GoAhead Software NDIA Systems Engineering 2010

High Availability and Fault Management in Objective Architecture Systems

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Outline

- Standards/COTS and the Mission-Critical Requirement
- Defining High Availability (HA)
- What is (OA) Open Architecture?
- Introduction to SA Forum Services
- Conceptual Alignment between OA and SA Forum
- Summary

Introduction

- Mission Critical Systems
  - Program/system examples: USN Aegis Weapon System, USA Integrated Battle Command System, USAF Space Fence, USN Air & Missile Defense Radar, USA Ground Combat Vehicle

- System architecture requires modularity and scalability

- COTS Solutions in general gaining traction

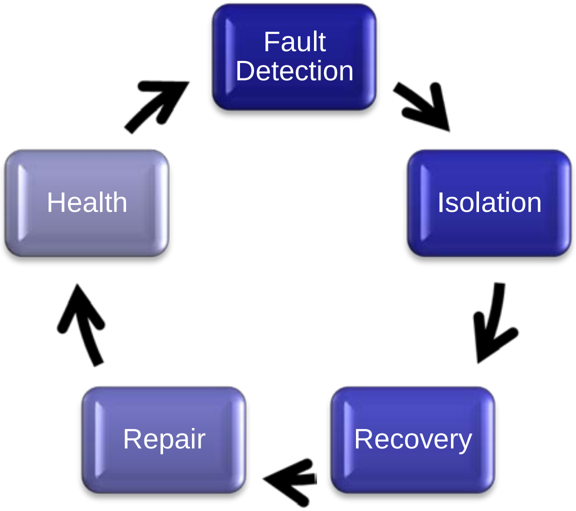
- The Service Availability Forum High Availability standards are gaining momentum for addressing mission critical requirements
  - DOD Information Technology Standards Registry (DISR), DOD-wide mandated standard
  - USN PEO IWS Combat System Product Line Architecture Description Document

Mission Critical Requirements

- Maintain continuous availability
  - Distributed infrastructure to support cooperating redundant applications
  - Infrastructure oversight of compute nodes and health awareness
- Automated, policy-based fault management cycle
  - Configuration of fault detection criteria
  - Deterministic fault recovery modeling
  - Sub-second MTTR recovery for real-time applications
- Distributed system management – framing a single coherent system
  - Central configuration and administrative control
  - Centralized alarm, notification, and log support
- Modular Open Systems Approach (MOSA)
  - Open standards, COTS based solutions
  - Reduce costs and risks

The Essence Of The High Availability Requirement

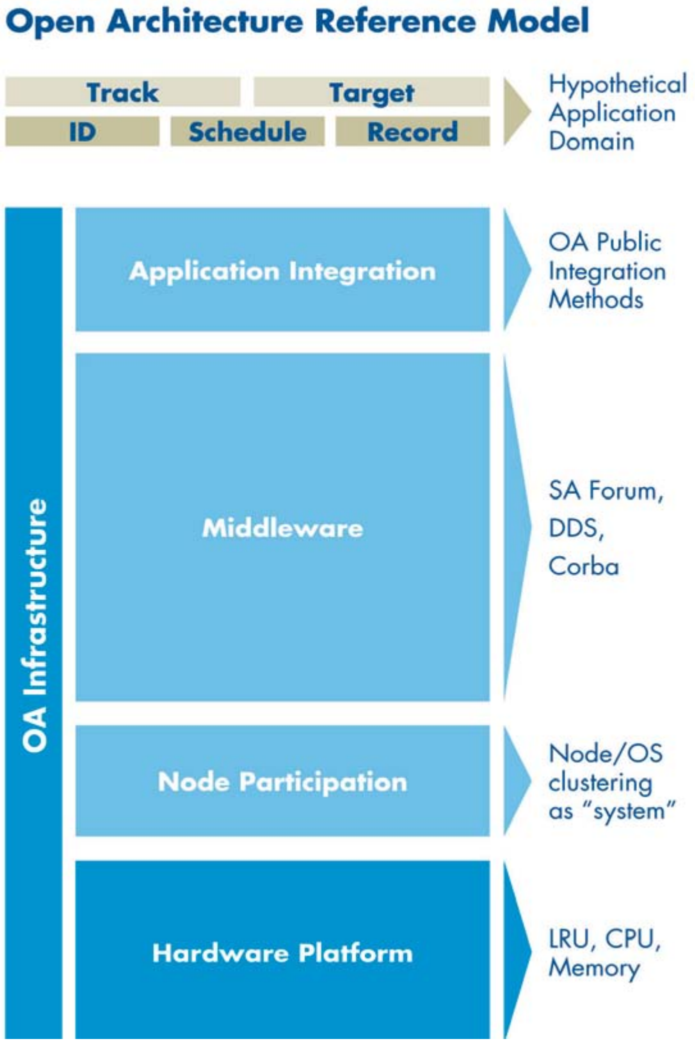
- Goal: Continuous availability (99.999% or better) despite
  - Hardware, software, human, and communication failures
  - Planned maintenance (migration, upgrade)
- Achieved via no single point of failure
  - Redundancy of mission critical applications
  - Failure detection at HW, OS, Node and App layers
  - Automated, policy-based real-time recovery and repair:
    - Sub-second, stateful failover
    - Alarms and Notifications
    - Custom policies
  - Proactive system monitoring with preventative measures
  - Clear integration points and modular design



Open Architecture Goals

Many meanings, but core is:

- Flexibility, openness, and re-use
- Layered infrastructure with common, open functions and interfaces
- Decouple domains of concern
- Modular, scalable
- Increased industry competition
- COTS, open standards



OA Reference Model and Infrastructure

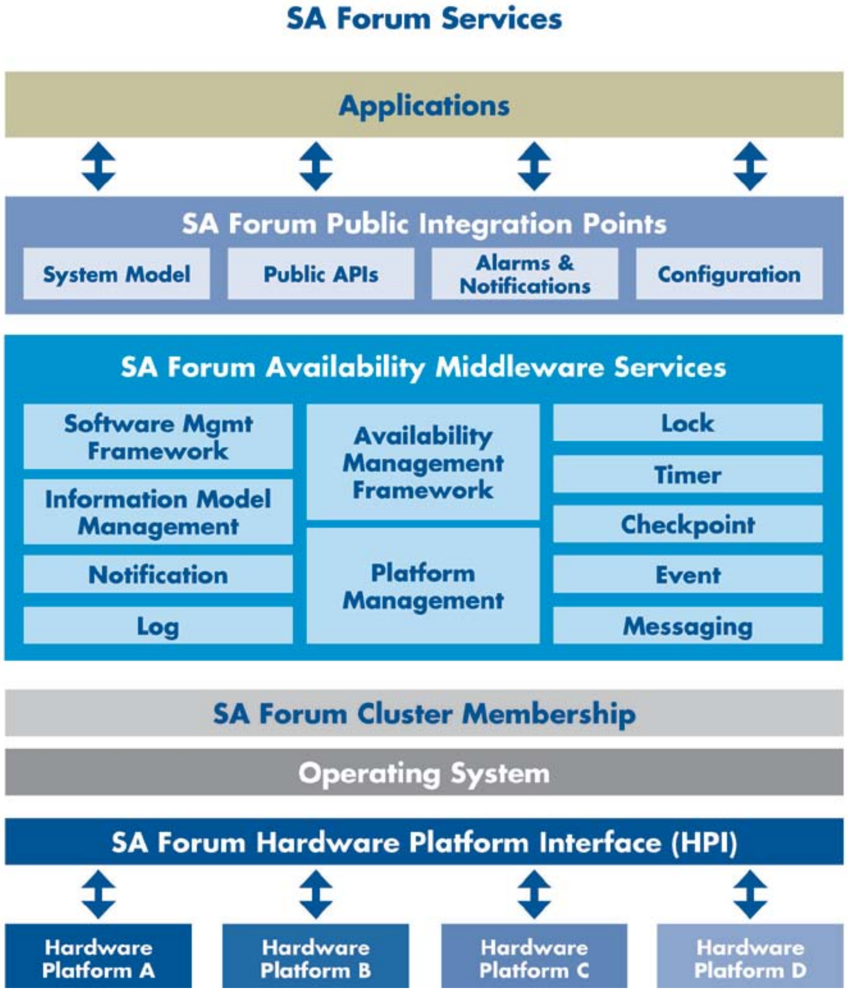
- Critical boundary – OA infrastructure and OA-compliant applications
- Applications – modular components that plug into OA reference model
- Common, open features at this boundary include:
  - Vertical integration - Interfaces for components to access infrastructure services
  - Horizontal integration - Interfaces for components to bind to each other
  - External integration – Interface to external world for configuration and administration
  - Modeling – Explains component capabilities and policy driven behaviors
- The better an OA solution enables components to explain their properties, resource needs, and policies:
  - The less such logic needs to be repeated within the applications
  - The more consistent the OA infrastructure can manage those issues

Open Architecture - Infrastructure

- Layered to better partition responsibilities and decouple dependencies
- When open architecture is applied to a specific domain, it is often referred to as an “Objective Architecture”
- In our example here, the layers are:
  - Platform layer – hardware abstraction layer
  - Node layer – operating system abstraction layer
  - Middleware layer – set of services that treat distributed nodes as a logical world of a single system – NOT a physical place or location
    - Includes functions such as: logging, notification, stateful fail-over, fault detection, and…
  - Application integration layer – component integration layer with integration methods
- This OA has a mission critical requirement – which could be inherent in the problem domain (ex: combat system), or based on a mixed system where mission critical needs arise because of system density

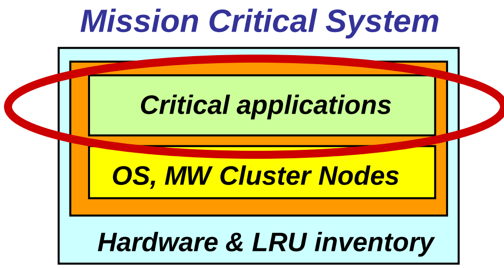
SA Forum Availability Middleware Services

- Public Integration Points
  - System Model
  - Public APIs for each service
  - Formal alarms and notifications
  - Formal configuration access
- Key SA Forum Services
  - Availability Management Framework (AMF)
  - Platform Management (PLM)
  - Cluster Membership (CLM)



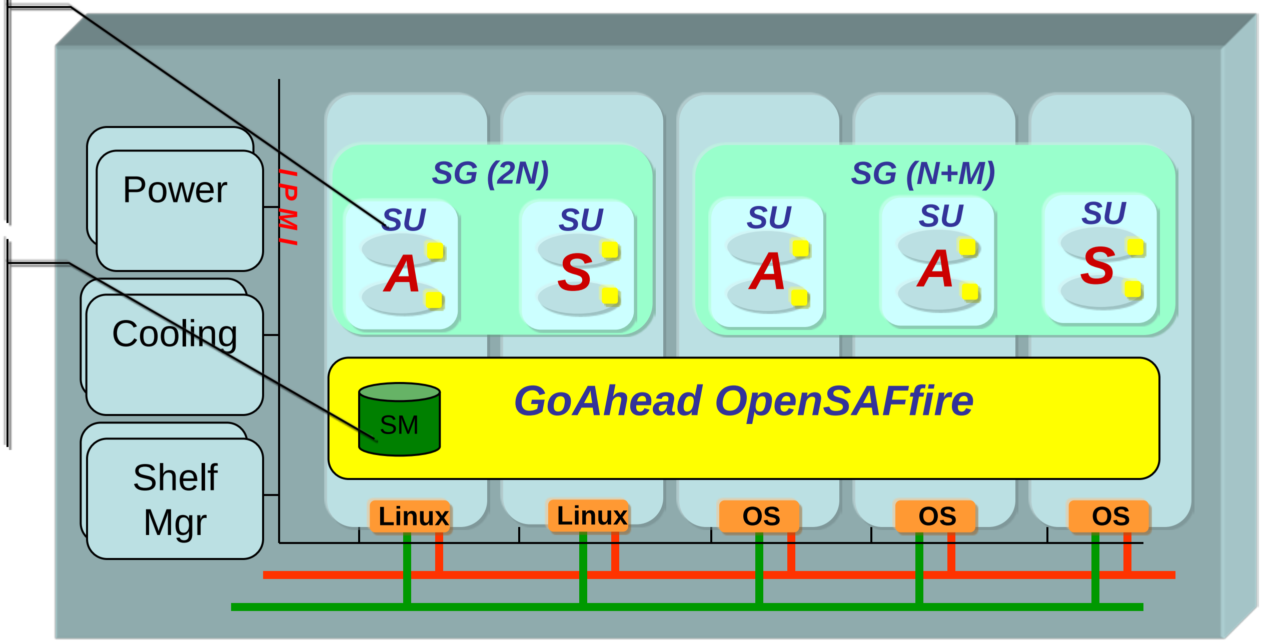
Availability Management Framework

Model the distributed, redundant applications



Mission Critical Apps
Distributed redundant applications configured in Active/Standby relationships

System Model Policies
Deterministic policies drive the AMF Fault Mgmt Policy Engine

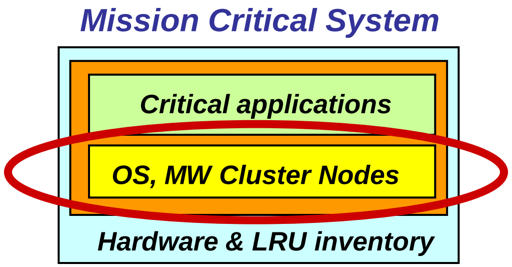


Logical Modeling Entities

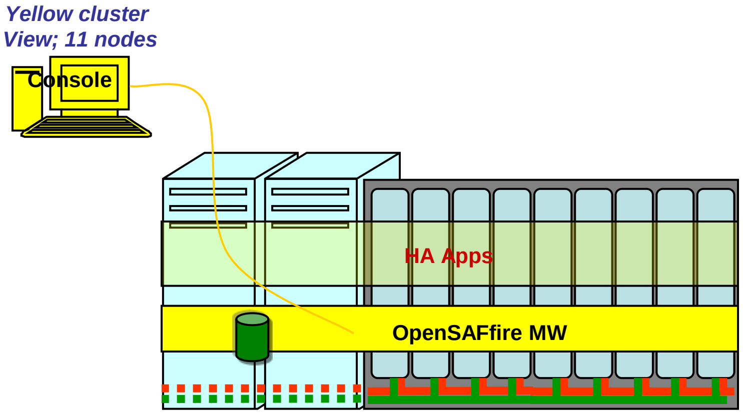
- Service Unit (SU)
- Service Group (SG)

Cluster Membership

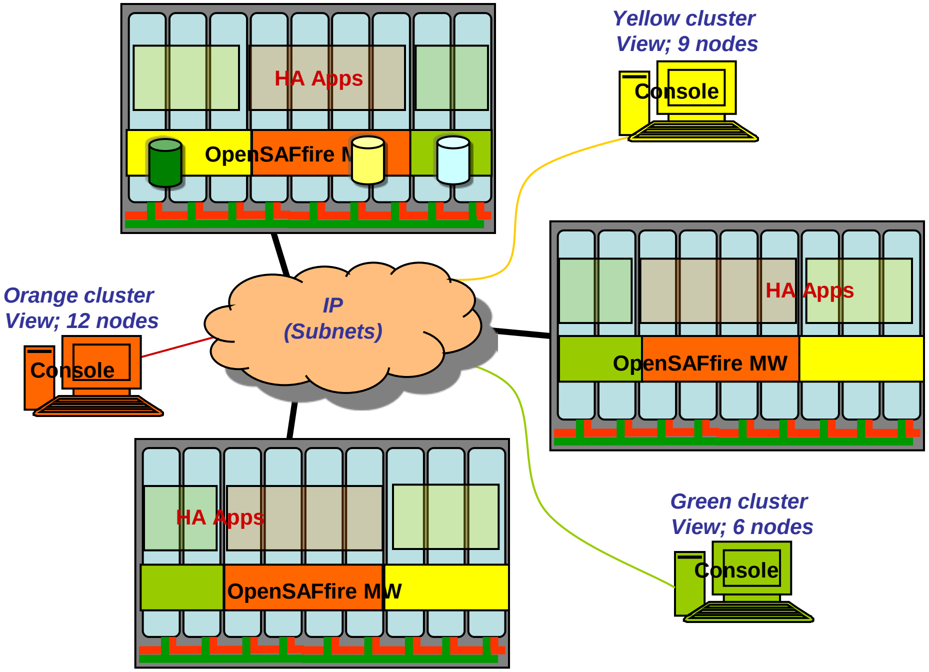
Model the cluster node members & state



A cluster made up of a chassis and other compute nodes



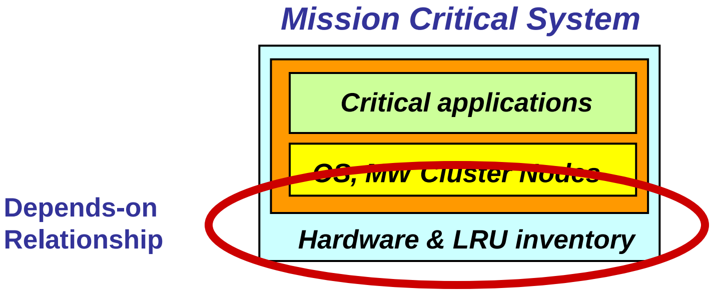
Three clusters partitioned over several chassis



A cluster can consist of the same or heterogeneous devices such as chassis, rack mount servers, etc. as long as each has visibility to each other through (redundant) communications paths

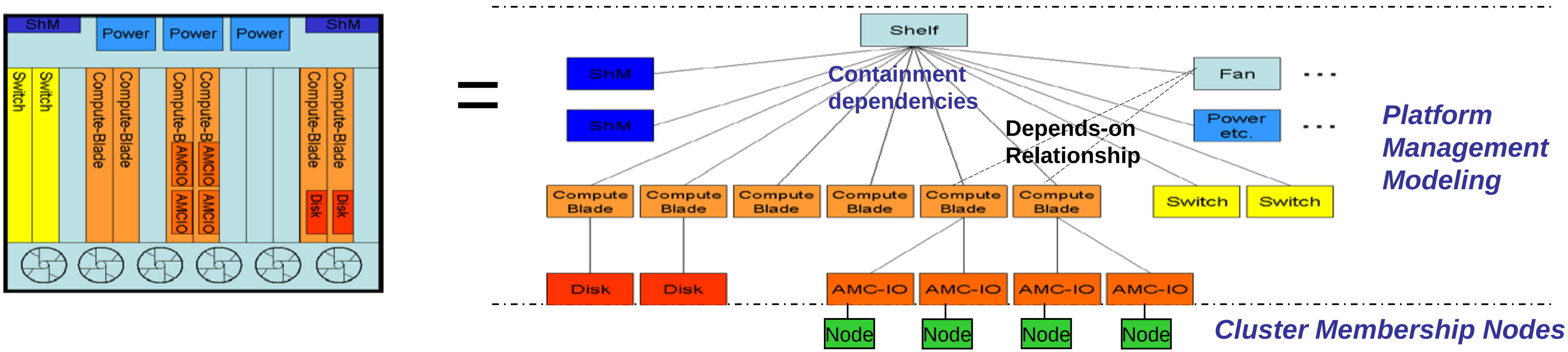
Platform Management

Model the FRU inventory and state



Physical

Logical



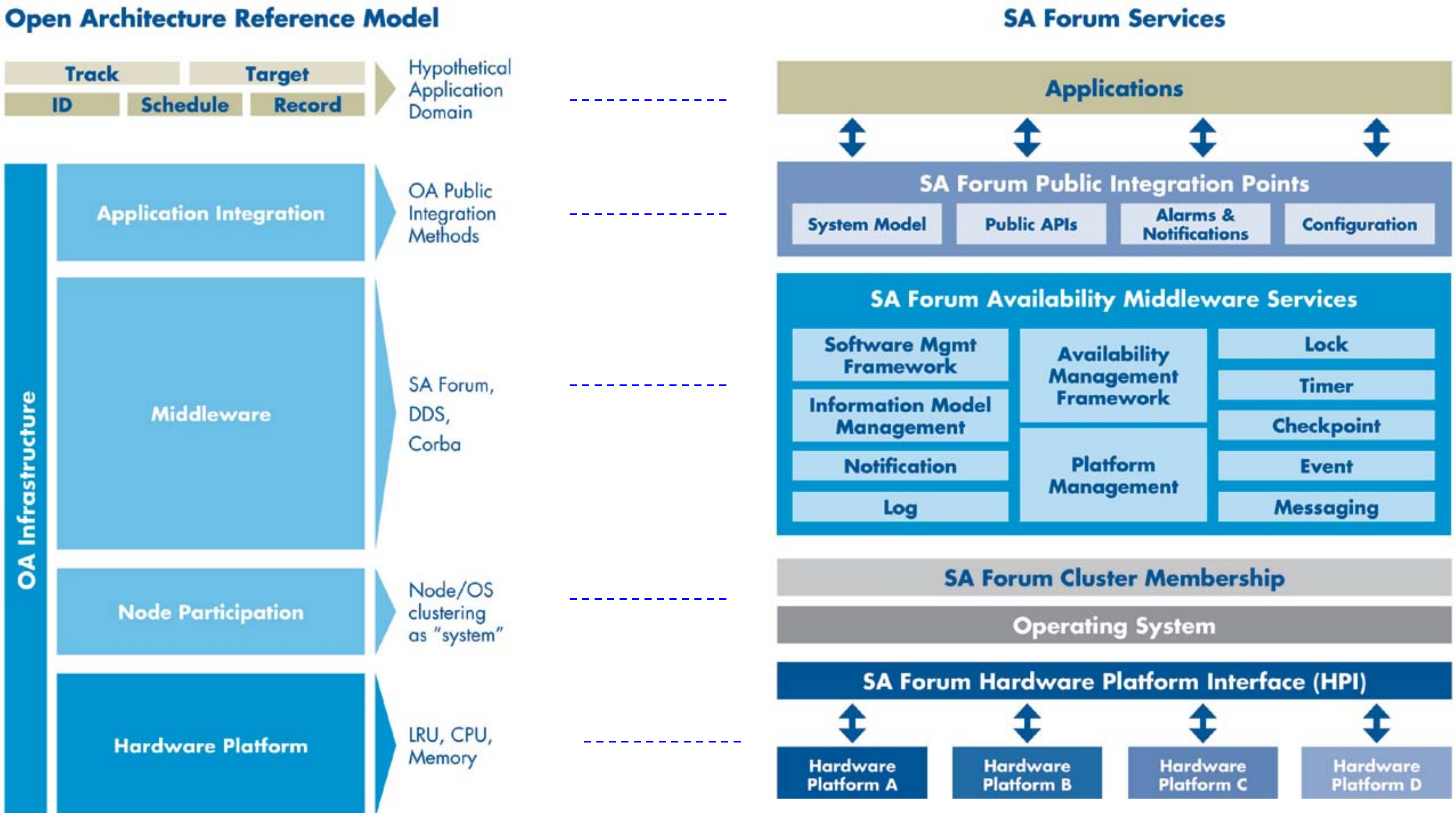
PLM Manages Hardware Resources

- Model HW elements and dependencies
- Automated validation of LRU Inventory
- Hot swap management
- Configurable power and temperature threshold alarms
- Power on, off and reset of HW resources

PLM Manages Execution Environments (Operating System)

- Model execution environments
  - Hosted directly by computer
  - Hosted by hypervisor
- Administrative control of operating system state

Two Models – Conceptual Alignment



Open Architecture Reference Model

Track
Target
ID
Schedule
Record

Hypothetical Application Domain

OA Infrastructure

Application Integration

OA Public Integration Methods

Middleware

SA Forum, DDS, Corba

Node Participation

Node/OS clustering as "system"

Hardware Platform

LRU, CPU, Memory

SA Forum Services

Applications

SA Forum Public Integration Points

System Model
Public APIs
Alarms & Notifications
Configuration

SA Forum Availability Middleware Services

Software Mgmt Framework
Information Model Management
Notification
Log
Availability Management Framework
Platform Management
Lock
Timer
Checkpoint
Event
Messaging

SA Forum Cluster Membership

Operating System

SA Forum Hardware Platform Interface (HPI)

Hardware Platform A
Hardware Platform B
Hardware Platform C
Hardware Platform D

Summary

- SA Forum and objective architecture align well
- Core Principles of open architecture reflected in SA Forum
- SA Forum Standards – the ONLY proven open standard for mission-critical systems
- SA Forum standards can be integrated into new systems or legacy scenarios
- Deployed in programs such as Aegis Weapon System, Littoral Combat Ship, Common Processing System, Deepwater

Thank You

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