Sharing and compatibility studies in the 28 GHz band in Japan

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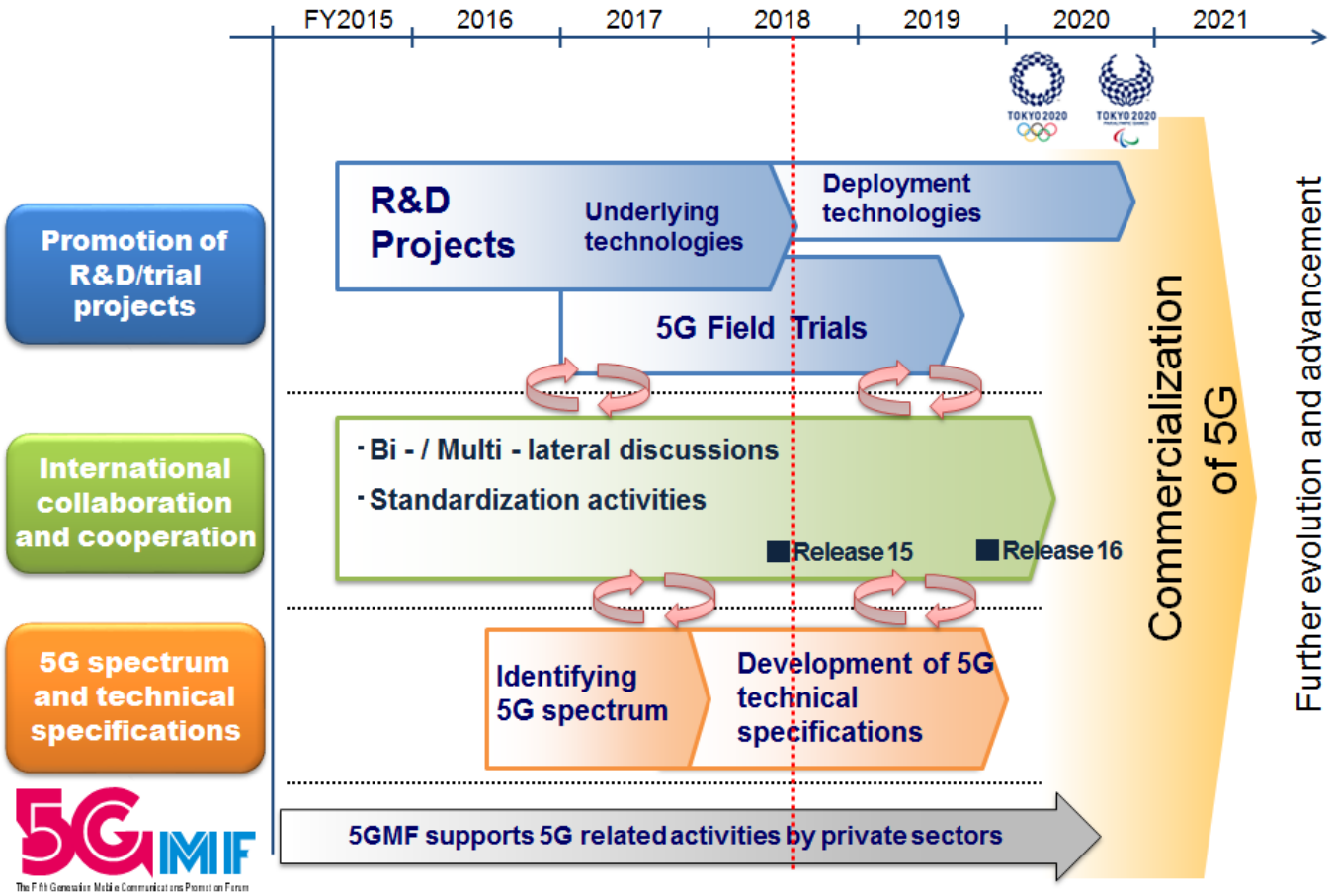
Roadmap for 5G commercialization in Japan

- In Japan, towards 5G commercialization by around 2020, relevant activities were started from around the year 2015.



Candidate new spectrum for 5G in Japan

- Towards 5G commercialization, **MIC* plans to allocate new spectrum for 5G by around the end of March 2019**.

*Ministry of Internal affairs and Communications

Candidate bands

- The 3.7 GHz band (3.6-4.2 GHz)
- The 4.5 GHz band (4.4-4.9 GHz)
- **The 28 GHz band (27.0-29.5 GHz)**

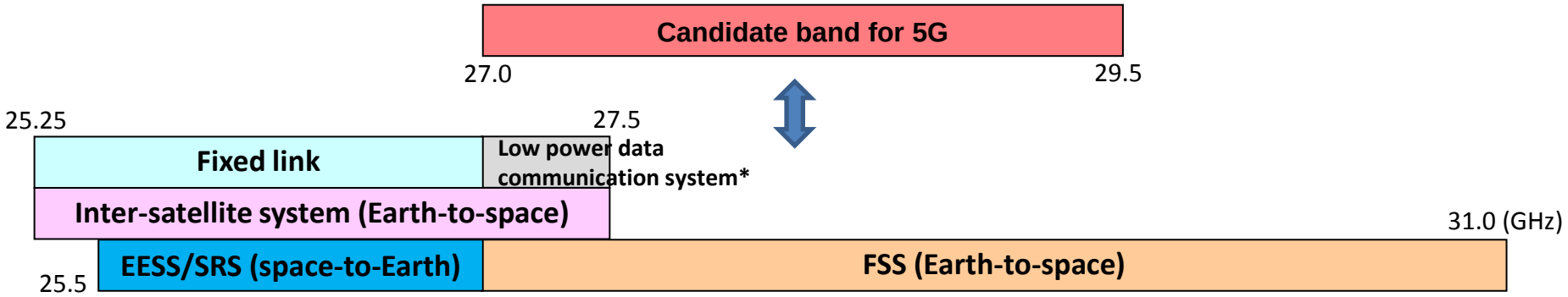
- **This presentation introduces an overview of the sharing and compatibility studies in the 28 GHz band in Japan, which have been completed recently.**

Report on 5G technical conditions by the Information and Communications Council

- In Japan, **before allocating spectrum for new technologies, conditions of spectrum use by such technologies are studied.**
  - The studies are conducted/reviewed by operators, manufacturers, academia, etc.

- **On 31st July 2018, the Information and Communications Council published a report on technical conditions for 5G in Japan.**
  - Press release by MIC (in Japanese)
    - http://www.soumu.go.jp/menu_news/s-news/01kiban14_02000343.html
  - Link to the report (in Japanese)
    - Overview: http://www.soumu.go.jp/main_content/000567503.pdf
    - Details: http://www.soumu.go.jp/main_content/000567504.pdf

Incumbent systems in the 28 GHz band in Japan



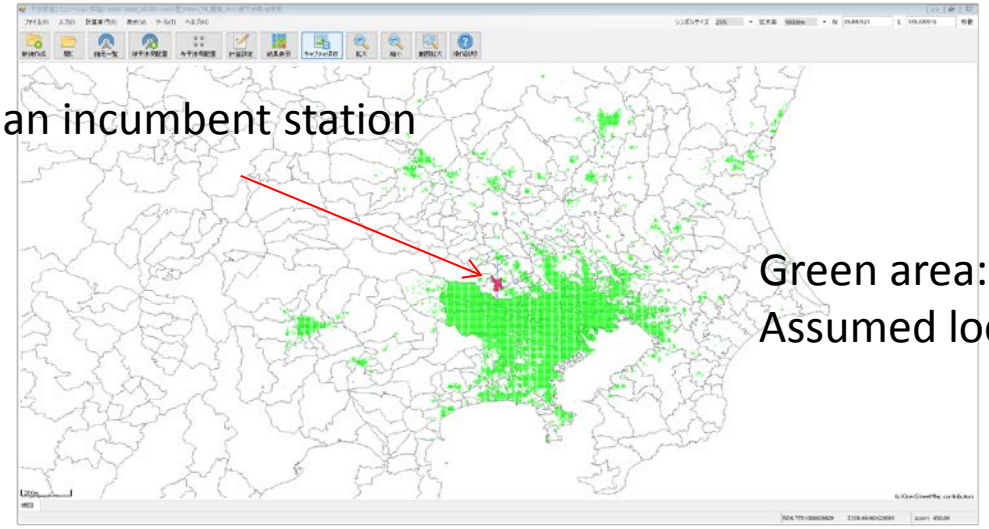
- FSS (Earth-to-space) including GSO and NGSO
- ISS (Earth-to-space)
- MS (Low power data communication system)*
- EESS/SRS (space-to-Earth)
- FS

*No station exit, currently

Methodologies for sharing and compatibility studies (1)

- **An interference calculation tool is used, which can take into account the terrain profile and clutter loss (average building height).**
  - Aggregate interference effect is also taken into account.

Image of the interference calculation tool

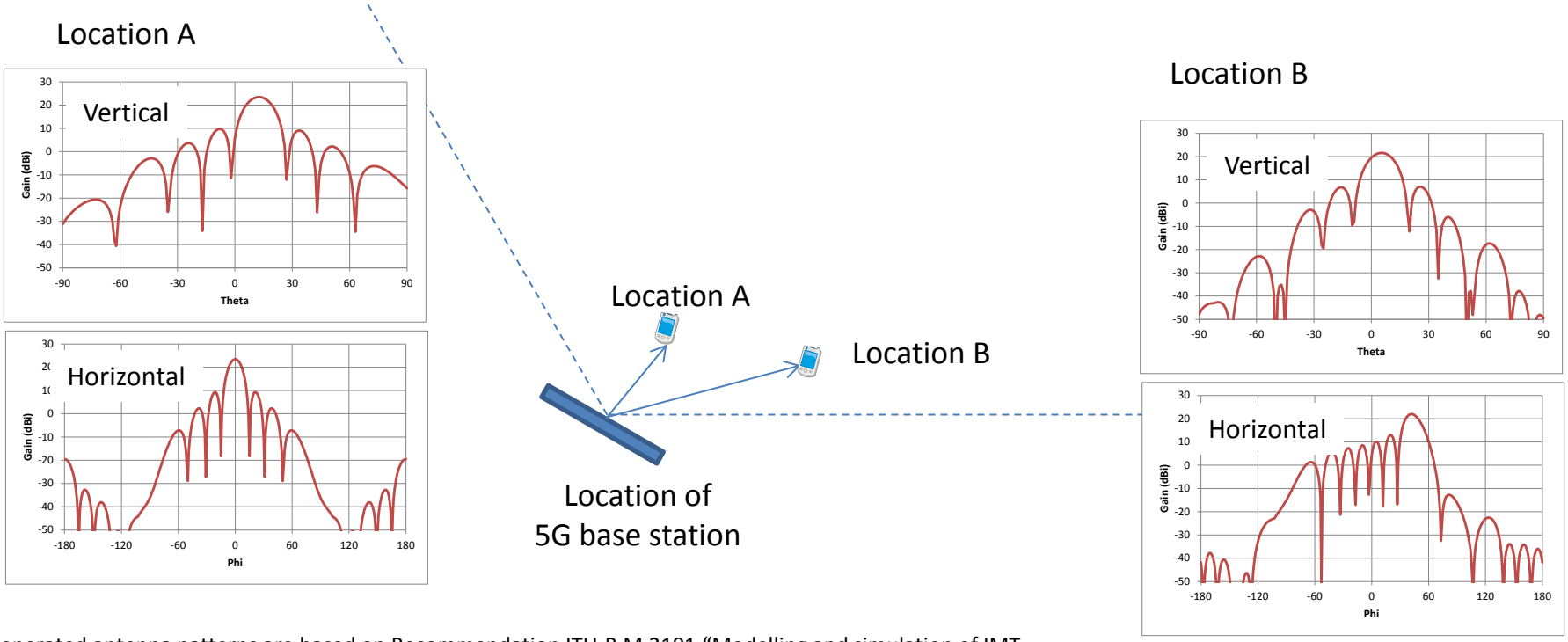


  - In some cases, simple single-entry analysis was used based on a minimum coupling loss model.

Methodologies for sharing and compatibility studies (2)

Effect of beam-forming of 5G stations

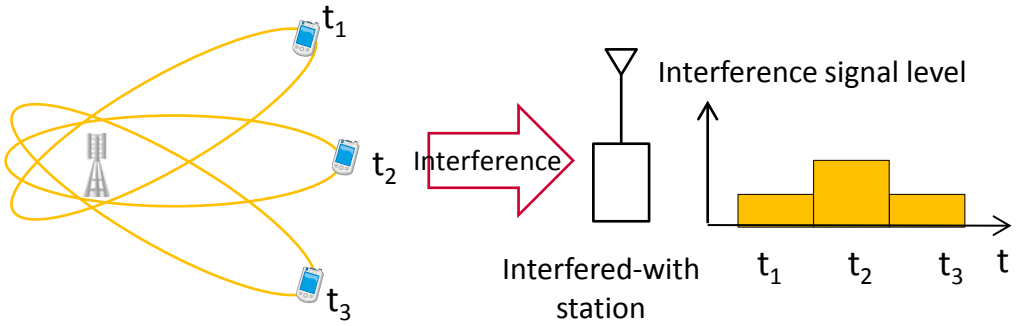
- Depending on its location, antenna patterns of a 5G base station vary.



Generated antenna patterns are based on Recommendation ITU-R M.2101 “Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies”

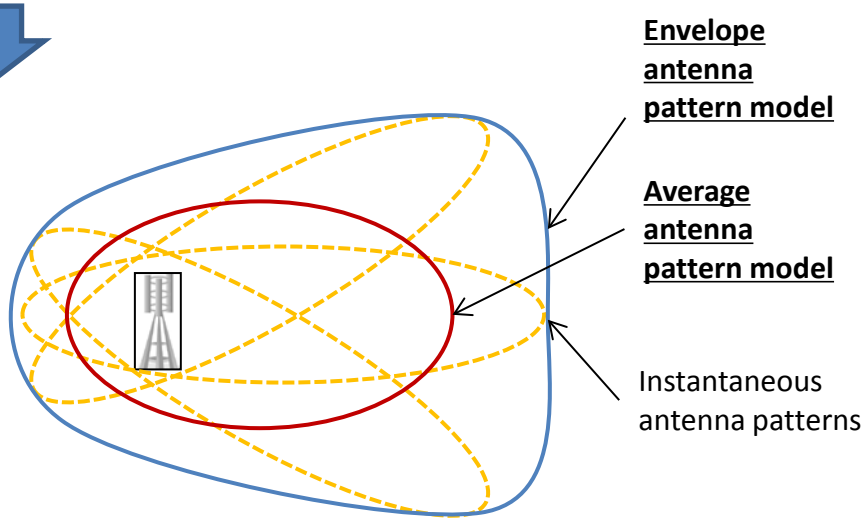
Methodologies for sharing and compatibility studies (3)

- **The interference signal level varies in accordance with the beam-forming antenna pattern.**



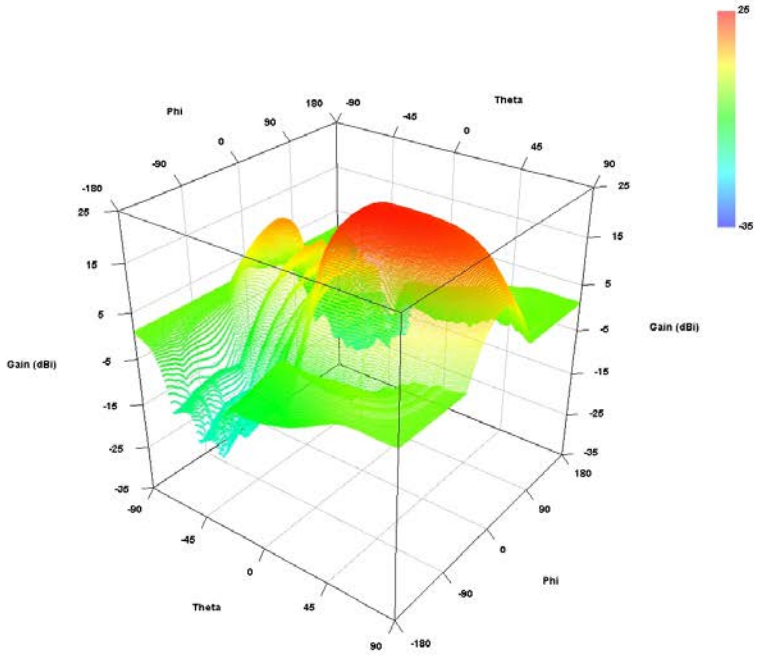
Beam-forming antenna patterns at different timings

- In the studies, **this variation is taken into account by modeling the antenna patterns used in the sharing studies**.

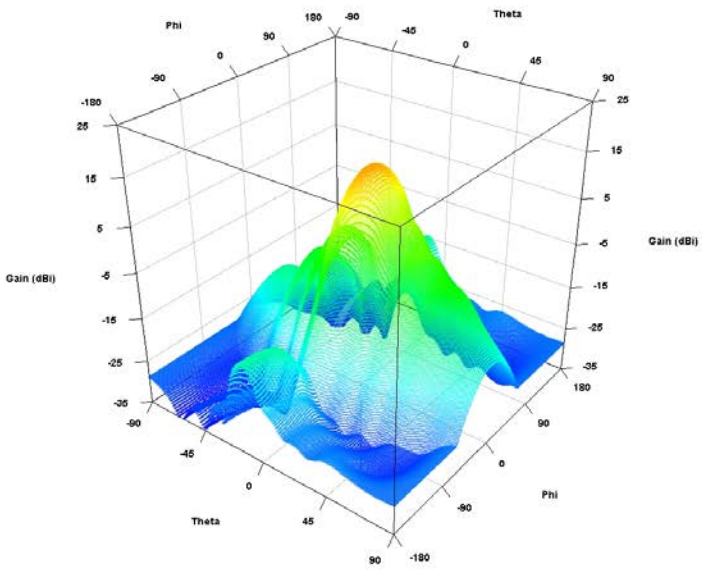


Methodologies for sharing and compatibility studies (3)

- **Envelope antenna pattern model**



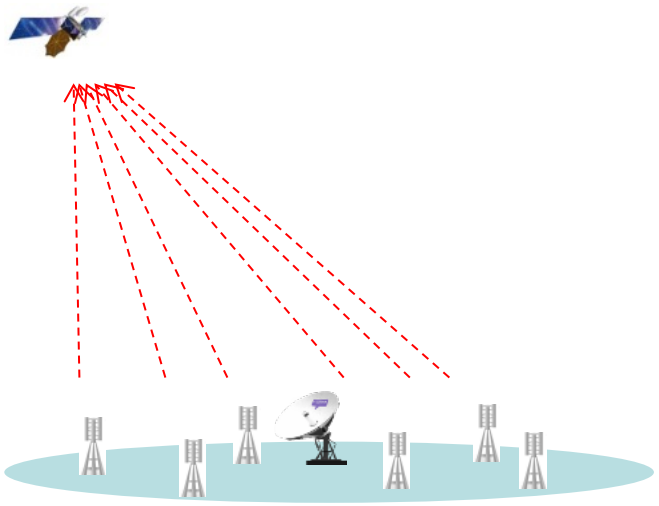
- **Average antenna pattern model**

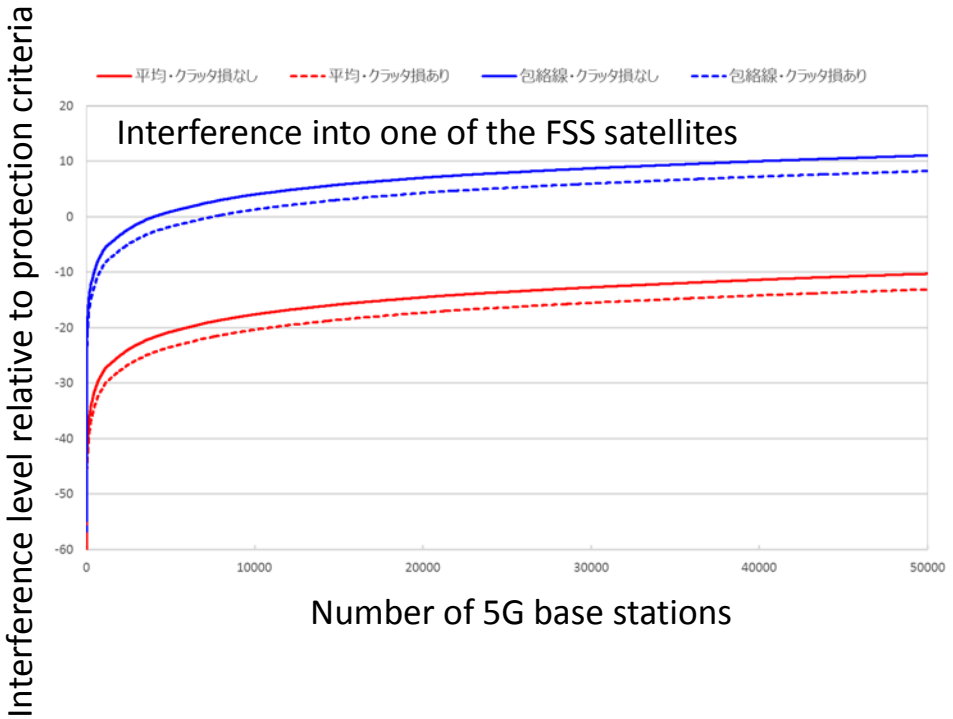


Example results of sharing and compatibility studies (1)

- **5G → FSS/ISS satellites**
  - Aggregate interference from multiple 5G base stations into satellites was evaluated.

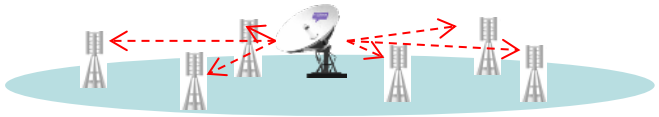
→ It is demonstrated that a sufficient number of 5G base stations can be deployed while protecting these satellites.

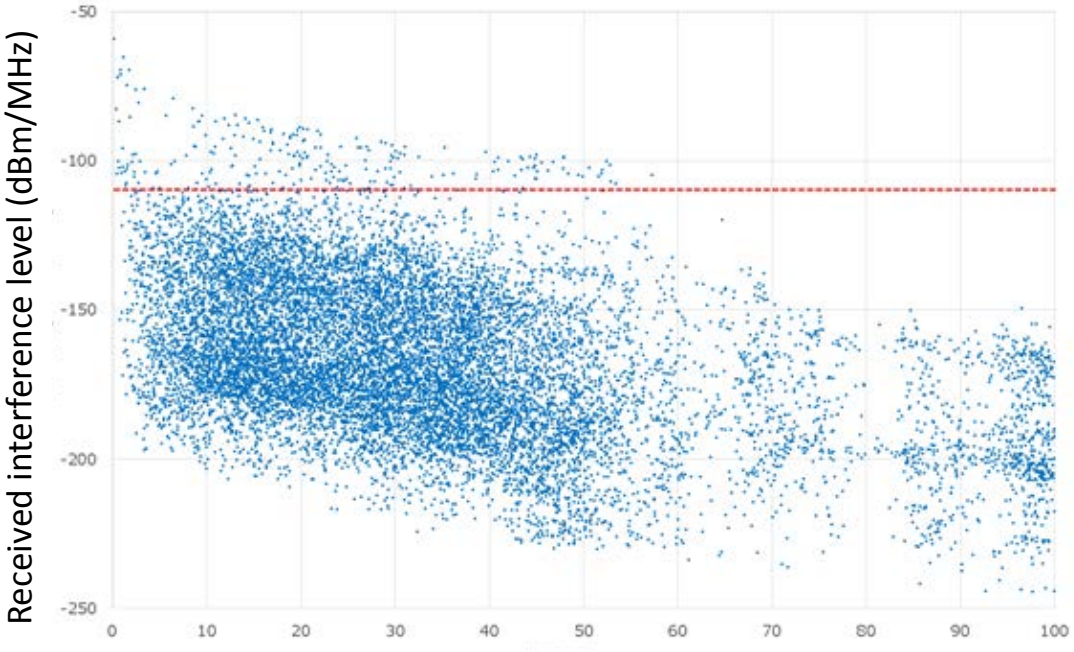




Example results of sharing and compatibility studies (2)

- **FSS/ISS earth stations → 5G**
  - → When the location of an earth station is specified (e.g., FSS/ISS gateway), sharing is feasible through coordination.
  - → When the location of an earth station is unspecified (e.g., small FSS earth station), sharing in the same band is difficult.

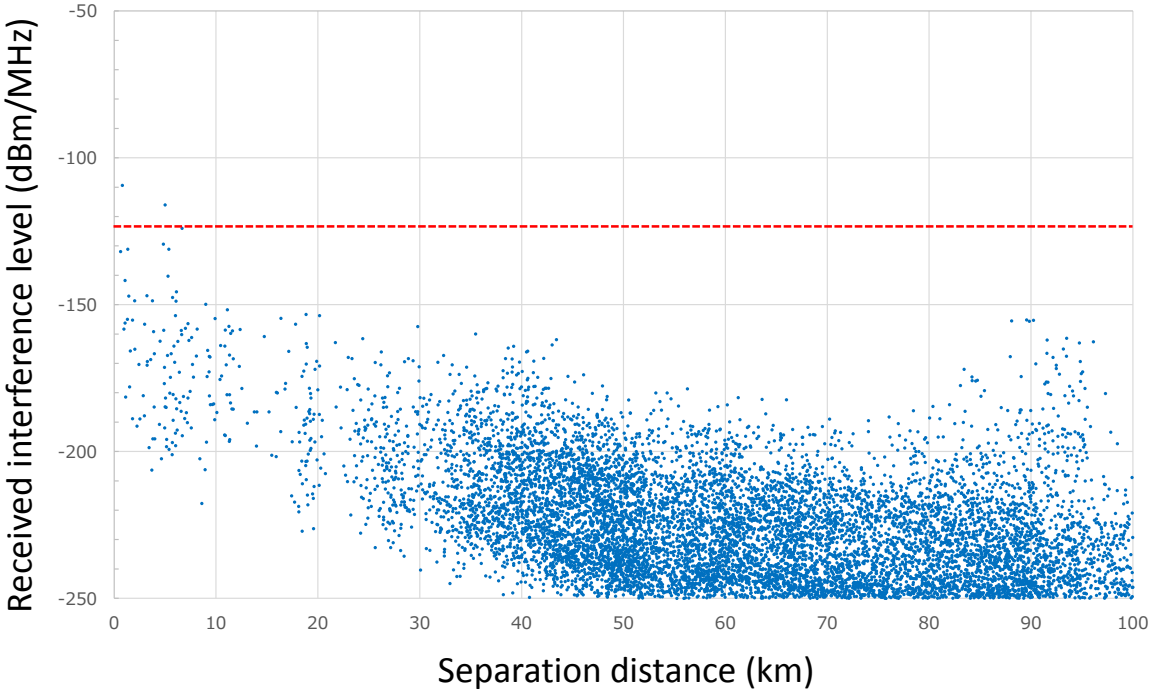




Example results of sharing and compatibility studies (3)

- **5G → EESS/SRS earth stations**
  - Aggregate interference from multiple 5G base stations into earth stations was evaluated.

→ As the earth stations are to be established in specified and limited locations, sharing is feasible through coordination.



Overview of results of sharing and compatibility studies in 28 GHz

Interference scenario		Overview of results
5G → FSS/ISS satellites	Co-freq.	• Sharing is feasible by appropriately monitoring the 5G base stations' deployment.
FSS/ISS earth stations → 5G	Co-freq.	• When the location of an earth station is specified (e.g., FSS/ISS gateway), sharing is feasible through coordination. • When the location of an earth station is unspecified (e.g., small FSS earth station), sharing is difficult. Thus, the use of a different band is required.
5G → EESS/SRS earth stations	Adj-freq.	• Sharing is feasible by coordination in the vicinity of earth stations.
5G → FS FS → 5G	Adj-freq.	• Sharing is feasible by coordination, including site-engineering technique.

Key issues to facilitate sharing

- **Realistic assumptions should be employed in the studies.**
  - Taking into account realistic operational characteristics of stations
  - Taking into account realistic propagation models (terrain profile, clutter loss, etc.)

- In some cases, **investigation on actual performance of stations is beneficial.**
  - Taking into account realistic unwanted emission levels,
  - Taking into account realistic protection criteria, etc.

- In order to take into account the above aspects, **mutual understanding between incumbent users and new comers is essential**.

Future expected actions

- Based on the results of studies summarized in the report, **MIC will:**
  - **Implement the 5G technical conditions into their relevant laws; and**
  - **Develop a detailed frequency allocation plan.**

- **Details of these contents will be available when their drafts are provided through MIC's public consultation.**

Summary

- In Japan, towards 5G commercialization by around 2020, MIC plans to allocate new spectrum for 5G by around the end of March 2019.
- For this purpose, sharing and compatibility studies for three candidate bands (3.7GHz, 4.5 GHz and 28 GHz) have been completed recently.
- Taking into account the results of studies and other aspects, MIC will develop a detailed spectrum allocation plan for 5G in Japan.