ScOSA

A Space Weather Tolerant High Performance Onboard Computer for Satellites

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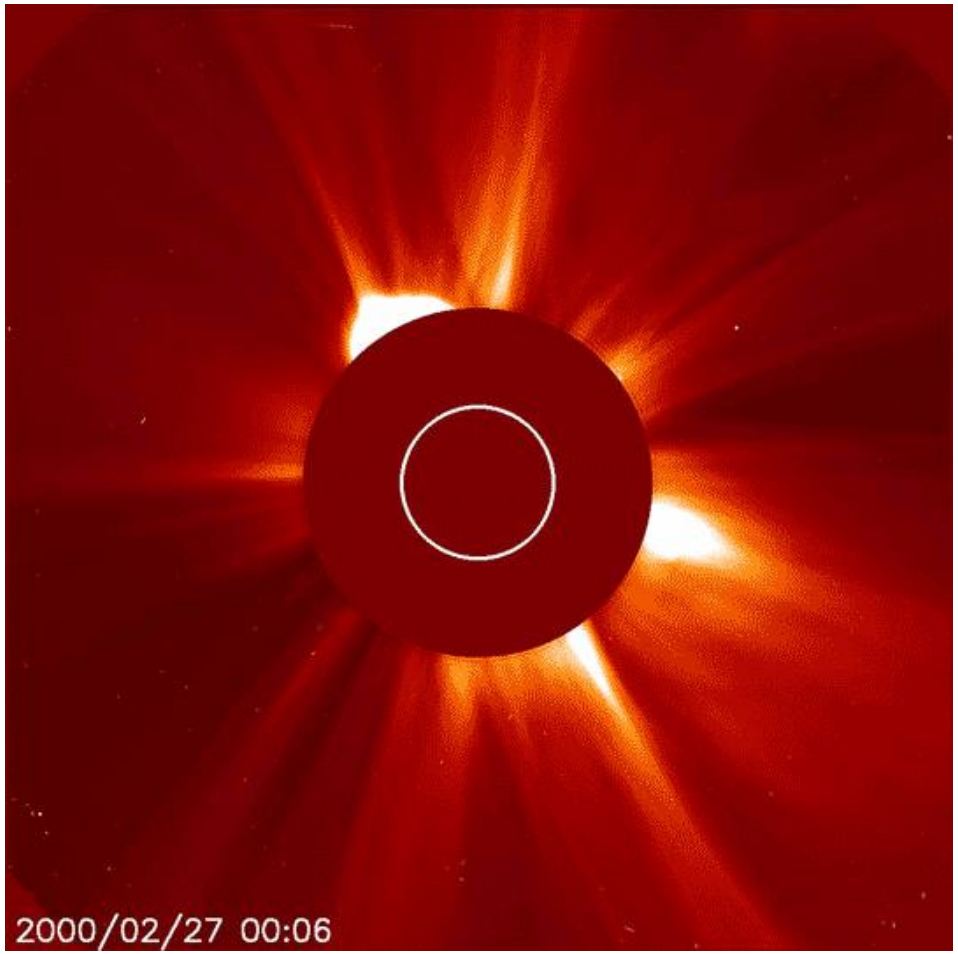
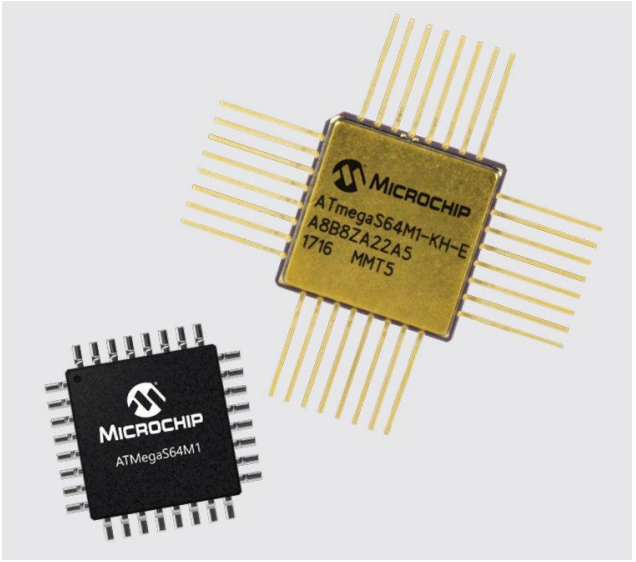
Space Weather Threatens OBCs

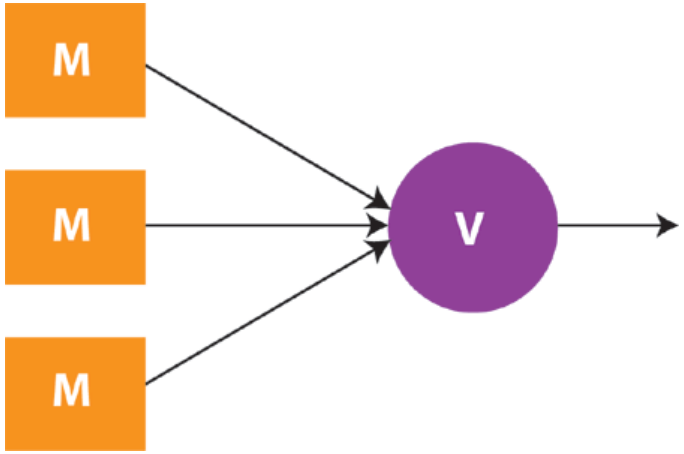
- Interplanetary Coronal Mass Ejections (ICMEs)
  - Three per day during solar maximum
  - Cause Single Event Effects (SEEs) and total dose effects
  - Result in data corruption through bit flips
  - Degrade onboard computers (OBCs)



How Satellites Deal with Solar Radiation Today

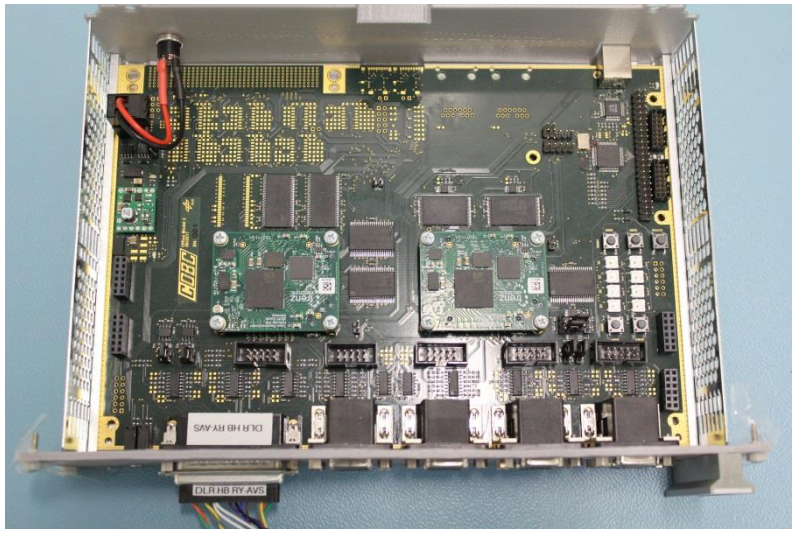


- Radiation-hardened processors
  - Expensive
  - Long development cycles
  - Very low computing performance
- Backups and Triple Modular Redundancy
- Heavy radiation shielding



The Perspective Opened by ScOSA

- Use both radiation-hardened and COTS processors
- COTS components for non-critical tasks with high computing demands
- Reconfigurable and fault-tolerant network
- Migrate tasks upon component failure

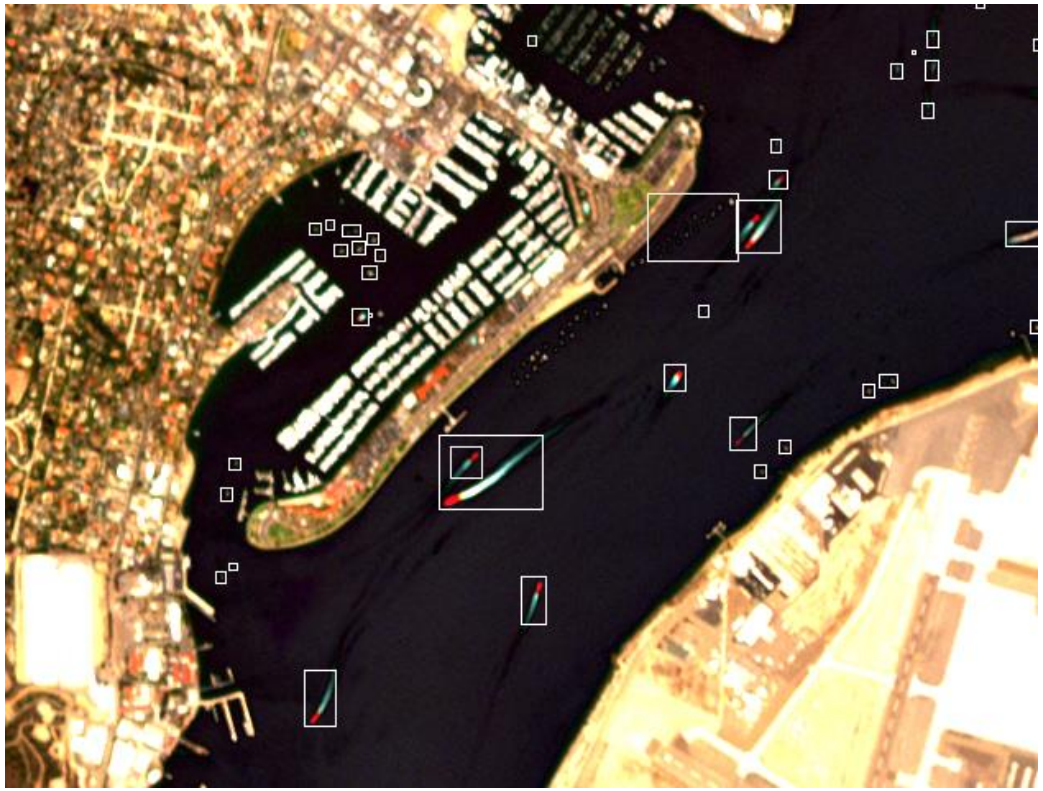


Radiation-hardened processor (RCN)

Three COTS processors (HPNs)

Example Applications Addressed by ScOSA

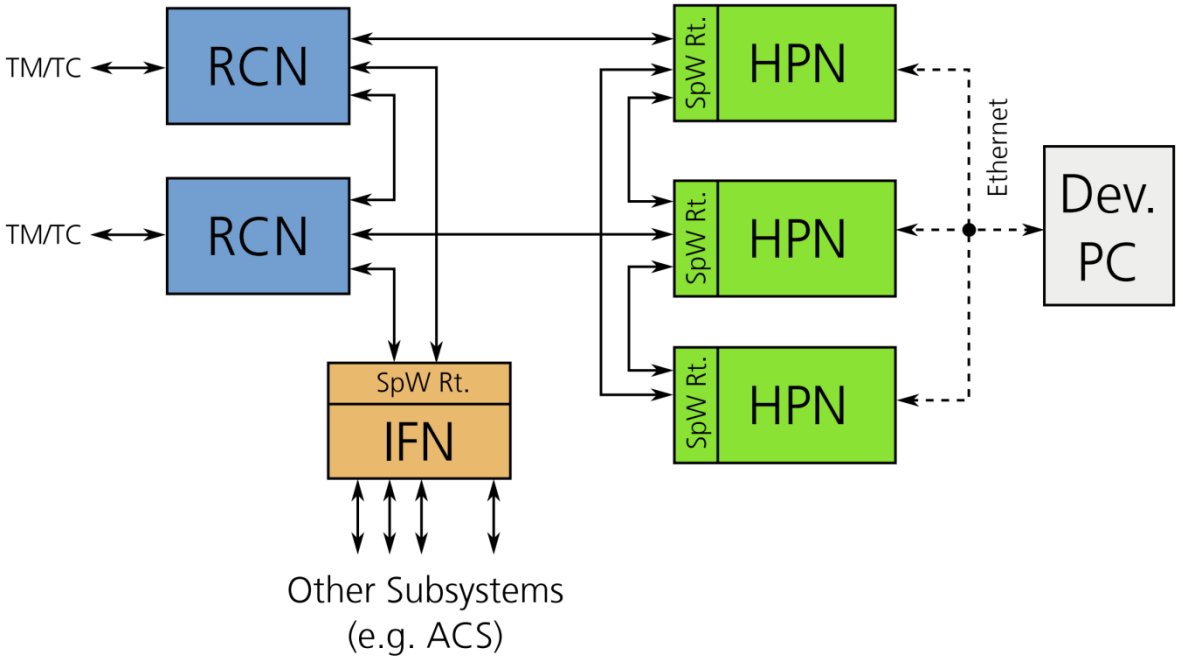
On Orbit Servicing – DLR Robotics Institute



Ship Detection – DLR Space Operations

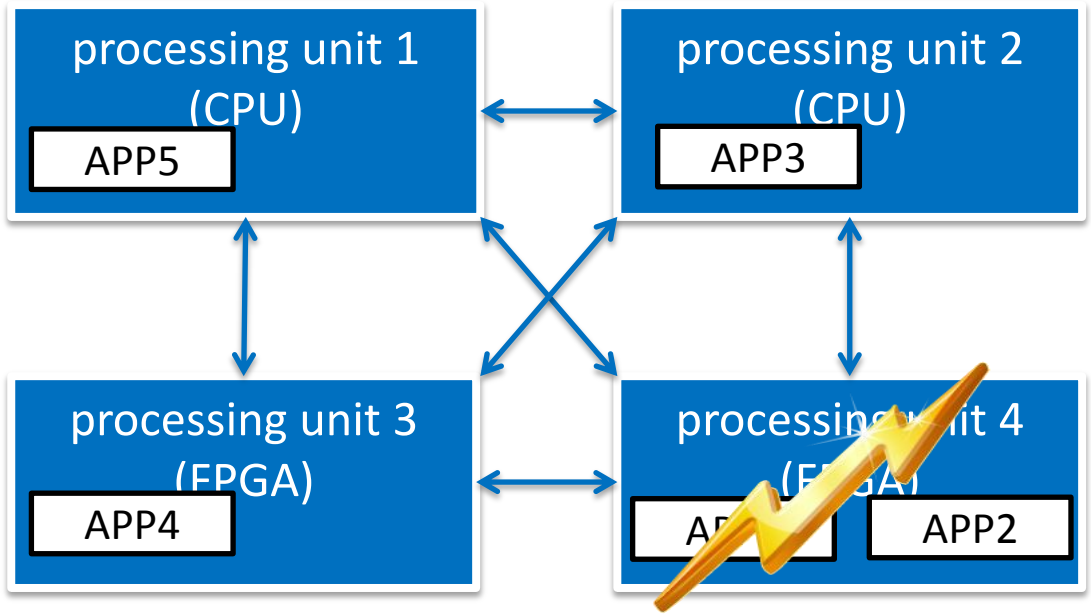
ScOSA Components

- Different types of microcontrollers
  - Reliable Computing Nodes (RCN)
  - High Performance Nodes (HPN)
  - InterFace Nodes (IFN)
- Nodes interconnected by network
- RCNs for stability
- HPNs for computing speed
- IFNs connect to other subsystems



Dynamic Reconfiguration

- Migrate tasks from failed node
- Tasks may be shifted to different Hardware
- Resume operation after reconfiguration



FDIR Services

- Fault tolerance
  - Distributed FDIR subsystem
- Detection
  - Heartbeat, Voters, Plausibility
- Isolation
  - Reconfigure to remove nodes
- Recovery
  - Reintegrate nodes after reboot

Scope	Software Mechanisms	Cause And Effect
Level 4 Safe Mode	Safe Mode SW Configurations	• Multiple level 2 or 3 failures • Hardware alarms
Level 3 System	• System Monitor (D) • Reconfiguration (I,R) • Reintegration (R)	• Subsystem failure • Inter-node mechanisms
Level 2 Node	• Watchdog Timer (D,I) • Soft Error Signal Handler (D,I)	• Subsystem failure • Local mechanisms
Level 1 Task	• System Alert (D) • Plausibility Check (D) • Checkpointing (R)	• Unit failure • Subsystem performance degradation
Level 0 Data	• Voter (D,I)	• Failures with no effect on the performance

Outlook on Potential Future Applications