



International Committee on  
Global Navigation Satellite Systems

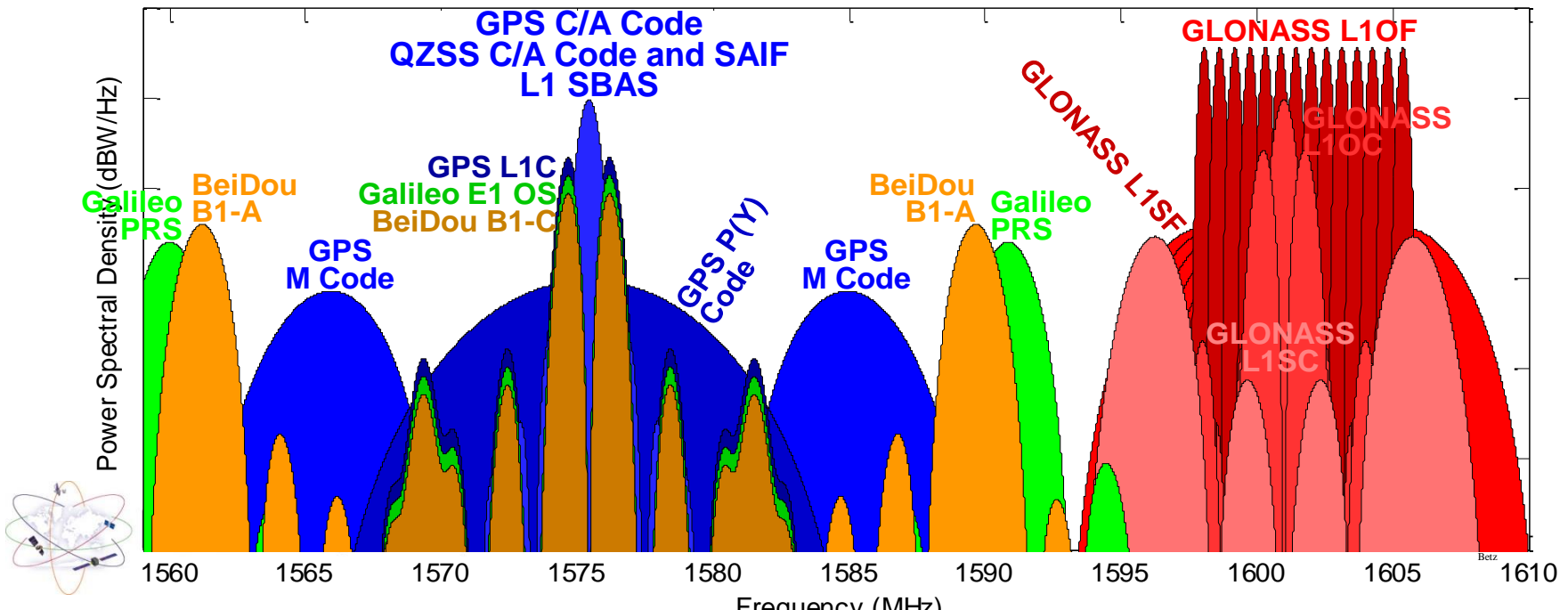
# Introduction to Interference

## Disclaimer

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

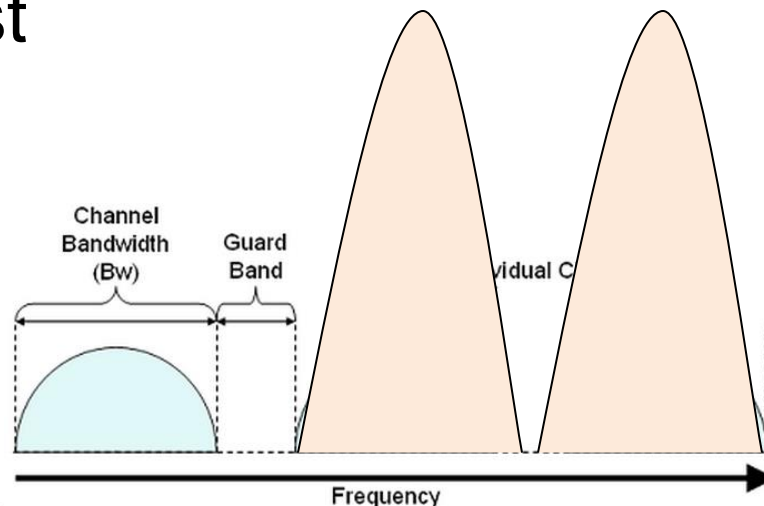
# Spectrum Interference

- 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



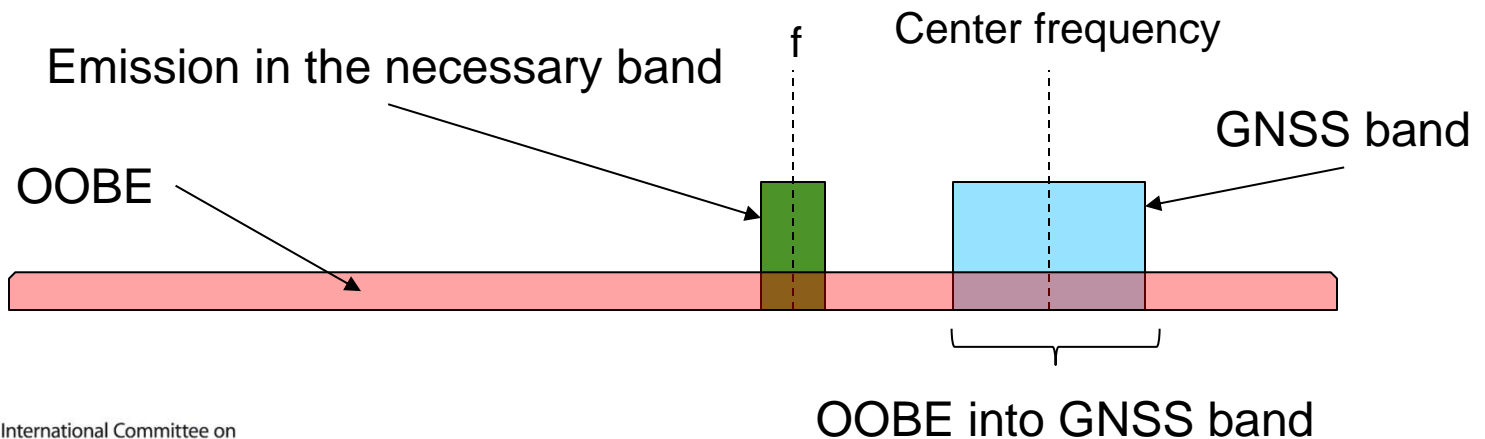
# Optimizing spectrum allocations

- 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



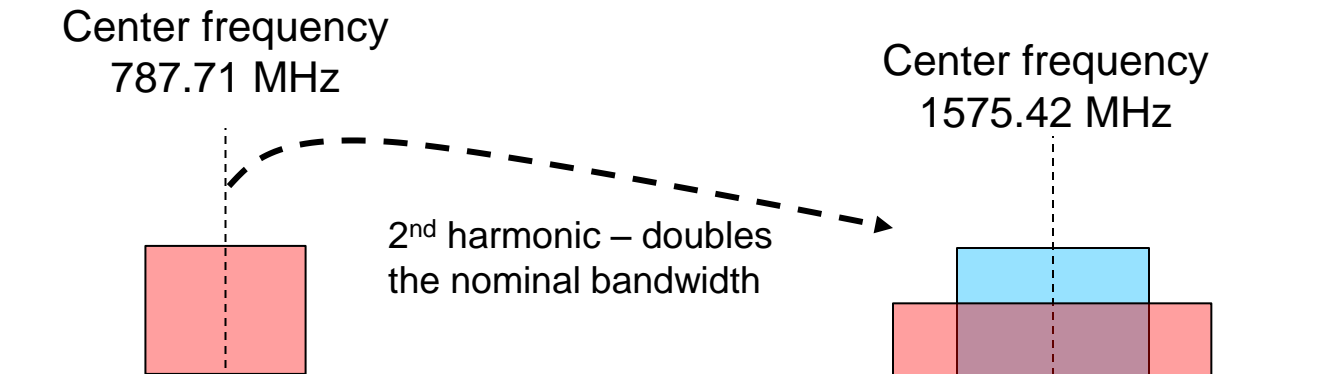
# Spurious Emission

- 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



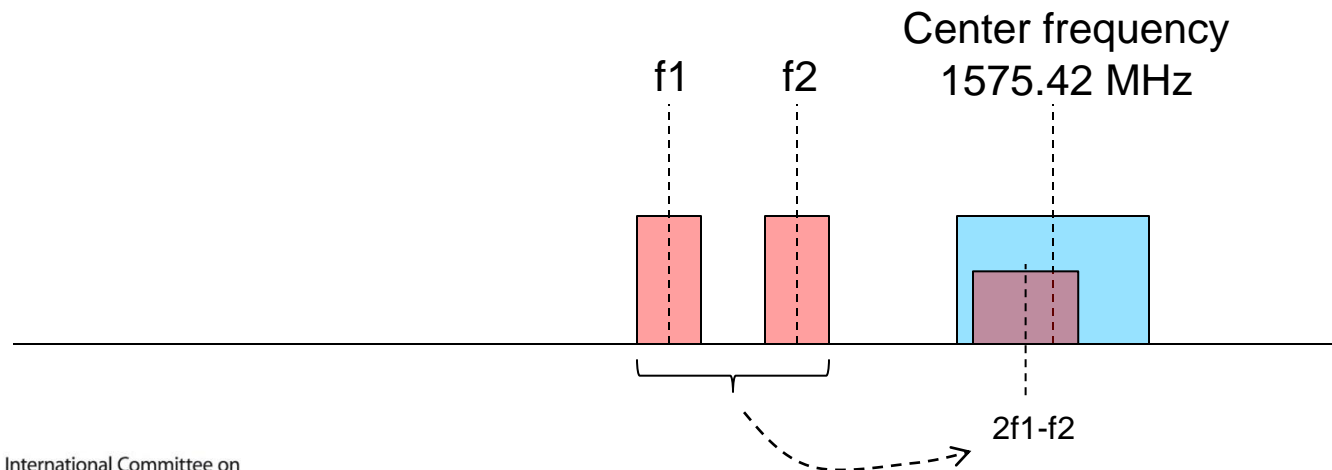
# Harmonic Emission

- $N$ -th harmonics for a signal whose fundamental frequency is  $f$ , has a frequency  $N \cdot f$
- Generally not a significant interference mechanism
- Example: WRC-15 Agenda Item 1.2 – signal plan A4 could have caused potential 2<sup>nd</sup> harmonic interference into the L1 band from mobile user equipment



# Intermodulation Products

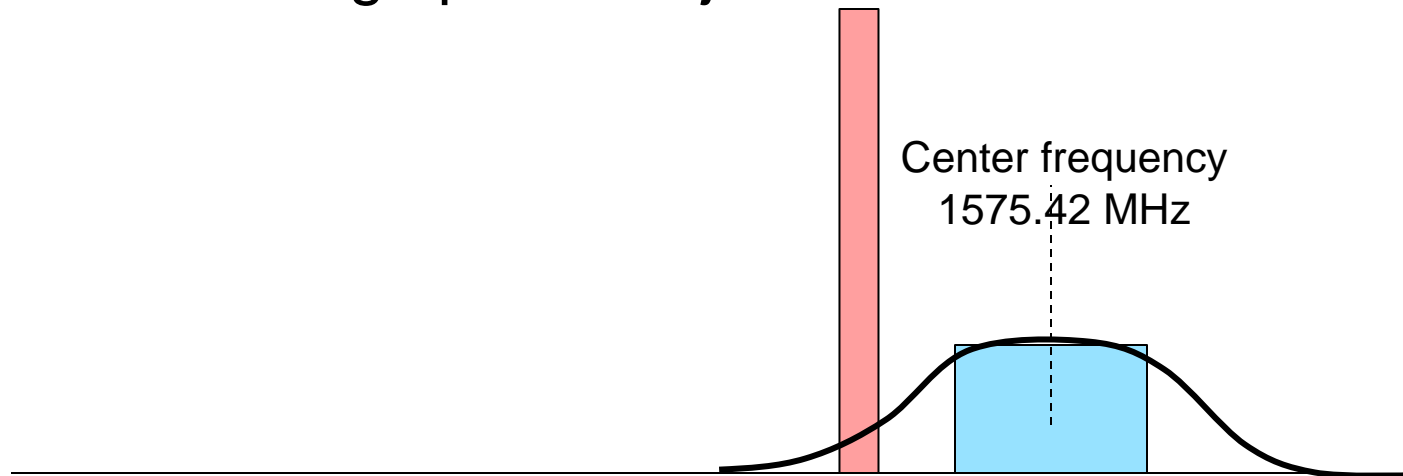
- Intermodulation products is caused by amplitude modulation of signals containing two or more difference frequencies, caused by non-linearities in the front end of a GNSS receiver
- Intermodulation products can end up in the GNSS band and desensitize a GNSS receiver frontend
- Example: 3<sup>rd</sup> Intermodulation products from an adjacent band signal plan





# 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 manufactures may help before checking 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 (i.e., and must be carefully considered to ensure interference-free environment for current and future GNSS.