

The Opportunities for New Generation of Wi-Fi in Japan Market

2024.06.05 Tadao Kobayashi

802.11ah Promotion Council

Wi-Fi is essential to a modern file

How and where Wi-Fi used

1 Information Access and Communication

- Internet Access
- Remote Work and Learning
- Social Media

2 Entertainment and Media Consumption

- Streaming Services
- Online Gaming

3 Smart Home and IoT

- Smart Appliances
- Voice Assistants

4 Healthcare and Wellness

- Telemedicine
- Wearable Devices

5 Commerce and Industry

- POS Systems
- Industrial Automation

6 Public Infrastructure

- Free Wi-Fi Hotspots
- Smart Cities

Usage of W-Fi

1 Data Traffics

Japan : Wi-Fi 300 GB Mobile 13 GB

US : Wi-Fi 530 GB Mobile 21 GB

2 Connecting Time [\(Japan Travel and Living Guide\)](#) [\(Japan Travel\)](#)

Japan : Wi-Fi 5.5 Hours/Day Mobile 2.5 Hours/Day

US : Wi-Fi 6 Hours/Day Mobile 3.5 Hours/Day

3 Numbers of Wi-Fi spots [\(Cisco Investor Relations\)](#) [\(Japan Travel\)](#)

Japan :

40 million households with Wi-Fi access points

500,000 public Wi-Fi spots

World Wide : 628 million (2023 forecast)

Wi-Fi : 月/家庭
モバイル : 月/ユーザー

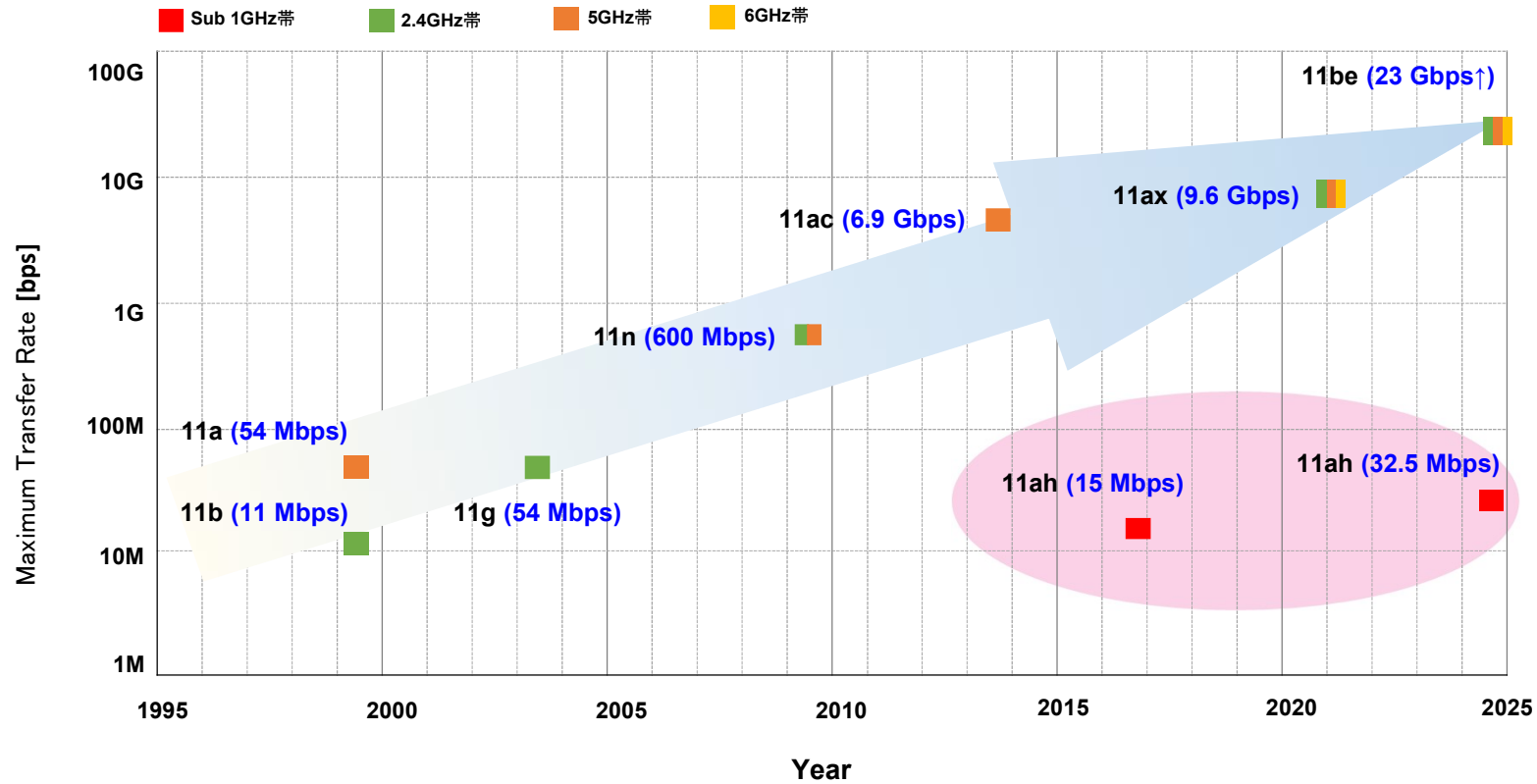
Survey Results in Japan - 7,000 Participants (2021 AHPC)

1 Usage Frequency : 80% use daily

2 Connection Time : 1/4 use for half a day or more, half use for 3 hours or more

3 Usage Time : 65% use WiFi more than Mobile, 9% use both equally

The Evolution of Wi-Fi (Speed Enhancement and Frequency Expansion)



※ Based on the Ministry of Internal Affairs and Communications Information and Communications Council's "5.2GHz and 6GHz Band WLAN Working Group" (9th Meeting, June 8, 2023) [Working Group 9-2]

The congestion status of 2.4GHz and 5GHz Wi-Fi bands

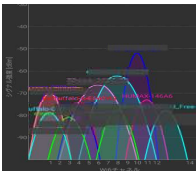


Issues

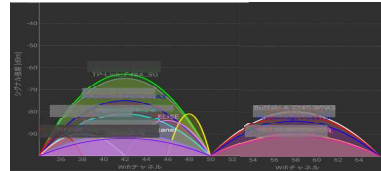
Wi-Fi devices are increasing in homes, offices, etc.
Congestion of frequency channels became noticeable

Example of Wi-Fi usage status in an apartment

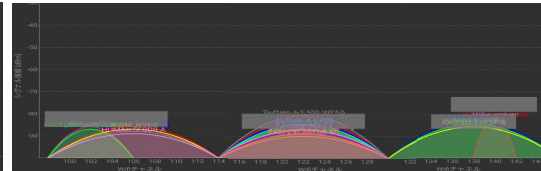
2.4GHz Band



5.2/5.3GHz Band

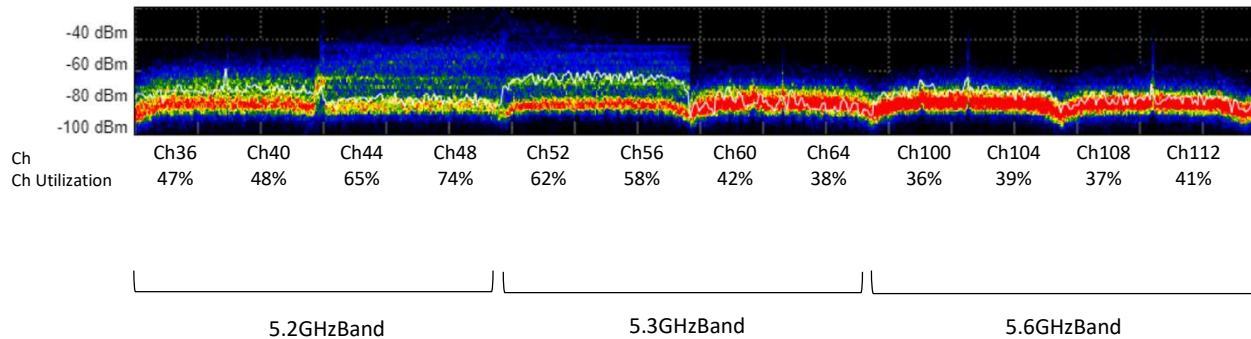


5.6GHz Band



➤ A state where there are no free channels and multiple radio waves are being transmitted on the same channel.

Example of Wi-Fi usage status in an office



➤ The 5.2GHz and 5.3GHz bands have high channel utilization and are congested.

Need New Frequencies !

規格名	IEEE 802.11n	IEEE 802.11ac	IEEE 802.11ax		IEEE 802.11be
The certified designations by the Wi-Fi Alliance	Wi-Fi 4	Wi-Fi 5	Wi-Fi 6	Wi-Fi 6E	Wi-Fi 7
The time of standardization by IEEE	Sep. 2009	Dec. 2013	Feb. 2021		Dec. 2024 (Planned)
Maximum theoretical communication speed	600Mbps	6.9Gbps	9.6Gbps		46Gbps
Target frequency bands 2.4GHz Band 98MHz 5GHz Band 455MHz 6GHz Band 500MHz	2.4HzG Band / 5GHz Band	5GHz Band	2.4HzG band / 5GHz band	2.4HzG band/5GHz band/ 6GHz band	2.4HzG band / 5GHz band / 6GHz band
Occupied frequency bandwidth	20MHz band/40MHz Band	20MHz Band / 40MHz Band / 80MHz Band / 160MHz Band			20MHz Band / 40MHz Band / 80MHz Band / 160MHz Band / 320MHz Band
The main changes from the previous generations	<ul style="list-style-type: none"> •New bandwidth(40MHz) •MIMO 	<ul style="list-style-type: none"> •New bandwidth, 80 Mhz and 160 MHz •Addition of modulation schemes (64QAM→256QAM) 	<ul style="list-style-type: none"> •Advanced MIMO •Addition of modulation schemes (256QAM→1024QAM) 	6GHz Band	<ul style="list-style-type: none"> • New bandwidth, 320MHz •Modulation schemes (1024QAM→4096QAM) •Multi-link •Preamble Puncturing

Characteristics of Wi-Fi6 / 6E / 7

Wi-Fi 6 (802.11ax) : 2.4, 5GHz Band

High-Speed

Maximum Speed: 9.6Gbps → **1000 times faster than 11b!**

High Bandwidth

Optimal for 4K/8K video streaming, online gaming

High Connection Density (OFDMA)

Allows simultaneous connection of numerous devices

MU-MIMO

Supports simultaneous communication of multiple devices

Low Latency

High responsiveness: Suitable for real-time applications

Power Efficiency

TWT: Extends device battery life

Security

WPA3: Supports the latest security protocols

Wi-Fi 7 (802.11be) : 2.4, 5, 6GHz Band

Ultra-High-Speed Communication

- Maximum speed: 30Gbps → **3000 times faster than 11b!**
- 320MHz channels: Significant improvement in data transfer speed

Multi-Link Operation (MLO)

- Simultaneous utilization of multiple channels: Enhances throughput and reduces latency
- Automatic link optimization: Improves communication stability

High Efficiency

- Enhanced OFDMA: Efficient data transmission and reception in high-density environments
- Evolved MU-MIMO: Comfortable communication even in heavily connected environments

Low Latency

- Strengthened real-time communication: Ideal for online gaming, VR, and AR

High Reliability

- BSS Coloring: Reduces peripheral network interference
- Improved TWT: Extends device battery life

Extended Frequency Bands

- Utilization of the 6GHz band: Wide bandwidth with minimal interference
- Use of new spectrum: Increases communication capacity

Wi-Fi 6E : 2.4, 5, 6GHz Band

Extended Frequency Bands

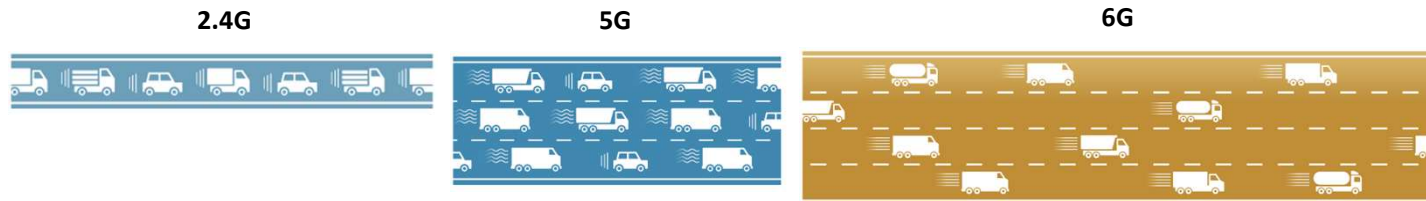
Currently the most effective option

Utilization of the 6GHz band

Offers a wide bandwidth with minimal interference

Additional channels

Allows more devices to maintain high performance



New Business Opportunities and Market Size for Wi-Fi 6/7

1 Smart Cities and Infrastructure

- Expansion of Public Wi-Fi : The availability of free Wi-Fi in public transportation, libraries, airports, and other public places improves convenience for citizens.
- Infrastructure Management : Smart lighting, traffic management systems, and optimized waste collection enhance the overall efficiency of the city.

2 Smart Homes and IoT

- Smart Appliances : The increase in Wi-Fi 6/7 compatible appliances enhances the efficiency and convenience of home networks.
e.g. Smart refrigerators, smart washing machines, smart locks
- Energy Management : Smart meters and energy management systems optimize household energy usage.

3 Industrial Automation

- Digital Transformation of Factories : High-speed and reliable Wi-Fi networks optimize production processes and enable predictive maintenance.
e.g. Real-time machine monitoring, robot control
- Logistics and Inventory Management : The high bandwidth and low latency of Wi-Fi 7 enable real-time inventory management and efficient logistics.

4 Entertainment and Media

- Augmented Reality (AR) / Virtual Reality (VR) : The ultra-high-speed communication and low latency of Wi-Fi 7 significantly enhance AR/VR experiences.
e.g. Gaming, virtual tourism, education
- Streaming Services : High-resolution 4K/8K video streaming is delivered more smoothly, improving the user experience.

5 Healthcare

- Remote Monitoring : Medical devices and patient wearables are constantly connected via Wi-Fi 6/7, advancing telemedicine.
e.g. Real-time monitoring of vital signs, remote consultations

6 Smart Hospitals

- Faster Data Communication : High-speed data communication within hospitals improves the quality of medical services.
e.g. Rapid access to electronic health records, real-time bed management

7 Educational Institutions

- Increased Use of Online Education : The use of online education and digital materials is growing in schools and universities.

Market Size Forecast and Annual Growth Rates for Wi-Fi 6/6E

Wi-Fi 6 Market

Expected to grow from \$5.7 billion in 2023 to \$20.9 billion in 2028

Annual Growth Rate : 29.3%

Wi-Fi 7Market

Expected to grow from \$1 billion in 2023 to \$24.2 billion in 2030

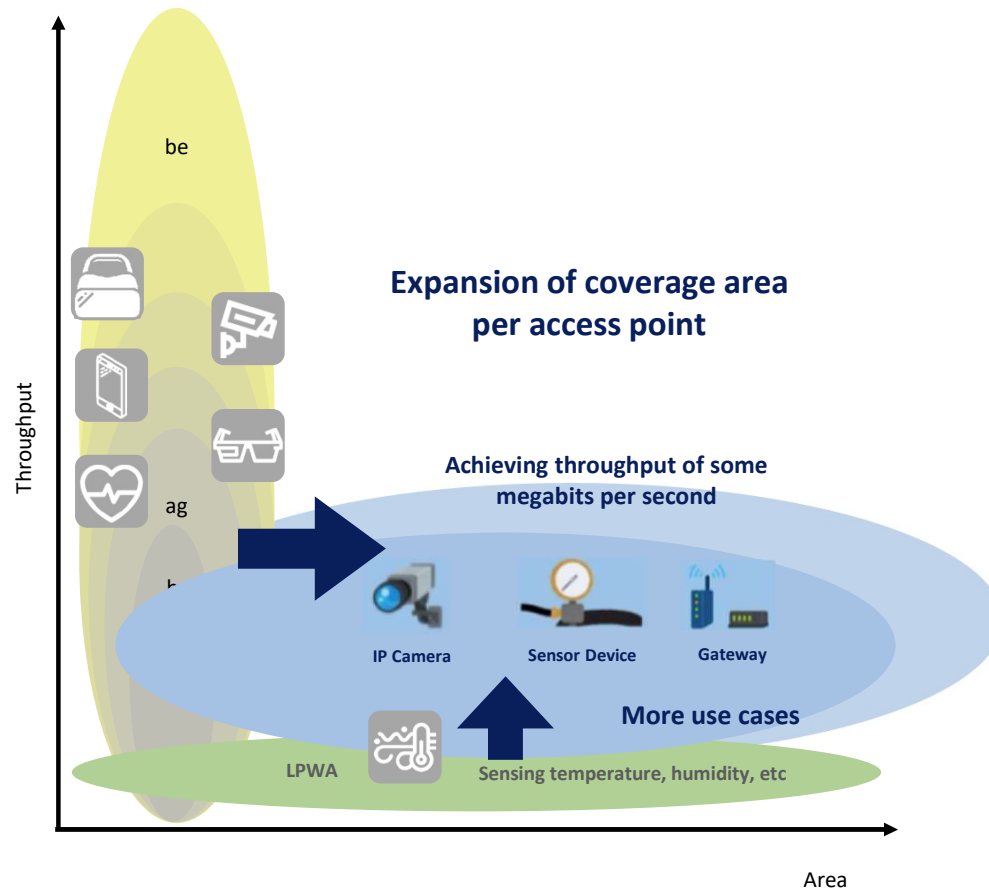
Annual Growth Rate : 57.2%

References

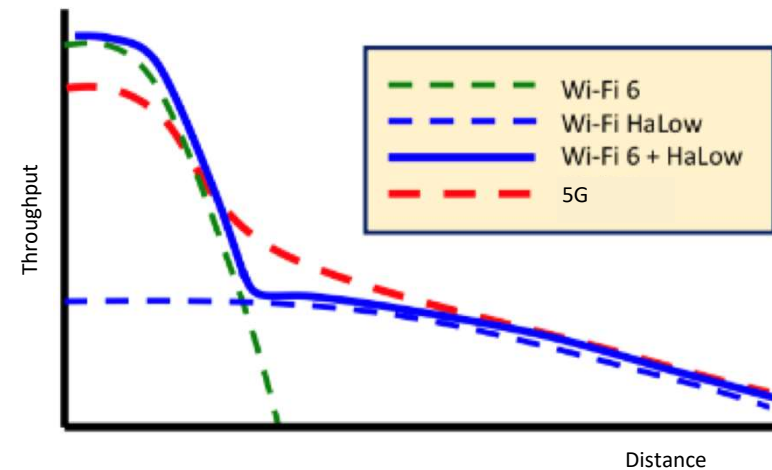
Wi-Fi 6 ([MarketsandMarkets](#))

Wi-Fi 7 ([MarketsandMarkets](#)) ([Grand View Research](#))

11ah will significantly change the Wi-Fi and traditional LPWA landscape.



With the addition of 11ah, flat deployment becomes feasible similar to mobile.



Comparison of 11ah and other communication systems (distance and throughput correlation)

Characteristics of Wi-Fi HaLow

Long-distance

Using the 920 MHz band (with future use of the 850 MHz band), it has a long signal range of over 1 km.
Applications : Suitable for use in wide areas, it can be applied in various industries, logistics, smart cities, and more.

Low power consumption

Optimized for battery-powered devices, achieving very low power consumption.
Applications : Ideal for IoT devices and sensors that require long-term operation.

High connection density

Capable of connecting a large number of devices simultaneously, enabling the creation of innovative IoT networks.

Applications : Ideal for industrial automation, equipment monitoring in factories, smart agriculture, and sensor systems in smart cities.

Excellent penetration

Enables stable communication in areas where traditional Wi-Fi coverage is challenging, such as inside buildings or underground.

Cost efficiency

While maintaining compatibility with existing Wi-Fi infrastructure, it allows for area deployment at a lower cost.

Applications : Enables easy adoption in various sectors such as small and medium-sized enterprises and emerging markets. Facilitates the construction of IoT networks requiring a large number of devices.

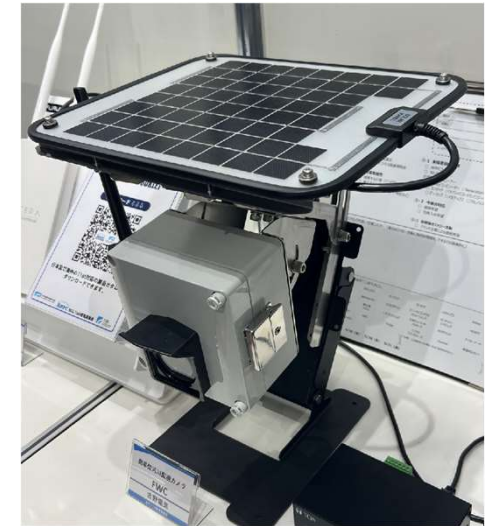
Security

Adopts the latest security protocols to ensure secure communication.

Applications : Provides reliable communication while protecting personal and corporate confidential information.

Wide range of applications

The characteristics such as long-distance communication and low power consumption offer new solutions across a wide range of fields, addressing applications that are challenging to achieve with traditional Wi-Fi or other wireless technologies.



The Business Opportunities and Market Size of Wi-Fi HaLow

1 Smart Agriculture

- Wide Coverage : Introduction of sensor systems covering entire vast farmlands enabled by Wi-Fi HaLow's long-range communication.
- Use Cases : Real-time monitoring of soil moisture, weather data, and crop growth status.
- Low Power Consumption : Battery-operated IoT devices can operate for extended periods, reducing maintenance costs.

2 Smart City

- Infrastructure Management : Efficient management of city-wide infrastructure facilitated by Wi-Fi HaLow's wide-area communication and high connection density.
- Use Cases : Optimization of smart lighting, traffic management systems, and waste collection.
- Cost Efficiency : Enables wide-area communication at low cost while leveraging existing Wi-Fi infrastructure.

3 Industrial Automation

- Predictive Maintenance : Real-time monitoring of equipment in factories and warehouses to detect abnormalities early.
- Use Cases : Efficiency enhancement of production lines, reduction of equipment downtime.
- High Connection Density : Enables simultaneous connection of numerous devices, facilitating integrated management of the entire production environment.

4 Healthcare

- Remote Monitoring : Constant connection of medical devices and wearable devices of patients via Wi-Fi HaLow, advancing telemedicine.
- Use Cases : Real-time monitoring of vital signs, remote consultations.
- Low Power Consumption : Extended battery life reduces the need for frequent charging, easing patient burden.

5 Smart Home

- Device Integration : Efficient coordination of smart home appliances and security systems with low power consumption enabled by Wi-Fi HaLow.
- Use Cases : Smart locks, smart thermostats, home energy management.
- Long-range Communication : Provides stable connections even in large homes or multi-story buildings.

Market size forecast

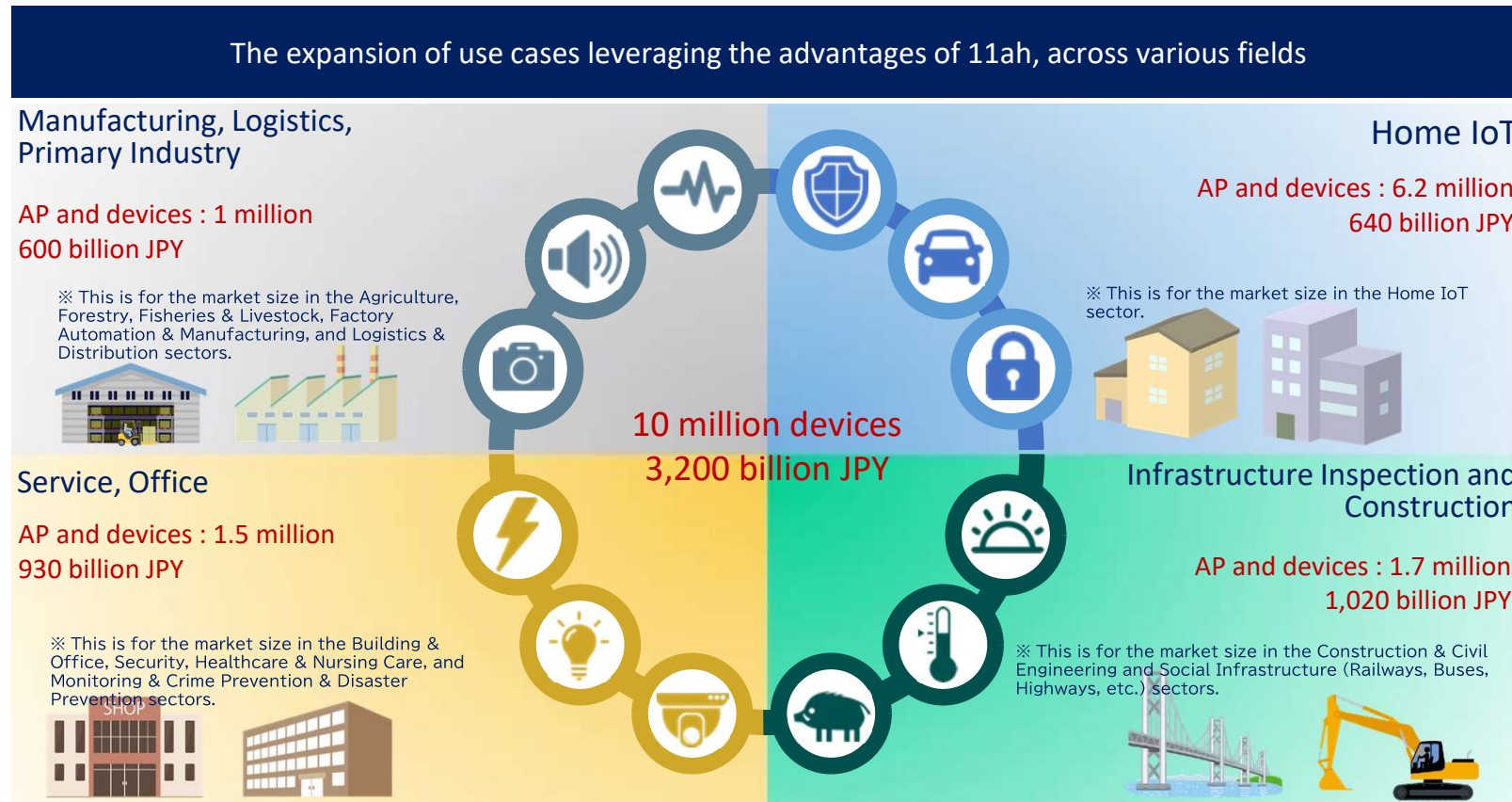
The world market size

The Wi-Fi HaLow market is projected to grow at a compound annual growth rate (CAGR) of 37.4% from 2024 to 2030, reaching approximately \$1.5 billion in 2030. ([IndustryARC](#)).

The market size in Japan

The Wi-Fi HaLow market in Japan is also expected to experience rapid growth, with demand from smart city projects and industrial automation driving market expansion.

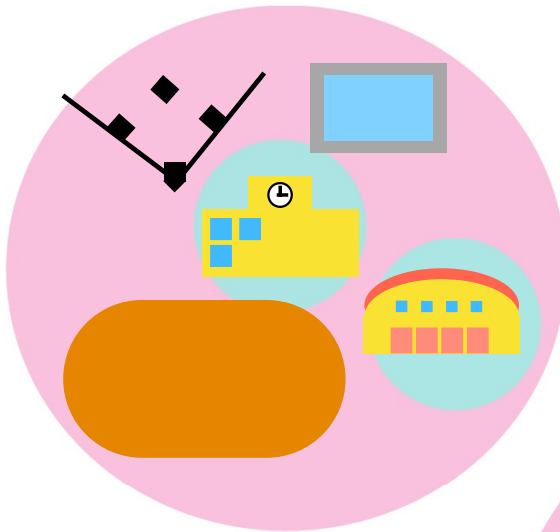
Business Opportunities and Market Size for Wi-Fi HaLow



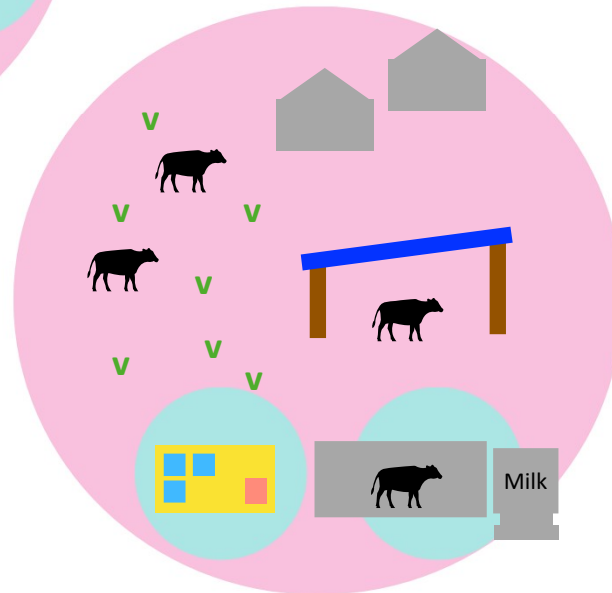
- ※ The figures are calculated based on the number of shipments in the domestic Wi-Fi market according to statistics from research firms, and the proportion that 11ah will account for over a period of 5 years after full deployment.
- ※ ※ Regarding device numbers, the values are calculated based on a ratio of 1 camera or 5 devices per 11ah product.
- ※ ※ The stated numbers represent the cumulative shipments of 11ah-compatible APs, cameras, and sensors.
- ※ ※ The stated amount represents the cumulative business scale of 11ah APs, devices, etc., including hardware sales and software sales such as cloud usage fees, based on information from research firms, and calculated by AHPC.

Use cases

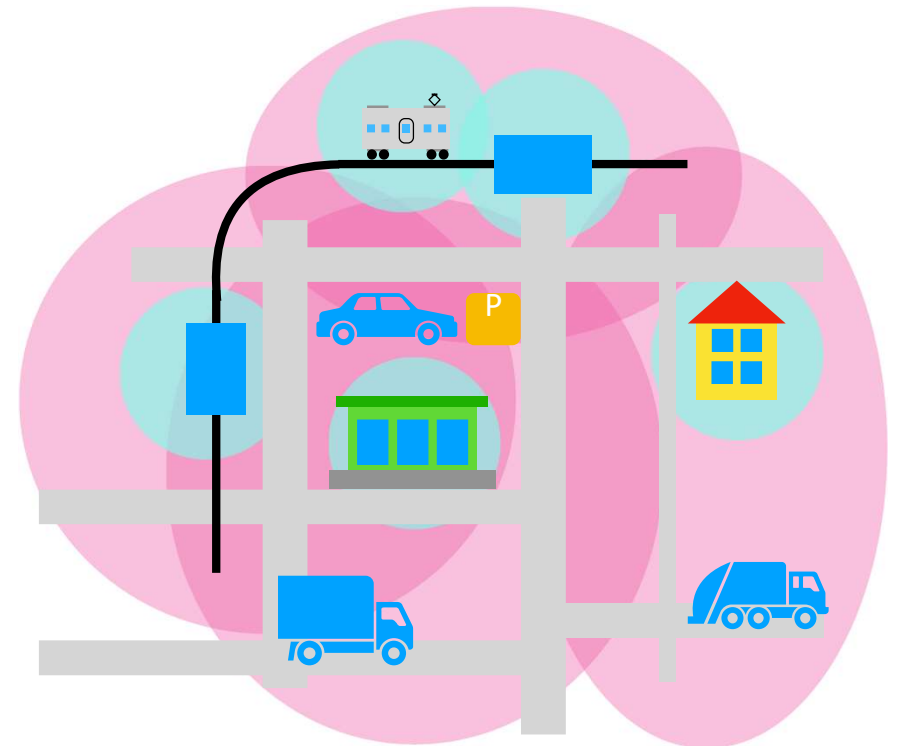
At School



At Farm



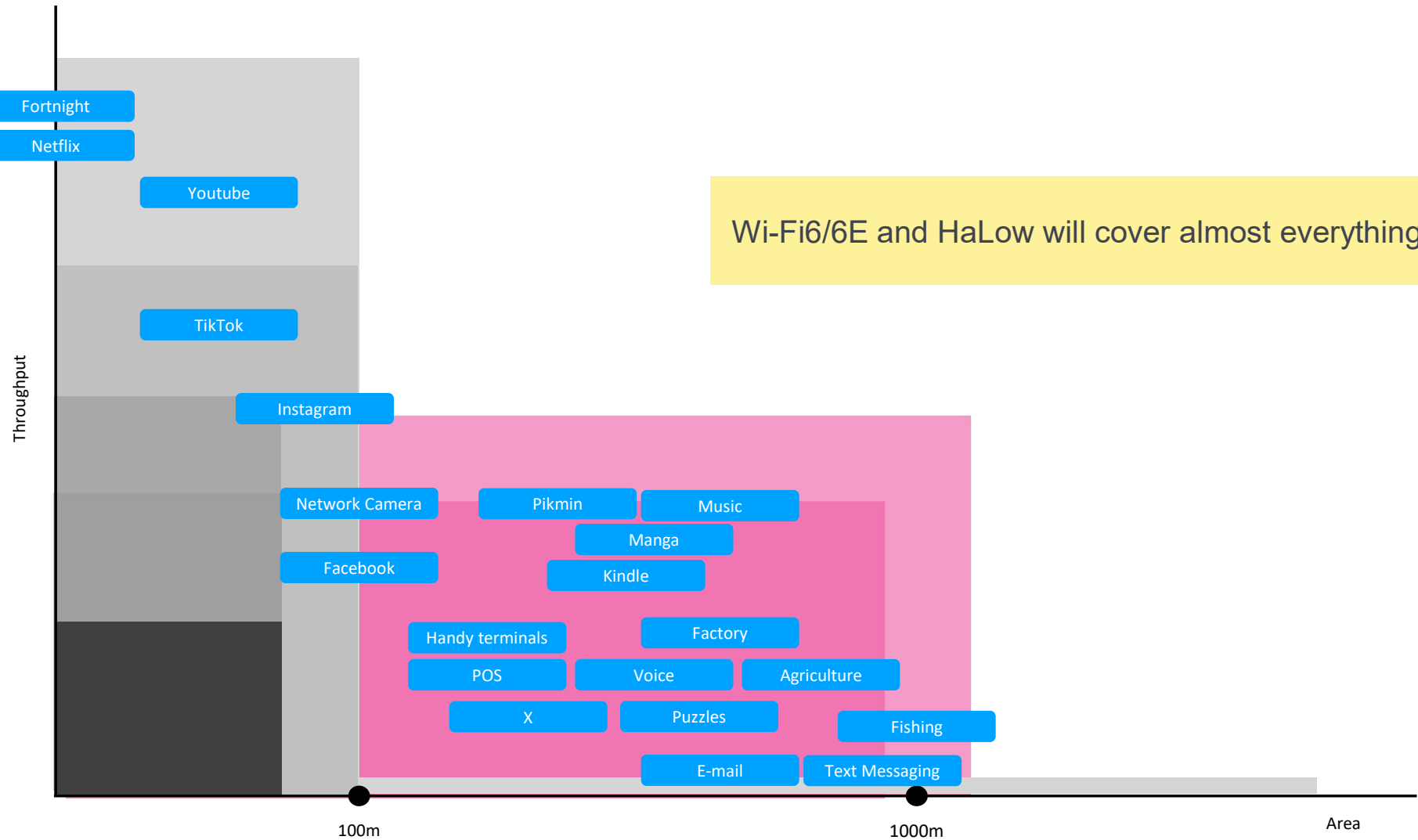
In the City



Wi-Fi

11ah

Required application speed and area



The Evolution of Wi-Fi HaLow with the Addition of the 850MHz Band and Business Opportunities

The Evolution of Wi-Fi HaLow and Its Impact

Current situation (920MHz band)

Frequency band : 920MHz
Bandwidth : Approximately 8MHz
Output : 20mW
Duty cycle limit: 10%

Evolution (addition of 850MHz band)

Frequency band : Addition of 850MHz band (20MHz or more bandwidth)
Output : 200mW
Duty cycle limit : None

Technical changes

Improvement in Communication Speed

Expansion of Bandwidth : Increasing from 8MHz to over 20MHz significantly enhances data transmission speed. **

Wider Coverage

Increase in Output Power : The increase from 20mW to 200mW extends the communication range, covering a wider area. **

Higher Connection Density

Increase in Device Connectivity: Higher connection density allows for simultaneous connection of numerous devices. **

New Business Opportunities

Smart Agriculture

Precision Agriculture : Enables real-time data collection over large agricultural areas. **

Smart City

Infrastructure Management : Advancements in optimizing traffic control, smart lighting, and waste collection. **

Factory Automation

Factory Automation: Expected efficiency improvements in predictive maintenance, robot control, and inventory management. **

Healthcare

Remote Monitoring : Enables efficient connection between medical devices and patient devices. **

Environmental Monitoring

Data Collection : Real-time monitoring of water quality and meteorological data becomes feasible over a wide area. **

Into New Business

- Smart Energy Management : Optimization of energy usage and real-time monitoring.
- Logistics Management : Optimization and real-time tracking of complex logistics networks.
- Augmented Reality (AR) / Virtual Reality (VR) : Providing new user experiences leveraging high bandwidth.
- Other : Integration into various endpoint devices.

** [Wi-Fi NOW Global](#)

The addition of 850MHz and advancements in chip technology enable the commercialization of various mobile devices and sensors, leading to the realization of new services.

Business Model : Complement or Compete?

- PHS/WiMax and Mobile
 - business models : same



Compete

Area vs. Area



- Wi-Fi and Mobile
 - business models : different
- Wi-Fi (6/7) and 11ah
 - Different in characteristics (Speed & Mobility)
- 11ah and Mobile
 - No compete at all

Complement

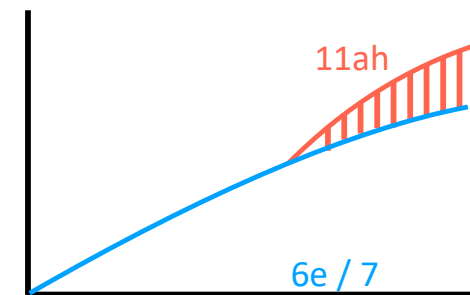
Area and Spot



Complementary relationship of Wi-Fi (6/7) and 11ah expands WiFi coverage and new applications emerge in IoT and ICT markets.

Big Wi-Fi Vendors and carrier like NTT DoCoMo show less interest on 11ah. They expect the sales decrease because of number of APs installed in a certain area decreases. However, this gives good opportunities to ventures and start-ups:)

The growth of Wi-Fi HaLow



Challenges and Growth Strategies

Current Challenges

- | | |
|--|--|
| 1 Low Awareness and Recognition | 4 Diversification of Means to Solve Technical Challenges |
| 2 Limited Availability of Wi-Fi HaLow Compatible Devices | 5 Expansion of Frequencies, Regulatory Relaxation |
| 3 Cost Reduction | |

Countermeasures

1 PR Activities for Wi-Fi HaLow

- Opening Showrooms
 - Utilizing CIAT Showrooms and vLAB
- Hosting Workshops and Wi-Fi HaLow Forums
- Joint Exhibition at Wireless Japan

2 Strengthening Partnerships with CIAT, ITRI, and Related Companies

- Building Field Trials and Success Models : Developing Best Use Case Models
 - Communications @ Mattermost, X
 - Technical Exchange
 - Working Group Activities on Technical Progress, Case Discussions, and Troubleshooting

3 Diversification of Products and Services

- Establishing new markets requires both wireless Infrastructure (base stations, access points) and devices.
- At the beginning of Wi-Fi, only PCs and WLAN Cards existed. Later expanded to include game consoles by Nintendo and Sony, devices by Intel, and iPhone
 - Market size correlates with number of devices.
 - Promoting development of various products and services utilizing Wi-Fi 6/7 and Wi-Fi HaLow.
 - Business matching between Japanese companies venturing into various use cases and Taiwanese companies excelling in product production at speed and reasonable costs.

4 Promotion of technological development and innovation

- Essential to establish market leadership through development of new technologies and services, Expansion of standards, and development of power-saving technologies for IoT full deployment

謝謝

Thank you.

ありがとうございます。