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

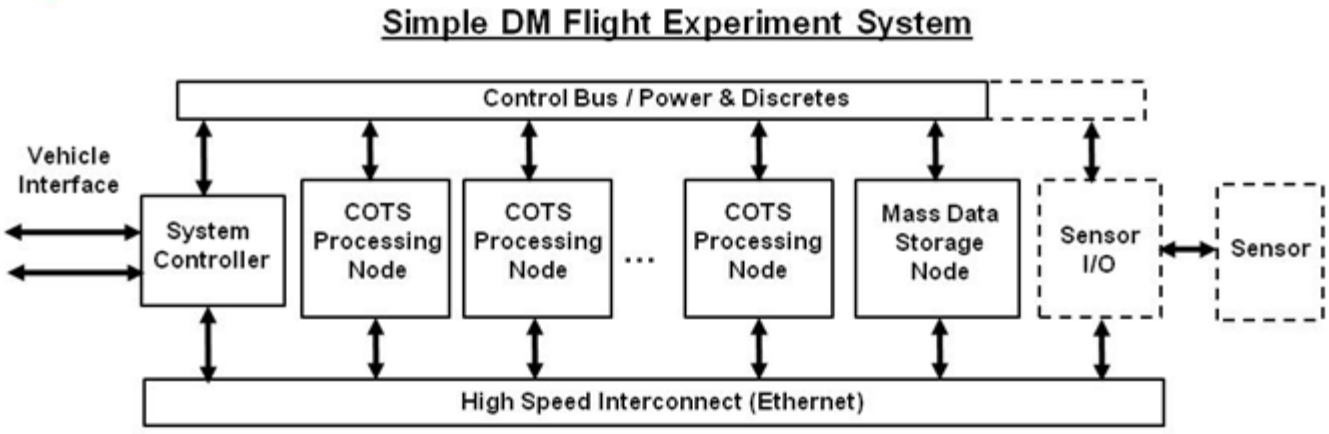
Honeywell

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

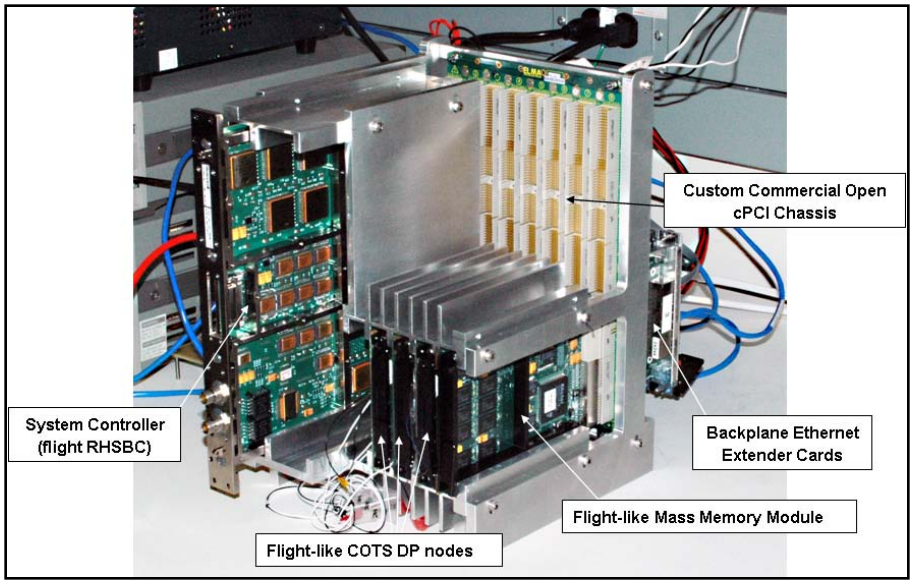
- DM is NOT the hardware – DM is a hardware independent set of middleware and management system for a set of processing nodes



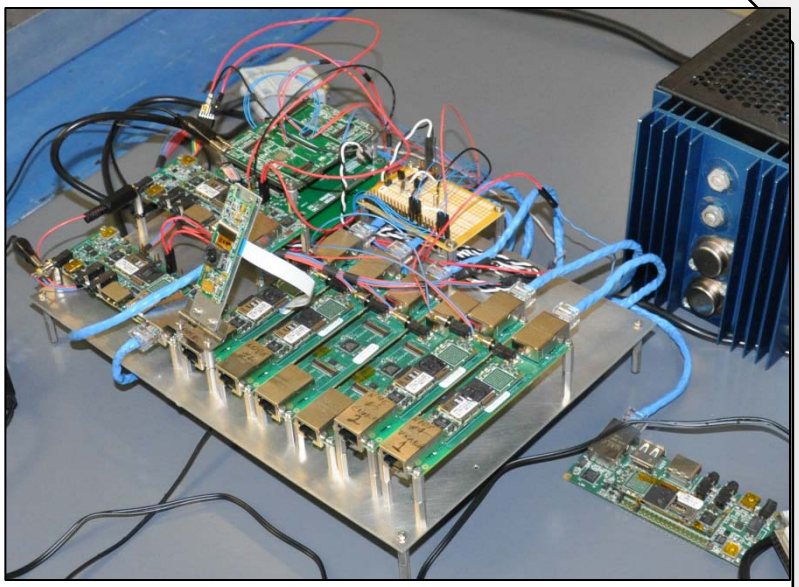
The Dependable Multiprocessor

- 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



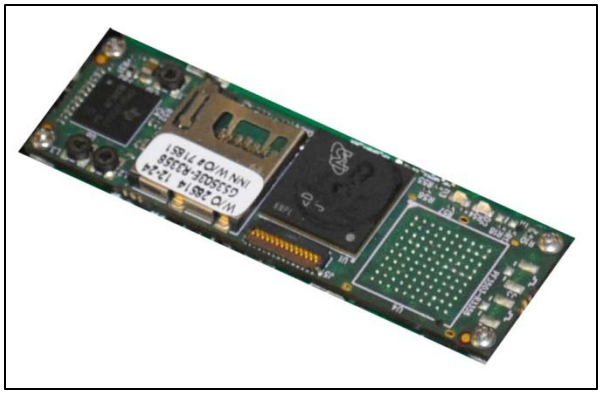
NASA ST8



Honeywell Gumstix

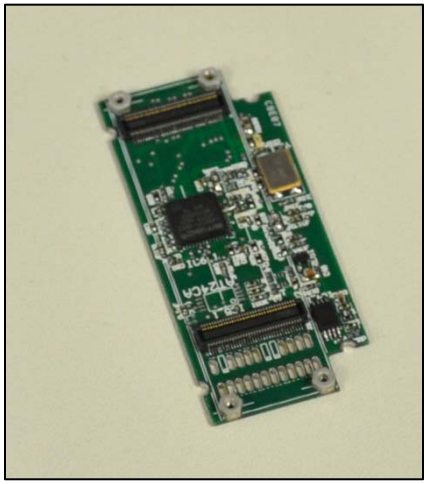
Building a CubeSat Host

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



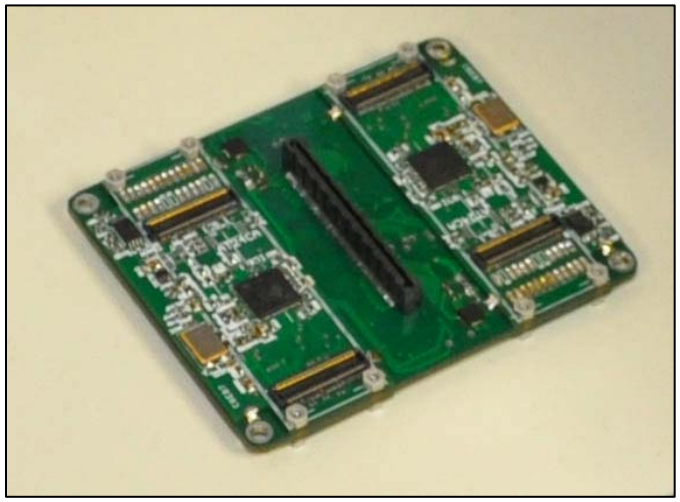
Building a Host

- 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



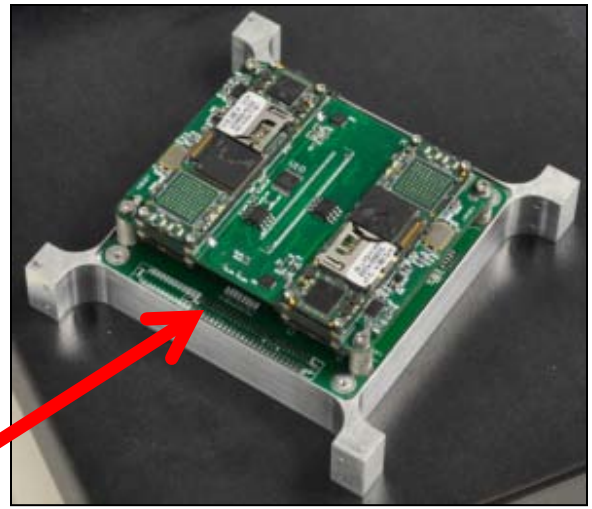
Building a Host

- Subsystem board
  - Mechanical
    - Retain each node
    - Interface to each node
    - Thermal management
  - Independent node management
    - Power sensing (I/V)
    - Power switching
    - Reset



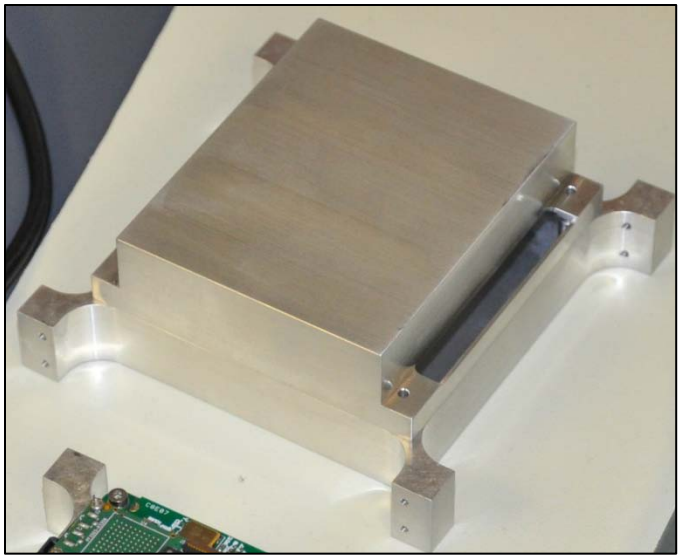
Building a Host

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



Building a Host

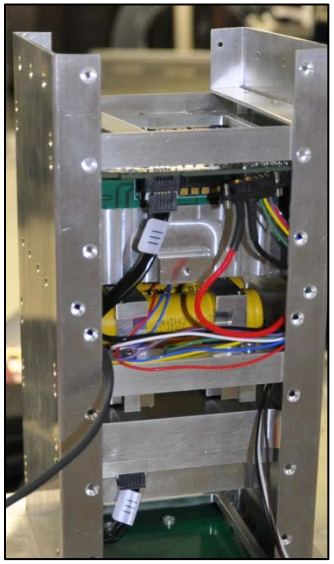
- Mechanical
  - Core 75mm x 75mm x 35mm
  - Legs to 97 mm
  - Legs conduct all heat to exterior faces then to satellite frame

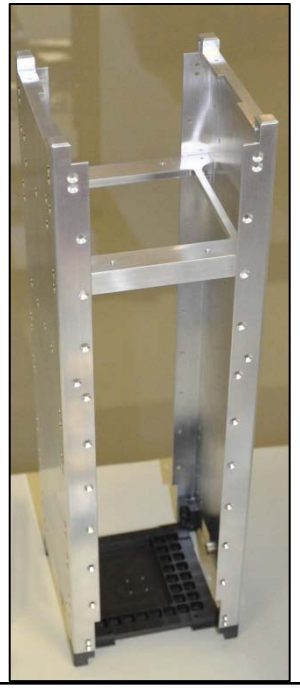


Building a Host

- The Cluster
  - Installation by exterior screw
  - Interface by Samtec SFSD connector

4 Months!





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

Contacts:

John Samson - Honeywell

Ben Malphrus - MSU

QUESTIONS