Real-Time Diagnostics for High Availability Systems

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Agenda

• Background

• System Management Overview

• Case Study: Insight

• The Benefits of Insight
The Aegis Weapons System

• Aegis is the world’s premier naval surface defense system. It is capable of simultaneous operation defending against air, surface, subsurface and ballistic missile threats.

• There have been 7 major releases, known as baselines, in the nearly 4 decade history of Aegis.

• Recent baselines have focused on re-engineering the weapons system to take advantage of commercially available off-the-shelf (COTS) operating environments (OE).
A Migration to Open Architecture

Proprietary Systems

Manufactured hardware and developed software

Open Technology

Emphasis on COTS hardware and software integration

Computing System Management functions have become more complex with the adoption of COTS technology
Open Technology

- An Aegis ship not much different from a large-scale commercial data center.

- The weapons system is comprised of a standard operating environment with unique components not seen in commercial architectures.
System Management Overview
Application Management

- Manage where applications are running
- Manage runtime state of the applications
- Manage recovery and reconfiguration
- Assess health status of the applications

Equipment Management

- Node/Server Management
  - Diagnostics
  - Performance Monitoring
- Network Management
- Asset Management
  - Validation and Verification
  - Software Distribution

Fault Detection / Fault Isolation
Root Cause Analysis
Aegis System Management

• In the current baselines, System Management for the Aegis Weapons System is comprised of multiple components.

• Each component exists as a standalone entity.

• Together, they interoperate to provide an end-to-end solution for Operational Readiness Assessment of the combat system.

Insight is a key component for managing the operating environment of the Aegis Weapons System
Case Study: Insight
What is Insight?

• An integrated computing system management toolkit.

• It is a highly configurable suite of open source, commercially available, and developed tools that perform system management functions across the enterprise.
  – Hardware and software diagnostics
  – Performance monitoring
  – Network management
  – System control
  – Validation and verification
The Catalyst For Insight

1969
Aegis begins. Baselines 1 through 5 are deployed with a proprietary operating environment.

1994
Baseline 6 signals the emergence of COTS processors to augment the legacy computer suite.

1999
Baseline 7 signals the emergence of an all-COTS computer suite.

2000
Deployment of Baseline 6 is plagued by schedule delays. Ad-hoc tools with weak fault detection and inefficient fault isolation.

2001
CSC produced a White Paper to address the need for a well defined system management strategy on the COTS baselines. Design and development of Insight begins.

2002
Initial version of Insight deployed to local data centers.

2003 - Current
Insight is deployed to Baseline 7 for use in shipyard integration activities and shipboard Operational Readiness Assessment.

1970 - 1990
1995
2000
2001
2002
2003
2005
Insight Component Architecture

- **Framework**
  - Graphical User Interface, Network Services, and Remote Agents

- **Tools**
  - Configurable collection of “best-of-breed” products and utilities to perform system management functions

- **Configuration Data**
  - Easily tailors Insight to the needs of the open architecture enterprise being managed

- **Baseline Data**
  - Repository of expected OE configuration state information
Extensive Use Of Open Source Technology

• Over 40% of Insight is comprised of Open Source software
  – Permits selection of cost effective, best-of-breed solutions
  – Reduces development time
  – Leverages intellectual resources from the worldwide development community

Capitalizing on Open Source saved approximately $1M in development costs
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Insight’s Toolkit
Insight Functionality

- On-demand Testing
- Runtime Monitoring
- Interactive Control
Consistent Interface for Disparate Tools

- Standardizes test execution
- Hides tool variability from the user
- Provides common results

Insight standardizes the execution and results of each tool, regardless of platform or tool origin
Hardware and Software Diagnostics

• Fault Detection / Fault Isolation (FD/FI)

• Assess the operational state of hardware and software components
  – NTDS Devices
  – I/O Boards
  – Specialized Processors
  – Tactical Interfaces
  – Middleware Components
Increased Productivity

The availability of Insight has increased the productivity rate to over 90% by providing rapid identification of operating environment issues.

Rapid Resolution = Increased Productivity = Significant Savings
Performance Monitoring

• Assess infrastructure performance under operational conditions
  – CPU utilization
  – Memory utilization
  – Process activities
  – Disk usage
  – I/O activity
  – Kernel-level trace

• Data is represented in real-time as well as archived for statistical representation
Insight assesses operational readiness of combat system components from a single console
Validation and Verification

• System Operability Test

• Checks a number of Operating Environment configuration parameters to determine overall system operability
  – Configured Devices
  – Filesystem Integrity
  – Kernel Tunables
  – Network Tunables
  – Installed Packages
  – OS Version and Patches
  – Firmware

• Ensures that the current state of a host’s OE is consistent with established baseline data
Automated Validation of the Operating Environment

Insight ensures that the deployed configuration is identical to the staged environment.

Integration and Test Facility

Deployed System
Automated System Validation: Months to Minutes

There are over 6000 configuration parameters on each node that are optimized for the application.

Manual validation of the configuration for the entire computer suite would take nearly 4 staff months.

Insight provides accurate validation for the entire computer suite within 3 minutes.

Automated validation provides complete confidence in the deployed configuration and saves significant taxpayer dollars.
Network Management

• Assess health status and performance of the local area network
  – LAN operability
  – Routes
  – Network utilization

System Control

• Manage the run-time state of the tactical applications
  – System Initialization
  – Shutdown
  – Reboot
Run-time state of the system can be monitored and controlled from a single console.
Concept of Operations

- Insight is used throughout the life-cycle of the combat system.

Development Data Center
- Validation of the build environment

Staging and Test Facility
- System validation, diagnostics, operability tests

Shipyard Integration
- Runtime status monitoring, operability tests, diagnostics

Deployed Systems

Insight has become standard operating procedure for Aegis
Safety Checks

Insight’s safety agent prevents intrusive functions during tactical operations.
The Benefits of Insight
A Vital Maintenance Solution for the Aegis Weapons System

Proprietary systems had an available toolset.

Insight provides a robust toolset for COTS systems.
Applying Insight to Support Various Activities

- **Life Cycle Support**
  - Fleet maintenance operations

- **Shipyards**
  - Integration activities

- **Development**
  - Engineering activities

- **Training Center**
  - Aegis curriculum for sailors

- **Sailors**
  - Shipboard system management

**Insight is a key component for Aegis System Management**
Enhanced Operational Readiness

Dispatching engineers to troubleshoot shipboard issues: $75K

Delaying a missile test due to system instability: $1M

Meeting deployment schedules and increasing credibility with your customer: Priceless

Insight is playing a vital role ensuring that ships are deployed on schedule for immediate use in various theatres of operation
“Innovation: Delivered”

- Deployed for 3 ½ years
- Multiple Baselines
- Domestic and Foreign Test Sites
- Domestic and Foreign War Ships
- Certified for Tactical Operations
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