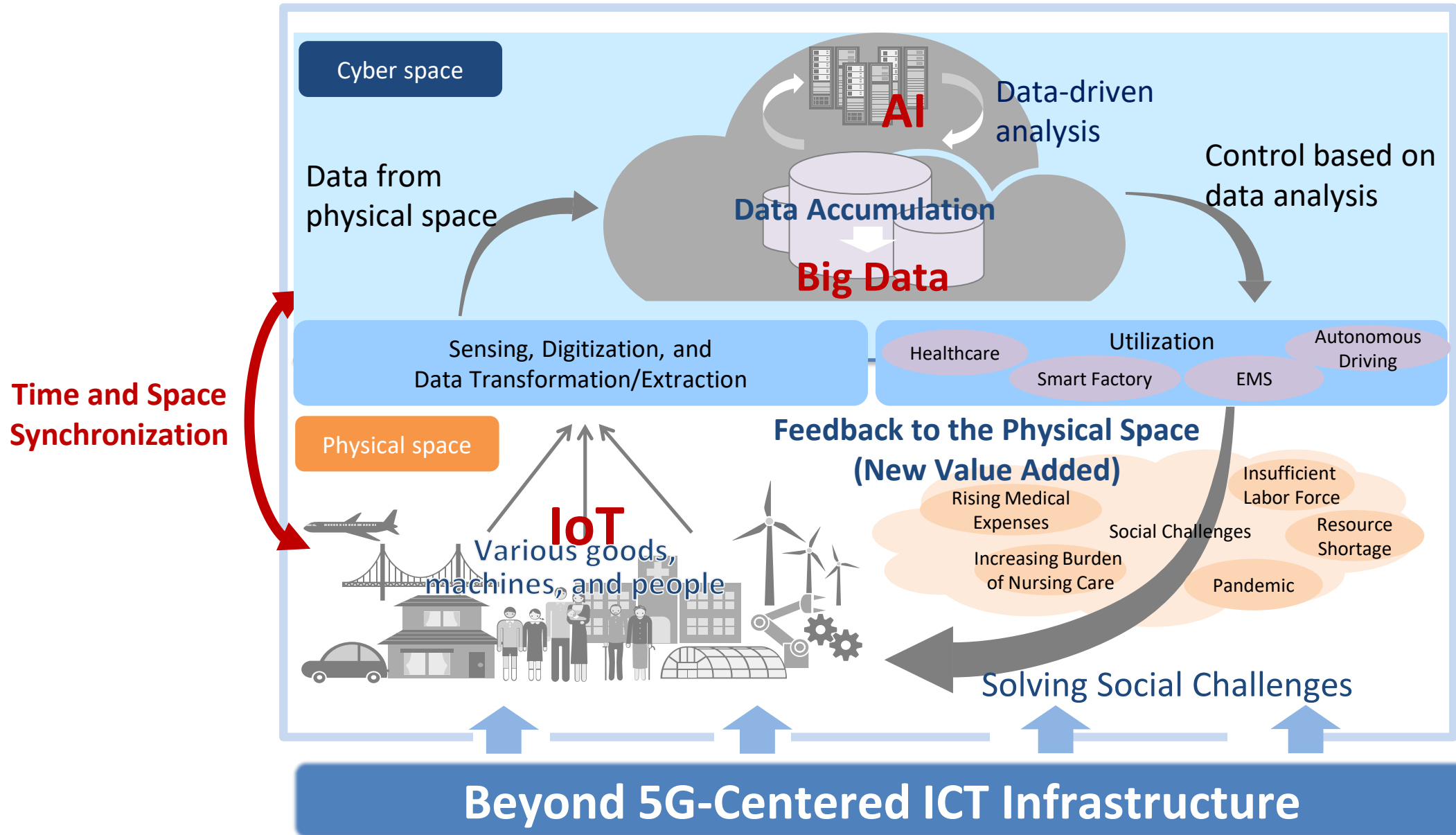




Toward the Beyond 5G/6G Era

- TAWARA Yasuo
- Director-General, Global Strategy Bureau
- Ministry of Internal Affairs and Communications,
Japan

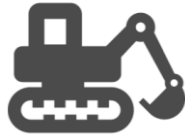
The Cyber Physical System in the Beyond 5G/6G Era



Beyond 5G Usage Scenarios



Finance



Construction and
real estate



Logistics and
transportation



Information and
communications



Media



Energy and resources



Motor vehicles



Food and
agriculture



Distribution, retail,
and wholesale



Medical care



Public services, government,
and education



Disaster risk reduction
and the regions



Space and HAPS



Machinery,
electrical machinery,
and factories

Beyond 5G as the basis for all industrial and social activities in the 2030s

- Ultra-fast, high-capacity services
- Services requiring ultra-low latency
- Services offering the simultaneous connectivity of numerous IoT sensors
- Liberation from the constraints of time and place
- Stable, secure provision of the service quality demanded by users

Key Features for Beyond 5G/6G

Beyond 5G

Further enhancing 5G's characteristic features

1. Ultra High Speed & Ultra High Capacity

- Network Access: **10x faster than 5G**
- Core Network Access: **100x faster than now**

2. Ultra Low Latency

- Latency: **1/10 of 5G**

3. Ultra Massive Connectivity

- Simultaneous Connectivity: **10x more than 5G**

5G

7. Ultra Security and Ultra Reliability

- Always Ensuring Cybersecurity
- Instant Recovery from Disaster/Failure

6. Autonomy

- Autonomous coordination among devices without manual intervention

5. Scalability

- Interconnecting devices to communicate anywhere

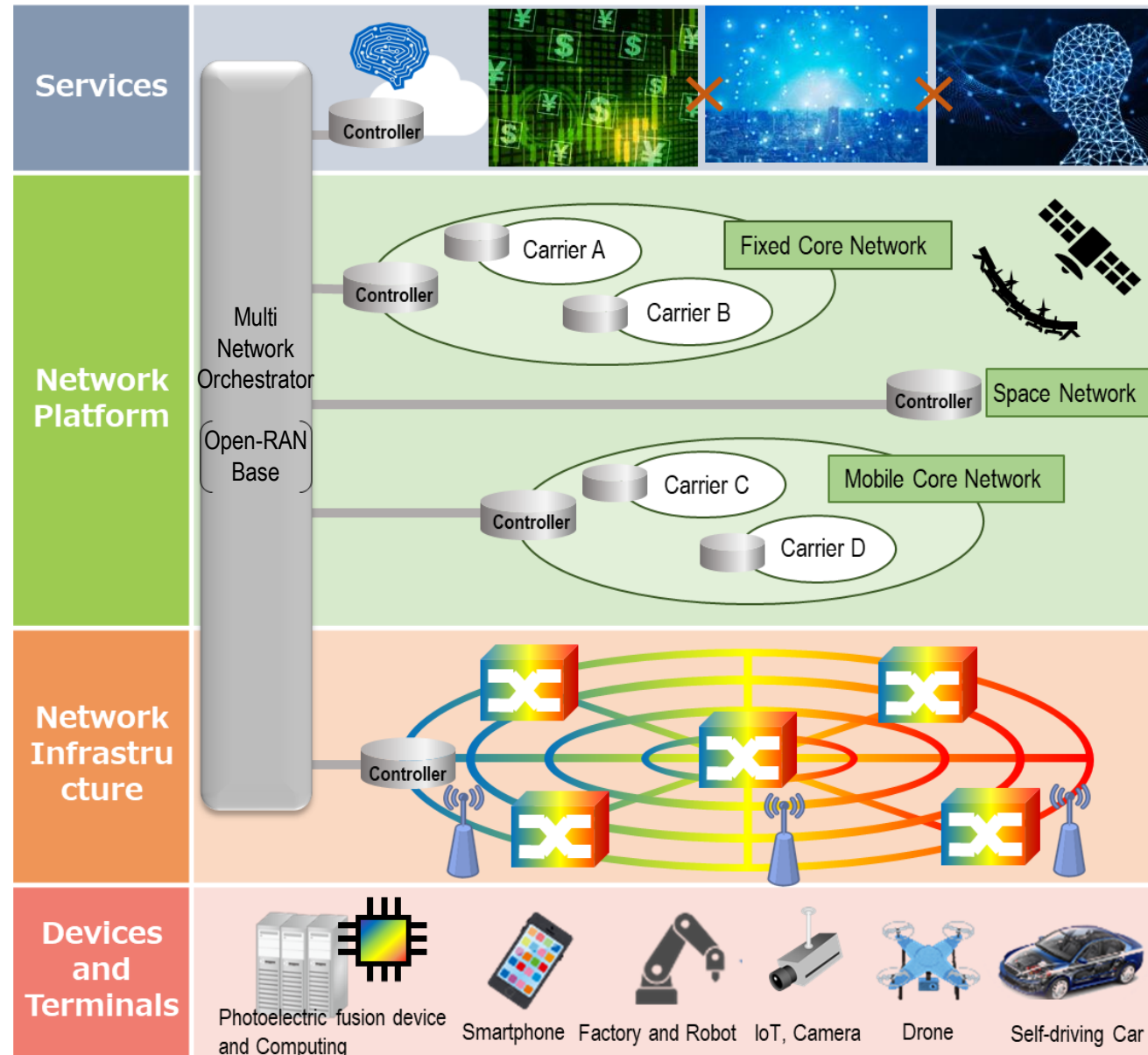
4. Ultra Low Power Consumption

- Power Consumption: **1/100 lower than now**

Beyond 5G

Adding new features that contribute to the creation of new value

The Vision of Beyond 5G Network Architecture



Innovative and attractive services and content are expected to flourish.

<Key concepts and elements >

-Not only RAN* but also whole network architecture should be considered.

-End-to-end high-capacity and ultra-low latency networks are desired.

-Energy efficiency should be realized throughout the networks.

-Communication coverage areas are expected to expand to sky, ocean, and space.

-Security and resilience are essential factors.

Support variety of mission-critical devices/systems/services

RAN: Radio Access Network

Beyond 5G/6G R&D Challenges

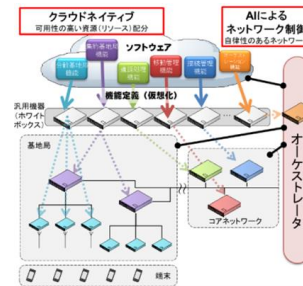
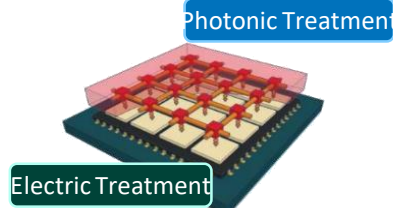
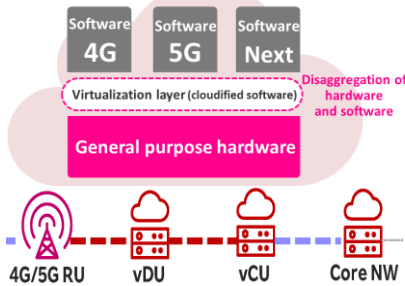
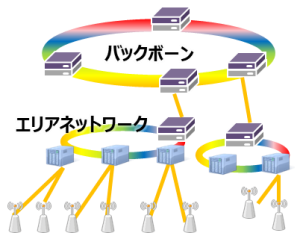
Challenge 1
All photonics network technology

Challenge 2
Open network technology

Challenge 3
Device technology

Challenge 4
Network orchestration technology

Challenge 5
Wireless network technology



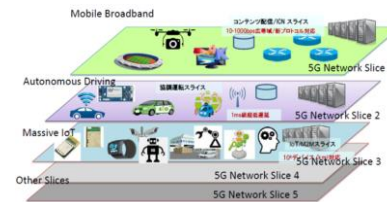
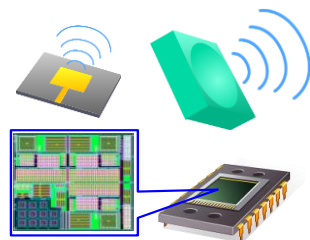
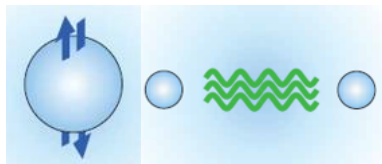
Challenge 6
NTN (HAPS/satellite network) technology

Challenge 7
Quantum network technology

Challenge 8
Terminal and sensor technology

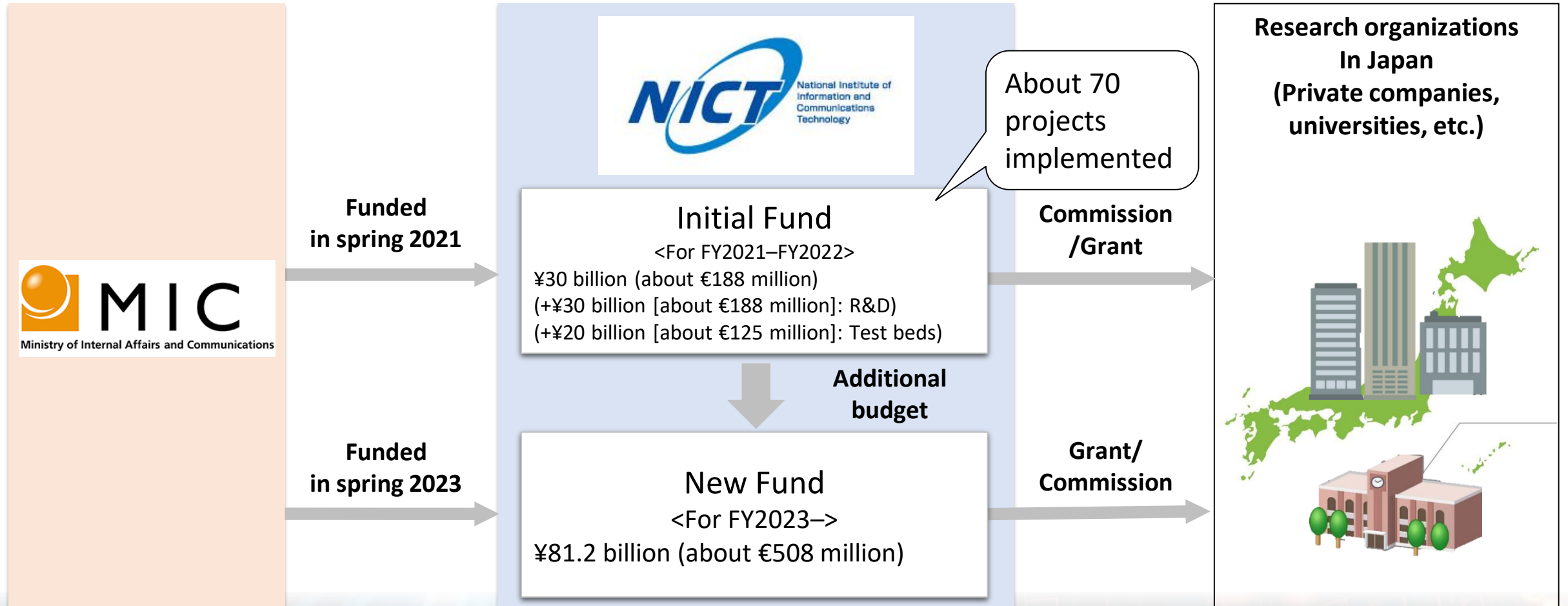
Challenge 9
E2E virtualization technology

Challenge 10
Beyond 5G service and application technology



Recent Beyond 5G Policy Updates in Japan

EUR 1 = JPY 160



G7 Digital and Tech Ministers' Meeting in Japan (April 2023)

Ministerial Declaration at the G7 Digital and Tech Ministers' Meeting (Excerpt)

20. In addition to these efforts to improve the security and resilience of current digital infrastructure, we note the importance of sharing a vision for the next-generation network in the Beyond 5G/6G era, and we **endorse the G7 Vision for the future network in the Beyond 5G/6G era**. We are committed to enhancing cooperation on research and development and the setting of international standards toward building digital infrastructure for the 2030s and beyond. [Annex 2]



The Annex on “Secure and Resilient Digital Infrastructure”

[Annex 2 and 3]

The G7 Vision for future networks in the Beyond 5G/6G era [Annex 2]

We share a common vision for future networks with the following elements. ①End-to-End High-Capacity and Ultra-Low Latency

Not only the radio access network but the whole network architecture should be considered when designing and developing critical technologies and standards for future networks.

②Energy Efficiency and Environmental Impacts

In order to minimize the energy consumption and environmental impacts associated with increased data traffic, a significant reduction in overall network power consumption and the development of eco-designed network equipment are essential factors for a sustainable digital society.

③Multi-Layered Networks

Network connectivity should be enhanced through developing and deploying multi-layered networks with terrestrial networks, submarine cables, and non-terrestrial networks (NTN), such as low earth orbit (LEO) satellites and high-altitude platform stations (HAPS), and we recognize the importance of seamless interoperability between these networks.

④Frequency Efficiency

With smaller cell diameters in the same spectrum, a higher-frequency reuse rate can be achieved. This may reduce the energy consumption of mobile networks, such as Beyond 5G/6G networks.

In addition to the above elements, we recognize that openness, interoperability, and modularity are important elements of future networks in the Beyond 5G/6G era.

The G7 Action Plan for Building a Secure and Resilient Digital Infrastructure [Annex 3] (Excerpt)

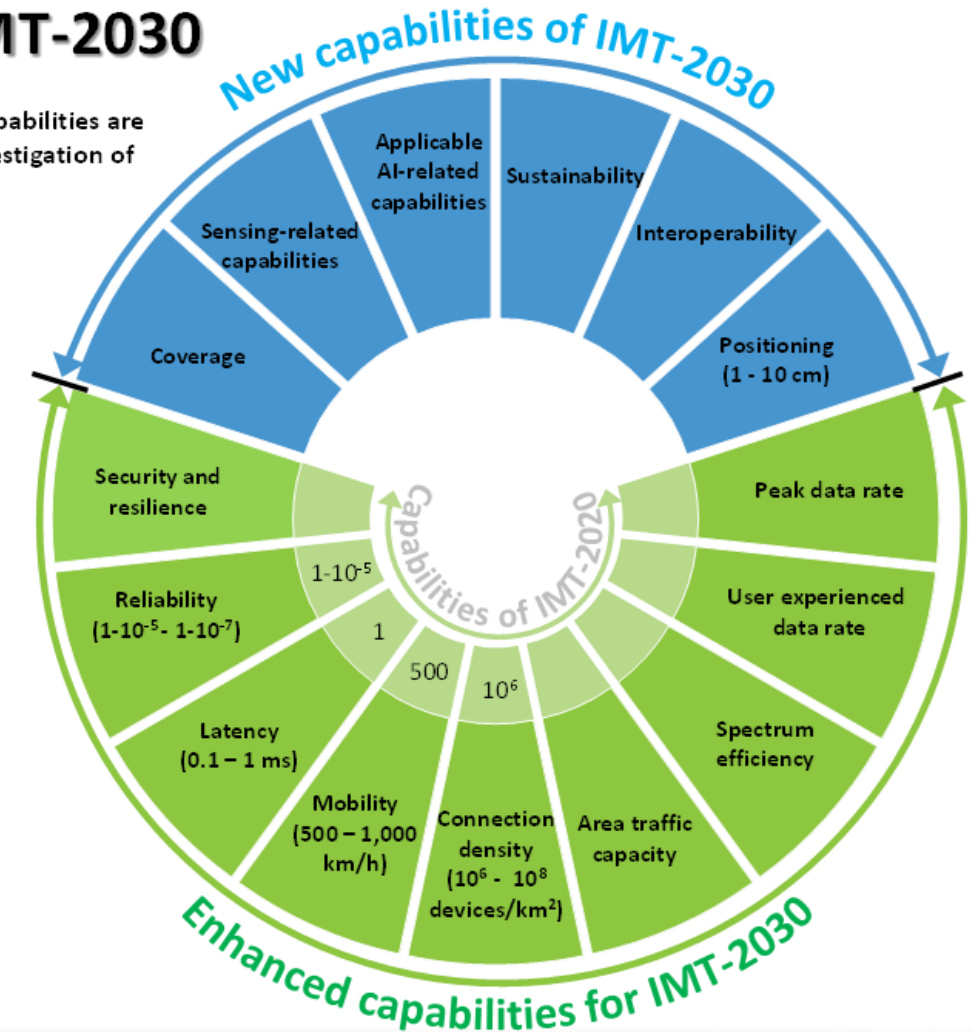
We endeavor to enhance cooperation on research and development and international standardization toward building digital infrastructure in the Beyond 5G/6G era. In that regard, we recognize the importance of measuring and monitoring the evolution of energy consumption and environmental footprint indicators through recurrent data collection and the use of indicators, based on known and stable methodologies.

ITU-R New Recommendation on the “IMT-2030 Framework” (November 2023)

- **Peak data rate:** Values of 50, 100, 200 Gbit/s are given as possible examples applicable for specific scenarios, while other values may also be considered.
- **User experienced data rate:** Values of 300 Mbit/s and 500 Mbit/s are given as possible examples, while other values greater than these examples may also be explored and considered accordingly.
- **Spectrum efficiency:** Values of 1.5 and 3 times greater than that of IMT-2020 are given as possible examples, while other values greater than these examples may also be explored and considered accordingly.
- **Area traffic capacity:** Values of 30 Mbit/s/m² and 50 Mbit/s/m² are given as possible examples, while other values greater than these examples may also be explored and considered accordingly.

Capabilities of IMT-2030













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



Recommendation ITU-R M.2160-0 (11/2023)

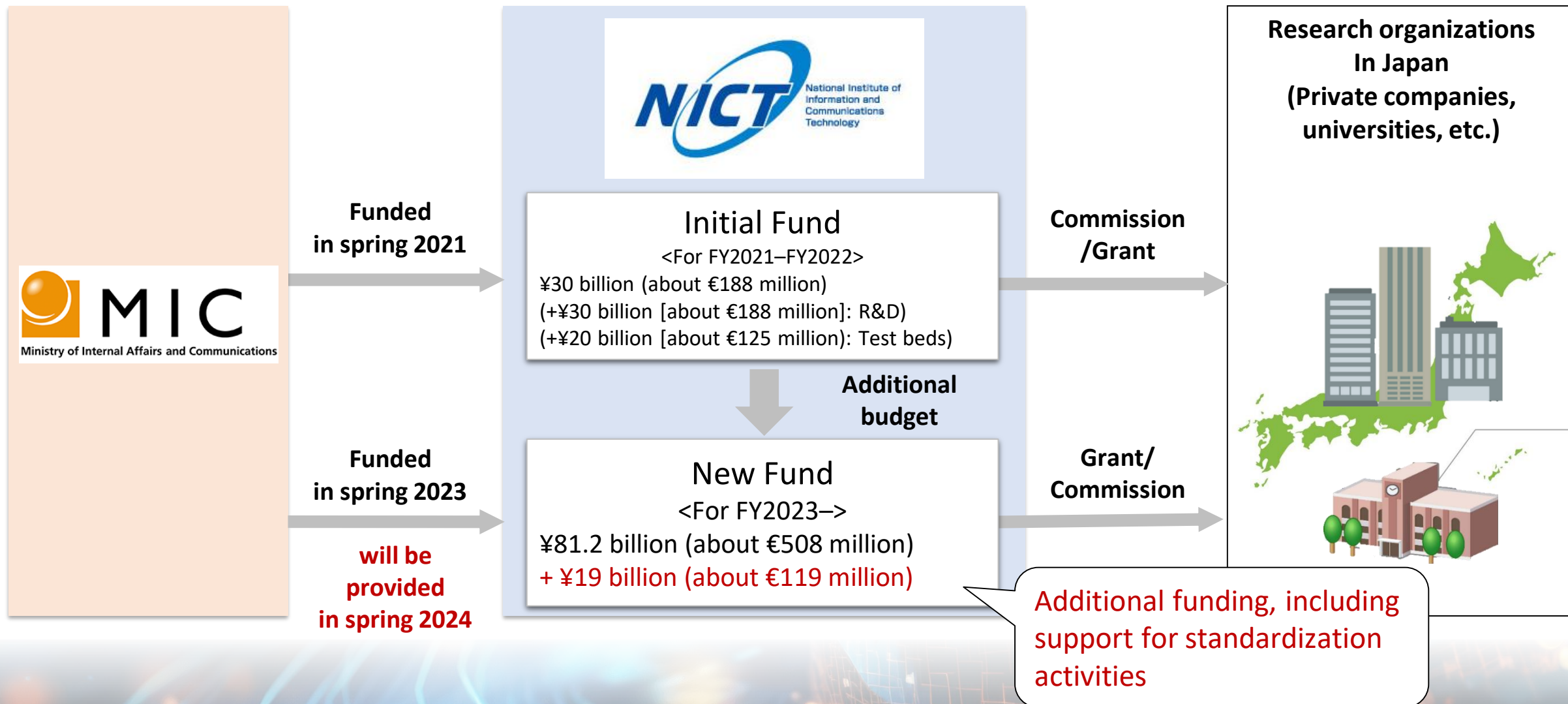
Beyond 5G International Conference

Standardization Bodies Related to Beyond 5G/6G

Dejure Standard	Forum Standard		
 <p>ITU</p>	 <p>IOWN GLOBAL FORUM</p> <p>IOWN Global Forum</p>	 <p>3rd Generation Partnership Project (3GPP)</p> <p>A GLOBAL INITIATIVE</p>	 <p>Internet Engineering Task Force (IETF)</p>
 <p>ISO</p>	 <p>Open ROADM</p> <p>Open ROADM</p>	 <p>Institute of Electrical and Electronics Engineers (IEEE)</p>	 <p>World Wide Web Consortium (W3C)</p>
 <p>IEC</p>	 <p>TELECOM INFRA PROJECT</p> <p>Telecom Infra Project (TIP)</p>	 <p>Optical Internetworking Forum (OIF)</p>	 <p>O-RAN Alliance</p>

Additional support for standardization activities

EUR 1 = JPY 160



Japan's Next Strategy, coming this summer

June 2020

「Beyond 5G Promotion Strategy」 (MIC)

January 2021

Amendment of NICT Act Launching Temporary Beyond 5G R&D Fund on NICT

June 2022

Interim Report by the Information and Communications Council

December 2022

Amendment of NICT Act Launching Permanent Beyond 5G R&D Fund on NICT

March 2023

The Beyond 5G R&D Fund started

November 2023

Resume the Review of the Information and Communication Council

Around summer 2024

Next Strategy (MIC)

Beyond 5G International Conference



Thank You

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- Director-General, Global Strategy Bureau
- Ministry of Internal Affairs and Communications,
Japan