

**ITU POLICY AND ECONOMICS COLLOQUIUM FOR AMERICAS / COLOQUIO UIT DE  
POLÍTICAS Y ECONOMÍA PARA AMÉRICA (IPEC-23)**

**REGIONAL ECONOMIC DIALOGUE / DIÁLOGO ECONÓMICO REGIONAL (RED)**

**San José, Costa Rica, 25-26 September /septiembre 2023**

# Spectrum Management Challenges for Emerging Technologies

**Joaquin RESTREPO**

**Capacity Building Coordinator; Study Groups Department (SGD);**

**Radiocommunications Bureau (BR); International Telecommunications Union, ITU**



# Content of the presentation

1. **Spectrum Management Basics**
2. **International Standardization (The ITU-R Sector)**
3. **Wireless Emerging Systems**



# Content of the presentation

1. **Spectrum Management Basics**
1. **International Standardization (The ITU-R Sector)**
2. **Wireless Emerging Systems**

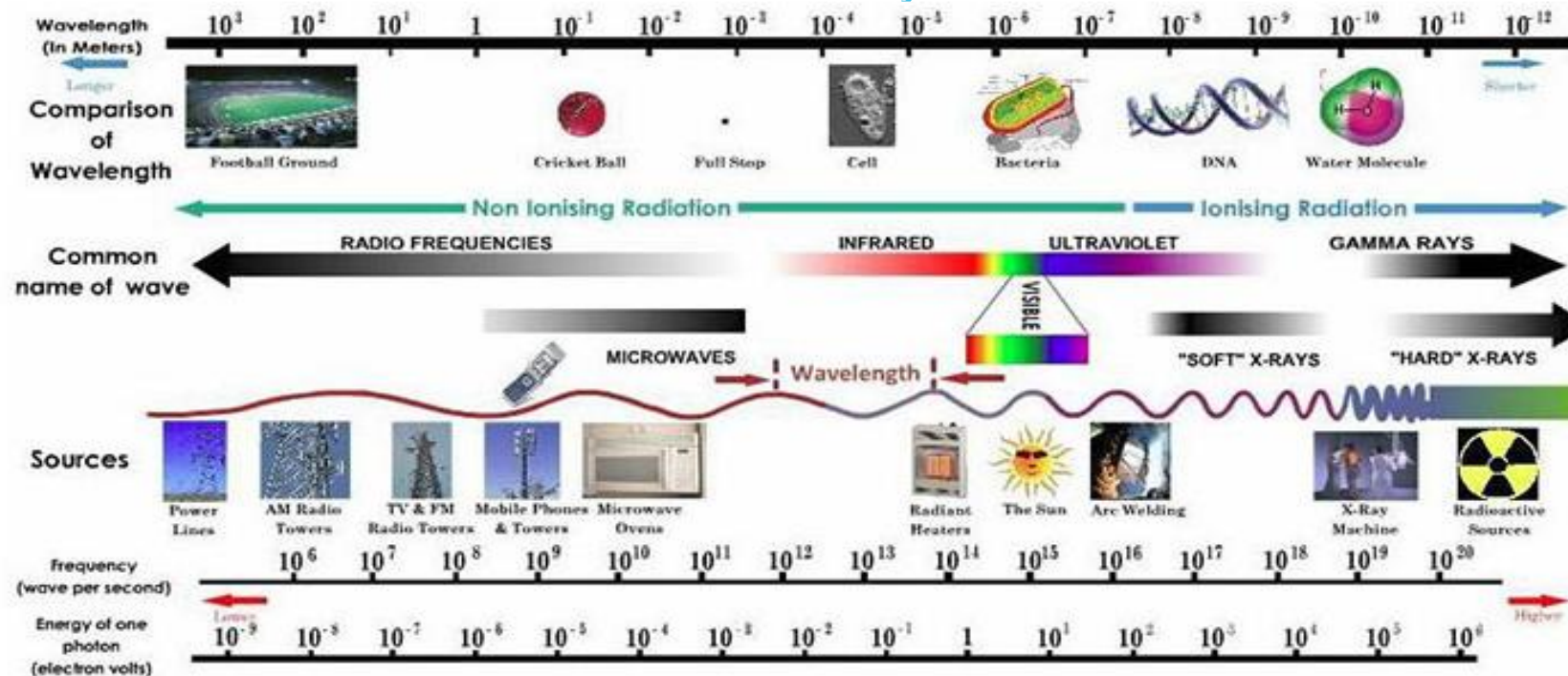


# RADIOELECTRIC SPECTRUM

**RR 1.3: Telecommunication:** Any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems.

**RR 1.5: Radio waves (or hertzian waves):** Electromagnetic waves of frequencies arbitrarily lower than 3000 GHz, propagated in space without artificial guide.” (usually refers as: “radio”)

**RR. 1.6 Radiocommunication:** Telecommunication by means of radio waves



# RADIOELECTRIC vs. ELECTROMAGNETIC SPECTRUM

- **Radioelectric Spectrum:** lower part of Electromagnetic Spectrum, used for Telecommunications
- Expression: “*Spectrum*” refers by default to Radioelectric Spectrum
- Communications systems that **DO NOT** use Spectrum (in red) may be regulated (National/International); but their regulatory framework is different than Spectrum Regulations

	Frequencies < 3.000 GHz?	Free Propagation?	Radioelectric Spectrum?
Infra-red Wireless link	NO	YES	NO
Cable TV (Coaxial)	YES	NO	NO
Optical Fiber	NO	NO	NO
Broadcasting TV	YES	YES	YES

## ITU RADIO REGULATIONS, RR

Spectrum cannot be limited to a given territory; international coordination is necessary

ITU Radio Regulations (RR) is an International Treaty, elaborated and revised by administrations and membership, during World Radio Conferences (WRC); RR has a binding nature for ITU Member states.

ITU acts as depositary of RR

Last version: RR-20 (as revised during WRC-19)

RR can be downloaded, free of charge, for the general public, in the 6 UN Languages, at: <https://www.itu.int/pub/R-REG-RR-2020>



# RR: KEY DEFINITIONS

**RR, No. 1.19 Radiocommunication service:** *A service involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes.*

**RR, No. 1.61 Station:** *One or more transmitters or receivers or a combination of transmitters and receivers, including the accessory equipment, necessary at one location for carrying on a radiocommunication service, or the radio astronomy service*

Terrestrial Services (NO satellite links)	
Fixed	
Broadcasting	
Mobile	Land mobile
	Aeronautical mobile
	Maritime mobile
Radiodetermination	Radionavigation
	Radiolocation

but also

Amateur
Standar Frequenct and Time
Meteorogical Aids
.
.

and more

Space Services (satellite links)	
Fixed-satellite	
Broadcasting-satellite	
Mobile-satellite	Land mobile-satellite
	Aeronautical mobile-satellite
	Maritime mobile-satellite
Radiodetermination-satellite	Radionavigation-satellite
	Radiolocation-satellite

but also

Amateur-satellite
Radio Astronomy
Space Research
.
.

and more

**41 different types of Services** (RR 1.20 to 1.60)

**53 different types of Stations** (RR 1.65 to 1.115)



# RR: ALLOCATIONS vs. ASSIGNMENTS

**RR, No. 1.16 allocation (of a frequency band):** Entry in the Table of Frequency Allocations\* of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.

**RR, No. 1.17 allotment (of a radio frequency or radio frequency channel):** Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions.

**RR 1.18 assignment (of a radio frequency or radio frequency channel):** Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.

Frequency distribution to	French	English	Spanish	Arabic	Chinese	Russian
Services	Attribution (attribuer)	Allocation (to allocate)	Atribución (atribuir)	توزيع (بوزع)	划分	распределение (распределять)
Areas or countries	Allotissement (allotir)	Allotment (to allot)	Adjudicación (adjudicar)	تعيين (يعين)	分配	выделение (выделять)
Stations	Assiguation (assigner)	Assignment (to assign)	Asignación (asignar)	تخصيص (يخصص)	指配	присвоение (присваивать)

**Allocations** are granted to Radiocommunications **Services**

**Assignments** are granted to Radiocommunications **Stations**

**NOTE:** Most of dictionaries display the expressions "**Allocation**" and "**Assignment**" as being synonymous; in the context of Spectrum Management and Regulation **they are different**.





# RR: OTHER CONCEPTS

**Other concepts:** although not explicitly defined, on the RR when dealing with band allocations (Art. 5), the use into footnotes of expressions: “*identified*” and “*designated*” express the interest/intention of some administrations on a future use of that band for a specific application; that **in benefit of a mid- and long-term harmonization of the use of that band**.

Examples\*:

**RR, Nos. 5.138, 5.150,....:** Bands designated for industrial, scientific and medical (ISM) applications.

**RR, No. 5.552A.... :** Bands designated for use by high Altitude Platform Stations (HAPS)

**RR, No. 5.516B.....:** bands identified\* for use by High-Density applications in the fixed-satellite service (*also named: High Throughput Satellites, HTS*)

**RR, Nos. 5.286AA, 5.313.A,....:** Bands identified\* for International Mobile Telecommunications (IMT)

\*: Footnotes stated that: “*This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations*”.

# RR: ALLOCATION PRINCIPLES

RR is technically neutral\*, hence, it

1. Does allocate frequency bands to radiocommunication services
2. Does not allocate to specific applications
3. Does not allocate to particular technologies
4. Does not define user profiles (official, commercial, private, etc.)

e.g.: allocation can be made to:

“mobile” (service; by default: terrestrial, land) → NFAT: shall be aligned with RR

- not specifically to : National Standards: ITU-R Recommendations
- a) cellular networks (*application*) :
- b) GSM, LTE, Wimax, etc. (*technology*)
- c) Official/commercial/particular (*user profile*)

# RR: CATEGORIES OF SERVICES

5.25 a) services in “CAPITAL CASE” (example: FIXED) are “PRIMARY” category (primary basis)

5.26 b) services in “Normal cases” (example: Mobile) are “Secondary” category (secondary basis)

5.48 3) services are listed by **category** then in **alphabetical order** (French language). The order of listing does not indicate relative priority within each category.

Stations of secondary service: **Non-Interference/Non-Protection (NI/NP)** vs PRIMARY service

a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;

b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;

c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date\*\*

(\*\*first in time, first in right)

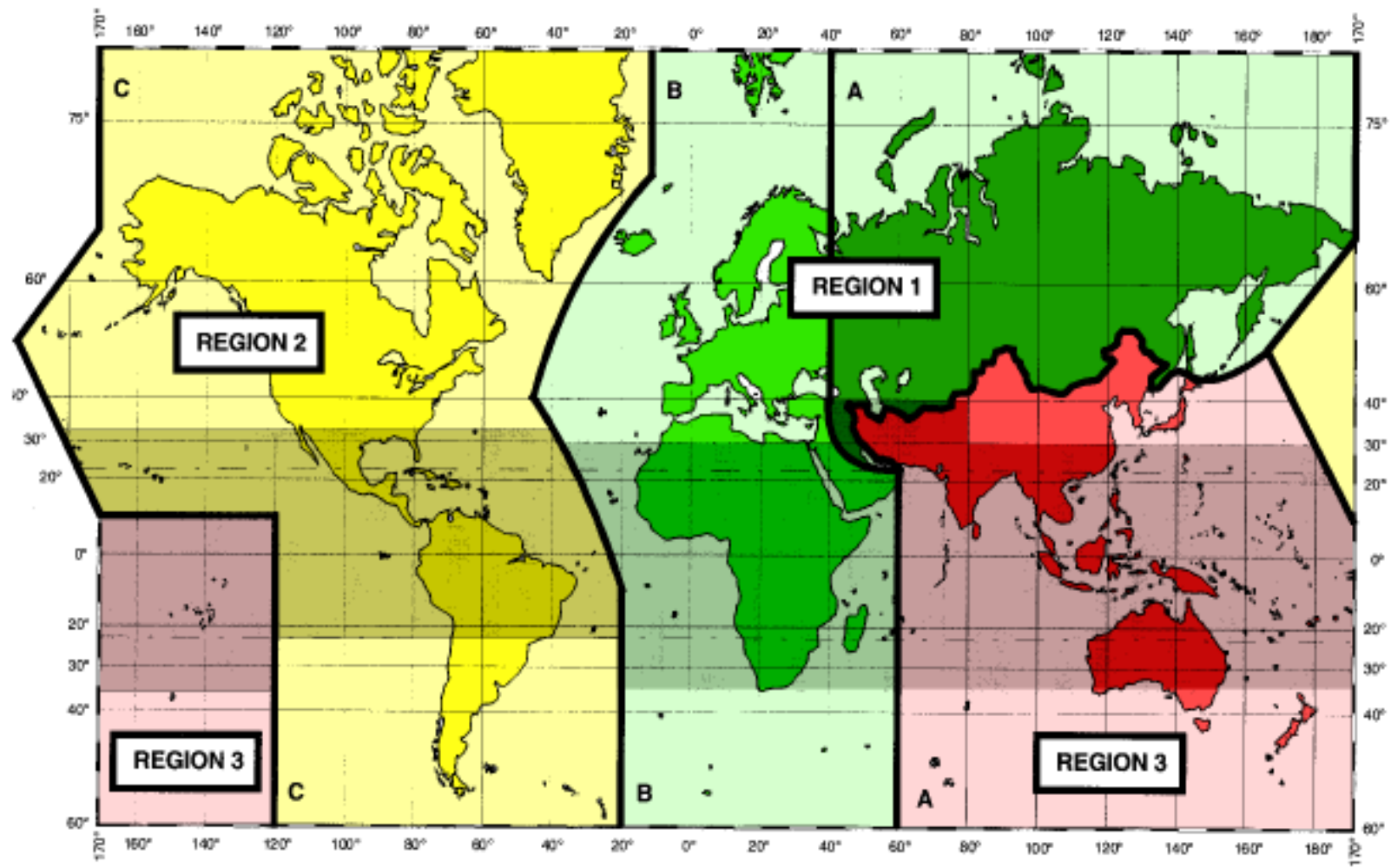
\* Arabic & Chinese versions, PRIMARY → bold characters:

متنقلة بحرية    无线电定位

متنقلة بحرية    无线电定位



# RR: WORLD REGIONS



# Content of the presentation

1. **Spectrum Management Basics**
1. **International Standardization (The ITU-R Sector)**
1. **Wireless Emerging Systems**

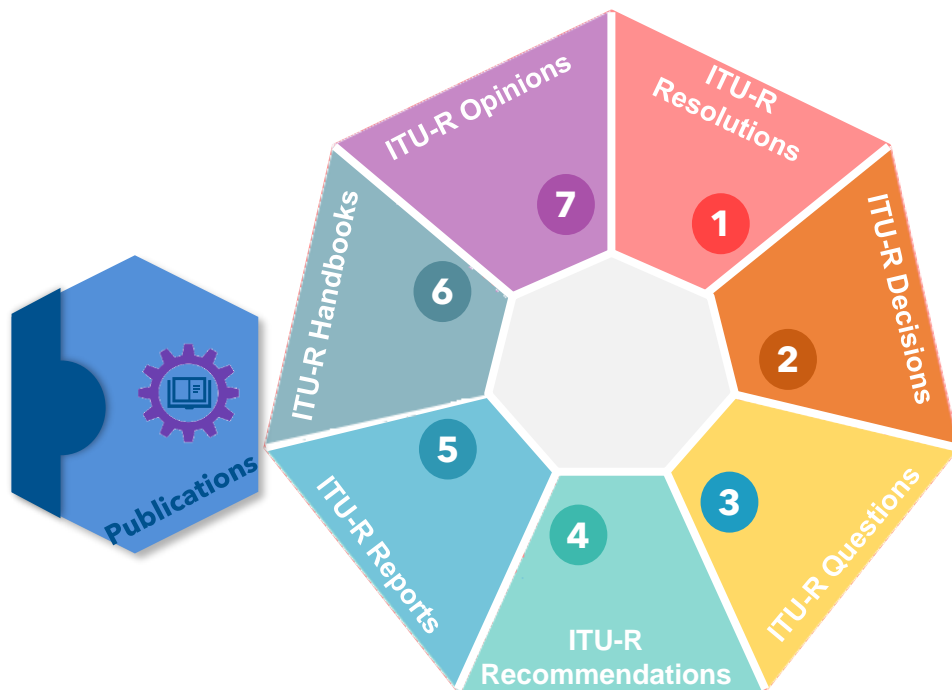




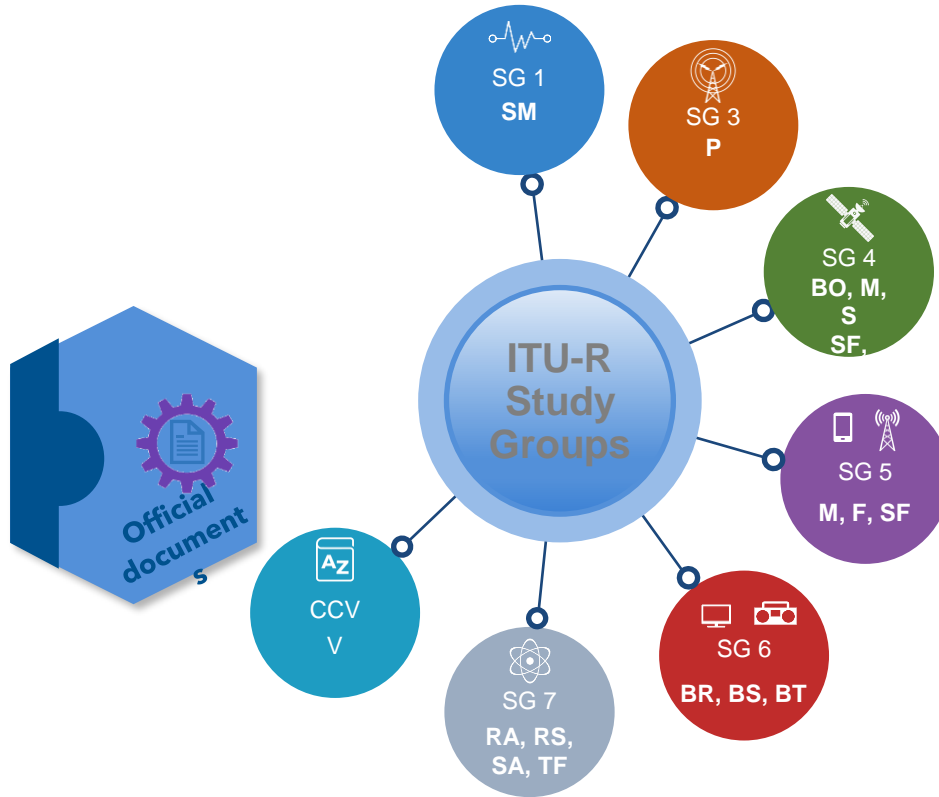
# ITU-R Study Groups and their Working Parties

<b>SG 1</b>	<ul style="list-style-type: none"> <li>WP 1A Spectrum engineering techniques</li> <li>WP 1B Spectrum economic approaches</li> <li>WP 1C Spectrum monitoring</li> </ul>
<b>SG 3</b>	<ul style="list-style-type: none"> <li>WP 3J Propagation fundamentals</li> <li>WP 3K Point-to-point propagation</li> <li>WP 3L Ionospheric propagation and radio noise</li> <li>WP 3M Earth-space propagation</li> </ul>
<b>SG 4</b>	<ul style="list-style-type: none"> <li>WP 4A Efficient orbit/satellite utilization for FSS and BSS</li> <li>WP 4B Systems, air interfaces, performance and availability objectives for FSS, BSS &amp; MSS</li> <li>WP 4C Efficient orbit/satellite utilization for MSS and RDSS</li> </ul>
<b>SG 5</b>	<ul style="list-style-type: none"> <li>WP 5A Land mobile, fixed, amateur and amateur-satellite services</li> <li>WP 5B Maritime and aeronautical mobile services and radiodetermination</li> <li>WP 5C HF and systems in the fixed and land mobile services</li> <li>WP 5D IMT systems</li> </ul>
<b>SG 6</b>	<ul style="list-style-type: none"> <li>WP 6A Terrestrial broadcasting delivery</li> <li>WP 6B Broadcast service assembly and access</li> <li>WP 6C Programme production and quality assessment</li> <li>TG 6/1 WRC-23 agenda item 1.5</li> </ul>
<b>SG 7</b>	<ul style="list-style-type: none"> <li>WP 7A Time signals and frequency standard emissions</li> <li>WP 7B Space radiocommunication applications &amp; research, meteorological satellite, etc.</li> <li>WP 7C Remote sensing systems: Earth exploration, space weather sensors, etc.</li> <li>WP 7D Radio astronomy</li> </ul>
<b>CCV</b>	Coordination Committee for Vocabulary

# Documentation of ITU-R Publications



- 1** A text giving instructions on the organization, methods or programmes of RA or SG work. (§ [A2.3.1](#))
- 2** A text giving instructions on the organization of the work of a Study Group. (§ [A2.4.1](#))
- 3** A statement of a technical, operational or procedural study, generally seeking a Recommendation, Report or Handbook. (§ [A2.5](#))
- 4** An answer to a Question or part(s) of a Question or other topics defined in Annex 1 (§ [A1.3.1.2](#))
- 5** A technical, operational or procedural statement, prepared by a Study Group on a given subject. (§ [A2.7](#))
- 6** Provide a statement of the current knowledge, the present position of studies, or of good operating or technical practice. (§ [A2.8.1](#))
- 7** A text containing a proposal or a request destined for another and not necessarily relating to a technical subject (§ [A2.9.1](#))



BR Document Search Tool

# SG official documents

## Published documents types

Series	Title
<b>BO</b>	Satellite delivery
<b>BR</b>	Recording for production, archival and play-out; film for television
<b>BS</b>	Broadcasting service (sound)
<b>BT</b>	Broadcasting service (television)
<b>F</b>	Fixed service
<b>M/M</b>	Mobile, radiodetermination, amateur and related satellite services
<b>P</b>	Radiowave propagation
<b>RA</b>	Radio astronomy
<b>RS</b>	Remote sensing systems
<b>S</b>	Fixed-satellite service
<b>SA</b>	Space applications and meteorology
<b>SF</b>	Frequency sharing & coordination between fixed-satellite & fixed service systems
<b>SM</b>	Spectrum management
<b>SNG</b>	Satellite news gathering
<b>TF</b>	Time signals and frequency standards emissions
<b>V</b>	Vocabulary and related subjects

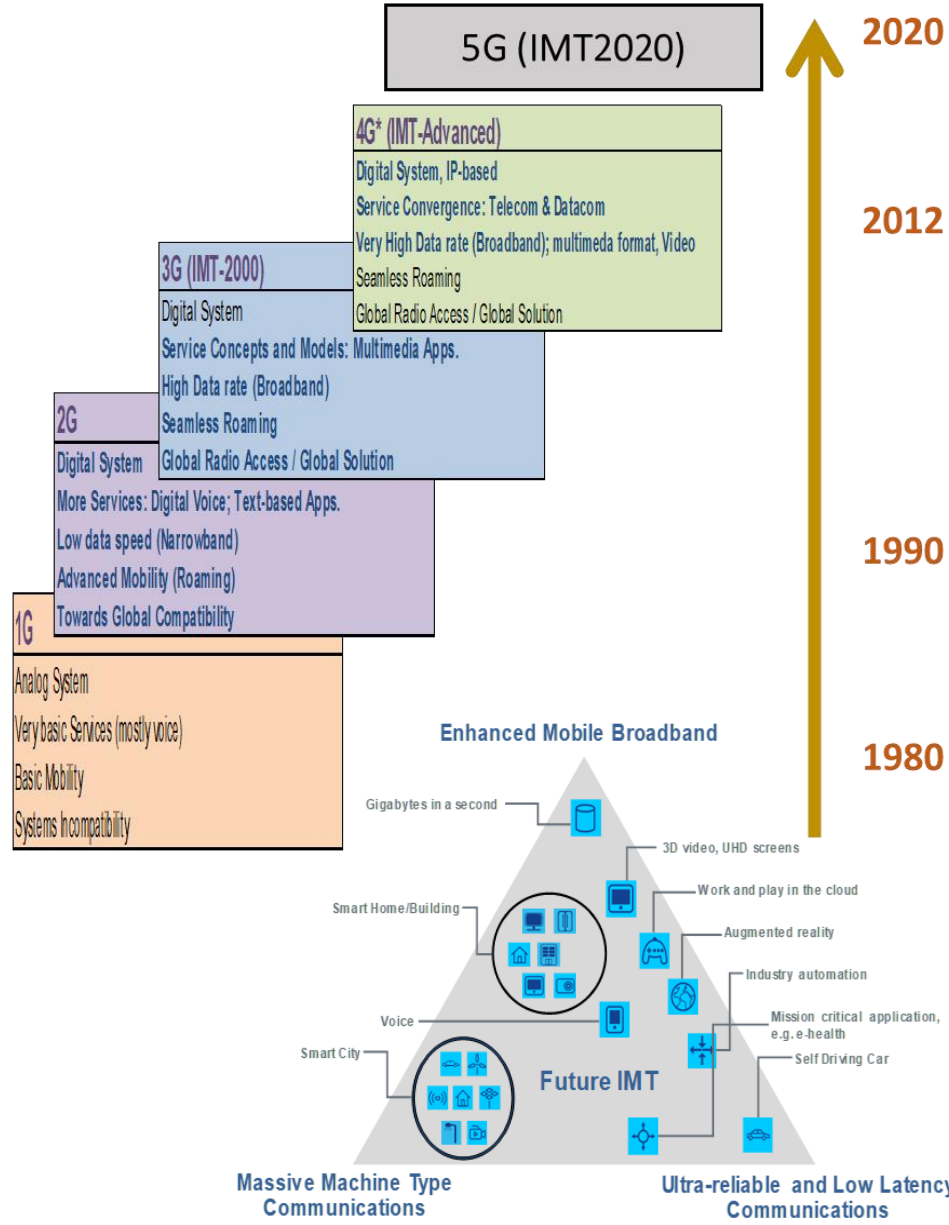


# Content of the presentation

1. **Spectrum Management Basics**
  2. **International Standardization (The ITU-R Sector)**
- 
1. **Wireless Emerging Systems**



# MOBILE BROADBAND



## • Radio Regulations:

**IMT: Application of MOBILE Service**

International Mobile Telecommunications IMT encompasses **all** IMT Versions:

*IMT-2000, IMT-Advanced, IMT-2020*

Some bands allocated to **MOBILE**, were identified for IMT

## • ITU-R Publications:

SG5/WP5D : ITU-R Series M

Publications for:

IMT Systems (large scope)

IMT-2020



# IMT BANDS in REGION 2

	Band (MHz)	Bandwidth (MHz)	Region 2 (35 Countries)	%	Footnote
1 GHz to 3 GHz	1427-1452	25	35	100%	5.341B
	1452-1492	40	35	100%	5.341B
	1492-1518	26	35	100%	5.341B
	1710-1885	175	35	100%	5.384A
	1885-2025	140	35	100%	5.388
	2110-2200	90	35	100%	5.388
	2300-2400	100	35	100%	5.384A
2500-2690	190	35	100%	5.384A	
3 GHz to 5 GHz	3300-3400	100	13	37%	5.429D
	3400-3500	100	35	100%	5.430A; 5.431B
	3500-3600	100	35	100%	5.430A; 5.431B
	3600-3700	100	7	20%	5.434
	4800-4900	100	3	9%	5.441A
	4900-4990	90	0	0%	none

none
< 20%
20% to 50%
>50%
All



# IMT BANDS in REGION 2

none
< 20%
20% to 50%
>50%
All

	Band (MHz)	Bandwidth (MHz)	Region 2 (35 Countries)	%	Footnote
24 GHz to 50 GHz	24250-27500	3,250	35	100%	5.532AB
	37000-43500	6,500	35	100%	5.550B
	45500-47000	1,500	1	3%	5.553A
	47200-48200	1,000	35	100%	5.553B
60-80 GHz	66000-71000	5,000	35	100%	5.559AA

**IMT Bandwidth  
Fully harmonized  
Region 2  
(35 countries, 100%)**

Band	Bandwidth (MHz)
< 1 GHz	282
1 GHz to 3 GHz	786
3 GHz to 6 GHz	200
> 34 GHz	15,750



# HIGH-ALTITUDE PLATFORM STATION (HAPS)



**HAPS:** radio stations located on an object at an altitude of 20-50 kilometers and at a specified, nominal, fixed point relative to the Earth.

(HAPS is a Station, NOT a Service)

HAPS might be used as IMT base stations (HIBS) as part of IMT networks.

- **Radio Regulations:**

Some bands allocated to **MOBILE** or **FIXED**, were designated (or identified) to allow the use of HAPS Stations

Some bands identified for **IMT** allow the use of **HIBS**

- **ITU-R Publications:**

SG5: ITU-R Series F, M

Publications for:

HAPS

HIBS

# HIGH THROUGHPUT SATELLITE: HTS (or HDS)

## Broadband connectivity via High Throughput Satellites (HTS)



Increasing demand for:

- 4G/ 5G backhaul,
- HD/ UHD TV (4K, 8K),
- interactive TV,
- high-speed Internet access to individual homes/ offices,
- enterprise networking

Demand for capacity will grow by 27%  
in the next 10 years\*

HTS capacity 100-300 Gbit/ s,  
increasing to more than 1 Tbit/ s by 2020\*

\* According to NSR (Northern Sky Research)

### • Radio Regulations:

Allocations to Fixed-Satellite Services, **FSS**  
**Footnotes to High-Density FIXED-SATELLITE SERVICES (HDS) and STATIONS (Satellite, ES)**

### • ITU-R Publications:

SG4: ITU-R Series S

Publications for:

High-Density FIXED-SATELLITE SERVICES (HDS)  
and Stations (Space or Satellite) Earth Station

Earth Station in Motion (**ESIM**):

Use of Mobile Earth Stations (airplanes, ships, trains,  
cars) within FSS

Different from MSS (personal satellite terminals)



# BIG LEOs (Broadband Non-GSO Constellations)



The expression FIXED or MOBILE refers to the user terminal NOT to the Station motion

FSS, MSS etc can be provided through:  
GSO satellites  
Non-GSO Satellites

## Radio Regulations:

Allocations to Fixed-Satellite Services, **FSS**  
**Footnotes to Non-GSO Satellites Systems)**

- **ITU-R Publications:**

SG4: ITU-R Series S

Publications for:

Non-GSO Systems

## “Unlicensed Devices”

On RR: authorized use (figure: *Designated*);

NOT a Service (no Allocation: no PRIMARY no Secondary)

They shall share frequencies in a regime of “non-interference/non-protection basis”:

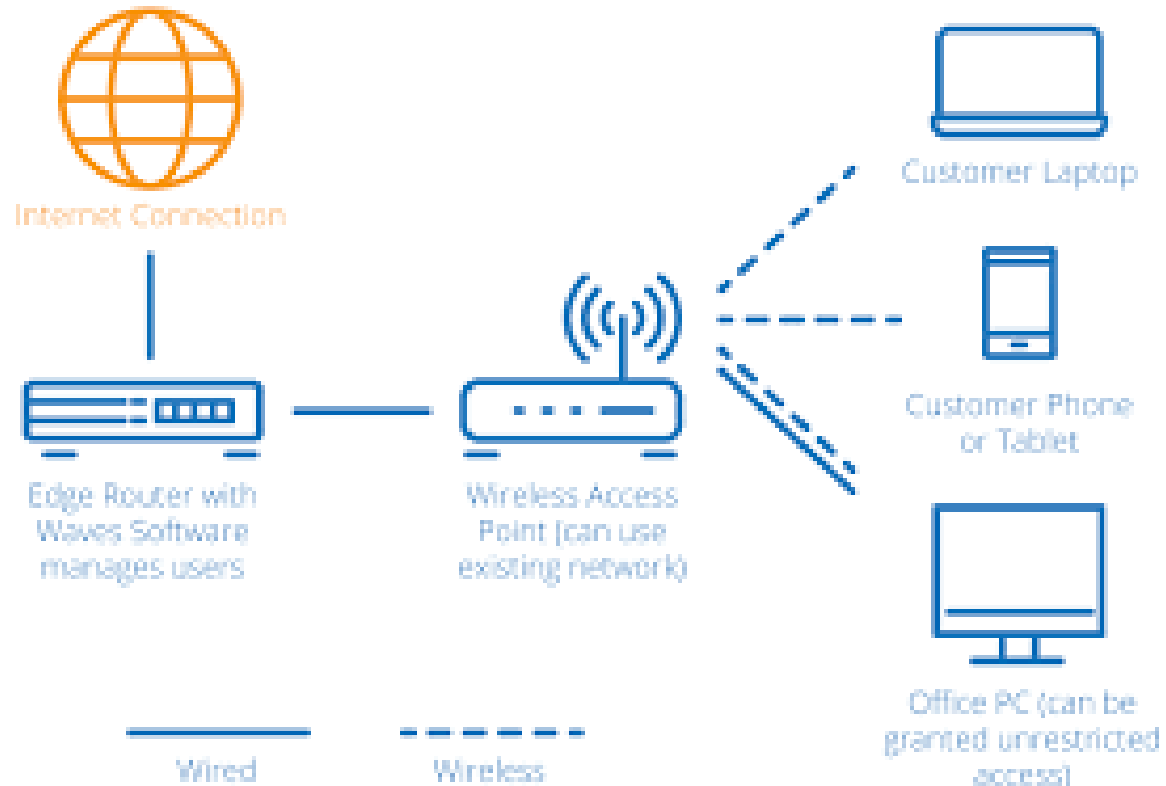
- With stations on allocated services (primary or secondary; present or future)
- other similar devices (all of them with equally rights, i.e., none of them having any priority )

Unlicensed devices **DON'T** operate on a secondary basis (no first come –first served protection)  
Without a limit to the amount of devices operating simultaneously in a same area, a minimum bandwidth cannot be guaranteed (hence, neither QoS)

As they are not protected and shall not interfere, they are not registered on Spectrum Users Databases: National, or International (MIFR)



# WiFi



Designed as a wireless LAN connection

For Indoor short range coverage

‘unlicensed device’ : NI/NP to/from

- Other services
- Other WiFi Hotspots
- Best Effort: No guarantee of bandwidth
- Too many Hotspots: Tragedy of commons

# TVWS

## Opportunistic Use of Spectrum

Bands allocated to BROADCASTING (TV, Primary)

In remote areas, some TV channels are not (yet!) used/covering it (TV White Spaces)

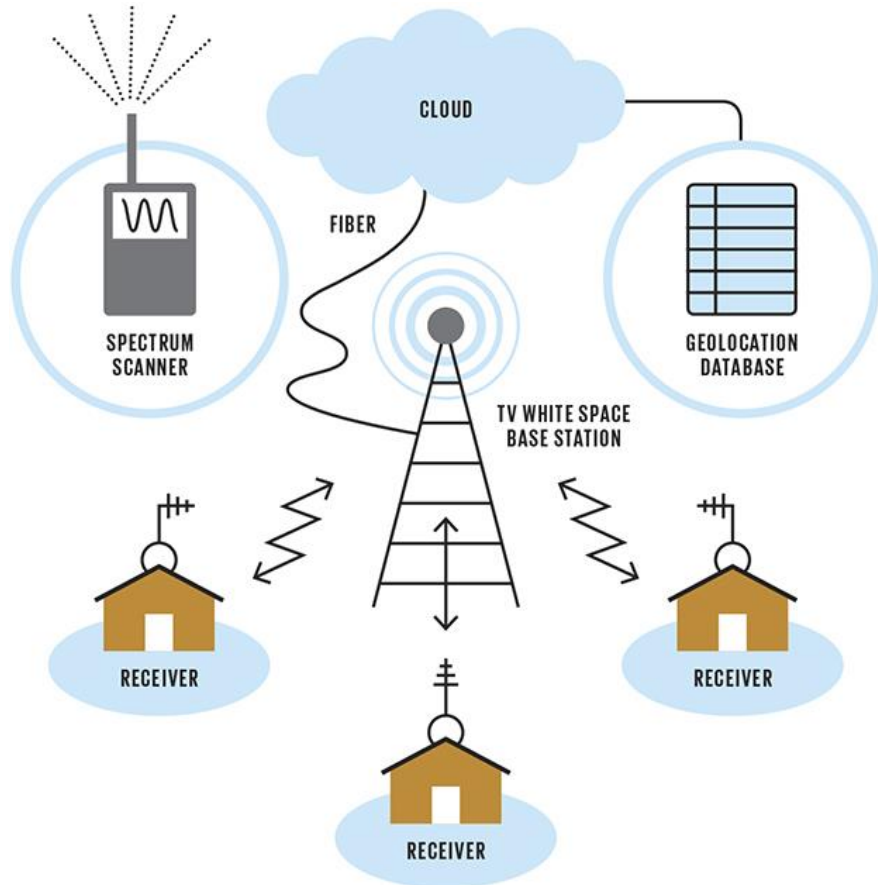
Those channels could be used as long as they are not used by Primary Operator (or refarmed)

- Opportunistic Window : area and time

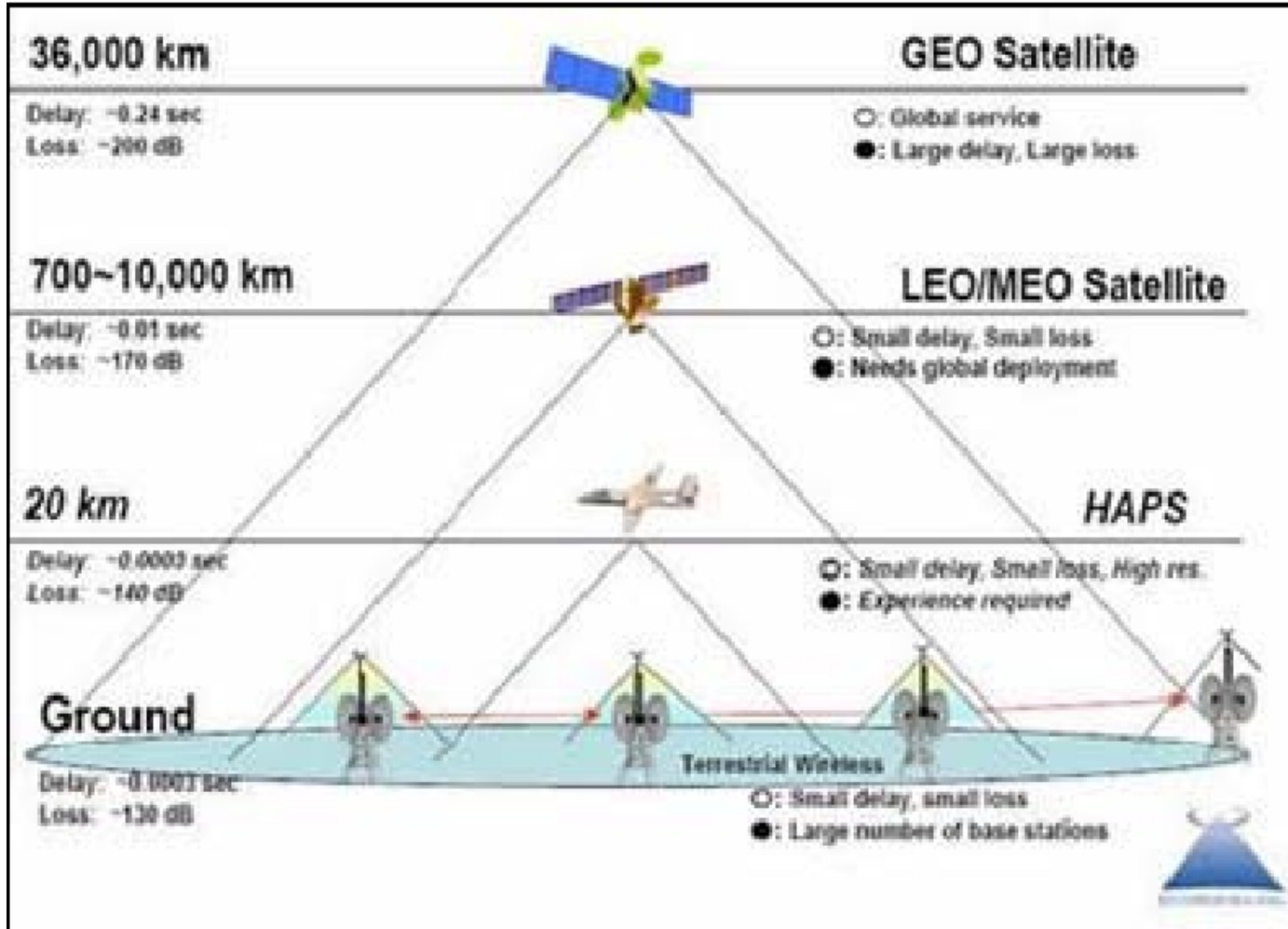
FIXED service (Broadband access to Internet) Local Backhaul (Point to Point, Point to Multi Point)

Base Station can be WiFi or any other last mile broadband solution

Pioneer Curse?



# Broadband Access



	Link		
	Last Mile	Local Backhaul	Long Backhaul
<b>Fixed</b>			
<i>Copper</i>	Yes		
<i>Coaxial</i>	Yes		
<i>Fiber</i>	Yes	Yes	Yes
<b>Wireless</b>			
<i>Mobile</i>	Yes		
<i>WiFi</i>	Yes		
<i>TVWS</i>		Yes	
<i>HAPS</i>		Yes	Yes
<i>Microwave</i>		Yes	Yes
<i>Non-GSO</i>	Yes	Yes	Yes
<i>GSO</i>	Yes	Yes	Yes

# WIRELESS BROADBAND TECHNOLOGIES

## TERRESTRIAL:

### Last mile

- Mobile Broadband: IMT-2000 (3G), IMT-Advanced (4G), IMT-2020 (5G)
- Unlicensed devices: WiFi

### Local Backhaul

- Opportunistic Use: TV White Spaces
- HAPS

- **SPACE:** (both last mile and Backhaul)
- GSO: High Throughput (Density)
- Satellites: HTS, HDS
- Non-GSO: Satellite Constellations (BIG LEOs)

		Area					
		Dense			Remote		
		Urban	Suburban	Rural	Urban	Suburban	Rural
	Link						
Fixed							
Copper	Last Mile	Yes	Yes		Yes	Yes	
Coaxial	Last Mile	Yes			Yes		
Fiber	Last Mile/ Backhaul	Yes			Yes		
Wireless							
Mobile	Last Mile	Yes	Yes	Yes	Yes	Yes	
WiFi	Last Mile	Yes	Yes	Yes	Yes	Yes	Yes
TVWS	Backhaul						Yes
HAPS	Backhaul				Yes	Yes	Yes
Microwave	Backhaul	Yes	Yes	Yes	Yes	Yes	Yes
Non-GSO	Last Mile/ Backhaul	Yes	Yes	Yes	Yes	Yes	Yes
GSO	Last Mile/ Backhaul	Yes	Yes	Yes	Yes	Yes	Yes

# Main Spectrum Management-relate Challenges

	<i>WiFi</i>	<i>IMT</i>	<i>TVWS</i>	<i>HAPS</i>	<i>Non-GSO</i>	<i>GSO</i>
<b>RR (&amp; NTFA) Allocations</b>	NOT a Service Authorized use NI/NP (unlicensed)	PRIMARY MOBILE Identified to IMT	PRIMARY BROADCASTING (TV) Opportunistic use NI/NP (unlicensed?) Fixed (Secondary?)	Station Designated/Identified FIXED, MOBILE	PRIMARY FSS Footnotes	PRIMARY FSS Footnotes

<b>CHALLENGES</b>	<b>Spectrum Allocation</b>	<b>MORE! (but all Spectrum is already allocated) --&gt; Sharing allocations: International (WRCs, ITU-R SGs), then National (NTFA)</b>					
	<b>Interferences</b>	<b>How to Share allocations? (WRCs, ITU-R SGs, NTFA)</b>					
	<b>Licensing</b>	Unlicensed but protected (?)	Commercial vs Non-Commercial (verticals)	Unlicensed but protected (?)		Global Licensing Campaigning	Global Licensing Campaigning
	<b>Infrastructure (Sharing, Agile Rules)</b>	Outdoor Wi-Fi	High	Low	Low	Low	Low
	<b>Business Model</b>	Tragedy of Commons (lower QoS?)	4G to 5G Auctions (winner curse)	Not Long-Term Spectrum Tenure (Closing Opportunistic Window); Pioneer Curse	Still Pilots?	USF Leverage	USF Leverage
	<b>Regulator Tasks</b>	Outdoor WiFi Unlicensed vs Licensed?	Auctions? Coverage Obligations? Verticals Ruling?	Spectrum Use Database short time licensing (hours, days) Spectrum Release (Closing Opportunistic Window)	Air Space rules	Use of Outer Space COPUOS, Nat. Rules Landing Rights Space Debris	Use of Outer Space COPUOS, Nat. Rules Landing Rights

# WIRELESS BROADBAND TECHNOLOGIES

	Devoted to	INDOOR	OUTDOOR	
			MOBILE	FIXED
<b>Mobile (IMT/4G 5G)</b>	Allocation: MOBILE Outdoor/Indoor Urban/Rural-Remote Licensed	<b>CORE SERVICE</b>		Fixed Links  <b>Regulation: MOBILE</b>
<b>Wi-Fi</b>	Allocation: NONE Authorized Use (ISM) Indoor Unlicensed (NI/NP)	<b>CORE SERVICE</b>	<b>Regulation: MOBILE (Lincensed) or Unlicensed NI/NP</b>	Fixed Links  <b>Regulation: Unlicensed NI/NP</b>
<b>TVWS</b>	Allocation: BROADCASTING Outdoor/Indoor Data-Based Short term License	<b>Core Service: BROADCASTING</b> NI/NP to/from BROADCASTING (current and <b>future</b> )  Regulation <b>Opportunistic Use? (daily/hourly licenses)</b> <b>Secondary? (1st come 1st served)</b>		

Technology allow to “extend” the services  
Whereas:  
Band Allocation shall prevail

Regulation is that of core service (not that of “extended” one)

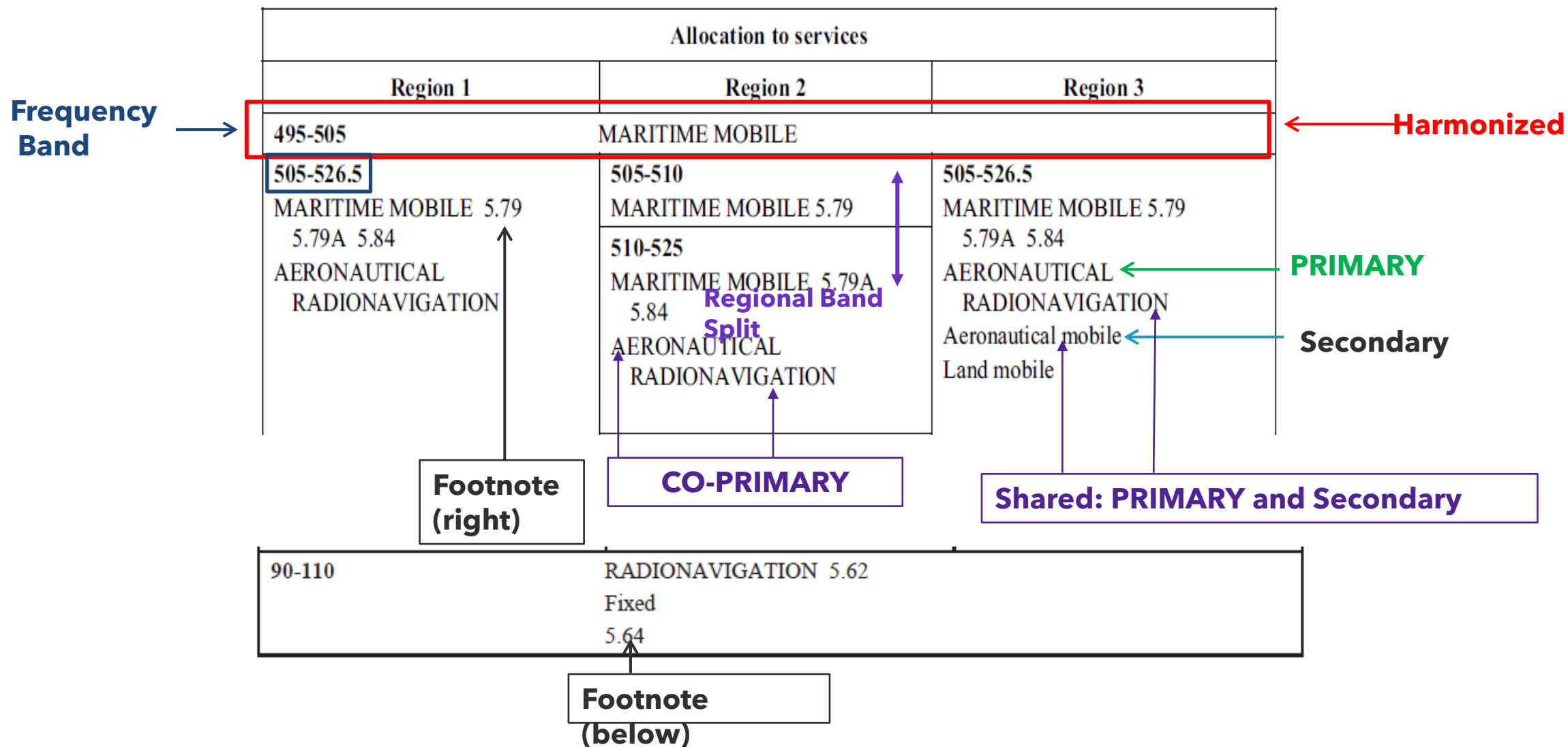
Is a regulatory matter to protect the ecosystem



THANKS 😊  
GRACIAS 😊

Further info:  
[joaquin.restrepo@itu.int](mailto:joaquin.restrepo@itu.int)

# RR: TABLE OF FREQUENCY ALLOCATIONS (Art. 5)



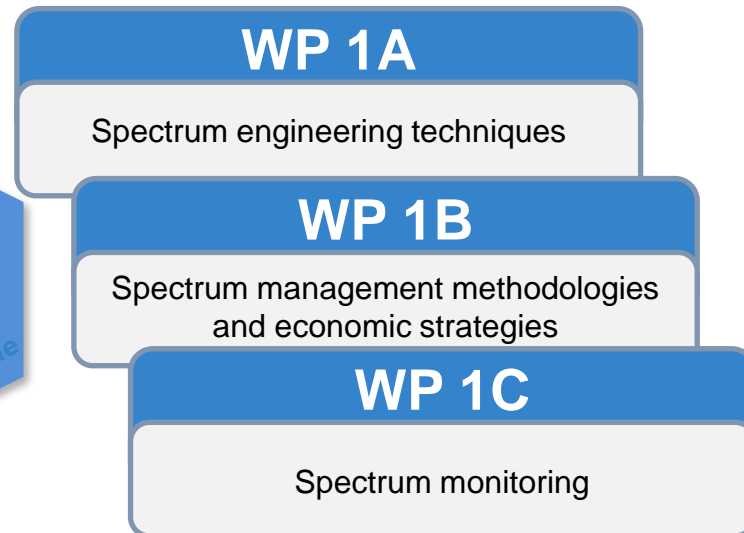
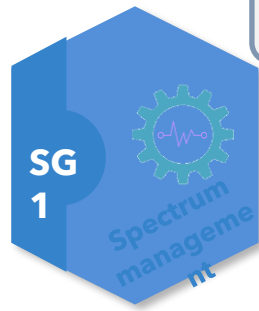


## Bands Harmonization

- Harmonized utilization of spectrum by different nations is an essential need to support international roaming, to facilitate interconnection and to provide more economical radiocommunication services,
- Frequency bands can be utilized at same point, in same time, almost once while there could be more than one demand for utilization,

**Global Harmonization:** Ultimate goal (as possible); RR Recommendation 34:  
*recommends that future world radiocommunication conferences:*

- Uncoordinated electromagnetic radiation of individual and independent spectrum users increase interferences matters
- 2. Should, wherever possible, allocate frequency bands on a worldwide basis (aligned services, categories of service and frequency band limits) taking into account safety, technical, operational, economic and other relevant factors;
- 3. Should, wherever possible, keep the number of footnotes in Article 5 to a minimum when allocating frequency bands through footnotes, in line with the Resolution 26






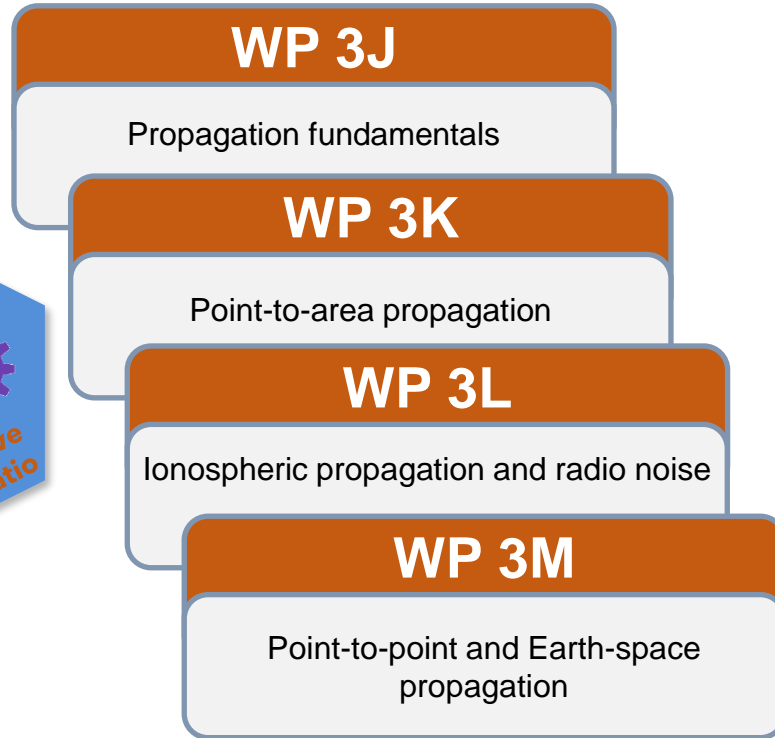
# Study Group 1

## Spectrum management

### Scope

- ❖ Spectrum management principles and techniques;
- ❖ General principles of sharing;
- ❖ Spectrum monitoring;
- ❖ Long-term strategies for spectrum utilization;
- ❖ Economic approaches to national spectrum management automated techniques;
- ❖ Assistance to developing countries;
- ❖ Wireless Power Transmission (incl. for electric vehicles);
- ❖ Harmonization for short-range devices;
- ❖ Performance evaluation of mobile Direction Finder units;
- ❖ Electromagnetic field measurements to assess human exposure.

 Chairman: Mr. Wael Sayed  
 Counsellor: Mr. Philippe Aubineau  
 [SG 1 website](#)






# Study Group 3

## Radiowave propagation

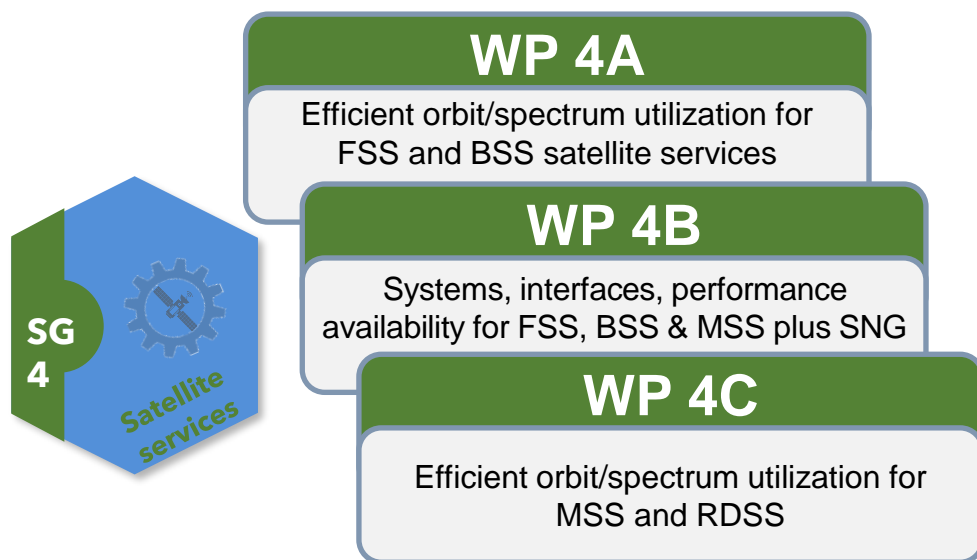
### Scope

- ❖ Propagation of radio waves in ionized and non-ionized media;
- ❖ Characteristics of radio noise, for the purpose of improving radiocommunication;
- ❖ Propagation models in support to all radio services;
- ❖ Building entry loss models;
- ❖ Clutter loss models.

 Chairman: Mrs. Carol Wilson  
 Counsellor: Mr. David Botha  
 [SG 3 website](#)




# Study Group 4

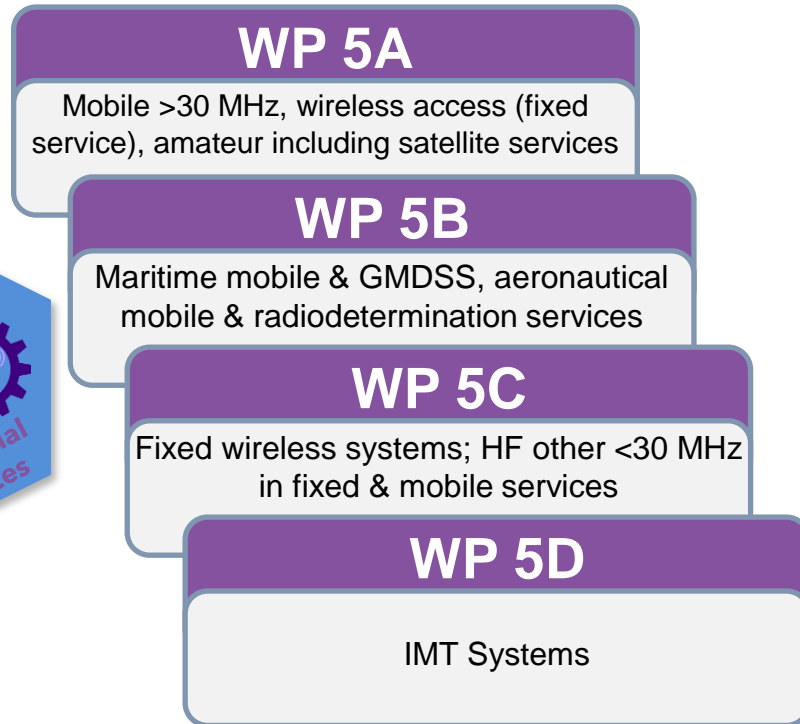
## Satellite services



### Scope

- ❖ Systems and networks for:
  - fixed-satellite service;
  - mobile-satellite service;
  - broadcasting satellite service;
  - Radiodetermination and radio navigation-satellite service.
- ❖ IP global broadband Internet access via satellite;
- ❖ Integration of satellite systems into Next Generation Access Technologies (5G);
- ❖ Early warning and relief operations.

 Chairman: Mr. Victor Strelets  
 Counsellor: Mr. Nelson Malaguti  
 [SG 4 website](#)



# Study Group 5

## Terrestrial services

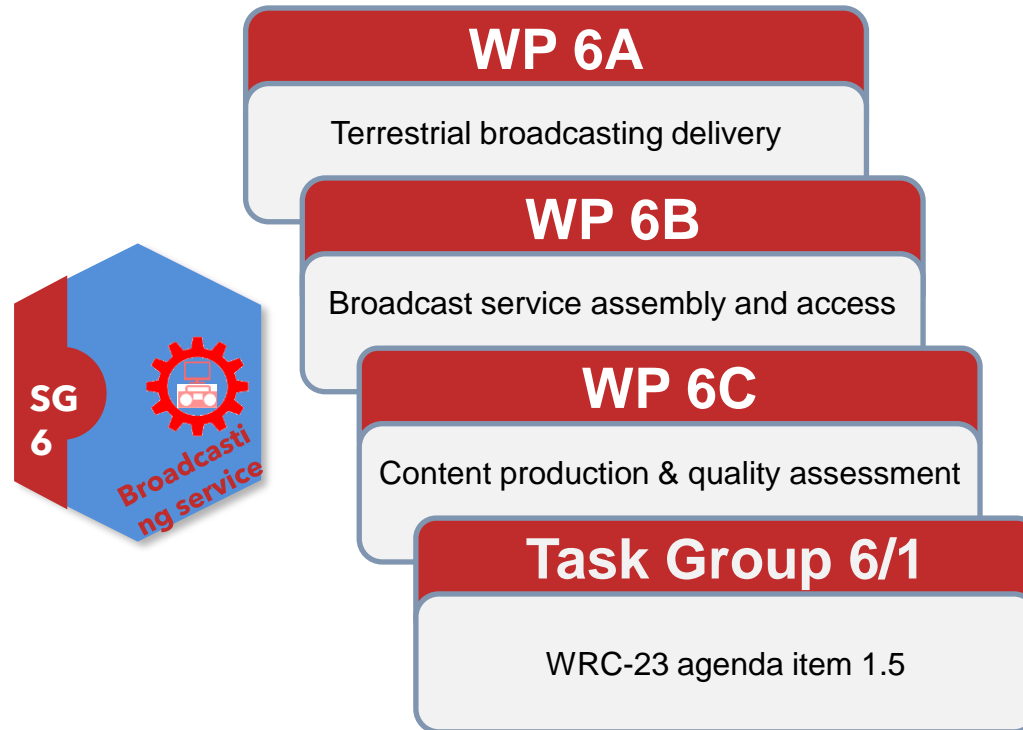
### Scope

- ❖ Radio local area networks (RLANs), amateur service and emergency telecommunications and Intelligent Transport Systems (ITS);
- ❖ Global Maritime Distress and Safety System (GMDSS), the aeronautical mobile service, the radiodetermination service, including both radiolocation and radionavigation services;
- ❖ Fixed wireless access (FWA) systems and HAPS;
- ❖ IMT-2000, IMT-Advanced and IMT-2020: which provide the global platform on which to build the next generation (5G) of mobile broadband connectivity;
- ❖ Internet of Things (IoT): Machine Type Communications in IoT to be connected through IMT networks, dedicated networks and short-range radio devices.

-  Chairman: Mr. Martin Fenton
-  Counsellor: Mr. Uwe Löwenstein
-  Counsellor WP 5B: Mr. Vadim Nozdrin
-  [SG 5 website](#)




# Study Group 6

## Broadcasting service



### Scope

- ❖ Radiocommunication broadcasting, including vision, sound, multimedia data services intended for delivery to the general public.
- ❖ New audio-visual formats (HDTV, UHD TV, immersive sound);
- ❖ Formats for international content exchange;
- ❖ Compression techniques & new multiplexing techniques (MMT);
- ❖ New DTTB systems and development in IBB systems;
- ❖ Advancing accessibility services;
- ❖ In Region 1, review spectrum use & needs of existing services & consider possible regulatory actions in the 470-694 MHz band in accordance with Resolution **235 (WRC-15)**.

 Chairman: Dr. Yukihiro Nishida  
 Counsellor: Mr. Ruoting Chang  
 [SG 6 website](#)



## WP 7A

Time signals and frequency standard emissions for terrestrial & satellite

## WP 7B

Space radiocommunication applications & research & meteorological satellite

## WP 7C

Satellite remote sensing systems, MetAids, weather & research sensors

## WP 7D



Radio & radar astronomy sensors Earth-& space-based, including VLBI

# Study Group 7

## Science services

### Scope

- ❖ Preserving spectrum for operation and development of meteorological applications;
- ❖ Global environment monitoring – atmosphere (including greenhouse gases emissions), oceans, land surface, biomass, etc.;
- ❖ Weather forecasting and climate change monitoring and prediction;
- ❖ Detection and tracking of many natural and man-made disasters (earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc);
- ❖ Providing alerting/warning information;
- ❖ Damage assessment and planning relief operations.
- ❖ Use of radio spectrum for meteorology in close collaboration with WMO.

 Chairman: Mr. John Zuzek  
 Counsellor: Mr. Vadim Nozdrin  
 [SG 7 website](#)

## “Unlicensed Devices”

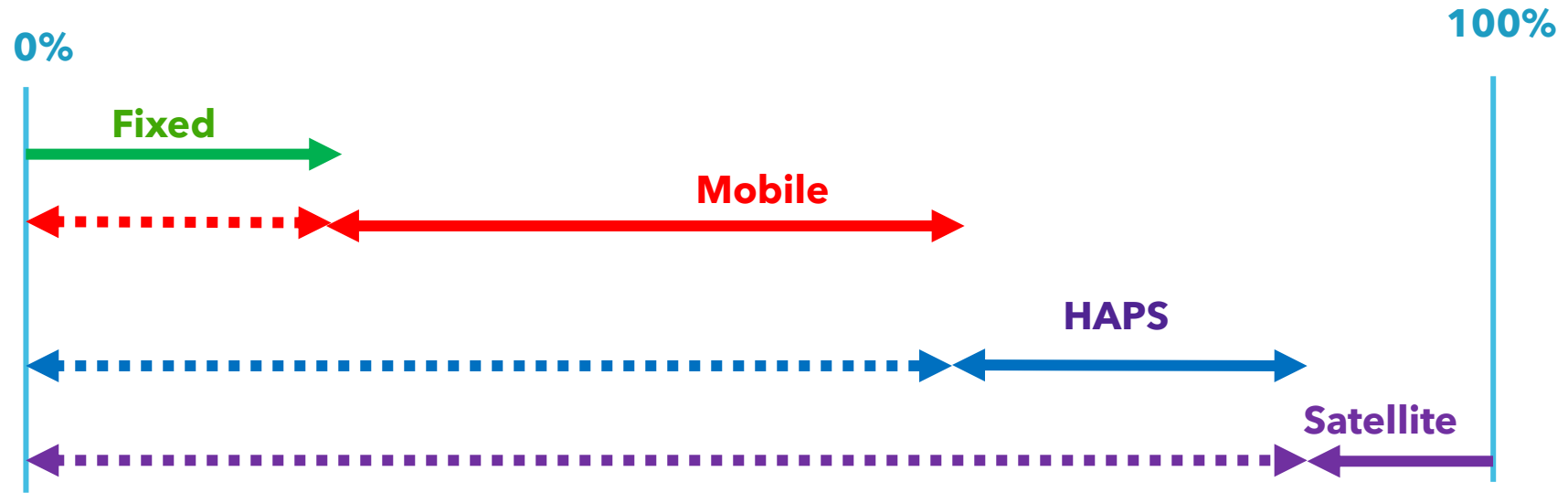
Expressions: “*unlicensed*”, “*license exempt*”, “*blanket licenses*” etc., refer to radio devices with transmitting capabilities (emitting radio waves) that can be operated by any person, **without** obtaining previously a **particular authorization** for it (no particular assignment/license).

This waiving is possible because the operation of such “**unlicensed devices**” has been **authorized to all public** through a **Generic Authorization**, (also named General License, Blanket License, etc.) that includes the set of technical and operational specifications to be strictly obeyed when operating such devices, in order to guarantee their use without interfering to other services or similar devices. Every “*unlicensed device*” shall be pre set-up to obey its ruling specifications, enabling to operate without adjustments performed by its final user; they are commonly labeled as “*X compliant*” to indicate to buyers its alignment with concerned ruling.

The expression “unlicensed” **shall not** be misinterpreted as **permission to operating** these devices **in a free will fashion**; its operation must strictly observe its ruling. Any alteration to exceed authorized pre setup parameters is an **infringement** of that ruling.



# Broadband Access



Final User Access to Broadband services (**last km, last mile**) is supported by 3 types of infrastructure of networks

- (Fixed: copper, coaxial, fiber)
- Wireless (Terrestrial): cellular, Wi-Fi? , HAPS
- Satellite: GSO, Non-GSO

# OTHER RELEVANT SERVICES

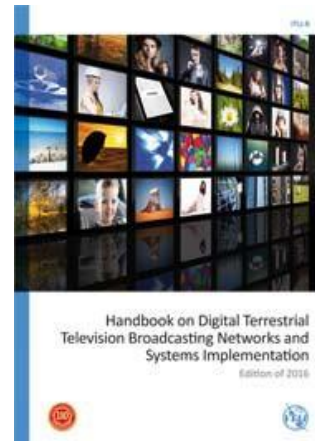
## BROADCASTING SERVICE

- Programme production
- Programme assembly
- Terrestrial broadcasting delivery
- Reception quality



- **Radio Regulations:**  
Allocations to Broadcasting (BS)

- **ITU-R Publications:**  
SG-6: ITU-R Series BR, BS (sound, BT (TV)  
New TV Standards: UHTV



**ITU-R STUDY GROUP 6**

# OTHER RELEVANT SERVICES

RADIO NAVIGATION  
AERONAUTICAL  
MARITIME



**ITU-R STUDY GROUP 5 (SG4 for “–  
*satellite*”)**

- **Radio Regulations:**  
Allocations to  
**Radio Determination**  
**Aeronautical**  
**Maritime**

# OTHER RELEVANT SERVICES

## SCIENCE SERVICES

- Space operation
- Space research
- Earth exploration
- Radio astronomy
- Standard frequency and time signals



- **Radio Regulations:**  
Allocations to Science Services

- **ITU-R Publications:**  
SG-6: ITU-R Series  
RA, RS, SA, TF

## ITU-R STUDY GROUP 7

