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FLYING WITH WIRELESS: THE IMPLEMENTATION OF A BLUETOOTH SPACECRAFT DATA BUS ON MICRO-SATELITE

Abstract

As the demand for smaller and more economical space systems increases, the needs for compact, complex, and efficient spacecraft have also been on the rise and yet the progress of several of the current standards in terms of speed and data load has been impeded by physical and mechanical constraints. One effective solution proposed has been the use of a wireless bus, more specifically a Bluetooth communication bus, to reduce both volume and complexity, while maintaining the integrity of the design. Throughout this paper, the engineering implementation of such a Bluetooth spacecraft data bus prototyping is introduced and discussed. Four scheduling algorithms for Bluetooth 2.0+ERD are studied for spacecraft application, namely, min-max fairness, lottery, round-robin and list scheduling. A topological assessment of the Bluetooth WPAN network based on designed PCBs and their respective schematics is also presented. In addition to the engineering of the Bluetooth wireless bus, some of the issues that need to be addressed include space radiation, thermal and mechanical effects on the physical wireless equipment; inter-spacecraft communication interference; software and hardware configuration interface; jitter management and security implications posed by the space environment and intentional human interference. This is enforced by modeling the space environment as it pertains to a Bluetooth bus and will be followed by ground simulation and expectantly in-orbit testing results. This paper will also investigate a wireless Bluetooth intersatellite data bus based on such characteristics as power consumption, effective range for small spacecraft, network access control (i.e. PnP and security), EM compatibility, and reliability in space. The building standard for a space qualified wireless Bluetooth bus will also be developed. It includes detailed descriptions of parts and components selection, interface design, assembly, integration, and validation of the electronic systems and environmental tests. Bluetooth appears to satisfy most of the evolving demands of the space industry but its main draw back is the lack of prior use in space applications which is an inevitable reality of using any new technology.