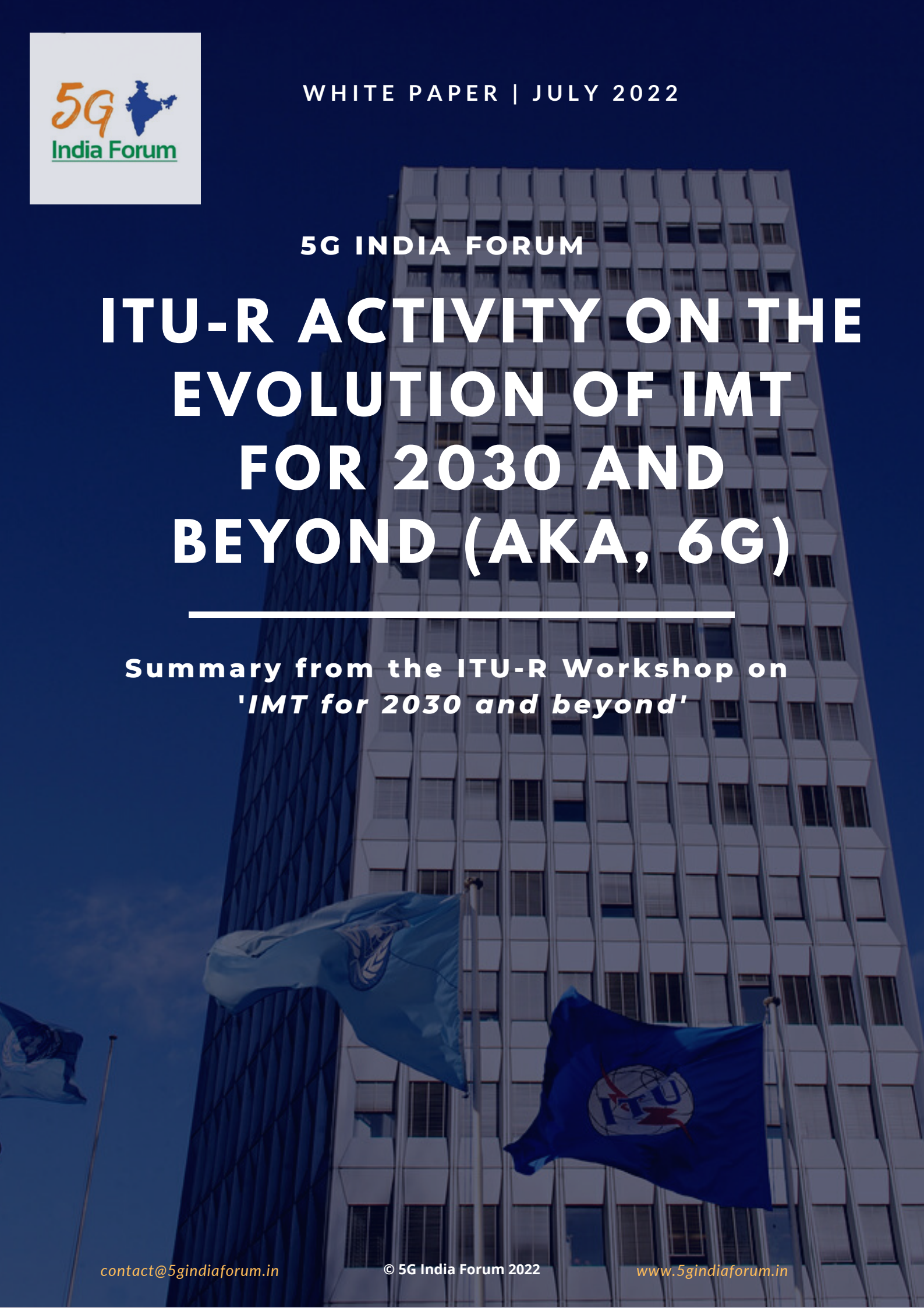
WHITE PAPER | JULY 2022

5G INDIA FORUM

ITU-R ACTIVITY ON THE EVOLUTION OF IMT FOR 2030 AND BEYOND (AKA, 6G)

Summary from the ITU-R Workshop on *'IMT for 2030 and beyond'*



contact@5gindiaforum.in

www.5gindiaforum.in

The Radiocommunication Sector of the International Telecommunication Union (ITU-R) started working on the development of a recommendation on the vision for IMT evolution for 2030 and beyond. The activity started in March 2021 with a targeted completion date of June 2023. The Working Party 5D (WP 5D) of ITU-R is developing this recommendation with the active participation of several Administrations and ITU Sector Members. WP 5D recently organised a day-long workshop in Geneva alongside the 41st WP 5D meeting on the 14th of June 2022. ITU had invited various organisations working on 6G topics, academic institutes, and countries to present their vision toward 6G. The workshop received 14 presentations and was attended by more than 300 participants. The objective of this workshop was to aid the WP 5D delegates with the recent research being conducted internationally related to the future of mobile communication targeting 2030 and beyond. All the workshop presentations are published on the ITU-R WP 5D website.

In this white paper, we have summarised the presentations from ITU-R "IMT 2030 and Beyond" workshop.

A. Key takeaways from the workshop:

A.1 Hexa-X is the leading European research program to lay the groundwork and promote industry agreements that will facilitate the development of 6G. Its vision is to connect the three worlds: the digital world of information and computing, the human world of our senses, bodies, and intelligence, and the physical world of objects and organisms through cognition and synched bio, real-time control, and twinning and control respectively. With core ideas sustainability, inclusivity, and integrity, six major research challenges were outlined along with 28 use cases, clustered into 6 categories. Hexa-X also defines various KPIs and KVIs along with the spectrum evolution aspect to improve the spectrum utilization and extend the boundaries to the sub- THz spectrum (7-24 GHz range).

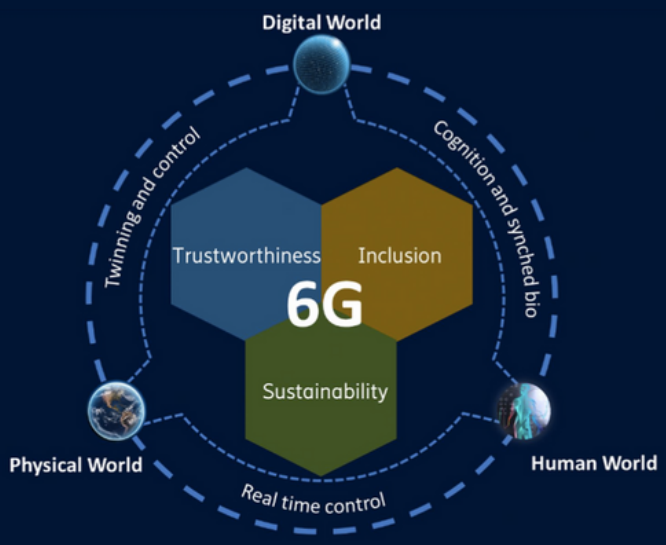


Figure 1. Hexa-X vision on 6G. Src: Hexa-X

A.2 One6G Associations covered the significant aspects of 6G use cases with new requirements such as self-adaptive and heterogenous device type, new devices for robust fronthaul and backhaul with extended coverage and sensing, enabling technologies from radio access to service execution platforms, and various vertical domains- automotive, transportation, industrial smart factories, healthcare, and agriculture.

Additionally, a holistic approach to network architecture, flat network architectures, mesh networking, and the "greenness of AI" were introduced.

A.3 NEXTG Alliance is the leading 6G program in North America that brings together 80 leading organizations and experts from industry, academia, and government agencies. It emphasises on the "6 pillars of success- Audacious Goals" presented that can lead IMT'2030 to success through trust, security, and resilience; effective deployment with improved delivery of services in urban, suburban, and rural areas; distributed cloud and communication services using remote data collections, untethered wearables, and implants; and personalised user experience and implants; and personalised user experience. NextG alliance also emphasises the important role of enhanced digital-world experience through multi-sensory extended reality and sustainability with energy efficiency, better re-use of raw and rare materials, circular economy, and using greener technology.

Figure 2. NEXT-G Audacious Goals. Src: NEXT-G

A.4 WWRF believes future 6G technologies will be leveraging key technology trends such as THz communications; integrated communication and sensing; reconfigurable intelligent surfaces and holographic radios; intelligent connectivity using AI and ML. The various use cases highlighted during the presentation were 'fibre over the air' technology and its challenges, cyber-physical interaction, immersive experience, and artificial intelligence.

A.5 6G Innovation Centre at the University of Surrey elucidated upon the evolution of various aspects of IMT'2020 towards the IMT'2030. It integrates communication and sensing on the system as well as user levels using the interaction between and within the virtual and physical worlds and introduces a number of use cases enabled with interactivity and teleportation using time synchronization, high accuracy geolocation, user-level sensing, and Tb/s per cell.

A.6 The University of Strathclyde, UK discussed the analysis of network requirements and technology trends to enable immersive living was initiated. New immersive experiences and digital twins will be made possible by the metaverse and cyber-physical. Key technologies include Quantum network, computing, sensing; New Hardware; Spectrum THz, sub-THz, and optical (infrared and visible light); Integrated AI Widespread use of AI in cognitive and data-driven networks, and Intelligent spectrum management.

A.7 HAPS Alliance or High Altitude Platform station has made it possible to explore Stratosphere and unlock its potential. Many operators shared their experiences related to HAPS-based trials and demonstrated the possibility of using HAPS systems along with IMT technologies. The various use cases and usage scenarios include provision connectivity for aero devices with a 3D coverage network, connectivity for aero devices; helping with natural disaster recoveries; and connecting the unconnected using new, flexible, and future-proof connections.

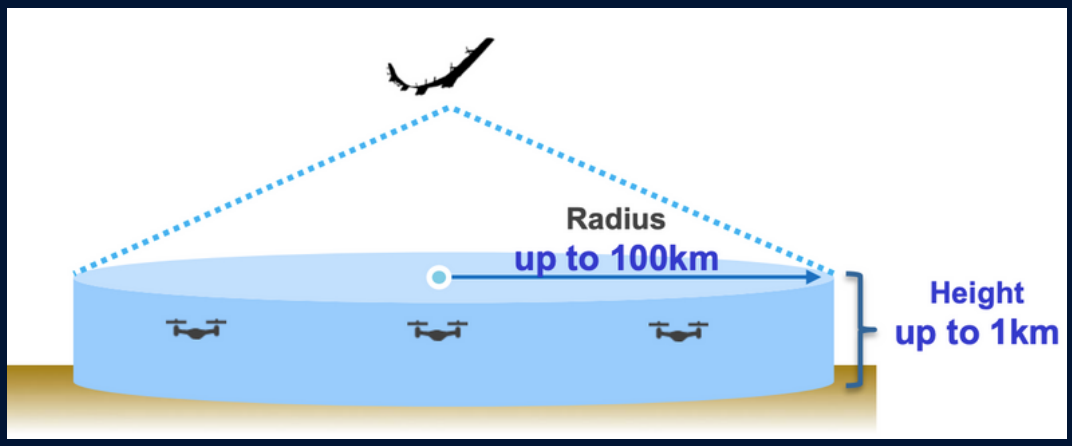


Figure 3. Ultra-Wide 3D coverage. Src: HAPS Alliance

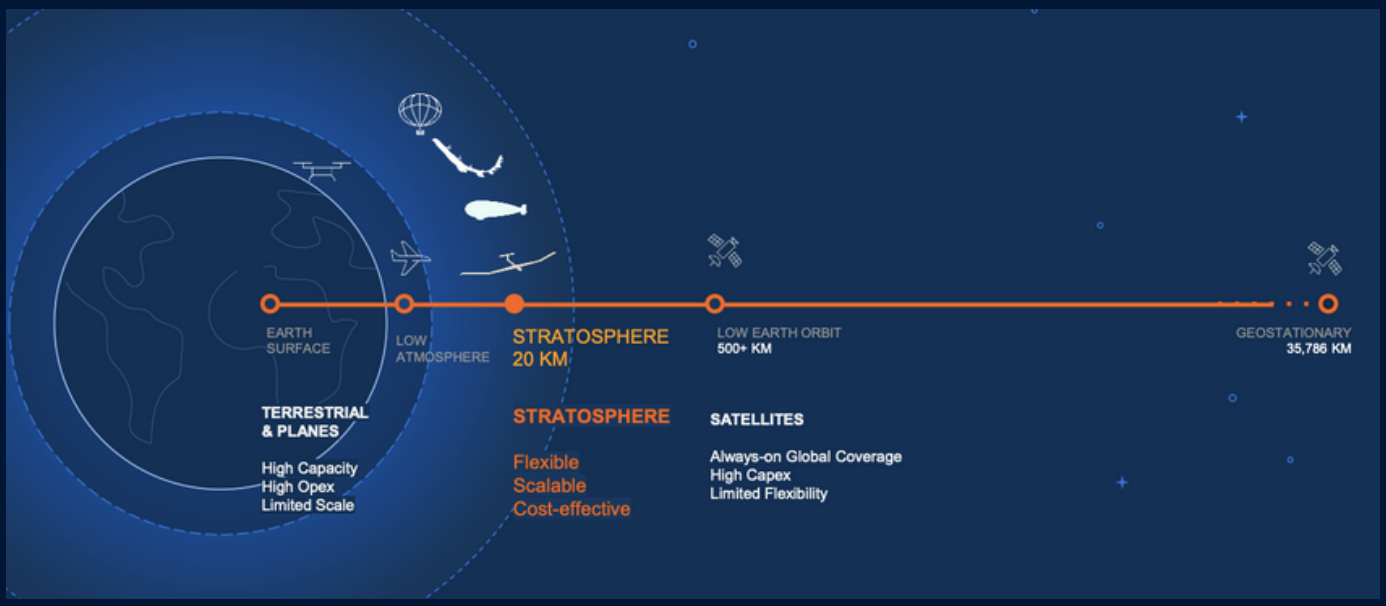


Figure 4. Communication at various layers of atmosphere. Src: HAPS Alliance

A.8 IMT-2030 (6G) Promotion Group represented the cutting-edge 6G technology development and industrial growth in China and includes extensive 6G use cases analysis, future market trends, network O&M requirements, and proposed 6G new usage scenarios key capability indicators. It proposes 6G will have outstanding technical features such as high performance, advanced intelligence, green and low carbon, wide-coverage, and balanced security. Some traditional wireless performance indicators may be improved by 10 to 100 times.

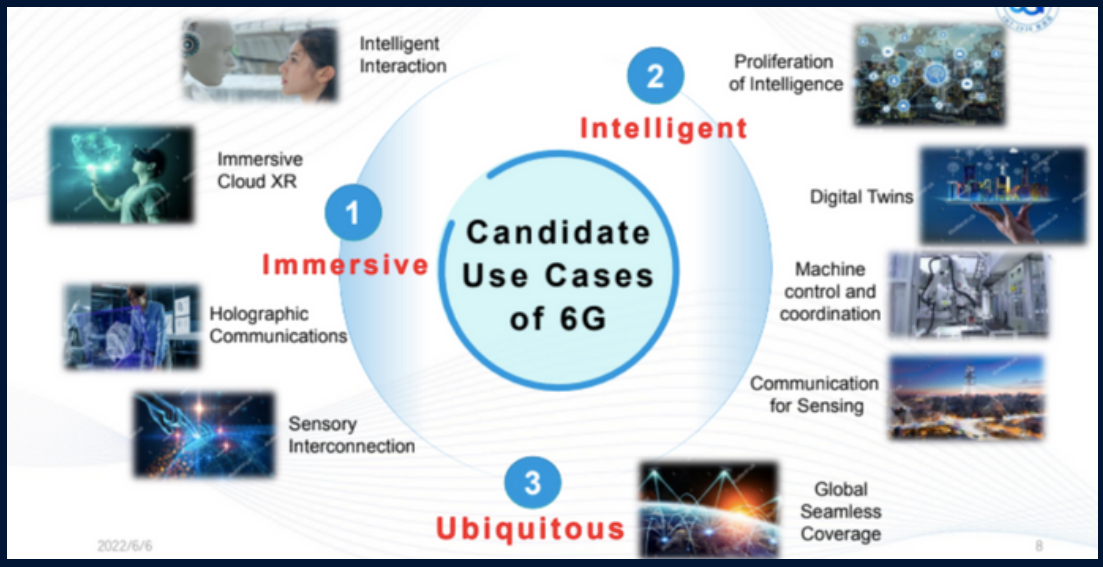


Figure 5. 6G use cases. Src: IMT-2030 (6G) Promotion Group

A.9 Beyond 5G Promotion Consortium, Japan recently published their white paper "Beyond 5G White Paper (v1.0), Message to 2030s". In the workshop, the Chair of the White Paper Subcommittee structuralized the writing of the white paper subdividing it into various chapters. The paper presents various research findings' for a variety of stakeholders, and offers insightful data for WP 5D's development for vision.

A.10 National Telecommunications Regulatory Authority (NTRA), Egypt points out the requirements of the developing countries towards the development of 6G and proposes using IMT- 2030 as a tool to bridge the digital divide by providing useful applications with a focus on affordability, flexibility in deployment, and societal well- being.

A.11 Radio Research and Development Institute, Russia elucidated the challenges IMT-2030 may face during the implementation of 6G. Some of the challenges highlighted are electromagnetic compatibility issues, propagation at higher bands, increased modulation orders, NTN deployment challenges, etc.

A.12 The Finnish 6G Flagship program presented by Univ. of Oulu, Finland aims to increase the global impact of Finnish 6G expertise and suggests a structured flow of IMT for 2030 and beyond. It includes goals and societal impacts, users, usage scenarios, future examples, enabling technologies, and KPIs/ its capabilities to strengthen national 6G development efforts toward secure, safe, sustainable, and inclusive 6G.

A.13 Network architecture for IMT-2030 IIT Bombay, India elucidated about signaling as a service in future networks, the SDN, 3GPP 5G systems(IMT-2020), Signalling, and data flow in 5G system along with extending network architecture proposals for IMT 2030.

A.14 Telecommunications Standards Development Society, India (TSDSI) highlighted its learnings from 5G and 6G Visions that include steering research to serve the country's goals and continuing engagement with global standards bodies for harmonization of efforts. The four key pillars include future technology to- achieve a Ubiquitous Intelligent Mobile Connected Society; help bridge the digital divide; localize services; support the connectivity and address ideal-world data ownership sensitivities.

B. Conclusion

The current draft recommendation being developed has contributions from various external organizations, ITU-R members, research projects, and academia with metaverse being a common topic across all, as well as sustainability being a constant vision from all of the presentations. The figure below encompasses various technology trends, IMT's role and evolution, use case scenarios, and capabilities.

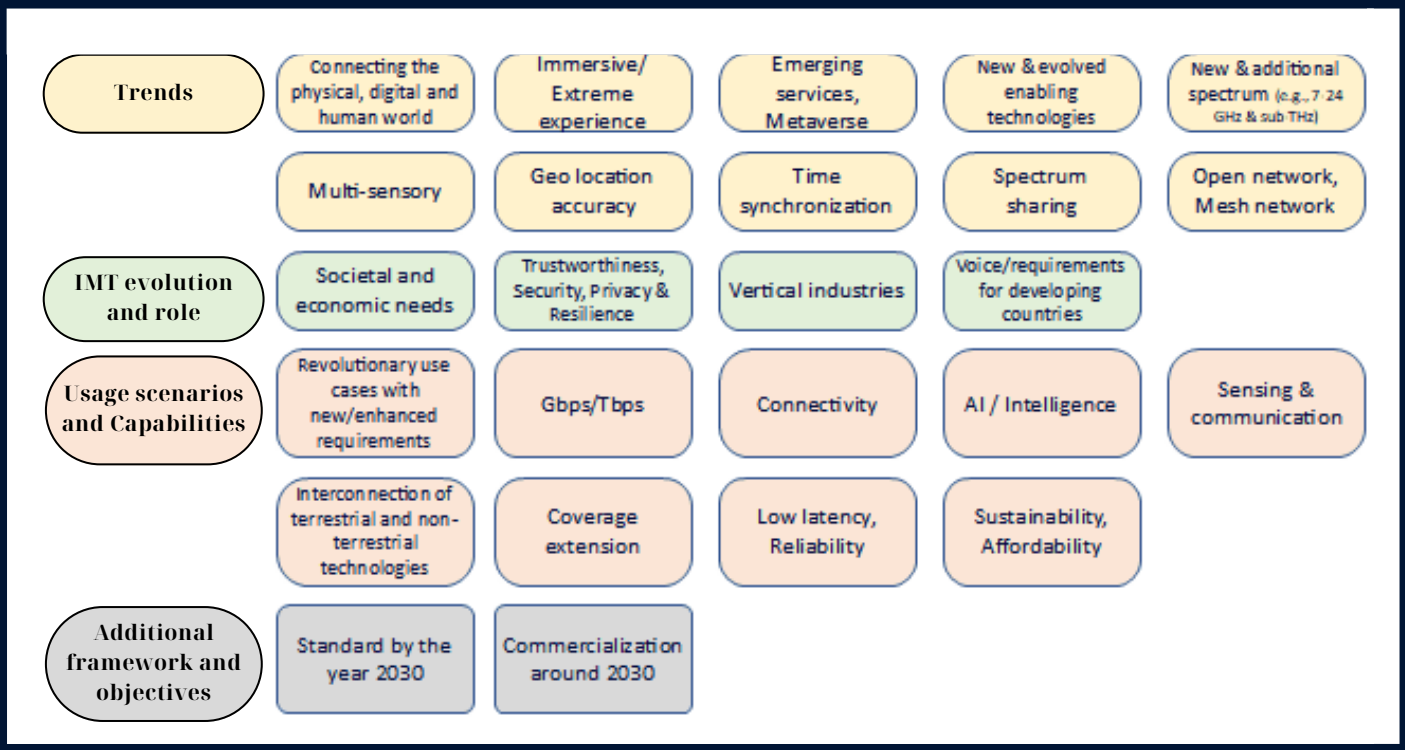


Figure 6. Snapshot from the Draft New Recommendation ITU-R M.[IMT.VISION 2030 AND BEYOND] Src: WP 5D

The various topics addressed in the workshop were: Trends of IMT which included user and application trends, technologies such as pervasive AI, immersive media, sustainable ultra-wide coverage communications, and their spectrum implications. It also included the evolution and role of IMT, use case scenarios, capabilities such as peak data rate, area traffic capacity, latency, energy efficiency, and objectives for IMT 2030 and beyond.

The next Working Party 5D meeting is scheduled to be held on 10th October 2022, in Switzerland [Geneva]; members and organizations interested in contributing can do so by 1st October 2022.