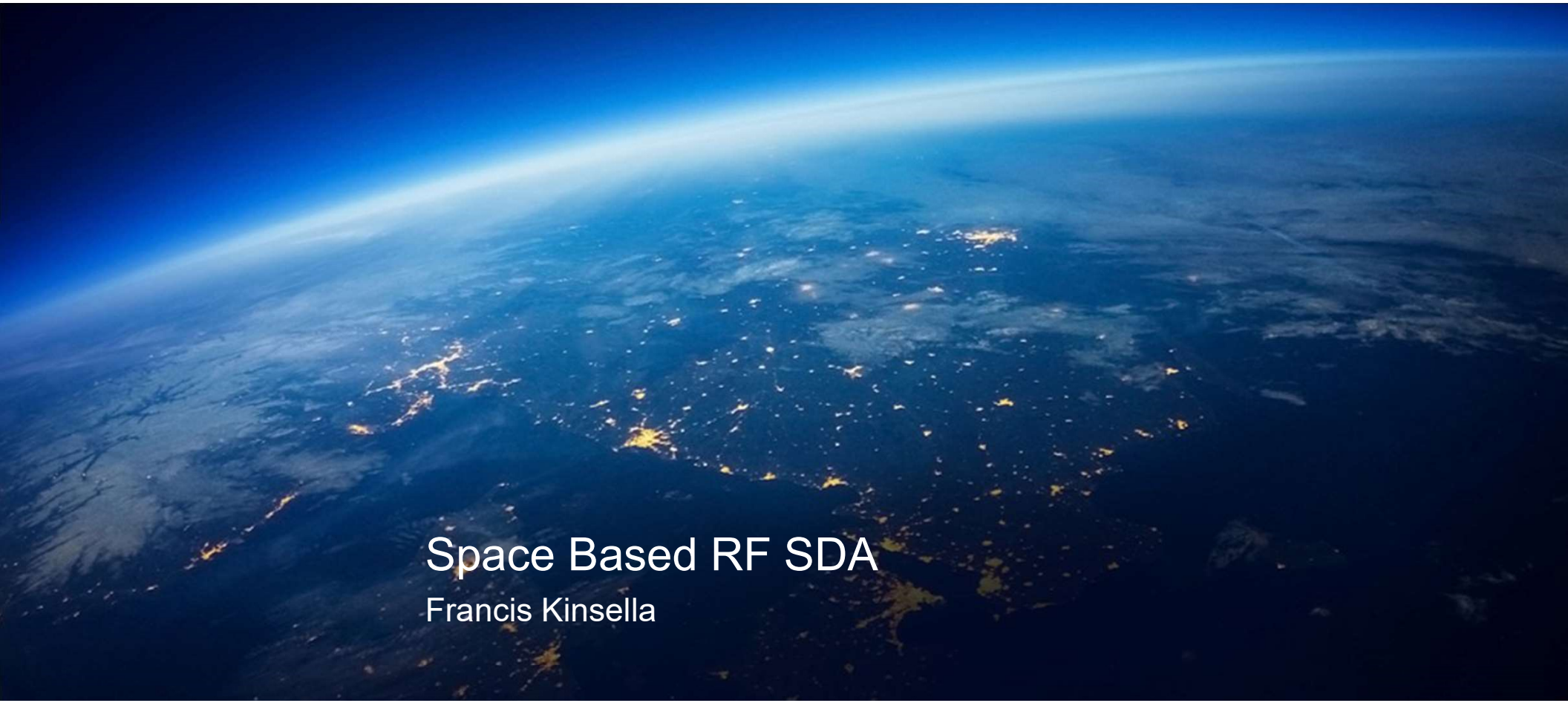


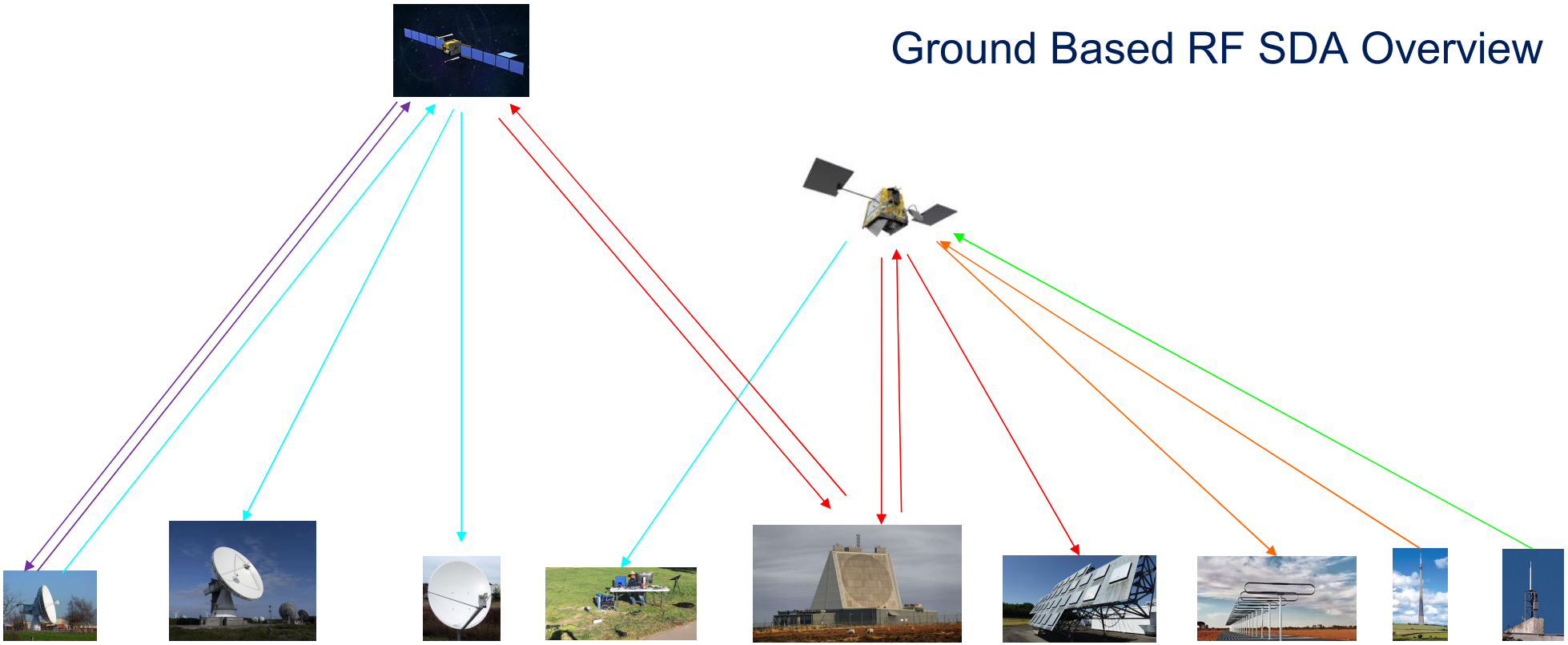
Space Based RF SDA

Francis Kinsella

DEFENCE AND SPACE

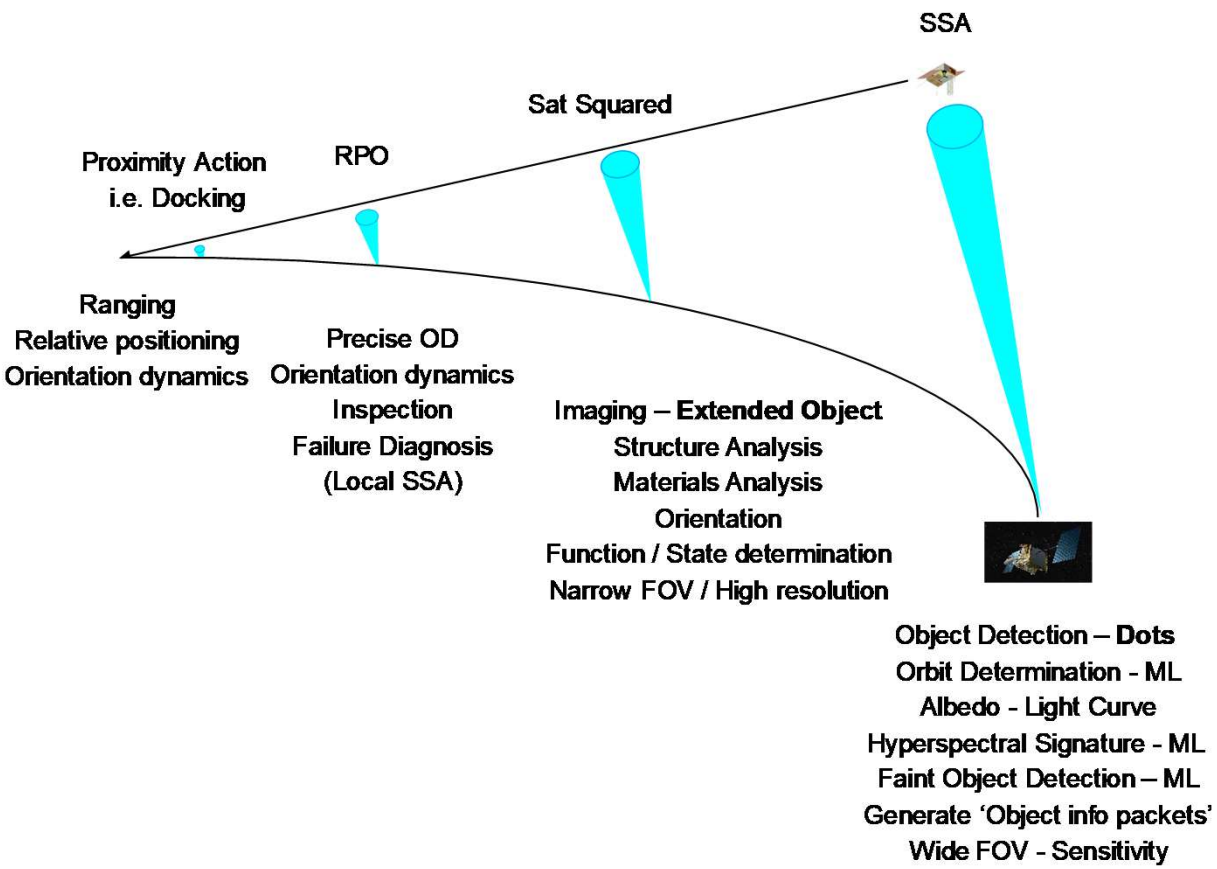
AIRBUS

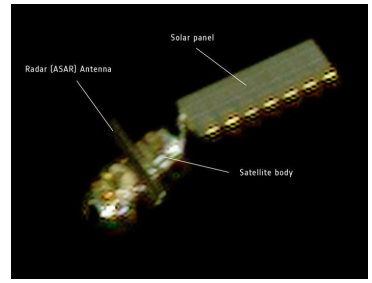
Ground Based RF SDA Overview

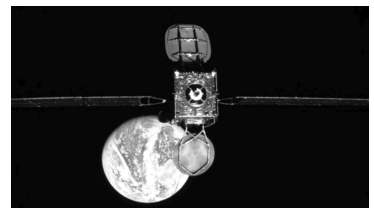


Ranging	Satcom Bistatic	Passive RF	Radar	Bistatic Radar	Passsive Radar	Beacon
SATRE / Tone	Airbus / GHY	Kratos, Safran, Clearbox	Fylingdales	Graves	Silentium	DORIS

Space Based SDA and Sat Squared







- Optical SDA Techniques are applied in Space
- Different imaging regimes according to Range
  - Wide multi- order of magnitude variation
- Space – Space Optical Imaging = Sat Squared
- RF SDA Techniques can similarly be applied in Space

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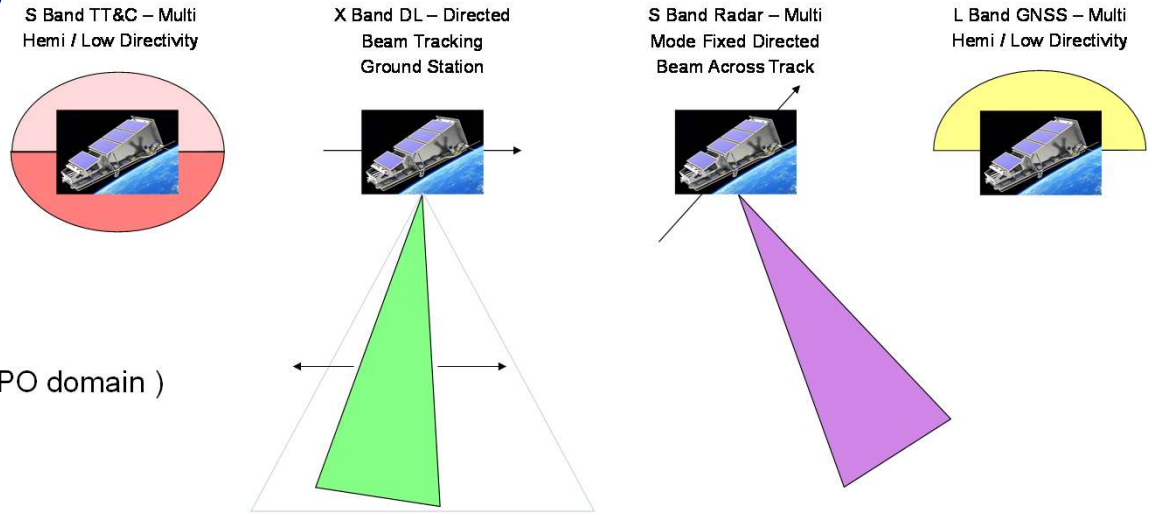
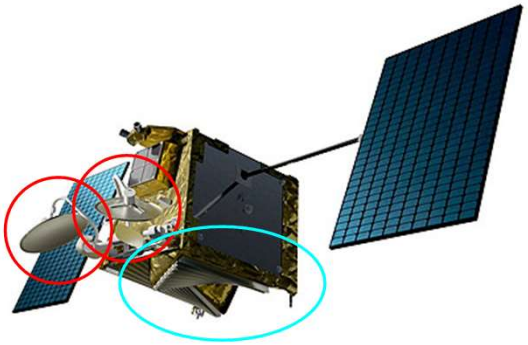
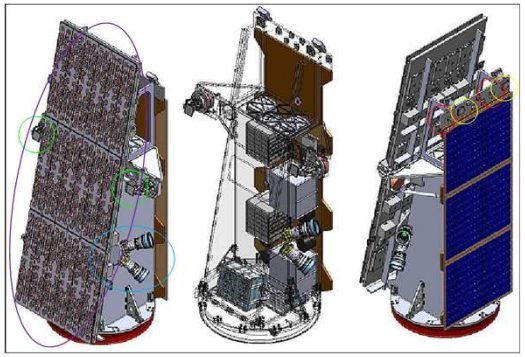
What Can We Detect? : Signatures



- RF Emissions from Space Vehicles
- Common across mission types :
  - TT&C (Telemetry) Transmissions
  - Electric Thruster RF Emissions
  - Stray emissions from clocks / LOs / power supplies (RPO domain)
- GEO / LEO Comsat :
  - Comms Traffic Downlinks (User / Anchor)
  - Pointing Beacon Signals
- LEO ISR :
  - Mission Data Downlink Transmissions
  - Sensor Transmissions (Radar / Sounders)
- Reflected RF Energy : Bistatic Radar





What Can We Do With RF Sensor Data? : Use Cases

- Detection of Active Objects from RF Emissions -> Protect and Defend vs RPO
- Identification of Objects from RF Signature
- Orbit Determination (added complexity with moving sensor)
- Characterisation of Objects from RF Emissions – Fingerprinting

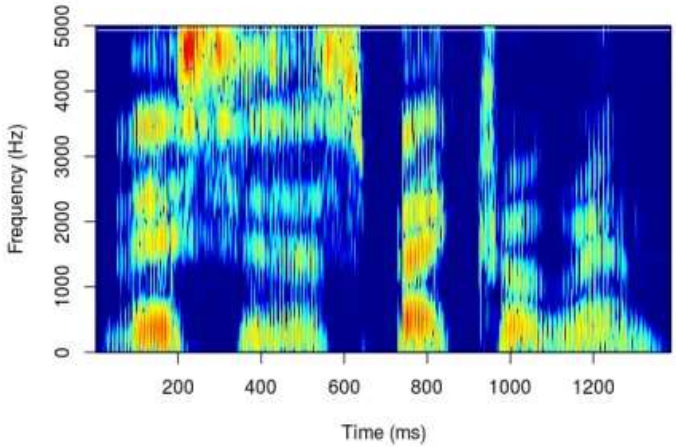
- Comsat Downlink Beam / Coverage Mapping
- Associated Ground Station Identification
- Manoeuvre Detection and Orbital Maintenance pattern identification
- RF Activity Cycle / Traffic Flow / Pattern of Life Analysis
- COMINT / Downlink / Telemetry Interception (specific orbital conjunction required)
- Anomaly Diagnostics (RPO)

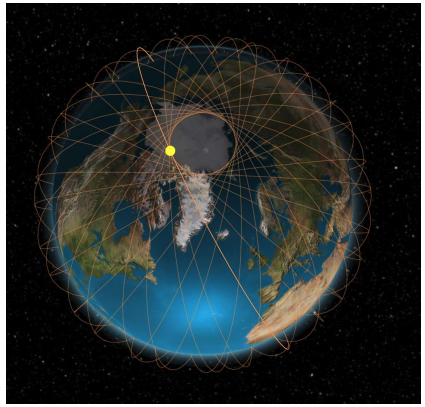
- Interference Identification -> **Spatio-Spectral Situational Awareness (S3A)**

- Support / pre-requisite to Space Control Operations

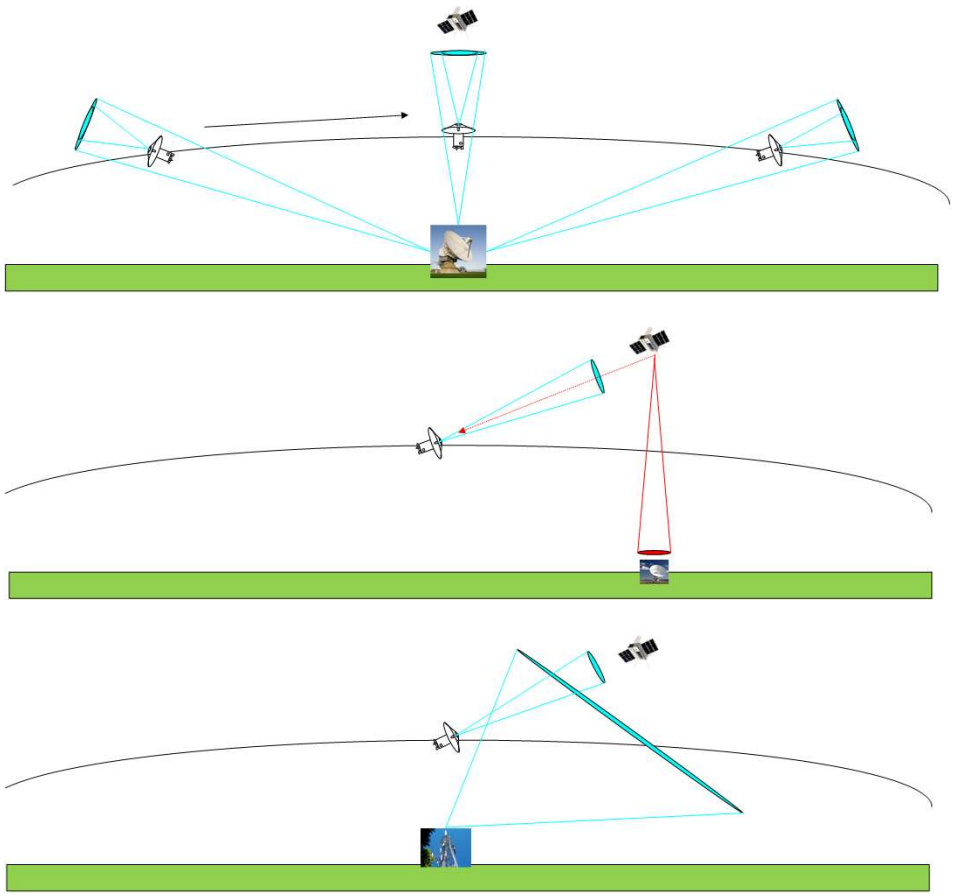
- Detection of inactive objects such as debris via detection of reflected RF energy (Bistatic Radar)

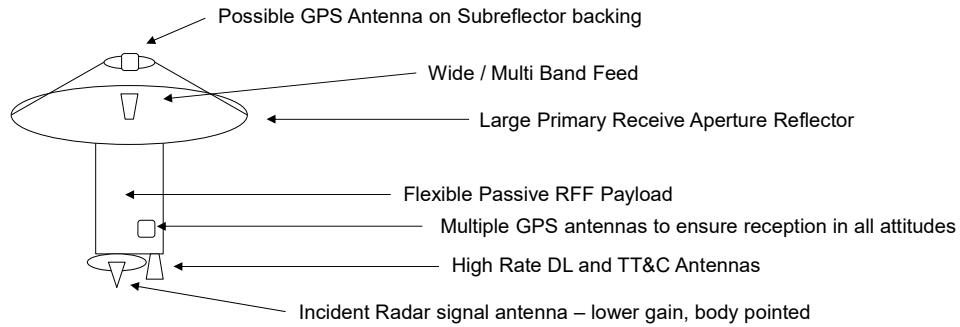
- Same as ground RF SDA Use Cases, within the constraints of platform capability (for example aperture) and platform orbital dynamics





What do we need to do this ? : Example Mission Concept : Concerto





- Multipurpose RF SDA Mission – Integrated with Ground Systems
- Large Aperture Antenna, Flexible SDR based Passive RF Payload

- Supports multiple Use Cases :
  - Colinear Bistatic Radar Configuration in Concert with Ground Based SSA Radar (Concerto / SISAR)
  - Offpointed Bistatic Radar modes (co-operative and non-co-operative / Signal of Opportunity)
  - Passive RF Space-Space SDA / RF Sat Squared
  - Ground Emitter SIGINT / Geolocation