tsdsi Telecommunications Standards Development Society, India

The 5G Journey... and the 6G Destination

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17th April 2025

6G Motivation (Why 6G?)

Hype

Support for New Services and Use Cases

- Enabling new services and use cases beyond traditional communication, such as integrated sensing and communication (ISAC), XR/immersive communication, and AI-based services – Compute.

Revenue Growth and Monetization

- Creating new revenue streams by monetizing network capabilities and supporting diverse applications across industries.

AI and Automation

- Implementing AI-native networks for automation, optimization, and improved efficiency in network management and resource allocation.

Energy Efficiency and Sustainability

- Reducing energy consumption and promoting environmental sustainability through energy-saving features in network design and AI-driven power management.

Spectrum Efficiency

- Utilizing spectrum efficiently, including dynamic spectrum sharing and exploring new spectrum bands.

Ubiquitous Coverage

- Seamlessly integrating terrestrial and non-terrestrial networks (NTN) for ubiquitous coverage and resilient services.

Total Cost of Ownership (TCO) Reduction

- Reducing capital expenditure (CAPEX) and operational expenditure (OPEX) through simplified network operations and improved energy efficiency.

Improved Service Reliability and Customer Experience

- Enhancing service reliability, resiliency, and insights for improved customer experience.

Network Simplification

- Simplifying network architecture, reducing complexity, and improving operational efficiency.

More of an engineering problem than a standards issue

5G deficiencies are not being discussed yet:

1. Coverage in Mid Band, mmWave yet to see any deployments
2. Massive MIMO efficiencies are limited
3. OFDM is still favoured for obvious reasons; what this means is that from LTE to 5G to even possibly in 6G, practical air interface spectral efficiencies have saturated

6G Goals – from the 6G workshop

Sustainability

- Focus on environmental, social, and economic sustainability. This includes energy efficiency, reduced resource consumption, and contributing to global emissions targets.

Resilience

- Designing networks that are robust and can withstand various events, including operational errors, heavy traffic, and disasters.

Security

- Increased security, integrity, and privacy are required from day one, incorporating zero trust principles and post-quantum security measures.

Customer Experience

- Improved end-user/customer experience through seamless, ubiquitous connectivity, ensuring reliable, high-quality services delivery. Optimized Quality of Experience (QoE) across diverse devices and network conditions.

Efficiency

- Cost reduction via simplified systems and operations, with AI-driven automation and optimization.

Interoperability

- Promoting open/interoperable interfaces and collaboration to foster innovation and avoid market fragmentation.

Lessons Learned from 5G

Challenges in Migration

- The transition from 5G Non-Standalone (NSA) to Standalone (SA) proved complex and difficult.

Architectural Complexity

- An excessive number of architectural options, features, and configurations led to high system complexity, impacting UE capabilities and deployment efficiency.

Slow Adoption of Key Capabilities

- Certain 5G features, such as network slicing, experienced slow adoption—necessitating an analysis of underlying causes and potential simplifications in 6G.

Deployment Inefficiencies

- Issues identified during 5G rollouts, including NRF profile inefficiencies and protocol challenges (e.g., HTTP/2 over TCP), should be addressed in 6G.

Optimized Network Functions

- Ensuring efficient Network Function (NF) sizing with clear decoupling, while further exploring stateless architectures.

Functionality Optimization

- 6G should focus on a well-dimensioned set of functionalities, minimizing redundant options and excessive configurations to reduce complexity.

Basic connectivity (coverage and spectral efficiencies) are ignored

Radio Access Network for 6G design considerations

- 6G Radio interface: Non-backwards compatible (from a UE perspective) to exploit full potential, with certain characteristics (e.g., waveform, modulation and channel coding) based on 5G NR with possible enhancements.
- Study needs to show **significant gains** to justify 6G Radio.
- Lean and Streamlined 6G, dimension appropriate set of functionalities, minimize adoption of multiple options for the same functionality, avoid excessive configurations
- **Superior coverage** for 6G radio from Day-1
- **Diverse device types** with scalable design from Day-1 based on, for example: Bandwidth/data rate, form factor, energy consumption
- Harmonized TN and NTN design
- AI/ML: **Extensible AI/ML framework** built on 5G-A as appropriate, with native support for AI/ML lifecycle management, (e.g., configuration, performance monitoring, deactivation, and seamless transition to conventional algorithms). And exploring new use cases.

3GPP 6G Workshop Summary

Kindly note the following:

1. Statements hinting that 6G will be based on 5G NR will be a nonstarter,
   a. “6G Radio interface: Non-backwards compatible (from a UE perspective) to exploit full potential, with certain characteristics (e.g., waveform, modulation and channel coding) based on 5G NR with possible enhancements”.
   b. **Study needs to show significant gains to justify 6G Radio** – This is key.
2. On the network side (including core), the conclusion looks like minor enhancements on 5G which is again non-motivating.
3. Key functionality such as Sensing and Reflective Intelligent Surfaces can (AND PROBABLY WILL) be accommodate on existing 5G networks
4. Any AI functionality is only as good as the data that’s made available (which has been a problem historically for operators to realize SON etc) and if the right is made available, AI or non AI algorithms are equally viable.

Summary: These are very initial days but the initial 6G discussions are starting on a wrong foot.

6G Directions

- **The 6G Radio Network (RAN) has the capacity to evolve independently of the core network, as such its best to pursue an approach of development of RAN specifications independent of the Core Network specifications with minimal dependency.**
- **“Connectivity issues” (Coverage and capacity) shall be central for the choice of any new radio technology.**
- **To foster better operator innovation, follow the “Platform” approach for the RAN and Core network**
- **Explore possible multiple independent (but possibly co-working) RANs for different verticals.**
- **A fresh look at “Openness” within 3GPP / TSDSI for RAN network independent of any external organization or existing specification influence.**

6G Directions

- Delinking RAN from the Core (or having a sufficient segregation) will allow for new technologies (ex: the purview of local regulatory authorities and the need to provide local standardization solutions) to be accommodated well within a technology generation cycle.
  - IOT, Broadcast, V2X, Drones, flavors of NTN, Digital Radio, new technologies?

- Open Hardware (Cloud and RAN), Open RAN, Open Platforms etc are opportunities that TSDSI will continue to focus on.

Thank You

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