SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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SPACE COMMUNICATIONS AND NAVIGATION (SCAN) TESTBED SOFTWARE DEVELOPMENT AND LESSONS LEARNED

Abstract

National Aeronautics and Space Administration (NASA) has developed an on-orbit, adaptable, Software Defined Radio (SDR)/Space Telecommunications Radio System (STRS)-based testbed facility to conduct a suite of experiments to advance technologies, reduce risk, and enable future mission capabilities on the International Space Station (ISS). The SCAN Testbed Project will provide NASA, industry, other Government agencies, and academic partners the opportunity to develop and field communications, navigation, and networking technologies in the laboratory and space environment based on reconfigurable SDR platforms and the STRS Architecture.

The SDRs are a new technology for NASA, and the support infrastructure they require is different from legacy, fixed function radios. SDRs offer the ability to reconfigure on-orbit communications by changing software for new waveforms and operating systems to enable new capabilities or fix any anomalies, which was not a previous option. They are not stand alone devices, but required a new approach to effectively control them and flow data. This requires extensive software to be developed to utilize the full potential of these reconfigurable platforms.

The paper focuses on development, integration and testing of the avionics processor system, and the software required to command, control, monitor, and interact with the SDRs, as well as the other communication payload elements. An extensive effort was required to develop the flight software and meet the NASA requirements for software quality and safety. The flight avionics must be radiation tolerant, and these processors have limited capability in comparison to terrestrial counterparts. A big challenge was that there are three SDRs onboard, and interfacing with multiple SDRs simultaneously complicates the effort. The effort also includes ground software, which is a key element for both the command of the payload, and displaying data created by the payload.

The verification of the software was an extensive effort. The challenges of specifying a suitable test matrix with reconfigurable systems that offer numerous configurations is highlighted. Since the flight system testing requires methodical, controlled testing that limits risk, a nearly identical ground system to the on-orbit flight system was required to develop the software and write verification procedures before it was installed and tested on the flight system.

The development of the SCAN testbed was an accelerated effort to meet launch constraints, and this paper discusses tradeoffs made to balance needed software functionality and still maintain the schedule. Future upgrades are discussed that optimize the avionics and allow experimenters to utilize the SCAN testbed potential.