NMP ST8 Dependable Multiprocessor

Precis Presentation

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Dependable Multiprocessor

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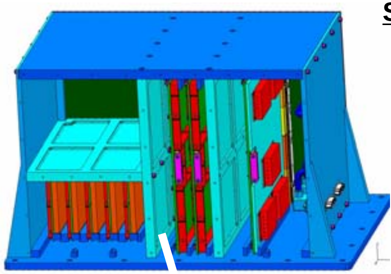
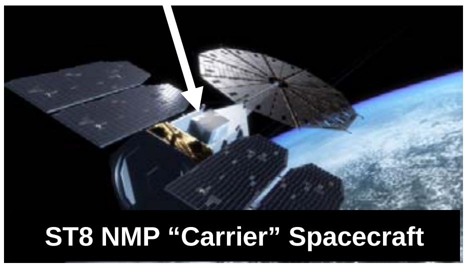


<u>Software</u>
Multi-layered system SW OS, Middleware, APIs, FT algorithms
SEU Immunity
- detection
- autonomous, transparent recovery

Multi-processing
- parallelism, redundancy
- combinable modes



<u>Hardware</u>
Dimensions 10.6 x 12.2 x 24.0 in. (26.9 x 30.9 x 45.7 cm)
Weight (Mass) ~ 61.05 lbs (27.8 kg)
Power ~ 120 Watts (max)

ST8 Dependable Multiprocessor Flight Experiment System

Description of technology advance

- Architecture and SW framework that enables COTS-based, high performance, scalable, cluster processing systems to operate in space - "SW-based SEU-tolerance enhancement"
- MPI-based for ease of porting applications from lab to space
- Adaptable to environment: radiation, mission, mode
- Validated models that can predict system performance in future missions & environments

Validation Objectives

- Demonstrate delivered onboard computational throughput capability 10x – 100x more than any computer flying in space today
- Demonstrate onboard processing throughput density > 300 GOPS/watt

Applications of DM Technology

- DM technology is applicable to a wide range of missions
- enables heretofore previously unrealizable levels of science and autonomy processing
  - -- NASA science missions
  - -- landers/rovers
  - -- robotic servicing of satellites
  - -- ground/lunar/Mars-based systems
- CEV docking computers - MKV video processor
- Unattended Airborne Vehicles (UAVs)
- Un-tethered Undersea Vehicles (UUVs)
- Stratolites
- Operationally Responsive Space (ORS)
- rad hard space applications

CY	'05	'06	'07	'08	'09	'10
Phase A - Concept Defn.	▲ TRL4 (7/04 - $0.5M)					
Phase B - Formulation	▲	TRL5/PDR ▲	▲			
Phase C/D - Implementation			▲ ▲ CDR	TRL6 ▲	ATLO △ △ Launch	
Phase E - Flight Exper.					△	TRL7 △
Funding	$1.2M	$2.5M	$4.0M	$2.7M	~~$0.5M~~	~~$0.3M~~

NASA budget issues forced elimination of ST8 flight experiment per directive issued 8/3/07

DM Status

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- Prototype DM SW transitioned to Honeywell Cat 4 software standard
  - prototype software tested for over a year
    - -- found and fixed minor bugs
    - -- no major problems uncovered
- Radiation testing of COTS flight components performed
  - performed proton testing and heavy ion testing of key parts
  - COTS components exhibited no catastrophic latch-up and sufficient SEU rates for flight experiment
- Flight experiment including command and telemetry defined
  - DM payload command and telemetry tables
  - operational experiment scenario
- Phase C/D flight testbed fabricated
- Prototype S/C interface SW developed and demonstrated
  - command processing
  - experiment data telemetry collection and reporting
  - demonstrated end-to-end command & telemetry loop with Orbital CTSIM (Command & Telemetry Simulator)
- Flight payload design finalized
  - electrical (including MIB)
  - structural
  - thermal
- Successful CDR, June 27, 2007
- Progressing toward TRL6 technology validation demonstration in FY ’08
  - includes comprehensive SW fault injection experiments and system-level radiation beam tests

DM Phase C/D Flight Testbed

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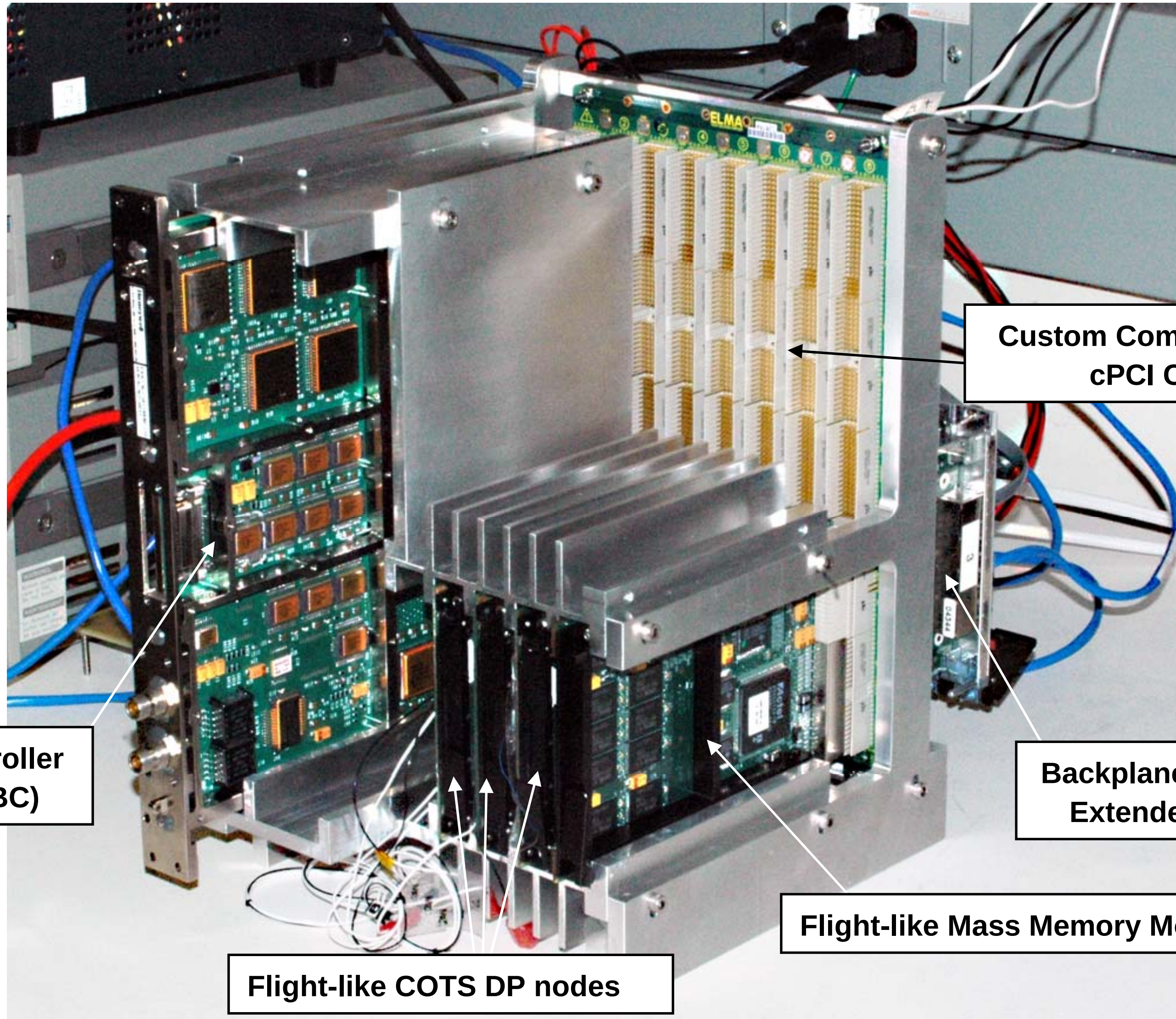

Summary & Conclusion

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- Flying high performance COTS in space is a long-held desire/goal
  - Space Touchstone - (DARPA/NRL)
  - Remote Exploration and Experimentation (REE) - (NASA/JPL)
  - Improved Space Architecture Concept (ISAC) - (USAF)
- NMP ST8 DM project is bringing this desire/goal closer to reality
- DM technology independence has been demonstrated on wide variety of platforms
  - x86, PPC clusters
  - IBM Cell technology
  - FPGAs
  - VxWorks, Linux OS
- DM technology ease-of-use has been demonstrated
  - porting of GSFC Neural Basis Function (NBF) Synthetic Neural System (SNS) algorithms for autonomous rendezvous and docking
  - porting of NOAO Stellar Photometry application (QWPST)
- Multiple applications have been successfully ported to and demonstrated on DM testbeds
  - SAR, HSI, NBF-SNS, QWPST, Matrix Multiply, 2DFFT, LUD, K-means