

6G Spectrum requirements & Potential bands for study in India

**National Conference on
6G Spectrum, Technologies, and Standardization**

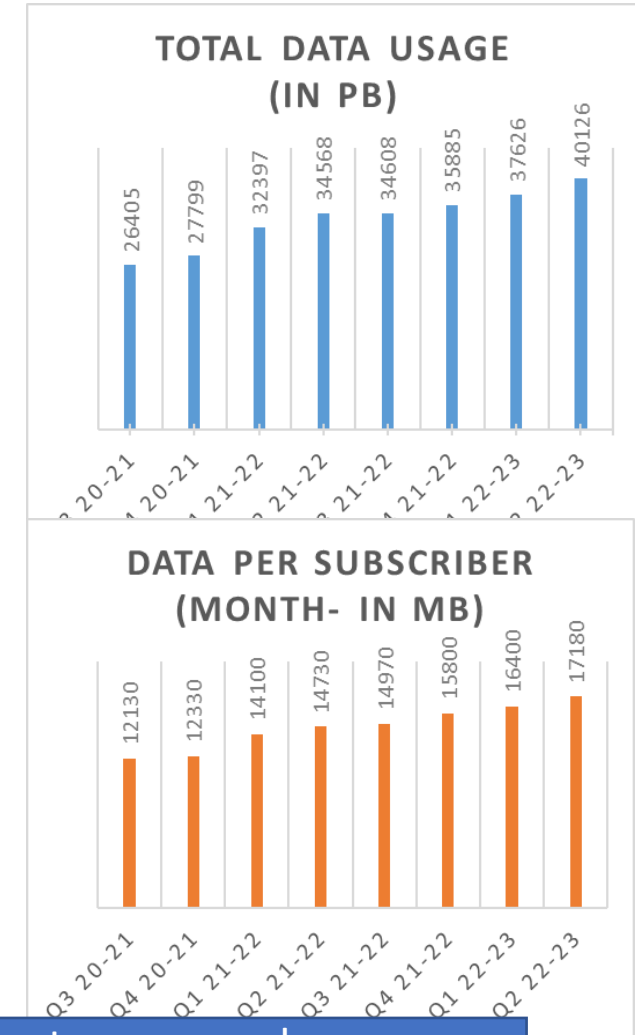
Reliance Jio



Growth of Mobile Broadband in India

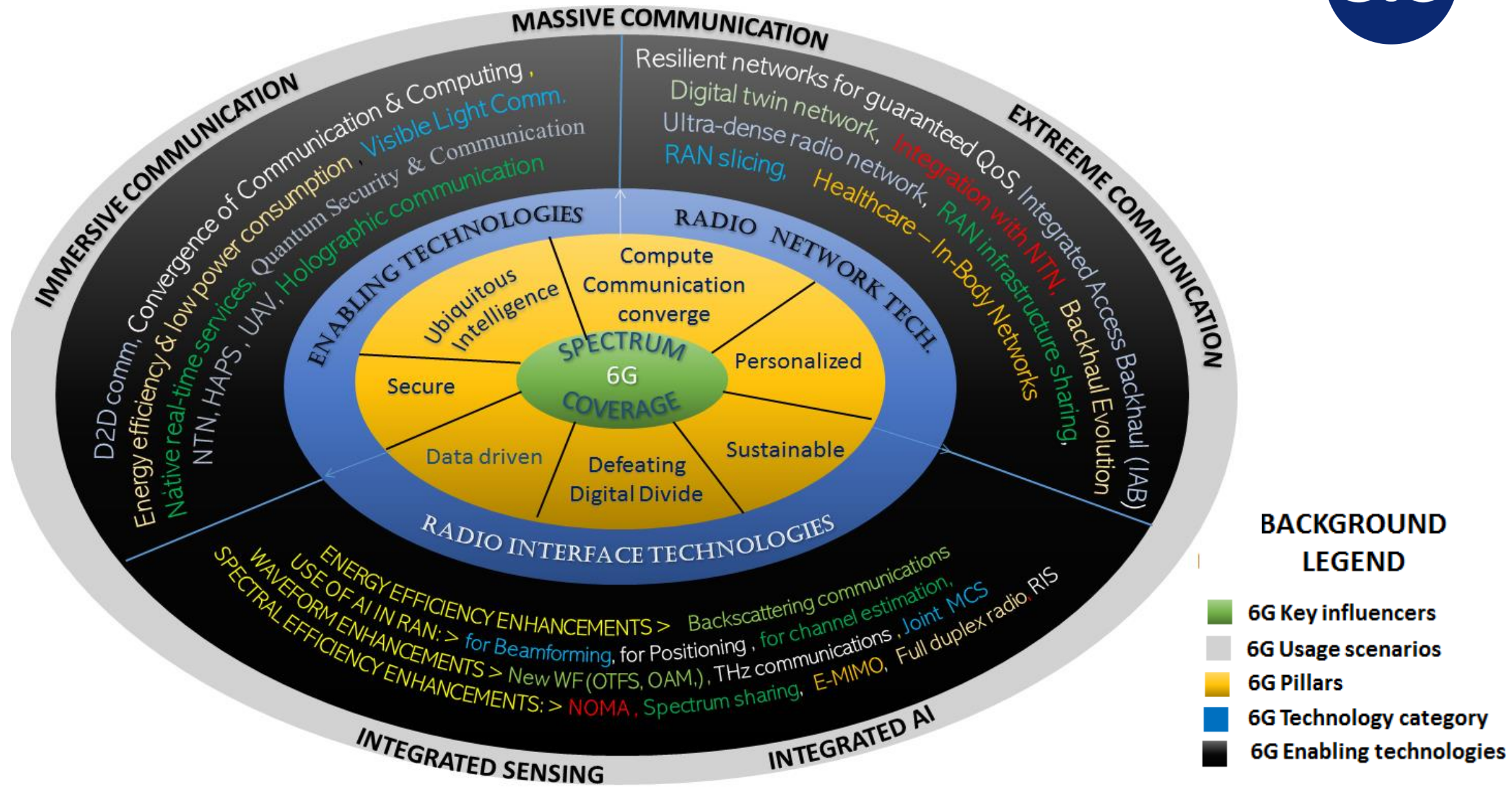


- The Indian Broadband connections rose to **839.18 million** in January 2023 from 61 million in March 2014, indicating growth of **1275%**.
- The **wireless broadband** account for more than **96%** of the broadband subscribers (806.07 million).
- On Jio's network, the data traffic has increased to **29.0 Exabytes**, up 23.6% YoY & with Per capita data consumption at **22.4 GB/ month**.
- The year 2022 witnessed Highest-ever auction revenue proceeds received from a single auction. Over **51,236 MHz** (71% of the total) was sold with bid amounting to **Rs. 1,50,173 cr**.
- Reliance Jio has acquired 5G spectrum in all the bands (Low- 700 MHz/Mid- 3.5 GHz/High bands- 26.5 GHz).
- With a total **5G BTS** of more than **1.2 Lakh**, Reliance Jio is the first telecom operator to extend futuristic and pioneering **True 5G services** in over **406 cities**.
- To further enhance the growth of India's digital transformation, adequate spectrum should be identified in various bands for IMT 2030.

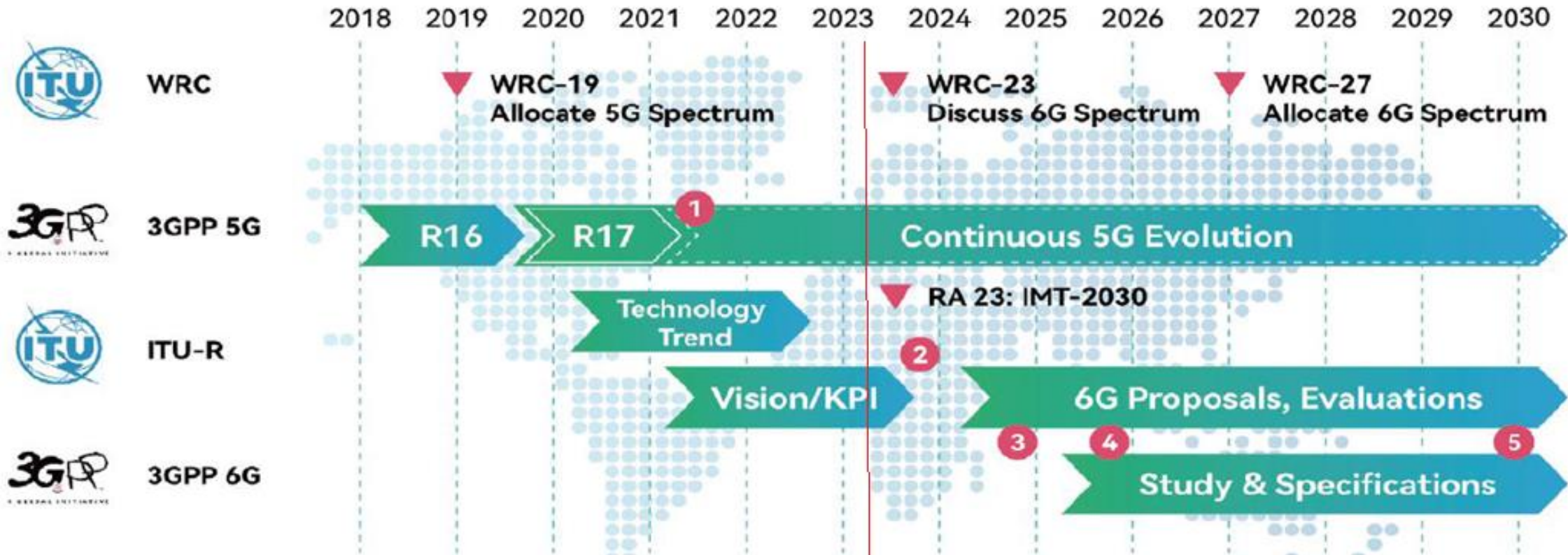


Mobile data is the key towards the success story of cheapest Broadband to the largest consumer base .
Availability of adequate low & mid-band spectrum is crucial to ensure the sustainability of the same.

IMT2030 Landscape



Potential IMT2030 Timelines



- 1 R18 starts 5.5G standardization
- 2 6G vision before WRC-23 ————— Approval of IMT2030 Framework document in June meeting
- 3 At the end of 2024, 6G workshop
- 4 At the end of 2025 or early 2026, 3GPP starts study of 6G (Requirement, SI, WI ...)
- 5 First specification of 6G finished in 3GPP in 2030



Spectrum needs of IMT2030 use cases

Estimated required spectrum needs per network to support the studied IMT-2030/6G use cases

Unit: GHz	XR	Holographic communications	ISAC/JCS
Wide area use cases	1	1.1	0.3-0.75
Local area use cases		>10s of GHz	>15

Source: "IMT-2030 (6G) SPECTRUM NEEDS ANALYSIS", APG23-5, GSA

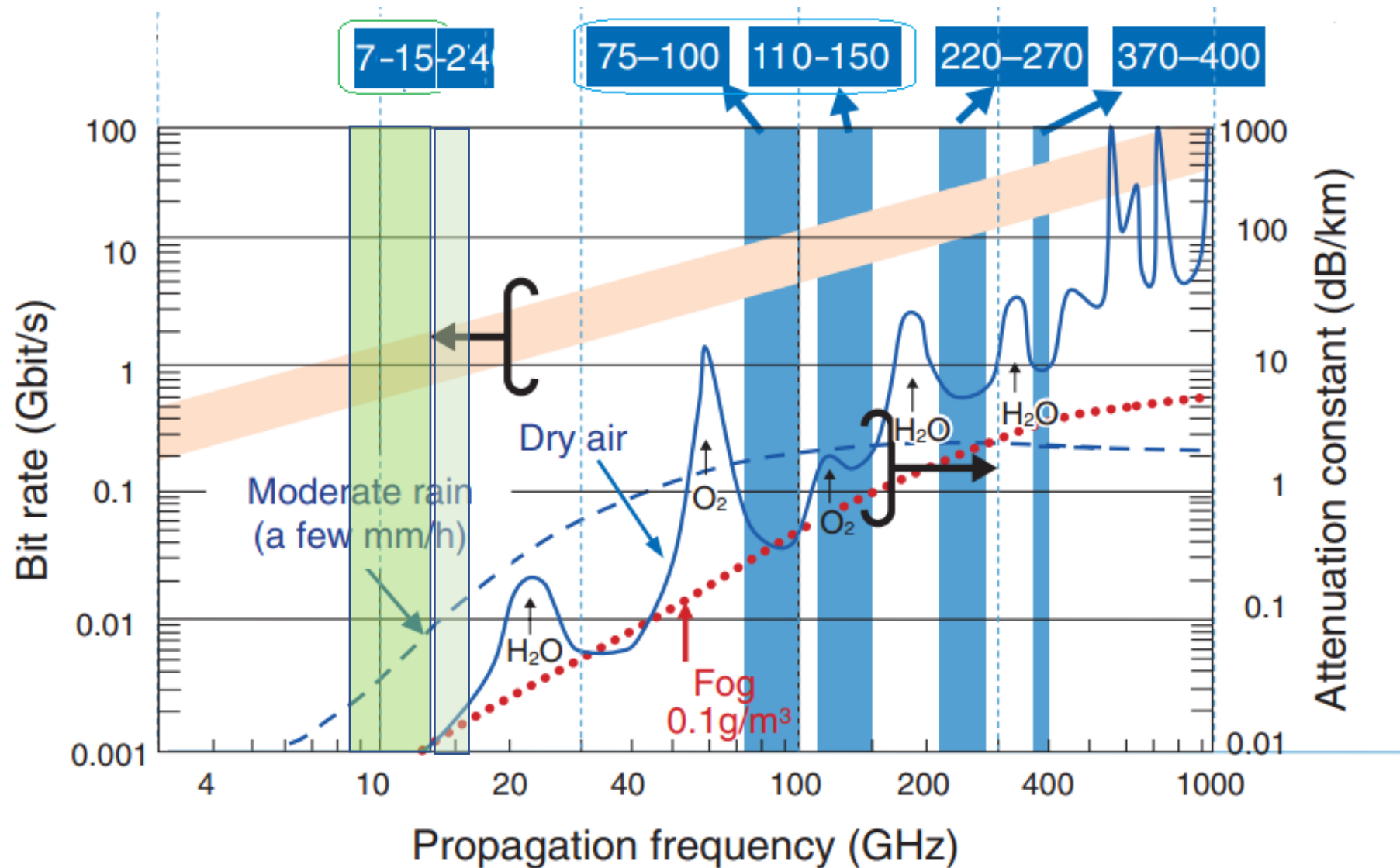
Required contiguous bandwidth – applicable for outdoor applications

Sensing range resolution Δr (in cm)	50	20
Required bandwidth B (GHz)	0.3	0.75

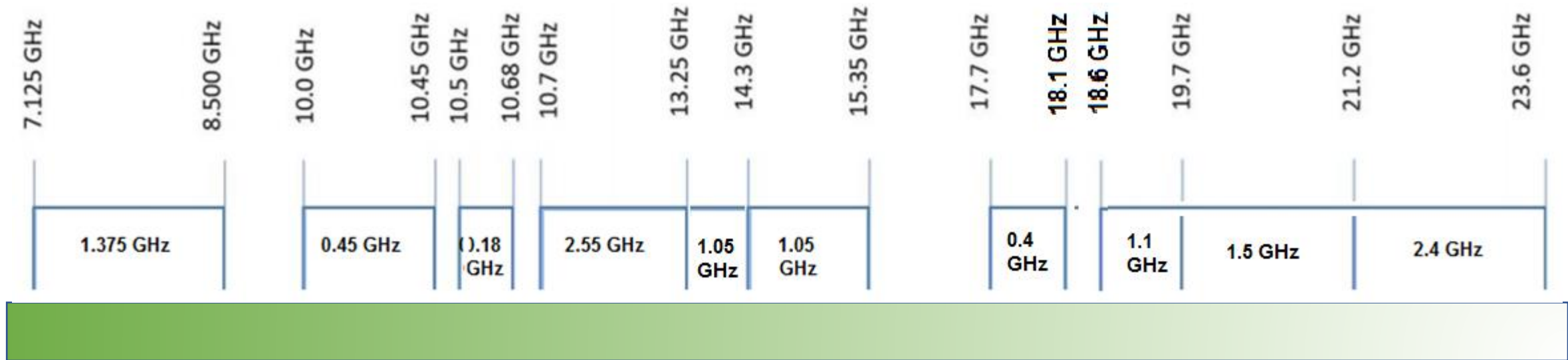
Required bandwidth – applicable for certain industrial applications

Sensing range resolution Δr (in cm)	1	<1
Required contiguous bandwidth B (GHz)	15	>15

Green Networks -> Optimum Spectrum



Mobile Service Allocation (Primary): 7.125 – 24 GHz, NFAP 2022



Indian industry appreciates the clear and concise position by Indian administration in APG23-5 meeting towards WRC23A.I. 10 IMT candidate bands.



WRC23 A.I. 10 : 7.125- 24 GHz

Following WRC23 AI10 Recommendation options can be identified per India NFAP 2022:

- 1. Priority -A:** Frequencies allocated only for Mobile & FS and/or shared with FSS (E-to-s) ,
 - No allocations for satellite services in the portions of bands
 - Sharing of spectrum with FSS (Earth-to-space) is possible (based on previous studies outcome in WRC-19 AI 1.13 and WRC-23 AI 1.2)

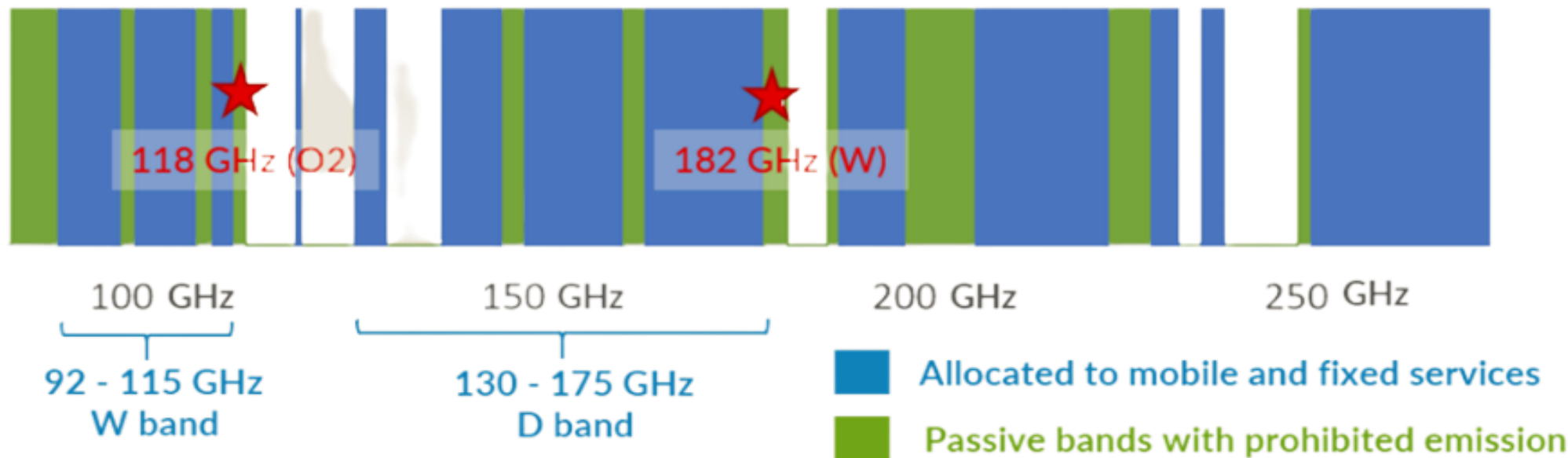
- 2. Priority-B:** Frequencies allocated for Mobile service and shared with EESS & SRS,
 - Sharing is feasible due to limited number of EESS earth stations (based on previous studies outcome in WRC-19 AI 1.13)
 - EESS (passive) allocations shared with active services in Region 3. Coexistence with 6G ICAS/IAB to be analyzed.

- 3. Priority -C:** Frequencies allocated for Mobile service shared with FSS (s-to-E),
 - Sharing might be challenging and to be consider on case-by-case basis, as an exclusion zone might be needed for coexistence.



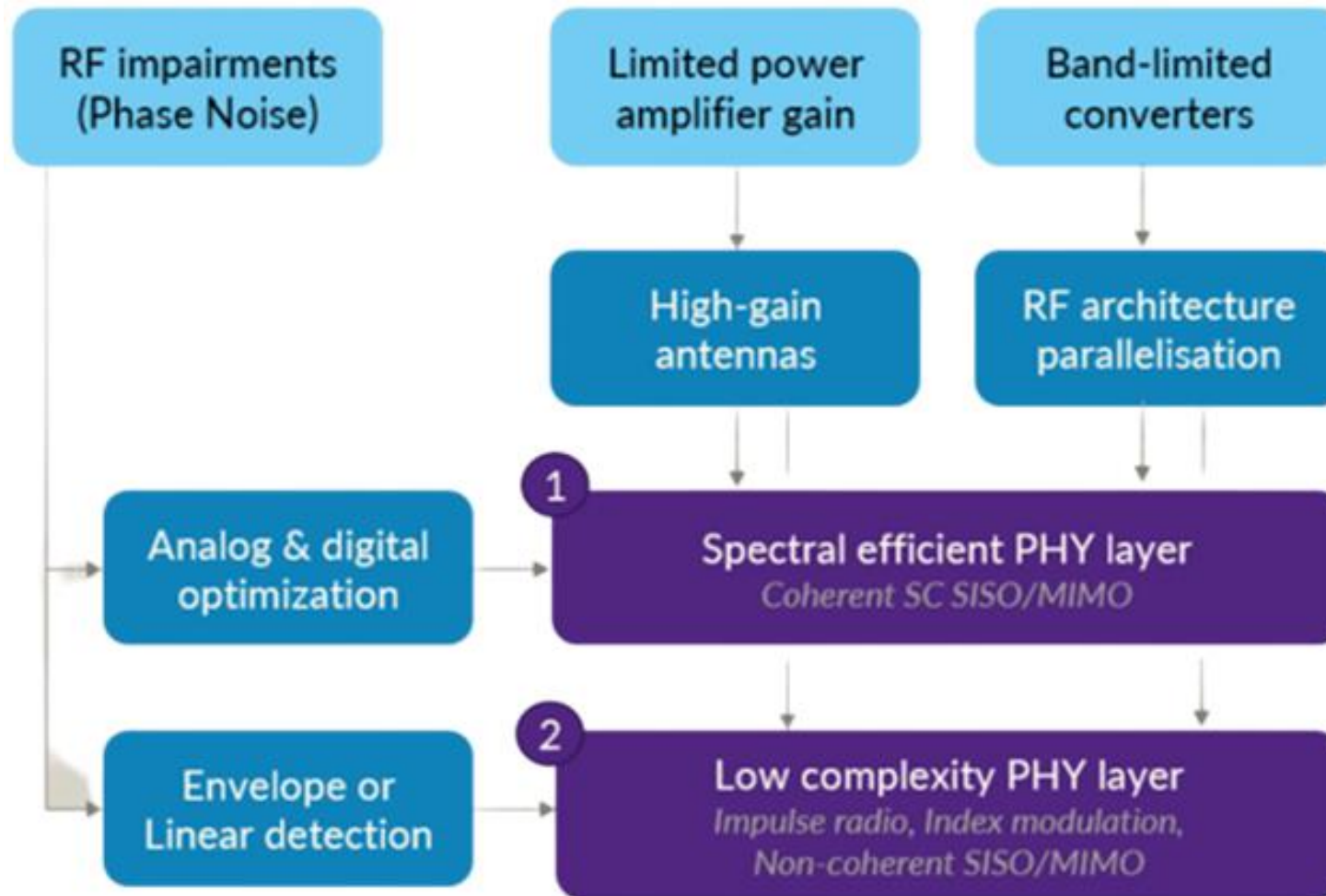
International Regulation in 90 to 275 GHz

The international Radio Regulation (RR) decided in 2000 which frequencies between 90 and 275 GHz can be used for fixed or mobile radio-communication services: 105.1 GHz in total across all regions. Emergence of two bands, the W and D bands, can be seen.



The use of the sub-THz frequency range relies on the development of components and an equipment ecosystem. This requires time to reach maturity, starting from the lowest sub-THz frequencies and slowly moving upwards in frequency.

Sub-THz band: Technological constraints





6G Usage scenarios

Extended mid-band

- Traditional MBB
- Massive Digital twinning
- Internet of senses
- Holographic communication

Sub-THz band

- High-capacity backhaul
- Enhanced short-range hotspot
- Device-to-device communications
- Joint sensing

The 6G use cases applicable for each band are unique and depend upon the propagation characteristics of the band. Hence the role of each band- Low, Mid & High- is critical, indispensable, and irreplaceable in 6G journey.

National framework: Spectrum research & studies



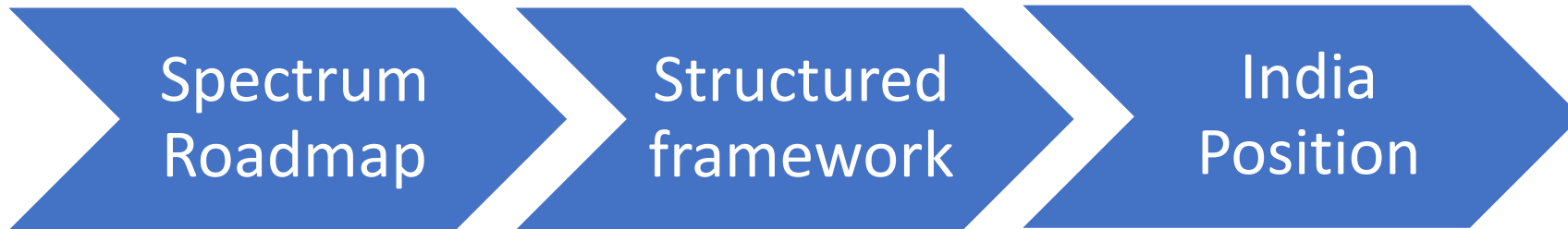
Potential Contributors

-
- COAI - Indian Industry
- Indian Academia – propagation modeling
- TSDSI – Regional SDO. Good platform to contribute on technical aspects.

Challenges

-
- Availability of incumbent Spectrum allotment details
- Availability of usage parameters of incumbent services
- Involvement of appropriate stakeholders in Spectrum studies
- Availability of a common national platform for sharing studies
- Channel & clutter modeling for Indian Metro cities

6G spectrum identification framework



Public consultation on spectrum requirements for all sectors & potential sharing and associated study cases.

Outcome:
Spectrum roadmap vision document

National preparations with proactive approach

- Regular meetings
- Technical workshops
- Annual calendar per year

TEC NSG to evolve into National forum for modeling sharing & compatibility studies.

Ensure availability of Spectrum & Usage parameters

Contributions to WP 4A (Satellite), 5D (IMT), 3K, 3M (Propagation)

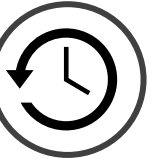
Outcome:
Clear formulation of Indian position on crucial WRC27 Ais.

Concise strategy on leveraging / extending global support accordingly

2023
Goal Setting



2024
WRC23 Review



2025-26
ITU-R WP 3K, 3M 4A, 5D



2027
India specific Results & positions on crucial WRC27 A.I.s





References

1. ITU-R Report [M.2516](#) "Future technology trends of terrestrial International Mobile Telecommunications systems towards 2030 and beyond", November 2022
2. ITU-R [\[1668\]](#), "Draft Working document towards a PDNR ITU-R M.[IMT.FRAMEWORK FOR 2030 AND BEYOND]", February 2023
3. "Overview of Millimeter and Terahertz Wave Application Research", NTT Microsystem Integration Laboratories Atsugi-shi, 243-0198 Japan
4. TSDSI [TR 6017](#), "6G: Use cases, Requirements and Enabling Technologies", July 2022
5. "IMT-2030 (6G) SPECTRUM NEEDS ANALYSIS", APG23-5, GSA
6. White paper - "Wireless connectivity in the sub-THz spectrum: A path to 6G", BRAVE



mail to: vinay.shrivastava@ril.com



<https://www.linkedin.com/in/vinayshrivastav>