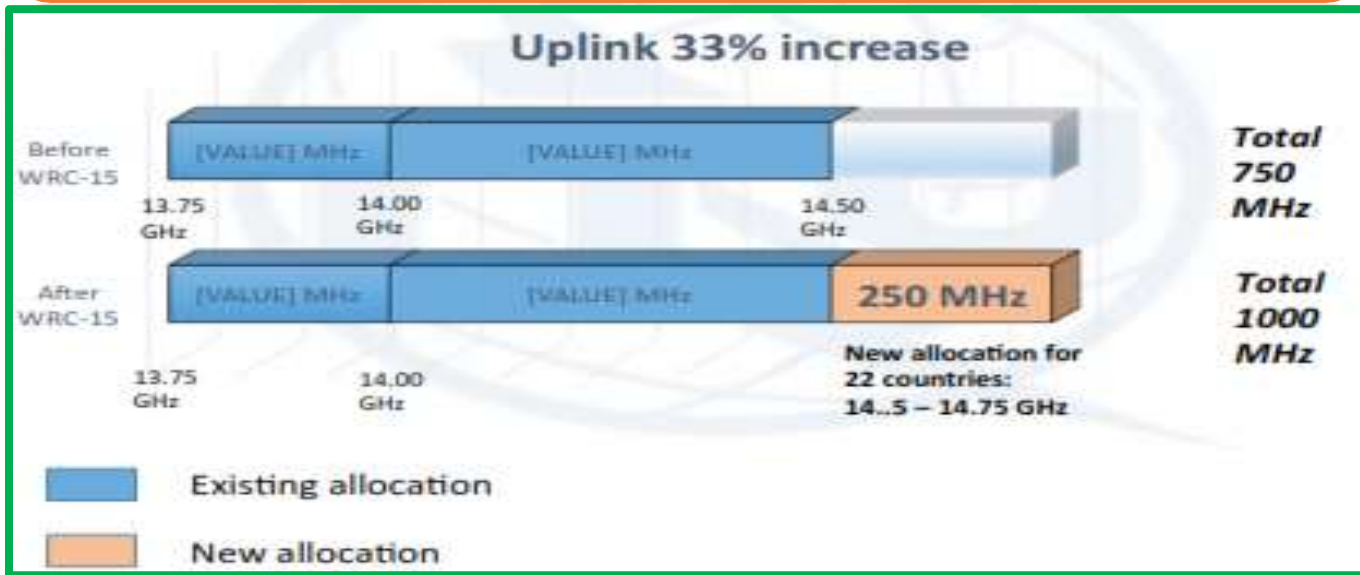
# Outcomes of WRC-15

## Fixed Satellite Service

(agenda Items 1.6, 1.7 and 1.8)



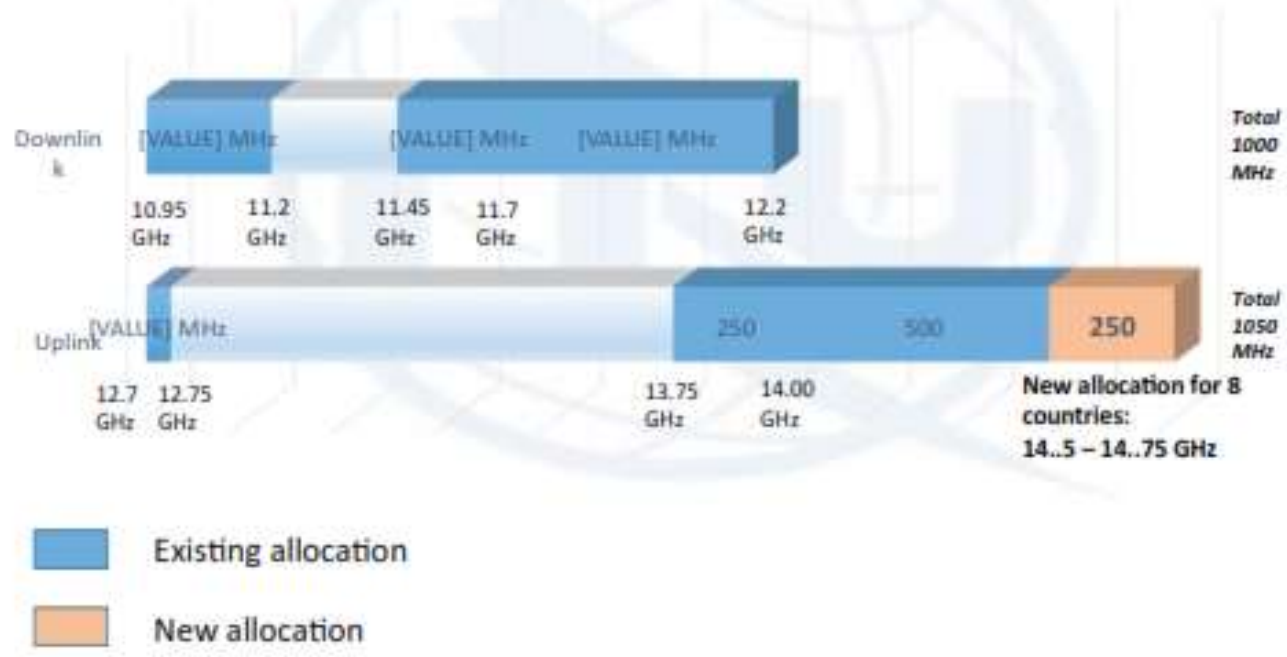
# Ku Band Frequency Allocation for unplanned FSS (Region 1)



# Ku Band Frequency Allocation for unplanned FSS (Region 2) -



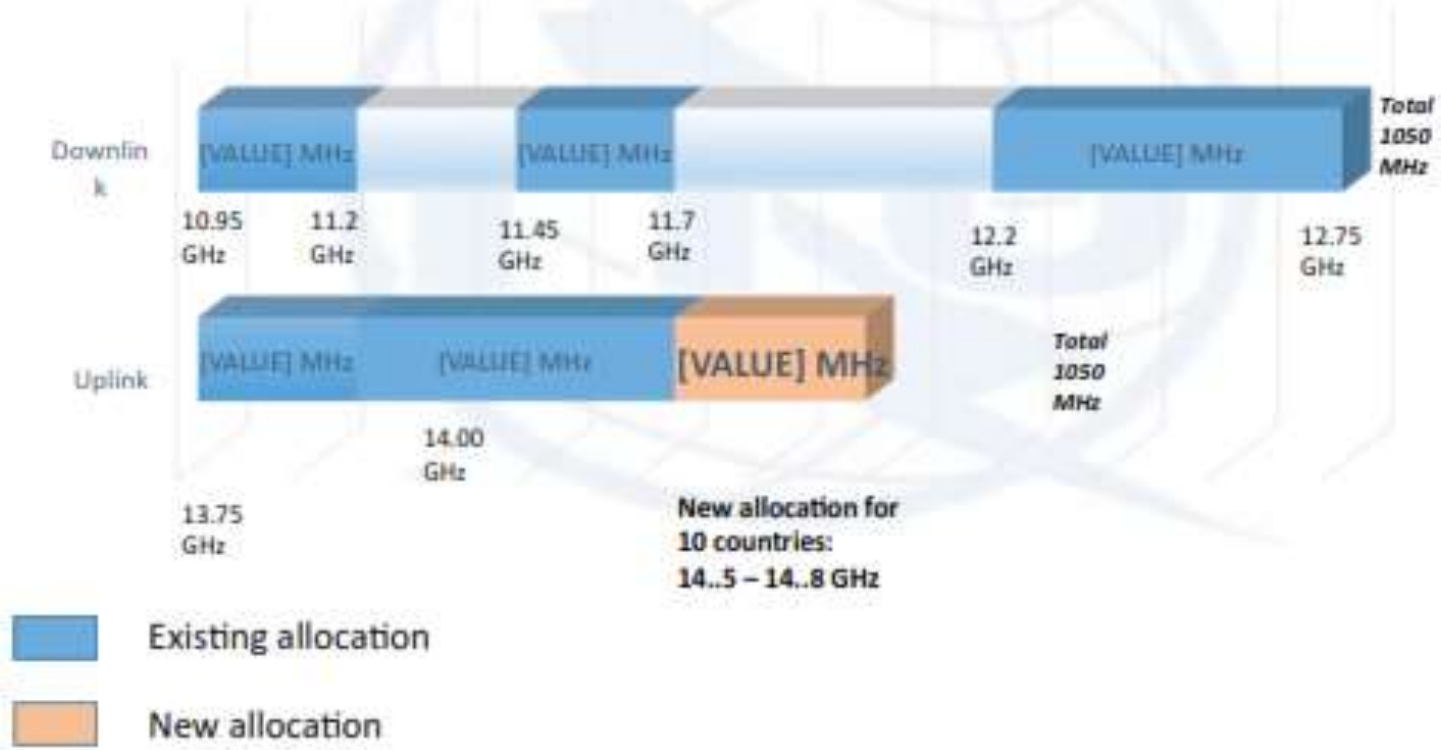
Improved balance between uplink and downlink



# Ku Band Frequency Allocation for unplanned FSS (Region 3)



### Improved balance between uplink and downlink





# Outcomes of WRC-15

## Maritime Mobile Satellite Service

(agenda Item 1.9.2)

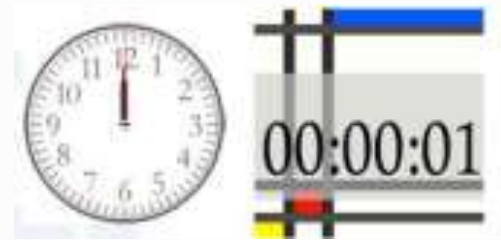


Increase of 400% of spectrum in the downlink!

# Outcomes of WRC-15

## Reference Time Scale

(agenda Item 1.14)



### ➤ Background

The Coordinated Universal Time (UTC) adjusts atomic time and ephemeris time based on Earth rotation time by the insertion or deletion of leap seconds. Digital systems are highly dependent on keeping very precise time synchronization and thus can be disrupted when a leap second is introduced.

### ➤ Results of WRC-15

The current implementation of UTC to insert leap seconds will continue until WRC-23 where the issue will be discussed again.

### ➤ Implications

Further studies by the International Bureau of Weights and Measures (BIPM) and ITU on various aspects of the current and potential future international reference time scale



# Outcomes of WRC-15

## Mobile Broadband (MBB)

(agenda Item 1.1 and 1.2)





# Challenges

*Every one in favor of spectrum harmonization*

***BUT***

*Everyone wants it be his way*

- The success of the MBB and its ubiquitous nature represents a threat of disruption to other services **if IMT is identified in the same band**. Even though technical solutions may exist to share between countries
- Main success of WRC-15 was
  - *Continue global harmonization for IMT and*
  - *Secure future access to spectrum for other services.*



# Background

## ➤ Need for More spectrum

User density	Total requirement by 2020 (MHz)	Region 1		Region 2		Region 3	
		Already identified (MHz)	Additional demand (MHz)	Already identified (MHz)	Additional demand (MHz)	Already identified (MHz)	Additional demand (MHz)
Low	1 340	981-1 181	159 – 359	951	389	885 - 1 177	163 – 455
High	1 960		779 - 979		1 009		783 - <b>1 075</b>

Estimated additional spectrum requirements by 2020 ranged from 159 to 1075 MHz depending on Region and user density)

Source: CPM-15 report (Additional Spectrum Requirements)



# Outcomes of WRC-15

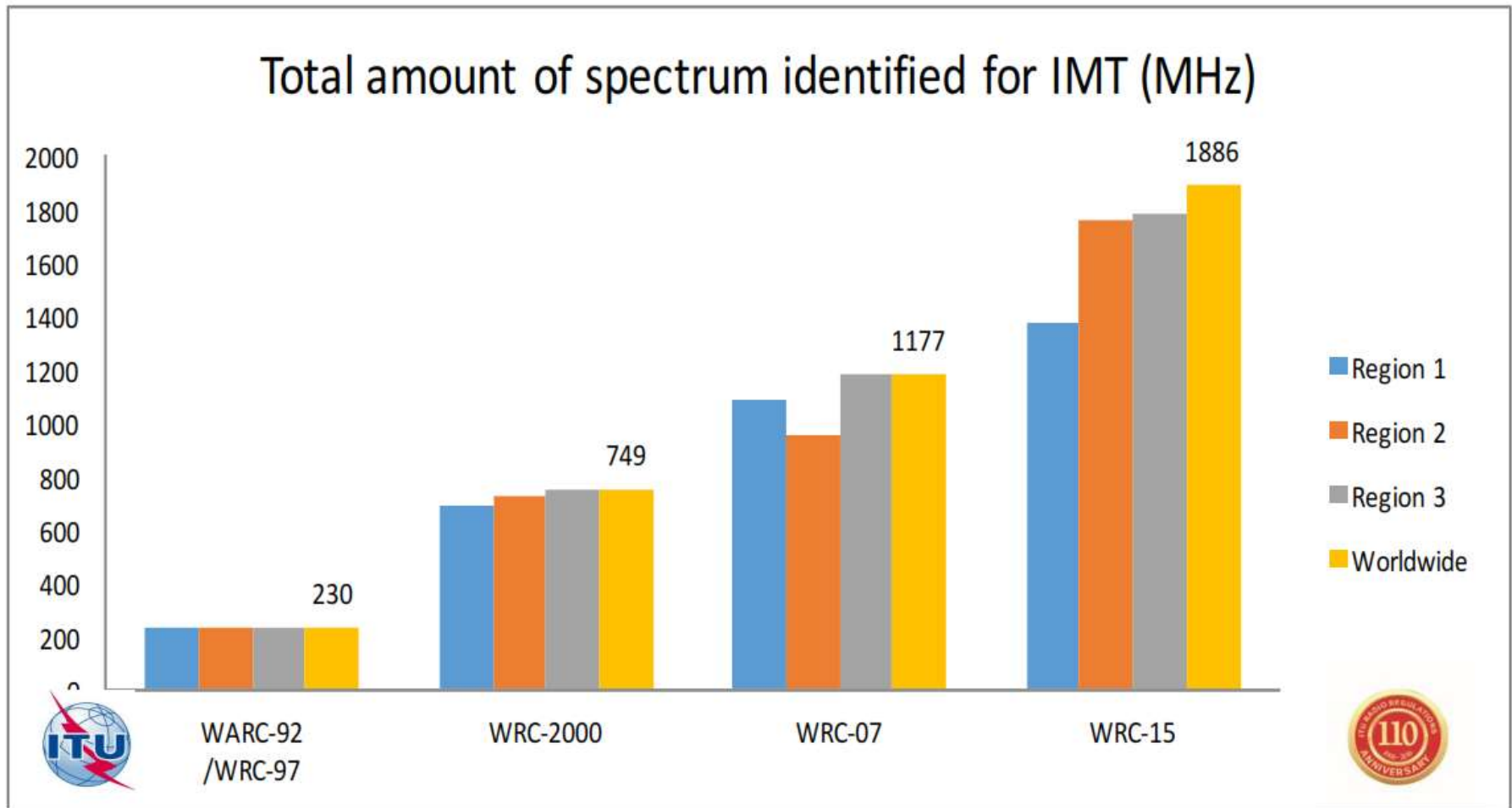
## ➤ New spectrum Identified

WRC - 15

Band (MHz)	Bandwidth (MHz)	R1	R2	R3
470 – 608	138		some	
608 – 698	84		some	
1427 – 1452	25	any	any	any
1452 – 1492	40	some	any	any
1492 – 1518	26	any	any	any
3300 – 3400	100	some	some	some
3600 – 3700	100		some	
4800 – 4990	190		some	some
	<b>New BW 709</b>			

# Outcomes of WRC-15

## ➤ New spectrum Identified over time





# Outcomes of WRC-15

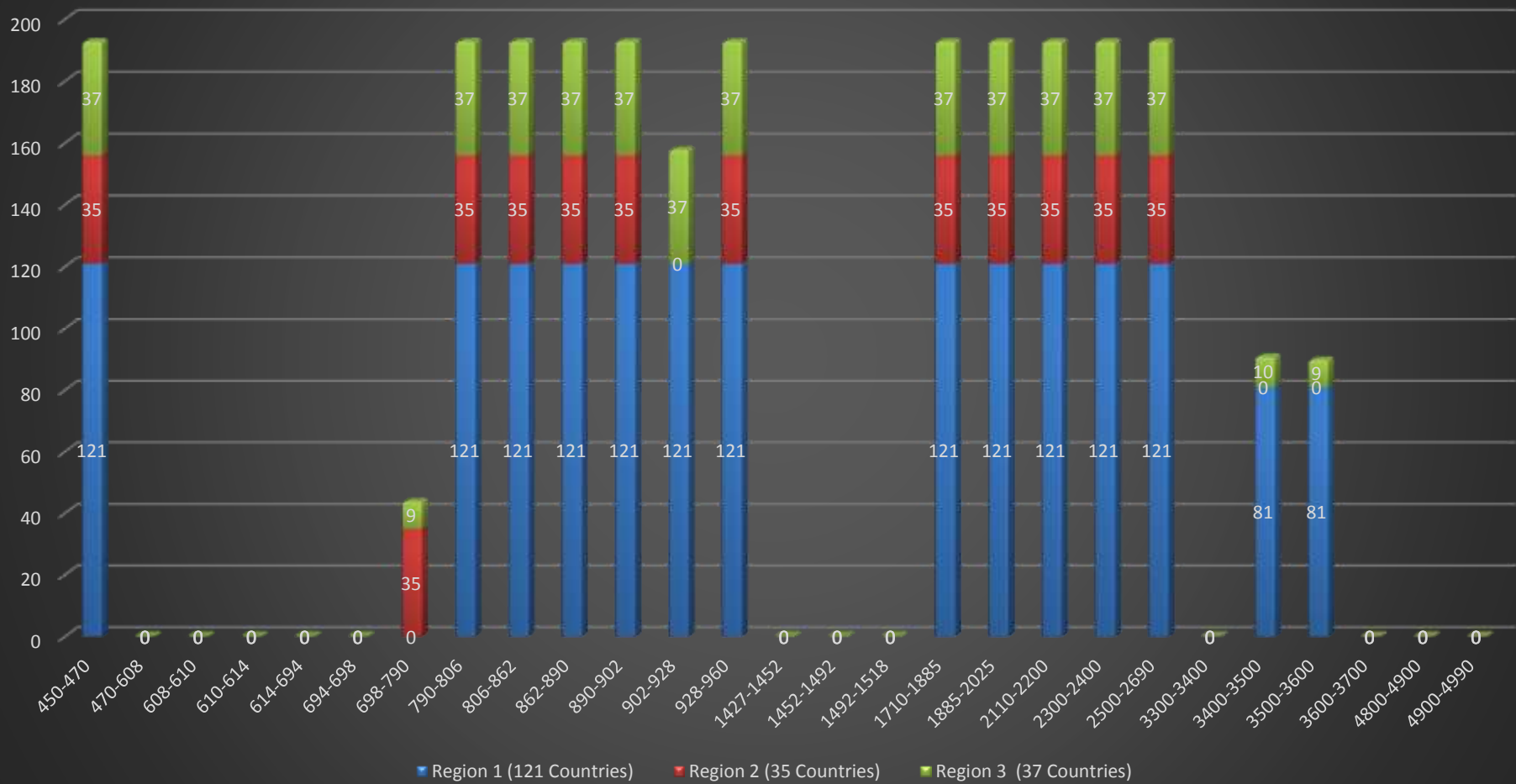
## ➤ Spectrum for IMT

Band (MHz)	Bandwidth (MHz)
450-470	20
470-608	138
608-698	90
698-960	262
1427-1452	25
1452-1492	40
1492-1518	26
1710-2025	315
2110-2200	90
2300-2400	100
2500-2690	190
3300-3400	100
3400-3600	200
3600-3700	100
4800-4990	190
	<b>1,886</b>
	<i>(Regional allocations vary and therefore totals can be different for a specific region)</i>

# IMT Bands after WRC-07



## IMT Bands After WRC-07 (Number of countries identified)

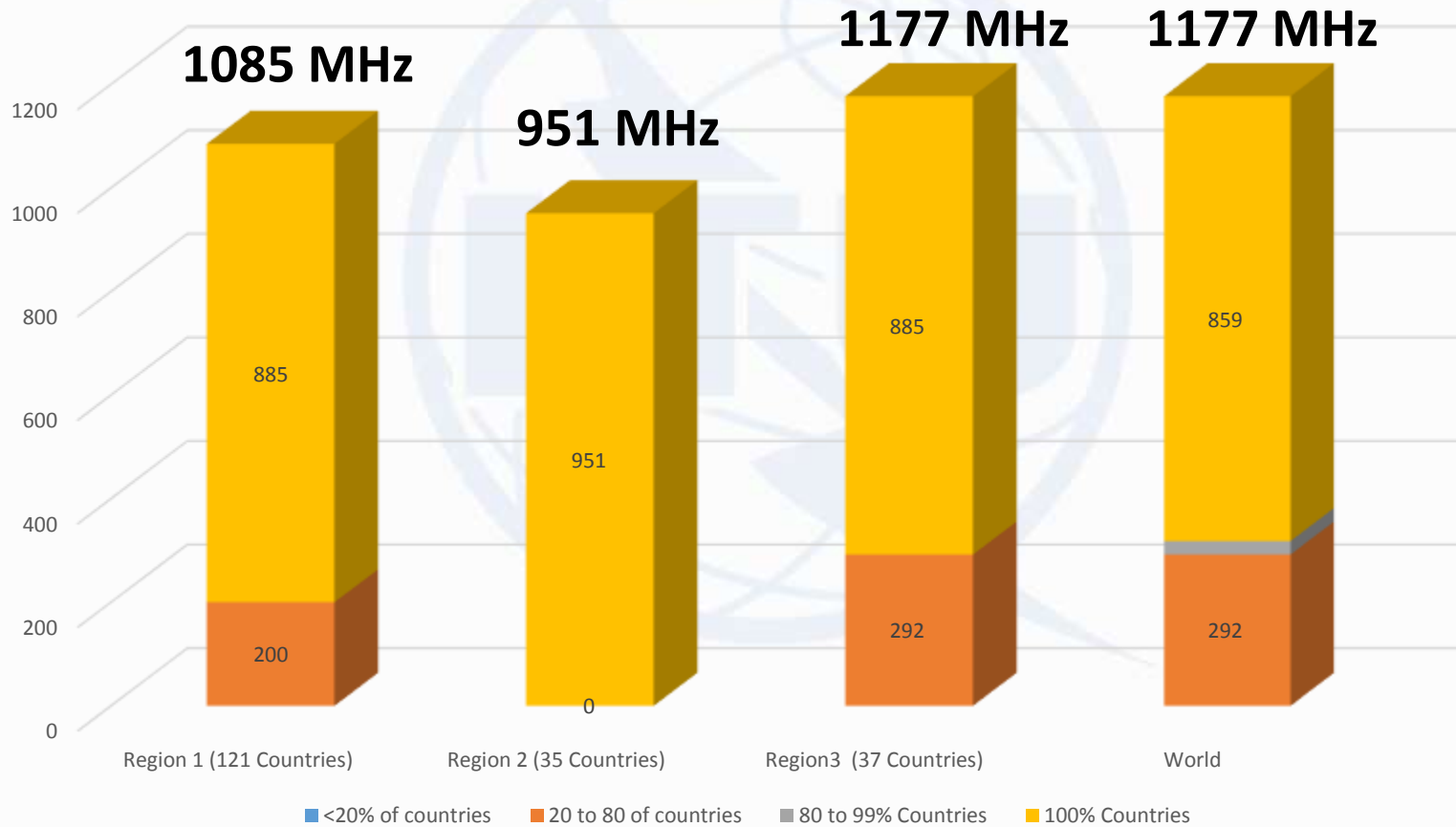






# IMT Spectrum after WRC-07

IMT Spectrum After WRC-07 (MHz)



# IMT Bands after WRC-15

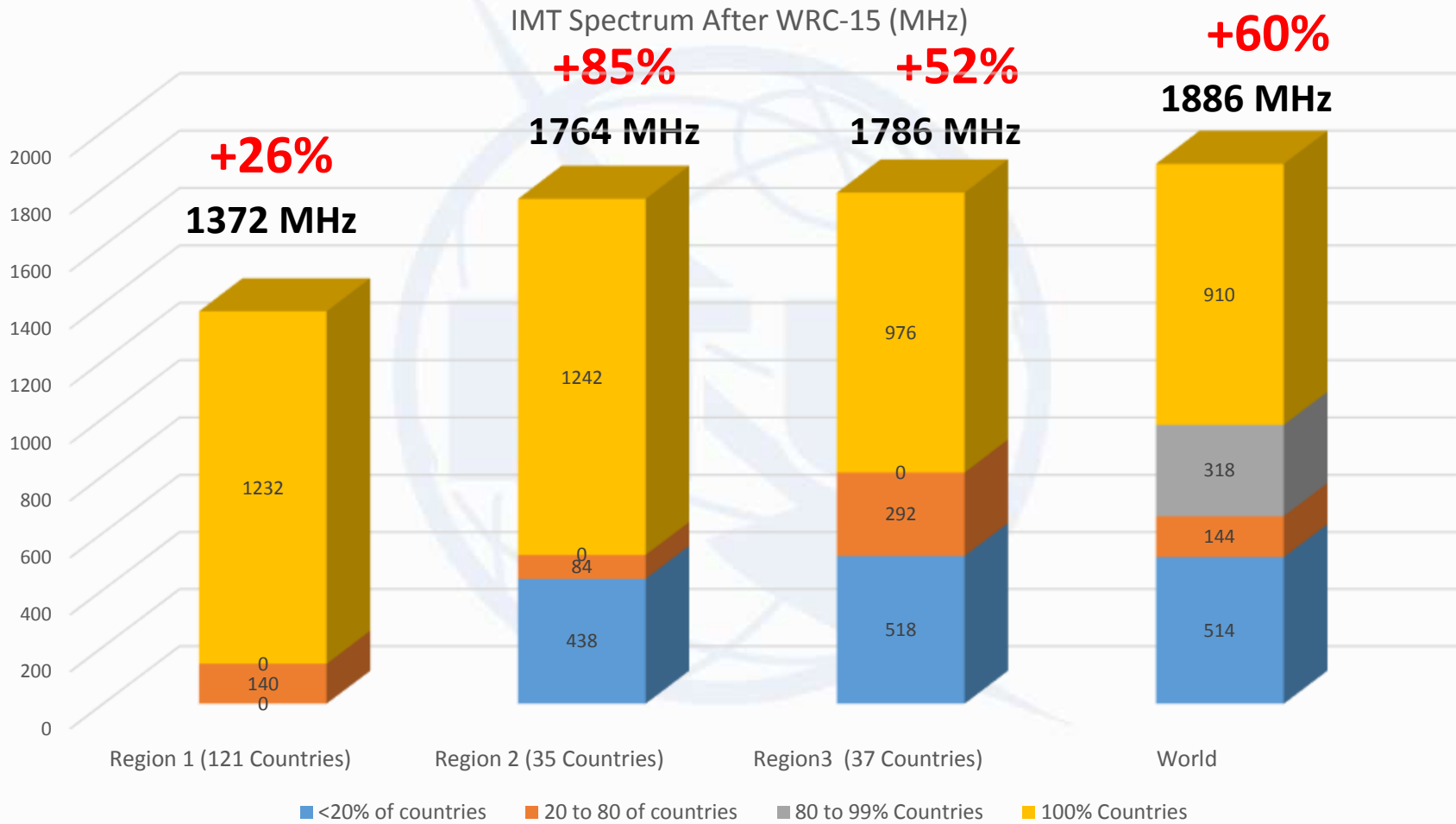


## IMT Bands After WRC-15 (Number of countries identified)

■ Region 1 (121 Countries)
 ■ Region 2 (35 Countries)
 ■ Region 3 (37 Countries)



# IMT Bands after WRC-15





# Other Outcomes of WRC-15

## ➤ Satellite Earth Stations in Motion

- WRC-15 agreed to facilitate the global deployment of Earth Stations In Motion (ESIM) in the **19.7 – 20.2 GHz** and **29.5 – 30.0 GHz** bands in the fixed-satellite service (FSS), paving the way for satellite systems to provide global broadband connectivity for the transportation community.
- Earth stations on-board moving platforms, such as ships, trains and aircraft, will be able to communicate with high power multiple spot beam satellites, allowing transmission rates in the order of **10 – 50 Mbits/s**.

## ➤ Standard C Band (3.7GHz-4.2GHz)

- **NOC** it keeps its allocation to FSS



# Significance of decisions on Mobile Broadband

- **Satisfy growing IMT broadband spectrum requirements:**
  - 60% increase in IMT bands after WRC-15
  - Total IMT spectrum of 1886 MHz
- **Harmonization of IMT bands:**
  - 39% increase in globally harmonized spectrum after WRC-15
  - 318 MHz of harmonized bands in more than 80% of countries:
- **Secures future of other services through:**
  - coordination procedures,
  - technical restrictions,
  - In some cases operation on a non-interference basis

# Recent ITU Outcomes related to IMT



- Recommendation **ITU-R M.1579-2** (03/2015): Global circulation of IMT-2000 terrestrial terminals
- Recommendation **ITU-R M.1036-5** (10/2015): Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR)
- Recommendation **ITU-R M.2012-2** (09/2015): Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)
- Recommendation **ITU-R M.2083-0** (09/2015): Framework and overall objectives of the future development of IMT for 2020 and beyond
- Report **ITU-R M.2370** (07/2015): IMT Traffic estimates for the years 2020 to 2030
- ITU-R Handbook on “**Global trends in IMT**” (05/2015)
- **ITU-R WP 5D**: Work plan, timeline, process and deliverables for the future development of IMT



# Other Outcomes of WRC-15

## ➤ Wi-Fi

- ITU-R studies indicate that the minimum spectrum need for WAS/RLAN in the 5 GHz frequency range in the year 2018 is estimated at **880 MHz** (*includes 455-580 MHz already utilized by non-IMT mobile broadband applications operating within the 5 GHz range resulting in 300-425 MHz additional spectrum being required*)

## ➤ *Invited the WRC-19 to consider the results of the ITU-R studies and take appropriate actions*

- *Res. 239 (WRC-15): Appropriate regulatory actions, incl. Additional MS allocations, for WAS/RLAN will be studied in the bands between 5 150-5 925 MHz*

## ➤ Satellite Regulatory Issues





# Going Ahead





# CPM19-1

- Following the WRC-15 the CPM19 had its first meeting from 30 November – 1 December 2015. **269** participants from **63** Member States, **1** Observer from the State of Palestine and **25** Sector Members
- **The main task of the CPM is to decide on the structure of the CPM Report (for the WRC-19 conference) and the chapter rapporteurs and allocate the work to the relevant study groups.**

*Resolution COM 6/16 contains the proposed agenda items for the WRC-19 and also references to the relevant Resolutions which are calling for the appropriate studies.*

➤ **CHAPTER 1:** *Land mobile and fixed services*

- **Agenda items:** 1.11, 1.12, 1.14, 1.15
- Rapporteur: Ms Keer ZHU (China (People's Republic of))

➤ **CHAPTER 2:** *Broadband applications in the mobile service*

- **Agenda items:** 1.13, 1.16, 9.1 (issues 9.1.1, 9.1.5, 9.1.8)
- Rapporteur: Mr José ARIAS (Mexico)

➤ **CHAPTER 3:** *Satellite services*

- **Agenda items:** 1.4, 1.5, 1.6, 7, 9.1 (issues 9.1.2, 9.1.3, 9.1.9)
- Rapporteur: Mr Nicolay VARLAMOV (Russian Federation)

➤ **CHAPTER 4:** *Science services*

- **Agenda items:** 1.2, 1.3, 1.7
- Rapporteur: Mr Vicent MEENS (France)

➤ **CHAPTER 5:** *Maritime, aeronautical and amateur services*

- **Agenda items:** 1.1, 1.8, 1.9, 1.10, 9.1 (issue 9.1.4)

Rapporteur:

Mr Wael EL SAYED (Egypt (Arab Republic of))

➤ **CHAPTER 6:** *General issues*

- **Agenda items:** 2, 4, 9.1 (issues 9.1.6, 9.1.7), 10

Rapporteur:

Mr Peter N. NGIGE (Kenya (Republic of))



# Agenda for WRC-19 (Agenda item 10 of WRC-15)

- **Res. 809** (WRC-15): **17 specific and 6 standing Items**
  
- **Res. 958** (WRC-15): **URGENT STUDIES** to be reported under WRC-19 agenda item 9.1 :
  - (9.1.6) Wireless Power Transmission (WPT) for electric vehicles
    - *Study suitable harmonized bands to minimize impact on RF services*
  
  - (9.1.7) Managing unauthorized operations of Earth Station terminals
    - *study need for possible additional measures and possible methods that will assist administrations*
  
  - (9.1.8) Narrowband & BB machine-type communication infrastructures
    - *study related technical and operational aspects of radio networks and systems (incl. spectrum needs & possible harmonized use of spectrum)*





# Other studies in WRC-15 Resolutions to be reported in WRC-19

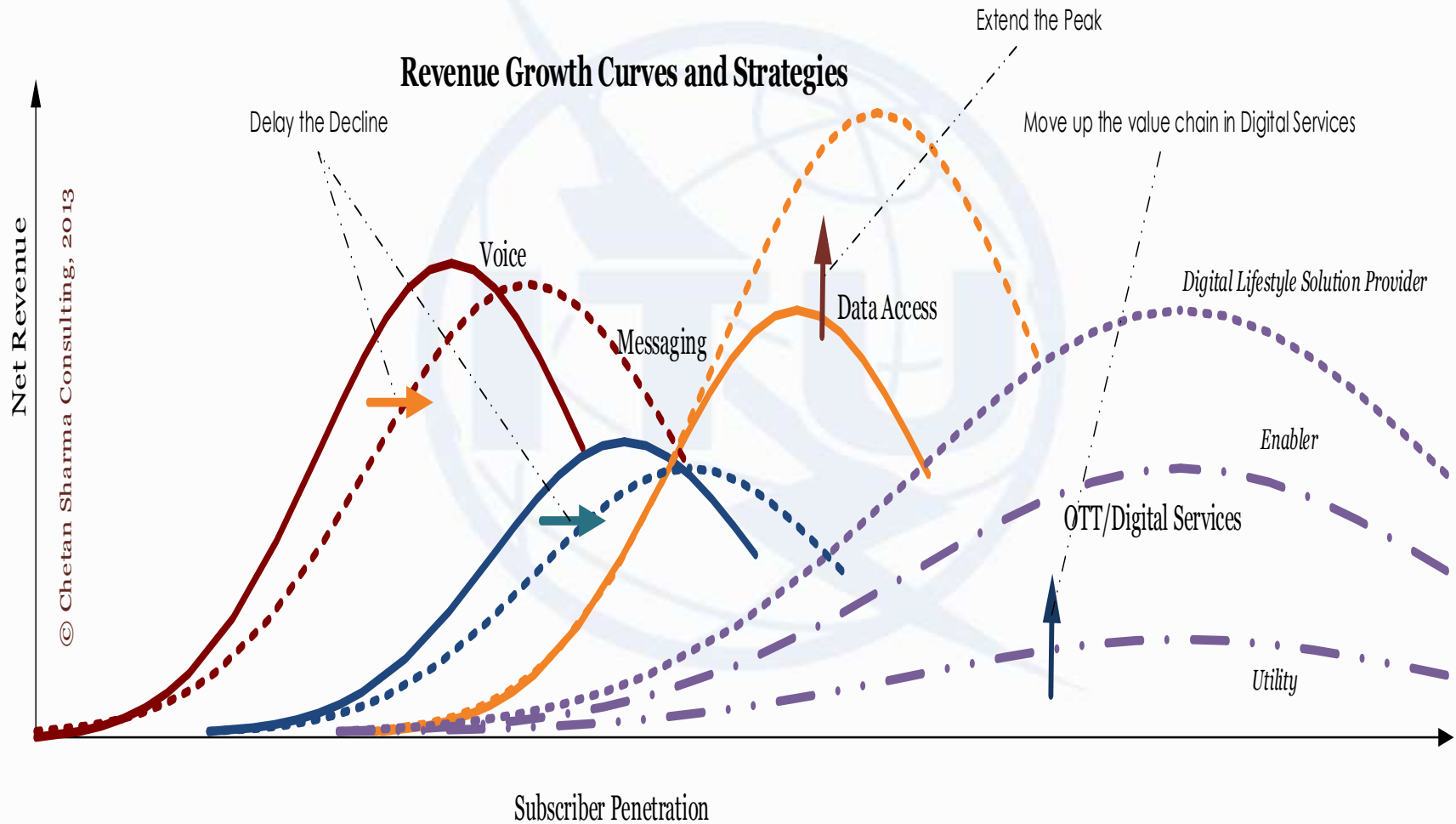
## ➤ **OTHER STUDIES** to be reported under WRC-19 agenda item 9.1 :

- (9.1.1) Res. 212 – Terrestrial and Satellite components (Rev.WRC-15) of **IMT**, co- existence & compatibility @ 1 885-2025 & 2110-2200 MHz
- (9.1.2) Res. 761 – **IMT** and BSS sound @ 1452-1492 MHz (WRC-15) in **R1&3**
- (9.1.3) Res. 157 – N-GSO Sat. in “C-Band” allocated to (WRC-15) the FSS
- (9.1.4) Res. 763 – Stations on board sub-orbital vehicles (WRC-15)
- (9.1.5) Res. 764 – Incorporation by reference of (WRC-15) Rec. ITU-R M.1638-1 & ITU-R M.1849-1
- (9.1.9) Res. 162 – FSS needs @ 51.4-52.4 GHz(WRC-15)



# Why the need for Efficient SM now?

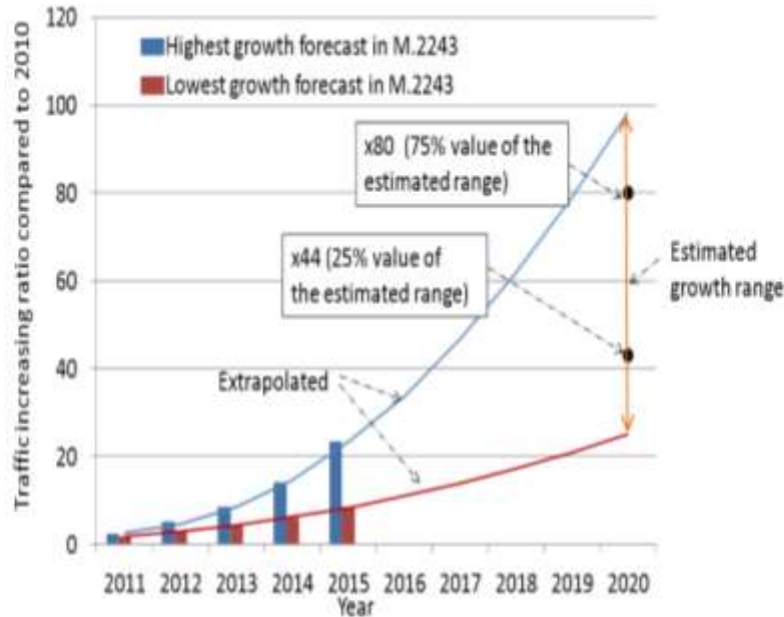
4<sup>th</sup> wave of growth in telecom sector



Current wave is defined by its complexity

# Why the need for Efficient SM now?

Demand of Content – Internet Traffic Explosion



**37%** of Internet traffic during prime time is online video



## Video

~ 70% of internet traffic by 2014

## Smartphones

2.5 billion devices by 2015  
32x increase per km<sup>2</sup>

## Mobile Internet

~ 70% of mobile traffic by 2014

## Machine-to-Machine

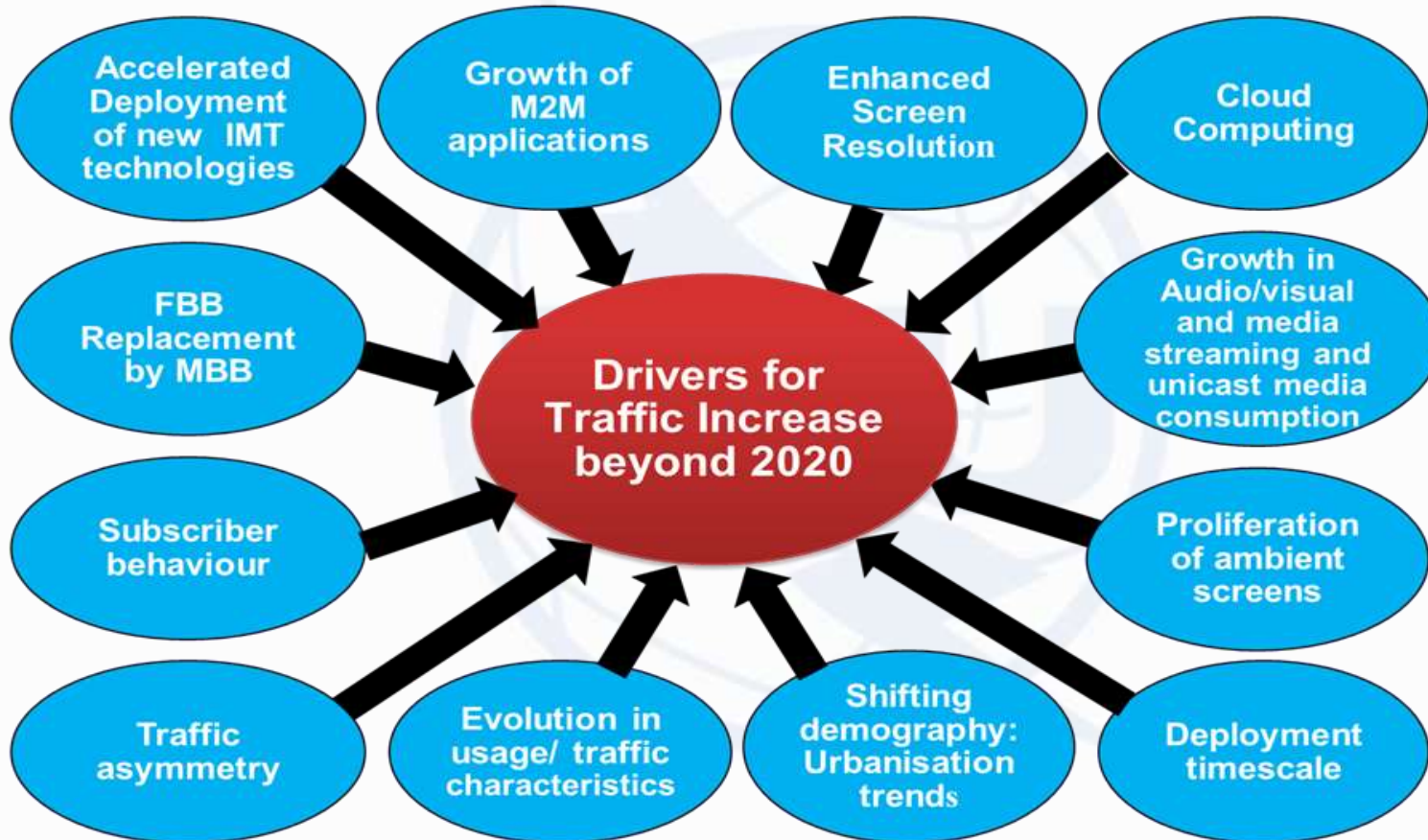
3x growth in the next five years

**Mobile broadband networks are at the heart of this trend ...**

**Source:** ITU Report M. 2290-0 and Alcatel Lucent

# Why the need for Efficient SM now?

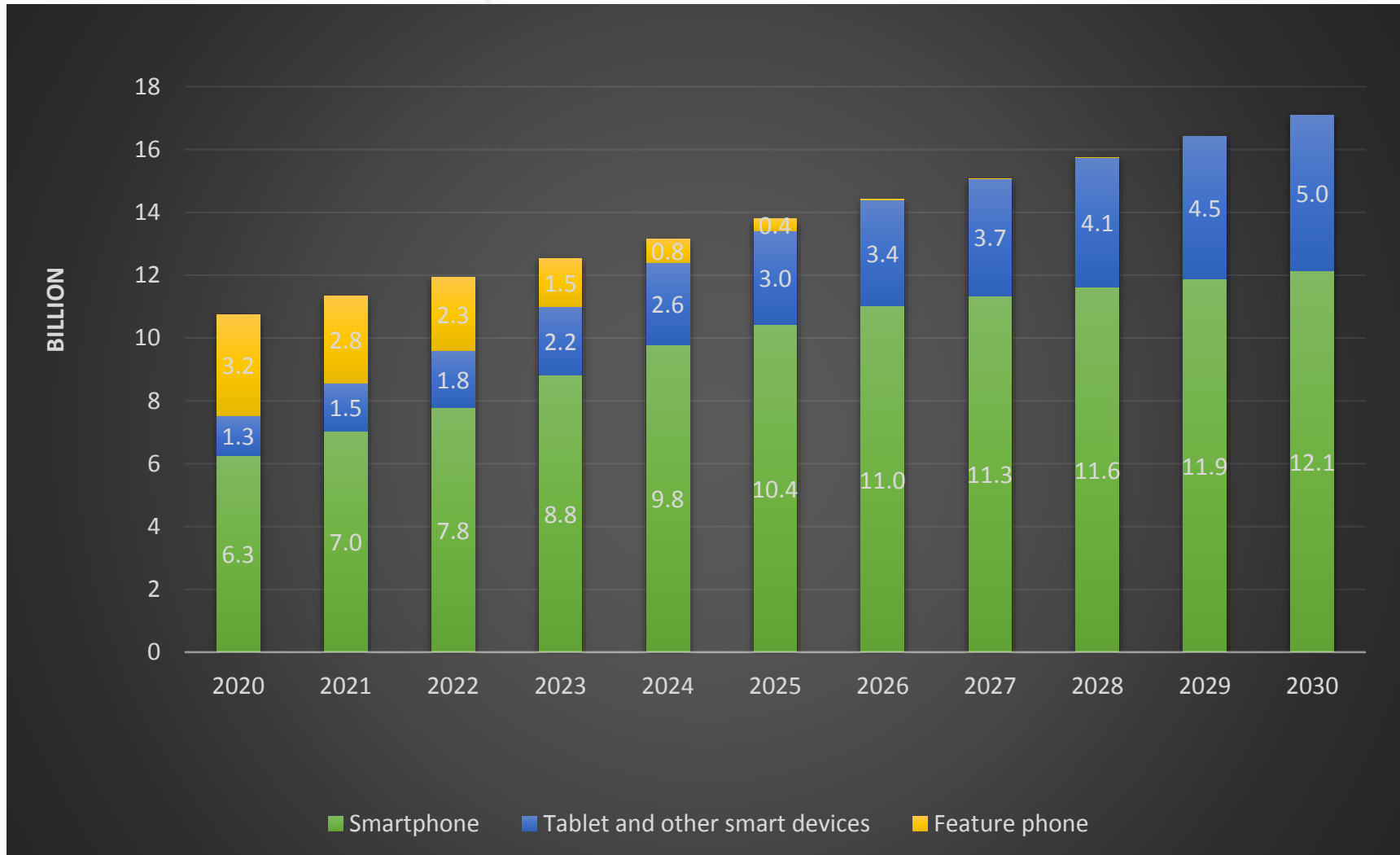
Drivers for traffic increase



Source: ITU Report M. 2370-0

# Why the need for Efficient SM now?

Estimation of global mobile subscriptions with different categories  
*Beyond 2020*



**Source:** ITU Report M. 2370-0

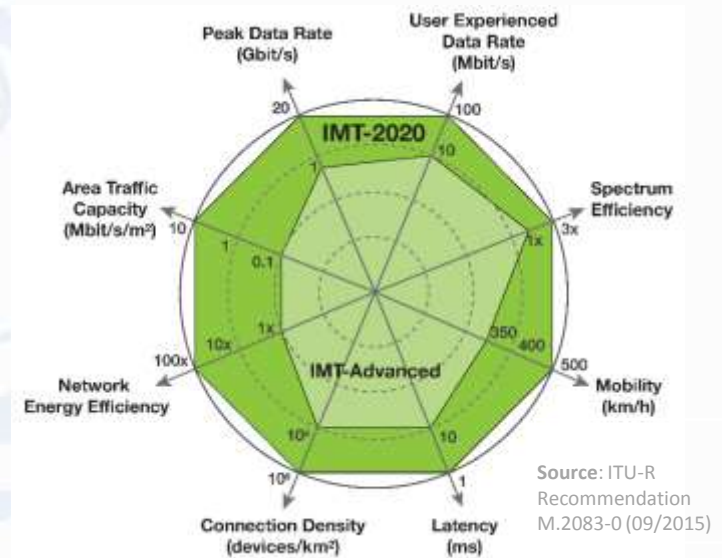
# BB applications in MS



(WRC-19 Agenda item 1.13 and 1.16)

➤ The following bands, which are already allocated to mobile, will be studied with a view to an IMT-2020 identification:

- 24.25 – 27.5 GHz
- 37 – 40.5 GHz
- 42.5 – 43.5 GHz
- 45.5 – 47 GHz
- 47.2 – 50.2 GHz
- 50.4 – 52.6 GHz
- 66 – 76 GHz
- 81 – 86 GHz



➤ The following bands will also be studied, although they do not currently have global mobile allocations: Res. 238 (WRC-15)

- 31.8 – 33.4 GHz
- 40.5 – 42.5 GHz
- 47 - 47.2 GHz



# Overlapping Bands in WRC-19 Agenda Items



1.6 – NGSO FSS Res. 159 (WRC-15)	1.13 – IMT Res. 238 (WRC-15)	1.14 – HAPS Res. 160 (WRC-15)	9.1 (9.1.9) – FSS Res. 162 (WRC-15)
	24.25 - 27.5	24.25 - 27.5 (Reg. 2)	
37.5 - 39.5 (s-E*)	37 - 40.5	38 - 39.5 (globally)	
39.5 - 42.5 (s-E*)	40.5 - 42.5		
47.2 - 50.2 (E-s*)	47.2 - 50.2		
50.4 - 51.4 (E-s*)	50.4 - 52.6		51.4 - 52.4 (E-s*)
<ul style="list-style-type: none"> <li>• <b>E-s: Earth-to-space; s-E: space-to-Earth.</b></li> <li>• <b>All bands in GHz</b></li> </ul>			

Studies to **address mutual compatibility & sharing feasibility** among the **services/applications** for which **allocation/identification is envisaged** under the corresponding Res. relating to the AI in the overlapping bands

# LMS and FS systems and applications



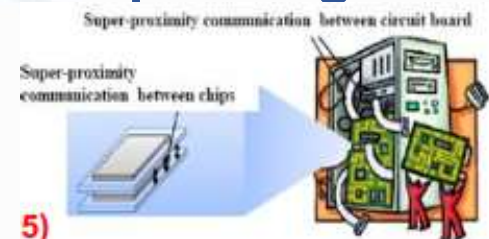
(WRC-19 Agenda item 1.14 and 1.15)

➤ **Res. 160 (WRC-15) Studies for considering appropriate regulatory actions for HAPS, within existing FS allocation i.e**

- at 47.2-47.5, 47.9-48.2 & 31.0-31.3\*\*/27.9-28.2GHz (outside Reg. 2, +5 ADMs @6.5/6.5MHz)
- or study new bands: 38-39.5 GHz & 21.4-22 & 24.25-27.5 GHz



➤ **Res. 767 (WRC-15) Studies towards an identification for use by Administrations for LMS and FS applications operating in the frequency range 275-450 GHz**





# New transport Systems in MS



(WRC-19 Agenda item 1.11 and 1.12)

- **Res. 236 (WRC-15)** Studies to facilitate global or regional harmonized bands to support railways RF systems between train & trackside within existing MS allocations



- **Res. 237 (WRC-15)** Global or regionally harmonized bands, to the maximum extent possible, for implementation of evolving ITS within existing MS allocations





# Other issues

- **Maritime** (WRC-19 Agenda item 1.8, 1.9.1 and 1.9.2)
  - **Res. 359 (WRC-15)** *Regulatory Issues to support GMDSS*
  - **Res. 362 (WRC-15)** *Regulatory actions within the band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and AIS*
  - **Res. 360 (WRC-15)** *Studies to consider RR MODs, including new MMSS (E-s & s-E) allocations, preferably within 156.0125-157.4375 MHz & 160.6125-162.0375 MHz of RR App. 18, to enable a new VDES (VHF data exchange system) satellite component*
  
- **Aeronautical and Amateur** (WRC-19 Agenda item 1.10 and 1.1)
  - **Res. 426 (WRC-15)** *spectrum needs & regulatory provisions for introduction and use of the GADSS (Global Aeronautical Distress and Safety System)*
  
- **Science** (WRC-19 Agenda item 1.2, 1.3 and 1.7)
  - *Res. 765 (WRC-15) MetSat and EESS, Res. 766 (WRC-15) for Metsat (s-E) and EESS (s-E) for DCS, Res. 659 (WRC-15) on TT&C in the SOS for non-GSO satellite*



# WRC-23 Preliminary Agenda

(WRC-15 Agenda item 10)

- **Res. 810 (WRC-15) 5 preliminary agenda items**
  - **Res. 361** – *Spectrum for GMDSS modernization & (WRC-15) implementation of e-navigation*
  - **Res. 656** – *Possible new allocations for EESS (active) for (WRC-15) spaceborne radar sounders @ 45 MHz*
  - **Res. 657** – *Spectrum needs & designation of radio (WRC-15) services for space weather sensors*
  - **Res. 161** – *Possible new alloc. for FSS @ 37.5-39.5 GHz (WRC-15)*
  - **Res. 235** – *spectrum use and needs of existing services (WRC-15) @ 470-960 MHz in Region 1 and possible regulatory actions @ 470-694 MHz in Region 1*



**I T hank U** “Committed to connecting the **WORLD**”

ITU Study Group Meetings  
ITU-D (Res. 9) and ITU-R SG1

**Your active participation in and contribution to these events is most welcome!**