

# 6G

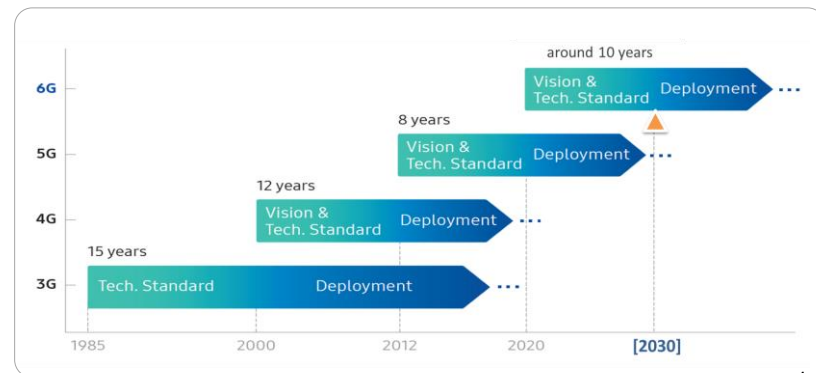
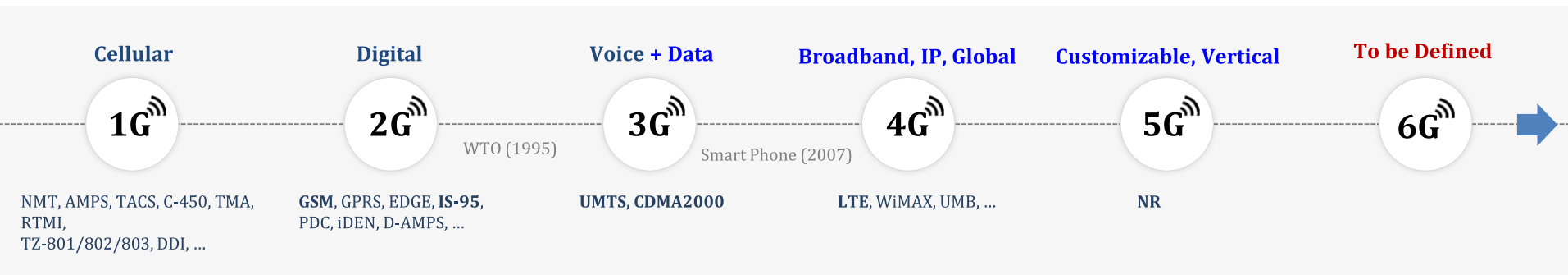
## The Next Hyper ——— Connected Experience for All.

**Suresh Chitturi,**

**Senior Director, Standards Research & TSDSI Vice-Chair**

**Samsung Research India – Bangalore (SRI-B)**

- ▶ International standards for cellular communications became mainstream beginning 3G (IMT-2000)
- ▶ Success of 4G (IMT-Advanced) triggered IT + Comm. convergence and Global Competition
- ▶ 5G (IMT-2020) designed to enable 3 use cases: eMBB, URLLC, mMTC





# 5G

## is full fledged



### Operators

# 249

 operators

in 97 countries  
have launched 5G

(GSA, Apr. '23)

# SA

40 operators have launched  
**5G SA**

(GSA, Mar. '23)



### Subscribers

# 1.15B

5G mobile subscribers

(GSA, Mar. '23)

# 2B

5G mobile subscribers by '23  
2/3 years faster than 4G

(Omdia, Mar. '22)



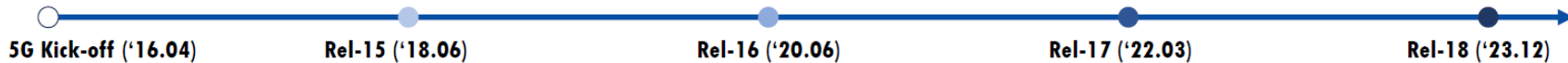
### Devices

# 1472

5G devices commercially  
available

(GSA, Feb. '23)

- **Rel-15: Introduction of 5G framework**
- **Rel-16: Expansion to vertical services and enhancement from Rel-15**
- **Rel-17: Full support of LTE services within 5G framework and enhancement from Rel-16**
- **Rel-18: Next phase of 5G evolution, a.k.a. 5G-advanced**



### Rel-15

- **Forward compatible design**
- **Flexible/scalable structure**
- **New channel coding**
- **Support for FR1 & FR2**
- **Service-based architecture**
- **Network slicing**
- **Support for 5G-AKA & EAP-AKA**

### Rel-16

- **Service expansion**
  - ≡ V2X (sidelink), NR-U, IAB, Vertical LAN (NPN, TSN)
- **NR positioning**
- **Enhancements**
  - ≡ eMIMO, eURLLC, 2-step RACH, UE power saving, PoS, Zero latency handover
- **Network Analytics**

### Rel-17

- **Service expansion**
  - ≡ Public safety (MBS, sidelink), RedCap, NTN
  - ≡ NR beyond 52.6GHz
- **Enhancements**
  - ≡ Coverage, ePoS, FeMIMO, DSS, eIAB, FeURLLC, MUSIM, NW automation, etc.
- **Enablers for edge computing**

### Rel-18

- **Study on AI/ML applications**
  - ≡ AI/ML for air interface, AI/ML for NG-RAN, System support for AI/ML-based services
- **Study on duplex evolution**
- **Enhancements**
  - ≡ NW energy saving, eCoverage, Vehicle Mounted Relays, UAV support, etc

V2X: Vehicular-to-Everything

MBS: Multicast and Broadcast Service  
eIAB: enhanced IAB

NR-U: New Radio Unlicensed

RedCap: Reduced Capability UE  
MUSIM: Multi-SIM

IAB: Integrated Access and Backhaul

ePoS: enhanced positioning  
eCoverage: enhanced Coverage

eMIMO: enhanced MIMO

AKA: Auth. & Key Agreement  
UAV: Uncrewed Aerial Vehicle

eURLLC: enhanced URLLC

FeMIMO: Further enhanced MIMO  
NPN: Non-Public Network

Pos: Positioning

DSS: Dynamic Spectrum Sharing  
TSN: Time-Sensitive Networking

## The Next Hyper — Connected Experience for All.

### Truly Immersive XR

\* eXtended Reality

- Sufficient wireless capacity to be secured for higher data rate to realize Virtual Reality, Augmented Reality, Mixed Reality, etc.



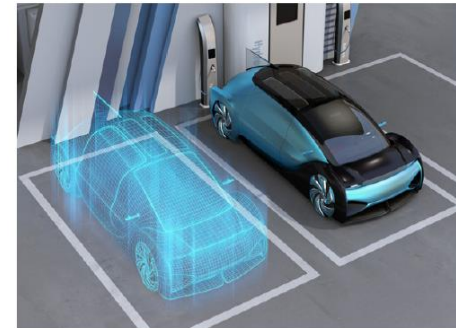
### High-fidelity Mobile Hologram

- Next-generation media technology presenting gestures and facial expressions by means of a holographic display



### Digital Replica

- Replicate physical entities and interact with them in a virtual world without temporal or spatial constraints





01

## Machines as the Main Users

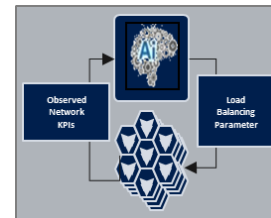
※ Virtually no Constraints/Limits!

	Human	Machine
Maximum Resolution	1/150° (Smartphone display 290 ppi at 30 cm)	
Latency Perception	<100 ms	
Audible Frequency	250-20,000 Hz	Exceeds Human Limitations!
Visible Wavelength	380-780 nm	
Viewing Angle	Azimuth 200°, Zenith 150°	

02

## AI as new tool for Wireless Communication

※ It was not possible earlier!



03

## Cloudification of Networks

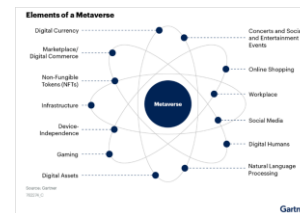
※ True IT scale SW on commodity HW



04

## Metaverse – New Possibilities

※ New Dimension to Requirements







## Spectrum

- Upper mid-band
- Lower mid-band
- THz / mmW
- Low band
- Spectrum sharing
- Unlicensed band

## AI-Native System

- AI-Native Air Interface
- Distributed Intelligence
- Split/Federated Learning

## Radio Technology

- X-MIMO (eXtreme MIMO)
- THz Communications
- Advanced Duplex
- RIS (Reconfigurable Intelligent Surface)
- Joint Comm. & Sensing, Positioning
- Near-Zero Energy Communications
- Waveform, Coding, and Modulation
- BS/UE Energy Saving

## Other Critical Aspects

- Green Network
- Cost-efficiency
- Migration from 5G to 6G

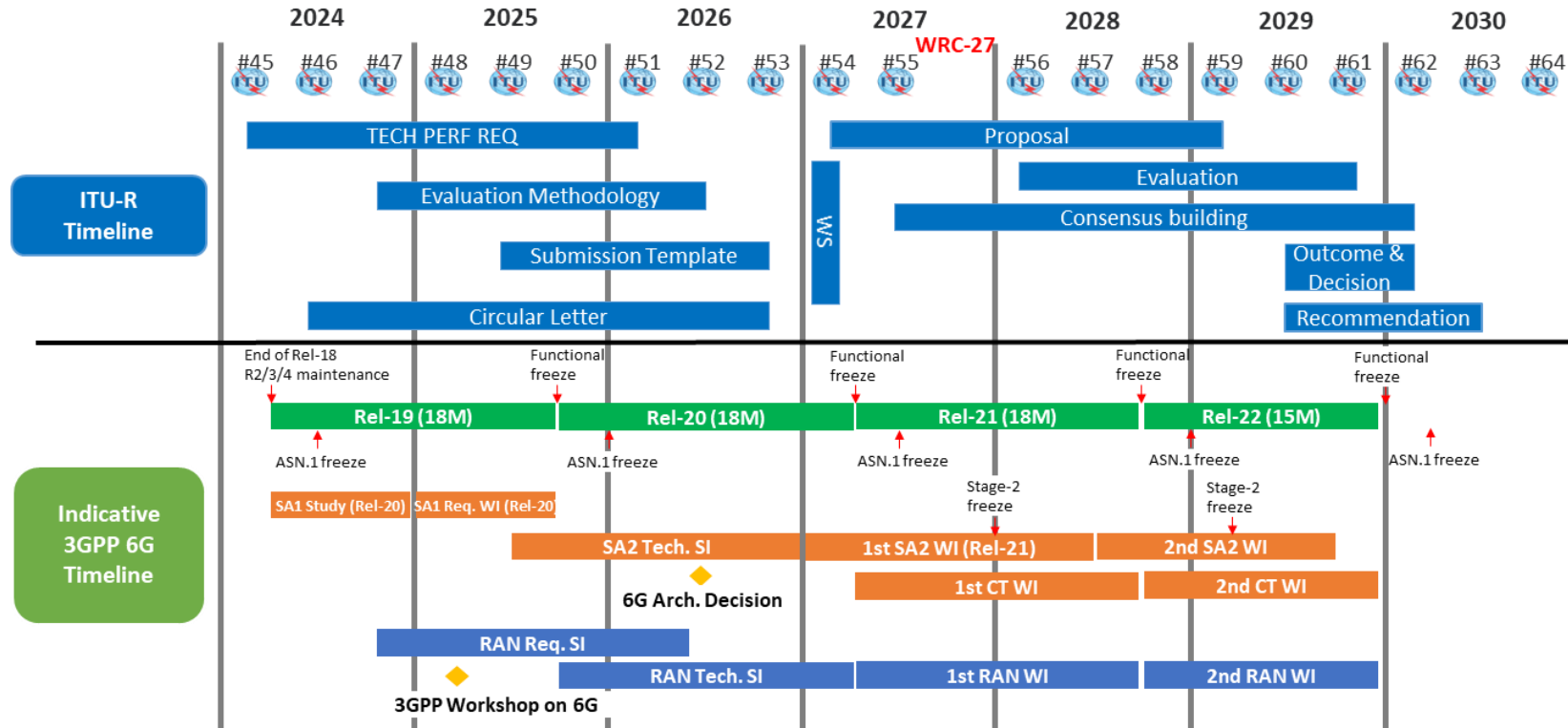
## Network Architecture

- Comm. & Computing Integration
- System for Distributed Cloud
- RAN-CN Architecture

## Trustworthy System

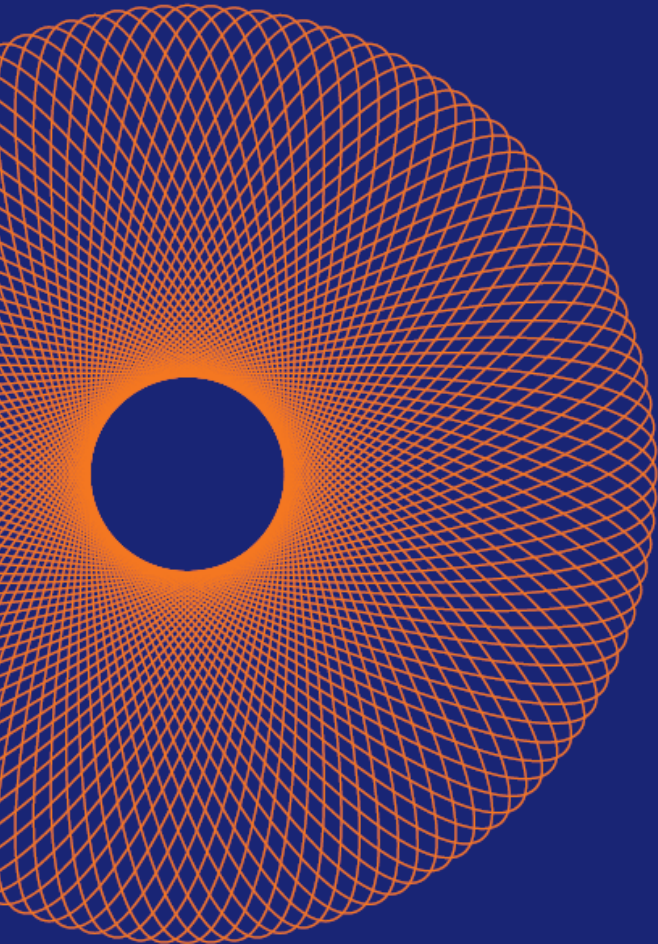
- Secure Identities & Protocols
- Resilience/Reliability
- Quantum Safety

- ITU-R has agreed on timeline to finalize 6G vision by June 2023 and IMT-2030 by 2030.



Note: this timeline is based on the assumption of submitting both Rel-21 and Rel-22 to IMT-2030 although IMT-2030 requirements have to be satisfied by Rel-21





# 6G

## The Next Hyper— Connected Experience for All.

Samsung 6G White Paper

<https://cdn.codeground.org/nsr/downloads/researchareas/6G%20Vision.pdf>

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# 6G

## Spectrum Expanding the Frontier

Samsung 6G Spectrum White Paper

[https://cdn.codeground.org/nsr/downloads/researchareas/2022May\\_6G\\_Spectrum.pdf](https://cdn.codeground.org/nsr/downloads/researchareas/2022May_6G_Spectrum.pdf)

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“ Let’s build a Hyper-Connected World for Tomorrow ”