Rad Hard By Software for Space Multicore Processing

David Bueno, Eric Grobelny, Dave Campagna, Dave Kessler, and Matt Clark
Honeywell Space Electronic Systems, Clearwater, FL

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Why Rad Hard By Software?

• Future payloads can be expected to require high performance data processing

• Traditional component hardening approaches to rad hard processing suffer several key drawbacks
  - Large capability gap between rad hard and COTS processors
  - Poor SWaP characteristics vs. processing capacity
  - Extremely high cost vs. processing capacity
  - Dissimilarity with COTS technology drives high-cost software development units

• Honeywell Rad Hard By Software (RHBS) approach solves these problems by moving most data processing to high performance COTS single board computers
  - Leading edge capability
  - Software fault mitigation = less hardware = reduced SWaP
  - Inexpensive
  - No difference between development and flight hardware
What is Rad Hard By Software?

- Dependable Multiprocessor (DM) is Honeywell’s first-generation Rad Hard By Software technology
- Coarse-grained software-based fault detection and recovery
  - Similar to the way modern communication protocols detect errors at the packet rather than the byte level
  - Rad Hard By Software detects errors at the “operation” rather than the instruction level
- Typical system
  - One low-performance rad-hard SBC for “cluster” monitoring and severe upset recovery
    - Could also serve as spacecraft control processor
  - One or more high-performance COTS SBCs for data processing
    - Connected via high-speed interconnects
  - One or more fault-tolerant storage/memory cards for shared memory
  - Dependable Multiprocessing (DM) software stack

This work applies DM to multicore/multiprocessor targets including the PA Semi PA6T-1682M, Freescale 8641D, and IBM 970FX
• DM provides a low-overhead approach for increasing availability and reliability of COTS hardware in space
  - DM easily portable to most Linux-based platforms
  - 7447a processing platform selected near start of NASA/JPL ST8 program (DM), but better options now exist

• Modern processing platforms provided impressive overall speedups for existing DM applications no additional development effort
  - ~5-6x speedup vs. existing 7447a-based DM platform
    - Leverages optimized libraries for SIMD and multiprocessing
  - ~2-3x gain in throughput density (MFLOPS/W) vs. existing DM solution
  - ~20-40x performance of state-of-the-art rad hard by process solutions

• Potential future work
  - Exploration of high-speed networking technologies with DM
  - Enhancements to DM middleware for performance/availability/reliability
  - Further evaluation of future processing platforms (rad testing, etc.)

Poster includes details on DM performance benchmarking for multiple platforms and applications