

SAS[®] Application Performance Monitoring for Solaris[™]

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ABSTRACT

Understanding individual SAS application system resource utilization can be a daunting task and has been the topic of several SUGI papers. For example, last year a SUGI25 paper by Maureen Chew "Peace between SAS Users and Solaris[™]/UNIX Systems Administrators: Finding a Middle Ground" (<http://www.sas.com/partners/sun/technology/performance/index.html>) explored system resource management and effective resource sharing. It dramatized the job of sharing systems with a multitude of SAS tasks on systems with finite resources.

However, large enterprise usage of SAS applications often leads to extremely unpredictable results as more and more users are added to the system. The simultaneous and collective application requests of any given subset of concurrent users starts to resemble "chaos" theory in terms of system resource utilization, capacity planning, and application service level.

Whether you are a SAS ASP (Application Service Provider) who must fulfill guaranteed service level agreements, or a forward looking systems administrator trying to get the most out of your computing resources, the Sun Management Center can help you get a comprehensive view of all aspects of your Solaris systems. Its graphical interface frees you from having to remember a litany of UNIX commands and from having to interpret their outputs.

SYMON[™] - SAS[®]

This article will attempt to expose system managers, of all experience levels, to a predictive system management tool provided by Sun Microsystems for use with their Solaris[™] operating system. It will show several methods for monitoring SAS tasks on your Solaris platforms. Sun Management Center, originally called SyMon, is a very good tool for evaluating SAS resource utilization on the Sun Solaris[™] platform.

Hopefully, some of the tips and examples used here will be helpful to you as you monitor system usage on your Solaris machines. Because of the limited length of this paper and the flexibility of the monitoring tool, we will only scratch the surface of the available features of Sun Management Center in this document. The features we will discuss are well suited to providing insights into performance of SAS applications. However, there are many other features within the product that we will not have time to discuss in this paper.

Furthermore, since the writing of this paper, Sun Microsystems has announced a new version, version 3., of Sun Management Center. Version 3 adds features such as a web browser interface and support for the UltraSPARCIII systems such as the Sun Blade[™] and Sun Fire[™] systems. It has been available from the Sun Management Center website since January 2001 but for purposes of this article, version 2.1.1 will be discussed.

WHAT IS THE SUN MANAGEMENT CENTER?

The Sun Management Center is a distributed 3-tier systems management tool for the Solaris[™] platform. The tiers represent:

- Console layer - java client application which runs on any enabled system to display the SMC data
- Agent layer - collects data on all systems of interest

- Server layer - assembles data from all agent systems and services console requests

Sun Microsystems's Sun Management Center is a single solution for managing multiple Sun systems, devices and networks. It provides single-point-of-management convenience for all Sun servers, desktops, storage systems, the Solaris[™] Operating Environment, applications, and data center services, as well as hooks to third-party management products (CA, Tivoli, HP OpenView, Halcyon). In addition, system views can be tailored for specific users or other systems managers allowing delegation of system monitoring responsibilities within the enterprise.

Its features include:

Scale Quickly and Easily: Sun Management Center software lets you scale the management of a single system to thousands of systems on a single, unified management platform. New features, referred to as modules, can be added and reconfigured without interrupting the ongoing monitoring.

Increase Uptime: With predictive failure reporting and comprehensive event and alarm management, Sun Management Center software warns you of potential problems--so you can solve them before they cause downtime. Pre-defined alarm tasks can begin to respond as system managers are alerted of problems thus reducing reaction time and speeding recovery time. Alarm conditions will show on the graphical display as well as initiating tasks such as emailing or paging system managers with details of the event.

Reduce Administration Costs: Sun Management Center software simplifies the management of your Sun environment, so you can use your administration staff and technical resources more efficiently and reduce the cost of delivering IT services. For example, the product provides remote online control, so administrators can work from anywhere. In addition, built-in security enables multiple administrators with different responsibilities to manage the environment.

Monitor Health and Performance in Real Time: Sun Management Center provides real-time system performance and configuration data, enabling administrators to isolate bottlenecks and optimize network performance. It also provides health monitoring, along with suggested steps for problem resolution, resulting in simplified administration.

Quick and Easy Installation: Shell scripts are provided to install the three major components of the management center. The **server**, **client** and **console** components are installed separately. Each monitored system must have an **agent** installed while the **console** and **server** components will be installed on the systems that provide those functions. The **console** and **server** components do not need to be installed on the same machine while **agents** must be installed and started on all monitored systems. All three components communicate via SNMP through a common UNIX port.

Easily Customizable Graphical Interface: The structure of the graphical interface is flexible. Categories and subcategories of systems can be defined. For example, the top level might be defined as a campus with a layer below defined as buildings with yet another layer below defined as rooms within the building. System views can be grouped within appropriate rooms allowing for easy physical location of troubled systems. (See Figure 1)

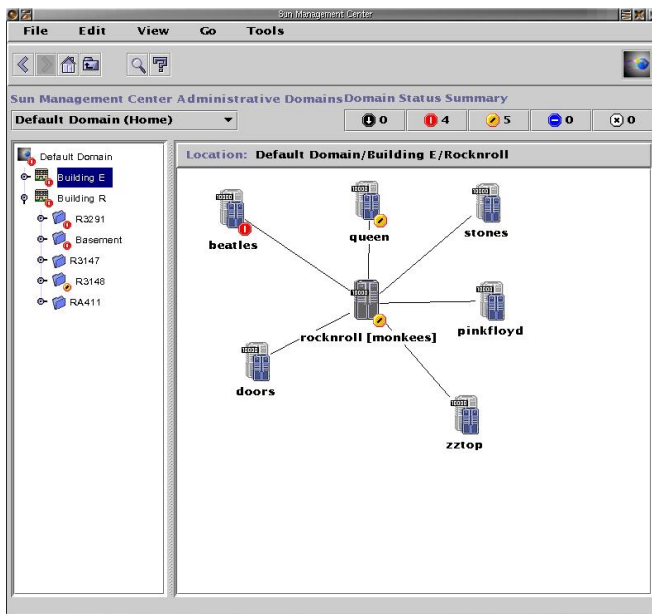


Figure 1

The Sun Management Center version 2.1.1 (<http://www.sun.com/sunmanagementcenter>) is downloadable for free and available for free use on a single system at a time. A license is required only if you wish to run the server and agents on a different system. However, you can run this freely on multiple domains of a single E10000 without any licensing fees. Many of the features as well as the licensing rules are changing for version 3. New feature lists and new guidelines can be found at the website.

COMMON PROBLEM AREAS WHEN RUNNING SAS APPLICATIONS

Often, SAS applications have no system resource issues when run individually. However, here are some very common scenarios where problems crop up as many users with competing resource requests start running jobs simultaneously. We'll look at how Sun Management Center can spot these scenarios and generate alarms of varying severities alerting appropriate staff to avert future problems.

- *Collective Resource Requirements over given day, month, quarter?*
When are the system peaks? What are the system bottlenecks? Can we use this information to either schedule non-critical work or provide a threshold for Capacity-on-Demand thresholds?
- *Filling up SAS WORK*
Because SAS applications often incidentally or programmatically use the SAS WORK area heavily (i.e.: proc SORT), users often never realize the impact of heavily burdened SAS WORK areas. How often and how close does SAS WORK fill up? What can be done?
- *CPU time share starvation*
Are there not enough CPU cycles to give each user a "fair" time slice? If this is an issue and increasing the number of CPUs is not an option, there are a number of ways to "favor" power users.
- *SAS/ACCESS@/CONNECT@/SHARE@ network overload*
Is the network a bottleneck? Are users transporting an

inordinate amount of data over the network? Are result sets returned too large for the bandwidth of the network? Should SAS/CONNECT be utilized? Are librefs, catalogs or extremely large data sets inadvertently set to NFS directories?

- *Hot disk(s) in heavily used volume*
Is there a single disk or set of disks that is under extreme I/O pressure? Often, systems with virtual memory constraints make a bad problem worse with a single disk SWAP area or a volume-logging disk is logging for several very active volumes. Either of these conditions can cause severe processing slowdowns.
- *Virtual memory shortage that causes severe system paging activity*
Often, the single biggest offender of system resource abuse is not having enough swap space on the system. Its manifestations can appear as an I/O bottleneck as high paging rates and swapping are induced particularly if the swap device is on the same I/O channel as the data disks.

APPLYING SUN MANAGEMENT CENTER TO SAS ON SOLARIS

Let's take a look at each of these scenarios in detail and demonstrate how Sun Management Center can identify and react or provide insight for alternative strategies.

Collective Resource Requirements:

Monitored system activity can be captured in log files resulting in text files like this:

```
historylog3 Jan 15 09:15:44 agent      INF-0    ctcsun2   Kernel
Reader      Load Averages Over The Last 1 Minute = 10.31Jobs
snmp://10.16.1.223:1161/mod/kernel-reader/load/avg_1min 0
978978682
historylog3 Jan 15 09:16:44 agent      INF-0    ctcsun2   Kernel
Reader      Load Averages Over The Last 1 Minute = 10.31Jobs
snmp://10.16.1.223:1161/mod/kernel-reader/load/avg_1min 0
978978682
historylog3 Jan 15 09:17:44 agent      INF-0    ctcsun2   Kernel
Reader      Load Averages Over The Last 1 Minute = 12.91Jobs
snmp://10.16.1.223:1161/mod/kernel-reader/load/avg_1min 0
978978682
historylog3 Jan 15 09:18:44 agent      INF-0    ctcsun2   Kernel
Reader      Load Averages Over The Last 1 Minute = 12.91Jobs
snmp://10.16.1.223:1161/mod/kernel-reader/load/avg_1min 0
978978682
```

The logs can be evaluated with SAS to determine trends and forecast system resources needed to continue to provide required levels of service.

Filling SAS WORK disk space:

This can have dramatic effects on system performance. One way to circumvent this is to be forewarned. For instance, setting alarms to alert administrative staff when the SAS workspace is filling is one way to avoid workspace conflicts. Alarms can be set on "free space", "free space (NON-Root)", "inodes used", "available inodes", or on "percentage of inodes free". Alarms may be set for varying thresholds including "Caution," "Alert," or "Critical" levels. If the file system parameter meets any of these conditions an action is triggered. For example, an email message sent by a file system full alert follows:

```
From: Super-User <root@ctcsun2.unx.sas.com>
Subject: Sun Management Center - Caution Alarm Action
```

```
Sun Management Center alarm action notification ... {Caution: ctcsun2
Kernel Reader /DATA2 Percent Used > 80%}
```

SAS process CPU utilization:

Since a CPU can only complete a unit of work if it is available, it is important to keep track of CPU utilization. Parameters for global resource utilization such as “% CPU Idle Time,” “% CPU User Time,” “% CPU Kernel Time,” and “% CPU Wait Time” can all be monitored and can trigger events through Sun Management Center. Individual user and user process statistics can also be monitored, as shown in Figure 2, and have alarms and events triggered at specified levels. This allows system managers to avoid the problem of single users monopolizing the systems unnecessarily.

Another important parameter to watch is “failed mutex enters”. These occur when shared memory locks (called mutual exclusion locks) keep additional CPUs from accessing needed memory. These can be very damaging to system performance. Unfortunately, adding more processors in this case can make performance worse. Having fewer, faster processors is usually a better solution.

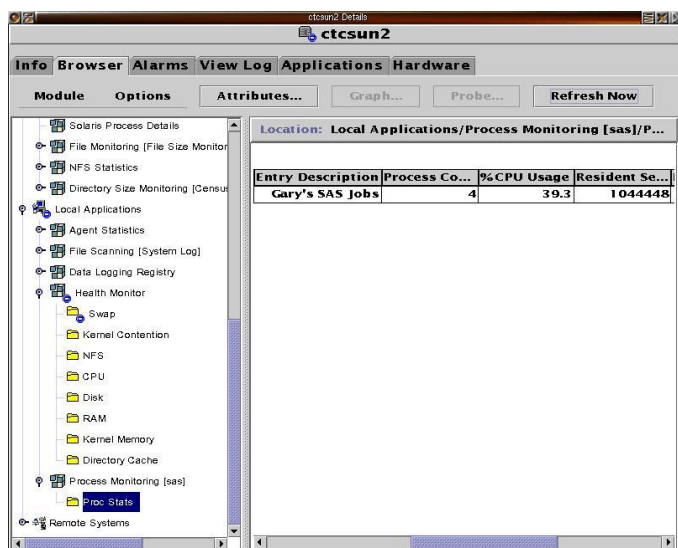


Figure 2

SAS ACCESS@/CONNECT@/SHARE@ network use:

Watching the network activity and the process workload concurrently can help you determine if network activity is slowing your SAS process. Solutions may include, but are not limited to, increasing the number of network interfaces, localizing the data or eliminating other network traffic. The effects of these changes can be evaluated with Sun Management Center. Real-time monitoring and analysis can help you determine what is needed.

Other network issues arise with the use of NFS for remote data access. Changing directory caching, MTU sizing as well as other system and network parameters will have dramatic effects on your processes. Sun Management Center can be used to evaluate any parameter changes you make. It is also a very good tool to determine if your slowdowns are being caused by network failures and errors or by system parameters or resource shortages.

Hot disk(s) in heavily used volumes:

By monitoring groups of disk devices overburdened disks can be detected and reported. Database disk farms or raid arrays of disks can be optimized when hotspots are identified and eliminated. The health monitor module, shown below in Figure 3, will show and track disk I/O activity.

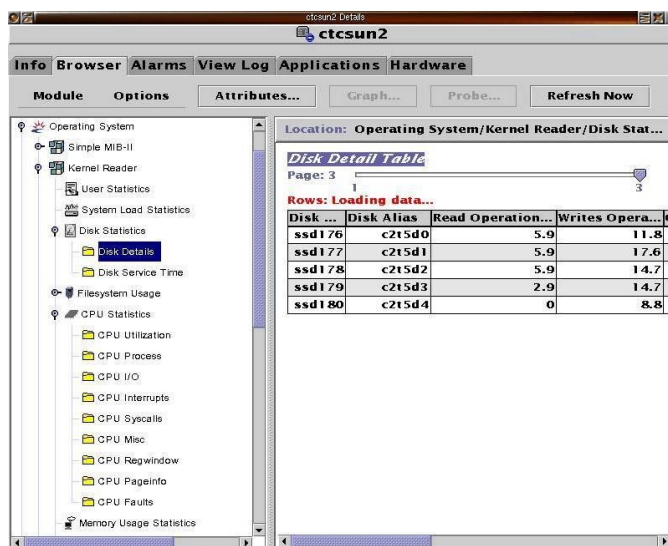


Figure 3

Virtual memory shortage that causes severe system paging activity:

Real-time monitoring and analysis can help you determine what is needed. Figure 4 is an example of real-time monitoring. It shows system RAM used vs. available system RAM. We see here that this system is handling too many memory intensive tasks. Our choices are to reduce the number of tasks, reschedule the tasks over different times of the day or add more memory. All of these options will have effects on other aspects of the system.

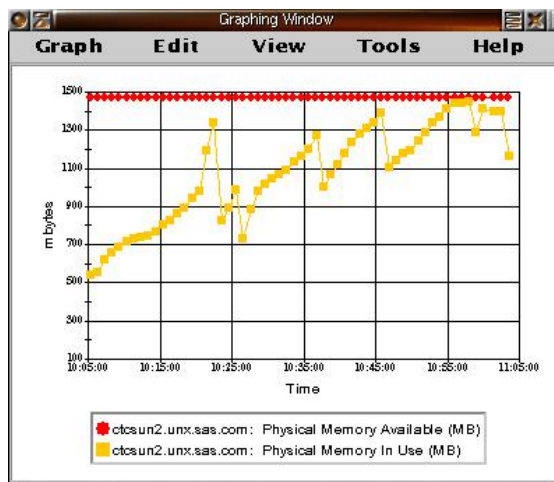


Figure 4

SYSTEM VIEWS FROM SUN MANAGEMENT CENTER

System administrators will appreciate the functional views of your systems that Sun Management Center provides. Once a system has been selected, the agent provides the system's configuration to the console. The system manager can decide between a logical view of the system's hardware configuration and a physical view. The logical view [Figure 5] shows a text list of all components as well as their Solaris identities.

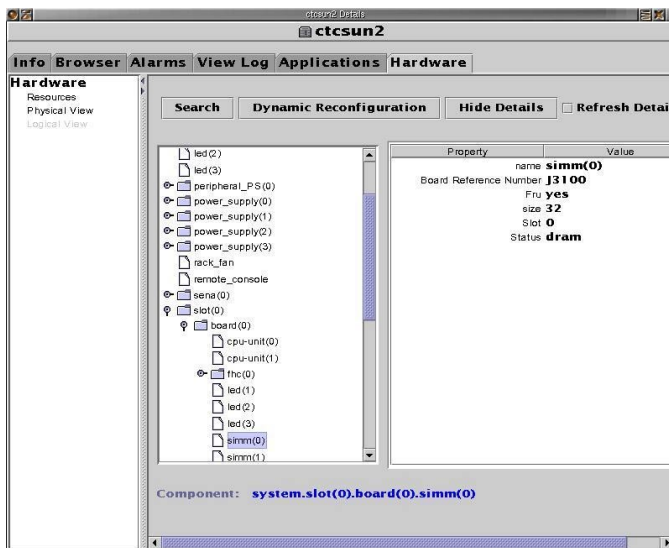


Figure 5

The physical views [Figure 6] offer rendered pictures of each system type with configured components highlighted for ease in identification. In addition, failing components are highlighted making them very easy to locate for repair. All views are customized for each system and system architecture as the agent is contacted. Dynamic reconfiguration is also available for applicable architectures.

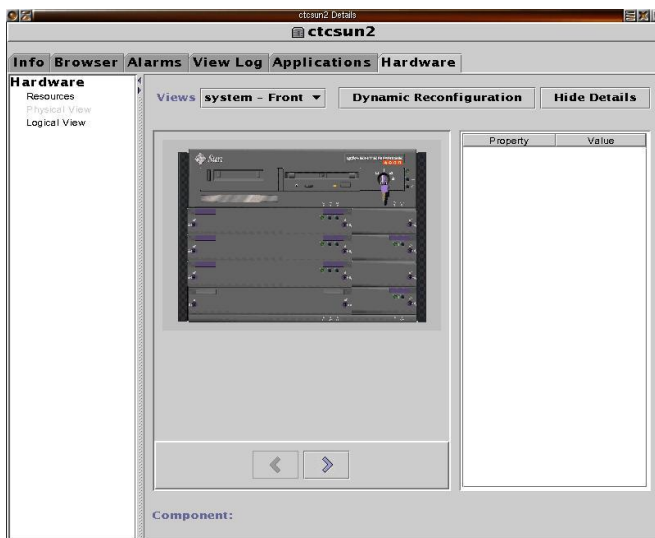


Figure 6

CONCLUSION

Building and/or providing highly available system configurations for a highly available RDBMs cluster is a fairly well understood process. The next step in the enterprise IT data center is to understand, characterize and respond to application service level availability. Sun Management Center paves the road to helping you understand this next level of availability.

The real-time views as well as the long term activity monitoring ability of Sun Management Center makes it an indispensable tool for fault analysis as well as long term trend analysis. This is a very valuable and powerful tool that Sun Microsystems is providing. System administrators and SAS system managers

can benefit greatly by its use.

In today's demanding business environment SAS applications help provide you with competitive advantages. You can't afford for your systems or your applications to be unavailable for any reason. Managing the systems that manage your data is more important than ever and Sun Management Center is an excellent tool responding to that need.

REFERENCES

Sun Management Center website
<http://www.sun.com/sunmanagementcenter>

Peace between SAS Users and Solaris™/UNIX Systems Administrators: Finding a Middle Ground
<http://www.sas.com/partners/technology/sun/performance/index.html>

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