永遠走在最前面
Always Ahead

Chunghwa Telecom's Perspective on 6G

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Chunghwa Telecom(CHT)

CHT Organizational Chart

- Board of Directors
- Headquarters
  - Business Units
    - Consumer Business Group
    - Enterprise Business Group
    - International Business Group
  - Technical Units
    - Network Technology Group
    - Information Technology Group
    - Telecom Laboratories

6 Oversea Subsidiaries

USA, Japan, Hong Kong, Vietnam, Singapore, Thailand

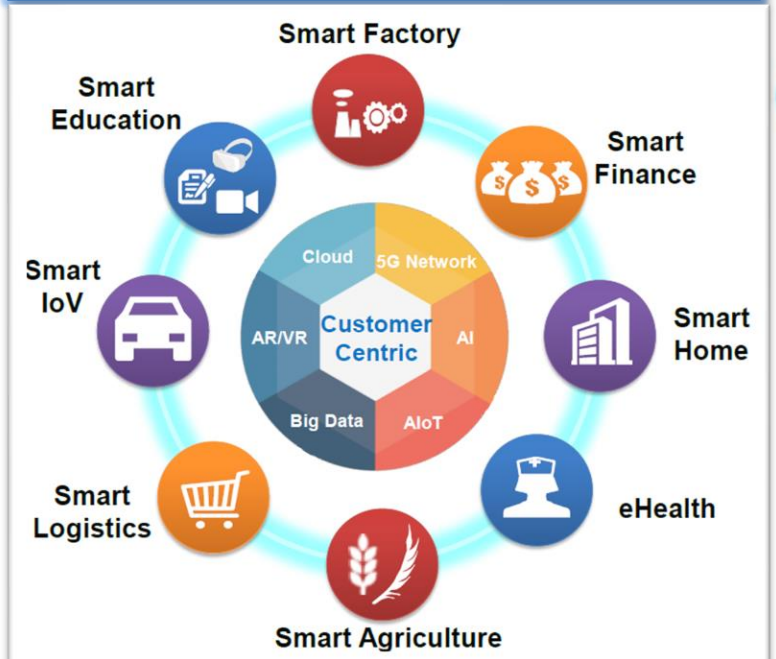
41 Affiliates

Invested Area

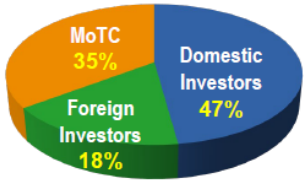
- Cyber Security
- Digital Content
- Data Center
- Channel Mgt.
- IC Testing
- Construction
- Investment

Vision of CHT

Make people enjoy Smart Life & Create Digital Economy ecosystem



CHT Profile



NYSE: CHT
TWSE: 2412

Market Cap
30.5B $USD
#No.24 Telco globally

Revenue 2022
7.1B $USD
#No.1 Telco in Taiwan

R&D Expenditure
125M+ $USD/year
#No.1 Telco in Taiwan

Mobile Subscriber
36% Market Share
#No.1 Telco in Taiwan

Broadband Subscriber
65% Market Share
#No.1 Telco in Taiwan

Enterprise Customer
700,000
#No.1 Telco in Taiwan

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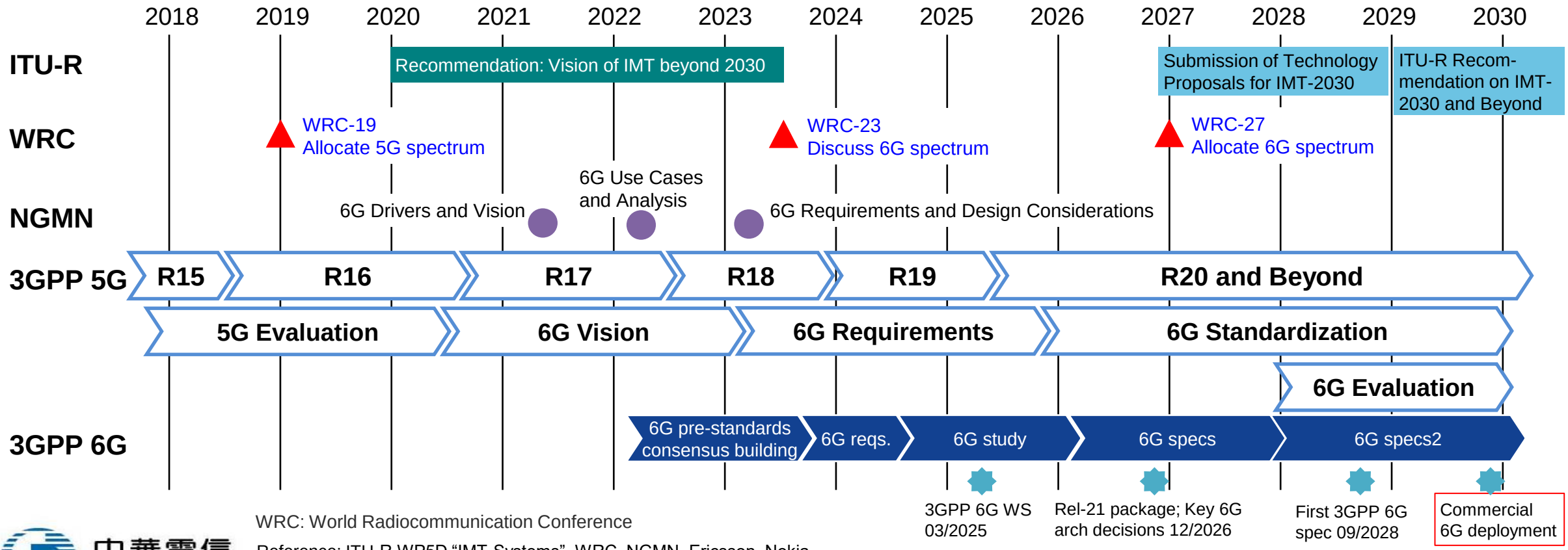
6G Development and Standardization

- **ITU-R:** The **WP5D** has launched a series of research on the future **technology trend of IMT-2030 and beyond** and released a report **" Framework and overall objectives of the future development of IMT for 2030 and beyond "** of meeting in June 2023
- **3GPP** is expected to release the first version of **6G specs in 2028**, and **6G commercialization** will begin around **2030**



WRC: World Radiocommunication Conference

Reference: ITU-R WP5D "IMT-Systems", WRC, NGMN, Ericsson, Nokia

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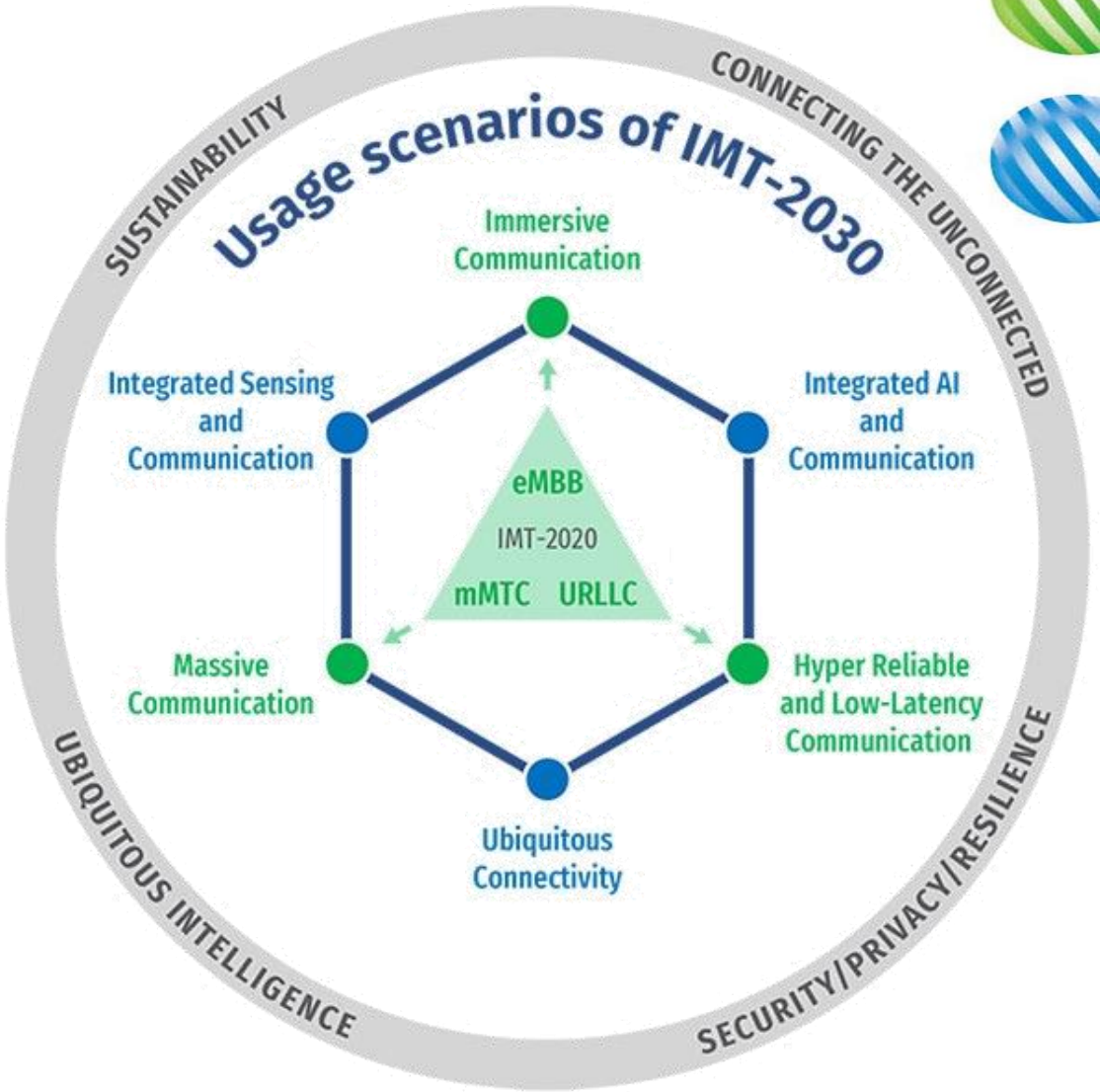
6G Usage Scenarios

- ITU-R Framework for IMT-2030 has 6 Usage scenarios
  - Three of which are extensions from IMT-2020, and the other three are new scenarios.
  - 4 design principles to all usage scenarios
- New use cases need overall environment prepared together
  - Device size
  - Technical maturity of service provision
  - Policy/regulatory issues



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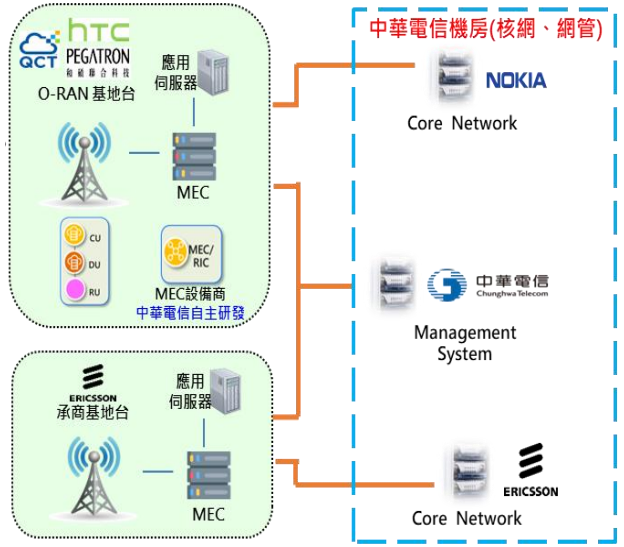
CHT's O-RAN Developments

- **Chunghwa Telecom collaborates with Auray OTIC Lab. to support Taiwanese ICT manufacturers to develop O-RAN solutions**
  - **Chunghwa Telecom joined the O-RAN Alliance in 2020.**
  - **Establish 5G Open Lab to support R&D and the test of O-RAN solution, including functionality, performance, stress, interoperability, security, etc.**
  - **Host O-RAN Global PlugFest in Taiwan in 2021 and 2022**

Auray OTIC Laboratory (2021)
The first in Asia and one of nine in the world.



Chunghwa Telecom 5G Open Lab

Cooperation Achievements Demo (2022)

CHT's Satellite Services and Developments

- **Chunghwa Telecom is a pioneer in satellite services in Taiwan and has long-term cooperation with global industries**
  - ✓ **Providing satellite communication services since 1969**
  - ✓ **Continued investment in self-own satellites and extensive cooperation with global GEO, MEO, LEO satellite operators**

CHT participated in TASTI 2023 organized by TASA

✓ **In Oct. 2023, announce plans to establish a satellite service terminal testing center in Taiwan**

Chunghwa Telecom cooperates with Eutelsat OneWeb for LEO satellite services

✓ **In Nov. 2023, signed exclusive agreement for LEO services across Taiwan**

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TASTI: Taiwan International Assembly of Space Science, Technology, and Industry ; TASA: Taiwan Space Agency

Participation of Global Organizations (1/2)

3GPP standardization activities

- **CHT participated in 3GPP meeting since 2006**
- CHT supports hosting 3GPP 100th Plenary meeting & Rel.19 workshop in Taipei, Taiwan at 2023/6

* Start the initial discussions on 6G requirements in 2023/6

The only Taiwanese board member of IOWN GF

- **The first member of IOWN GF in Taiwan since 2020**
- Actively participates in IOWN GF's activities and promotes IOWN GF to Taiwanese industry

IOWN: Innovative Optical and Wireless Network IOWN GF: IOWN Global Forum

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Participation of Global Organizations (2/2)

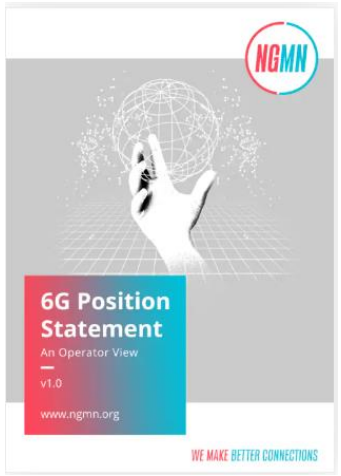
The only Taiwanese board member of NGMN

- **The first Taiwanese member of NGMN since 2015**
- Working together with global leading operators to influence the development and evolution of 5G/B5G/6G technologies

EU-Taiwan 6G Joint R&D Programs

- Based on the great achievements of EU-TW framework in 5G
- **TAICS signed MoU with 6G-IA in 2023/5**

new 6G related NGMN publications @2023/09



- high-level design principles for the development of next-generation 6G mobile networks and cloud-native technologies

NGMN

CHT along with 20 leading global telecommunications operators, released "6G Position Statement: An Operator View" and "Cloud Native Manifesto: An Operator View."

TAICS: Taiwan Association of Information and Communication Standards

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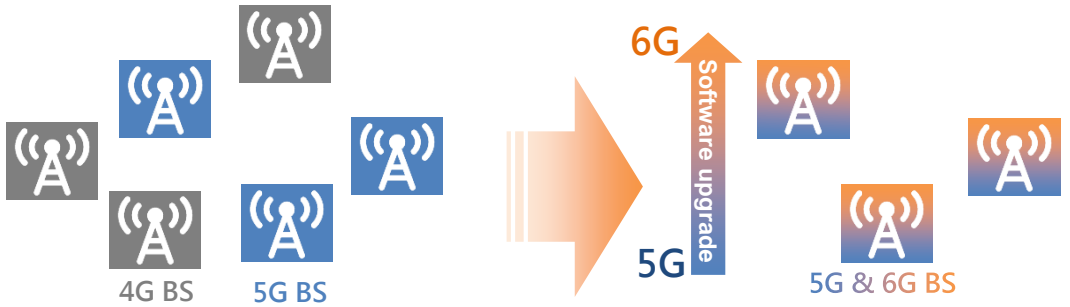
Telecom operators' perspective on 6G

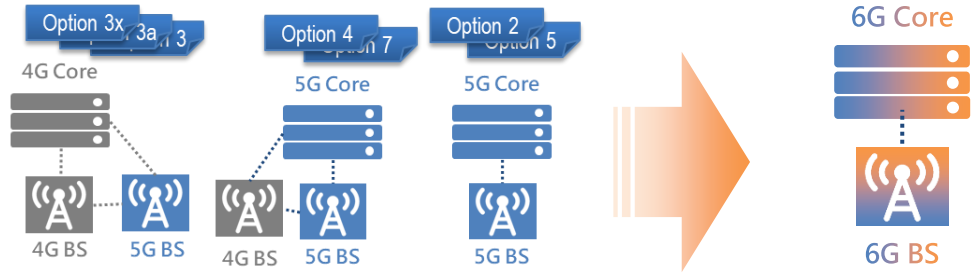
Software upgraded by 5G infrastructure



CAPEX and Energy saving issue

Reuse network elements.
Software defined technology.

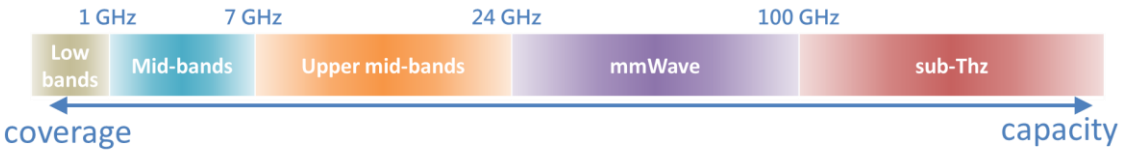
Simple Architecture Options



5G had 7 architecture options delayed the system development schedule.

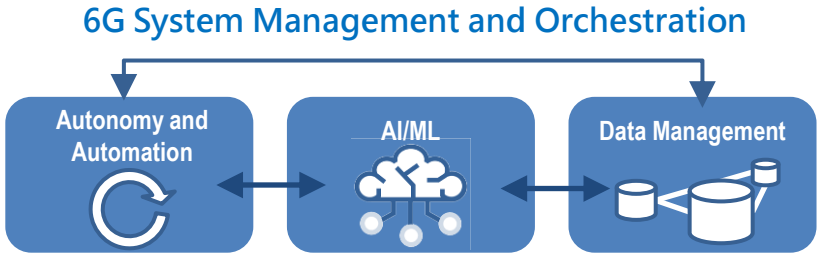
6G should have one simple and unified architecture.

Low and mid bands essential in 6G



Low bands has relatively better propagation characteristics.
Mid bands can secure coverage and capacity in a balance way.

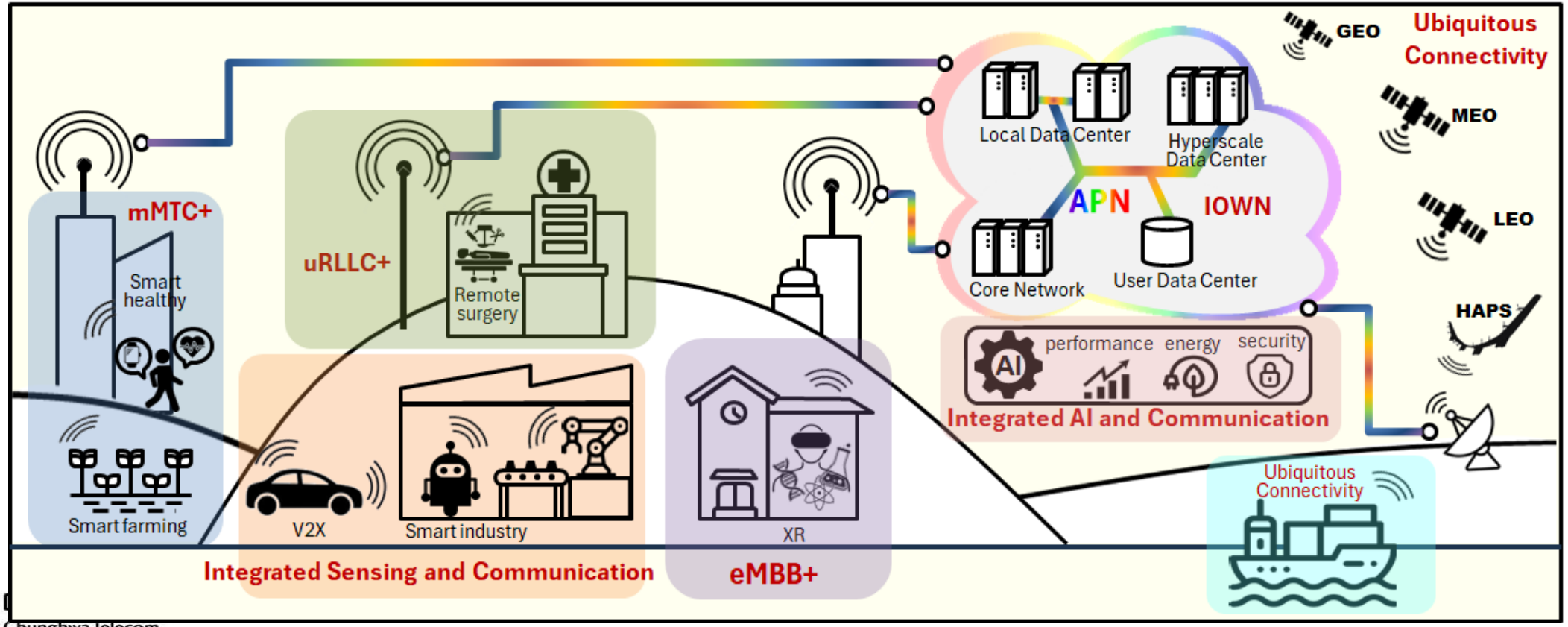
Network simplification and automated network operations



Network simplification leading to lower operational cost.
Energy reduction when assessed across mobile and fixed networks.
Features such as AI to enable efficient, dynamic service provisioning.

NTN, AI and IOWN are Key Technology for 6G

- 3D network constructed by integration of terrestrial networks and NTN.
- The intelligent wireless network based on cloud-native and AI-native.
- Many 6G use cases require the support of ultra-high data rate and capacity, low latency and power consumption, and massive computing, IOWN is a good solution.



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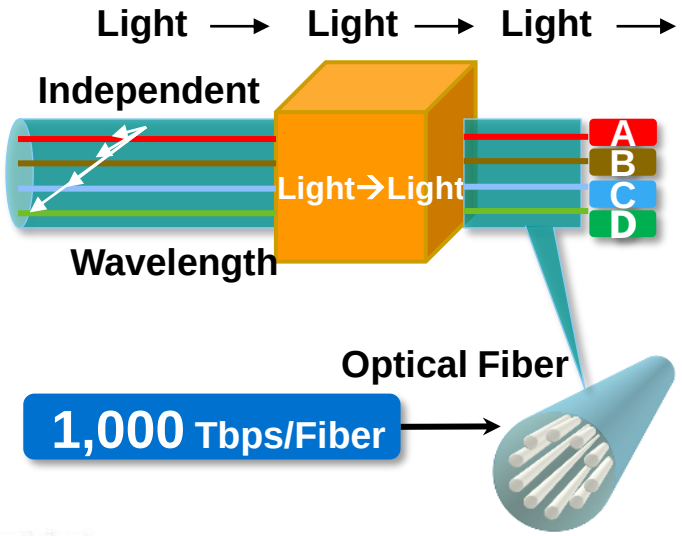
NTN: Non-Terrestrial Network IOWN: Innovative Optical and Wireless Network

IOWN Technologies

- **IOWN is an innovative infrastructure with all photonics network and data-centric and distributed computing to support 6G**

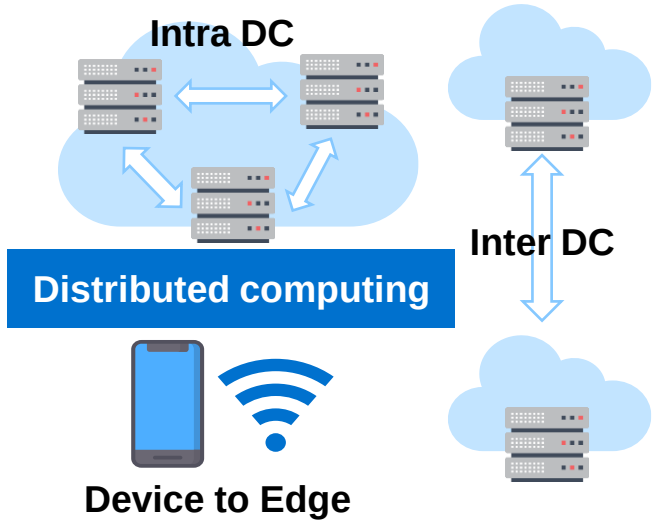
Open All Photonics Network(APN)

End-to-end optical transmission eliminates optical-electronic conversions and provide larger bandwidth and lower power consumption



Data-Centric and Distributed Computing

Computing resources pooling and sharing with data-centric architecture largely reduce processing latency and effectively enhance energy efficiency



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IOWN: Innovative Optical and Wireless Network

CHT's Perspective Towards IOWN APN

By moving from proprietary OTN network toward to open architecture, there will be a multi-vendor APN-T ecosystem. Operators can upgrade and replace based on operators' requirement.

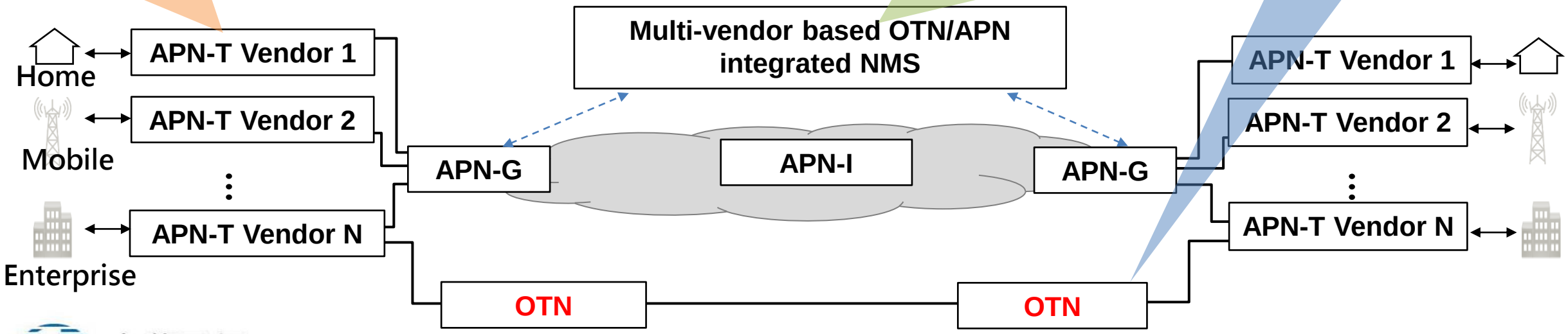
Multi-vendor APN-T

The multi-vendor Open APN and current OTN include various equipment interfaces and data models, there will be an integrated NMS for overall control and management with automatic E2E provisioning, deterministic performance, and failure management.

Integrated NMS

Towards Open APN, it will be a gradual migration from existing OTN transport network to Open APN.

Network Evolution



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Collaborations between CHT and Industry Partners

IOWN GLOBAL FORUM

NTT Tomorrow, Together KDDI orange SK telecom

FUJITSU Orchestrating a brighter world NEC Infinera Red Hat NVIDIA intel Accton Making Partnership Work wistron

ITRI Industrial Technology Research Institute 台灣雲端物聯網產業協會 Cloud Computing & IoT Association in Taiwan pida Photonics Industry & Technology Development Association TAICS Taiwan Association of Information and Communication Standards 財團法人資訊工業策進會 INSTITUTE FOR INFORMATION INDUSTRY

We participate major fora including IOWN GF to deliver spec and standards for innovative technologies.

We discuss and collaborate with like-minded operators and together step forward to next generation of telecommunications.

We collaborate with vendors with leading-edge technologies to evaluate and develop innovative technologies

We work closely with partners in Taiwan and actively promote new technologies and use cases of IOWN GF.

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IOWN's Collaborations between CHT and NTT

- **NTT and Chunghwa Telecom sign basic agreement for IOWN's collaborations on October 25th, 2023**
  - The realization of international network connectivity between Japan and Taiwan through IOWN
  - To establish interfaces and international connection rules for communication transparency in international network connections

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Summary

- **6G will emphasize on Ubiquitous, Intelligent, Green and Resilient**
  - **Performance Enhancement**
    - Higher data rates, More connections
    - Higher reliability & Lower latency
    - Better energy efficiency & Security
  - **Scenario Enhancement**
    - Global broadband and all Earth coverage
    - Compute-AI services, Quality Guaranteed
    - Sensing & Communication

- **From the telecom operator's view, 6G will be software upgraded by 5G, simple and unique architecture option, low-band and mid-band, automated network operations, 3D network, cloud-native and AI-native network, etc..**
- **Chunghwa Telecom agrees with the vision of IOWN innovation and believes that IOWN will be a key technology in 6G. We will cooperate with global telecom operators and industries to jointly develop, verify and promote IOWN.**

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ALWAYS AHEAD

永 遠 走 在 最 前 面

Thank You !

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