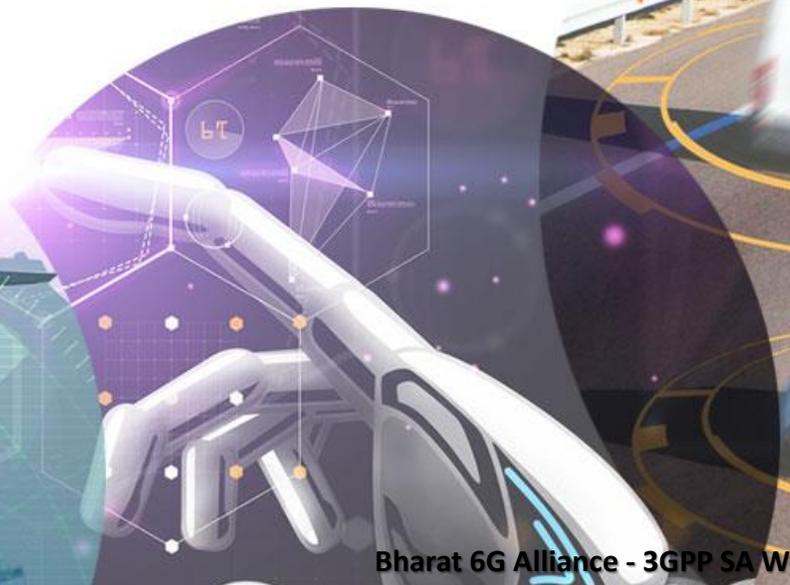




**Rajesh Kumar Pathak**  
**Director General**  
**Bharat 6G Alliance**

# 3GPP Stage 1 Workshop on IMT2030 Use Cases

Rotterdam, NL  
08 - 10 May 2024





“

Design, develop and deploy 6G network technologies that provide ubiquitous intelligent and secure connectivity for high quality living experience for the world.

”



- Bharat's 6G Vision & Introduction to Bharat 6G Alliance
- Bharat's 5G Experience
- Key 6G Use cases
- Bharat's 6G Drivers
  - Use Cases for 6G and Beyond
- Societal Needs
  - Sustainability
  - Ubiquitous, Reliable and Secure connectivity
- Bharat's initiatives
- Q&A

- Build upon 5G technology and provide more reliable, ultra-low latency and affordable solutions with peak speeds much faster than 5G to enhance and drive new mobile broadband communication applications
- Technological advances should not just improve user experience but also transform economies and lives everywhere
- Include AI enabled intelligent network management and control, and integrated wireless sensing and communication while balancing the potential consequent carbon footprint with reduced energy consumption and a myriad of sustainable and eco-friendly initiatives



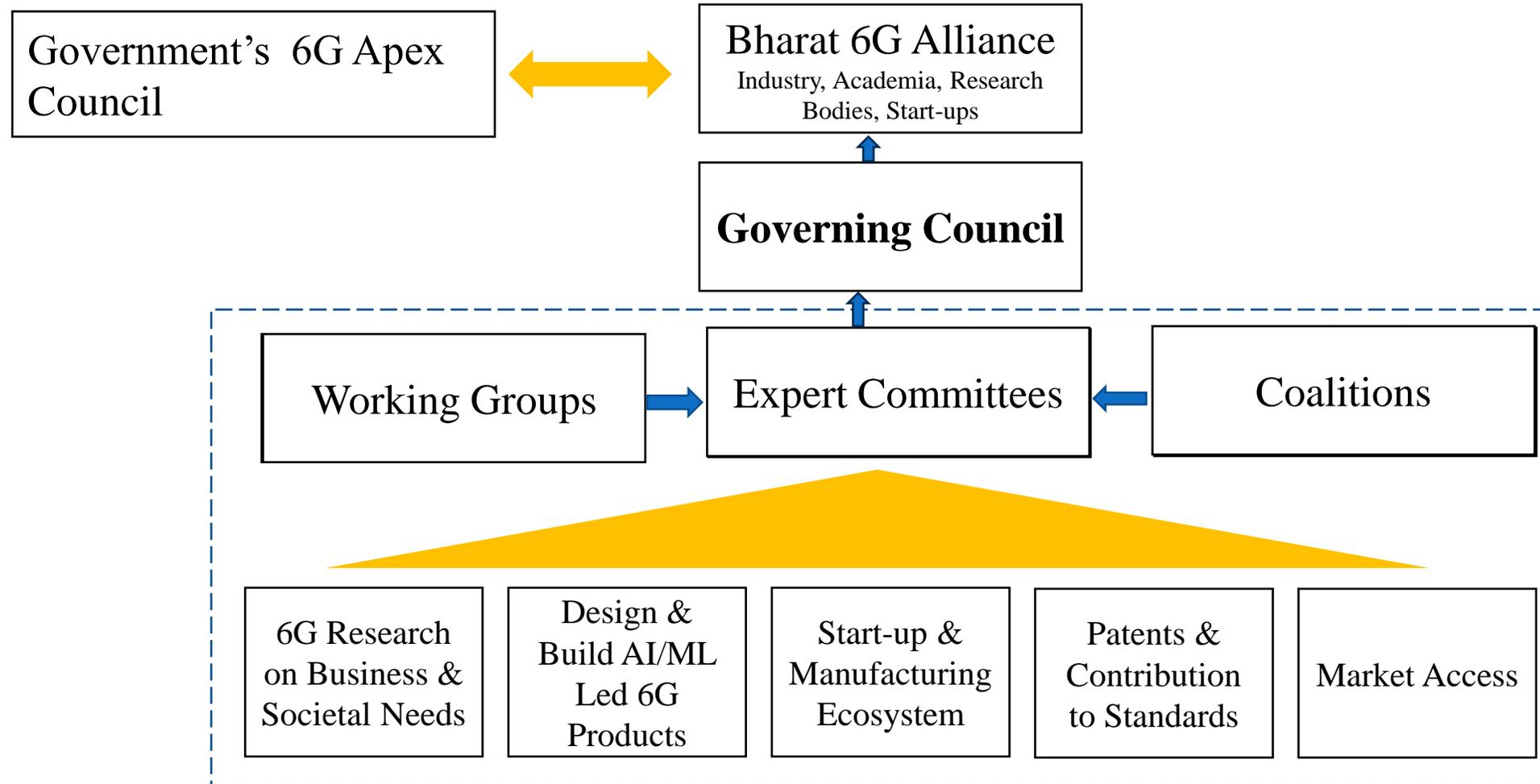
Indian Innovations for the world

B6GA is an industry led body consisting of public/private companies, academia, research institutions and Standard Development organizations

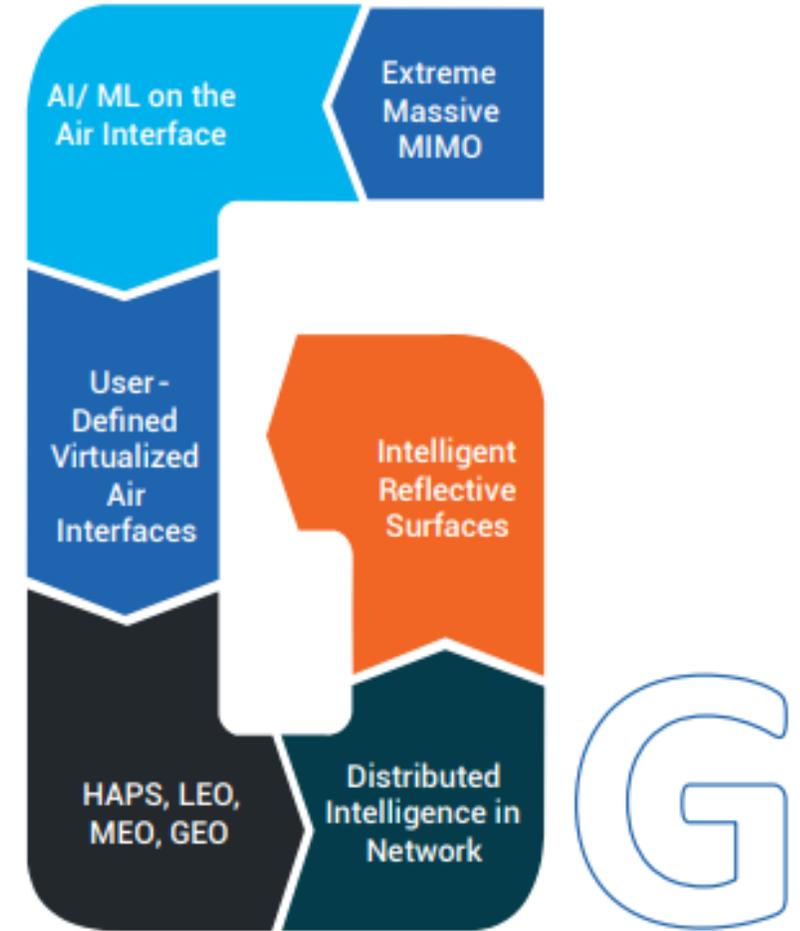
- Understand business and societal needs 5G advanced and 6G technology
- Contribution to 6G and other future technology-related global standards, deployments, products, operations and services
- Support and energise Indian participation in standard development organizations
- Promote high impact Open R&D and pursue pre-standardization efforts
- Identify priority areas for research by involving all stakeholders including industry, academia, and service providers, spanning theoretical and simulation studies, proof-of concept prototypes and demonstrations, and early market interventions led by start-ups.
- Build coalition and synergies with like-minded 6G Global Alliances and global technology alliances and associations
- Facilitate availability of 6G test beds and access to 6G chipsets

**Facilitate the realization of 'Bharat 6G Vision'**

# Bharat 6G Alliance (B6GA)

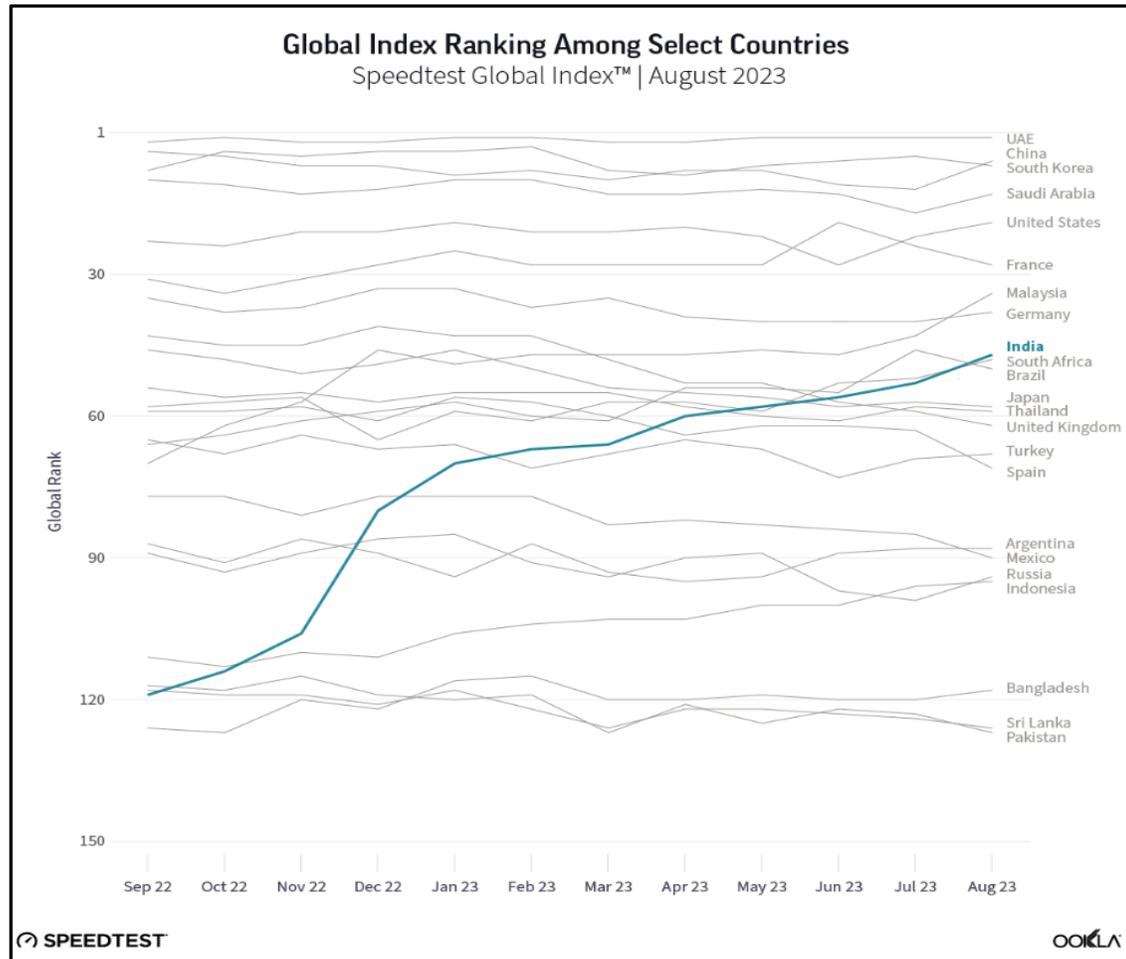


- Spectrum
- Device technology, sensors and manufacturing ecosystem
- Technology
- Applications
- Green and sustainability
- Outreach
- 6G use-cases and revenue stream



# **BHARAT'S 5G EXPERIENCE**

# India's 5G Journey : 5G Experience



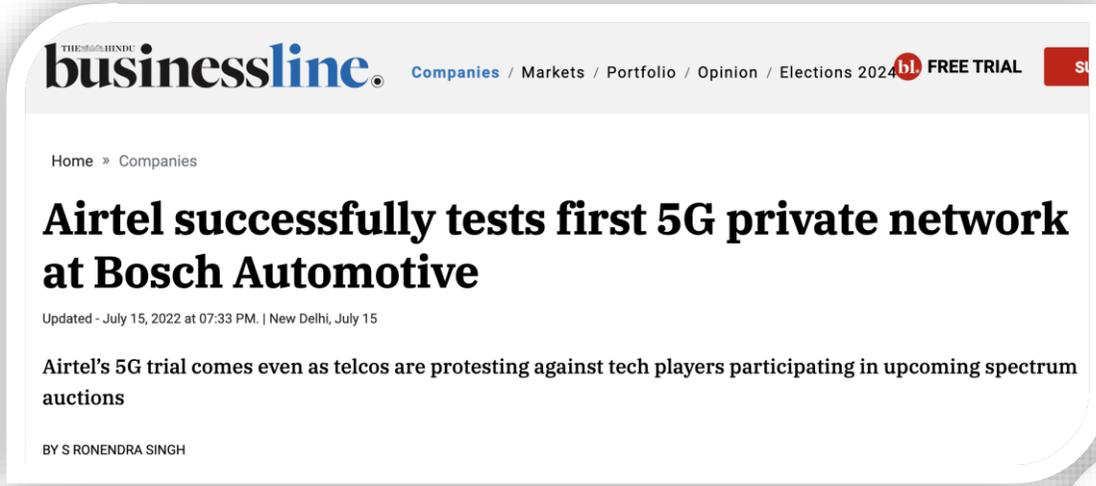
- Speedtest global Index ranking has improved 72 places from 119 to 47 position. (ookla report Oct'23)
- Latest report (March 2024) shows India has climbed to 16<sup>th</sup> place

- One of the fastest 5G roll out globally
  - >435K 5G cell-sites deployed
  - 5G service available in every state & union territory
  - 135 million active 5G users
- Most affordable cellular services globally
- Both SA & NSA based deployments (primarily in FR1: 3.5ghz & 700mhz)
- Main business case: mobile broadband
- 5G adoption and investment will continue to grow in India over this decade

*“Mobile-first” market with highest data consumption per smartphone globally*

# India's 5G Journey

## Status in Vertical Industry



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### Airtel successfully tests first 5G private network at Bosch Automotive

Updated - July 15, 2022 at 07:33 PM. | New Delhi, July 15

Airtel's 5G trial comes even as telcos are protesting against tech players participating in upcoming spectrum auctions

BY S RONENDRA SINGH

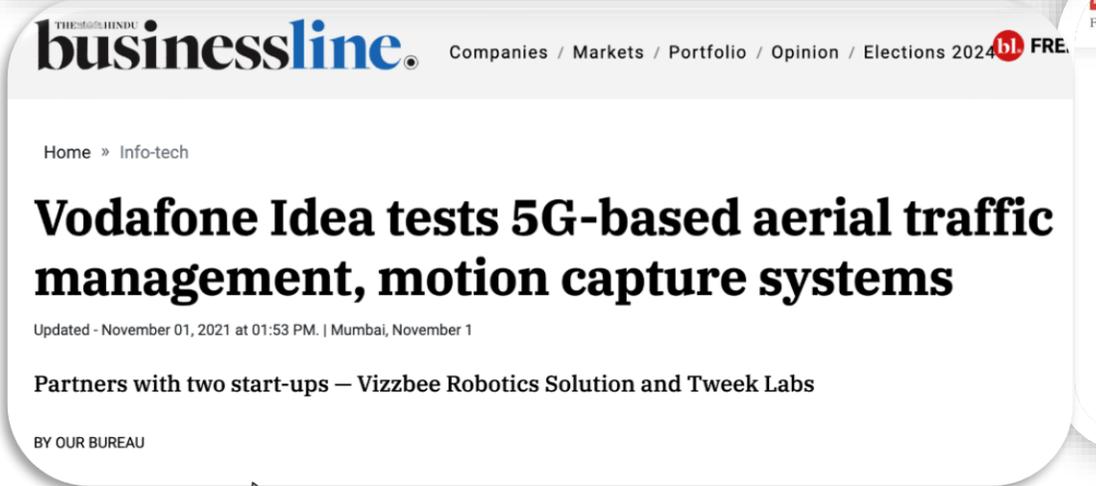


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### Jio conducts connected drone trial on its indigenous 5G network



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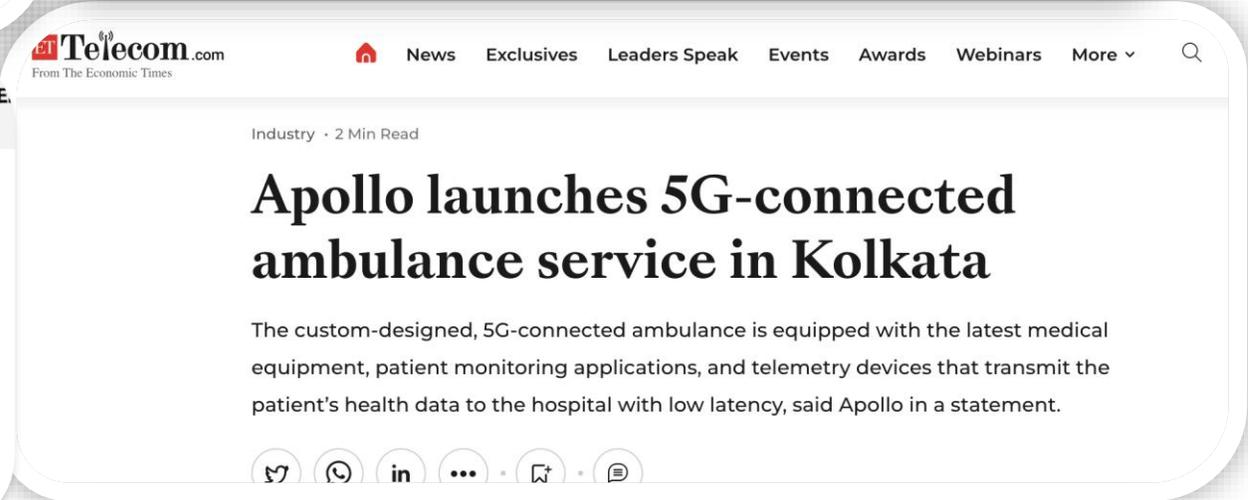
Home » Info-tech

### Vodafone Idea tests 5G-based aerial traffic management, motion capture systems

Updated - November 01, 2021 at 01:53 PM. | Mumbai, November 1

Partners with two start-ups – Vizzbee Robotics Solution and Tweek Labs

BY OUR BUREAU



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Industry · 2 Min Read

### Apollo launches 5G-connected ambulance service in Kolkata

The custom-designed, 5G-connected ambulance is equipped with the latest medical equipment, patient monitoring applications, and telemetry devices that transmit the patient's health data to the hospital with low latency, said Apollo in a statement.

Many trials & experiments in verticals but monetization yet to take off

## Current Scenario

- 5G market potential yet to mature
- Mobile broadband commercialized
  - Yet to leverage other functionalities of 5G
- Commercialization of uRLLC and mMTC is yet to fructify at scale
- Business opportunities and regulatory setup will continue to evolve

## Expected Scenario around 2030

- SA along with 5GC is mature and will be dominant 5G PAN India deployment
- 5G deployed in low-band, mid-band, and possibly mm-wave, with multi-band CA
- 5G would have just overtaken 4G in terms of global subscriptions
- Large volume of Redcap and NB-IoT devices expected to be deployed in industrial and B2B2C (e.g. smart grids) expect longer support cycles
- Hopefully, some monetization of Network APIs
- Growth / penetration of non-3GPP and RLAN technologies (Wifi-7/ Wifi-?, RF-mesh, BLE) in indoor, in-car, smart-cities

- Huge gap between 5G promises and on field deployments
- 5G in vertical industry still in a very early phase
- Enabling MBB in FR2 remains a challenge in 5G
- Sustainability measures in 5G were an afterthought
- Too many architecture options for migration from 4G
- Realistic assessment of new use cases & verticals is crucial
- Spectrum choice shall be aligned to usage scenario
- Profiling 6G technology as per usage scenario
- Sustainability should be foundational basis of 6G definition
- Smoother migration from 5G to 6G
- 3GPP to enable open-interfaces in 6G RAN ensuring no vendor locking

**6G use cases/applications identified have to be practical/monetizable**

# **BHARAT'S 6G DRIVERS**



## Growing Capacity and Reducing TCO

- Efficient energy consumptions, and sustainable expansion of infrastructure
- Capacity expansion with cost effective network upgradation, improved coverage, efficient spectrum sharing

## Introducing new revenue streams by addressing new use-cases in 6G

- Ability to offer new services from investments
- 6G use case for agriculture, 6G immersive education and healthcare
- Including scaling 5G applications like cloud gaming, connect automotives, collaborative industrial applications

- **Architecture and Design Principles**

- Design key new use-cases based on thorough due diligence and not just driven by peak capabilities e.g. peak throughput is 100x of 5G
- Enable localized, use-case specific deployment for offering specific 6G service
- 3GPP to enable open interfaces in 6G RAN for interoperability
- Support native applications to meet regulatory obligations (Voice, LI, Positioning etc)
- Be business driven to co-exist with 5G and 4G networks
- Ability to introduce 6G in existing bands, co-exist with 5G

- **Core**

- Software upgradation of 5GC to support 6G RAT along with 5G RAT
- Simplified network deployment option

- **AI-Native & Programmability**

- Support for interoperable AI framework for network and device performance improvement
- AI in Management, Control, User Plane, Security Monetization etc.
- 6G System as platform and Enable the right APIs in a multi-party ecosystem
- Holistic automation of networks and services throughout lifecycle

- **Sustainability Aspects as Design**

- Sustainability should be part of 6G design principle
- Energy Efficiency – Radio interfaces, Network load balancing

- **Security**

- Readiness to resist new threats in the post quantum age
- Provision to introduce national level security requirements

# Day-1 Services on 6G



NextG mobile broadband



Fixed Wireless Access (FWA)



Immersive /Cloud gaming



Extended Reality



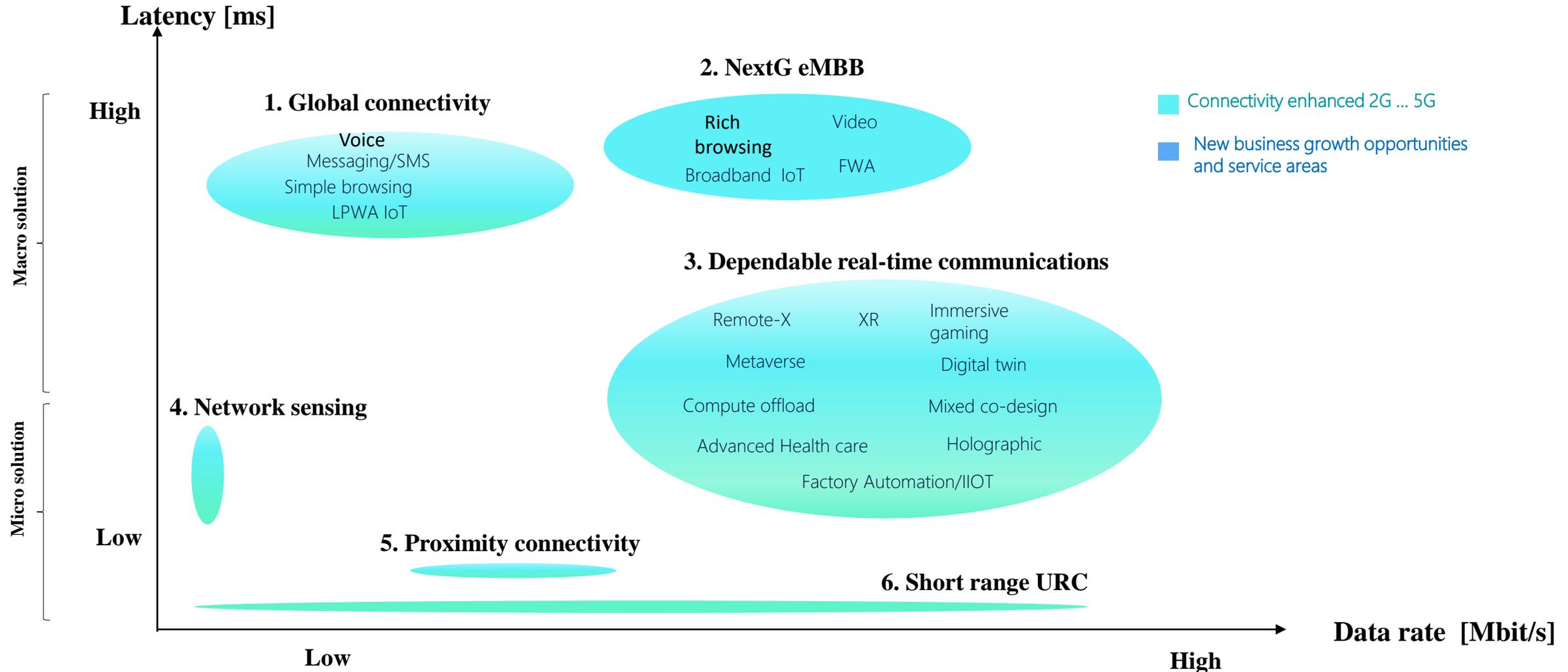
IoT/LPWA native support

- New communication service
    - Enhanced Voice, Immersive communication
  - 6G based Low Power Wide Area Network (LPWA )
    - Including continued support for 4G, 5G IoT services
  - Beyond communication services
    - Integrated network based sensing/service exposure
    - Network ability to offer AI and compute as services
  - Trustworthiness in Network (for service exposure) to various industries including government agencies and sectors
  - Traffic, Public Safety, Security and Surveillance; Health, Agri & Education
- Reliable Vo6G, 6GC (with built in AI), 6gNB (TN and NTN), 50G-PON based X-haul, Self-healing management plane
  - Self Organizing Network, Integrated Access and Backhaul, Reconfigurable Intelligent Surfaces
  - Co-existence with 4G and 5G

6G to build on 5G success  
and do so in a more  
efficient, economical,  
scalable and sustainable  
way

# Use Case Families

Augment the existing ones and emerging applications



- **Ubiquitous Connectivity**
  - Improving Connectivity through TN (Terrestrial Network) and NTN (Non-terrestrial network)
    - Targeting coverage distance for TN (ISD)  $> 8$  km, Coverage area for NTN ( TBD sqkm)
    - Targeting  $> 1$ Gbps user throughput and peak throughput  $>25$ Gbps using TN,
    - Targeting (few) Mbps user throughput from NTN
  - TN Extension & enhancement through Relays, IAB (Integrated access and backhaul), RIS (Reconfigurable Intelligent Surface) & Extreme MIMO
  - Support of mix of 4G TN, 5G (TN, NTN) and 6G (TN,NTN) network from 6GC
  - Core evolved from 5GC to support of 4G TN, 5G (TN, NTN) and 6G (TN,NTN)
  - Energy Efficiency and Coverage Expansion through New Waveforms
  - Support for Vo6G (Voice over 6G) with high reliability
- **Integrated Sensing and Communication**
  - Improve safety and efficiency of intelligent transportation systems (railways/road/ shipping/ air)
  - Use of multiple FR2, FR3 bands to improve sensing capability
  - Ability to support sensing in a standalone mode as well

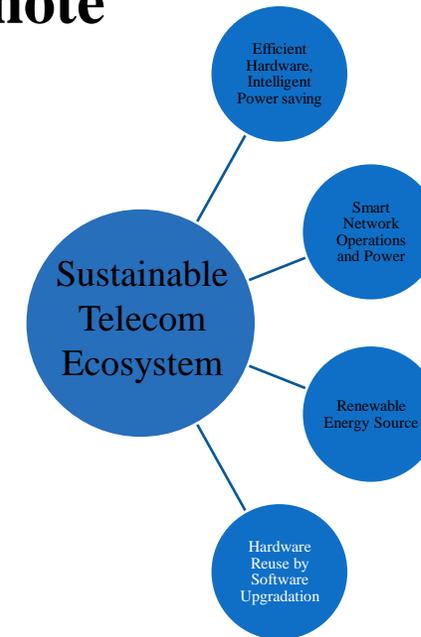
- **Immersive Communication**
  - Holographic communication & Telepresence
  - Robotic surgery enabled through holographic visualization
  - Digital twin of Smart cities, Factories, Healthcare and Infrastructure
- **AI and Communication**
  - AI for improving Radio and Network Performance
  - AI for improving positioning
  - AI for enhanced sustainability
- **Asset Tracking**
  - Battery and Battery-less asset tracking
  - IoT NTN for asset tracking
- **Convergence of Broadcast with Fixed and Mobile Broadband**

# **6G SUSTAINABILITY & SOCIETAL NEEDS**

## Vision

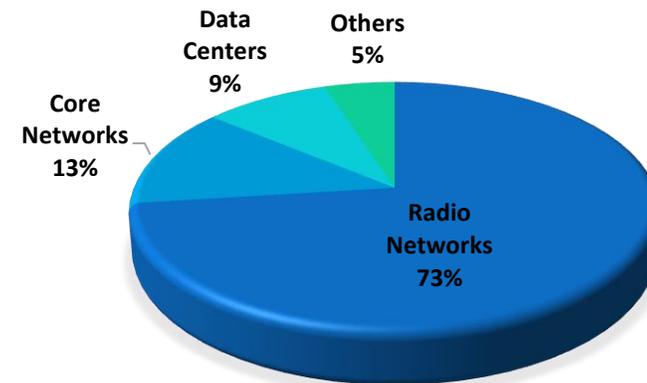
- The Bharat 6G Working Group “Green and sustainability”
- Focuses on bringing together interested partners from the 6G community,
  - Setting the directions and moderating the exchanges in the community to reinforce the importance of sustainability and
  - To reduce the carbon footprint of future mobile networks

## Means to Promote sustainability



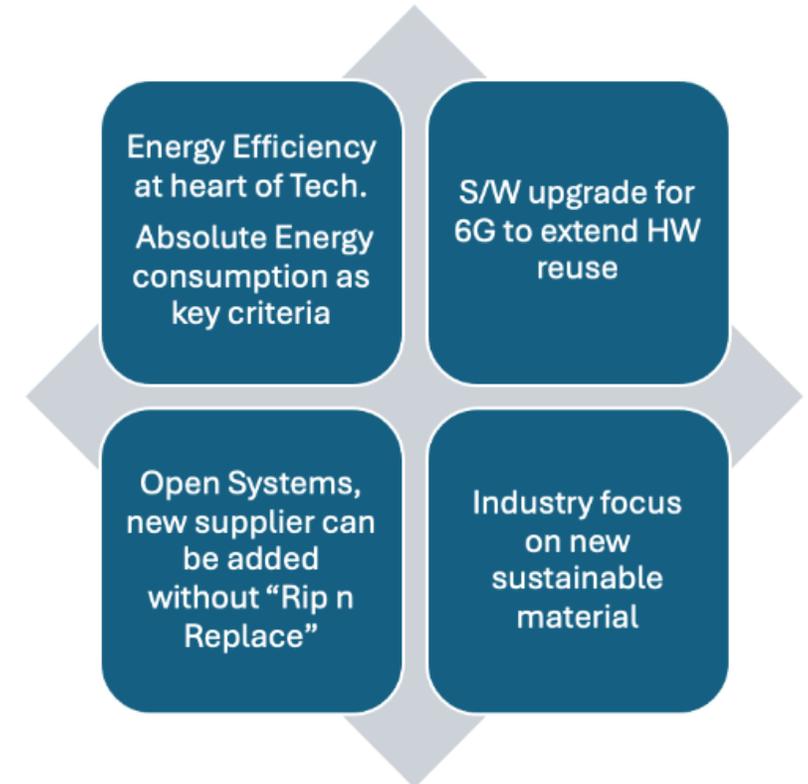
## Key Energy Efficiency aspects

- Network Energy Efficiency
- Energy efficiency through network planning & automation
- Identifying & Implementing AI based operational energy saving mechanisms in devices and network



Energy Consumption

- Development of 6G keeping sustainable telecom infrastructure is key
- Recommend e-waste recycling models, carbon foot-print reduction models
- Improving network efficiency (for e.g. Spectrum, energy, qos)
- Future network to enable industrialization, enable usable capabilities for sustainable agriculture, forestry and fisheries
- Platform for enabling sustainable cities of future; a trustworthy network for service exposures (e.g. various government agencies, consumer, industries)



# **BHARAT's INITIATIVES**

# Inclusive with Ubiquitous, Reliable and Secure connectivity

- India has built world's largest digital public infrastructure using JAM
  - Jan Dhan accounts (financial inclusion program)
  - Aadhar – digital ID
  - Mobile
- Digital service ubiquity (any device, anytime & anywhere)
- Ubiquitous secure & trustworthy across the communication network to onboard critical national digital infra (e.g. Power grid, railway infra, road transport)
- Interworking to support citizen centric services (e.g. Mobile banking)
- Convergence across technologies (mobile and non-mobile) to ensure reliable baseline digital service delivery (for e.g. KYC, otps, mobile banking)



6G Networks to be trustworthy and reliable for advanced service delivery with chain of trust in an increasingly vulnerable cyber world

- Digital inclusion continues to be our core objective
- Enable sustainable Agri, forestry and fisheries- leverage environmental sensing and automation
- Sustainable ICT for healthcare availability for under privileged sections
- Circularity at the core of manufacturing or material extraction
- Climate is real and direct impact on weather forecast, agriculture pattern, water resource management, high tremors and land slides in hills.



India's step-wise plan for a greener India and include

- Achieving net-zero by 2070,
- Reducing total projects carbon emissions by one billion tons till 2030.
- Increasing renewable energy components to 50% of the total energy requirement, reducing carbon intensity by 45%.

ICT can be key enabler for same in addition to reducing its own energy consumption.



- Accelerated research on 6G eco-system
- 6G end-to-end communication system
- Extreme MIMO testbed
- Advance optical communication test bed
- 6G: thz test bed with orbital angular momentum and multiplexing
- Sub-THz wireless communication with intelligent reflecting surfaces (IRS)
- Digital twin for national infra optimization
- Ai4bharat- to position as a global leader in AI
- National Mission- interdisciplinary cyber physical system
- Quantum mission
- AI mission

Leverage academia, startups and R&D labs with support from industry and telecom service providers in 6G technology and use-case development

## General considerations

- Monetization should be central to evolution
- Leverage 5G investments and enable smooth evolution in meeting future requirements

## Considerations on 6G

- Networks need to be G agnostic in future, network elements should be software upgradable
- Core to handle 6G and 5G RAT, simplified network deployment paths
- 3GPP to enable open interfaces in 6G RAN for improved interoperability across building blocks
- Expectations and on field performance should be aligned
- Ubiquitous connectivity ensured through multiple spectrum bands across terrestrial and non-terrestrial network technologies
- Voice over 6G, Energy efficiency, Coverage, Sustainability, Native Intelligence, etc., need to be part of design (not an afterthought)
- 6G RAT should be backward compatible (IoT devices) in existing bands, able to co-exist with 5G and smoothly migratable

**Q & A**

**<https://bharat6galliance.com>**



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# Thank you

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<https://bharat6galliance.com>

Invited to 6G Global Vision Workshop on 16<sup>th</sup> October 2024 in New Delhi

Welcome you all to WTSA 2024, 14-25 October 2024, New Delhi