System Performance Management

Moving from Chaos to Value

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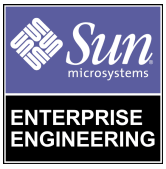
Sun BluePrints™ OnLine - July 2001



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Part No.: 816-1660-10
Revision 01, 06/25/01
Edition: July 2001

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The Gartner Group rates IT management processes, referring to different levels of management sophistication as “maturity levels.” (Gartner clients can refer to Research Note #DF-08-6312,’IT Management Process Maturity,’ by analysts Donna Scott and David Williams.) Gartner describes a range of maturity levels:

Chaotic	No consistent use of performance tools
Reactive	Organization uses event consoles
Proactive	Organization uses performance monitoring and historical tools
Service	Organization employs capacity planning
Value	IT/Business Metric Linkage

This article will discuss why you want to move the maturity of your operations from “chaotic” to “value,” and provide an overview of the classes of tool that can simplify that evolution. This broadly based article is intended for those at technical through management positions who are preparing to select or justify the purchase of system performance management tools.

Who Cares about System Performance and Why?

While it would be hard to find the IT manager or system administrator who professes a lack of interest in the state of their system performance, there are many reasons that they should be *more* interested. The rise of the internet and the increase of dependence on computing devices have exposed more “consumers” of the services provided by networked computers to the bottlenecks and inefficiencies of our industry. As quickly as computers are being assimilated into our day-to-day

lives, we are frequently struggling to keep up with the demand for faster service. System performance management is important to every level within the hierarchy of service providers, including managers, systems administrators, and even vendors.

Management

Corporate managers, such as CEOs, CIOs, presidents, and vice presidents, are most directly interested in making sure that a company is highly profitable. Because computer systems are frequently crucial to maintaining the profitability of companies, corporate managers are very interested in making sure that those systems are kept running smoothly.

Computer system performance has always had the possibility of affecting business profitability, but with the advent of the World Wide Web where customers interact directly with Web servers, response time can have a direct and dramatic impact on business revenue. According to Harley Manning, research director at Forrester Research, “One of the biggest reasons that people leave a site is because they're having a lousy experience--either pages aren't available or they take so long to download that it's just not worth it.” [*InternetWeek*, August 2, 1999]

Sometimes performance bottlenecks do more than just impact response time—sometimes systems are brought completely down. The costs can be staggering. For example, one prominent internet provider experienced an outage that lasted 22 hours, resulting in a loss of revenue estimated at $3 million to $5 million, with an associated 26% drop in their stock price. Managed performance is easily equated with money saved.

System Administrator

While the corporate managers are concerned with the bottom line, it is the system administrators, including webmasters, network managers, or management service providers (MSPs), that are held accountable--by manager and user alike. They need tools to douse the “fires” of poorly running, failing, or even failed services. Better yet, they need tools that can prevent the fires from occurring in the first place. Although many have created their own tools, often evolving over years of experience, they need consistent tools and interfaces, and tools that adapt to the challenges of the heterogeneous networked environment.

Vendors and VARs

Systems vendors and value-added resellers (VARs) have a different, but equally urgent challenge: how to size a system for a given application and problem. Without capacity planning tools, it is difficult to provide consistent and supportable recommendations. These same tools become critical later in determining *when* and *how* to expand a configuration to meet future needs.

Finding Out You Have a Problem

All too often we find out about performance problems from users, or worse yet, from the boss. If you are a system vendor or VAR, you might learn from an angry customer you over-sold or under-sold system capacity. If you are a system administrator, you might find out about a performance bottleneck from a user who can't make a purchase on your web site. Or, worse yet, you might get a call from the boss who wants to know why sales transactions were off 25% last week.

Just about anyone would agree, this is not how things should be. Ideally, we would all plan for the future and purchase just the right configuration to handle future business workloads. If, even after such careful planning, a system should need to be expanded sooner than expected, our performance management software would warn us long before any users became frustrated, and long before there could be any negative financial impact on the company.

Fortunately, there are tools available today that can help you find out you have a problem before the users do. Better yet, they can help you predict— and plan for— future problems. It is worth considering some of the reasons companies *don't* invest in performance management tools:

- Tools cost too much. Besides that, we have a real sharp systems administrator who can write scripts that get the same information--for free!
- Tools are too complex, and we don't have anyone that knows how to use them.
- We don't have time to worry about tools.

We'll address these excuses in our conclusions. For now, they should serve as clear warnings of a company that is operating at the chaotic end of corporate maturity.

Performance Management Tools

There are four classes of performance management tool that will be considered in this article:

Event Consoles	Alert systems administrators to trouble or potential trouble.
Performance Monitors	Show detailed information regarding what is happening.
Historical Analysis Tools	Show history, show present trends, and predict future probabilities.
Capacity Planning Tools	Predict the effects of future business workloads and changes to system configuration.

Richard Croucher, director of architecture for Sun's EMEA Professional Services organization, says his group “found that performance tools enabled us to provide fast, accurate analysis of all Sun's servers, right up to the 64-way Sun Enterprise™ 10000 server. These tools can achieve this with a minimum of effort and without unduly perturbing the system being analyzed. They can be safely installed and left to collect the performance statistics, which can then be analyzed in depth, or loaded into a capacity planning tool.”

We will avoid the recommendation of any specific tools in this article, although we will use as examples tools available from both Sun and TeamQuest. There is a valid question, which we will defer for now, of whether to use individual tools that represent the “best-of-breed” in each class, or choose an integrated toolset.

Event Consoles: Tell Me Before It's too Late

The simplest form of software for alerting a system administrator to a performance problem is an **event console**: this software can help find problems *before* users, customers, or the boss. Event consoles will flag problems so that corrective action can be taken. Some will even make recommendations, and can be set up to automatically take action or activate a pager.

Figure 1 shows events being flagged by Sun™ Management Center event console. It's free if you only need to watch one system. To manage multiple systems, you will need to purchase an additional license.

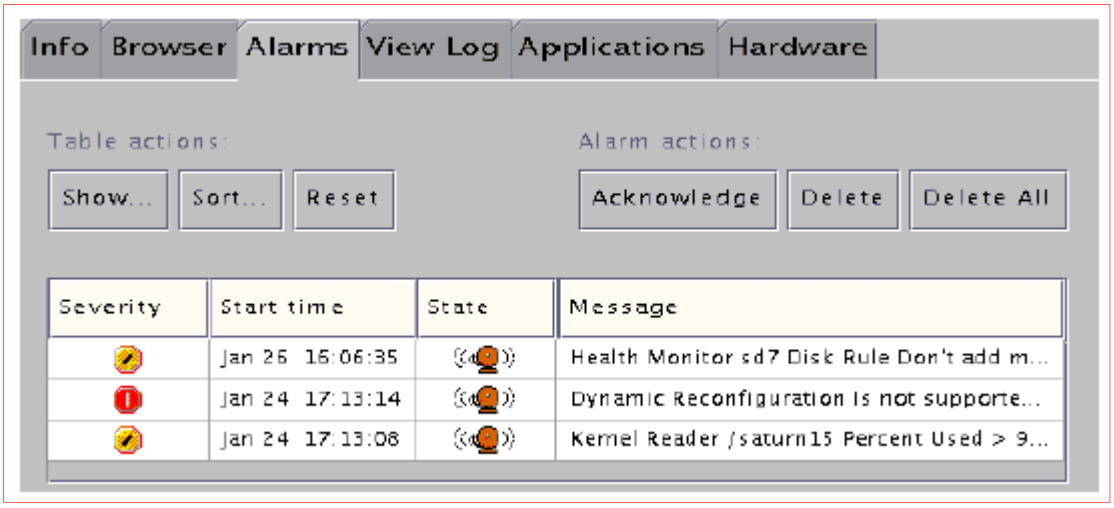


FIGURE 1 Events Flagged by Sun Management Center event console

The events or alarms being shown in Figure 1 indicate conditions that require attention from the system administrator. The yellow **severity** symbol is simply called an “alert” condition. The red indicates a “critical” situation. Other possible severity levels for the Sun Management Center event console include “caution,” “down,” and “off.”

The **state** indicator is either a ringing bell or a silent bell. A ringing bell means that the alarm condition is currently true: the problem still exists. For conditions that existed in the past, but are no longer active, a silent bell is displayed.

The **messages** displayed describe the alarm conditions. In Figure 1, for example, the third alarm shown says “Kernel Reader /saturn15 15 Percent Used >9...” This message can be expanded so that you can read additional details. The alarm is informing the system administrator that the disk subsystem called “saturn15” is nearly full.

Figure 2 shows the overall status of several enterprise systems as shown by TeamQuest Alert, an event console from TeamQuest Corporation. A free version, called TeamQuest Lite, can watch up to five systems.

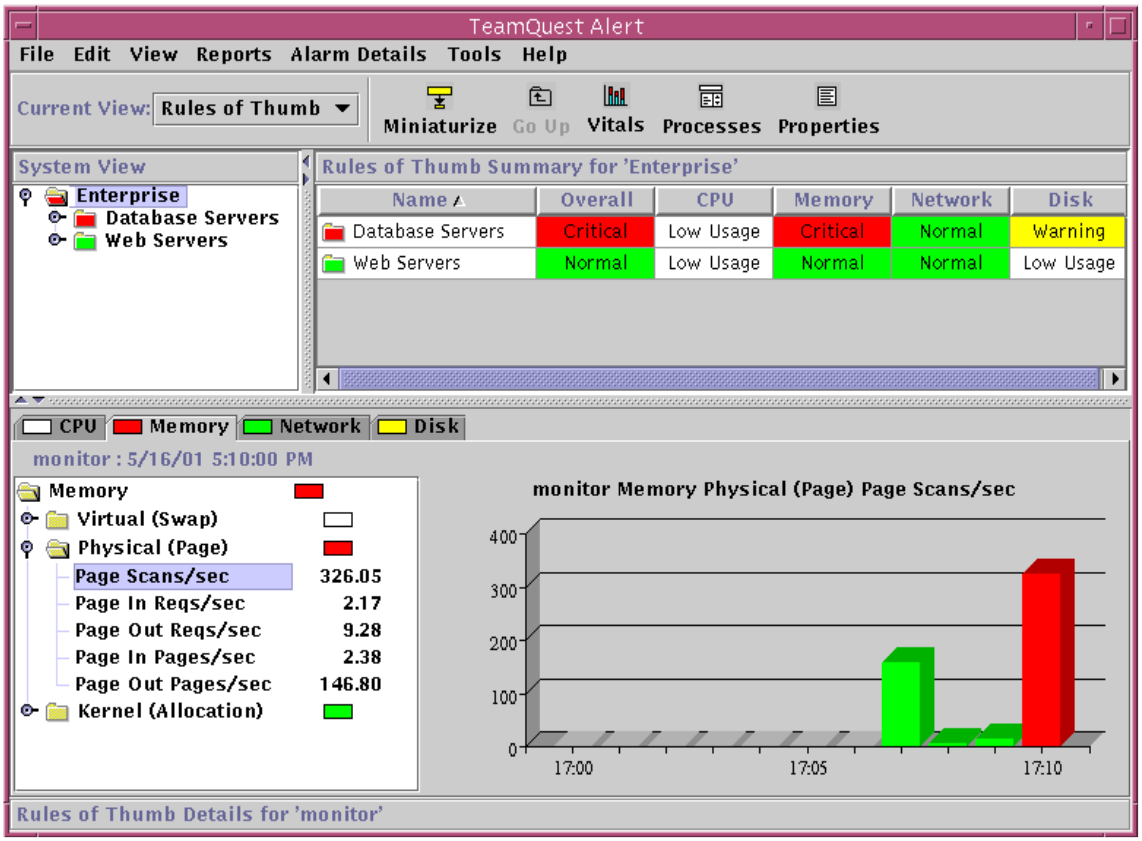


FIGURE 2 Overall Status Indicated by TeamQuest Alert

Figure 2 shows a screenshot containing a “Rules of Thumb Summary” for the status of a group of systems, some database servers and some web servers. The display shows that the **overall** status of the database servers is in a red “critical” state and that the web servers are “normal.” Other possibilities for the state indicators in TeamQuest Alert include “warning” and “grave” conditions. Judging from the red “critical” indicator under **memory**, it seems that the problem with the database servers might have to do with memory.

The lower portion of the display in Figure 2 shows the paging statistics for a database server named “monitor.” This was displayed as part of an effort to discover the particular server having a potential problem. The system administrator displayed this chart while trying to figure out who was responsible for the overall critical condition.

Doing More with Event Consoles: Finding the Culprit

Once an event console has informed you that you have a problem *somewhere*, you need to obtain additional information regarding the problem. You need to know what system or subsystem is having a problem, or what application on a particular system is experiencing difficulties. Since individual users may inadvertently be the cause of the problem, determining their identity is important to both correct and prevent future occurrences of the problem.

Finding the “culprit” on a single system can be difficult enough, but with distributed computing environments it can be nearly impossible, unless you have the right tools. Particularly with a multi-tiered heterogeneous computing environment, it can be extremely challenging to figure out which overall system component is at fault.

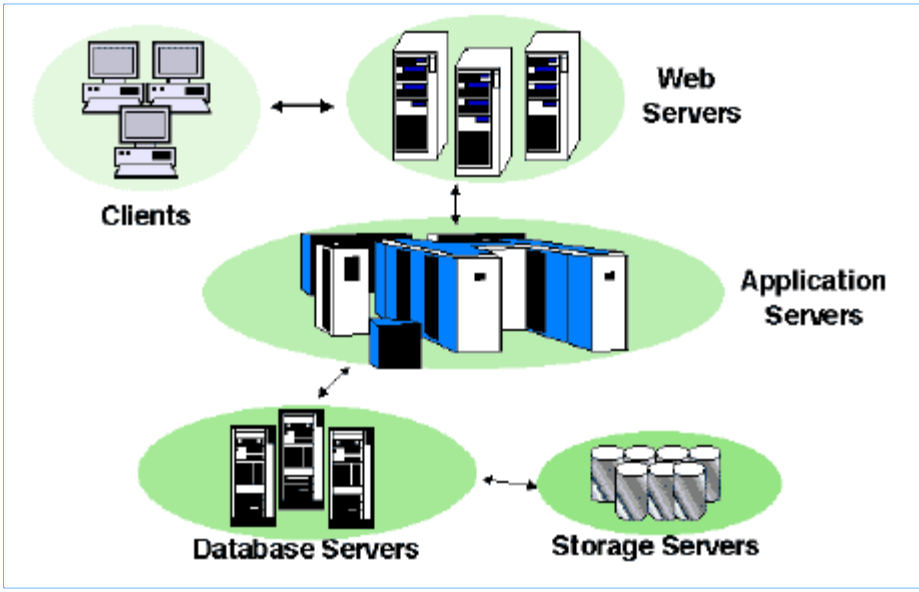


FIGURE 3 The Ultimate Challenge: Multi-tiered Performance Management

Take, for example, the environment shown in Figure 3. When the response time experienced by clients is degraded, the system administrator is faced with a daunting task: finding the system component causing the bottleneck. Is the problem with the web servers, the applications servers, the database servers, or with the storage servers? Once you find the *hardware* component causing the problem, how do you determine the *software* component causing the problem?

Many event console or performance monitoring solutions provide assistance in finding the actual cause of a performance problem. Let's explore a simple example.

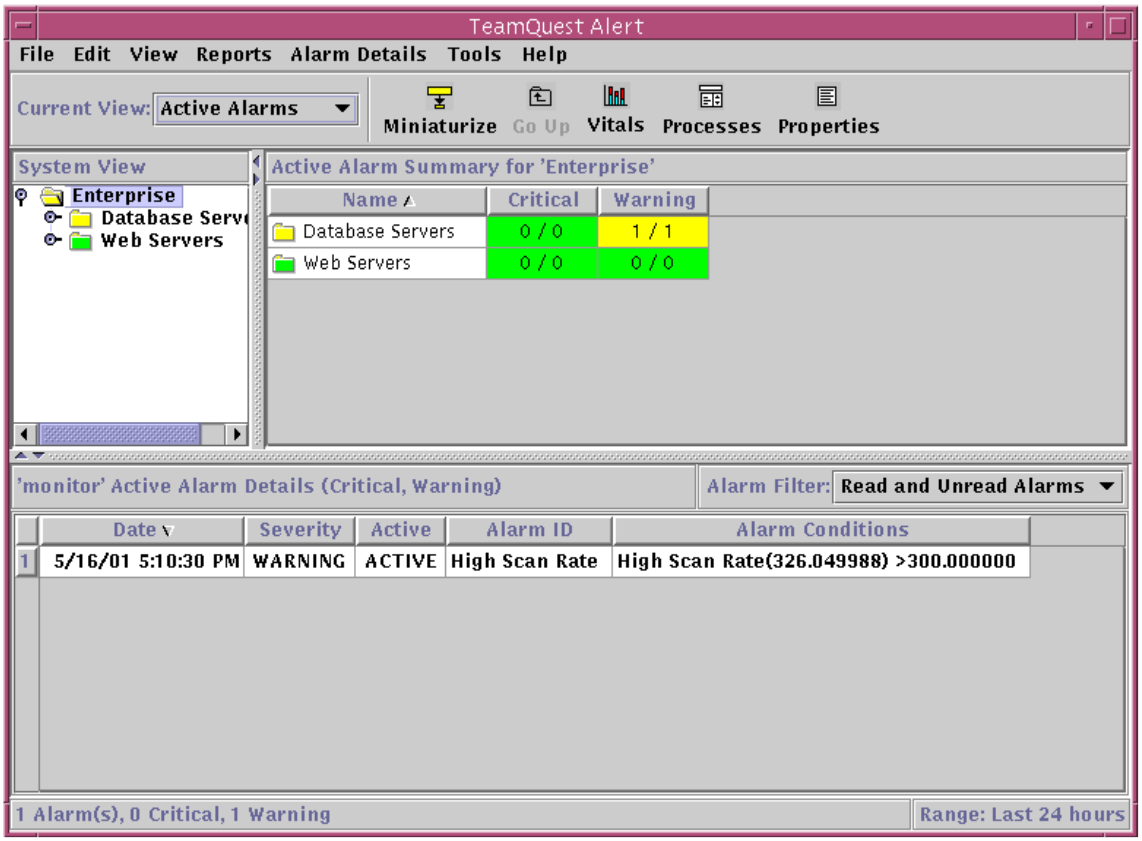


FIGURE 4 Active Alarms

In Figure 4, TeamQuest Alert displays information for one active alarm. That alarm is letting us know about an abnormally high scan rate on the system in question. This is the same problem that we explored in the earlier example, only now we are looking at the problem in TeamQuest Alert's “Alarm Mode.” You can see that the scan rate was 326 scans per second, and the alarm is triggered when the scan rate exceeds 300 scans per second. A high scan rate such as this, together with a high rate of pages being swapped out, can be an indication of a serious memory problem.

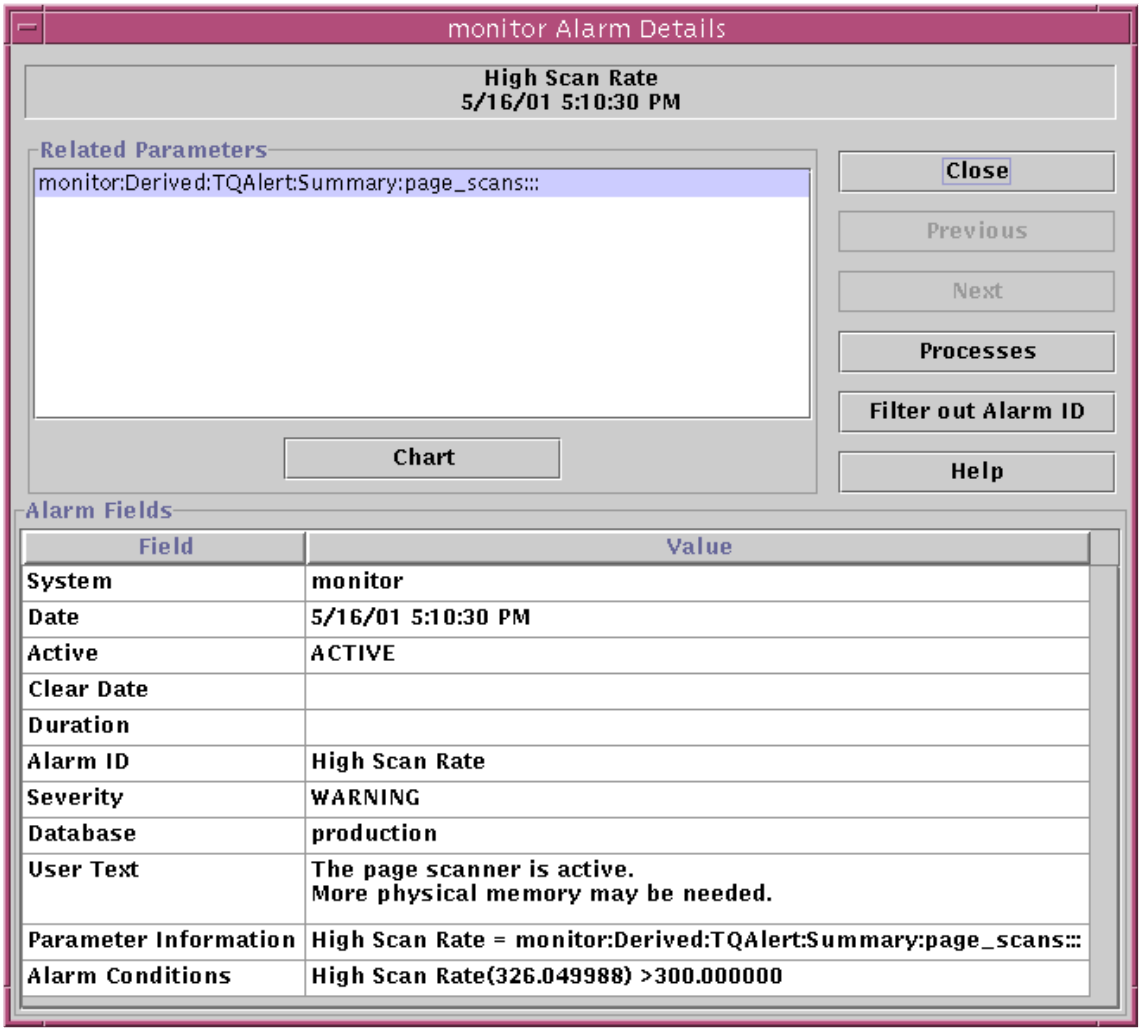


FIGURE 5 Details for High Scan Rate Alarm

In Figure 5 we have elected to display detailed information regarding the High Scan Rate alarm. Figure 6 shows what we see when we click on the Chart button to find out more about the performance parameter. Figure 7 shows information regarding each process running on the system. Apparently, the processing causing the problem is running a program called “ora_app” on behalf of user adams. A system administrator could then check with adams regarding that particular program, in an effort to minimize or eliminate the paging problem.

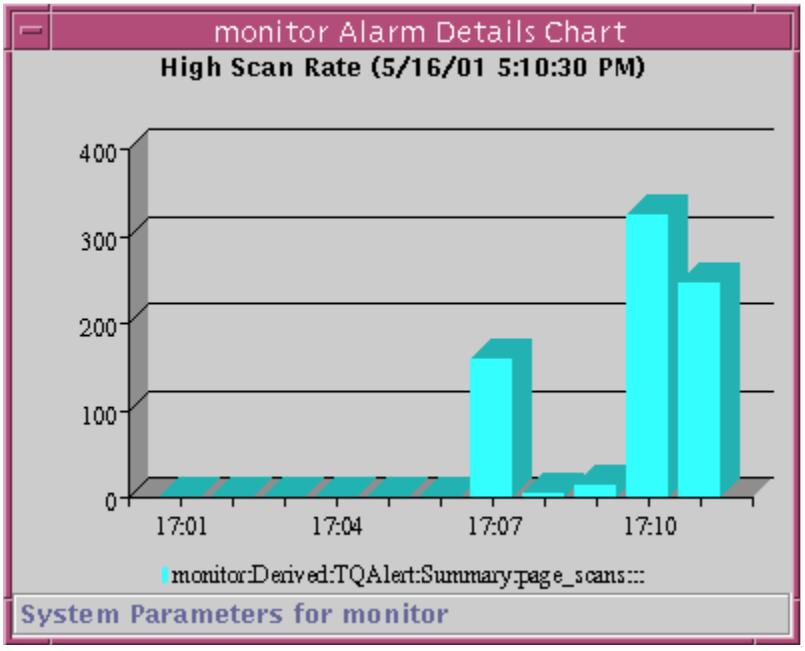
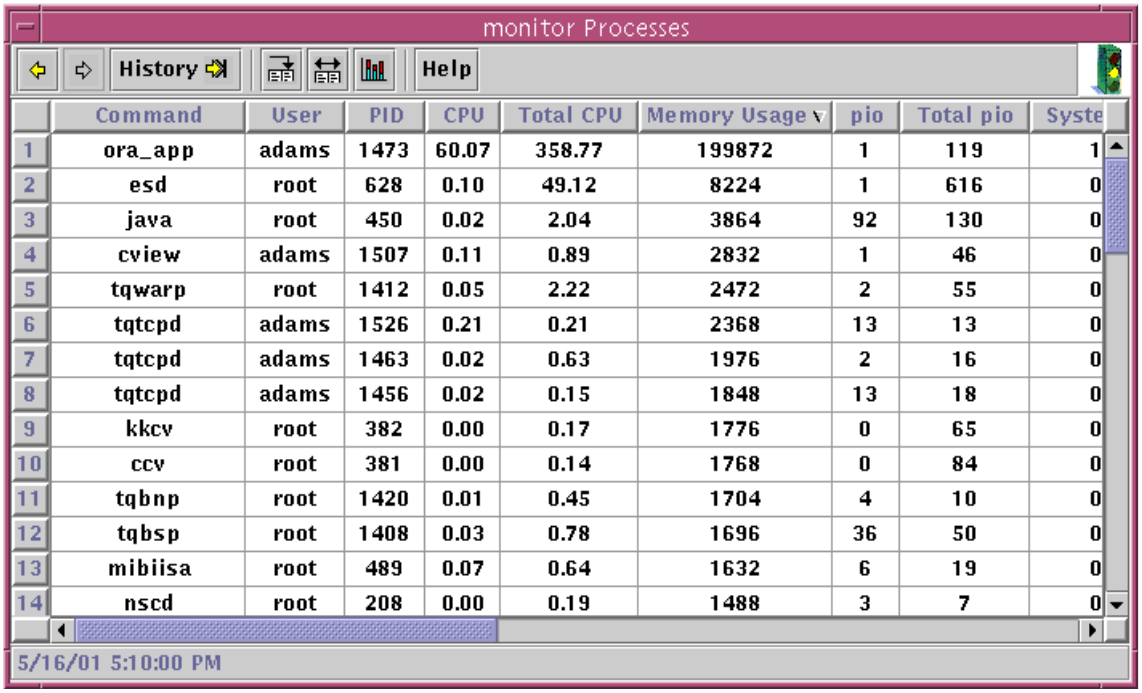


FIGURE 6 Chart for High Paging Rate

This has been a very simple example showing how an event console can provide the tools that a system administrator needs in order to learn about and diagnose performance problems on server systems. Similar tools and techniques would be used to solve more complex problems.



	Command	User	PID	CPU	Total CPU	Memory Usage	pio	Total pio	Syste
1	ora_app	adams	1473	60.07	358.77	199872	1	119	1
2	esd	root	628	0.10	49.12	8224	1	616	0
3	java	root	450	0.02	2.04	3864	92	130	0
4	cview	adams	1507	0.11	0.89	2832	1	46	0
5	tqwarp	root	1412	0.05	2.22	2472	2	55	0
6	tqtcpd	adams	1526	0.21	0.21	2368	13	13	0
7	tqtcpd	adams	1463	0.02	0.63	1976	2	16	0
8	tqtcpd	adams	1456	0.02	0.15	1848	13	18	0
9	kkcv	root	382	0.00	0.17	1776	0	65	0
10	ccv	root	381	0.00	0.14	1768	0	84	0
11	tqbnp	root	1420	0.01	0.45	1704	4	10	0
12	tqbsp	root	1408	0.03	0.78	1696	36	50	0
13	mibiisa	root	489	0.07	0.64	1632	6	19	0
14	nscd	root	208	0.00	0.19	1488	3	7	0

FIGURE 7 Processes Running at Time of Alarm

In some cases, it is helpful to have a more capable performance monitor available to locate and analyze the cause of problems detected by an event console. This is the subject of the next section.

Performance Monitors: More In-Depth Analysis

Event consoles exist for the purpose of watching groups of systems. They are especially important in larger enterprises, or even within small organizations using distributed systems.

As shown in the previous section, event consoles frequently overlap in functionality with performance monitors. Event consoles can usually do rudimentary analysis of a problem after an alarm event occurs, but they can not perform the kind of detailed analysis and reporting available from a full-blown performance monitor.

For example, using TeamQuest View, a tool that includes performance monitoring capability, you can display a graph of system performance similar to the chart produced by the event console shown in Figure 6. But you can also produce an even

larger variety of customized charts and graphs. Figure 8 shows a TeamQuest View display of CPU utilization, with four related parameters displayed on the graph at the same time: %idle, %wio, %sys, and %usr.

To isolate the problem causing the peak beginning at 17:04, you can right click on the peak to get more detailed information.

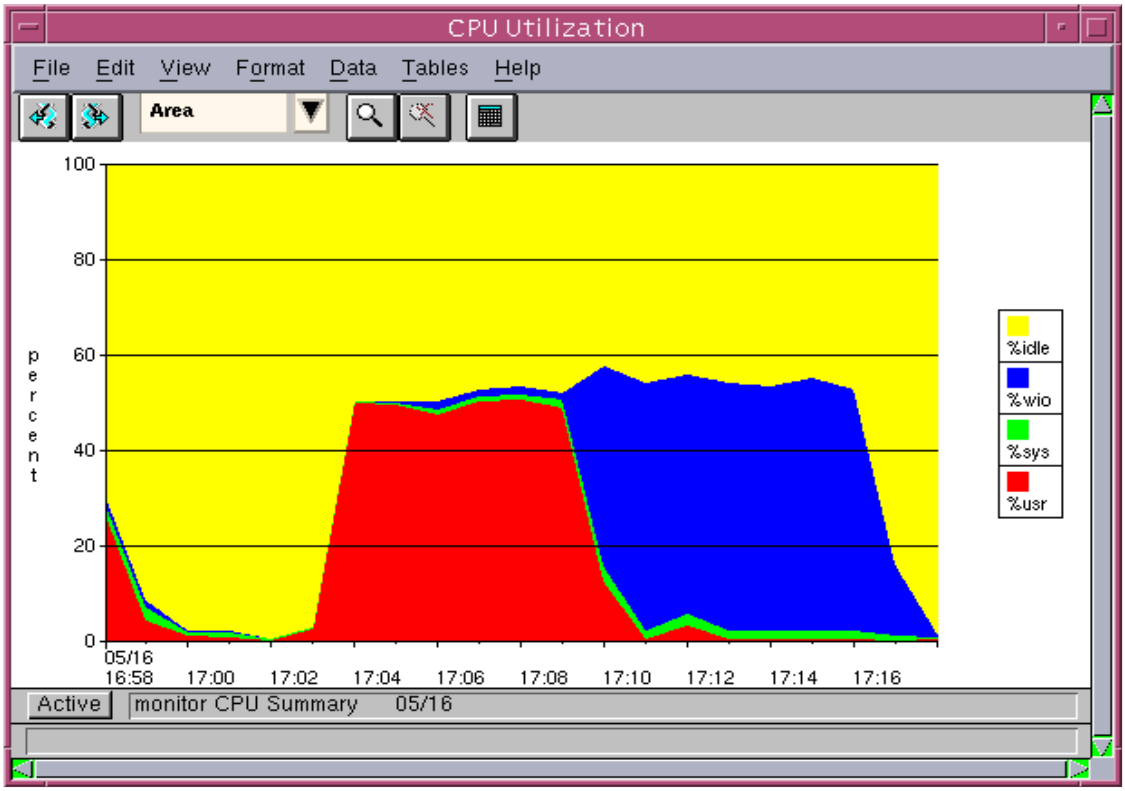
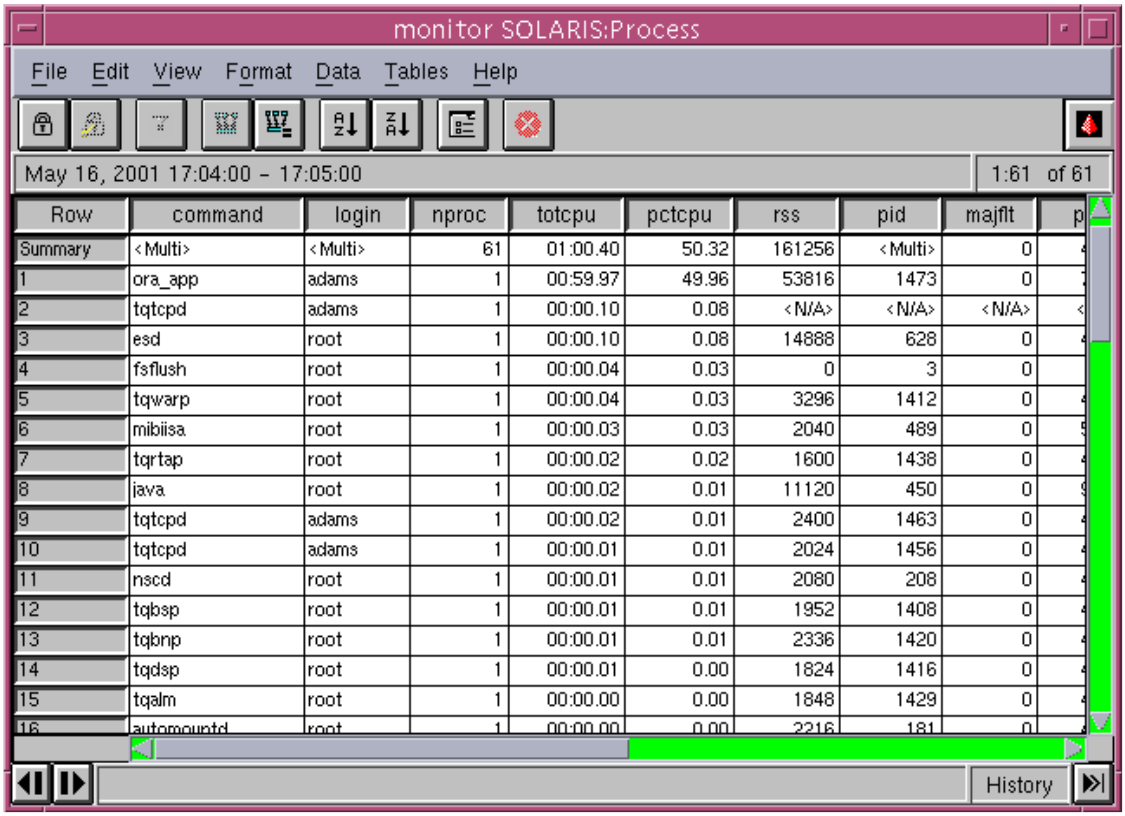


FIGURE 8 Processes Running at Time of Alarm

Figure 9 shows additional detail available at the peak. This display shows statistics for the various processes running on the system at the time of the peak. A number of parameters are displayed in columns for each process listed: totcpu, pctcpu, rss, pid, majflt, etc. In this case, we sorted the rows by total CPU utilization, or totcpu.

The top row is a summary of all of the processes running on the system at that point in time. These processes, when added together, take up 50.32% of the CPU. It is row 1 that interests us. The process shown is running a command called “ora_app,” and is taking up 49.96% of the CPU. This is the same application that was causing paging problems in our event console example, earlier. It makes sense for the system administrator to determine what the ora_app process is about. It may need to be reconfigured or modified so that it does not hog the CPU (and memory).



Row	command	login	nproc	totcpu	pctcpu	rss	pid	majflt	p
Summary	<Multi>	<Multi>	61	01:00.40	50.32	161256	<Multi>	0	
1	ora_app	adams	1	00:59.97	49.96	53816	1473	0	
2	tqtcpd	adams	1	00:00.10	0.08	<N/A>	<N/A>	<N/A>	
3	esd	root	1	00:00.10	0.08	14888	628	0	
4	fsflush	root	1	00:00.04	0.03	0	3	0	
5	tqwarp	root	1	00:00.04	0.03	3296	1412	0	
6	mibiisa	root	1	00:00.03	0.03	2040	489	0	
7	tqrtap	root	1	00:00.02	0.02	1600	1438	0	
8	java	root	1	00:00.02	0.01	11120	450	0	
9	tqtcpd	adams	1	00:00.02	0.01	2400	1463	0	
10	tqtcpd	adams	1	00:00.01	0.01	2024	1456	0	
11	nscd	root	1	00:00.01	0.01	2080	208	0	
12	tqbsp	root	1	00:00.01	0.01	1952	1408	0	
13	tqbnp	root	1	00:00.01	0.01	2336	1420	0	
14	tqdsp	root	1	00:00.01	0.00	1824	1416	0	
15	tqalm	root	1	00:00.00	0.00	1848	1429	0	
16	automountd	root	1	00:00.00	0.00	2216	181	0	

FIGURE 9 Processes Running at Time of Alarm

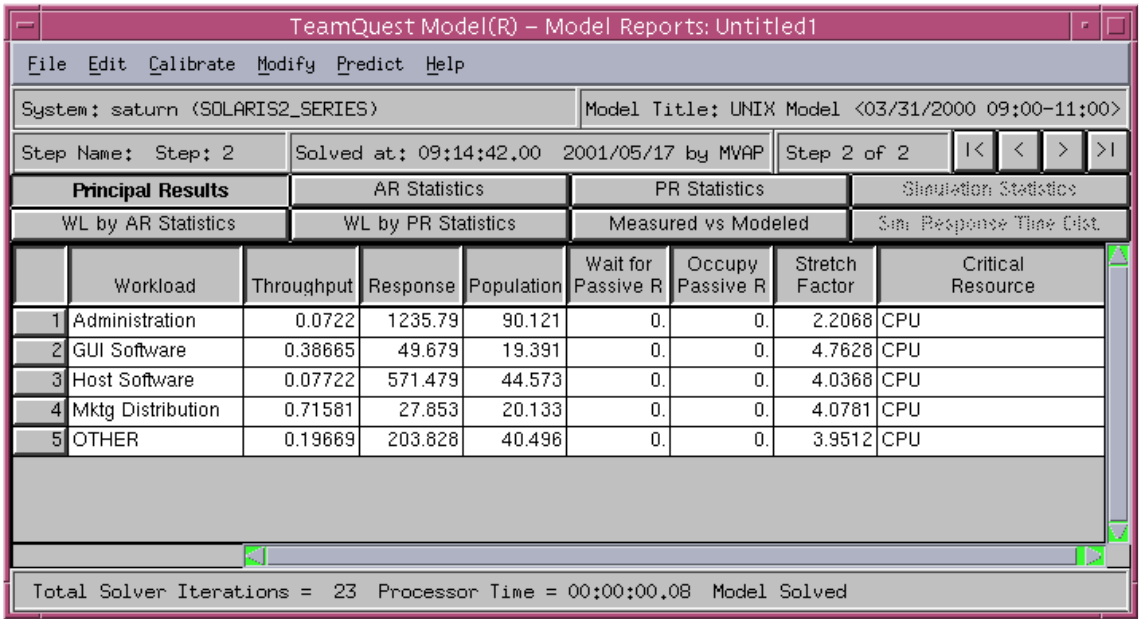
Besides providing more detailed information and more versatile reporting capabilities, a performance monitor will typically provide more in-depth analysis. TeamQuest View can, for example, automatically help you find the root cause of a problem. To do this it correlates a symptomatic parameter with others that it analyzes, looking for causal parameters that might be related. This can greatly accelerate the process of locating the actual cause of a performance problem.

Historical Analysis and Capacity Planning Tools: Being Proactive

The popular book, *The Seven Habits of Highly Effective People*, by Steven Covey, encourages the reader to break free of the reactive, continual fire-fighting mode that most of us live in. Likewise, we carry a similar message in this article: it is much more efficient to plan ahead and be prepared than it is to react to problems after they occur. So far, we have spent most of our time discussing how to react more quickly when a problem occurs. At best, by using a performance monitor or event console, you can detect a performance glitch before it becomes serious trouble. But it is possible to do better than that: system administrators are not doomed to always act as firefighters!

The only way to eliminate fire fighting is to take the time now to plan for what lies in the *future*. Fortunately, there are two classes of performance management tools that can help you do just that: Historical Analysis and Capacity Planning. Using these classes of tools, you can establish a baseline of performance for your servers, build a model for future demand, and predict what performance will be like based on that model.

TeamQuest View is an example of a performance tool with the historical analysis capability needed to establish a baseline. With it, for example, you can have on record the number of hits your servers took the last holiday season, including detailed information regarding the load that those hits created. Further, you can take that information and use it as the baseline for a capacity-planning tool, such as TeamQuest Model, shown in Figure 10, to predict future performance. With such a modeling tool, you can make hypothetical changes to your system configuration, such as the amount of memory, number of CPUs, or disk subsystem configurations, and predict the change in performance.



	Workload	Throughput	Response	Population	Wait for Passive R	Occupy Passive R	Stretch Factor	Critical Resource
1	Administration	0.0722	1235.79	90.121	0.	0.	2.2068	CPU
2	GUI Software	0.38665	49.679	19.391	0.	0.	4.7628	CPU
3	Host Software	0.07722	571.479	44.573	0.	0.	4.0368	CPU
4	Mktg Distribution	0.71581	27.853	20.133	0.	0.	4.0781	CPU
5	OTHER	0.19669	203.828	40.496	0.	0.	3.9512	CPU

FIGURE 10 Adding a Proposed CPU in TeamQuest Model

The ability to model performance based on an existing baseline not only minimizes the risk of over-purchasing hardware, but helps in two other areas of interest: justification of system expansion and server consolidation.

Justify System Expansion

A common scenario is that you know you need more computing resources, but your boss or friendly accountant suggests otherwise. Rather than making a request based on a “gut feeling,” it is possible to produce charts showing how poorly the current system will perform under future workloads, versus how an adequately configured system would perform.

Plan for Server Consolidation

The success of distributed computing has resulted in some environments with too many servers (“server saturation”) to effectively manage the waste of under-utilization of the aggregate computing resources. Consolidation of servers into a lesser number of larger machines can reduce complexity, simplify administration,

and increase efficiency of utilization. However, server consolidation efforts are often lengthy, complex, and can increase short-term risk: until applications are actually redistributed to their new hosts, it is hard to verify sizing. But with performance management tools in place, it is possible to establish an actual performance baseline and model the behavior in a changed environment. These tools become a powerful basis for rational consolidation and resizing of the computing environment. The result can be significantly decreased operating cost and more efficient operations.

Value Creation

So far, we have talked about the classes of tools that can be used to attain all but the highest maturity level described in the introduction to this article. That highest level is called “Value” and at the “Value” level, *performance*, or Information Technology (IT) metrics, must be analyzed together with *business* metrics, so that business considerations are combined with those concerning IT infrastructure.

Actually, this merging of business and IT metrics is frequently necessary when planning system expansions. To prepare for future system expansion, you need to predict future workloads. To do that, you need to understand something about your business and how you expect your business to grow in the future. Capacity planning for the purpose of planning system expansion frequently includes analysis that combines business and IT metrics.

It can also be useful to monitor or analyze business metrics, together with IT measurements, on a *daily* basis. An organization’s management might want to view, for example, sales revenue together with server transaction statistics. This can be possible using current performance management tools. For example, TeamQuest View includes the User Data Probe, which can be configured to gather data relating to virtually any process, whether it be a business process or software running on a computer system. The User Data Probe, together with TeamQuest’s “workload definition” capability, make it possible to analyze business metrics together with IT metrics, and state results in terms that make sense from a business management point of view, rather than from a point of view that relates solely to the information technology being used.

The “Value” management process maturity level is the highest and most difficult to attain. But once IT performance is viewed together with, and in terms of, business performance, it becomes easier for management to see the business value of the overall processes which include information technology. Few organizations manage their businesses and their information technology at the Value level, but those that do are able to realize and measure the true business benefits.

Separate or Suite?

Earlier we deferred the question of whether to select separate tools or employ integrated suites. Separate tools do allow the selection of best-of-breed applications. However, the four classes of tool we described are related to each other, and without full, rigorous, and open interfaces, integration between them can be difficult. For example, when looking at a problem reported by an event console, it is frequently necessary to obtain more detailed information in order to determine the cause of an alarm condition. If the alarm is still active, then the capabilities of a performance monitor might come in handy. To see what led up to a problem, or to analyze an alarm that is no longer active, it becomes necessary to use historical analysis tools. Integration between historical tools and capacity planning tools becomes very desirable when predictions are based on past baseline measurements; the ease of moving data between tools promotes more “what if” scenarios, and better planning.

Until recently, the dominant standard for interaction of managed objects and various management tools was Simple Network Management Protocol, or SNMP. Unfortunately that protocol lives up to its name, Simple, and has a number of shortcomings. Those shortcomings are addressed by a newer, more capable management standard, Web-Based Enterprise Management, or WBEM.

The WBEM standard consists of two parts; a schema for management information, and an interoperability capability based on standard internet protocols, XML and HTTP. This allows for communication between various management software and managed objects.

The schema in WBEM is the Common Information Model, or CIM. CIM provides a standard way to represent managed objects and their attributes, and to represent relationships *between* managed objects.

The combination of CIM and WBEM's interoperability protocol holds promise for a future where management applications and managed objects can interact freely. It could become easier, for example, to consolidate and analyze data gathered by management applications from different vendors. WBEM standards development is now the responsibility of the Desktop Management Task Force, or DMTF. For more information on DMTF's work, refer to their web site at: `http://www.dmtf.org/`.

Buy or Build?

One last question worth considering is whether to buy or to build performance management tools yourself. The UNIX® environment is rich with the building blocks for creating such tools, and with the tradition and expertise to build them. However, a number of issues suggest off-the-shelf tools should remain a serious consideration:

- While you *can* build the tools, *will* you?

- How will you maintain these tools? Who will document and train the users?
- Have you considered the true cost of building and maintaining custom tools?
- How will you support a heterogeneous environment?

The effort to craft a powerful and useful tool is not trivial, and features that could prove to be very useful are often left out, either through lack of expertise or resources.

Summary

This article has presented the “whats” and “whys” of performance management tools. We have discussed and provided brief examples of four classes of tool: event monitors, performance monitors, historical analysis tools, and capacity planning tools. There are a number of worthy tools available today that support heterogeneous environments. The important thing is that tools exist and should be used. We discussed both the motivations to provide better *reactive* support and the value in using tools to become more *proactive*. It is only when we monitor and measure what we have, and model for the future, that we can get out of the endless cycle of “fire fighting.”

Future articles will explore the details of the “hows” of using performance management tools to achieve these goals.

Acknowledgments

The authors would like to thank Jill Wicht for the two figure drawings included. Inclusion of original artwork in the Sun BluePrints™ OnLine is a special pleasure and luxury. References to Gartner Group’s work are used with permission.

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