

# 802.11ah future trends in Japan :

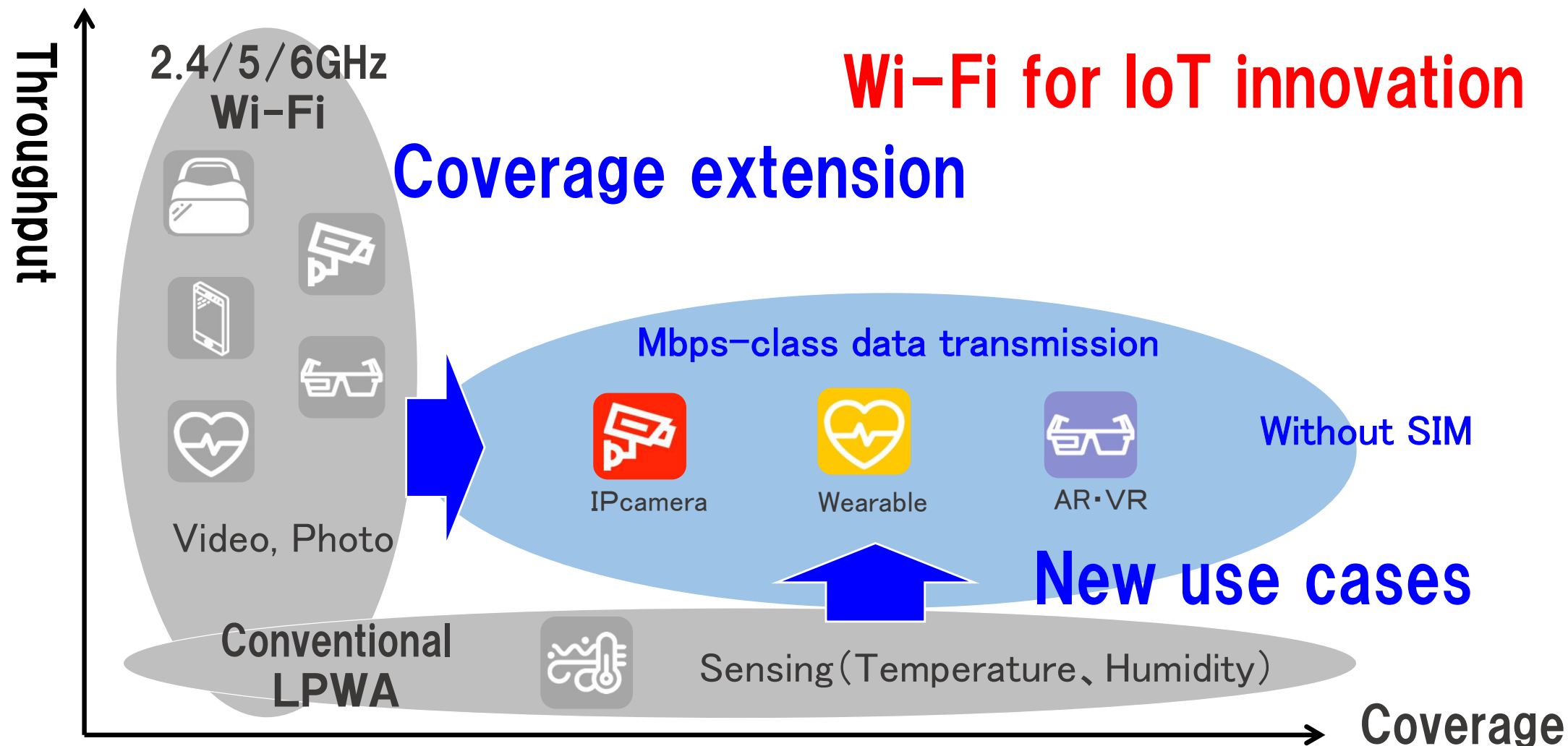
## New frequency development in the 850MHz band and its potential

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June 6<sup>th</sup>, 2024  
802.11ah promotion council  
Yasushi Takatori

# IoT innovation with 802.11ah

802.11ah / Wi-Fi HaLow is available in Japan since 2022



# Requirements for IoT wireless access

- Coverage / reliability in indoor/outdoor environment:
  - NB-IoT > LPWA > 802.11ah > Local 5G > Wi-Fi
- High throughput for video transmission:
  - Wi-Fi  $\doteq$  Local 5G > 802.11ah > NB-IoT > LPWA
- Easy deployment:
  - Wi-Fi  $\doteq$  802.11ah >> LPWA  $\doteq$  NB-IoT >> Local 5G
- Lower cost:
  - 802.11ah  $\doteq$  Wi-Fi < NB-IoT < LPWA << Local 5G
- Robust security
  - NB-IoT  $\doteq$  Local 5G > 802.11ah  $\doteq$  Wi-Fi >> LPWA
- Lower power consumption
  - NB-IoT  $\doteq$  LPWA  $\doteq$  802.11ah << Wi-Fi << Local 5G
- Lower latency
  - Local 5G  $\doteq$  Wi-Fi < 802.11ah << NB-IoT < LPWA
- Massive connectivity
  - NB-IoT  $\doteq$  LPWA  $\doteq$  802.11ah > Wi-Fi  $\doteq$  Local 5G

- Source: Wi-Fi HaLow™: Wi-Fi® for IoT applications

<https://www.wi-fi.org/file/wi-fi-certified-halow-wi-fi-for-iot-applications-2021>

- LPWA: Wi-SUN, LoRa/SIGFOX/ZETA, ELTRES

# Comparison with other wireless systems for IoT

802.11ah enables high data transmission keeping the multi-km range compared to other systems.

System Attributes	802.11ah	Conventional LPWA			Cellular
		LoRaWAN	Wi-SUN	SIGFOX	NB-IoT
Frequency	Sub-1 GHz	Sub-1 GHz	Sub-1 GHz	Sub-1 GHz	Sub-1 GHz
Range	<b>&gt;2.5 km*</b>	<10 km	<1 km	<40 km	<10 km
Data rate (bps)	150K- <b>20M**</b>	300-27k	6.25k- 800 k	100 or 600	20k- 127k
license-exempt bands	✓	✓	✓	✓	-
Battery life ***	Years	Years	Years	Years	Years

This table is created based on the white paper published by Wi-Fi Alliance.

**\*>2.5km: 2Mbps@2.5km is confirmed by the measurement conducted by AHPC**

**\*\*20M: Maximum data rate with 4 MHz BW and 1 spatial stream specified in the standard**

**\*\*\* Battery life: Expected battery life for wireless sensors**

# Features of 802.11ah

## Sub-1 GHz

- Range of >1km
- Robust wireless link

## Easy installation

- Star / tree configuration
- Accommodates 1024 devices
- Range extension by relay

## Sub-1 GHz (802.11ah)

## Low power consumption

- Sleep modes
- Power saving mechanism

## Flexible band width

- 1 / 2 / 4 MHz bands
- From 150 kbps to multi-Mbps

## Wi-Fi brand IoT

- Internationally popular IP-based standard
- WPA3 provides high security



- |                                 |                                |                              |
|---------------------------------|--------------------------------|------------------------------|
| Prioritized for Passive Systems | Prioritized for Active Systems | Dedicated for Active Systems |
|---------------------------------|--------------------------------|------------------------------|

Notes:

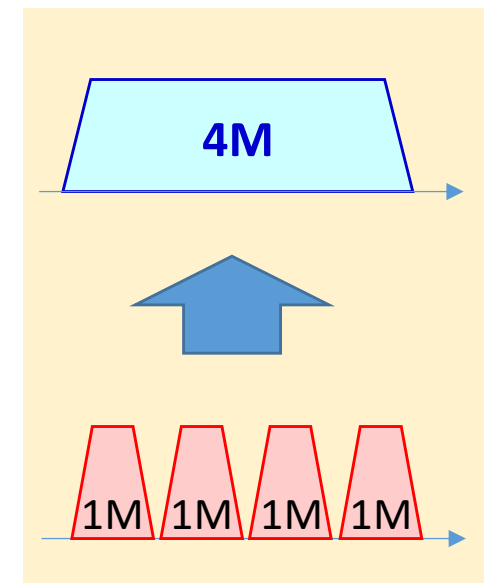
- [https://www.arib.or.jp/english/html/overview/doc/5-STD-T108v1\\_5-E1.pdf](https://www.arib.or.jp/english/html/overview/doc/5-STD-T108v1_5-E1.pdf)

# 1/2/4MHz mode is available

4.5 times throughput is expected with 4MHz mode compared to 1MHz mode.



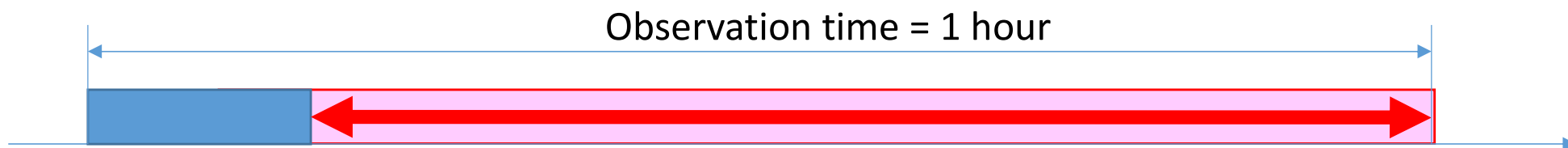
MCS index	Modulation type	Coding rate	PHY Data rate (Mbit/s)		
			1 MHz channels	2 MHz channels	4 MHz channels
7	64-QAM	5/6	<b>3.34</b>	<b>7.22</b>	<b>15.0</b>
6	64-QAM	3/4	3.0	6.5	13.5
5	64-QAM	2/3	2.67	5.78	12.0
4	16-QAM	3/4	2.0	4.33	9.0
3	16-QAM	1/2	1.33	2.89	6.0
2	QPSK	3/4	1.0	2.17	4.5
1	QPSK	1/2	0.67	1.44	3.0
0	BPSK	1/2	0.33	0.72	1.5



# Duty-cycle restriction in 920MHz

It is mandatory to transmit so that each radio station's total transmission time per hour is 360 seconds or less (10 % or less duty cycle). Setting the **observation time to 1 hour** is adequate when performing high-speed transmission only once per hour. Setting **the observation time short (1 second or less)** is effective for continuous communication such as video/audio streaming.

## ■ When performing high-speed transmission once an hour

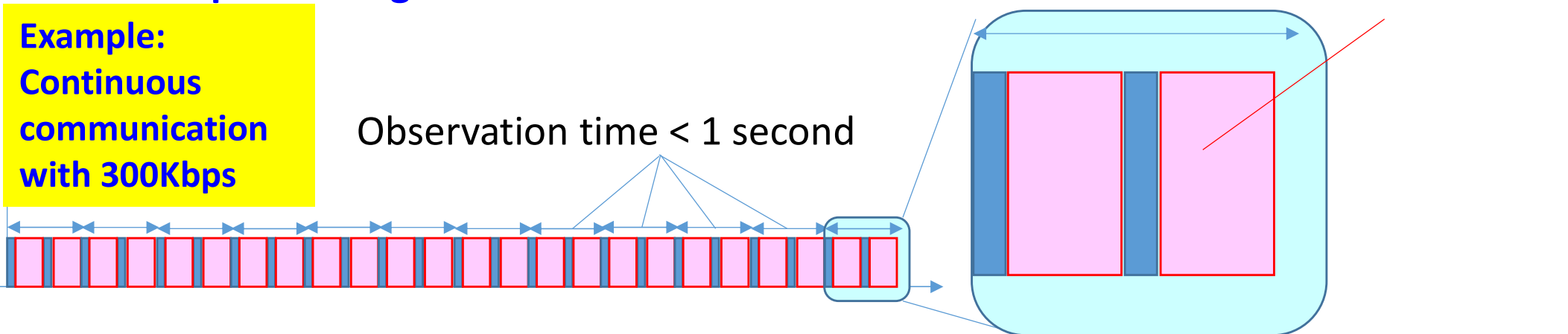


**Example: 3Mbps data transmission for 10 minutes** Must NOT transmit data for remaining 50 minutes

## ■ When performing continuous communication

**Example:  
Continuous  
communication  
with 300Kbps**

Observation time < 1 second



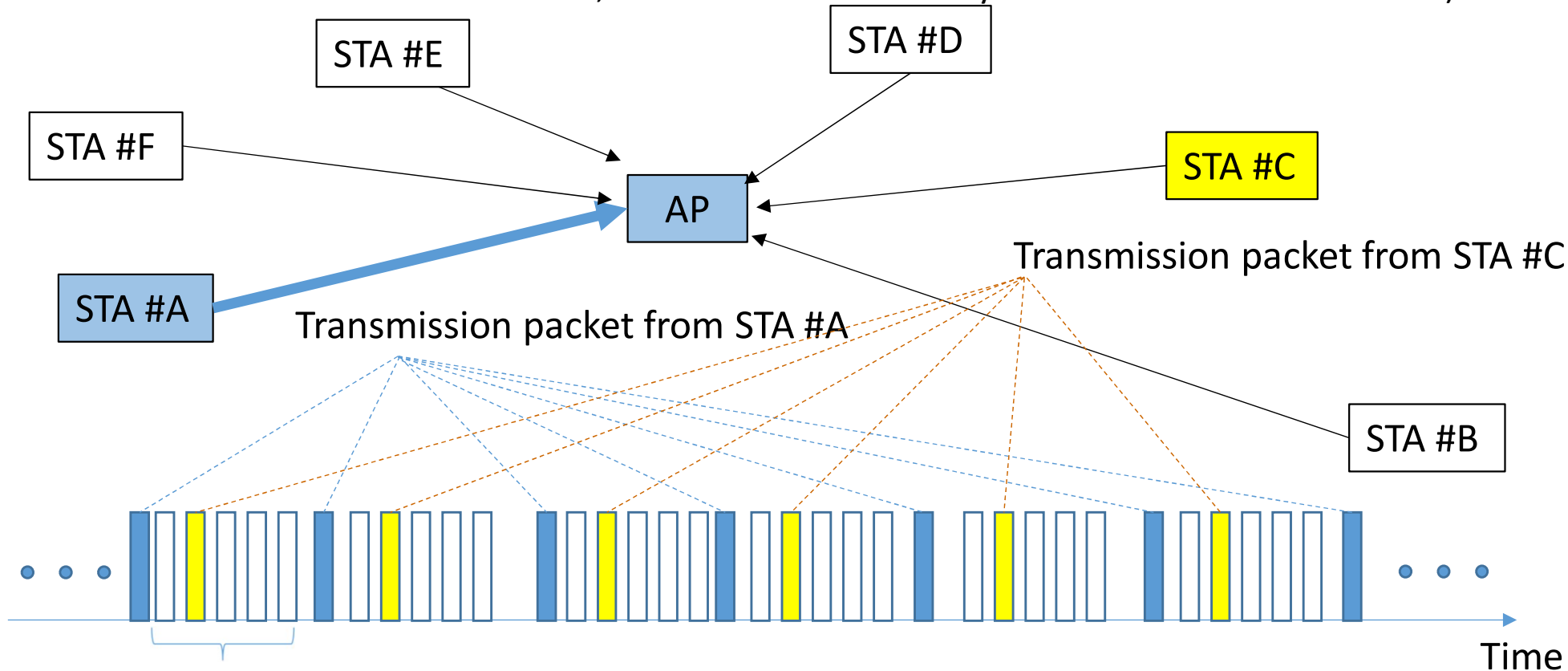


# Duty-cycle restriction in multi-link scenarios

Wideband transmission using 1/2/4MHz bands makes transmitting video, such as moving images, possible.

**Uninterrupted transmission is possible** while maintaining the duty ratio by sending data in short segments. Duty restriction is applied to each STA.

(i.e. if there are five STAs associated to an AP, the AP can receive totally 50 % of time from all the STA.)



Transmission packet from STA #B,#C,#D,#E,#F to AP

# NEXT STEP

More and more varieties of devices and applications are expected in the next step.

## Current 11ah market

### Agriculture & Livestock



### Local safety



### School



### Disaster prevention



Extending the market

NEW market creation

## Next Step

### ■ Factories, Logistics ■



- Environmental monitoring
- Production management
- Use of dedicated terminals
- Digitization of analogue meters

### ■ Regional revitalization ■



- Environmental monitoring
- Safety management

### ■ Office ■



- Office environmental management and monitoring
- Entry/exit management / Intrusion detection

### With Matter ■ Home ■



- Vital management of the elderly
- Home security: Door lock management, parking monitoring

# (From the article) Wi-Fi HaLow for Smart Home

## NTT east's initiatives for Smart Home with home IoT/Matter

URL <https://japan.cnet.com/article/35216010/>

March 14<sup>th</sup>, 2024

\* The article is in Japanese.

Why NTT East is enthusiastic about smart homes becoming "fully popular" in 2024 -- **new Wi-Fi standard makes it easier to connect**

"We believe that by promoting Wi-Fi HaLow, the instability of communication will be resolved."



PHOTO from <https://japan.cnet.com/article/35216010/>

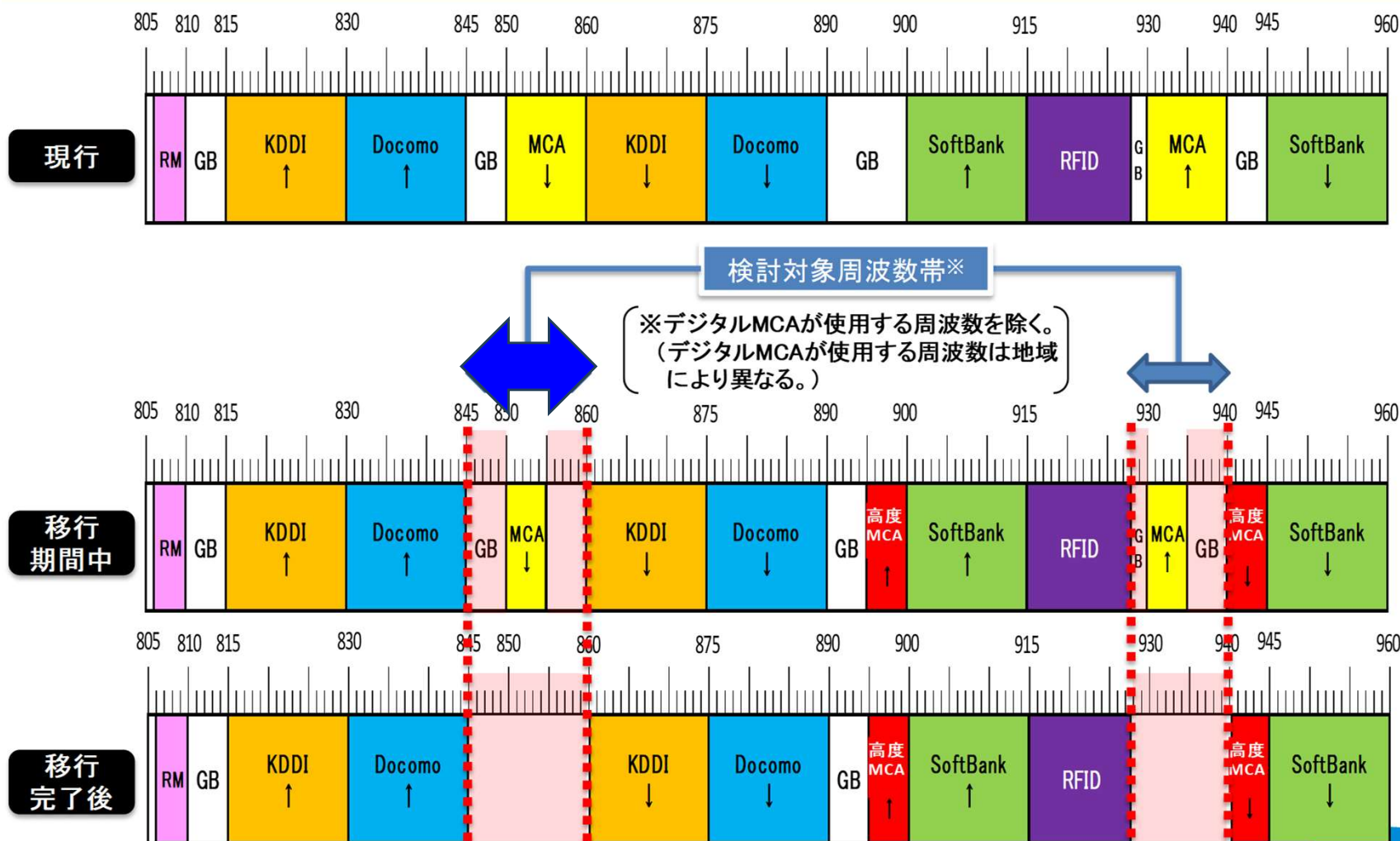
Matter: <https://csa-iot.org/>

# New frequency development in the 850MHz band and its potential

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# Possible new frequency bands for 802.11ah

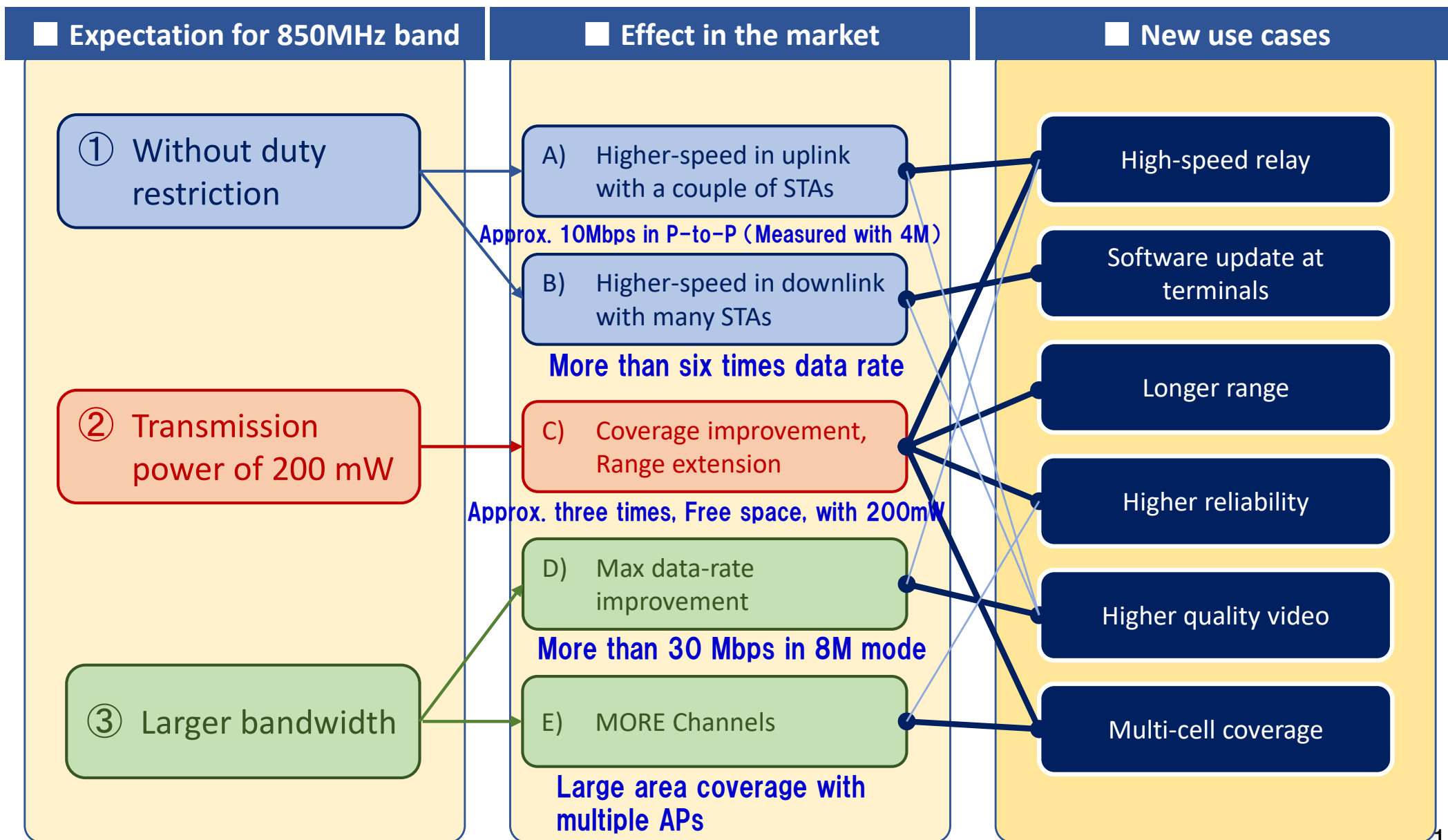
Digital MCA system operating in both 845-860 MHz band and 930-930 MHz band will move to different frequency bands. Japanese ministry (MIC: Ministry of Internal Affairs and Communications) has launched an official working group to discuss the **frequency allocation of 845-860MHz** for new wireless systems, **802.11ah** and **Metropolitan Beacon System (MBS)** in April 2024.





# Expectation for 850 MHz band to expand the IoT market

## Expected effect in 850MHz band and new use cases



# Toward further fruitful expansion

**New frequency allocation at 850MHz band enhances the key features in all use-cases.**

## Agriculture & Livestock



## Local safety



## School



## Disaster prevention



Extending the market

**NEW**  
market  
creation

## Next Step

## Further enhancement

### ■ Factories, Logistics ■



- Environmental monitoring
- Production management
- Use of dedicated terminals
- Digitization of analogue meters

Higher reliability

Higher quality video

Software update at terminals

### ■ Regional revitalization ■



- Environmental monitoring
- Safety management

High-speed relay

Longer range

Multi-cell coverage

Software update at terminals

### ■ Office ■



- Office environmental management and monitoring
- Entry/exit management / Intrusion detection

Higher reliability

Higher quality video

Multi-cell coverage

Software update at terminals

### With Matter

### ■ Home ■



- Vital management of the elderly
- Home security: Door lock management, parking monitoring

Higher reliability

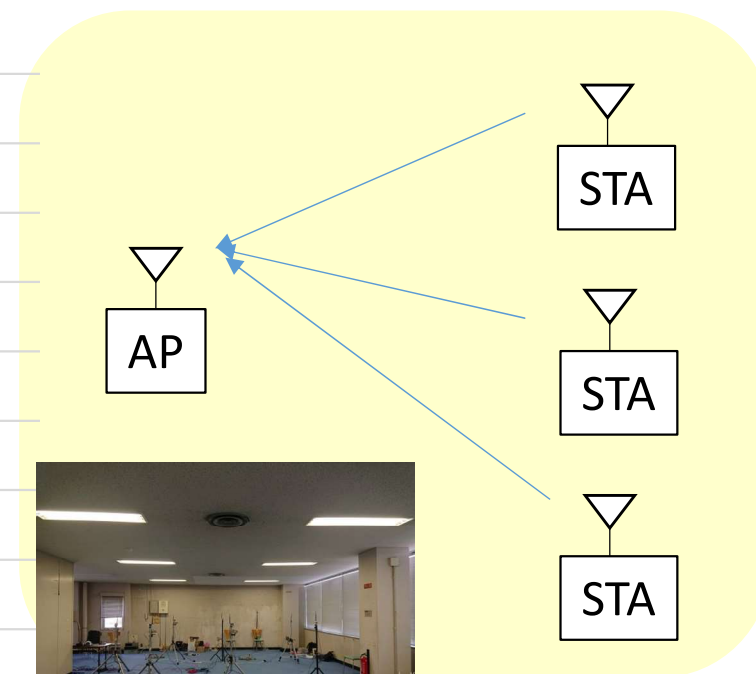
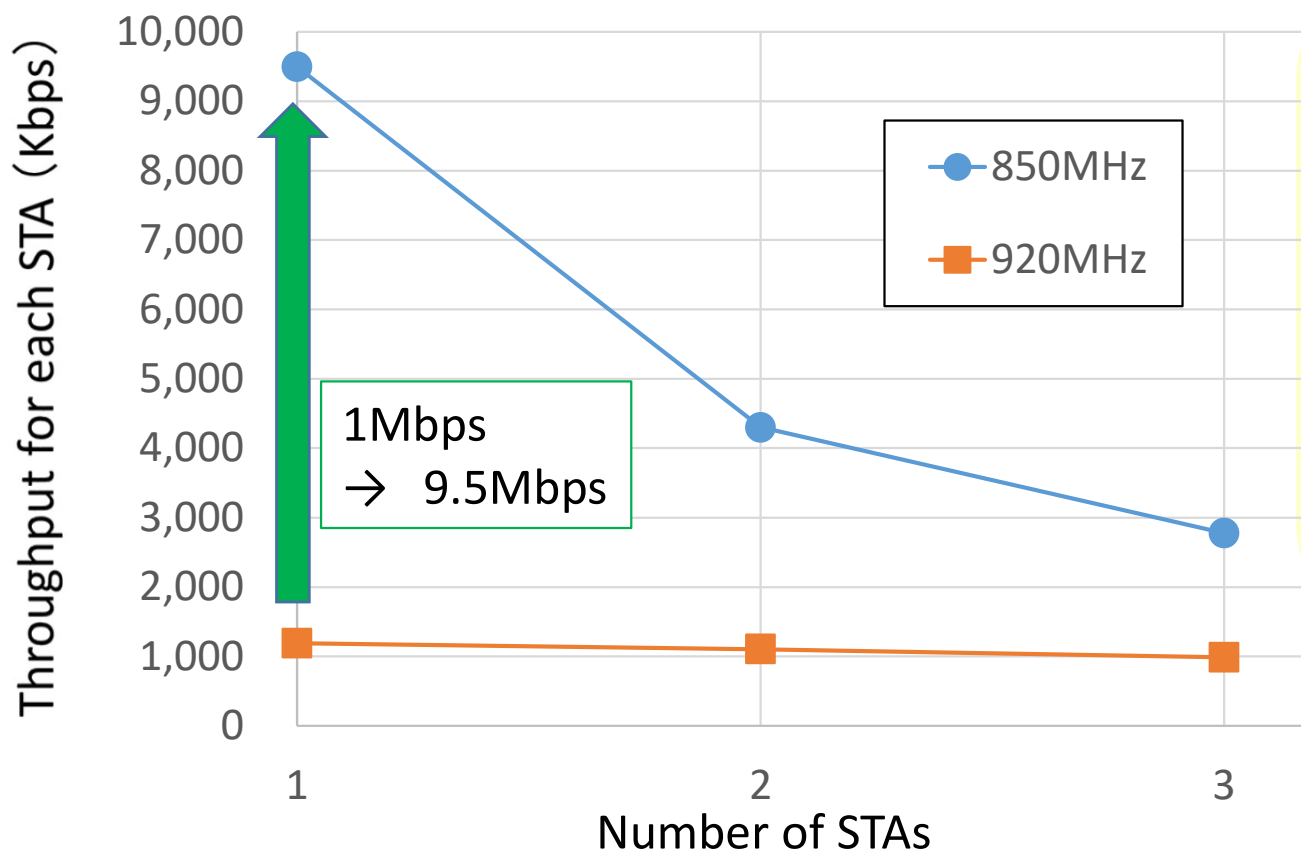
Higher quality video

Software update at terminals

**10 Mbps class transmission** is proved in uplink P-to-P by the trial.

802.11ah @850MHz : 4MHz mode, **without duty-cycle restriction**, with A-MPDU

802.11ah @920MHz : 4MHz mode, with duty-cycle restriction, without A-MPDU



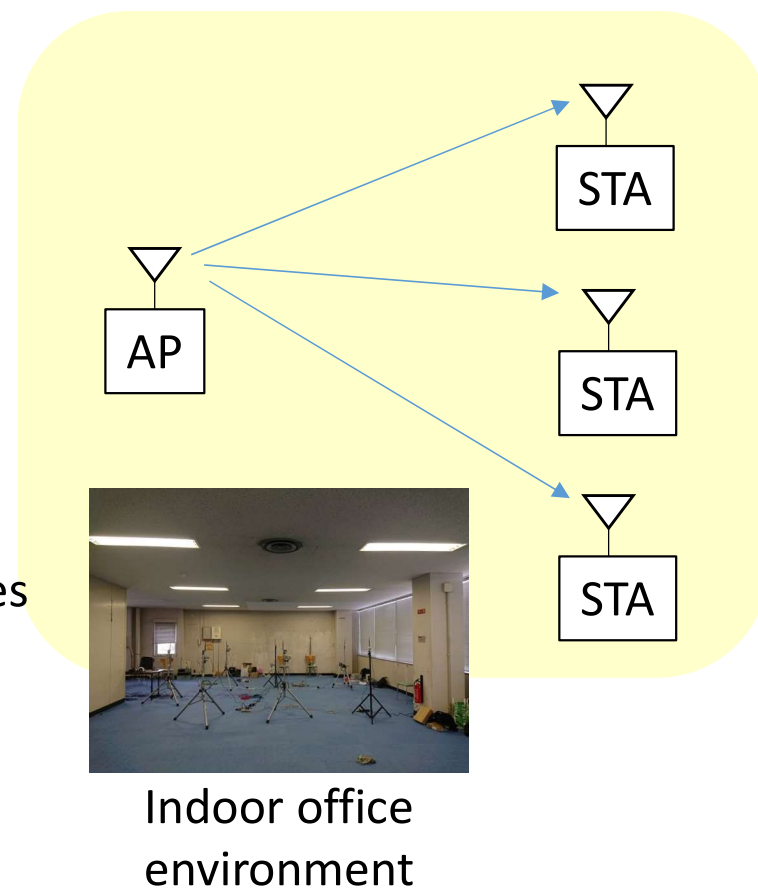
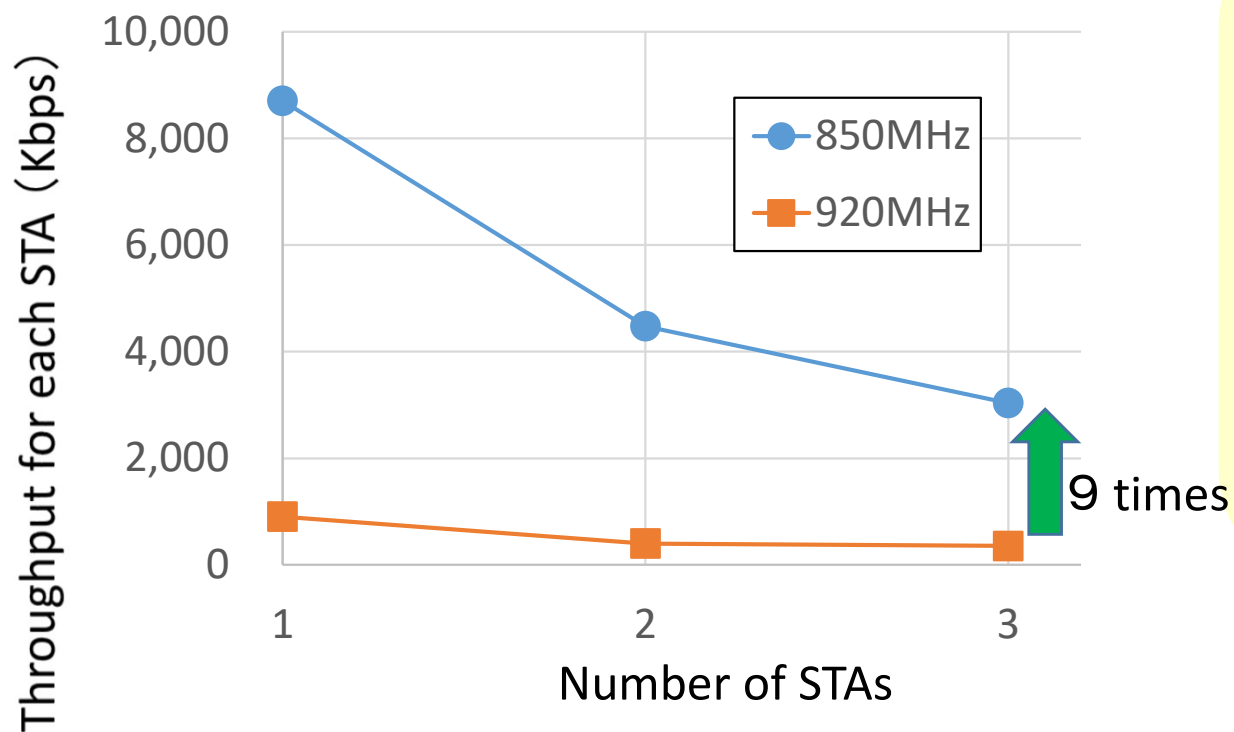
Indoor office environment



About **9 times throughput** is proved in down link P-to-MP by the trial.

802.11ah @850MHz : 4MHz mode, without duty-cycle restriction, with A-MPDU

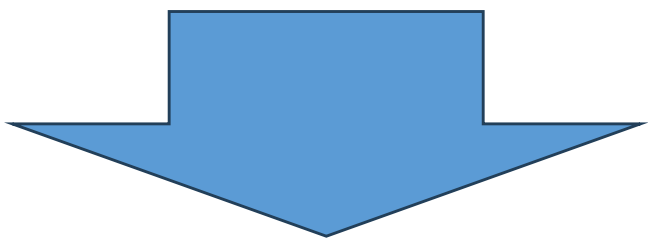
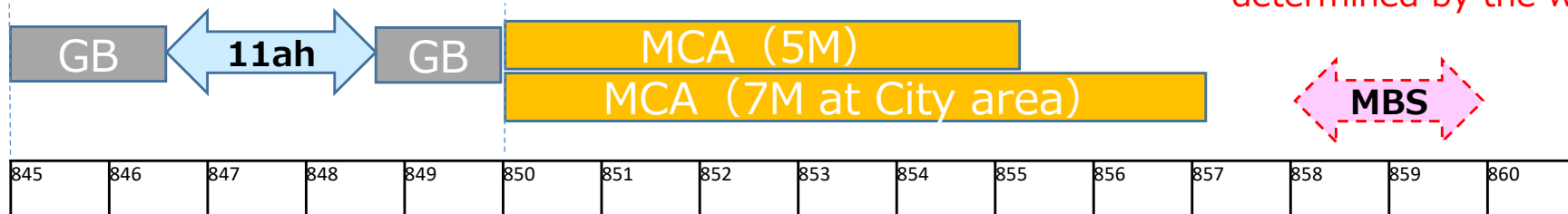
802.11ah @920MHz : 4MHz mode, with duty-cycle restriction, without A-MPDU



# Expected frequency allocation at 850MHz

## ■ During the transition period:

※ Actual GB width will be determined by the working group.

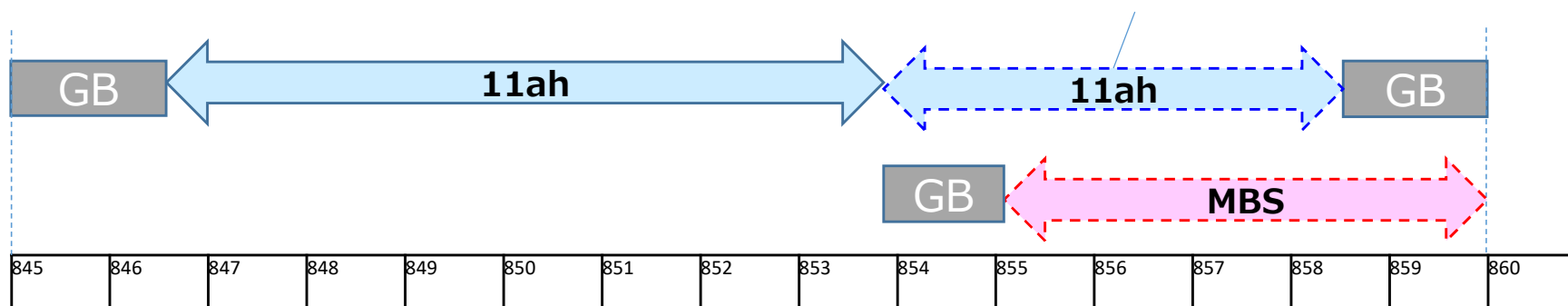


**Steep BPF** suppressing interference at the adjacent frequency bands will reduce GB and thus enable broader frequency band allocation.

## ■ After the transition, June 2029~

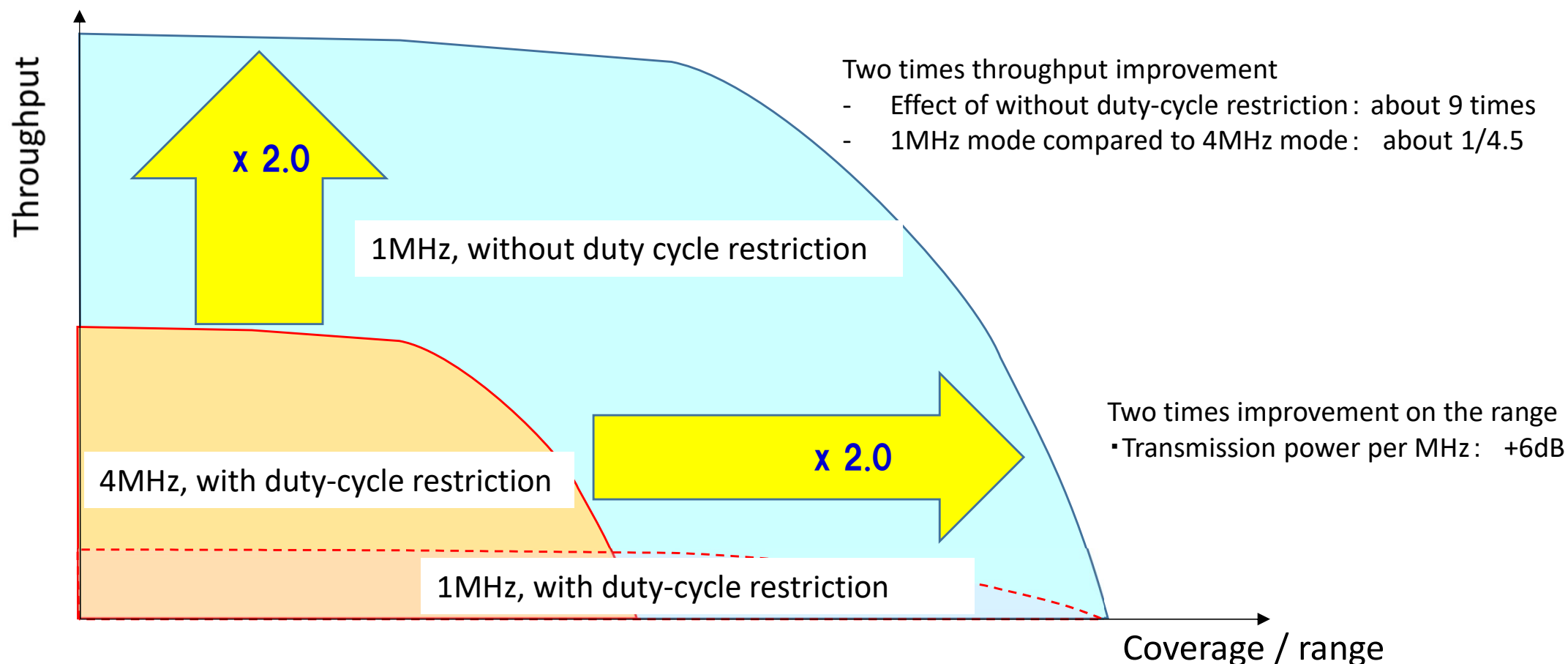
※ Actual GB width will be determined by the working group.

How to coexist with MBS is one of the working items at the working group.



# Expected improvement by the “duty-cycle restriction free”

Even in the case of 1MHz band transmission without duty-cycle restrictions, it enables to double both maximum throughput and communication range compared to the current 4MHz mode at the 920MHz band with 10 % of duty restriction.



Effect of without duty-cycle restriction in P-to-P with 1MHz mode

# Summary

- 802.11ah has been available in Japan since 2022. However, due to **the limited variations of devices**, the current 11ah market is limited to agriculture and livestock, local safety, school, and disaster prevention.
- The next step is to extend the current market. Moreover, creating a new market, such as **office/home IoT**, is essential. Support from Taiwan companies is helpful in realizing this step.
- A new frequency allocation of 850MHz is under discussion, which will enhance the expansion of the market.
- In addition to the available frequency expansion, we expect duty-cycle restriction-free operation in the new frequency band. This will improve the throughput and coverage area even in 1MHz mode in the transition period.
- **Steep BPF and the coexistence with MBS** enable broader frequency band allocation for 802.11ah in Japan.

# Wi-Fi HaLow: The Future of Long-Range Wireless is Here

**Thursday, 20 June 2024  
7:00 PM - 8:00 PM EDT**

**LIVESTREAM**

## **SPEAKERS**



**Zac Freeman**

Vice President of Marketing and  
Sales, Newracom



**David Halasz**

Director of Standards, Morse Micro  
1st Vice Chair, IEEE 802 LMSC



**Yasushi Takatori**

Senior Distinguished Researcher, NTT  
Access Network Service Systems  
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<https://engagestandards.ieee.org/HaLow-Livestream.html>