Software Partitioning Technologies

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Software Partitioning Technologies

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Agenda

- Software Partitioning Overview
- Smiths Software Partitioning Technology
- Software Partitioning in the Vetronics Domain
The Problem

- How do we implement systems to take advantage of rapidly increasing COTS processing resources while at the same time:
  - Reducing system obsolescence by increasing software portability
  - Enabling new software applications to be integrated into legacy systems with minimal impact on
    • Military system validation process
    • Civil system FAA certification process
  - Reducing life-cycle costs and increasing functionality for “new” systems
  - Enabling the integration of applications at multiple levels of criticality/security on the same processing resource
The Solution -- Software Partitioning

- Integrate software on powerful, standard hardware through Software Partitioning.
- Software Partitioning provides:
  - Application Independence
    - All application interactions (I/O, CPU usage and Memory usage) are controlled and deterministic
  - Hardware Independence
    - Provides an industry standard Application Program Interface (API) to the operating environment (POSIX and ARINC653)
    - Increases portability by providing a “black box” I/O architecture
  - Reduced system modification/certification/validation costs
    - New applications can be added to system spare partitions without affecting the other partitions in the system
    - Only those parts of the system that change must be re-certified/re-validated
The Solution -- Software Partitioning

- **ARI NC 653** defines Software Partitioning and provides an API
  - Developed by aviation community consensus
  - Applicable to other domains (veterronics, medical, industrial)

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| Partition Level OS                        |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |

| Core Module Level OS                      |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |
|                                           |                      |                 |                |                  |                  |

**API Layer**

**Partitioning Services**
Smiths Software Partitioning Technology

- Smiths has developed the Software Partitioned Operating Environment (SPOE) to embody Software Partitioning
- SPOE in a nutshell
  - Partitions multiple applications on a single CPU in conformance with the ARINC 653 specification
    - Provides CPU throughput, memory, and I/O protection between apps.
    - Guarantees CPU throughput, memory availability, and I/O resource access for apps.
  - Isolates changes in functionality - reducing re-test and re-qualification efforts for upgrades
  - Enables integration of apps. at different criticality/certification levels
  - Provides tiered health management - captures and handles anomalies at the appropriate scope
  - Provides ARINC 653 and POSIX APIs for use by applications
Smiths Software Partitioning Technology

- SPOE in a nutshell (continued)
  - Supports multiple languages (Ada83/95, C, C++, ...)
  - COTS development tool sets (Rational Apex, GNAT Ada, gcc)
  - Hosted on multiple POSIX compliant COTS operating system platforms (LynxOS, Linux, Solaris)
  - Hosted on Multiple COTS Hardware Platforms:
    - Pentium -> Desktop PC Development and Embedded Target
    - PowerPC -> Embedded Target
    - SUN -> Desktop/Server Development Environment
  - Supports multiple physical I/O mediums (VME, PCI, 1553, ARINC 429, Ethernet, ...)
  - Scalable I/O partition provides support for a multi-processor environment
SPOE Implementation Architecture

- Hardware
- POSIX Compliant Operating System
- Applications and I/O Partition(s)
- ARINC653 / POSIX API
- Partitioning Layer
- POSIX Compliant Operating System
- Time and Space Partitions
Smiths Software Partitioning Technology

- Smiths’ technology development efforts
  - Participant in SAE AS-5 committee (Avionics Architecture Definition Language)
  - Integrated Modular Architecture (IMA)
    - Standardized within avionics community
    - Avionics (or Advanced) Computing Resource (ACR)
      - General purpose computing platform for software partitioning
      - Improves logistics (spares) and reduces cost through commonality
      - Applicable to vetronics as well as avionics
  - Safety/mission critical networking technology
  - Participant in WSTAWG OE IPT
    - Developing a demonstration prototype software partitioned WSTAWG API compliant OE
Software Partitioned WSTAWG OE

- Demonstrates:
  - WSTAWG OE API apps. in a partitioned system
  - Interaction between apps. written to dissimilar APIs
  - Portability of WSTAWG OE API apps.
  - Integration enabling features of SPOE
Software Partitioning for Vetronics

Benefits

- Provides “assured” real-time embedded processing for multiple applications on a single or multiple processing resources
  - Guaranteed Quality of Service (QoS) for applications
- Software partitioning will reduce system life-cycle costs
  - Eases initial software integration effort
    - Multiple applications built by different vendors can be integrated by 3rd party vendor at the object level
    - 3rd party and other vendors don’t need to “see” proprietary source
  - Enables new applications to be added to the system while retaining validated status of the existing system
    - New applications (FBCB2 for example) can be added to “spare” partitions
  - Enables impact of changes/upgrades to legacy applications to be isolated to one “partition”
- Reduces amount of processing hardware required
  - reduces initial system costs
  - reduces lifecycle cost of spares, etc.
Software Partitioning for Vetrionics

- **Benefits (continued)**
  - Abstraction of software from hardware (and I/O)
    - Facilitates embedded simulation and training - operational software is used unmodified for simulation and training
    - Software portability is enhanced
  - ACR technology
    - Reduces logistical footprint
      - Common modules - fewer module types to “spare”
      - Upgrades to modules can result in fewer modules for the same platform
    - Provides “pre-validated” hardware environment