

The Next-G Challenge

Vision for the next era of wireless

India's path towards a successful leadership in 6G (IMT-2030)

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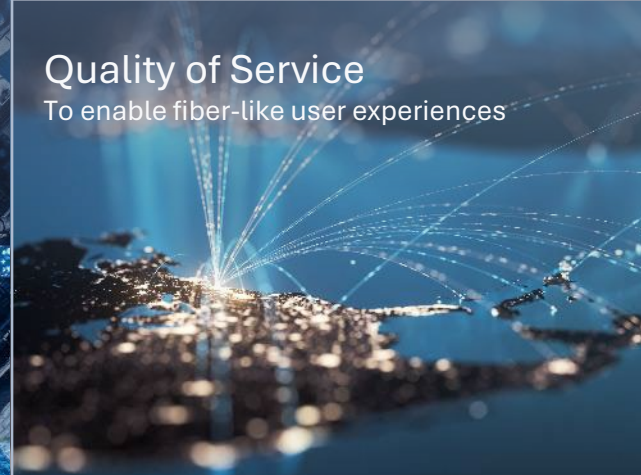




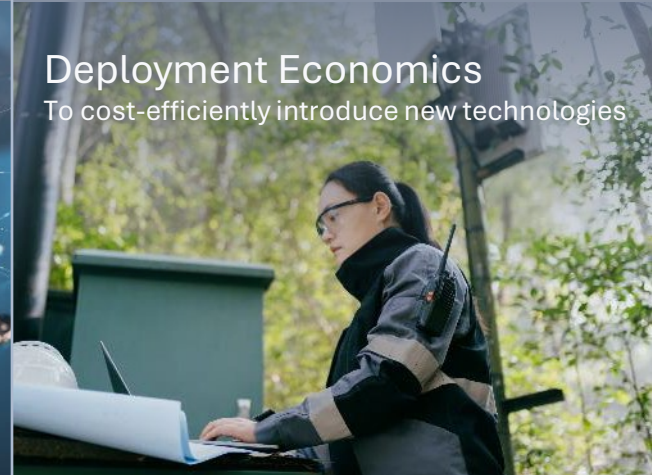
Coverage
To deliver ubiquitous multi-Gbps connectivity



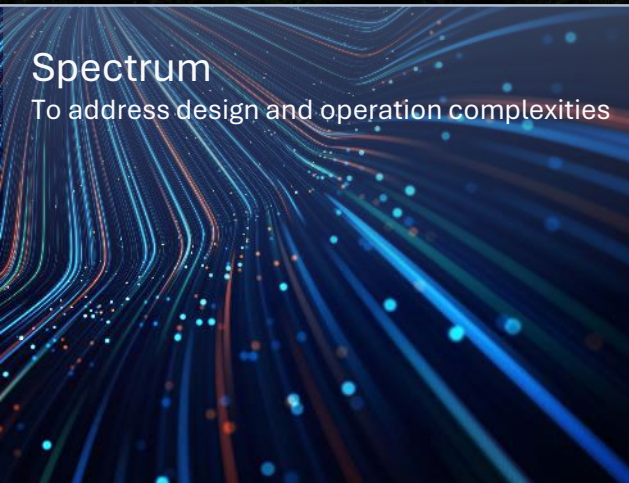
Capacity
To fuel next-generation wireless at scale



Quality of Service
To enable fiber-like user experiences



Deployment Economics
To cost-efficiently introduce new technologies



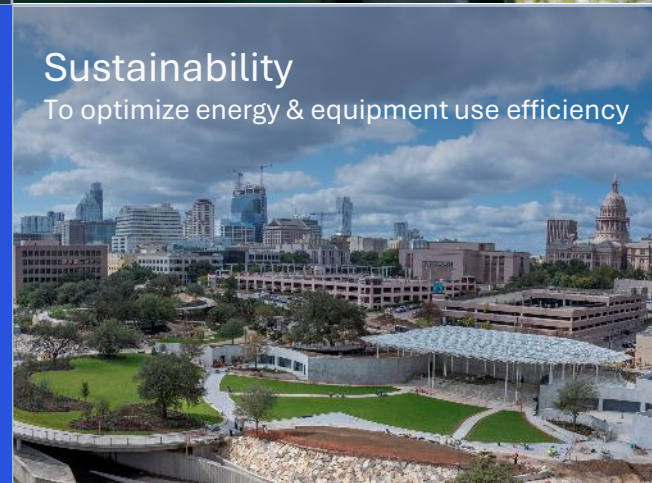
Spectrum
To address design and operation complexities



Universal Challenges for Wireless

that the research community
needs to address beyond 6G

With 6G/7G, Wi-Fi 9/10, and other emerging wireless technologies



Sustainability
To optimize energy & equipment use efficiency



Link Budget for High-Frequency
To effectively deliver new bandwidths



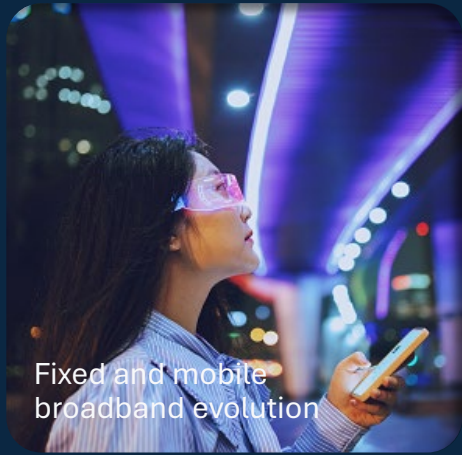
Immersive Multimedia
To enable enhanced and richer perceptions



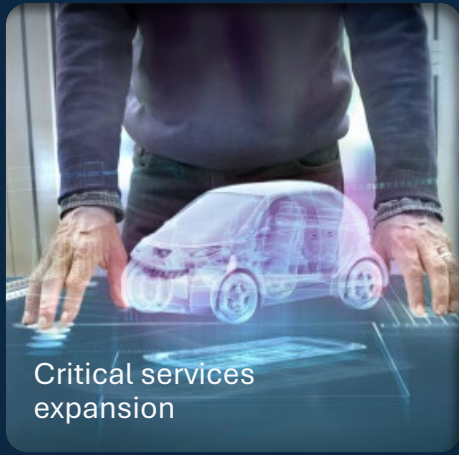
New Applications
To proliferate wireless into new industries



System Implementation
To foster continued technology innovations



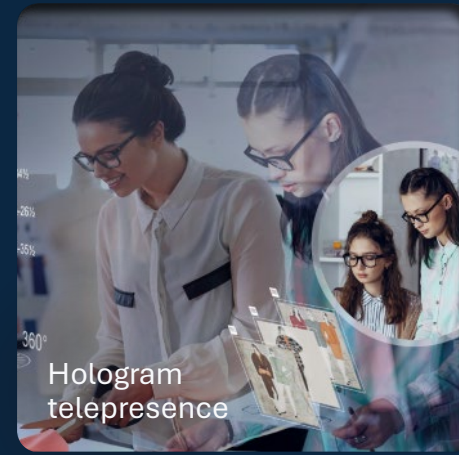
Fixed and mobile
broadband evolution



Critical services
expansion



Collaborative robots, real-
time command and control



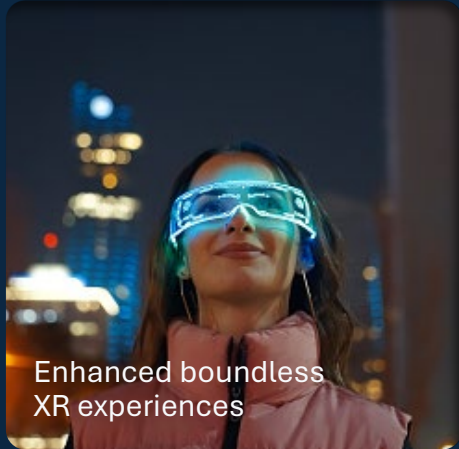
Hologram
telepresence



Ultra-wide area to
micro connectivity



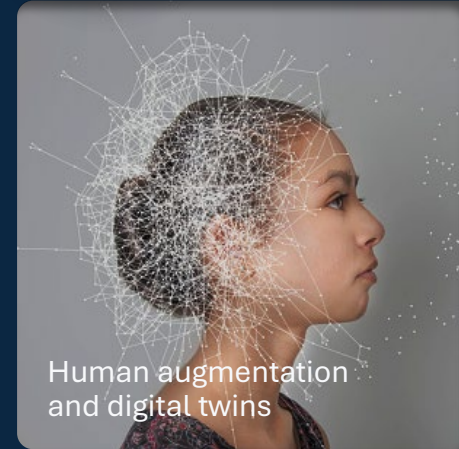
Smarter
verticals



Enhanced boundless
XR experiences



Wireless sensor
fusion



Human augmentation
and digital twins



Unknown future
use cases

The capacity and quality of service challenges (affordability)

Commercial innovation, with Harmonized global standards for scale – followed by building societal innovation above commoditized technologies

The sustainability challenge

Contributing to sustained economic, societal, and environmental goals



Spectrum
sharing



Lower spectrum cost
and higher usage



Equipment
sharing



Improved cost, energy efficiency,
and quicker deployment



Higher cell
density



Energy saving with lower
transmit power

And more...

Evolving towards a more dynamic energy-efficient wireless system

On-device energy savings

INDEPENDENTLY AT THE DEVICE



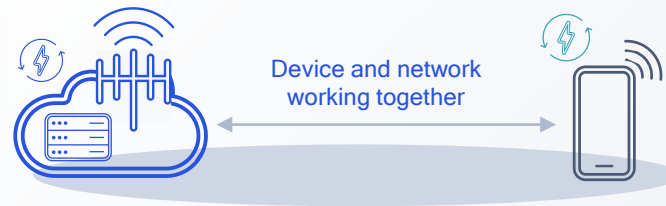
On-device power savings by optimizing existing functions

Rel-16 introduced techniques such as wakeup signal (WUS) and enhanced carrier aggregation

Rel-17 optimized paging operations in idle mode and reduced PDCCH monitoring time in connected mode

Network energy savings

COORDINATED BETWEEN DEVICE AND NETWORK



Shifting focus to network-side savings and continuing to optimize device power consumption

Rel-18 further enhanced device energy efficiency for XR and RedCap; Rel-19 may further enhance low-complexity IoT with WUS/WUR

Rel-18/19 focuses on new network energy saving techniques in the time/freq/power/spatial domains

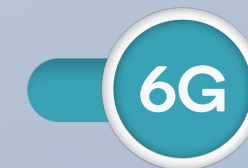
Native E2E energy savings

AT ALL DEVICE AND NETWORK LAYERS



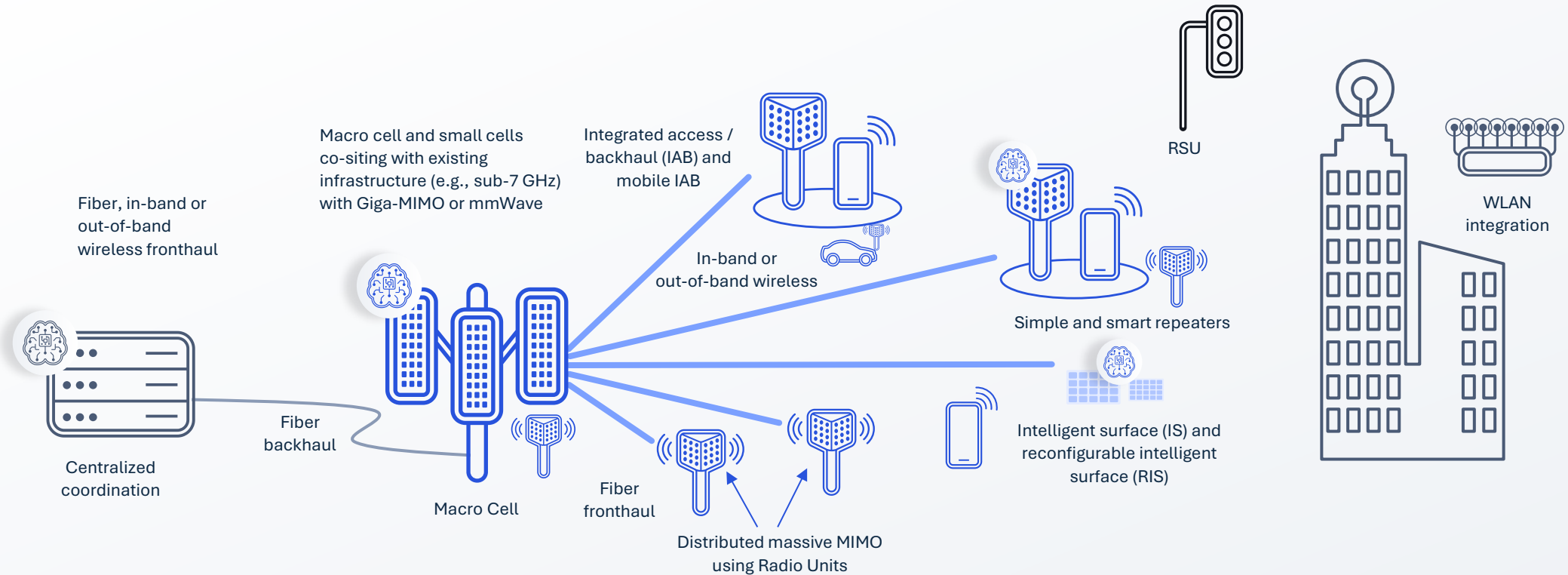
Device and network energy optimization across all protocols and layers

Continuing to improve and balance end-to-end system performance/energy efficiency tradeoffs (e.g., MIMO, mobility, power amplifier efficiency, distributed topology, and others), as well as deployment complexity and performance

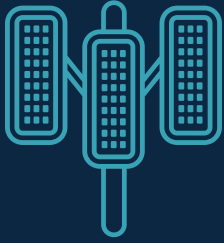


The deployment challenge (towards ubiquity)

Expanding topology options to optimize cost and ease of expanding coverage



A scalable and distributed network architecture can meet diverse coverage, capacity, and other performance requirements



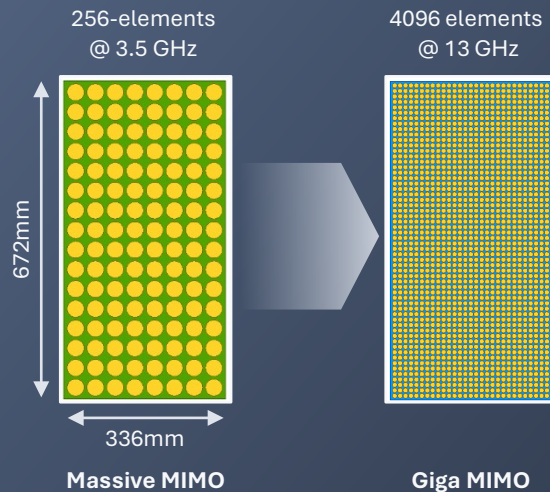
The coverage challenge

Enabling new wide-area bandwidth, for example, in the **6-15 GHz bands**

Giga MIMO with wide bandwidth and large number of antenna elements (e.g., 4k elements)

More antenna elements in the same aperture, 3-4x wavelength reduction → 9-16x elements, compared to 3.5GHz

Building on 5G sub-6 GHz and mm-Wave technologies and approaches



For supporting wide-area use cases in upper mid-band (e.g., 6-15 GHz)

Global spectrum discussions underway

Experimental licenses e.g., 8.5-9 GHz, 12.75-13.25 GHz

Regional and ITU discussions ongoing for longer term refarming



512 elements
@ 3.5 GHz



4096-elements
@ 13 GHz

Same coverage in Qualcomm Morehouse campus in the two bands with co-sited, same aperture antenna panels

Targeting new bandwidth opportunities

GHz bandwidth —10x more capacity than existing massive MIMO systems

Comparable wide-area coverage to massive MIMO in 3.5 GHz range

Higher positioning, radar, and RF sensing resolutions

Further evolving cellular for non-terrestrial communication

That complements terrestrial communication

5G Rel-15

Study Item focused on deployment scenarios and channel models

5G Rel-17

Work Item focused on supporting satellites and HAPS for eMBB and IoT1 with enhancements to synchronization, scheduling, HARQ, mobility, and more

6G

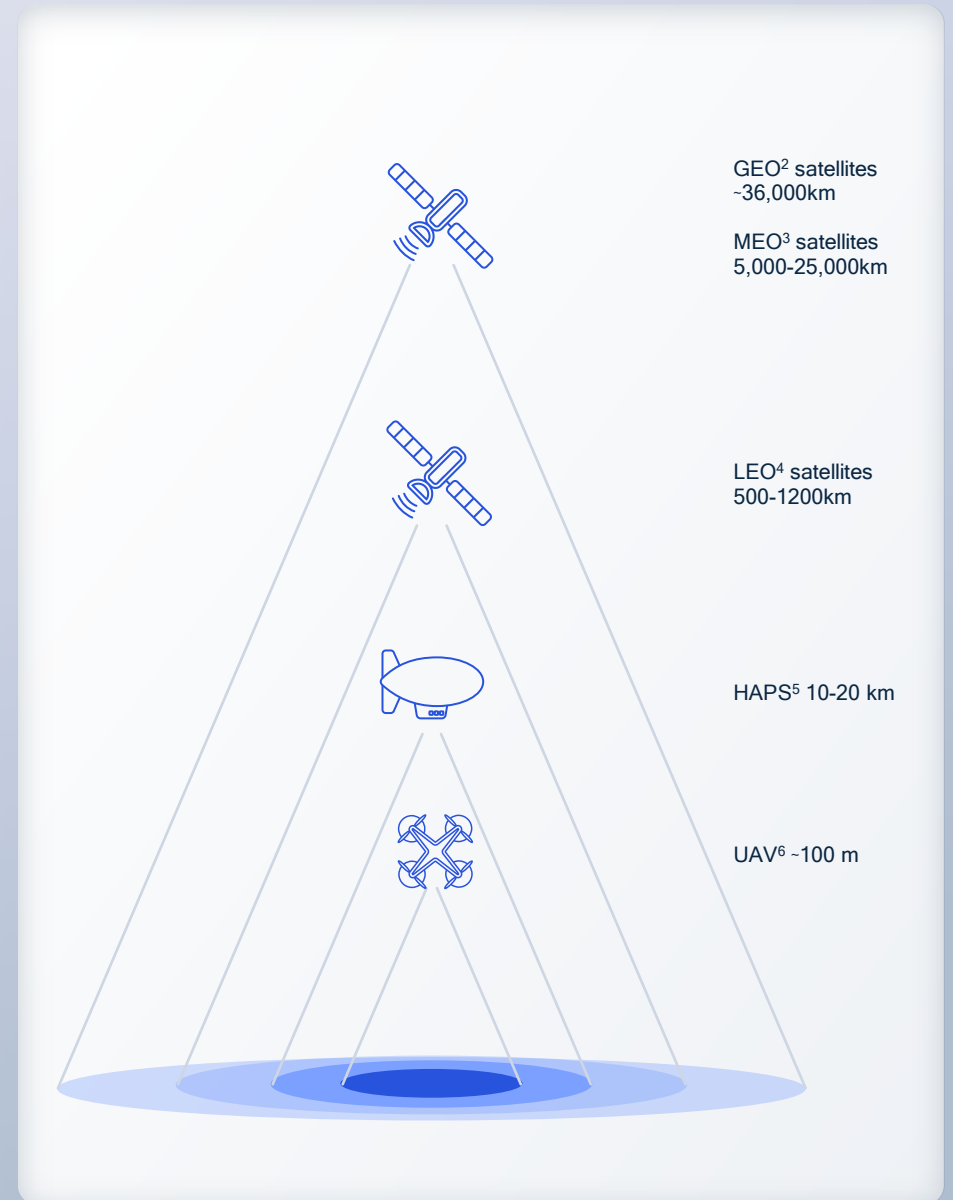
Potential focus on delivering an integrated 3D heterogeneous network, where terrestrial infrastructure can be complemented by non-terrestrial ones

5G Rel-16

Study Item focused on solutions for adapting 5G NR to support NTN

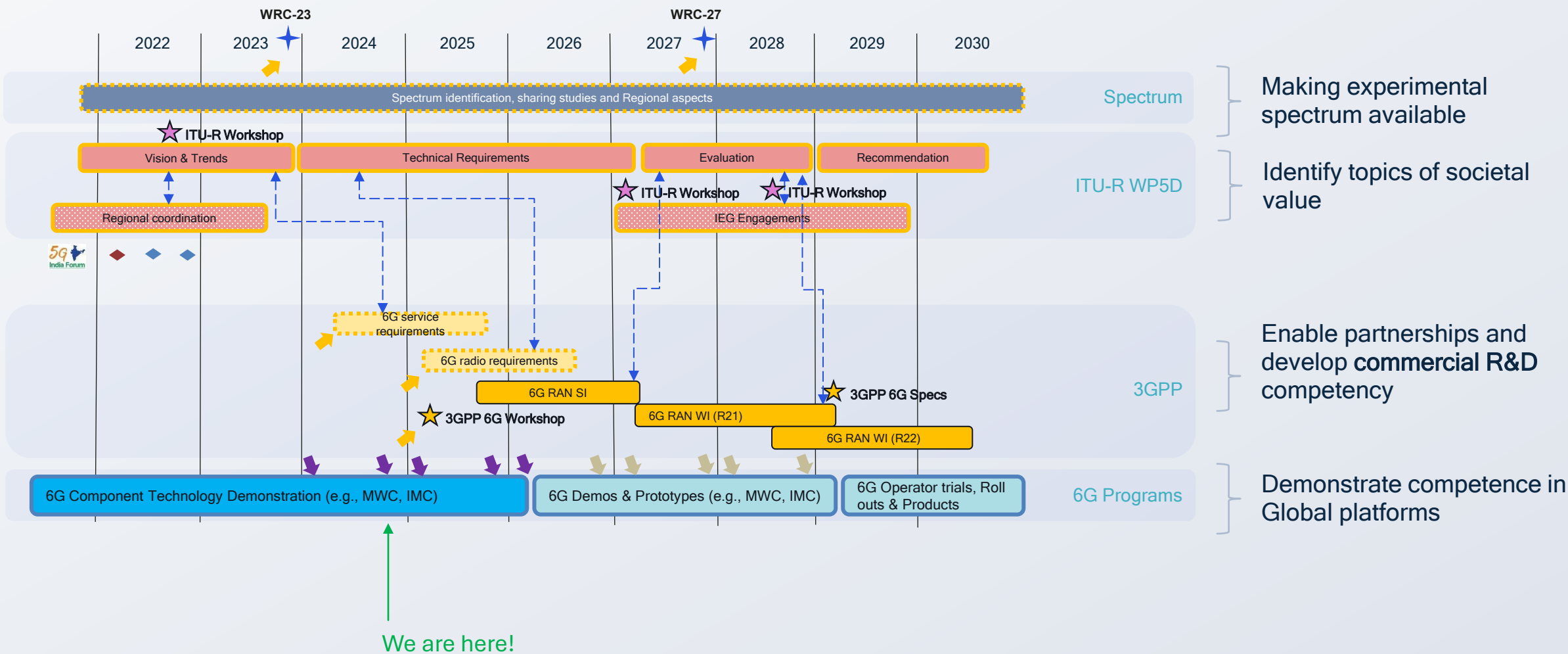
5G Rel-18+

Expected to further enhance communications for UAV, HAPS, and satellites



A timeline for India!

6G networks should evolve G-agnostic and support future evolving use cases



Note: Timeline not to scale and needs validation

Thank you



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