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Japan

Development of the world's most advanced ICT infrastructure, – Radio Policy Vision towards 2020's –

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Development of the world's most advanced ICT infrastructure, – Radio Policy Vision towards 2020's –

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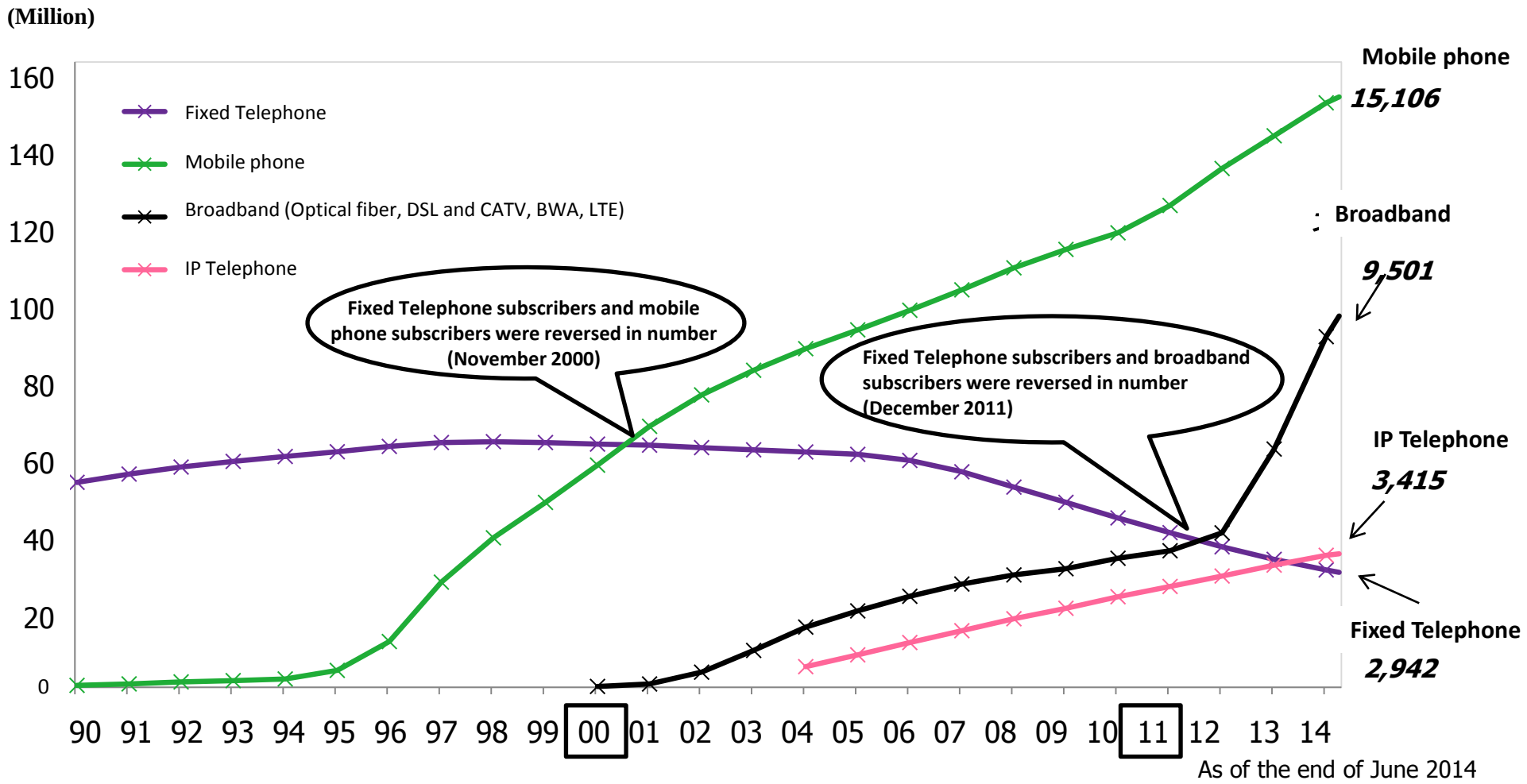
Transition of Telecommunications Service Subscribers

- Fixed line: The number of broadband subscribes surpassed that of Fixed Telephone subscribes in December 2011, and the number of Fixed Telephone subscribers dropped by 50% of that at the peak in November 1997 (i.e.,63.22 million subscribers dropped to 29.42 million subscribers).
- Mobile: The number of mobile phone subscribers surpassed that of Fixed Telephone subscribers in November 2000, and increased approximately twice (151.06 million) in 10 years.

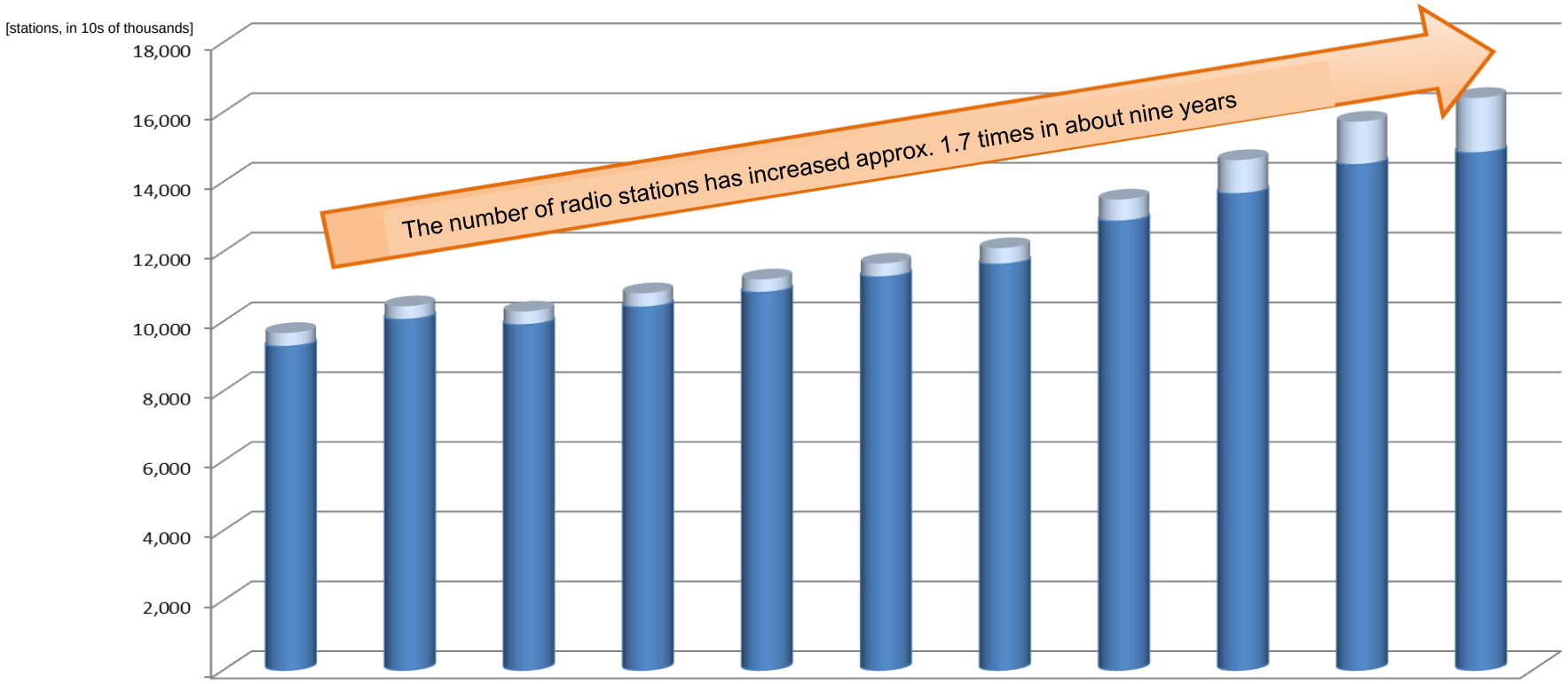


1. Current State of Radio Spectrum Use (1)

(1) Increase in the number of radio stations and expansion in radio spectrum usage

- ✓ There are **more than 164 million radio stations*** in Japan, based on the number of radio station licenses.
- ✓ In addition, there are many registered stations and unlicensed stations (wireless LANs, designated low-power radio stations, radio stations that emit extremely weak radio signals, etc.), and expansion in all forms of radio spectrum usage.

*There are **148.26 million mobile phones** (as of Sep. 30, 2014). **Sales by mobile communication carriers totaled approximately ¥15.5 trillion** (in FY 2013).



	Mar. 2005	Mar. 2006	Mar. 2007	Mar. 2008	Mar. 2009	Mar. 2010	Mar. 2011	Mar. 2012	Mar. 2013	Mar. 2014	Sep. 2014
No. of radio stations [in 10s of thousands]	9,664	10,430	10,280	10,804	11,202	11,656	12,098	13,489	14,623	15,724	16,403
Mobile phones (terrestrial mobile stations)	9,272	10,047	9,894	10,401	10,824	11,266	11,632	12,864	13,653	14,488	14,826
Other types of stations	392	382	386	402	378	390	466	625	970	1,236	1,578

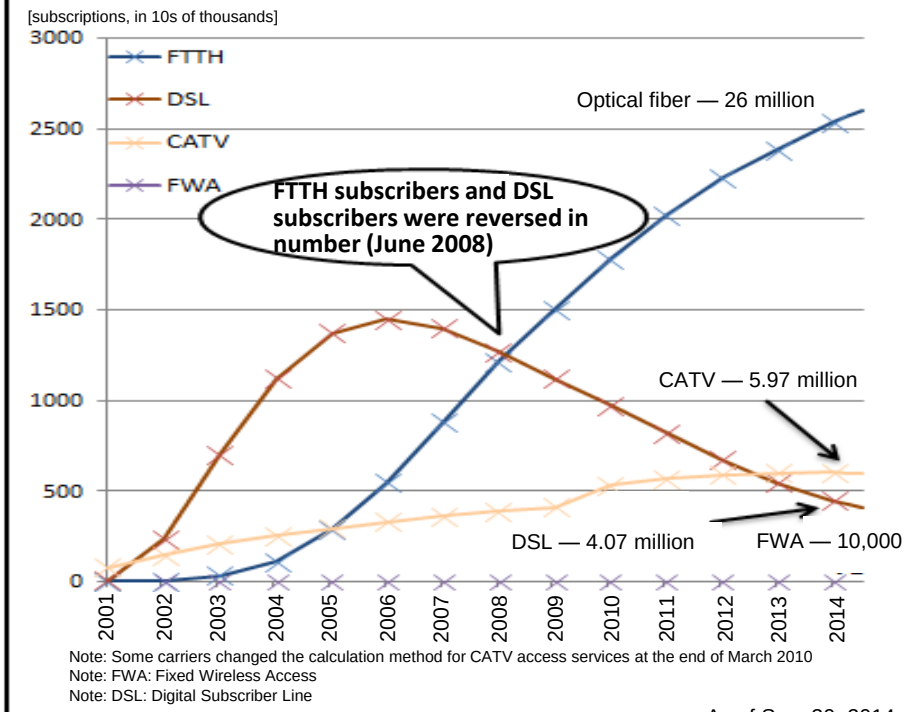
1. Current State of Radio Spectrum Use (2)

(2) Increase of ultra-high-speed broadband service subscribers

- ✓ The number of subscribers of mobile ultrahigh-speed broadband service continues to increase: **66.51 million were subscribers to mobile broadband services** (as of Sep. 30, 2014), an **increase of approximately 1.7 times in one year**.
- ✓ In FY 2013, the number of subscribers to ultra-high-speed mobile broadband services surpassed the number to fixed-line services; **radio spectrum use is now vital to Japan's broadband communications environment**.

Fixed Broadband

The number of Fiber to the Home (FTTH) service subscriptions exceeded that of DSL service subscribers in June 2008, and currently occupies **about two-thirds of all fixed broadband subscribers**

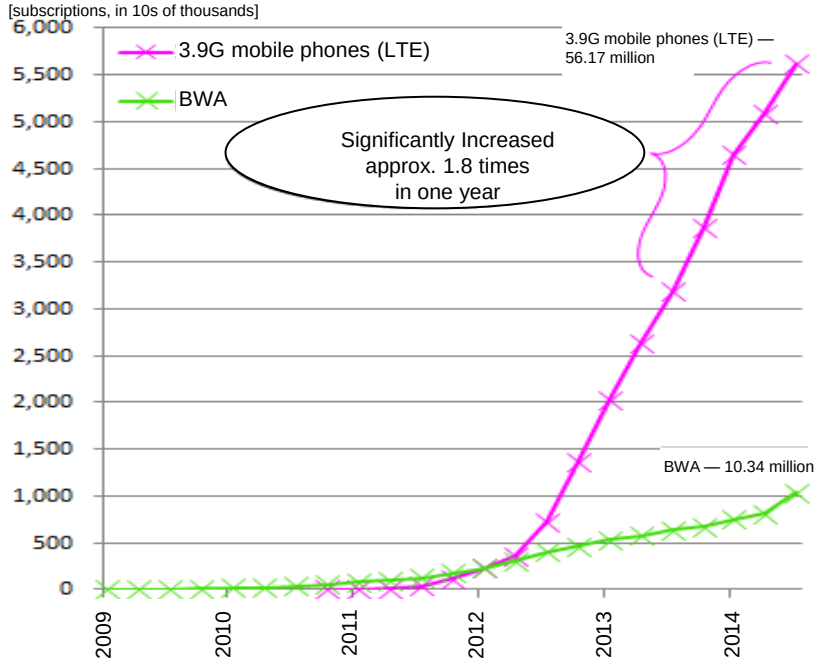


Note: Some carriers changed the calculation method for CATV access services at the end of March 2010
Note: FWA: Fixed Wireless Access
Note: DSL: Digital Subscriber Line

As of Sep. 30, 2014

Mobile Broadband

The number of 3.9G mobile phone (LTE) service subscribers significantly increased **approximately 1.8 times in one year**.

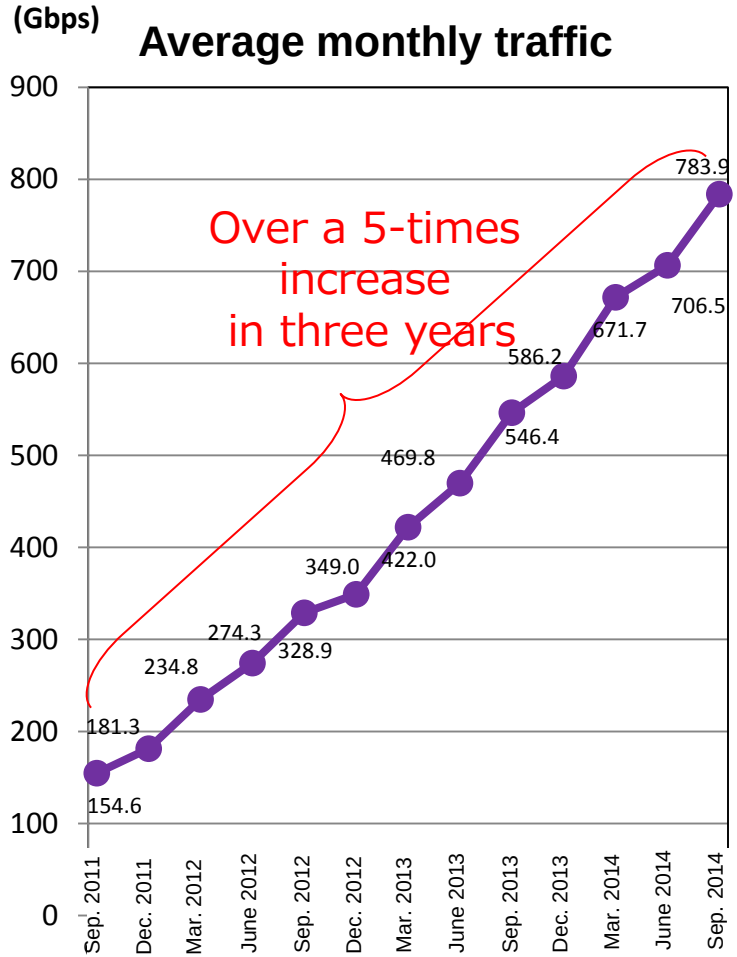


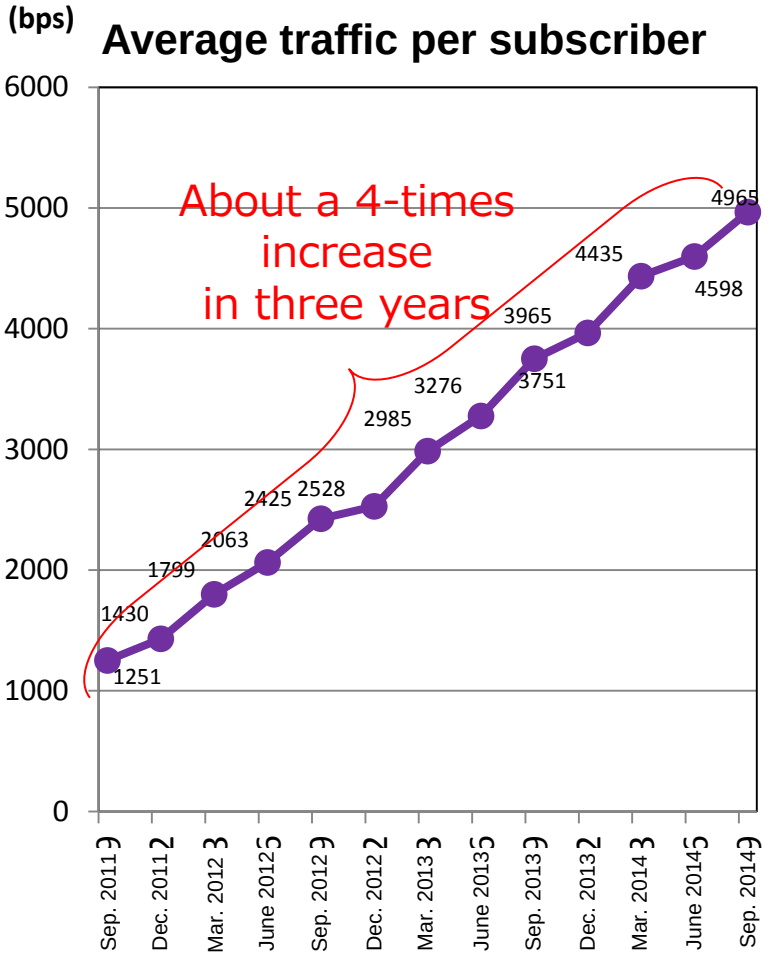
As of Sep. 30, 2014

1. Current State of Radio Spectrum Use (3)

(3) Increase of mobile data communications traffic

- ✓ The number of smartphone subscribers on September 30, 2014 was 62.48 million (an increase of approximately 6.5 times over three years).
- ✓ Since the number of smartphone subscribers are increasing, **the average monthly mobile communications traffic** (per second) **has risen more than 5 times in three years**, reaching 783.9 Gbps in September 2014.





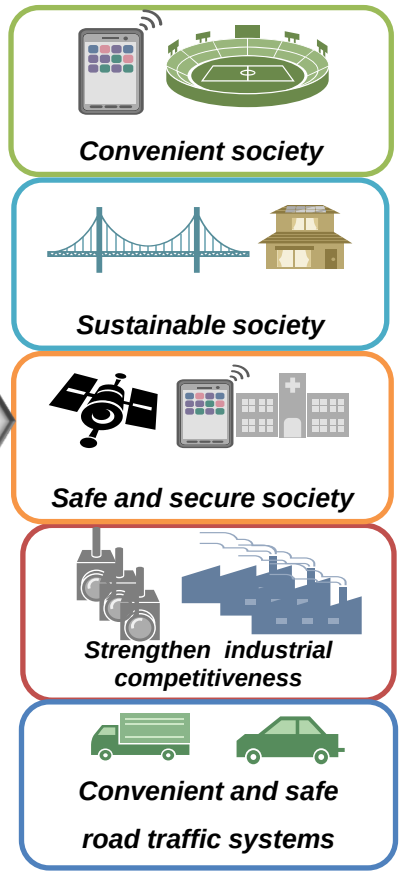
2. The Future of Radio Spectrum Use in Japan (1)

(1) Future image of radio spectrum use in 2020 and beyond

- Services and content distribution provided over mobile broadband will increase via a **diverse range of communication devices, including smartphones, tablets, and wearables**. Various services and businesses that use the radio spectrum will grow and become popular.
- Applications of the radio spectrum for industrial efficiency and in medicine and the environment will expand with the use of G-space, M2M, IoT, and sensor networks.

⇒ We will continue to maintain **the world's most advanced radio spectrum use environment** as an essential platform for all industries and for all citizen activities.

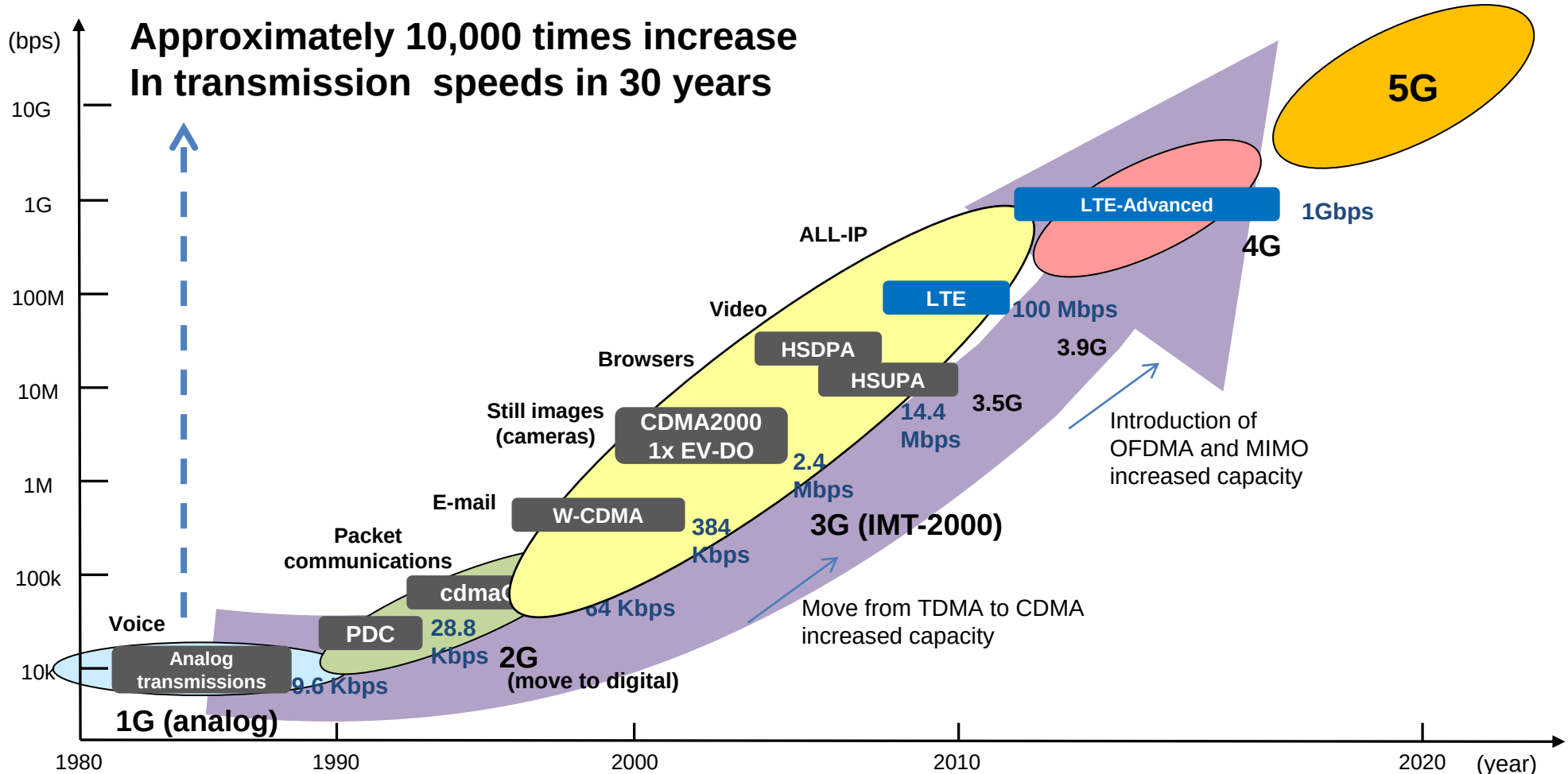
Image of new radio spectrum	Specific image of radio frequency applications
(1) **Expanding of mobile communications i**n terms of quality and quantity	• **4G and 5G** mobile communication systems realize the **same level of traffic speed as optical fiber** • Various devices including **wearables devices become popular**
(2) Expansion of **machine-to-machine (M2M) and IoT / IoE communications** without human mediation	• Everything in society will be connected wirelessly (IoE) • The use of radio frequency expands in various fields (Smart Grids, Smart Cities, Smart Homes, etc.)
(3) Progress of use **high-definition image** and its integration with communication services	• **Viewing 4K video while traveling** on tablets and other devices is commonplace • Convergence of actual and virtual spaces, augmented reality, experience sharing
(4) Assurance **of safety and security and improvement of resilience** by using wireless communication systems	• Countermeasures against aging of social infrastructure and for its maintenance using M2M • Support for safe driving using **next-generation ITS and automated driving system** • Observation and response to disasters using G-space information
(5) Realization of efficiency responses in the public sector	• Ensuring l**ifelines and means for communication in times of disaster** • Effective response using quasi-zenith satellite and G-space
(6) Progress of radio spectrum use other than communications	• Utilization for n radar, positioning, and sensor rings • Dissemination of wireless **power transmission**



(2) Wireless systems expected to be realized in 2020 and beyond

i. Development of Wireless Broadband Technology

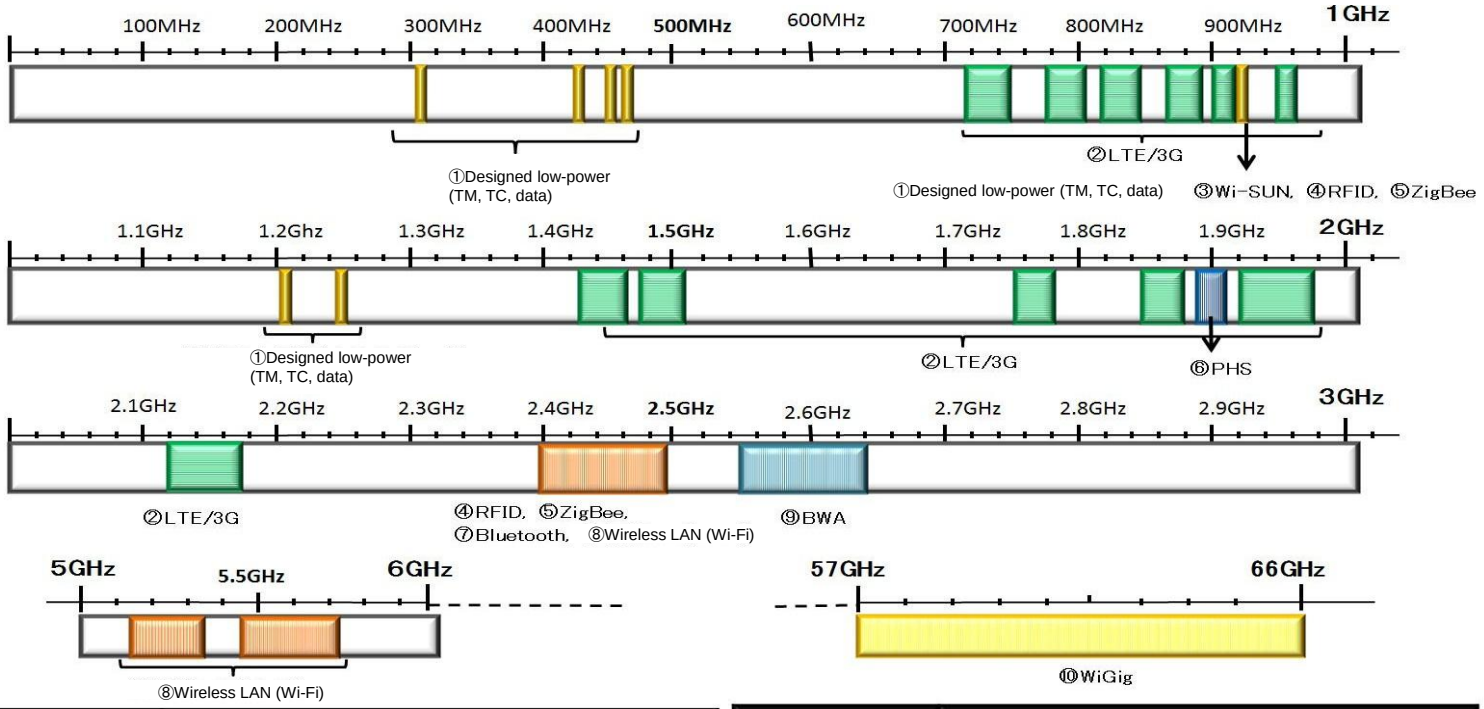
4G has been introduced in 2015, and 5G is expected to be introduced around 2020. We will work to **introduce more efficient technologies**, and ensure **the necessary frequency bands** while **promoting international harmonization**.



ii. M2M/ IoT/ IoE system that connects everything wirelessly

- ✓ **M2M/ IoT/ IoE systems and wireless sensor networks will grow exponentially.** As a huge variety of applications are developed, data content, distributors, and application industries explode.
- ✓ As autonomous driving requires extremely high levels of reliability and security, to realize the systems supporting such quality of service will be needed.

Frequencies that can be used for M2M / IoT/ IoE



Wireless systems	Frequency band
①Designed low-power (TM, TC, data)	400 MHz band, 900 MHz band, 1.2GHz band
②LTE/3G	700 MHz band, 800 MHz band, 900 MHz band, 1.5 GHz band, 1.7 GHz band, 2 GHz band
③Wi-SUN	900 MHz band
④RFID	900 MHz band, 2.4 GHz band
⑤ZigBee	1.9 GHz band, 2.4 GHz band

Wireless systems	Frequency band
⑥PHS	1.9 GHz band
⑦Bluetooth	2.4 GHz band
⑧Wireless LAN (Wi-Fi)	2.4 GHz band, 5GHz band
⑨BWA	2.5 GHz band
⑩WiGig	60 GHz band

iii. Realization of ultra-high-definition television broadcasts

- ✓ Based on the development of content transmission for ultra-high-definition television broadcasts and the state of compatibility leading up to the Tokyo Olympic and Paralympic Games, it is necessary **to aim for effective frequency use, such as developing transmission compression technologies**.
- ✓ **Users will record and share 4K video** with their own device, and wireless use will rise because of the expanded sense of realism and emotion.

iv. Diversification and multi-layering of networks to ensure safety and security

- ✓ **Communication means will diversify and diverge, and uninterrupted wireless communication systems will be ensured even during disasters**. In consideration of the varied characteristics of each of these wireless systems, it will be necessary to ensure the necessary frequency bands for each service.
- ✓ It will be necessary to promote the **construction of joint-use disaster-response wireless networks with the introduction of LTE** (ensure communication means during disasters with the use of wireless networks that are ordinarily used for various services).

v. Development of radio spectrum uses other than communications (such as wireless power transmission)

- ✓ Under government-industry-academia partnerships, we will push for technical development and international standards to pave the way for **wireless power supply systems for automobiles**. We will promote R&D with the goal of demonstrating and commercializing this technology at the Tokyo Olympic and Paralympic Games.

(1) Expansion of mobile wireless communication traffic

◆ Leading up to 2020, we will see 4K and other high-resolution video come to mobile environments, trillion sensors, IoT, M2M, and expanded mobile and cloud computing services. A huge range of applications is expected to be offered and traffic is anticipated to jump even further.

→ We should **set goals for future communication capacities that are larger than conventional estimates**, so as to not interfere with the development of future radio spectrum-related industries that are forecast to grow in the coming years.

Mobile communication traffic will increase due to inherent traffic increases in mobile communications and due to switchovers from fixed-line communications to mobile communications. Given past increase rates, it is reasonable to **set a target capacity of 100 to 1,000 times current levels over 10 years**.

◆ To prepare for the increased traffic demand, it is essential that:

(1) communication carriers move ahead with initiatives to increase the density of their networks and improve their **frequency usage efficiencies**; and

(2) the administration work to **increase the frequency bands that can be allocated to mobile communications**.

◆ In consideration of the following, **it is necessary to think about optimizing network configurations and operations**.

(1) The balance between optical fiber backbones and wireless access

(2) The balance between frequency band widths and upper-layer operations, from the perspective of traffic management on mobile communication networks

(2) Smooth build-out of 4G mobile communication systems

◆ 4G mobile communication systems are the next-generation successors to 3.9G mobile communication systems (LTE). 4G will realize **communication speeds on a par with optical fiber (max. 1 Gbps).**

< interim report(2014.7) >

- It is appropriate to make allocations in consideration of **measures for areas with poor mobile phone reception and the relationship with area coverage rates**.
- It is desirable to **give attention to the provision of services (rate levels, etc.) that match the needs** of consumers.

<A policy for frequency assignment(2014.9) >

・in September of last year, a policy on frequency assignment to **introduce 4G in a 120 MHz segment (from 3.48 GHz to 3.6 GHz) of the 3.4 – 3.6 GHz band was published; the following review criteria were incorporated** based on the recommendations above.

(1) Carriers are obliged to **attain a population coverage ratio over a certain amount** within a defined period and to **set varied rates**.

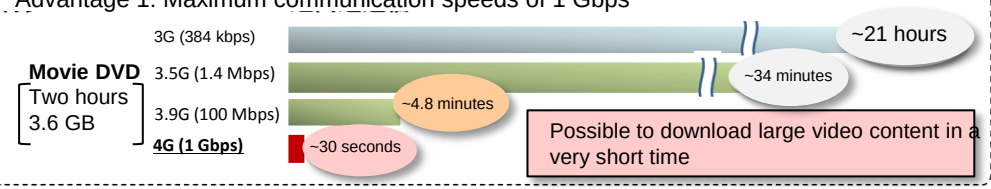
(2) Established, as a review criterion in competitive applications, to **more or less eliminate non-service area populations** by the end of the fiscal year two years after certification.

Applications were received from NTT DoCoMo, the KDDI Group, and Softbank Mobile, and reviews were conducted in line with the frequency assignment policy. Last December, each company was assigned a 40 MHz segment of the 4G band.

4G characteristics

Characteristics

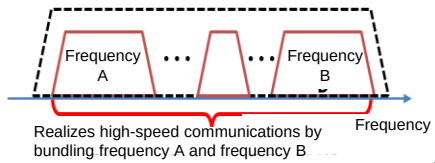
Advantage 1: Maximum communication speeds of 1 Gbps



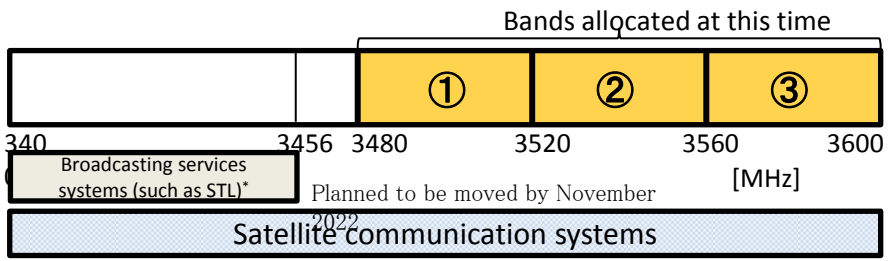
Advantage 2: Highly flexible radio spectrum use

- Conventionally, it was necessary to secure many adjacent frequencies in order to realize high-speed communications
- With 4G however, it is possible to bundle multiple signals at different frequencies (carrier aggregation technology)

⇒ **Realizes high-speed communications while allowing flexible radio-spectrum use**



Frequency band allocated to 4G (3.48 - 3.6 GHz)



(3) 5G mobile communications system

- ✓ Japan aims for commercial launch of 5G in **2020**.
- ✓ Measures for 5G implementation : Promoting Body, Research and Development, International and Standardization Activities.

1. The Fifth Generation Mobile Communications Promotion Forum (5GMF)

- a 5G promotion framework through Industry-Academic-Government cooperation, established in September 2014.
- Objectives of 5GMF
  - ✓ To promote R&D concerning 5G mobile, research and study on 5G standardization.
  - ✓ To collect information relating to 5G mobile and exchange it with other organizations.
  - ✓ To correspond and coordinate with related organizations concerning 5G mobile.
  - ✓ To conduct dissemination and enlightenment pertaining to 5G mobile.

2. Research and Development Activities

- MIC will start 5G related R&D projects earnestly in FY2015 including R&D projects on technologies that utilize higher frequencies and utilize spectrum more efficiently.
- Starting Verification Tests in FY 2017, and commercializing in 2020.

3. International and Standardization Activities

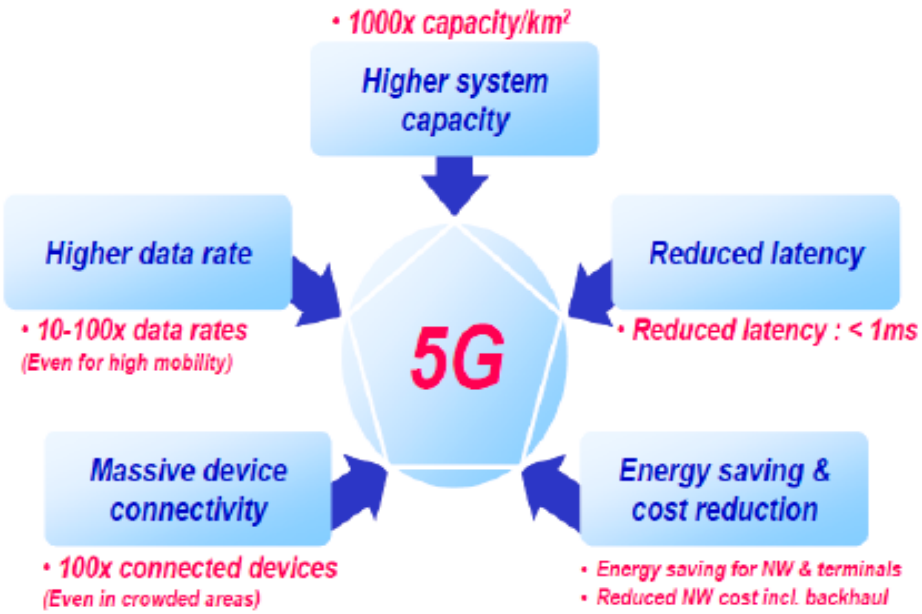
(4) 5G mobile communications systems: from R&D and standardization to deployment

Requirements for 5G

○ **Ultra fast speeds and ultra low latency**

○ **Simultaneous connections with a diverse range of devices**, such as sensor networks

- ✓ 1000 times the system capacity of current LTE
- ✓ 100 times the number of connected devices of current LTE
- ✓ Peak speeds of over 10 Gbps
- ✓ Latency of less than 1 millisecond (wireless access networks)
- ✓ Lower power consumption



Issues of the smooth standardization and deployment of 5G

➢ It is important to **ensure even broader frequency bands** to realize faster communications and to handle 1000 times the traffic of 2010 levels

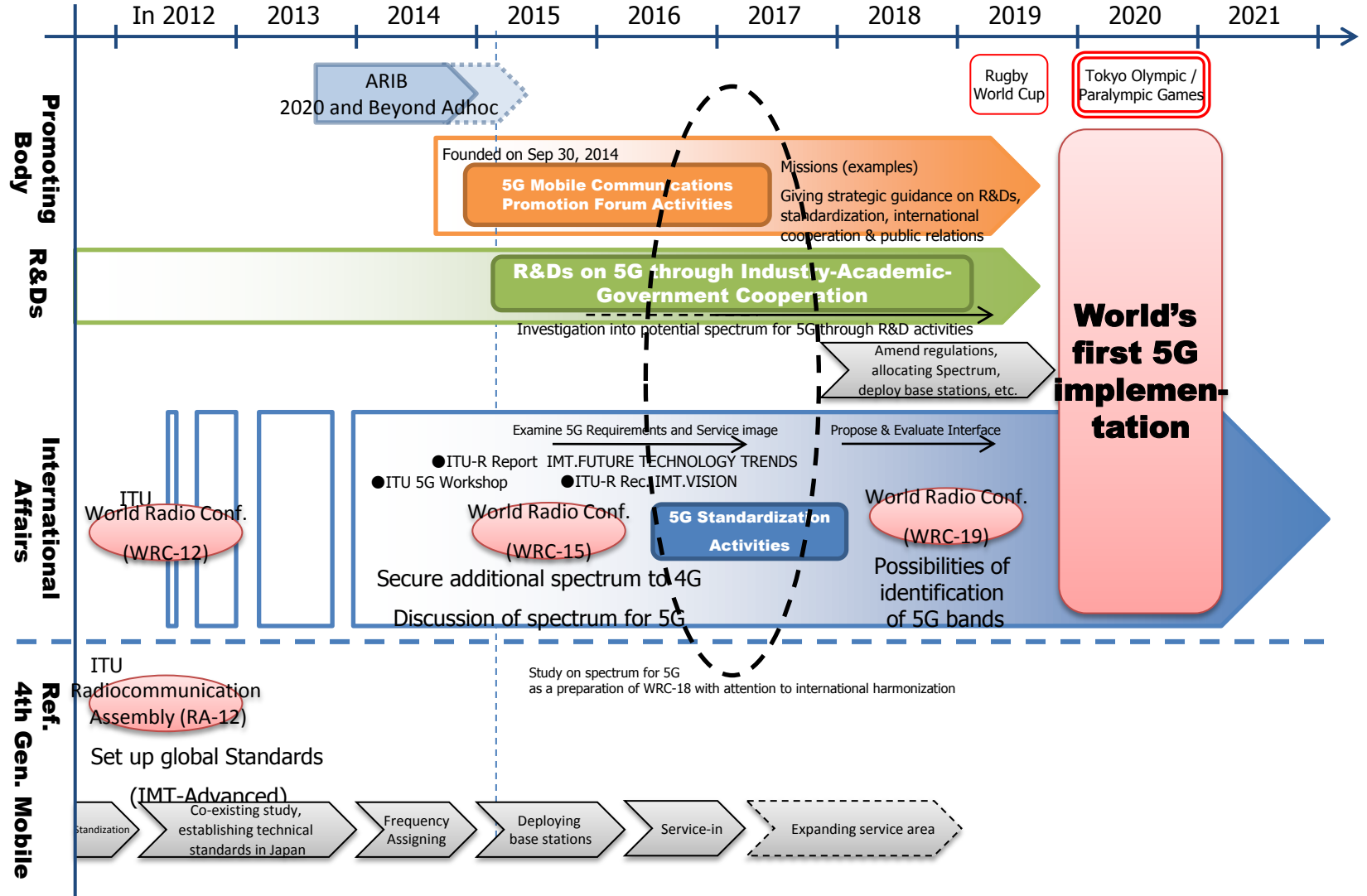
➢ 5G and subsequent systems do not use only signals on a single frequency band. Instead, they **combine signals from multiple frequency bands**, ranging from low VHF-band frequencies to high millimeter-band frequencies. This permits **flexible radio spectrum use**, in which the best usage method is selected depending on the location, time, and application, and realizes more stable communications.

We must **promote in parallel mobile communication technological development and international standardization activities from the earliest stage, including millimeter-band frequencies over 30 GHz and other high frequency bands**. We must also take the lead in pushing ahead international cooperation on 5G standardization.

3. Major Mobile Communication Systems in 2020 and Beyond (5)

5G roadmap towards 2020

・The **5G Mobile Communication Promotion Forum (5GMF) was established** on September 30, 2014, with the ARIB and TTC jointly serving as the secretariat, as a 5G promotion framework through government-industry-academia partnerships. (Industry, academia, and government share a clear roadmap and advance R&D and 5GMF activities to realize 5G in 2020.**)**



(5) Wireless LANs

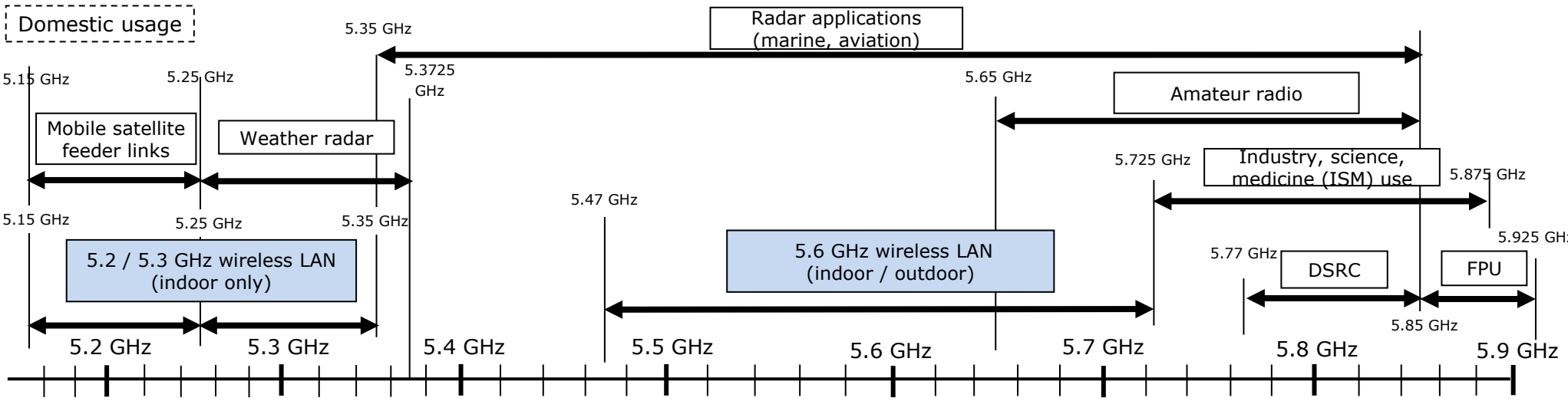
- As mobile communications system has advanced and mobile data traffic increased, there is a concern that the **congestion on wireless LANs**, witch is major offload point for mobile communications, **become more severe** in public spaces and in large housing complexes.
- In view of the 2020 Tokyo Olympic and Paralympic Games, it is vital to examine technologies and operation methods to ensure easy access to wireless LANs and to continue to build out wireless LAN access points. It is also **important to take measures to expand the frequency bands used to support the increase in wireless LAN usage**.
- Specifically, it is necessary to study

  (1) **outdoor use of the 5.2 GHz to 5.3 GHz bands** (set limits on number of stations that use these frequencies,

  (2) **the potential for additional allocations in the 5.4 GHz band and 5.8 GHz band** (verification of the potential for shared use with other systems), and

  (3) **potential for using white spaces**.

Usage of 5 GHz frequencies



(6) Realization of next-generation ITS

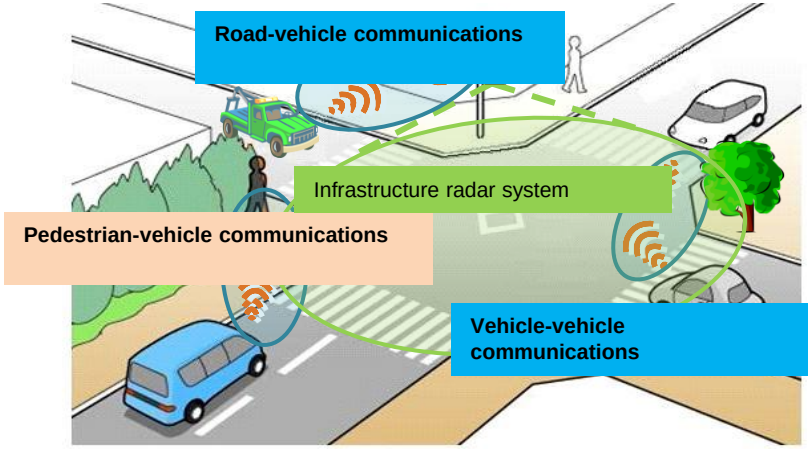
- We will realize **next-generation ITS (collaborative ITS)** that will allow **cars to sense cars or pedestrians in blind spots and take appropriate collision-avoidance maneuvers using wireless communications (vehicle-vehicle communications and road-vehicle communications)** with entities outside the car.

- We will examine initiatives to demonstrate to the world next-generation ITS that make use of Japan's advanced ICT, including **development of an autonomous driving system at a practical level for the Tokyo Olympic and Paralympic Games**.

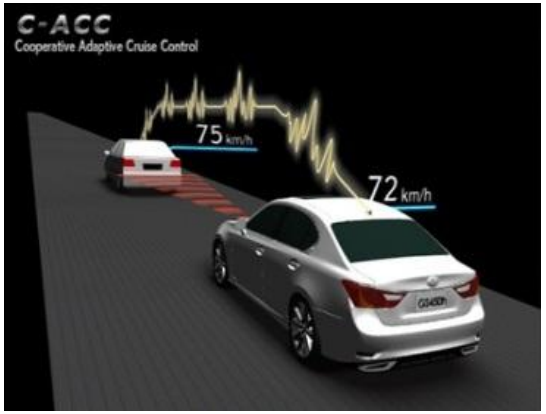
- Realizing next-generation ITS will require:
  - ✓ Platforms to verify the interoperability of onboard devices and roadside equipment
  - ✓ Establishment of technical mechanisms and the establishment of operational systems for stakeholders to ensure the authenticity of data senders and the integrity and confidentiality of communication data for security purposes.

  Therefore, it is important for the government and industry to work together to establish an international **open radio spectrum test bed** and conduct **large-scale demonstration tests** that envision actual operational conditions.

- **Securing international collaboration on the use of frequencies for next-generation ITS** is key to improving the international competitiveness and promoting international expansion of automakers and equipment makers in the next-generation ITS sector.



Realization of next-generation ITS



Autonomous driving systems

Thank you for your attention!

Ministry of Internal Affairs and Communications

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