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ESA'S OPS-SAT MISSION: TESTING A FLYING LABORATORY

Abstract

ESA's OPS-SAT mission will serve as an orbiting laboratory specifically designed to demonstrate novel concepts in satellite and ground control software under real flight conditions and to finally break out of the "has never flown, will never fly" cycle. Intended as a free and open platform for experiments, OPS-SAT will provided unique opportunities to test and validate new operational concepts and algorithms. To accommodate the more than 100 registered experiments, the satellite and the ground system have to be extremely versatile and powerful in terms of processing power and uplink / downlink speeds. The satellite itself has to be inherently safe since testing new concepts inevitably goes along with discovering potentially critical bugs. In order to address the challenges that come along with testing such a satellite and ground system, new testing methodologies need to be developed based around the central need to create reliable and reusable test procedures from very early on in the design phase through to operations. By exploiting the fact that the satellite hardware is mainly made of relatively low cost commercial off-the-shelf (COTS) hardware it has been possible to build a flight representative spacecraft a very long time before launch and therefore to perform these tests on real hardware, rather than a simulator. This has both advantages and disadvantages. Test procedures will be developed from unit level upwards so that they are flexible enough to accommodate any change as the project progresses. Once testing procedures have proven valid, automated execution of the procedures will be implemented using existing automation tools like ESA's Mission AutomaTIon System (MATIS). Due to the numerous experiments that may be continuously changed or improved throughout the mission, it would be impossible to do extensive tests for each individual experiment. Since there is limited insight into the details of the individual experiments, a chance exists that bugged experiments or even intentionally hostile experiments pose a threat to the mission schedule or the satellite itself. To counter those threats, additional strategies will be developed to ensure that the ground testing is capable of detecting mission critical threats before an experiment gets uploaded to the satellite. This research focuses on creating and executing testing strategies for individual components (unit level) up to a system level which will be used throughout the OPS-SAT project. The gathered insights shall serve as a basis for optimization and simplification of the testing process of future space missions.