SWS-240013

B5GPC's Views on IMT2030 use cases

～From White Paper Ver. 3.0～

Beyond 5G Promotion Consortium (B5GPC), Japan

Agenda

1. B5G Promotion Strategy in Japan and introduction of B5GPC
2. Activities and contributions of B5GPC White Paper Subcommittee
3. Outline of B5GPC White Paper and use cases from various industries for IMT-2030
4. What is required for IMT-2030?

   ~ based on reflections on 5G standardizations and commercialization ~
5. Summary/conclusion

1. B5G* Promotion Strategy in Japan and introduction of B5GPC

*B5G means to cover not only 5G-Advanced but also 6G and its Beyond

Major issues in Japan

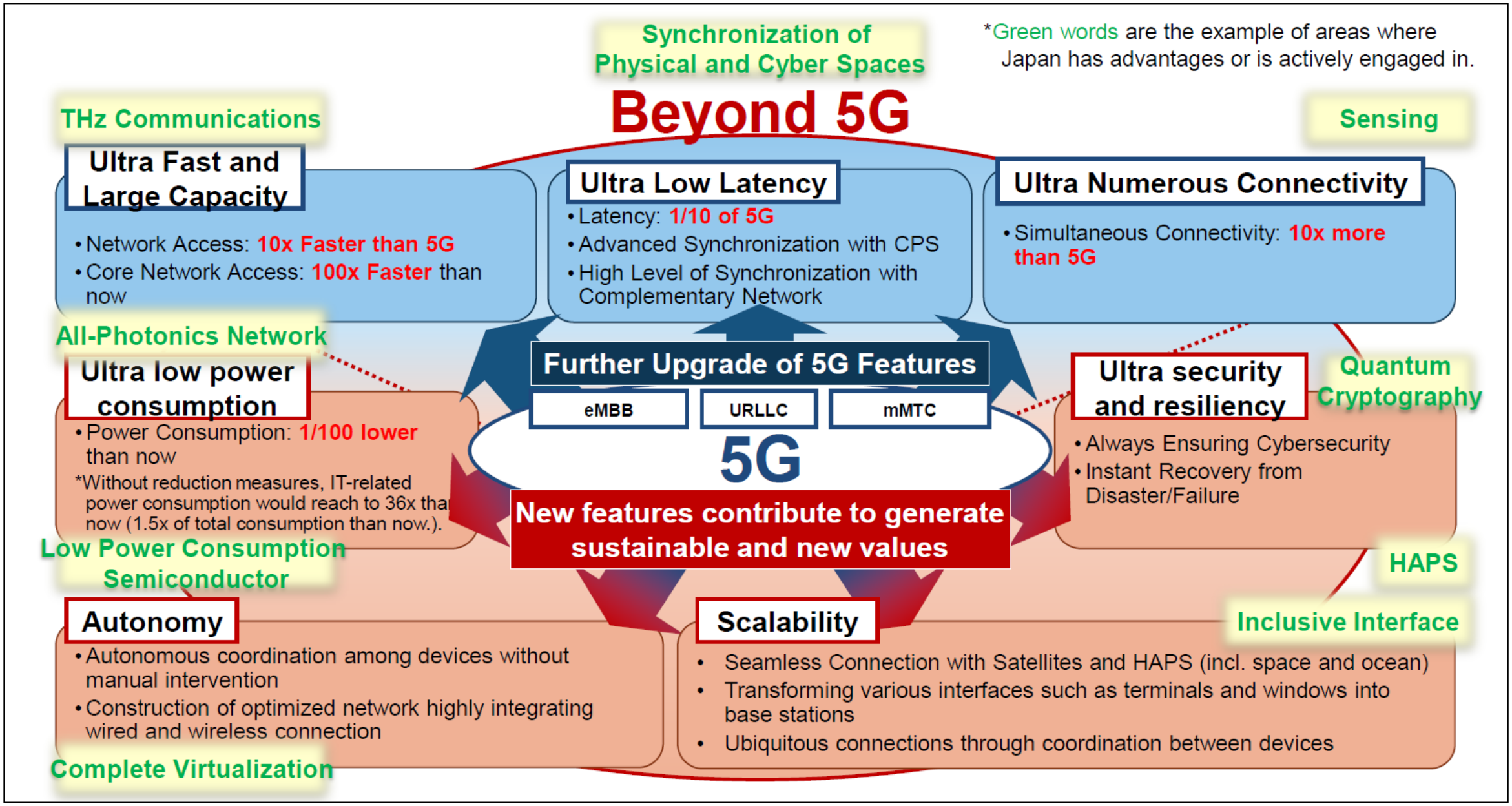
Low birth rate and aging population

Economic activation in local regions

Increase of natural disasters

Prolonged low economic growth

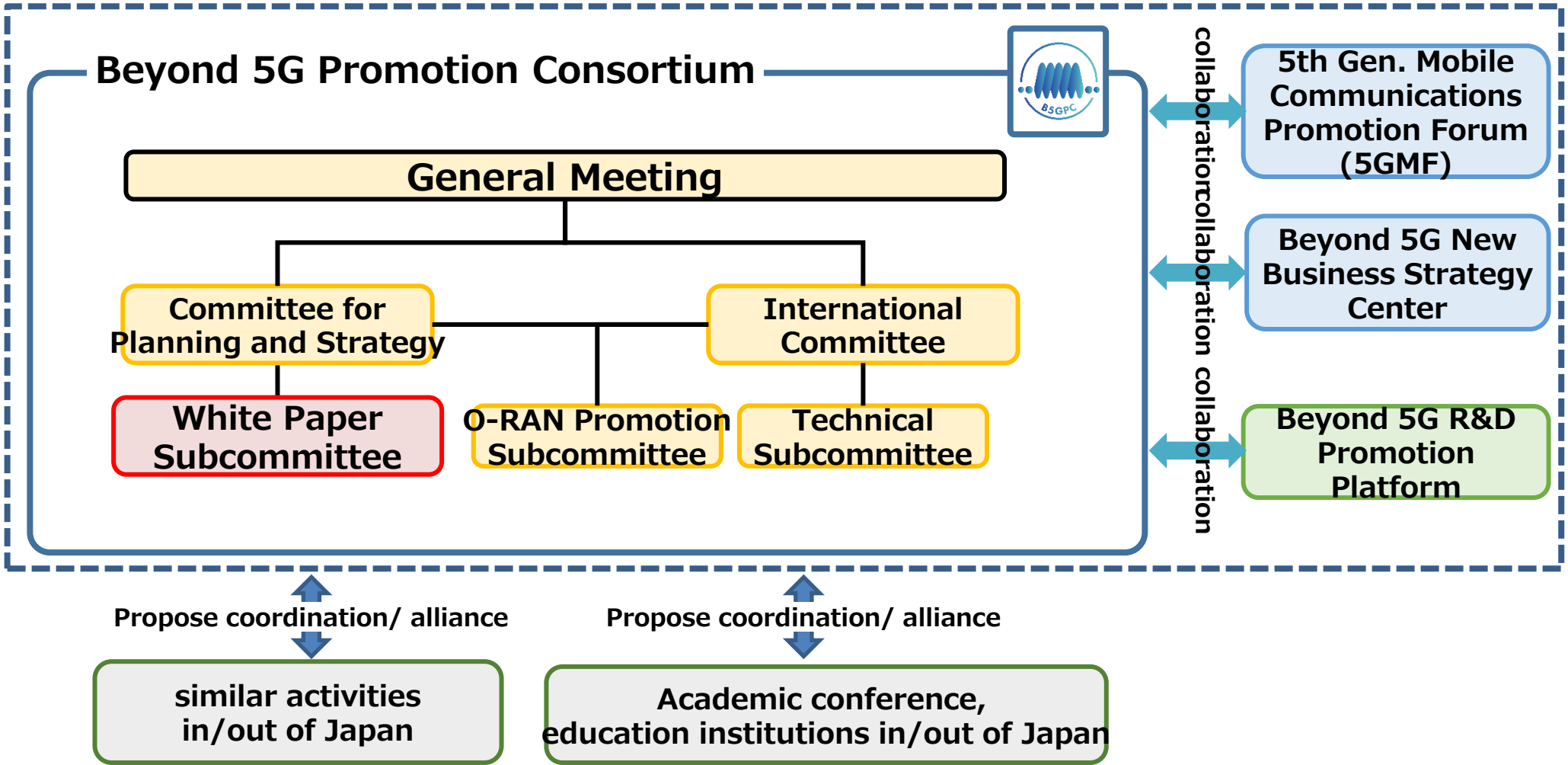
B5G Promotion strategy in Japan



Beyond 5G Promotion Consortium (B5GPC)

Aimed to promote **B5G Promotion Strategy** through **industry-academia-government** collaboration

- International conference for international cooperation
- Vision for Beyond 5G, White Paper etc.
- Technical discussion including O-RAN promotion



Announcement

5G Mobile Communications Promotion Forum (5GMF)

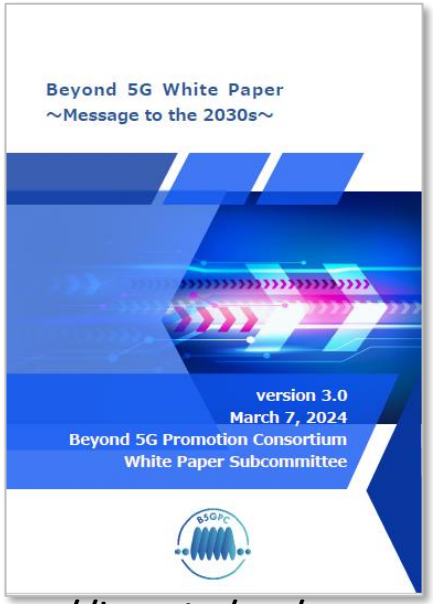
Beyond 5G Promotion Consortium (B5GPC)

From April 2024

XG Mobile Promotion Forum (XGMF)

We will further promote international collaborations as well as studying use cases and technologies for B5G/6G

2. Activities and contributions of B5GPC White Paper Subcommittee



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Structure of White Paper Subcommittee, B5GPC

Committee for Planning and Strategy

White Paper Subcommittee — **Chair : T. NAKAMURA (NTT DOCOMO)**

Vision Working Group — **Leader : S. KONISHI (KDDI), Sub leader: S. NAGATA(NTT DOCOMO)**

To develop the vision part of the white paper with **forecasting our society around 2030 and studying use cases and requirements of Beyond 5G**

Technology Working Group — **Leader : K. SAKUMOTO (FUJITSU), Sub-leader: H. SHIMONISHI(NEC)**

To develop the technology parts of the white paper with studying technology trends of Beyond 5G and clarifying roles and expectations of functions and values for users and markets

Spectrum Working Group — **Leader : Y. HONDA (ERICSSON JAPAN)**

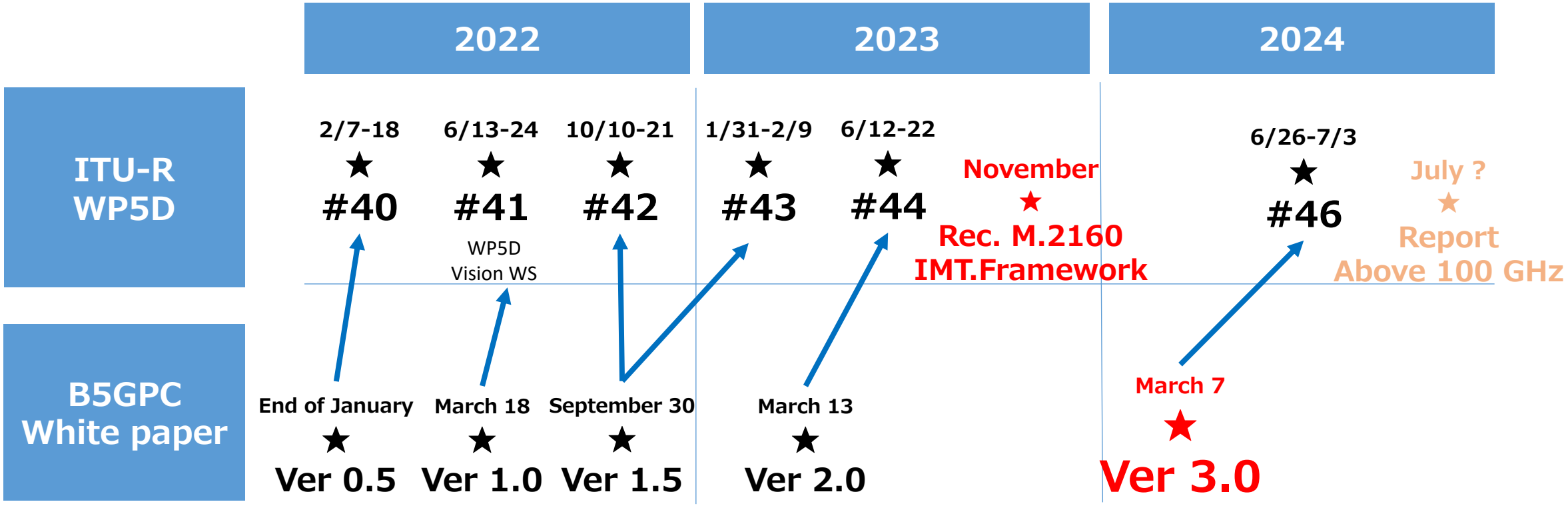
To develop the spectrum related information with conducting survey on spectrum for Beyond 5G

WP5D Ad Hoc — **Leader : M. AGATA (KDDI), Sub-leader: M. TAKETSUGU (NEC)**

Action planning and contribution to ITU-R WP5D based on studies in the subcommittee

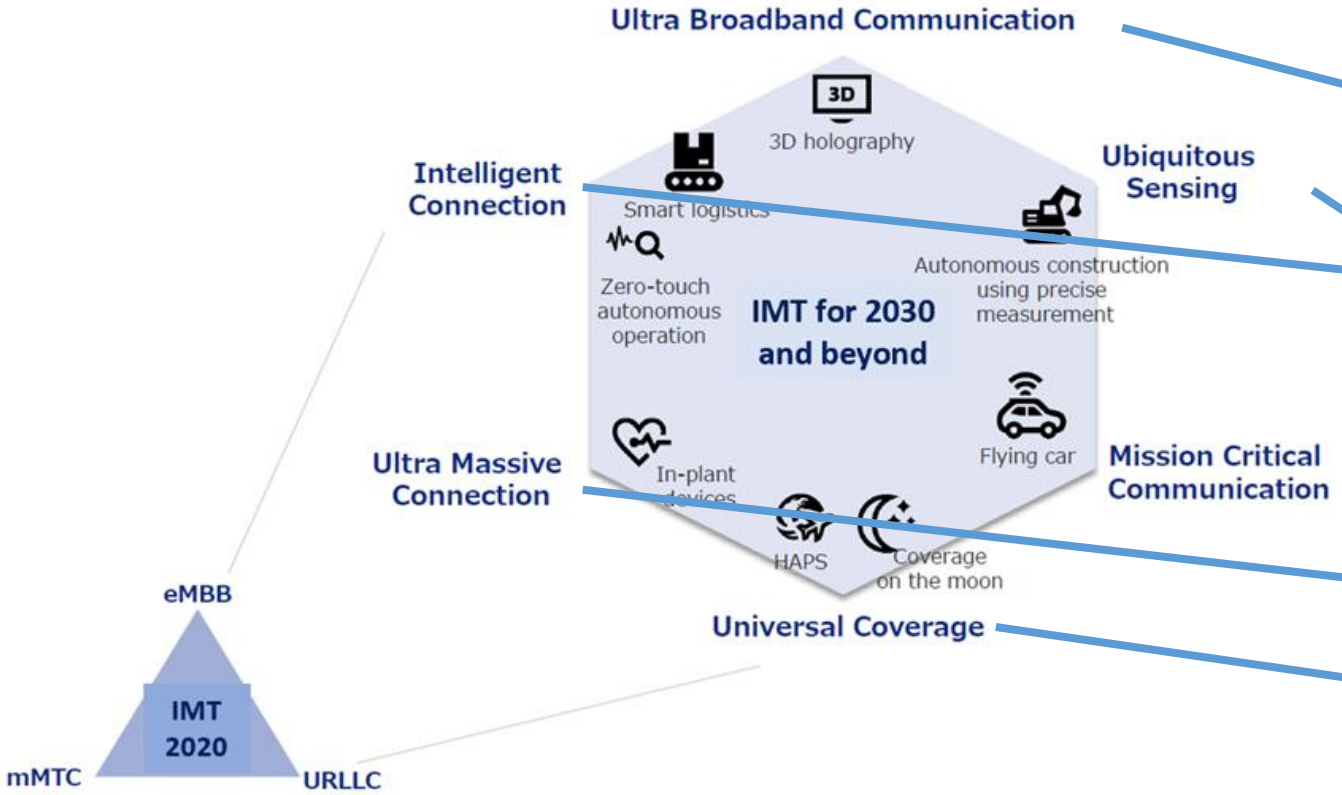
Version 3.0 published on 7 March 2024

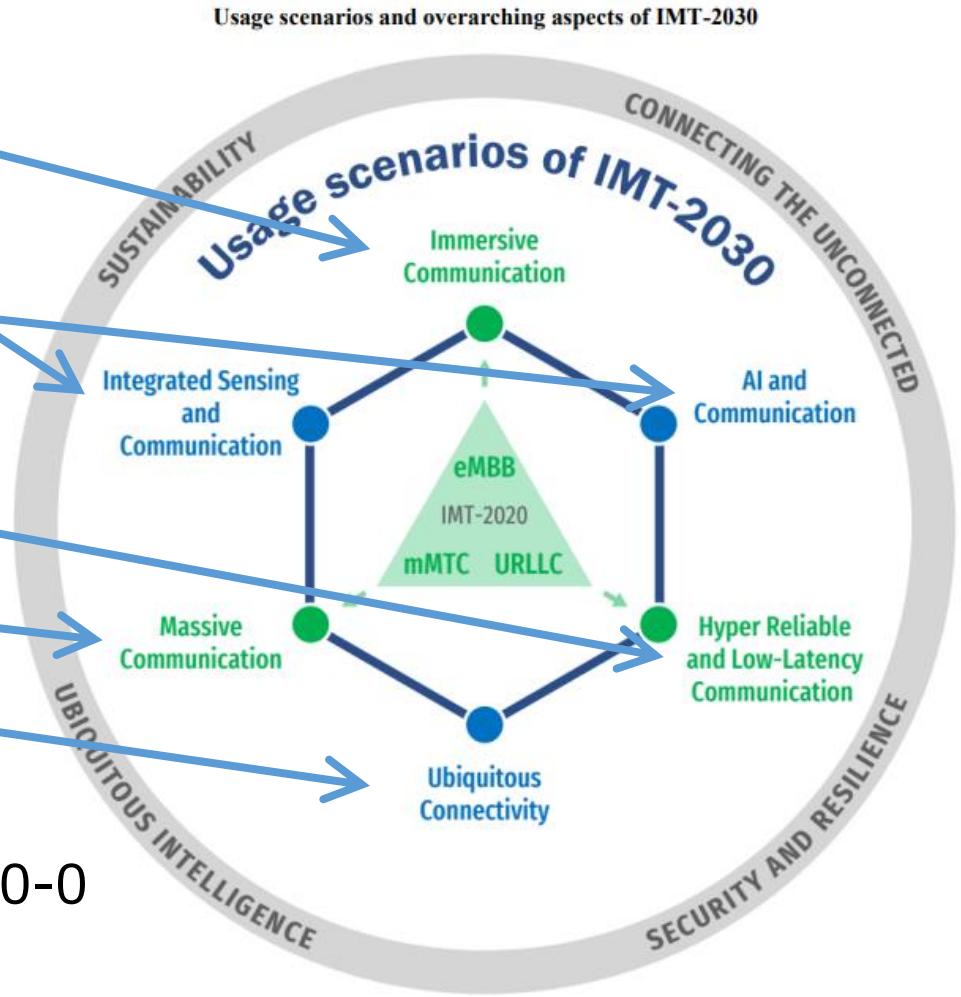
White paper have been contributing to ITU-R Rec. and Reports



Proposal of usage scenarios for IMT-2030

Japan, as a member state, proposed usage scenarios, symbolic figures, and KPIs developed by B5GPC to ITU-R WP5D





Following proposals were adopted to ITU-R Rec. M.2160-0

- IMT-2030 is an **evolution of IMT-2020**
- Representation in a **hexagonal shape**
- **Usage scenarios at the vertices** of the hexagon (with different terminologies)

3. Outline of B5GPC White Paper and use cases from various industries for IMT-2030

Structure of White Paper

Chapter 1. Introduction

Chapter 2. Traffic trends

- This chapter describes the trends in traffic from mobile applications and use cases of Beyond 5G that are predicted to arrive around the year 2030.

Chapter 3. Market trends in the telecommunications industry

- This chapter discusses market trends in the mobile communications sector, particularly changes in the share structure for smartphones, base stations, and other communication infrastructure equipment, and technical trends in components related to smartphones.

Chapter 4. Trends from other industries

- This chapter identifies the current challenges in all existing industries, provides suggestions for problem solving, and summarizes the visions and dreams that industries should aspire for, as well as the performance and capabilities that are expected of Beyond 5G.

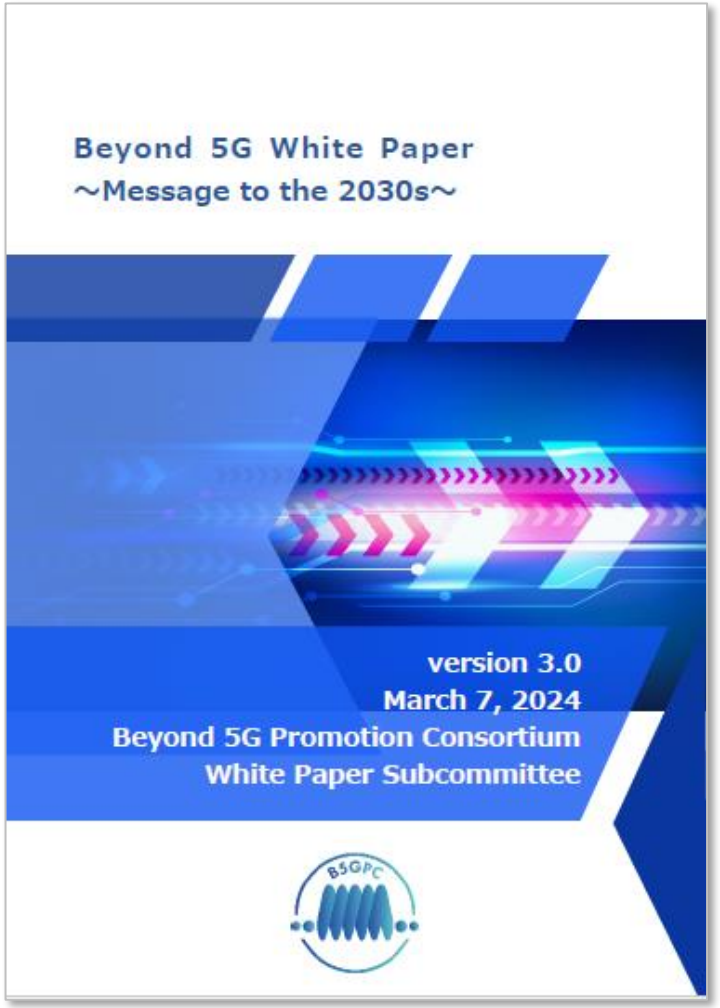
Chapter 5. Capabilities and KPIs required in Beyond 5G

- This chapter identifies the unique use cases in the various industries discussed in Chapter 4 and summarizes the performance of Beyond 5G required for each use case, together with the symbol figure of Beyond 5G, the six usage scenarios and the target KPI (Quantitative and Qualitative).

Chapter 6. Technology trends

- This chapter examines the trends in technologies required for Beyond 5G and clarifies the functions and values it will provide, as well as the roles it will play and the expectations of the users and markets.

Chapter 7. Conclusion



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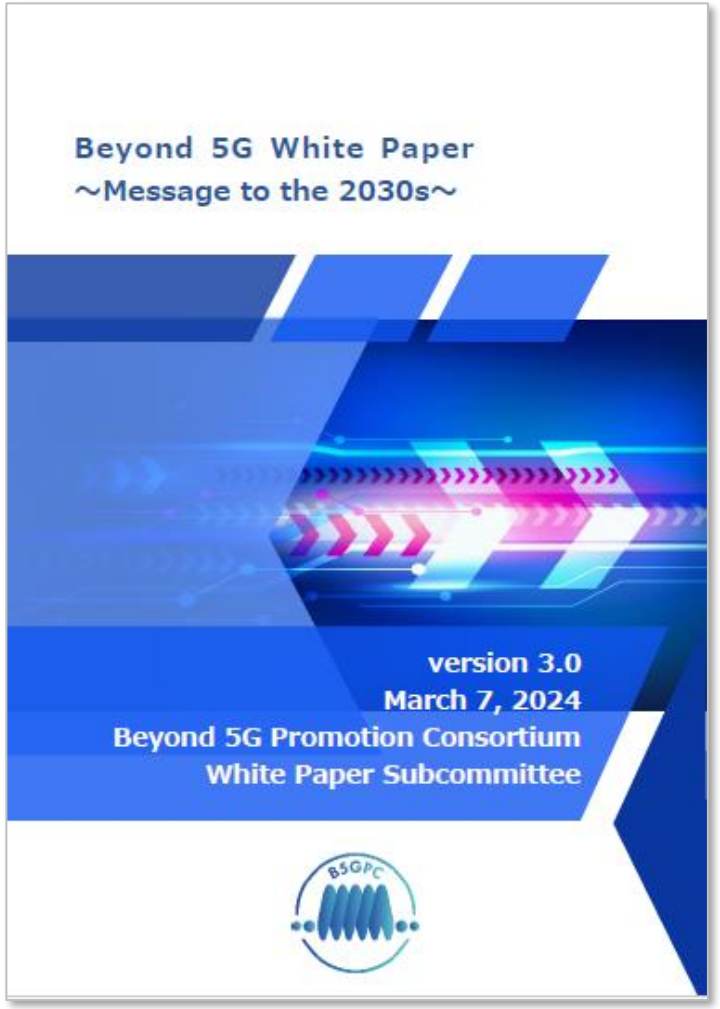
To obtain voices from various industries…

- **Establishment of “Workshop on Society in 2030s”**
- **Obtained comments such as issues, expectations, and requests through presentations and discussions from various industries**

- Academia
- Automotive
- Broadcasting
- Construction
- Contents
- Electronics
- Finance
- Food
- IT
- Logistics
- Nursing care
- Robotics
- Space business
- Telecommunication
- Transportation

Contents in Chapters 4&5 of B5GPC White Paper



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4. Trends from other industries
4.1 Finance
4.2 Construction and Real Estate
4.3 Logistics and Transportation
4.3.1 Warehousing and Logistics
4.3.2 Aviation
4.3.3 Railway
4.4 Telecommunications, IT
4.5 Media industry
4.6 Energy, resources and materials
4.7 Automotive industry
4.8 Machinery industry
4.8.1 Machining Equipment
4.8.2 Construction Machinery
4.8.3 Agricultural Machinery
4.8.4 Robots
4.8.5 Shipbuilding (Ships)
4.9 Electronics and precision electronics industry
4.9.1 Electronics and precision electronics
4.9.2 Semiconductors
4.10 Living, food, agriculture industry
4.10.1 Agriculture and fisheries
4.10.2 Food
4.10.3 Living and Cultural Goods
4.11 Retail, wholesale, and distribution sectors
4.12 Services, Public Services, Corporate Services
4.13 Restaurant industry
4.14 Entertainment, and Leisure
4.15. Academic and others
4.15.1 Space
4.15.2 HAPS
4.15.3 Society

5. Capabilities and KPIs required in Beyond 5G
5.1 Capabilities required in Beyond 5G
5.2 Conceptual figure of Beyond 5G and usage scenarios
5.3 Target Key Performance Indicators

Machinery Industry

What is required for Beyond 5G

Expected Use Cases

1 Intelligent / automated work / manufacturing process

Automatic process generation / improvement, **ultra-low latency motion control***, direct teaching, real-time CPS

2 Remote operation / control / diagnosis

Application of robot technology to construction machinery and agricultural machinery, application of autonomous driving technology to aircraft and ships, intuitive HMI, product / breeding management

3 Flexible construction / processing / production / operation management

Smart maintenance by AI and/or robot / equipment sharing / reflection of production / working environment conditions

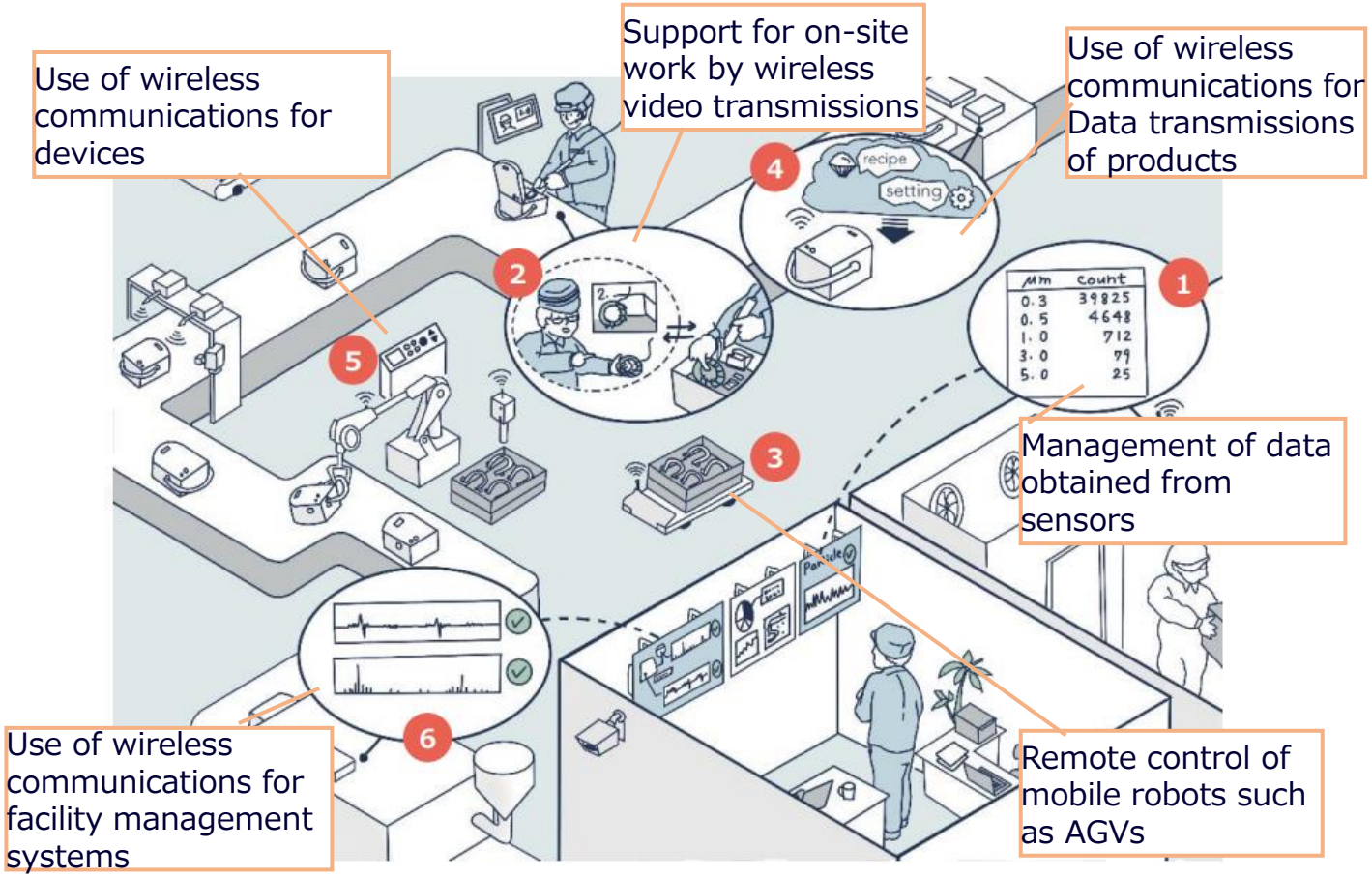
4 High-speed mobility / energy saving / comfort

High-precision positioning and control of wide-area, high-speed moving objects, navigation plan management by utilizing data, automation and sophistication of security inspections, traceability , seamless transportation

5 New mobility service

Flying taxi, simulated experience

Examples of wireless communication usage in a large-scale factory



Based on NEDO "Guidelines for the Introduction of Wireless Communication Technology in Manufacturing Sites" (In Japanese)
https://www.nedo.go.jp/content/100971411.pdf

*: **100 micro-second in E2E** for local area communication

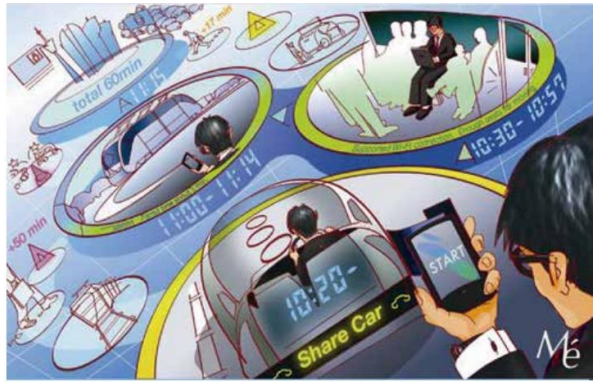
Automotive Industry

Future Vision

1. All people can move freely and efficiently

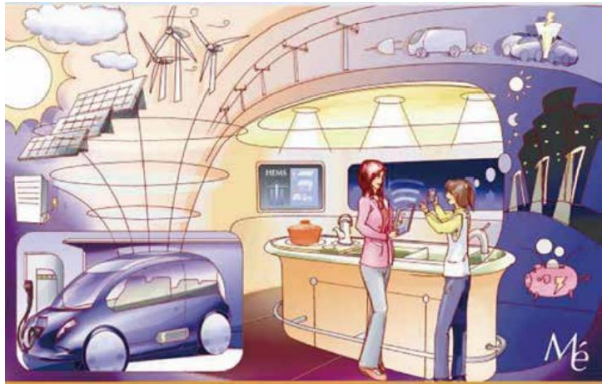
Source: ITS Japan

2. MaaS Platform allows the Multi-modal mobility of people



Source: ITS Japan

3. Collaboration between vehicles with Smart Cities



Source: ITS Japan

4. Enabling digital society to realize Mobility-inclusive

Source: The Government of Japan, ITS Roadmap

What is required for Beyond 5G

For autonomous driving, the followings will be required

- ICS with sensing accuracy **at cm level**
- Distributed AI learning & inference
- PQC security
- Remote monitoring and driving functions with **50Gbps**, **1ms E2E latency**, and at least **10^{-6} reliability**

Warehousing/Logistics Industry

Future Vision

- Well optimized supply chain through logistics DX for simple and smooth logistics
- Logistics structural reforms against labor shortage toward labor friendly logistics
- Robust and sustainable logistics networks for strong and flexible logistics

What is required for Beyond 5G

- Required evolution of applications: Advanced AI/ML (incl. radio IF), Digital twin, Full automation, Fast automated delivery, NTN/HAPS
- Latency requirement is on the order of **milliseconds** in the local network
- Time synchronization is required to support PTP for the order of **microseconds**

Healthcare Industry

What is required for Beyond 5G

Various use cases with Beyond 5G

1-1 Assisting perceptual abilities
Augmented human, Brain machine
2-1 Minimum contact, monitoring infections
Positioning, Centralized management of health status
3-1 DB of genome analysis
Personalized medicine, AI-based drug discovery
4-1 Tele-surgery
Robotics, AI based surgery
5-2 Minimally invasive surgery
Nano/Micro robotics, Energy harvesting

Requirements for Beyond 5G

Tele-surgery
- **Tens of Gbps** throughput
- **10^{-7}** reliability

Minimally invasive surgery
- **up to 10^7 devices/km^2** connectivity
- Autonomous communication control of devices

Media Industry

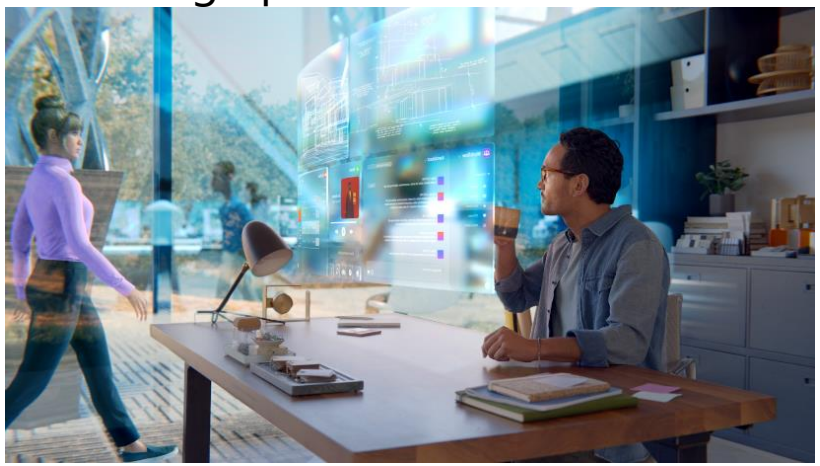
Future Vision

- All the contents can be accessed online via internet. Likewise, **richer user-created contents** can be delivered more easily regardless of time, place and device type
- Utilization of virtual space and **Holographic communication**
- Personalization/customization for more efficient content delivery

What is required for Beyond 5G

- **Enhanced radio communication**: Further improve frequency utilization efficiency, coverage and latency
- **Extended architecture, protocols**: Support radio access and network architectures to enable efficient content delivery using both broadcasting and communication
- **Utilization of AI/ML**: To implement a range of personalization and customization
- **A few tens ~ hundreds Gbps** of peak throughput

Holographic communication



Entertainment in virtual space

Source: https://about.meta.com/what-is-the-metaverse/?utm_source=about.facebook.com&utm_medium=redirect

Note: Summary of numerical requirements (1)

Requirements	Capabilities required by each industry (industry)
Ultra-fast and large capacity	• **10 to 100 Gbps** for holographic communications (Media) • 50 Gbps for remote monitoring and remote control (Automotive) • **10 to 100 Gbps** for Smart logistics (Retail and wholesale distribution) • Several tens of Gbps for Remote surgery (Healthcare) • **48 to 200 Gbps** for volumetric video (Entertainment) • Several tens of Gbps for Low to medium satellites (Space) • 10 Mbps for natural disaster prevention measures (Society)

Note: Summary of numerical requirements (2)

Requirements	Capabilities required by each industry (industry)
Ultra-low latency	• Order of milliseconds* for local networks (Warehousing and logistics) • Several milliseconds* for emergency stops (Railway) • 100 ms* for immersive remote-control systems (Energy) • **1 ms** for remote monitoring and remote controls (Automotive) • **100 micro sec*** for local communications (Machinery) • **1 ms*** for robot remote controls (Semiconductor) • Motion-to-photon (MTP) 10 ms*, time-to-present (TTP) 70 ms* for Volumetric video (Entertainment) * Including processing delay at application layers

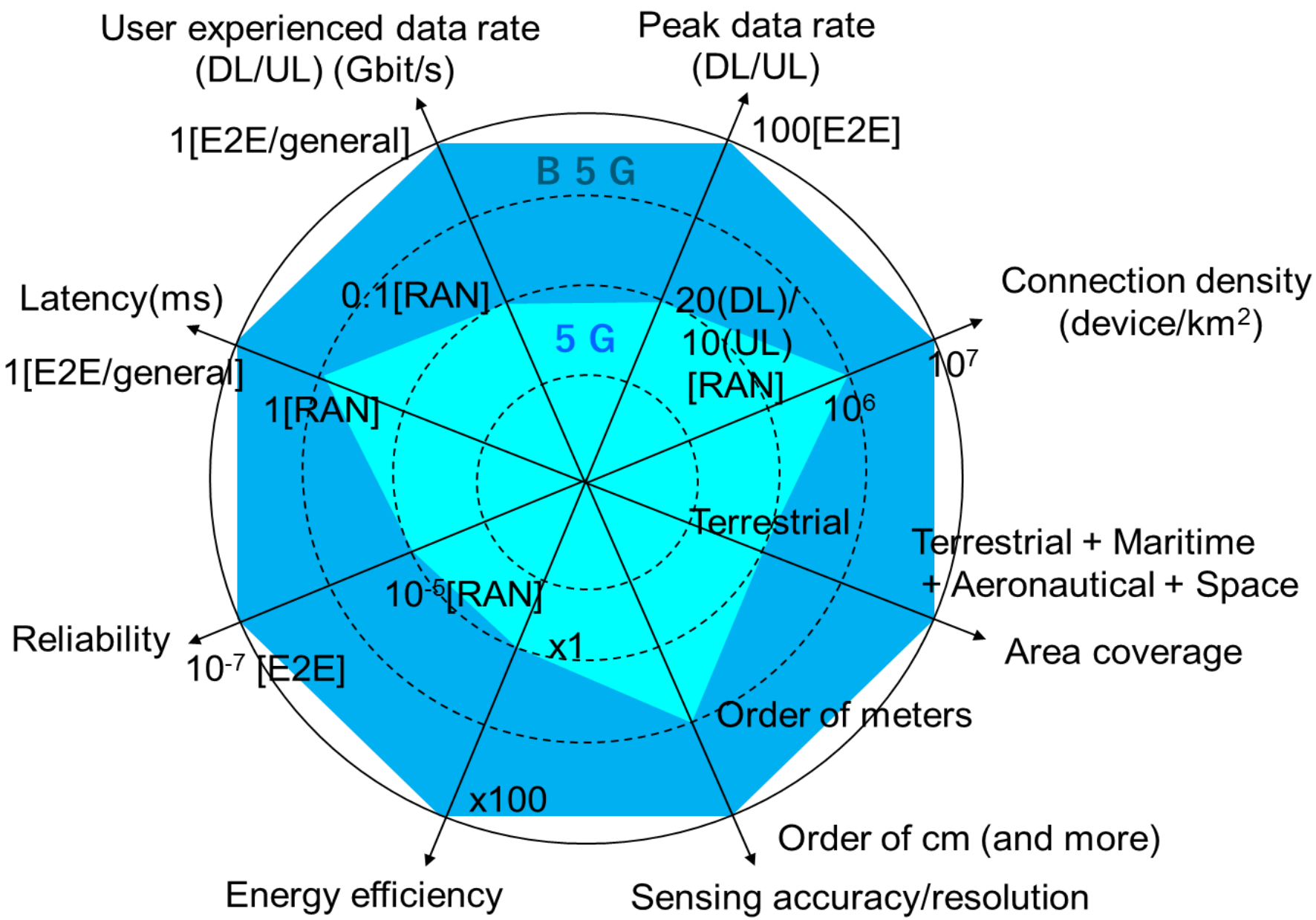
Note: Summary of numerical requirements (3)

Requirements	Capabilities required by each industry (industry)
Ultra-resiliency and reliability	• 10^{-6} for remote monitoring and remote controls (Automotive) • 10^{-7} for remote surgery (Healthcare) (unit: block error rate)
Positioning and sensing	• Positioning accuracy of **1 to 2 cm** for civil engineering (Construction and real estate) • Centimeter-level sensing accuracy for vehicles traveling (Automobile)

Note: Summary of numerical requirements (4)

Requirements	Capabilities required by each industry (industry)
Ultra-massive connectivity	• **10^6 to 10^7 devices/ km^2** for in-vivo devices (Healthcare)
Universal coverage	• Supersonic passenger aircraft flying at high altitudes **around 10 km**, and coverage area at an altitude of **more than 100 km** (Aircraft) • **100% land coverage** (Telecommunications and IT) • **Coverage area in outer space and the moon** (Space)

Radar chart on target KPIs (compared with 5G)



Common expectations from multiple industries

Common themes related to several industries	Expectations and dreams in industries	Expectations to Beyond 5G
(a) Decreasing birthrate and aging population	• Utilization of robots • Remote control • Autonomous driving	Ultra-fast and large capacity (up to 50Gbps) Ultra low latency (100 micro sec to 1 ms), Ultra-resiliency (10^{-7})
(b) Safe and secure	Prediction of natural disasters, life saving, and early recovery	100% coverage area with at least 10 Mbps
(c) Further wonderful life	• Flying cars • Immersive experience	Ultra-fast and large capacity (up to few 100 Gbps), Ultra low latency (1 ms), and Coverage area in outer space
(d) Exciting future	Activity supports in outer space and the moon	Communication infrastructure in outer space

4. What is required for IMT-2030?

~ based on reflections on 5G standardizations and commercialization ~

What are required IMT-2030 based on reflection of 5G?

Pros	Cons
• Definition of three usage scenarios clarified directions of 5G and NSA as well as sharing frequencies between 4G and 5G led to smooth deployment of 5G	• New functions and capabilities increased the standardization burden, leading to higher cost of system development and operations
• New capabilities in 5G brought much attraction and expectations of vertical industries	• There are gaps arisen between actual network performances and the expectations of users due to the followings; ✓ the indices of KPIs only refer to RAN ✓ the **NW performances were not guaranteed** ✓ all the three usage scenarios have not yet been realized

Necessity of guaranteed NW ensuring a required NW performance (SLA)

5. Summary/conclusion

Summary/Conclusion

- Introduced B5GPC and possible use cases and numerical requirements from various industries for IMT-2030 from B5GPC White Paper
  - ✓ Contents of B5GPC White Paper were proposed to ITU-R WP5D from Japan and then adopted to ITU-R M.2160

- Unique aspects of the white paper capture all the industries and summarize specific requirements with values such as
  - **100 micro-second E-E latency** in factories to replace Ethernet cables
  - **a few 100 Gbps** for immersive experience using new media such as holography
  - **10^7 devices/km^2** should be supported

- On top of the above challenging KPIs, what is required to telecom industry is to provide **guaranteed NW** ensuring a required NW performances (i.e. SLA)!
  - ✓ in addition to enhancement of individual peak NW performances, new architectures and functions are needed to support such guaranteed NW

Thank you