

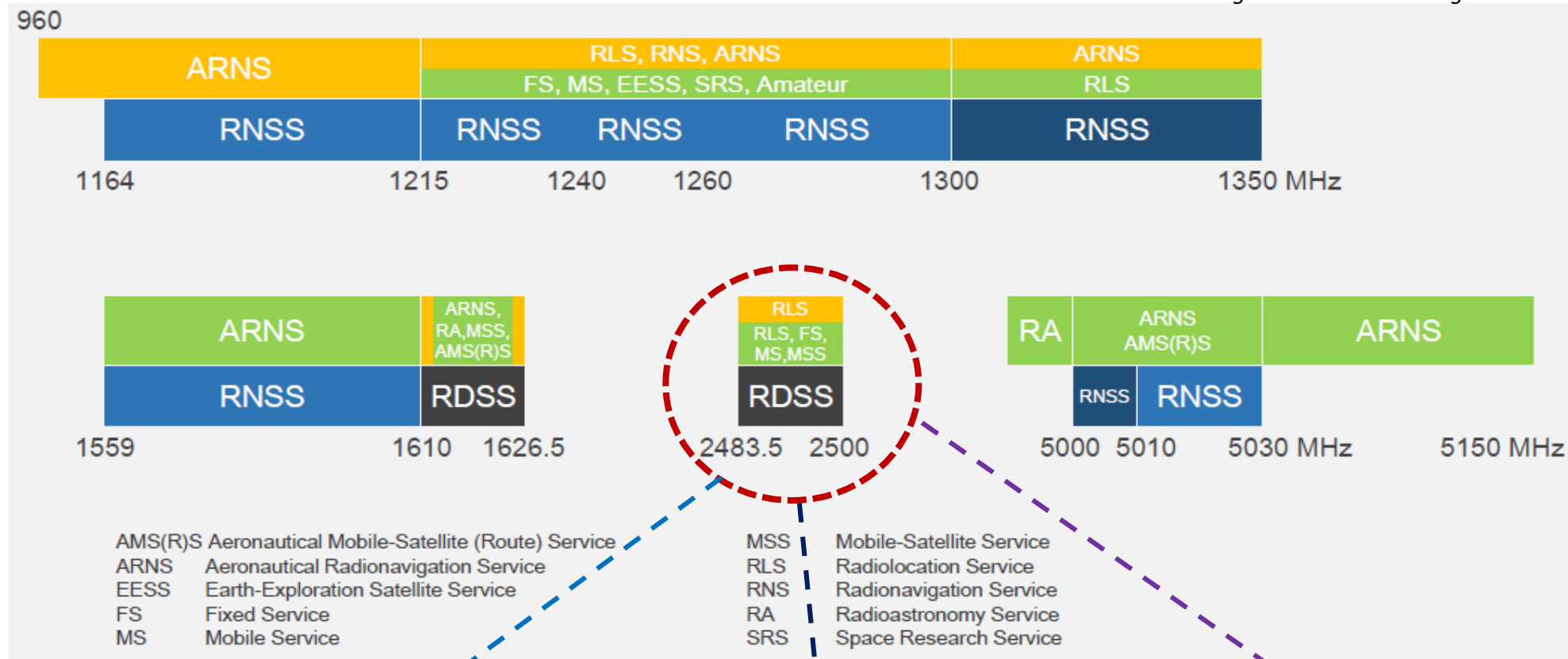
9th ICG Workshop on GNSS Spectrum Protection and Interference Detection and Monitoring

Interference Scenario in S band NavIC Experience

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S Band: Navigation Spectrum Sharing

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

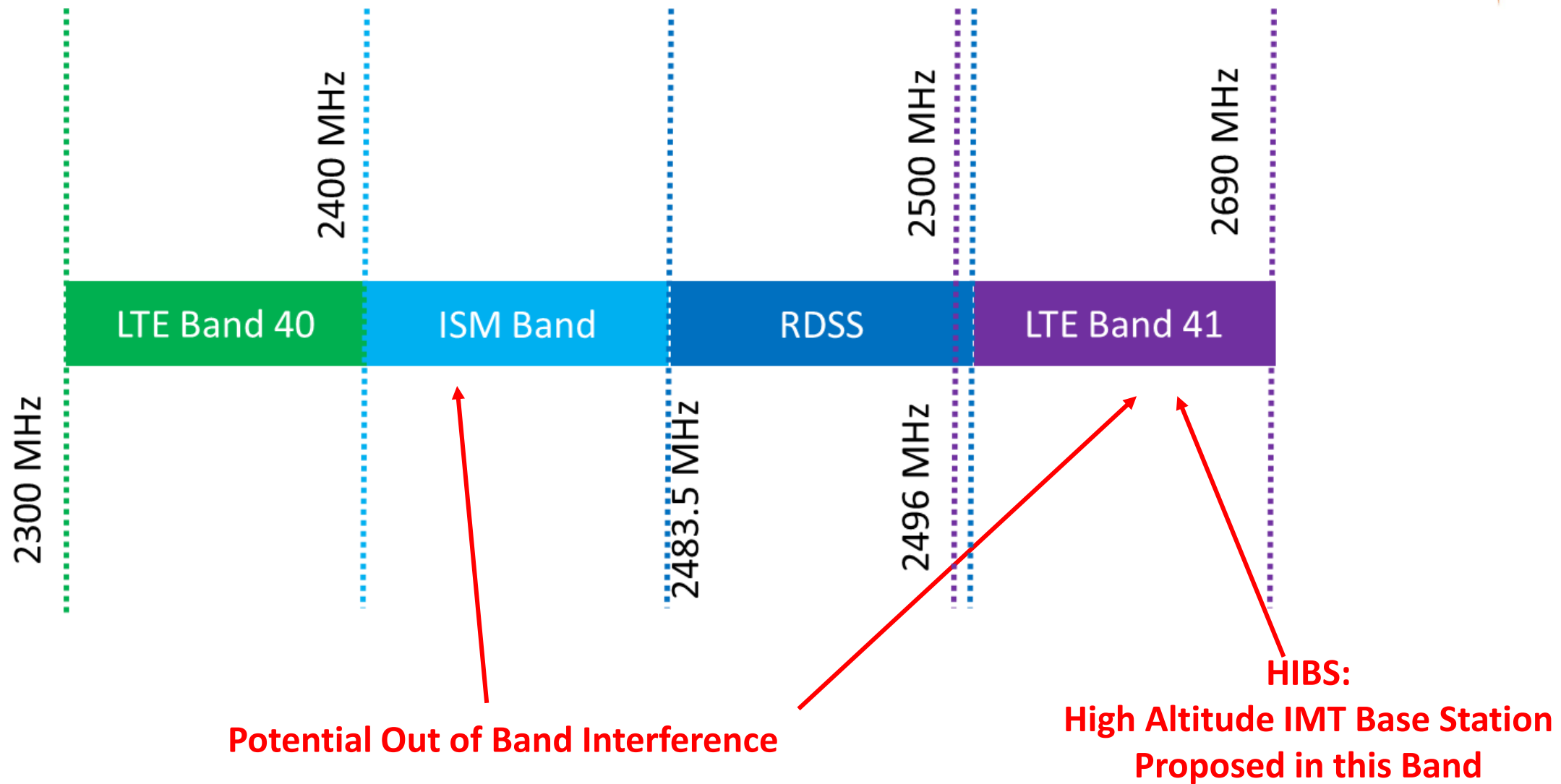


S band Use for Navigation:
Operational: India and China
Under Study: South Korea

S band Use for MSS:
Globalstar

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

S band: Adjacent Band Scenario

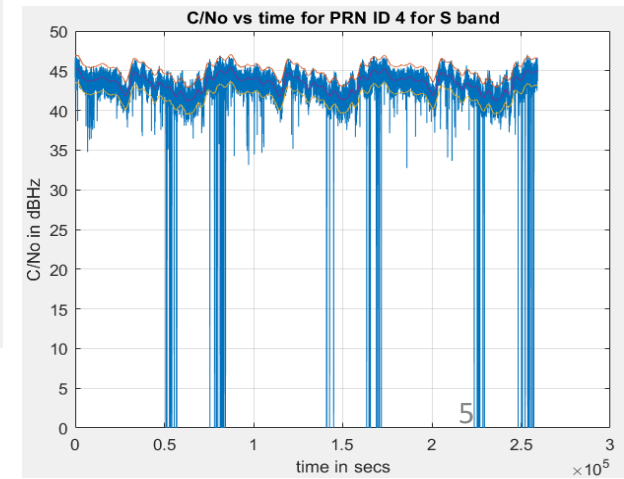
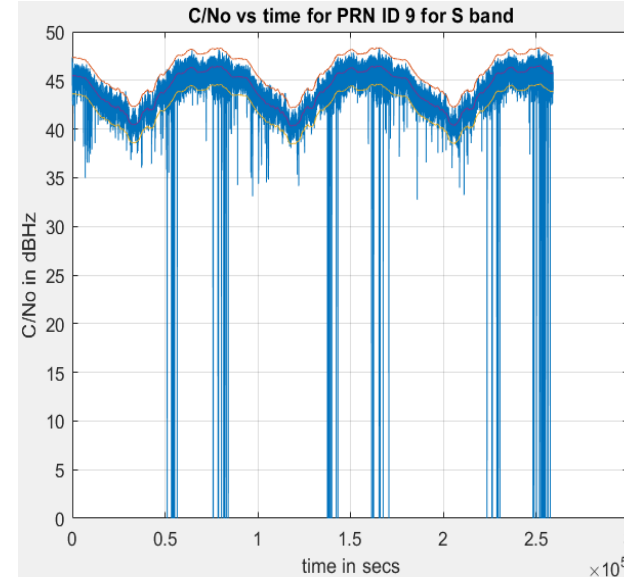
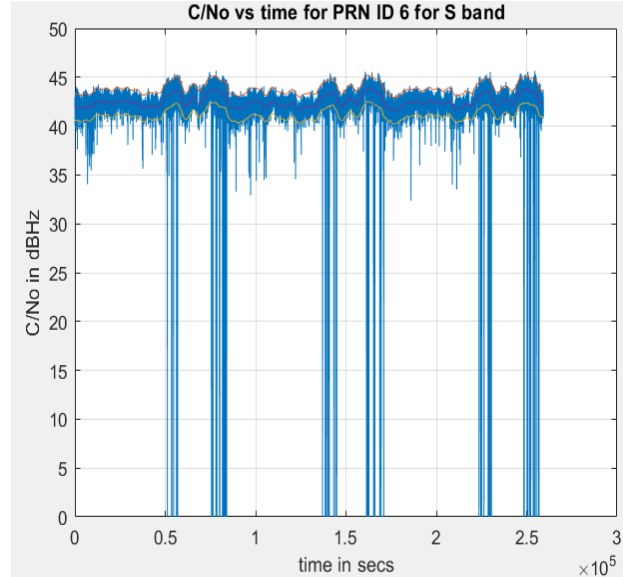
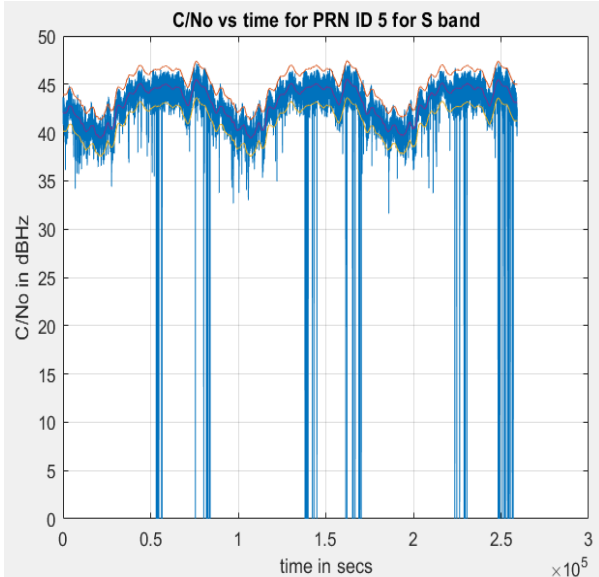
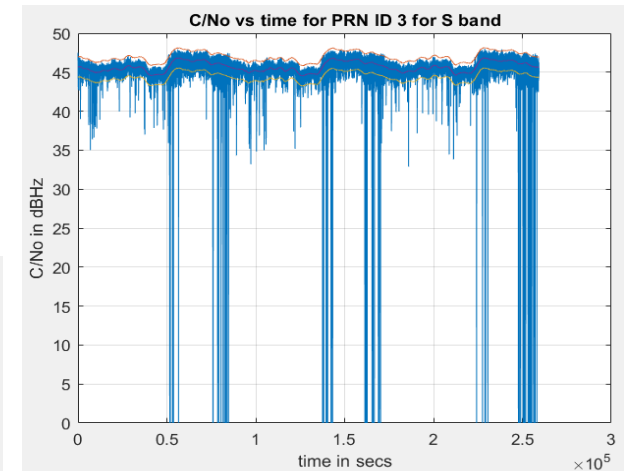
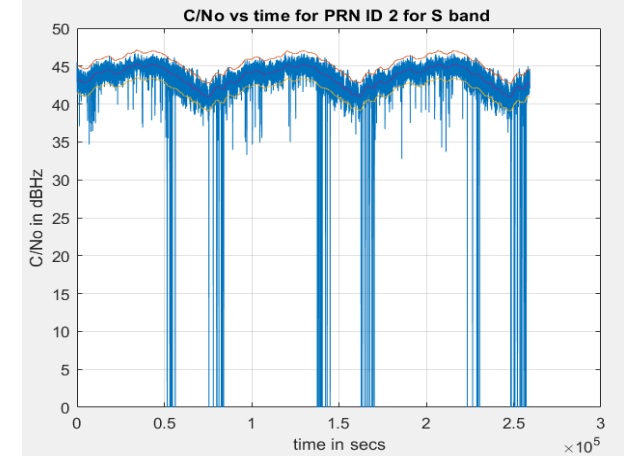


Interference in S band: NavIC Signals

- 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.

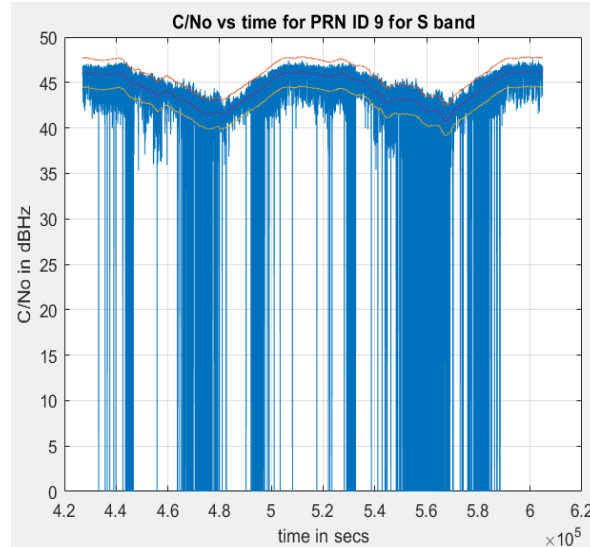
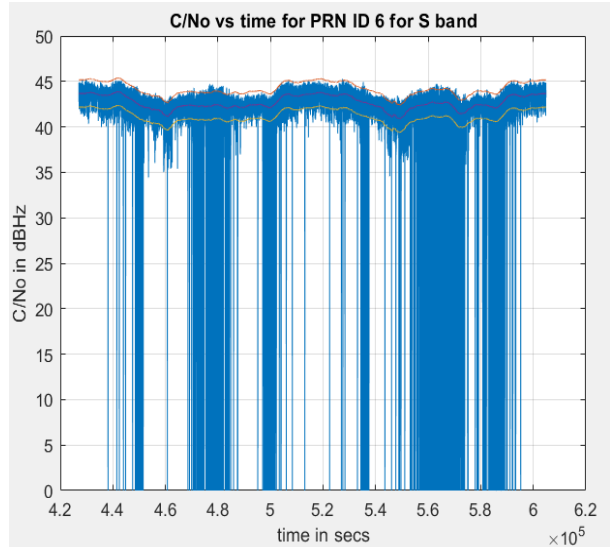
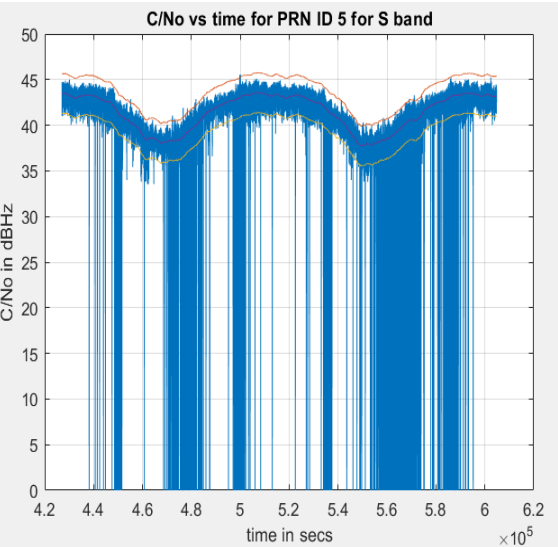
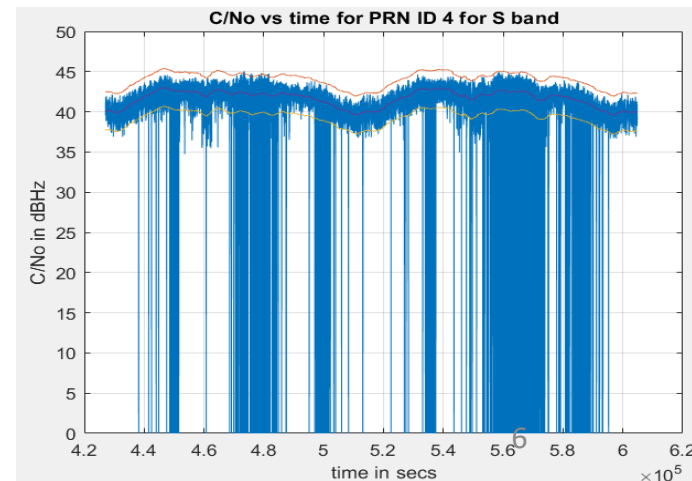
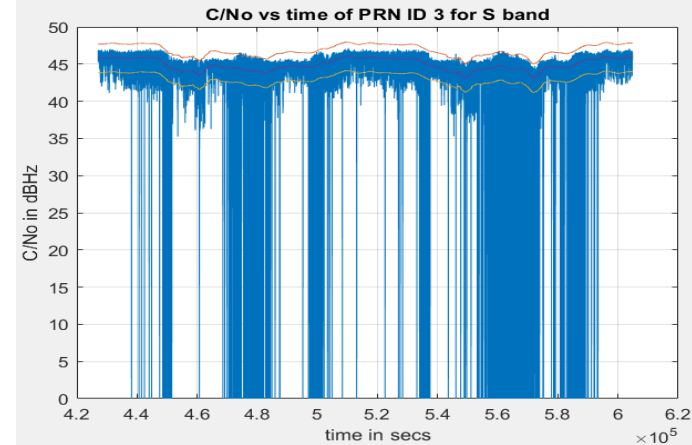
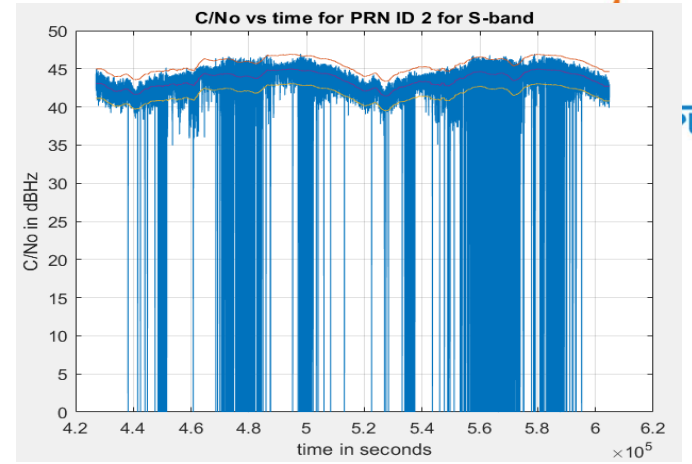
NavIC S band: Observations at Ahmedabad

Total Test duration \approx 3 days						
	PRN-2	PRN-3	PRN-4	PRN-5	PRN-6	PRN-9
Unlock Stats						
Max unlock duration(sec)	12	4	7	13	4	13
Avg unlock duration(sec)	2.51	2.3	3.25	3.53	2.68	2.69
Unlock percentage	0.06	0.06	0.08	0.08	0.09	0.06
Below Nominal Stats						
Max below nominal duration(sec)	24	36	168	117	204	24
Avg duration(sec)	1.7	1.57	2.29	2.1	2.26	1.51
Below nominal percentage	1.62	2.58	3.03	2.28	3.11	1.5



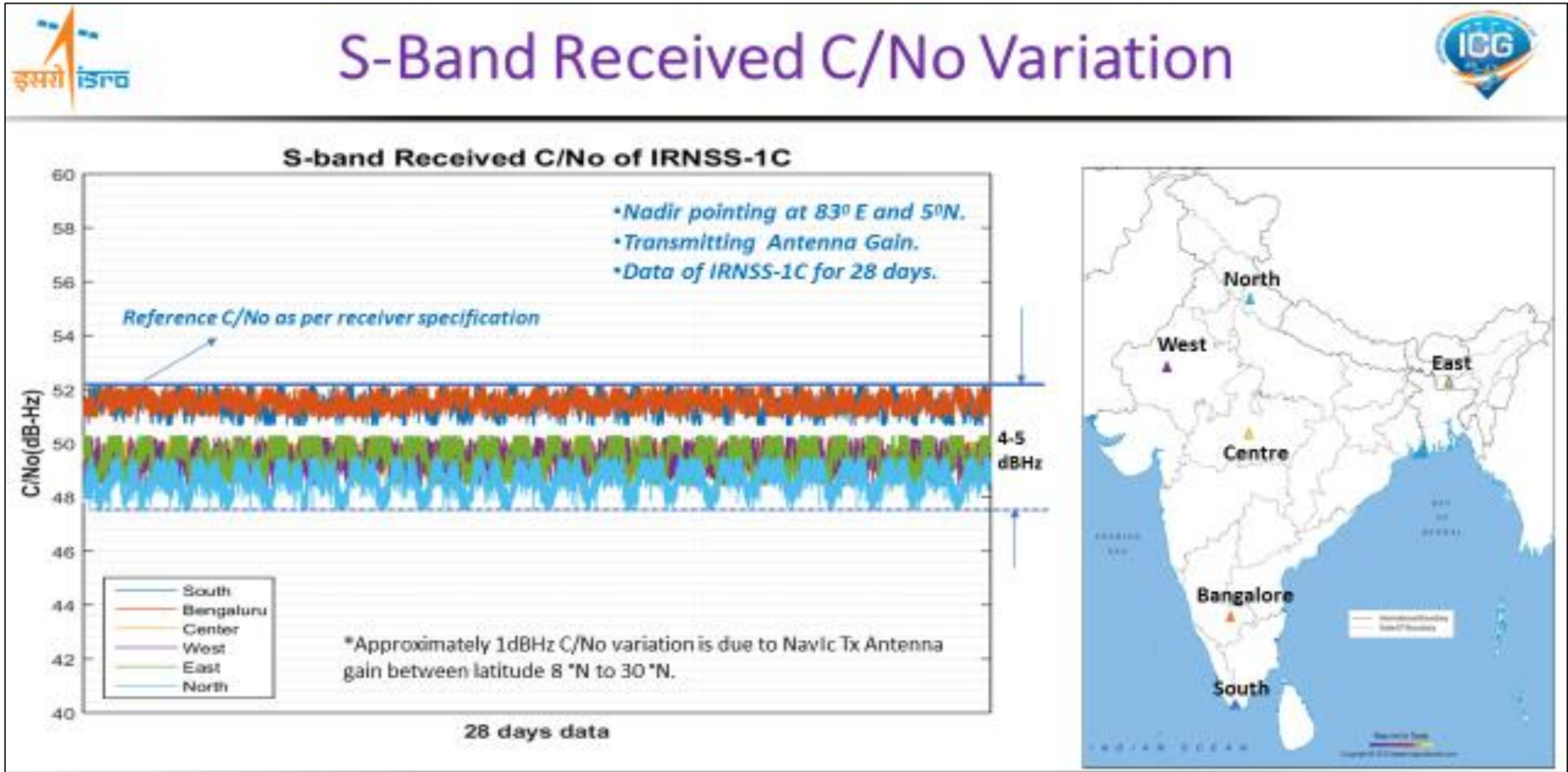
NavIC S band: Observations at Surat

Total Test duration \approx 2 days						
	PRN-2	PRN-3	PRN-4	PRN-5	PRN-6	PRN-9
Unlock Stats						
Max unlock duration(sec)	12	4	62	4	40	26
Avg unlock duration(sec)	2.56	2.42	3.44	3.22	2.56	2.78
Unlock percentage	0.95	0.89	1.28	1.19	0.95	1.03
Below Nominal Stats						
Max below nominal duration(sec)	38	38	62	40	39	42
Avg duration(sec)	1.57	1.55	1.91	1.66	1.65	1.64
Below nominal percentage	4.46	4.98	2.83	2.55	5.03	5.41



NavIC S band: Observations Across IRIMS

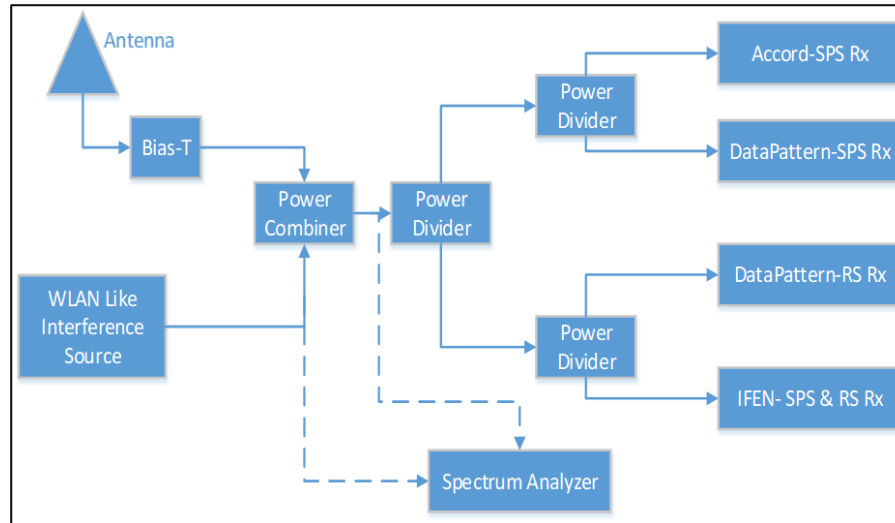
Presented during ICG-14



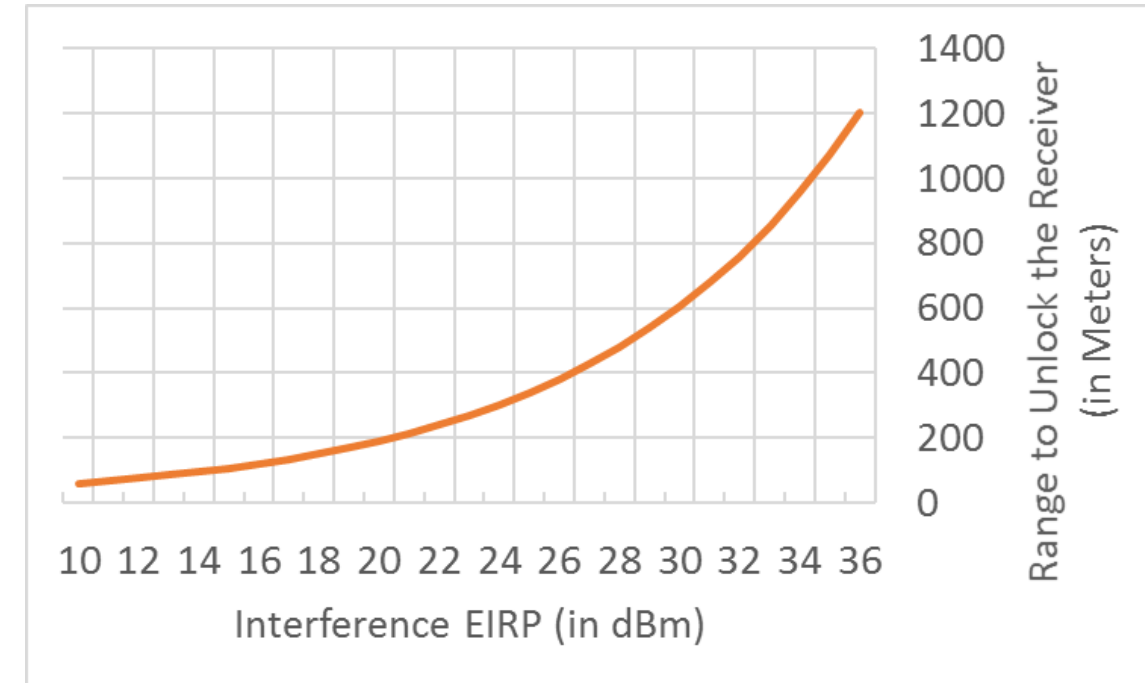
The additional degradation (≈ 3 dB) towards North & East Locations can be attributed to other RDSS signals

NavIC S band: Impact of WLAN

- Experiments carried out to assess the impact of adjacent band WLAN signals on the NavIC S band signals using various makes of receivers.



- Interference power at input of receiver to effect unlock was found out experimentally.
- Based on typical receiver parameters and LoS propagation the standoff distance is estimated for WLAN interferer.



- Typical ODU LNA gain of 23 dB.
- Antenna gain at low Elevation angle as -3 dB.
- ODU to IDU cable loss as 4 dB.

Significance of S band for Navigation

- Next available spectrum after L band.
 - Crowding at L band may lead to migration to this band for new services, signals and systems.
- S band single frequency 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.

Conclusion

- The S band RDSS spectrum is important for currently operational satnav systems as well as for future systems and services.
- Significant interference from terrestrial systems has been observed to the S band RDSS signals.
- The interference from terrestrial systems needs to be discussed at forums such as ITU and ICG.
- The interference among RDSS system operators/providers has to be resolved through bilateral coordination.
- Concerted efforts of GNSS community is required for protection of S band RDSS spectrum from interference threats of existing terrestrial systems and future system such as HIBS.

Thank You

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