What is spectrum management
Why manage spectrum?

• Recall: if GNSS signals share frequencies with high power terrestrial systems, eg mobile phones, GNSS reception would not be possible.

• To avoid interference, the Radio Regulations separate different service types (eg terrestrial mobile, satcoms, TV) into different frequency bands or "allocations", eg,
  – mobile at 900MHz
  – TV at 600MHz
  – satcoms at 1650MHz
  – GNSS at 1575MHz
How do you avoid interference?

- By separating systems that expect to receive very different signal levels, interference can be minimised.
- Typically satellite systems are kept well separated from terrestrial systems.
  - However, systems using highly directional antennas sometimes share frequencies, e.g. point to point links.
- Radio frequency filters are used in transmitters and receivers to avoid frequency overlap.

![Diagram of frequency bands and interference](image from TI Inc)
Adjacent frequency systems

- The problem is, frequency filters are not perfect, there is some overspill, both for transmitters and receivers
Terrestrial transmitter next to a GNSS receiver

• Imagine a GNSS receiver operating a short distance from a base station or mobile phone
• the terrestrial signal levels could be many billion times larger than the GNSS signals
• if the frequency separation is insufficient, there is a real risk that overspill tails from the terrestrial system will swamp the GNSS receiver
• the ITU spends many years working out the appropriate frequency separations to reduce interference
• and, to prevent interference between systems, national regulators apply ITU recommendations
Radio Regulation Allocations

- The result of decades of compatibility studies

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<th>Allocation to services</th>
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<td><strong>Region 1</strong></td>
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<td>1525-1530</td>
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<tr>
<td>SPACE OPERATION</td>
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services are either:
- PRIMARY
or
- secondary
(must not cause interference to primary)
Typical National Allocations

• National implementations usually align with, or mirror, the Radio Regulations
• Aligning with the RR helps minimise interference between neighbouring countries and services
• Also allows countries to benefit from harmonised spectrum use, lower equipment costs, etc
• Chart below shows UK allocations around the GNSS L-bands
Minimise interference, maximise benefits

• The Radio Regulations are the results of many decades of compatibility studies
• Experts at the ITU consider the specific characteristics and operational aspects of systems
• the experts evaluate whether systems can either share the same frequencies or use frequencies adjacent to each other
  – these are the radio compatibility studies
• the experts also define recommendations to facilitate harmonious use of the spectrum
• The Radio Regulations generally work!