Significance & Need for Protection of S-band

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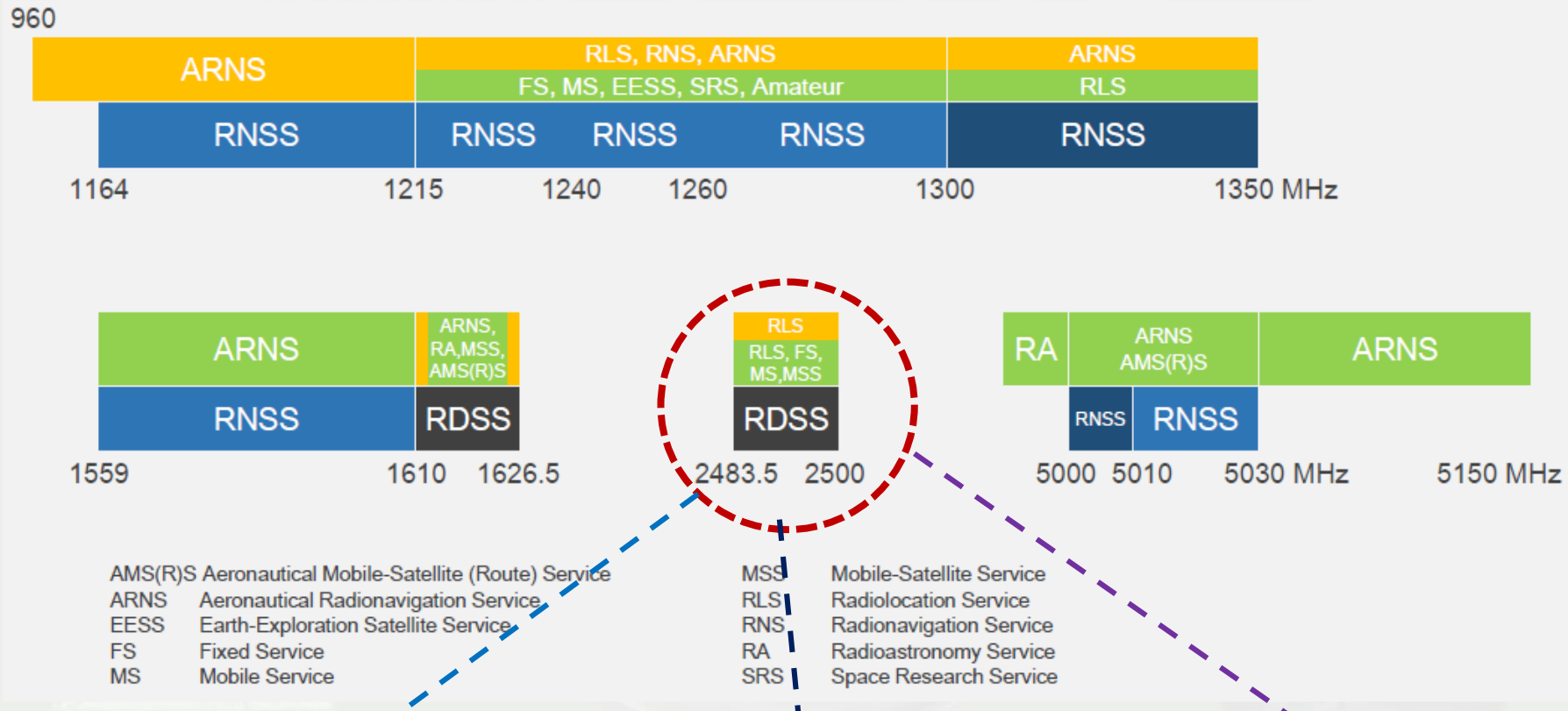
S Band: Navigation Spectrum Sharing



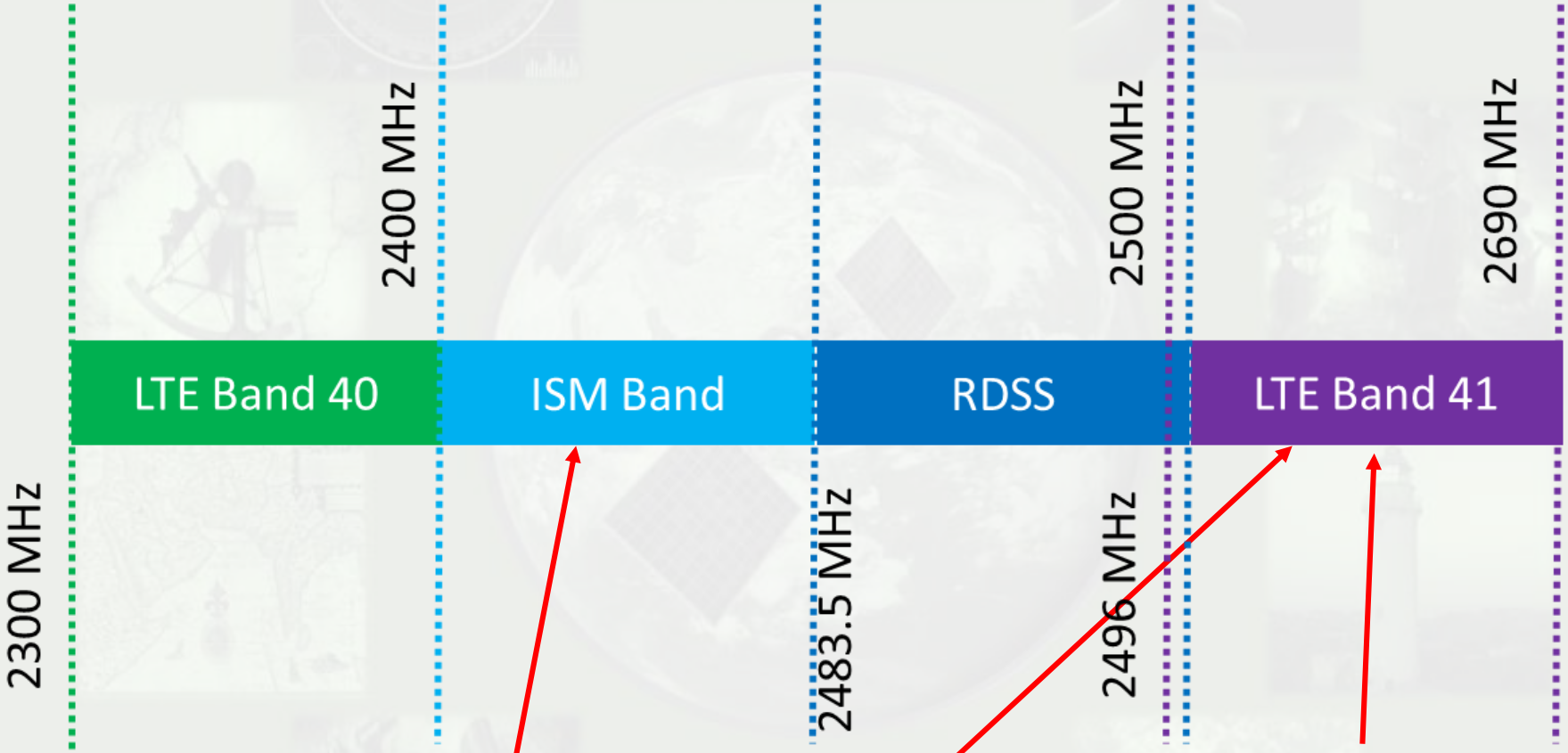
S band Use for Navigation:
Operational: India and China
Under Study: South Korea

S band Use for MSS:
Globalstar

LTE: Band 41, Band 53
Globalstar Terrestrial
(US Only)

Figure From: Hon Fai Ng "ITU's role in GNSS" @ICG-13

S band: Adjacent Band Scenario



Interference in S band: NavIC Signals

- NavIC has SPS (Standard Positioning Signal) and RS(Restricted Service) signals in S-band.
- Instances have been observed of adjacent band interference on NavIC S band signals.
- The interference manifest as:
  - Loss of Lock
  - Degraded Noise floor (reported as C/No degradation)
- Also, there are observations regarding interference from other RDSS signals.

Significance of S band

- S band is the next available spectrum after L band
  - Crowding at L band may lead to this band for new services, signals and systems.
- S band single frequency potentially offers equivalent performance as L band dual frequency
  - Less Ionosphere errors
  - Simpler hardware
- Advantageous for IoT applications
  - Close to ISM band, however, same is a disadvantage from interference susceptibility
  - Needs a balancing act here.

Need for Protection of S band

Considering,

- ***The limited spectrum availability for GNSS,***
- ***Performance benefits of S band, and***
- ***Suitability of S band for harmonized NavCom applications***

S band is not only important for currently operational systems but also for future GNSS systems and services.

- *Protection criteria for L band signals is well defined in ITU.*
- *India has taken steps to define protection criteria for S band RDSS also in ITU forums.*

Out of band interference experience on NavIC S-band

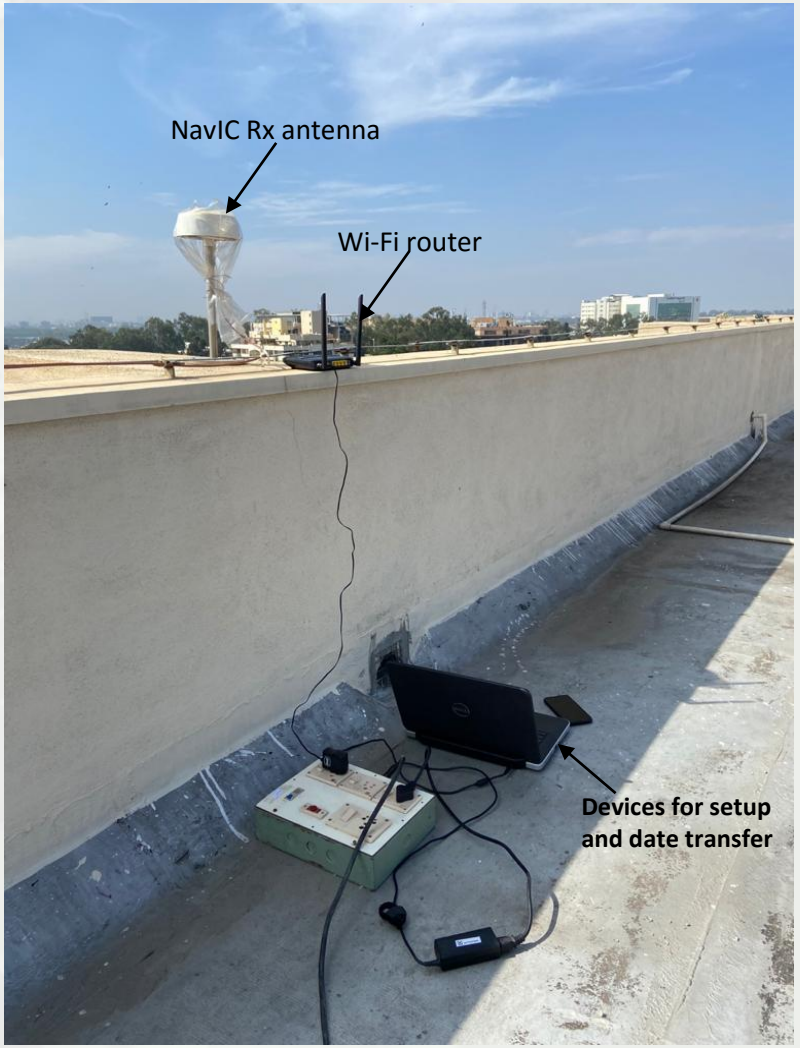
Ghan Shyam, Braj Bhushan Gupta, Ramarao G, URSC

Indian Space Research Organisation

India

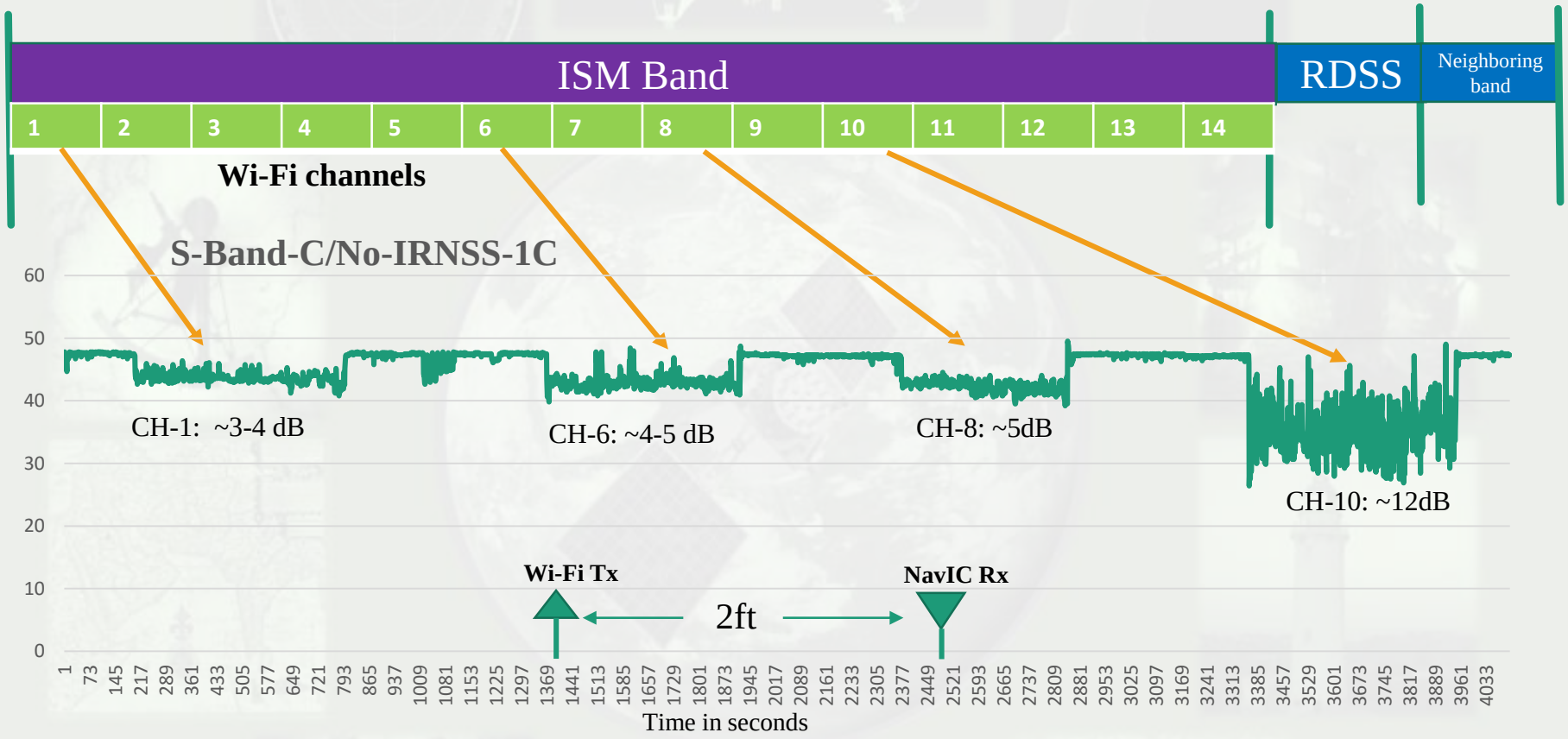
Wi-Fi Interference

- An operational WLAN router was kept close to NavIC receiver at 2 ft and 15 ft distance.
- The WLAN router was configured for different channels and impact on NavIC S band C/N0 was observed.



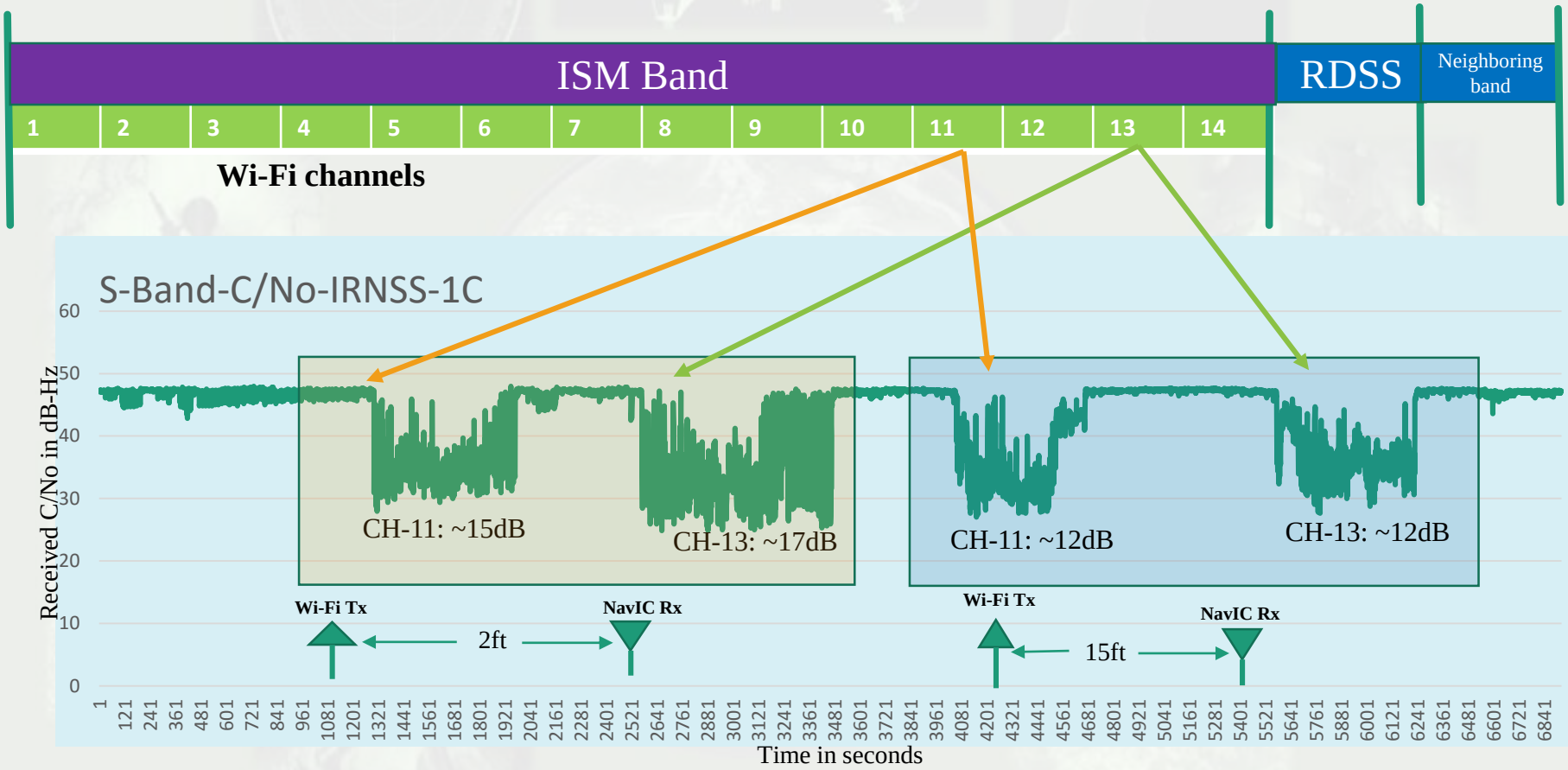
Specification of Wi-Fi Router	Specification of NavIC receiver
Make: D-Link DSL-2750U **Frequency:** 2.4GHz - 2.483GHz **Channels:** Ch-1 to Ch-13 **Power:** ~17dBm/50mw **Bandwidth:** 20MHz/40MHz	**Make:** Accord NavIC-GPS-SBAS **Frequency band:** L1, L5 and S **Signal:** SPS signal BPSK(1) **Centre frequency:** 2492.028MHz(S)

Wi-Fi Interference…



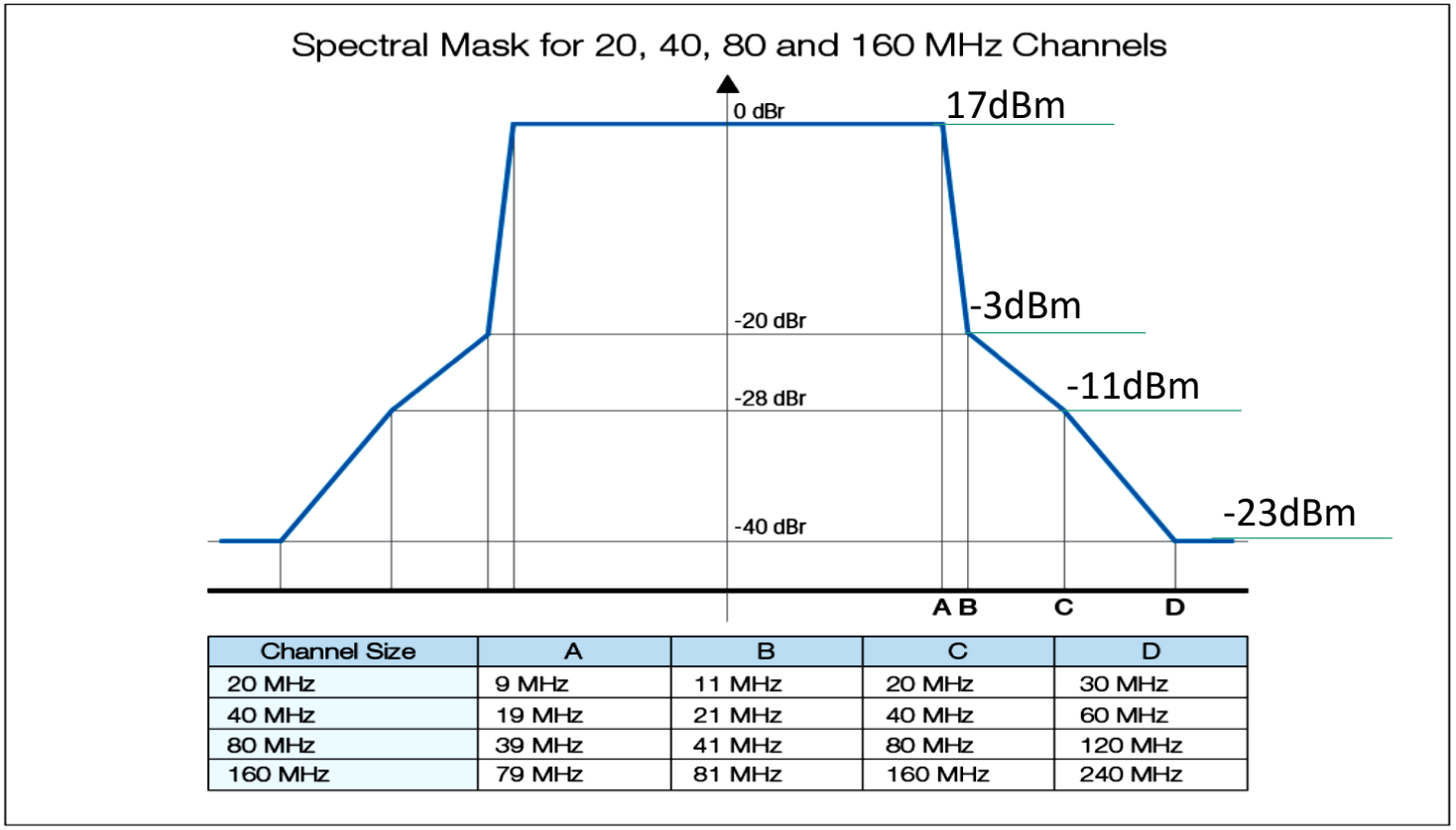
The Interference from Wi-Fi channels increases as it comes close to RDSS band.

Wi-Fi Interference…



Wi-Fi Channel 13 has most severe impact

Wi-Fi device spectral mask



Channel Size	A	B	C	D
20 MHz	9 MHz	11 MHz	20 MHz	30 MHz
40 MHz	19 MHz	21 MHz	40 MHz	60 MHz
80 MHz	39 MHz	41 MHz	80 MHz	120 MHz
160 MHz	79 MHz	81 MHz	160 MHz	240 MHz

Figure 8. OFDM spectral mask used for 802.11a/g/n/ac.

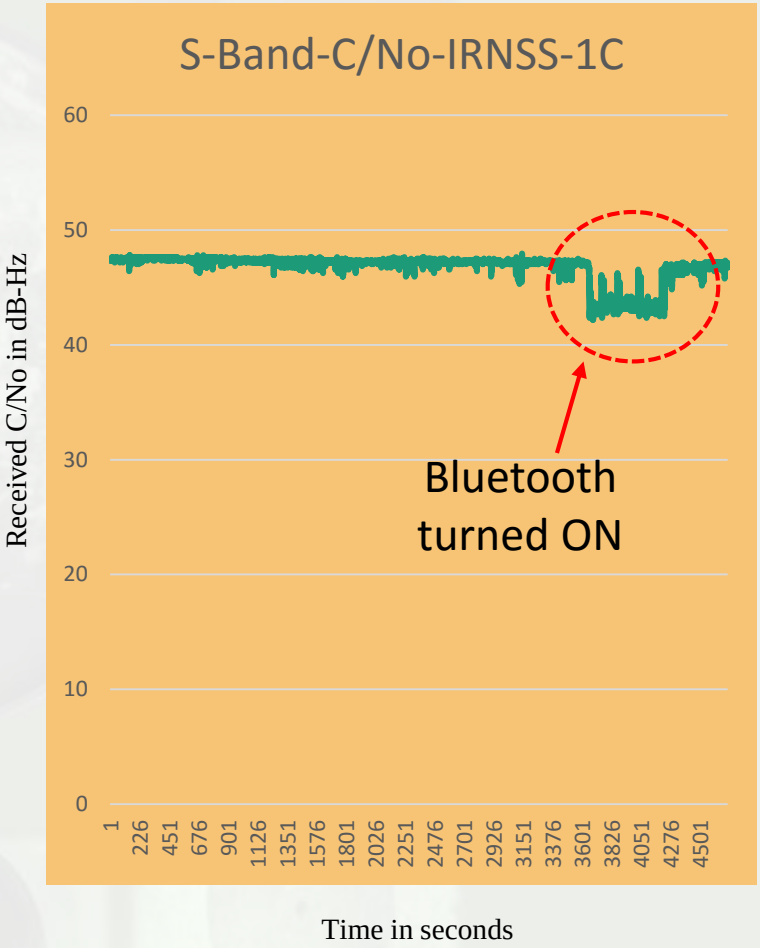
Ref: ITU-R Recommendation ITU-R M.1450-5

The Out of band emission from Wi-Fi devices is very high leading to interference in adjacent RDSS band.

Interference due to Bluetooth

- Two mobile phones with Bluetooth 5.0 were paired and kept close to NavIC receiver (at 2 ft).

- The C/N0 degradation due to Bluetooth devices is around 3-4 dB.



Conclusion

- ITU recommendations R-1901, R-1318, R-1787, R-1904 etc, are present for L5, L2, L1 and C navigation frequency bands. Similar recommendations to protect S-navigation frequency band are not yet present.
  - Support of all stakeholders is envisaged.
- ICG may initiate the interference mitigation studies for protection of S band RDSS services.
- Appropriate regulatory and technical measures shall be adopted to minimize Wi-Fi interference possibly by sharper filer design or by regulating the transmit power etc.

Concerted efforts of GNSS community is required for protection of S band navigation spectrum from interference threats of existing and upcoming terrestrial systems.

Thank You

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