Frequency and Legal Regulations Surrounding a Ground Station Network

Naomi Kurahara
Regulations

- Launch provider related
- Satellite operator or service provider related
- Ground service provider related
Regulations

• Satellite operator or satellite service provider related
  • Satellite operation related
    • International frequency coordination (via ITU)
    • IARU coordination for amateur frequency
    • Radio licensing for satellite and ground station (Radio law)
    • Permission/Registration (The law for space activity)
  • Mission related
    • Remote sensing law
    • Communication business act
    • etc.
Why Do We Need to Care?

International Frequency Coordination

• To avoid harmful interferences

Because number of LEO satellite is increasing so rapidly, pressure to obey the rule is also increased.

• ITU, IARU
• Government: FCC, etc.
• Launch provider
• GEO satellite operators, terrestrial radio operators

We need to follow the rules, if we want to keep use frequencies
ITU Frequency Coordination Principles

• Radio frequencies and orbits are limited natural resources.

• Therefore, any radio service operator needs to try to limit the number of frequencies and the spectrum used to the bare minimum to provide their necessary services in a satisfactory manner.

• Any new assignment, any change of frequency, or any other basic characteristic of an existing assignment must avoid causing harmful interference to other services.
ITU Frequency Coordination Mechanism

Interference Control Mechanism

- Allocation
  - Regulatory Protection
    - Power Limits

Coordination
1) Allocation

- Frequency allocation:

  Frequency use definition separated by stations of different services
  
  - Each frequency band includes one or more radio service.
  
  - NOT allowed to use a band for undefined services.
  
  - The world has been divided into three regions and each region has different frequency allocation.
<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
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<tbody>
<tr>
<td>410-420</td>
<td>FIXED</td>
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<tr>
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<tr>
<td>420-430</td>
<td>FIXED</td>
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<tr>
<td>Radiolocation 5.269 5.270 5.271</td>
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<td>430-432</td>
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<td>5.269 5.270 5.271 5.284 5.285 5.286</td>
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</tbody>
</table>

**Capital: Primary Service**

**Non-capital: Secondary Service**

**Footnote**
The band **449.75-450.25 MHz** may be used for the **space operation service** (Earth-to-space) and the **space research service** (Earth-to-space), subject to agreement obtained under No. 9.21.
Radiocommunication Services

- Radio waves transmission and/or reception for specific telecommunication purposes.

- Because frequency allocation defines the permitted services, the satellite operator must choose their service carefully and accurately.

- If the wrong service is written in an application, it might be rejected.
IARU most strongly recommends that satellite builders asking for coordination make sure that their mission fits the definitions of the amateur services.

**RR 1.56**  
amateur service: A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

**RR 1.57**  
amateur-satellite service: A radiocommunication service using space stations on earth satellites for the same purposes as those of the amateur service.
2) Regulatory Protection

Special regulatory protections for specific applications.

Example

- **Geostationary satellite** is given priority over **non-geostationary satellite**. Non-geostationary satellite shall not cause unacceptable interference to and shall not claim protection from geostationary-satellite networks. (Summarized from RR Volume 1, Article 22, 22.2)

- **Data collection systems (DCS)** need to have stable regulatory certainty for **long-term continuity for its operation**. The establishment of power limits for earth stations is necessary. (Summarized from RR Volume 3, RESOLUTION 765 and 766 (WRC-15))
3) Power Limits

- **Power Flux -Density (PFD)**
  
  to protect terrestrial services from space services.

- **Equivalent Isotropically Radiated Power (EIRP)**
  
  to protect space services from terrestrial services.

- **Aggregate Equivalent Power Flux -Density (EPFD)**
  
  to protect geostationary-satellite services from non-geostationary-satellite services.
Make proper frequency coordination application, avoid time loss & extra work

- 1 coordination could cover series of satellite
- Proper service?
- Enough understanding of regulatory protection and power limits?
Summary 2

• Follow the ITU rules

• If CubeSats and the small satellite community continue to use amateur frequencies without a long-term strategy, we may lose other frequency bands can be used

• There is a need to make the community’s voice heard in the ITU
Severity of testing station target countries

- USA
  - Down: NA
  - Research: Fine
  - Difficulty: Bad – no frequency allocation

- France
  - Down: NA
  - Research: Fine
  - Difficulty: Maybe good

- 4 Northern Europe
  - Down: No need license
  - Research: Good
  - Difficulty: Maybe good

- Germany
  - Research: Middle

- Lithuania
  - Research: Middle

- Russia
  - Research: Bad

- Kazakhstan
  - Down: OK
  - Research: Middle
  - Difficulty: Bad – Regulation on foreign entity

- Mongolia
  - Research: Bad
  - Difficulty: Bad – Regulation on foreign entity

- Bangladesh
  - Research: Bad
  - Difficulty: Bad – Regulation on foreign entity

- India
  - Research: Bad
  - Difficulty: Bad – Regulation on foreign entity

- Singapore
  - Down: NA
  - Research: Fine
  - Difficulty: Fine

- Australia
  - Down: NA
  - Research: Fine
  - Difficulty: Good
  - Sat Name: Need

- Italy
  - Down: OK
  - Research: Middle
  - Difficulty: maybe OK

- South Africa
  - Down: OK
  - Research: Good
  - Difficulty: Not Clear

- Rwanda
  - Down: not clear
  - Research: Bad
  - Difficulty: said OK
Thank You

Please feel free to directly reach out if you have any questions.

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