International Committee on
Global Navigation Satellite Systems

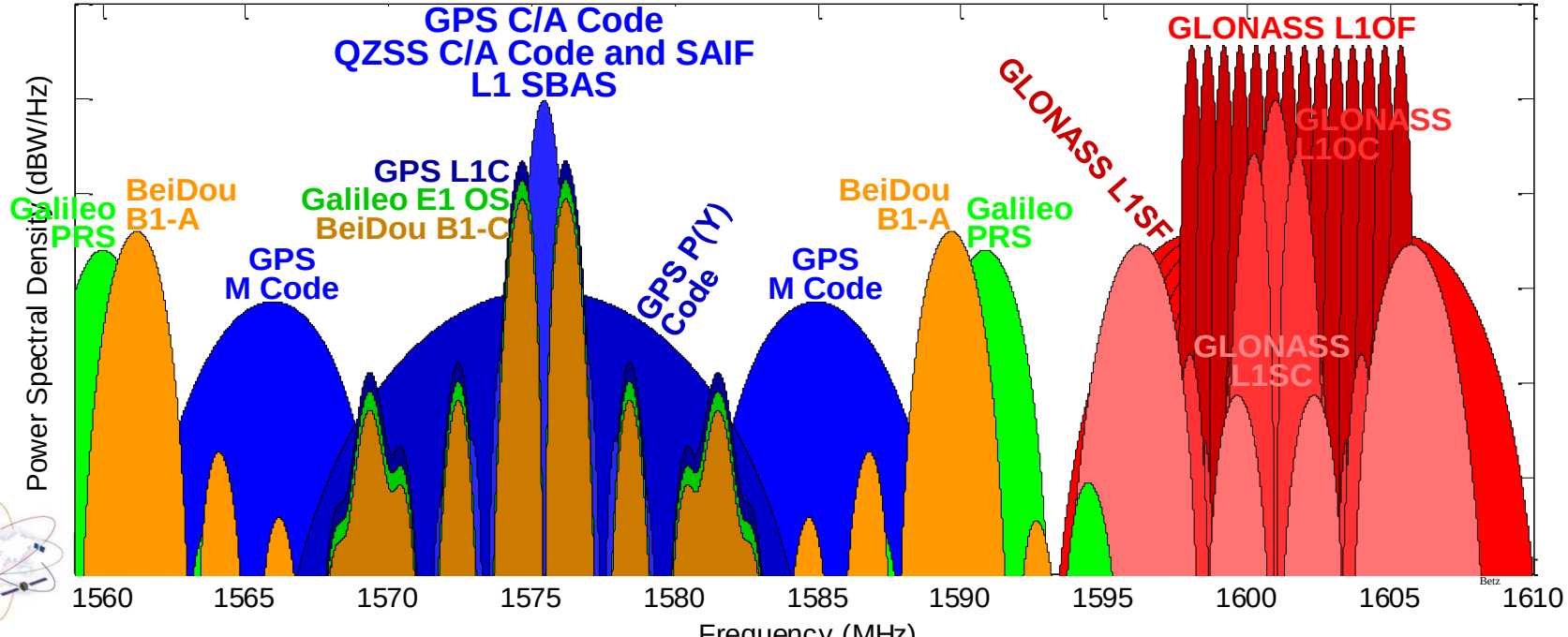
Introduction to Interference

Disclaimer

The views and opinions expressed herein do not necessarily reflect the official policy or position of any government agency

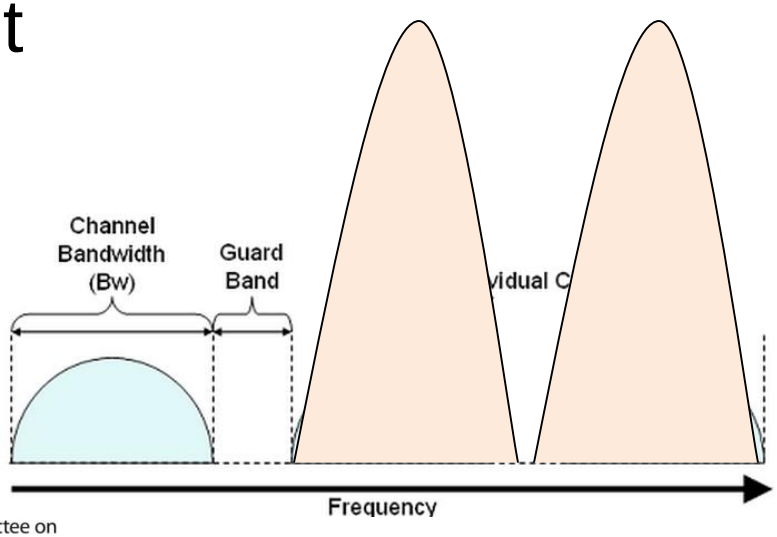
Spectrum Interference

- More technology → higher spectrum demand
  → Increased potential for spectrum interference
- Spectrum interference is an electromagnetic disturbance generated by an external source that affects the RF receiver's circuitry
- Can be unintentional or intentional



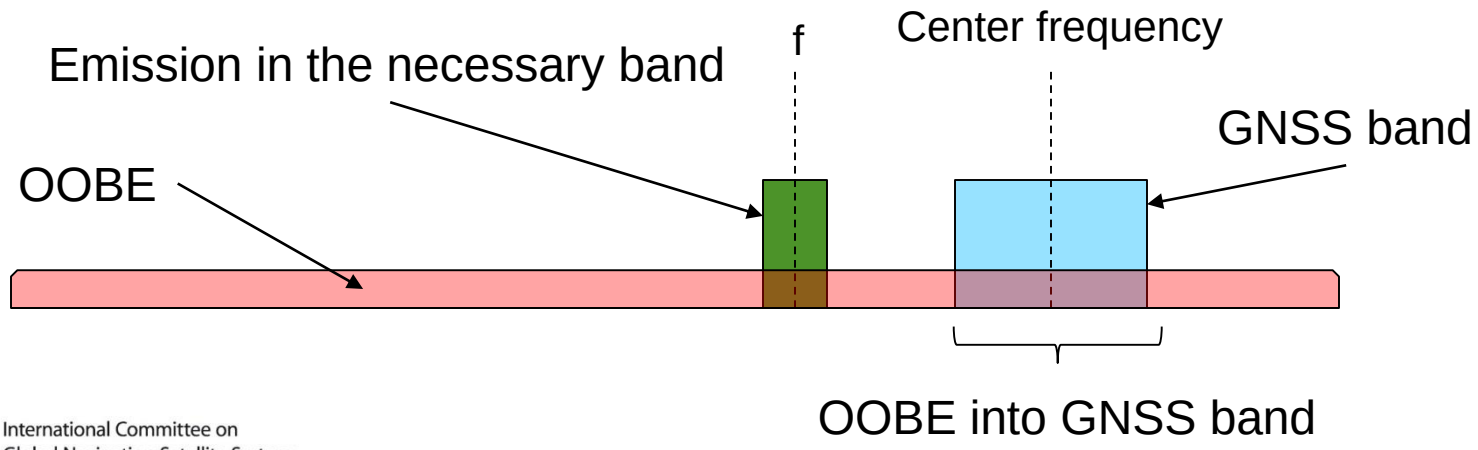
Optimizing spectrum allocations

- ITU Radio Regulations divide radio spectrum into separate "allocations" to reduce the potential for interference between different types of radio use
  - eg GNSS and TV have separate frequencies
- To minimize interference, "guard bands" between very different services have been used in the past



Out-of-Band Emission

- Out-of-band emission is an emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excludes spurious emissions
- It raises the noise floor of the GNSS receivers and the Carrier signal-to-Noise ratio (CNR) is reduced, impacting GNSS receiver performance

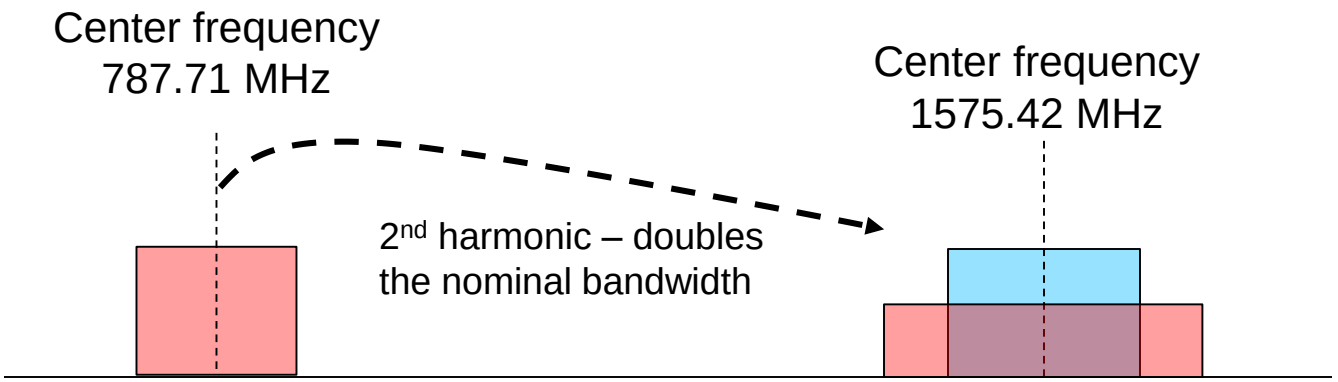


Spurious Emission

- Spurious emission is an emission not deliberately created or transmitted on a frequency or frequencies which are outside the necessary bandwidth
- Examples include harmonic emissions and intermodulation products
- These are described in the next two slides

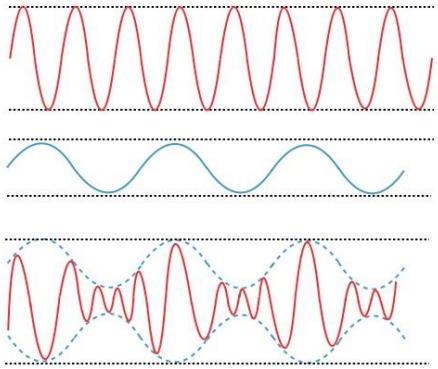
Harmonic Emission

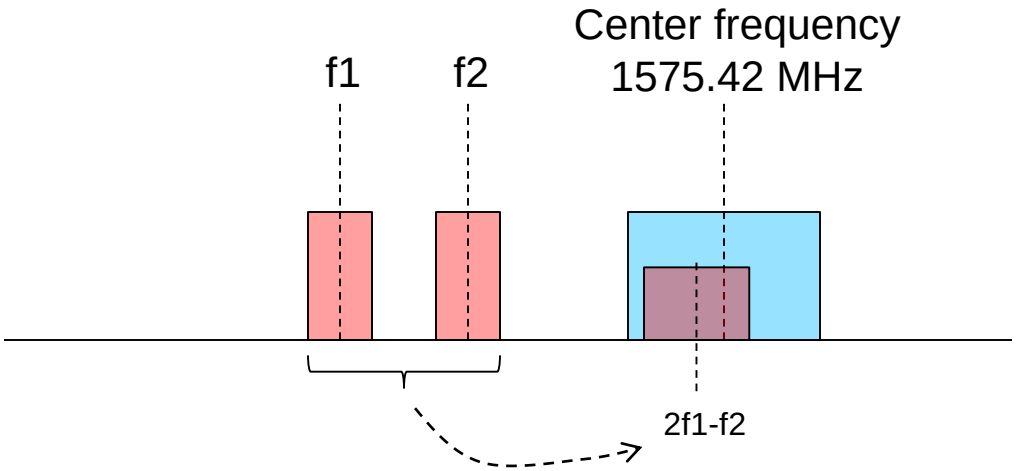
- *N*-th harmonics for a signal whose fundamental frequency is *f*, has a frequency *N*f*
- Generally not a significant interference mechanism
- Example: Signal at 787.71 MHz could cause potential 2nd harmonic interference into the L1 band from mobile user equipment



Intermodulation Products

- Intermodulation products are caused by amplitude modulation of signals containing two or more different frequencies, caused by non-linearities in the front end of a GNSS receiver
- Intermodulation products can end up in the GNSS band and desensitize a GNSS receiver frontend
- Example: 3rd order intermodulation products from an adjacent band signal plan





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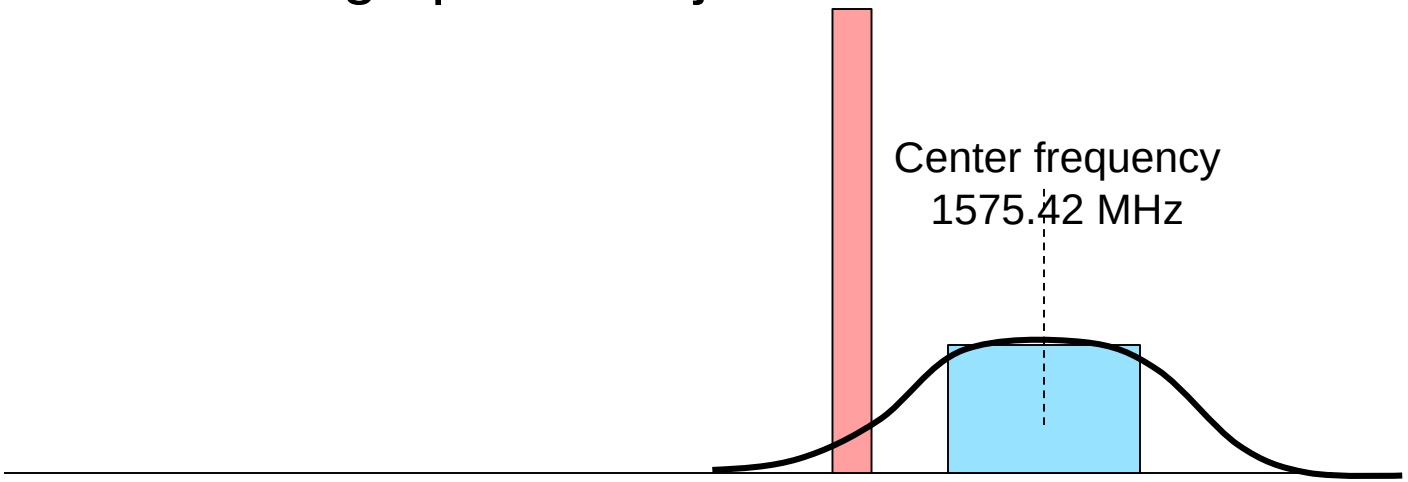
Adjacent Band Interference

- Two frequency bands next to each other
- Applicable in cases when high powered “terrestrial” service is planned adjacent to the quiet “satellite” bands to create overload
- The frontend of the receiver is compressed or overloaded
- Front-end filtering can help reduce this effect which can be difficult with high power adjacent band source



Before You Suspect Interference

- Please check if receiver functions with similar radio spectrum environment;
  - If not, it may be something in receivers themselves (not due to interference events)
  - Receiver manufacturers may help before checking with your national regulators
- There may be radio emission sources you are unaware of;
  - Cable equipment which not properly installed can be potential radio emission sources
  - Switching Power Supplies?
  - Cable TV Leakage?

Summary

- This presentation introduced the concept of spectrum interference and described three possible source of interference to GNSS
  - Out of band emission
  - Spurious emission
  - Adjacent band interference
- They can all cause performance degradation
  - Therefore they must be carefully considered to ensure interference-free environment for current and future GNSS