Samsung Research

Emerging Technologies for Next Generation Standards

Mohan Rao, Corporate VP, Samsung R&D Institute Bangalore (SRI-B)

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The start of 6G!

- 3GPP has finalised the logo of 6G recently!
- 1st Workshop on use cases is happening in 3GPP as we speak
- 1st 6G Tech Workshop is scheduled in March 2025

5G Experiences To Date

Ongoing 5G efforts to create value for both end-users & operators

End-User View

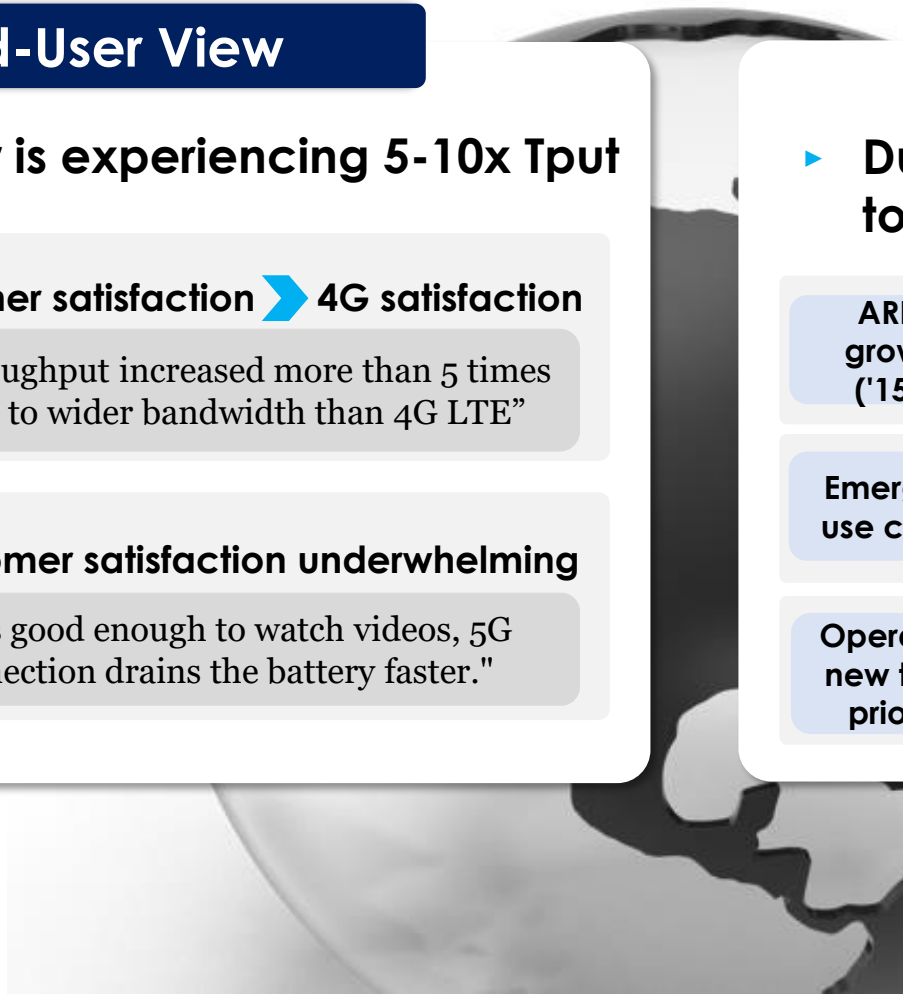
- **U.S. end-user is experiencing 5-10x Tput**

5G customer satisfaction ❯ 4G satisfaction

"5G throughput increased more than 5 times thanks to wider bandwidth than 4G LTE"

5G customer satisfaction underwhelming

"4G is good enough to watch videos, 5G connection drains the battery faster."



Operator's Experience

- **Due to saturated ARPU, operators strive to find out new revenue driver**

※ ARPU: average revenue per user

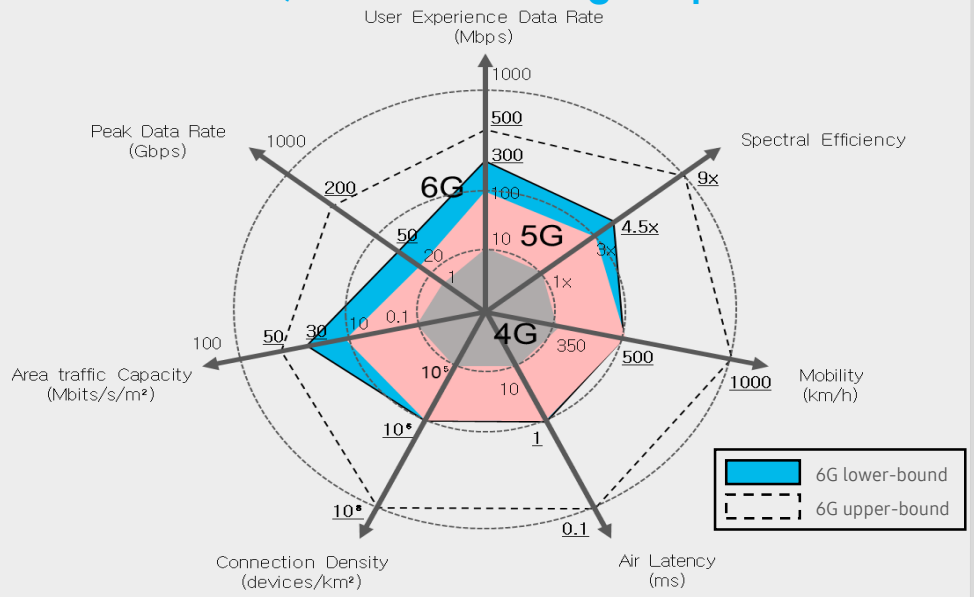
ARPU growth ('15~)	KT ▲0.8%, SKT ▼1.7%, LGU ▼3.8% / US ▼4.5% / EU ▼1.6%
Emerging use cases	**FWA** (* US subscriptions 5M → 11-13M (2023) (2025)), **Private NW**, **NW Slicing**, **Edge Computing**
Operators' new tech. priority	**Energy Efficiency** (84%) ❯ **Security** (72%) ❯ **AI Automation** (62%) ❯ **O-RAN** (59%) — Extremely Important / Very Important / Moderately Important

Key Attributes of 6G

6G requires new ways of thinking to enable unique user experience and service

Past 'G's Focus

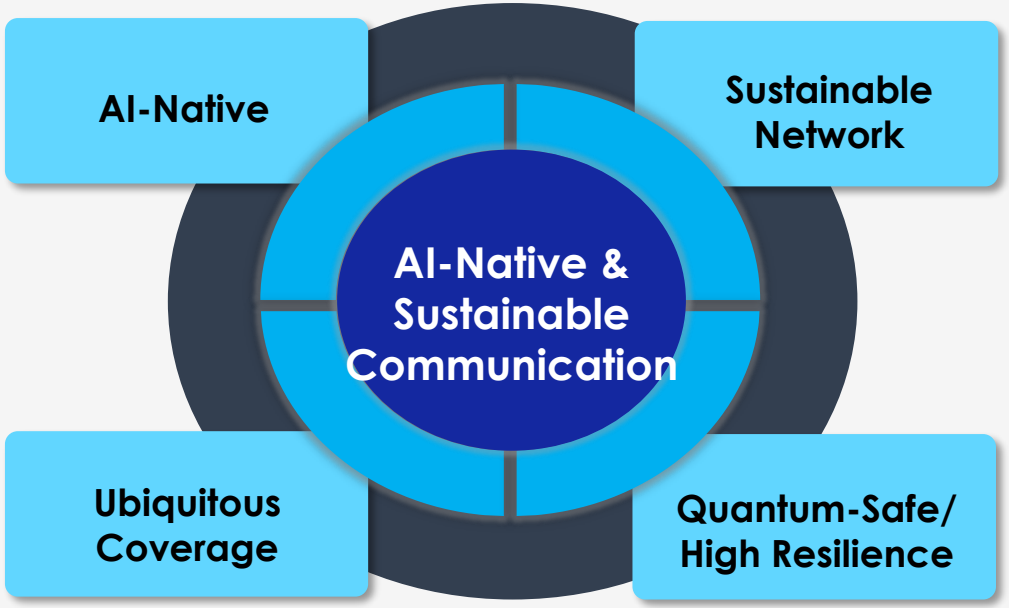
4G→5G, major upgrade in peak rate & latency
5G→6G, moderate change expected



※ ITU-R IMT-2030 Framework

6G New Attributes

Future-proof and sustainable user experience



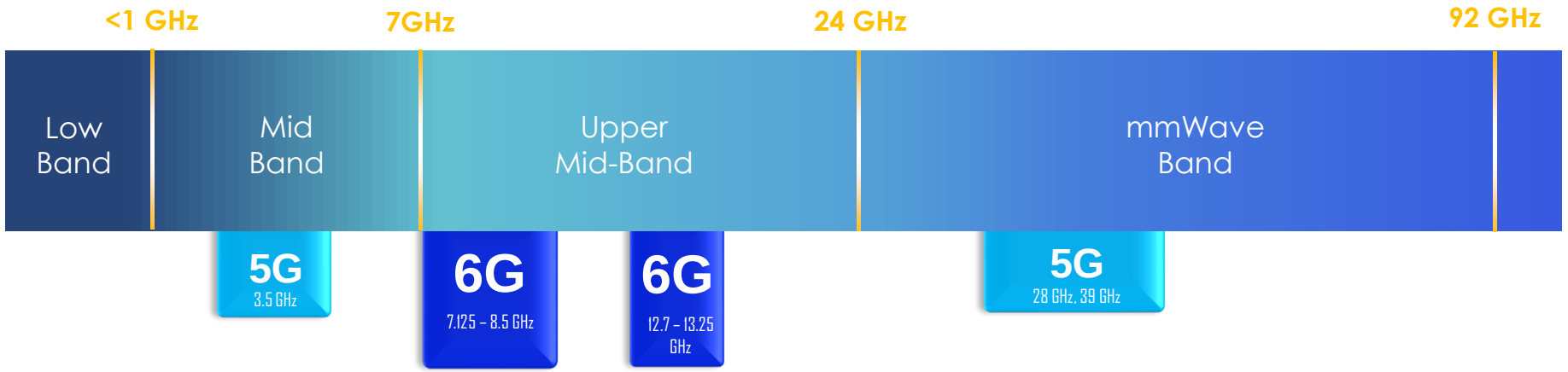
Lessons from the 5G experience

- Gap between IMT-2020 vision and market reality
- 6G needs market-driven approach toward use case ideation and technology development

6G Candidate Spectrum Bands

New spectrum band is key to 6G realization: Low & Upper Mid-Band

Decision expected after Nov 2023 ITU WRC (World Radio Congress) meeting



New Spectrum Candidate Bands

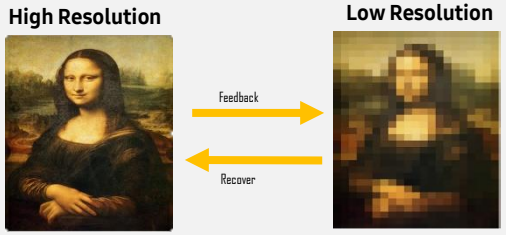
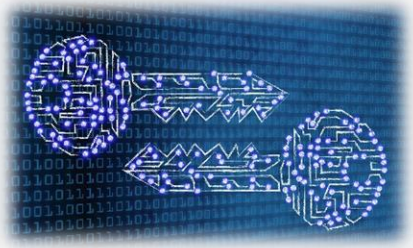
- Upper mid-band (FR3)
- Explore low band for energy & coverage

Existing Spectrum and re-farming

- C-band and extension
- mmWave bands

Key Attributes and Technologies for 6G

Powered by AI - Sustainable, Uniform, Safe

New attributes	AI-Native	Sustainable Network	Ubiquitous Coverage	Quantum-Safe/ High Resilience
				
Enabling Techs	AI channel Restoration/generation	NW/UE Power Saving w/ RF Innovations	FR1 Distributed MIMO & FR2 Joint Time & Phase Array	Post-Quantum Cryptography
	AI optimization	New mod./coding/waveform	FR3 Hybrid X-MIMO	Zero Trust Architecture
	AI network automation	Scalable vRAN	Multi-Connectivity Network (Ground & Satellite)	Reliable Cloud vRAN
Underlying attributes	Data Rate	Latency	Capacity	Spectrum Efficiency	Connection Density	Mobility

AI-Native for 6G

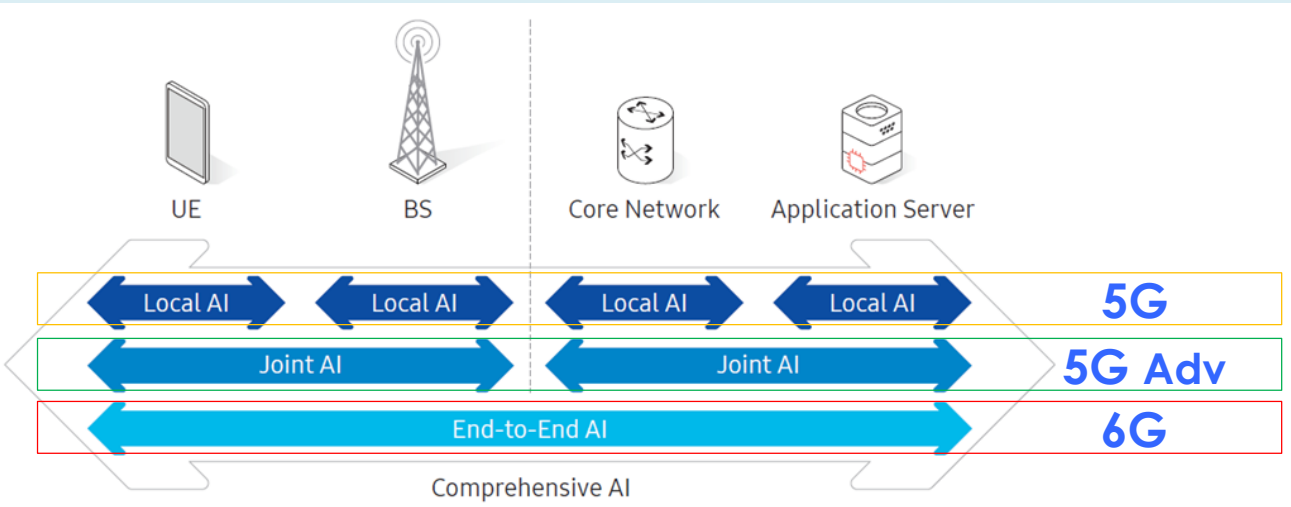
Current 5G AI Applications

1. **Network planning**
   e.g., optimization of site locations
2. **Prediction, detection, and self-healing of network anomalies**
3. **Network management**
   e.g., configuration automation, power consumption minimization
4. **Performance improvement**
   e.g., handover optimization and scheduler enhancement

Comprehensive 6G AI

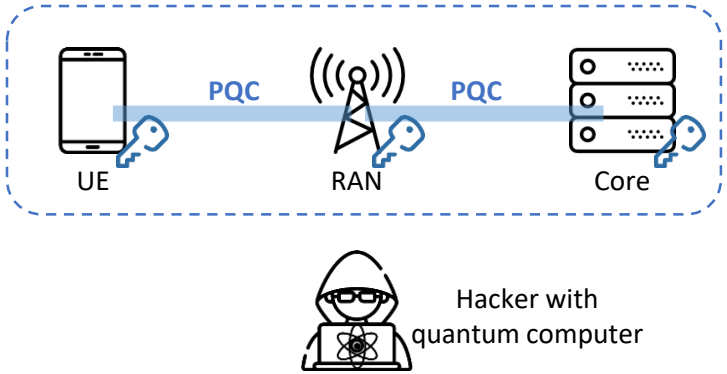
E2E optimization of network performance & operation

- Local/joint AI for global awareness
- Joint optimization across functions and layers
- Handling nonlinearity and long-term correlations



Quantum-Safe/High Resilience

Post-Quantum Cryptography



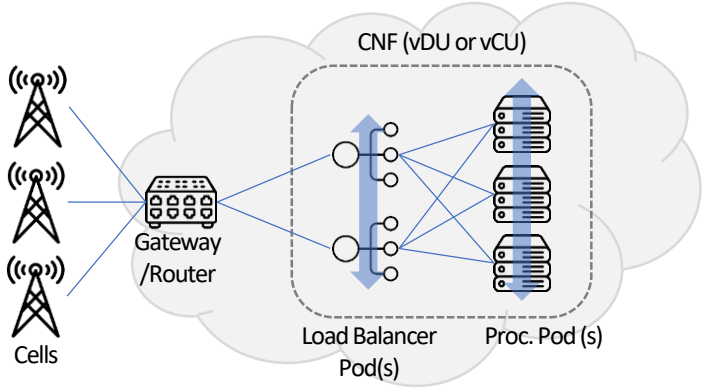
- PQC is a set of cryptographic algorithms to make legacy asymmetric cryptography safe from attacks of using quantum computer.
- 6G security protocols should be re-designed with PQC against attacks using quantum computer.

Zero Trust Architecture

Example of Zero Trust Architecture

- Zero Trust Security is cybersecurity paradigm or framework that focus on users, assets, and resources.
- 6G security architecture based on zero trust will be more secure with strong authentication and continuous device/resource monitoring.

Reliable Cloud vRAN



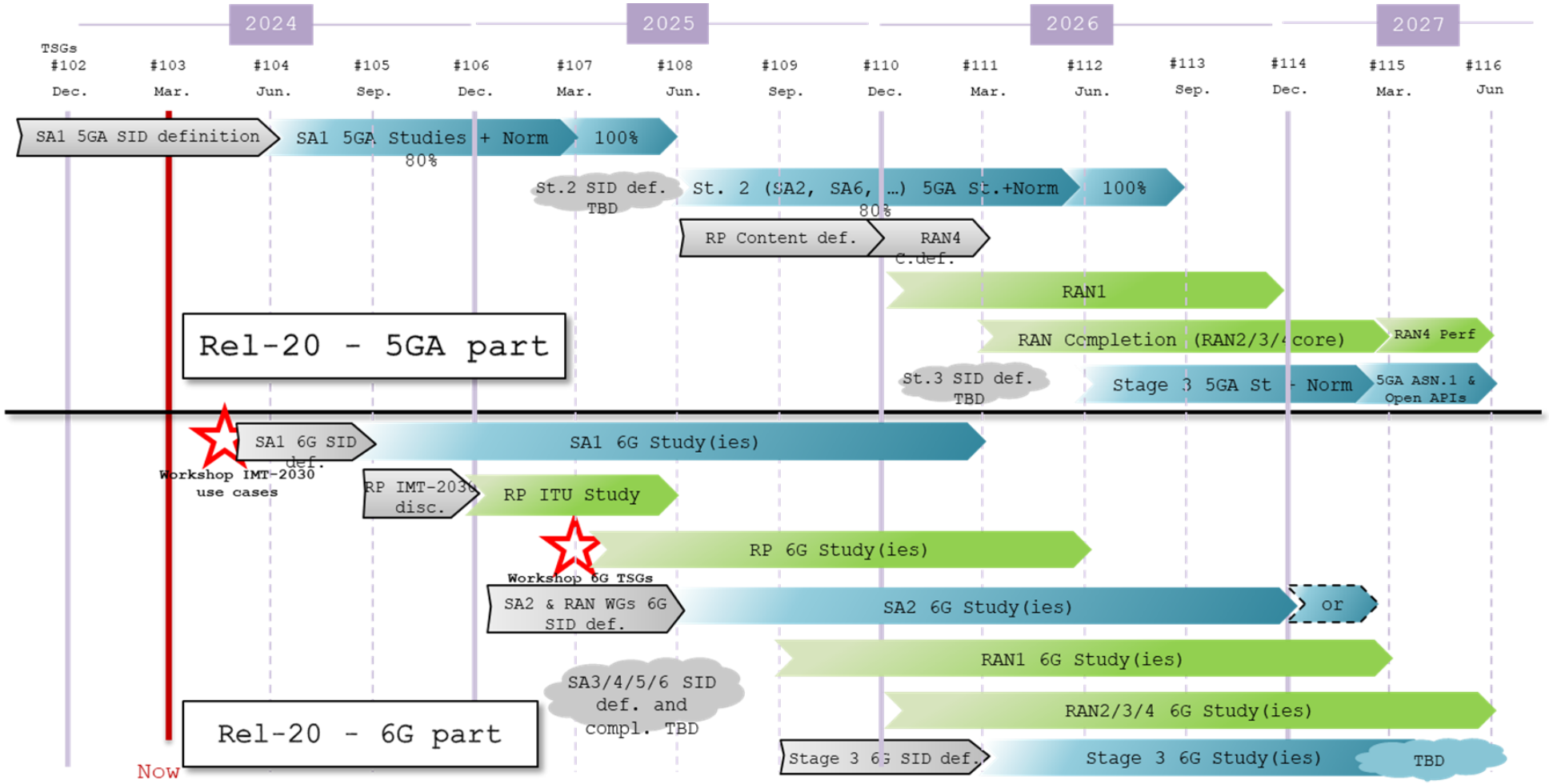
Example of all-active and scalable vRAN

- All-active architecture of pods with load balancer makes vRAN to be more reliable even if one of pods happens to fail.
- All vRAN pods should be scaled to prevent system overloads with high traffic demands

5G Advanced & 6G Timelines as defined by 3GPP

- **Rel-20: Study Item for 6G (mid-2027)**
- **Rel-21: Work Item for 6G (timeline is TBD)**

- **5G Advanced: 3GPP will enhance 5G in Rel-20**
  - **5G is here to stay for a long time!**



6G from India

- **6G starts now and opens immense opportunities for India**
- **AI-native, Ubiquitous and Sustainable networks are the future**
- **Regional Standards should work in unison with Global Standards**
  - Economies of scale needs interoperability – 3GPP has given us that for 2+ decades
  - TSDSI is playing an important role as an Organisation Partner to 3GPP
- **Samsung supports Standardization activities from India**

Let us work together, collaborate and harness India's potential for 6G!

Thank you