

ETRI

Electronics and Telecommunications
Research Institute

6G R&D in Korea

- ETRI Perspective

Feb. 2024

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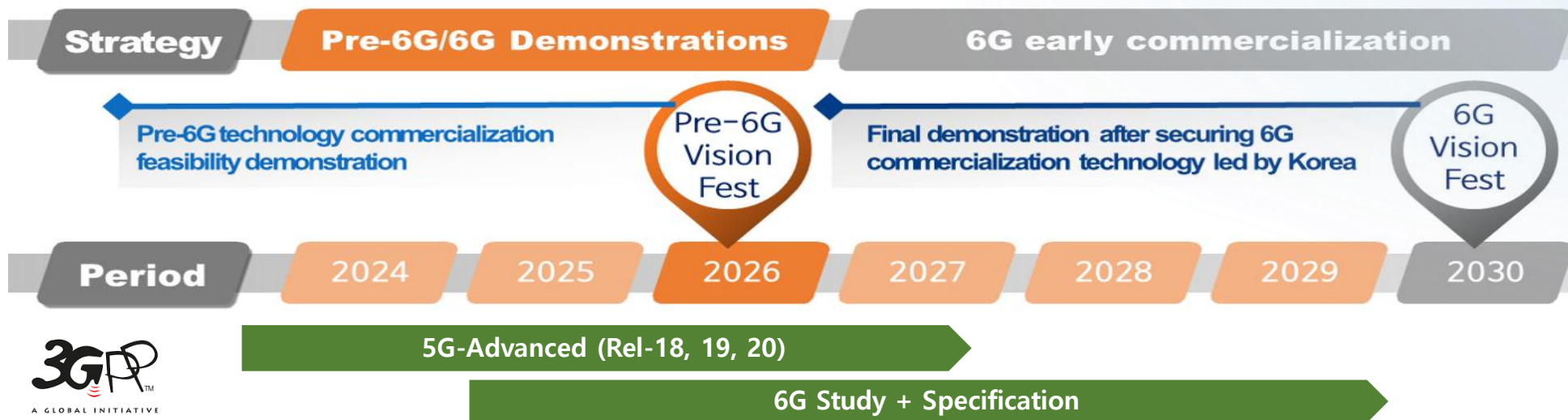


01 · Korea 6G Research



	Hyper Performance	Hyper Broadband	Hyper Precision	Hyper Space	Hyper Intelligence	Hyper Trust
6G Phase1 (2021~2025) 165M\$	1Tbps level data rate	100~300Ghz frequency candidate band	Latency 1/10 of 5G	Up to 10km from the ground	AI technology to entire Network	Security by design embedded

	Advanced Wireless	SW-Centric	Beyond Com.	Energy Saving	Supply Chain
6G Phase 2 (2024~2028) 327M\$	Upper Mid-Band Coverage Expansion	Open RAN Cloud-native AI-native	Computing + Com. Sensing + Com.	AI based power saving High-efficient & Low energy devices	UE/RAN components Optical components



01 - Korea 6G Research

🌀 Project: Development of 6G LEO Satellite Communication System (Under review)

- **Scope:** 6G LEO Sat. Comm. **Payload**(incl. ISL), 6G LEO Sat. Comm. **Ground System**(GW & Terminal)
- **Budget and Period:** 370M\$, 2025~2030 (6 years)
- **First Launch:** **Y2027 (1, 5G-Adv. NTN)**, **Second Launch:** **Y2030 (2, 6G NTN)**



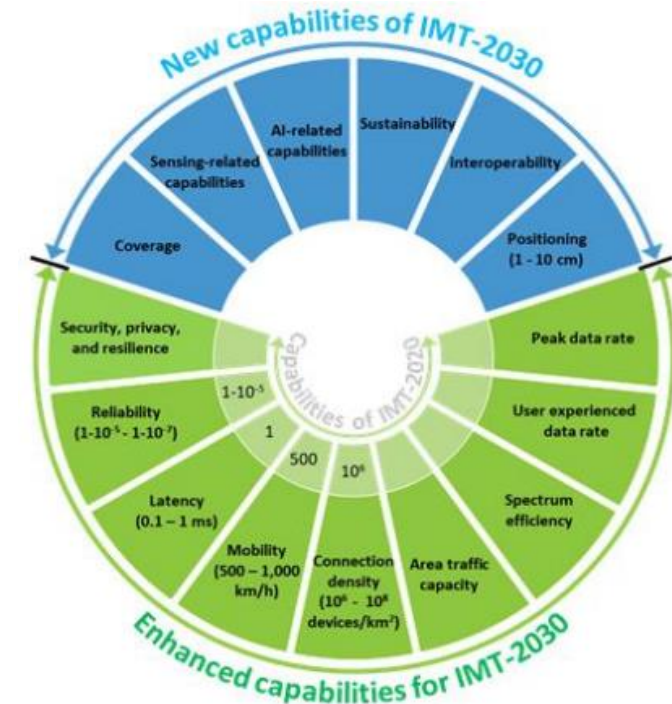
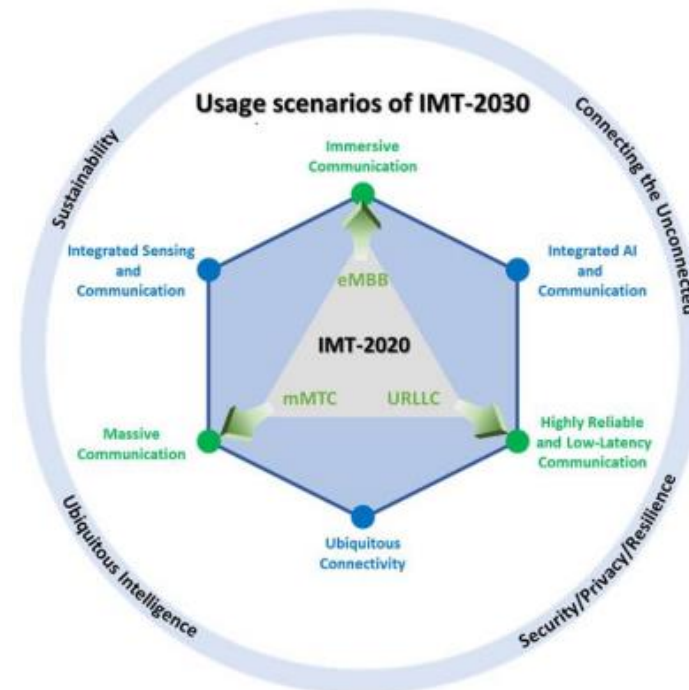
02 · 6G Technologies | IMT-2030 Framework

Usage scenario

- eMBB → Immersive Communication
- URLLC → Hyper Reliable and Low-Latency Communication
- mMTC → Massive Communication
- Ubiquitous Connectivity
- Integrated Artificial Intelligence and Communication
- Integrated Sensing and Communication

Capabilities

- Peak Data rate, User experienced data rate
- Spectrum efficiency, Reliability, Latency
- Mobility, Connection density and so on
- AI related capabilities
- Interoperability, Sustainability
- Sensing-related capabilities and so on



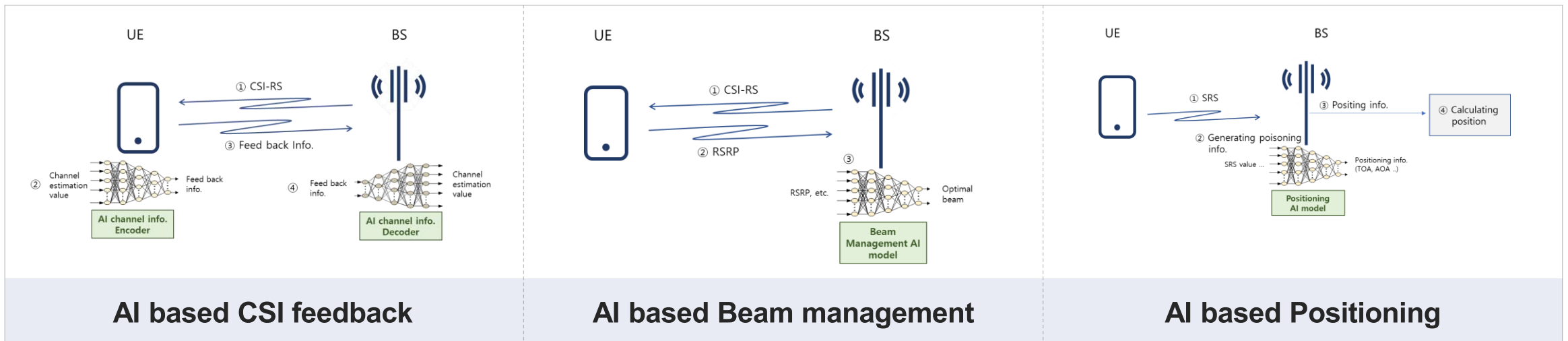
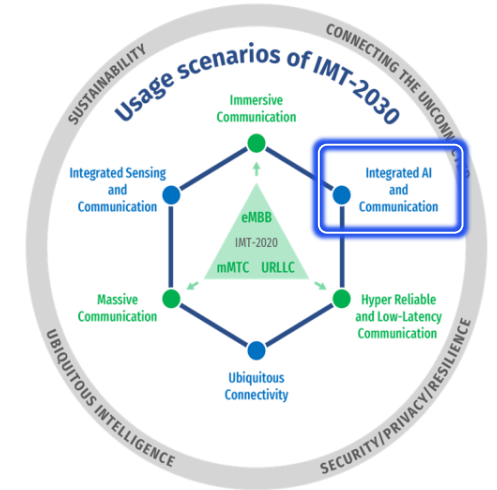
02 · 6G Technologies | Key Features

AI native air interface and radio network

Anticipated integration of AI in upcoming 6G

- MIMO/Beamforming (CSI feedback)
- Positioning
- SON(Self Organized Network), etc.

Integrated AI and Communication



CSI: Channel State Information

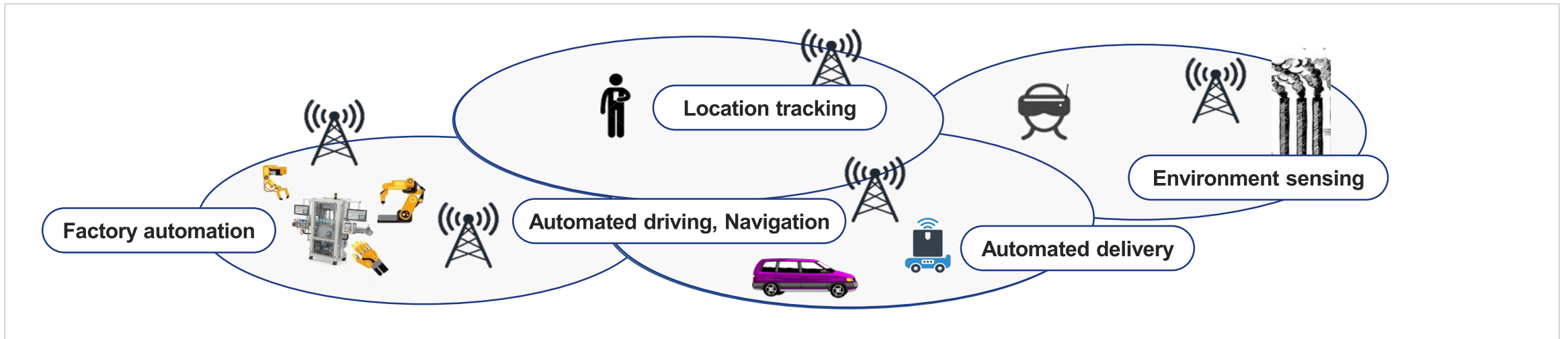
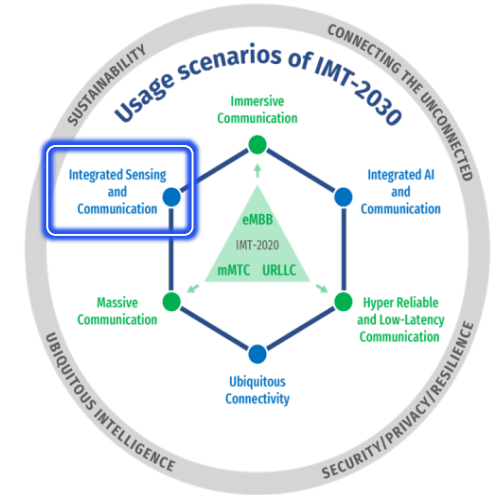
02 · 6G Technologies | Key Features

Integrated sensing and communication

Associated 6G capabilities

- ▶ High precision positioning, range/velocity/angle estimation
- ▶ Presence detection, imaging/mapping, etc.

Integrated Sensing and Communication

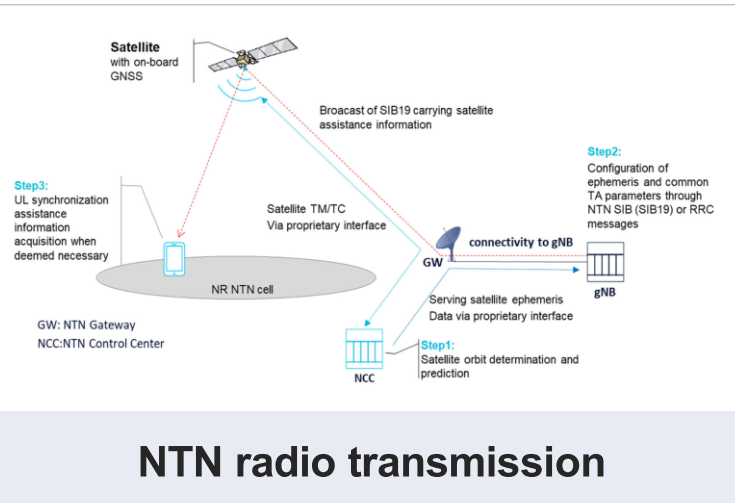
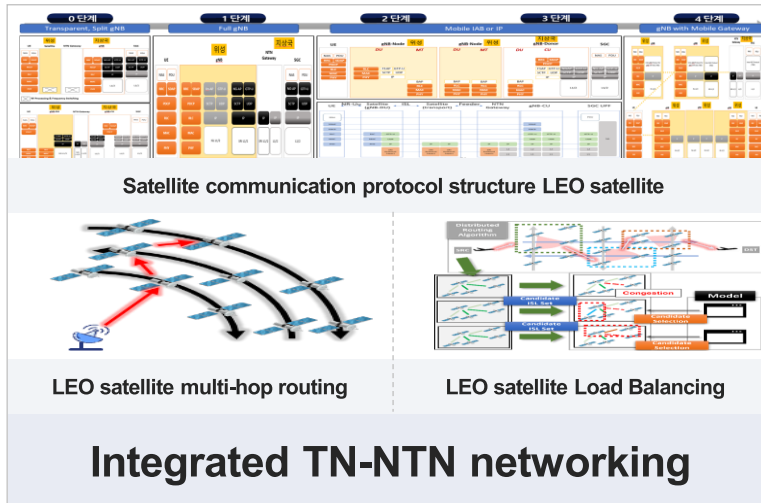
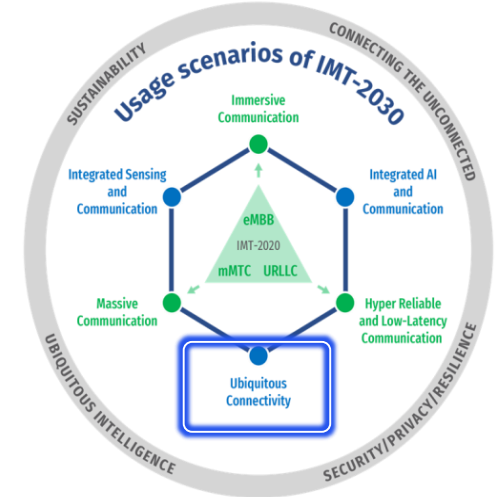


02 · 6G Technologies | Key Features

🔄 Interworking of the TN with NTN

- ▶ 6G integrated TN-NTN networking protocols
- ▶ 6G NTN radio transmission technologies
- ▶ 6G LEO satellite payload component technologies

Ubiquitous Connectivity



02 · 6G Technologies | Key Features

📶 New frequencies | More usage scenarios → More spectrum

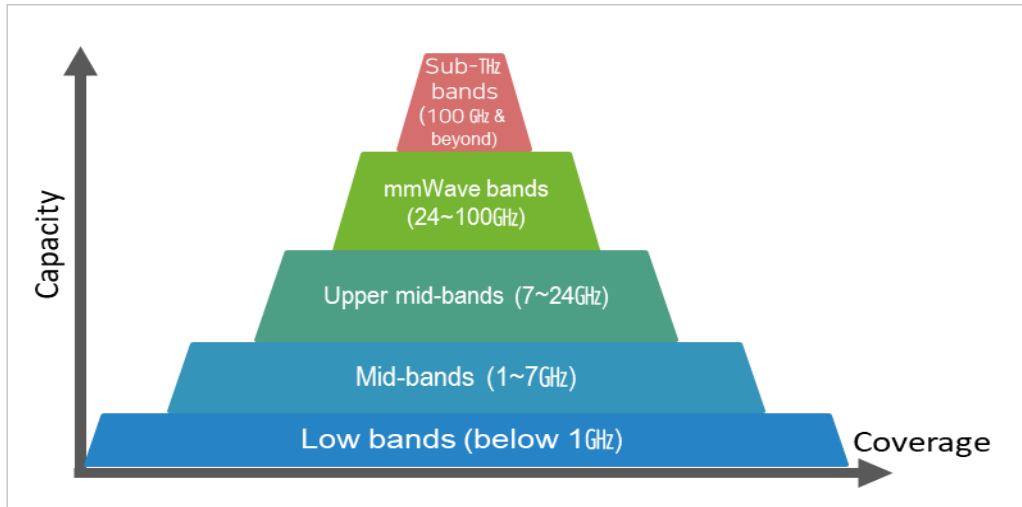
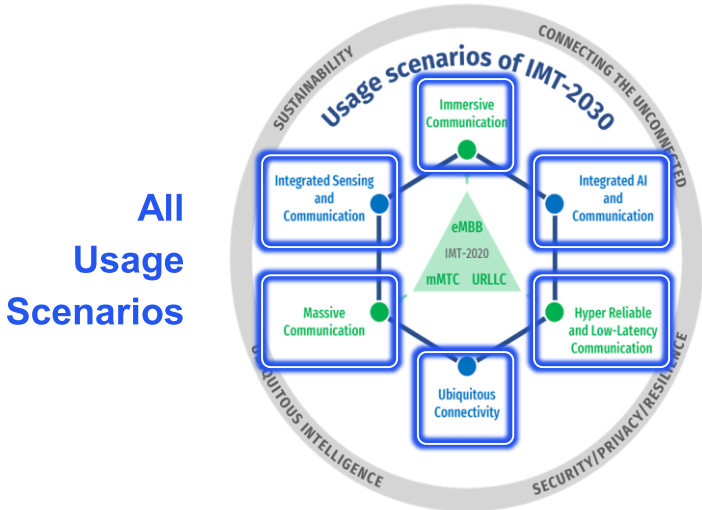
**Mobile comm
expanding
to whole
industrial areas**

- ▶ High Band (mmWave + sub-THz) → Sensing & Ultra Capacity

- ▶ Upper Mid Band (7-24GHz) → Coverage & Extreme Capacity

- ▶ Mid Band (1-7GHz) → Coverage & Capacity

- ▶ Low Band (below 1GHz) → Extended Coverage



- ▶ KOREA 6G Candidate Upper Mid band | 7.125 ~ 8.4, 12.75 ~ 13.25, 14.8 ~ 15.35GHz

- ▶ APT view | 7.125 ~ 15.35GHz for IMT spectrum in WRC-23

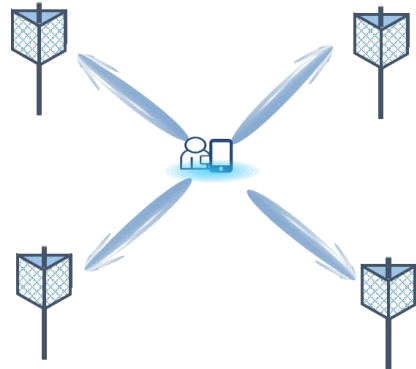
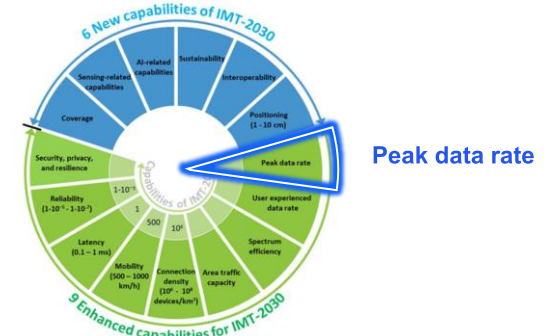
- ▶ Wider Channel Bandwidth | 400MHz in the Upper Mid Band

- ▶ Spectrum Technology
 - 4G: Carrier Aggregation
 - 5G: Dual Connectivity
 - 6G: Advanced Duplex

Sub THz Communication

▶ Develop Sub THz radio transmission technologies

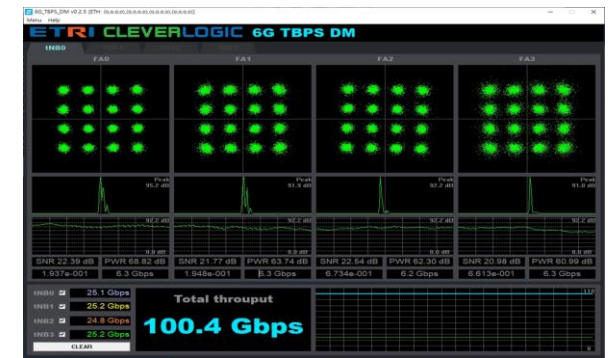
- Multi point transmission, waveform, RF impairment compensation ...
- International standardization : ITU-R IMT-2030 frame work ...
- Development of Sub THz PoC system and demonstration: 100Gbps



Multi point transmission



PoC system

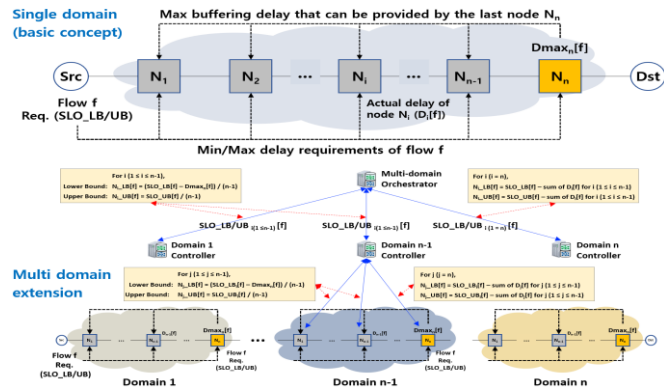
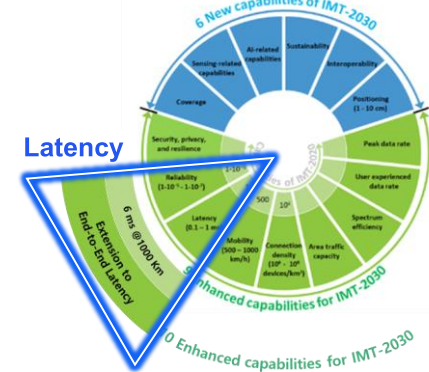


Demonstration

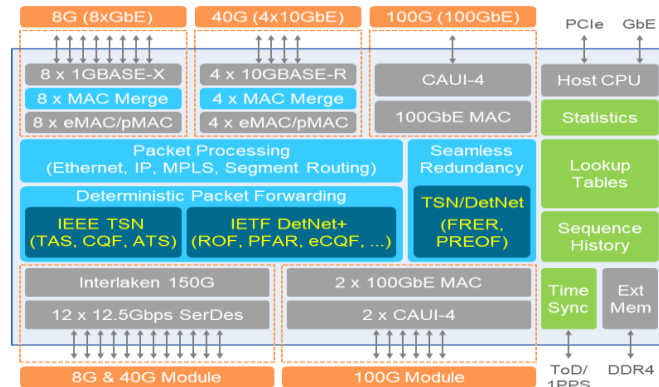
03 · ETRI 6G Technologies | Network

Large-scale DetNet for hyper-immersive interactive services

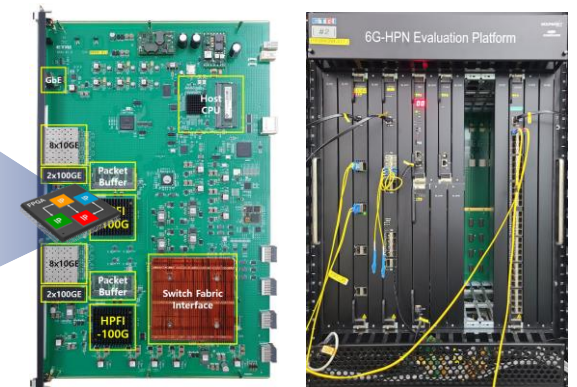
- ▶ **Leading Time-deterministic Tech. with DetNet and TSN mechanisms**
 - Industry's first field trials: **8Gbps (2019), 40Gbps (2020), 100Gbps (2022)**
- ▶ **Large-scale DetNet standardization and prototype development**
 - **100Gbps packet forwarding engine PoC trial(2025)**
 - : Target E2E latency <5msec In-time, <±1μsec On-time (@800km-fiber delays)



ROF (Resource-based On-time Forwarding)



High-precision On-Time Packet Forwarding Engine

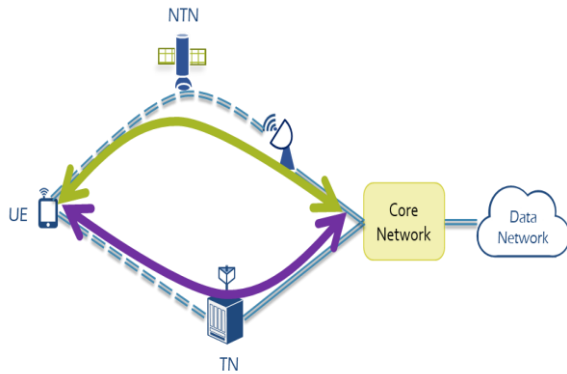
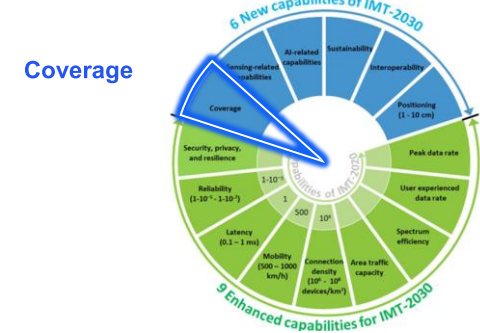


Evaluation Platform (prototype system)

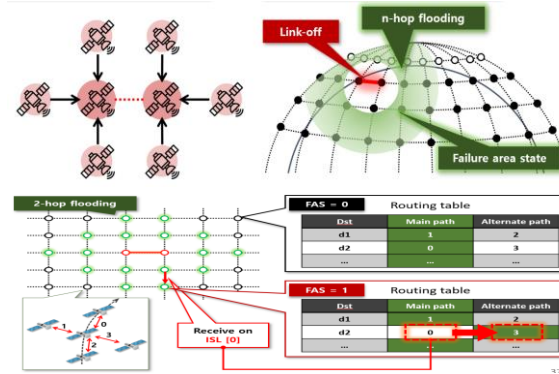
03 · ETRI 6G Technologies | NTN

6G integrated TN-NTN networking protocols

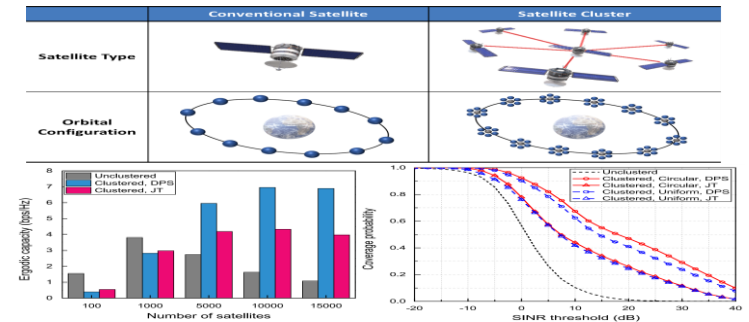
- ▶ **Dual Steer:** Technology for integrated TN-NTN multi-connectivity
 - Dual steer and mobile core-based satellite structure (3GPP SA contributions)
- ▶ **Network optimization simulators** considering LEO cluster environment
- ▶ **Satellite clustering** technology for high-density LEO constellations
(Accepted in IEEE Veh. Technol. Mag.)



TN-NTN Dual Steer



LEO network optimization

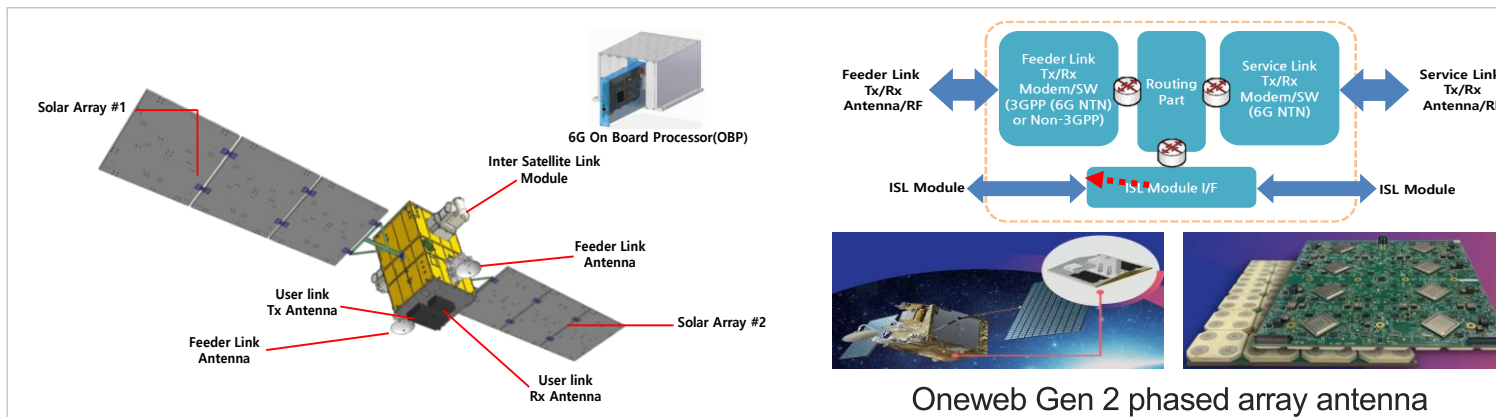


Throughput improvement of more than 6 times compared to the conventional method

LEO satellite clustering

6G LEO satellite communication payload technologies (Planned)

- ❑ LEO satellite communication **payload RF/antenna** technology
 - Multi-beam phased array antenna & BF technology of communication satellite payload
- ❑ **Modem & SW** implementation technology of 6G NTN technologies operated on **LEO OBP**
- ❑ **Inter-satellite link (ISL) laser communication** technology for LEO communication



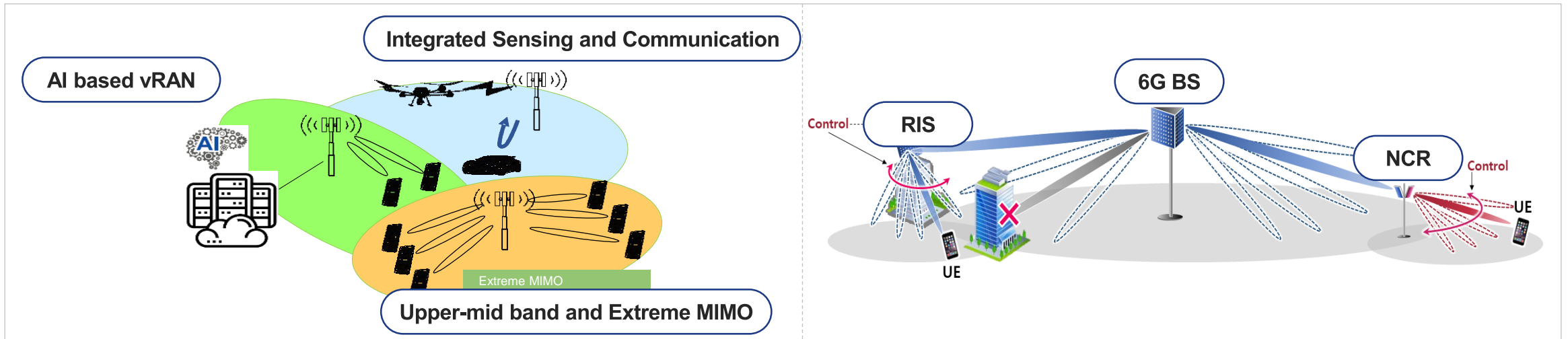
Draft 6G LEO satellite communication payload model



LEO satellite clustering

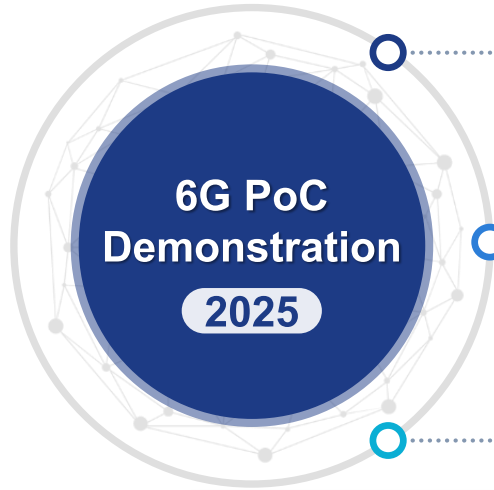
Further research topics (Planned)

- ▣ Upper-mid band E-MIMO
- ▣ vRAN, Low PHY modem for O-RAN
- ▣ Sensing and communication integration
- ▣ Coverage extension technologies (RIS, NCR, Full duplex ...)
- ▣ AI-native RAN, Mobile Core

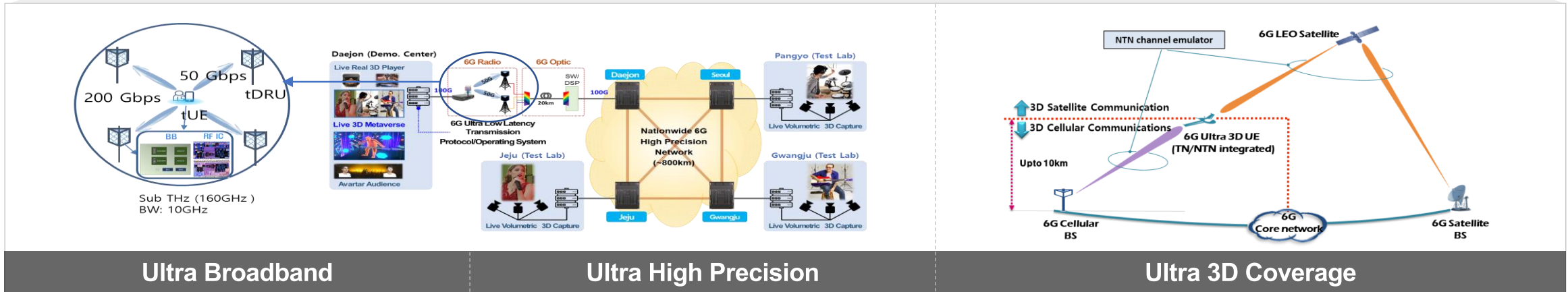


* RIS: Reconfigurable Intelligent Surface, NCR: Network Controlled Repeater

05 · ETRI 6G Future Research | PoC plan



- 1 • 200 Gbps Ultra Broadband
- 2 • 5 msec@800 km End to End Ultra High Precision
- 3 • Gbps level TN/NTN integrated Ultra 3D Coverage



A futuristic cityscape at night, illuminated with blue and white lights. The scene features a large satellite in the upper left corner, emitting a beam of light towards the city. In the upper right corner, an airplane is shown in flight, also emitting a beam of light. The city below is a dense urban environment with numerous skyscrapers and buildings, all lit up. A large body of water is visible in the foreground, reflecting the city lights. The overall atmosphere is one of advanced technology and global connectivity.

THANK YOU