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Small Satellite Operations (3)

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SAPPHIRE IN ORBIT – A LOW COST, AGILE SPACECRAFT FOR SPACE SITUATIONAL
AWARENESS

Abstract

Knowledge of objects in the near-Earth orbital environment is critical for successful spacecraft operation due to increasingly densely populated orbits. Terrestrial based methods for detecting and tracking Resident Space Objects (RSO), e.g. orbital debris, spacecraft, etc., are limited by atmospheric conditions. A space-based platform can augment terrestrial tracking systems through the ability to be tasked on a 24-hour basis, without lost opportunities due to weather.

The Canadian Department of National Defence (DND), through prime contractor MDA, developed the Sapphire system, including ground segment, launch and operations, to address this need. The Sapphire spacecraft was founded upon a low cost, highly agile, spacecraft bus, which was built and qualified by SSTL, and incorporates an optical payload provided by COM DEV Canada. The bus and payload were integrated by MDA in Canada and the satellite is operated by MDA.

Sapphire resides in a sun-synchronous, dusk/dawn orbit and tracks space objects against a background of stars. It meets challenging imaging and slewing requirements for over 375 space objects per day, within a 35 cone off the vector normal to the orbit plane.

The platform is based on the SSTL-150 bus, which has flight heritage from the RapidEye constellation and has been modified for the requirements of Sapphire. Sapphire is the first 150kg class satellite mission to track RSOs using an optical telescope in space. The satellite was launched by the Indian Space Research Organisation using a PSLV-CA rocket, flight C20, at 12:31 on 25 February 2013 from the First Launch Pad at the Satish Dhawan Space Centre.

The Sapphire bus and ground segment commissioning was conducted by a joint team from SSTL and MDA at the Satellite Operations Facility in Richmond, BC. Sapphire's commissioning results show the system has exceeded key performance metrics, including RSO tracking accuracy, throughput (satisfied tasks per day) and data latency.

Whilst providing an update on the in-orbit capabilities, this paper focuses on the design of the spacecraft bus, the in-orbit AOCs capabilities, FDIR strategy and how Sapphire will support and improve

coordinated spacecraft operations.