OPS-SAT ORIOLE – Experimenter Information Sheet

⚠ ***Notice:*** This project is in development, and *all information is subject to changes*. Over time, the project will evolve and updates to experimenter documentation will be provided.

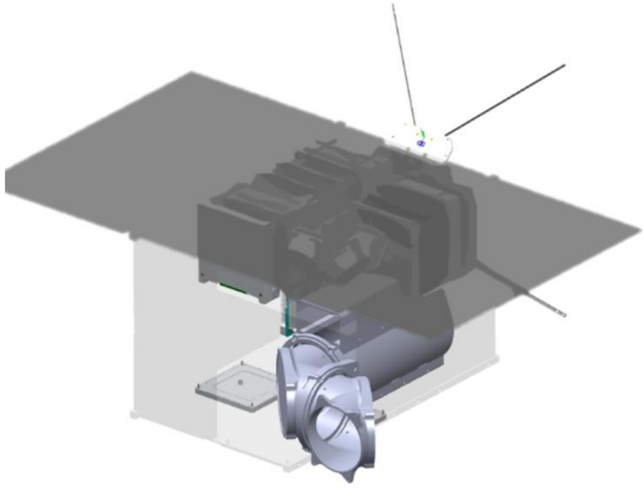


Figure 1: Very early layout plans for OPS-SAT ORIOLE. Shown subsystems are the platform and the main optical payload. There is cca. 3U free volume for additional payloads. All elements of this image are subject to change.

Quick info

OPS-SAT ORIOLE is 12U CubeSat available for third party experimentation through the OPS-SAT Experimenter Service. On ORIOLE, 25% of the mission is allocated to OPS-SAT operations. The purpose of its main in-orbit activity is to demonstrate and validate the capabilities of a combined optical telecommunication system and thermal infrared imager.

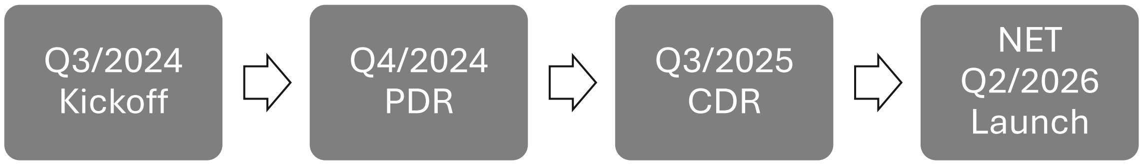
ORIOLE is built by Hungarian nanosat manufacturer C3S Electronics Development LLC, with Estonian company Golbriak Space OÜ contributing the main free-space optical communication and imaging payload, and the Estonian SpaceIT OÜ contributing the ground segment for nominal operations. ORIOLE will be the first commercial Estonian satellite.

OPS-SAT background

OPS-SAT Space Lab is an ESA service to help accelerate innovation in OPS related areas. It uses powerful, reconfigurable space elements that can be used for in-flight experimentation not possible or desirable on other missions. The service provides access to these labs for all European industry and institutions, using a fast, cost free, non-bureaucratic process. Industry can concentrate of generating value while ESA assumes the risk of performing these experiments.

On OPS-SAT-1, 134 teams from 26 countries conducted 285 experiments (Oct 2024). The subject of the experiments ranged from AI and machine learning, FPGA, navigation and attitude algorithms, camera and radio experiments, new protocols and compression algorithms, to ground station experiments and ground software such as new MCS.

Preliminary timeline



Technical overview

OPS-SAT ORIOLE is built using a combination of flight proven, reliable platform subsystems, and payloads seeking to demonstrate the viability of the latest technologies, also available for OPS-SAT experiments, as detailed below.

Satellite platform

OPS-SAT ORIOLE is built onto C3S' TRL9 CubeSat platform, which includes an OBC for critical platform-side tasks, a UHF COM for commissioning and basic operations TM/TC, a rock-solid Electric Power Subsystem (EPS), and an Auxiliary Electronics subsystem (AUX) for managing crucial deployments (antennas, solar panels). As a rarity on the current nanosatellite market, the previously listed subsystems all feature double cold-redundancy, and are tolerant to single-point failures. This, along with carefully designed FDIR measures in all platform subsystems, enables the satellite to recover from even the most precarious forms of adversity.

The platform is complemented by C3S' Orbital Whereabout Locator (OWL) subsystem, providing accurate satellite identification and localization via GNSS, as well as position, velocity, angular rotation, and total ionizing dose measurements. This subsystem also features a very low bandwidth backup downlink possibility via VHF.

Payloads are interfaced with the satellite platform via C3S' Customizable High-Performance On-Board Computer subsystem, which, as usual for C3S satellites, functions as an Intelligent Payload Controller (IPC). The IPC consists of a quad-core ARM Cortex A35 system-on-module running Linux, complemented by an interface extender FPGA. OPS-SAT experiment software will be deployed onto this subsystem in a sandboxed manner and may only access platform functionality via a curated set of interfaces. Unfortunately, the FPGA of the current subsystem model does not provide on-board reconfigurability, hence it is not available for OPS-SAT experiments (TBC).

As the platform OBC is kept a domain of the satellite operators and is the subsystem chiefly responsible for FDIR, on-board OPS-SAT experiment software *will not* be deployed on this subsystem and will have no direct access to it (confirmed). As it is the main access point for safe mode and recovery operations, on-ground OPS-SAT experiment software *will not* provide telecommands to the UHF COM (TBC).

To provide an independent high-speed communication link besides optical and allow for a more diverse set of experiments, an S/X band transceiver will also be a part of ORIOLE (confirmed), connected to the IPC. Unlike the UHF COM, experimenters *will* be given limited access to this subsystem and may use it for monitoring and control of their on-board experiment software (TBC, details TBD).

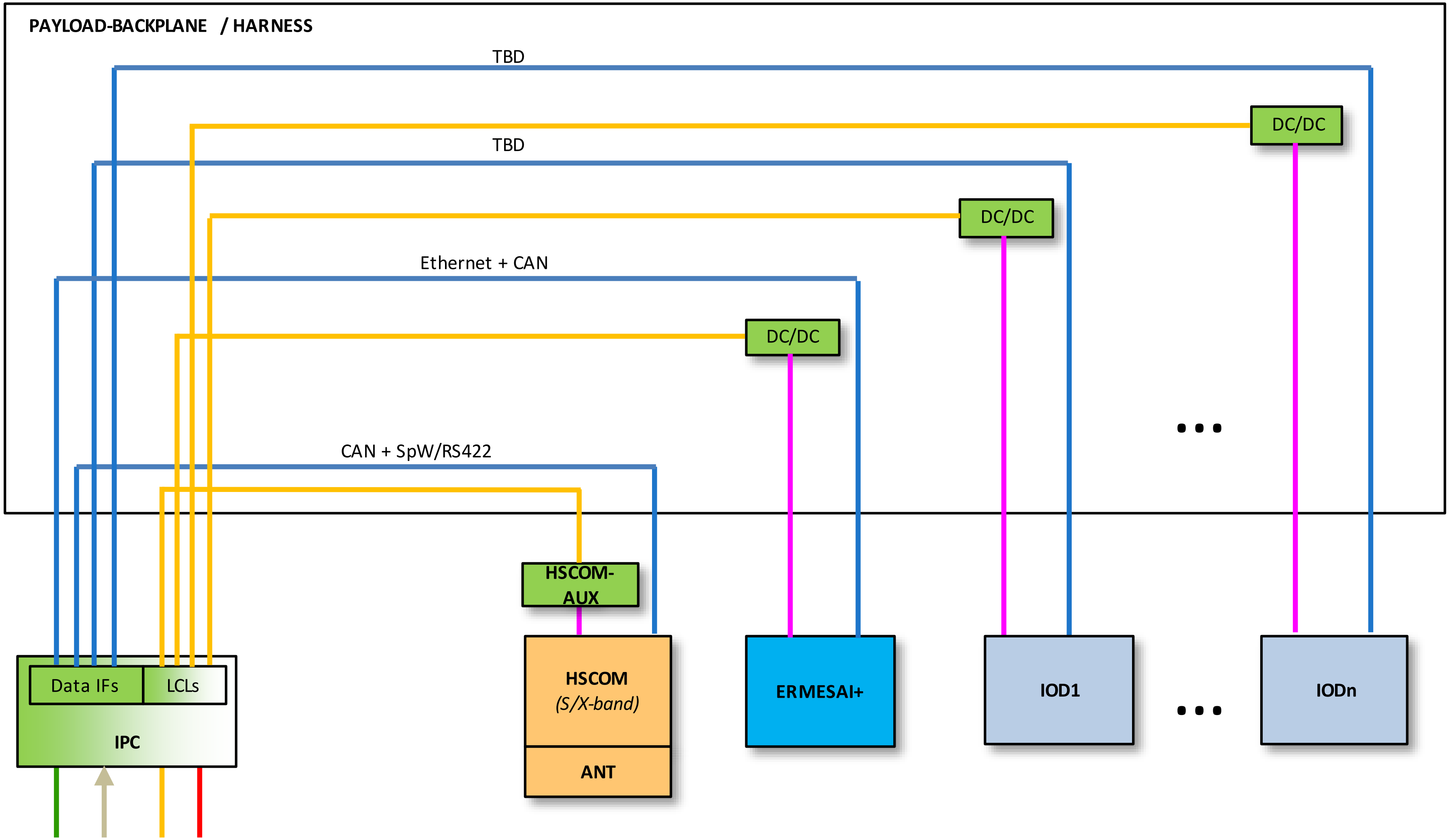


Figure 2: Architectural overview of OPS-SAT ORIOLE.

Free space optical communication and imager payload

A combined Optical telecommunication terminal and thermal infrared imager based on Golbriak ERMES-AI+ proprietary architecture, complete with a full pointing gimbal system, will be available for experimentation under the OPS-SAT environment.

External entrusted JAVA software can be run on the payload to take full advantage of its computational and telecommunication capabilities (TBC), or it can be controlled through an extensive API from the spacecraft or ground.

The gimbal and optical telecommunication stack are compatible with ESTOL and SDA protocols (TBC). They will be available to experimenters to take full advantage of the gimbaled 76mm aperture telescope, with capabilities for space to space and space to ground data exchange up to 2.5Gbps.

Subsystems with OPS-SAT experimenter interaction

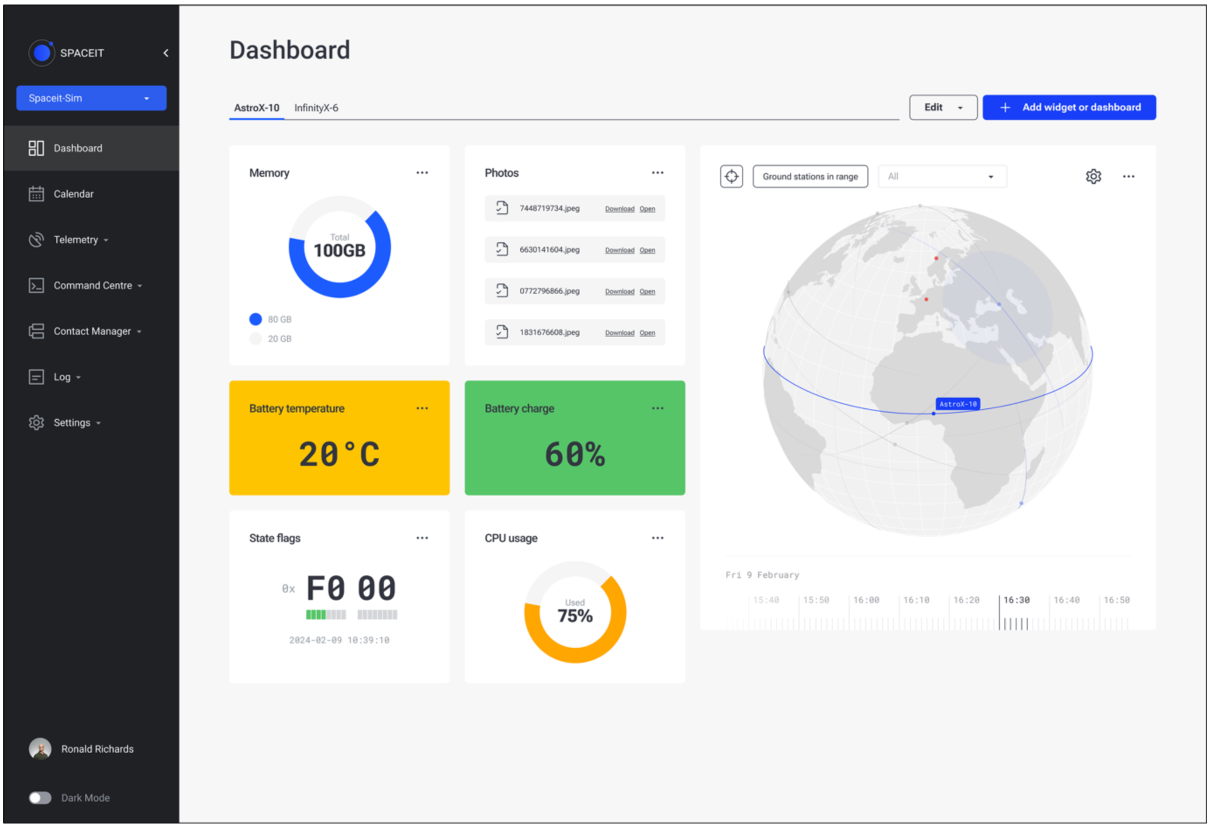
System	**Type, Product**	**Short info**	**Experimenter interaction**
Payload computer	C3S Intelligent Payload Controller 1100	Quad-core Cortex A35 @ 1.2 GHz, 1GB RAM, at least 256GB mass storage (TBC), running Linux	Deploy software on ARM64 Linux (confirmed). Limited platform monitoring and control via API (TBD).
High-speed COM	*TBD*	S/X band transceiver.	Limited monitoring and control via API on IPC (TBD). TM/TC of deployed SW experiment via radio link (TBC).
Free Space Optical Communication subsystem	Golbriak Space ERMESAI+	Free-space optical terminal	Reconfigure parameters, protocols, etc Reconfigure optical system FPGA (TBC) Optical communication via optical link (TBD).
Infrared imager – integrated into FSOC	Golbriak Space MirCam sensor	1080p sensor, TBD ground resolution	Access data, change configuration, request image using API on IPC (TBC)
Visible imager – integrated into FSOC	Golbriak Space VIS image sensor	4K sensor, TBD ground resolution	Access data, change configuration, request image using API on IPC (TBC)
ADCS	*TBD*	Attitude Determination and Control Subsystem.	Access data, change configuration, change mode, control input via API (TBC)

Tracking beacon (RILDOS standard)	C3S Orbital Whereabout Locator 1000	Platform-independent VHF multi-constellation GNSS tracking beacon with auxiliary sensors to aid LEOP.	Access GNSS position and velocity (TBC). Access GNSS time (TBC). Access satellite angular velocity from IMU (TBC). Access satellite TID (TBC).
Additional payloads TBD – payload IOD available, see below.			

Mission Operations Software

OPS-SAT ORIOLE operations are managed using Spaceit's Mission Operations Software Platform, which features the following key characteristics:

- **Cloud-Based:** Infrastructure for overseeing and managing satellite operations, including satellite monitoring, command and control, telemetry, data handling, and communication.
- **Ground Station Marketplace:** Integrated with ground station networks worldwide to ensure broad coverage and minimal delays for near-real-time data delivery. It covers contact management, booking, and service and price optimization.
- **Satellite Platform and Cloud Agnostic:** Spaceit Platform supports various satellite protocols (e.g., CCSDS, CSP, AX-25, etc.) and is deployed on different clouds.
- **Extended Telemetry Processing:** Limit checking, alarms, and notifications, telemetry parameter mnemonics, and synthetic telemetry parameters.
- **Advanced Telecommanding:** Session-based command queues, stored telecommand sequences, event, and time-based telecommand execution, and telecommand validation based on telemetry values.
- **Mission Log:** Records events created by the system and users in the mission log, with search and filtering capabilities.
- **Crafted for Users:** The Platform prioritizes user-centric design, ensuring an intuitive and seamless experience. All are tailored to enhance your workflow
- **Asset Configuration and States:** Supports a wide variety of input formats for asset configuration, integration with Git, and asset state management based on telemetry, events, user entries, search, and filtering of asset states.
- **Event-Based Automation:** An automation system accessible directly from the Spaceit Platform's user interface, allowing for actions to be executed on specified events, with immediate notification in case of failure.
- **Advanced Communication:** File uplink functionality and automated retransmission of corrupted/missed packages for uplink and downlink.
- **Extended Dashboards:** Templating for dashboards and activation of dashboards.
- **Online Payments:** Built-in capability for online payments for mission control and ground station services.
- **Seamless Integration:** Integration with third-party solutions (e.g., flight dynamics, mission planning, etc.).



SPACEIT
Spaceit-Sim
Dashboard
Calendar
Telemetry
Command Centre
Contact Manager
Log
Settings
Ronald Richards
Dark Mode
Dashboard
AstroX-10
InfinityX-6
Edit
Add widget or dashboard
Memory
Total
100GB
80 GB
20 GB
Photos
7448719734.jpeg
6630141604.jpeg
0772796866.jpeg
1831676608.jpeg
Download
Open
Ground stations in range
All
AstroX-10
Fri 9 February
15:40
15:50
16:00
16:10
16:20
16:30
16:40
16:50
Battery temperature
20°C
Battery charge
60%
State flags
0x
F0 00
2024-02-09 10:39:10
CPU usage
Used
75%

Fly your experiment on ORIOLE!

Do you have an experiment fitting for ORIOLE? With your broad concept or concrete idea, contact the team at ESA via email to Esoc-Ops-Sat@esa.int. Once feasibility is confirmed, the experiment can be officially registered, developed and supported through OPS-SAT experimenter support.

Experimenters can also be on-ground! Discuss with the OPS-SAT Space Lab team if your ground station could be used to establish an optical link with ORIOLE.

Fly your payload on ORIOLE!

Do you have more than software in mind? OPS-SAT ORIOLE is not yet complete: C3S LLC, the satellite prime is still looking for partnerships for in-orbit demonstrations to fill the remaining 2-3U volume in the payload bay. Please contact C3S via email to sales@c3s.hu to discuss details and feasibility of a hardware or VHDL IP core IOD.

The C3S platform is designed with great care to allow for straightforward integration of a wide range of possible payloads. With ample available power and a generous set of possible control/data interfaces (including GPIO, SPI, UART, RS-232, RS-485, M-LVDS, I^2C, SpaceWire (ECSS-E-ST-50-12C), CAN 2.0B, USB 3.0, and Gigabit Ethernet), a C3S CubeSat provides a stellar opportunity to grant your designs flight heritage.

Planned delivery date of the FM IODs to C3S: August 2025

Planned launch date of the satellite: Q2 2026