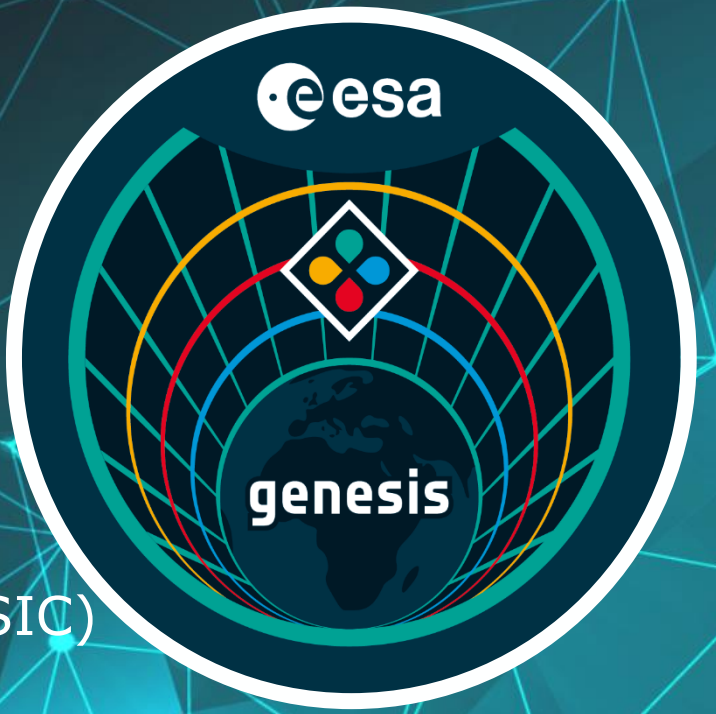
GENESIS - A Multi-Technique Geodetic Observatory in Space

S.Gidlund, G.Fusco, P.Waller, E.Honore-Livermore, E.Sakalauskaite: ESA ESTEC
W.Enderle, E.Schoenemann, F.Gini, JC.Berton: ESA ESOC
V.Navarro: ESA ESAC

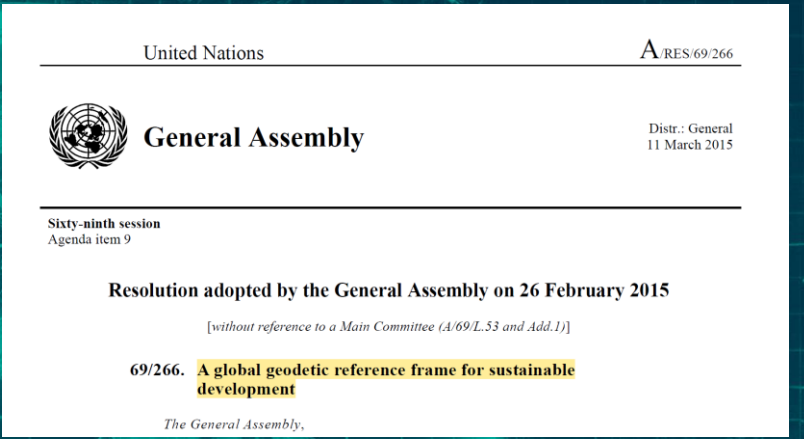


64th Meeting of the Civil GPS Service Interface Committee (CGSIC)
Baltimore, MA, USA, September 16-17, 2024

GENESIS Primary Objectives

Contribute to improve ITRF accuracy and stability by providing in-orbit colocation and necessary combined processing for the four space-based geodetic techniques that contribute to its realization. The goal is to contribute to the achievement of the Geodetic Global Observing System (GGOS) objectives for the ITRF realisation, aiming for a parameter **accuracy of 1 mm and a stability of 0.1 mm/year**, in order to provide significant scientific benefits in Earth modelling, and to support a wide range of societal applications (as endorsed by the United Nation resolution A/RES/69/266).

Contribute to improve the link between the ITRF and the ICRF, thanks to the increased consistency of the Earth Orientation Parameters (EOP). In particular, this mission shall allow for the first time a link between the orbit reference frame, ITRF and ICRF.



United Nations A/RES/69/266

General Assembly

Distr.: General
11 March 2015

Sixty-ninth session
Agenda item 9

Resolution adopted by the General Assembly on 26 February 2015

[without reference to a Main Committee (A/69/L.53 and Add.1)]

69/266. A global geodetic reference frame for sustainable development

The General Assembly,

Targets:

Accuracy: 1 mm

Stability: 0.1 mm per year

ESA's GENESIS

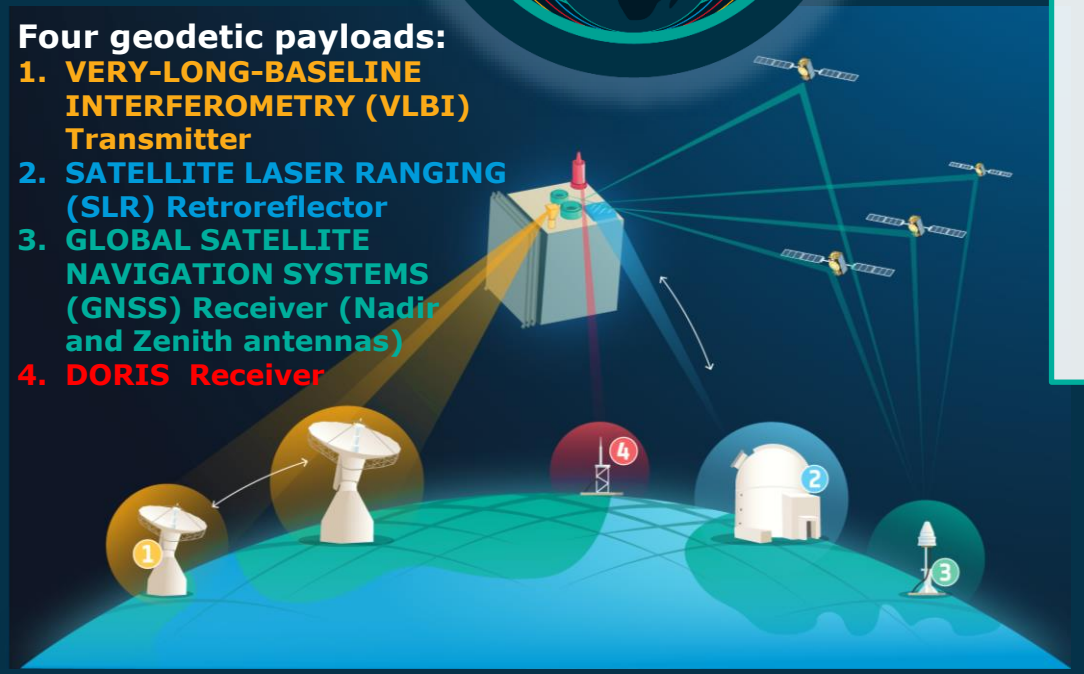
At the foundation of navigation

GENESIS in short

- **250-300 kg** Satellite
- **Orbit**
  - **~ 6000 Km** Altitude,
  - **~ 95 deg** inclination
- Very Precise on-Board Metrology
- **Launch in 2028**

Four geodetic payloads:

1. **VERY-LONG-BASELINE INTERFEROMETRY (VLBI) Transmitter**
2. **SATELLITE LASER RANGING (SLR) Retroreflector**
3. **GLOBAL SATELLITE NAVIGATION SYSTEMS (GNSS) Receiver (Nadir and Zenith antennas)**
4. **DORIS Receiver**



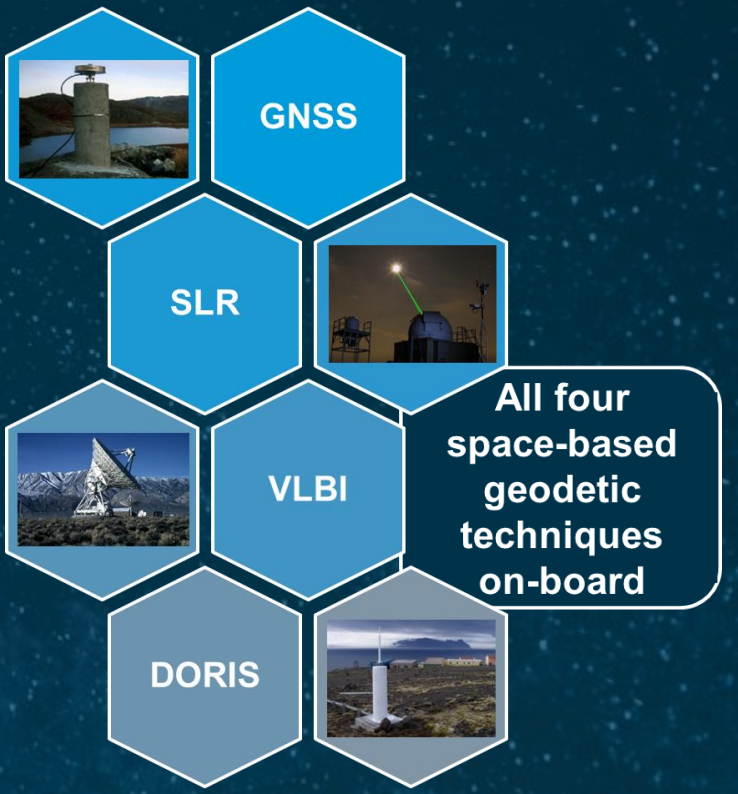
Overview of the GENESIS Mission

Overview

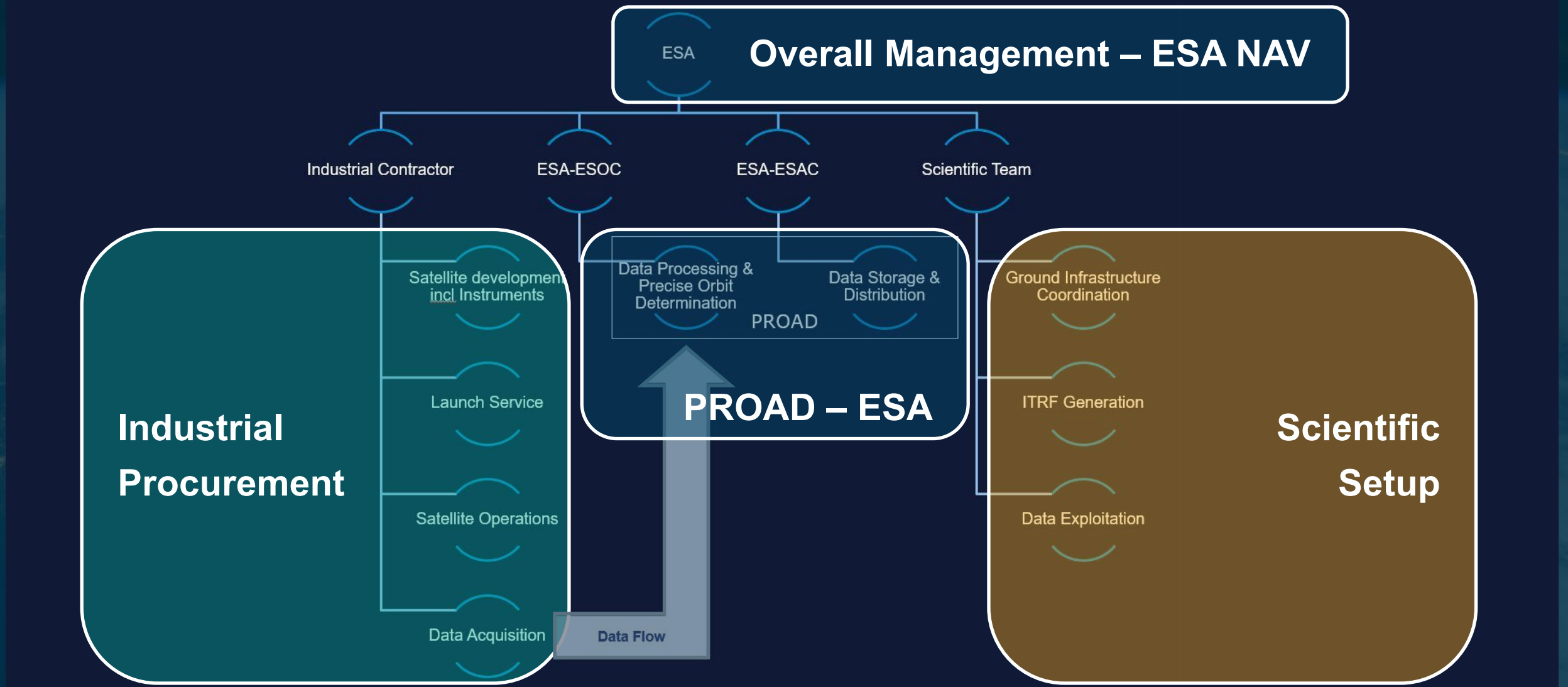
- GENESIS is managed by the ESA Navigation Directorate and part of its **FutureNAV Programme**

Mission scope

- Design, development, qualification and calibration of the **satellite (incl payloads) and ground segment**
- **Launch and early operations** including commissioning and calibration
- **Operations** (2 years, option for extension)
- **Data exploitation** (Including processing, archiving and data distribution from ESA facilities)



Overview of the GENESIS Mission



GENESIS - Next Steps

GENESIS Science Workshop ✓

Kick-off of Industrial activities ✓

Genesis Science Exploitation Team Appointments ✓

Requirements Consolidation, Development, Testing, Qualification, Calibration

&

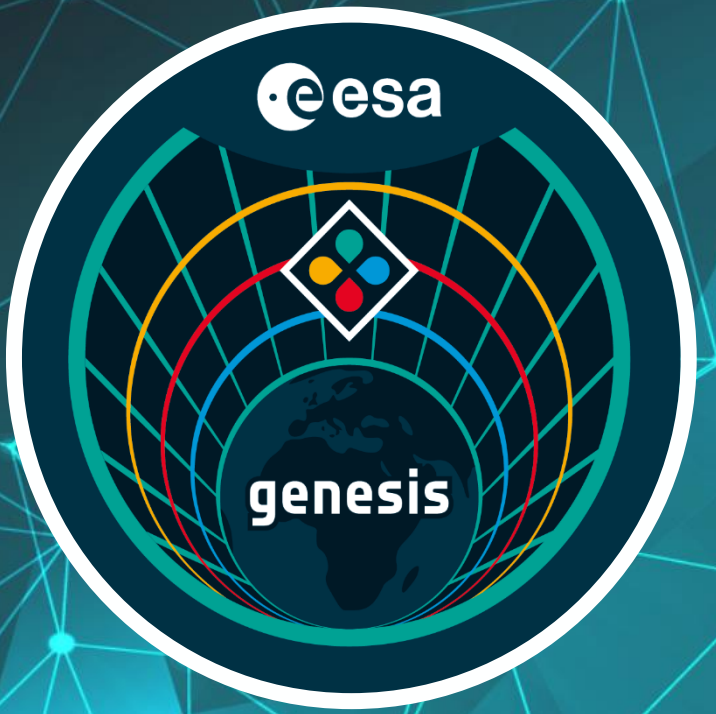
Preparation of Operations & Scientific Exploitation

GENESIS Launch 2028

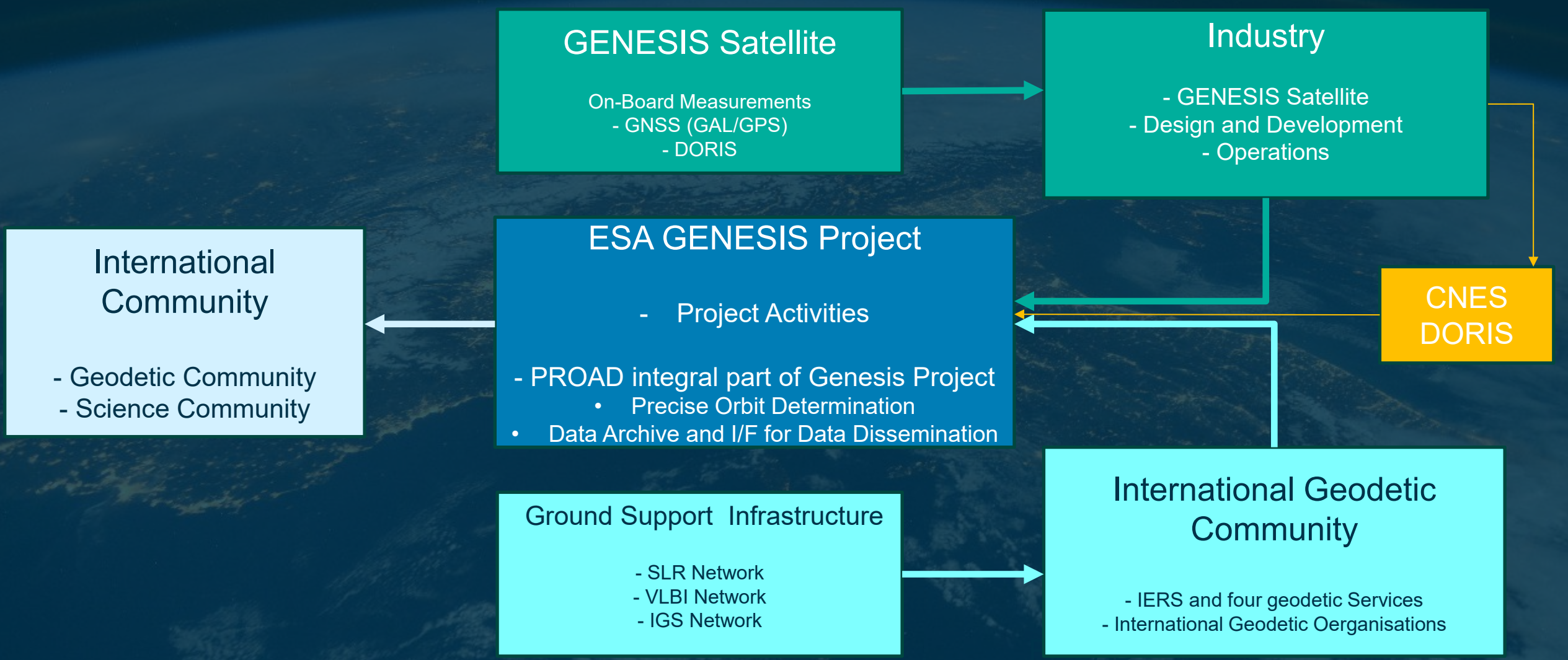
GENESIS Operations

Scientific Exploitation

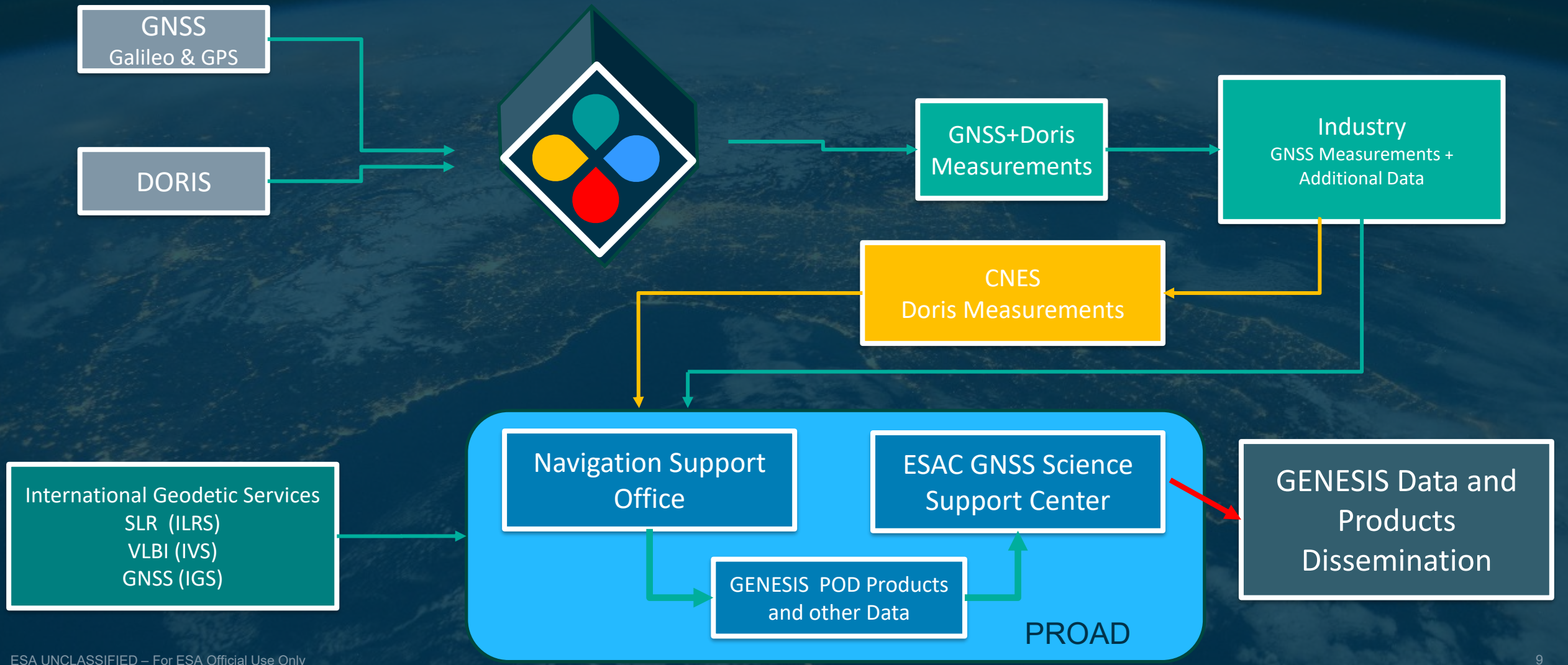
GENESIS – PROAD
Data PROcessing, Archiving and Delivery



GENESIS – PROAD General Interface Overview



GENESIS – PROAD Data Flow



GENESIS – PROAD
Precise Orbit Determination Data Products

- Precise Orbit Determination for Galileo and GPS satellites
- Precise Orbit Determination for GENESIS satellite
- In-Orbit validation of the pre-launch calibrated space ties between the different geodetic payloads on board the GENESIS satellite
- **Additional Products are possible, based on agreements with International Organizations**

GENESIS – PROAD

Potential New PROAD Products

Combined solutions

- Solution A: coherent processing of all four geodetic techniques in a single least squares process
- Solution B: Solution A including MEO satellites
- Solution C: Solution B including LEO satellites (e.g. Sentinel satellites, Lageos satellites, etc.)

Important: so far, no GNSS LEO contribution towards the ITRF

GENESIS – Contributions from ESA's Navigation Support Office

ESA's Navigation Support Office, located at the European Space Operations Center (ESOC) in Darmstadt, Germany is currently an official Analysis Center (AC) for the following geodetic techniques and respective services:

- Global Navigation Satellite Systems - GNSS (IGS)
- Satellite Laser Ranging –SLR (ILRS)
- Doppler Orbitography and Radiopositioning Integrated by Satellite - DORIS (IDS)

The Navigation Support Office is currently an Associated Analysis Center (AC) for

- Very Long Baseline Interferometry (IVS)

ESA's Navigation Support Office contributed over the past decades as an official AC to the ITRF generation and this will be continued in the future.

In the context of the GENESIS PROAD activities, the Navigation Support Office will provide new, additional products in order to support evolution and improvements of the ITRF generation.

GENESIS – PROAD Collaborating across ESA

Measurements and Ancillary Data

Data and Products

Data Processing
&
Precise Orbit Determination

Data Storage
&
Distribution

IGS — GNSS

IVS — VLBI

ILRS — SLR

esa ESOC

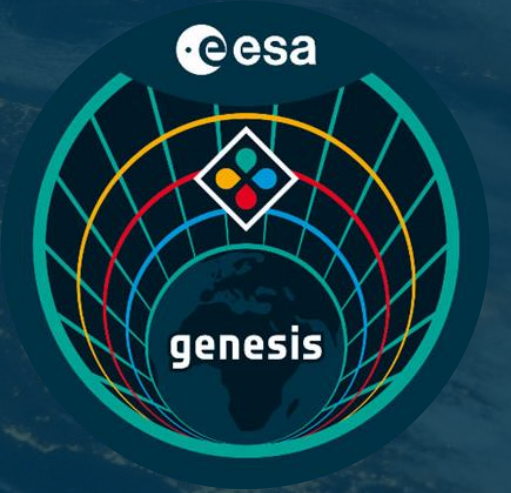
esa ESAC

Navigation Support Office

GNSS Science Support Centre

POD Products and Additional Data

PROcessing, Archiving and Distribution (PROAD)



GENESIS – PROAD Advanced Ingestion Services

Contributors

IGS INTERNATIONAL GNSS SERVICE

esa

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GSSC

ESAC

esa

Resource Type	All | None	Hit

Attitude Data (52,318)
Broadcast Ephemerides (96,502,835)
Datalab (11)
Differential Code Bias (15,744)
Earth Orientation Parameter (139,978)
GNSS Observables (154,991,940)
Ionospheric Products (179,295)
Meteorological Data (7,271,856)
Others (276,774)
Precise GNSS Orbits (397,917)
Predicted Orbits (756,898)
SLR Full-Rate Data (1,106,139)
SLR Normal Point Data (304,573)
SWARM spacecraft dynamics product (8,807)
Satellite and Station Clock Products (230,022)
Station Logs (10,009)
Station/Receiver Position and Velocities (573,947)
Time Products (9)
Tropospheric Products (2,610,396)

To conclude…

Thanks to combined efforts from Scientific Community, ESA Member States, Industry and ESA, the **GENESIS Mission has become a reality!**

This challenging mission will be a stepping stone towards **improved GNSS and navigation**, together with addressing **major scientific and societal goals**

Despite a challenging schedule, ESA, Industry and the Scientific community are fully committed to the **success of the Mission**,

We are looking forward to updating the community on the progress of the mission

The success of GENESIS depend on international cooperation

Thank you for your support!

Sara GIDLUND & Werner ENDERLE
on behalf of the GENESIS Team
European Space Agency (ESA)

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