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Systems Management of the SAS® 9.2 Enterprise Business Intelligence Environment

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ABSTRACT

The evolution of the SAS 9.2 architecture provides a powerful, distributed, and flexible environment for real-time, responsive analytic and reporting capabilities. This paper describes how information technology (IT) and SAS administrators can use vendor and open source enterprise systems management products to ascertain the state or status of the SAS 9.2 Enterprise Business Intelligence environment, as well as generate alerts for user-specified conditions. The management products reviewed include IBM Tivoli Enterprise Console, HP Software OpenView, open source products Xymon and Hyperic, and the SAS 9.2 Audit and Performance Measurement package.

INTRODUCTION

Systems management of the SAS 9.2 Enterprise Business Intelligence environment can be broadly divided into two unique functional areas or disciplines. The first area is systems management for the physical hardware and software environment, along with monitoring the real-time status of the SAS 9.2 deployment. The audience for this area is typically an IT team, which has the responsibility to ensure that the computing environment is operational and available for servicing the business operations. The second area is monitoring the internal usage and performance of the SAS Enterprise Business Intelligence computing architecture, including activities such as user workloads, responsiveness of the environment, tracking of server usage, and user audit-related activities.

The information presented in this paper describes the features and facilities that are available for the IT professional, SAS administrator, or executive who is responsible for the administration and operational management of the environment.

OVERVIEW: OPERATIONAL MANAGEMENT CONSIDERATIONS

The considerations for managing the environment are dependent on the functional roles and responsibilities within an organization. SAS administrators, IT personnel, and executives often have a common set of questions related to the theme of monitoring and management. The following questions characterize the information that is required for monitoring and managing the environment:

- What is the operational state of the physical hardware, nodes, and network?
- What is the state of the software services that are executing in the environment?
- How can I ascertain the performance and load on the computing infrastructure?
- If a failure occurs, how quickly can an alert action be generated to respond to the event?
- If a failure occurs within the environment, how does that impact business operations?
- How many users are actively using the computing environment?
- Which SAS products, procedures, or data libraries are being used within the environment?
- Which SAS servers are consuming the most computing resources?
- How can I measure current workloads and predict future capacity requirements?
- Which users are logging into the environment and what services are they using?
- What authorization, access control and administration changes are occurring?
- Are there any attempts to access the environment without proper authentication or authorization?

These questions and the corresponding answers are integral to successfully managing the environment. The specific tools or services that a site employs are dependent on a number of organizational and operational considerations. This paper reviews several options that are available to a SAS 9.2 customer for monitoring and managing the environment. SAS has worked closely with our hardware and software partners to deliver integration management packages that are suitable for larger enterprise deployments, as well as monitoring and management solutions that exploit open source technology for sites that do not require a broad enterprise-wide management solution.

OVERVIEW: SAS 9 ENTERPRISE BUSINESS INTELLIGENCE ARCHITECTURE

The SAS 9 Enterprise Business Intelligence framework is depicted in Figure 1. The key elements of the framework that are important to highlight include:

- Multiple integrated tiers within the framework, including:
  - o The SAS server tier, which is comprised of various analytic servers
  - o The SAS Web tier, which includes SAS Web-based applications to present SAS analytics
  - o The SAS client tier, which includes a diverse set of desktop clients and Web browser applications that exploit services of the analytic server and Web tiers
- SAS Metadata Server, the hub of the deployment architecture, which includes:
  - o Mapping for logical and physical computing services
  - o Mapping of logical and physical SAS libraries and data sets
  - o User ID authentication and authorization controls
  - o Web tier and client tier context information for user-customized presentation services
- Distributed heterogeneous computing framework, which might include:
  - o Server tier analytic applications deployed across multiple physical or logical server environments, as well as on different processor architectures
  - o Web tier applications deployed within multiple industry-standard Web application servers
  - o Client tier applications hosted on a diverse collection of hardware and software environments
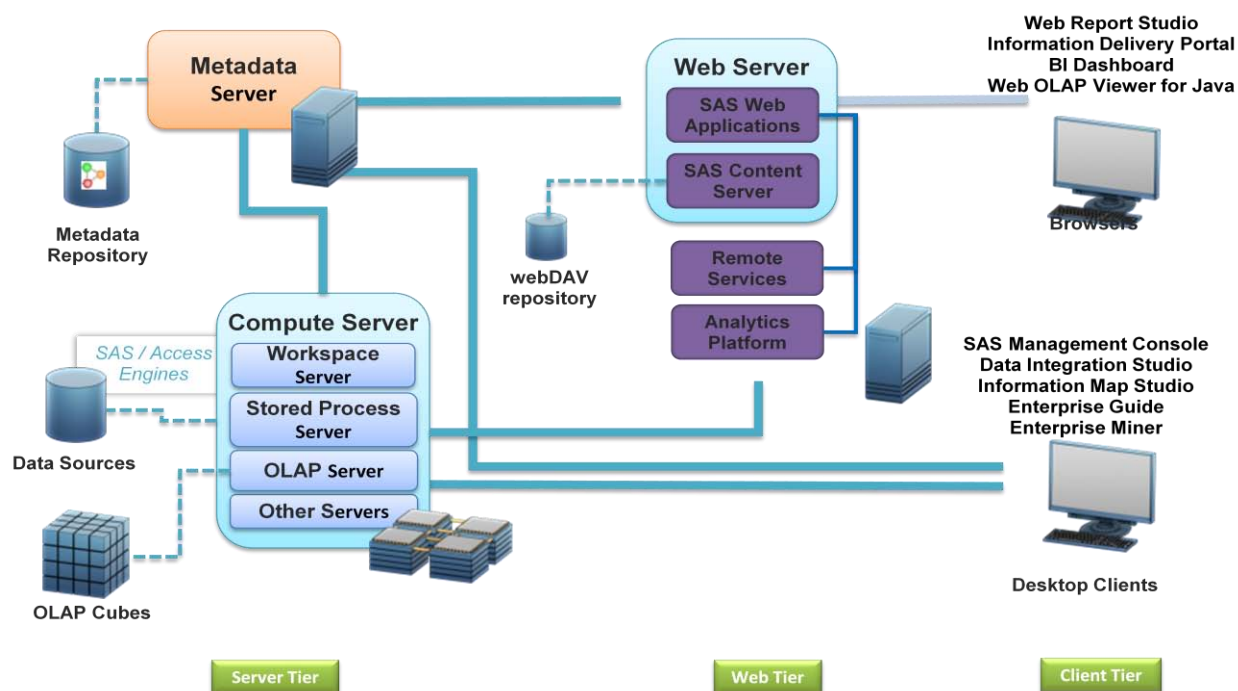
Figure 1: SAS 9 Enterprise Business Intelligence Deployment Diagram

ENTERPRISE SYSTEMS MANAGEMENT INTEGRATION

INTRODUCTION AND OVERVIEW

Enterprise systems management products share a number of common characteristics and behaviors. However, the underlying implementation and configuration of vendor and open source products differ significantly. The Enterprise Management Integration (EMI) team in the Platform Research and Development division at SAS is chartered with implementing packages that help SAS customers manage the SAS 9 Enterprise Business Intelligence environment using the features that each of the management products provide. Generally, each of the vendor products shares the following common behaviors and features:

- A centralized management console or Web interface that displays status and alerts for managed systems

- Server(s) that collect and centralize statistics and data from managed nodes
- Deployed agents or remote execution services, on managed nodes, to collect statistics and data
- Host and/or operating system features that collect fundamental metrics for managed nodes. Examples include:
  - Hardware state, network connectivity, and configuration
  - CPU utilization, memory usage, and disk utilization metric monitors
  - Methods to monitor processes or services associated with operating system functions
  - Alert event methods to emit alerts for metrics and parameters for failed conditions
  - Extensions scripts or facilities to augment the features provided as part of the base product

Given the common and unique characteristics for the vendor products, the EMI team focuses on implementing management packages that allow SAS customers to manage the SAS 9 Enterprise Business Intelligence environment using features that fit naturally into the vendor product's environment. This allows a site to leverage its investment in an enterprise management package and extend the features of the package to manage a SAS 9 deployment. Additionally, where possible, the EMI team adds functionality to further optimize the monitoring and management of the SAS 9 environment within the vendor's monitoring framework.

The following sections describe the key features of the implementation packages that SAS has developed in cooperation with our partners. These packages are made available to our customers from our Research and Development teams at SAS World Headquarters in Cary, NC, USA, and are provided with no licensing fees or restrictions.

IBM TIVOLI INTEGRATION

The IBM Tivoli suite of management solutions provides a number of products to monitor and manage enterprise-wide computing resources. The EMI team worked closely with the IBM Tivoli development team to implement two monitoring packages for sites that depend on IBM for their monitoring and management solutions. The packages that we developed have been validated by the IBM Tivoli teams, and the packages have been registered in IBM's Open Process Automation Library (OPAL).

SAS 9.2 WITH IBM TIVOLI ENTERPRISE MONITORING SERVER 6.2

The SAS 9.2 integration package uses IBM Tivoli Enterprise Monitoring Server 6.2 (TEMS) and IBM Tivoli Enterprise Portal Server 6.2 (TEPS). The package includes monitoring and management of SAS 9.2 deployments for UNIX environments.

SAS uses a number of default TEMS and TEPS features to monitor the state of SAS applications, and the IBM Tivoli Universal Agent is used to monitor SAS server processes and log files. SAS includes in the integration package a custom set of metadata definition (.mdl) files and helper scripts to monitor the SAS 9.2 deployment. The integration document also describes how to create custom TEP workspaces and situations for the SAS 9.2 environment. The following displays depict the IBM TEP SAS Workspace:

SAS 9.2 Tivoli workspace integrated into the IBM TEP framework

SAS 9.2 server state, using a Java utility supplied by SAS and integrated into the TEMS framework

SAS 9.2 server status monitoring, demonstrating a "critical situation" within the TEMS framework

SAS® 9.1.3 WITH IBM TIVOLI ENTERPRISE MONITORING 5.1.2 AND TIVOLI ENTERPRISE CONSOLE 3.9

SAS 9.1.3 customers have the ability to monitor and manage their SAS environments using earlier versions of IBM Tivoli Monitoring 5.1.2 and IBM Tivoli Enterprise Console (TEC) 3.9. The IBM TEC environment shares some of the same monitoring features and behaviors as the SAS 9.2 integration package. Additional information about the SAS 9.1.3 integration package can be found in the IBM TEC Integration section of the SAS EMI Web site.

The following display demonstrates the IBM TEC package with highlights for monitoring SAS Metadata Server log files (1 and 2), SAS connection client events (3), status alerts for server state (4), and messages that can be safely ignored within a server context (5).

SAS 9.1.3 server status monitoring within the IBM TEC 3.9 framework

HP OPENVIEW OPERATIONS MANAGER INTEGRATION

HP OpenView Operations Manager provides an extended suite of management facilities to enable consolidated monitoring and management of the computing infrastructure. OpenView includes support to monitor distributed servers, applications, services, and related processing on UNIX and Windows environments. OpenView includes a centralized console for monitoring and management and centralized methods to distribute agents throughout the enterprise. In addition to a centralized management console, OpenView includes a rich set of monitoring features such as:

- UNIX and Windows operator commands to remotely manage a distributed system
- UNIX and Windows process or service monitors for state, event, and log events
- Extensive features for alert events to include alert event state, continuation, and termination
- Java Web application administration, configuration, and alert event features
- Smart Plug-In (SPI) feature to create a customized suite of management tools

The SAS integration component with HP OpenView integration is delivered using the SPI technology and is delivered in a Windows install package for an HP OpenView Operations (OVO) Windows console environment.

The SAS SPI package includes the following features to monitor the SAS 9.2 server tier and Web tier environment and processes:

- SAS scripts and HP OVO tools for both UNIX and Windows environments
- Administration features to auto-deploy and configure the SAS SPI
- Administration features to monitor key SAS servers and services, including remote methods to start, stop, pause, and continue server execution
- Facilities to monitor the state of SAS servers, monitor logs for key events, and report those events into the HP OVO operator's console framework
- HP OVO "service map" that depicts the logical and physical SAS 9 Enterprise Business Intelligence environment. The following display shows the SAS 9.2 SPI service tree and service map:

HP OVO console with a "tree node" and "service map" view of the environment

HP OVO includes dependency maps for services and processes, such that the failing processes and services will automatically report as failures in subordinate or superordinate events. The SAS 9 Metadata Server is the central hub of the SAS 9 Enterprise Business Intelligence architecture. Therefore, if the metadata server fails, all dependent processes are similarly reported as down in the "service map" view.
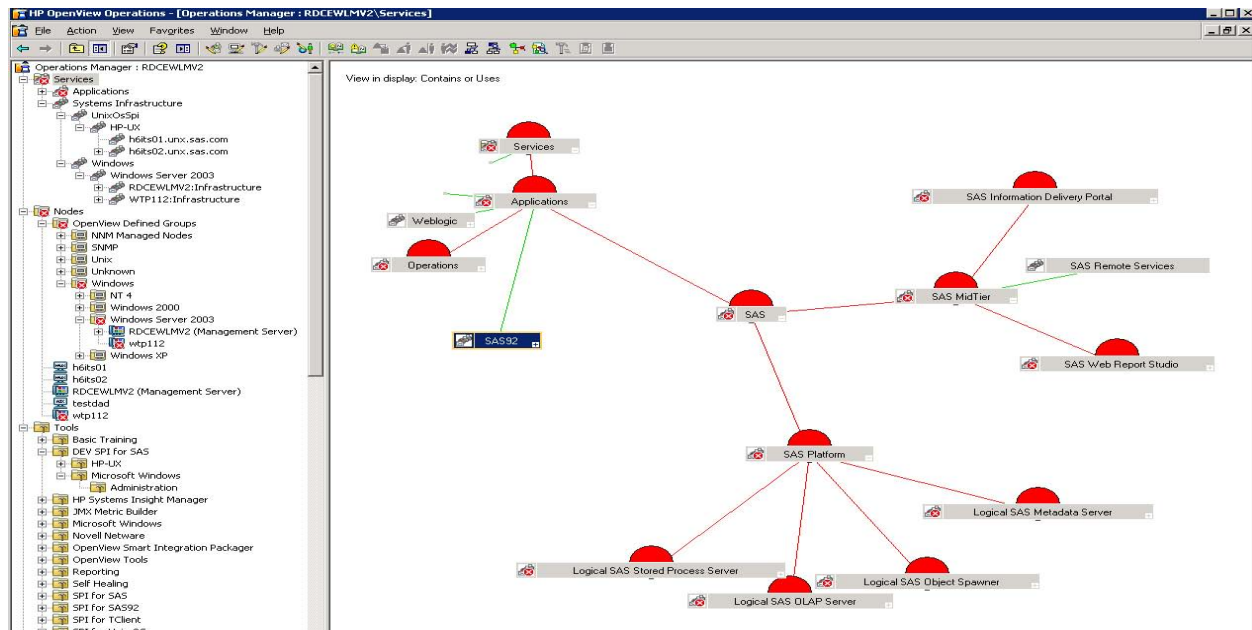

SAS 9 Metadata Server failure, with the HP OVO "service map" failing all dependent services

HP OVO also provides methods for classifying the severity of messages and surfacing alerts to the service map based on severity. For example, a message that is classified as "critical" can be evaluated by an operator, acknowledged, and the priority adjusted as necessary. Changes are automatically filtered to the "tree view" and "service map" views.
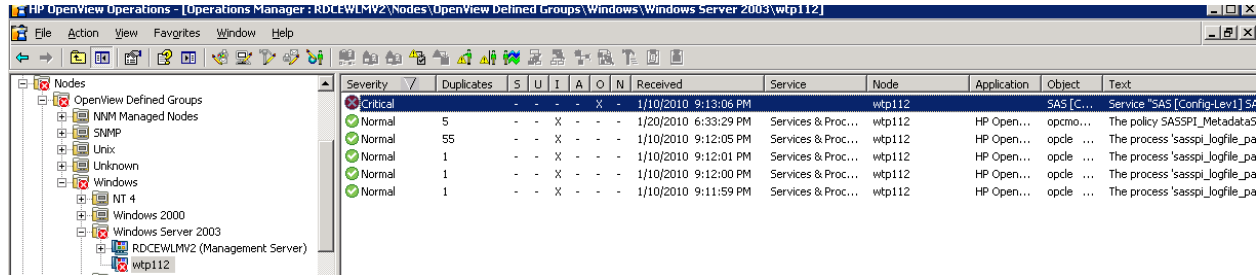
SAS 9 OLAP Server Critical event, depicted in the "tree view"
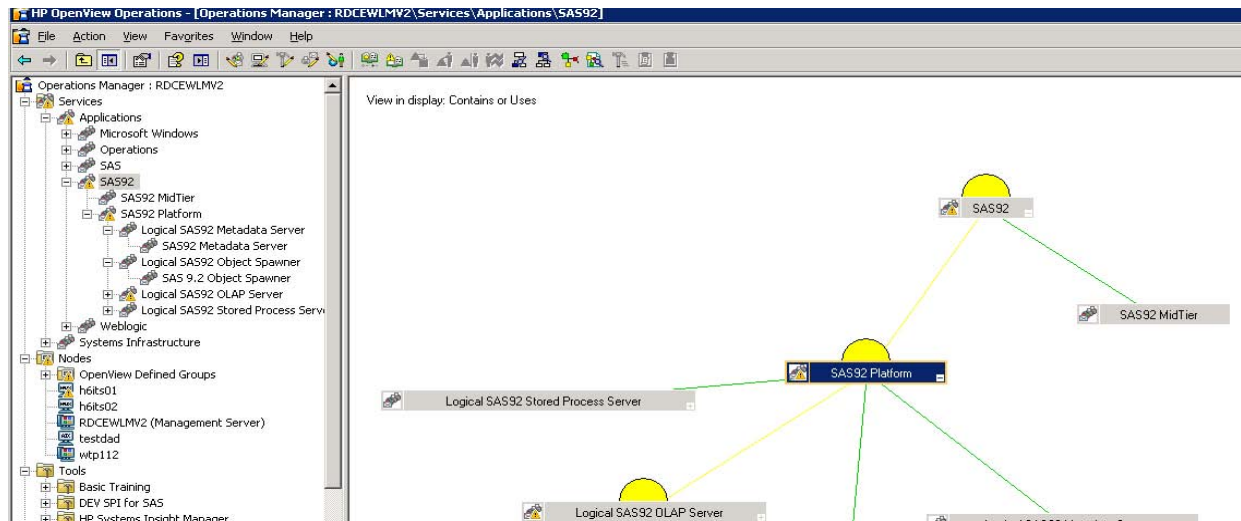
SAS 9 OLAP Server Critical event, reclassified as a Minor event

HP OVO features include the ability to administer, monitor, and configure industry leading Java Web application servers. The implementation is seamlessly integrated into the HP OVO operator's console, with the ability to respond to alerts and events on distributed nodes directly from the console.
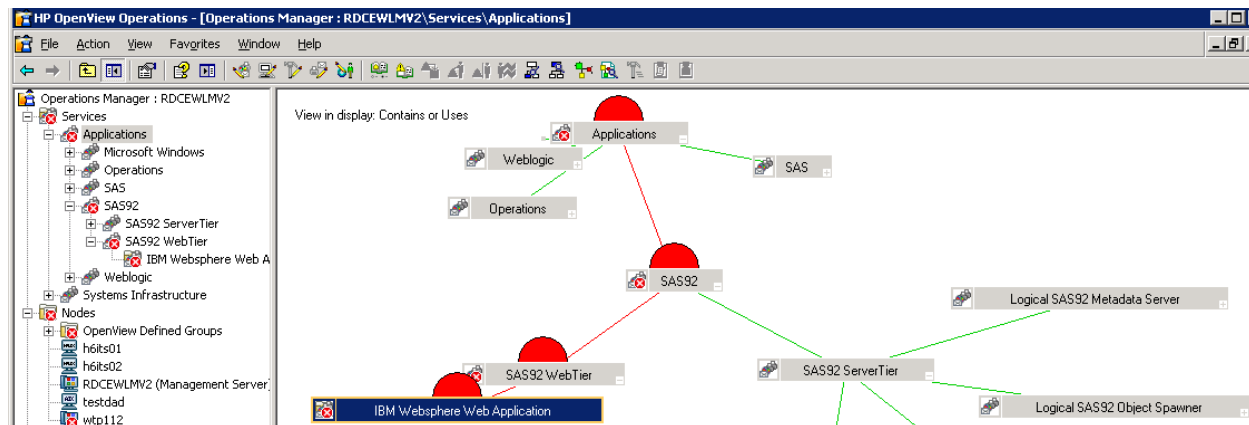
HP OVO "service map" and "tree view" of a Critical event for a SAS 9 Web tier service

The integration package for SAS 9 Enterprise Business Intelligence monitoring for the HP OVO environment provides a significant benefit to sites that have invested in HP Software systems management products. Customers have the ability to implement default monitoring for SAS 9 services and can customize the features to meet unique site monitoring and management requirements.

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XYMON OPEN SOURCE MONITOR

The Xymon Monitor, formerly Hobbit Monitor, is a host and network monitoring package that is widely used by sites that have the flexibility to choose an open source product. Xymon is distributed under GNU General Public License (GPL) agreements. The Xymon Monitor features a Web-based server console to depict status and metrics for the monitored systems, along with drill-down capability to view detailed reports and history. The Xymon server executes in UNIX environments, and client agents are available for both UNIX and Windows operating systems.

Xymon inherits many of the features of more sophisticated enterprise management products and offers efficiencies such as a very low-overhead implementation cost, simplicity in configuration, and a robust set of extensions for custom monitoring requirements.

The SAS 9 integration package consists of detailed documentation and scripts to enable monitoring for the SAS 9 Enterprise Business Intelligence environment. The monitored features for the Xymon environment include:

- Host and operating system monitoring for CPU, memory, and disk utilization
- Status of the SAS 9 Enterprise Business Intelligence servers and SAS Web applications
- Status of SAS processes, TCP/IP ports, and log files
- Event reporting facilities to include e-mail, Short Messaging Service (SMS), or customized messaging
- Custom alert levels for monitored metrics, tailored for a specific host or metric
- UNIX oriented scripting to create custom extensions

The following displays demonstrate the Web-based interfaces provided by Xymon. Descriptions of the depicted features are provided. In this scenario, the Xymon Monitor has detected that an event or multiple events exist for the managed systems. Selecting the specific server group icon will drill into a detailed page for the hosts associated with the grouping. Detailed graphs are also available for the monitored conditions, and an archive history is retained in an included RRD database.
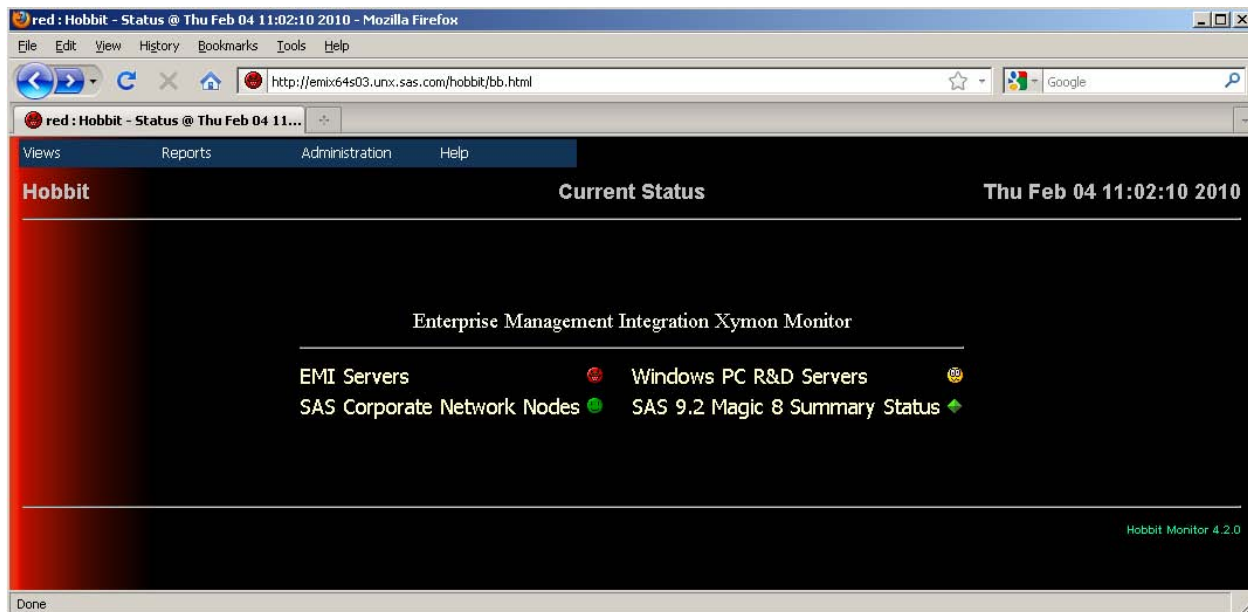
Xymon top-level page, with hosts organized by functional areas and a RED background to indicate an active alert

Xymon group detail page showing disk, ports, and procs metrics in alert states

SAS 9.2 Enterprise Business Intelligence on the UNIX host "testdad," showing TCP/IP port status for the SAS servers
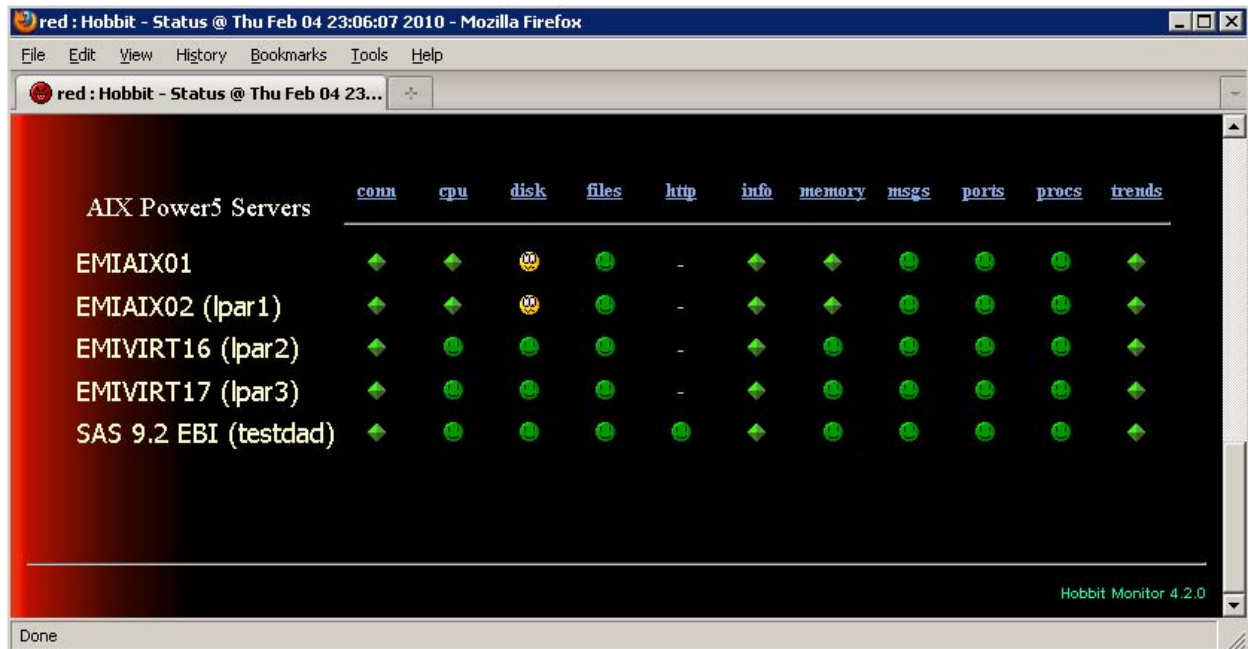
Xymon reporting the disk space issue partially corrected and the SAS OLAP Server restarted

The EMI team Web site contains details about the Xymon integration package along with documentation and .sas programs to facilitate implementation.

HYPERIC HQ ENTERPRISE MONITOR (SPRING SOURCE, VMWARE)

Hyperic HQ consists of two levels of monitoring solutions. Hyperic HQ Open Source is distributed without usage fees and is licensed under the GNU GPL v2 licensing model. Hyperic also offers the Hyperic HQ Enterprise monitor for large-scale environments in which more sophisticated monitoring and capacity planning features are required. Both versions share some of the same features and characteristics, including:

- Web-based interface designed to manage Web applications, network resources, and applications
- Auto-discovery for a wide range of software applications, virtual and physical topology
- Performance metrics for operating system resources and applications and trend graphs
- Alert and event features to help manage system failures or resource constraints

In addition to the default features, Hyperic HQ also includes customized methods to add user-defined resources for unique site management and monitoring requirements.

The SAS 9.2 Hyperic HQ integration package consists of a suite of scripts, resource definitions, and documentation to enable Hyperic monitoring for SAS 9.2 Enterprise Business Intelligence deployments. The monitoring features that are enabled for SAS 9.2 environments include:

- A Hyperic HQ resource definition template for SAS 9.2 Enterprise Business Intelligence environments
- UNIX and Windows resource definitions for SAS processes, services, and Web applications
- Status, state, and event reporting for SAS servers and Web applications
- Resource metrics monitoring and events for CPU, memory, and disk usage of SAS resources
- Installation, configuration, and integration documentation

The following displays demonstrate the Hyperic HQ Dashboard and the monitoring features available with the SAS 9.2 Hyperic integration package.
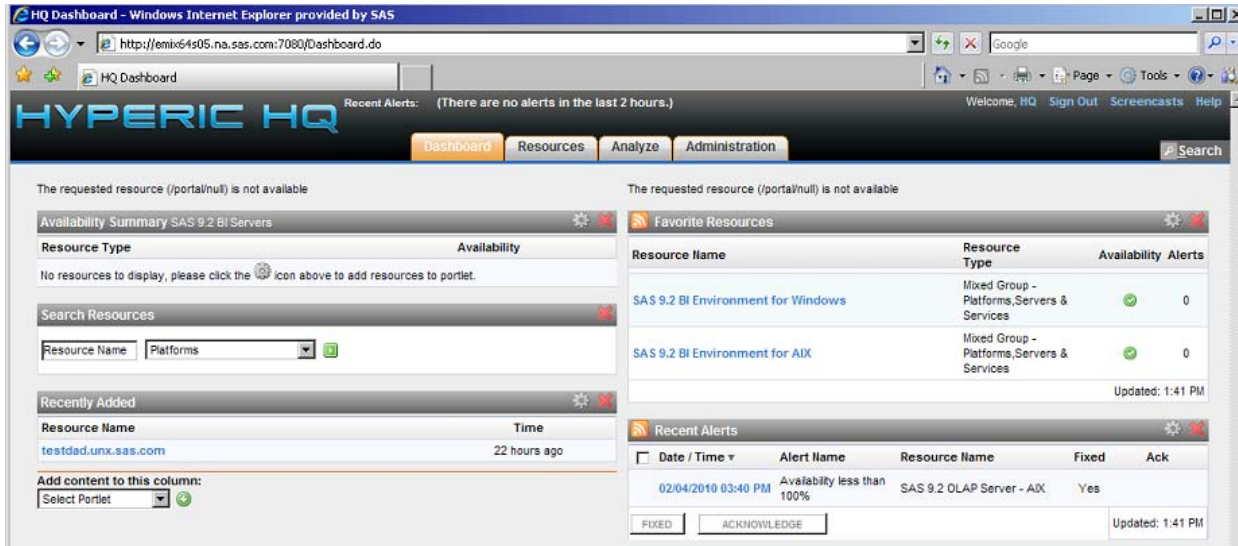
Hyperic HQ Dashboard monitoring a SAS 9.2 Enterprise Business Intelligence deployment on Windows and UNIX

Resource availability events or alerts can be classified according to severity and are percolated into the dashboard based on the resource group definitions. A failure or event will be reported under the appropriate resource group. When the group is selected, a detailed view of the affected resources is presented. Alerts can also be directed to external collectors such as e-mail or distribution lists.
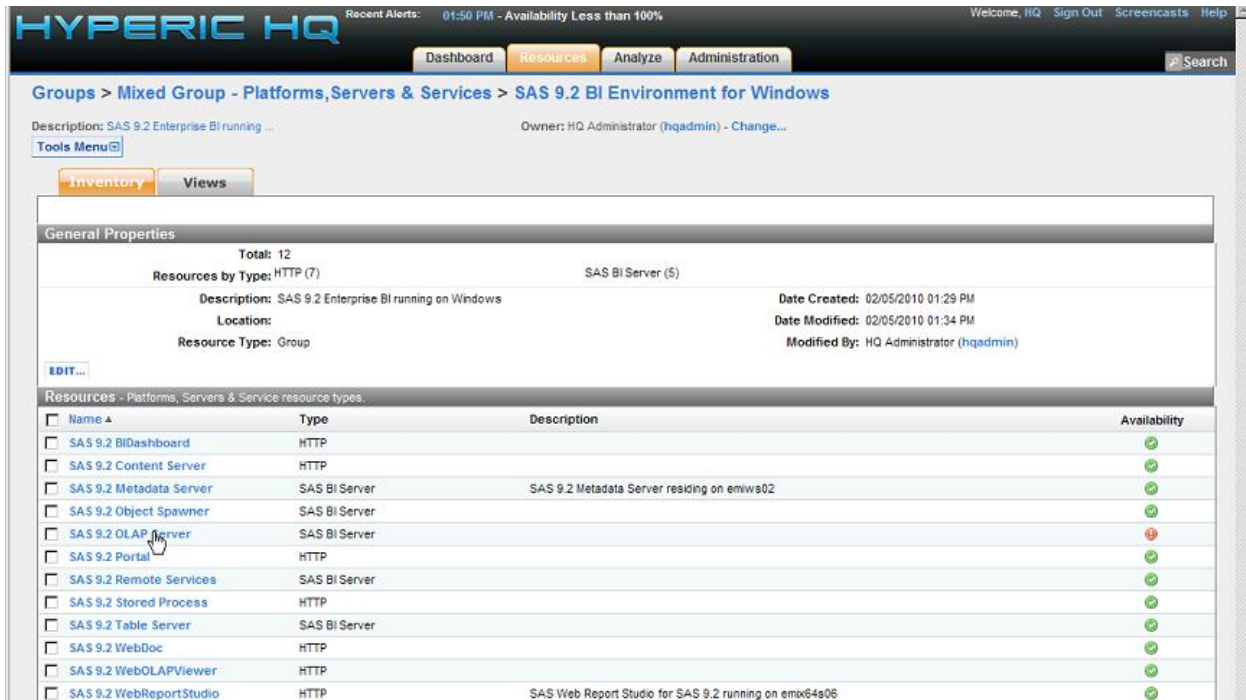

Hyperic HQ resource group on Windows, with a SAS OLAP Server failure
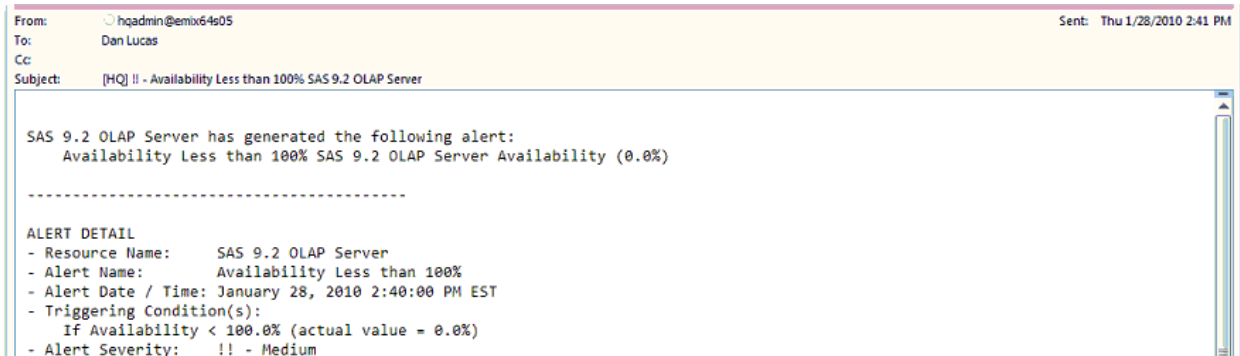
Hyperic HQ e-mail alert event for the SAS 9.2 OLAP Server failure

Hyperic HQ offers the ability to track common metrics associated with defined resources. Alerts values and levels can be configured for the monitored metrics. Hyperic HQ includes a wide range of metrics for monitoring the performance of Web applications executing within a Web application server.
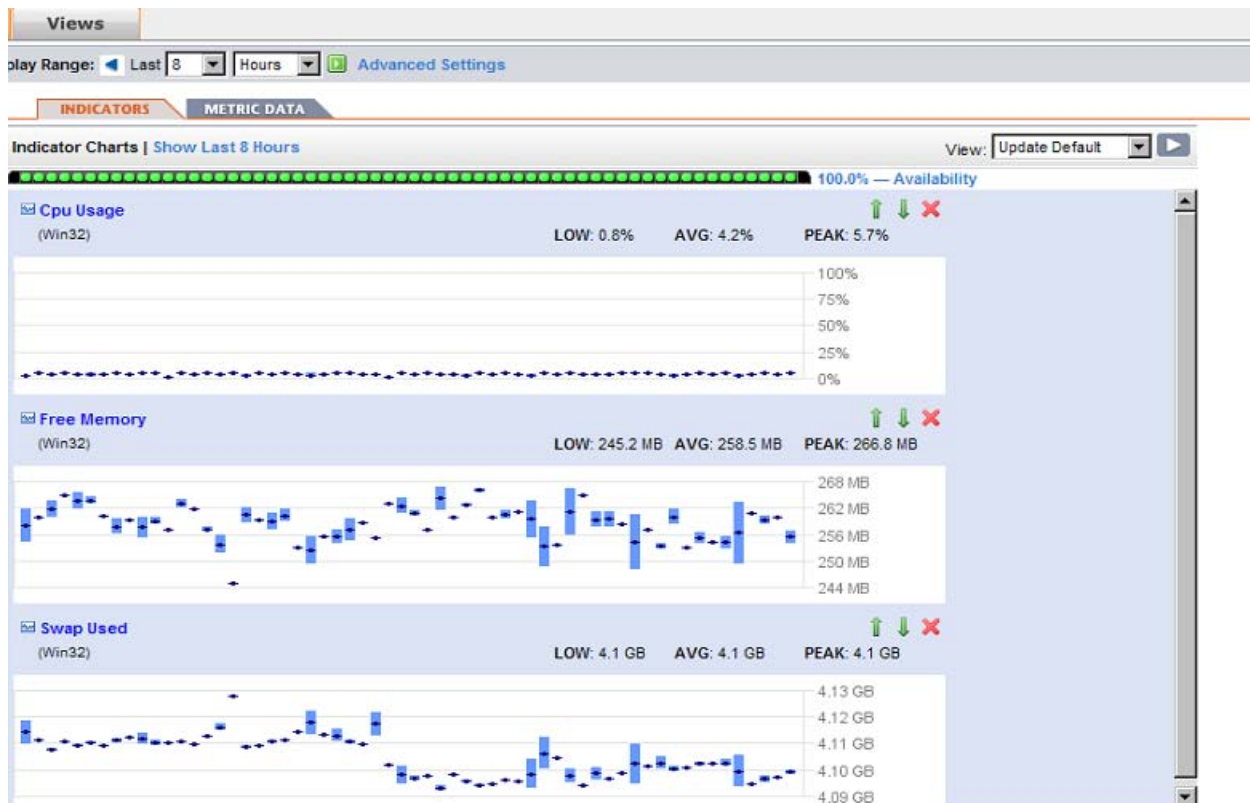
Hyperic HQ process metrics and graphs for a Windows service

The combination of Hyperic HQ features and the SAS 9.2 Enterprise Business Intelligence integration components allow sites to quickly and easily customize Web-based dashboards for their SAS 9 deployments. Additionally, Hyperic HQ offers a wide range of templates for monitoring distributed, heterogeneous hosts and applications from a consolidated Java Web-based dashboard.

SAS 9.2 AUDIT AND PERFORMANCE PACKAGE

The SAS 9.2 Audit and Performance Measurement (EBIAPM92) instrumentation package is a collection of utilities provided by SAS that customers can download, install, and configure for their organizations. The package is available for UNIX, Windows, and z/OS environments and allows a site to monitor the state of the SAS 9 Enterprise Business

Intelligence architecture, implement audit reports for regulatory compliance, and report on the performance and usability of the SAS 9 analytic server environment. The key features include:

- SAS Enterprise Business Intelligence environment status reports
- Metadata server audit reporting
- SAS Enterprise Business Intelligence analytic server performance usage reports

The following display depicts the operational package as configured on a UNIX HTTP server, demonstrating the key features described previously:
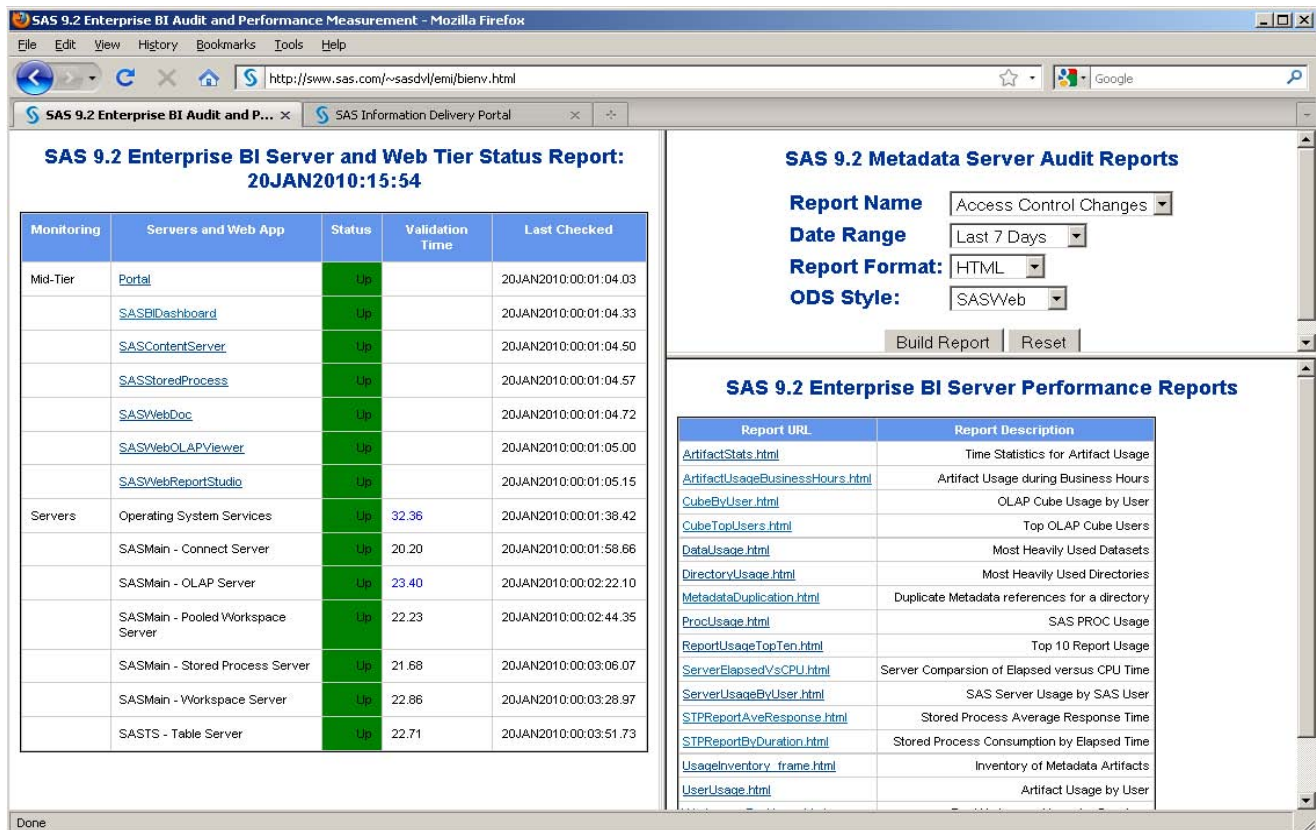
**SAS 9.2 EBIAPM92 SERVER AND WEB TIER STATUS AND ALERTS**

Real-time status for the SAS server and Web tiers are available via the status Web page. In the following example, the SAS OLAP Server and SAS Table Server are unavailable:

The server and Web tier status feature includes the ability to emit e-mail events via the SAS e-mail access method. Interfaces are available to create external alert events to partner systems management packages including IBM Tivoli, HP OpenView, Microsoft Event Viewer, and Xymon Server.

SAS® 9.2 INFORMATION DELIVERY PORTAL WEB APPLICATION

The package can also be surfaced through the SAS Information Delivery Portal Web application by using a URL portlet. This capability is demonstrated below, with the SAS 9.2 Information Delivery Portal running on IBM WebSphere Application Server on an IBM zSeries (z/990) computer with the z/OS operating system:
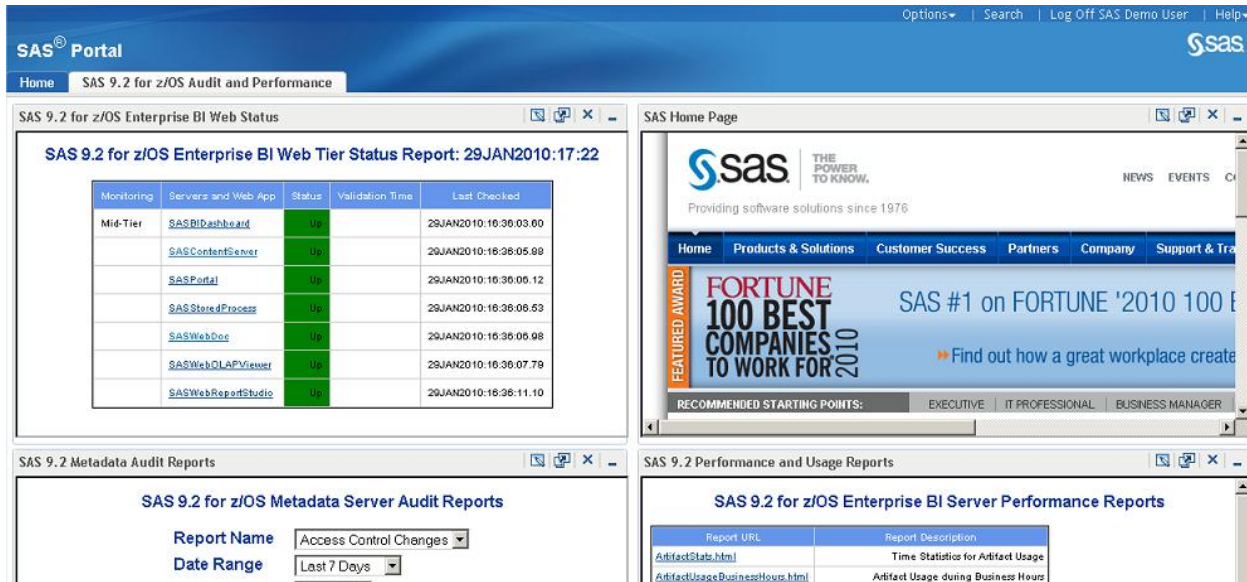
SAS 9.2 EBIAPM92 AUDIT REPORTS

The package produces audit reports by analyzing the SAS Metadata Server audit logs and archiving the results in SAS data sets. Default formats for the reports include HTML, PDF, RTF, XML, and CSV styles. Reports are available for "access control changes," "administrator users," "userid," and "group" modifications. The following display is a partial report of access control changes in the previous seven days.
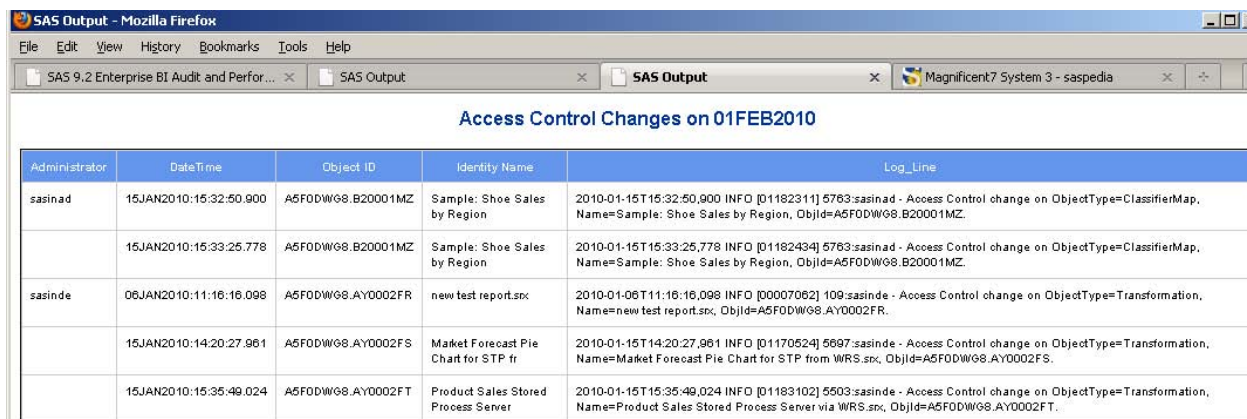
SAS 9.2 EBIAPM92 PERFORMANCE REPORTS

The performance and usage reports provide a wealth of information related to the specific usage and user performance of the SAS analytic server environment. The performance reports include details such as:

- Usage of SAS 9.2 metadata including libraries, cubes, reports, stored processes, and tables

- SAS OLAP Server cube reports based on top users, name, and frequency counts
- Workspace server utilization, including detailed metrics for elapsed time, CPU, I/O, and memory usage
- SAS PROC utilization based on server type and frequency metrics
- SAS Web Report Studio reports and SAS Stored Process utilization reports

The following sample reports demonstrate a few of the defaults available in the package:

SAS Metadata Server library report, artifactType, with metrics for each library

z/OS workspace server user session report, with metrics for sessions, time, CPU, I/O, and memory
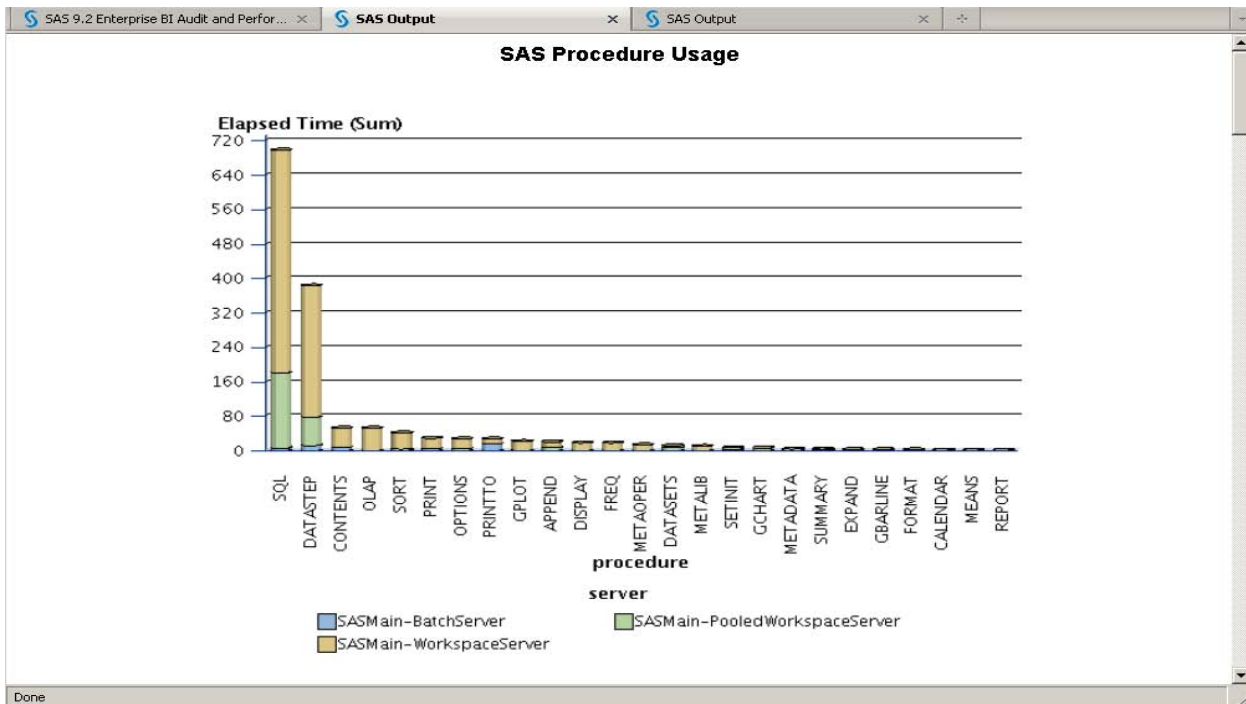
UNIX SAS procedure usage report chart and frequency table

The SAS 9.2 Audit and Performance reporting package is distributed with full source code, data model descriptions, and customization information. This allows sites to easily extend the package to create highly customized reports that are optimized for their unique organizational requirements.

CONCLUSION

Enterprise systems management is evolving into a complex and sophisticated environment that is critical to providing computing and analytic capabilities to business operations. IT staff and administrators, SAS administrators, and executives have to implement, monitor, and manage an expansive set of distributed resources, hardware, network, and applications.

SAS offers a number of solutions and technologies that our customers can select from to effectively meet the systems management requirements of their organizations.

Customers can leverage their investments in our partner enterprise management products (IBM Tivoli or HP OpenView) to monitor the state and status of the SAS 9 Enterprise Business Intelligence framework. SAS customers that use open source solutions can investigate using the Xymon Monitor or Hyperic HQ monitor products to monitor the SAS 9 environment.

Finally, sites that have a need to understand detailed status, audit, and performance reports on the SAS 9 environment should consider implementing the SAS 9.2 Audit and Performance Package. The package includes usage reports for SAS libraries, SAS procedures, user workloads per server type, and detailed metrics related to resource utilization across the server environment.

Customers will find additional details about the information provided in this paper by referring to the Enterprise Management Integration section of the Focus Areas topic on the SAS Customer Support Web site.

REFERENCES

The following references or sources can be used for additional information and research activities:

- SAS Customer Support home: http://support.sas.com
- SAS Enterprise Management Integration home: http://support.sas.com/rnd/emi
- SAS 9.2 Documentation home: http://support.sas.com/documentation/cdl_main/index.html
- SAS 9.2 Intelligence Platform documentation:
  - Installation and Configuration Guide
  - System Administration Guide

CONTACT INFORMATION

Our team is very interested in answering your questions or providing additional information related to your systems monitoring and management requirements. Please contact the author at:

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