22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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ESEO GROUND SEGMENT SOFTWARE SOLUTIONS:
DESIGN, IMPLEMENTATION AND TESTING

Abstract

This paper describes the Ground Segment (G/S) software solutions developed to support the operations of the European Student Earth Orbiter (ESEO) mission, a 50 Kg microsatellite equipped with seven payloads supplied by European universities to be launched in low Earth orbit in 2016.
This unusually large number of payloads makes spacecraft operations a challenging task, thus requiring reliable and high-performing software tools to manage the mission control system (MCS). Since ESEO is a small budget project, commercial solutions are not suitable for this purpose, therefore new and customized G/S software tools were implemented.
Telemetry (TM) and telecommands (TC) are handled by an application developed in LabVIEW, connected to a MySQL database, used to store mission data and user segment requests. The designed user interface meets the requirements for this kind of applications: it is intuitive and easy-to-navigate through the several functionalities it offers, it contains several types of indicators, buttons and an automatic e-mail system to warn engineers about equipment failure and out-of-range values.
Automatic flight operations procedures are also possible, they are coded as MATLAB scripts and can be launched from a dedicated interface, speeding up TC uploading.
TC packets are coded using the AX.25 radio amateur protocol and frames are forwarded to the Ground Station (GS) PC running an application implemented to modulate the transmitted signal using a Software Defined Radio (SDR). In the same way, signals are received, processed, saved into binary files and demodulated. This application is also connected to a satellite tracking software for frequency Doppler correction.
A mission report tool has also been implemented to ease TM data trend analysis and dissemination by offering the capability to quickly retrieve, plot and display the calibrated data from a TM parameters list and datetime interval.
The ESEO platform will be controlled via the Forli GS at UHF band and in case of local outages, from Vigo GS, while payload scientific data will be downloaded from both Forli and Munich GS at S-band. To create a conflict free satellite operational pass schedule, the operator will be assisted by a dedicated tool.
The ESEO project is now moving into phase D: most of the software tools functionalities have already been verified as well as software and RF compatibility with the onboard transceiver. The MCS will be validated during EGSE tests and the whole G/S will be validated by end-to-end tests, which will be performed following the project timeline.