“FELIZ CINCO DE MAYO!”

http://www.banderasnews.com/1405/images/cincodemayo.jpg

https://www.birimport.com/wp-content/uploads/2020/04/000153-BIRRA-CORONA-EXTRA-033x24-1.png

Battle of Puebla (1862) and Corona Beer

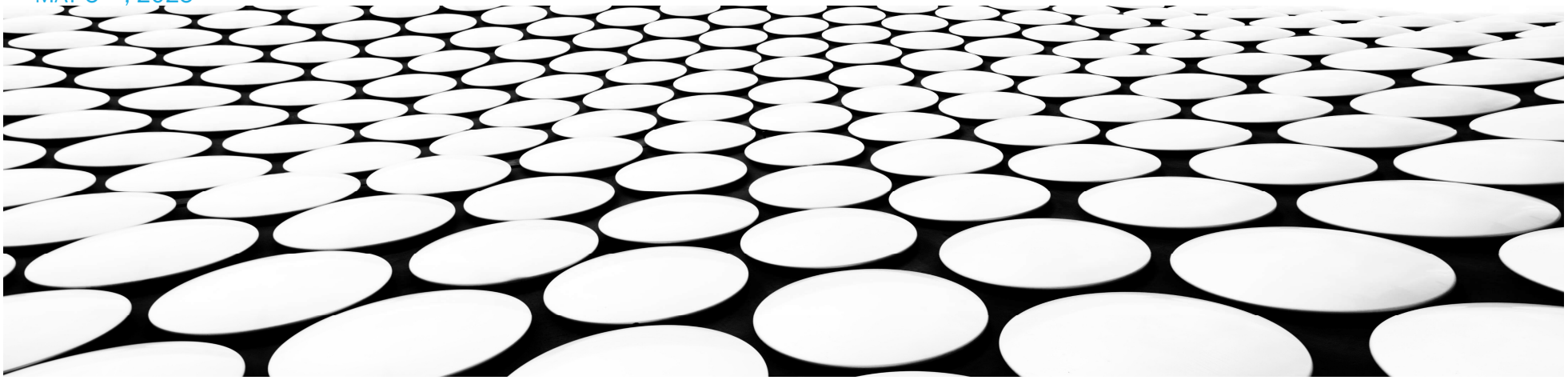
AI-NATIVE AND 6G UPDATE

STRIDE TOWARDS 6G WITH AI, TECHNOLOGIES AND TESTBEDS

MITCH TSENG, PH.D.

MANAGING MEMBER, TSENG INFOSERV, LLC

MAY 5TH , 2025



MITCH'S STORY – IT ALL STARTED AT 1987

1987

US, or go Home?

Individualism & Freedom!

"2nd Order Time-Frequency domains Transformation"

1999

"Hi! I am Mitch!"

Comm. as a Career!

Split 3G, Reunited 4G

2010

Tseng InfoServ, LLC

2nd Highest Pay for Huawei Consultants

oneM2M, IIC, ITS

2020

Next Generation Alliance

ITRI USA, Taiwan, 5G-ACIA

Connecting The World!

6G TRAIN IS LEAVING THE STATION

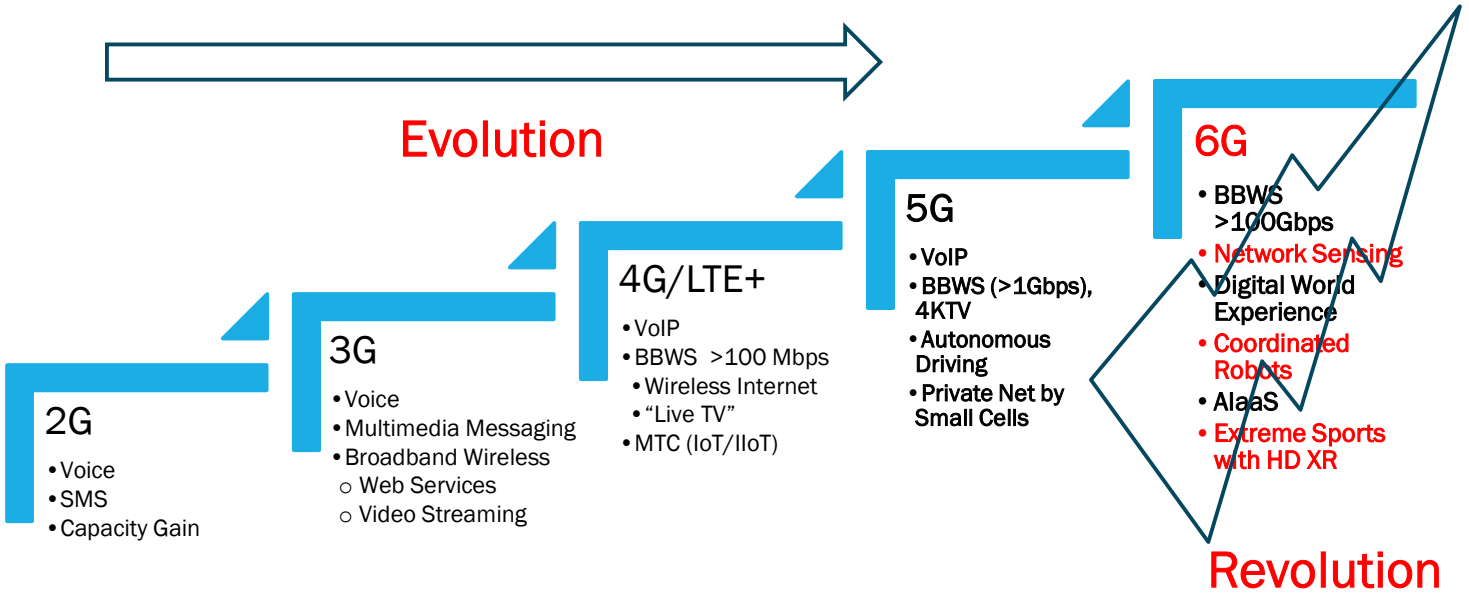
6G

"How to make 6G Transformation Profitable?"

"Will 5G be the last generation for Wireless?"

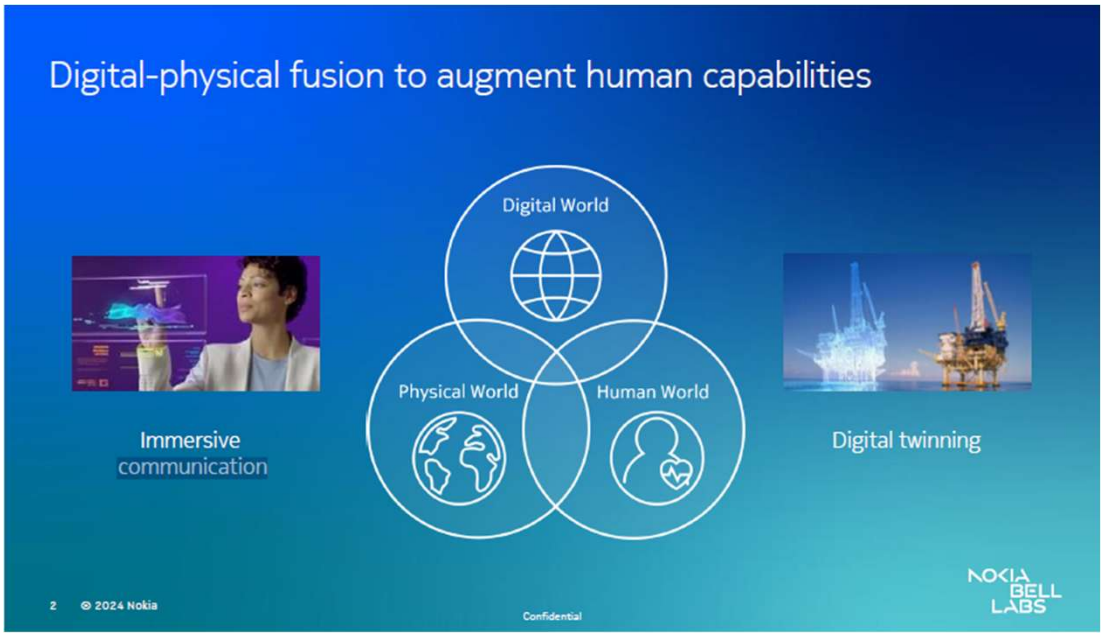
Get on the 6G Train now, and Prove your 5G Offerings!

EVOLUTION OF WIRELESS SYSTEMS AND SERVICES

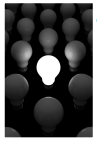


6G will have BOTH "Revolution" and "Evolution" Paths.

6G: BETTER LIVING THROUGH IMMERSIVE COMMUNICATIONS



Source: Peter Vetter, Nokia; “Digital-Physical Fusion in the 6G-era”, 6G Symposium Fall 2024


Enormous Sensing

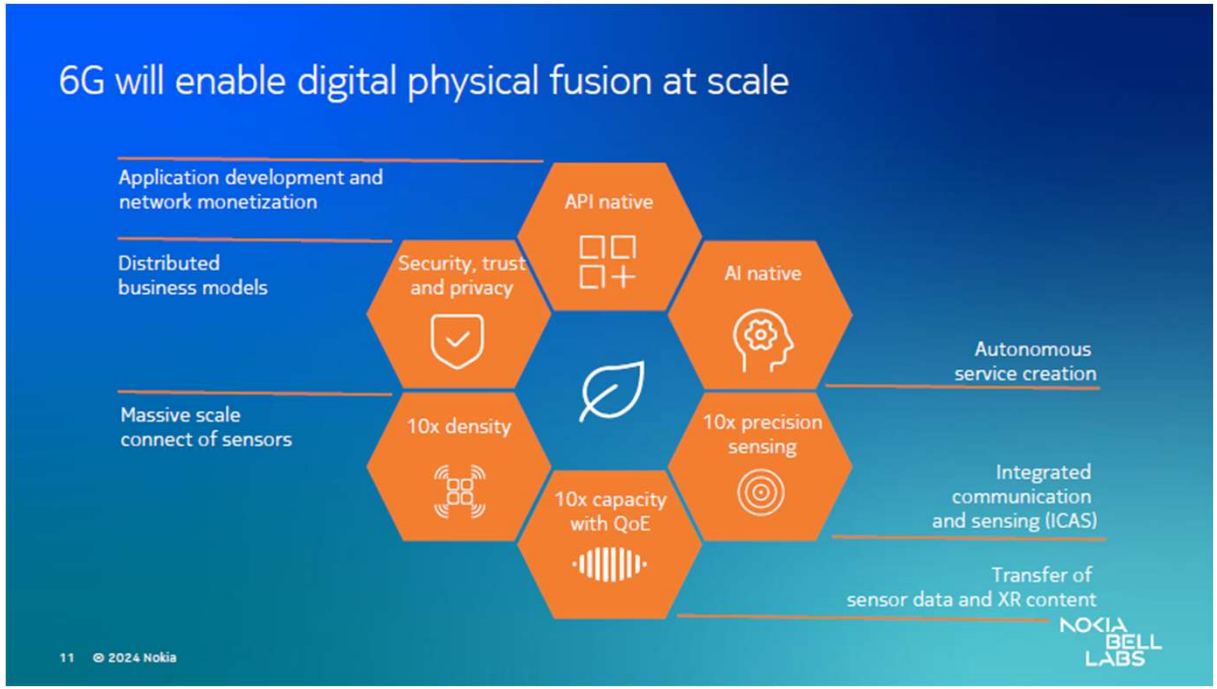

AI-Native Networks

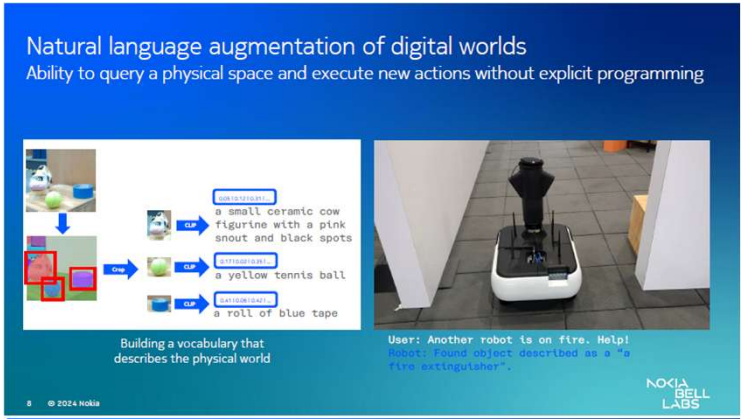

Natural Language Interfaces

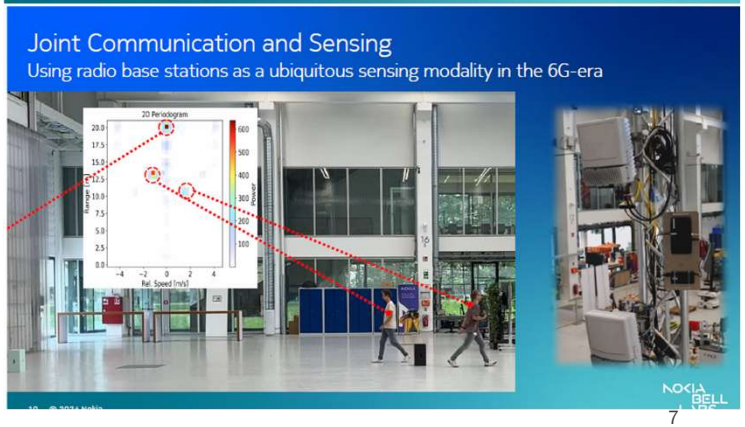

Heterogenous Accesses + NTN


Ultra-Realistic HMI

6G: LARGE SCALE DIGITAL-PHYSICAL FUSION

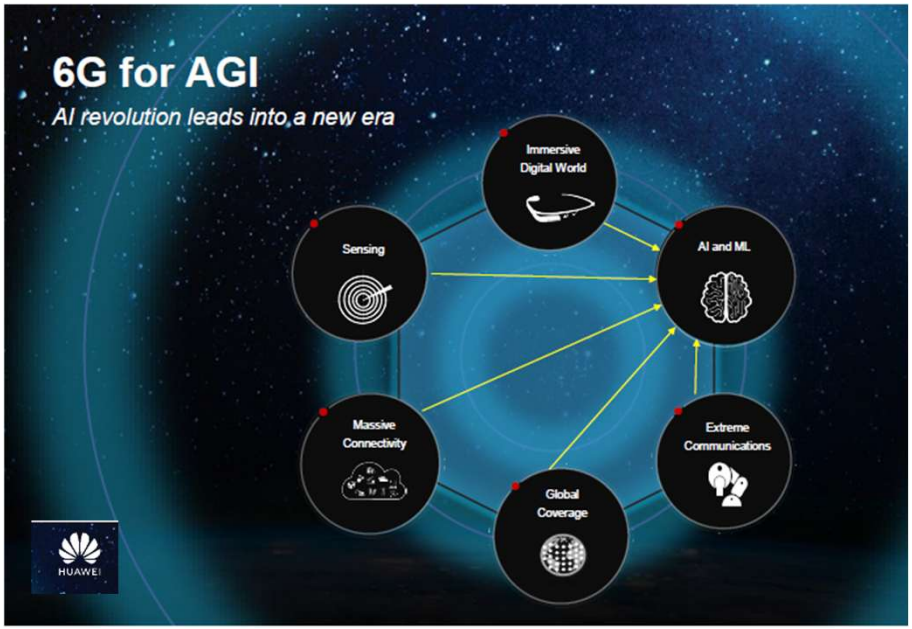




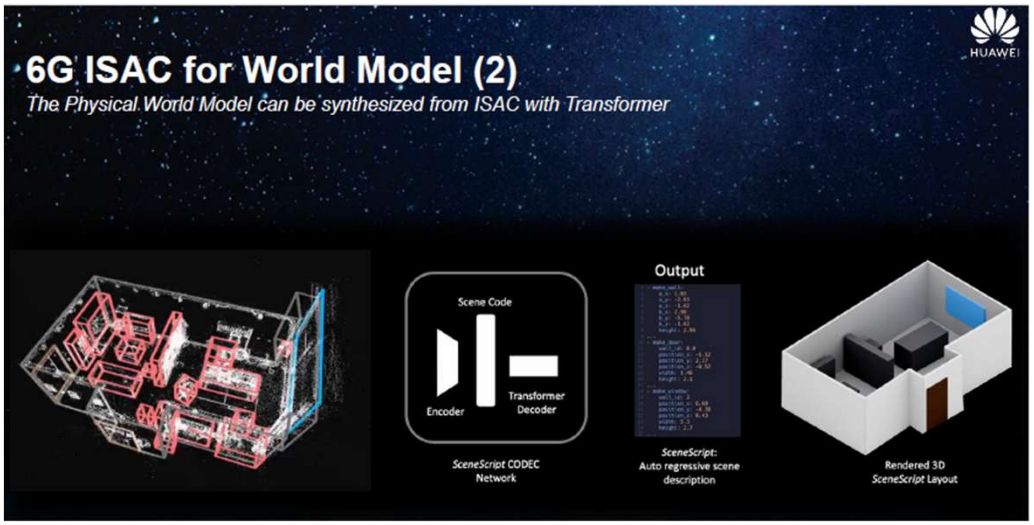


Source: Peter Vetter, Nokia; “Digital-Physical Fusion in the 6G-era”, 6G Symposium Fall 2024

6G: AI-POWERED INFRASTRUCTURE

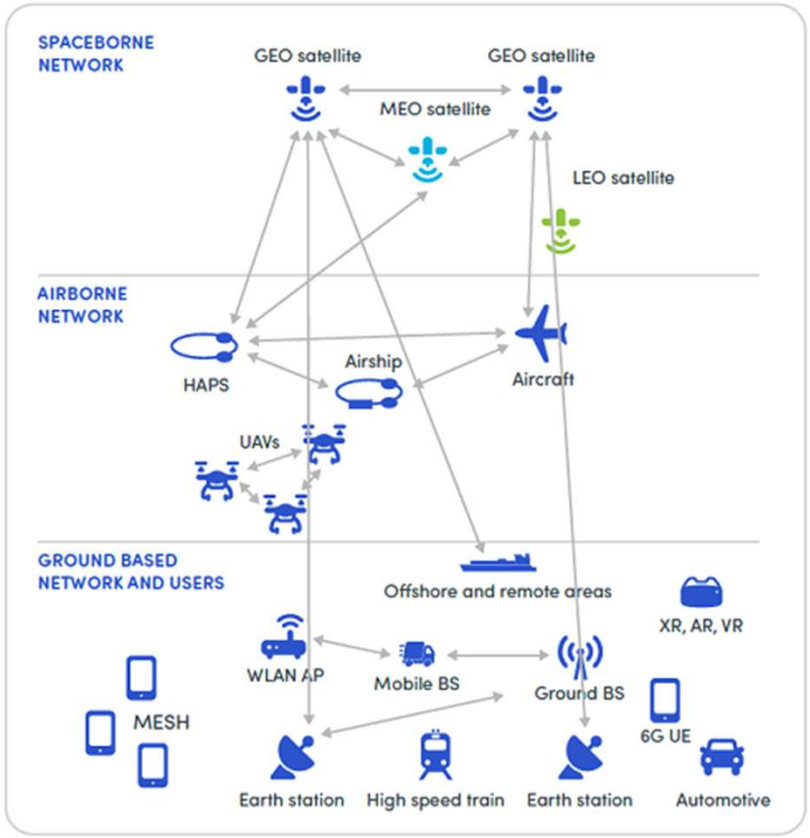


Source: Peiying Zhu, Huawei, "A-RAN, A-CORE, and A-UE" NGMN Munich 2024



6G: Immersive Communication Systems for the Cyber-Physical World by leveraging the Enormous Data collected through ubiquitous Sensing, and Powered by AI processing.

6G: TERRESTRIAL AND NON-TERRESTRIAL NETWORKS



Satellites Multi-Orbit
- GEO
- MEO
- LEO

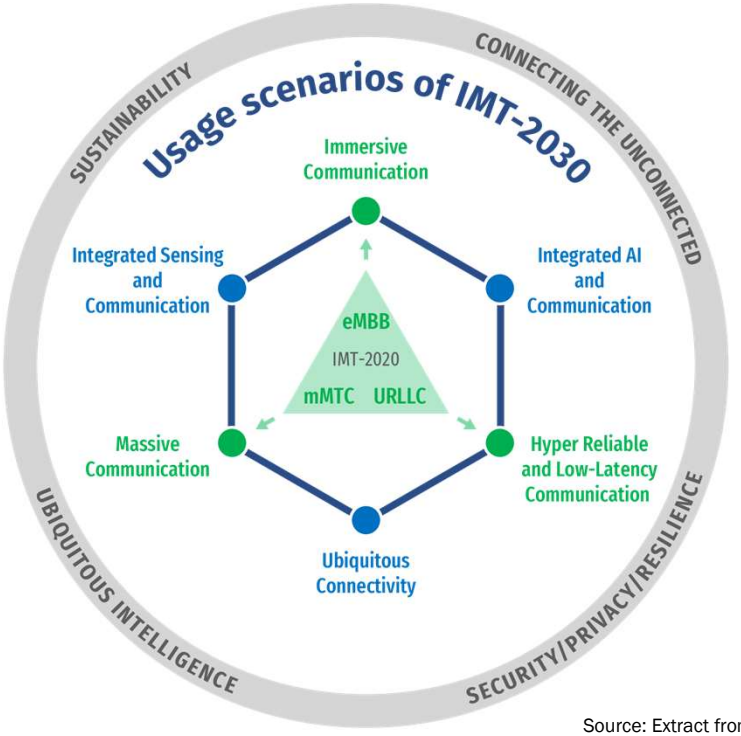
HAPS
- Airplanes
- Airborne Vehicles (Blimps)
- Drones

Terrestrial
- Ground Stations
- Roof Top Antenna
- Devices

NTN-TN “Interoperable” or “Interconnect”?

Source:
https://images.ctfassets.net/wcxs9ap8i19s/67Xsz5WrACUN8W4af8kLmd/019c6f6707d2f064f936add518c4a539/Network_architecture.png

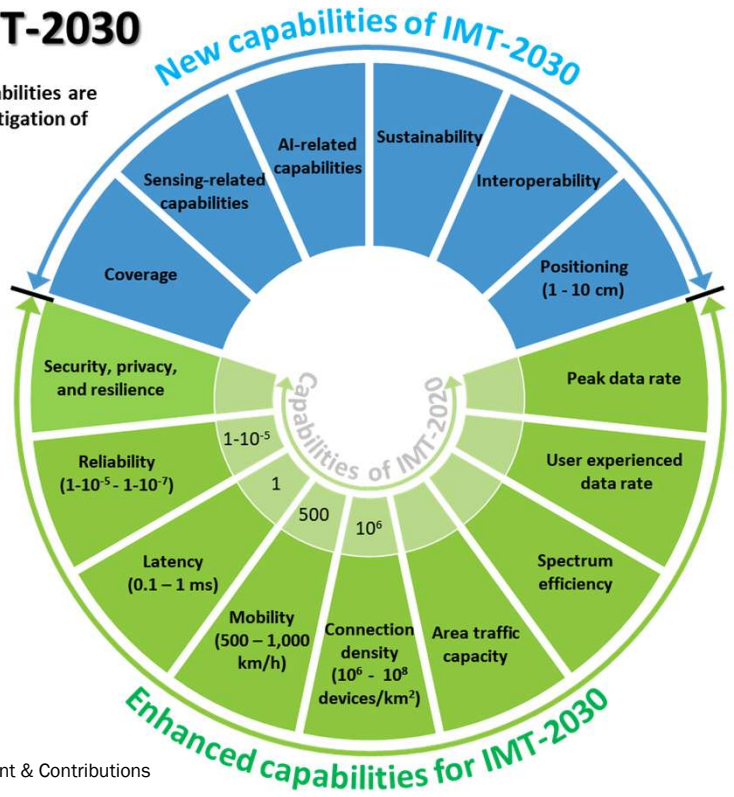
6G GLOBAL USE AND CAPABILITIES: IMT-2030 VIEWS



Capabilities of IMT-2030

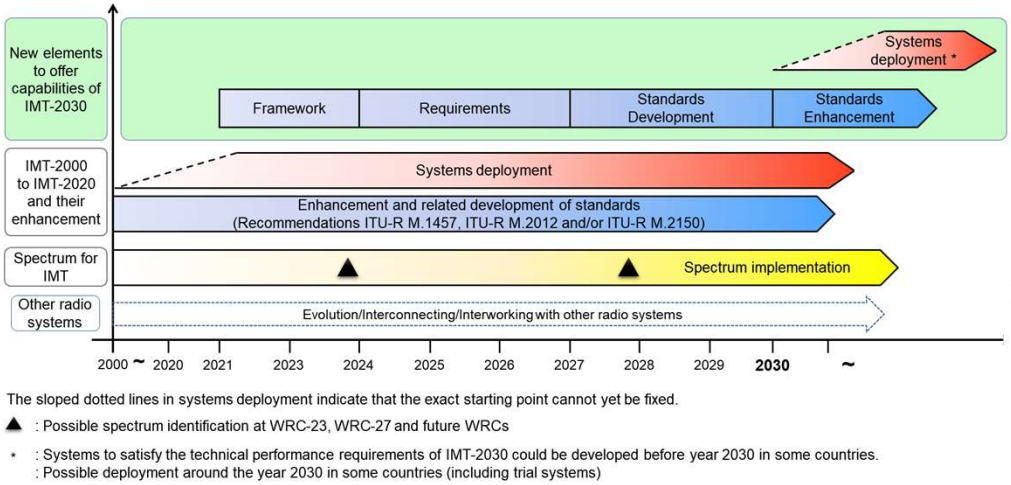
NOTE: The range of values given for capabilities are estimated targets for research and investigation of IMT-2030.

1. Coverage
2. Sensing
3. AI-ML
4. Sustainability
5. Spectral Efficiency
6. Interoperability
7. Positioning
8. Security
9. Peak Data Rate
10. Connection Density



Source: Extract from various ITU-R WP5D ITU IMT-2030 Working Document & Contributions

6G TIMELINE AND CHALLENGES

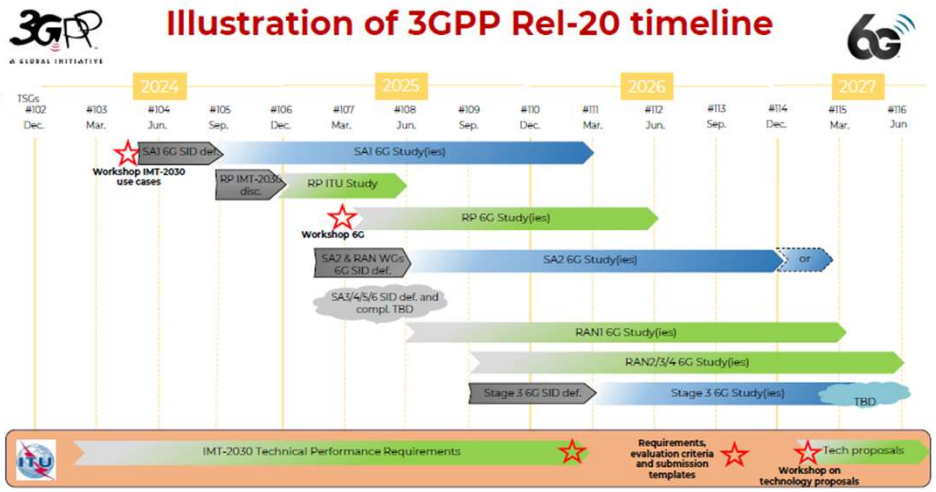


The sloped dotted lines in systems deployment indicate that the exact starting point cannot yet be fixed.

▲ : Possible spectrum identification at WRC-23, WRC-27 and future WRCs

* : Systems to satisfy the technical performance requirements of IMT-2030 could be developed before year 2030 in some countries.
: Possible deployment around the year 2030 in some countries (including trial systems)

Standards by 2030
3GPP Release 21



- What will be New and Novel features in 6G?
- How will this change the User Worlds?
- How do we avoid regional inconsistency?

6G APPLICATION DRIVERS

Security	Sensing	Northbound API
AI	Smart Life	Healthcare
Immersive Communications	Native Vo6G	Positioning
Sustainability and Energy Efficiency	FWA-FWC	Autonomous Driving
Ubiquitous and Resilient Coverage	LPWA	Backward Compatibility

From 3GPP SA1 Workshop on IMT-2030 Use Cases (March 2025) - So, what kind of Testbeds are needed?

PRACTICAL DISCUSSIONS ABOUT 6G RECENTLY

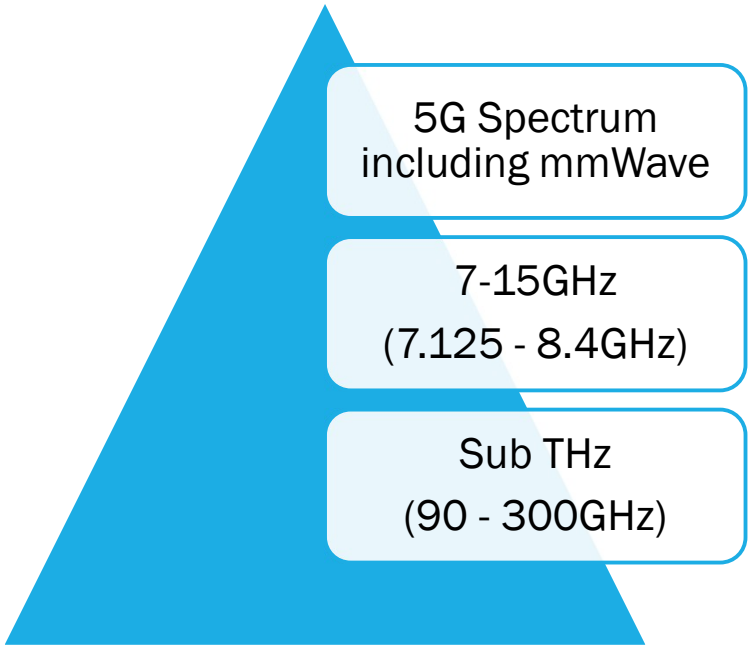
2023	2024	2025
6G Applications: XR, Intelligent Manufacturing, Robotics, Green Energy	6G Application Drivers	Streamline Technologies and Total Cost of Ownership (TCO) Reduction
Technologies: Cyber-Physical Twins, JCAS, RIS, NTN, Sensing and PUE	Immersive Communications and NTN Sensing, AI, and Verticals	Return on Investment (RoI), Business Model for Operations.
"The Killer Application for 5G is, 6G!"	How to Make 6G Transformation Profitable?	Evolution to 6G SA (How to Ensure 5G Profitable?)

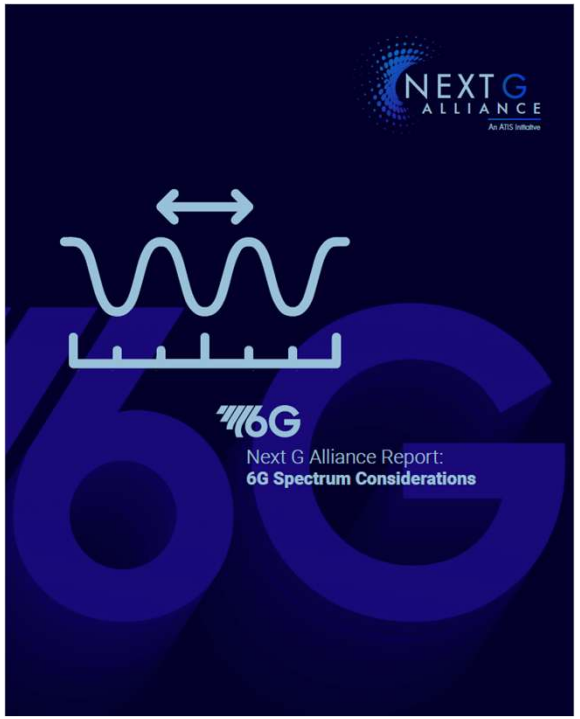
The Wireless Evolution Won't Stop Here!

“6G TECHNOLOGIES”

RIS	• “No dead zone for Radio coverage!” • “Active RIS with Applications”
JCAS/ISAC	• Means for “Sensing” – SubTHz • Collected Data fed to AI model Training
AI-Native	• Optimization of the System (Core, Radio) • “Powerful Core” for Applications
Digital Twin	• Simulator of the Physical System • “Digital Life!” – powered by AI/ML
NTN	• Satellites (LEO/MEO/GEO) for coverage • HAPS (Airplane, Ballons, Drones)

6G SPECTRUM

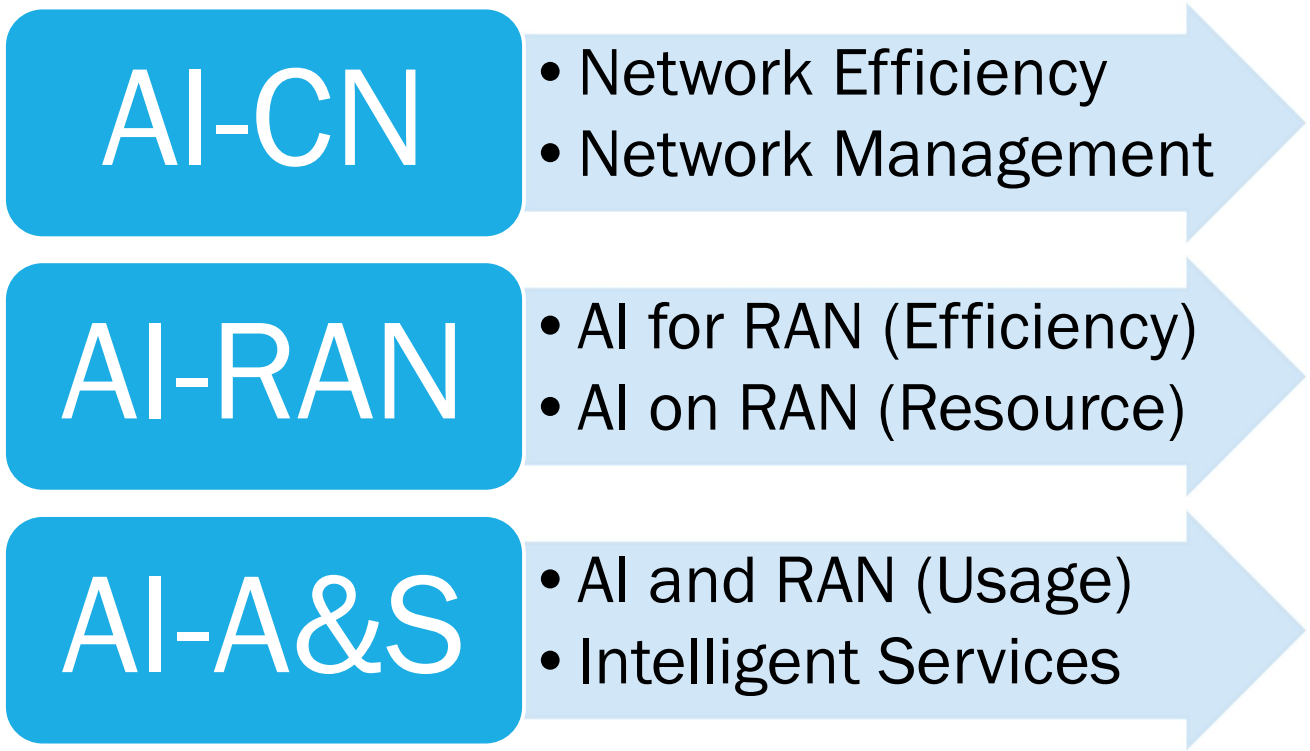




- Spectrum Sharing (e.g. MASS) is a widely discussed topic.

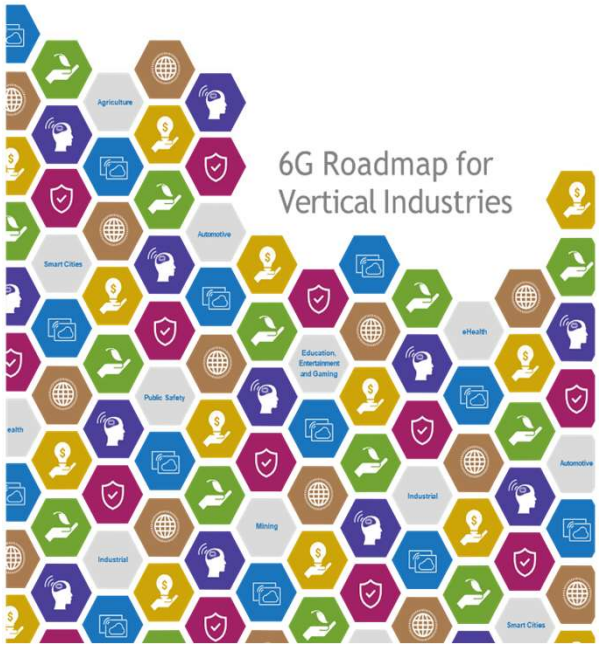
https://nextgalliance.org/white_papers/6g-spectrum-considerations/
Next G Alliance Library:
https://nextgalliance.org/6g-library/

AI-NATIVE IN 6G SYSTEMS



NGA ROADMAP FOR VERTICAL INDUSTRIES

May 2023



Agriculture

Automotive

Education, Gaming and Entertainment

eHealth

Industrial IoT *(included Utilities)*

Mining

Public Safety

Smart Cities *(included Utilities)*

What we did:

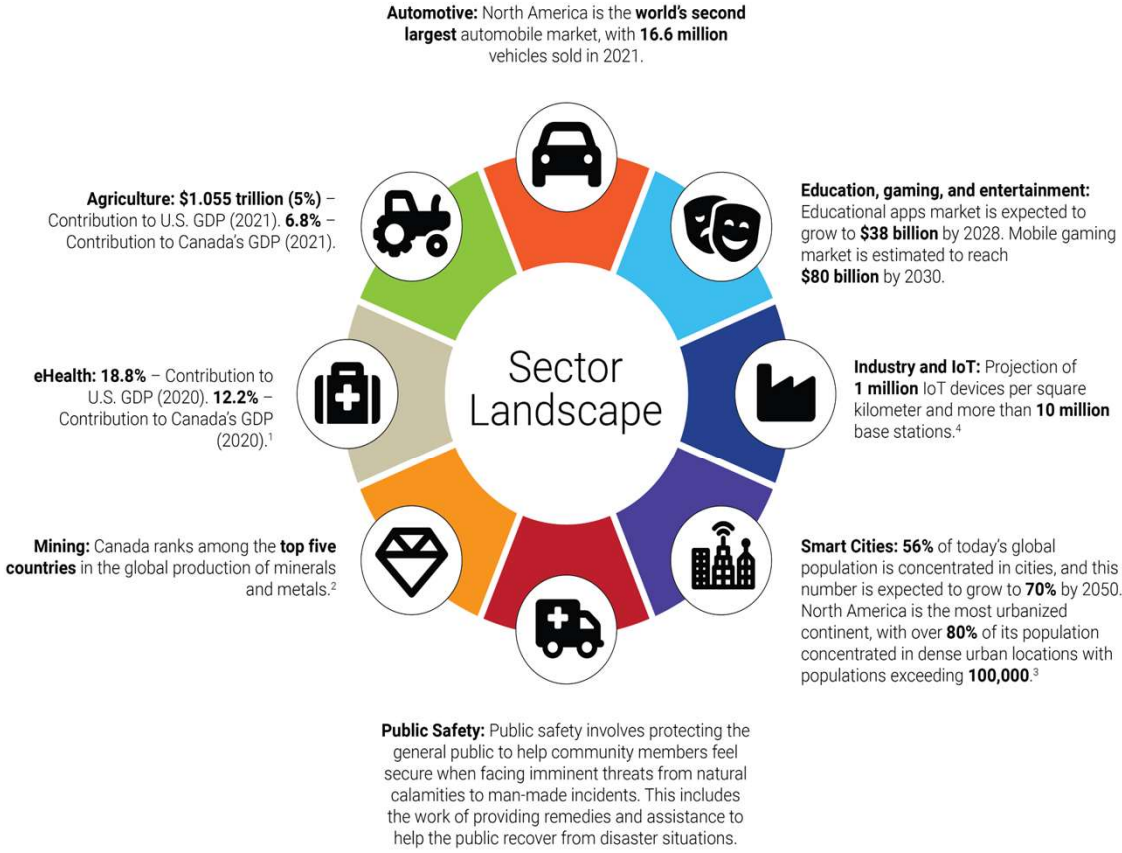
Research into vertical industry dynamics & societal needs

Develop insights into industry needs and enabling application

Characterize vertical industry needs as a basis for action

NGA VERTICAL WORKSHOP KEY FINDINGS (MARCH 2025)

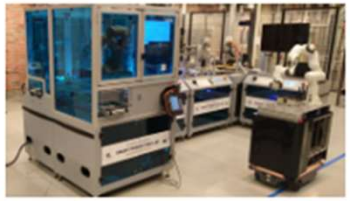
1) Ecosystem readiness is as critical as technical standards
2) Vertical industries expressed two main needs:
    1) Connectivity; and
    2) Technology to enable new services.
3) The range and diversity of vertical industry interests span a mix of evolutionary and revolutionary capabilities



Source: Next G Alliance "Vertical Workshop Report" (2025-03)

5G-ACIA TESTBEDS

5G mmWave for industrial applications with high bandwidth demands



5G-based Zero Touch Production

5G Performance for PROFINET and PROFIsafe Communication

5G Performance Evolution for Material Handling in Manufacturing

5G Open RAN Industrial Communication and Positioning Testbed

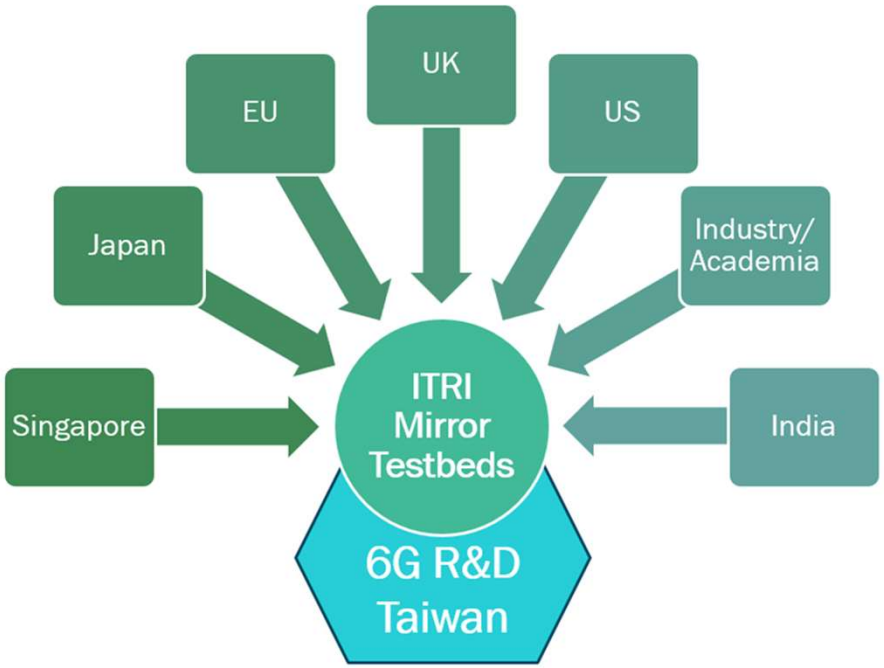
5G-Industry Campus Europe

Industrial Needs

Accessible

5G and More

CONNECTING TO THE 6G WORLD

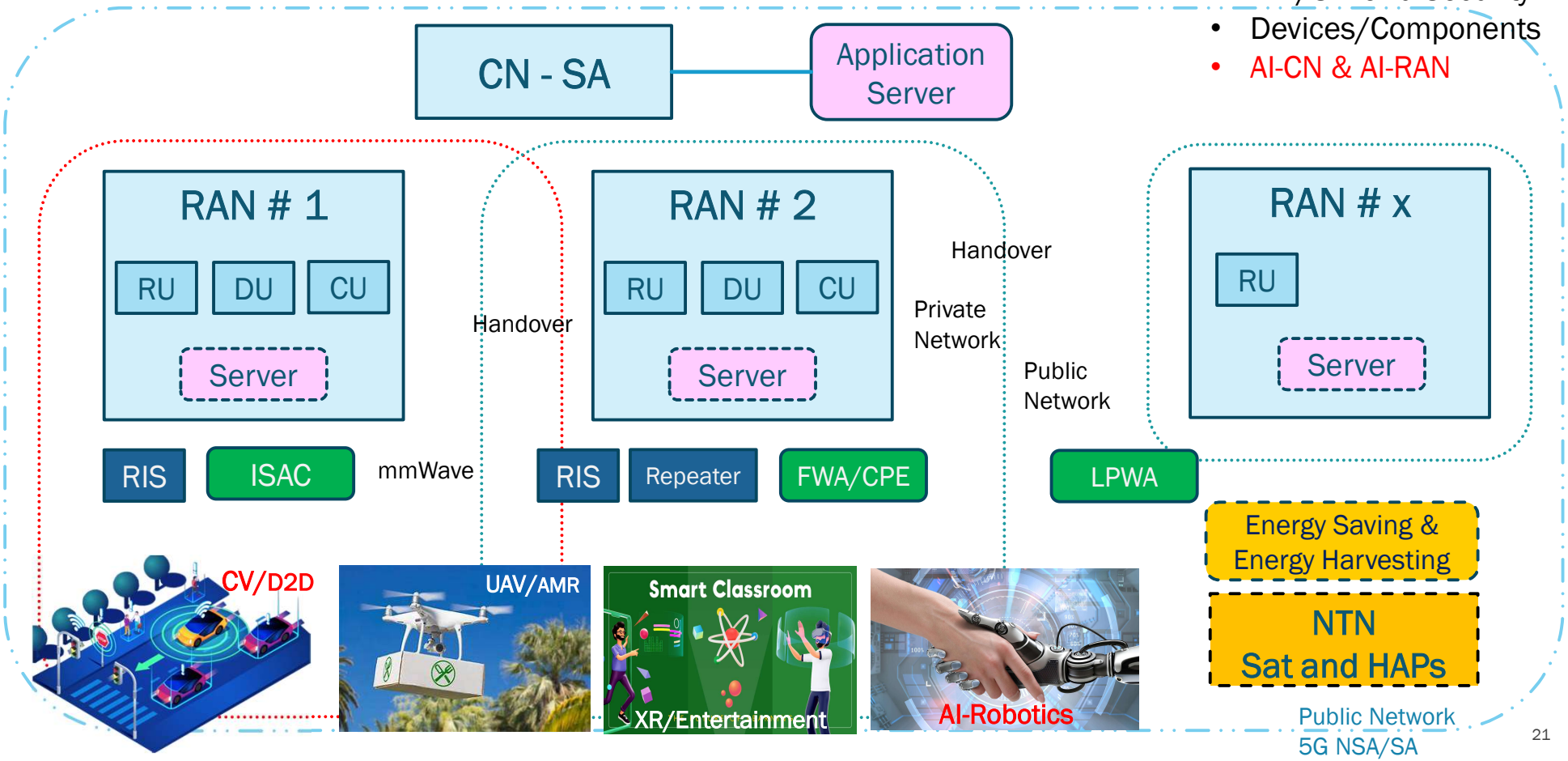


以臺灣 6G R&D 為本建構 Mirror Testbed 在現有國合基礎上拓展全球 6G 技術合作

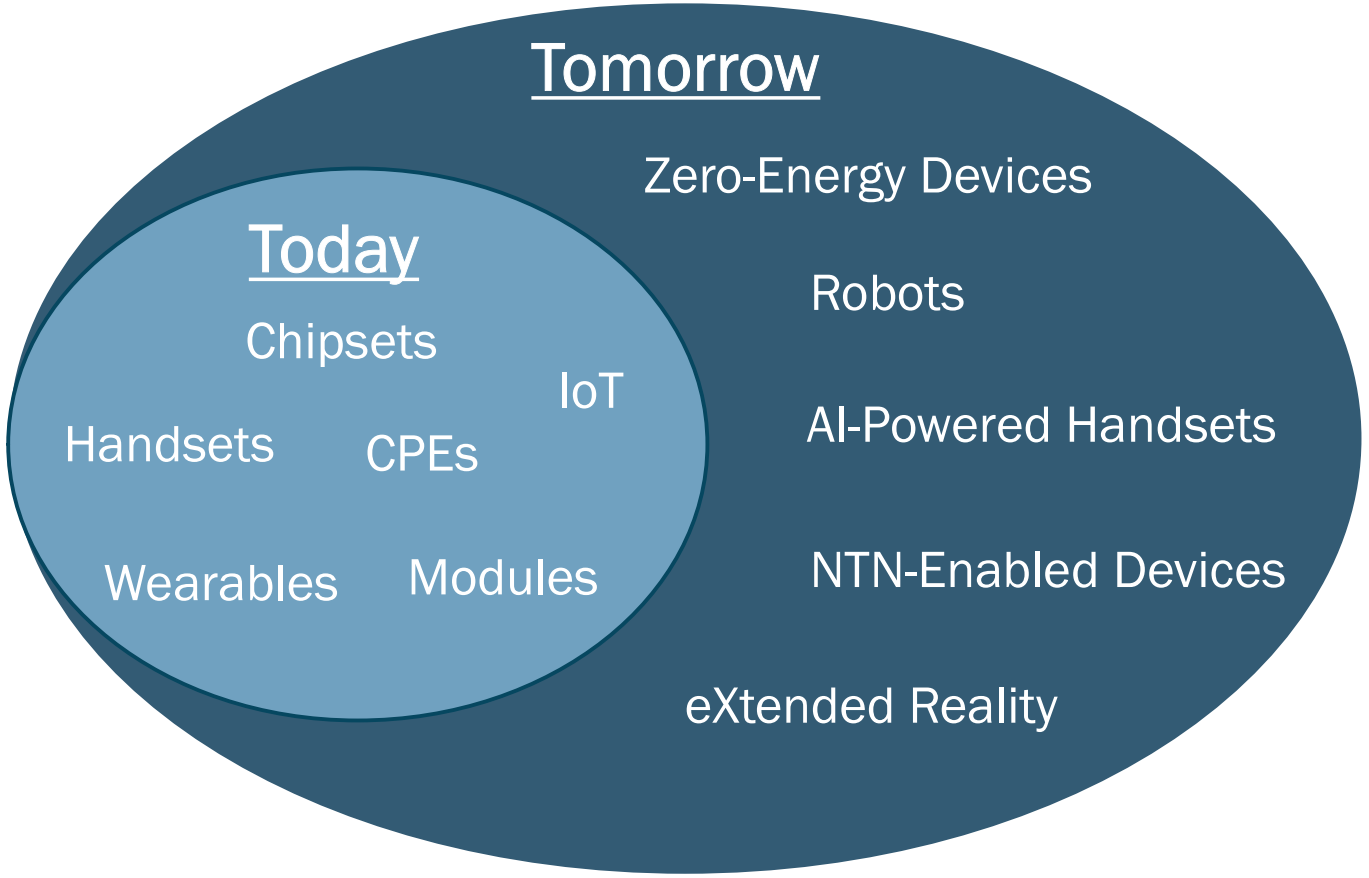
Industrial Forums: Hexa-X-II, NGA, IOWN, IIC/DTC, 5G-ACIA
6G-SNS, XGMF, 6G Forum (Korea), 6G Flagship (Finland)
Bharat 6G Alliance, one6G
Research: VTT, TNO, UKTIN/DSIT,
Universities: Oulu, Surrey, Bristol, Cambridge, Antwerp, Northeastern, Purdue
Business Finland, Business Tampere/Oulu
Resource Pool: Spain, Poland, Estonia/Latvia/Lithuania, Ukraine/Türkiye, Lebanon, Israel, Indonesia/Thailand/Philippine

$\mathcal{X}$-6G TESTBED

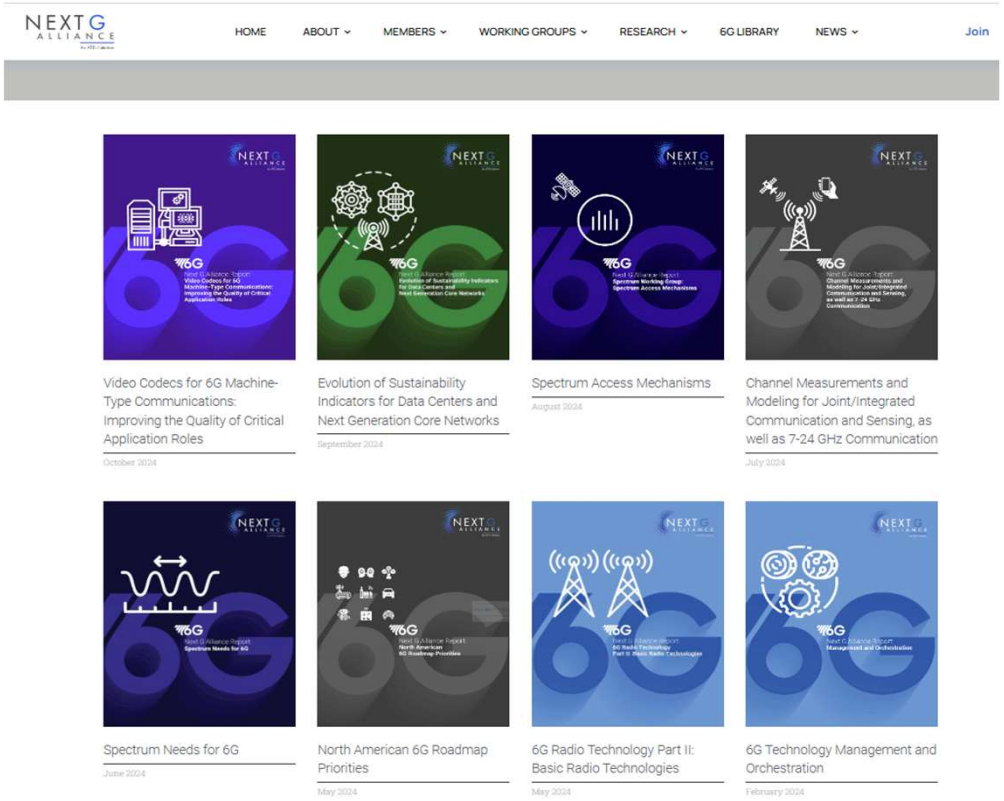
- Coverage/Connectivity
- Services/Applications
- HW/SW and Security
- Devices/Components
- AI-CN & AI-RAN



NGA VERTICAL WORKSHOP KEY FINDINGS (MARCH 2025)



NGA CONTINUES PUBLISHING INTERESTING WHITE PAPERS



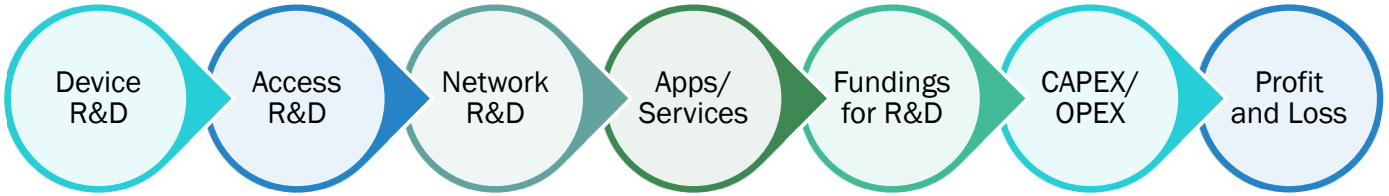
- ❑ Video Codec for 6G mMTC
- ❑ Sustainability for Data Centers
- ❑ Spectrum Access Mechanisms
- ❑ JCAS Channel Modeling
- ❑ North American 6G Roadmap
- ❑ 6G Radio Technologies

https://nextgalliance.org/6g-library/

END-TO-END VIEW: KEY TO TURN POC TO REALITY

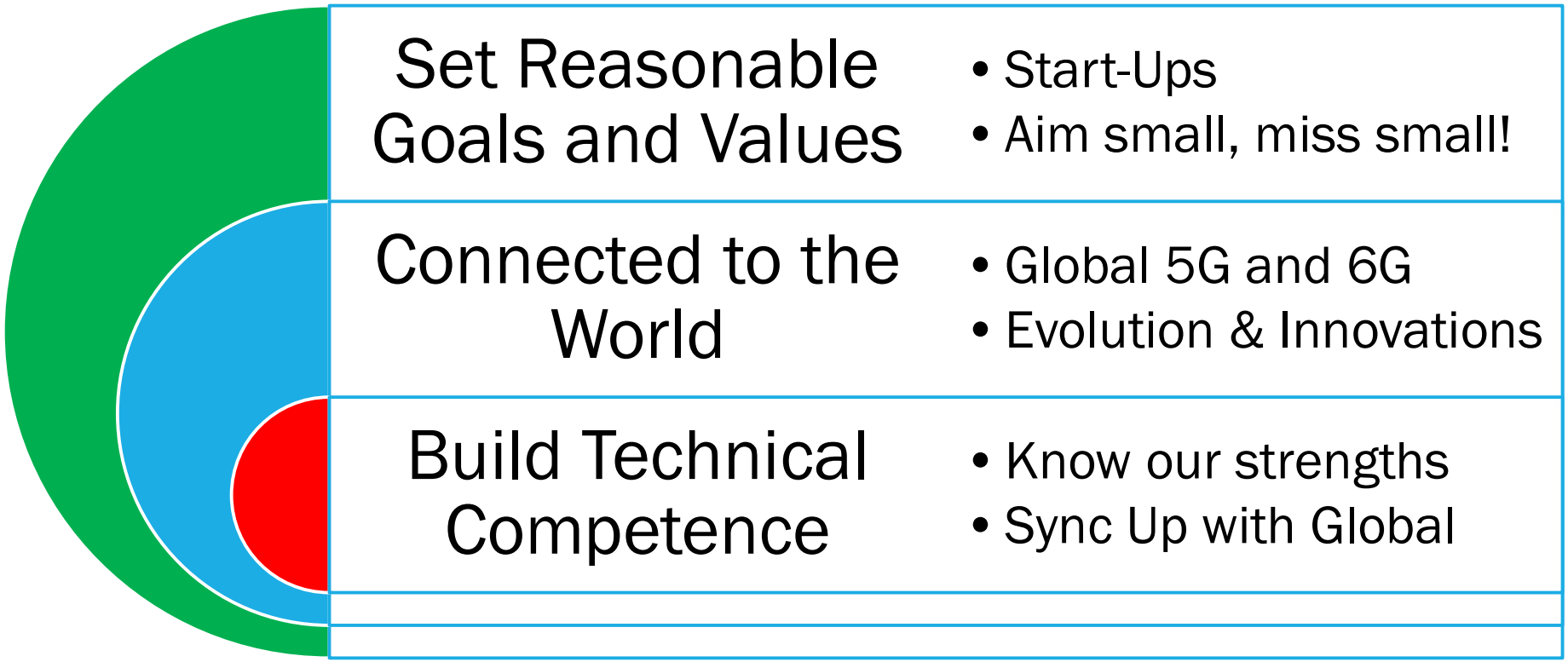
End-to-End Data Flow

End-to-End Capital Flow



Go beyond PoC:
Real Services, Value-Added Services - Crucial for 5G and 6G Success

HOW TO BRING UP THE TECHNICAL SUSTAINABILITY?



“MAXIMIZE THE VALUE OF INFORMATION BY PROVIDING THE RIGHT INFORMATION TO THE RIGHT PERSONS AT THE RIGHT TIME!”

Tseng InfoServ, LLC
mitch@T-infoserv.com

Connection

Training

Information

Mitch Tseng, Ph.D.