

Performance Analysis Roadmaps and Checklists

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Performance Analysis

Roadmaps and Checklists

This appendix contains the most important procedure roadmaps and checklists for performance analysis of SAP-based software components.

The prerequisites for performing an analysis are as follows:

- ▶ The component starts without error.
- ▶ Sufficient work processes are still available to run the performance analysis.
- ▶ If there are no available work processes, you can call the SAP auxiliary program `dpmon`. This program is called on the operating system level and enables you to access basically the same information as is found in the work process overview.

The checklists for performance analysis contain references to other sections in this book that explain available optimization options. Please ensure that you carefully consider the explanatory and cautionary notes in these sections before making any changes to your system.

Overview of the Times in Statistics Records and Workload Monitor

For the times indicated in the single-record statistics (Transaction STAD) and in the workload monitor (Transaction ST03), several relationships apply.

The *work process time* is calculated as follows:

Work process time

Time in work process = *response time* – *wait time* – *roll wait time*

The *wait time* is the period of time that a query waits in the dispatcher queue for a free work process and should actually be referred to as dispatcher wait time because there are many more wait situations in the system. The roll wait time occurs if a running program is rolled out from the work process because it waits for the response of a communication partner for an RFC or HTTP communication.

Dispatcher
wait time

The *processing time* is defined as follows:

Processing time

Processing time = response time – wait time – roll wait time – roll-in time – load and generation time – database time – DB procedure time

The processing time therefore excludes all times when the program waits for the work process, is rolled in to the work process, is loaded or generated, or waits for the database, an RFC, or an HTTP call. In other words, this is the time in which the work process executes the program (excluding the SQL statements contained in the program, stored procedures, RFCs, and HTTP calls).

Usually, this relationship applies:

Processing time > CPU time

This rule can be violated in individual cases because CPU is required in the work process during the roll-in, loading, and generation and during the database call. Therefore, the CPU time runs in these times, as well.

Another rule is that a large difference between processing time and CPU time should result in a detailed analysis (see Chapter 3, Section 3.3.3, Interpreting Response Times).

For the roll wait time, this relationship applies:

Roll wait time

RFC time + GUI time + HTTP time > roll wait time

RFC time, GUI time, and HTTP time (i.e., calling time in the HTTP area) are gross times for an RFC, an RFC to GUI, or an HTTP call. They comprise the setup of communication, data transfer, and roll-out and roll-in, respectively. The roll wait time, however, is the net time that the system waited for the communication partner. Note that a roll wait time can occur in an RFC but doesn't have to (see Chapter 7, Section 7.2, Remote Function Calls (RFCs), and Chapter 8, Section 8.1, SAP GUI).

The response time that a user actually perceives in SAP GUI results from the following formula:

Response time

SAP GUI response time = response time + frontend time

The SAP GUI response time is not explicitly indicated in the single-record statistics and workload monitor. Also note that the frontend time (FE

net time) cannot always be determined and can therefore equal zero in individual cases (see SAP Note 679918).

The entire time for communication with the SAP GUI results from:

Frontend time + GUI time

The GUI time is part of the response time; the frontend time is not (see Chapter 8, Section 8.1, SAP GUI).

Only in transactions in the SAP GUI can a time for the communication with the frontend be indicated in the single-record statistics and the workload monitor. Other UI technologies, such as Web UI or the Excel-based SAP BEx Web analyzer, use other analysis methods (see Chapter 8, Section 8.3, Analyses on the Presentation Server, and Chapter 13, Section 13.2, Analysis of Expensive BW Queries).

One specific detail occurs when an RFC calls another RFC. To avoid double counts, the roll wait time is subtracted from the response time in the calling remote function.

Checklists

This section contains *problem checklists* in the form of short summaries for individual problems that are frequently identified in performance analysis. Each checklist identifies the priority of the problem, provides indications and procedures for finding and analyzing the problem, gives applicable solutions and references to portions of this book relevant to the problem, points out essential reading before attempting to solve the problem, and offers a boxed reminder.

The checklists suggest the following priorities:

Prioritizing

► Very high

Reserved for when there is a danger that performance problems will soon cause a system standstill and there are no longer sufficient free work processes available to analyze or solve the problem. The only alternative is to stop the software component.

► **High**

Problems that are likely to drastically reduce system-wide performance.

► **Medium**

Problems that are likely to drastically reduce the performance of individual programs or application servers. Do not underestimate the impact of these problems on critical business processes or the possibility that the problem will escalate.

► **Low**

Do not list performance problems with a low priority in the checklists.

Detailed Analysis of Hardware Resources (Transaction ST06)

Problem: CPU Bottleneck Due to High Resource Consumption from Individual Processes	
Priority	Medium to high
Indications and procedures	A computer has less than 20% CPU capacity available. Check this using the TOP CPU PROCESSES function in the operating system monitor. To access this function, use Transaction ST06 and select DETAIL ANALYSIS MENU • TOP CPU PROCESSES. The new screen shows individual processes that consume considerable CPU resources over long periods of time.
Solution	<ul style="list-style-type: none"> ► Use the work process overview (Transaction SM50 or SM66) to identify the SAP work process, the program, and the user; then analyze the program or reschedule it. ► Identify the Java process/thread in the process overview in the SAP Management Console; then analyze the program. ► Identify the database processes in the database process monitor (for example, ST04, Detailed Analysis menu, Oracle Session [for an Oracle database]), and optimize the corresponding SQL statement. ► For external processes with high CPU utilization, optimize or terminate them.
Reference	Chapter 2, Section 2.2, Hardware Monitoring

Problem: CPU Bottleneck Due to Nonoptimal Load Distribution	
Priority	Medium: This problem can lead to high response times on specific computers.
Indications and procedures	In a distributed system with multiple computers, you detect a hardware bottleneck on at least one computer, while other computers still have available, unused resources.
Solution	Redistribute the SAP work processes, after which you may need to reset the associated virtual memory areas, buffers, and user distribution.
Reference	Section 2.2, Hardware Monitoring, and Chapter 7, Load Distribution and Remote Function Calls

Problem: Main Memory Bottleneck	
Priority	Medium to high: This problem can lead to high response times on specific computers.
Indications and procedures	A computer displays high paging rates. These are especially critical for increased CPU usage. Calculate the main memory allocated by SAP instances and the database and compare it with the physically available main memory on the individual computers. If the allocated memory exceeds the physically available main memory by more than 50% and there are high paging rates, you have a main memory bottleneck.
Solution	If the load cannot be redistributed (see problem above), the main memory must be upgraded.
Reference	Chapter 2, Section 2.2, Hardware Monitoring

Detailed Analysis of SAP Work Processes (Transactions SM50 and SM66)

Problem: Terminated Work Processes	
Priority	High to very high
Indications and procedures	Numerous terminated work processes (indicated as complete in the STATUS column). After you restart the processes, they are terminated again.

Problem: Terminated Work Processes	
Solution	<ul style="list-style-type: none"> ▶ Wrong configuration parameters (i.e., memory management, problem with the SAP kernel or with logging on to the database) ▶ Check whether the SAP kernel version is up to date by calling Transaction SM51 and selecting RELEASE INFO. Refer to the SAP Service Marketplace for relevant SAP Notes or contact SAP Support.
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes

Problem: Work Processes Stuck in Private Mode or in Roll-In/Roll-Out	
Priority	Medium to high: This problem can lead to high response times on specific computers.
Indications and procedures	More than 20% of the work processes are indicated in the work process overview (Transaction SM50 or SM66) as being in PRIV mode or in roll-in or roll-out.
Solution	The problem is in SAP memory management. Correctly set the parameters of SAP memory management, for example, <code>em/initial_size_MB</code> , <code>rdisp/ROLL_SHM</code> , <code>ztta/roll_extension</code> . See also the checklist "Extended Memory Is Too Small" in this section.
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Section 2.4, Analyzing SAP Memory Configuration

Problem: Deactivated Update Service	
Priority	Very high: This problem can cause a standstill in the SAP system.
Indications and procedures	All update work processes (indicated as UPD in the work process overview) are occupied. Transaction SM13 indicates that the update has been deactivated.
Solution	The system log contains an entry for the time, user, and reason for the deactivation. Resolve the reported problem (for example, a database error). Then reactivate the update service with Transaction SM13.
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Section 2.3, Database Monitoring

Problem: High Database Response Times	
Priority	Medium to very high
Indications and procedures	The ACTION column in the work process overview (Transaction SM50 or SM66) indicates sequential read, direct read, waiting for DB lock, or other database activities for various work processes.
Solution	The problem is related to the database. Therefore, rather than increasing the number of SAP work processes, examine the database more closely (see the "Detailed Analysis of the Database" checklist).
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Section 2.3, Database Monitoring

Problem: Long Runtimes for Individual Programs	
Priority	Medium: This problem can lead to high response times for specific programs.
Indications and procedures	Programs with long runtimes block work processes.
Solution	Determine whether the related ABAP program is still running properly. Analyze the affected programs and optimize or terminate them, as appropriate.
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Chapter 4, Identifying Performance Problems in ABAP Programs

Problem: Non-Optimal Load Distribution	
Priority	Medium: This problem can lead to high response times on specific computers.
Indications and procedures	In a distributed system with multiple computers, you detect a work process bottleneck on at least one computer, while other computers still have free work processes.
Solution	Call Transaction SMLG and check whether all the servers are available for load distribution with logon groups or logon errors have been reported. Use Transaction SMLG to optimize the logon groups.

Problem: Non-Optimal Load Distribution	
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Chapter 7, Load Distribution and Remote Function Calls

Problem: Insufficient Work Processes	
Priority	Medium: This problem can lead to high response times on specific computers.
Indications and procedures	None of the previously listed problems apply, but there is still a problem with work processes.
Solution	If the computer has sufficient reserves of CPU and main memory, increase the number of SAP work processes.
Reference	Chapter 2, Section 2.5, Analyzing SAP Work Processes, and Chapter 7, Load Distribution and Remote Function Calls

Detailed Analysis of Java Servers

Problem: Frequent Full Garbage Collection	
Priority	High: This problem can cause temporary standstills of several seconds for the Java server.
Indications and procedures	Frequent full garbage collections: The time required for garbage collections is greater than 5%. The growth rate of old memory space (OGR) does not decrease significantly at times of low load.
Solution	Check whether the load distribution is unfavorable and analyze the Java programs.
Reference	Chapter 10, Optimizing Java Virtual Machine and Java Programs

Problem: High Number of Occupied Java Threads	
Priority	High: This problem can cause temporary standstills of several seconds for the Java server.
Indications and procedures	Run a Java thread dump; it lists all active Java programs.

Problem: High Number of Occupied Java Threads	
Solution	Check whether the load distribution is unfavorable and analyze the Java programs.
Reference	Chapter 10, Optimizing Java Virtual Machine and Java Programs

Detailed Analysis of the Database (Transaction DBACOCKPIT)

Problem: Long Database Locks	
Priority	Medium to very high: This problem can cause a standstill in the SAP system.
Indications and procedures	In the database monitor, click PERFORMANCE • WAIT EVENT ANALYSIS • LOCK MONITOR (ORACLE) (or use Transaction DB01). Refresh this monitor several times within a short time frame and check whether long-lasting wait situations occur because of database locks. With the help of the fields CLIENT HOST and CLIENT PID in the work process overview, you can determine which programs and users hold locks. Determine whether the related ABAP program is still running properly.
Solution	After consulting the affected users, terminate a program or process manually.
Reference	Chapter 2, Section 2.3, Database Monitoring

Problem: CPU Bottleneck on the Database Server	
Priority	High: This problem can lead to high database response times.
Indications and procedures	Call the operating system monitor (Transaction ST06) on the database server and see whether it shows a CPU bottleneck.
Solution	Check whether the CPU bottleneck originates from expensive SQL statements, incorrectly set database buffers, or an I/O bottleneck. You may need to reduce the load on the database server or increase its CPU capacity.
Reference	Chapter 2, Section 2.3, Database Monitoring, Section 2.2, Hardware Monitoring, and Chapter 7, Load Distribution and Remote Function Calls

Problem: Number of Logical Processors for the Database Instance	
Priority	High: This problem can lead to high database response times.
Indications and procedures	There are profile parameters that specify the maximum number of processors that are physically available to the database instance. These parameters include <code>MAXCPU</code> (for SAP MaxDB) and <code>NUMCPUVPS</code> (for IBM Informix). Check whether this parameter is optimally configured.
Solution	If necessary, adjust this parameter.
Reference	Chapter 2, Section 2.3, Database Monitoring

Problem: Database Buffer Too Small	
Priority	Medium to high: This problem can lead to high database response times.
Indications and procedures	Call the database performance monitor in the <code>PERFORMANCE OVERVIEW</code> screen (Oracle) and check whether the buffer quality and other key figures match recommended values.
Solution	Increase the size of the buffer once by 25% and then check whether the quality improves.
Reference	Chapter 2, Section 2.3, Database Monitoring

Problem: Expensive SQL Statements	
Priority	Medium to high: This problem can lead to high database response times.
Indications and procedures	Call the database monitor and select <code>PERFORMANCE • SQL STATEMENT ANALYSIS • SHARED CURSOR CACHE (ORACLE)</code> . If there are few expensive SQL statements that cause more than 10% of the total response time, continue with a detailed analysis of the SQL statements.
Reference	Chapter 2, Section 2.3, Database Monitoring, and Chapter 11, Optimizing SQL Statements

Problem: Database I/O Bottleneck	
Priority	Medium to high: This problem can lead to high database response times.
Indications and procedures	<p>Call the database monitor and select PERFORMANCE • WAIT EVENT ANALYSIS • FILESYSTEM REQUESTS (ORACLE). In the OS monitor of the database server (ST06), select DETAIL ANALYSIS MENU • DISK.</p> <p>Check if the value in the UTIL column is greater than 50%. This indicates an I/O bottleneck.</p> <p>Check whether data files that are heavily written reside on these disks.</p>
Solution	Resolve the read/write (I/O) bottleneck by improving table distribution in the file system. Ensure that heavily accessed files do not reside on the same drive. These include files for the swap space, redo log, and transaction log.
Reference	Chapter 2, Section 2.2, Hardware Monitoring, and Section 2.3, Database Monitoring

Problem: Statistics for the Database Optimizer Are Obsolete or Not Available	
Priority	Medium to high: This problem can lead to high database response times.
Indications and procedures	To check whether optimizer statistics are created regularly, call the DBA PLANNING CALENDAR.
Solution	Schedule the program for updating statistics.
Reference	Chapter 2, Section 2.3, Database Monitoring, Chapter 11, Optimizing SQL Statements, and SAP Help for topics on database administration

Problem: Missing Database Indexes	
Priority	<p>Very high if a primary index is missing: This can cause data inconsistencies.</p> <p>Medium if a secondary index is missing: This can cause high response times for individual programs.</p>

Problem: Missing Database Indexes	
Indications and procedures	Check whether there are any missing database indexes by calling the monitor for analyzing tables and indexes (Oracle) and selecting DETAIL ANALYSIS MENU • STATE ON DISK: MISSING INDICES.
Solution	Re-create the missing indexes.
Reference	Chapter 2, Section 2.3, Database Monitoring, and Chapter 11, Optimizing SQL Statements

Problem: Large Differences in Database Times Caused by Buffer Load Process	
Priority	Medium to high: This problem can lead to high response times for specific programs.
Indications and procedures	To view occasional, long database accesses to buffered tables, use one of the following: the local work process overview (Transaction SM50), an SQL trace (Transaction ST05), or the single-record statistics (Transaction STAD).
Solution	Call the table access statistics (Transaction ST10) and verify the efficiency of table buffering.
Reference	Chapter 12, SAP Buffering

Problem: Network Problems	
Priority	Medium to high: This problem can lead to high response times on specific computers.
Indications and procedures	Determine whether there is a network problem between the database server and the application server by comparing SQL trace results on these two servers.
Solution	Resolve the network problem between the two servers.
Reference	Chapter 2, Section 2.3, Database Monitoring, and Chapter 4, Section 4.2.2, Evaluating an SQL Trace

Detailed Analysis of Memory Management and Buffers (Transaction ST02)

Problem: Extended Memory Is Too Small	
Priority	High
Indications and procedures	To determine whether either the extended memory or roll buffer is too small, use the SAP memory configuration monitor (Transaction ST02). See also the "Work Processes Stuck in Private Mode or in Roll-In/Roll-Out" checklist in this appendix.
Solution	Correct the SAP memory configuration parameters such as <code>em/initial_size_MB</code> , <code>rdisp/ROLL_SHM</code> , and <code>ztta/roll_extension</code> . If you have sufficient main memory on the server, you can increase the memory size by 20 to 50%. Check to see if this improves the situation.
Reference	Chapter 2, Section 2.4, Analyzing SAP Memory Configuration, and Chapter 6, Memory Management

Problem: Displacements in SAP Buffers	
Priority	Medium
Indications and procedures	Look for displacements in the SAP buffers in the SWAPS column in the SAP memory configuration monitor (Transaction ST02). Displacements mean the buffers are configured too small.
Solution	Increase the maximum number of buffer entries or the size of the SAP buffer, provided that the computer still has sufficient main memory reserves.
Reference	Chapter 2, Section 2.4, Analyzing SAP Memory Configuration