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Prediction, Testing, Measurement and Effects of space environment on space missions (3)

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RESULTS FROM TESTING LOW COST, HIGH PERFORMANCE TERRESTRIAL PROCESSORS FOR LOW COST HIGH PERFORMANCE, AUTONOMOUS SPACE MISSIONS

Abstract

There has been a significant increase in the use of microsatellites and cubesats in the past decade. However, it has proved difficult to scale up current cubesat avionics systems to enable larger, longer, more complex missions, and challenging to scale down traditional microsatellites to an affordable price point. The need exists for a microsatellite capability at a cubesat cost. A key enabler of developing a robust Next Generation Microsatellite Platform is a suitable low-cost microprocessor that can be used to form the foundation of an affordable, robust, flexible, performant and autonomous satellite platform avionics system. Space-qualified, long-lifetime, radiation-tolerant (or hardened) processors do exist, however, these are expensive, tend to deliver poor mission performance compared to the latest terrestrial Commercial-Off-The-Shelf (COTS) components and are not compatible with the limited resources onboard cubesats and smallsats. We have performed a test campaign to identify commercially available microprocessors that leverage the latest innovations in microprocessor technology and which meet a set of system criteria that make them suitable for use as a microsatellite platform processor for a wide range of missions; from single modest spacecraft, through to proliferated architectures requiring autonomous operations. We are sharing these test results freely with the space community to advance small satellite capabilities and to stimulate the development of the next wave of cost-effective missions, applications and services. KISPE and Surrey Space Centre (SSC) at the University of Surrey (UoS) undertook a project to define system requirements, identify candidate processors, and conduct benchmarking and evaluation tests in a representative space Electron radiation environment to determine the feasibility of selected microprocessors for use in future Low Earth Orbit space systems. This paper: • Discusses market drivers for the development of the Next Generation Microsatellite Platform, • Describes the purpose and objectives of the radiation test campaign and the motivations for sharing the results freely • Explains the criteria applied to a long-list of processors in order to downselect candidate processors for test, • Describes the software developed to exercise the processors during radiation test, • Provides details about the test campaign, UoS radiation test facilities, test setup and test process, • Summarises the test results and conclusions, • Illustrates the benefits of the KISPE-SSC industrial-academic collaboration, • Discusses lessons learned from the project, • Describes the next steps to perform Proton testing and to test additional low-cost COTS devices which could extend platform, system and mission capabilities.