Dependable Multiprocessor: An Application Approach

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Presentation Overview

- The Team
- The Dependable Multiprocessor
- The CubeSat Host
- Conclusion
Presentation Overview

- The Dependable Multiprocessor Team
  - Morehead State University
    - Kevin Brown, Ben Malphrus, et al
  - Honeywell
    - John Samson, et al
  - Radiance Technologies
    - Kathy Byrd, et al
  - Funders: NASA, Army, Honeywell, MSU
The Dependable Multiprocessor

• NASA Sponsored Dependable Multiprocessor (DM) Technology
• Cluster of high performance COTS processors are grouped to mitigate space environment effects
• DM Technology is a middleware package. It is Flexible, Scalable, Low Overhead, Easy to Use
The Dependable Multiprocessor

- DM is NOT the hardware – DM is a hardware independent set of middleware and management system for a set of processing nodes.
The Dependable Multiprocessor

- Provides more payload processing capability within given size, weight, power & cost constraints
- Supports easily programmable, adaptable, scalable, parallel processing
- Software-enhanced SEE tolerance for COTS
  - rapid autonomous recovery from SELs, SEFIs, & SEUs
  - high Availability & Reliability (Computation Correctness)
- Offers 10X – 100X higher throughput density compared to software programmable rad hard processing solutions
The DM: Hosts

NASA ST8  Honeywell Gumstix
Building a CubeSat Host

- First a host processor must be selected
  - Gumstix – Earth
    - Reasonable price, COTS
    - Small to fit in within CubeSat
    - Demonstration boards
    - Established Linux software
Building a Host

• A Node
  – Nodes must communicate
  – Ethernet network
    • 100 Mbps LAN
  – Gumstix Processor module does not contain a PHY layer
  – Gumstix has high density low profile connector
Building a Host

• Subsystem board
  – Mechanical
    • Retain each node
    • Interface to each node
    • Thermal management
  – Independent node management
    • Power sensing (I/V)
    • Power switching
    • Reset
Building a Host

- **Backbone**
  - Central Ethernet switch
    - 100 Mbps satellite connection to cluster
  - Power Regulation
  - Power Distribution
  - Telemetry UART
  - Node UARTs, Reset, etc
Building a Host

• Mechanical
  – Core 75mm x 75mm x 35mm
  – Legs to 97 mm
  – Legs conduct all heat to exterior faces then to satellite frame
Building a Host

• The Cluster
  – Installation by exterior screw
  – Interface by Samtec SFSD connector
Conclusions

Host system successfully demonstrated DM system with a 5 MP imager. Compressed images were sent as telemetry in different compression sizes. System is sized for the CubeSat form factor for future mission needs.
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