Recent status of spectrum management in mm/submm bands in 2024

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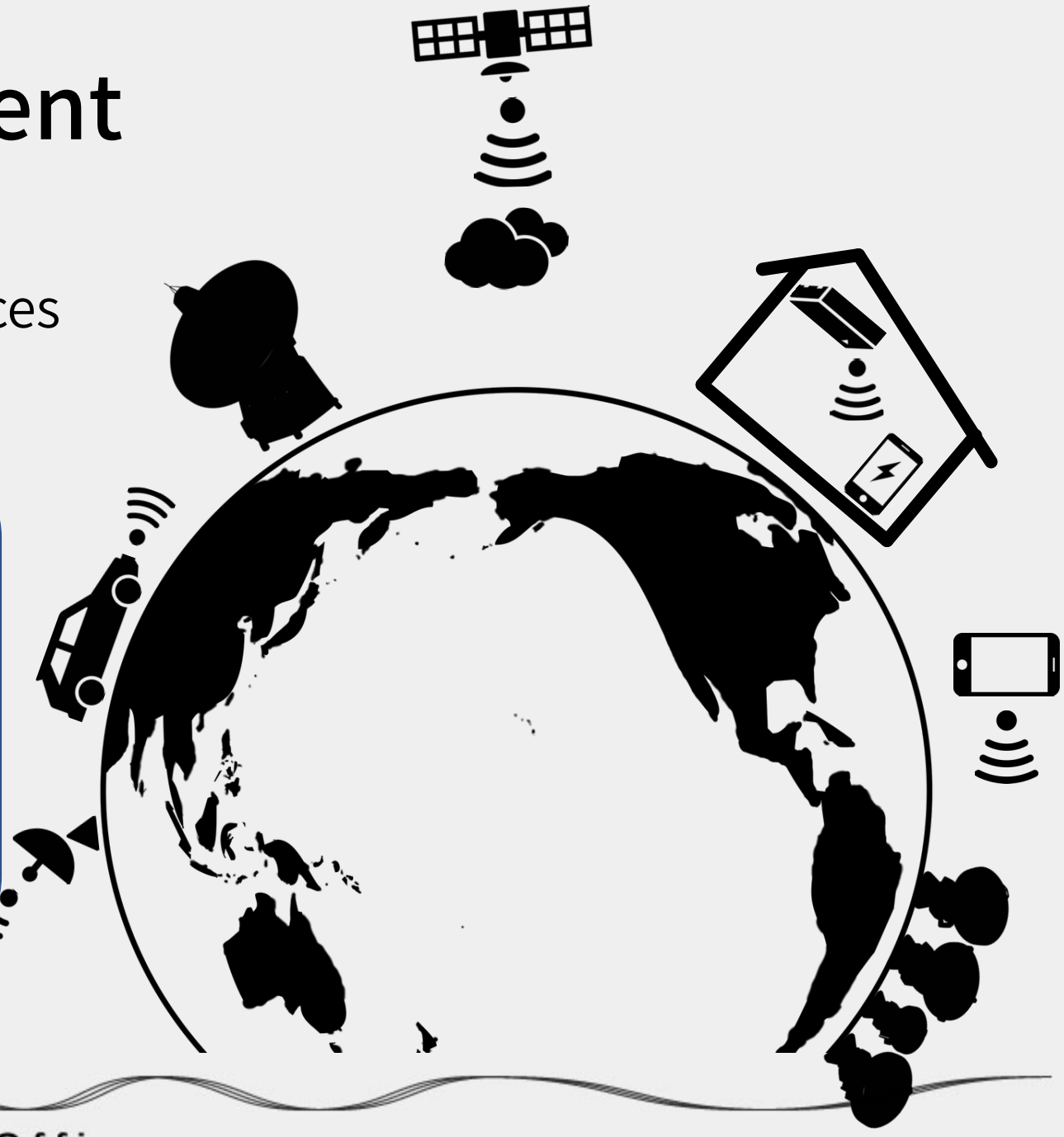
1. Framework of Spectrum Management for Astronomy

Spectrum Management

We are sharing finite frequency resources with many services and applications.



NAOJ Spectrum Management Office

- ✓ **Coordination and discussion** with Administrations and other radio users to establish **coexistence** between radio astronomy and other radio applications.
- ✓ > 40 domestic/3 international meetings in 2024.

Overall Structure of Spectrum Management

総務省
(MIC)

Subsecretaría de
Telecomunicaciones (Subtel)

Radiocommunication Sector, the International Telecommunication Union (ITU-R)

- ✓ studies issues related to radio communications
- ✓ allocate frequency ranges to various services

Spectrum Managers in World Radiocommunication Conference 2024 in Dubai

2. International Issues, including topics in Chile

ALMA Integrated Spectrum Management Team

- Giorgio Siringo (JAO), Andrew Williams (ESO), MH (NAOJ), Harvey Liszt (NRAO), Sean Dougherty (JAO)

- Had several online meetings in 2024.
  - Sharing the situation of spectrum management in Chile (CWG).
  - Sharing international context of spectrum management in ITU.
  - Recommended JAO to more tight connection with SubTel.

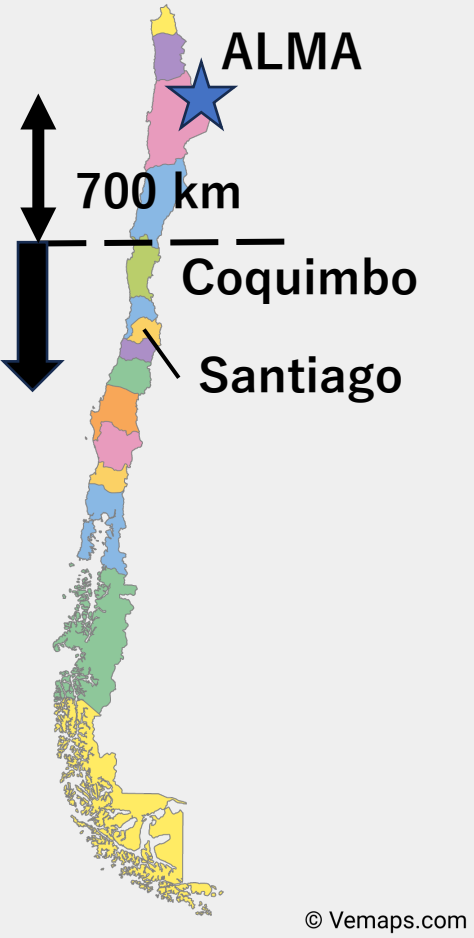
ESA/JAXA EarthCARE

- 94.05 GHz Cloud Profiling Radar
- Launched in May 2024
  Operation started in June 2024

- Agreement between ESA and IUCAF:
  The EARTHCARE CPR will be set to "Silent State" when above the radio astronomy sites (including ALMA and Nobeyama).

- JAXA produced a short movie which introduces EarthCARE takes a short nap above telescopes.

Good news: ALMA/ASTE are protected from GW stations



Chile Map by Vemaps.com

- Gateway stations: massive link with satellites
  - Some companies, including SpaceX, are considering to use mm-wave for gateway-satellite connection.
- Subtel modified the regulation on 30 Nov. 2024.
  - "In the bands 71 - 76 GHz and 81 - 86 GHz only gateways located from **the Coquimbo region to the south** of the country are authorized (…), which may be decided **to avoid interference with ALMA**, or avoid interference with other telecommunications services."
- Gateway stations using mm-wave will not come close to ALMA/ASTE!
  - BUT this is only effective in Chile. No regulations in Bolivia and Argentina.

Protection of Radio Astronomy from Satellites

- **New ITU-R resolution for studies to protect RQZ and other radio astronomy sites** from interference from satellite constellations until 2027.
- Studies include
  - how the interference from **unwanted emissions from a non-GSO satellite system** affects the operation of Radio Astronomy stations.
  - **new coexistence measures** between non-GSO satellite systems and RAS stations in the RQZs (SKA in South Africa and ALMA in Chile).
- And to consider appropriate **technical and/or regulatory measures**

Other WRC-27 Agenda Items in mm/submm

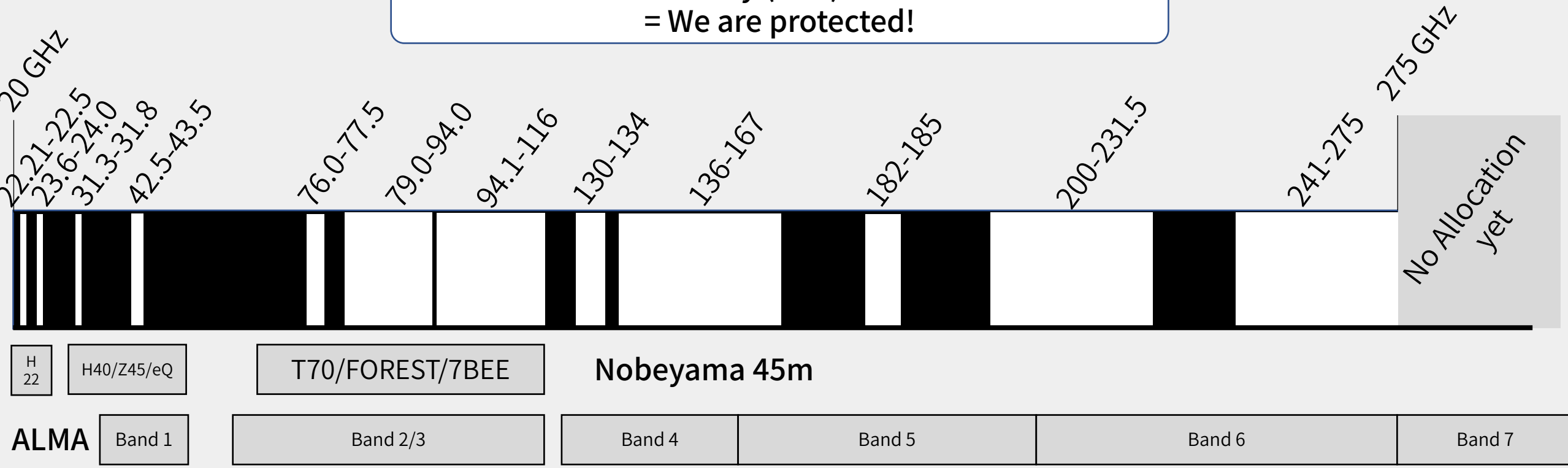
- to consider
  - possible **additional spectrum allocations** to the radiolocation service in the frequency range **231.5-275 GHz**
  - possible **new identifications** for radiolocation service applications within the frequency range **275-700 GHz for mm/submm imaging systems**

- Several agenda items to study frequency usage and technical/regulatory measures for
  - 40/50 GHz satellite communications
  - > 76 GHz active services

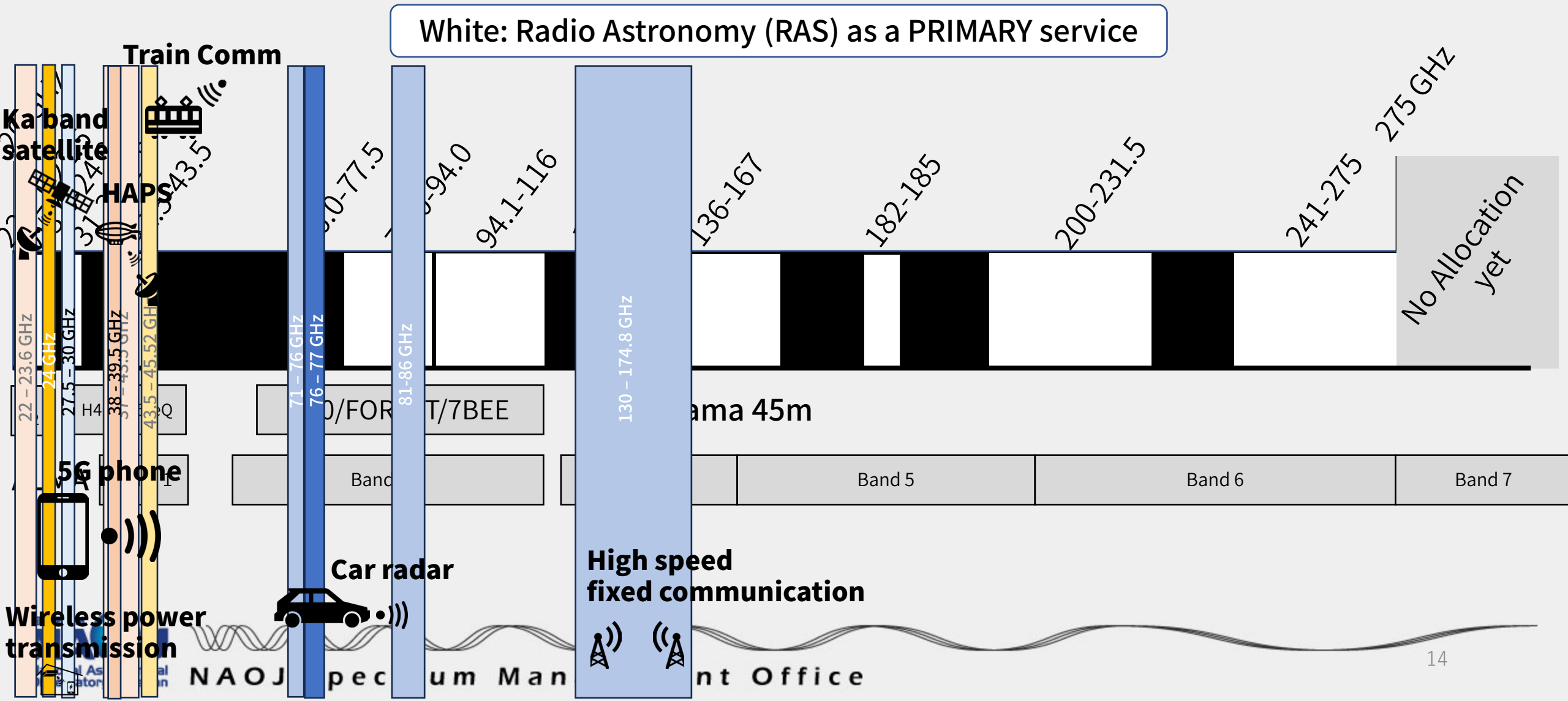
3. Domestic Issues in Japan

Frequency Allocation in mm-wave band

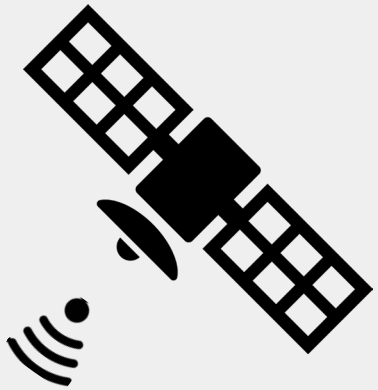
White: Radio Astronomy (RAS) as a PRIMARY service
= We are protected!



Frequency Allocation in mm-wave band



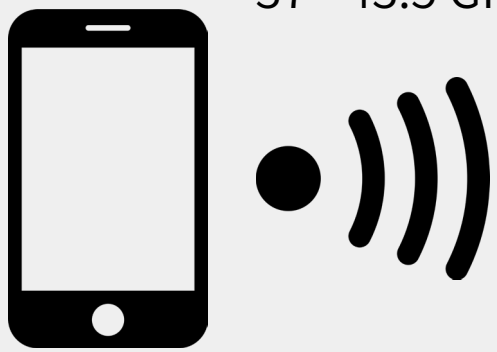
Ka-band Satellite（Amazon Project Kuiper）



17.7-18.6, 18.8-20.2 GHz
27.5-30.0 GHz

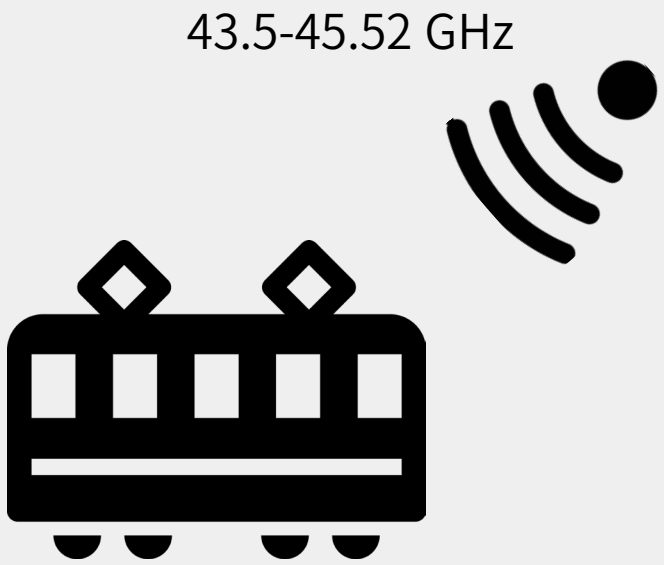
- ✓Background：
  - ✓**Amazon** plans to construct a satellite constellation consisting of 3236 satellites.
  - ✓Two experimental sats were launched in October 2023.
- ✓Protection of radio astronomy:
  15.35-15.4, 22.01-22.5, 23.6-24, 31.2-31.8 GHz
- ✓Current status:
  - ✓Official discussion in MIC is taking place.
  - ✓No direct overlap or adjacency with bands allocated to radio astronomy.

40 GHz “5G” cellphone



- ✓Background: To expand cellphone bands**, 26/40 GHz is going to be assigned for 5G**.
- ✓Technical studies are underway to move fixed wireless, which currently uses 26 GHz, to 22 GHz.
- ✓Allocation to Radio Astronomy:
  22.21 -22.5, 23.6 - 24, 42.5 - 43.5 GHz
- ✓Current Status:
  - ✓**Separation distance of ~ xx km** between a radio telescope and cellphone base stations is required.
  - ✓Official discussion for frequency assignment (in Japan) started.

40 GHz Train video transmission

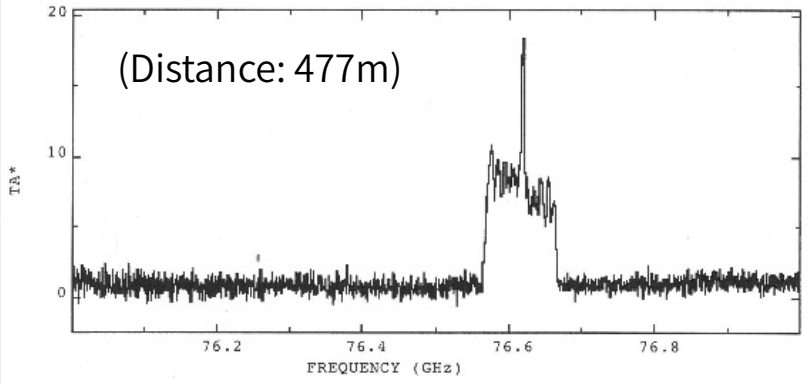


- ✓Background: designed for **video transmission between trains and station platforms**. Assumed to ensure safety when doors are operated in one-man operations.
- ✓Allocation to Radio Astronomy: 42.5 – 43.5 GHz
- ✓Current status：
  - ✓**Separation of 33 – 57 km is needed** when a transmission beam directly points to a radio telescope. However, because the beam is narrow, **if it is separated by more than 6 degrees, there will be no harmful effect**.
  - ✓In final stage for official approval by MIC.

76 GHz automotive radar

- ✓Background: Companies want to realize **higher power radar for better sensitivity** (wider FoV and longer distance).
- ✓76 -77 GHz: Co-primary with Radio Astronomy
- ✓Current Status:
  - ✓ Discussion with radar companies is ongoing.
  - ✓ Calculating necessary separation around Nobeyama and VERA.

Radar experiment at NRO45m (May 2015)

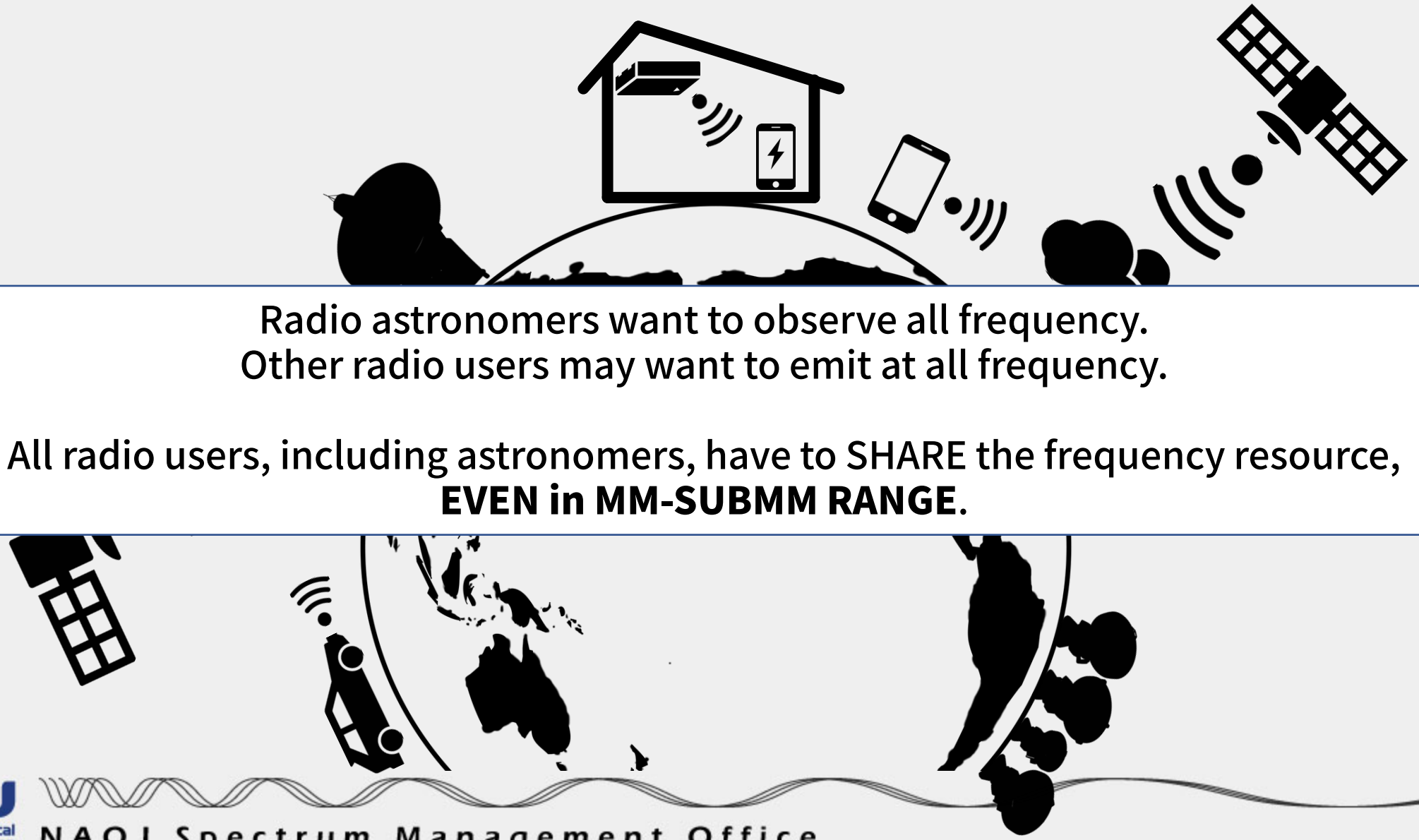


Mm-wave high speed fixed communication

71-76, 81-86,
130-174.8 GHz

- ✓Background: **Demand for broadband fixed wireless communication systems** is increasing. Discussions on the realization of a new type of communication in mm-wave band are underway from FY2022.
- ✓Allocation to Radio Astronomy:
  76-77.5, 79-94, 130-134, 136-167 GHz
- ✓Current status：
  - ✓Official discussion with MIC started October 2024.
  - ✓For current system, **individual operation coordination** is needed if the distance between transmitter and a radio telescope is **less than 50 km**. Similar condition may be introduced.

Spectrum Management



Radio astronomers want to observe all frequency.
Other radio users may want to emit at all frequency.

All radio users, including astronomers, have to SHARE the frequency resource,
EVEN in MM-SUBMM RANGE.