Section 4 Trends of radio wave usage in Japan

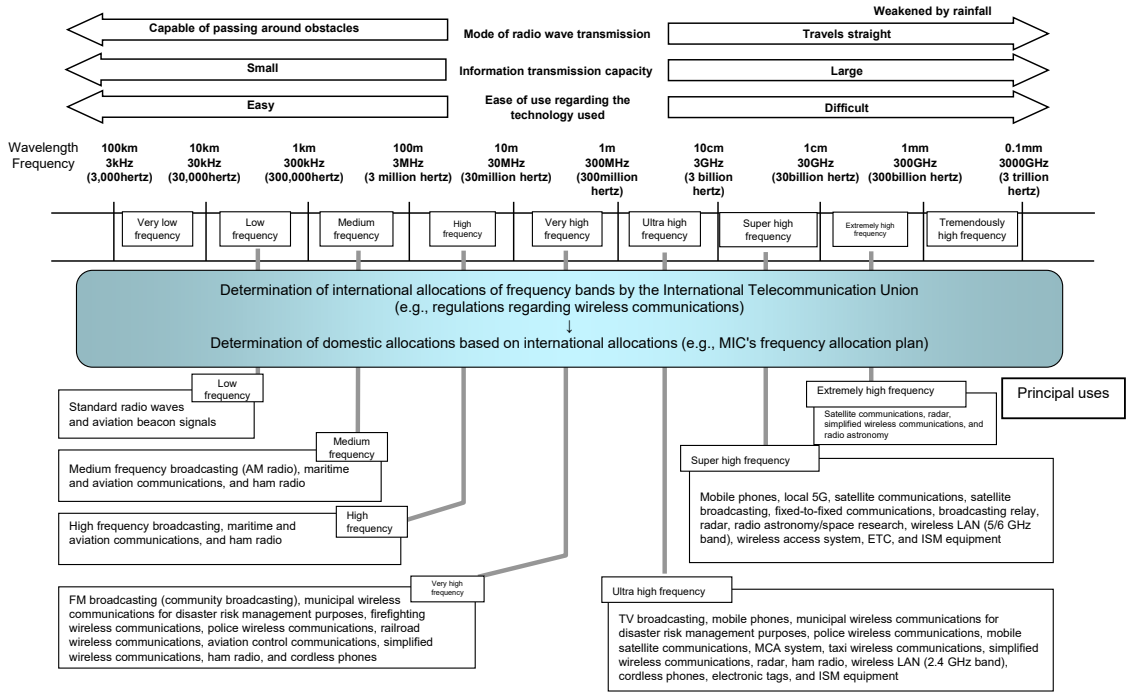
1. Principal use by frequency band

Regarding frequency, the radio regulations stipulated by the International Telecommunication Union (ITU) Convention establishes the allocation of international frequencies by dividing the world into three regions and defines the category of operations for each frequency band.

In order to help applications for radio station licenses, etc., MIC has established the Frequency Assignment Plan[1] based on international allocation and the Radio Act, which defines the frequencies that can be assigned, category of operations, purposes, conditions, etc. When establishing or changing a plan, the Radio Regulatory Council is consulted.

The main uses and characteristics of each frequency band in Japan are shown in (**Figure 4-4-1-1**).

Figure 4-4-1-1 Main uses and characteristics of each frequency band in Japan



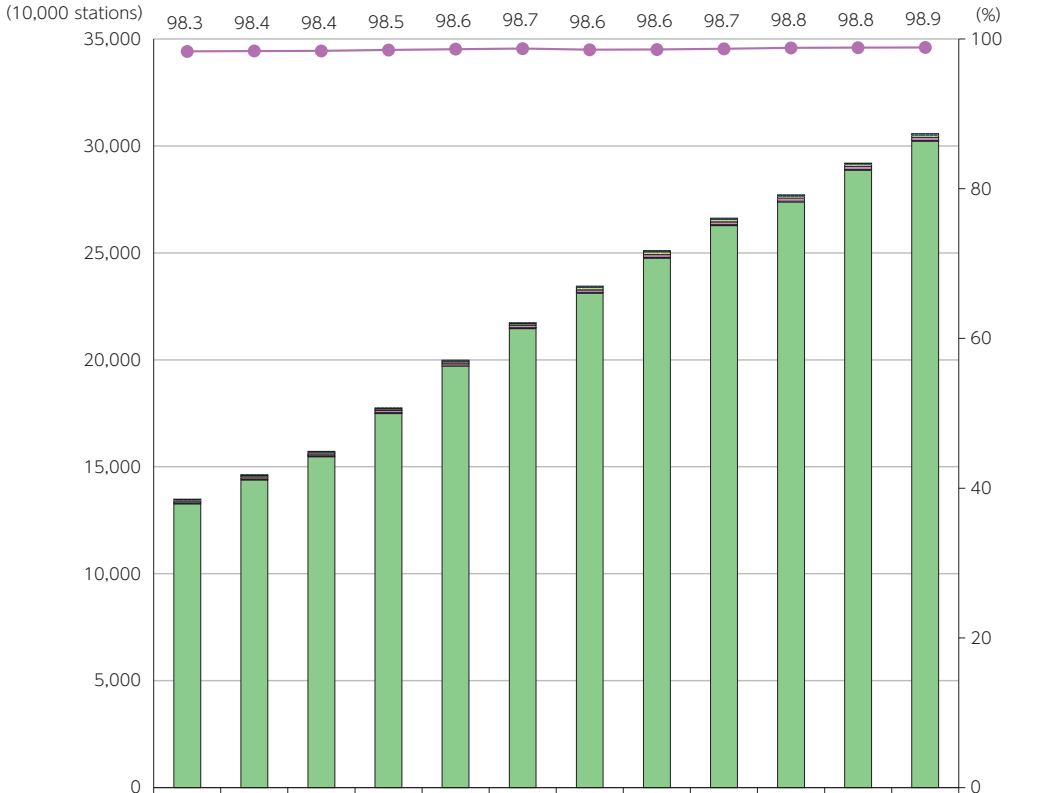
Spectrum	Wave length	Characteristics
Very low frequency	10 to 100km	Propagating along ground surface, waves of this spectrum can go over low hills. Being capable of propagating in water, the spectrum can be used for seabed exploration
Low frequency	1 to 10km	Being capable of propagating to very distant places, the spectrum is used by standard frequency stations to inform radio clock, etc. of time and frequency standard.
Medium frequency	100 to 1000m	Capable of propagating through reflection off the E-layer of the ionosphere that is formed at the height of about 100km, the spectrum is used mainly for radio broadcasting.
High frequency	10 to 100m	Capable of reaching the other side of the globe by being reflected off the F-layer of the ionosphere that is formed at the height of about 200 to 400km and by repeating reflection between F-layer and the ground surface. Widely used for ocean ship and international flight plane communication, international broadcasting and amateur radio.
Very high frequency	1to 10m	Waves of this spectrum propagate rather straight and are not easily reflected off the ionosphere, butare capable of reachingthe other side of mountains and buildings to a certain extent. The spectrum is widely used for a variety of mobile communications including emergency and fire emergency radio.
Ultra high frequency	10cm to 1m	Waves of this spectrum have stronger tendency to propagate straight compared with very high frequency, butare capable of reachingthe other side of mountains and buildings to a certain extent. The spectrum is widely used mostly for a variety of mobile communication systems including mobile phones, and digital television broadcasting and microwave ovens.
Super high frequency	1to 10cm	Due to the strong tendency to propagate straight, this spectrum is suitable for emission to a specific direction. It is mainly used for fixed trunk circuits, satellite communication, satellite broadcasting and wireless LAN.
Extremely high frequency	1mm to 10mm	With strong tendency to propagate straight, waves of the spectrum can transmit very large information quantity, but not very far in bad weather due to rain or fog. For this reason, the spectrum is used for relatively short-distance radio access communication and image transmission systems, simplicity radio, car collision prevention radar and radio telescopes for astronomical observation.
Tremendously high frequency	0.1mm to 1mm	The spectrum has nature similar tolight. It is rarely used for communication but used for radio telescopes for astronomical observation as is the case of Extremely high frequency.

[1] Frequency Assignment Plan: https://www.tele.soumu.go.jp/j/adm/freq/search/share/index.htm

2. Changes in the number of radio stations

The number of radio stations (excluding license-free radio stations such as wireless LAN terminals) at the end of fiscal 2022 was 305.67 million, an increase of 4.7% from the previous year, including 302.19 million mobile phones and other land mobile stations (increase of 4.7% from the previous fiscal year). At 98.9%, the percentage of mobile phones and other land mobile stations is at a high level. The number of convenience radio stations also increased to 1.43 million (up by 0.9% from the previous fiscal year) **(Figure 4-4-2-1)**.

Figure 4-4-2-1 Changes in the number of radio stations



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other	43	46	50	50	55	49	49	55	59	61	51	55
Base stations	58	63	68	71	70	73	125	132	117	95	108	112
Convenience stations*2	77	84	90	97	105	112	118	125	132	137	142	143
Amateur stations	44	44	44	44	44	43	43	41	40	39	38	37
Land mobile stations*1	13,266	14,388	15,472	17,493	19,711	21,457	23,109	24,748	26,278	27,379	28,859	30,219
Percentage of land mobile stations	98.3	98.4	98.4	98.5	98.6	98.7	98.6	98.6	98.7	98.8	98.8	98.9

*1 Land mobile station: A radio station (such as a mobile phone devices) operated while moving on land or stopped at an unspecified point.

*2 Convenience radio station: A radio station that performs simple radio communication.

3. Satellites

In the field of satellite communications, Japan is working to powerfully advance social implementation and international standardization of the results of the development for realizing the expansion of communication coverage for seamless connection of land, sea and air (non-terrestrial network (NTN) technology that includes satellites and HAPS).

Due to their wide coverage, high broadcast possibilities, disaster resistance and other advantages, communication satellites including geostationary satellites and non-geostationary satellites are used for in-house channels, communications with mountainous regions and isolated islands where use of terrestrial channels is difficult, mobile satellite communications services for ships and aircraft, and communications at the time of disaster. Some communication satellites are used for satellite broadcasting (CS broadcasting).

(1) Geostationary satellites

Rotating in a geosynchronous orbit at a height of 36,000 km above the equator with an orbital period matching the Earth's rotation period, geostationary satellites appear to maintain a fixed position when observed from the earth. The high position enables three geostationary satellites to cover the entire earth except for the polar regions, and these satellites are used for fixed and mobile satellite communications. Due to the long distance from the earth to satellites, the transmission delay is long and high output is required from terminals, which makes terminal downsizing difficult.

Figure (related data) Major geostationary satellites used for communications services in Japan (at the end of fiscal 2022)
URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00167
(Data collection)

(2) Non-geostationary satellites

Non-geostationary satellites travel in an orbit that is not geostationary and is generally at a lower altitude than geostationary orbits. For this reason, the transmission delay of non-geostationary satellites is shorter and terminal output is smaller, which makes it possible to make the terminals smaller and mobile. Communication in polar regions is possible, which is difficult in a geostationary orbit on the equator. However, as satellites pass over an area in a short period of time, it is necessary to simultaneously operate a large number of satellites in order to cover a wide area while ensuring communicable time.

Figure (related data) Major non-geostationary satellites used for communications services in Japan (at the end of fiscal 2022)
URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00168
(Data collection)

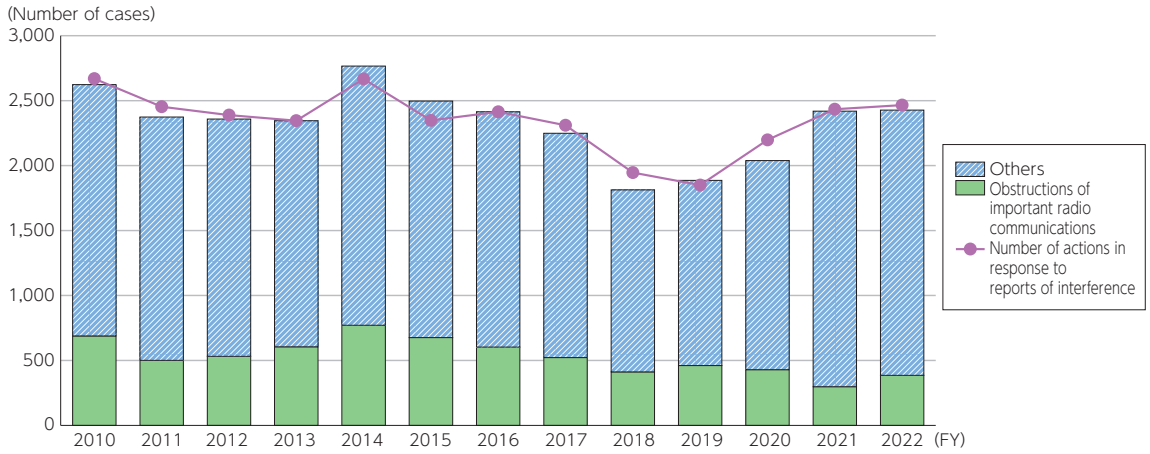
4. Radio wave monitoring to eliminate obstruction of important radio communications, etc.

Using sensor station equipment installed on steel towers and building roofs in major cities across the country and vehicles for searching for unlicensed radio stations, MIC is investigating sources of radio emissions that jam important radio communications including fire/emergency radio, aeronautical/maritime radio and mobile phones and is cracking down on unlicensed radio stations. In addition, MIC has established DEURAS, which is a system that detects emission sources of radio waves including unlicensed radio stations that cause obstructions in the radio usage environment, and is using it to monitor radio waves.[2]

In fiscal 2022, there were 2,432 reports of jamming and obstruction, an increase of 13 from the previous fiscal year, including 385 reports of obstructions to important radio communications, an increase of 87 (up 29.2%) from the previous fiscal year. In fiscal 2022, the number of actions[3] taken for jamming and obstruction reports was 2,466 (**Figure 4-4-4-1**).

Additionally, the number of unlicensed radio stations found in fiscal 2022 was 4,481, down 4,053 (30.5% decrease) compared to the previous year. The number of actions taken in fiscal 2022[4] increased by 297 (up 35.8%) from the previous year to 1,098 actions taken, which breaks down is 94 prosecutions (6.1% of all actions taken) and 1,004 guidance actions (93.9% of all actions taken) (**Figure 4-4-4-2**).

Figure 4-4-4-1 Changes in the number of reports of jamming and obstruction of radio stations and the number of actions taken



Number of reports of interference or obstruction	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	(FY)
Obstructions of important radio communications	689	501	532	605	771	676	603	522	412	461	429	298	385	
Others	1,934	1,873	1,826	1,740	1,995	1,821	1,811	1,727	1,401	1,425	1,610	2,121	2,047	
Total	2,623	2,374	2,358	2,345	2,766	2,497	2,414	2,249	1,813	1,886	2,039	2,419	2,432	

Number of actions in response to reports of interference or obstructions

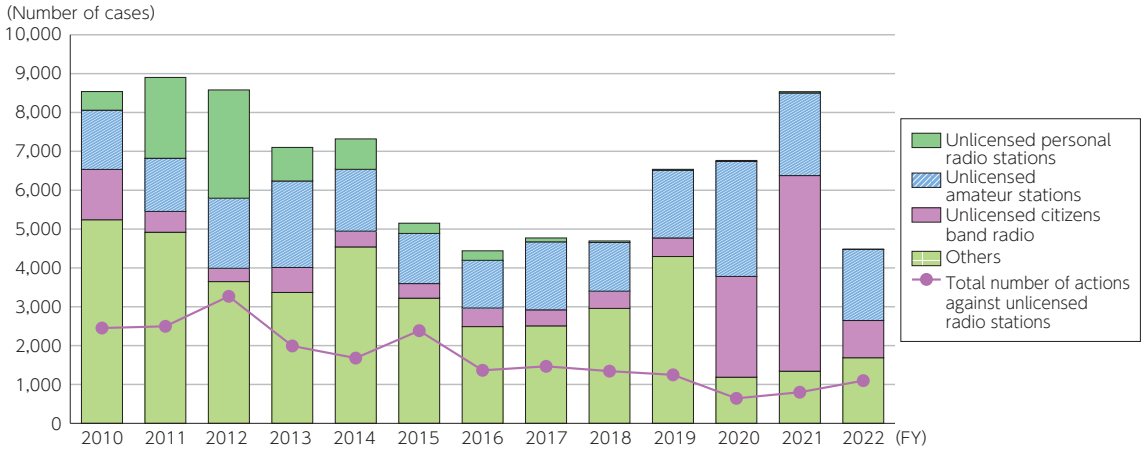
Number of actions in response to reports of interference	2,669	2,453	2,389	2,346	2,667	2,348	2,414	2,310	1,946	1,850	2,198	2,434	2,466

[2] Regarding obstructions to important radio communications, in fiscal 2010, DEURAS established a 24-hour system for receiving obstruction reports and have been working to promptly eliminate them. As an international radio wave monitoring facility registered with the International Telecommunication Union (ITU), DEURAS plays a role in HF and cosmic radio wave monitoring.

[3] The number of actions taken includes actions in response to reports made in the previous fiscal year, for which action had not previously been taken.

[4] The number of actions taken includes actions in response to reports made in the previous fiscal year, for which action had not previously been taken.

Figure 4-4-4-2 Changes in the number of reports of unlicensed radio stations and the number of actions taken



(FY)

Number of unlicensed radio stations found		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Stations found	Unlicensed personal radio stations	479	2,081	2,788	865	784	265	245	99	40	28	25	32	3
	Unlicensed amateur stations	1,525	1,367	1,803	2,225	1,592	1,291	1,229	1,749	1,253	1,739	2,959	2,126	1,831
	Unlicensed citizens band radio	1,295	538	342	642	404	375	478	414	443	477	2,594	5,035	958
	Others	5,239	4,917	3,648	3,369	4,541	3,221	2,489	2,508	2,958	4,293	1,187	1,341	1,689
	Total	8,538	8,903	8,581	7,101	7,321	5,152	4,441	4,770	4,694	6,537	6,765	8,534	4,481

Number of actions against unlicensed radio stations

Number of actions	Prosecution	262	249	231	228	215	230	168	168	208	189	62	49	94
	Guidance	2,190	2,247	3,038	1,764	1,465	2,156	1,196	1,300	1,136	1,058	581	752	1,004
	Total	2,452	2,496	3,269	1,992	1,680	2,386	1,364	1,468	1,344	1,247	643	801	1,098