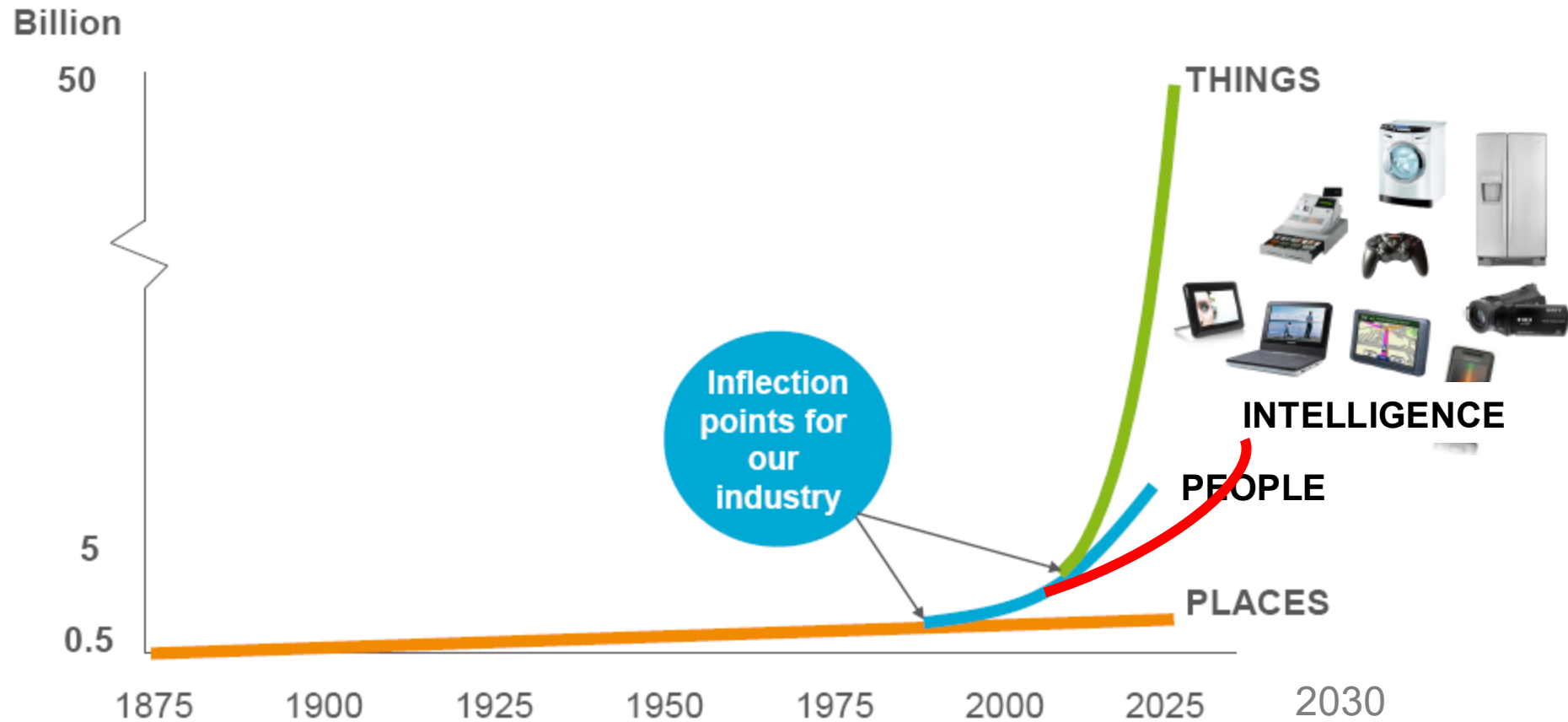


Spectrum and Policy Roadmap for 6G

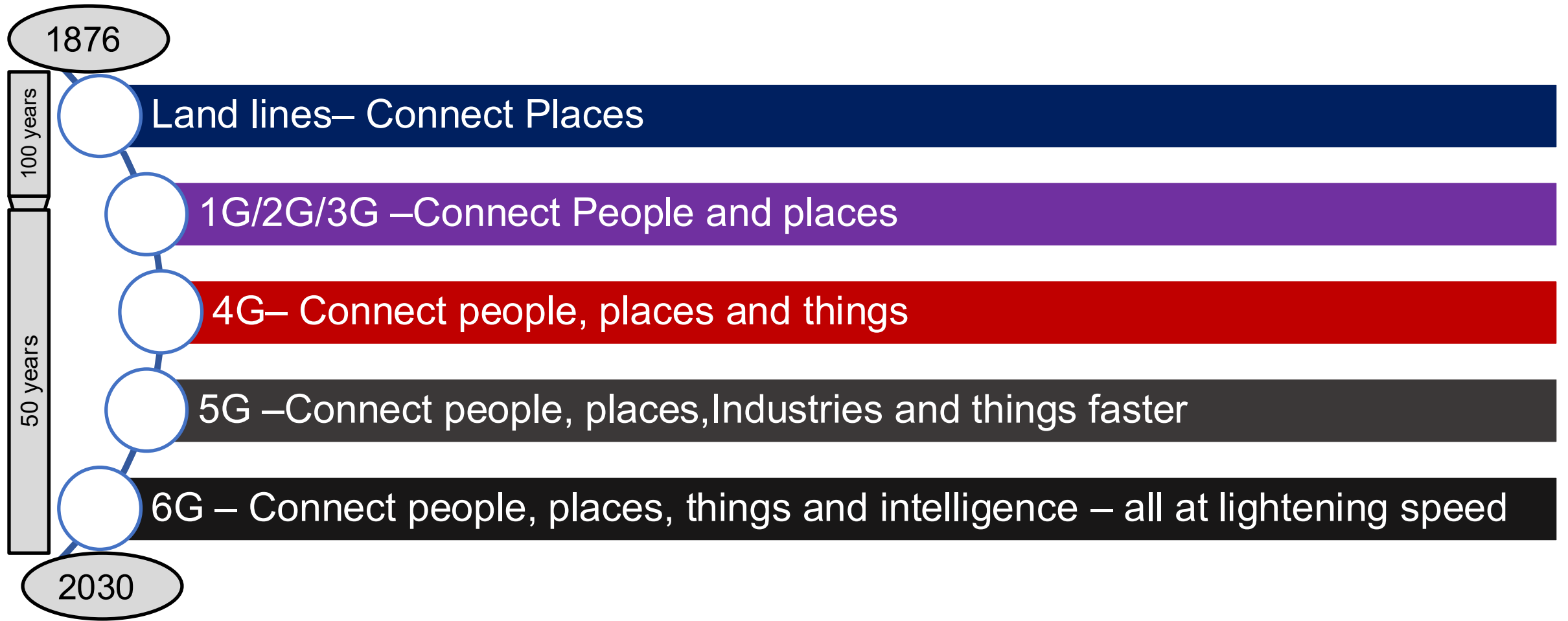
Bharat B Bhatia (BB)
President and CEO, ITU-APT Foundation of India (IAFI)
Vice Chairman - World Wireless Research Forum (WWRF)
Chairman, ITU WP5D WG General
Chairman, Editorial Group APT Prep Group for WRC-27
Special Advisor, APT Wireless Group

Wireless Technologies are evolving at extremely high pace

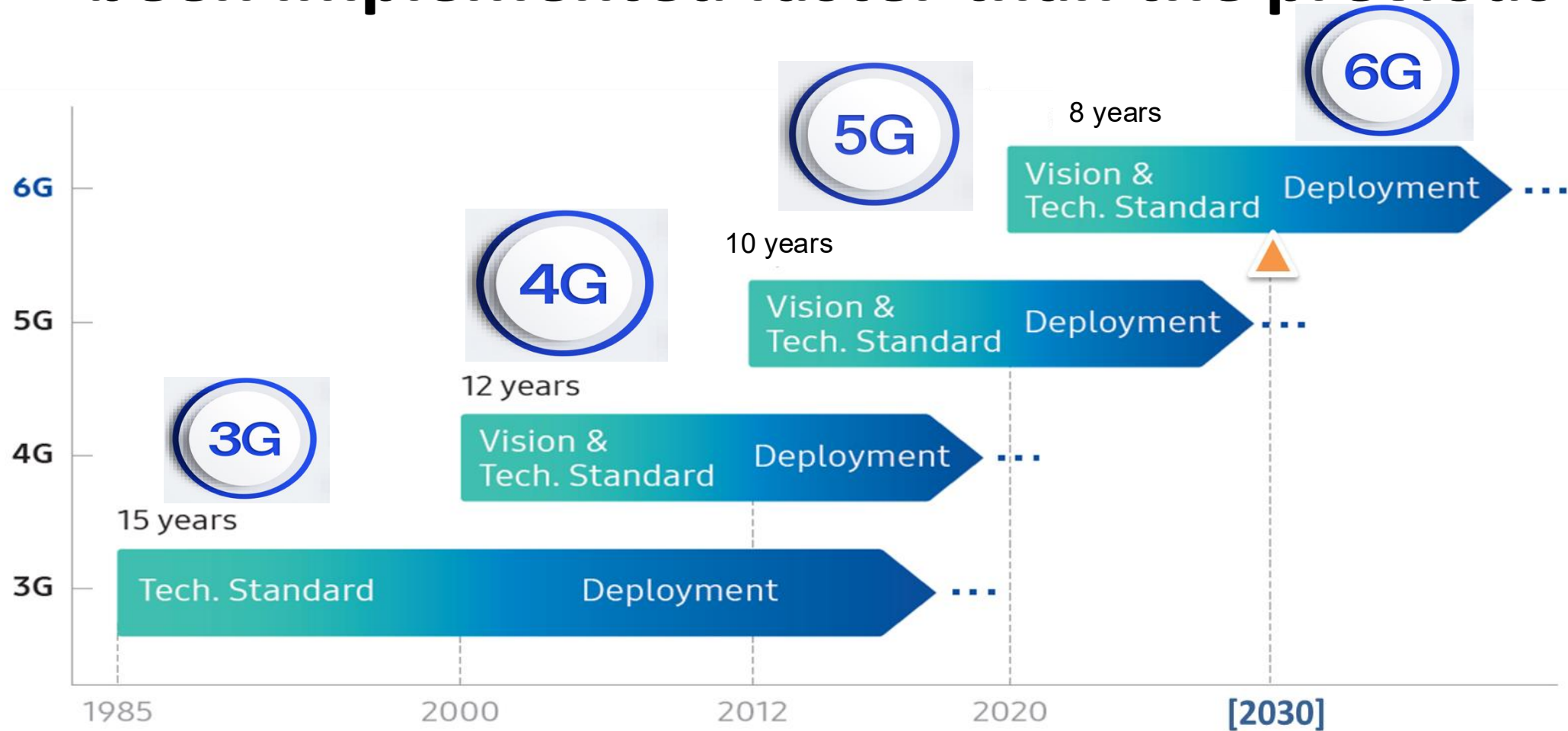


Evolution from Connecting "places", to connecting "people", to connecting "things" to connecting "intelligence"

The Telecom Journey



Each New Generation of Wireless Technology has been implemented faster than the previous



ITU has been leading the successive G Standardization

3G/4G/5G/6G named by the ITU as IMT family
“International Mobile Communications”

IMT



**3G /
IMT-2000**

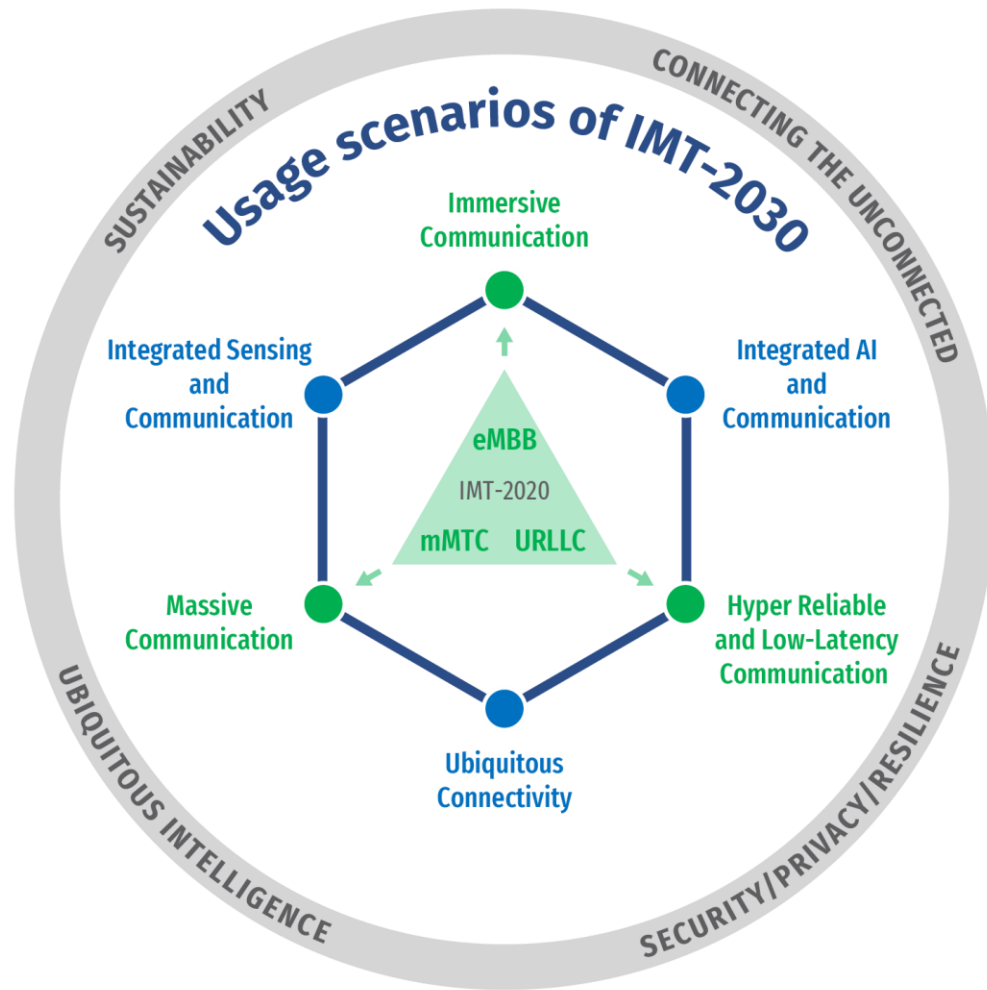
**4G /
IMT-Advanced**

**5G /
IMT-2020**

**6G /
“IMT-2030”**

6G overarching requirements finalized by the ITU in 2023

Ubiquitous Intelligence, Sustainability, Connecting the unconnected and security



ITU 'Framework & overall objectives of the future development of IMT for 2030 and beyond

ITU developed 6G - IMT-2030 - 'Framework' Recommendation. It took 2 years to develop from 2021 to 2023. **This "Framework" is now the global dominant and de-facto standard 6G reference point**

6G Usage Scenarios - 6 groups 3 evolving from IMT-2020 (5G)

- eMBB → **Immersive** Comms
- mMTC → **Massive** Comms
- URLLC → **HURLLC** (Hyper Reliable & Low-Latency Comms)

3 New for IMT-2030 (6G)

- **Integrated** AI & Comms
- **Ubiquitous** Connectivity
- **Integrated** Sensing & Comms

6G is all about ubiquitous and integrated connectivity and intelligence in a sustainable world

AI

6G and AI will interact in two ways...

1

AI enabled 6G – AI-RAN will optimise resource management and increase efficiency (energy & data)

2

6G enabled AI – AI applications (e.g. genAI, gaming, video) will increase overall traffic including uplink requirements

Spectrum is key to meeting the 6G overarching requirements



Ubiquitous Intelligence

Spectrum enables AI-native networks and intelligent services everywhere



Sustainability

Spectrum enables greener, more efficient networks

Efficient and optimized use



Connecting the unconnected

Spectrum expands coverage to bridge the digital divide

Access to new frequency bands



Security

Spectrum provides resilient, reliable and secure connectivity

Trusted and robust networks

More capacity and flexibility

SPECTRUM

THE FOUNDATION FOR 6G

SPECTRUM TODAY | A MORE CONNECTED, INTELLIGENT AND SUSTAINABLE TOMORROW

Mobile networks cover **95%** of the world's population but only **50%** of the landmass



Spectrum needs to be identified (low Band) or allocated (for Mobile Satellite Services for NTN) to meet these requirements of ubiquitous connectivity



But the Radio Frequency Spectrum is a limited natural resource

40 Radio Communications service are all vying to get the same limited frequency bands, in particular bands below 300 GHz

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

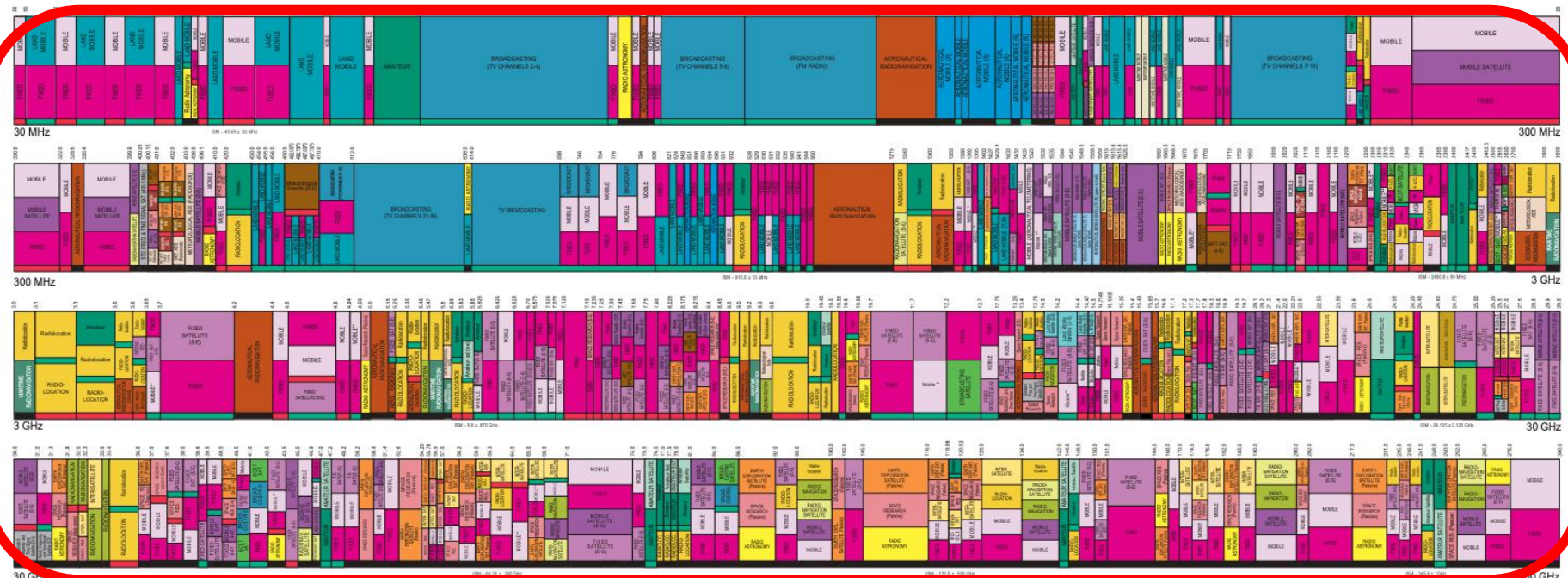
AERONAUTICAL MOBILE	INTER-SATELLITE	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITE	LAND MOBILE	RADIO DETERMINATION SATELLITE
AERONAUTICAL RADIO NAVIGATION	LAND MOBILE SATELLITE	RADIO LOCATION
AMATEUR	MARITIME MOBILE	RADIO LOCATION SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	RADIO NAVIGATION
BROADCASTING	MARITIME RADIO NAVIGATION	RADIO NAVIGATION SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL AID	SPACE OPERATION
EARTH EXPLORATION SATELLITE	METEOROLOGICAL SATELLITE	SPACE RESEARCH
FIXED	MOBILE	STANDARD FREQUENCY AND TIME SIGNAL
FIXED SATELLITE	MOBILE SATELLITE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

ACTIVITY CODE

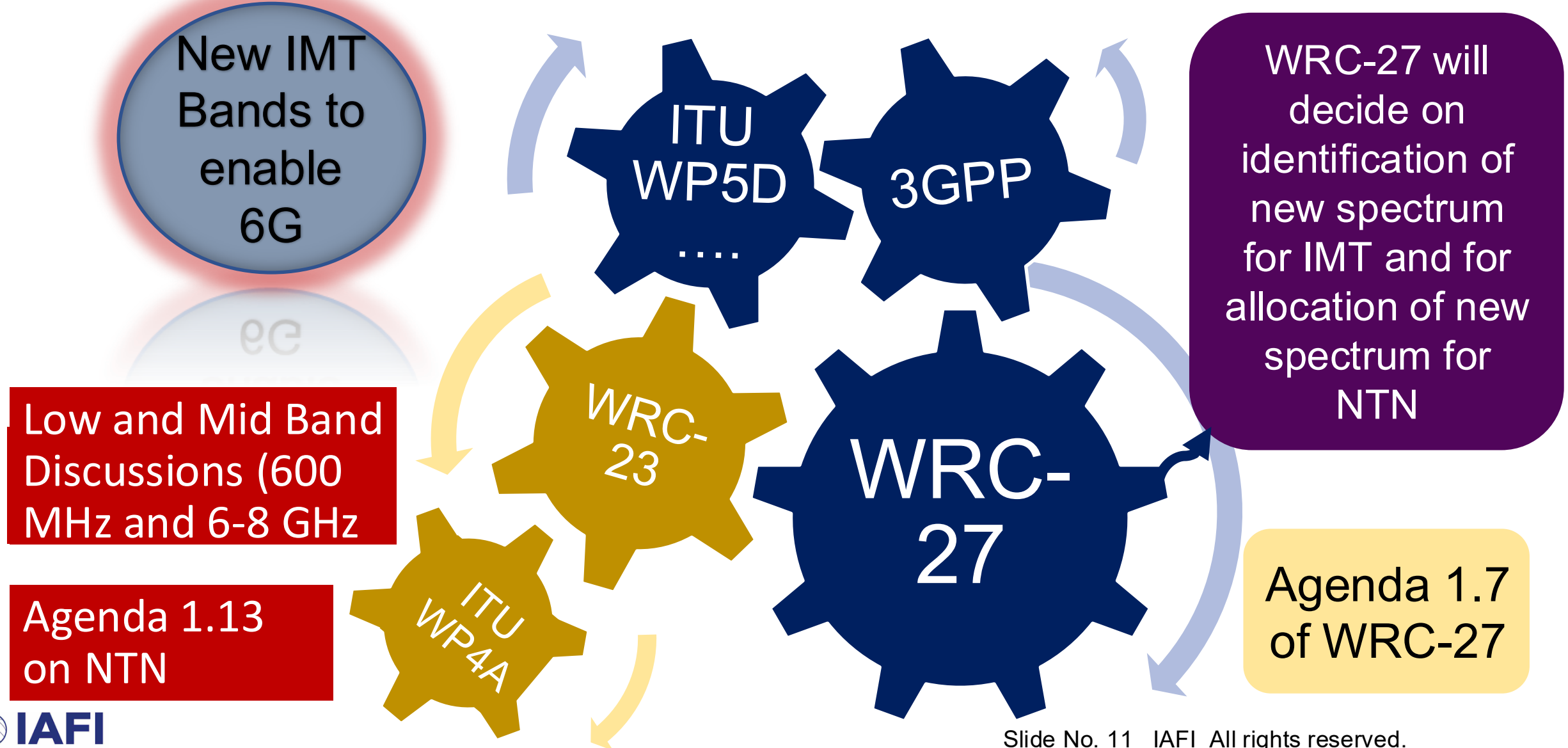
GOVERNMENT EXCLUSIVE	GOVERNMENT/NON-GOVERNMENT SHARED
NON-GOVERNMENT EXCLUSIVE	

ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	NAV	Naval Vessels
Secondary	NAV	Naval Vessels
Coastal	NAV	Naval Vessels



Decisions on Spectrum Allocation and identification are made in the **ITU World Radio Conferences**



There is already large amount of spectrum identified for IMT (3G, 4G, 5G) by the Previous WRCs – But here is why we need to identify new bands for IMT to enable 6G

1 

Cities with over 50% of the world's urban population will be capacity-constrained by 2030 if mid-band spectrum remains at today's levels.

2 

A global average of 2-3 GHz of total mid-band spectrum will be required in urban areas by 2035-2040; higher-demand countries will need 2.5-4 GHz in this period.

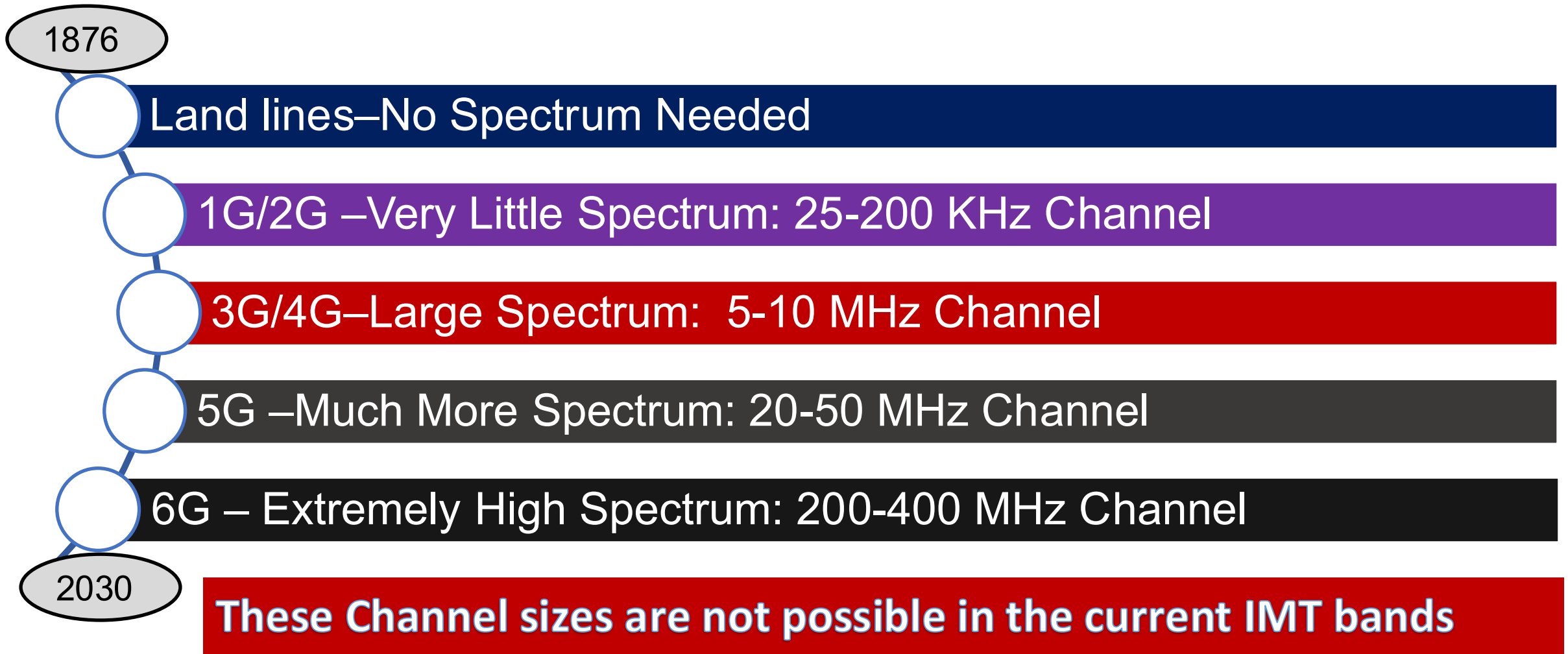
3 

A harmonised spectrum roadmap that delivers the total mid-band spectrum requirements should be developed to enable operators to meet these capacity demands from 2030.

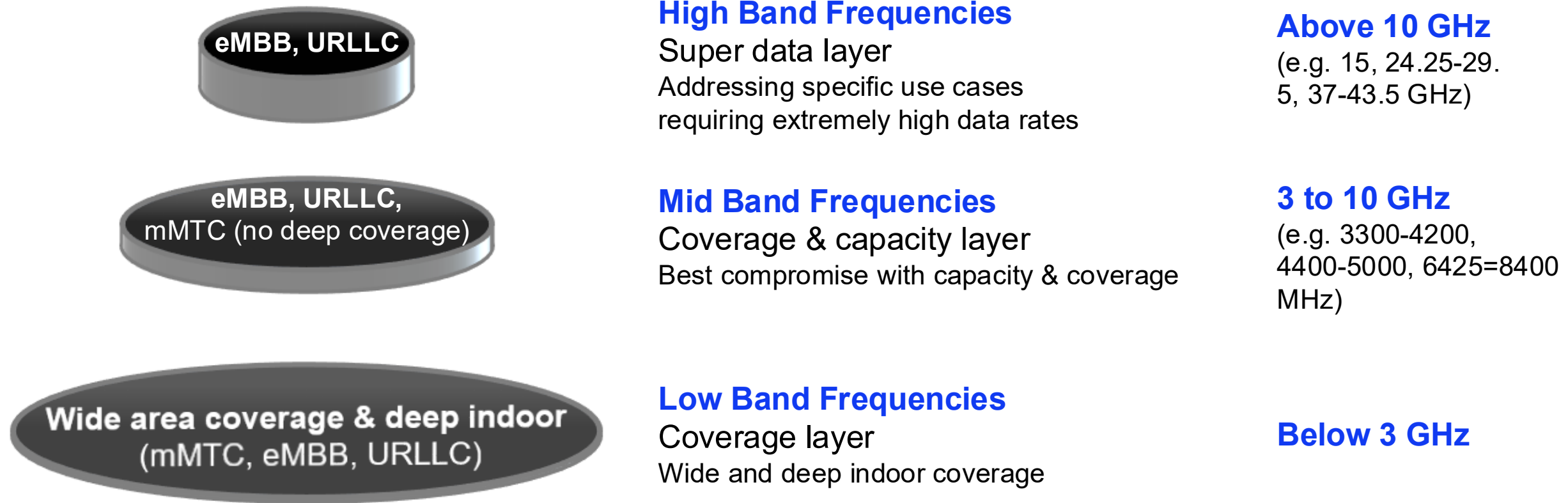
4 

Regulators should seek to assign spectrum in 3.8-4.2 GHz and upper 6 GHz to mobile by around 2030 to meet demand and consider 4.4-4.99 GHz and 7-8 GHz beyond that.

Further, 6G will need much larger contiguous bands due to larger Channel Sizes



6G will still adopt the Multi-band approach (Same as 4G & 5G)



eMBB – enhanced Mobile Broadband
URLLC – Ultra Reliable Low latency communications
mMTC – Massive Machine type communications

6G will also follow the same Multi-layer approach (Same as for 4G & 5G)

URBAN

SUBURBAN

RURAL



15-70 GHz
Typical Bandwidth ~1 GHz

**HOTSPOT /CAPACITY
LAYER**

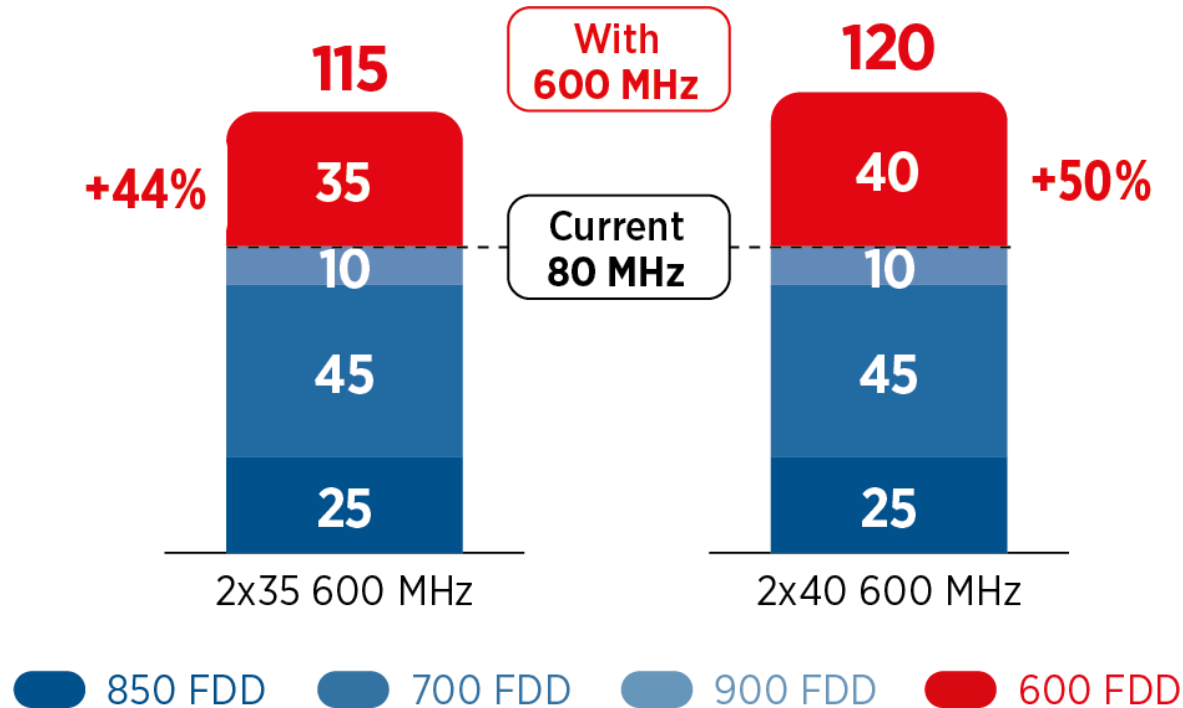
3-10 GHz
Typical Bandwidth 50-400 MHz

**CAPACITY
LAYER**

Below 3 GHz
Typical Bandwidth 5-20 MHz

**BASIC COVERAGE
LAYER**

Low Bands will still be critical for 6G Coverage



Spectrum below 1GHz could...

- Enable 6G coverage in rural areas
- Increase throughput
- Enhance digital inclusion
- Maximise spectral efficiency and cost-effectiveness with wider bands

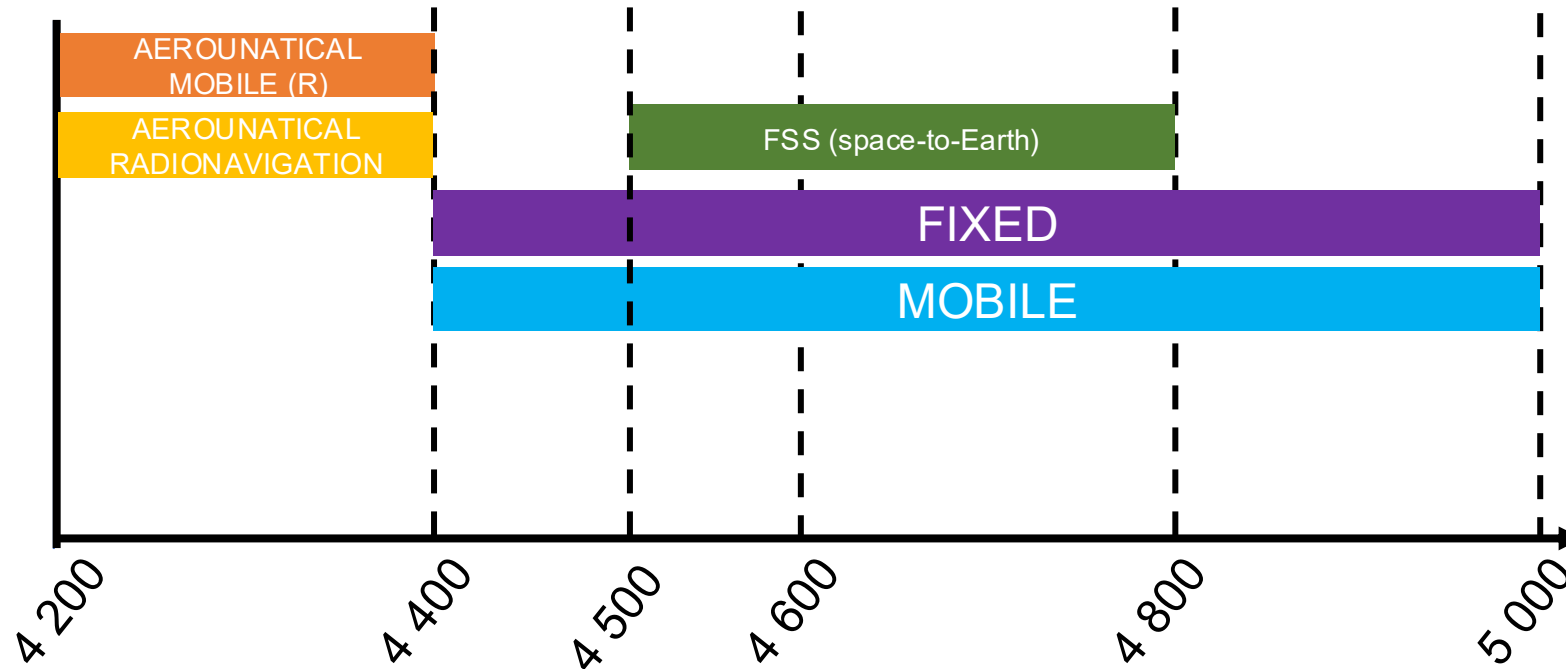
Spectrum Below 1GHz Improves Coverage

- The frequency bands below 1GHz (600/700/800/900 MHz) have been the most commonly used low bands for 5G and will be the key for 6G ubiquitous connectivity.
- At the end of 2025, Most operators were using the 600MHz or 700MHz bands for 5G Coverage.
- Countries that have deployed using the 600 or 700MHz band have typically been able to deploy 5G more quickly – and also provide better quality 5G services. Same will apply for 6G



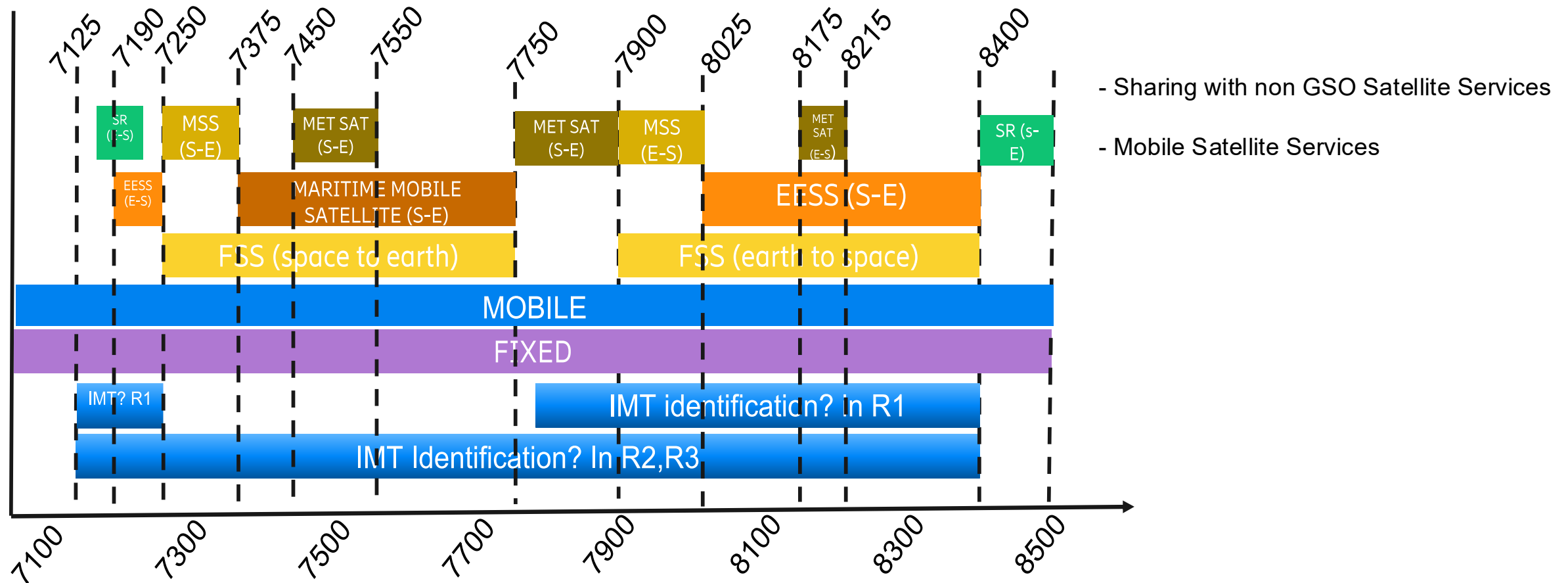
WRC-27 : Searching for new mid band Spectrum for 6G

Many Existing services in 4 400-4 800 MHz MHz will need to be protected.



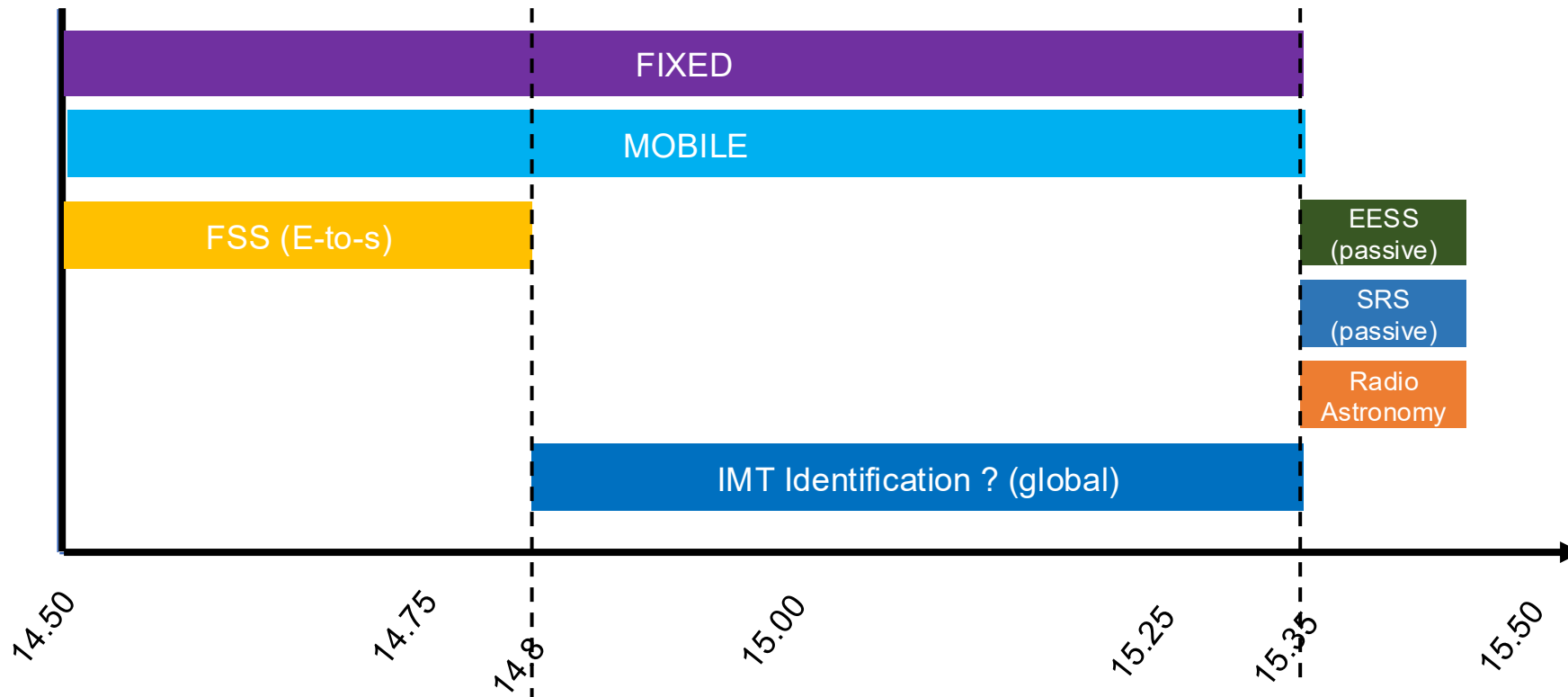
WRC-27 : Searching for new mid band Spectrum for 6G

Many Existing services in 7 100-8 400 MHz will need to be protected.

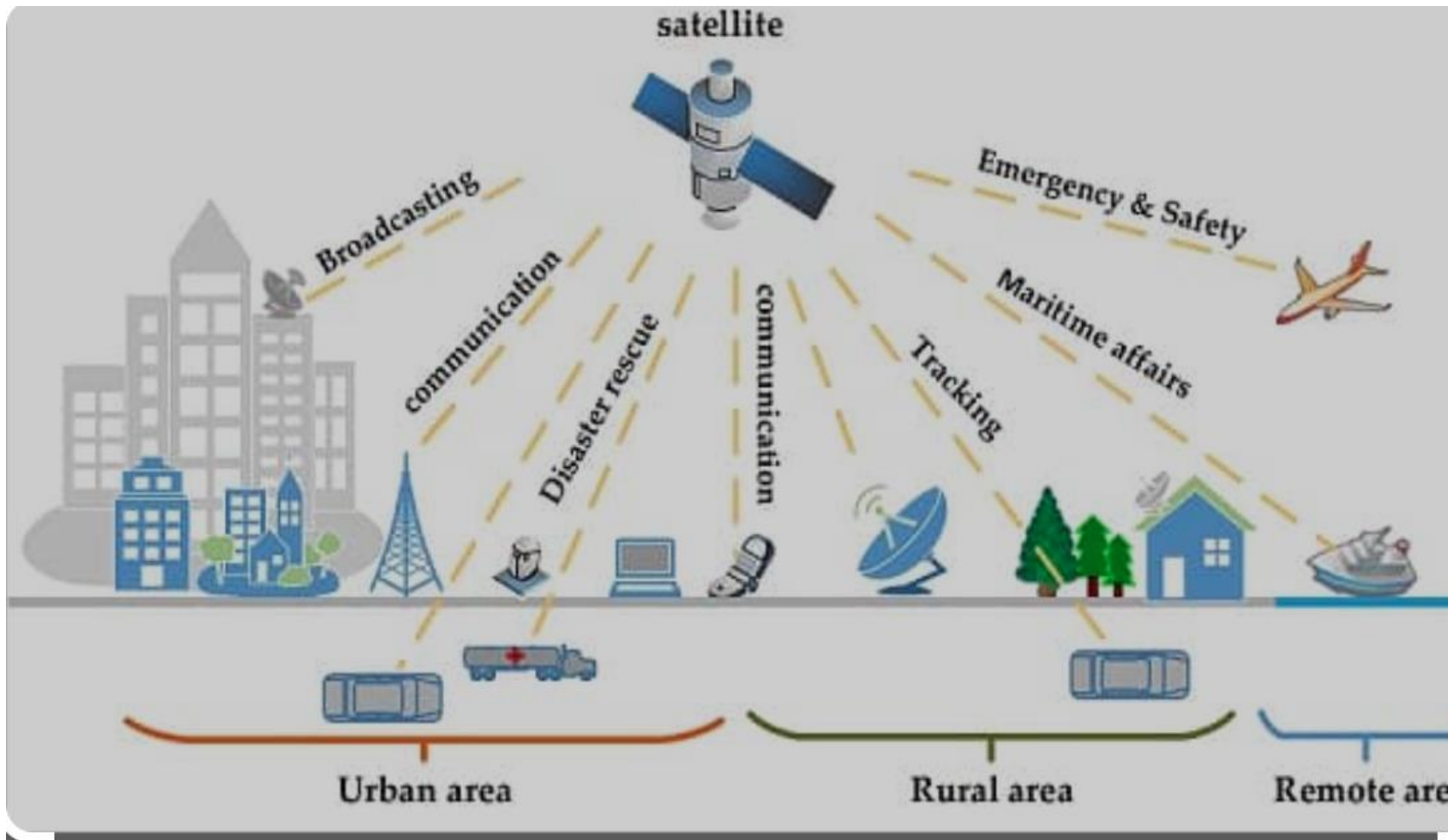


WRC-27 : Searching for new High band Spectrum for 6G

Many Existing services in 14.8 -15.35 GHz will need to be protected.



Satellite Services are key to many sectors of the economy - communications, health, agriculture , imagery, weather, industry...



**28/18 GHz SATELLITE-POWERED
E-AGRICULTURE CAN INCREASE
GLOBAL CROP YIELDS 67%**



**28/18 GHz SATELLITE ESIMs
CONNECT PASSENGERS + CREW**



Direct to Device will connect the normal standard smart phone to the Satellites



Non-Terrestrial Networks are key to connecting the unconnected

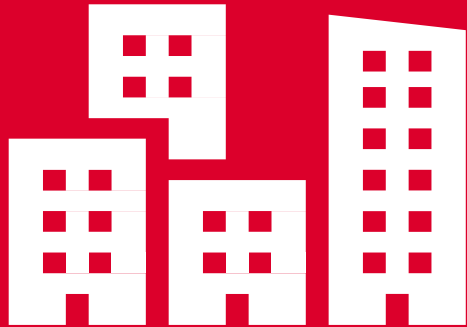
In summary :

Two New key Frequency Bands for meeting 6G overarching requirements

Ubiquitous Intelligence, Sustainability, Connecting the unconnected and security

6-8 GHz

➔ Ubiquitous
Intelligence



600-700 MHz bands

➔ Ubiquitous Coverage,



And a Supportive Spectrum and Policy Road map for NTN and Satellite Services under agenda item 1.13 of WRC-27 to support Connect The Unconnected



THANK YOU

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