

Chapter 19: Performance

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Overview

This chapter is an introduction to performance issues in R/3. We provide only general guidelines, not detailed performance tuning instructions. It is not possible in one chapter, to provide the breadth and depth of information available in the SAP training class or the *Performance Optimization* book. For more detailed performance tuning, we recommend the following resources:

- ▶ *BC315 – R/3 Workload Analysis* (the SAP Performance Tuning class)
- ▶ *SAP R/3 Performance Optimization*, by Thomas Schneider, SAP's TCC organization, which recently published a book on performance optimization.

Performance tuning is specialized troubleshooting. Since you are trying to solve performance issues, all troubleshooting techniques are also relevant.

Rather than using database and operating system-specific details, where possible, we will be using R/3 transactions to access relevant database and operating system data. This approach makes the information database and operating system independent.

Critical Assumption

The hardware, operating system, database, and R/3 have been properly installed based upon SAP's recommendations.

Why

As with the design of this book, performance tuning has to have a starting point. This point is the SAP-recommended configuration for hardware, database, operating system, network, etc.

An extreme example (that did occur with a customer) is where the operating system, the database, and R/3 has been installed on a single logical drive. In this situation, all the drives in the server were configured in a single RAID5 array and treated as a single, **huge** drive. This situation created a classic condition known as "head contention," where R/3, the database, and the operating system all simultaneously competing for the same disk drive head.

Head contention is similar to you being asked to do many things at the same time, such as:

- ▶ Cook dinner
- ▶ Read a book
- ▶ Help your child with homework
- ▶ Water the yard
- ▶ Fix the fence

You run around doing a little of each task then going to the next. None of the tasks get done with any reasonable speed.

This is an example of a problem that is not new. Head contention existed in the early days of computing. The solution now is essentially the same as it was back then, that is, to spread the data over multiple drives.

Priority of Evaluation

The SAP EarlyWatch group has determined that the majority of the performance issues and gains are from within R/3. This gain is followed first by database issues, then operating system, then hardware. Thus we will primarily discuss R/3 performance issues.

General Procedure

The general procedure when working on performance issues is not new. It is the standard problem-solving procedure:

- ▶ Gather data
- ▶ Analyze the problem
- ▶ Evaluate the alternatives
- ▶ Make only one change at a time

If there is a problem, you will not know which change caused a problem. There are times where several changes need to be made to fix a problem. Even so, unless they **must** be done together, such as related program changes, make the changes one at a time.

- ▶ Document the changes.
 - If a change causes a problem, you need to undo the change.
To do that you need to know what the configuration was before the change and what you did.
 - If the change needs to be applied to multiple systems, you need to know **exactly** what changes to make, and how to do it.
This process must be repeated **exactly the same** on all systems.

R/3

One of the most common reasons for R/3 performance problems is poorly written custom (or modified standard) ABAP programs.

Workload Analysis of the System (Transaction ST03)

What

Workload analysis is used to determine system performance.

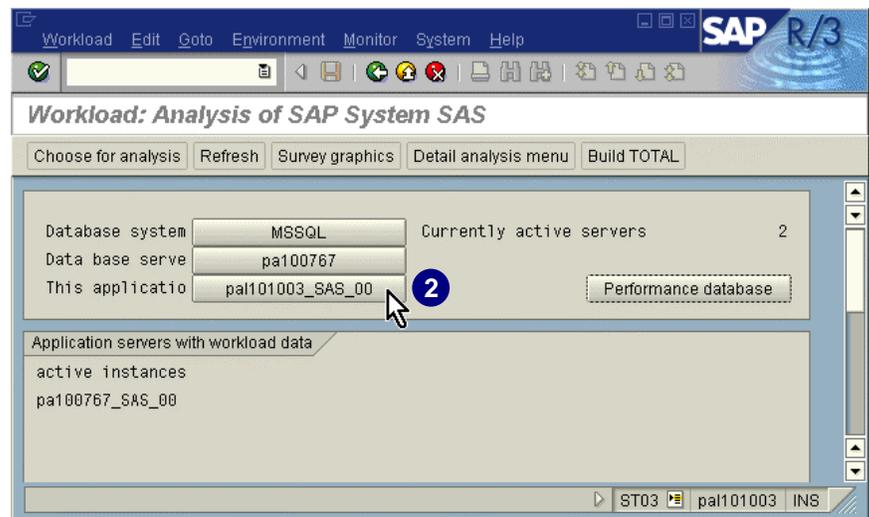
How

You should check statistics and record trends to get a “feel” for the system’s behavior and performance. Understanding the system when it is running well helps you determine what changes may need to be made when it is running poorly.



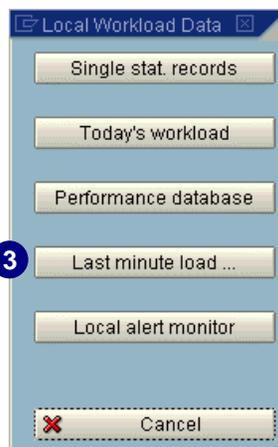
Guided Tour

1. In the *Command* field, enter transaction **ST03** and choose *Enter* (or from the *SAP standard menu*, choose *Tools* → *Administration* → *Monitor* → *Performance* → *Workload* → *ST03-Analysis*).
2. Choose *Data base server* or *This application server*. (In this example, we chose *This application server*, *pal101003_SAS_00*.)



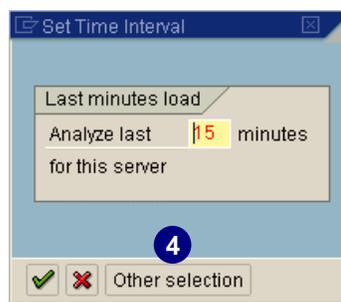
3. Select a time period to analyze.

(In this example, we chose *Last minute load*.)



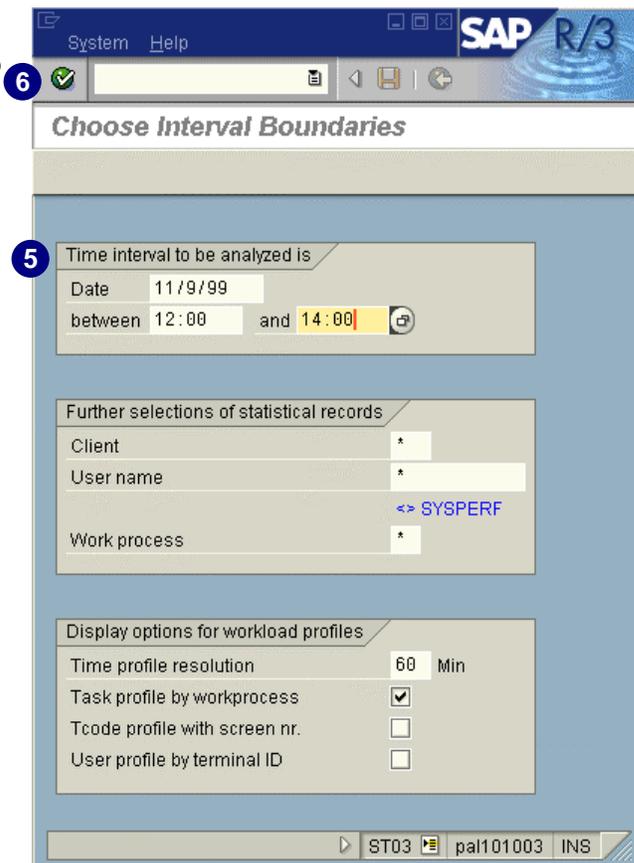
4. Enter how many minutes back to analyze, or choose *Other selection* to specify a date and time period to analyze.

In this example, we chose *Other selection*.



5. Under *Time interval to be analyzed is*, enter the *Date* and time range to be analyzed.

6. Choose .



7. Check the *Current* value under *Task types* (for example, *Total*).

The *task types* are:

- ▶ *Total*
- ▶ *Dialog*
- ▶ *Background*
- ▶ *RFC*

8. Choose the appropriate button to view performance values for that *Task type*.

9. Examine *Av. response time*.

If this value is less than 1,000 ms (1 second), the response time meets the target standard response time.

For more information on *Av. response time*, see notes below.

10. Choose *Transaction profile*.

Performance: Recent Workload for Server pal101003_SAS_00

Top time | Transaction profile | Time profile | Memory profile | Accounting profile | Task type profile | Application sta

Instance (10)

SAP System	SAS	Date	11/09/1999	First record	12:00:36
Instance no.	*	Last record		Last record	13:59:36
Server	pal101003	Time elapsed		Time elapsed	01:59:00

Workload

CPU time	321.0 s	Database calls	485,482
Time elapsed	7,140.0 s	Database requests	44,266
Dialog steps	485	Direct reads	22,810
Average CPU time	661.9 ms	Sequential reads	19,227
Av. RFC+CPIC time	2.2 ms	Changes	2,229
Av. response time	3,888.2 ms	Time per DB request	7.1 ms
Average wait time	130.3 ms	Direct reads	0.0 ms
Average load time	147.6 ms	Sequential reads	0.1 ms
Av. Roll i+w time	111.6 ms	Changes and commits	139.6 ms
Av. DB req. time	647.5 ms	Roll-in time	6.7 s
Av. enqueue time	10.5 ms	Roll-out time	5.5 s
Average bytes req.	119.7 kB	Roll wait time	16,098.6 s
		Roll-ins	2,082
		Roll-outs	524

Task types (8)

7 Current Total Others Dialog Background RFC

ST03 | pal101003 | INS



Judgment must be applied when reviewing statistical values. If you just started the R/3 System, the buffers will be empty and many of the statistics will be unfavorable. Once the buffers are loaded, values can be properly evaluated.

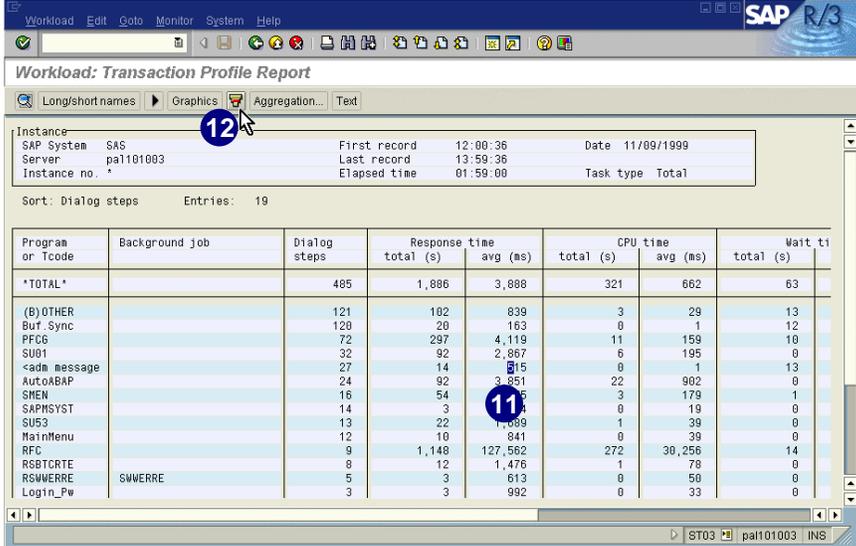
In this example, the *Av. response time* of almost 4 seconds must be evaluated with other factors in mind.



The R/3 user default for a *decimal point* is a *comma*. If your default profile for *decimal point*, (point or comma) is not appropriately set, the display may be misread. For example, rather than 3,888 ms, it would read 3.888 ms. Quite a difference!

11. Click on any cell in the *Response time avg* column.

12. Choose .



Workload: Transaction Profile Report

Instance

SAP System	SAS	First record	12:00:36	Date	11/09/1999
Server	pal101003	Last record	13:59:36		
Instance no.	*	Elapsed time	01:59:00	Task type	Total

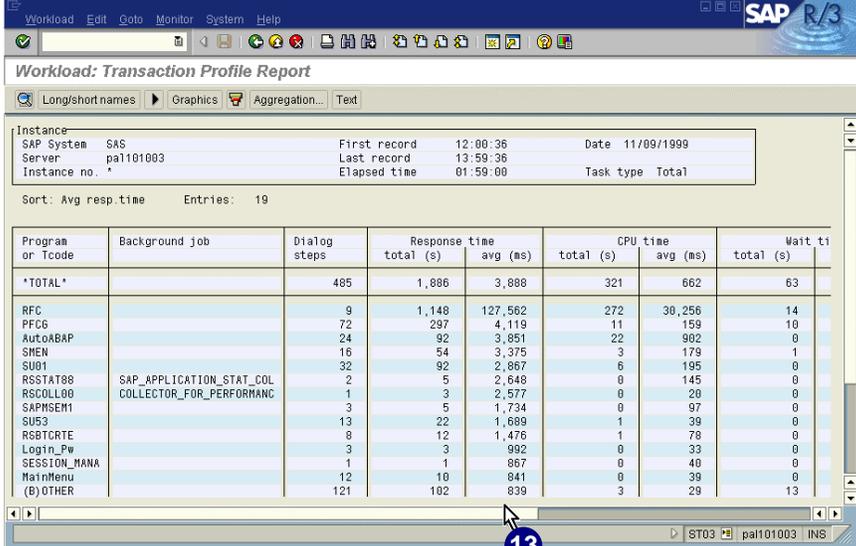
Sort: Dialog steps Entries: 19

Program or Tcode	Background job	Dialog steps	Response time		CPU time		Wait ti
			total (s)	avg (ms)	total (s)	avg (ms)	
TOTAL		485	1,086	3,088	321	662	63
(B)OTHER		121	102	839	3	29	13
Buf.Sync		120	20	163	0	1	12
PFCG		72	297	4,119	11	159	10
SUB1		32	92	2,867	6	195	0
<adm message		27	14	815	0	1	13
AutoABAP		24	92	3,851	22	902	0
SMEN		16	54	3,375	3	179	1
SAPMSYST		14	3	15	0	19	0
SUS3		13	22	1,689	1	39	0
MainMenu		12	10	841	0	39	0
RFC		9	1,148	127,562	272	30,256	14
RSBTCRTE		8	12	1,476	1	78	0
RSWERR	SWERR	5	3	613	0	50	0
Login_Pw		3	3	992	0	33	0



Analysis of transaction *ST03* is covered in BC315 (the Workload Analysis and Tuning class). We recommend you take this class.

13. The programs and transactions are now sorted in average response time order.



Workload: Transaction Profile Report

Instance

SAP System	SAS	First record	12:00:36	Date	11/09/1999
Server	pal101003	Last record	13:59:36		
Instance no.	*	Elapsed time	01:59:00	Task type	Total

Sort: Avg resp.time Entries: 19

Program or Tcode	Background job	Dialog steps	Response time		CPU time		Wait ti
			total (s)	avg (ms)	total (s)	avg (ms)	
TOTAL		485	1,086	3,088	321	662	63
RFC		9	1,148	127,562	272	30,256	14
PFCG		72	297	4,119	11	159	10
AutoABAP		24	92	3,851	22	902	0
SMEN		16	54	3,375	3	179	1
SUB1		32	92	2,867	6	195	0
RSSTAT88	SAP_APPLICATION_STAT_COL	2	5	2,648	0	145	0
RSCOLLO0	COLLECTOR_FOR_PERFORMANC	1	3	2,577	0	20	0
SAPMSE1		3	5	1,734	0	97	0
SUS3		13	22	1,689	1	39	0
RSBTCRTE		8	12	1,476	1	78	0
Login_Pw		3	3	992	0	33	0
SESSION_MANA		1	1	867	0	40	0
MainMenu		12	10	841	0	39	0
(B)OTHER		121	102	839	3	29	13

A few standard functional transactions will exceed the one-second guideline. They include, but are not limited to the following:

Type	Transaction
Create Sales Order	<i>VA01</i>
Change Sales Order	<i>VA02</i>
Display Sales Order	<i>VA03</i>
Create Billing Document	<i>VF01</i>
Create Delivery	<i>VL01</i>
Maintain Master HR data	<i>PA30</i>

Buffers (ST02)

What

The buffer tune summary transaction displays the R/3 buffer performance statistics. It is used to tune buffer parameters of R/3 and, to a lesser degree, the R/3 database and operating system.

Why

The buffer is important because significant buffer swapping reduces performance. Look under *Swaps* for red entries. Regularly check these entries to establish trends and get a feel for buffer behavior.



Guided Tour

1. In the *Command* field, enter transaction **ST02** and choose *Enter* (or from the *SAP standard menu*, choose *Tools* → *Administration* → *Monitor* → *Performance* → *Setup/Buffers* → *ST02-Buffers*).

Tune Summary (pa101003_SAS_00)

System: pa101003_SAS_00 Tune summary
 Date & time of snapshot: 09/13/1999 13:42:05 Startup: 09/13/1999 12:04:35

Buffer	Hitratio [%]	Allocated [kB]	Free space [kB]	Dir. size [%]	Free directory Entries	Free directory [%]	Swaps	Database accesses
Nametab (NTAB)								
Table definition	78.88	3,364	2,698	98.68	20,000	19,738	98.69	0
Field description	69.30	31,567	29,638	98.79	40,001	39,745	99.36	0
Short NTAB	80.99	4,567	2,979	99.30	40,001	39,846	99.61	0
Initial records	73.97	7,567	5,949	99.15	40,001	39,887	99.72	0
Program								
CUA	83.45	204,474	121,748	60.87	50,000	49,315	98.63	0
Screen	95.11	3,000	2,630	95.53	1,500	1,477	98.47	0
Calendar	98.63	4,297	4,129	99.35	2,000	1,975	98.75	0
Calendar	100.00	488	380	79.50	200	72	36.00	0
Tables								
Generic key	99.95	5,859	594	10.40	1,000	877	87.70	0
Single record	47.21	2,000	1,724	86.72	100	80	80.00	0
Export/import	100.00	4,096	3,767	100.00	2,000	2,000	100.00	0
SAP memory								
	Current use [%]	Max. use [kB]	In memory [kB]	On disk [kB]				
Roll area	2.15	176	624	8,192	0			
Paging area	0.01	16	24	9,600	252,544			
Extended Memory	7.09	9,216	16,384	130,048				
Heap Memory		0	0					

2. The two important things to review on the above screen are:

- a. *Hit Ratio*

The target value is 95 percent and higher. Soon after starting the system, this value is typically low, because buffers are empty. The hit ratio will increase as the system is used and the buffers are loaded. It usually takes a day to load the buffers that are normally used.

- b. *Swaps*

The target value is less than 1,000. Swaps occur when the necessary data is not in the buffer. The system has to retrieve the data from the database. The swap value is reset to zero (0) when the system is restarted.



Analysis of transaction *ST02* is covered in BC315 (the Workload Analysis and Tuning class). We recommend you take this class.

Memory Defragmentation

What

A computer's memory behaves similar to a hard disk. As different programs execute, they are loaded into, and later deleted out of, memory. Over time, like a hard disk, the usage of the computer's memory becomes fragmented with unused spaces scattered throughout.

Why

At a certain point you may have sufficient "free memory" (that is, the total of all the unused spaces), but not a contiguous (single) piece of memory large enough to allow certain programs to execute. At that point, those types of programs attempting to run that need contiguous memory will fail because they cannot be loaded into memory.

How

To defragment the system's memory:

1. Stop R/3.

This step requires stopping R/3 on all application and database servers. (For more information, see *Start/Stop R/3* in chapter 10.)

2. Restart R/3.

You only need to restart R/3, you do not need to cycle the server.



When R/3 is restarted, the buffers are refreshed. This process means that the first person who accesses the buffered object will have a long response because the system must get the data from disk and load it into the buffer. The second person will have a normal (quick) response time. This process repeats until all normally used objects are loaded into the buffer, which usually takes up to a day to accomplish.

Database

See chapter 13 (*Database Administration – Microsoft SQL Server*) for the database-related performance tuning transactions:

- ▶ Activity - *ST04*
- ▶ Tables/Indexes - *DB02*

Operating System

Operating System Monitor (OS07)

What

The operating system monitor allows you to view relevant operating system and hardware details.

The operating system-related detail, such as:

- ▶ Memory paging
- ▶ Operating system log

In addition, the following hardware details are available:

- ▶ CPU utilization
- ▶ Free space on disks

Why

Certain operating system items will impact R/3 performance.

How

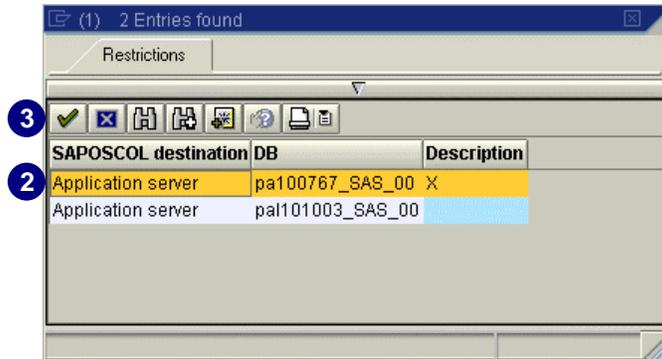


Guided Tour

1. In the *Command* field, enter transaction **OS07** and choose *Enter* (or from the *SAP standard menu*, choose *Tools* → *Administration* → *Monitor* → *Performance* → *Operating System* → *Remote* → *OS07-Activity*).

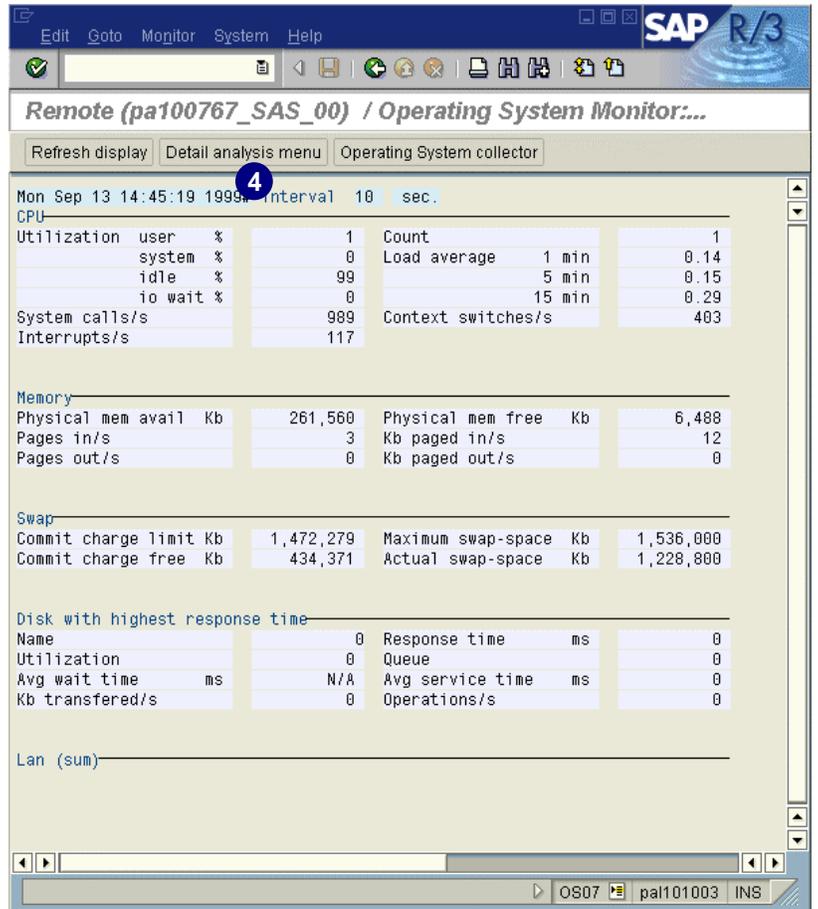
2. Select the appropriate server.

3. Choose

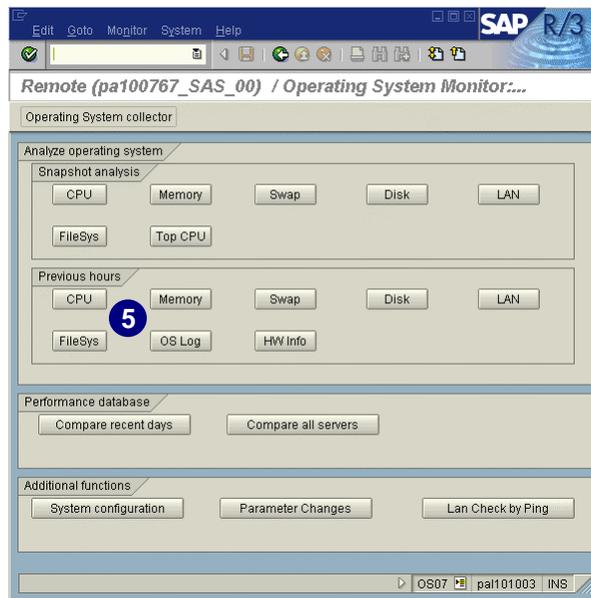


This screen is a snapshot of the *CPU*, *Memory*, *Swap*, and *Disk response* data.

4. To analyze, choose *Detail analysis menu*.



- Choose an item under *Previous hours* (for example, *Memory* or *OS Log*).



This screen shows CPU utilization over time.

The screenshot shows the SAP R/3 CPU Last 24 Hours report. The title bar reads 'Local (pa100767) / CPU Last 24 Hours'. The report is titled 'Fri Sep 24 15:30:45 1999#'. The data is presented in a table with columns for Hour, CPU utilization in % (User, System, Idle, IO Wait), Interrupts /h, System calls /h, and Context switches /h.

Hour	User	System	Idle	IO Wait	Interrupts /h	System calls /h	Context switches /h
15	2	0	97	0	468,991	4,775,230	2,259,900
14	3	1	96	0	523,247	4,948,771	2,367,004
13	2	0	97	0	457,528	4,672,382	2,205,977
12	1	0	98	0	407,184	4,537,849	2,109,301
11	3	1	97	0	482,844	4,895,516	2,048,414
10	2	0	97	0	443,356	4,664,275	2,154,187
9	3	0	97	0	468,081	4,793,774	2,250,104
8	1	0	98	0	402,431	4,542,066	2,081,770
7	2	0	98	0	409,428	4,537,035	2,091,826
6	1	0	99	0	400,765	4,520,351	2,073,069
5	1	0	99	0	400,619	4,520,264	2,075,525
4	1	0	99	0	400,664	4,524,943	2,076,276
3	1	0	99	0	399,915	4,517,178	2,074,882
2	1	0	99	0	400,220	4,523,763	2,074,870
1	1	0	99	0	401,051	4,520,623	2,075,096
0	1	0	99	0	401,398	4,532,451	2,080,059
23	1	0	99	0	400,836	4,527,753	2,077,385
22	1	0	99	0	401,362	4,527,213	2,079,398
21	1	0	99	0	400,695	4,521,722	2,078,147
20	2	0	98	0	417,872	4,530,691	2,103,561
19	1	0	99	0	406,681	4,530,450	2,088,532
18	1	0	99	0	410,274	4,540,728	2,094,931
17	2	0	98	0	423,179	4,580,493	2,119,640
16	2	0	97	0	443,662	4,651,516	2,162,805

This window shows the memory paging and free memory over time.

Local (pa100767) / Memory Last 24 Hours

Graphics by column

Fri Sep 24 15:30:45 1999#

Hour	Pages in /h	Pages out /h	Paged in [Kb/h]	Paged out [Kb/h]	Free memory/h in Kbyte		
					minimum	maximum	average
15	39,143	25,496	156,572	101,984	3,676	8,272	5,797
14	56,644	55,916	226,576	223,664	2,140	7,276	4,911
13	29,157	27,175	116,628	108,700	2,304	8,500	5,767
12	3,905	3,472	15,620	13,888	3,452	10,600	7,578
11	39,274	38,720	157,096	154,880	2,692	11,532	7,179
10	19,073	28,735	76,292	114,940	4,032	16,496	12,227
9	41,782	36,814	167,128	147,256	984	27,856	12,554
8	763	2,809	3,052	11,236	20,424	28,228	24,422
7	6,410	3,264	25,640	13,056	15,456	48,180	22,655
6	82	3,225	328	12,900	37,856	48,784	45,465
5	45	2,634	180	10,536	36,276	46,412	44,007
4	31	2,537	124	10,148	31,816	41,320	39,075
3	179	2,108	716	8,432	28,564	38,736	35,343
2	162	1,831	648	7,324	27,344	34,976	33,943
1	376	2,363	1,504	9,452	21,416	34,280	28,798
0	694	2,312	2,776	9,248	17,568	27,348	24,676
23	406	2,459	1,624	9,836	14,520	23,828	19,480
22	1,222	1,901	4,888	7,604	11,592	19,692	16,577
21	789	2,250	3,156	9,000	7,340	17,688	13,716
20	13,865	7,975	55,460	31,900	2,948	19,216	9,376
19	4,436	4,302	17,744	17,208	2,136	7,032	5,732
18	5,897	5,739	23,588	22,956	2,084	6,704	5,176
17	13,420	12,177	53,680	48,708	2,708	7,520	5,450
16	21,537	23,205	86,148	92,820	2,880	8,820	6,211

OS07 pa100767 INS

This is the *Operating System Log*.

Operating system log

Operating System Log

Contents of Operating-System Log

NT Eventlog extract
Report generated at 15:32:40 24.09.1999

Event: 3263

Source:DCOM Type=ERROR from PA100767
Time:14:22:05 22.09.1999 Event ID=10006 Category:0
Event Message Text:
DCOM got error "%2148007941" from the computer pa1002840 when attempting to# activate the server:#
{EFC29CC0-A03C-11D0-A1F2-0000F62893CC}

Event: 3262

Source:Srv Type=WARNING from PA100767
Time:14:21:20 22.09.1999 Event ID=2013 Category:0
Event Message Text:
The H: disk is at or near capacity. You may need to delete some files.

Event: 3261

Source:EventLog Type=INFORMATION from PA100767
Time:14:15:25 22.09.1999 Event ID=6005 Category:0
Event Message Text:
The Event log service was started.

OS07 pa100767 INS

Hardware

CPU and Disk

Also see *Operating System – Operating System Monitor (OS07)* to get data on:

- ▶ CPU utilization
- ▶ Free space on disks

Memory

The hardware item that has the largest effect on R/3 performance is memory. The R/3 System uses memory extensively. By keeping data in buffer, physical access to the drives is reduced. Thus, in general, the more memory you have, the faster R/3 will run.



Physical access to the drives is the slowest activity.

