



What is spectrum management

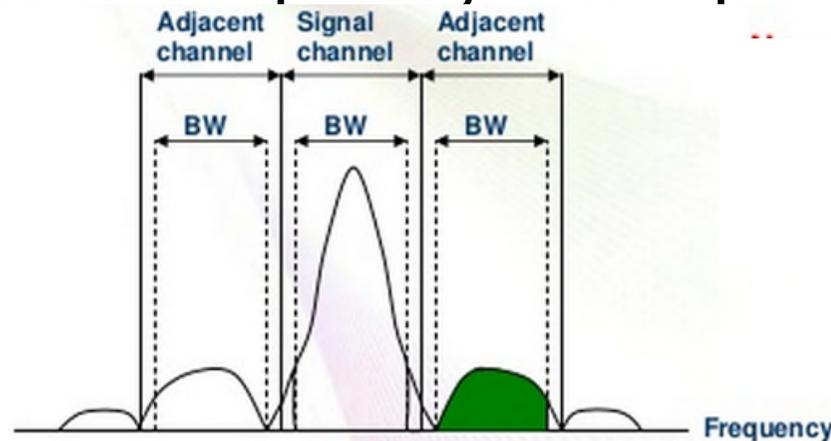
Why manage spectrum?

- Recall: if GNSS signals share frequencies with terrestrial systems, eg mobile phones, GNSS reception would not be possible
- To avoid such interference, the **Radio Regulations** separate different types of services (eg terrestrial mobile, satcoms, TV) into different frequency bands or "**allocations**"
 - eg mobile at 900MHz
 - TV at 600MHz
 - satcoms at 1650MHz
 - GNSS at 1575MHz



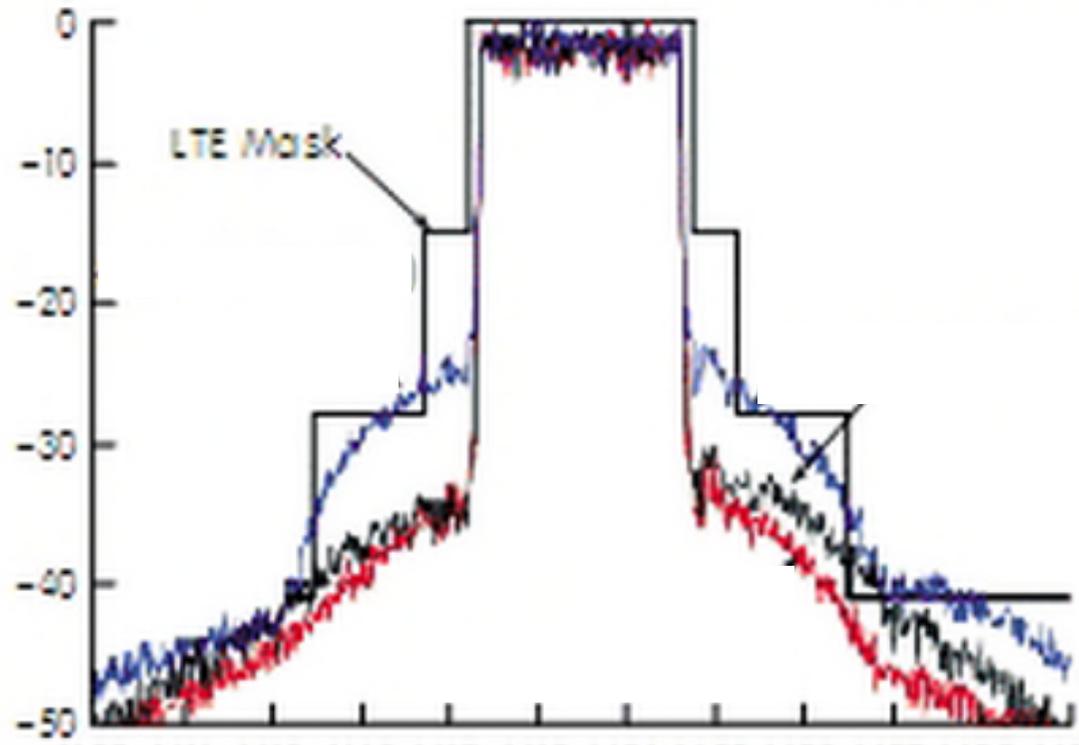
How do you avoid interference?

- 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, eg point to point links
- radio frequency filters are used in transmitters and receivers to avoid frequency overlap



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 are 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 separations to reduce interference
- to prevent interference between systems, national regulators apply ITU recommendations

Radio Regulation Allocations

- The result of decades of compatibility studies

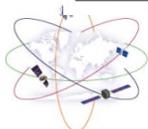
Allocation to services		
Region 1	Region 2	Region 3
1 525-1 530 SPACE OPERATION (space-to-Earth) FIXED MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A Earth exploration-satellite Mobile except aeronautical mobile 5.349 5.341 5.342 5.350 5.351 5.352A 5.354	1 525-1 530 SPACE OPERATION (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A Earth exploration-satellite Fixed Mobile 5.343 5.341 5.351 5.354	1 525-1 530 SPACE OPERATION (space-to-Earth) FIXED MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A Earth exploration-satellite Mobile 5.349 5.341 5.351 5.352A 5.354
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1 535-1 559	MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A 5.341 5.351 5.353A 5.354 5.355 5.356 5.357 5.357A 5.359 5.362A	
1 559-1 610	AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.208B 5.328B 5.329A 5.341 5.362B 5.362C	

services are either:

- PRIMARY

or

- secondary
(must not cause interference to primary)

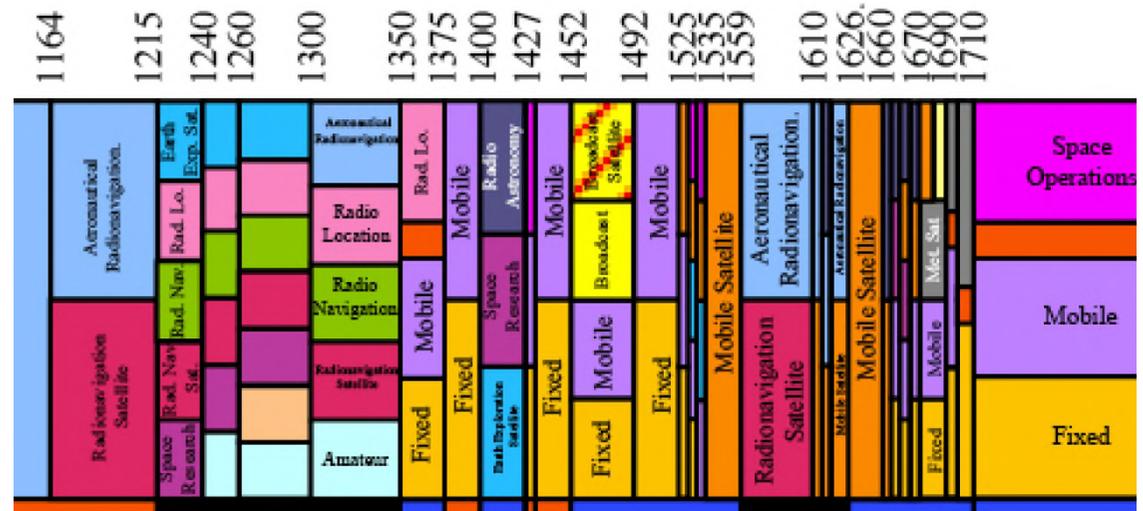


Typical National Allocations

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



ICG International Committee on
Global Navigation Satellite Systems



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!

