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FROM PROTOTYPE TECHNOLOGY TO FLIGHT: INFUSING THE FRONTIER RADIO ON THE RADIATION BELT STORM PROBES MISSION

Abstract

New technologies are constantly being developed at many space-related institutions. A significant challenge is to not only propose and develop these new technologies, but to infuse them into real space missions. The Johns Hopkins University Applied Physics Laboratory (JHU/APL) has a successful history of infusing such new technologies into NASA flight programs, including non-coherent navigation in the CONTOUR mission (launched 2002), a circularly-polarized phased-array antenna on the MESSENGER mission (2004), and a low-power receiver on the New Horizons missions (2006). Over the last several years, JHU/APL has developed a new software-defined radio product, the Frontier Radio, to be used on flight missions. A first-generation version of this radio will fly on the NASA Radiation Belt Storm Probes (RBSP) mission, launching in 2012. This paper discusses how the prototype Frontier Radio was infused into the RBSP mission. The completion of several intermediate milestones enabled the RBSP project to baseline this radio into its system design, beginning with requirements development and prototype design, fabrication, and test. This work was carried out within the NASA Communication, Navigation, and Networking reConfigurable Testbed (CoNNeCT) Program, in which JHU/APL designed, built and tested a prototype S/Ka-Band software-defined radio. Once this prototype's radio functionality was successfully demonstrated and the benefits and risks to the RBSP project were well understood, an S-Band-only version of this radio was baselined for the RBSP mission. To transition the prototype radio to a flight radio for the mission, a technology development plan was developed and implemented requiring the qualification of several new packaging technologies and the completion of two more intermediate radios in succession: a Breadboard and a Qualification Model (QM) radio. The Breadboard Radio phase culminated in a project-level Engineering Design Review (EDR), after which the building of QM radio began. The QM was built and tested as close to the intended flight configuration as possible with some compromises allowed for schedule constraints and parts availability. The technology development plan called for the QM radio to be qualified to a Technology Readiness Level (TRL) of 6, which requires a demonstration in a relevant environment exercising all interfaces. The QM was subjected to full environmental testing and compatibility testing with all the intended communications networks required for the RBSP mission. With the successful completion of the QM phase of the development, the Frontier Radio was deemed ready for use in a flight mission.