Ministry of Internal Affairs and Communications, JAPAN

The R&D strategy policy for “Beyond 5G” in Japan

November,1st, 2022@6G Global 2022 in Seoul

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MIC plans to release New ICT Strategy for Beyond 5G — towards Robust and Vibrant Society in the 2030s by Information and Communications Council on 30th June 2022

<Overview>

Beyond 5G/6G will become the infrastructure of society and industry in the 2030s.

(Beyond 5G is not a just extension from 5G mobile functions, but expands to the next generation network integrated with fixed and mobile)

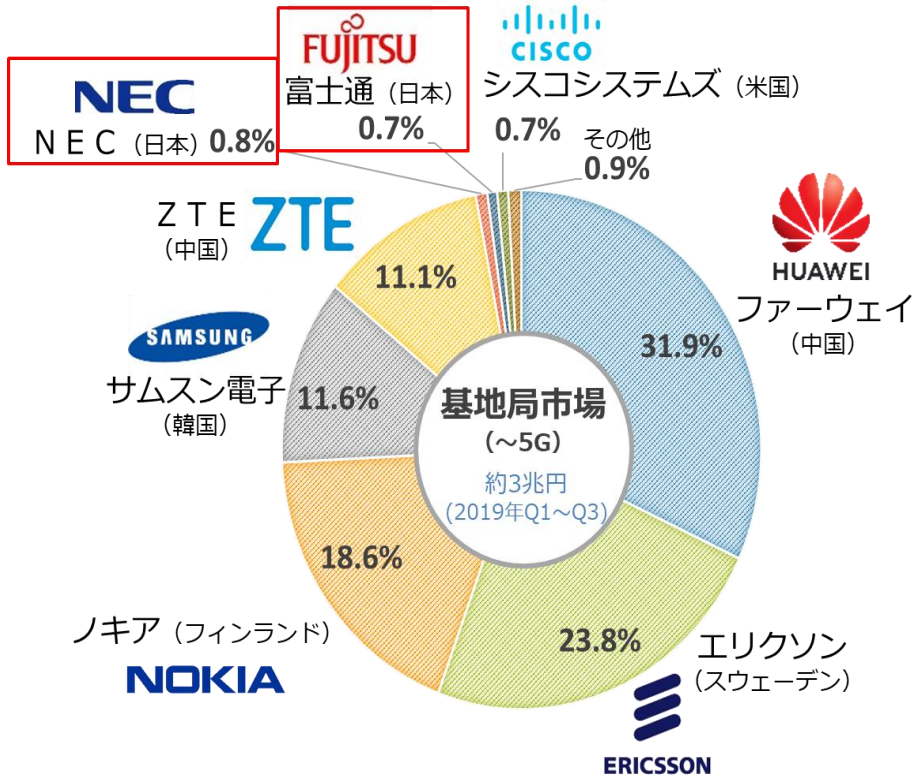
Under the intensifying international competition, it is necessary for Japan to **strengthen its competitiveness** and **ensure economic security** by strategically **promoting R&D, IP and international standardization** in industry-academia-government cooperation.

Information and Communications Council held a series of deliberations **on technology strategies including R&D, IP and international standardization to accomplish the issues**, while sharing initiatives and knowledge of relevant associations and major players in Japan.

Challenge (1) Fierce international competition

- Japanese vendors are trailing behind in the international market for 5G base stations
- While Japanese companies have outstanding technical capabilities in the **Beyond 5G field**, they face challenges regarding international competitiveness and market acquisition

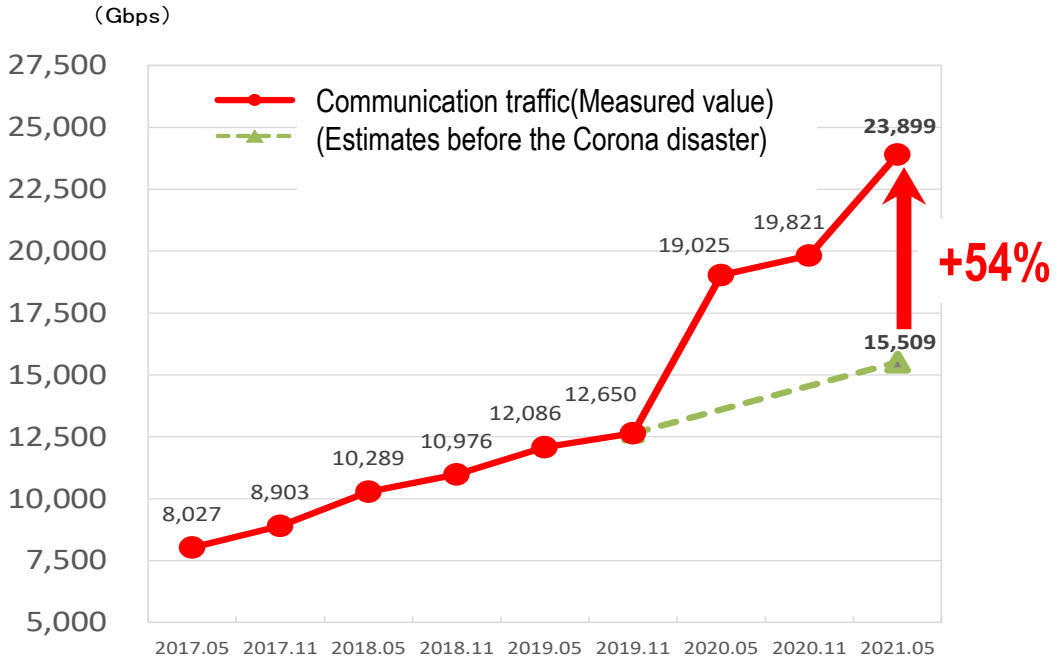
<Market share for 5G base stations (2019)>



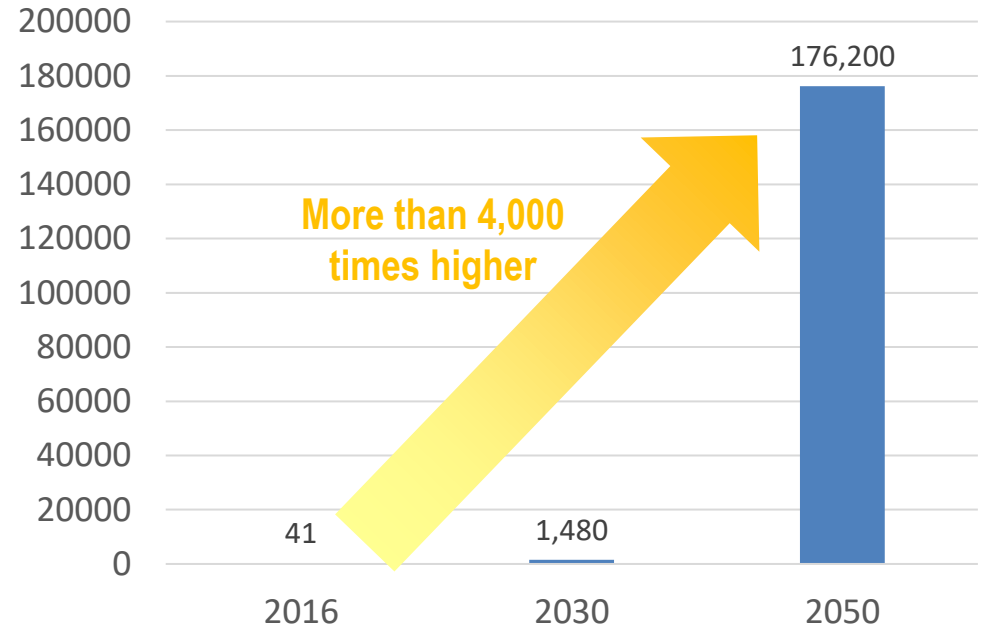
Challenge (2) Power consumption of ICT systems

- Due to lifestyle changes triggered by the pandemic, **communication network traffic and electric power consumption are on the rise**
- **Without technological innovation, further upsurges** are forecast, **making the goal of carbon neutrality hard to achieve**

<Changes in communications traffic in Japan>



<Projected ICT-related power consumption>

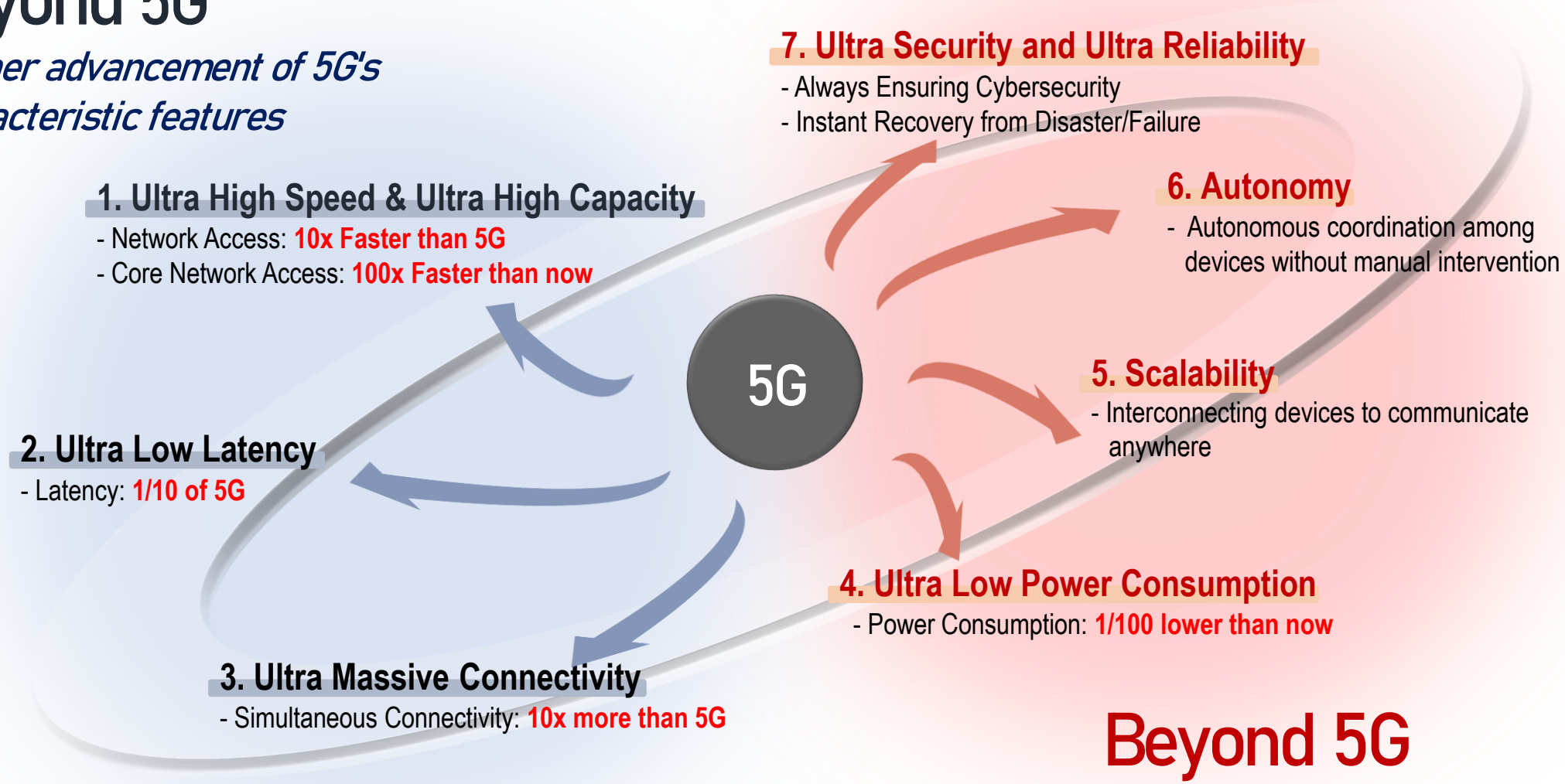


- There is a **need for a national strategy implemented by the government as a whole**, under which relevant ministries and agencies work in close partnership to **deliver the benefits of Beyond 5G to the public** by expanding functions beyond 5G, with the aim of **achieving digitization that allows everyone to flourish and leaves no one behind**

Key Features for Beyond 5G/6G

Beyond 5G

Further advancement of 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**

4. Ultra Low Power Consumption
- Power Consumption: **1/100 lower than now**

5. Scalability
- Interconnecting devices to communicate anywhere

6. Autonomy
- Autonomous coordination among devices without manual intervention

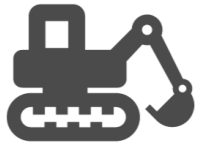
7. Ultra Security and Ultra Reliability
- Always Ensuring Cybersecurity
- Instant Recovery from Disaster/Failure

Beyond 5G

Adding sustainable features that contribute to the creation of new value

Beyond 5G usage scenarios

Finance



Construction and real estate

Logistics and transportation

Information and communications

Media

Energy and resources

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 simultaneous connectivity of numerous IoT sensors
- Liberation from constraints of time and place
- Stable, secure provision of the service quality demanded by users

Motor vehicles

Machinery, electrical machinery, factories

Food and agriculture

Distribution, retail, and wholesale

Medical care

Public services, government, and education

Disaster risk reduction and the regions

Space and HAPS

Acceleration strategy (1) 10 R&D challenges

Challenge 1

All photonics network technology

Ultra-fast, high-capacity, ultra-low latency

Ultra-low power consumption

Challenge 2

Open network technology

Autonomy

Ultra-security and resiliency

Challenge 3

Device technology

Ultra-fast, high-capacity, ultra-low latency

Ultra-low power consumption

Challenge 4

Network orchestration technology

Autonomy

Ultra-low power consumption

Challenge 5

Wireless network technology

Ultra-fast, high-capacity, ultra-low latency

Ultra-numerous connectivity

Challenge 6

NTN (HAPS/ satellite network) technology

Scalability

Ultra-security and resiliency

Challenge 7

Quantum network technology

Ultra-security and resiliency

Challenge 8

Terminal and sensor technology

Ultra-fast, high-capacity, ultra-low latency

Ultra-numerous connectivity

Challenge 9

E2E virtualization technology

Autonomy

Ultra-security and resiliency

Challenge 10

Beyond 5G service and application technology

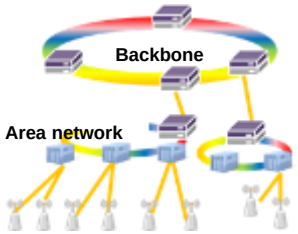
Scalability

● Designating priority R&D programs on which the government should focus

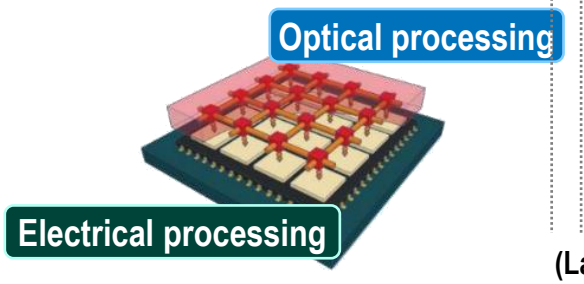
- Prioritizing technologies where Japan's strengths lie, and which can be combined to enable Japan to become a world leader

(1) All photonics network technology

Creating ultra-fast, energy-efficient communications infrastructure



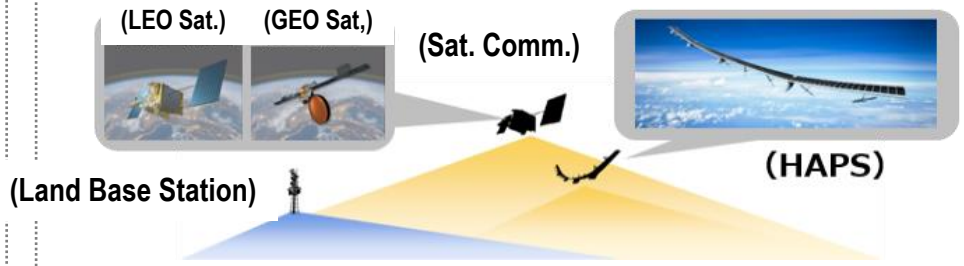
(Optical network technology)



(Photonics-electronics fusion technologies)

(2) Non-terrestrial network technology

Expanding communications coverage to seamlessly link land, sea, and air

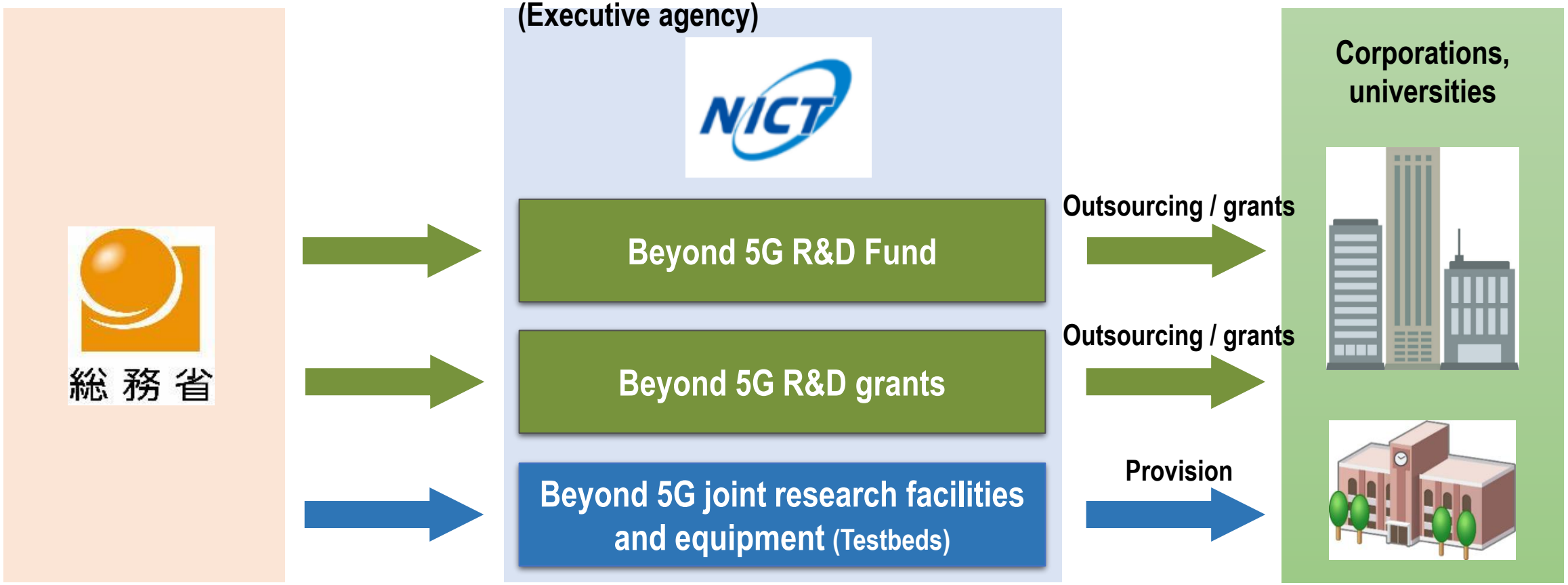


(3) Secure virtualization and integrated network technology

Creating a secure, highly dependable communications environment for users

- Need to powerfully expedite R&D through intensive investment by the government
- Creation of a framework allowing for a multi-year budget would be necessary

Acceleration strategy (3) Budget of B5G R&D



(1) R&D Fund

Third supplementary budget for FY2020: ¥30 billion

(2) R&D grants

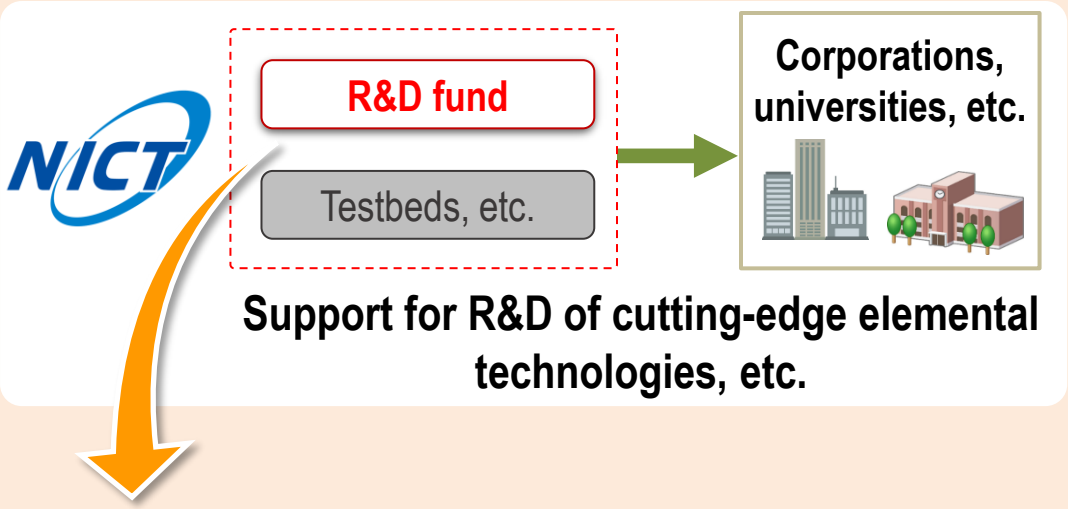
Supplementary budget for FY2021: ¥20 billion, Initial budget for FY2022: ¥10 billion

(3) Facilities and equipment

Third supplementary budget for FY2020: ¥20 billion

Acceleration strategy (4) Support for B5G international joint R&D

Beyond 5G R&D Promotion Project



(1) Beyond 5G Function Realization Program

(2) Beyond 5G International Joint R&D Program

(3) Beyond 5G Seeds Creation Program

- **R&D of terahertz band channel models and applications to support Beyond 5G's ultra-high-capacity wireless communications**
  (JP) **Sharp**, Kyoto University, University of Tokyo
  (U.S.) U.S. communications providers and research institutes
- **R&D of floating cyber-physical systems and wide-area cooperation to achieve low latency and autonomy**
  (JP) **Kyushu Institute of Technology**, KDDI Research
  (U.S.) City College of New York

- **R&D of a terahertz network working at 300 GHz, undertaken in collaboration with the EU**
  (JP) **Gifu University**, Waseda University, Chiba Institute of Technology
  (EU) Technical University of Braunschweig, Fraunhofer Institute for Applied Solid State Physics, University of Lille Institute of Electronics,etc.
- **Open and secure Beyond 5G mobile data offloading using next-generation public wireless LAN roaming**
  (JP) **Kyoto University**, Local 24, Tohoku University, Research Organization of Information and Systems National Institute of Informatics
  (Overseas organizations) GÉANT
- **Ecosystem for self-propagating sustainable digital twins to support City as a Service**
  (JP) **Waseda University**, Shibaura Institute of Technology, Tokyo University of Technology, Gaiax, Fukuoka University
  (EU) Dipartimento di Ingegneria Elettronica, Università degli Studi di ROMA "Tor Vergata", Italy

Acceleration strategy (5) IP and standardization strategy

Open / closed strategy

(1) All Photonics network (APN)

(2) Non-Terrestrial Networks(NTN)

(3) Secure virtualization and integrated networks

[International standardization strategy] (Open strategy)

- Standardization based on the results of demonstrations.
- Promote the international deployment from FY2026 onwards.

- International spectrum allocation (WRC-23, 27).
- Deliver world-leading communications services.

- Promote R&D by FY2025.
- Take the initiative virtualization of Open RAN virtualization technology.

[IP strategy] (Closed strategy)

- Tailoring patent applications to standardization to establish standard-essential patents
- Filing applications for intellectual properties(ex.patents) or ensuring complete concealment

Consider open/closed strategy in the adoption process

Beyond 5G R&D Promotion Project

B5G project-implementing company

Project promotion

Plan → 1st year of project → 2nd year of project → . . .

Evaluation for adoption

Evaluation for continuation of the project

Social implementation

Presentation of strategies

Acceleration strategy (5) International standardization strategy integrated with the R&D strategy

- The ITU Telecommunication Standardization Sector (ITU-T) is gaining even greater importance as the international organization responsible for the standardization of the cutting-edge technologies required for Beyond 5G.

International Telecommunication Union (ITU)

ONOE Seizo Director-Elect of the ITU-T
Current post: Chief Standardization Strategy Officer (CSSO),
Nippon Telegraph and Telephone (NTT) Corp.

- Cultivating personnel who will promote IP and standardization at companies

・ Training for younger corporate talent with executive potential (Leaders' forum)
・ Efforts to promote company-wide understanding of IP and standardization activities (standardization awareness guidebook)
・ Support for HRD through international conferences

Acceleration strategy (6) Social implementation strategy

● Starting social implementation early

The outcomes of priority R&D programs will begin to be implemented progressively in domestic networks and launched onto the market in 2025

● Identifying scenarios for migration to Beyond 5G

[From FY2024]

- Verifying technology at public institutions and other advanced user areas, combining all photonics network technology with secure virtualization and integrated network technology

[From FY2025]

- Integrated effort by industry, academia, and government to spread the word about the aforementioned outcomes worldwide via Expo 2025 Osaka, Kansai

[From FY2026]

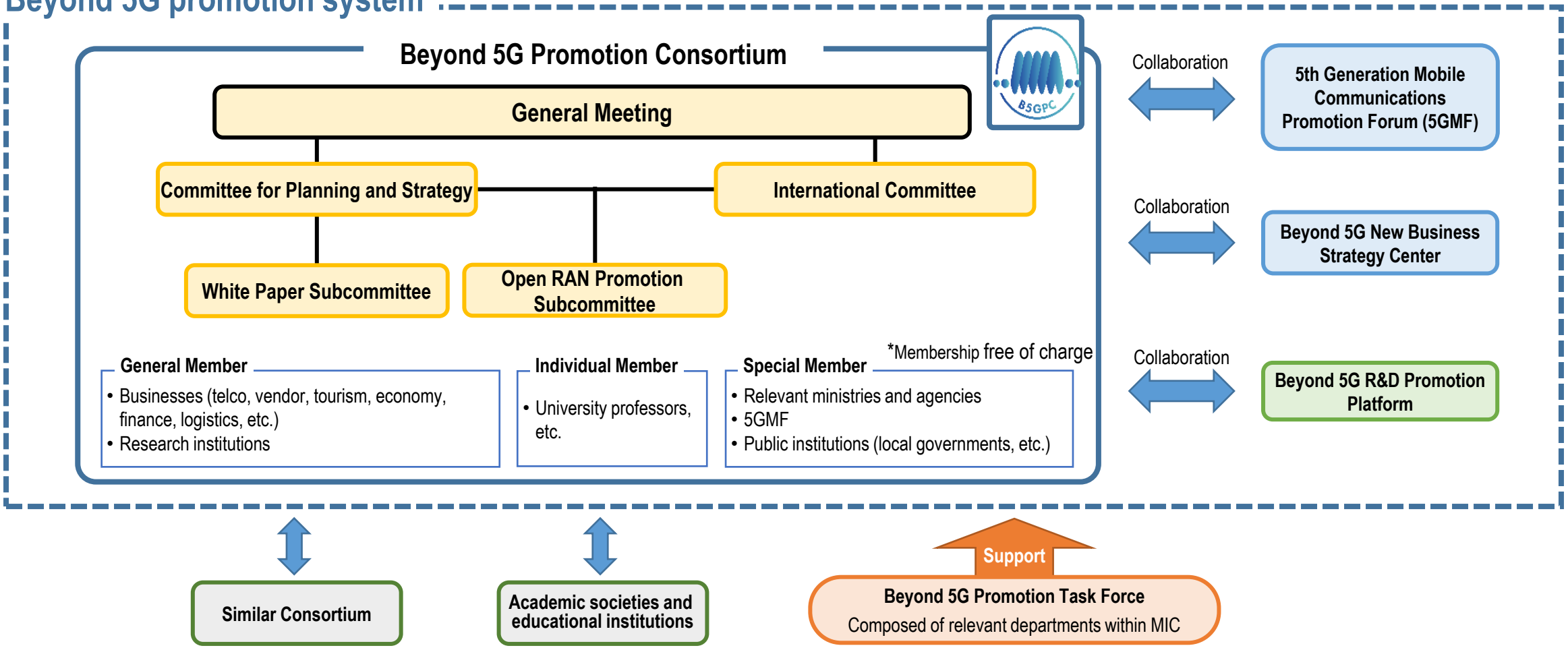
- Augmenting the functions of all photonics network technology and secure virtualization and integrated network technology, and implementing a phased expansion of the areas served
- Expanding the areas served to cover the whole of Japan and the rest of the world, in combination with non-terrestrial network technology

● Encouraging the introduction of Global Beyond 5G Key Technologies by communications carriers overseas

- While **working in partnership appropriately with major global vendors**, we will **promote the introduction of the outcomes** of our **priority R&D programs by communications carriers overseas**

Acceleration strategy (8) Beyond 5G Promotion Consortium

Beyond 5G promotion system



President	GONOKAMI Makoto (President, RIKEN (Institute of Physical and Chemical Research))
Vice-President (Alphabetical order)	Il Motoyuki (President & CEO, NTT DoCoMo), MIYAKAWA Junichi (President & CEO, Softbank), SAWADA Jun (Chairman, NTT), TAKAHASHI Makoto (President, KDDI), TOKUDA Hideyuki (President, NICT), TOKURA Masakazu (Chairman, Keidanren (Japan Business Federation)), YAZAWA Shunsuke (President, Rakuten Mobile) YOSHIDA Susumu (The Fifth Generation Mobile Communications Promotion Forum (5GMF))

Acceleration strategy (9) Beyond 5G White Paper

- Published a white paper (March 2022) that summarizes ways of using Beyond 5G, along with performance targets. The updated Version 1.5 of the white paper was published in September 2022.
- Proposed the usage scenarios and performance targets as a topic for discussion relating to the international standardization of Beyond 5G at the International Telecommunication Union (ITU) (June 2022)

<Beyond 5G White Paper>

- Beyond 5G: vision for society and usage scenarios (XR, autonomous driving, use in health care)
- Performance targets required of Beyond 5G (ultra high speed, more than 10 times faster than 5G (at least 100 Gbps); ultra-low latency, etc.)
- Beyond 5G elemental technologies (terahertz, antenna technologies, photonic communication technology, etc.)

<Beyond 5G usage examples>

Entertainment using virtual spaces

Source: https://about.fb.com/news/2021/10/facebook-company-is-now-meta/

Advanced medical care

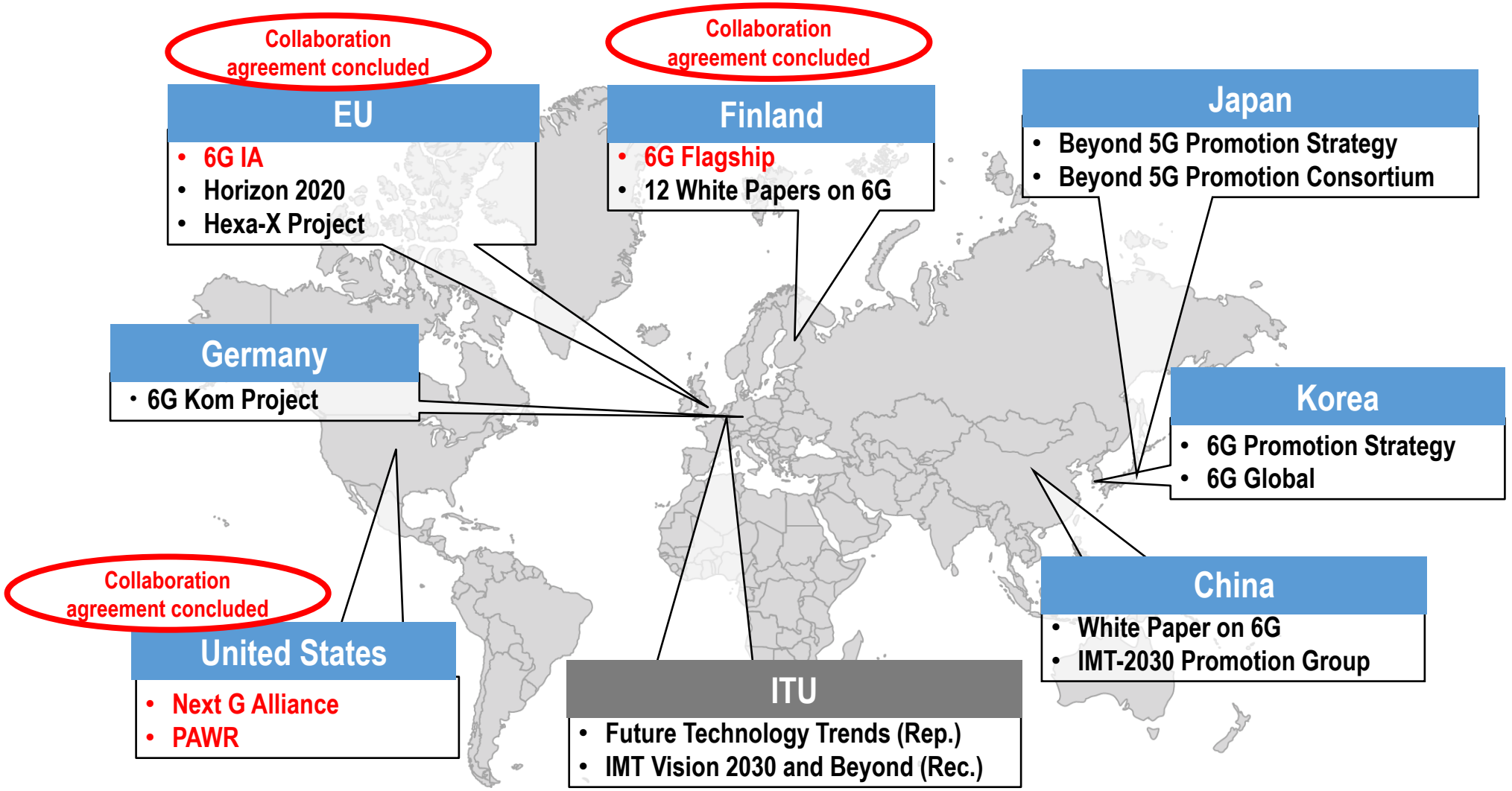
Source: AMED (Information about outcomes)

<Key performance indicators (KPIs) for Beyond 5G>

Quantitative requirements	Outcomes of deliberations by the Beyond 5G Promotion Consortium
Ultra-fast, high-capacity	100 Gbps or more
Ultra-low latency	0.1 millisecond
Ultra-numerous simultaneous connectivity	10^6 - 10^7 devices/km^2
Ultra-low power consumption	One-hundredth of that of 5G
Coverage	Over a radius of dozens to hundreds of kilometers

Acceleration strategy (10) Efforts on Beyond 5G/6G

- Many countries have issued 6G white papers and have started to conduct R&D on 6G.
- ITU has started discussing standardization for IMT-2030 (Beyond 5G/6G).



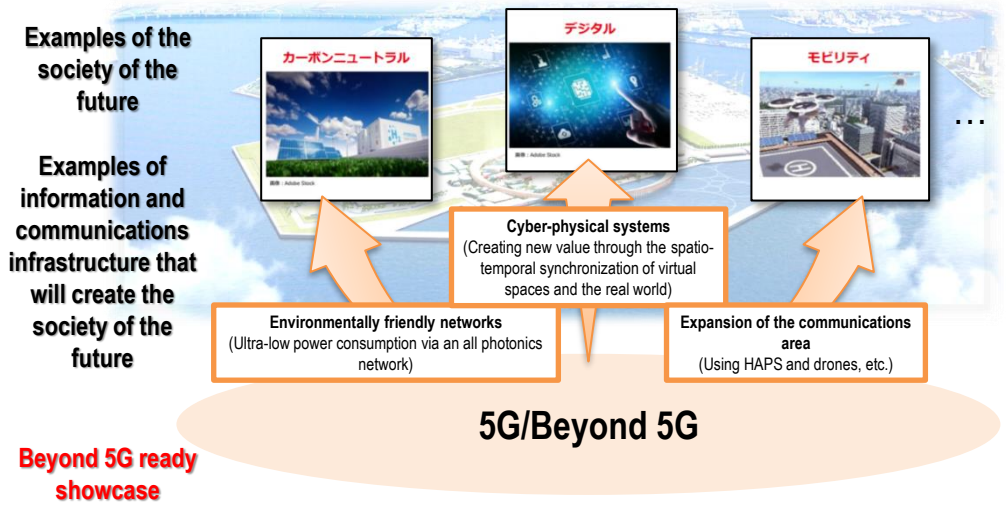
Beyond 5G ready showcase @ Expo 2025 Osaka, Kansai

Outline of policies and implementation

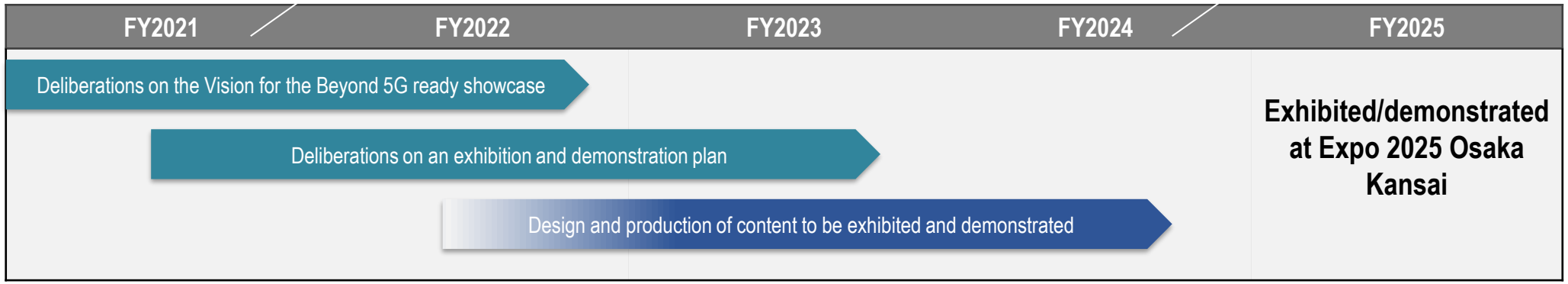
Efforts to realize Beyond 5G and deploy it worldwide will be expedited by creating the Beyond 5G ready showcase to highlight the outcomes of R&D conducted in the priority phase through to 2025, displaying and demonstrating these technologies to a global audience, and using the showcase as a springboard for efforts to expedite subsequent initiatives.

Status of deliberations aimed at implementation

(Timing) During Expo 2025
(Location) At the Expo 2025 venue
(Responsible organizations) Private sector business operators, etc. are expected to take the lead



The advanced technologies of the 2030s can be implemented and promoted to the world



以降、予備スライド

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Vision for a society where Beyond 5G is a reality

Vision for society in the 2030s
A robust and vibrant society

(Beyond 5G Promotion Strategy)

A society where everyone can flourish
Inclusive

- Vision for a Digital Garden City Nation
- Health and medical care, extending social longevity
- Work style reform

A society growing sustainably
Sustainable

- **Greener environment and energy**
  - Greening of ICT by 2040
  - Greening of ICT by 2050
- **Bolstering international competitiveness, achieving economic growth**
  - An open and fair Beyond 5G market environment, etc.

A society where people can undertake activities with peace of mind
Dependable

- Economic security
- Mid- and post-pandemic society
- Disaster prevention, mitigation, and national resilience

Realization of Society 5.0

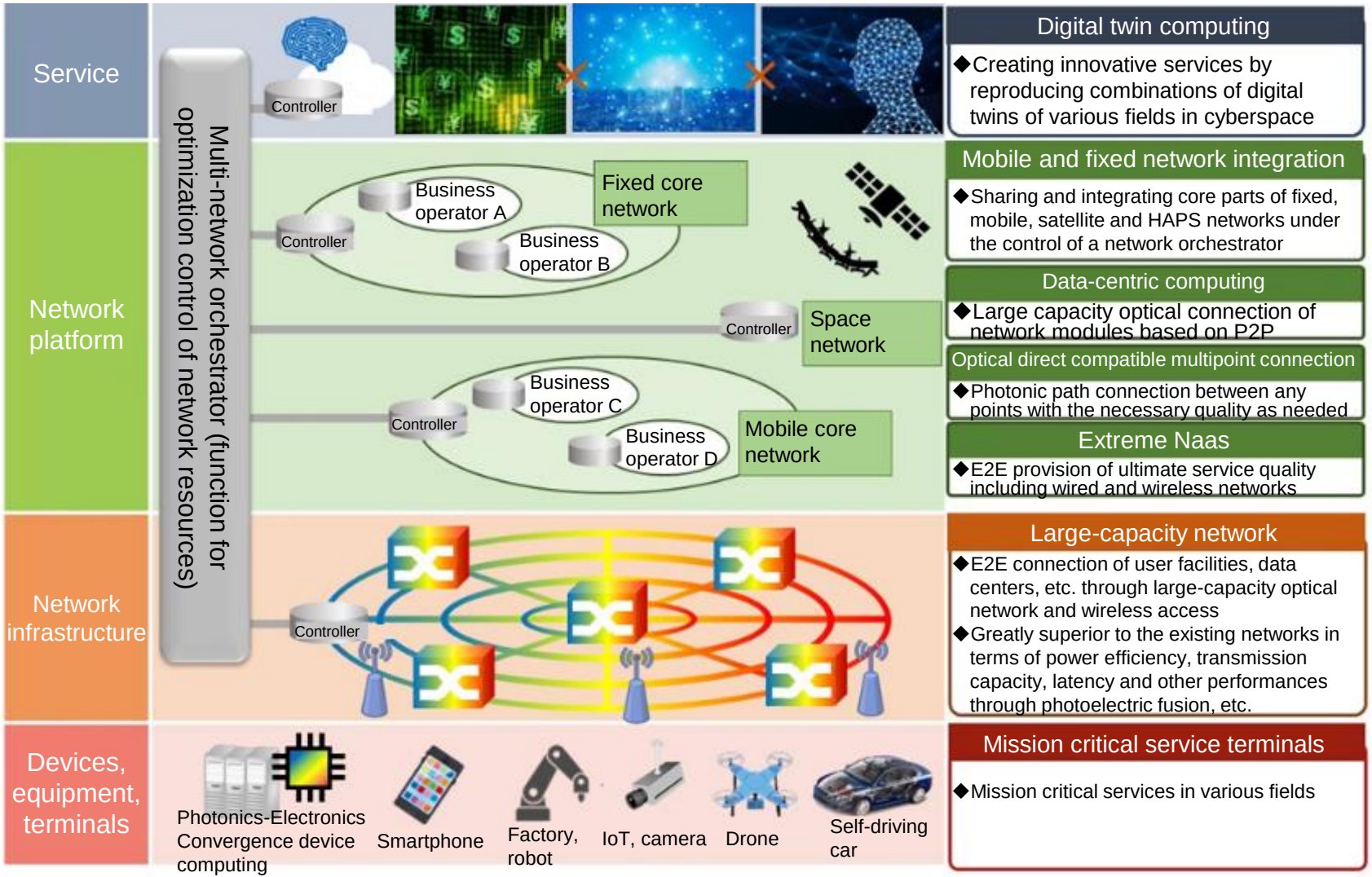
Vision of Beyond 5G Network

[Goals to reach]

Digital Garden City Nation infrastructure with 100% land-air-sea coverage of Japan

Double the electric power efficiency of the overall communication network
(Together with expansion of the use of renewable energy)
2040 carbon neutrality of the information

Secure 10% of essential patents and **30% share of the global market to lead the world market**



Japan's Roadmap for securing bandwidth by the 2030s