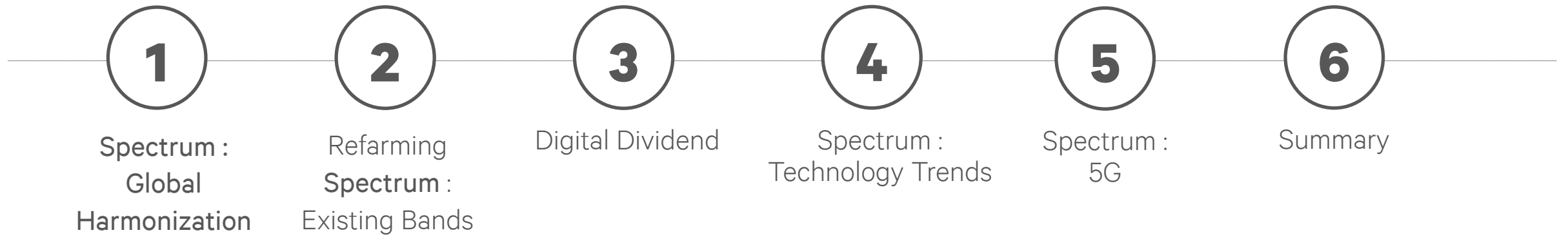


Jitendra Singh,
Senior Director, Government Affairs Qualcomm (India & South Asia)
24 August, 2017

Digital Dividend and Spectrum Refarming

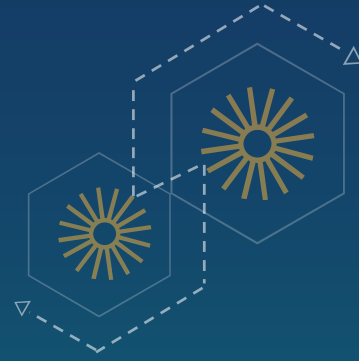
QUALCOMM®



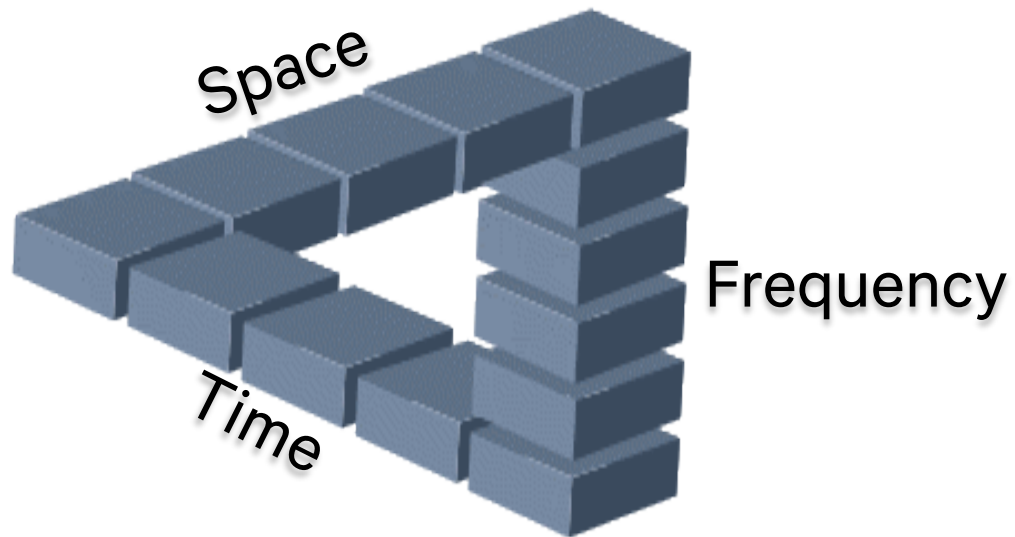


Presentation Outline

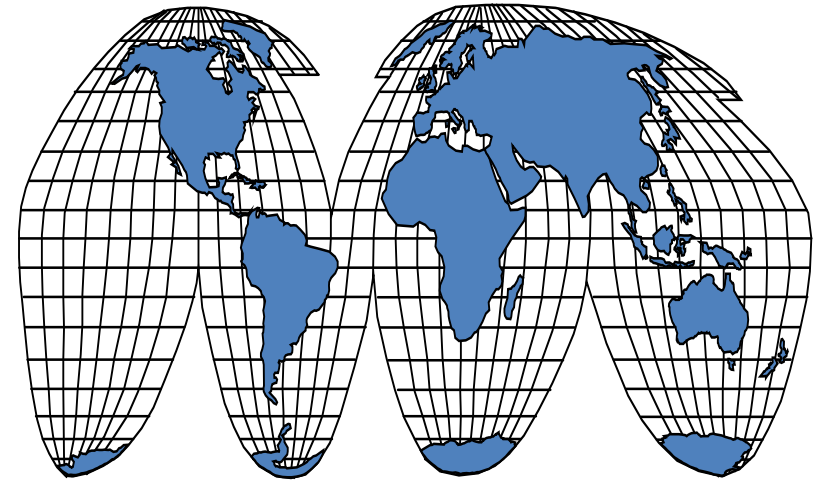
Spectrum : Global Harmonization



Spectrum : Characteristics



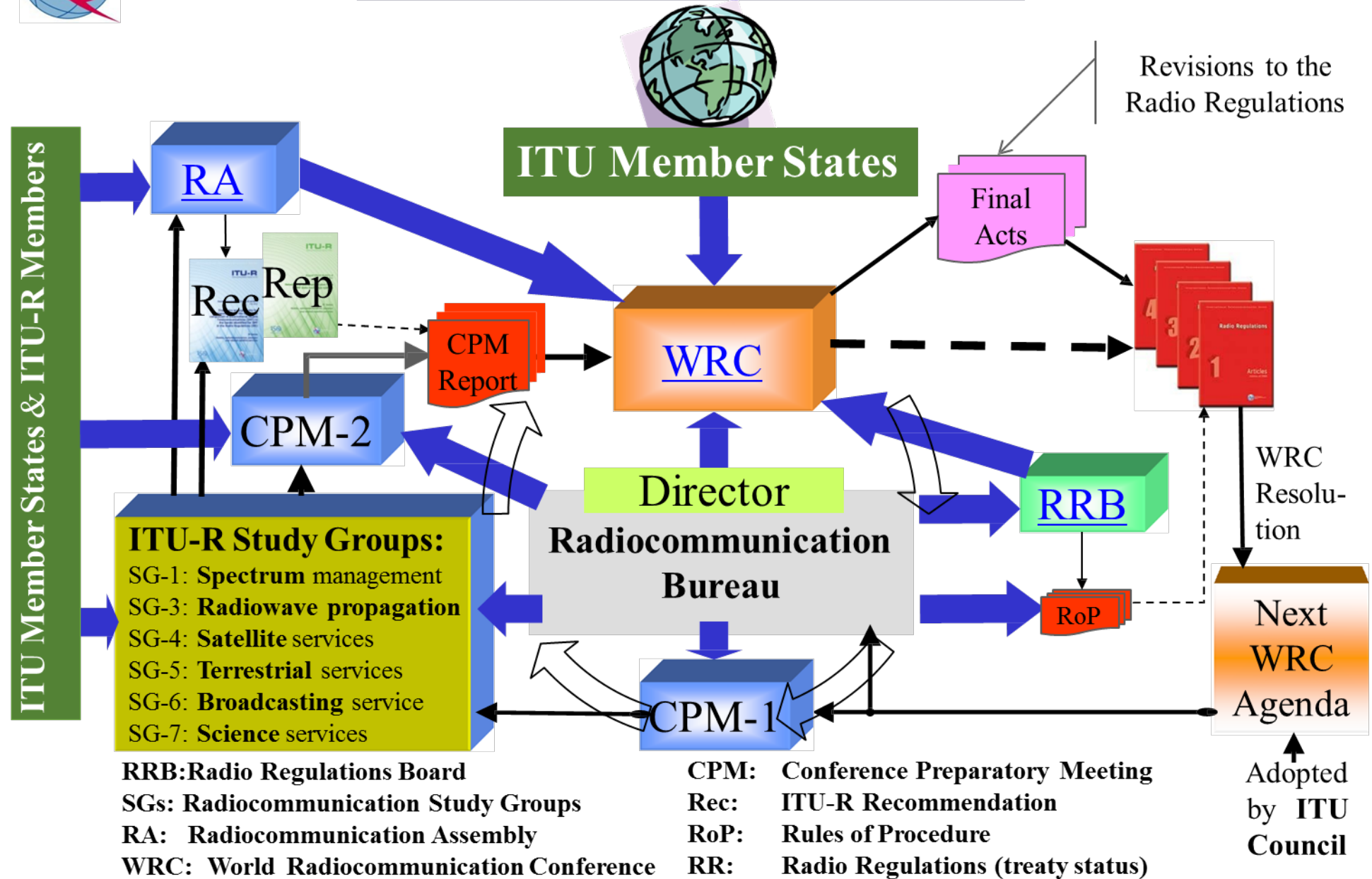
Global Harmonization



Spectrum does not have Boundaries hence Harmonization is must



The WRC Cycle



Spectrum : Harmonization

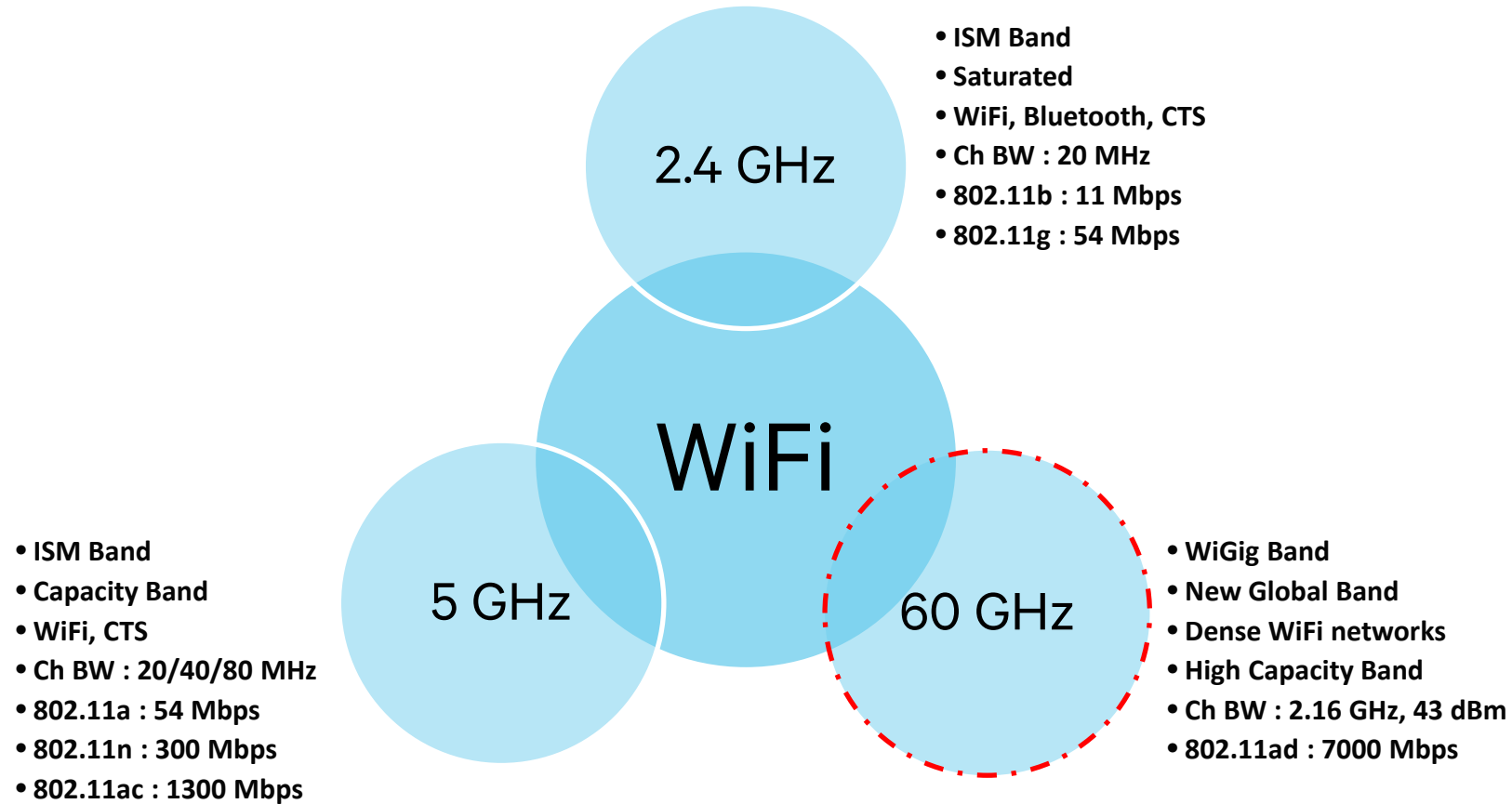
- Clear Demarcation of Services
- Interference Management
 - With Existing Services
 - Cross Border
- Improved Efficiency
- Device Eco-system
 - Economies of Scale
- International Roaming
- Future Spectrum Road Map
- Newer Technologies

Licensed Spectrum Bands

Band (MHz)	Footnotes identifying the band for IMT		
	Region 1 or parts thereof	Region 2 or parts thereof	Region 3 or parts thereof
450-470	5.286AA		
470-698	-	5.295, 5.308A	5.296A
694/698-960	5.317A	5.317A	5.313A, 5.317A
1 427-1 518	5.341A, 5.346	5.341B	5.341C, 5.346A
1 710-2 025	5.384A, 5.388		
2 110-2 200	5.388		
2 300-2 400	5.384A		
2 500-2 690	5.384A		
3 300-3 400	5.429B	5.429D	5.429F
3 400-3 600	5.430A	5.431B	5.432A, 5.432B, 5.433A
3 600-3 700	-	5.434	-
4 800-4 990	-	5.441A	5.441B

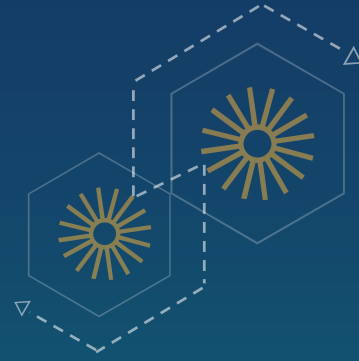
Indian Spectrum Bands are Harmonized with Region 3

Unlicensed Spectrum Bands



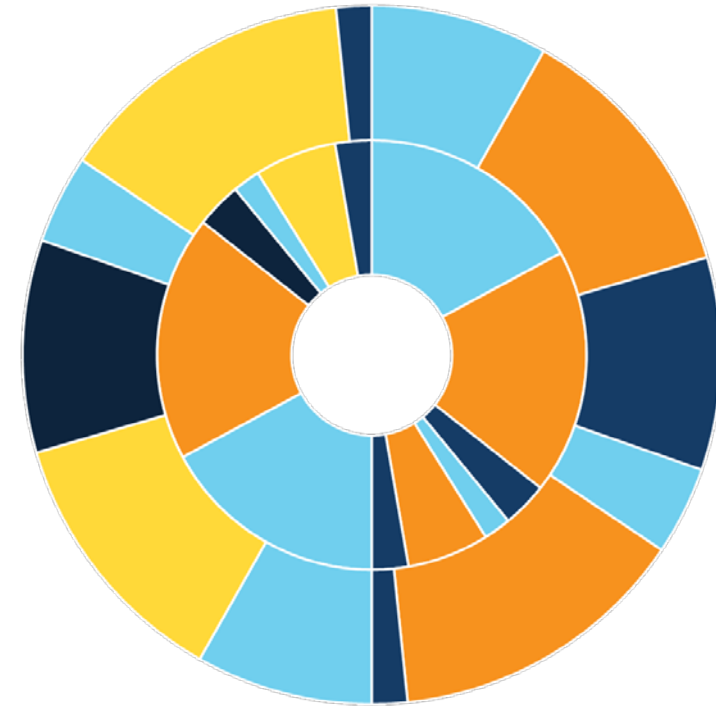
Unlicensed Bands to be Globally Harmonized

Refarming Spectrum : Existing Bands



Spectrum : Issues with Existing Assignments

- Fragmented Assignments
- Assignments in Narrow Blocks
- Govt Agencies in Commercial Bands
- Non-Serious Players
- Multiple Auctions
- Non Co-Terminus Licenses
- All Spectrum Bands not Treated Equal
- Merger and Acquisition

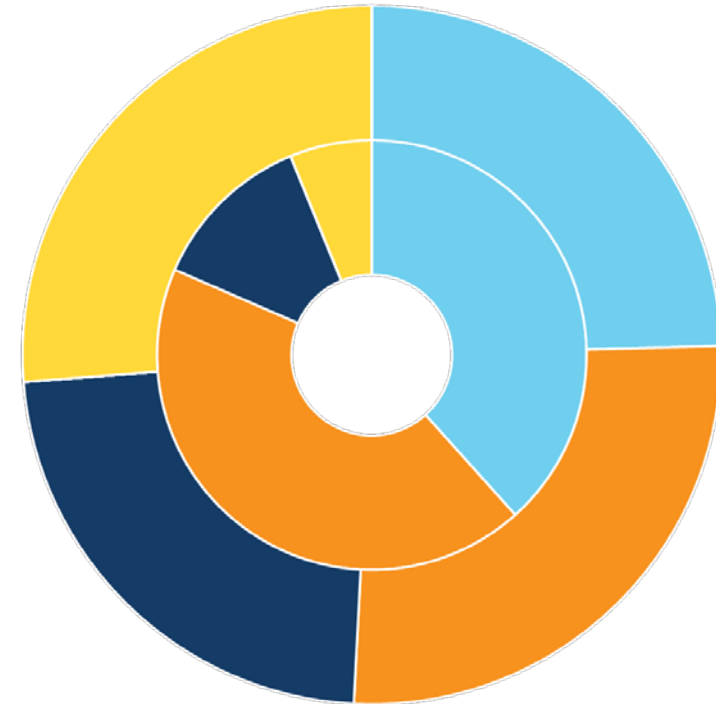


Fragmented Assignments

Need for ReFarming and Defragmentation

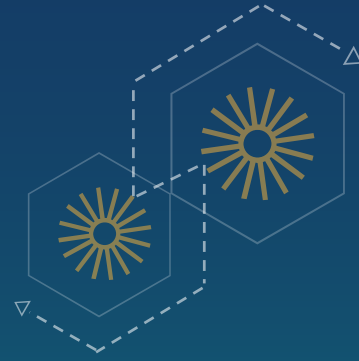
Spectrum : Refarming

- Spectrum used for one purpose/technology, need to be used for other
 - Services
 - Technology
 - Users
- Benefits
 - Refarming is a cost-effective
 - Alternative source of spectrum
 - Increases capacity
 - Enhances Quality of Spectrum
 - New technologies
 - Better interference management
- Challenges
 - Time consuming process
 - Existing users inertia
 - Co-existence issues
 - Phasing out of technology
 - User awareness



Defragmented Assignments

Digital Dividend



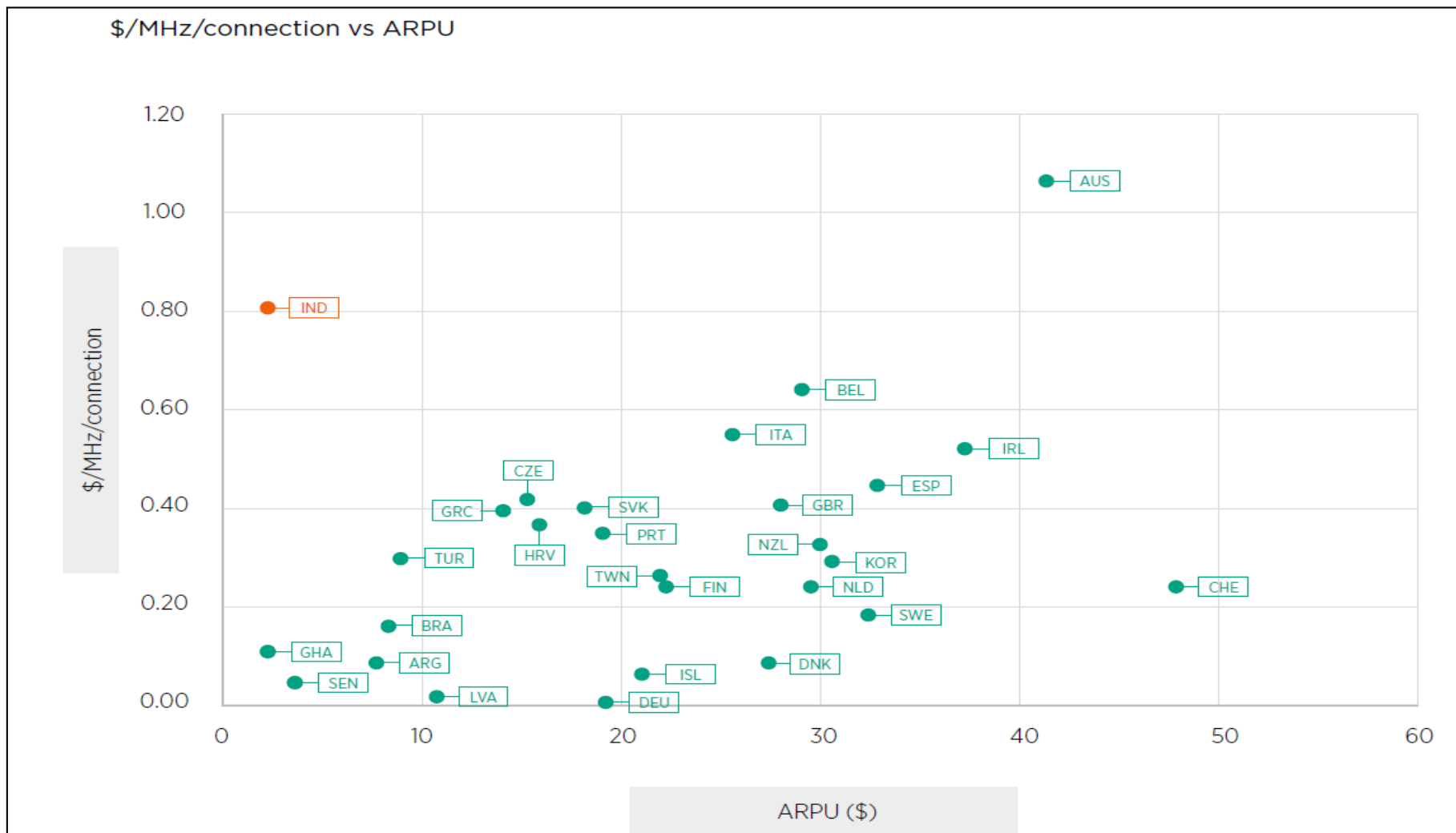
Digital Dividend – Broadcasting Spectrum

- Digital dividend refers to radio spectrum which is released in process of digital television transition
- Size of digital dividend will vary from country to country
- Amount of spectrum to be released in switchover depends on
 - National peculiarities
 - Digital television technology being planned to replace analogue services
- Digital dividend spectrum is broadcasting spectrum between 200 MHz and 1 GHz
- Allocations on Primary basis to services other than broadcasting
- Digital dividend for mobile services will require regional harmonization
- Key spectrum bands under discussion for IMT are
 - 600 MHz band (617-698 MHz)
 - 700 MHz band (698-806 MHz)
- Harmonization will create enormous benefits towards social impact & increased productivity

Digital Dividend – Broadcasting Spectrum

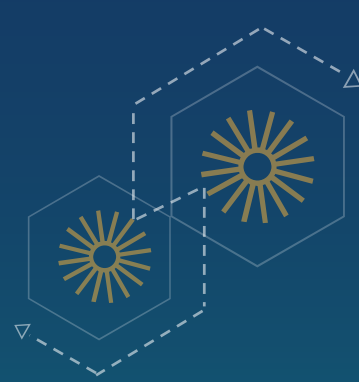
- To ensure that the band is clean when making the allocation -
 - Develop a clear and accurate allocation schedule
 - Preset timescales
 - Ensure the most efficient process.
- Benefits of lower frequency bands
 - Lower frequencies reach farther and have less penetration loss
 - Better rural coverage and improved indoor urban coverage
 - Good for MTC, especially NBloT
- Prioritize coverage opportunities provided by the band
 - Do not seek to maximize the price, or
 - Establish tough compliance conditions that will delay deployment

700 MHz (Digital Dividend) Spectrum vs ARPU



Low Revenue, High Spectrum Cost

Spectrum : Technology Trends



Mobile has made a leap every ~10 years



1G

Analog
voice

AMPS, NMT, TACS

1980s



2G

Digital voice

D-AMPS, GSM,
IS-95 (CDMA)

1990s



3G

Mobile broadband

WCDMA/HSPA+,
CDMA2000/EV-DO

2000s



4G

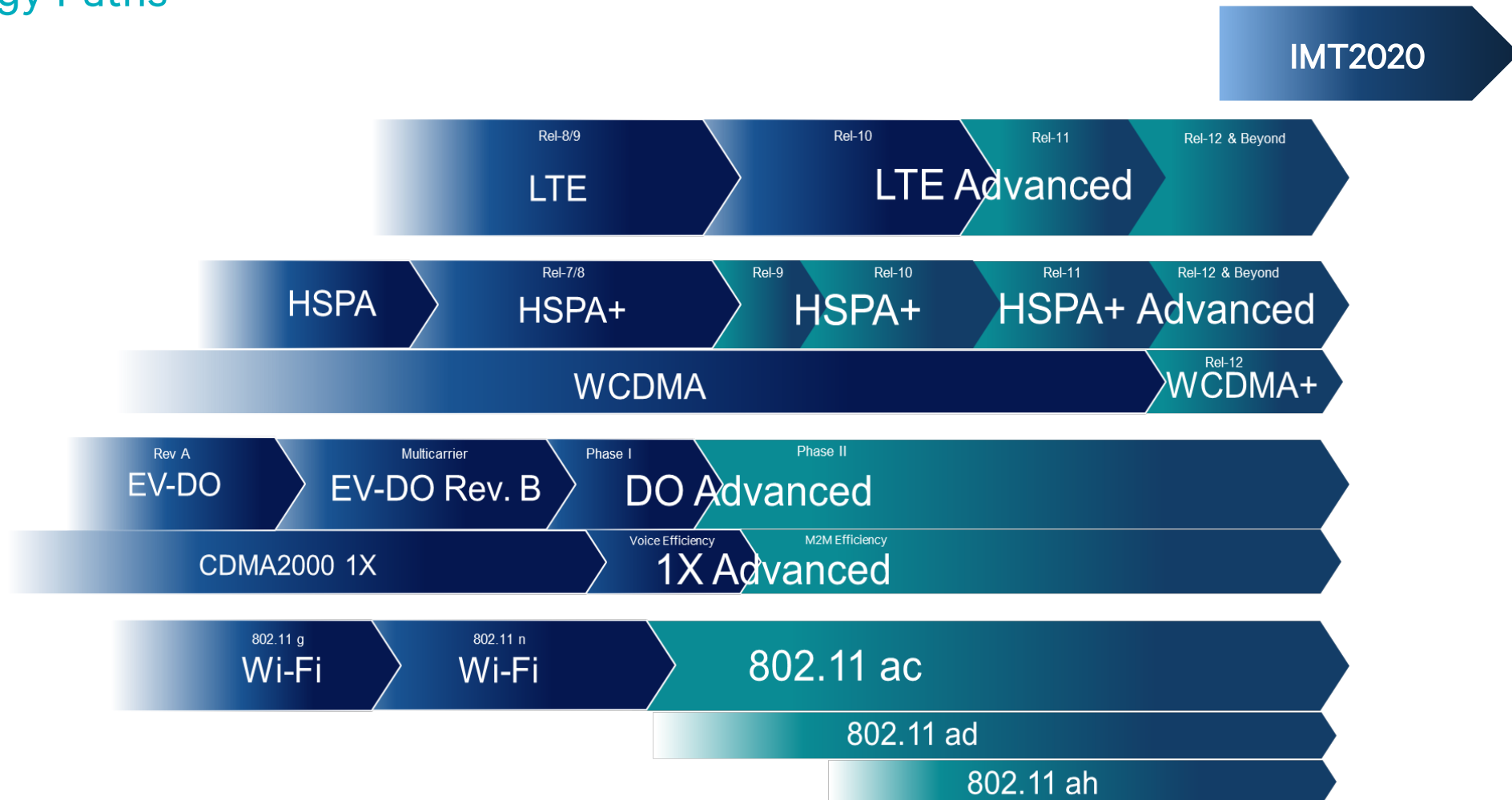
Faster and
better MBB

LTE,
LTE Advanced

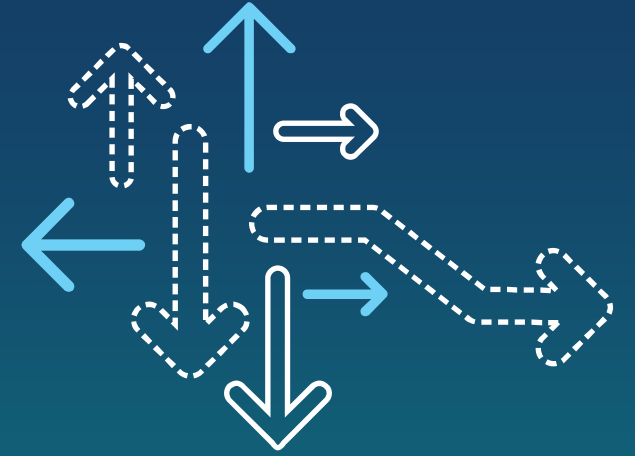
2010s

Wireless Broadband Standards keep evolving

Technology Paths



5G - Spectrum



The background of the slide is a dark blue field filled with a complex, abstract mesh of glowing blue particles. These particles form swirling, organic shapes that resemble nebulae or data flows, creating a sense of dynamic movement and connectivity.

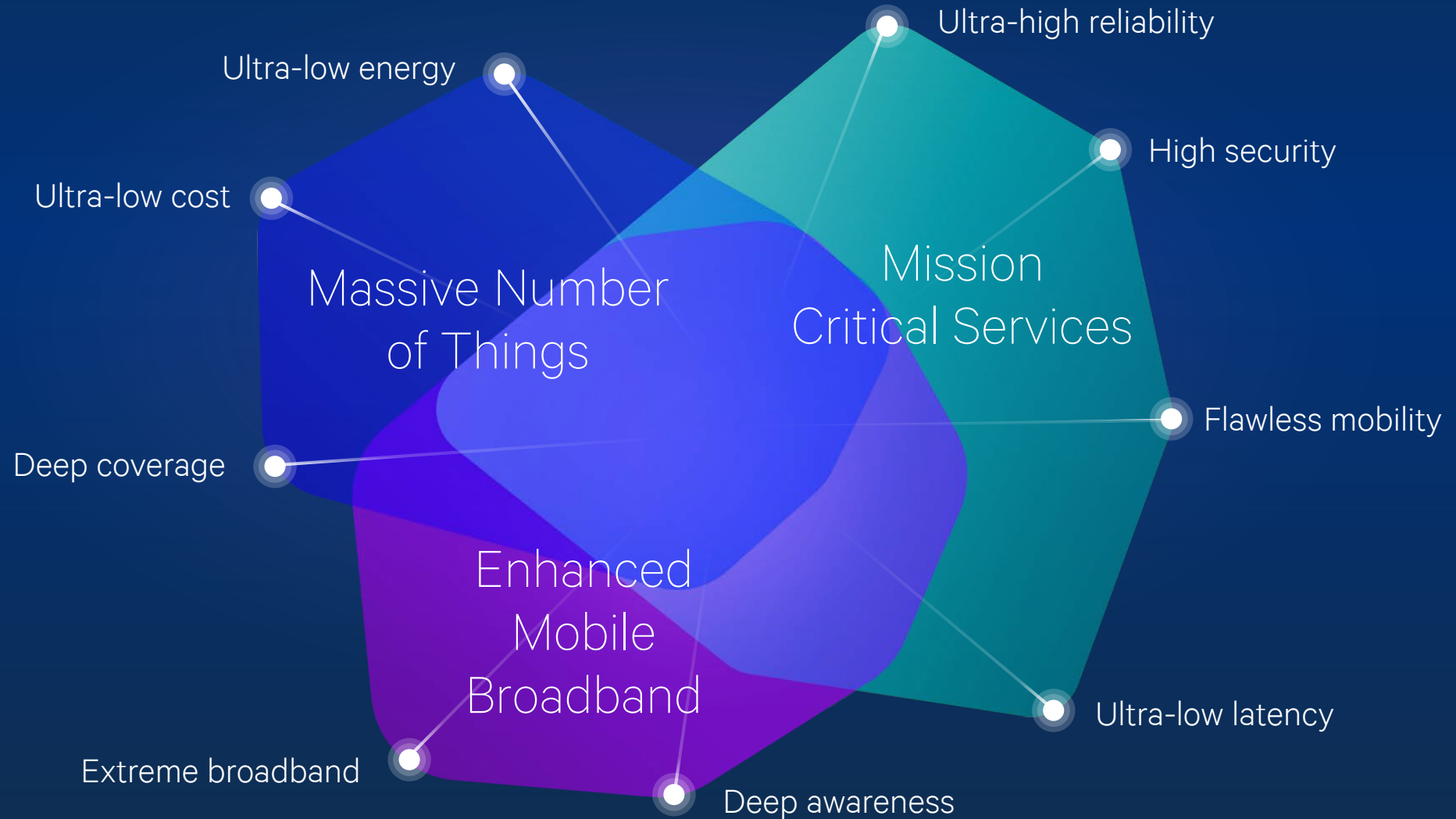
Enabling
new services

5G

Connecting
new industries and devices

Empowering
new user experiences

Support Extreme Variation in Requirements



Spectrum for 5G

Key Considerations

Peak Data Rates

Latency

User Type

Spectrum Efficiency

Energy Efficiency

User Density

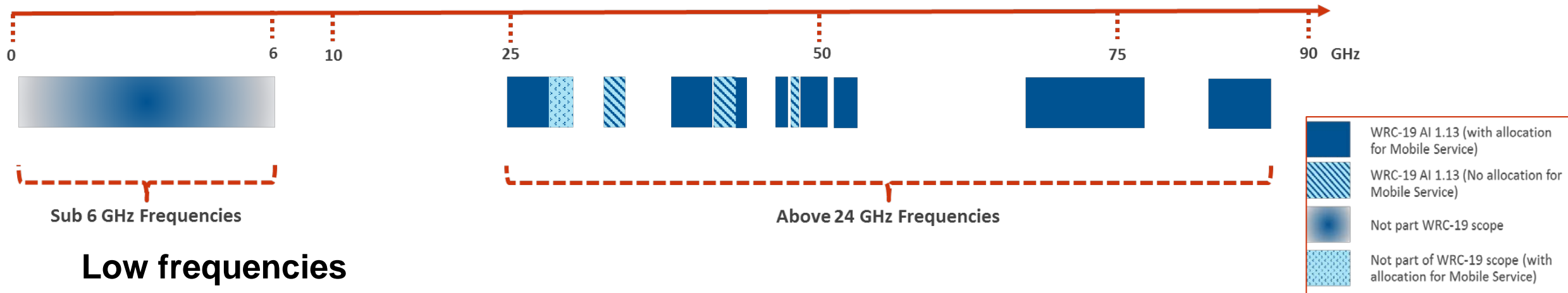
Network Capacity

Reliability

Mobility

Study Frequency Ranges for IMT-2020

Higher and lower frequencies are both needed to meet all multiple 5G use cases



Low frequencies

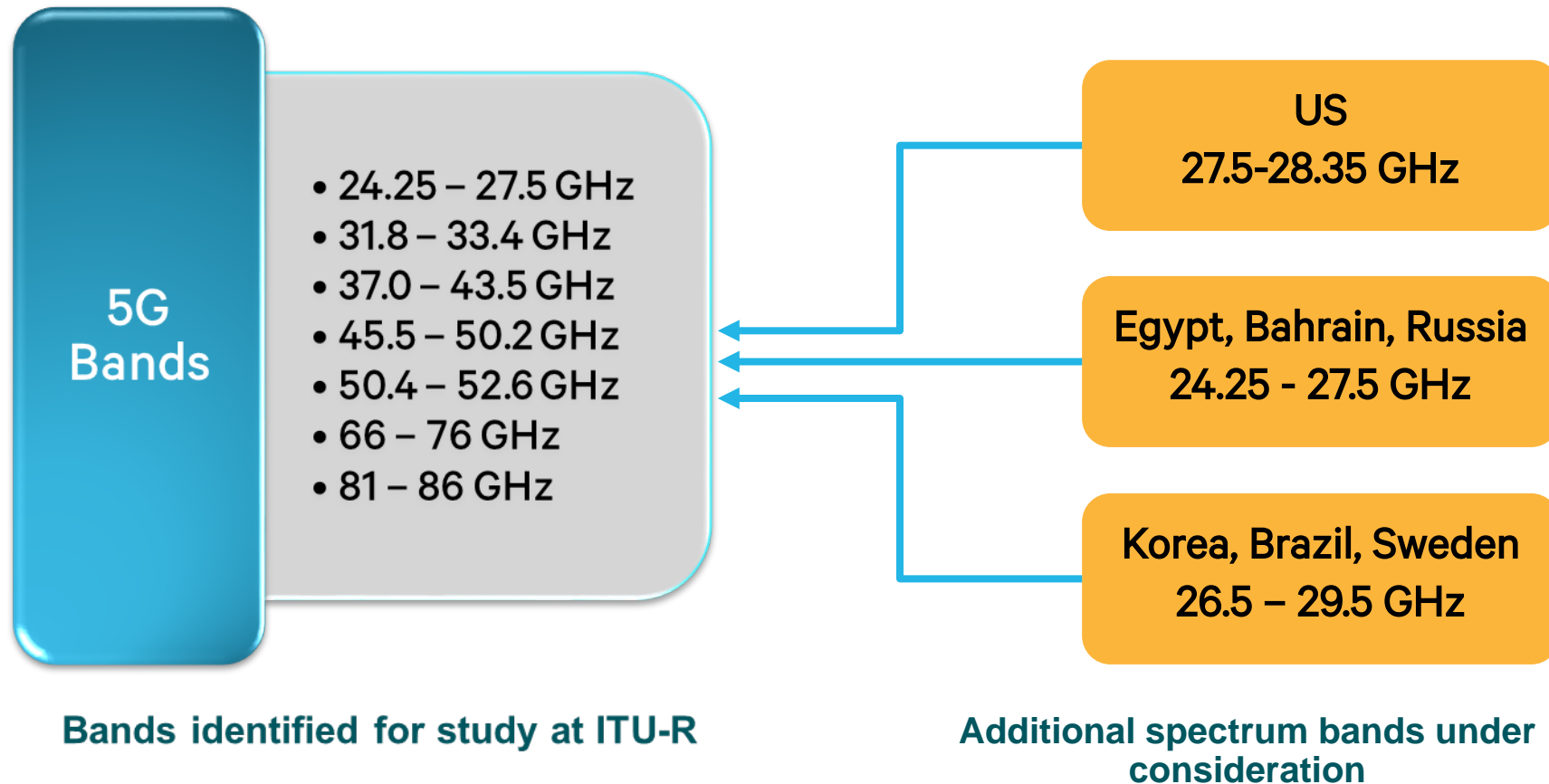
- **Full area coverage** allowing cost effective delivery of mobile services
- **Bandwidths** considerably wider (in the order of 100s of MHz) than those of today, providing a combination of capacity and coverage
- **New bands** below 6GHz should be identified for 5G

High frequencies

- Needed for applications requiring very high data rates
- Will accommodate wider channel bandwidths (e.g. in the order of GHz per operator)
- Propagation characteristics may facilitate sharing with existing services

Study Frequency Ranges for IMT-2020

Summary of Frequency Ranges under Consideration



Study Frequency Ranges for IMT-2020

5G Early Commercial Plans in the World



- China** 3400-3600 MHz for 5G trial; consultation on 3300-3600, 4800-5000 MHz and 24.75-27.5, 37-42.5 GHz for 5G
- Japan** 3600-4200, 4400-4900 MHz and 28 GHz for 5G trial (targeting commercial service in 2020 Summer Olympic)
- Korea** 3400-3700 MHz and 26.5-29.5 GHz (for 2018 Winter Olympic 5G trial)
- EU** 3400-3800, 700 MHz and 24.25-27.5 GHz as 5G pioneer bands; working on 31.8-33.4 and 40.5-43.5 GHz
- USA** 27.5-28.35, 37-40 & 64-71 GHz; and the 600 MHz

Summary



Summary

Spectrum Situation is Unique for each Country

Harmonization to Meet Future Needs will Enhance Spectrum Value

Innovative Refarming Approach and Customization Required for Harmonization

Right Policy on Digital Dividend Spectrum Must for Achieving Sustainable Development Goals

Thank you

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