A method is provided for a radiation-hardened (rad-hard) solid-state drive for space mission memory applications by combining rad-hard and commercial off-the-shelf (COTS) non-volatile memories (NVMs) into a hybrid architecture. The architecture is controlled by a rad-hard ASIC (application specific integrated circuit) or a FPGA (field programmable gate array). Specific error handling and data management protocols are developed for use in a rad-hard environment. The rad-hard memories are smaller in overall memory density, but are used to control and manage radiation-induced errors in the main, and much larger density, non-rad-hard COTS memory devices.

Small amounts of rad-hard memory are used as error buffers and temporary caches for radiation-induced errors in the large COTS memories. The rad-hard ASIC/FPGA implements a variety of error-handling protocols to manage these radiation-induced errors. The large COTS memory is triplicated for protection, and CRC-based counters are calculated for sub-areas in each COTS NVM array. These counters are stored in the rad-hard non-volatile memory. Through monitoring, rewriting, regeneration, triplication, and long-term storage, radiation-induced errors in the large NV memory are managed. The rad-hard ASIC/FPGA also interfaces with the external computer busses.

This work was done by Douglas J. Sheldon of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

Radiation-Hardened Solid-State Drive
NASA’s Jet Propulsion Laboratory, Pasadena, California

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