Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [**IoT for Public Protection and Disaster Relief**]
Date Submitted: [14 May 2025]
Source: [Public Safety Radio Communications Office, Radio Department]
Organization: [Ministry of Internal Affairs and Communications(MIC), Japan]

Re: [Wireless Next Generation]

Abstract: [Report for the May 2025 Session]

Purpose: [Contribution for WNG]

総務省

IoT for Public Protection and Disaster Relief

Introducing Narrowband IoT Communication System in VHF band (VHF-IoT*)

* This abbreviation is not official but is only used in this article.

As of May 2025

Public Safety Radio Communications Office,
Radio Department,
Ministry of Internal Affairs and Communications(MIC), Japan

IoT for Public Protection and Disaster Relief (PPDR)

- Japan is a country prone to natural disasters such as typhoons, heavy rains, heavy snowfall, floods, earthquakes, tsunamis, and volcanic eruptions.
- The government, which protects the lives and property of its citizens, is strongly expected to prepare for these disasters even in peacetime, detect their occurrence as quickly as possible, and respond appropriately. **IoT is one of the most effective means of communication to achieve this response**.
- As a means of IoT communication for PPDR, several use cases have been proposed from in Japan.

Tsunami after earthquake (Iwate Pref.) Mar. 2011
(Source: Disaster Prevention White Paper 2023)

Disaster Relief Operation (Miyagi Pref.) Mar. 2011
(Source: Disaster Prevention White Paper 2023)

Earthquake (Ishikawa Pref.) Jan. 2024

Flood (Ishikawa Pref.) Sep. 2024

IoT use case for PPDR - Smart meter, Monitoring

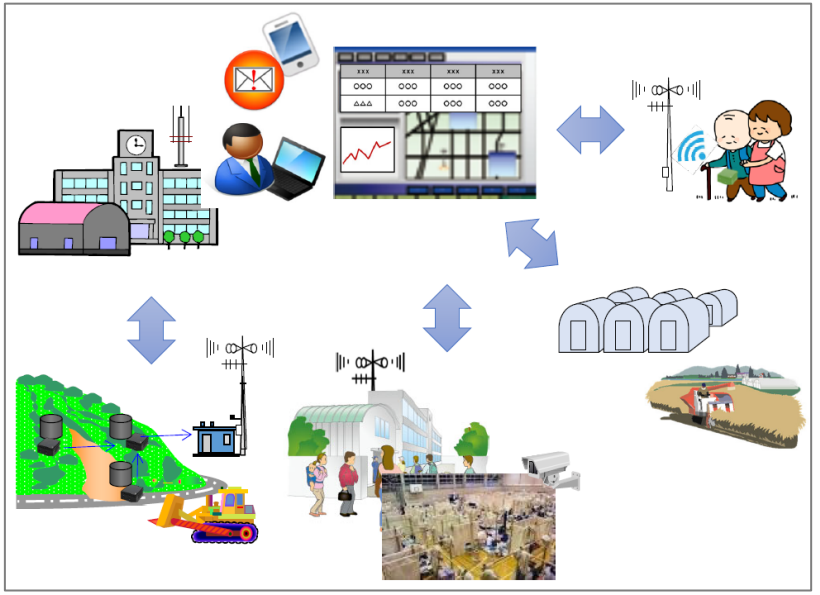
Wide-area communication using multi-hop mesh networks

- Monitoring in various environments where wireless signals are difficult to reach, including urban areas, buildings, and factories, as well as during disasters

High-speed communication (up to 2.4Mbps with OFDM support)

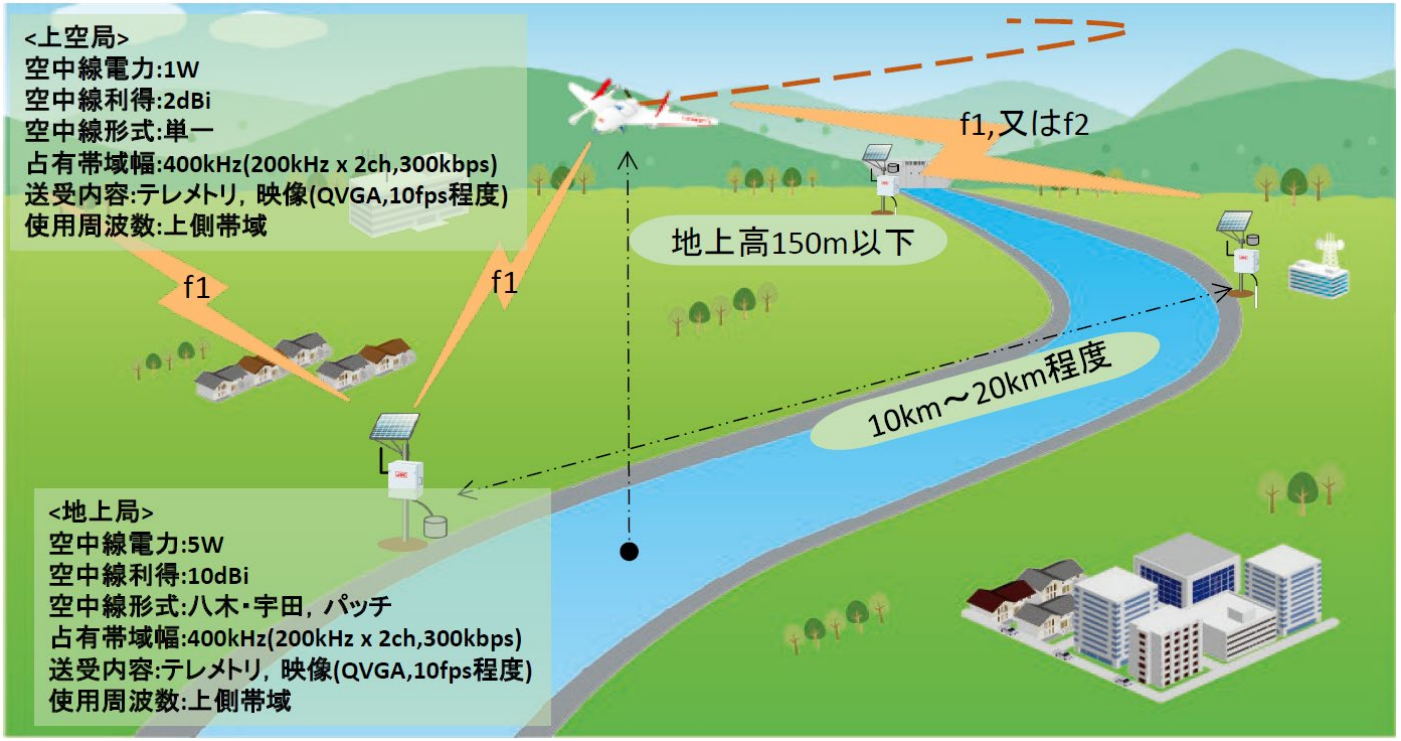
- Simultaneous collection of sensor data
- Remote monitoring with video

1. **Surveying and measurement** (smart meters)
2. **Monitoring** (including on-site video surveillance)
   - ① Infrastructure maintenance and management (including environmental monitoring)
     - Building health
     - Bridge and steel tower management
     - Street light management (smart streetlights)
     - Traffic monitoring
     - Railway monitoring (maintenance and safety measures)
     - Environmental monitoring
     - Power generation equipment monitoring (solar and wind power generation equipment, etc.)
   - ② **Disaster prevention**
     - Slope disaster prevention
     - River disaster prevention
     - Fire and crime detection
     - Digital signage
3. **In-factory communications** (support for automation, etc.)



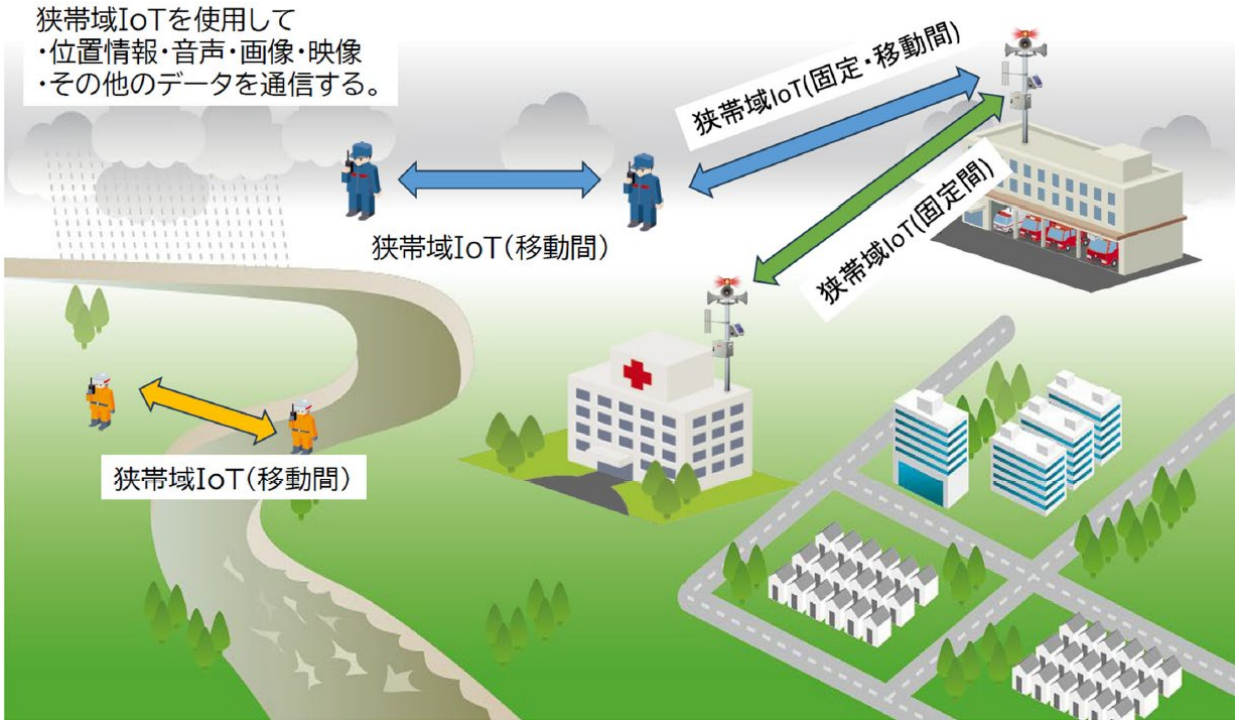
IoT use case for PPDR - Drones

- This proposal is for use as radio equipment for flights above rivers and roads for beyond visual line of sight flights, with the purpose of **transporting supplies, grasping the damage situation by drone** to the areas with poor transportation access and **disaster-stricken areas**.
- A communication speed of 300kbps is desired using **200kHz x 2 channels** for **video transmission (QVGA 10fps approx.)** and **position transmission**. Transmit Antenna Power is expected to be **1W in the air and 5W for the ground station**.
- The Ministry of Land, Infrastructure, Transport and Tourism is considering a project “Facilitating the use of airspace above rivers in drone logistics“ and the proposer sees this as one of the communications methods that will help make the project a reality.



IoT use case for PPDR - Communication devices

- The proposal is to use as a means of communication for disaster response personnels. The communication devices are allowed the personnels to realize data communication among government buildings such as city hall and the personnels.
- The device can send and receive images and video, as well as location data for management.
- A 200 kHz or 400 kHz bandwidth is desired for video and image transmission. For location management, location data will be transmitted once every 10 seconds.
- In order to extend the communication distance, a maximum output of 5W is desired.



What is Narrowband IoT Communication System (VHF-IoT)?

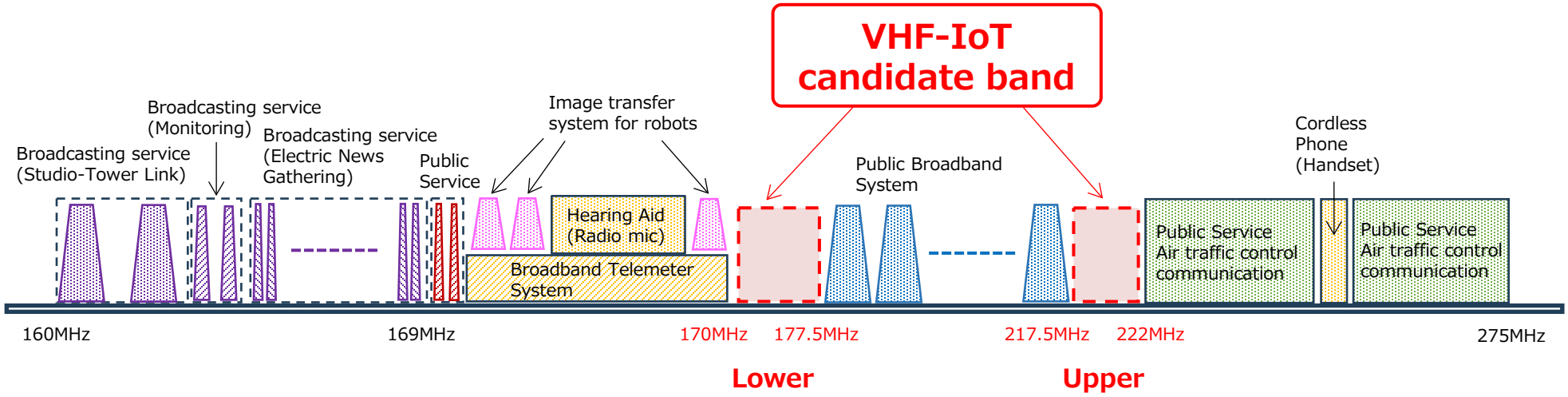
- During disaster response, cell phones, wireless LAN, and satellite communications are also used for communication means, but **in crisis situations, commercial means will be unavailable** for a certain period until they are restored.
- Therefore, private radio communications are effective in the crisis, and even more effective are those using wide-reaching frequencies such as VHF.
- For this reason, the MIC has begun considering the introduction of **VHF-IoT for PPDR, taking advantage of the wide reach nature of VHF**, and has decided to allocate the band for IoT that was formerly used for terrestrial analog television broadcasting.
- Based on the proposed use cases, the technical conditions will be examined by the Working Party(WP) of the Information and Communications Council, and the MIC plans to revise the relevant regulations based on the outputs that are reached consensus at the WP.
- The "Frequency Reorganization Action Plan (FY2024)" published by the MIC also states the following:

> Chapter 4. I. 3 (4) (i)
> With regard to the V-High band (170 to 222 MHz), …, technical conditions will be examined to extend the frequency for the 200 MHz band public broadband mobile communications system (public BB), and to **introduce narrowband IoT communication systems**, **which enable several public safety agencies and other organizations to share information at multiple locations in the event of a disaster**, into guard bands between the public BB and other systems. Technical conditions for these systems will be examined, and **regulatory revisions will be completed by the end of FY2025**.

https://www.tele.soumu.go.jp/e/adm/freq/search/actionplan/action_plan_fy2024.pdf

VHF-IoT candidate band and related spectrum usage

Spectrum Usage in Japan 160MHz-275MHz



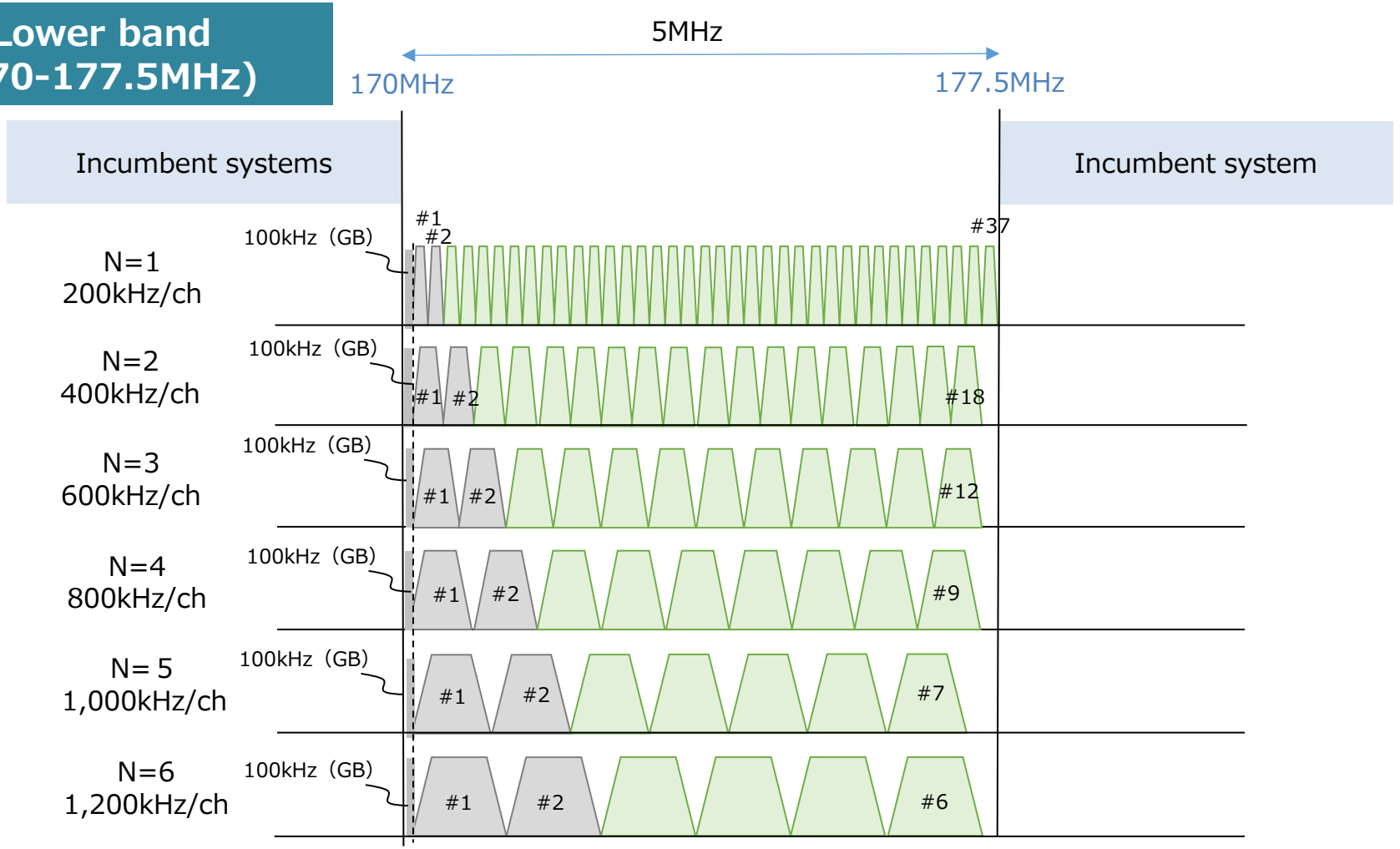
- VHF-IoT candidate bands are 170-177.5MHz and 217.5-222MHz.
- In adjacent bands, there are Broadcasting Service, Public Broadband System, Public Services, Air traffic control etc. as incumbents.

Current main items

- The WP is now considering domestic technical conditions especially for co-existence not only with adjacent radio usage, but within VHF-IoT system.
- In order to realize the co-existence, the following technical conditions for VHF-IoT are current main items to be considered.
  - Channel Plan
  - Antenna Power
  - EIRP
  - Tolerance of adjacent channel leakage power
  - Tolerance of unwanted emission (including the need to introduce filters)
  - Carrier Sense (Energy Detection)
  - Transmission time limit
  - License Type (License band / Registration band / License-free band)
- In addition, the WP is aware that domestic technical conditions should be comply with the standardization activities in IEEE 802.15 will be an important factor from the perspective of global distribution of equipment.

[Draft] Channel Plan of VHF-IoT

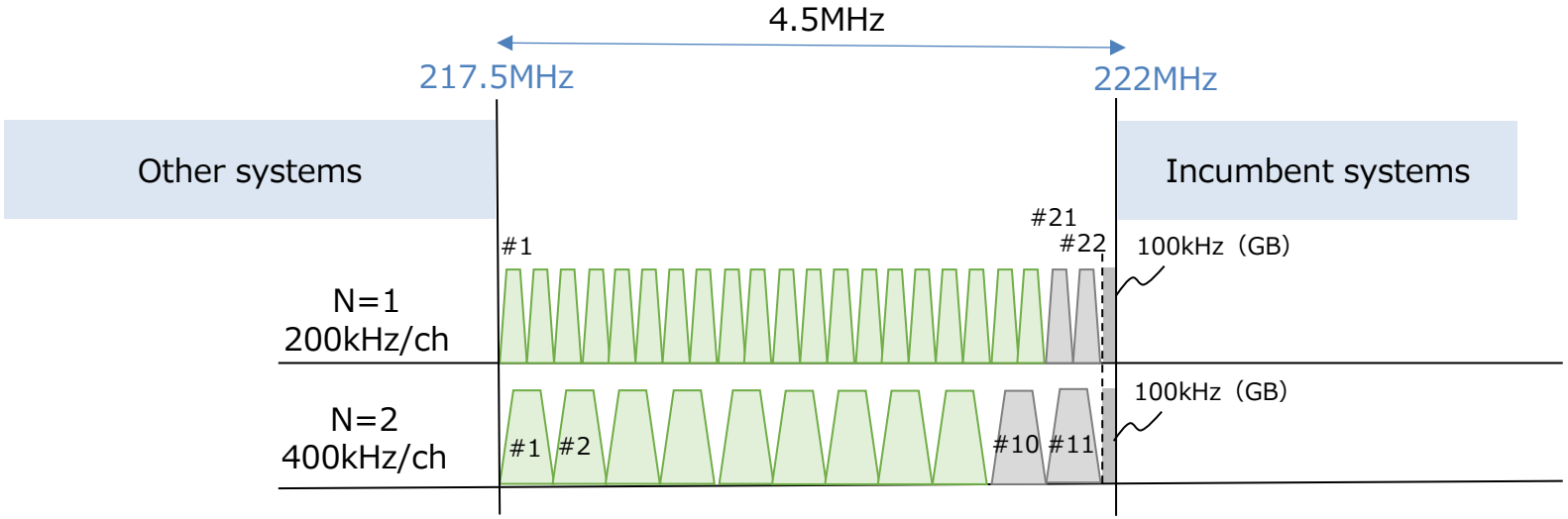
Lower band (170-177.5MHz)



- An unallocated area (100 kHz: equivalent to the Guard Band (GB)) shown in gray color will be provided for sharing with incumbent systems below 170 MHz.
- Based on the sharing study with incumbent systems and other systems, the WP will consider which channels in the channel plan can be issued with a radio station license in Japan. As of the current status of consideration, the channels shown in green may be used in Japan.

[Draft] Channel Plan of VHF-IoT

Upper Band (217.5-222MHz)



- An unallocated area (100 kHz: equivalent to the GB) shown in gray color will be provided for sharing with incumbent systems above 222 MHz.
- Based on the sharing study with incumbent systems and other systems, the WP will consider which channels in the channel plan can be issued with a radio station license in Japan. As of the current status of consideration, the channels shown in green may be used in Japan.

[Draft] specification of VHF-IoT

		Lower	Upper
Frequency Band		170.0-177.5MHz	217.5-222.0MH z
Transmit Antenna Power		20mW / 250mW or less (For land use only)	5W or less 1W or less in the sky
Occupied Bandwidth		200kHz×N (channel spacing 200kHz, N=1-6) (200、400、600、800、1,000、1,200kHz)	200kHz×N (channel spacing 200kHz, N=1 and 2) (200、400kHz)
Data Rate		2,400kbps or less (FSK : 600kbps or less、OFDM: 2,400kbps or less)	600kbps or less (FSK : 300kbps or less、OFDM: 600kbps or less)
Modulation		FSK, OFDM	
		FSK: IEEE802.15.4-2020 SUN FSK section 19.3 and IEEE802.15.4aa-2022 SUN FSK section 19.3 compliant OFDM: IEEE802.15.4-2020 SUN OFDM section 20.3 compliant	
Communication Frame Format		FSK: IEEE802.15.4-2020 SUN FSK section 19.2 compliant OFDM: IEEE802.15.4-2020 SUN OFDM section 20.2 compliant	
Reception Sensitivity		FSK: IEEE802.15.4-2020 SUN FSK section 19.6.7 compliant OFDM: IEEE802.15.4-2020 SUN OFDM section 20.5.3 compliant	
Antenna Gain		6dBi or less (Compensate of antenna gain for feeder loss or antenna power reduction is permitted)	10dBi or less (Compensate of antenna gain for feeder loss or antenna power reduction is permitted)
Tolerance of adjacent channel leakage power	Adjacent channel	When Transmit Antenna power is 20mW or less: -25dBc or less When Transmit Antenna power is 250mW or more: -20dBc or less When Transmit Antenna power is exceeding 20mW and 250mW or less: ACPR(dBc)=(5/11)(Transmit Antenna Power(P_o)-13)-25 or less (13<P_o≦24dBm)	
	Next adjacent channel	-35dBc or less	
Tolerance of unwanted emission		-30dBm/100kHz (Equivalent isotropic radiated power(EIRP))	
Carrier sense (Energy Detection)		Applicable (Threshold level: -80dBm, Transmission Time Limit: Applicable)	Applicable (Threshold level: -65dBm, Transmission Time Limit: Applicable)
Remarks		Concept: IEEE802.15.4-2020 SUN FSK and SUN OFDM are planned to expand to the VHF band by adding the channel spacing and modulation parameters newly specified in IEEE802.15.4aa-2022	

[Red text] is currently under consideration at the Working Party

Current schedule for the introduction of VHF-IoT

2025

- May-July — The WP develops a draft report
- July-August — Committee of the Information and Communications Council will commence a public comment session on the draft report
- September — The Information and Communications Council completes the report with VHF-IoT technical conditions and submits to the MIC

2026

- March or earlier — MIC revises relevant regulations based on the report after consulting with the Radio Regulatory Council

- If any issues remain that require continued consideration or if there is progress in discussions at standardization meetings such as the IEEE, the WP will be reopened as necessary to continue discussions.