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1. Overview

What is spectrum management?

- The coordinated usage of the entire electromagnetic radiation spectrum.

Frequency Range covered: freq.< 9 KHz to 400 GHz<freq.
(near D.C. to the near-IR)

Geographical Regions covered: National,
International,
Interplanetary (?), ...

Organization for Control:

National -	NTIA and FCC.
International -	The International Telecommunications Union (ITU) headquartered in Geneva
Interplanetary -	TBD

Mechanism for Control:

- World Radiocommunications Conferences (WRCs) held by the ITU every 2 years (now) with set agendas, and
- Voluntary compliance internationally.

Level of Control/Definition:

- Final Acts of WRC's have treaty-level status (President signs the treaty with advice/consent of Senate).
- These Acts trickle into the U.S. Radio Regulations.

Governing agencies in the U.S.A.:

- NASA answers via the National Telecommunications and Information Agency (NTIA), and
- Non-governmental parties answer through the Federal Communications Commission (FCC).

Frequency Bands are allocated to specific services:

Earth Exploration Science Service (EESS, or us),

Space Research, Radio Astronomy,

Fixed (point-to-point) Service, etc.

Rarely are bands uniquely assigned to any one service:

- Sharing and determining the parameters that allow sharing are crucial to obtaining and maintaining band allocations.
- Intelligent compromise is the essence of existence.

Services are given allocations in each band:

- Primary - Equal rights/privileges with all other primary users in the band. Must coordinate with other primary users when interference exists. Newcomers must coordinate with all known band users.
- Secondary - Operate on a non-interference basis with (to) primary users, and without protection from harmful interference caused by primary users.

Footnotes to the regulations are used for minor additions and exceptions, and frequently are country-specific.

Allocations are often assigned by geographical region:

- Region 1: Europe, Africa, and Northern Asia
- Region 2: North and South America
- Region 3: Southeast Asia and the Southern Pacific

Acceptable interference levels have been recommended by the International Telecommunications union - Radiocommunications Sector (ITU-R). These recommendations are not formally in the Radio Regulations, although they are usually treated that way internationally. These pragmatic levels are not always appreciated:

- 5% for randomly occurring interference (not always at the same location); and
- 1% for interference at the same location which precludes observations there forever.

Transmitters are licensed; receivers are registered:

- To protect the “owner” by notifying others of his/her existence.
- To ensure proper coordination can be done.

N.B.: Coordination mechanisms exist, are documented, and do work; they can be expensive to implement.

Why should we care?

If we violate the radio regulations and cause harm or harmful interference, we can be sued!

If we produce obnoxious and potentially damaging signals, our license may include severe restrictions regarding when and where we may operate.

Conversely, without the proper level of protection, others can interfere with us to the point where our instruments are useless and operations difficult or irrelevant, and we have no recourse or remedy.

In practical terms:

If our SARs, scatterometers, radar altimeters, etc. or X-band transmitters cause anybody a problem today, we must coordinate our operations with the affected parties. Now we have a primary allocation for most of the active sensor bands and for X-band usage in most of the world; formerly, we had no choice but to turn off in favor of primary users in those bands. If we caused others damage and we were not within the letter of the law, we could be sued as well.

Further, our remote sensing instruments are very sensitive to interference and the quality of our data depends upon sensing a clean environment. Acceptable levels of interference have been defined, although not every remote sensing scientist likes them. However, they provide a more-or-less quantifiable means for peaceful coexistence.

Two principal areas of concern for Office of Earth Science (OES)

Remote sensing bands used by our scientific instruments, both:

- active (e.g., SARs, altimeters, scatterometers) and
- passive (radiometers); and

Communications bands used by our spacecraft, including:

- Tracking, Telemetry (downlinked data sometimes called housekeeping data), and Control (uplinking commands to the S/C), collectively called TT&C, and
- Downlinking science data.