31st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 31st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IPB)

Author: Dr. Gilles Mariotti
Sitael Spa, Italy

Mr. Matteo Venanzi
Sitael Spa, Italy
Mr. Eliseo Strollo
Sitael Spa, Italy
Mr. Antonino Campolo
Sitael Spa, Italy
Mr. Alberto Bertuzzi
Sitael Spa, Italy
Mr. Leonardo Amoruso
Planetek Italia, Italy
Ms. Marianna Carbone
Planetek Italia, Italy
Mr. Luca Cinquepalmi
Planetek Italia, Italy

MICROHETSAT GROUND SEGMENT AND FLIGHT OPERATIONS

Abstract

The microHETSat (micro- Hall Effect Thruster Satellite) is an ESA mission launched on December 1st, 2023 on a Falcon 9 rocket, designed to perform IOD-IOV activities for SITAEL's low power (100W class) Hall Effect thruster-based micro-propulsion system, internally developed by the company.

The mission is supported by a ground segment relying on a cloud-based architecture, operated by a Mission Control Center (MCC) and communicating in UHF with the spacecraft via a GSN (Ground Station Network).

The GSN is based on third-party networks of UHF ground stations, thanks to the wide availability of commercial providers (GSaaS). The implemented network consists of a single ground station operated by KSAT at its Brøstadbotn site (Norway). The station also physically hosts the Software Defined Radio (SDR) handling the modulation and coding of the RF signal.

Operations are executed by a four-people team from the Mission Control Center, located in the Forlì (Italy) SITAEL premise: two spacecraft controllers, one spacecraft operations manager, and one spacecraft engineer.

The ground segment implementation resides on a Microsoft Azure virtualized environment, hosting all the software components (MCS - Mission Control System, GSM - Ground Station Manager, ARC – data archive, MPS – Mission Planner, FDS – Flight Dynamics System, SCO – Telemetry Visualization Tool).

The virtual machines provide a redundant copy for all components and two separate chains: a VAL chain dedicated to testing and rehearsal (connected to the microHETSat avionic test bench), and the PROD chain that is used for the actual operations.

The Mission Control System is based on the ERMES software developed by Planetek Italia, that acts as the central hub of the system, interfacing with all the other components including the human operator. These several interfaces are handled by ERMES modular design: SHDS handles packets from and the

SDR, while MCM oversees the spacecraft database (SCOS-2k format). Finally, ADAPTERS manages the connection with the MySQL archival system and the SPELL driver.

SPELL is an automated procedure execution environment developed by SES, allowing the implementation of scripted procedures that automatically issue commands and evaluate received telemetry, with the capability of going through branching decision paths. Hence, the mission can perform complex tasks with minimal operator interaction, reducing operative complexity.

The data visualization and presentation solution is based on a Grafana webserver.

The paper will present the first months of satellite operations, from LEOP to commissioning, to routine Operations, highlighting lesson learned from this Ground Segment architecture.