GENESIS Science workshop - 12-13 March 2026, Brussels, Belgium

OHB ITALIA

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SPACE SYSTEMS

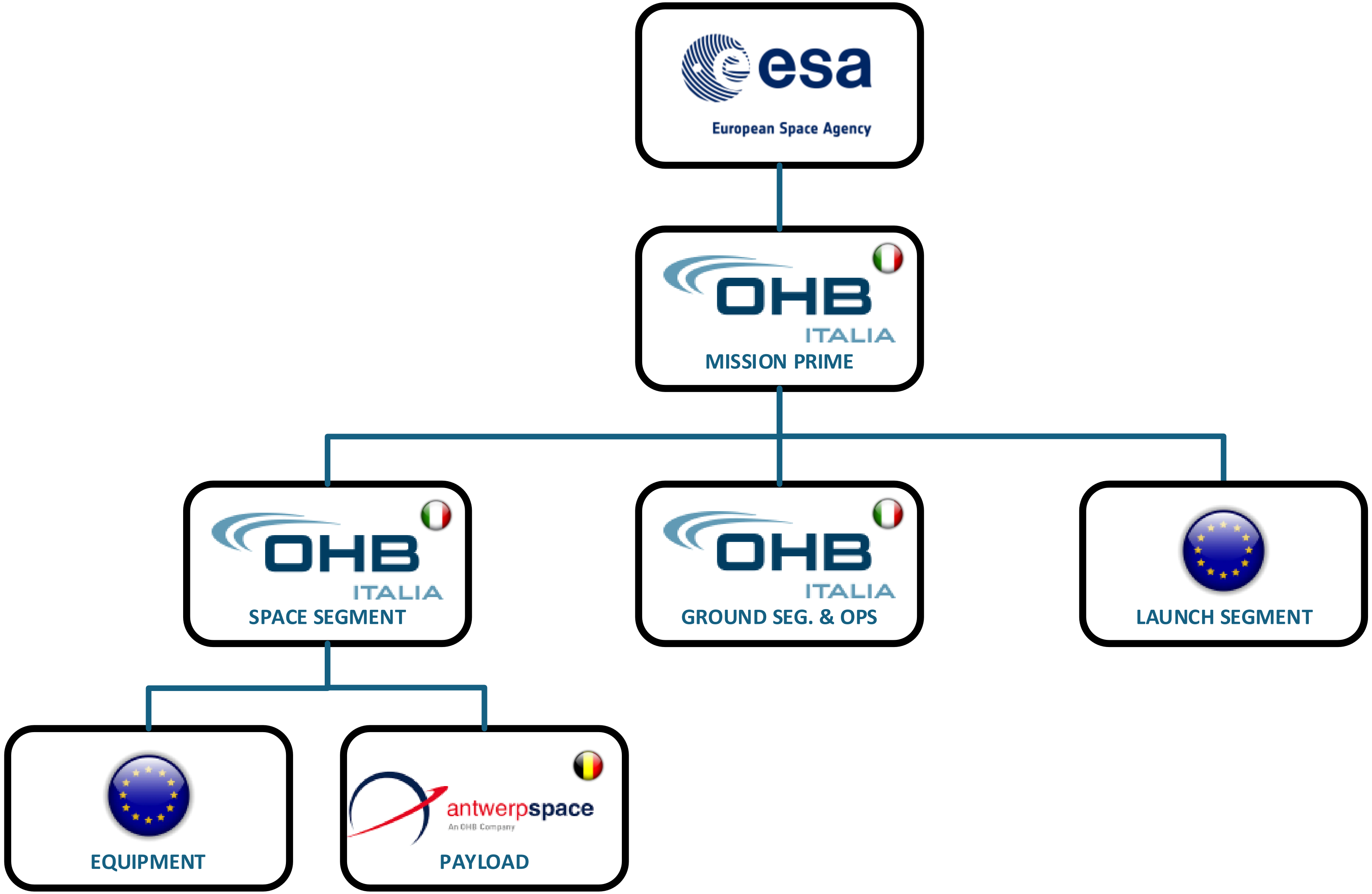
GENESIS SCIENCE WORKSHOP 2026 – OHB-I

GEN-PRES-OHI-SYS-0029

Agenda/Index

Industrial Structure

- **OHB-I** is the Prime Contractor for GENESIS Mission Phases A/B/C/D/E in charge of the design, development, launch and operations of the GENESIS Satellite Protoflight Model (PFM), this include the development of the Ground Segment for the GENESIS Mission and the launcher procurement
- **Antwerp Space** is the Payload Prime for the GENESIS Mission in charge of the design/procurement, development, delivery and verification of the GENESIS payloads
- More than 40 companies across Europe are at today involved in the GENESIS Mission!



GENESIS System Architecture

- **Space Segment:**

  One Satellite embarking the following Payloads:

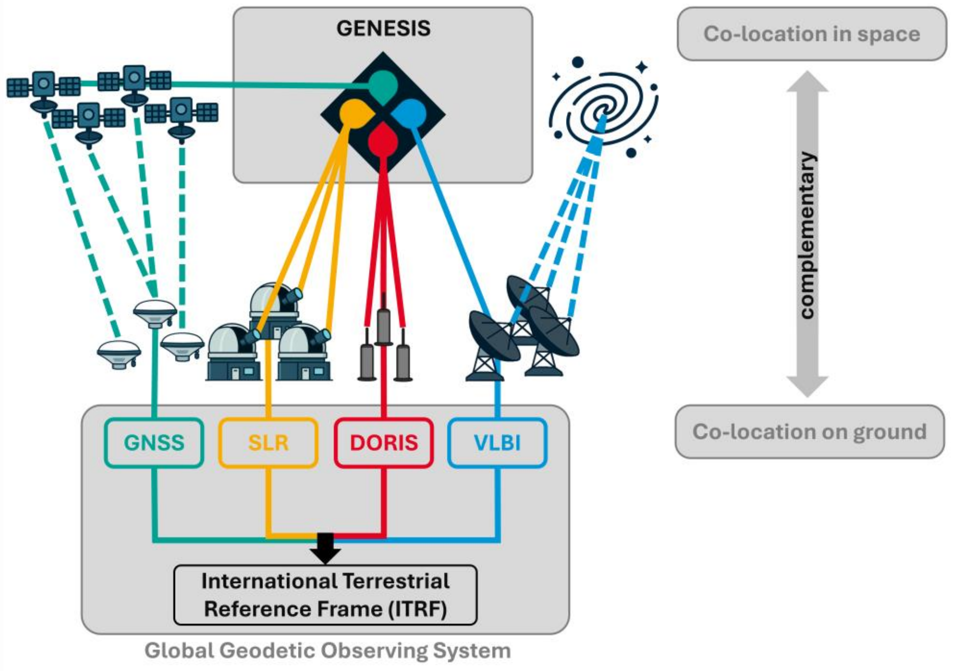
  - Very-Long Baseline Interferometry (VLBI) - **TX**
  - Global Navigation Satellite system (GNSS) - **RX**
  - Satellite Laser Ranging (SLR) - **Passive**
  - Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS) – **RX**
  - Ultra Stable Oscillator and Distrib. Amplifier **(USO and DA) – internal equipment**

- **Ground Segment:**

  - 1 Ground Station (G/S) for Nominal Ops (Polar):
  - 1 Additional G/S for LEOP Phases
  - 1 Mission Control Centre (OHB-I Rome premises) interfacing with PROAD
  - Mission Control Team (OHB-I Staff)

- **Launcher:**

  - EU Small Launcher Class (expected Launcher Selection by System-CDR)



GENESIS Reference Orbit	
Semi-major axis	12378 km (h ~6000 km)
Inclination	95.5 deg
Orbit period	228 min
Eccentricity	1E-3
Reference epoch	01 January 2028 00:00.000

Satellite Configuration

Key drivers for the Satellite Configuration Design:

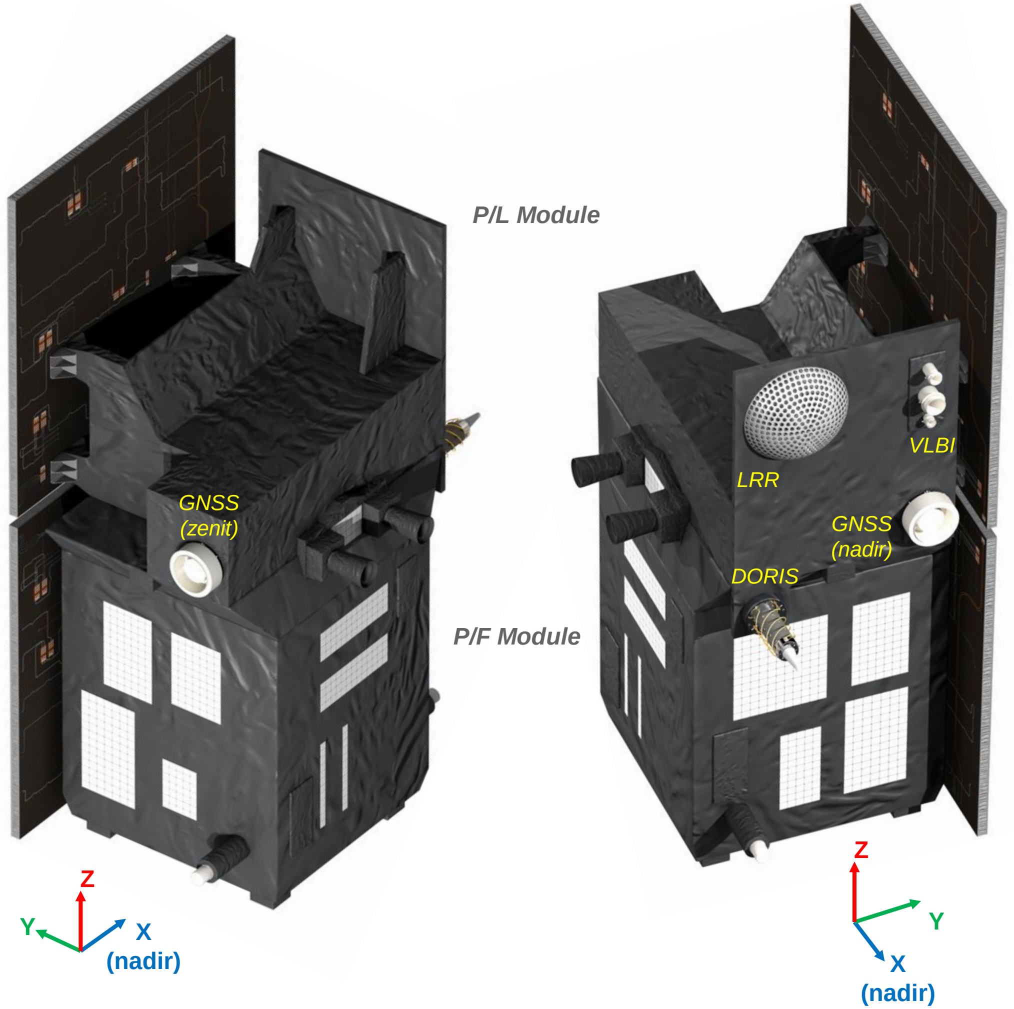
- Small EU Launcher **Fairing size** and **mass injectable in orbit**
- **Radiation Environment** @ 6000 [km] altitude:
    - Total Non-/Ionising Dose (TID, TNID) impacts electronic equipment
    - High structure mass

PDR Configuration Design:

- 2 Body mounted Solar Arrays on the +Y side of the Satellite
- Satellite split into 2 modules:
    - **Payload Module (top):** Sandwich-CFRP structure for **P/L Antenna and LRR**
    - **Platform Module (bottom):** Sandwich-Al structure for electronic equipment

Payload Accommodation:

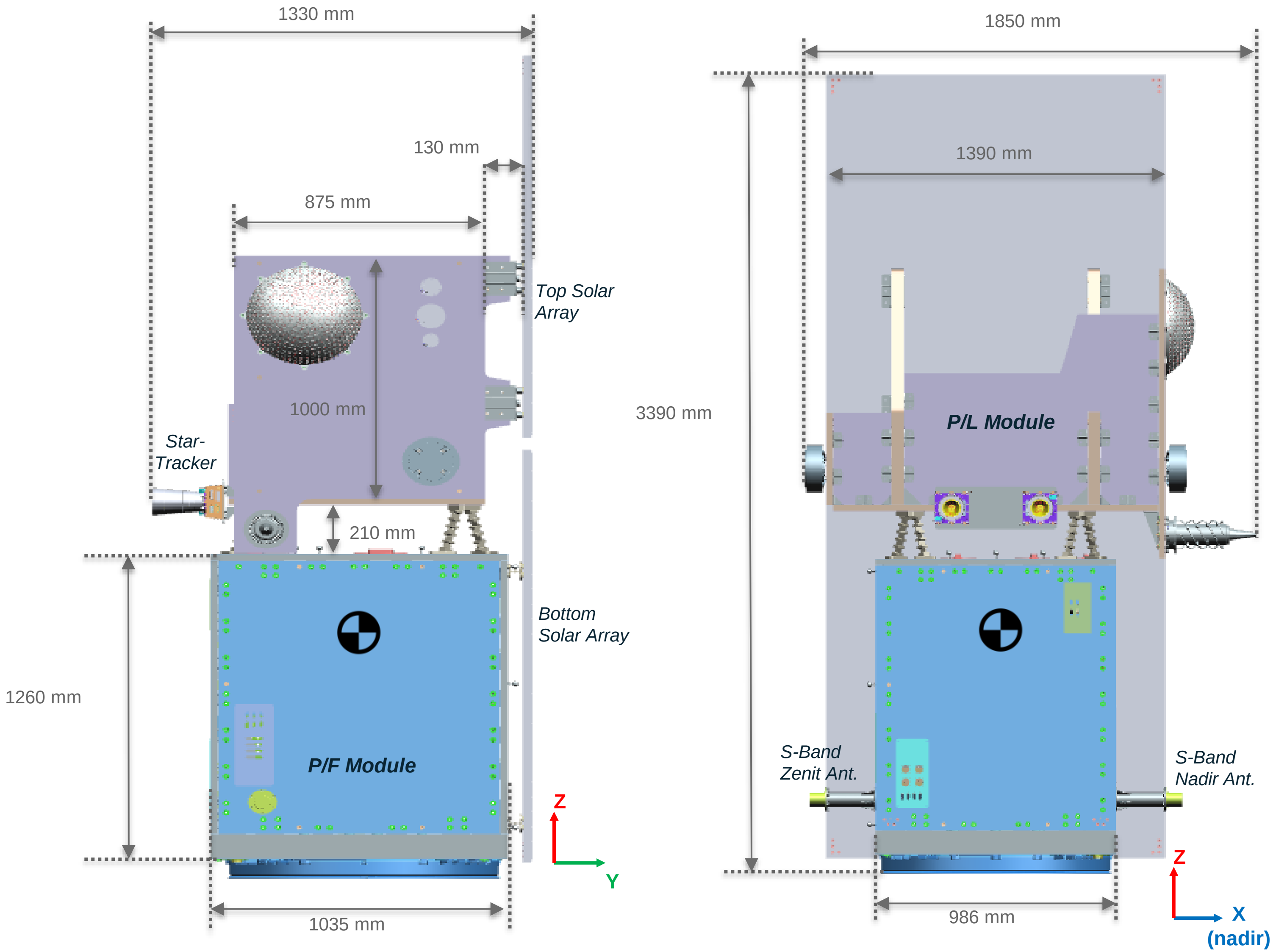
- 1 Item on Zenit panel: GNSS Ant. 1
- 4 Item on Nadir panel: GNSS Ant. 2, VLBI Ant. (3 antennas), SLR, DORIS Ant.
- VLBI-TX, DORIS-Rx, GNSS-Rx, USO and DA: inside Platform Module



GENESIS Spacecraft - PDR Design

Satellite Configuration

GENESIS Satellite - Naked Structure



Satellite Main Data 1/2

Satellite Platform key facts:

- 3-axis stabilised satellite
- Nadir Pointing attitude
- No propulsion system (to improve CoM stability)
- Science Data Availability: ≥ 95% of the time (avg over year)

SATELLITE PLATFORM CHARACTERISTICS (1/2)	
Subsystem/Unit	**Baseline design**
System	Mass: ~406 Kg
	Envelope: 1850 x 1330 x 3390 mm
EPS	Power consumption: 280 W
	Main bus: 28V unregulated
	Solar array: Fixed solar array. Overall surface 4.55 m2
	Battery: Li-Ion battery.
Communication	S-band
	Downlink datarate: 2.5 Mbps
	Uplink datarate: 64 Kbps

Satellite Main Data 2/2

Satellite Platform key facts:

- 3-axis stabilised satellite
- Nadir Pointing attitude
- No propulsion system (to improve CoM stability)
- Science Data Availability: ≥ 95% of the time (avg over year)

SATELLITE PLATFORM CHARACTERISTICS (2/2)	
Subsystem/Unit	**Baseline design**
Data Handling	CPU: GR712RC with Dual-Core LEON3-FT SPARC V8 Processor (80 MHz) + RTG4 Companion FPGA
	Memory: 256MB SDRAM plus 128MB EDAC
	Mass memory dimension: 200Mbyte (TBC)
ACS	**Actuators:** • Reaction wheels: 4 wheels • Magnetic torquers: 3 MGT of 145 Am^2 **Sensors:** • Star trackers: 2 cold-redundant units • Magnetometers: 2 redundant units • Sun-Sensors: 14 Coarse Sun Sensors **Performance:** Nadir Pointing error accuracy: ≤1 deg (2σ)
Payloads	*Ref to dedicated slides*

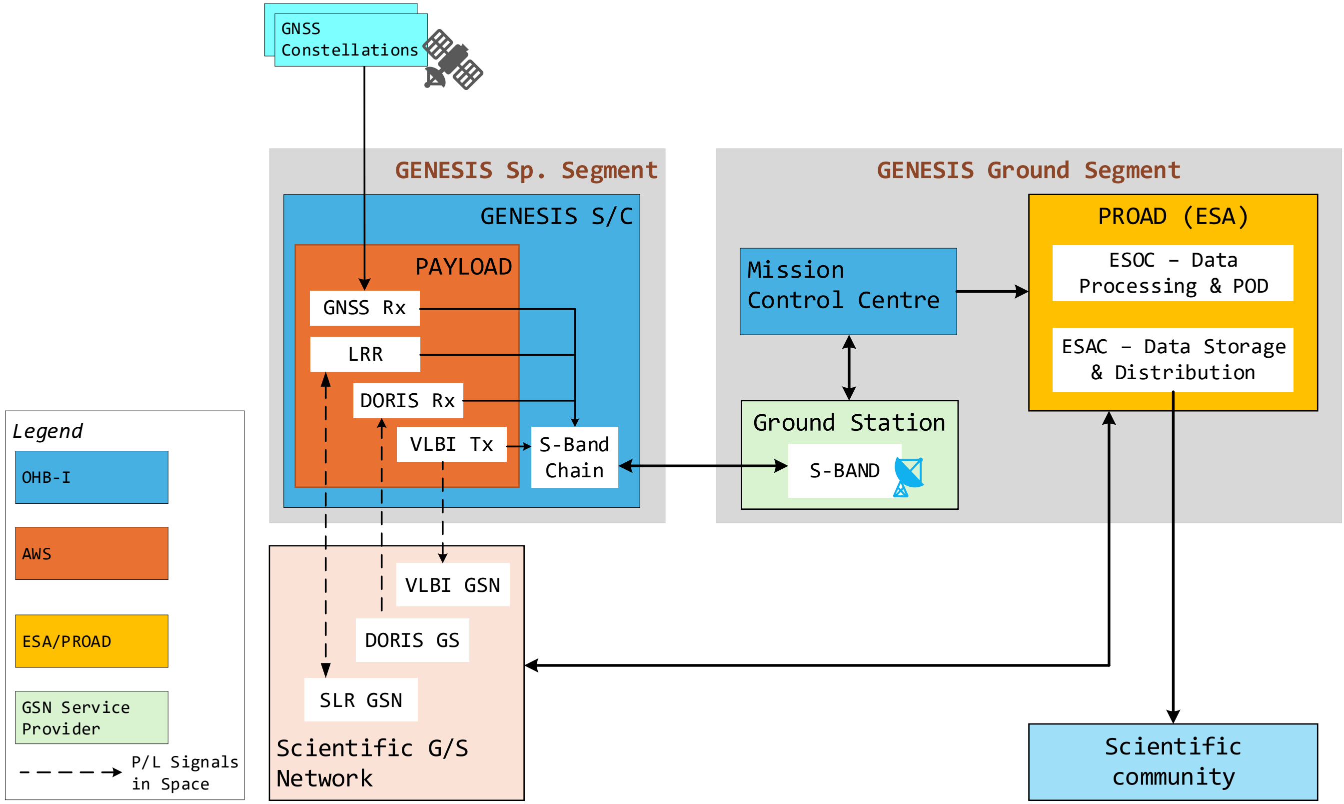
Preliminary Operations concept (1/2)

Operational mission phases:

- Launch and Early Orbit Phase – LEOP (~7 days)
- Commissioning Phase (~2 months)
- **Nominal operational Phase** (2 years baseline + extension option)
- Passivation phase (duration TBC)

Nominal Operations Phase Planning

- *Long Term Planning* (LTP): 2-3 months TBC (OHB + ESA/PROAD)
  - Defined with inputs of *Scientific G/S Network*
- *Short Term Planning* (STP): 10 days TBC (OHB)
  - Derived from LTP, plus specific Ops Needs or ad-hoc requests



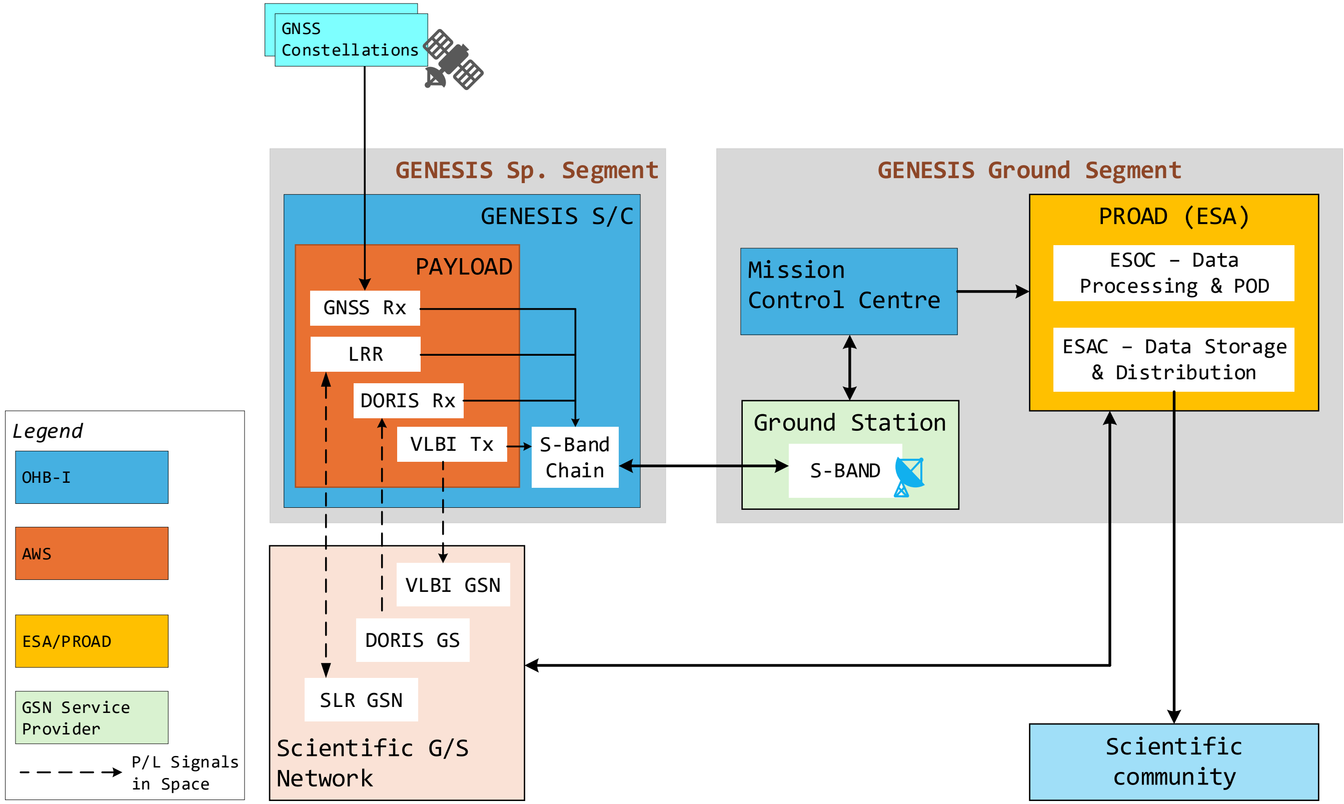
Preliminary Operations concept (2/2)

Ground-Station (G/S) passes for Sat TM/TC:

- Avg of 6 orbit per day; 1 pass/orbit
- Pass duration: ~ 30-40 [min] (TBC)
- Total HKTM + Science Data: ~ 570 MB/day (incl. margin)

Nominal Ops Activities:

- S/C mostly operated autonomously:
  - *Short Term Plan* converted into time-tagged TC uploaded to the S/C
- Each pass:
  - SAT TM data (incl. P/L) downlinked to MCC, Status Check
- Raw Data, L0/L1 product and Ancillary data fw to PROAD within 24h



OHB-I GENESIS Team

Francesca Cirillo

Project Manager

Nicola Hyeraci

Chief Engineer

Salvatore Mignano

Satellite System Engineer

Vincenzo Ingravallo

Payload Interface Manager

Come and talk to us for any question!

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SPACE SYSTEMS

Thank You!

GENESIS Payload

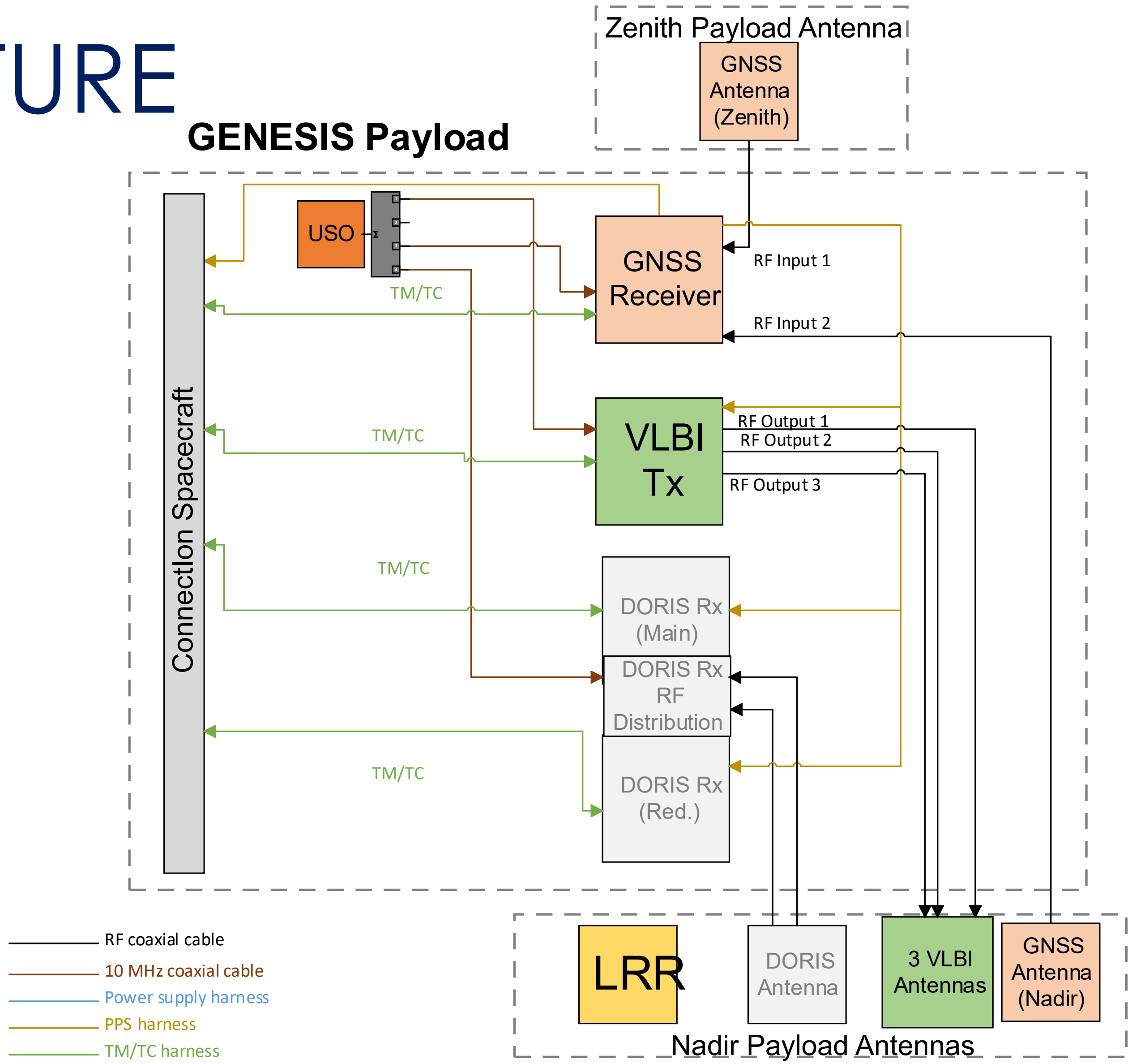
Antwerp Space

GENESIS Payload

Table of Content

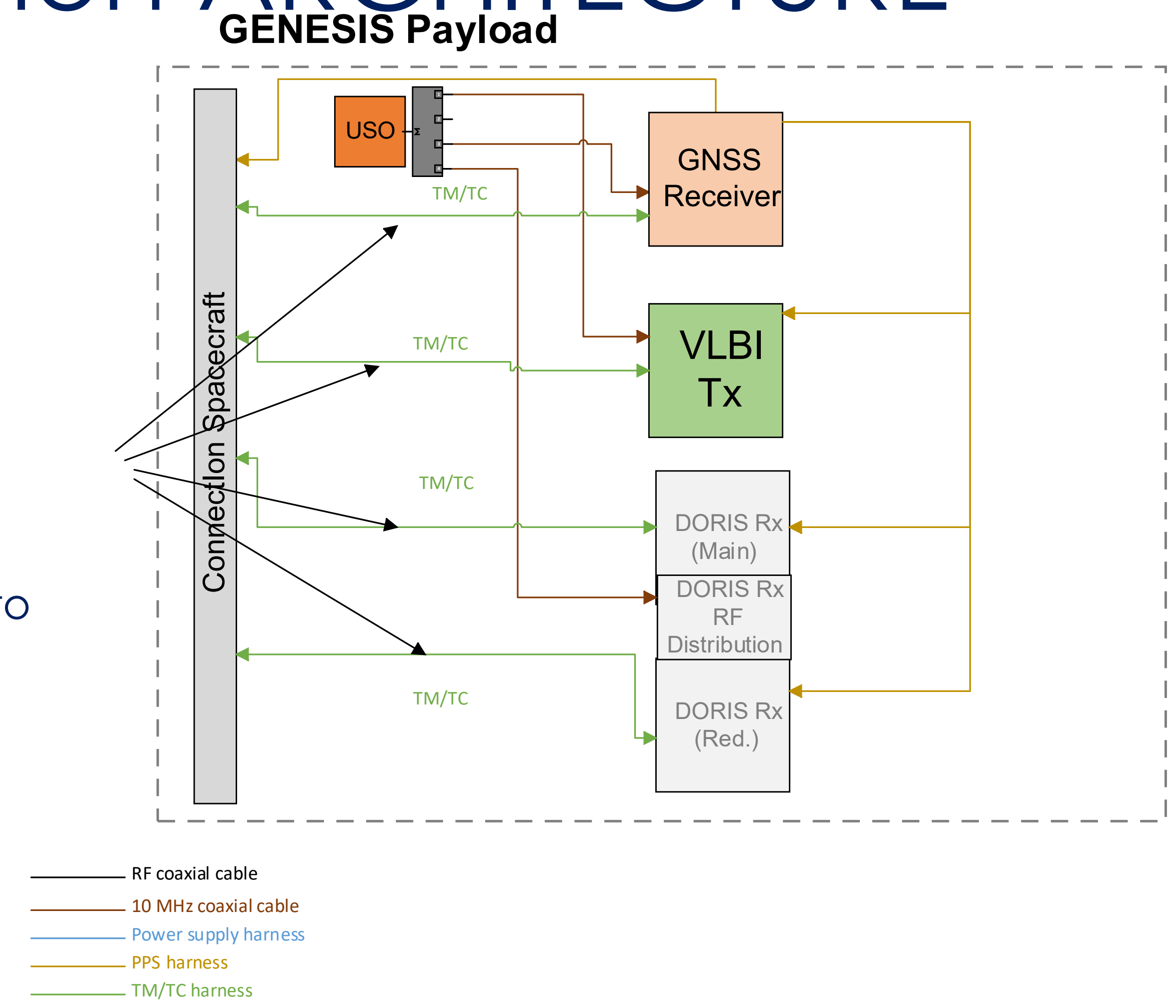

DORIS
USO & DA
LRR
GNSS
VLBI

PAYLOAD ARCHITECTURE



PAYLOAD Timing Synchronization ARCHITECTURE

- USO provides the 10Mhz frequency reference for all instruments
- The GNSS after frequency lock provides the 1 PPS timing reference to the other instruments and the System
- Instruments distribute timing information through TM/TC link to the System

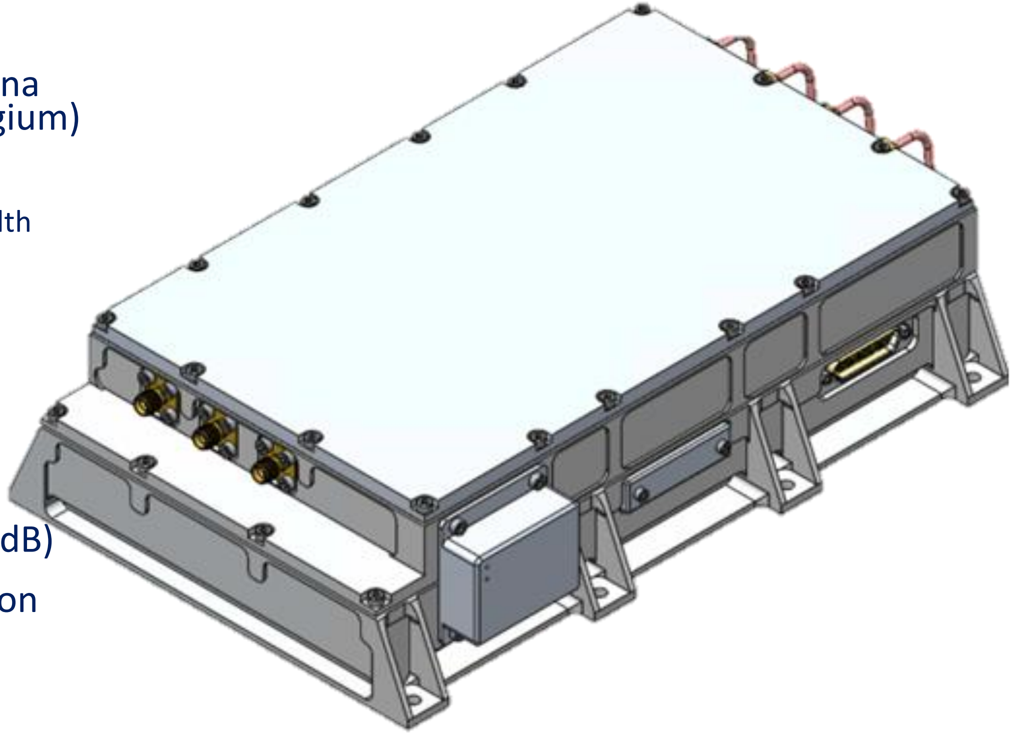


Main challenges

- Environment: MEO Orbit, Radiation, Thermal constraints
- Usage of heritage units
- Stringent requirements on performance

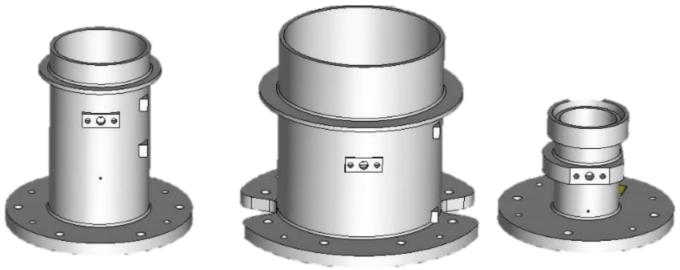
VLBI Transmitter

- Electronic box under development by Antwerp Space (Belgium) and antenna subsystem under development by UCL (Université Catholique Louvain Belgium)
- Space geodetic VLBI technique:
  - Conventional "quasar-like" noise emissions in more than 1 GHz of combined bandwidth
  - Customizable spread-spectrum-based time transfer feature
- Supports 4 frequency bands
  - S band at 3.2 GHz with 200 MHz of occupied BW
  - C band at 5.41 GHz with 320 MHz of occupied BW
  - Low X band at 8.2125 GHz with 375 MHz of occupied BW
  - High X band at 9.55 GHz with 500 MHz of occupied BW
- Low-power emissions (up to 10 Jy boresight) with high dynamic range (20 dB)
- Preliminary Signal-in-Space Interface Control Document under consolidation



- Field of view $\pm 31^{\circ}$
- The antennas are LHCP with axial ratio < 10dB
- Antenna gain variation over FOV <5dB

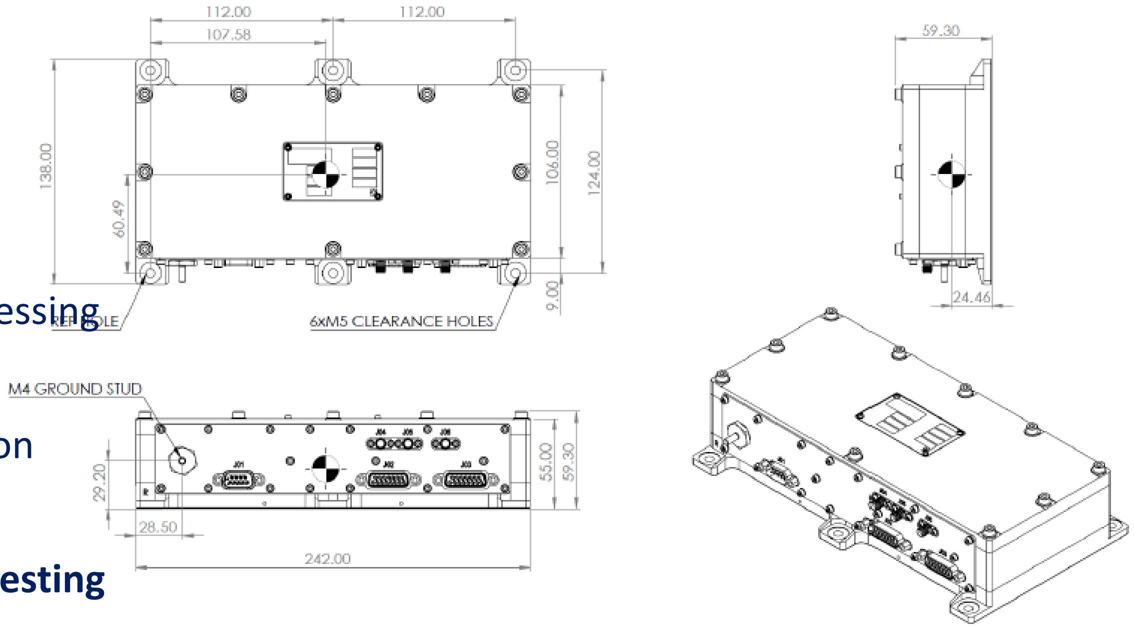
- EM e-box & antenna EQM testing is scheduled over Summer 26



GNSS Receiver

- **Provided by SpacePNT**
- **GENESIS mission challenges**
  - GNSS visibility from MEO orbit
  - Super high accuracy for POD post-processing
  - Operation in challenging MEO radiation environment
- **Proposed solution [NaviLEO™] - Tailored for GENESIS Mission**
  - Triple frequencies
  - External clock input from USO
  - Close coordination between ESA and Industry to identify optimizations to ensure the high accuracy for the POD processing ongoing
  - Increased number of tracking channels
  - Radiation Hardness Assurance to cope with extended mission lifetime
  - EM Testing is scheduled over summer period
    - **Data will be made available after completion of the testing**

External dimensions



  - Dual antennas from Beyond Gravity Sweden
  - COTS antenna
  - the GNSS Patch Excited Cup (PEC) Antenna with choke rings

USO Technical Overall Structural Description

- Master Oscillator

- Distribution Amplifier

Space Ultra Stable OCXOs
> 380 Flight Models

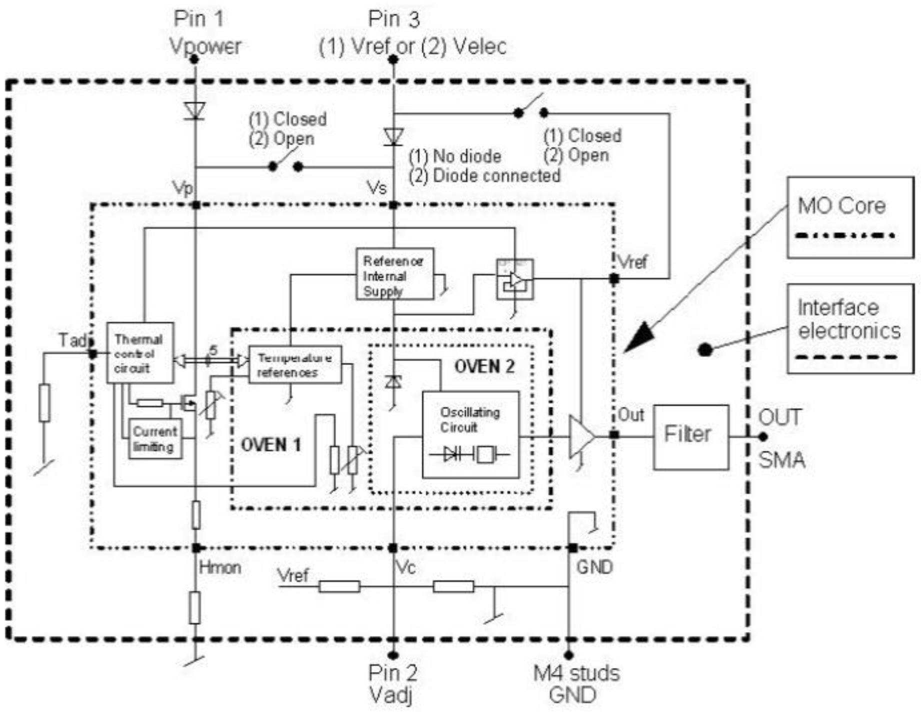
Provided by SafranTT
Frequency reference of the payload for synchronization.
The USO is a COTS.

A Distribution amplifier has been added to provide the 10MHz reference with appropriate power levels to the instruments.

The EM will be tested in 2nd half of this year

- SAT COM
- Earth Observation
- Navigation
- Deep Space

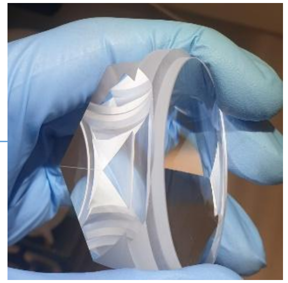
Adaptation for GENESIS Mission:
- Low phase noise (important for GNSS and DORIS
- Stringent ADEV requirements



FUNCTIONAL BLOCK DIAGRAM OF THE MO

TECH	STABILITY	KEY FEATURES	WEIGHT/ consumption	TRL ESA
OCXO 5 to 15MHz MO	<+/-1E-9 (-20° to 60°C) <+/-1E-10/day < 5 E-13 1s to 100s	• LEO/MEO/ GEO programs • Low phase noise (-110 dBC/Hz @1Hz) • High reliability	220 g/ 5W @-20°C	9

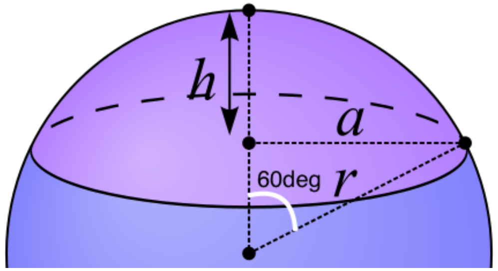
LRR Laser Retro-Reflector



- Provided by INFN
- Dedicated design for Genesis mission LRR

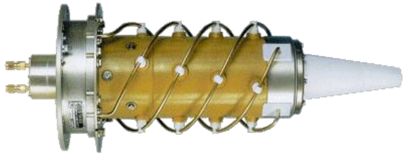
  scaling from heritage LRR
- D(cap) ≃ 403.5 mm
- N(CCRs) ≃ 385 (127 mm)
- D (LRR) ≃ 470 mm
- h (LRR) ≃ 138 mm (req: 150 mm)

- LRR of many Cube Corner Retroreflectors (CCRs).
- OCS ≥ 6 Msqm
- Laser light wavelength 532 nm
- Mass < 8 kg
- Volume envelope < 450mm x 450mm x 150mm (h)



DORIS Receiver

The DORIS system (Doppler Orbitography and Radiopositioning Integrated by Satellite), developed by CNES in the 1980s, can pinpoint anywhere on Earth with centimetre accuracy and precisely determine satellite orbits.



DORIS omnidirectional antenna Credit: CNES

The DORIS is provided by CNES and all activities are performed in close cooperation with CNES.

Main challenges:

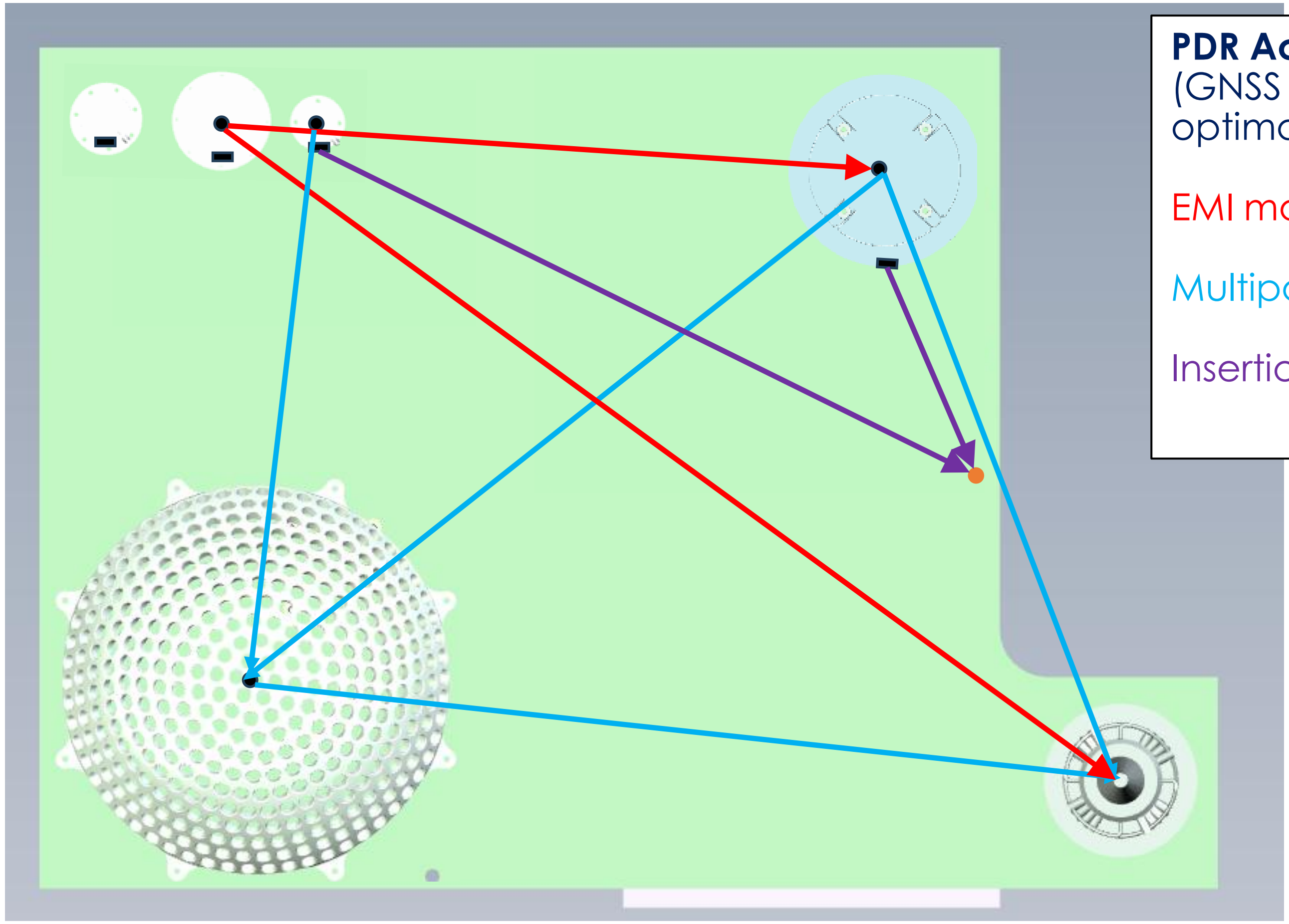
- MEO Orbit
  - Larger distances to the beacons and Challenging link budget
  - Adaptation of the software to cope with higher amount of beacons in FOV

- First mission using external USO from SafranTT:
  - Under investigation by CNES
  - Separate tests are planned with USO and DORIS EM before end of the year.

  - No hardware modifications required, only software

Antenna accommodation

- Several iterations on the antenna accommodation have been performed.
- The accommodation on the satellite is challenging. iterations to optimize were done considering these constraints:
  - P/L panel size, unobstructed FOV, Antenna stay out region, link budgets, AIT & TED
- Has the following degrees of freedom:
  - Antenna position and orientation
- Uses KPI’s insertion loss, multipath ripple and EMI margin to determine optimal position



PDR Accommodation (GNSS insertion loss optimal)

EMI margin (maximize)

Multipath (maximize)

Insertion loss (minimize)

PAYLOAD CALIBRATION PLAN/PROCESS

- **Calibration and characterizations will be carried out by a combination of tests and analyses at both unit and spacecraft level**
  - Tests are done to the furthest extend possible on ground
  - In-orbit calibration plan will be determined at a later stage
- **Measurements Summary:**
  - Antenna Phase, Gain, and Group Delay (anechoic chamber at PFM spacecraft level at ambient temperature)
  - Calibration of cable delays over temperature
  - GNSS inter-frequency bias over temperature, VLBI group delay, DORIS under discussion with CNES
- **Analysis of instrument behaviour:**
  - Antenna + cable + unit combination
  - Temperature telemetries from unit and antenna (used also for cable temperature estimation)
  - Impact of thermal on antenna calibration
  - LRR laser range correction calculated from placement and the properties of the individual corner cube reflector

Ground calibration plan is under definition.
Details on ground calibration plan will require the involvement of both Industry and Scientific Community.
The exchange with the Science Community was kicked off yesterday and needs to be consolidated until Critical Design Review

Antwerp Space people attending the Workshop

- Jean-François Boone, Genesis Payload Project Manager
- Panagiotis Charlaftis, Subcontractor Manager Payload Instruments
- Robert Klingenberg, Technical Lead Genesis Payload
- Davide Marcantonio, Responsible Calibration
- Zeljko Jelic, Technical Lead Genesis VLBI Instrument