

Agenda item 10  
Candidate Bands for IMT  
Co-Existence Studies

- Jitendra Singh

# What is Agenda item 10

## Standing agenda item

- to recommend to the Council items for inclusion in the agenda for the next WRC, and items for the preliminary agenda of future conferences, in accordance with Article 7 of the Convention and Resolution 804 (Rev.WRC-19);
- Resolution **804 (Rev.WRC-19)** : Principles for establishing agendas for world radiocommunication conferences

### *resolves*

- 1 that recommended agendas for future WRCs shall include a standing agenda item for the establishment of preliminary agendas for subsequent WRCs;
- 2 that the principles in Annex 1 to this Resolution should be used when developing future WRC agendas;
- 3 to encourage administrations and regional telecommunication organizations to submit, to the extent practicable, information on possible items/topics for the agenda of future WRCs under the WRC standing agenda item mentioned in resolves 1 to the second session of the CPM,

### *resolves to invite administrations*

- 1 to use the template in Annex 2 to this Resolution in proposing agenda items for WRCs;
- 2 to participate in regional activities for the preparation of future WRC agendas.

# Why we need Spectrum for 6G

Some crucial elements for Digital India

- Real-time Governance
- Precision Agriculture
- Smart Villages
- Smart Cities' & Smart Communities
- Tele Medicine and Digital Health
- Intelligent Transport Systems
- High speed trains (e.g. Bullet trains)
- AR/VR Based e-Education
- Smart logistics and Export Hubs
- Security & Surveillance
- Industry 4.0
- Drone based services
- Smart / Assisted Driving infra
- Real-time Public Protection and Disaster Relief

Broadband  
Highways

Universal Access to  
Mobile  
Connectivity

Public Internet  
Access Programme

e-Governance –  
Reforming  
Government  
through Technology

eKranti – Electronic  
delivery of services

Information for All

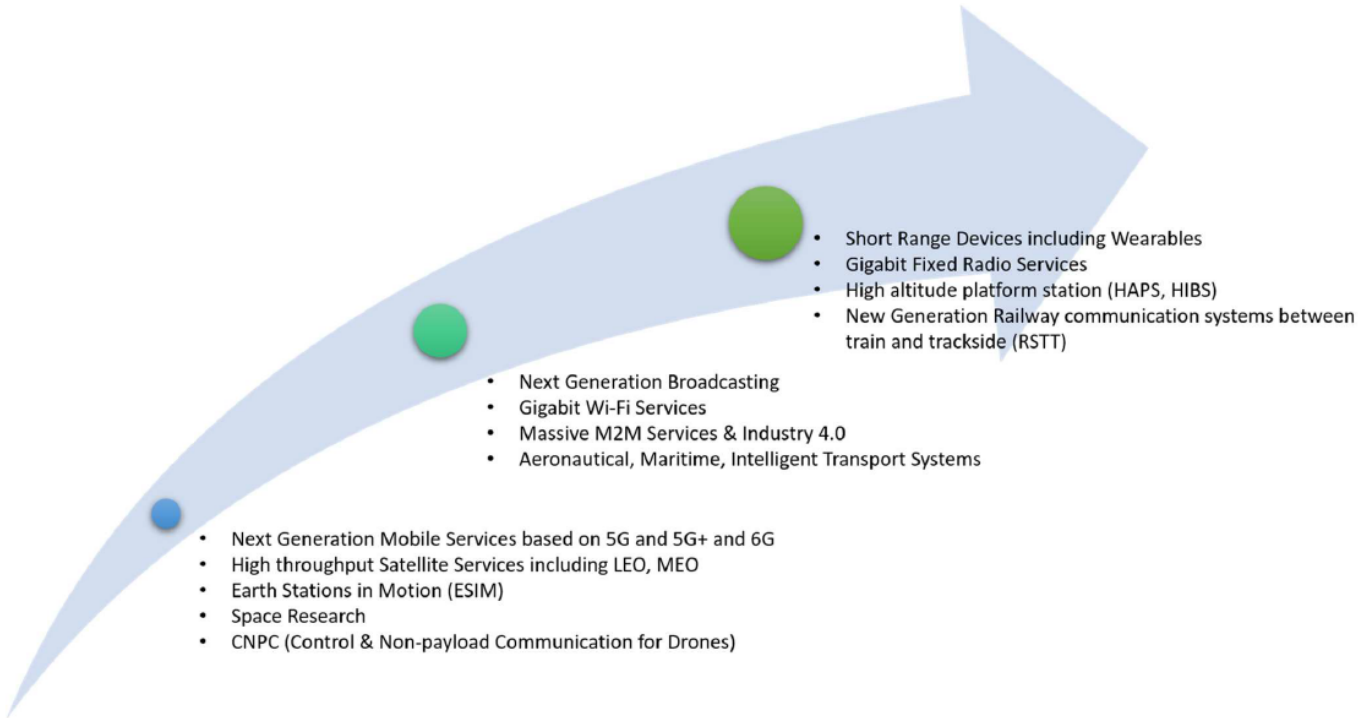
Electronics  
Manufacturing

IT for Jobs

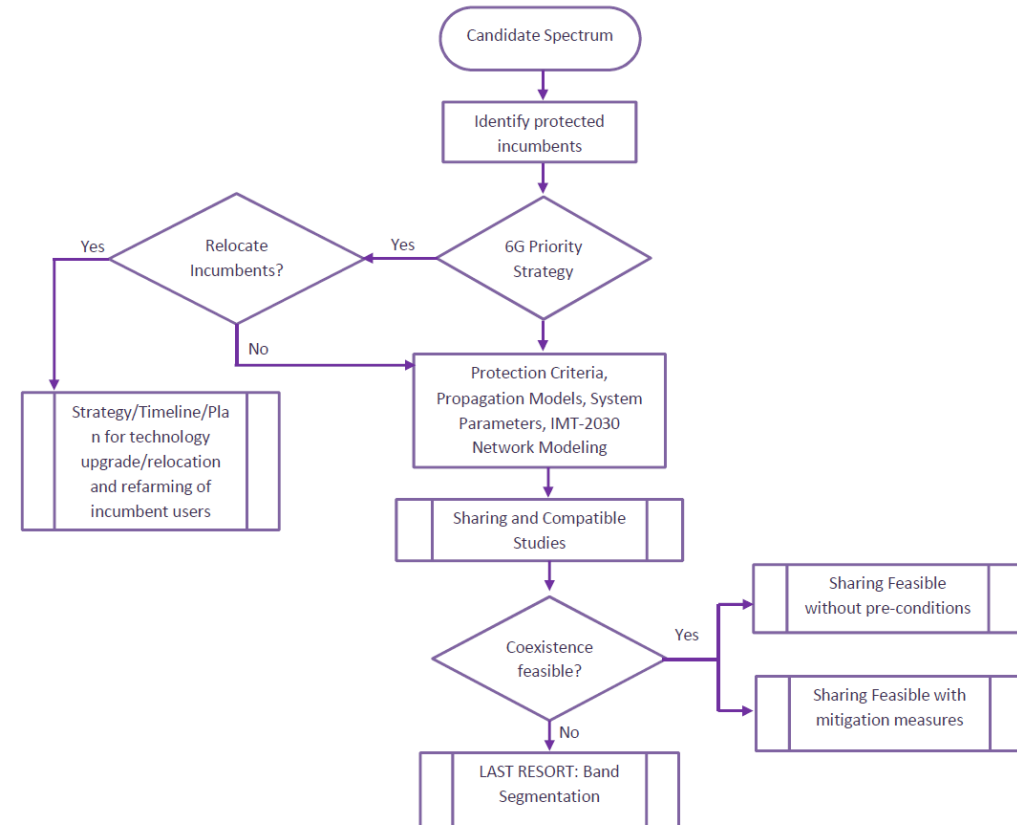
Early Harvest  
Programmes

# Why we need Spectrum for 6G

New Era of Services by 2030 from 5G+ and 6G Technologies

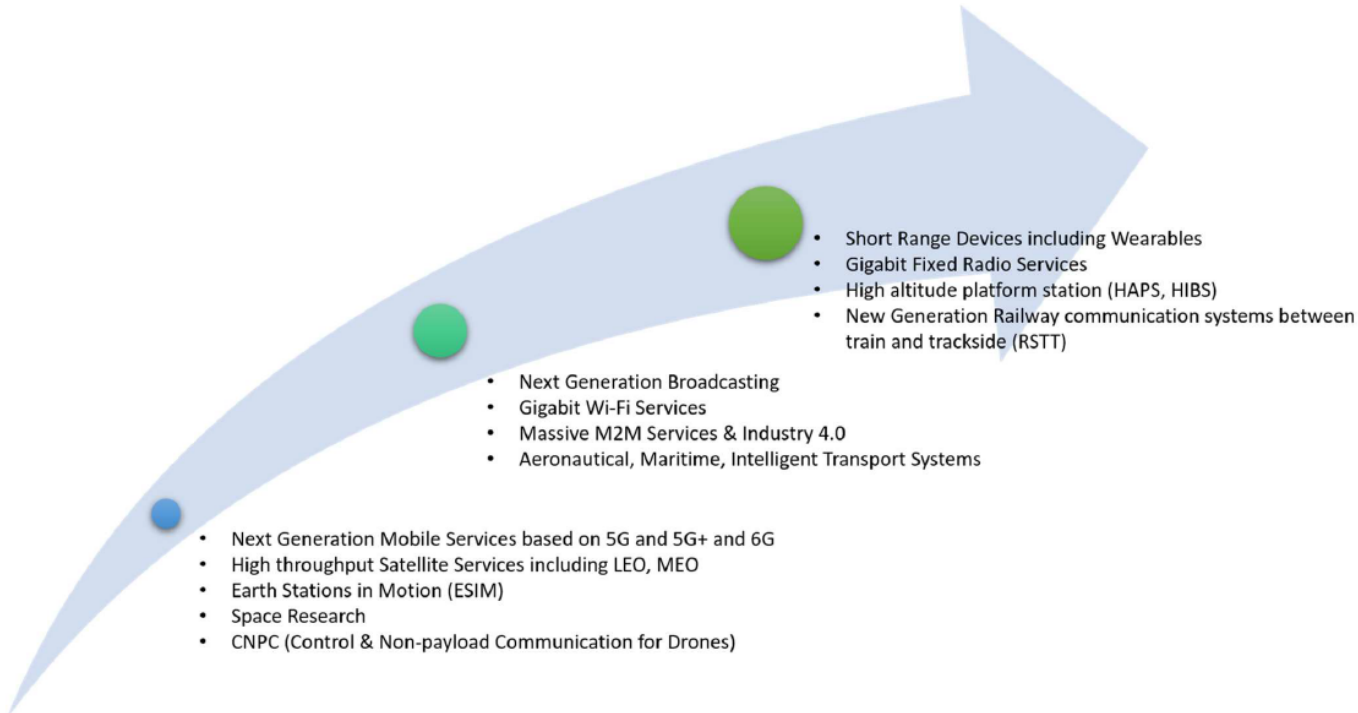


Approach towards ensuring timely and predictable availability of 6G spectrum

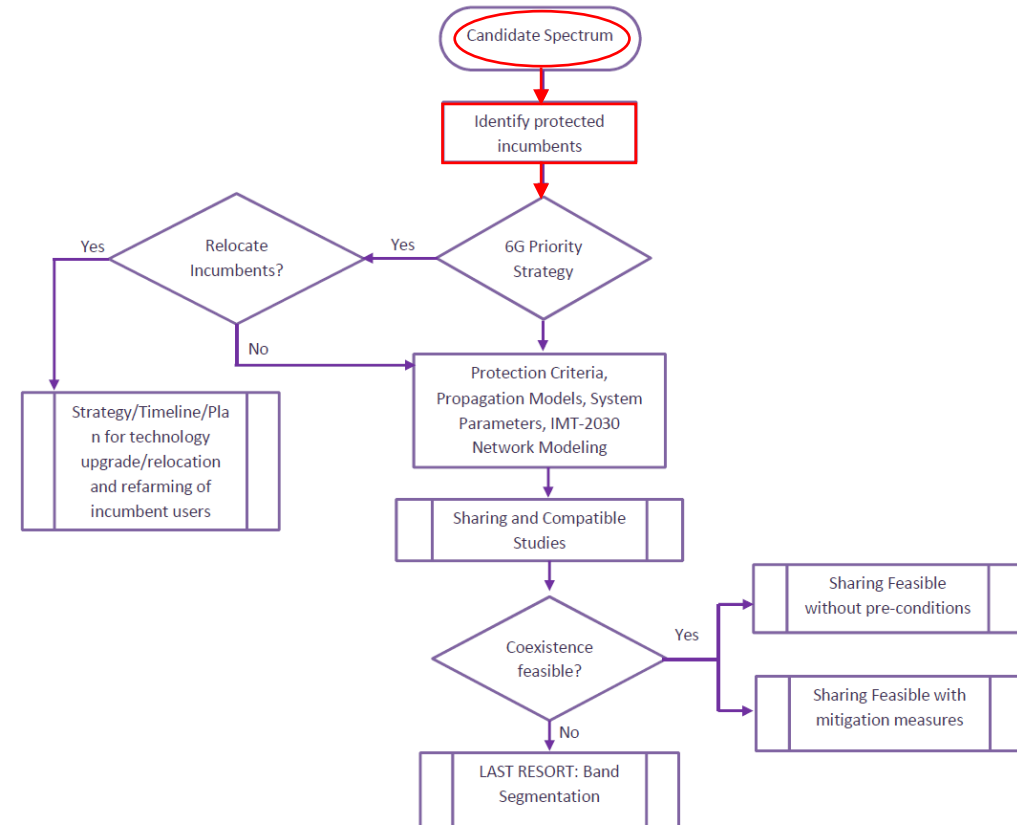


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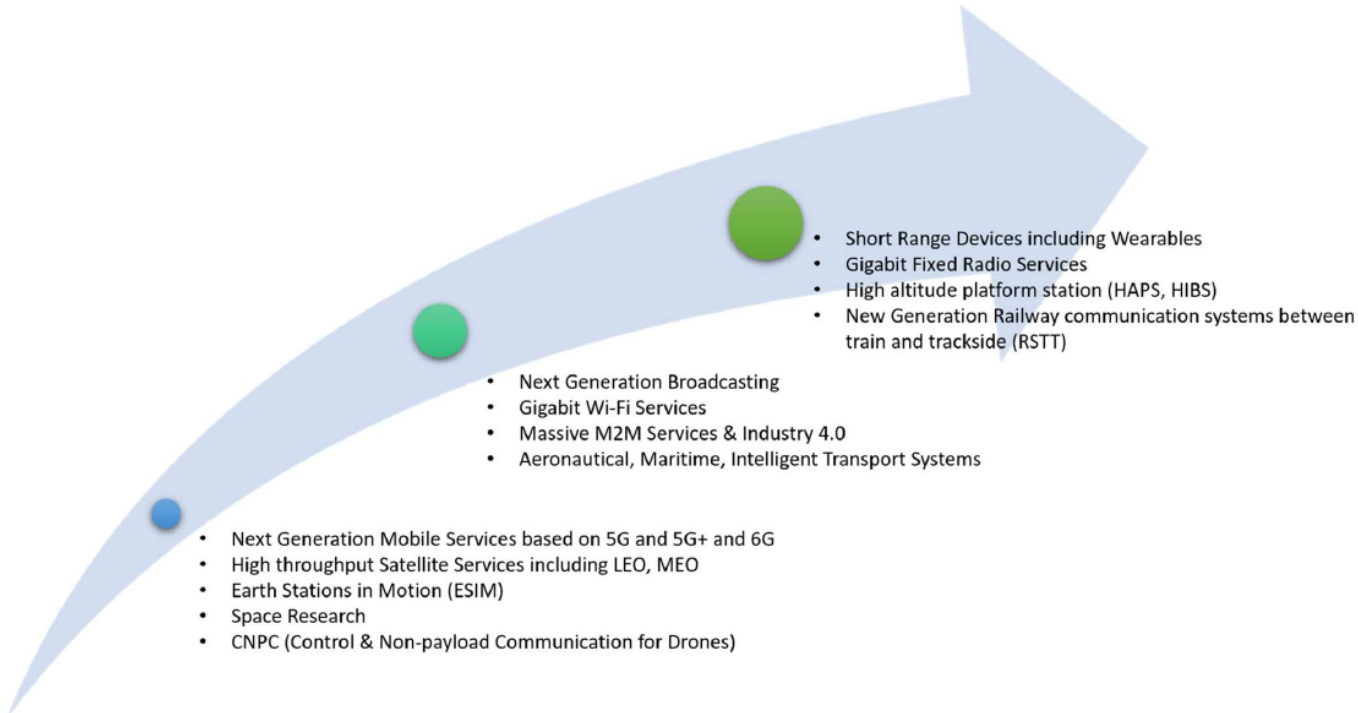


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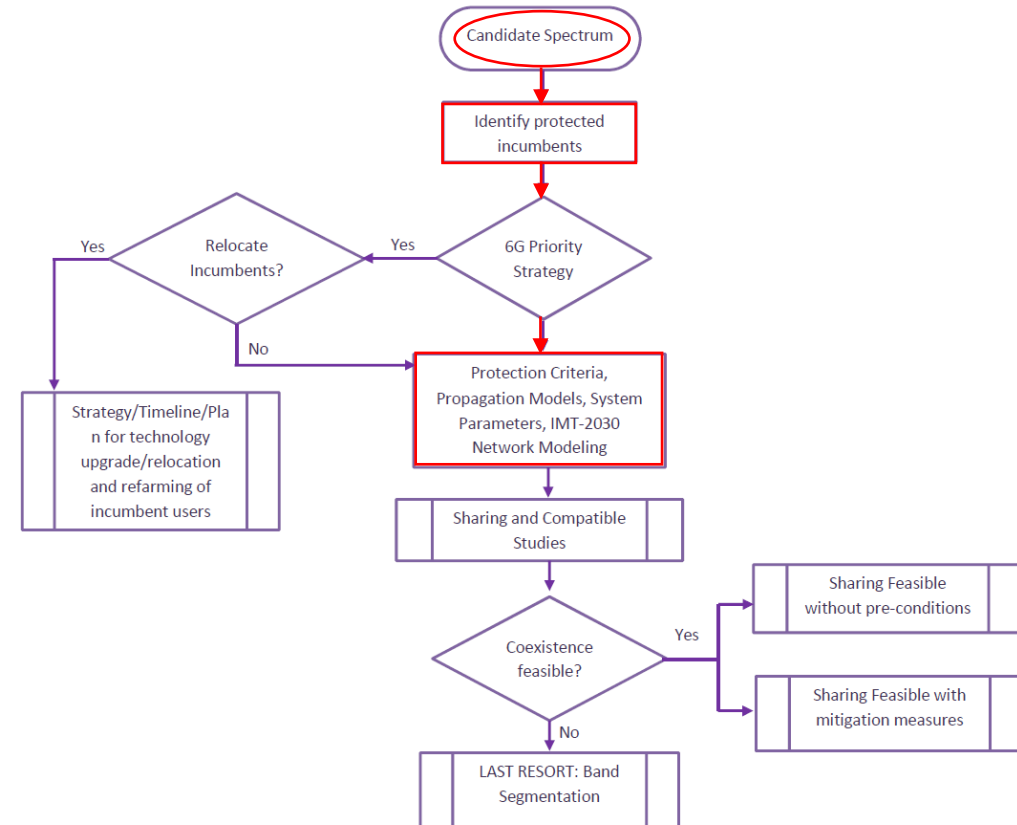


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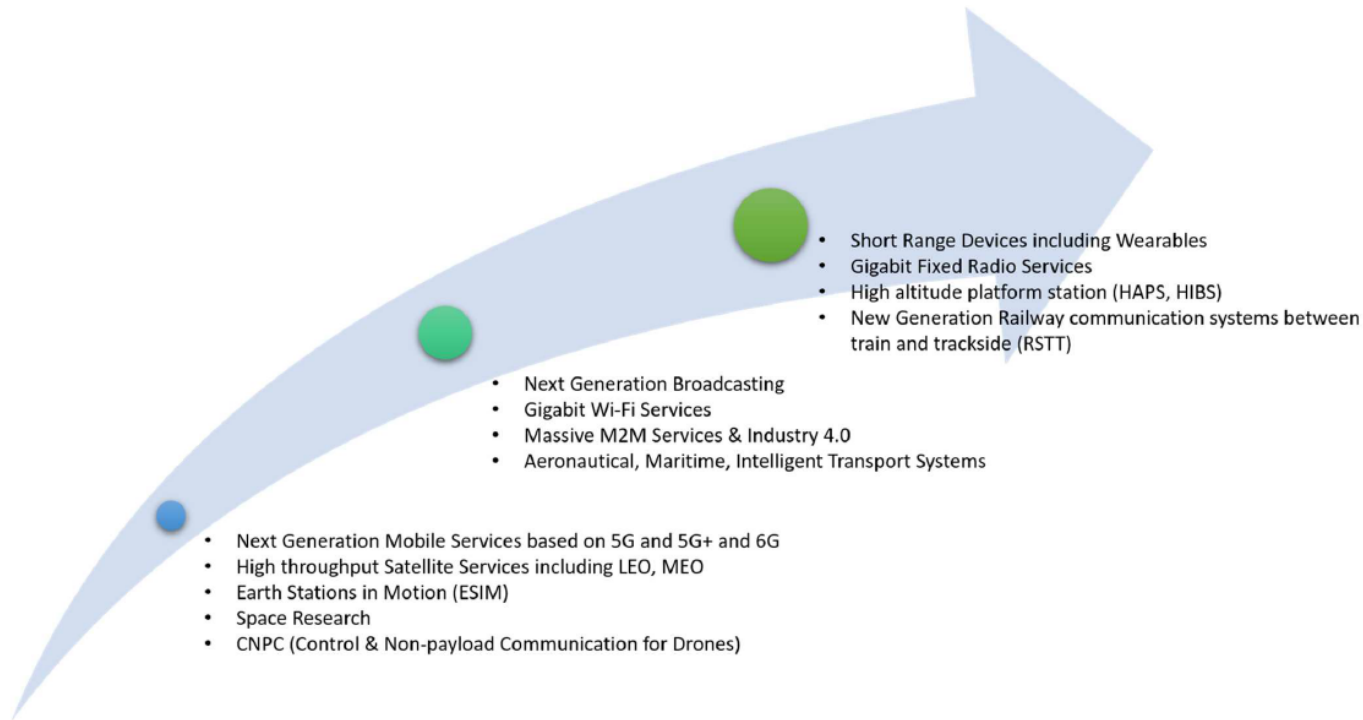


Approach towards ensuring timely and predictable availability of 6G spectrum

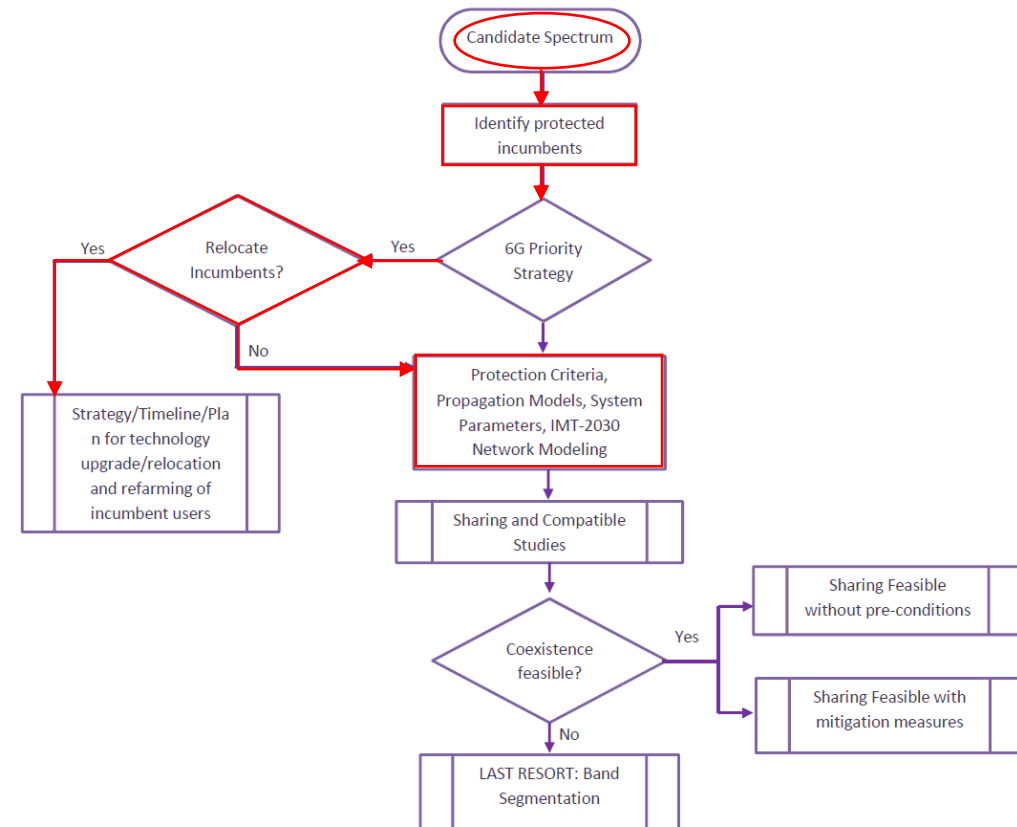


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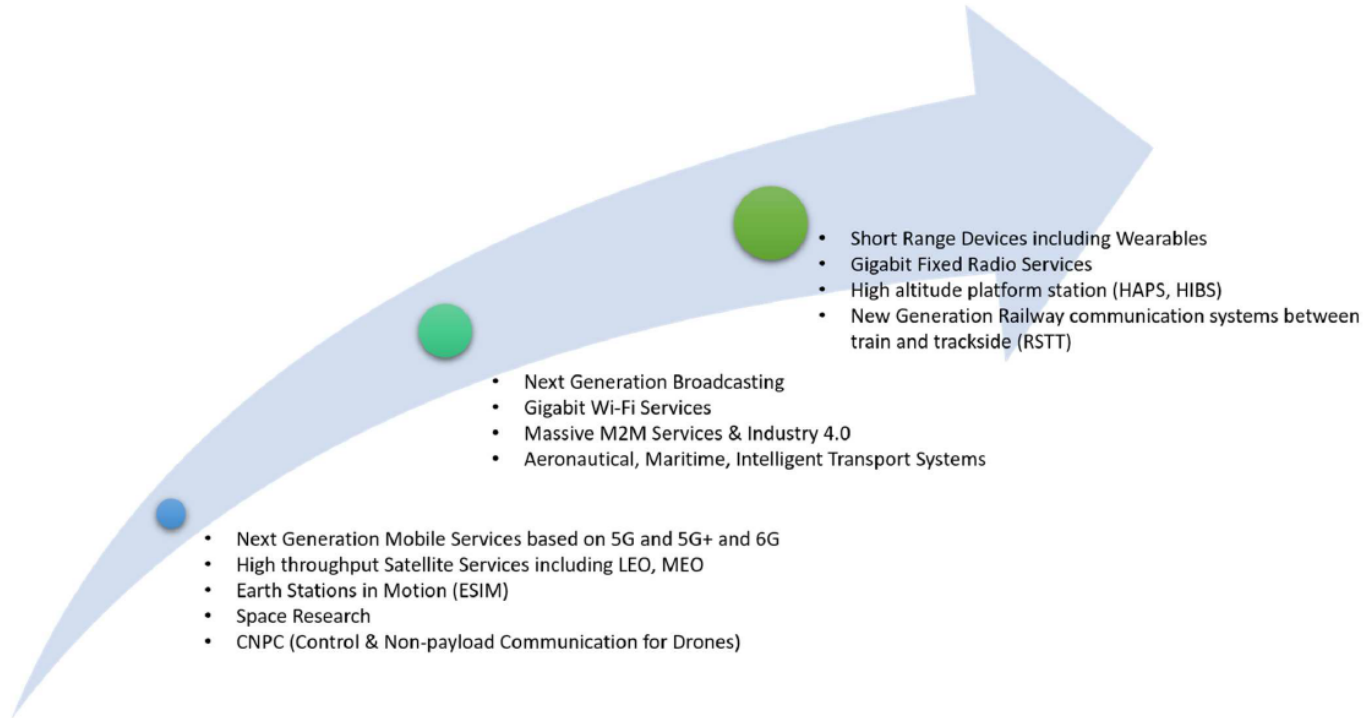


Approach towards ensuring timely and predictable availability of 6G spectrum

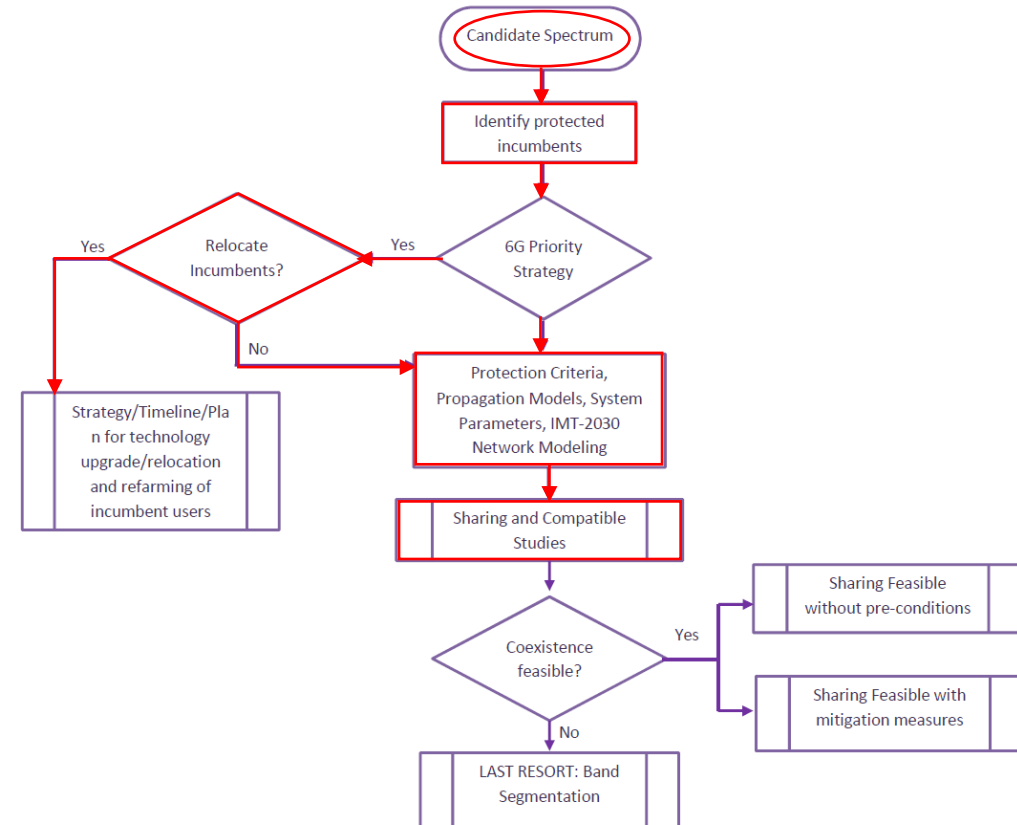


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New Era of Services by 2030 from 5G+ and 6G Technologies



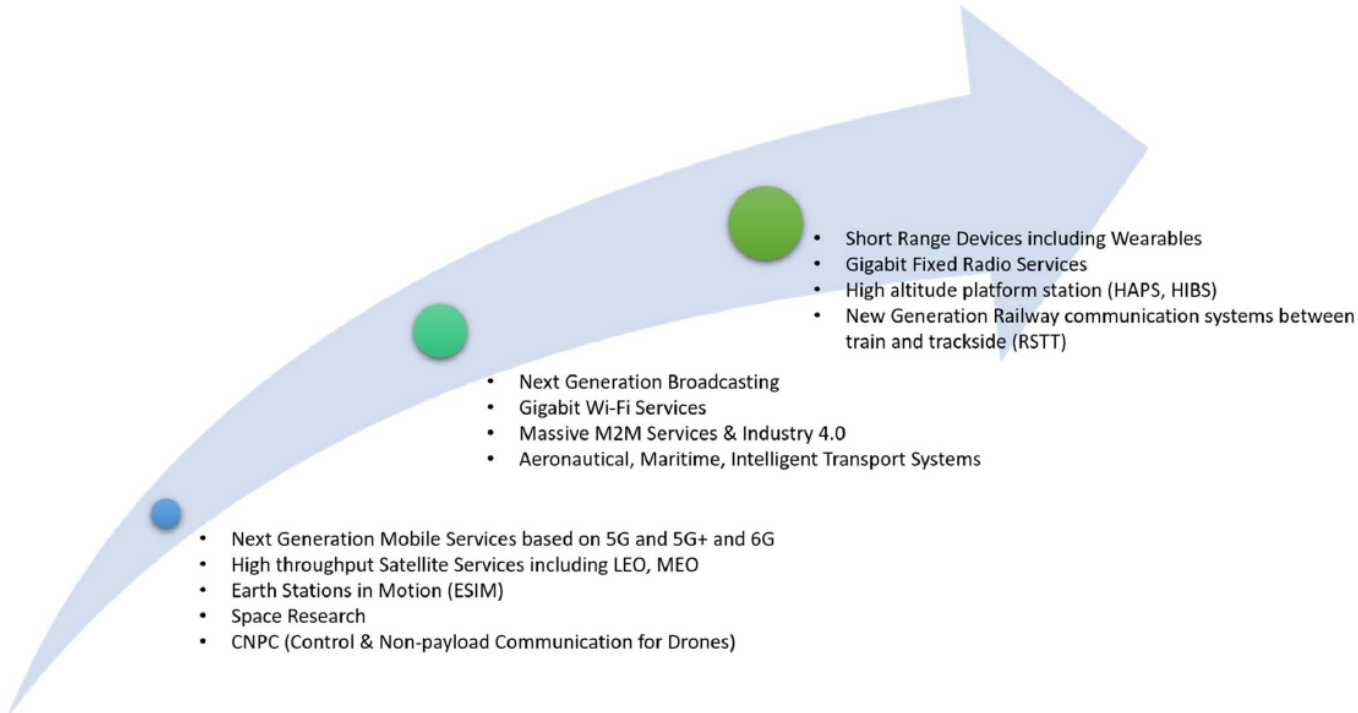
Approach towards ensuring timely and predictable availability of 6G spectrum



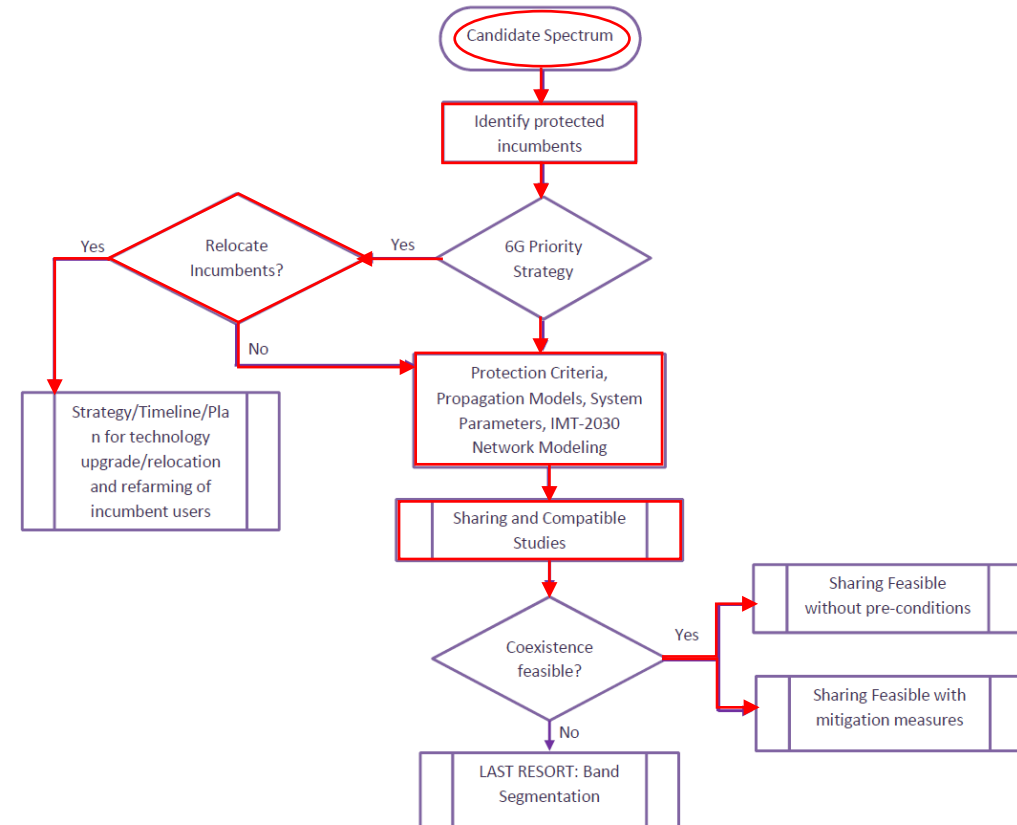


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New Era of Services by 2030 from 5G+ and 6G Technologies

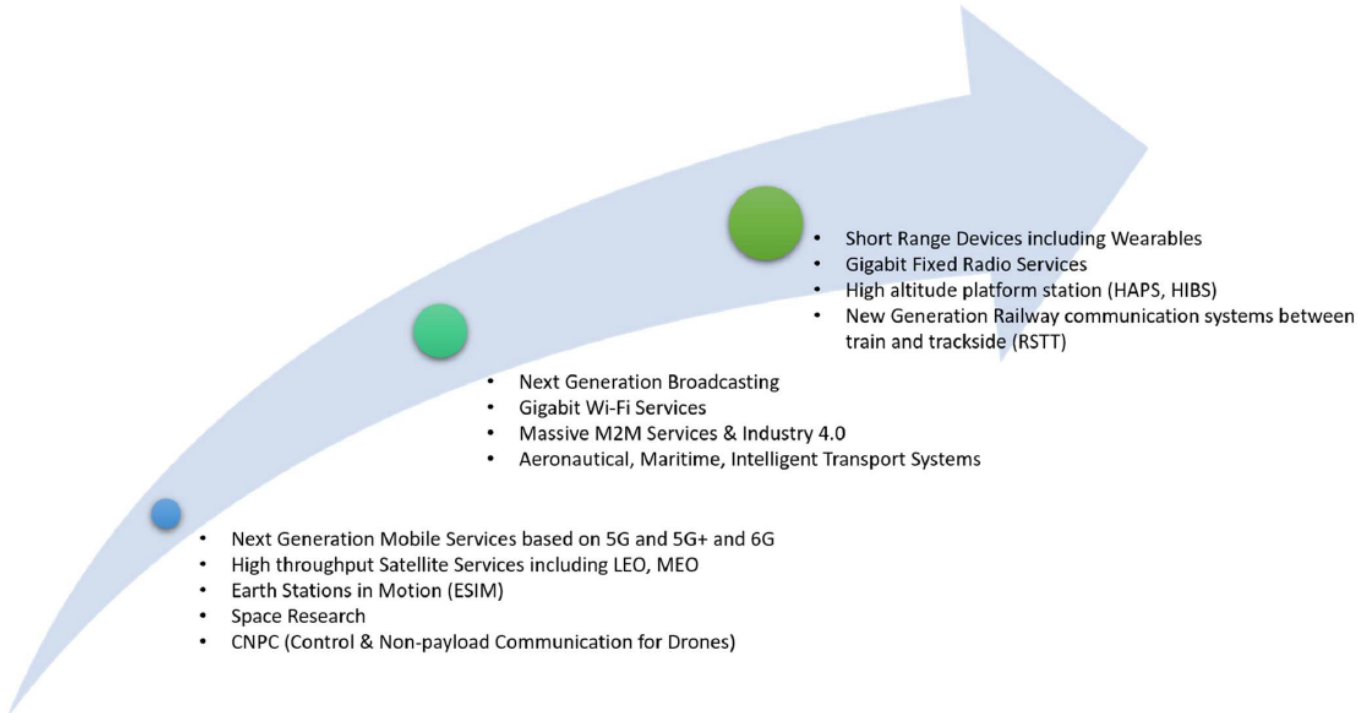


Approach towards ensuring timely and predictable availability of 6G spectrum

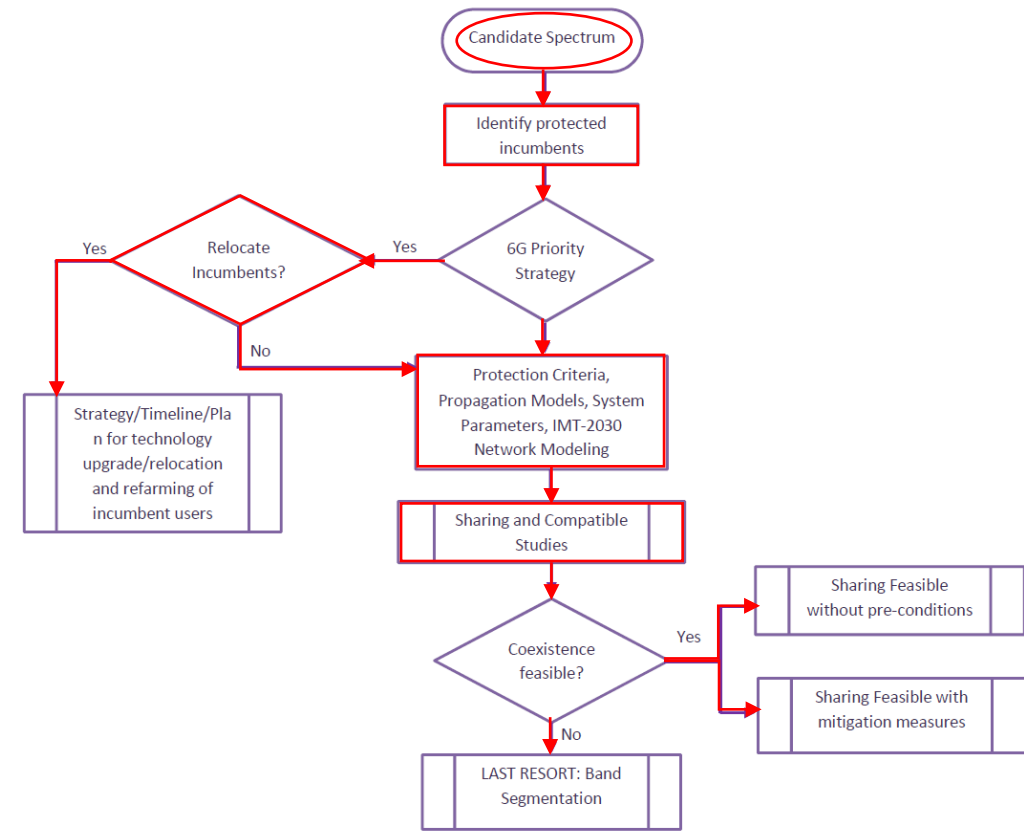


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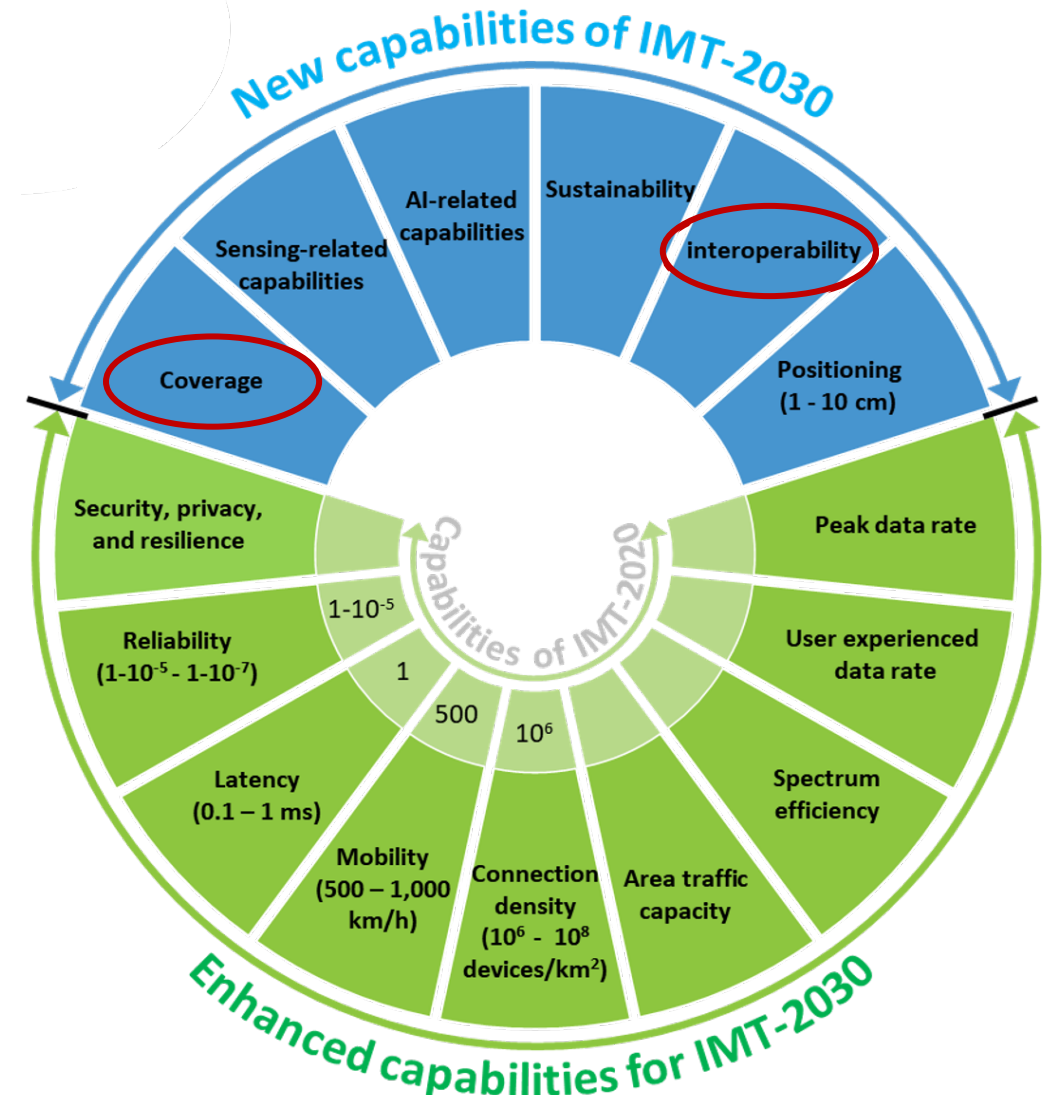
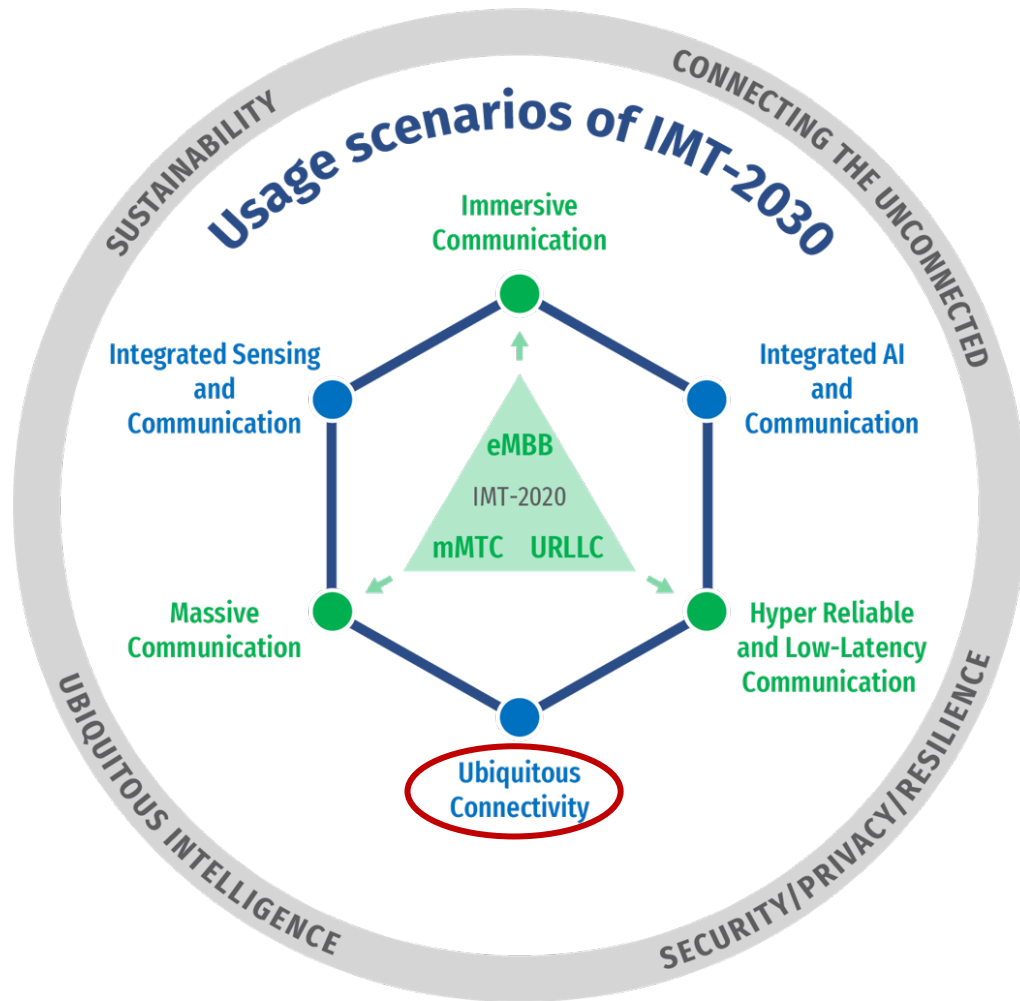


Approach towards ensuring timely and predictable availability of 6G spectrum

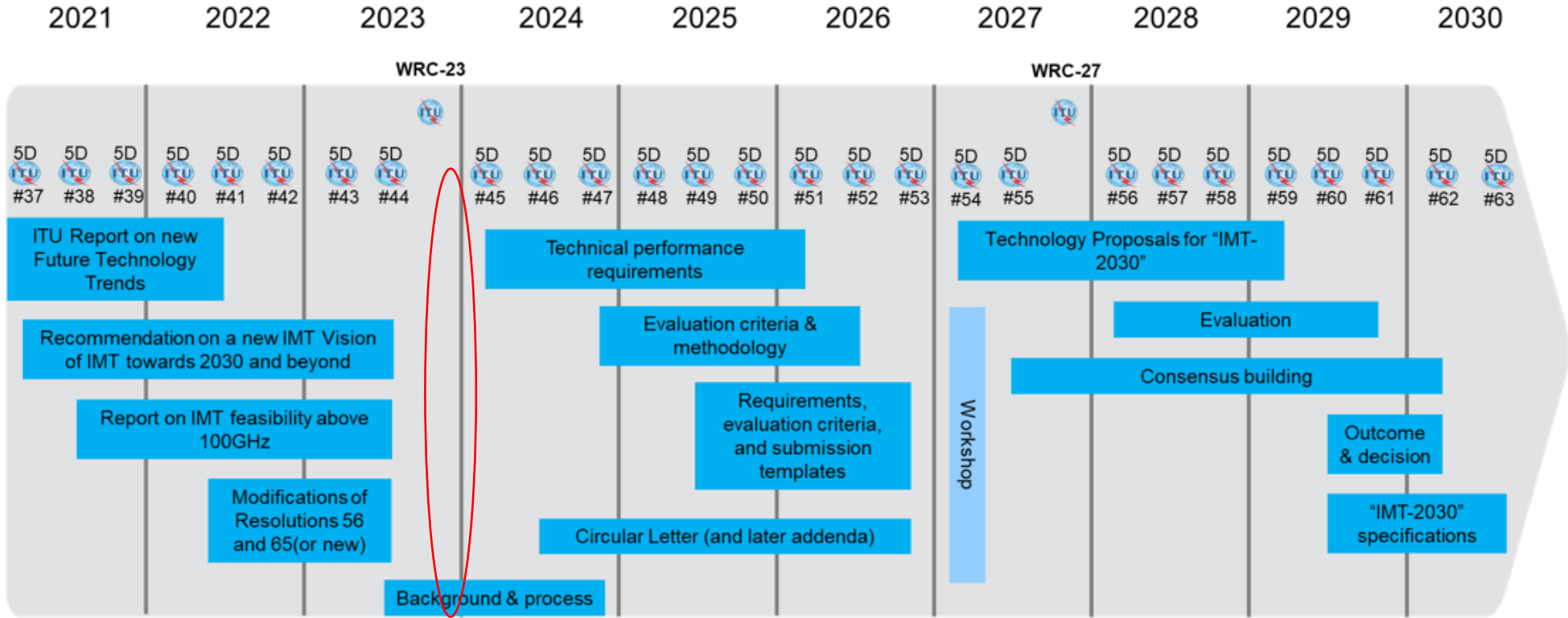


# IMT-2030 Framework

## Usage Scenarios and Capabilities



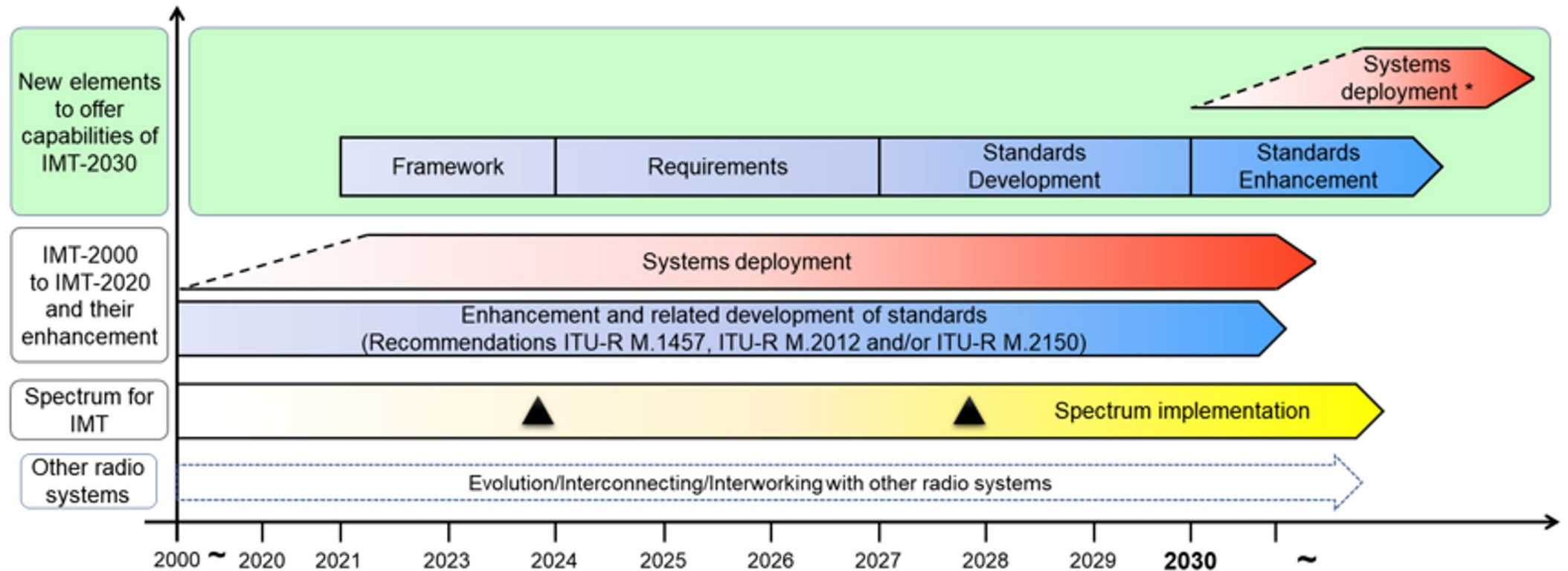
# WP5D Timeline for IMT towards 2030 and Beyond



Note 1: Meeting 5D#59 will additionally organize a workshop involving the Proponents and registered IEGs to support the evaluation process  
 Note 2: While not expected to change, details may be adjusted if warranted. Content of deliverables to be defined by responsible WP 5D groups

# Relationship and Timelines

- Roadmap for technology/standard development, deployment and spectrum
- In addition, enhancement of existing IMTs and relationship with other radio systems



The sloped dotted lines in systems deployment indicate that the exact starting point cannot yet be fixed.

▲ : Possible spectrum identification at WRC-23, WRC-27 and future WRCs

- : Systems to satisfy the technical performance requirements of IMT-2030 could be developed before year 2030 in some countries.
- : Possible deployment around the year 2030 in some countries (including trial systems)

# Mobile has made a leap every ~10 years

Mobile voice communication

Efficient voice to reach billions

Focus shifts to mobile data

Mobile broadband and emerging expansion

A unified connectivity platform

The next innovation platform

1G

2G

3G

4G

5G

6G

1980s

Analog voice

AMPS, NMT,  
TACS

1990s

Digital voice

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

2000s

Wireless Internet

CDMA2000/EV-DO  
WCDMA/HSPA+,

2010s

Mobile broadband

LTE, LTE Advanced,  
Gigabit LTE

2020s

Connected intelligent edge

5G New Radio  
(NR)

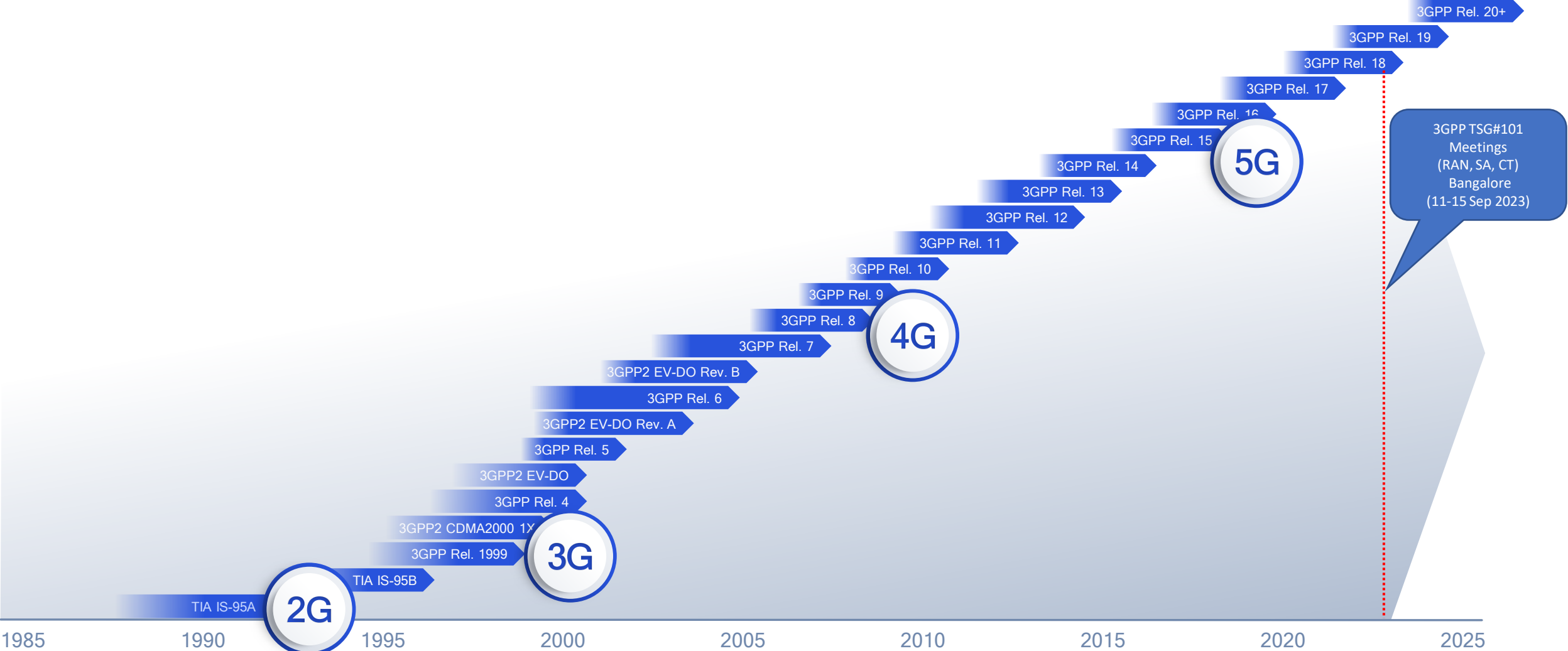
2030s

Next-gen wireless

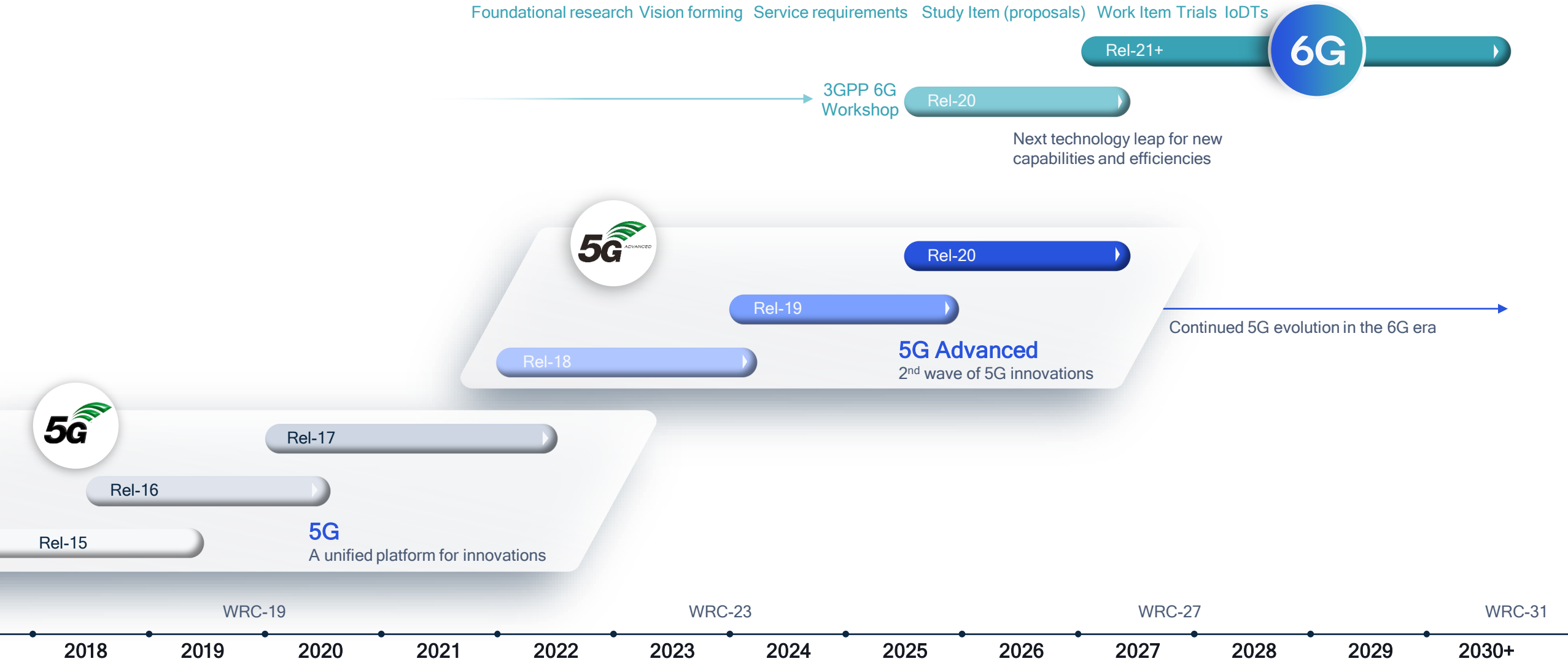
AI-native, new spectrum, RF  
sensing, and many more...

# Cellular technology evolves gradually, building on itself

Each release or generation building on top of previous ones to enable backward compatibility

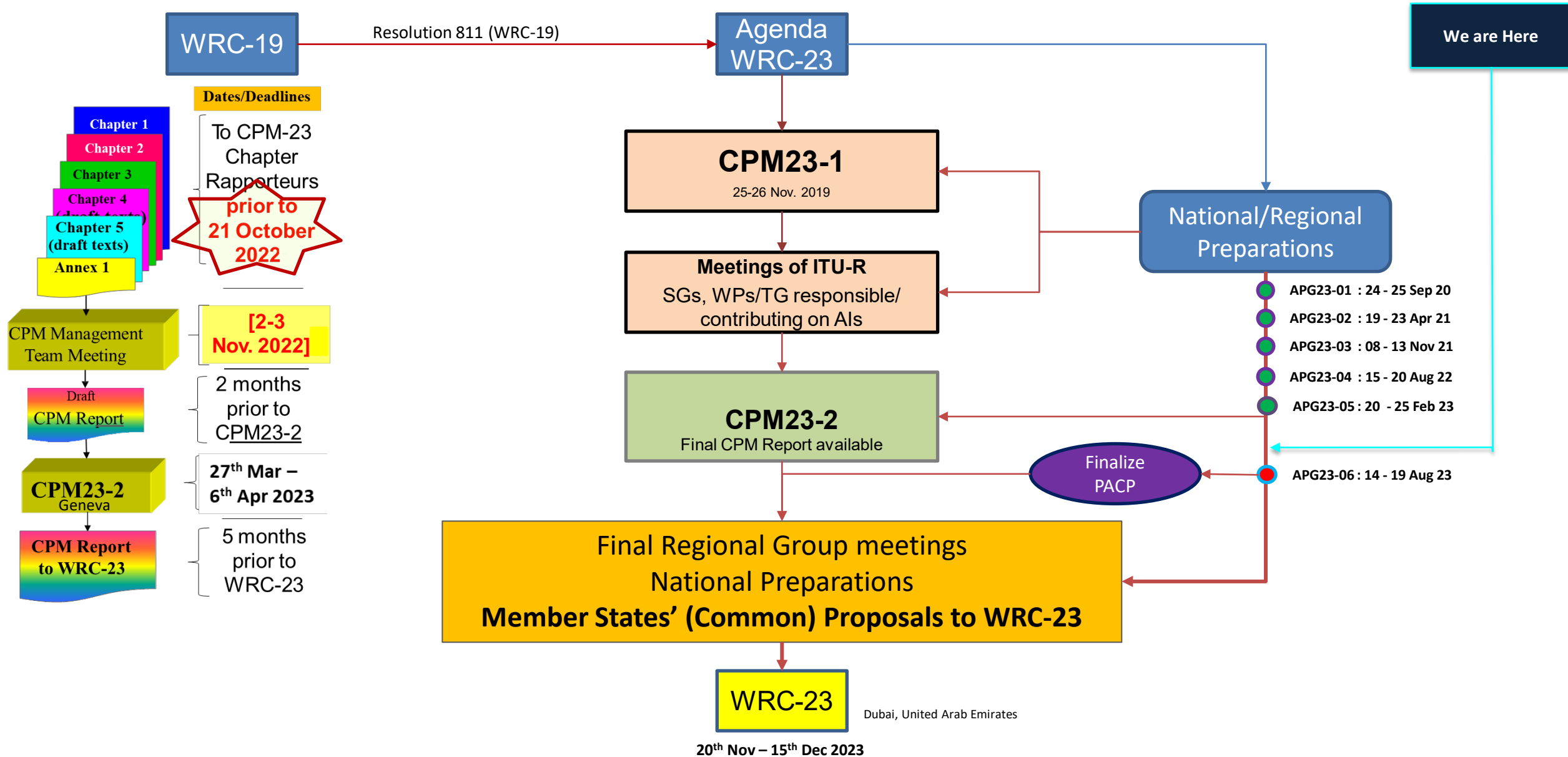


# 5G Advanced on the path to 6G





# WRC-23 Cycle : Main Steps



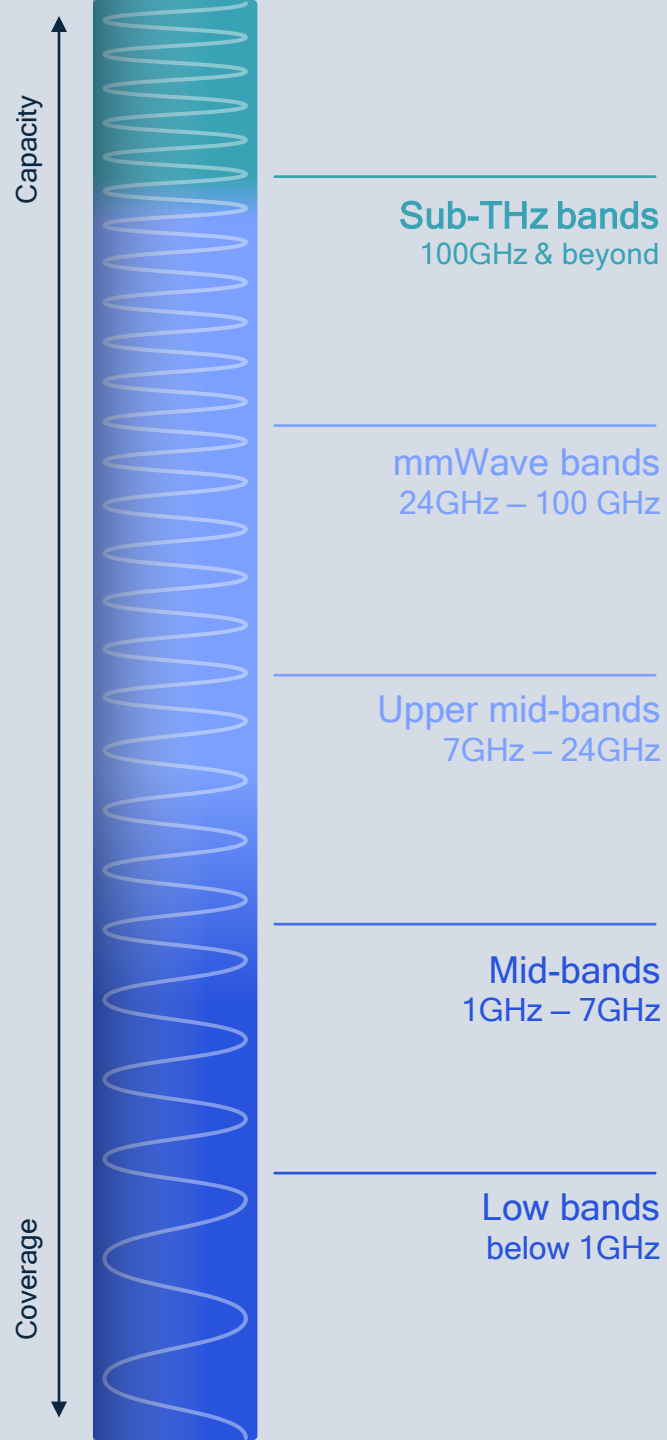
# Proposals for potential Agenda Item for WRC-27

- Following Groups for AI 10
  - Group 10A : New/Revision of Resolutions
  - Group 10B : IMT, WPT
  - Group 10C : Satellite Issues
  - Group 10-2.6 : Space Weather Sensors

# 6G system targets all spectrum types and bands

Critical for the success of next-generation wireless systems

“Sharing by design” approach



## Licensed spectrum

Exclusive use of spectrum that remains the industry's top priority



## Unlicensed spectrum

Shared use of more available spectrum



## Shared spectrum

Evolving spectrum sharing that allow fair and more efficient sharing

# What Spectrum for 6G

## Digital India 2030 Mobile and Broadband Policy Objectives

2022 Roadmap		2030 Roadmap		Spectrum Requirements 2030 (5G+ and 6G)		Spectrum Bands to be made available
High speed broadband to citizens, Enterprises, public services. Connect all villages	→	100 Mbps to every citizen (large coverage of 5G and beginning of 6G)	→	Likely to double from the current planned spectrum quantities (covering lower, mild, millimeter and Tera Hz bands) Diverse access technologies Mobile, GSO, NGSO, HAPS, HIBS, etc.	→	<1 GHz Bands Mid Band: up to 10 GHz <b>6.425-24 GHz Bands</b> Millimetre Bands: 26, 28, 40, 66, 70, 90 GHz, etc. Tera Hz bands
10 Gbps to every GP	→	500 Gbps to every GP	→	High speed backhaul to complement Fibre connectivity	→	Q, V, E, D, W Bands Free Space Optics <b>6.425-24 GHz Bands</b> Free Space Optics
50% Households with Broadband	→	90% Households with High-speed Broadband	→	FWA – Fixed Wireless Access (would be a cost-effective option) using 5G and E, V Band links & other access technologies including fibre	→	Millimeter bands of 37, 50, 66 GHz V Band (57-66 GHz) <b>6.425-24 GHz Bands</b> Free Space Optics

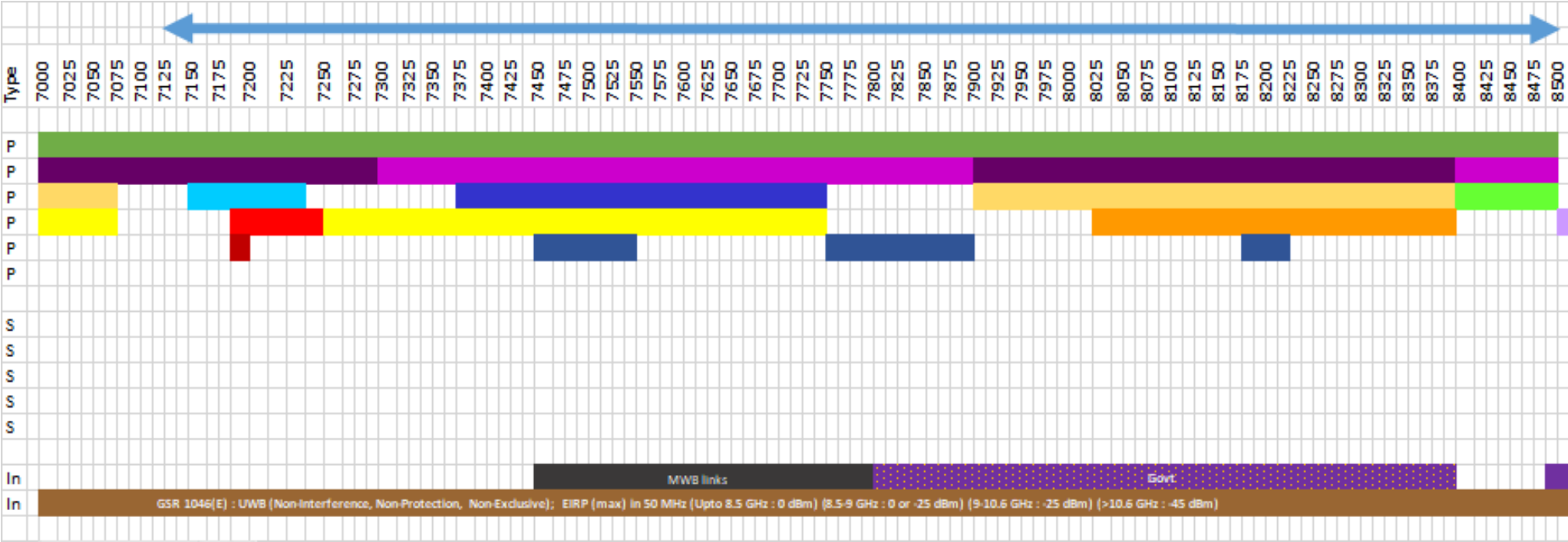
# What Spectrum for 6G

Work progressed so far.....

- Spectrum remains a critical enabler and spectrum discussions have already started in global, regional and national groups
- India decided to support co-existence studies in 7.125-24 GHz range for 6G (IMT)
- India submitted its proposal to APG23-05 in February 2023
- Some other countries also supported (Korea, Japan, Singapore, Vietnam)
- Many countries asked for smaller/sub ranges for discussion
- APG23-05 submitted this proposal without specific range to CPM23-02 in March 2023 under AI 10
- A multi-country proposal from Region 3 was also submitted to CPM23-02 under AI 10
- Support was seen from other regions (except CEPT)
- During offline Region 3 meetings, it was decided to propose sub ranges in APG23-06 meeting
- Industry has aligned on certain sub ranges for 6G co-existence studies
  - 7.125-8.500 MHz
  - 10.7-11.7 GHz
  - 11.7-12.75 GHz
  - 12.75-13.25 GHz
  - 14-14.8 GHz
  - 14.8-15.35 GHz

# Spectrum Situation in India

7 125-8 500 MHz

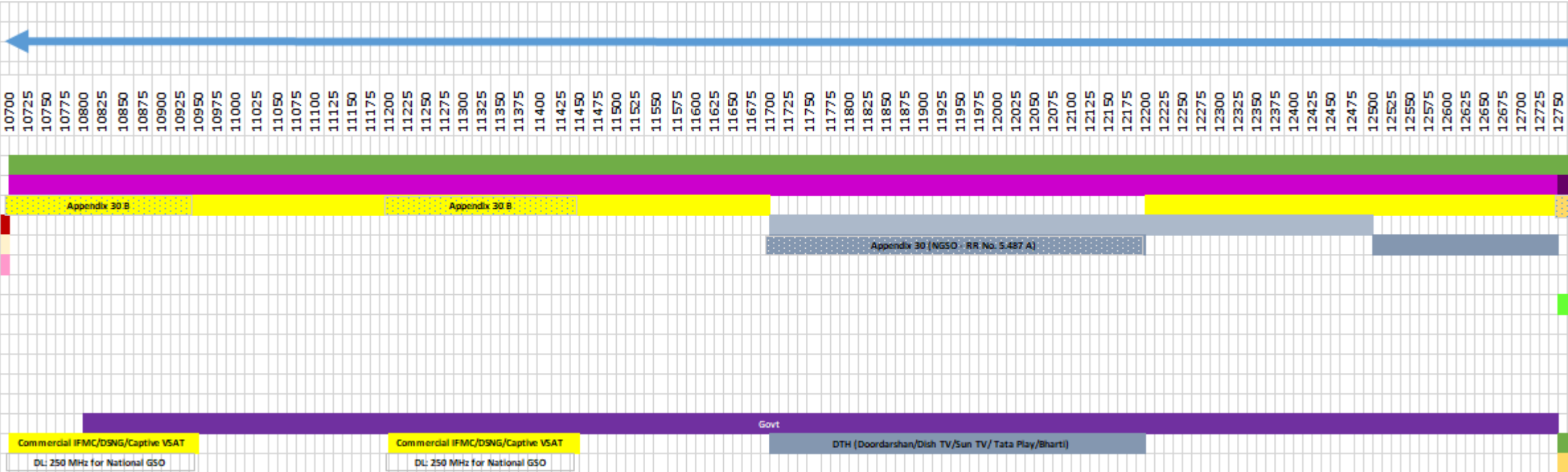


Aeronautical RNS	Grey
Amateur	Light Grey
Amateur Satellite	Dark Grey
Broadcasting	Light Blue
BSS	Blue
EESS (active)	Orange
EESS (E-S)	Red
EESS (passive)	Dark Red
EESS (S-E)	Light Orange
Fixed	Green
FSS (E-S)	Light Yellow
FSS (S-E)	Yellow

Maritime RNS	Cyan
Meteorological (S-E)	Dark Blue
MSS (E-S)	Blue
MSS (S-E)	Light Blue
Mobile	Dark Purple
Mobile w/o Aeronautical	Magenta
RAS	Light Yellow
RLS	Light Purple
RNS	Cyan
SRS (active)	Light Green
SRS (E-S)	Cyan
SRS (passive)	Pink
SRS (S-E)	Light Green

# Spectrum Situation in India

10.7-12.75 GHz

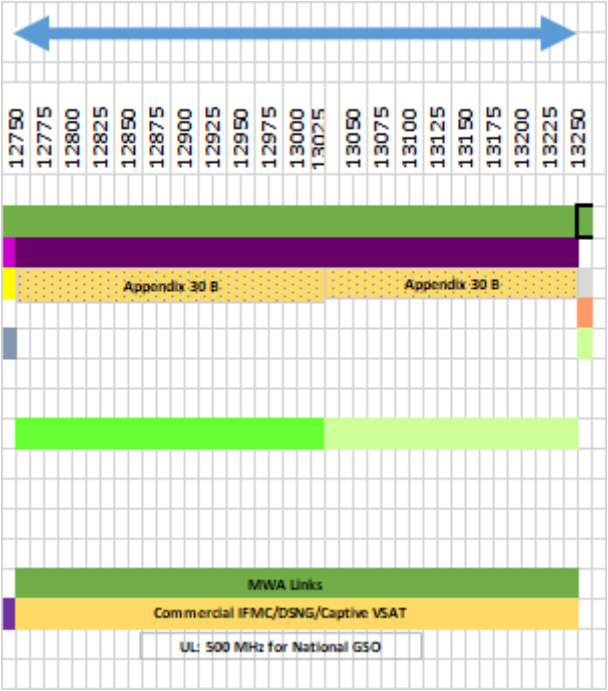


Aeronautical RNS	Grey
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EESS (passive)	Dark Red
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Fixed	Green
FSS (E-S)	Light Green
FSS (S-E)	Yellow

Maritime RNS	Cyan
Meteorological (S-E)	Dark Blue
MSS (E-S)	Blue
MSS (S-E)	Light Blue
Mobile	Purple
Mobile w/o Aeronautical	Dark Purple
RAS	Light Yellow
RLS	Light Purple
RNS	Light Cyan
SRS (active)	Light Green
SRS (E-S)	Light Blue
SRS (passive)	Pink
SRS (S-E)	Light Green

# Spectrum Situation in India

12.75-13.25 GHz



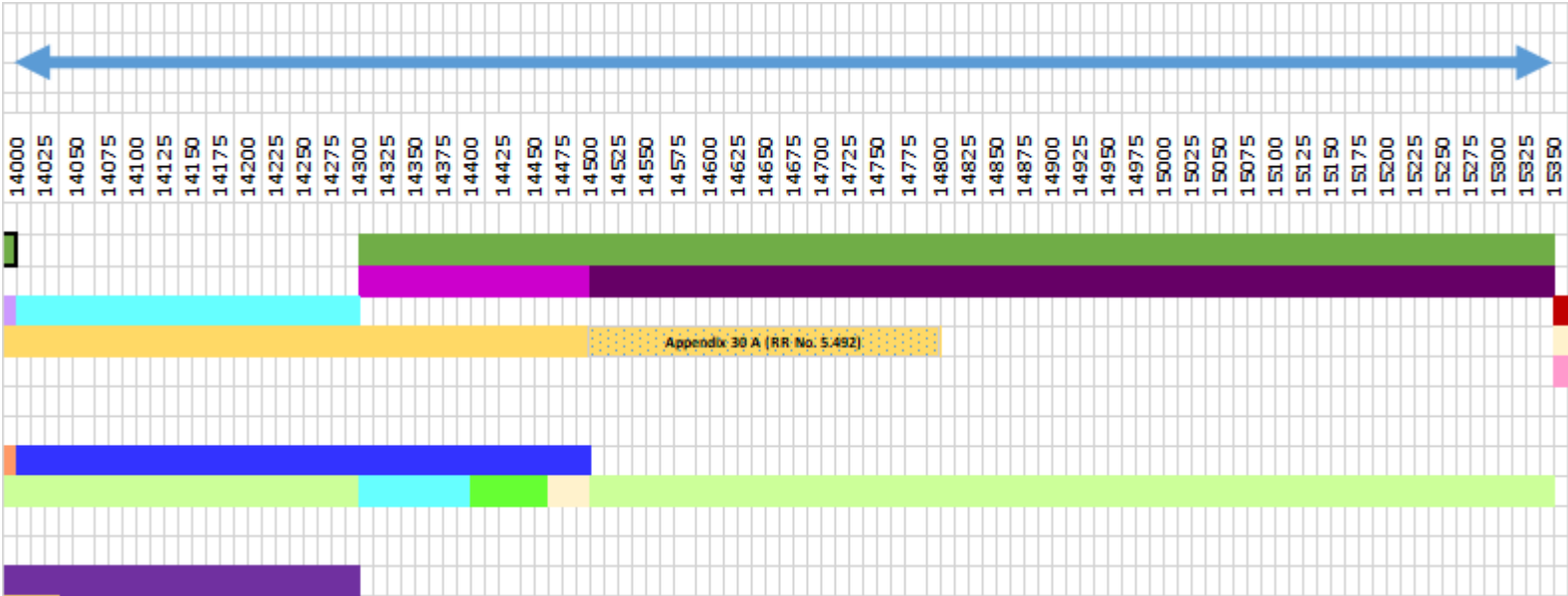
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BSS	Blue
EESS (active)	Orange
EESS (E-S)	Red
EESS (passive)	Dark Red
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Fixed	Green
FSS (E-S)	Light Yellow
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Meteorological (S-E)	Dark Blue
MSS (E-S)	Blue
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Mobile w/o Aeronautical	Magenta
RAS	Light Yellow
RLS	Light Purple
RNS	Cyan
SRS (active)	Light Green
SRS (E-S)	Light Blue
SRS (passive)	Pink
SRS (S-E)	Light Green



# Spectrum Situation in India

14.0-15.35 GHz



Aeronautical RNS	Grey
Amateur	Light Grey
Amateur Satellite	Dark Grey
Broadcasting	Blue-White
BSS	Blue
EESS (active)	Orange
EESS (E-S)	Red
EESS (passive)	Dark Red
EESS (S-E)	Dark Orange
Fixed	Green
FSS (E-S)	Yellow-Orange
FSS (S-E)	Yellow

Maritime RNS	Cyan
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# 6G : Leveraging cellular for non-terrestrial communication

## 5G Rel-15

Study focused on deployment scenarios and channel models

## 5G Rel-17

Projects focused on satellites for eMBB & IoT<sup>1</sup> and HAPS/UAV

## 6G

Continued evolution of 5G NTN & NTN IOT into the 6G era, depending on ecosystem status at that time

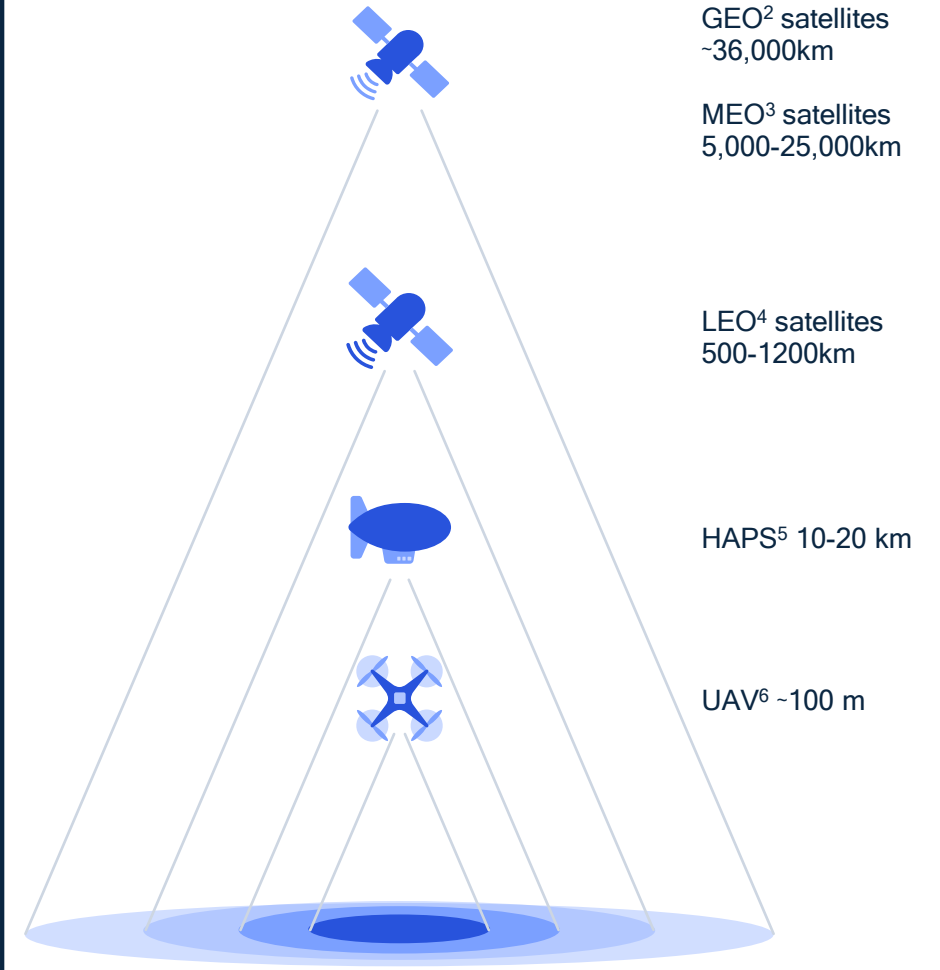
## 5G Rel-16

Study focused on adapting 5G NR to support NTN

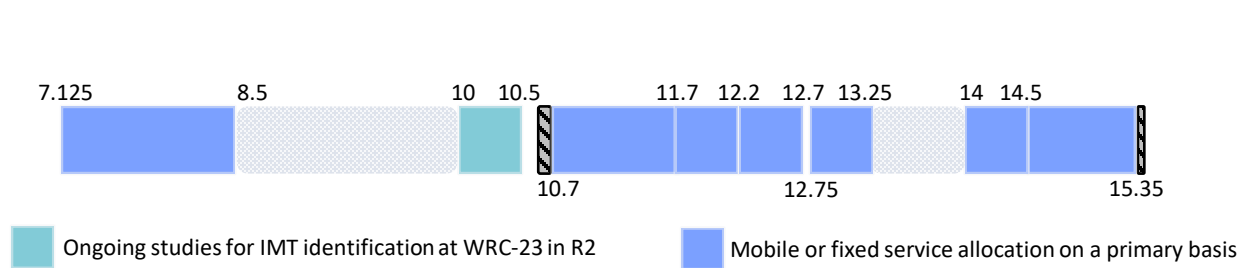
## 5G Rel-18+

Further enhancements for UAV, HAPS, and satellites

1 eMTC and NB-IoT; 2 Geostationary; 3 Medium Earth Orbit; 4 Low Earth Orbit; 5 Unmanned Aerial Vehicles; 6 High Altitude Platform Station;



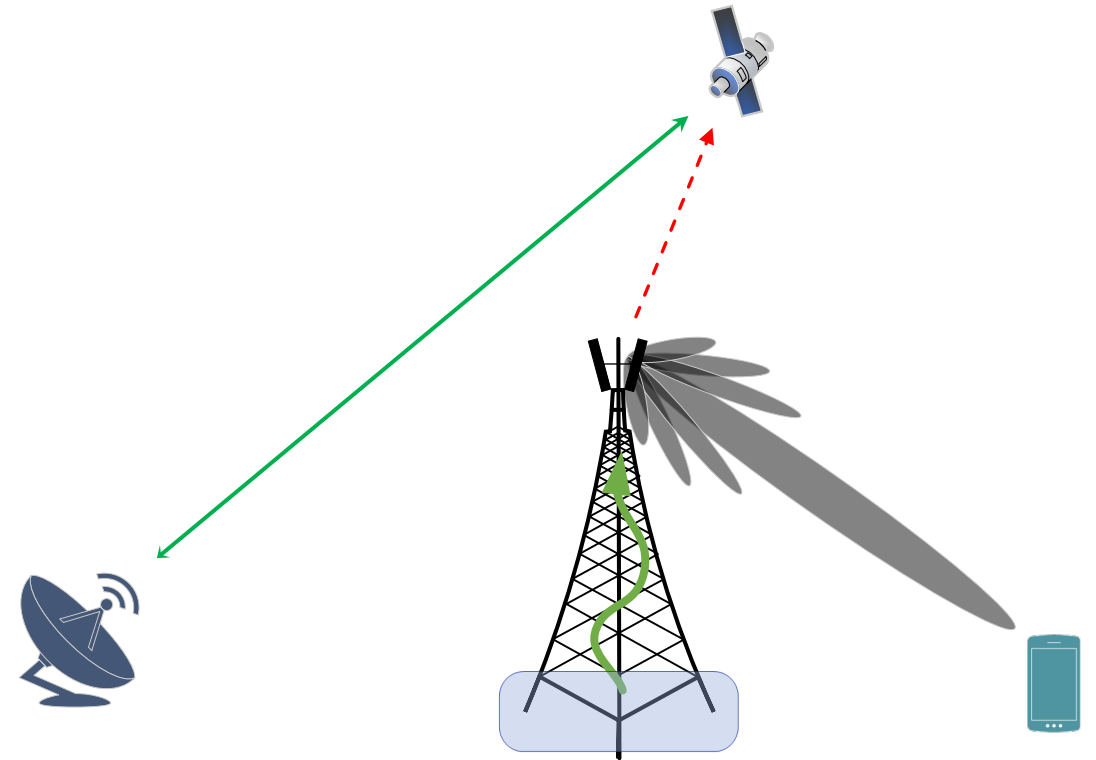
# Giga-MIMO improves coexistence with other systems



Compared to previous generations, we expect 6G design to account for sharing with non 3GPP systems, i.e., implementing a “sharing by design” approach

Giga-MIMO allows tight control of very narrow beams that in the presence of incumbent systems enable new coexistence approaches

Specific sharing mechanisms will depend on the target bands and incumbent systems



Flexible new 6G air interface design with native support for spectrum sharing

Qualcomm

# Driving the path to 6G

ongoing research vectors to enable innovative use cases for 2030 and beyond



Communications



AI & compute



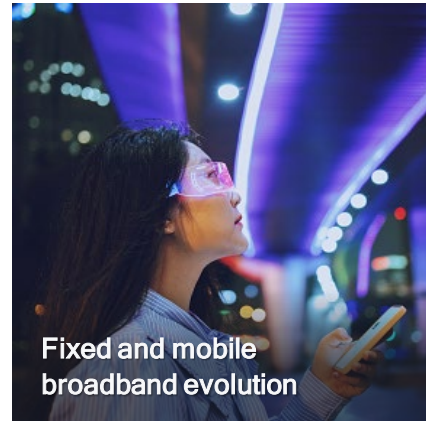
System resiliency



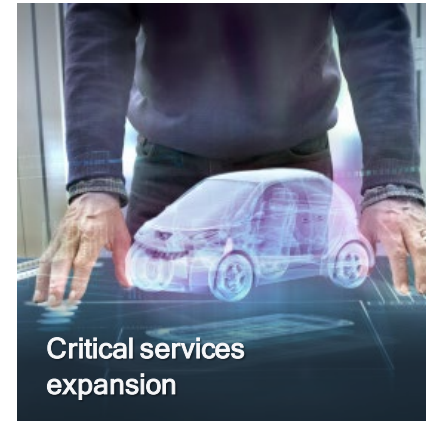
Integrated sensing



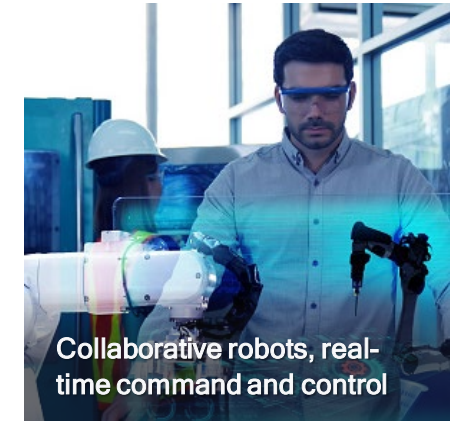
Green network and devices



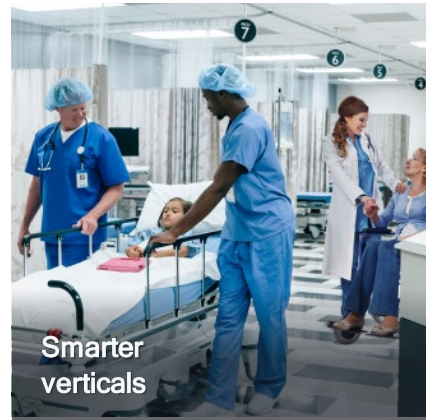
Fixed and mobile broadband evolution



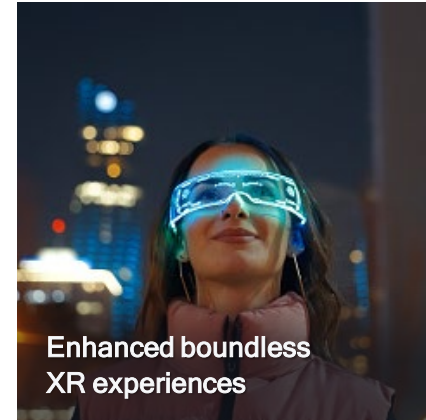
Critical services expansion



Collaborative robots, real-time command and control



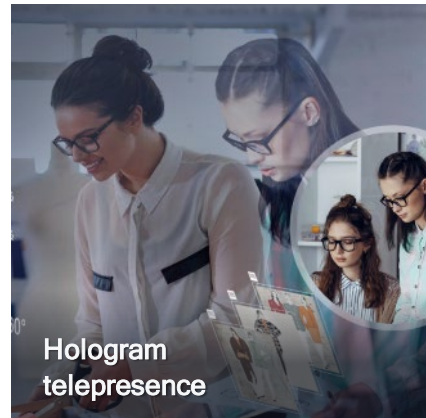
Smarter verticals



Enhanced boundless XR experiences



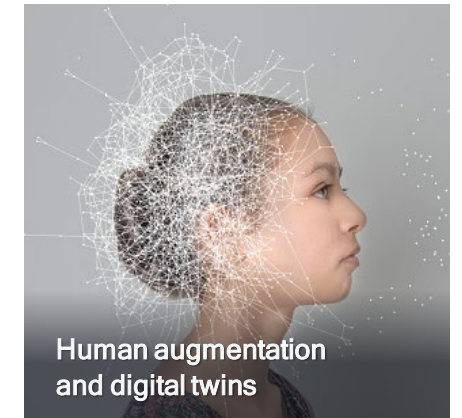
Wireless sensor fusion



Hologram telepresence



Ultra-wide area to micro connectivity



Human augmentation and digital twins

Thankyou