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CHARACTERISATION OF COTS SYSTEM-ON-MODULES (SOM) AS ELECTRONIC CONTROL BOARDS (ECB) FOR LUNAR SURFACE APPLICATIONS

Abstract

Future missions on the lunar surface will rely on a host of elements, spanning from key power-infrastructure, to communication hubs and other commercial systems. Electronic Control Boards (ECB) will be required to support very different use-cases, from applications in small payloads or sensors, to deployments in stationary units, towers or habitats. The required capabilities, size, mass, computational power, and durability/hardness of the avionics will vary depending on the use-case, and include radiation hardening for Single Event Effects over different degrees of dependability. Space commercialisation will also witness smaller and diverse entities, such as SMEs and universities, delivering scientific payloads or demonstrating new capabilities with a budget-effective approach, and in non-critical operations. For

these scenarios, development of software and applications on well-known environments (Unix OS) and SDK (Software Development Kit) and drivers/libraries (OpenGL, etc.), on high computational-power boards will speed-up the time-to-prototype and the time-to-flight also for running complex applications (3D rendering, edge computing, ML local classification, image processing or compression, telecommunications and routing). Commercial-Off-The-Shelf (COTS) System-on-Modules (SoMs) offer high performance at a reduced size, and provide flexibility of well-established SDKs and drivers. Although widely used on Earth in robotics and industrial applications, their reliability and tolerance to radiation is not well established for applications beyond LEO (Low Earth Orbit), where exposed to ionizing and non-ionizing radiation, along with temperature and pressure shocks. Here, we present the results of an extended characterisation campaign conducted by ESA on COTS SoMs targeting lunar surface applications. This covers trade-off selection of four (4) SoMs basing on performance, reliability, availability, suitability for targeted use-cases, and radiation hardness; test campaign results examining the SoMs under various conditions (TID, SEE Proton/Heavy-Ion, Life-test, Out-gassing, Off-gassing tests); insights and lessons learned, and discussion on the way-ahead and on benefits/challenges of using COTS ECBs beyond LEO.