



Space borne GNSS-Reflectometry with NavIC

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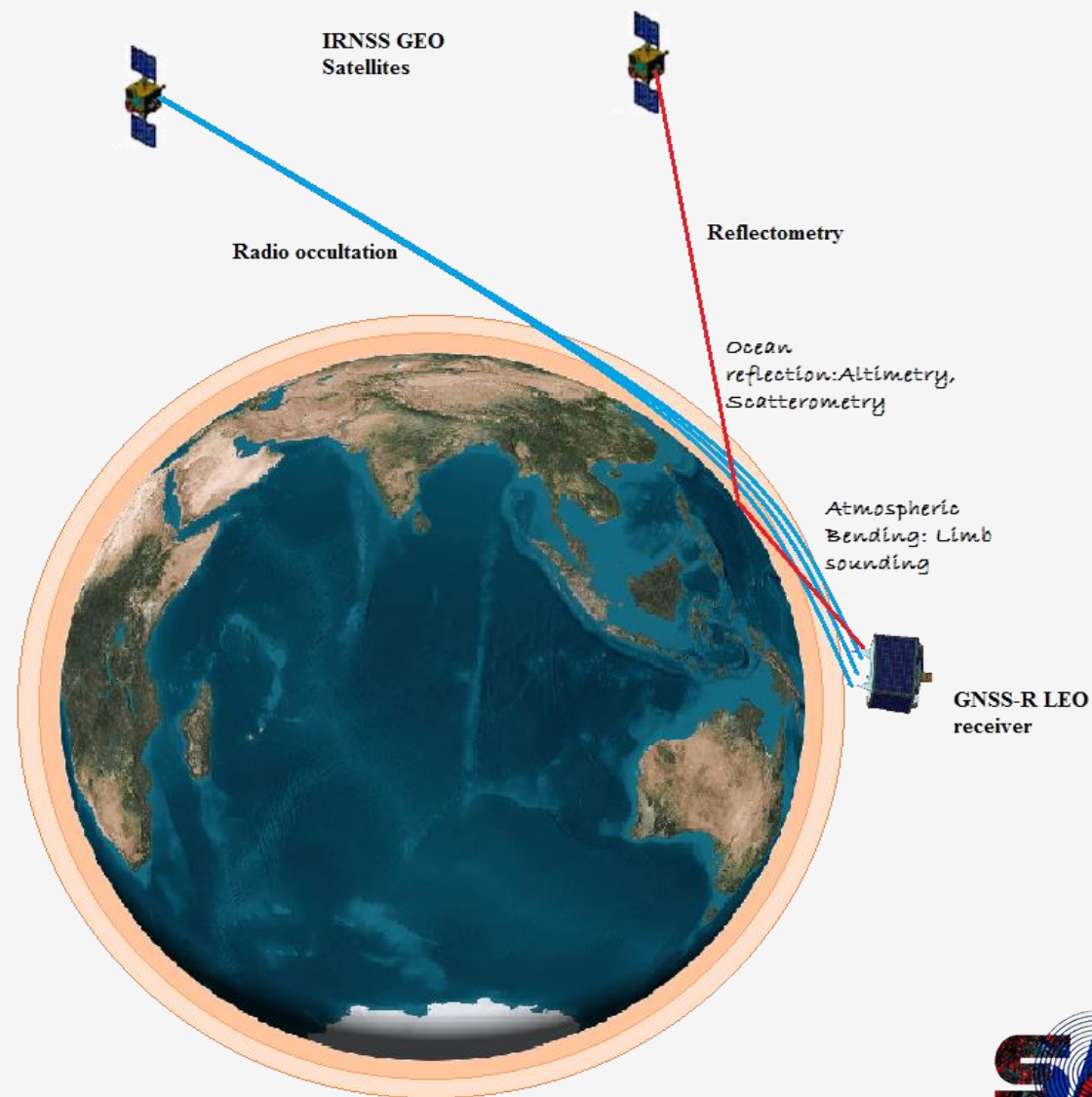
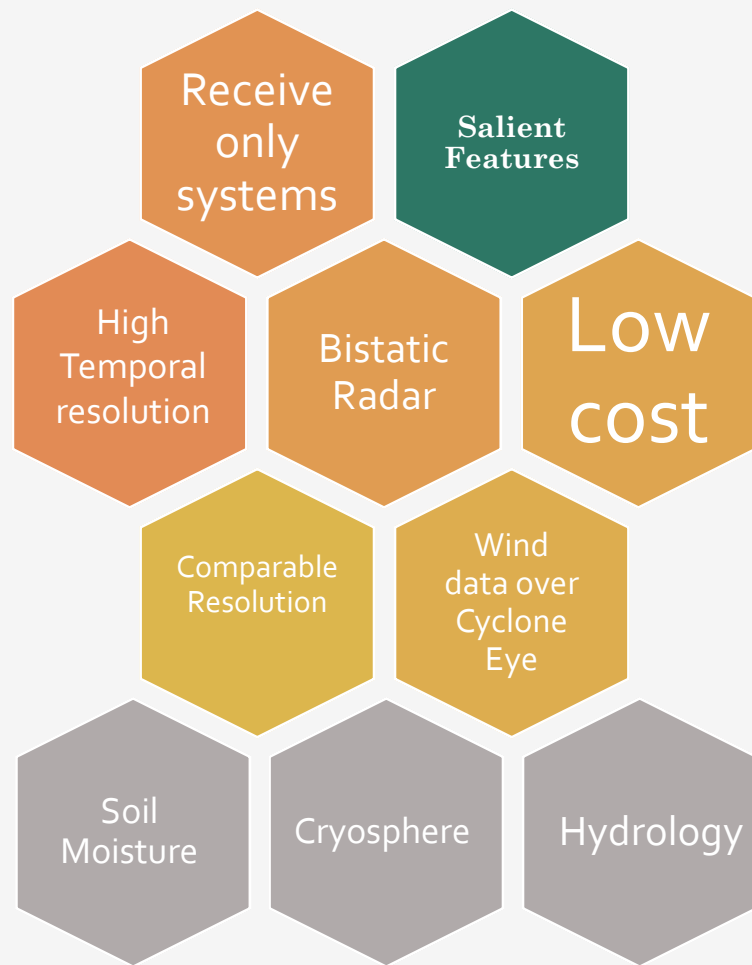
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Introduction to GNSS-Reflectometry



Application Goal

- Ocean Winds:
 - 3-35 (50 target) m/s wind speed detection within the accuracy of 2m/Sec or 10% of actual wind speed (whichever is higher)
 - Wind detection till 100 mm/hr (typical) rainfall (can go up to 150mm/hr)
 - Best diffused scattering resolution: 3 km x 3 km , Coherent reflection: up to 550 m x550 m
 - Soil moisture: Measurement up to -25 dB Reflectivity in LHCP polarisation.
 - Cryosphere: Measurement up to -25dB reflectivity in LHCP polarisation.
 - Other applications:
 - Flood inundation detection
 - Land bound waterbody mapping
 - River flow rate measurement
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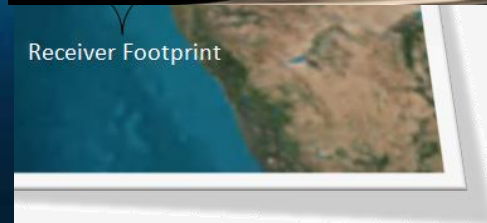
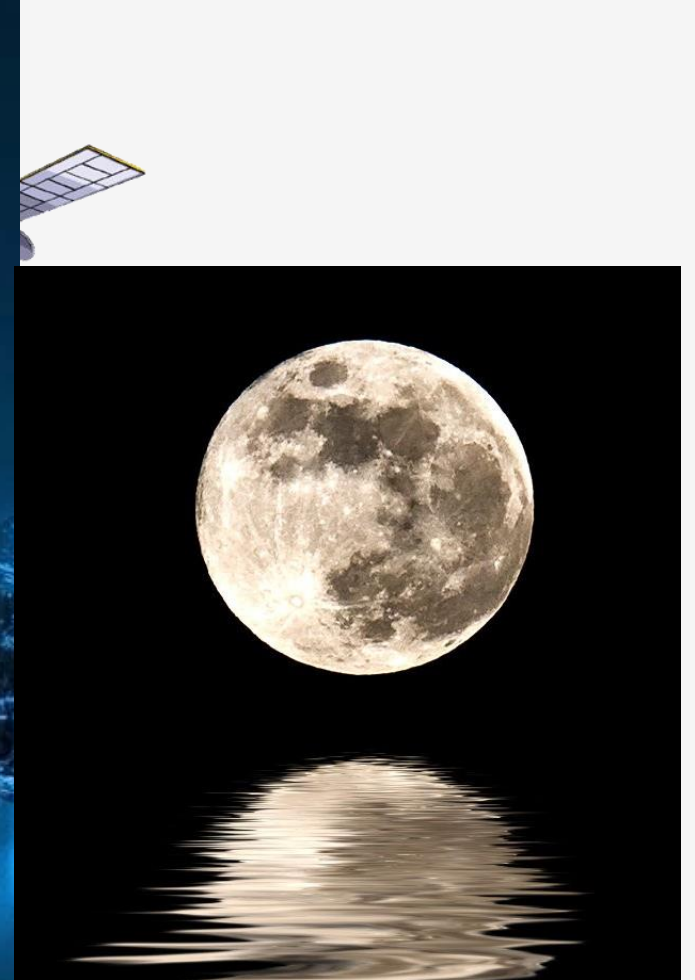
Concept

Glint point / Specular reflection point

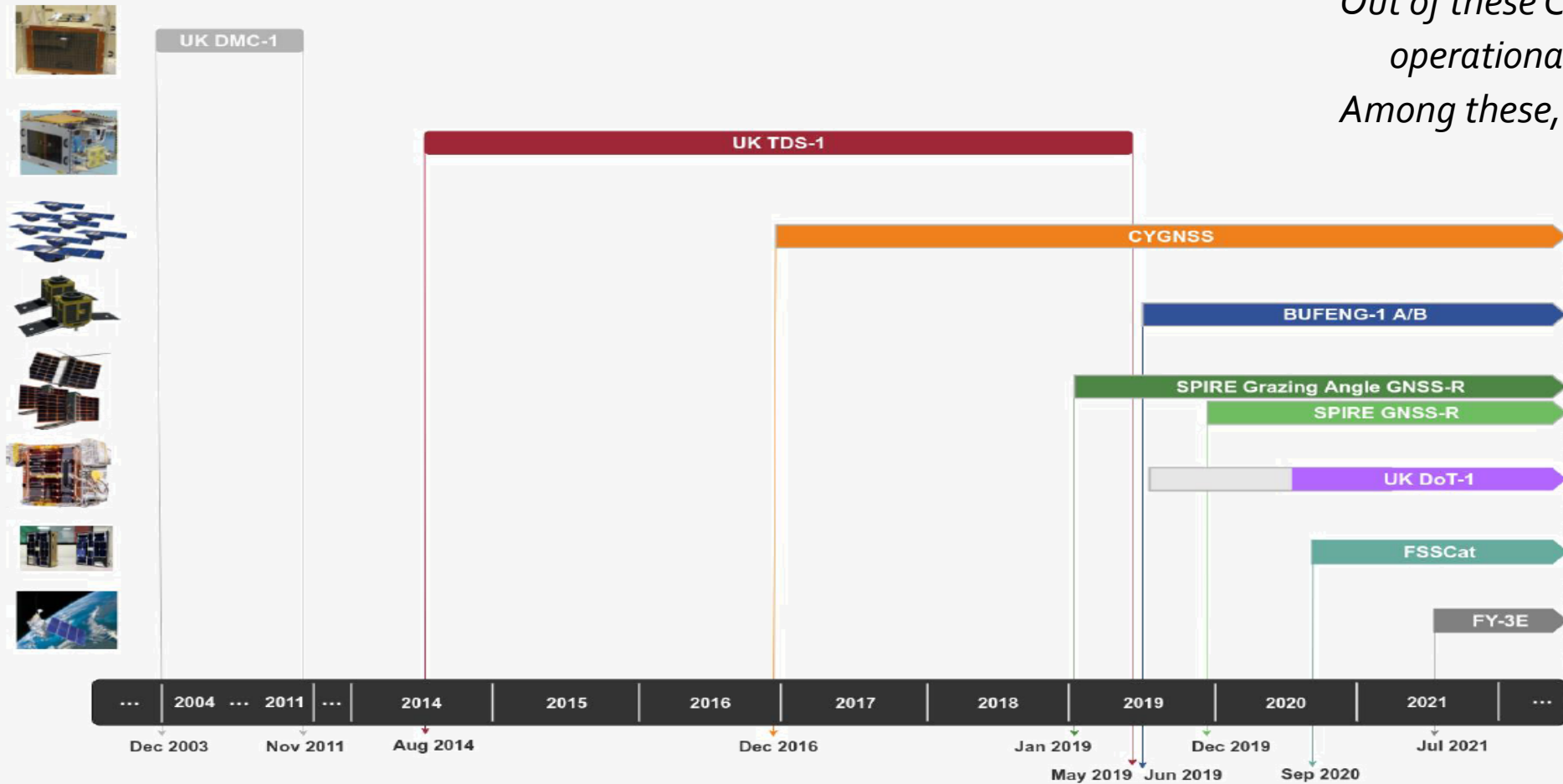
Snell's reflection principle holds for all electromagnetic waves

Bistatic Radar:

Where the transmitter and the receiver are at two different positions and hence the transmitted signals suffers forward scattering from the targets.



Past and present missions



Out of these CYGNSS is highly focused and operational grade data are generated
Among these, **SPIRE** is of private ventures

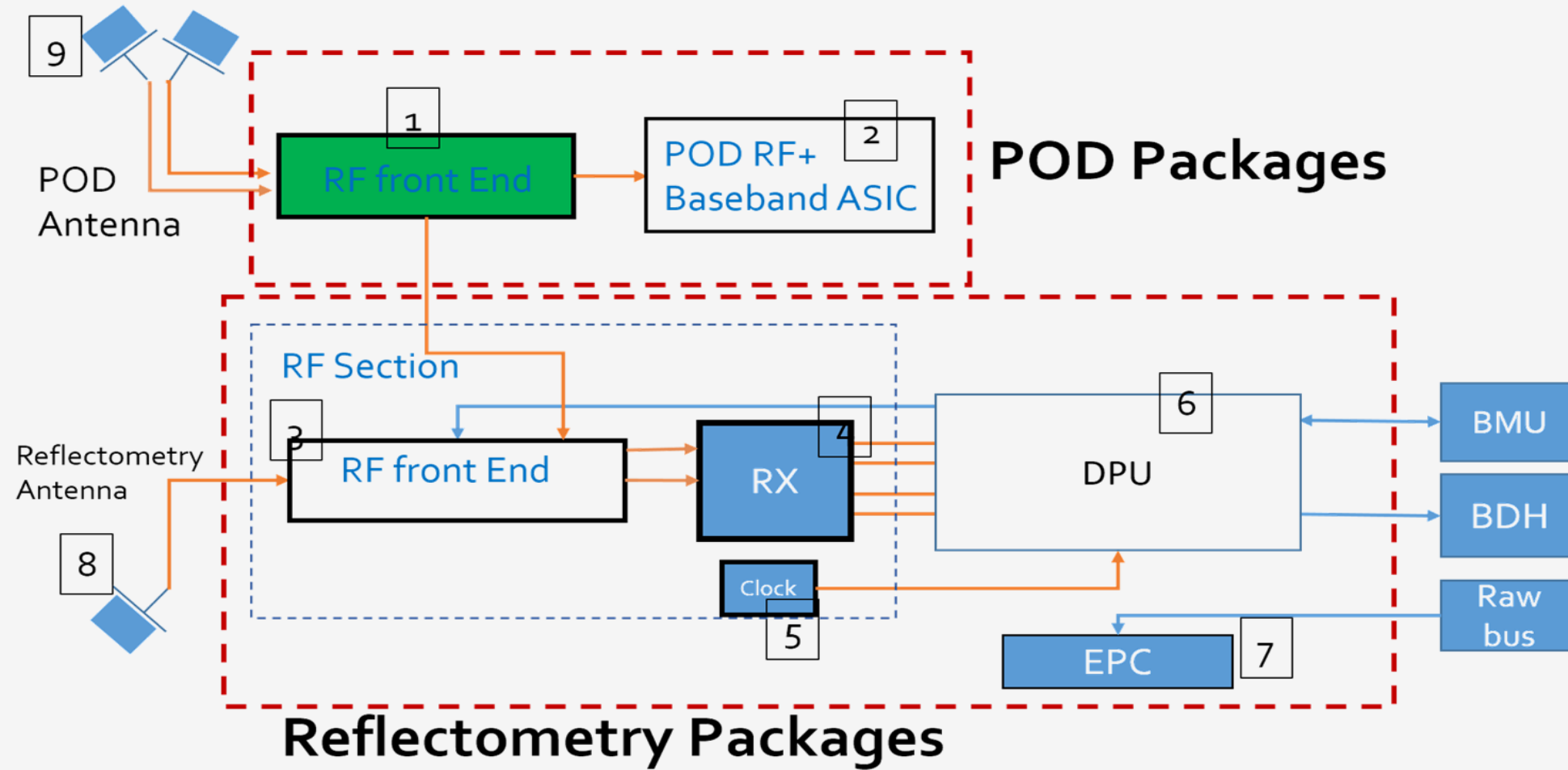
Global gap filling and New scopes in GNSS-Remote sensing

Experiment	Global Configuration	Proposed Unique Configuration/ Gaps filling/ new scope	Application advantage
Reflectometry	LHCP receive in L1 Band	LHCP S band (New scope)	Wind detection: Better roughness sensitivity and the time required for the portion of the roughness spectrum sensed by a GNSS-R instrument to respond to changes in wind speed.
		LHCP-RHCP dual pol L/S band (gap filling)	Polarization ratio information provides more information on target properties in lower elevation angles- Wind detection and soil moisture retrieval

Major Features/ Specifications for 1st Phase

Field	Specification
Bands	GPS- L1 and IRNSS L5
Orbit Height	350Km to 720 km
Reflectometry Polarization	LHCP
Spatial Resolution	10 km x 10 km (beam outer edge)over ocean to up to 550 m x 550 m over land (beam inner edge) (at 350 km)
Stacked Up Volume	~ 0.43m x 0.35m x 0.45 m
Power (Raw Bus)	~ 45W
Payload Weight	~ 16.5kg with 3 (2+1) antennas and structure
$\Delta\sigma_0$ (NBRCs precision)	<0.5 dB
Lowest NBRCs detection	7 dB (10dB Corresponding to 50m/s Wind speed)
Operation Regions	Ocean, Land, Ice (entire globe)

Basic Systems Block:

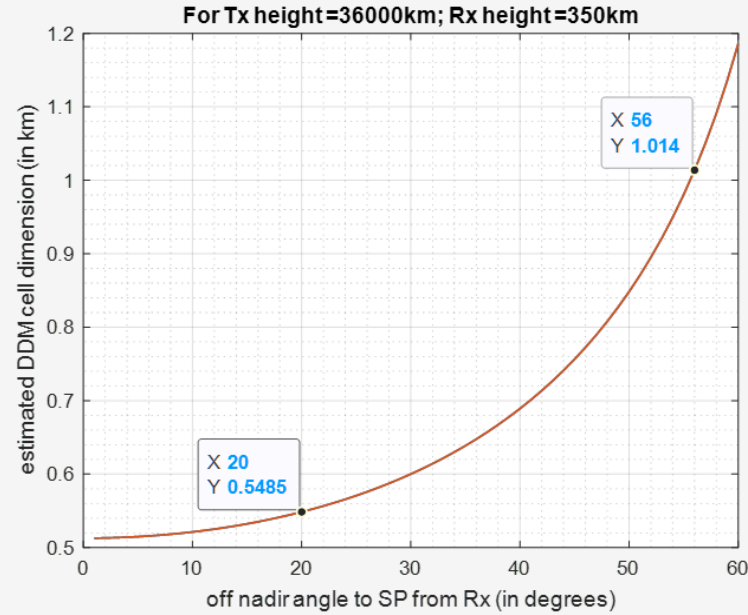


Orbit vs Resolution

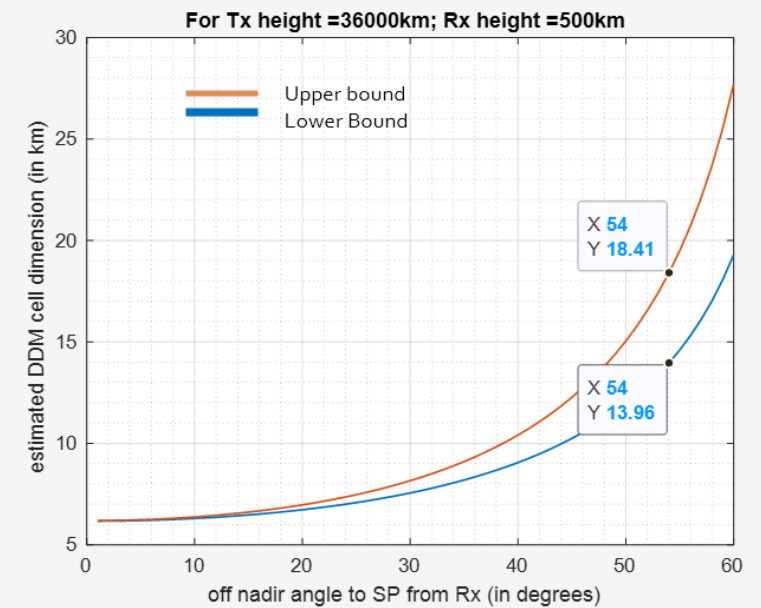
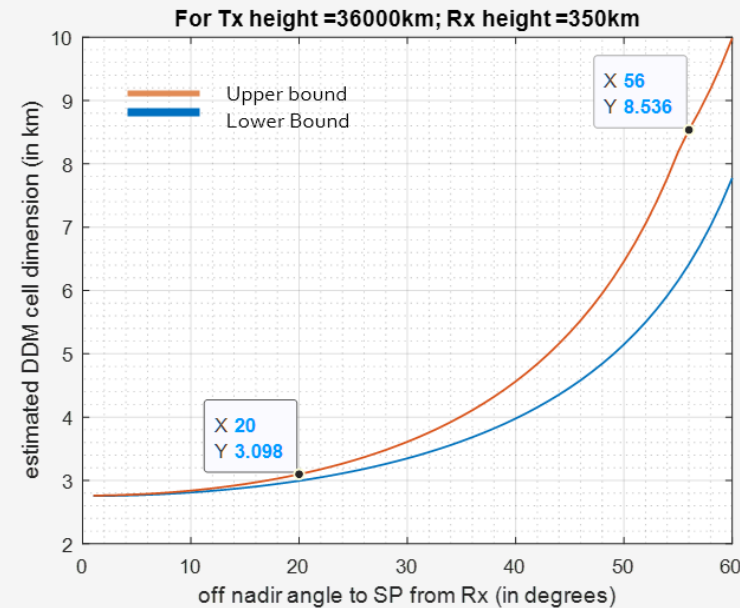
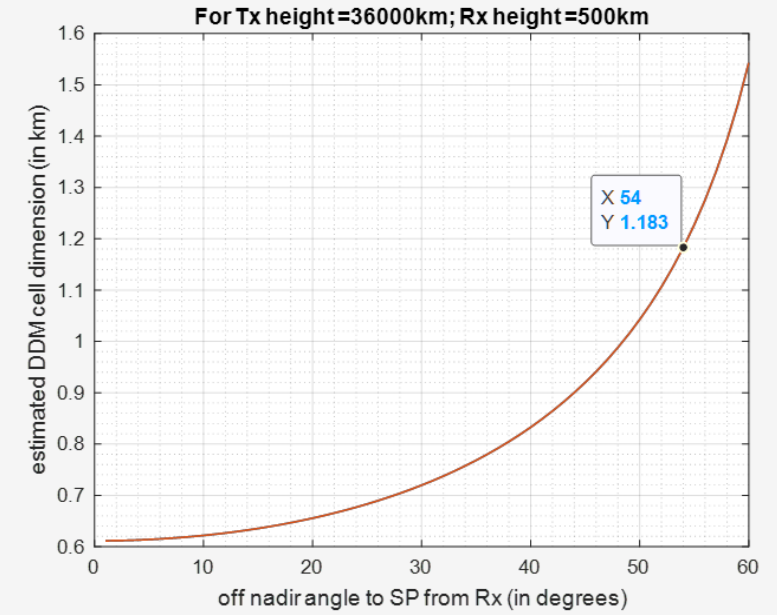
Coherent
Reflection
resolution

Diffused
Reflection
resolution

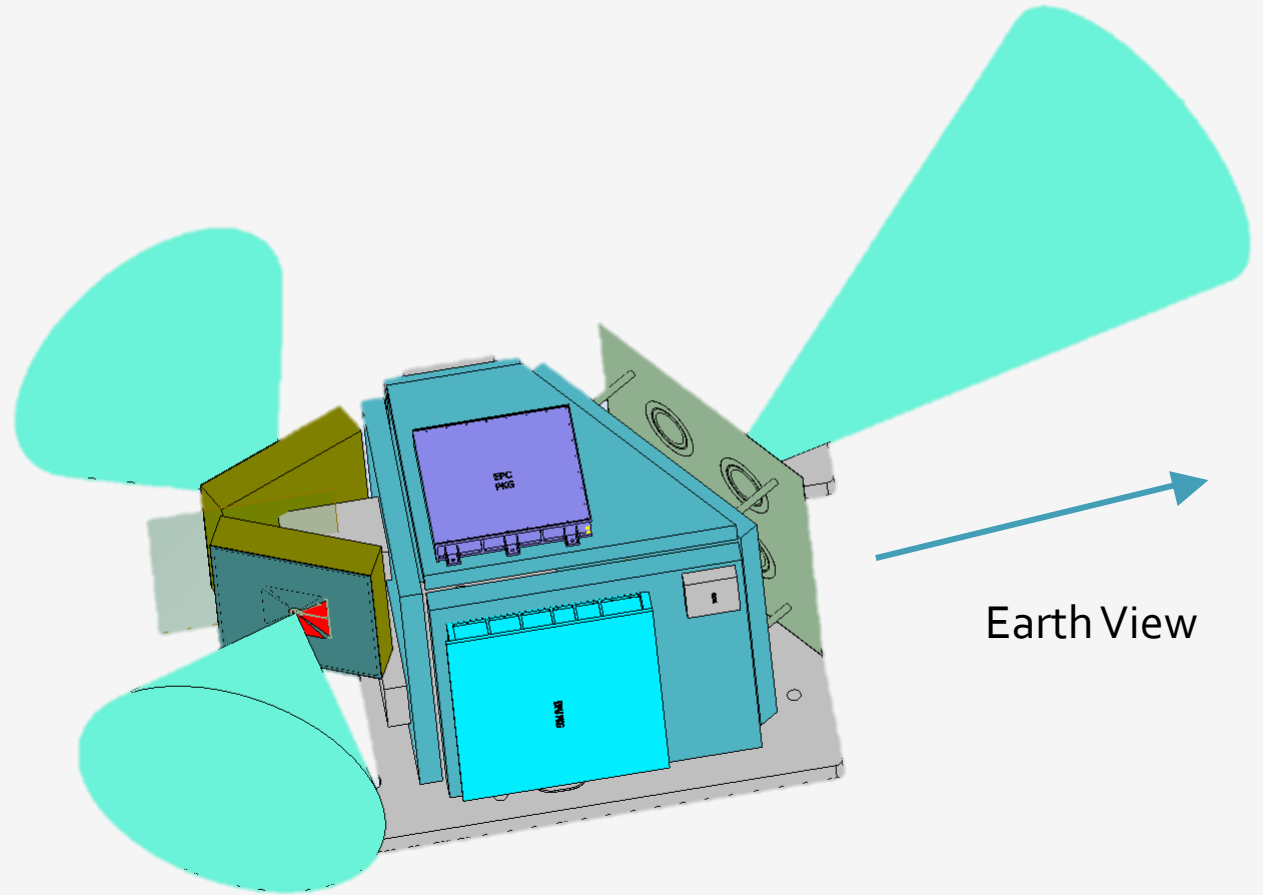
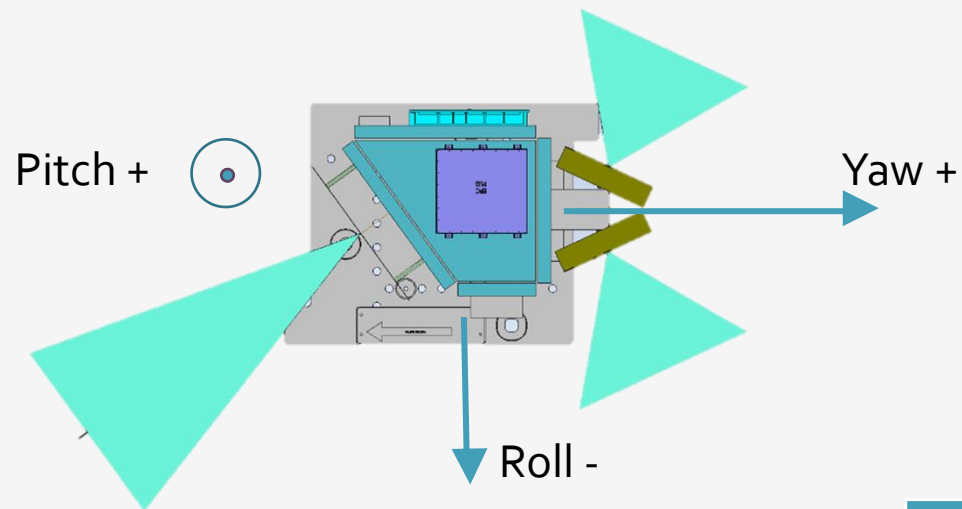
350 Km orbit



500 Km orbit



Preliminary Accommodation Study



Power (Raw Bus)	~ 45W
Weight	~ 16.5kg with 3 (2+1) antennas and structure



Mission Takeaway

- 1st Indian attempt on space borne GNSS-Remote sensing payload.
- Validation of System design taking care of calibration aspects to attain better than 0.5 dB B-RCS precision.
- Overall system design optimization opportunity for a more compact payload.
- Raw IF data from Grazing angles will provide Radio Occultation opportunities. POD data will have carrier and Code phase information to support RO accuracy req.