OPS-SAT Space Lab: Flight Opportunities

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IWPSS 2023

July 2023

Overview

- What is OPS-SAT Space Lab?
- OPS-SAT-1 Space/Ground Segment
- OPS-SAT Space Lab Service Process
- Some experiment highlights
- OPS-SAT-2 VOLT

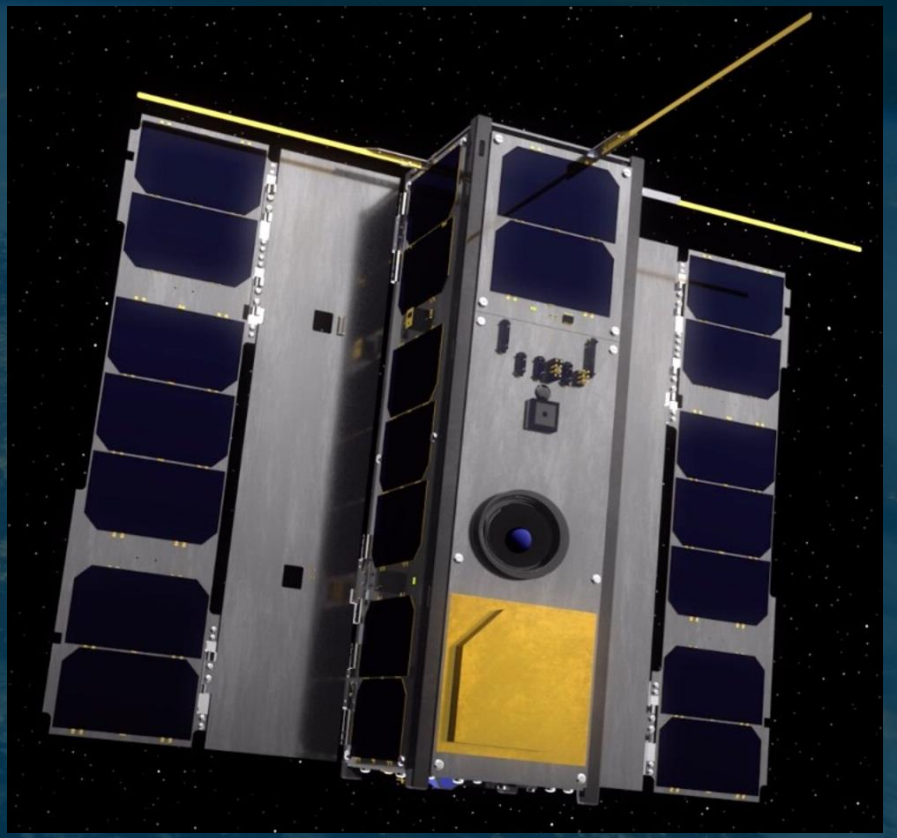


Image: ESA

What is the OPS-SAT Space Lab?

OPS-SAT-1 theme:
Communication
Protocols

OPS-SAT-2 theme:
Optical and Quantum
Communication

Images: ESA

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**
- ESA assumes the **risk and cost** of executing these in-flight experiments

OPS-SAT-1 Intro

- 1st nanosatellite (3U CubeSat) to be owned and operated by ESA
- Development funded by GTSP and ESOC innovation funding
- Launched 18th Dec 2019 from Kourou (VS23)
- 250+ registered experiments from 26 countries
- Academia, start-ups, large corporations and other space agencies (CNES, DLR, JPL, JAXA, EU commission) are all innovating using OPS-SAT

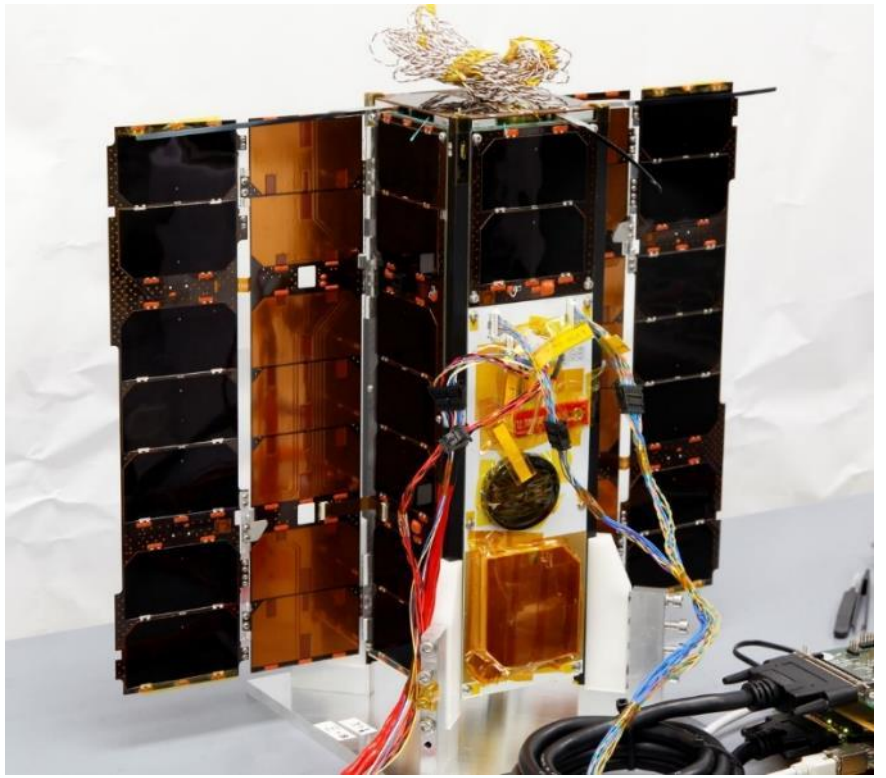


Image: TU Graz

OPS-SAT is 1st ESA led mission to receive the International SpaceOps Award for outstanding achievement (Dubai, March 2023)

OPS-SAT-1 Orbit

Launched 2019-12-18 (VS23)

from Kourou with CHEOPS and COSMO-SkyMed SG

Orbit: LEO 515km, Dusk-Dawn Sun-Synchronous Orbit

Image: ESA - AOES Medialab

Image: ESA

Image: Arianespace

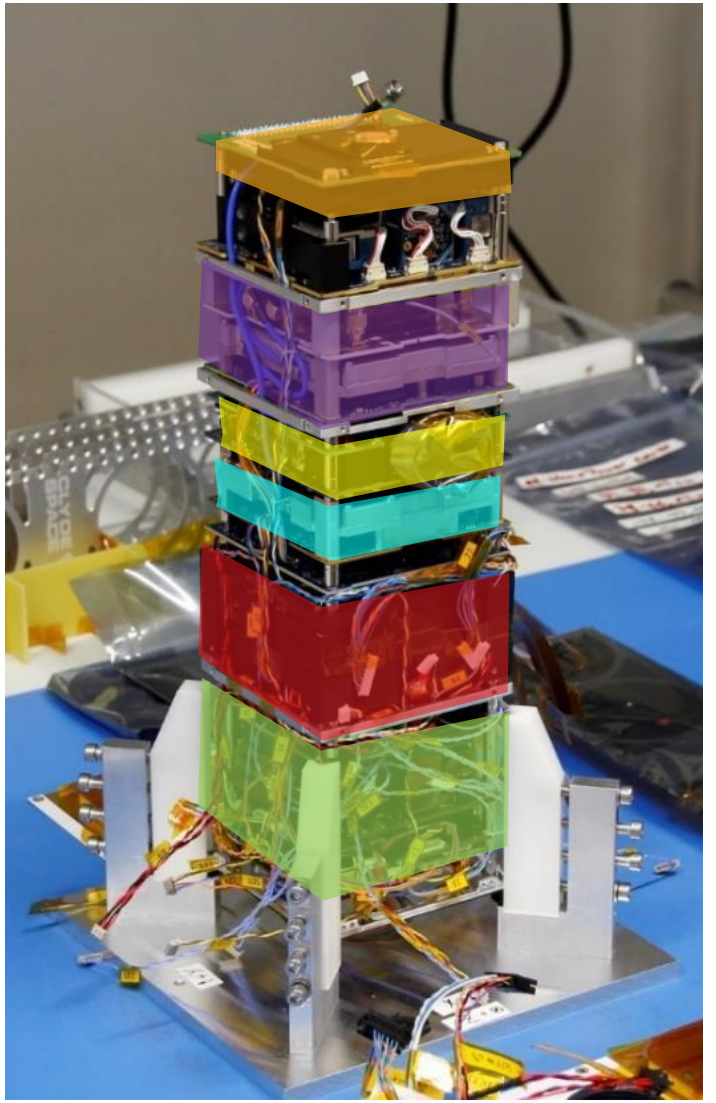
OPS-SAT-1 Space Segment Hardware

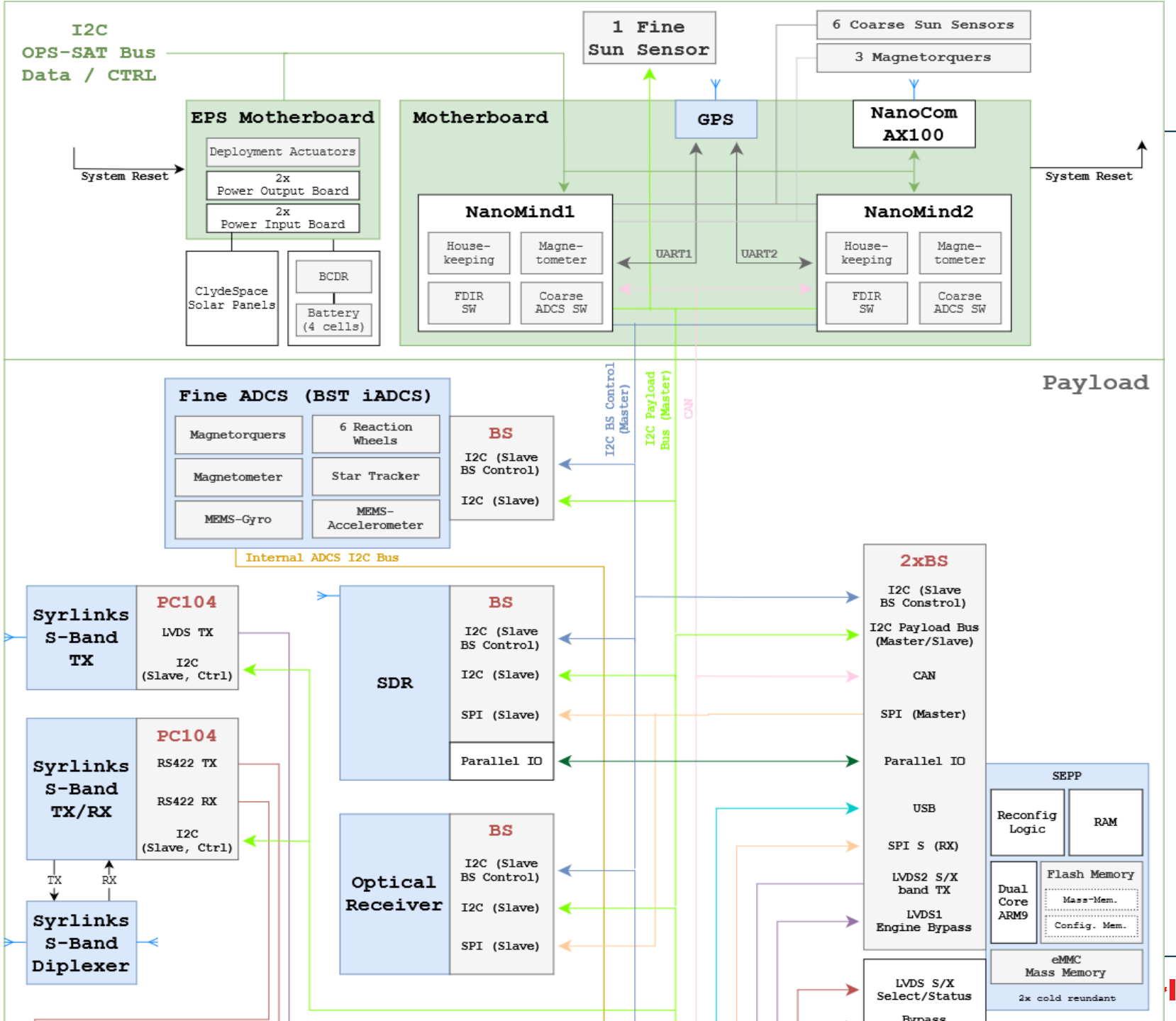
Satellite bus:

- Gomspace UHF AX100 radio + EPS/ACU
- Nanomind A3200 OBC (On-board computer, AVR32)
- S-band (2.2 GHz) TRX TMTC encoder/decoder (256kbps↑ 1Mbps↓)
- GNSS receiver

Satellite payloads available to experimenters:

- Software Defined Radio (LMS6002D)
- HD-camera (Nadir-facing)
- Optical receiver (data uplink via laser)
- Advanced iADCS (Attitude Determination & Control Sys.)
- X-band transmitter (3-50MBit/s)
- 2x Cyclone V SoC (800MHz Dual Core ARM Cortex-A9 + FPGA fabric)

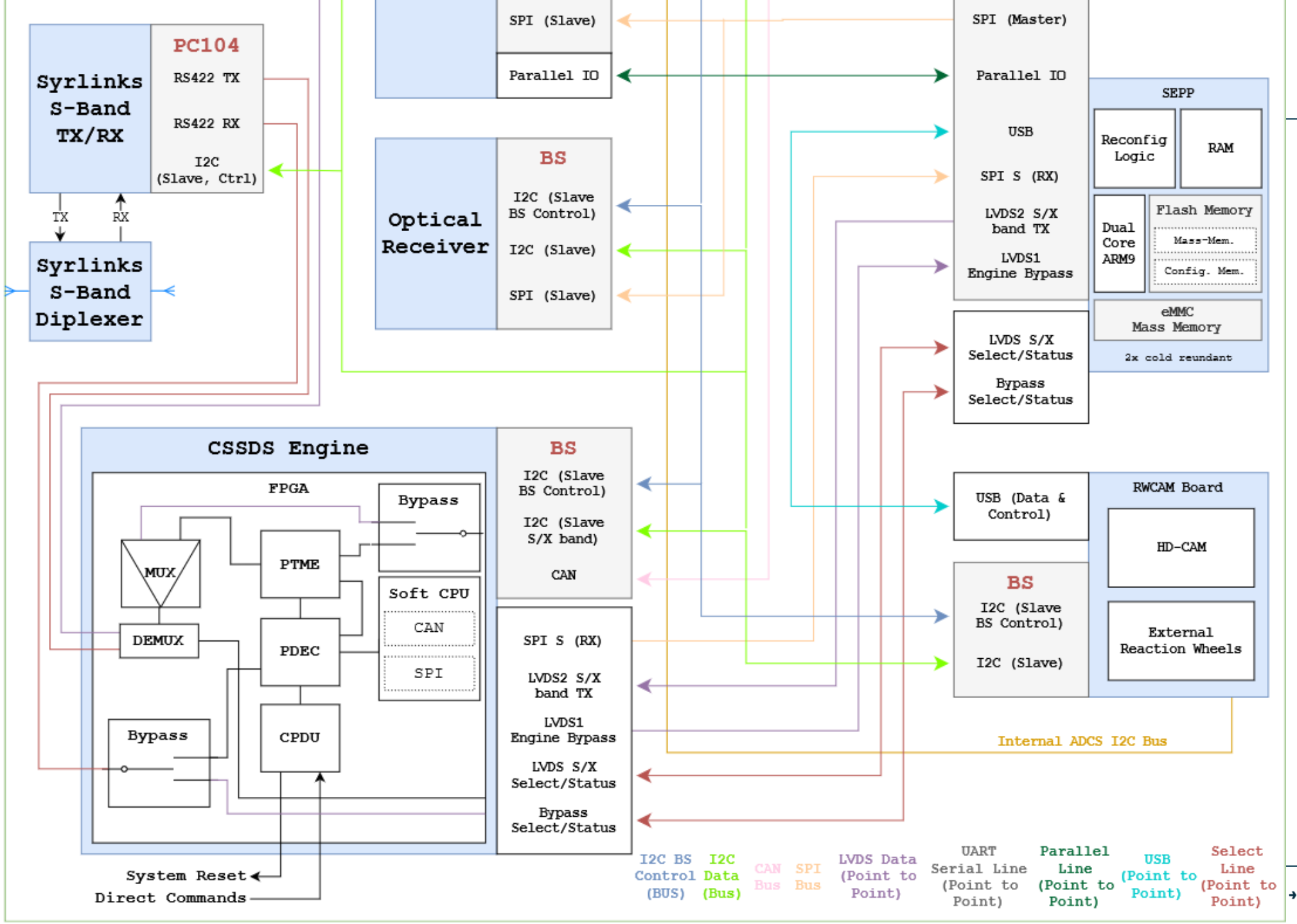




BUS

PAYLOAD

SEPP

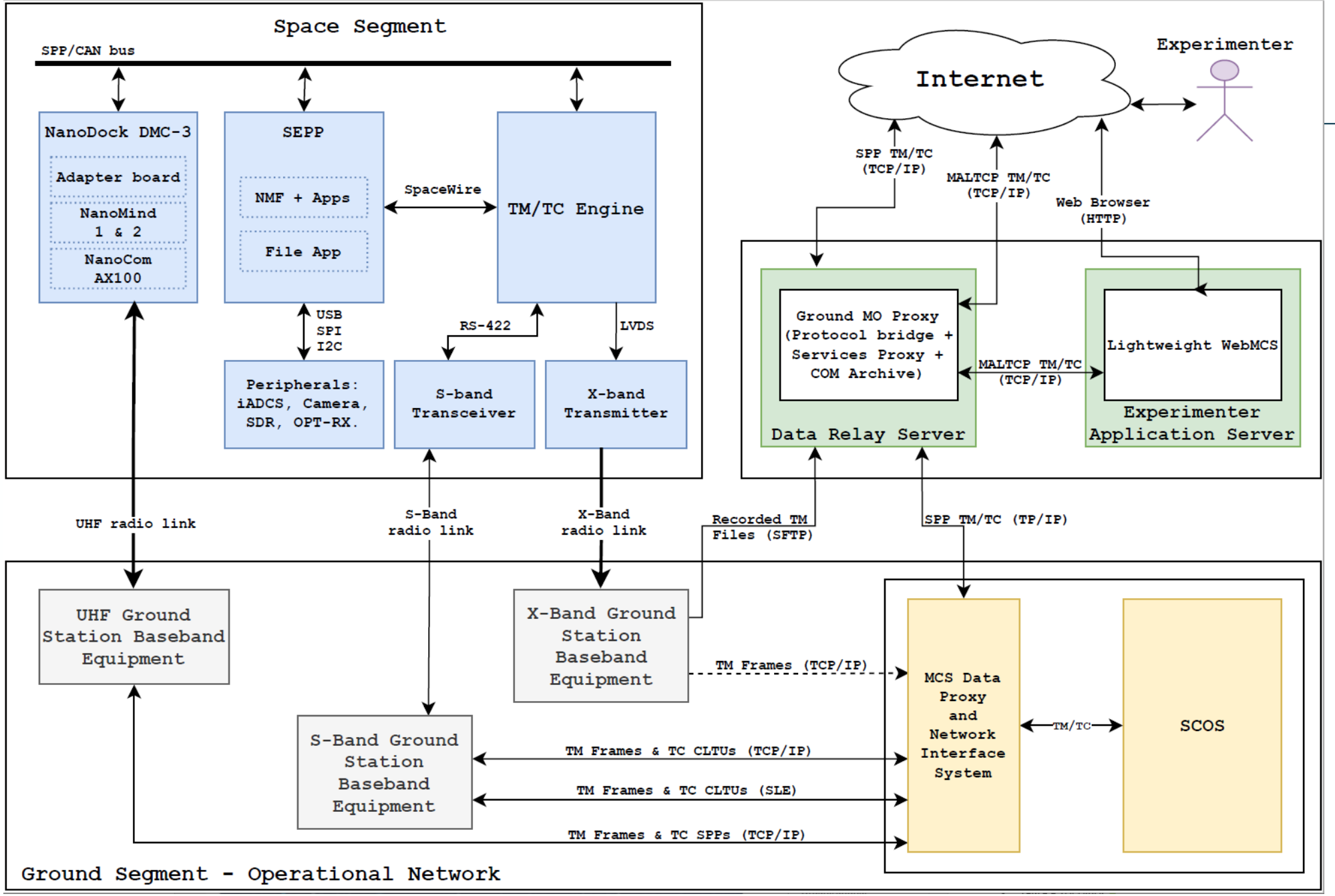


SEPP

PAYLOAD

Space Segment Software

- SEPP - developed by TU Graz (mission prime)
- Running embedded Linux (built on Angstrom + Yocto 2.4.4 platform)
- Operated like a remote Linux machine (remote shell, package manager)
- Integrated reconfigurable Altera Cyclone V FPGA
- Software stack:
    - Java Runtime,
    - Python 3.5
    - Payload API user-space libraries
    - NanoSat MO Framework – high level application framework
    - TensorFlowLite – AI from Google….


Space Segment
SPP/CAN bus
NanoDock DMC-3
Adapter board
NanoMind 1 & 2
NanoCom AX100
SEPP
NMF + Apps
File App
SpaceWire
TM/TC Engine
USB
SPI
I2C
RS-422
LVDS
Peripherals: iADCS, Camera, SDR, OPT-RX.
S-band Transceiver
X-band Transmitter
Internet
Experimenter
SPP TM/TC (TCP/IP)
MALTCP TM/TC (TCP/IP)
Web Browser (HTTP)
Ground MO Proxy (Protocol bridge + Services Proxy + COM Archive)
Data Relay Server
MALTCP TM/TC (TCP/IP)
Lightweight WebMCS
Experimenter Application Server
UHF radio link
S-Band radio link
X-Band radio link
Recorded TM Files (SFTP)
SPP TM/TC (TP/IP)
UHF Ground Station Baseband Equipment
X-Band Ground Station Baseband Equipment
TM Frames (TCP/IP)
MCS Data Proxy and Network Interface System
TM/TC
SCOS
S-Band Ground Station Baseband Equipment
TM Frames & TC CLTUs (TCP/IP)
TM Frames & TC CLTUs (SLE)
TM Frames & TC SPPs (TCP/IP)
Ground Segment - Operational Network

GROUND

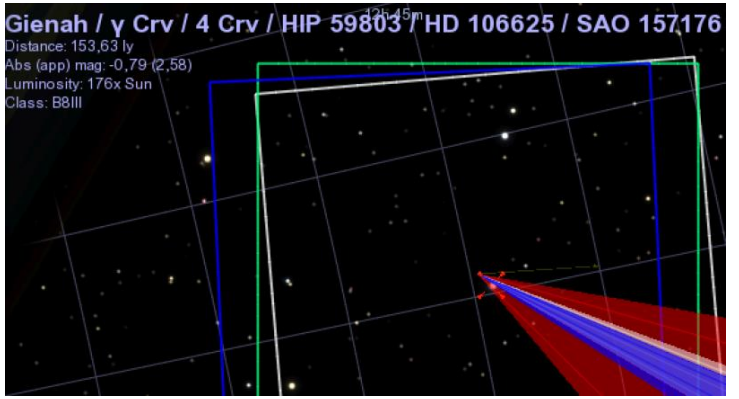
OPS-SAT Space Lab Service Process

1. Contact OPS-SAT Space Lab

Industry initially contacts OPS-SAT Space Lab via ops-sat-experimenter-support@esa.int to discuss feasibility.

Experiment Highlights

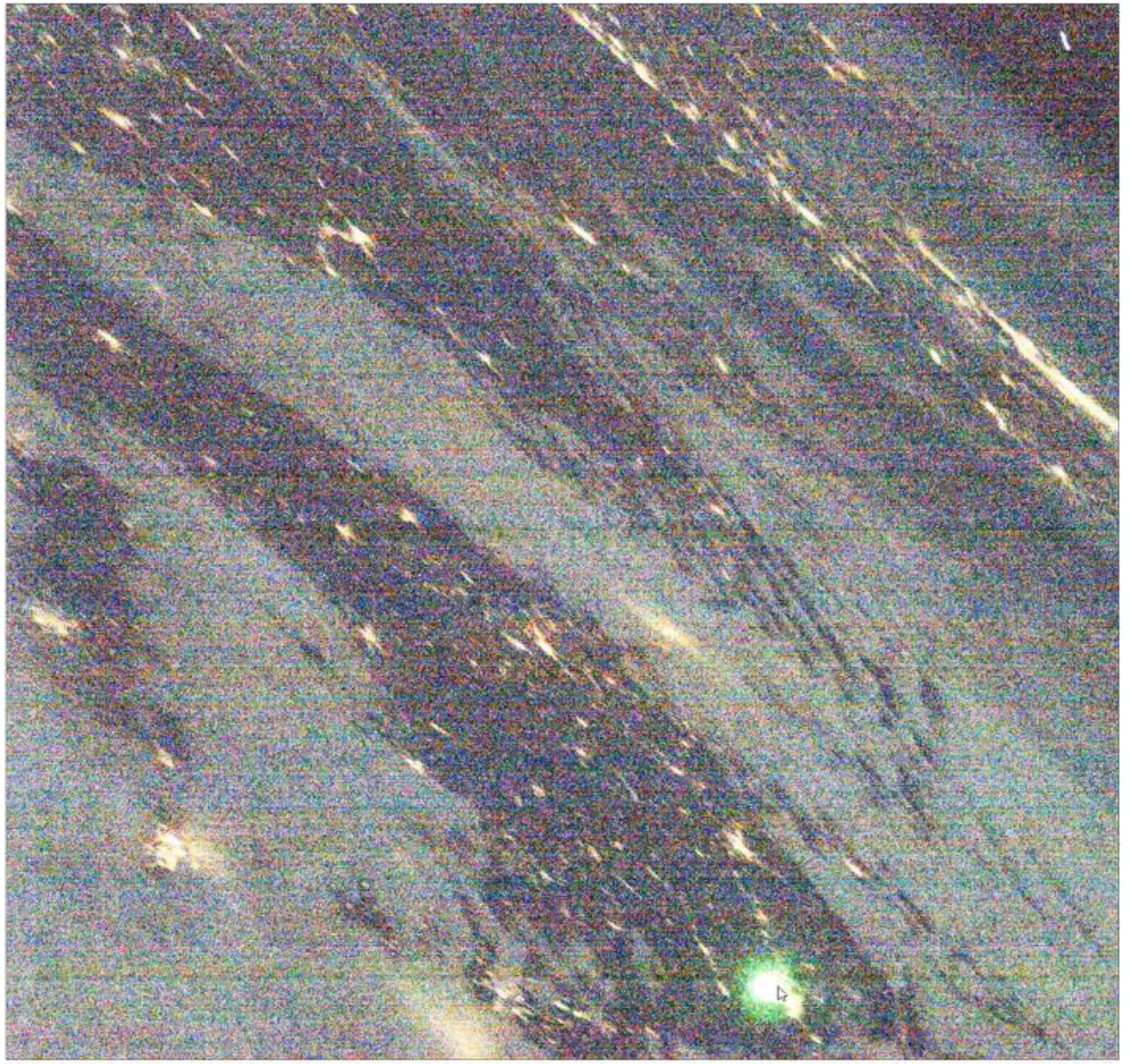
- CCSDS protocols: Many new standards tested and validated in space
- Everyday AI use: assisted attitude control loop, picture classification, FDIR
- FPGA: Reprogramming of firmware on a daily basis
- Software Defined Radio: Acquiring and end to end processing on-board



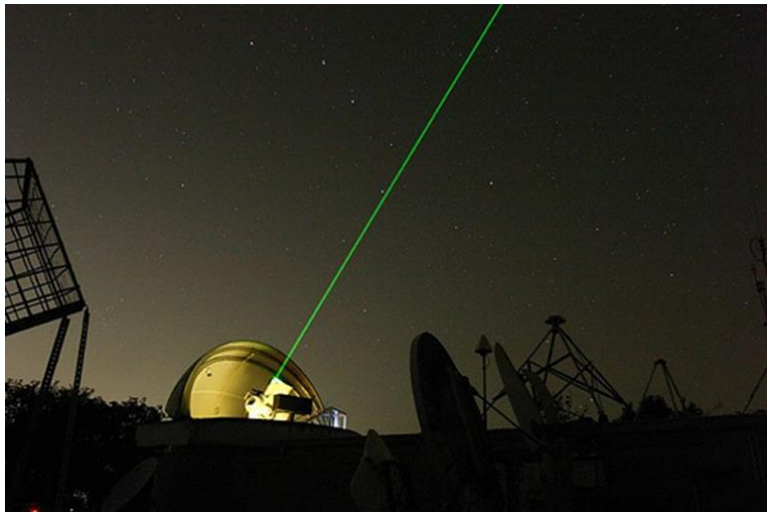
Firsts by OPS-SAT:

- First in-orbit use of CCSDS File Delivery Protocol (CDFP) by ESA
- First use of CCSDS 124 “Pocket” HKTM compression
- First use of CCSDS MO services for operational spacecraft control
- First machine learning model training done on-board an ESA mission
- First spacecraft controlled via EGS-CC (new ESA mission control software)
- First worldwide offensive cyber security demonstration on an active spacecraft
- First mission directly controllable by the public over internet
- First stock market transaction in space

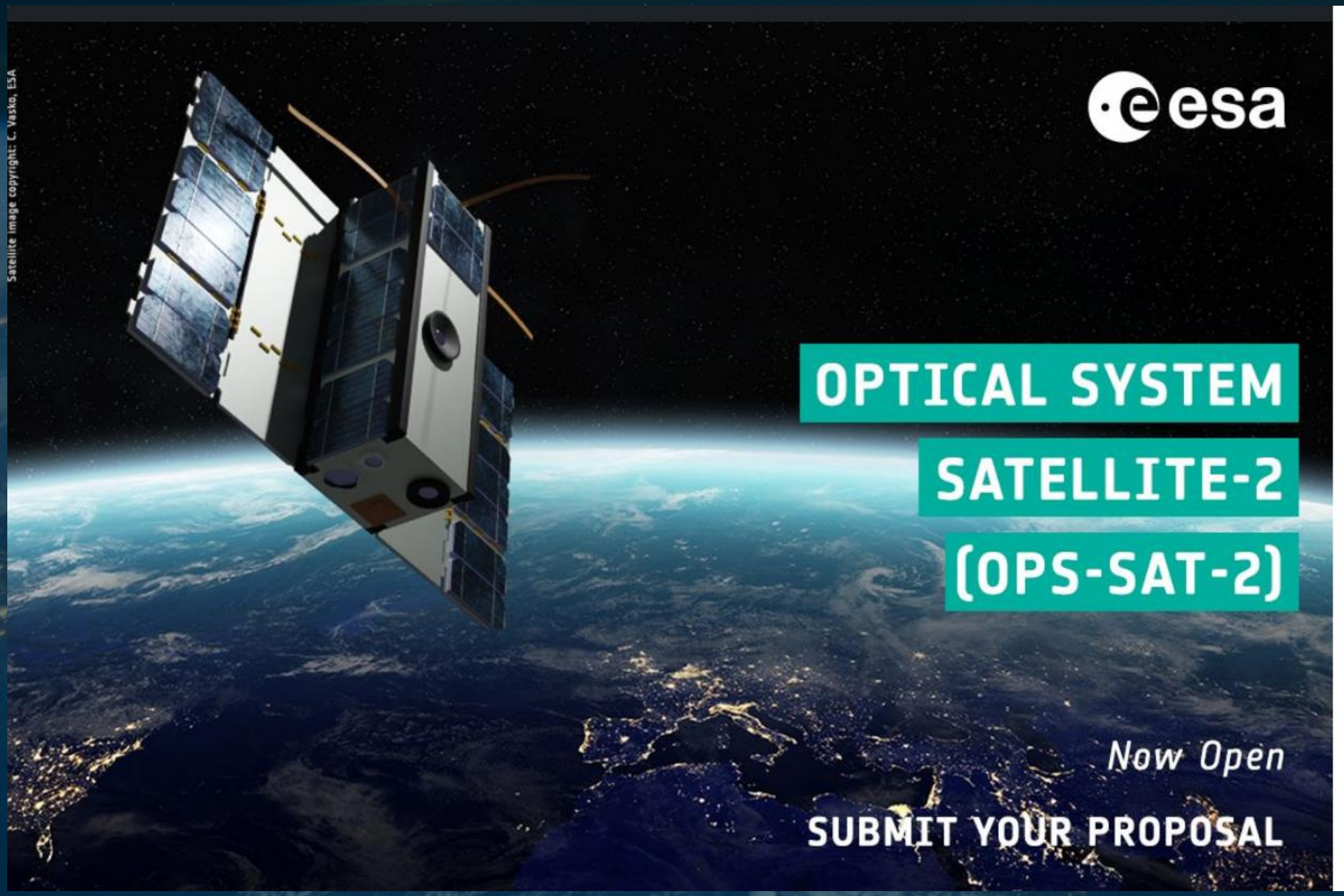
OPS-SAT-1 optical comms lessons learnt



- ADCS
- GNSS
- Clouds
- Testing
- Diagnostics
- Ground truth



OPS-SAT-2 VOLT available for experiments in 2026!



ESA S...
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+ Follow

OPS-SATs are powerful, reconfigurable, flying labs for experiments that go beyond even technology demonstrations. We invite you to submit your idea for an OPS-SAT-2 mission dedicated to optical and quantum communications.

New thematic call, now open! ➡
https://lnkd.in/g4VWwXY5

More information on OPS-SAT – how to join

https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/The_Discovery_Campaign_on_OPS-SAT_experiments