OPS: Ground Systems Engineering and Innovation

Industry Space Day 2026

2026-09-16

EUROPEAN SPACE AGENCY

Core Competencies

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Ground Segment Engineering and Innovation – in OPS for ESA

End-to-End Ground Segment Engineering

- Ground Segment infrastructure and Systems – hard- and software

Directly linked to Space and Ground Operations

- Reliable, highly available, mission-critical operational systems

Research and Development

- Innovative Solutions and new Technologies
- Centre of Competence in Europe

Core Competencies

- **Ground Station Engineering**
  - RF and Optical Ground Assets for Near-Earth and Deep-Space,
  - Communication Architecture in Solar System
- **Ground Data Systems Engineering:**
  - Mission Control Systems, Mission Planning Systems, Spacecraft Simulators, Multi-Mission Systems
- **Flight Dynamics**
  - Mission Analysis, Precise Navigation

Core Competencies

- **Ground Segment Cybersecurity**
  - Ready to provide security certified end-to-end mission operations
- **Standardisation**
  - for Interoperability and Inter-Agency Cooperation

Ground Station Engineering

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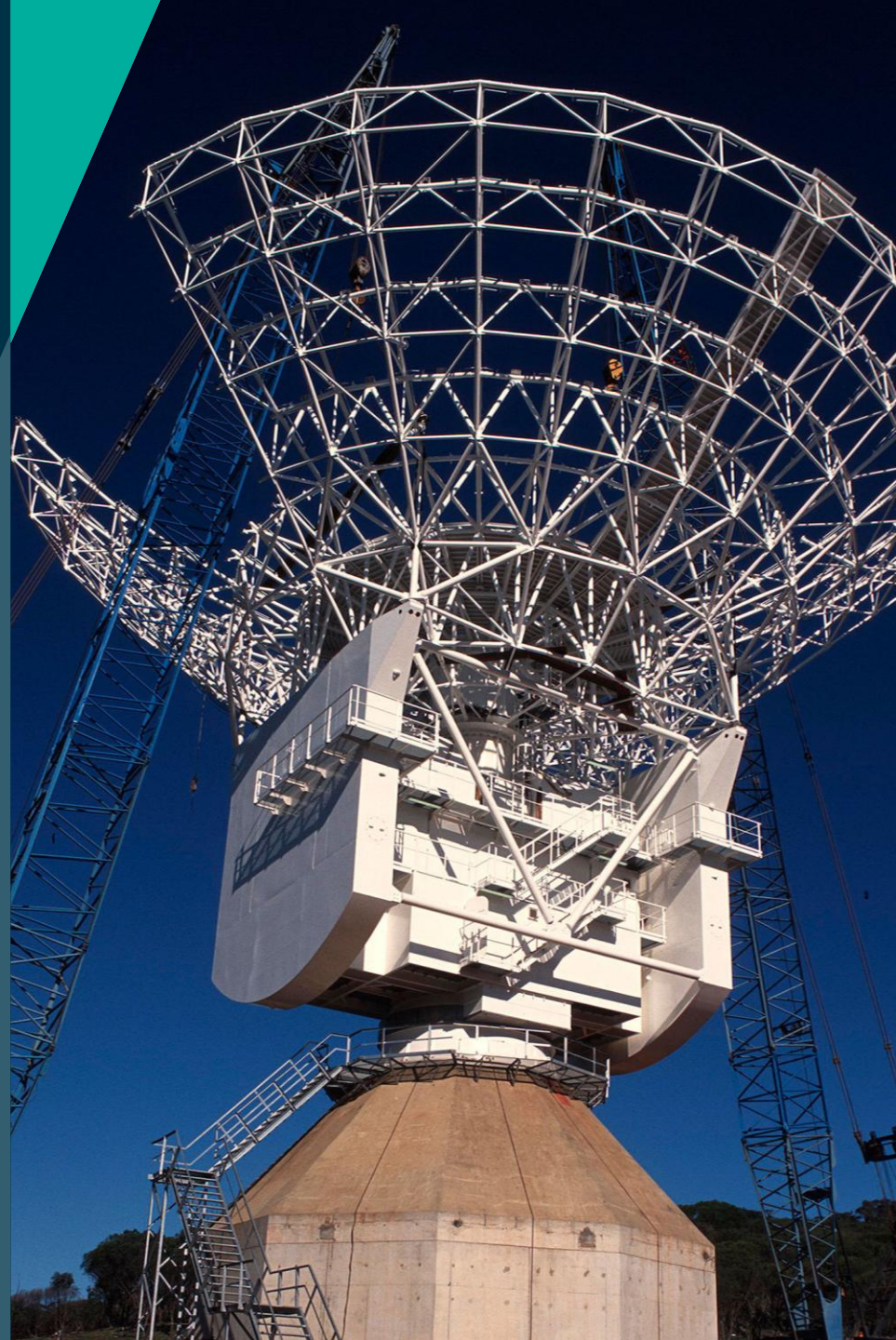


Ground Station Engineering – Competencies, Activities and Projects

- **Optical and RF Ground Assets**
  - Antenna (communication and Radio Science), Radar
  - Optical communication, Momentum Transfer, Laser Ranging and Time Transfer
- **Support Member States with upgrade of existing Assets**
  - Examples: Goonhilly (UK), Radar (Romania), Sardinian Radio Telescope (SRT) and the Fucino FOC-1 (IT)
- **Deep Space Antenna 5 in Chile (DSA-5)**
  - Site Infrastructure Development (Power Plant, Road, Buildings,…)
  - 35 m Deep Space Antenna Development
- **ESTRACK Evolution**
- **All Digital Ground Station (Next Generation Signal Processing Chain)**

Ground Segment Reference Facility GSRF

- Facilities with ESTRACK representative hardware and software
- Radio Frequency Compatibility Testing
  - TT&C and Payload (X- and K-Band)
  - Transponders under development (e.g., IDST, Kongsberg, C-DST)
  - Large and Small missions, including CubeSats (e.g., HENON)
  - For 3rd party missions, at ESOC or at Prime facilities, with GSRF transportable systems or consultancy support only
  - Expanding to Optical compatibility testing
- ESTRACK System and subsystem tests and interoperability testing
- Support to spacecraft investigations through RF suitcases testing
- Support to spacecraft anomaly investigations
- ESTRACK Evolution Lab for New Protocols, Concepts and Technology

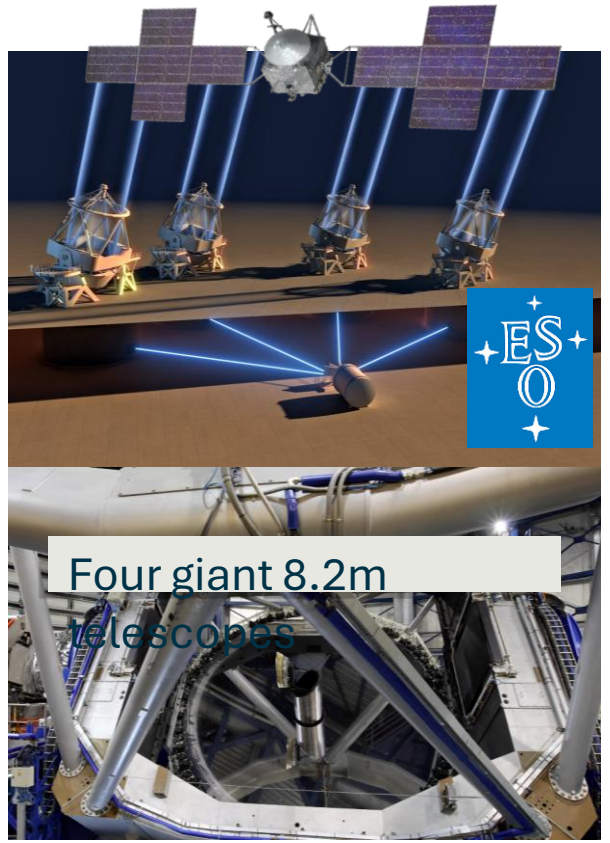
Demo: >100 Mbps optical data return from Mars

Team up with European Southern Observatory (ESO)

- ESA-ESO legal framework existing
- Use existing 4x 8.2m 'Very Large Telescopes' in Chile for DSOC
- Use existing 3.8m NTT, La Silla, Chile
- ESA+JPL to install Ground Laser Receivers in ESO telescopes
- Jointly demonstrate 100 Mbps links with DSOC on JPL PSYCHE mission

Support from national GSTP delegates needed:

- GT17-881GS (5 MEUR) '*100Mbps from Mars demo*'
  Deep-Space Optical Comm. Ground Laser Transceiver (GLTX) for Mars and beyond
- GT17-882GS (1.5 MEUR)
  All-digital photon-starved optical modem prototype



Systems and Applications Engineering

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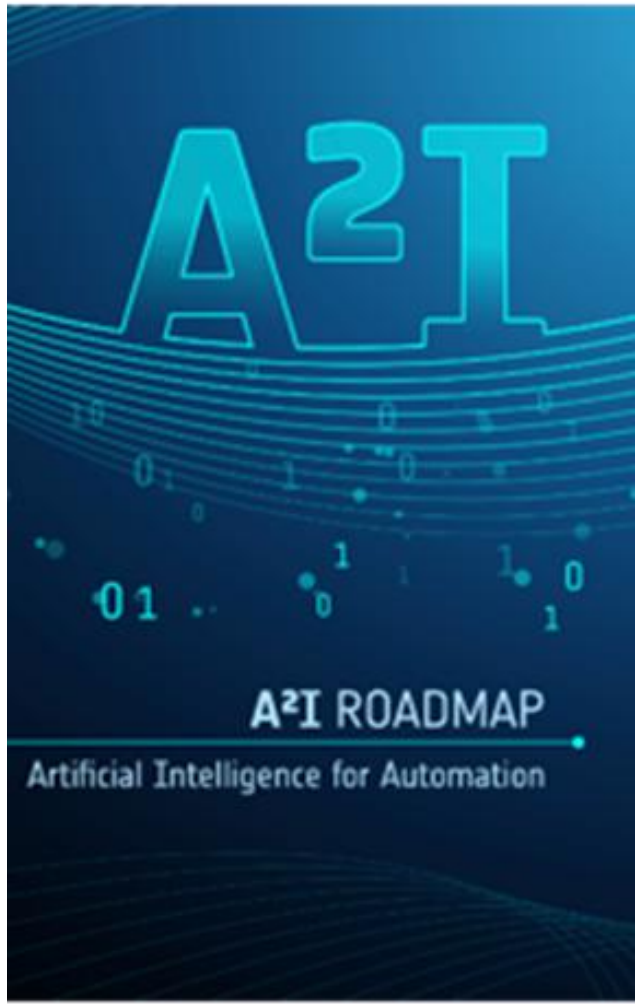
Systems and Software Infrastructure

- Pulse – the next generation MCS Infrastructure
- EGOS-MG – Secure end-to-end multi-mission ground segment platform
- Mission Planning systems
- Payload Data Processing (e.g. for Space Safety Program SWE)
- Smart Preparation and Simulation Suite
- Spacecraft Digital twins

Artificial Intelligence, Machine Learning in Ground Segment Engineering

- AI enhanced:
  - modelling and simulation
  - user interaction
  - automated content generation
  - decision recommendation and planing
- Automated health monitoring and control
- Data management: handling, governance and data assurance



Cybersecurity for Ground Segments

- **Building** Secure Ground Segments

  Zero Trust Architecture, DevSecOps, Encryption, Secure Architectures, System Security Engineering tools

- **Proving** Cyber Resilience

  Certification and security assurance, SpaceSecLab for penetration testing and attack simulation

- **Shaping** Future Cybersecurity

  Post-quantum security, AI-assisted security monitoring, standards and next-generation technologies (e.g. secure Solar System Internet)

Flight Dynamics

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Flight Dynamics, Mission Analysis and Precise Navigation

Expertise for your business to profit:

- Mission and end-to-end trajectory design
- LEO/MEO/GEO, Lunar, Lagrange, deep-space, formations or constellations – you name it

GODOT, GENEOS, MIDAS, CUDAjectory

- Community-licensed Flight Dynamics and Mission Analysis Solutions =
  Flight-Proven Software Tools for your missions

Precise Navigation

- LEO/Lunar PNT is geodesy, GNSS-based precise Orbit Determination, UTC time reference

Planning to go to the Moon?

We have been there - the best routes and all the cool (or hot) places:

- Low-thrust and chemical **manoeuvre strategies**
- Orbit **determination and prediction**, manoeuvre optimisation and calibration
- And now: **Digital Terrain Models** for landing site selection, Rover path planning, visibility analysis, Autonomous navigation and surface operations

OPS-G and Industry – Partnership for Success

INDUSTRY SPACE DAYS 2026

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Check out or Community Licensed Software Solutions

- More information: https://esoc.esa.int/services-software
- Get support

Opportunities – upcoming ITTs and RFPs

- Watch esa-star

R&D activities in preparation

- Watch esa-star

Opportunities – upcoming ITTs and RFPs – (OPS-GS)

- **Deep Space Antenna 5 in Chile (DSA-5)**
  - Site Infrastructure Development (Power Plant, Road, Buildings,…)
  - 35 m Deep Space Antenna Development
  - Local Services
- **ESTRACK Evolution (ITT on-going)**
  - 3 LOTs + Backend + 5 Frame Contracts
- **All Digital Ground Station**
- **Kiruna-3 Antenna Project**
  - NEW 10-Meter Class TRI-Band Antenna with X-Band Payload Acquisition and & KA-Band Tracking Capabilities

Opportunities – upcoming ITTs and RFPs – (OPS-GA)

Tender on-going/kicked off:

- DLT-based Access Management for the (Co-)Operation of Shared Space Assets (TDE)
- Security framework for AI applications
- Methodology to update operational models of a spacecraft system

Tender under preparation:

- Self-healing Architectures for Cyber Resilient Ground Segment Systems (TDE)
- Secure Segregated Payload Operations Ground Segment Services (ARTES 4S)
- Threat-Driven Validation for Distributed Mission Operations (TDE)
- Trustworthy and resilient framework for AI solutions in space operations
- Structured data foundations for machine learning in space mission applications
- AI enhanced Digital Twins Simulators for Operations and AIT: enhanced calibration, status awareness, and fidelity

Opportunities – upcoming ITTs and RFPs – (OPS-GF)

Submitted to IPC:

- T109-900GF – Improving forecasts of LEO satellite drag via data-assimilative empirical models
- T710-902GF – First Guess Low-Thrust Trajectory Generation Leveraging AI Techniques for Mission Analysis

In Preparation:

- Techniques for multi-arc orbit determination and global parameter estimation for large-scale problems
- Almost real time prediction of satellite drag
- Novel approaches to building differentiable software
- Enhanced and more robust ESA Earth Orientation Parameter
- AI-ready PNT Data Ingestion and Processing
- Autonomous On-Board POD across mission phases

Ready for a Follow-up?

See us at the **OPS booth** or

book a **face-to-face meeting:**

- **Daniel Fischer:** Research & development topics, end-to-end ground system engineering
- **Mehran Sarkarati:** Ground Stations Engineering
- **Katarzyna Cichecka, James Egglestone:** System and Applications Engineering
- **Frank Dreger:** Overall OPS-G, Flight Dynamics

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THANK YOU!

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