Memory Management (BC-CST-MM)

Release 4.6C

SAP ™

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Icons

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⚠	Caution
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🧭	Recommendation
SYN	Syntax

Contents

Memory Management (BC-CST-MM)

This documentation introduces you to the SAP R/3 Memory Management System and explains which parameters are available and what the optimal settings for your system are.

It describes the basic functions of the SAP Memory Management System and how best to configure your system depending on the platform you use, the available resources, and what you want your system to do.

It also describes hardware and operating system requirements and explains how to monitor the system and recognize and resolve problems.

The documentation is divided into several sections:

Functions of the R/3 Memory Management System

An application runs in an R/3 Work Process [Page 14] where an ABAP program is normally executed. The process requires memory to do this, which allocated to it by the memory management system. The order in which the work process is assigned the memory type depends on the work process type, either dialog or non-dialog (see R/3 Memory Types [Page 9]), and the underlying operating system.

This is described in more detail in the documentation on the operating system.

The location of the various memory areas in the virtual address space is explained in Virtual Address Space of a Work Process [Page 14].

The area of a user context [Page 13] that is directly accessible is now extended as needed, if the user context has expanded. For dialog work processes, the data of the user context, including internal tables is located in this expanded area. You can therefore access all the data in the user context. Only the data types "**extract**" and "**export to memory**" remain in the SAP Paging [Ext.].

The R/3 roll area [Page 10] is used for the initial memory assigned to a user context, and (if available) for additional memory if the expanded memory is full.

The following diagram displays the memory types that can be assigned to R/3 work processes on the R/3 and operating system level. Here are the most important system profile parameters that control the availability of the memory types.

Functions of the R/3 Memory Management System

Roll Area	Extended Memory	Private Memory
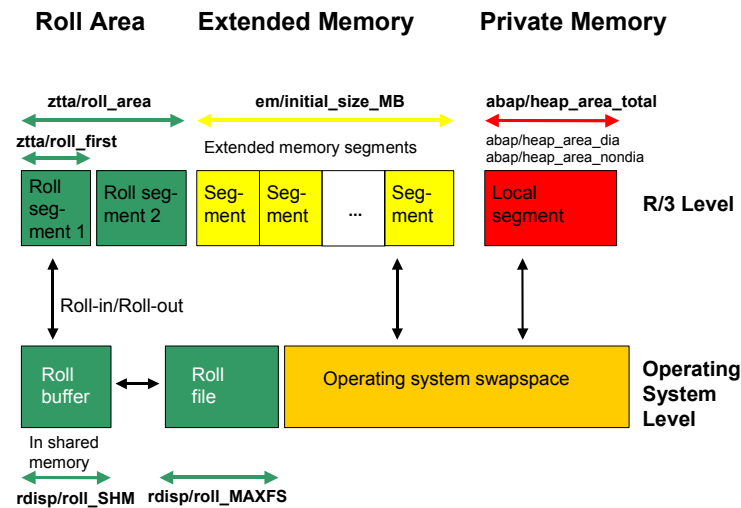
Whenever a dialog step is executed, a **roll action** occurs between the roll buffer in the shared memory and the memory area, which is allocated according to ztta/roll_first [Page 69] in a dialog process. Then the area in the shared memory is accessed that belongs to this user context.

The following graphic displays the roll process performed by the dispatcher.

- **Roll-in:** User-dependent data is rolled in from the common resource in the work process (and is processed there).

- **Roll-out:** User-dependent data is rolled out from the work process in the common resource (after the dialog step has ended).

The common resource stands for the different R/3 memory types [Page 9]:
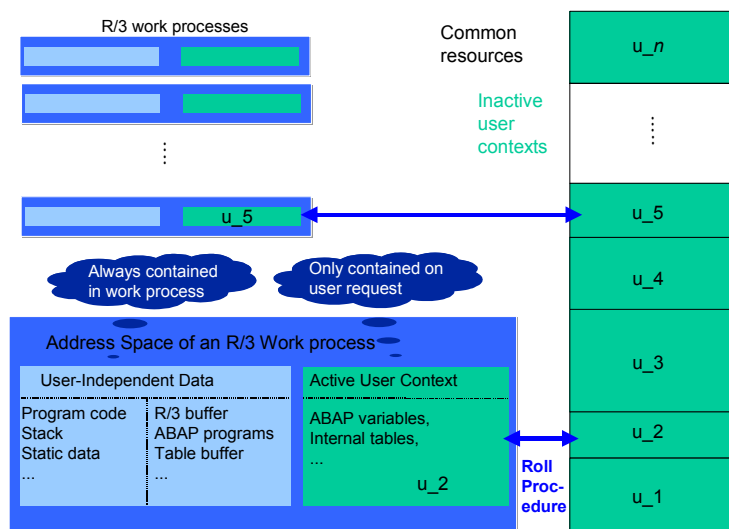
R/3 Memory Types

Definition

The memory management system assigns memory to a work process. Here are some of the various memory types:

- R/3 Roll Area [Page 10]

- SAP Extended Memory [Page 10]

- Private Memory [Page 11]

To find out the order in which memory type is assigned, refer to Allocating Memory for User Contexts [Page 18].

The area of a User Context [Page 13] that is directly accessible is now extended as needed, if the user context has expanded.

Use

For dialog work processes, the data of the user context, including internal tables is located in this expanded area. You can therefore access all the data in the user context. Only the data types *Extract* and *Export to Memory* remain in the SAP Paging.

The **roll area** is used for the initial memory assigned to a user context, and (if available) for additional memory if the expanded memory is full.

The majority of the user context is stored in the extended memory. Page management of this memory as a stack is not taken from the operating system; rather it is performed directly from the R/3 System. This extended memory is implemented as an unnamed mapped file (on AIX and optionally on HP-UX as shared memory). This means the address space uses the paging file or uses the swap space of the operating system as background memory. For more information, please see the platform-specific documentation.

With the context change, the user context is not copied as with the roll area. Instead it is assigned to alternating work processes by mapping operations. The roll area can be decreased, which results in a faster context change because less data is copied and mapping an extended area is not work-intensive.

All internal tables and ABAP variables are located completely in the area of a user context that can be directly addressed. Copying and in/output operations when accessing internal tables and lists is no longer needed. The result is low CPU usage and shorter access times.

The advantages of the memory management system require increased swap space and main memory. The need for swap space increases because full-sized internal tables and lists are in the address space and take up swap space. The main memory requirements may increase to prevent excessive operating system paging due to the increased swap space requirements.

See also:

Swap Space Requirements [Page 74]

R/3 Roll Area

Definition

The roll area is a memory area with a set (configurable) size that belongs to a work process. It is located in the heap of the virtual address space of the work process.

AS/400: The roll area is a fixed-size (configurable) area of memory situated in the shared memory in the virtual address space of the work processes.

Use

When the context of a work process changes, the data is copied from the roll area to a common resource called the *roll file*. To prevent repeated copying, another **roll buffer** is located in between that is part of the shared memory.

AS/400: If the context changes, quick mapping operations are performed that make the current shared memory segment in the work process available.

Structure

The roll area consists of 2 segments. The first segment, which can be set with the parameter ztta/roll_first [Page 69], is assigned to the work process first as memory. If this is used up, the work process has more memory assigned to it. The amount of memory is determined by the difference between the parameters ztta/roll_area [Page 69] and ztta/roll_first.

For more detailed information, please see the platform-specific section under *Implementation*.

Integration

For technical reasons, the roll area is always the first memory that receives a work process. Only afterwards can extended memory be requested.

See also: Virtual Address Space of a Work Process [Page 14]

R/3 Extended Memory

Definition

SAP R/3 extended memory is the core of the R/3 memory management system. Each R/3 work process has a part reserved in its virtual address space for extended memory (see Virtual Address Space in a Work Process [Page 14]). You can set the size using the profile parameter em/initial_size_MB: Size of Extended Memory [Page 67]. Under Windows NT, further memory is assigned dynamically as needed, and you can also set this amount.

Use

You can map the extended memory from the common resource onto any work process, and after onto another process (see graphic) on the same address in the virtual address space. This is important if you work with pointers in the ABAP program.

Structure

Depending on the operating system, how you implement the extended memory is different.

The section *Implementation* explains the implementation for the different platforms in more detail.

Integration

The R/3 System builds a layer on to the operating system functions for the page management of this memory. This extended memory is implemented as an unnamed mapped file. This means the address space uses the paging file or uses the swap space of the operating system as background memory.

Private Memory

Definition

Other processes cannot use private (heap) memory. After releasing the assigned memory, the operating system still considers the (virtual) memory as being occupied by the allocating process. These characteristics of heap memory require that:

1. The work process can be run in PRIV mode (private) when the local memory is assigned. This means that the work process is reserved for processing the current user context until the context releases the work process again when the request has ended.

2. The work process, if it has used a lot of private memory, is restarted when the user context is terminated and the local memory is returned. The restart makes the local memory available again for other processes. A restart occurs if a work process uses more local memory than is defined in the parameter abap/heaplimit [Page 61]. The mechanism is displayed again there.

See also: Virtual Address Space of a Work Process [Page 14]

Use

If a dialog work process has used up the roll area assigned to it *and* the extended memory, private memory is assigned to the work process. The work process goes into PRIV mode (private).

In the parameter settings, ensure that not too many dialog work processes are simultaneously in the PRIV mode, since this lowers system performance.

The other Work Process [Page 14] types (background, update, enqueue and spool work processes) are assigned heap memory after the roll area is used up. Allocating Extended Memory is not useful since no context change occurs for these processes.

Private Memory

Integration

Automatic Termination of PRIV Mode Processes

If too many dialog work processes run in the PRIV mode in an R/3 application server, performance problems arise. The normal processing of user inquiries is slowed down by the PRIV mode work processes.

The R/3 System offers a mechanism that lets you terminate non-active dialog processes in the PRIV mode. This mechanism helps reduce performance problems.

The mechanism works as follows:

In the PRIV mode, a maximum number (n) of dialog work processes can run without any time restrictions.

To determine this number n, set the value of the profile parameter `rdisp/wppriv_max_no`. If a value is not entered, the R/3 System determines this number using the following formula:

the number (n) is set to the greater of the 2 following values:

- Number of dialog work processes minus 5

- 1

If more than (n) dialog work processes are active *and* the time span set in parameter `rdisp/max_priv_time` (default 600 seconds) has elapsed, the transaction for that PRIV process, which has spent the longest possible time in PRIV mode, is reset.

You have configured 10 dialog work processes on one R/3 instance. The parameters `rdisp/wppriv_max_no` and `rdisp/max_priv_time` are not changed (default settings).

Then, the R/3 System checks periodically if more than 5 dialog work processes are in PRIV mode after 600 seconds (10 minutes). If this is the case, the transaction is reset that has been in PRIV mode for the longest time. A corresponding dialog box appears to the user.

If performance problems arise, you can change these parameters, but do this only after consulting with SAP.

Non-dialog work processes (background, update, etc.) are not contained in this mechanism and are also not considered.

User Context

Definition

The user context is the data that is specifically assigned to an R/3 user.

Use

Whenever an R/3 user starts a transaction (an ABAP program), the work process processing the request always requires the user context.

Structure

Each user can open up to six external sessions (*System → Create session*).

The user context contains a **user-specific area** containing user and authorization data, and a **session context** for each R/3 session [Ext.].

Each external session can administrate from its side several internal sessions (indicated here with *IS*), that will not be explained in further detail here.
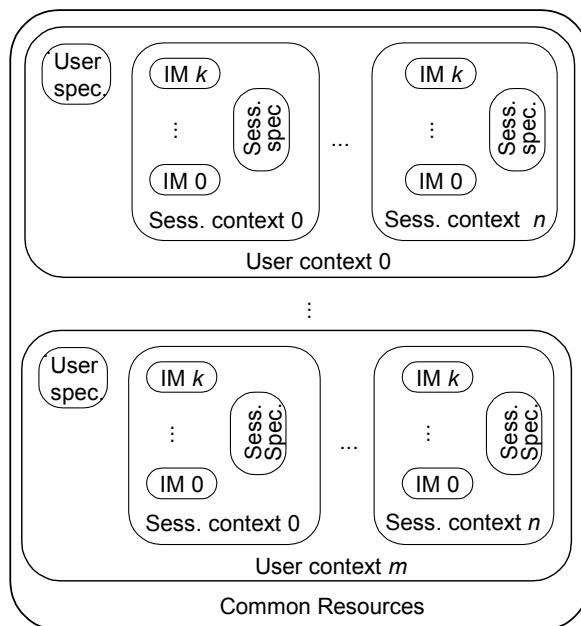
Integration

All user contexts are contained in a common resource (SAP Extended Memory [Page 10], R/3 Roll Area [Page 10]), which enables a fast context change.

Work Process

Dispatcher [Ext.]

Definition

An R/3 application server must process requests from many frontends. The application server has use of a dispatcher that gathers the requests and transfers them for processing to the **work processes**; they then execute the desired requests (for example, an ABAP program).

Use

Here are the following types of work processes:

Work process	Use
Dialog	Executes dialog programs (ABAP)
Update	Asynchronous database changes (is controlled by a COMMIT WORK statement in a dialog work process)
Background	Executes time-dependent or event-controlled background jobs
Enqueue	Executes locking operations (if R/3 transactions have to synchronize themselves)
Spool	Print formatting (to printer, file or database)

Several dialog work processes usually run on one application server; there are only one or two from the other types of work processes. For more information, see Setting Up Work Process Distribution [Ext.] in the CCMS Documentation.

Structure

A work process consists of a screen processor, the ABAP interpreter, the database interface and the task handler that calls these programs.

Integration

The dispatcher is the central process of the application server. After it has been started, it generates the work process. You can configure the number different types of work processes that run on an application server (see Setting Up Work Process Distribution [Ext.]).

Virtual Address Space of a Work Process

With 32-bit systems, 4 GB of memory can theoretically be addressed; depending on the operating system, there are approximately 2 GB of virtual address space available to a process.

This consists of a text and a data segment, a dynamically extendible heap and a dynamically extendible stack. The heap increases in size from the bottom and the stack increases from the top; this enables the entire virtual address space to be used.

With an R/3 work process, there are special areas reserved on the heap whose size can be set using a profile parameter. These are:

- Roll Area [Page 10]

- SAP paging [Ext.] area

- Private memory [Page 11]

The largest reserved area is located between the heap and stack: the SAP Extended Memory [Page 10].

Stack

Shared Memory

Extended Memory

sbrk

Private Memory

Heap

Roll Area

Paging Area

Data

Text

Virtual Address Space of a Work Process

Context for User x

Extended Memory (memory mapped file)

Roll File or Roll Buffer

Paging File or Paging Buffer

Common Resources
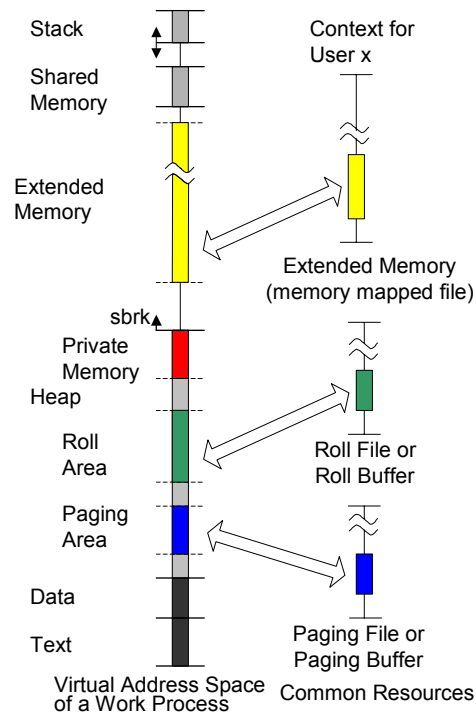
Platform-Specific Description of Memory Management

Use

The following section explains the platform-specific features of memory management.

Both implementation and the setting of parameters depends on the operating system used.

Integration

The basic functions of memory management are platform dependent and are described in detail under Functions of the R/3 Memory Management System [Page 7]. The implementation and parameter settings, however, depend largely on the operating system used.

Features

The platforms supported by SAP can be divided into the following categories:

- UNIX [Page 16]

    This section highlights any differences that may exist between the various UNIX systems supported by SAP.

- Windows NT [Page 39]

- AS/400 [Page 46]

Memory Management under UNIX

The memory management system is automatically activated and configured using your entries during the installation or the upgrade.

Prerequisites

Before you install the R/3 System or upgrade to a 4.x version, ensure that the host system(s) on which the R/3 application server is/are set up, fulfill all the requirements particularly regarding **main memory** and **swap space**.

For more information, see:

Operating System and Hardware Requirements [Page 32].

Also refer to the installation checklist and the installation documentation *OS Dependencies*.

Procedure

Configuring the Memory Management System

The memory management system is preconfigured in the course of the installation/upgrade procedure. The installation/upgrade program requires information about the host system and sets the memory management parameters for each procedure either to the default values or to the values corresponding to the input. This preconfiguration is valid for the host system on which you perform the installation, and for the server you set up during the installation.

Checking and Adjusting the Configuration

Check the preconfigured memory management system and your host system using the following sample configuration and guidelines.

Requirements for the Host:

Checking the Hardware and Operating System of the Host System [Page 35]

Checking the Operation of the Memory Management System and Setting Necessary Parameters if Necessary

For more information, see:

Monitoring the Memory Management System [Page 71]

Important R/3 Notes in SAPNet on Memory Management

Note Number	Description	Operating System
33576	Memory management in releases as of 3.0C, UNIX and NT	UNIX
32915	OSF1 kernel parameters for 3.0x memory management	DEC
36410	AIX Early versus late swap space allocation	AIX
98153	ABAP program buffer greater than 256 MB for AIX	AIX

Implementing Memory Management (UNIX)

As described in Functions of the R/3 Memory Management System [Page 7], there are various kinds of memory (R/3 Memory Types [Page 9]).

The memory management system decides when and what type of memory gets allocated and the limit at which a different memory type is allocated.

This all depends on the platform and the work process type (dialog or non-dialog work processes). The allocation of memory for UNIX platforms is described in more detail under Allocating Memory for User Contexts [Page 18].

Under AIX, you can also use a different method to implement the extended memory. This means that more extended memory is available for an individual context. The procedure and the benefits thereof are described in more detail under Configuration for AIX [Page 23].

See also:

Allocating Memory for User Contexts [Page 18]

Implementing the Extended Memory Under UNIX [Page 20]

Allocating Memory for User Contexts (UNIX)

Use

The memory management system assigns memory to the user contexts from the following 3 areas: Roll area, R/3 Extended Memory and heap memory.

The order of assignment from these memory areas arranges itself according to whether the user context runs in an R/3 dialog work process or in another R/3 work process. This enables the R/3 System to optimally use the characteristics of the individual memory types.

When allocating memory, the following characteristics for individual memory types become noticeable.

Memory type	Characteristics
R/3 Roll Area [Page 10]	Sequential memory allocation to several work processes using a relatively slow copying process
SAP Extended Memory [Page 10]	Sequential memory allocation to several work processes using a fast allocation process Uses swap space
Private Memory [Page 11]	Allocation to a local work process, as required for the running user context in the process Uses swap space

Flow

The flow depends on whether it is a dialog work process or not. Unlike other work process types, dialog work processes require frequent context changes. Private memory that is linked to a work process is only assigned if there are no other options.

Allocating Memory for Dialog Work Processes

The following graphic shows how the memory management system assigns memory to a dialog work process with different memory types. Normally, dialog work processes process requests from dialog users of the R/3 System.

User Context that Can Be Addressed Directly

Extended memory limit exceeded/all extended memory used up

Roll area used up

SAP or operating system limit for private memory reached
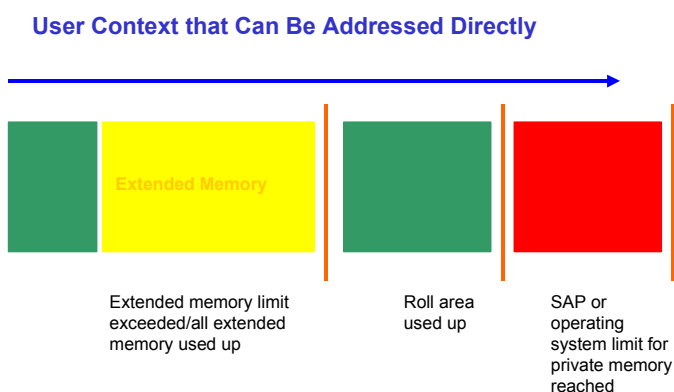
1. For technical reasons, the roll area provides the first 100 to 250 KB (depending on the operating system) that is required for the user context. Additional memory for this initial assignment sets itself according to the system profile parameter ztta/roll_first [Page 69]. If, for example, ztta/roll_first is set to 1 MB, approximately 1.2 MB roll area is provided.

2. If the memory from the roll area is not sufficient for the user context, more memory is provided from the R/3 Extended Memory. Extended Memory remains available for the user context as long as:

- The work process reaches the **limit of the R/3 Extended Memory** for work processes. This limit is set in the system profile parameter ztta/roll_extension [Page 62].

- The **R/3 Extended Memory** is **used up**. The size of the extended memory pool is set in the system profile parameter em/initial_size_MB [Page 67].

3. If this memory is also insufficient for the user context, more memory is provided from the roll area until this area is completely used up, or until the limit set in ztta/roll_area [Page 69] is reached. The roll memory now available sets itself according to the difference between the 2 parameter values `ztta/roll_area` (total memory in the roll area) and `ztta/roll_first` (size of assigned roll memory in step 1).

4. If the user context still requires additional memory, it is assigned heap memory (Private Memory [Page 11]). Heap memory is available until one of the following situations occurs:

> **R/3 limits**: Either the limit of the heap memory for dialog work processes is reached (defined in the system profile parameter `abap/heap_area_dia`), or the entire heap memory of all work processes for an R/3 application server reaches its limits (defined in parameter `abap/heap_area_total`).

> **Operating system limits** for allocating memory

> The swap space in the host system is used up or the upper limit of the operating system address space (as determined by the 32 bit architecture) is reached. Try to avoid these situations at all times. To avoid this situation, you must set parameter abap/heap_area_total [Page 66] correctly.

Allocating Memory for Other Work Processes

The following graphic shows how the memory management system assigns memory to non-dialog work process (background, update, lock and spool work processes) with different memory types.

Allocating Memory for User Contexts (UNIX)

User Context that Can Be Addressed Directly

Roll area
used up

SAP or
operating
system limit for
private memory
reached

Extended memory limit
exceeded/all extended
memory used up
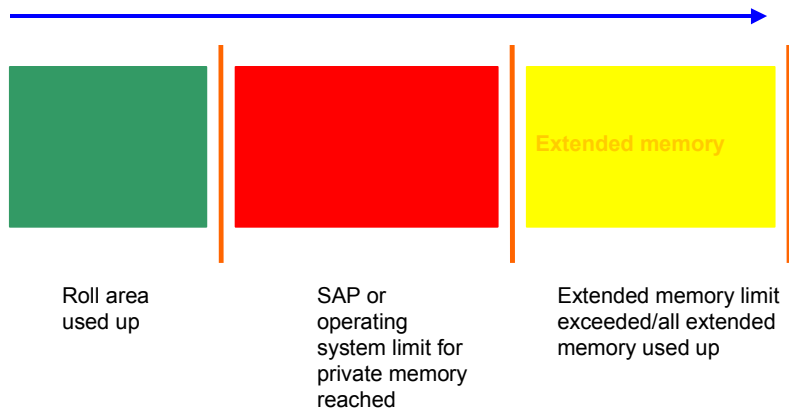
1. The memory is taken from the roll area until the area is used up. The maximum size of
   the roll area is set in the system profile parameter `ztta/roll_area`.

2. If the roll area is full, heap memory is allocated to the work process. Heap memory is
   available until one of the following situations occurs:

- **R/3 limits**: Either the limit of the heap memory for non-dialog work processes is reached
  (defined in the system profile parameter abap/heap_area_nondia [Page 65]), or the entire
  heap memory of all work processes for an R/3 application server reaches its limits (defined in
  parameter abap/heap_area_total [Page 66]).

- **Operating system limits** for allocating memory

- The **swap space** in the **host system** is used up. This situation should never occur (see
  Swap Space Requirements [Page 74]).

3. If no more heap private memory can be allocated, a non-dialog work process can use the
   R/3 Extended Memory.

Implementing the Extended Memory Under UNIX

Extended memory is implemented under UNIX using a *memory mapped file* with memory protection (*protect/unprotect*).

Here, a roll-in corresponds to removing the protection for a context in the extended memory, and a roll-out corresponds to protecting a context.

All user contexts are always mapped in the virtual address space **for each** work process. At the beginning, all the contexts are protected.

The following graphic displays 2 work processes that are accessing a common resource.
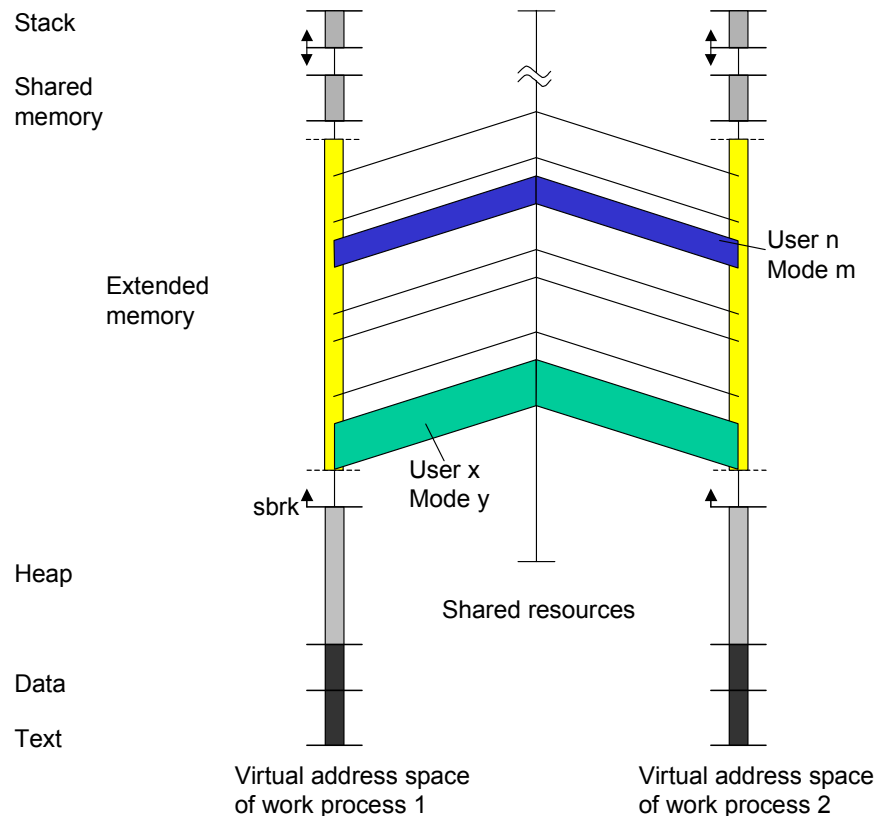
Work process 1 removes the protection for the context from user X, mode Y. To do this, this context is locked for all other work processes. After processing, the protection is restored. Now, work process 2 can process this context.

For more information on *memory mapped files* under UNIX, refer to the man page of the "mmap" command.

Configuration for UNIX

Prerequisites

Check if your host system fulfills the SAP recommendations for main memory and swap space.

Check the resources and system-specific requirements on all host systems on which an R/3 server is to be installed. For more information, see Operating System and Hardware Requirements [Page 32].

Procedure

Set the R/3 profile parameters that influence the memory management system.

For more information on what each parameter does, see Profile Parameters of Memory Management [Page 60], and for more information on parameter settings, see Sample Configurations [Page 27] or Setting Profile Parameters [Page 24].

Set these parameters in the instance profile that is used by the R/3 application servers in your system. For more information, see the CCMS Guide [Ext.].

> ⚠️
>
> The configuration of Memory Management under IBM AIX is very different to other UNIX systems. The configuration for AIX memories is described in more detail in Configuration for AIX [Page 23].

💡

R/3 note no. **97497** describes the parameter settings for the different platforms.

The following notes contain platform-specific information for the different UNIX variants:

HP-UX

Note Number	Short text
27269	TSV_TNEW_INDEX_NO_ROLL_MEMORY
43427	HP-UX: Shared Memory Limits
37537	Improving Performance Using Shared Memory Pools

DEC/OSF1

Note Number	Short text
32915	OSF1 kernel parameters for 3.0x memory management
30606	Entries in /etc/sysconfigtab under DEC Unix
97179	Digital Unix, swap allocation with huge systems

AIX

See Configuration for AIX [Page 23]

Configuration for AIX

Prerequisites

Particular functions of AIX (late swap, allocation, disclaim) enable an alternative implementation of the extended memory with a size of several GB as of R/3 Release 3.1G kernel. A single user context can still only use approximately 1 GB of extended memory, but the sum of usable extended memory for all user contexts combined can be much higher.

Since a lot of extended memory is provided, you can set a high limit for the shared memory consumption. It is also no longer necessary to assign mainly heap memory in background processes to keep the usage of the extended memory low. Heap is particularly small on AIX.

You can also minimize roll memory, which accelerates the context switch (roll-in/out) and the dialog and background processing, for example, with synchronous updating.

This is described in more detail in the R/3 note **95454**.

Procedure

Recommended parameters in the instance profile:

Parameter	Recommendation:	Meaning
ES/TABLE	SHM_SEGS	Switches to the alternative implementation of the extended memory (EM)
em/max_size_MB	4096	Enables maximum 4 GB of extended memory; can be larger if needed
ztta/roll_extension	500000000	Limit of approximately 500 MB (2 shared segments) of extended memory per user context
ztta/roll_area	3000000	Reduces consumption of roll memory in background processes
ztta/roll_first	1	Reduces consumption of roll memory in dialog processes
abap/heap_area_nondia	20000000 (20 MB)	Can be set relatively low, so that a heap bottle neck is avoided in the data segment

The following parameters should only be changed after consulting with SAP.

Parameter	Default	Meaning
es/shm_proc_seg_count	3	Specifies the number of shared memory segments that are used as shared and privately.

Setting the Profile Parameters (UNIX)

es/shm_max_priv_segs	2	This parameter must be lower by 1 than es/shm_proc_seg_count. (=>2*256 MB is usable)
es/shm_user_count	1024	This describes the maximum number of users in all open sessions.
es/shm_user_count		This specifies the maximum number of AIX system segments that ESSHM uses.

See also: <u>Shared Memory ID under IBM AIX [Page</u> 34<u>]</u>

These recommendations depend not only on whether the alternative method of implementing extended memory is active, but also on the AIX version used.

The following R/3 notes relate to memory management under AIX:

Note Number	Short text
28992	AIX Number of shared memories exceeds 10
33576	Memory management in releases as of 3.0C, UNIX and NT
36410	AIX Early versus late swap space allocation
78498	High paging rate on AIX 4.x database servers
95454	Large amount of extended memory on AIX
124555	AIX Recommendation for maximum extended memory
132748	AIX ES SHM_SEGS error handling corrected
143646	AIX patches for new memory management (95454)
115220	Signal 11 and signal 4 on AIX

Setting the Profile Parameters (UNIX)

Use

The ideal parameter settings depend on the hardware resources available (main memory and swap space) on the one hand and the system load on the other, that is, the maximum/average number of (active) users working on an application server.

Procedure

The following table serves as a guideline for setting profile parameters on UNIX platforms.

⚠️

Memory management on IBM AIX is very different from on other UNIX systems. For this reason, setting the parameters under AIX is dealt with in a separate section (see Configuration for AIX [Page 23]).

Parameter	Unit	Default setting	Recommendation:	Comment
abap/heaplimit: Work Process Restart [Page 61]	Bytes	40000000 (40 MB)	20000000	
ztta/roll_extension: Limit for Extended Memory [Page 62]	Bytes	250000000 (250 MB)	Possibly more (approx. 500MB), depending on the application	If there is a large amount of memory available, you can also increase the value if certain programs are taking up lots of memory.
abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes [Page 64]	Bytes	80000000 (80 MB)	200000000-500000000	
abap/heap_area_nondia: Heap Memory Limit [Page 65]	Bytes	40000000 (40 MB)	900000000 (900 MB)	⚠️ Siemens-Nixdorf: max. 350 MB HP-UX: 600000000 (600 MB)
abap/heap_area_total: Heap Memory Limit [Page 66]	Bytes	800000000 (800 MB)	physical memory + swap space - allocated virtual memory	You can monitor the physical memory and swap space using transaction ST06. Allocated virtual memory consists of allocated memory from: • All R/3 instances • Database buffers and database processes • Operating system, special file system cache You can view this using transaction *ST02 → Detail Analysis Menu → Storage*.

Setting the Profile Parameters (UNIX)

em/initial_size_MB: Size of Extended Memory [Page 67]	Megabyte (MB)	128	200 to 500 MB, approximately 5 MB for each R/3 user	
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	8 KB blocks	0	8000	Unless the Tune summary in the CCMS (Transaction ST02) (under Monitoring the Memory Management System [Page 71]) specifies that a larger roll buffer is required, do not set a value larger than 12500 (100 MB). **Absolute upper limit:** 250000 blocks (2 GB) for special applications (file system must be large enough)
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	8 KB blocks	2048	64000	Absolute upper limit: 250000 blocks (2 GB) for special applications (file system must be large enough)
rdisp/PG_SHM: Size of the Paging Buffer [Page 68]	8 KB blocks	0	1024	Absolute upper limit: 250000 blocks (2 GB) for special applications (file system must be large enough)
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	8 KB blocks	2048	32768	Absolute upper limit: 250000 blocks (2 GB) for special applications (file system must be large enough)
ztta/roll_first: Size of the Initial Allocation from the Roll Area [Page 69]	Bytes	1000000 (1 MB)	1 byte	One (1) byte means that only one small amount of memory specifically for that system is allocated and then goes in to the extended memory. A high value (1 MB or more) may be useful if there is not a lot of extended memory available (see Recognizing and Correcting Problems [Page 85]).
ztta/roll_area: Roll Area [Page 69]	Bytes	6500000 (6.5 MB)	6500000 (6.5 MB)	
em/blocksize_KB: Segment Size for the Extended Memory [Page 70]	Kbyte	1024 (1 MB)	1024 (1 MB)	⚠ You may not change the default value.

Sample Configurations (UNIX)

The configuration of the memory management system depends largely on the number of users for each R/3 application server. Various configurations are described in the following sections:

Application Servers with Up to 15 Users (UNIX)

The values listed in the following table for the host systems and server should ensure the best possible operation of your R/3 application sever for up to 15 users.

The lower limit values represent a type of minimum configuration for small R/3 installations:

Main Memory and Swap Space on the Host System

Resource	SAP Recommendation
Size of swap space	**Minimum:** the greater of the 2 following numbers: • 1 GB • three times the main memory **Recommendation: 2 -3 GB**
Main memory	**Minimum: 256 MB** (without a database) You will achieve performance advantages with a larger main memory. **Recommendation: min. 512 MB** This value is recommended for hosts where only one R/3 server runs. If you install the database system or other servers on a host, contact the Hardware Competence Center or your system consultant.

R/3 Profile Parameters

How to use the individual parameters is described in Profile Parameters of Memory Management [Page 60].

Parameter	Recommended Value

Application Servers with Up to 15 Users (UNIX)

abap/heaplimit [Page 61]	20000000 (20 mil. bytes)
abap/heap_area_dia [Page 64]	200000000 (200 mil. bytes)
abap/heap_area_nondia [Page 65]	• IBM AIX: **190000000** (190 Mbytes) • Siemens-Nixdorf SINIX: **350000000** (350 Mbytes) • Other platforms: **400000000** (400 Mbytes)
abap/heap_area_total: Heap Memory Limit [Page 66]	**1500000000** (1.5 GB)
em/initial_size_MB: Extended Memory Pool Size [Page 67]	**128** (128 MB, 6 MB per user) Minimum 64 MB
em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	16384
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**2048**
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**16384**
rdisp/PG_SHM: Size of the Paging Buffer [Page 68]	**512**
ztta/roll_area: Roll Area [Page 69]	**6500000** (6.5 Mbytes)
ztta/roll_first: Size of the Initial Allocation from the Roll Area [Page 69]	1000000 (1 mil. bytes) If more than 6 MB of extended memory is available per user (em/initial_size_MB), you can set this value to 1 (1 byte).
ztta/roll_extension: Limit for Extended Memory [Page 62]	50000000 (50 mil. bytes), except for background servers under IBM AIX and Siemens-Nixdorf SINIX. You can find more information in the parameter documentation

The settings listed here are recommended base values that you may, however, have to change if you monitor and optimize your R/3 System. For more detailed information, see Monitoring the Memory Management System [Page 71].

Check the changes to the system profiles using the program *sappfpar*. For more information, see Operating System and Hardware Requirements [Page 32].

Application Servers with Up to 50 Users (UNIX)

Profile Parameters of Memory Management [Page 60]

The values listed in the following table for the host systems and server should ensure the best possible operation of your R/3 application sever for up to 50 users.

Main Memory and Swap Space on the Host System

Resource	SAP Recommendation
Size of swap space	**Minimum:** the greater of the 2 following numbers: • 1.5 GB • three times the main memory **Recommendation: 3 GB**
Main memory	**Minimum: 512 MB** (without a database) You will achieve performance advantages with a larger main memory. **Recommendation: 768 MB** This value is recommended for hosts where only one R/3 server runs. If you install the database system or other servers on a host, contact the Hardware Competence Center or your system consultant.

R/3 Profile Parameters

Profile Parameters of Memory Management [Page 60] describes what each parameter does.

Parameter	Recommended Value
abap/heaplimit [Page 61]	20000000 (20 mil. bytes)
abap/heap_area_dia [Page 64]	200000000 (200 mil. bytes)
abap/heap_area_nondia [Page 65]	• IBM AIX: **190000000** (190 Mbytes) • Siemens-Nixdorf SINIX: 350000000 (350 mil. bytes) • Other platforms: 400000000 (400 mil. bytes)
abap/heap_area_total: Heap Memory Limit [Page 66]	**2000000000** (2 GB)
em/initial_size_MB: Extended Memory Pool Size [Page 67]	**5 MB** per active user + **1.5** MB per user; minimum **256 MB**

Application Server with Over 50 Users (UNIX)

em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	**32768** (32768 8KB blocks)
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**4096** blocks or 1 MB per active user up to a maximum of 12,500 blocks (100 MB), unless more memory is required (analysis with Transaction ST02)
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** (32768 8KB blocks)
rdisp/PG_SHM: Size of the Paging Buffer [Page 68]	**4096** blocks (25 blocks, per user)
ztta/roll_area: Roll Area [Page 69]	6500000 (6.5 mil. bytes)
ztta/roll_first: Size of the Initial Allocation from the Roll Area [Page 69]	1000000 (1 mil. bytes) If more than the maximum (5 MB per user, 256 MB) extended memory is available (em/initial_size_MB), you can set this value to 1 (1 byte).
ztta/roll_extension: Limit for Extended Memory [Page 62]	**128000000** (128 mil. bytes) except for background servers under IBM AIX and Siemens-Nixdorf SINIX. For more information, please consult the parameter documentation

The settings listed here are recommended base values that you may however, have to change if you monitor and optimize your R/3 System. For more detailed information, see Monitoring the Memory Management System [Page 71] and Profile Parameters of Memory Management.

Check the changes to the system profiles using the program *sappfpar*. For more information, see Checking the Hardware and Operating System of the Host System [Page 35].

Application Server with Over 50 Users (UNIX)

Profile Parameters of Memory Management [Page 60]

The correct configuration for the memory management system in large R/3 application servers depends on the several factors. SAP can therefore not give any recommendations for the

standard configuration. However, you can calculate your own approximate values by referring to the information in this unit and in the other units that are referred to.

To determine the required resources for the host system, contact your hardware partner's SAP Competence Center. Then you can configure the R/3 Server by setting the R/3 memory management parameters in the R/3 system profile.

Main Memory and Swap Space on the Host System

Resource	SAP Recommendation
Size of swap space	**Minimum:** the greater of the 2 following numbers: • 3 GB • three times the main memory In each case, this must be larger than the sum of: • the required R/3 swap space (can be approximated using the program *sappfpar*; see Additional Swap Space Needs [Page 74]) • the memory requirements of the operating system • to be safe, at least 200 MB free memory area when executing the operation
Main memory	**Guidelines:** **Central system with all services, no database:** 180 MB plus 5.7 MB per active user or at least 512 MB **With database:** Add 150 MB plus 0.3 MB per active user **Application server:** 120 MB plus 5.3 MB per active user More memory increases performance. Also contact your hardware partner or the SAP Competence Center for your hardware partner.

R/3 Profile Parameters

How to use the individual parameters is described in Profile Parameters of Memory Management [Page 60].

Parameter	Recommended Value
abap/heaplimit [Page 61]	20000000 (20 mil. bytes)
abap/heap_area_dia [Page 64]	**2000000000** (2 GB)
abap/heap_area_nondia [Page 65]	Platform dependent, see the parameter documentation
abap/heap_area_total: Heap Memory Limit [Page 66]	**2000000000** (2 GB); see the parameter documentation
em/initial_size_MB: Extended Memory Pool Size [Page 67]	UNIX: **5 MB** per active user + **1.5** MB per user; minimum **256 MB** Windows NT: **8192**

Operating System and Hardware Requirements (UNIX)

em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	UNIX: **32768** (32768 8KB blocks) Windows NT: **the same value as rdisp/ROLL_SHM**
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**8192** blocks or 1 MB per active user up to a maximum of 16.500 blocks (100 MB), unless more memory is required (analysis with Transaction ST02)
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** (32768 8KB blocks)
rdisp/PG_SHM: Size of the Paging Buffer [Page 68]	**1024** blocks
ztta/roll_area: Roll Area [Page 69]	6500000 (6.5 mil. bytes)
ztta/roll_first: Size of the Initial Allocation from the Roll Area [Page 69]	1000000 (1 mil. bytes) If more than 5 MB of extended memory is available per user (em/initial_size_MB), you can set this value to 1 (1 byte). Windows NT: **1** (1 byte)
ztta/roll_extension: Limit for Extended Memory [Page 62]	**256000000** (256 mil. bytes),except for background servers under IBM AIX and Siemens-Nixdorf SINIX You can find more information in the parameter documentation

The settings listed here are recommended base values that you may, however, have to change if you monitor and optimize your R/3 System. For more detailed information, see Monitoring the Memory Management System [Page 71] and Profile Parameters of Memory Management.

Check the changes to the system profiles using the program *sappfpar*. For more information, see Operating System and Hardware Requirements [Page 32].

Operating System and Hardware Requirements (UNIX)

Memory Management auf 64-Bit-Systemen (UNIX) [Page 36]

The following requirements must be met so that you can use memory management with your R/3 System:

• The swap space may not fall below a specified level.

• You may have to install additional main memory.

• Various operating system parameters must be set correctly.

The following sections contain information on the requirements for swap space.

Swap Space Requirements [Page 74]

The following documentation contains more detailed information on **changing kernel parameters** and the **software requirements** for various UNIX systems:

• UNIX Systems: *R/3 Installation on UNIX -- OS Dependencies*. You receive this document with the installation and upgrade packages.

The following documentation contains details on **hardware requirements**:

• For installations: you can find details in the installation documentation.

• For upgrades: you can find details in this document and the upgrade documentation. For additional information, see the upgrade and installation notes for the SAP online system as well.

You can find more information under:

Data Segment Size (UNIX) [Page 33]

VPAGEMAX under OSF/1 [Page 34]

Shared Memory ID under IBM AIX [Page 34]

Checking the Hardware and Operating System of the Host System [Page 35]

Data Segment Size (UNIX)

Memory Management auf 64-Bit-Systemen (UNIX) [Page 36]

The data segment size restricts the size of a user context that is executed as an R/3 background job. The default value is 64 MB, which is however, not sufficient and should be increased.

Set the data segment size for a process to the following values:

UNIX Operating System	Data Segment Size
32 bit UNIX systems	Increase data segment size to approx. 600 MB.
64 bit UNIX systems (OSF/1 from Digital Equipment Corporation)	Set data segment size to at least 2048 MB.

VPAGEMAX under OSF/1

⚠️

The maximum segment size under IBM AIX is 256 MB (see Configuration for AIX [Page 23] and Shared Memory ID under IBM AIX [Page 34]), compared to 384 MB under Siemens-Nixdorf SINIX.

You can check data segment sizes using the R/3 test program *memlimits*. (You must stop the R/3 server to do this.) Note the output row that appears as follows: **Process xxxxx allocating.** The segment size is displayed in the row `Size =`.

For more detailed information, please refer to the R/3 installation guide in the section covering UNIX kernel parameters.

VPAGEMAX under OSF/1

In the operating system OSF/1 from Digital Equipment Corporation, you must increase the value of the parameter VPAGEMAX for the extended memory by up to 800 MB (parameter em/initial_size_MB = 800) to 131072. You will find more information on larger memories in SAP note 32915 in SAPNet.

VPAGEMAX defines the size of the unnamed mapped file for the R/3 extended memory.

Shared Memory ID under IBM AIX

A shared memory ID is used for each shared memory segment (256 MB) used in a work process. There is a maximum of 10 shared memory IDs for each process. If the parameter em/initial_size_MB [Page 67] is set to a value up to 256 MB, an ID is used. However, if the value for this parameter is set between 256 and 512 MB, 2 IDs are used, and so on.

You must reduce the number of R/3 shared memory areas so that the memory management system can be used under AIX. This includes the areas in pools. For this, set the parameters ipc/shm_psize_<nn> in the R/3 system profile.

Recommended pools:

• To shift the R/3 shared memory area 6 into the R/3 shared memory pool 10, use the following parameter settings:

```
ipc/shm_psize_06 =-10
ipc/shm_psize_10 = <newly suggested size from SAP program
sappfpar>
```

- If the shift from area 6 is insufficient, shift area 41 to 49 into
  pool 10. Shared memory pool 4 is no longer required.

  ```
  ipc/shm_psize_41 =-10
  ...
  ipc/shm_psize_49 =-10...
  ipc/shm_psize_10 = <newly suggested size from SAP program
  sappfpar>
  ```

For more details on this subject, refer to the SAPNet note **Notes 98084, 95260,** and **95454** in the SAP online system.

Configuration for AIX [Page 23] describes how to configure Memory Management under AIX.

Checking the Hardware and Operating System of the Host System (UNIX)

Memory Management auf 64-Bit-Systemen (UNIX) [Page 36]

Using the R/3 Program sappfpar, you can check the profile of an application server and the hardware resources of the host.

Under UNIX, use the following syntax:

```
/usr/sap/<SYSTEM NAME>/SYS/exe/run/sappfpar check
pf=/usr/sap/<SYSTEM NAME>/SYS/profile/<Profile name> nr=<System
number> name=<Systemname> | more
```

Here, `Profile name` is the profile name used by the corresponding application server. Program *sappfpar* is in the kernel library.

If you work with the Maintain Profile function (Transaction RZ10) in the Computing Center Management System, you can begin the error check using the function *Check* in the initial screen.

See also:

Monitoring the Memory Management System [Page 71]

Recognizing and Correcting Problems [Page 85]

Memory Management on 64-Bit Systems (UNIX)

An almost maintenance-free memory management solution (**Zero Administration Memory Management**) can be implemented on 64-bit platforms (HP-UX, AIX, Reliant, DEC-UNIX) if the 64-bit R/3 kernel is used.

This is achieved by defining an adequate default value for the virtual address space for buffer areas (program buffers, table buffers) and the user contexts (extended memory).

Approximation Computation for an R/3 Instance

64-bit executables and data segment for 60 work processes	1 GB
Program and table buffers	1.5 GB
Other shared memories	0.5 GB
Extended memory	4 GB
Heap requirement for large batch jobs	2 GB
Total	**9 GB**

This means that up to 9 GB of virtual address space can be assumed for each R/3 instance, and possibly with the database and all other external programs in addition.

⚠️

> To ensure that the maximum virtual address space requirements - also for worst case scenarios - can be met by the relevant physical background memory, approximately **20 GB of hard disk space** is required for the **swap area**.

🧭

This means that you must configure at least 20 GB of swap space on your 64-bit system.

Given the potential savings with regard to support and consultancy, this is an extremely cost-efficient solution.

Recommended Parameters for 64-Bit Systems

The following settings are recommended for memory profile parameters:

Parameter	Recommendation:
em/initial_size_MB	**1024** to **8192** (MB)
em/blocksize_KB	**1024** or **4096** (KB)
ztta/roll_first	1
ztta/roll_area	**3000000** (3MB)
ztta/roll_extension	**2000000000** (2GB)
abap/heap_area_dia	**2000000000** (2GB)
abap/heap_area_nondia	**2000000000** (2GB)
abap/heap_area_total	**2000000000** (2GB)

The following settings apply to HP-UX only:

Parameter	Recommendation:
es/use_shared_memory	TRUE
es/use_mprotect	TRUE

⚠️

>Ensure that the HP-UX operating system parameters have been set correctly. See also R/3 Note 172747.

Further information is available in the section entitled Memory Management on 64-Bit Systems: Questions and Answers [Page 37].

Memory Management on 64-Bit Systems: Questions and Answers

When should you use the 64-bit kernel?

The following requirements must be fulfilled:

- The application servers have more than 2 GB of main memory

- At least 20 GB of swap space is available

- Your 32-bit system is already optimally configured (EarlyWatch, GoingLive Check)

- You have a development or test system where you can test the 64-bit kernel

What combinations of database software and R/3 kernel are possible?

- 32-bit database with 32-bit R/3 kernel

- 64-bit database with 64-bit R/3 kernel

- 64-bit database with 32-bit R/3 kernel

- **Not supported:** 32-bit database with 64-bit R/3 kernel

How can I find out if a 64-bit kernel is in use?

Choose *System* → *Status*. The *Platform ID* field contains a value. The possible values and their meaning are explained in the following table.

Platform	32-bit	64-bit
DEC-Alpha	–	288
HP-UX	272	273
RM600 (Reliant)	322	323
AIX	320	324

SUN	369	370

The availability of the R/3 kernel is described in the notes for the component XX-SER-SWREL.

How can I find out if a 64-bit database is in use?

- Informix: choose transaction *ST04* → *'Detail analysis menu'* → *'Onstat commands'* → *'-V print version'*

    `7.24.UC3`, for example, is then output. If a 64-bit database is in use, the letter F is displayed after the second period (for example, `7.30.FC3`).

    ⚠

    The version specified on the initial screen of transaction ST04 (for example, Informix-OnLine Version 7.21C1) may be incorrect! For this reason, proceed as follows:

- Oracle (8.0.5 upwards): choose transaction *ST04* → *'Detail analysis menu'* → *'V$Tables'* → *'V$Version'*

    The string `'64-bit version'` is output for 64-bit versions.

Why do I need 20 GB of swap space?

64-bit technology means that the address space can now be used more generously. This minimizes maintenance requirements and the problems associated with memory management, since the size of the buffers and other areas in the shared memory can be increased considerably so that programs do not reach the system limits.

As a result, there is no risk of program crashes due to memory bottlenecks and no need for complex 'parameter tuning'.

Windows NT

The previous valid recommendations for setting the memory management cannot be completely used for Windows NT. The operating system can use other memory administration mechanisms than the various UNIX derivatives. You must evaluate the performance statistics displayed by transactions ST02 and ST06 (monitoring system performance) differently than with UNIX systems due to the above-mentioned reason.

This unit serves as a guide for setting the SAP R/3 Memory Management under Windows NT. By using this guide, the system administrator for a Windows NT application server should be better able to evaluate the performance of the system and to tune the system accordingly.

Implementing the memory management system under Windows NT is described in Implementation on Windows NT [Page 39].

For guidelines on how to configure memory management under Windows NT, refer to Rules for Memory Management under Windows NT [Page 42], and for a quick overview of all important parameters, refer to Parameter Overview for Windows NT [Page 45].

Implementation on Windows NT

The basis for the **Zero Administration Memory Management** under Windows NT is the dynamic extended memory. The technique provides you with a nearly unlimited memory resource. Initially, the extended memory is set to the size of the profile parameter `phys_memsize` ([PM]). If the user requires more memory, extended memory extends itself in steps from "[PM] / 2" up to the set limits in the profile parameter `em/max_size_MB`, or until the address space in the NT page file is used up. By setting the default value for `em/max_size_MB` to 2000 MB, the size of the NT page file represents the actual limit for extending the extended memory. The profile parameter `phys_memsize` determines how much of the total main memory is used by R/3. The parameter is entered according to the input at installation. The default value for `phys_memsize` is the size of the main memory [MM].

The memory allocation strategy for a non-dialog work process was changed as of Release 4.0B. Through the previous allocation sequence, the extended memory was protected to the benefit of the heap memory. This is no longer necessary when using the dynamic extended memory, and the allocation sequence of the batch work processes is identical to the sequence of the dialog work processes (see Allocating Memory for User Contexts [Page 18]). Another beneficial side effect is that you can avoid the PRIV mode (see Private Memory [Page 11]) for background work processes and thereby starting the work processes.

Sequence of allocating memory for non-dialog work processes:

1. Roll memory until the limit "ztta/roll_first"

2. Extended memory until the limit `min {em/address_space_MB, ztta/roll_extension}`

3. Roll memory until the limit `ztta/roll_area`

Implementing the Extended Memory Under Windows NT

4. Heap memory until the limit "abap/heap_area_nondia"

The basis for zero administration memory management is a sufficiently large NT page file. The previous recommendation

      NT page file = 3 to 4 times the main memory size

still remains.

All relevant memory management parameters are set with an optimal default value so that all manual configurations are unnecessary.

See also: Memory Management under Windows NT [Page 39]

Implementing the Extended Memory Under Windows NT

Windows NT: Implementation with *Map/Unmap*

Here, a roll-in corresponds to *mapping* a context in the extended memory, and a roll-out corresponds to *unmapping*.

The following graphic displays 2 work processes that are accessing a common resource.
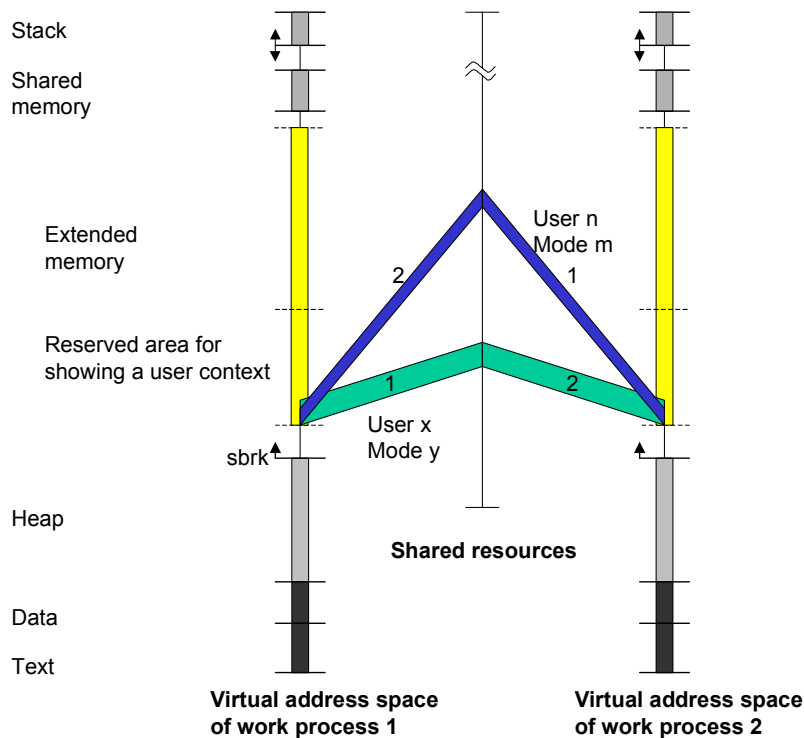
The common resource (memory mapped file) contains all the user contexts. The extended memory of a work process contains an area reserved for mapping the current user context.

The graphic displays a context change or transfer: First, the context for user X, mode Y is mapped in the extended memory of work process 1. The work process processes an inquiry of this context. Analogous to this, the context from user N, mode M is mapped in the reserved area of work process 2 (marked with a 1). After processing, both work processes "put" the (changed) context back in the common resource by making the context visible again.

Then work process 1 can process the context for user N, mode M and work process 2 can process the context from user X, mode Y (marked with a 2).

The start address for the mapped context is always the same.

Special Features under Windows NT

- The **Windows NT file cache** directly competes with R/3 programs and pushes these programs out of the working memory. Unlike UNIX, the file cache is only influenced indirectly by a switch in the network setting.

- **Writing** and **reading R/3 roll and paging blocks** in the relevant storage files extends the Windows NT file cache and pushes out the R/3 programs from the working memory.

Rules for Memory Management under Windows NT

- **Copying roll and paging blocks** when changing contexts is more time-consuming than including memory blocks when using Extended Memory. Extended Memory also has the advantage that it is subject to the performance-oriented Windows NT paging mechanism.

- Windows NT does not offer you **code sharing** (exception: DLLs). This means that all work processes fill the complete memory area in the memory. This leads to a greater memory requirement for the work processes compared to UNIX.

- Pages in the extended memory that are not in the address area of an active process are transferred automatically in the page file by the operating system. The pages remain duplicated in the physical memory until the memory area is required by another process. They are marked as transferred. The transfer has a low priority and is described as a **lazy page out**. If a work process now accesses a *lazy page out*, the memory area is included again without the page file access. If there is enough working memory, the result is a large [page out] and a small [page in] value. When a *lazy page out* action occurs, Windows NT creates permanently free available working memory. Therefore, even a page-in with a page file access is faster than on UNIX systems, since it is not necessary to transfer another page beforehand (no direct page-out before a page-in).

  See also: SAP Extended Memory [Page 10]

Rules for Memory Management under Windows NT

The following are rules for memory management under Windows NT:

Minimizing the Windows NT File Cache [Page 42]

Maximum Use of Extended Memory [Page 43]

Setting Dimensions for Sufficient Extended Memory [Page 44]

Determining the Number of Work Processes [Page 44], compared to reducing UNIX

Parameter Overview for Windows NT [Page 45]

Minimizing the Windows NT File Cache

The Windows NT file cache directly competes with R/3 programs for working memory. It pushes other programs out of the memory. Therefore, you should minimize the file cache with the following configuration.

There is only one way to minimize the file cache under Windows NT. Call up the network setting ("Network" symbol) in the control panel.

Minimizing the Windows NT File Cache

Windows NT Version	Procedure

Windows NT 3.5x	Under *Services*, choose *Server*.
	Choose *Configure*.
Windows NT 4.0	Choose *Services*.
	Under *Services*, choose *Server*.
	Choose *Properties*.

In the following screen in the field *Optimization*, choose *Maximize Throughput for Network Applications*, and then choose *OK*.
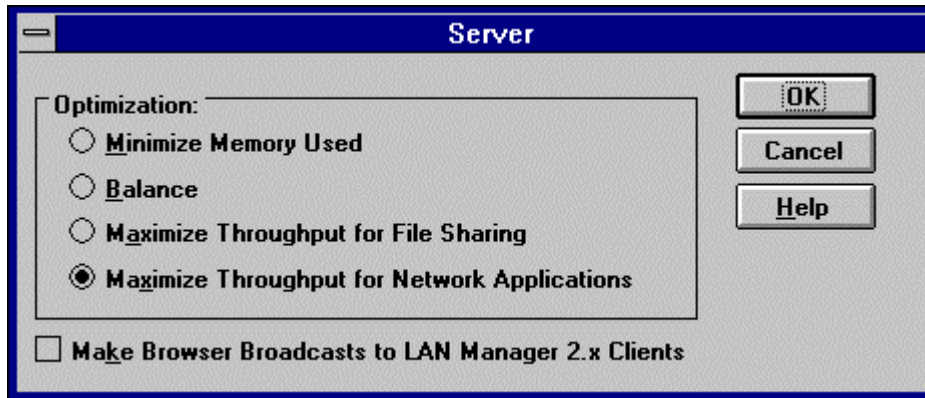
To activate the reduced file cache, you must restart the computer.

Maximum Use of Extended Memory

As previously described, the SAP Memory Manager copies the memory blocks of the roll area between the process address area and the shared memory with a memory copy command. However, the memory blocks of the Extended Memory are included again when the user context is changed. This is more efficient than copying blocks of the roll area. For this reason, the user context should largely be located in the extended memory. The profile parameter ztta/roll_first sets the size of the allocated memory in the roll area, before extended memory is used. If you set the profile parameter to 1, the SAP Memory Manager is told to use the extended memory immediately.

Maximum Use of Extended Memory Parameter Values under Windows NT

Profile Parameter	Parameter Value
ztta/roll_first	1 (byte)
ztta/roll_area	2000000 (bytes)
	The smaller values may lead to errors.

See also:

Setting Dimensions for Sufficient Extended Memory

You must ensure that extended memory is sufficiently large due to its intensive use. The prerequisite for this is a correspondingly large virtual memory area from Windows NT. As a basis, you need approximately 6 MB extended memory for each active user. Ensure that there is sufficient memory area by comparing the maximum extended memory used and memory created (Transaction ST02). Even during heavy system load, the value [max use] should not reach the value [in memory]. However, if this does occur, you must increase the profile parameter em/initial_size_MB [Page 67] accordingly.

Setting the Dimensions for Extended Memory Parameter Values under Windows NT

Profile Parameter	Parameter Value
em/inital_size_MB	≈ **6 MB** per active user (application-dependent)
	Extended memory should always be sufficient.
	→Check using transaction ST02.

⚠️

Extended memory should always be sufficient. Ensure that enough extended memory exists at all times. Check the configuration using Transaction ST02.

Transaction RZ03 displays an overview of all the application servers for a distributed system.

Determining the Number of Work Processes

The context change for processes under Windows NT is more time-consuming compared to UNIX. Therefore, the recommended number of work processes is smaller than compared to UNIX systems. The number of work processes is not calculated according to the number of users. Rather it is calculated according to the number of processors in the system and may be taken from the following table.

You can determine the number of work processes using the CCMS Maintain Operation Modes and Instances: *Tools → Administration → CCMS → Configuration → Op Modes and Servers* and *Operation mode → Maintain instances*.

Number of Work Processes under Windows NT

Number of Processors	Number of Work Processes
1	5-6
2	8-10
4	15-20

⚠️

The number of work processes depends on the number of processors and not the number of users.

Parameter Overview for Windows NT

All relevant memory management parameters are set with an optimal default value so that all manual configurations are unnecessary.

The following table gives you an overview of these values.

Profile Parameter	Default Value	Unit
abap/heap_area_dia	2000000000	Byte
abap/heap_area_nondia	2000000000	Byte
abap/heap_area_total	2000000000	Byte
em/initial_size_MB	[PM]	MB
em/max_size_MB	20000	MB
em/address_space_MB	512	MB
rdisp/ROLL_MAXFS	[BE] * 100	8KB block
rdisp/ROLL_SHM	[BE] * 100	8KB block
rdisp/PG_MAXFS	32768	8KB block
rdisp/PG_SHM	[BE] * 50	8KB block
ztta/roll_first	1	Byte
ztta/roll_area	2000000	Byte
ztta/roll_extension	2000000000	Byte

where

[MM] = size of the physical main memory

[PM] = value of the profile parameter PHYS_MEMSIZE (default value=[MM])

[BE] = maximum possible number of users (calculated from [PM])

The Zero Administration Memory Management under Windows NT tries to reduce the number of relevant profile parameters so that maintenance and configuration of the application server is simplified, and the available resources are optimally used.

Memory Management on AS/400

Memory management on AS/400 is based on temporary, dynamic memory. Both **single-level storage** (SLS) and **teraspace** are used.

- In the single-level storage concept main memory and auxiliary storage (for example, disk storage) are considered as a single large address space, whose linearly addressable areas can grow to a maximum of 16 MB in size.

- A teraspace is temporary dynamic storage, which provides an address space of 1 terabyte in size for each process (that is, OS/400 job). A teraspace can consist of a number of separately allocated and deallocated storage areas. Between these areas, "addressability holes" can exist, that is, areas of storage that are not allocated. Although teraspace is also based on single-level storage, it is completely transparent to the processes (OS/400 jobs).

For the R/3 memory management to function optimally, sufficient free auxiliary storage space must be available.

R/3 extended memory is located in the teraspace and is allocated when the R/3 instance is started. You specify the size of the extended memory pool using system profile parameter em/initial_size_MB [Page 67]. Dynamic extension is not possible.

As of Release 4.6A the memory allocation strategy for non-dialog work processes has been changed. Previously, process local memory was used in preference to extended memory. Now that sufficient extended memory is allocated statically, this ceases to be necessary and the allocation sequence for batch work processes is the same as for dialog work processes (see Allocating Memory for User Contexts [Page 18]). A useful side effect of this new strategy is that you can avoid using PRIV mode (see Private Memory [Page 11]) for background work processes and, consequently, avoid expensive work process restarts. The memory allocation sequence for non-dialog work processes is as follows:

1. Roll memory up to the quota `ztta/roll_first`.

2. Extended memory up to the quota **min**{`em/initial_size_MB, ztta/roll_extension`}

3. Roll memory up to the quota `ztta/roll_area`.

4. Heap memory up to the quota `abap/heap_area_nondia`.

Implementing R/3 memory on the AS/400 has the following effect:

- **Roll area**

    Unlike on other platforms, user contexts are not rolled into and out of work processes by means of copy procedures. Instead, the roll area is implemented in a similar way to R/3 extended memory. On AS/400 a "roll-in" is achieved by setting pointers to the user roll memory.

    The roll area is only used for internal system areas of the user context. The remainder (for example, internal tables) are in extended memory.

    ⚠️

    Roll area parameters `ztta/roll_area` and `ztta/roll_first` are preset and cannot be changed.

Since no data is copied during roll-in and roll-out, the corresponding system profile parameters are not used. These parameters (rdisp/ROLL_MAXFS and rdisp/ROLL_SHM) must be set to the value 0 (zero), which is the default value.

- **R/3 paging**

    AS/400 does not distinguish between the paging cache (R/3 System profile parameter rdisp/PG_SHM) and the paging file (R/3 System profile parameter rdisp/PG_MAXFS). The complete paging file is buffered. As a result, the settings for rdisp/PG_SHM and rdisp/PG_MAXFS are identical.

- **Shared memory pools**

    You do not have to define or manage any shared memory pools. (Shared memory pools are defined in the system profile using parameter ipc/shm_psize.) Parameter ipc/shm_psize is ignored on AS/400.

Storage Pool Requirements (AS/400)

Since all R/3 jobs run by default in the `*BASE` pool (system pool 2), you should make as much memory as possible available for this pool. 400 MB is the absolute minimum. If you still have other applications running on your AS/400 system, assign a separate pool to the R/3 System.

Minimum memory for pool 2: 400 MB

See also:

Checking the Hardware and Operating System of the Host System

Using the R/3 Program sappfpar, you can check the profile of an application server and the hardware resources of the host.

Under OS/400, use the following syntax:

    call pgm(sappfpar) parm('check' 'pf=/usr/sap/<SYSTEM NAME>/SYS/profile/<Profile name>' 'nr=<System number>' 'name=<System name>')

Here, **Profile name** is the profile name used by the corresponding application server. Program *sappfpar* is in the kernel library.

If you work with the Maintain Profile function (Transaction RZ10) in the Computing Center Management System, you can begin the error check using the function *Check* in the initial screen.

Extended Memory with Teraspace Shared Memory Segments (AS/400)

Definition

R/3 extended memory is the core of the R/3 memory management system. Each R/3 work process has a part reserved in its virtual address space for extended memory. You can set the size using the profile parameter em/initial_size_MB [Page 67].

Use

You can map the extended memory from the common resource (shared memory segment) into any work process (see graphic) at the same address in the virtual address space. This is important if you work with pointers in the ABAP program.

Structure

The following graphic shows 2 work processes that are accessing a common resource.
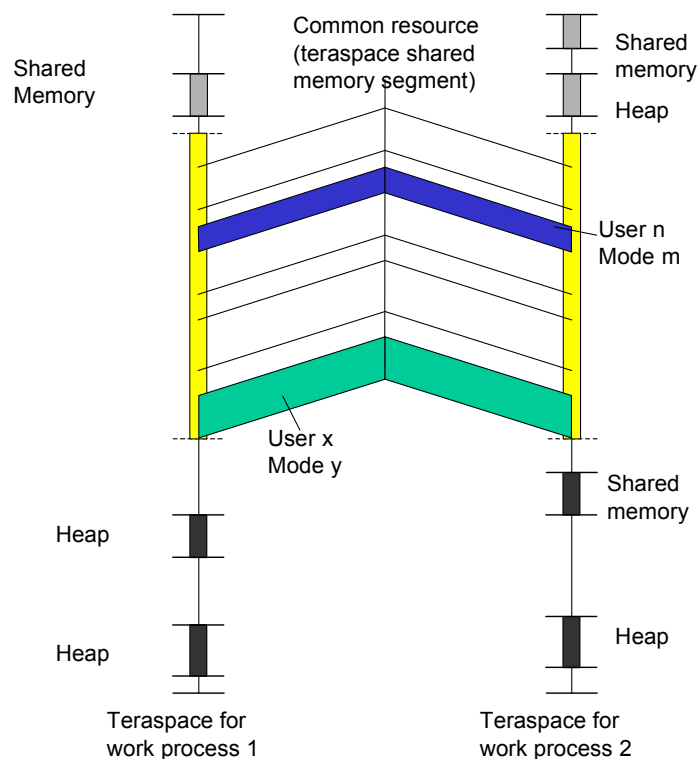
The common resource (teraspace shared memory segments) contains all the user contexts and is always mapped completely in the teraspace address space of each work process.

The graphic shows a context change or transfer:

- The context for user X, mode Y is made available in the extended memory of work process 1. The work process processes an inquiry of this context.

- Analogous to this, the context for user n, mode m is made available in work process 2.

- After processing, both work processes "put" the (changed) context back into the common resource by releasing the context again.

- Then work process 1 can process the context for user n, mode m and work process 2 can process the context for user X, mode Y.

The start address for the extended memory in teraspace is the same across all work processes.

Integration

The R/3 System builds a layer on to the operating system functions for the page management of the extended memory. The extended memory is implemented as teraspace shared memory. This means the address space uses unprotected storage of the operating system as background memory. For more information, refer to the teraspace documentation for OS/400.

Configuration for AS/400

For information about how the memory management system is implemented on AS/400, see Memory Management on AS/400 [Page 46].

In the tables below, you will find information about the necessary settings for the memory management system.

- Check that your host system fulfills the SAP recommendations for main storage and free space in additional memory (ASPs).

    Check the resources and system-specific requirements on all host systems on which an R/3 server is to be installed. For more information, see Checking the Hardware and Operating System of the Host System [Page 35].

- The R/3 profile parameters that the memory management system uses are set automatically and are stored in the instance profile used by each R/3 application server in your system. For more information, see Profiles [Ext.].

    If you modify the profiles directly with a system editor, you must perform an error check. For more information, see Checking the Hardware and Operating System of the Host System [Page 35].

The values listed in the following table for the host systems and servers should ensure the best possible operation of your R/3 application sever.

Main and Unprotected Storage on the Host System

Resource	SAP Recommendation
Free memory area ASP 1	Minimum: 2 GB Recommend 4-6 GB
Main storage	512 MB is sufficient for approx. 15 dialog users. 1024 MB is sufficient for approx. 50 dialog users. You will achieve performance advantages with higher values. These values are valid for hosts on which only one R/3 System runs. If other R/3 Systems run on the host, contact the Hardware Competence Center or your system consultant.

Configuration for AS/400

Storage pool 2	All R/3 jobs run in pool 2 according to the default values. Therefore, make as much space available for pool 2. 250 MB is the absolute minimum.

Recommended R/3 Profile Parameters

Parameter	Recommended Value
abap/heaplimit [Page 61]	**40000000** (40 MB)
abap/heap_area_dia [Page 64]	**2000000000** (2 GB)
abap/heap_area_nondia [Page 65]	**2000000000** (2 GB)
abap/heap_area_total: Limit for Heap Memory [Page 66]	**2000000000** (2 GB)
em/initial_size_MB: Size of the Extended Memory Pool [Page 67]	**4092** Minimum 64 MB
em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20** (Size above which the user context is logged for statistical purposes)
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600** (Interval in which statistics are gathered for the user context size)
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	**0**
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**0**
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** blocks (Maximum size of the ABAP paging file - 64 MB)
rdisp/PG_SHM: Size of the Paging Buffer [Page 68]	**32768** blocks (Size of the paging buffer - 64 MB)
ztta/roll_area: Roll Area [Page 69]	**3 MB** Minimum 16 MB
ztta/roll_first: Size of the Initial Allocation from the Roll Area [Page 69]	**1**
ztta/roll_extension: Limit for Extended Memory [Page 62]	**2000000000** (2 GB)

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The values listed here are recommended basic values. In the course of monitoring and optimizing your R/3 System, you may have to change these values under certain circumstances. For more information, refer to Monitoring the Memory Management System [Page 71] and Temporary Memory on AS/400 [Page 51].

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Check the changes to the system profiles using the program *rspfpar*. For more information, see Checking the Hardware and Operating System of the Host System [Page 35].

Temporary Storage (AS/400)

Using the following parameters, you can limit the maximum use of the process-specific temporary storage. This in turn limits the maximum use of temporary storage by an R/3 application server.

Parameters for Controlling the Use of Temporary Storage:

Parameter	Meaning
rdisp/PG_SHM [Page 68]	Paging memory per application server
rdisp/PG_MAXFS [Page 68]	Paging memory per application server
abap/heap_area_dia [Page 64]	Heap limit for a dialog work process
abap/heap_area_nondia [Page 65]	Heap limit for a non-dialog work process
abap/heap_area_total [Page 66]	Heap limit for the entire R/3 application server
em/initial_size_MB [Page 67]	Extended memory pool per application server

For more information about the parameters, see Allocating Memory for User Contexts [Page 18].

Temporary storage almost completely covers the memory requirements of R/3. The main consumers are:

- Internal buffers with a fixed share (PXA, table buffer, paging buffer)

- R/3 memory management with a fixed share (extended memory)

- R/3 memory management with a variable share (roll memory, private memory) depending on the number of users logged on and the application type (direct memory requirements)

Setting the Profile Parameters (AS/400)

Use

The optimum parameter settings are dependent on:

- Available hardware resources (main memory and free auxiliary storage)

- System load, that is average or maximum number of active users on an application server

Procedure

The following table is a guide for setting the profile parameters for the AS/400 platform

Parameter	Unit	Default Setting	Recommendation	Comment

Setting the Profile Parameters (AS/400)

abap/heaplimit: Work Process Restart [Page 61]	Bytes	40000000 (40 MB)	40 MB	
ztta/roll extension: Extended Memory Limit [Page 62]	Bytes	2 GB	Possibly lower depending on application.	Absolute upper limit: 2 GB.
abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes [Page 64]	Bytes	2 GB	2 GB	
abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes [Page 65]	Bytes	2 GB	2 GB	
abap/heap_area_total: Heap Memory Limit [Page 66]	Bytes	2 GB	2 GB	You can use the operating system monitor (ST06) to monitor physical storage and ASP usage. Allocated unprotected temporary storage includes the allocated memory of: - All R/3 instances - Database buffers and processes - Operating system You can look at this in detail using Transaction ST02 → *Detail analysis* → *Storage*.
em/initial_size_MB: Extended Memory Pool Size [Page 67]	MB	4092	8190 MB maximum	

rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	8 KB blocks	0	0	Do not define a value higher than 12500 (100 MB) unless the CCMS Tune Summary (Transaction ST02) under Monitoring the Memory Management System [Page 71] states that a larger roll buffer is required. Absolute upper limit: 250000 blocks (2 GB) for special applications
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	8 KB blocks	0	0	Absolute upper limit: 250000 blocks (2 GB) for special applications
rdisp/PG_SHM: Paging Buffer Size [Page 68]	8 KB blocks	32768	32768 (the same value as rdisp/PG_MAXFS)	Absolute upper limit: 250000 blocks (2 GB) for special applications
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	8 KB blocks	32768	32768	Absolute upper limit: 250000 blocks (2 GB) for special applications
ztta/roll_first: Initial Allocation Size from the Roll Area [Page 69]	Bytes	1 byte	1 byte	This value is set automatically and cannot be changed.
ztta/roll_area: Roll Area [Page 69]	Bytes	3 MB	3 MB	This value is set automatically and cannot be changed.
em/blocksize_KB: Segment Size for the Extended Memory [Page 70]	KB	4096 (4 MB)	4096 (4 MB)	⚠ Do not change the standard value!

Sample Configuration (AS/400)

The configuration of the memory management system is largely dependent on the number of users per R/3 application server. A number of sample configurations are given below:

Application Server with up to 15 Users [Page 54]

Application Server with up to 50 Users [Page 55]

Application Server with over 50 Users [Page 57]

Application Server with up to 15 Users (AS/400)

The values listed in the following table for the host system and server should ensure the best possible operation of your R/3 application server for up to 15 dialog users.

The lower limit values represent a type of minimum configuration for small R/3 installations.

Main and Unprotected Storage on the Host System

Resource	SAP Recommendation
Free auxiliary storage	**Minimum:** The greater of the following two values: • 4 GB • Three times the main storage **Recommendation: 4-6 GB**
Main storage	**Minimum: 256 MB** (memory pool without database). More main storage provides performance advantages. **Recommendation: at least 512 MB** This value is recommended for hosts on which only one R/3 instance is running. If you are planning to install the database system or a second instance on a host, please contact your Hardware Competence Center or system consultant.

R/3 Profile Parameters

For information about the use of the various parameters, see Profile Parameters for Memory Management [Page 60].

Parameter	Recommended Value
abap/heaplimit: Work Process Restart [Page 61]	**40000000** (40 MB)
abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes [Page 64]	**2000000000** (2 GB)
abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes [Page 65]	**2000000000** (2 GB)
abap/heap_area_total: Heap Memory Limit [Page 66]	**2000000000** (2 GB)

em/initial_size_MB: Extended Memory Pool Size [Page 67]	**128** (128 MB, 6 MB per user) Minimum 64 MB
em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	**0**
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**0**
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** (The same value as rdisp/PG_SHM)
rdisp/PG_SHM: Paging Buffer Size [Page 68]	**32768**
ztta/roll_area: Roll Area [Page 69]	Set automatically
ztta/roll_first: Initial Allocation Size from the Roll Area [Page 69]	Set automatically
ztta/roll_extension: Extended Memory Limit [Page 62]	**200000000** (200 MB).

The settings listed here are recommended base values that you may, however, have to change if you monitor or optimize your R/3 System. For more information, see Monitoring the Memory Management System [Page 71].

Check the changes to the system profiles using the program **rspfpar**. For more information, see Operating System and Hardware Prerequisites [Page 32].

Application Server with up to 50 Users (AS/400)

The values listed in the following table for the host system and server should ensure the best possible operation of your R/3 application server for up to 50 dialog users.

Main and Unprotected Storage on the Host System

Resource	SAP Recommendation
Free auxiliary storage	**Minimum:** The greater of the following two values: • 4 GB • Three times the main storage **Recommendation: 4-6 GB**

Application Server with up to 50 Users (AS/400)

Main storage	**Minimum: 512 MB** (without database). A larger main memory provides performance advantages.
	Recommendation: 768 MB
	This value is recommended for hosts on which only one R/3 instance is running. If you are planning to install the database system or a second instance on a host, please contact your Hardware Competence Center or system consultant.

R/3 Profile Parameters

For information about the use of the various parameters, see Profile Parameters for Memory Management [Page 60].

Parameter	Recommended Value
abap/heaplimit: Work Process Restart [Page 61]	**40000000** (40 MB)
abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes [Page 64]	**2000000000** (2 GB)
abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes [Page 65]	**2000000000** (2 GB)
abap/heap_area_total: Heap Memory Limit [Page 66]	**2000000000** (2 GB)
em/initial_size_MB: Extended Memory Pool Size [Page 67]	**5 MB** per active user **+ 1.5 MB** per user; minimum **512 MB**
em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	**0**
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**0**
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** (The same value as rdisp/PG_SHM)
rdisp/PG_SHM: Paging Buffer Size [Page 68]	**32768**
ztta/roll_area: Roll Area [Page 69]	Set automatically
ztta/roll_first: Initial Allocation Size from the Roll Area [Page 69]	Set automatically

ztta/roll_extension: Extended Memory Limit [Page 62]	**200000000** (200 MB)

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The settings listed here are recommended base values that you may, however, have to change when you monitor or optimize your R/3 System. For more information, see Monitoring the Memory Management System [Page 71] and Profile Parameters of Memory Management [Page 60].

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Check the changes to the system profiles using the program **rspfpar**. For more information, see Operating System and Hardware Prerequisites [Page 32].

Application Server with over 50 Users (AS/400)

The correct configuration for the memory management system in large R/3 application servers depends on the several factors. SAP cannot, therefore, give any recommendations for standard configuration. However, you can calculate your own approximate values by referring to the information in this section and in the other sections that are referred to.

To determine the required resources for the host system, contact the SAP Competence Center of your hardware partner Then you can configure the R/3 Server by setting the R/3 memory management parameters in the R/3 system profile.

Main and Unprotected Storage on the Host System

Resource	SAP Recommendation
Free auxiliary storage	**Minimum:** The greater of the following two values: • 6 GB • Three times the main memory In either case, this must be greater than the sum of: • The required R/3 unprotected storage (can be estimated using the program **rspfpar**, see *Additional Swap Space Requirements*). • The memory requirements of the operating system • To be on the safe side, at least 2 GB free ASP when executing the operation

Application Server with over 50 Users (AS/400)

Main storage	**Guidelines:**
	Central system with all services, no database: 180 MB plus 5.7 MB per active user or at least 512 MB
	With database: Add 150 MB plus 0.3 MB per active user
	Application server: 120 MB plus 5.3 MB per active user
	An increase in storage improves performance. Please also contact your hardware partner or the SAP Competence Center of your hardware partner.

R/3 Profile Parameters

For information about how the various parameters are used, see Profile Parameters of Memory Management [Page 60].

Parameter	Recommended Value
abap/heaplimit: Work Process Restart [Page 61]	**40000000** (40 MB)
abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes [Page 64]	**2000000000** (2 GB)
abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes [Page 65]	See parameter documentation.
abap/heap_area_total: Heap Memory Limit [Page 66]	**2000000000** (2 GB); see parameter documentation.
em/initial_size_MB: Extended Memory Pool Size [Page 67]	**5 MB** per active user **+ 1.5 MB** per user; Minimum **1024 MB**
em/stat_log_size_MB: Statistics - User Context Size [Page 71]	**20**
em/stat_log_timeout: Statistics - User Context Size [Page 71]	**600**
rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]	**0**
rdisp/ROLL_SHM: Roll Buffer Size [Page 67]	**0**
rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File [Page 68]	**32768** (The same value as rdisp/PG_SHM)
rdisp/PG_SHM: Paging Buffer Size [Page 68]	**32768**
ztta/roll_area: Roll Area [Page 69]	Set automatically

ztta/roll_first: Initial Allocation Size from the Roll Area [Page 69]	Set automatically
ztta/roll_extension: Extended Memory Limit [Page 62]	**2000000000** (2 GB)

The settings listed here are recommended base values that you may, however, have to change when you monitor or optimize your R/3 System. For more information, see Monitoring the Memory Management System [Page 71] and Profile Parameters of Memory Management [Page 60].

Check the changes to the system profiles using the program **rspfpar**. For more information, see Operating System and Hardware Prerequisites [Page 32].

Operating System and Hardware Prerequisites (AS/400)

Before you can use memory management with your R/3 System, you have to make sure that your System fulfills the following prerequisites:

- The free auxiliary storage does not fall below a specified level

- You have installed additional main memory, should this be necessary

- Various operating system parameters are set correctly

For details of the prerequisites for free auxiliary storage, see:

Swap Space Requirements [Page 74]

For information about changes to kernel parameters and software prerequisites and on the hardware requirements, refer to the following documentation:

- If you are installing an R/3 System, see *R/3 Installation: IBM AS/400*.

- If you are upgrading an R/3 System, see *Upgrading to Release 4.6C: IBM AS/400.*

    You will find additional information in the R/3 installation and upgrade Notes.

See also:

Memory Pool Requirements for AS/400 [Page 47]

Checking the Hardware and Operating System of the Host System [Page 35]

Profile Parameters of Memory Management

Use

Profile parameters enable you to set up your memory management system to get maximum benefit from it. By setting the parameters correctly, you can adjust memory management exactly to your resources and requirements.

Notes on Implementation

The default parameter settings usually ensure the smooth operation of your memory management system. Monitoring the Memory Management System [Page 71] enables you to uncover possible weak spots.

Integration

This section explains what each parameter does. The different settings for each platform are described in the Platform-Specific Description of Memory Management [Page 15].

Features

The parameters govern how the memory management system behaves and restrict it so that it does not exceed operating system or hardware limitations. Certain parameters may only restrict individual work processes, and others might limit resources that are used by all work processes, for example, the extended memory. There are also parameters that help you configure memory management statistics.

Controlling Memory Management

Memory Management Resources for One Work Process

Memory Management Limitations

Memory Management Statistics

abap/heaplimit: Work Process Restart

Use

This value specifies the memory amount in bytes. When this amount is exceeded, a work process is restarted after executing a dialog step.

ztta/roll_extension: Extended Memory Limit

In a work process, heap memory (malloc) can be allocated for a user context. See Allocating Memory for User Contexts [Page 18] and Private Memory [Page 11]. If a user context releases this memory again, it still remains reserved by the process (compared to the operating system), and is only available for other processes if the process itself has ended.

The following chart illustrates this situation using the example of a dialog work process.

Memory usage

Operating system limit (swap space)

abap/heap_area_dia

abap/heaplimit

End of dialog step

Work process restart

Time

⌒∿　Heap usage

⁄⌒⌣　Swap-space usage of operating system
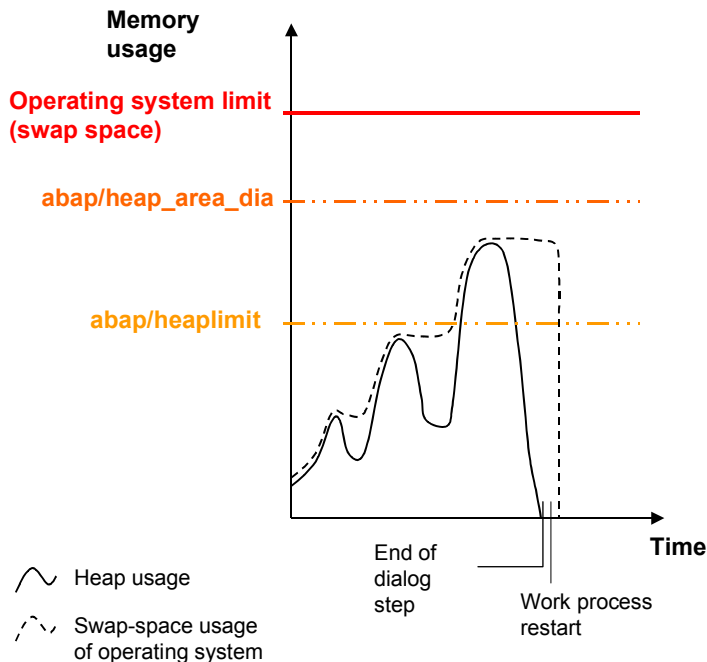
Goal:

As few restarts of work processes as possible, but swap space bottlenecks may not occur. The local memory allocated by the work processes has to be released again.

As depicted in the graphic, the value of *abap/heaplimit* should be smaller than abap/heap_area_dia [Page 64] or abap/heap_area_nondia [Page 65], so that the dialog step that is running can still be executed. This prevents the work process from working against the operating system's swap space limit if there is a programmed termination of the work process.

To determine how many work processes are restarted, use the CCMS (transaction `rz03`). Note that the column *Err* in the work process display (transaction `sm50`) does not refer to work processes that are restarted.

ztta/roll_extension: Extended Memory Limit

User Context [Page 13]

The value specifies the amount of memory that **one** user context can allocate to the R/3 extended memory. Valid for all types of work processes.

em/initial_size_MB

Extended memory (shared)

ztta/roll_extension

The value refers to the SAP Extended Memory [Page 10] that a user context allocates. If the value entered is exceeded, heap memory is allocated. The work process is assigned only to this user context and represents other user contexts that are no longer available since it is switched to the PRIV mode (in the work process monitor, Transaction **sm51**). See: Private Memory [Page 11]

If the value is set too high, caused by a large user context, an extended memory bottleneck can occur. If a large user context fills the R/3 extended memory, other smaller user contexts could thereby switch work processes into PRIV mode before their R/3 extended memory limit has been used up.

SAP recommends you test your system using a high value (500 MB). If the PRIV mode is switched on prematurely, you can decrease the size.

Under IBM AIX (see also Configuration for AIX [Page 23]) and Siemens-Nixdorf SINIX you can use ztta/roll_extension to balance the effects of the relatively small values that can be defined for abap/heap_area_nondia (see abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes [Page 65]). If the maximum data segment size is a relatively small value, this restricts the heap memory available for background processing tasks on these platforms.

In order for the background processing to have at least 500 MB memory allocated to it, SAP recommends setting the parameter ztta/roll_extension to the values listed below. Set these values **only** on the servers that are used primarily for background processing. Otherwise, the R/3 extended memory may be filled by just a few work processes and the PRIV mode will be switched on prematurely (see Recognizing and Correcting Problems [Page 85]).

- SINIX value for background processing: > 200 MB

You must always increase the value for em/initial_size_MB: Extended Memory Size [Page 67], so the active processes can be executed. Using the CCMS Alert Monitor (transaction **rz20**), you can determine how much extended memory your server allocates. The peak value displays the "high water mark" (maximum allocation) for *Extended Memory*.

Goal:

Minimize the number of dialog work processes in the PRIV mode.

abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes

- **em/initial_size_MB**: should be significantly larger than ztta/roll_extension.

- **ztta/roll_area**: a higher value saves on R/3 extended memory.

- **rdisp/ROLL_SHM, rdisp/ROLL_MAXFS**: If you increase the value of ztta/roll_area, you must adjust these parameters

abap/heap_area_dia: Heap Memory Limit for Dialog Work Processes

The heap memory limit restricts the local memory (Private Memory [Page 11]) that an R/3 dialog work process can allocate. This ensures that there is enough swap space available.
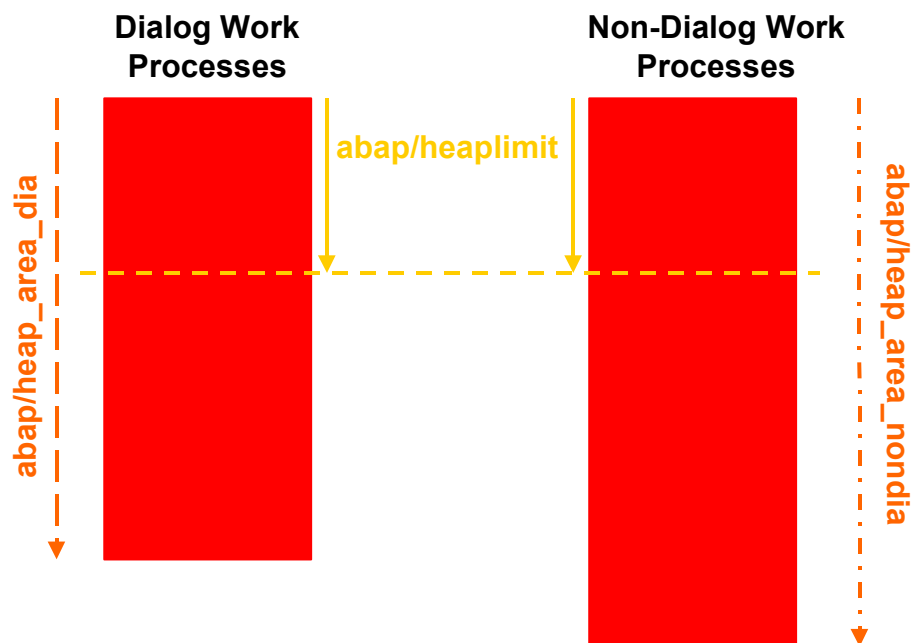
If the value is exceeded, the user context that was just executed is terminated prematurely.

Goal:

Prevent a single dialog work process (user context) from filling up the entire heap memory of the application server.

A work process from an application server can allocate only so much heap memory as specified in parameter abap/heap_area_total [Page 66]. The limit specified in the parameter refers to the combined heap memory usage of all work processes for an application server.

Ensure that the value is high enough to meet all regular memory requirements, but not so high that the work process exceeds the operating system's swap space restrictions (see graphic in abap/heaplimit: Work Process Restart [Page 61]).

abap/heap_area_nondia: Heap Memory Limit for Non-Dialog Work Processes

This parameter sets the limit for the heap memory (heap memory) that an R/3 non-dialog work process can allocate. This value refers to spool, update, and background processes. This value ensures that there is enough swap space available in the system.
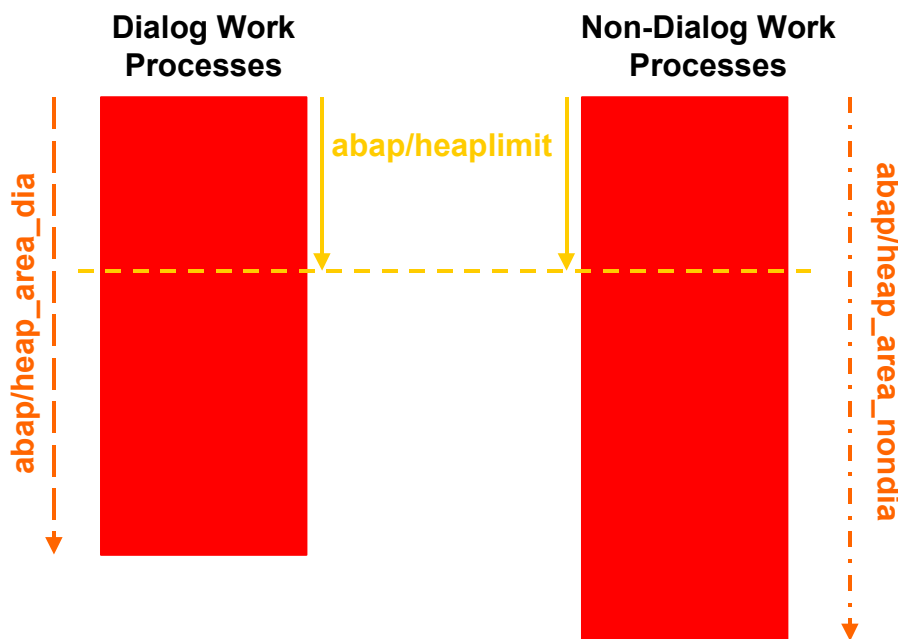
Goal:

Prevent a single non-dialog work process (user context) from filling up the entire heap memory of the application server.

The work processes of an application server can allocate only so much heap memory as specified in parameter abap/heap_area_total [Page 66]. The limit specified in the parameter refers to the combined heap memory usage of all work processes for an application server.

The value should be high enough for the largest possible background processing context in your R/3 System. If the value is too small, SAP Extended Memory [Page 10] is assigned to the

background process. This extended memory is not available for dialog work processes. See Allocating Memory for User Contexts [Page 18].

The default value is generously sized and does not usually have to be increased.

abap/heap_area_total: Heap Memory Limit

This parameter sets the maximum heap memory limit that all work processes of an R/3 application server can allocate. You can use this upper limit to restrict the swap space usage of an R/3 application server to a specific amount. You can find more details on this topic under Functions of the R/3 Memory Management System [Page 7].

Dialog Work Processes   **Non-Dialog Work Processes**

Extended memory   Extended memory   Extended memory

abap/heap_area_dia

Extended memory

abap/heap_area_total

Extended memory   abap/heap_area_nondia
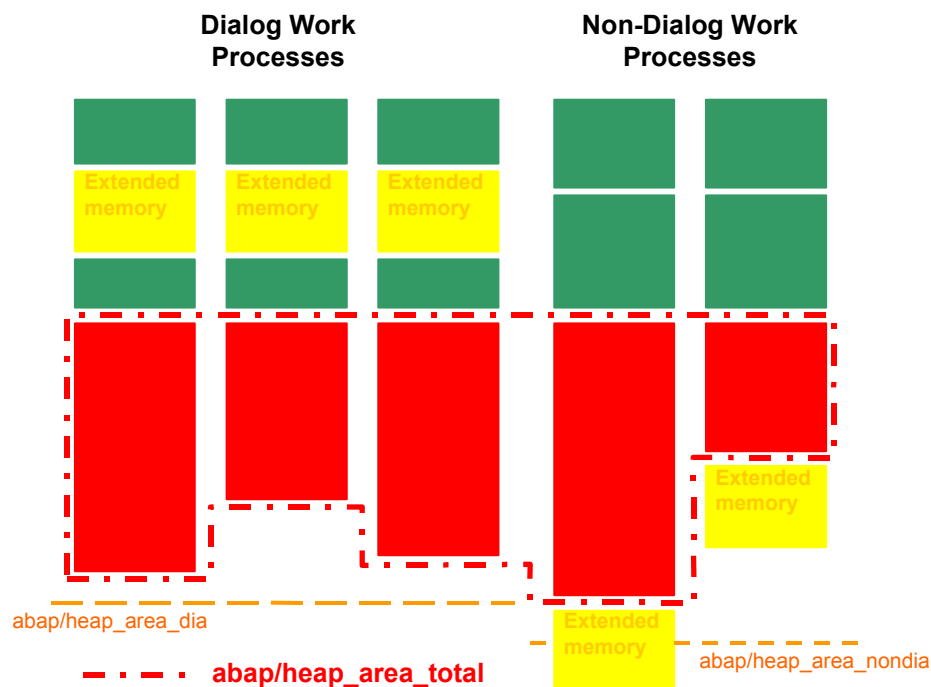
Goal:

This value ensures that even at maximum swap space usage of the R/3 System and during normal operation, **at least 100 MB swap space (or approximately 10-15%) remains free**. See also Swap Space Requirements [Page 74]

em/initial_size_MB: Extended Memory Pool Size

This value specifies the extended memory pool size that the R/3 System manages for the extended memory.

Goal:

Ideally, this pool is large enough to contain the sum of all the user contexts. The pool must always be much larger than the size of the parameter ztta/roll_extension [Page 62]. This parameter specifies how much extended memory can be allocated to a user context.

If the pool is used up, heap memory is allocated (see Private Memory [Page 11] and Allocating Memory for User Contexts [Page 18]). The work process switches to the PRIV mode and is reserved exclusively for the current user context. After processing the user context, the work process might restart automatically if the process size specified in abap/heaplimit [Page 61] is exceeded.

Basic rules: Ensure that the pool is 10 to 15 times as larger as ztta/roll_extension; The exact value is oriented according to the available swap space and the number of users in the host system.

The swap space must be sized so that it can contain the R/3 extended memory and has enough space for the R/3 usage of heap memory (see Swap Space Requirements [Page 74]). There must also be enough space available for competing system users outside of the R/3 System. The swap space must also be large enough to ensure a safety reserve.

rdisp/ROLL_SHM: Roll Buffer Size

This value specifies the size of the roll buffer in 8 KB blocks.

The roll buffer functions as the cache for the roll file. For a fast change of context to occur, the roll areas of all user contexts should find space in the roll buffer (approximately 1 MB for each user).

Goal:

Minimum time for a context change

> Buffered data is in the shared memory; accessing this data here is much faster than accessing a file.

> For technical reasons, the roll buffer size must be **at least 10% of the roll file size** (parameter rdisp/ROLL_MAXFS: Maximum Roll File Size [Page 68]).

rdisp/ROLL_MAXFS: Maximum Roll File Size

R/3-Rollbereich [Page 10]

This value specifies the size of the roll file in 8 KB blocks. The roll file functions as memory for the part of the user contexts that finds space in the roll area.

Goal:

Space must be sufficient; problems should not occur even if the dimensions are large.

Space must be available in the file system.

rdisp/PG_SHM: Paging Buffer Size

This value specifies the size of the paging buffer in 8 KB blocks. Since Release 4.0, a paging buffer is no longer necessary for SAP Memory Management because internal tables and lists are not located in the R/3 paging.

See also: SAP Paging [Ext.].

Goal:

Value = 0, to save swap space

rdisp/PG_MAXFS: Maximum Size of the R/3 Paging File

This value specifies the size of the R/3 paging file in 8 KB blocks. The paging file functions as memory for extracts and exports to memory. **See also:** SAP Paging [Ext.].

Goal:

Space must be sufficient; does not present a problem even if the dimensions are large.

Space must be available in the file system.

ztta/roll_first: Initial Allocation Size from the Roll Area

R/3-Rollbereich [Page 10]

This is the amount of roll memory allocated to a dialog work process before R/3 extended memory is allocated.
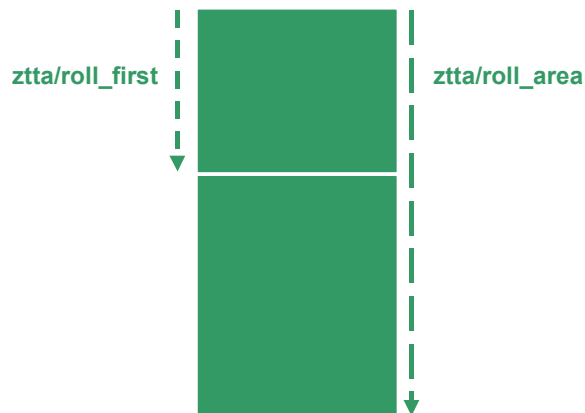
See Allocating Memory for User Contexts [Page 18]

ztta/roll_area: Roll Area

Total size of the roll area in bytes.
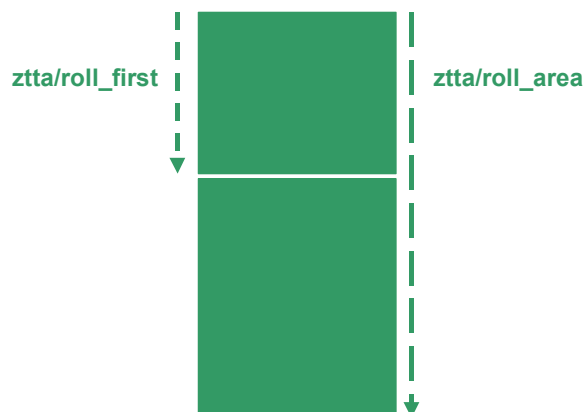
A part of this area (in the graphic Roll area 1) is allocated a user context at the beginning. Its size is defined in ztta/roll_first [Page 69]. The partial area is for the data that must be contained in the

em/blocksize_KB: Segment Size of the Extended Memory

roll area. During a user context change, this data is "rolled" (copied) into and out of a work process. If ztta/roll_area is larger than ztta/roll_first, the additional space makes a second part available (Roll area 2).

If the user context cannot be allocated more extended memory, this second part of the roll area is available for the dialog processes (see Allocating Memory for User Contexts [Page 18]).

By specifying a higher value for ztta/roll_area than for ztta/roll_first, you avoid allocating local private memory as soon as the set limits of the R/3 extended memory are reached. The remaining roll memory therefore serves as the last buffer before a user context has to allocate heap memory.

This pushes back the point in time at which a work process is switched to PRIV mode (see Private Memory [Page 11]). Although there advantages to this procedure, there are also the following disadvantages: The copying procedure is much slower for storing data in the roll area for changing work process contexts. The copy necessary for the roll area during context changes is slower than the allocation procedure used for the context change with R/3 extended memory. Therefore, increasing the roll area memory slows down the context change.

Goal:

Reduce data transfer to a minimum using copy procedures during context changes (value closer to ztta/roll_first), higher values avoid problems however (address space, swap space, operating system paging, work process change to PRIV mode, if the R/3 extended memory limit is reached).

⚠️

- rdisp/ROLL_SHM: Should be adjusted if you change ztta/roll_area.

- rdisp/ROLL_MAXFS: Must be adjusted if you change ztta/roll_area.

- ztta/roll_area: Must be larger than or the same size as ztta/roll_first.

em/blocksize_KB: Segment Size of the Extended Memory

This value specifies the size of the segments that are assigned to the R/3 extended memory.

Only SAP is allowed to change this parameter.

em/stat_log_size_MB: Statistics - User Context Size

Use

In the SAP memory management system, the sizes of user contexts are gathered for statistical purposes if the size exceeds the specified value.

Only SAP is allowed to change this parameter.

em/stat_log_timeout: Statistics - User Context Size

Use

In the SAP memory management system, the sizes of user contexts are gathered for statistical purposes. This parameter specifies the cycle in which the sizes are logged.

⚠️

Only SAP is allowed to change this parameter.

Monitoring the Memory Management System

Use

You should monitor the R/3 System during operation to check that Memory Management has the necessary resources, and that frequent paging at operating system level does not slow down the system or cause any bottlenecks.

Flow

The following tools are suitable for monitoring:

- **Tune Summary** (transaction `st02`): The current status and the memory resource usage for a specific R/3 application server are displayed here. The procedure is described in Checking Roll /Paging Area and Extended Memory using Transaction ST02 [Page 72].

- Transaction `st06` for monitoring the available swap space in the host system. See also Monitoring Memory Resources Using Transaction st06 [Page 73].

- **CCMS Alert Monitor** (transaction `rz20`): For more information, see the Tutorial [Ext.]in the CCMS documentation.

- **Overview of Users** (transaction `sm04`): Use transaction `sm04` or choose *Tools → Administration → Monitor → System monitoring → User overview*, and then choose *Goto →*

Checking Roll /Paging Area and Ext. Memory with Trans. ST02

Memory to display the amount and type of memory reserved by the user contexts of all users for a specific R/3 application server.

- **Overview of Work Processes** (transaction **sm50**): Select the Detail button to display the memory resources that have been reserved for a certain work process.

  By monitoring work processes in the R/3 System (transaction **sm50**) or from outside the system (**dpmon** program at operating system level), you can determine the status of the work processes in relation to the PRIV mode. If work processes are often switched to the PRIV mode, you must increase the extended memory and/or adjust the limit for the extended memory (see Functions of the R/3 Memory Management System [Page 7]). In this case, you must consult with SAP.

- You can evaluate this information for all the work processes by using Transaction **sm66**.

- You can determine the Swap Space Requirements [Page 74] at R/3 and operating system level.

Many monitoring tools are operating-system dependent. The procedures for monitoring systems on various platforms are described in the following:

Monitoring on UNIX [Page 77]

Monitoring on Windows NT [Page 81]

Monitoring on AS/400 [Page 83]

Checking Roll /Paging Area and Ext. Memory with Trans. ST02

SAP memory	Current use	Max. use	In memory	On disk	
	[%]	[kb]	[kb]	[kb]	[kb]
Roll area:	5,47	448	1.280	8.192	0
Paging area	0,01	16	72	9.600	252.544
Extended Memory	4,03	6.144	22.528	152.576	
Heap Memory		0	0		

This is a snapshot of the current (percentage and absolute values in kBytes) and the maximum memory usage of the various R/3 memory types [Page 9]. The table also indicates whether, and to what extent, the requirement is satisfied from the main memory and from the disk.

You can determine from the row *Extended Memory* that the SAP Extended Memory [Page 10] is sufficiently large. The value [Max. use] is, in this example, noticeably smaller than the created memory area [In memory]. If both values are identical, you must increase the extended memory (profile parameter: em/initial_size_MB [Page 67]).

See also:

R/3 roll area [Page 10]

SAP paging [Ext.]

SAP Extended Memory [Page 10]

Private Memory [Page 11] (Heap Memory)

Monitoring Memory Resources Using Transaction ST06

Use

The OS Monitor (the initial screen of transaction `ST06` shows the configured swap space). For more detailed information, see Swap Space Requirements [Page 74].

Procedure

You can display the memory requirements and the swap space using the pushbutton `Detail analysis menu`. This displays the requirements and swap space either as a snapshot or from over a period of hours (the pushbuttons `Memory` and `Swap`).
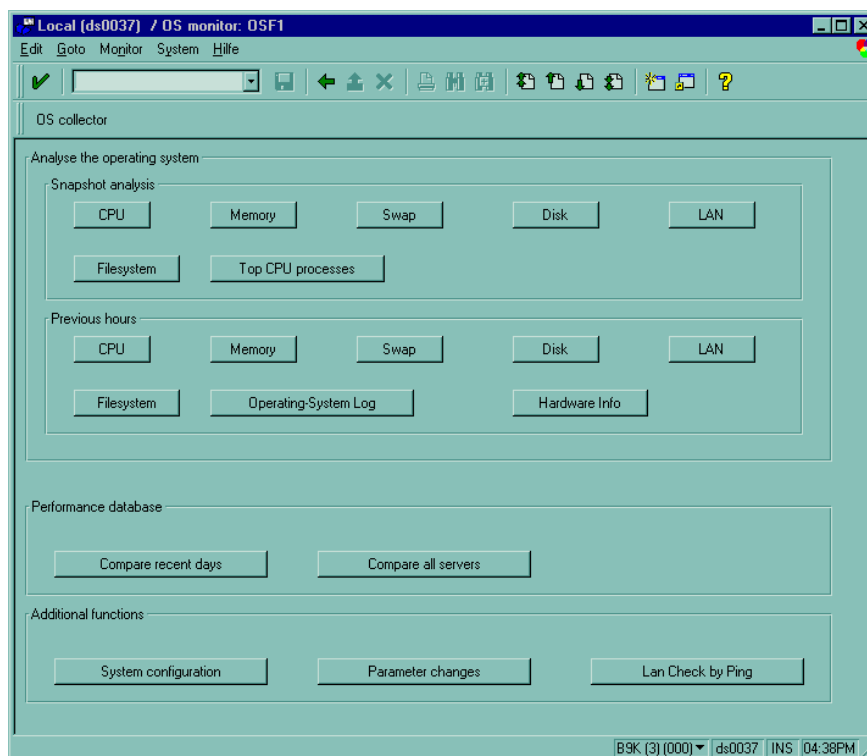
Swap Space Requirements

R/3 application servers are important users of swap space. If the swap space on a computer is used up, serious system problems occur as a result. Therefore, you must monitor swap space usage.

To monitor swap space, you can use either the monitoring tool for host operating systems or the system monitor from the SAP Computing Center Management System (CCMS). The CCMS Alert Monitor, which is available via the system monitor, issues warning messages if the swap space usage exceeds a preset limit. You can also display the present usage.

The procedure depends on the operating system and is described in the relevant documentation:

Monitoring on UNIX [Page 77]

Monitoring on Windows NT [Page 81]

Monitoring on AS/400 [Page 83]

An R/3 application server divides its swap space with non-R/3 processes in the host system. The maximum swap space size that an R/3 application server can occupy is determined by the following factors:

- The total size of the shared memory segments used by SAP, in particular the SAP buffer (for example, the program and table buffer).

  Typical size: 200 to 700 MB

  You can test this using the program `sappfpar check pf=<profile>`. (For more information on UNIX, see Determining Swap Space Requirements [Page 78]).

- Number of work processes in an R/3 server

  Each work process requires approximately 12 MB of swap space plus the roll area of the active user context; therefore approximately 20 MB per work process.

- As with the parameter em/initial_size_MB [Page 67], the SAP Extended Memory [Page 10] defines the R/3 extended memory pool: This parameter allocates the swap space area that the R/3 System uses for its extended memory. The pool has a set size. The total size is allocated directly after starting the application server.

  Typical values: 500 - 1500 MB

- R/3 limits defined for the HEAP memory (Private Memory [Page 11]) used by the work processes of an application server. The parameter abap/heap_area_total [Page 66] defines these limits (maximum private local (heap) memory that can be allocated to all R/3 work processes). This is the upper limit of the swap memory that can be allocated to the R/3 work processes when they run in PRIV mode and use heap memory. The memory is allocated to the work processes in the application server taking this limit into account. The size used varies depending on whether the work processes switch to or are restarted in the PRIV mode when they leave the PRIV mode.

  This parameter lets you foresee when the R/3 System requires swap space. This allows you to prevent a critical shortage of swap space. Work processes cannot use heap memory resources anymore than specified in this parameter.

  Typical values: 2 -4 GB

 Basic rules:

For **optimal performance**, the swap space should be approximately 3 times that of the main memory or be at least 3 GB, according to whichever value is higher.

The rsmemory Report

Use

You can use the *rsmemory* report to define your memory allocation strategy for work processes. You can specify the memory class assigned to a work process, the extent of the class assigned, and the order in which it is allocated. A distinction is made here between dialog work processes and non-dialog work processes (batch, update, spool).

Changes made here only apply to the server on which you are currently logged on and only remain in effect until the R/3 instance is stopped again.

Prerequisites

You are familiar with the SAP Memory Management concept and have read the section entitled Functions of the R/3 Memory Management System [Page 7].

Features

The following memory classes exist: R/3 roll area [Page 10], SAP Extended Memory [Page 10], and private memory [Page 11]. These memory classes are assigned the following values, which are also displayed in the initial screen of the *rsmemory* report.

Value	Memory class
0	Roll area
1	Extended Memory (EM)
2	Private memory (heap)

The initial screen of the report is structured as follows:

The rsmemory Report

The screen comprises three parts:

- **Quota Dialog:** The allocation strategy for dialog work processes is defined here. You can specify the steps in which each class is allocated memory, and how much memory is allocated.

  No entry in the memory class field corresponds to class 0 (heap memory).

  The entry here does not have to match the defined memory parameters. If you enter a value for the heap memory in the 4th step that is different from the abap/heaparea_dia parameter, the value entered here takes precedence.

In this case, 1 MB of roll area is first allocated by a dialog work process, and then 300 MB of extended memory. Following this, 6.5 MB of roll area are allocated again before 200 MB of heap memory (the process then switches to PRIV mode) are allocated.

- **Quota Batch/VB/Spool:** As is the case with the quota dialog, the allocation strategy for non-dialog work processes is defined here (see also Allocating Memory for User Contexts (UNIX) [Page 18]).

- **Other parameters:** You can change the following memory parameters here for test purposes (these changes only apply until the next server restart):

  – abap/heap_area_dia [Page 64]

  – abap/heap_area_nondia [Page 65]

  – abap/heap_area_total [Page 66]

  – em/stat_log_timeout

  – em/stat_log_size_MB

Displaying the Memory Areas:

You can display a list of all the users on the application server, with their respective memory requirements, by choosing *Goto → EM/HEAP areas*. The used heap memory and extended of the user are displayed first, followed by the EM usage according to internal sessions.

This is followed by a history of users who have used more than the MB limit specified by em/stat_log_size_MB.

The available HEAP and EM memory is displayed at the end of the list.

Activities

In the initial screen of transaction `se38`, enter the report `rsmemory` and choose *Execute* or F8.

Monitoring on UNIX

As well as the monitoring tools described above that are the same regardless of the operating system, there are also certain tools that are platform dependent.

These are described (with reference to UNIX platforms) in the following sections.

- Determining the Swap Space Currently Available [Page 78]

- Determining the Swap Space Requirements [Page 78]

- Checking Page Fault Rates [Page 79]

Determining the Swap Space Currently Available (UNIX)

Procedure

The program *memlimits* lets you determine how much swap space is currently available in the host system.

To start the program *memlimits*:

`/usr/sap/<SYSTEM NAME>/SYS/exe/run/memlimits | more`

Start the R/3 program *memlimits* from the UNIX command line to determine the available swap space on the host system, where an R/3 application server is to be started.

The application must be stopped for this.

> You can monitor the memory resources (including the swap space) of an R/3 server that is in operation using transaction st06 (see Monitoring Memory Resources Using Transaction st06 [Page 73]).

Result

The available swap space is given at the end of the program output in the output line **`Total available swap space:`** . The program also specifies, if the amount of swap space is adequate and determines the size of the file segments in the system.

Determining Swap Space Requirements (UNIX)

The program **sappfpar** lets you check the minimum and maximum (worst case) swap space requirements for an R/3 application server. It also checks the shared memory requirements and whether or not the parameters em/initial_size_MB [Page 67] and abap/heap_area_total [Page 66] are set correctly. Proceed as follows:

1. To check the instance profile for the R/3 application server, start the R/3 program **sappfpar** from the UNIX command line.

```
/usr/sap/<SYSTEM NAME>/SYS/exe/run/sappfpar check pf=/usr/sap/<SYSTEM
NAME>/SYS/profile/<Profile name> nr=<System number> name=<Systemname> |
more
```

2. The program generates a list. Note the total value for the shared memory in the field *Shared memory* under *Memory requirements estimated*. This value corresponds to the size of the shared memory required for this profile, and must be calculated into the shared memory requirements for the new Memory Management.

3. At the end of the list, the program specifies the minimum swap space requirements, the maximum heap memory requirements and the swap space requirements in a worst case scenario:

> **Total, minimum requirement.....:** `169.5 MB` (shared memory requirement)
> **Process local heaps, worst case:** **762.9 MB**
> (is set with **abap/heap_area_total**)
> **Total, worst case requirements:** **962.5 MB**

> Ensure that there is more swap space available than what is specified in the worst case scenario. (This is because non-R/3 processes also require swap space.)

The following minimum values for the swap space are valid in each case for host systems on which application servers run:

- 3 GB (OSF/1 systems)

- 2 GB (all other systems)

For optimum performance, 3-6 GB swap space is recommended.

The additional swap space requirements may be higher for application servers where heavy online operations and background jobs with large data volumes alternate (day/night operation).

Expanding the swap space may require additional disk space in certain circumstances. This is highly recommended due to inexpensive hardware prices.

Independent of the swap space size, you should monitor the swap space itself to avoid bottlenecks.

Checking Page Fault Rates (UNIX)

Prerequisites

Unlike Windows NT, pages are swapped out to the working memory under UNIX if the space is needed, and then they are overwritten. This swapping out uses up valuable time and performance.

Transaction **st06** displays a small *Pages out* value and a similar *Pages in* value in a performing system. The *Pages out* value is very important when assessing system performance.

Procedure

The following graphic displays the screen for transaction **st06**. In the first screen, the current values for *Pages in/s* and *Pages out/s* are listed (in the following graphic under the heading `Memory`).

Checking Page Fault Rates (UNIX)

```
Local (ds0037) / OS monitor: OSF1                                    _□×
Edit  Goto  Monitor  System  Hilfe                                      ●

✔ │          ▼ │ 🖫 │ ← ⬆ ✕ │ 🖨 🔍 🔍 │ ⟳ ⟳ ⟳ ⟳ │ 🔲 🔳 │ ❓

   Refresh display   Detail analysis menu   OS collector

Wed Mar 24 11:32:52 1999# interval   10   sec.
CPU
Utilization  user   %          41   Count                        4
             system %           6   Load average    1 min      1,73
             idle   %          53                   5 min      1,43
             io wait %          0                  15 min      1,53
System calls/s            3.897   Context switches/s        1.544
Interrupts/s               220


Memory
Physical mem avail  Kb    4.194.304   Physical mem free   Kb    73.032
Pages in/s                       9   Kb paged in/s                79
Pages out/s                      0   Kb paged out/s                0


Swap
Configured swap     Kb    6.151.192   Maximum swap-space  Kb    6.151.192
Free in swap-space  Kb    2.613.592   Actual swap-space   Kb    6.151.192


Disk with highest response time
Name                         rzd16   Response time       ms        1.385
Utilization                    109   Queue                            2
Avg wait time       ms         N/A   Avg service time    ms        1.385
Kb transfered/s                  6   Operations/s                     0


Lan (sum)
Packets in/s                   207   Errors in/s                      0
Packets out/s                  208   Errors out/s                     0
Collisions                       0

                                        B9K (1) (000) ▼ ds0037  INS  11:33AM
```

To display the selection screen for more detailed information, choose *Detail analysis menu*. To get a list of the *Pages in* and *Pages out* values in the past 24 hours, in the block *Previous hour* choose *Memory*. The following screen displays this report.

⚠️

The following values for *Pages in* **should not be exceeded** in the short or long-term.

Value Limit: *Pages out* **under UNIX:**

Pages Out	Value Limit:
Short-term maximum for [Pages out]/s	200
Long-term maximum for [Pages out]/h	600.000

Monitoring on Windows NT

Use

Prerequisites

Flow

Result

Windows NT: Checking Page Fault Rates

Prerequisites

If the operating system is not occupied with other functions, all the pages in the working memory that are not in the address area of an active work process are swapped out (lazy page out) of the operating system as a preventive measure. If space is then required, the pages already swapped out only have to be deleted.

In a performing system, Transaction ST06 thereby displays a high *Pages out* value and a small *Pages in* value in relation. This indicates that many of the swapped out pages were not overwritten and could not be included again through a work process without a page file access. Therefore, only the *Pages in* value is very important when assessing system performance.

See also: Special Features under Windows NT [Page 41]

Procedure

The following values for *Pages in* **should not be exceeded** in the short or long-term.

Value Limit: *Pages in* under Windows NT

Pages in	Value Limit:
Short-term maximum for *Pages in/s* (Transaction ST06)	200
Long-term maximum for *Pages in/h* (Transaction ST06)	600.000

Checking Unused Working Memory Using Transaction ST06 (Windows NT)

⚠️

A high *Pages out* value has no bearing on system utilization. Only the Pages in value is used as a measure of system utilization. If the value limits are exceeded, this an indication that the memory capacity of the machine is too small.

Checking Unused Working Memory Using Transaction ST06 (Windows NT)

Using the paging mechanism *lazy page out* (removing the pages that are not in the address area of an active process), Windows NT creates permanently free working memory (see Special Features under Windows NT [Page 41]). Therefore, Transaction ST06 displays a very high value for *Physical mem free* in comparison to *Physical mem avail* (see the following graphic). Due to a faulty interpretation, the number of work processes is often increased ("There is still unused working memory available").

💡

Instead of using Transaction ST06, you can also use the menu path:

Tools → CCMS → Control/Monitoring → Performance Menu → Operating System → Local → Activity

See also Operating System Monitor: Overview [Ext.] from the CCMS documentation.

💡

A higher *Physical mem free*-value has no bearing on the memory use of the system (no. 9 in the following graphic). *Physical mem free* in relation to *Physical mem avail* is by definition very large (see Windows NT: Paging Mechanism *Lazy Page Out*).
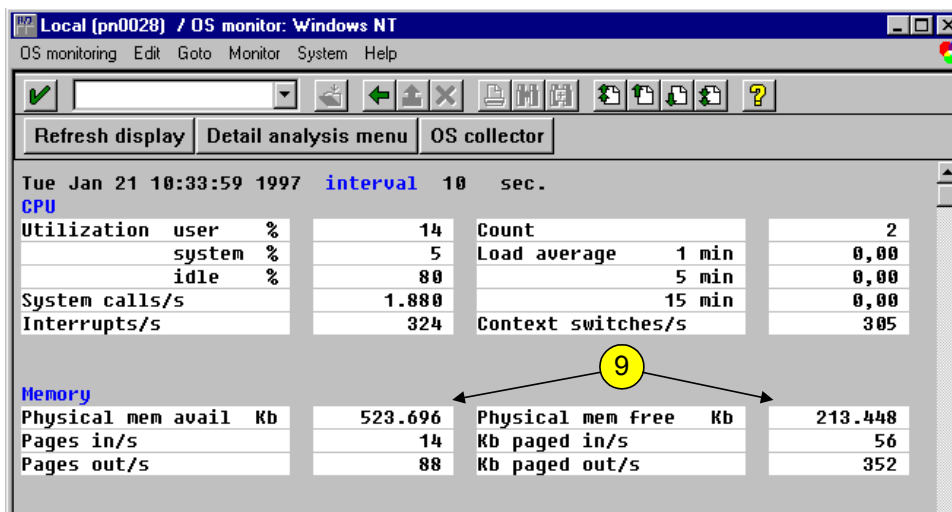
Monitoring on AS/400

Use

In addition to the monitoring functions which do not depend on the underlying operating system, there are also some platform-specific tools.

Features

- [Main Storage Pools (AS/400) [Page 83]](#)

- [Temporary Storage (AS/400) [Page 51]](#)

- [Checking Page Fault Rates (AS/400) [Page 83]](#)

Increasing the Size of Main Storage Pools (AS/400)

If you notice that a main storage pool has a high paging rate, increase the size of the pool affected. (You can check paging rates using the operating system monitor (Transaction ST06) or the CCMS alert monitor (Transaction RZ20).

- Machine Pool: This is always system pool 1.

  The paging rate should be lower than 10 faults per second.

- Other pools: Ideally, the paging rate should be lower than 200 faults per second.

For more information about paging rates, see [Checking Page Fault Rates (AS/400) [Page 83]](#).

Checking Page Fault Rates (AS/400)

If data is already in main storage, it can be accessed independently of the main storage pool in which it is stored. However, if required data is not available in a main storage pool, it is brought into the same main storage pool as the job that referenced it. (This is called a "page fault".) When data is transferred from auxiliary storage into a memory pool, other data is replaced and - provided the data was changed - stored in auxiliary storage. (This is called "paging".)

Under OS/400 [*Pages in*] = [*Pages out*].

Since page faults adversely affect performance, you must make sure that the main storage pool is large enough to keep paging to an acceptable level.

Value limits for page faults under OS/400

Checking Page Fault Rates (AS/400)

If you notice that there is a high page fault rate in a main storage pool, increase the size of the pool. (To see information about page faults, use the operating system monitor (Transaction ST06) or alert monitor (Transaction RZ20).

Pool	Value Limit
Machine pool (always system pool 1)	Since the machine pool contains objects used throughout the whole system, page faults in the machine pool affect all the jobs in the system. For this reason, make sure that the page fault rate is as low as possible in this pool. Upper limit: 10 page faults per second
Other pools	For optimum performance, an average rate of 2 page faults per second for each active work process should not be exceeded. The upper limit that should not be exceeded is a rate of 20 page faults per second for each active work process. (see example below)

The following examples can help you when determining page fault rates in your system:

Example for Best Performance

Page faults per second in the memory pool	20
Active work processes (that is, AS/400 jobs with status RUN) in the memory pool	10
Disk service time	10 ms (average disk service time). Substitute the current value from your system for this value.
Result	2 page faults/s * 10 ms = 20 ms/s paging

This corresponds to a paging overhead of approximately 2%.

Example for Upper Limit

Page faults per second in the memory pool	200
Active work processes (that is, AS/400 jobs with status RUN) in the memory pool	10
Disk service time	10 ms (average disk service time). Substitute the current value from your system for this value.
Result	20 page faults/s * 10 ms = 200 ms/s paging

This corresponds to a paging overhead of approximately 20%. The 20% limit should not be exceeded.

Recognizing and Correcting Problems

If the aforementioned requirements are fulfilled, the memory management system should function without any problems.

However, if problems should occur, they are probably very serious. System performance will be noticeably reduced, enabling you to recognize the problem relatively easily.

Often, to solve the problem, you will have to increase the swap space, or change the size of the roll and paging buffers.

The following problems can occur on any platform:

Swap Space Bottleneck During R/3 Operation [Page 85]

Background Jobs or Update Process Canceled due to Swap Space

Slow Response Times for Certain Users [Page 86]

The following sections deal with platform-specific problems:

Platform-Specific Problems: UNIX [Page 88]

Platform-Specific Problems: Windows NT [Page 91]

Platform-Specific Problems: AS/400 [Page 91]

Swap Space Bottleneck During R/3 Operation

Symptom

Diverse error messages that refer to memory bottlenecks, or, more precisely, a swap space bottleneck. For example, System Panic; cmemreserve: reservation overrun; ENOMEM, Not enough core; ENOSPC, No space left on device; SIGDANGER (under AIX only). In the R/3 System, the R/3 system log message "*no memory of class perm*" is output.

This problem can occur with R/3 processes and external processes as well. The relevant process cannot allocate anymore heap memory. This can lead to the database operation being ended or R/3 work processes being stopped.

Error messages in the R/3 System appear in the developer trace files `dev_disp`, `dev_w<n>` in the system log and in dumps. The following messages may appear:
`TSV_TNEW_;._NO_ROLL_MEMORY`; `NO_MEM`; `NO_MEMORY`; `RESIZE_EM_ALLOC_ERROR`, `Storage class PERM`.

This problem mostly occurs if background jobs are active with large amounts of data.

Possible Causes

- There is no more swap space available (Swap Space Requirements [Page 74]).

Slow Response Times for certain Users, Very Good Response Times for other Users

- The highest value for one of the R/3 profile parameters that limit the swap space usage has been exceeded. In this case, the following parameters are relevant: abap/heap_area_dia [Page 64], abap/heap_area_nondia [Page 65] and abap/heap_area_total [Page 66].

- The operating system limits for the process size (segment size) have been exceeded. For example, no more that 256 MB can be assigned under AIX and no more than 384 under SINIX.

Corrective action

Increase the swap space or decrease the R/3 Extended Memory [Page 10]. If the swap space already corresponds to the SAP recommendations, 1.5 to 2 GB may still be required. There should always be several hundred MB of free swap space available. You can reduce the maximum swap space need of the R/3 System by reducing the value of parameter *abap_heap_area_total*. For more detailed information, see Monitoring the Memory Management System [Page 71].

You can also distribute the load onto several application servers and increase the roll area. Check if the maximum process size (operating system parameters) is sufficient.

Other problems relating to swap space are described in the platform-dependent section.

Slow Response Times for certain Users, Very Good Response Times for other Users

Prerequisites

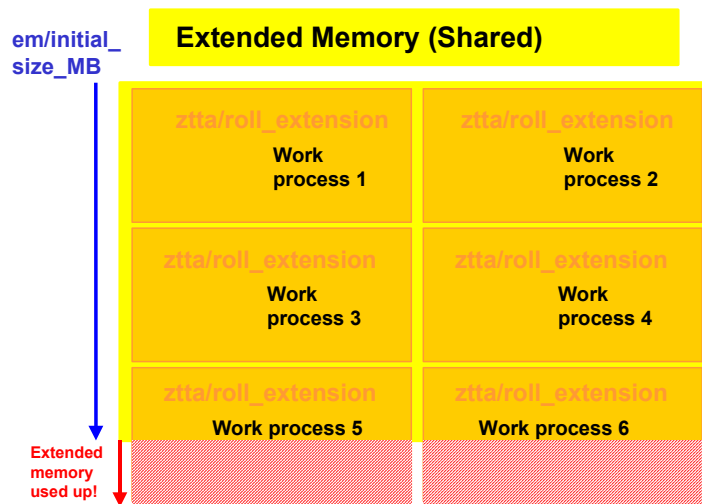The R/3 extended memory is completely filled; dialog work processes are switched to PRIV mode.

Procedure

Use transaction `sm50` to determine the work processes in the PRIV mode.

Possible causes /Corrective action

- No more SAP Extended Memory [Page 10] is available.

**Slow Response Times for certain Users, Very Good Response Times for other Users**

In this example, work processes 5 and 6 cannot allocate any more extended memory because the pool is used up, although its limit for *ztta/roll_extension* would still allow extended memory. They switch into PRIV mode prematurely (see Allocating Memory for User Contexts [Page 18])

Action:

Increase the R/3 extended memory pool (em/initial_size_MB: Size of Extended Memory Pool [Page 67]) to prevent work processes being switched to PRIV mode.

- The limit for the extended memory is too low for most user contexts (set with parameter ztta/roll_extension [Page 62]). Many contexts allocate heap memory and switch to PRIV mode.
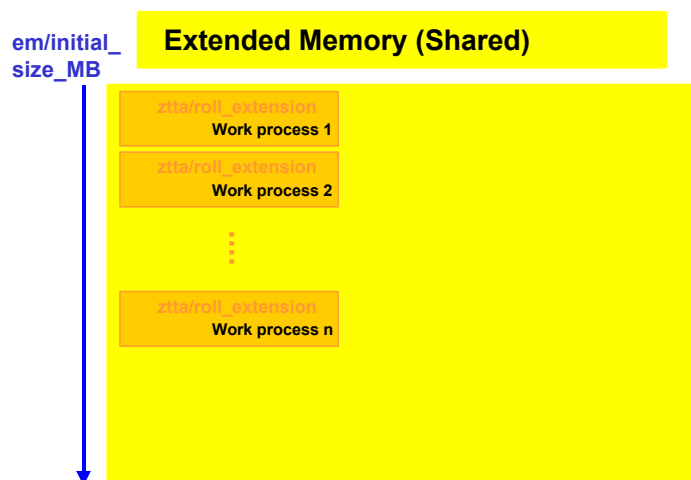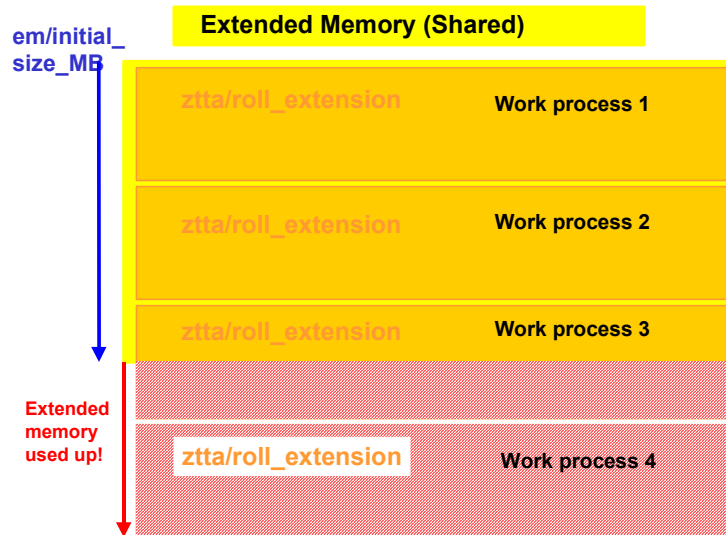

Action:

Increase the limit for the extended memory using *ztta/roll_extension*.

Platform-Specific Problems (UNIX)

- The limit for the extended memory is too high. A few user contexts can completely fill the entire extended memory, whereby other processes are switched into PRIV mode before the limit is reached.

Reduce the limit on the extended memory (defined in ztta/roll_extension [Page 62]), or increase the extended memory (see em/initial_size_MB [Page 67]).

Platform-Specific Problems (UNIX)

The following problems may occur on UNIX operating systems:

Preventing Swap Space Bottlenecks [Page 88]

Insufficient Swap Space Already at System Startup

OSF/1 from DEC: Memory Allocation Problems [Page 89]

IBM AIX: Background Processing Problems due to Segment Size Limitations [Page 90]

IBM AIX: Start or Enqueue Problems or No Connection to Program SAPOSCOL [Page 90]

Preventing Swap-Space Bottlenecks (UNIX)

Swap Space-Engpaß während des R/3-Betriebs [Page 85]

By using the following parameters, you can limit the maximum use of the process-specific memory. This in turn limits the maximum use of swap space by an R/3 application server.

Consider the following parameters:

Parameter	Limits the amount of process-specific memory used...
abap/heap_area_dia [Page 64]	...by any particular dialog work process
abap/heap_area_nondia [Page 65]	... by any particular non-dialog work process (background, spool, etc.)
abap/heap_area_total [Page 66]	...by an R/3 application server -- all dialog and non-dialog work processes

You can find more information on the functions of these parameters under *Limits for Allocating Heap Memory* in Functions of the R/3 Memory Management System [Page 7].

Normally, only background work processes use a large amount of swap space.

Dialog processes do not usually use a lot of swap space, as long as the following conditions apply:

- The R/3 extended memory is not used up (set with parameter em/initial_size_MB [Page 67]); and

- Not many of the user contexts have exceeded the upper limit for using the extended memory (set with parameter ztta/roll_extension [Page 62]).

> The following generally applies: The more main memory that an application server has, the better the performance.

OSF/1 from DEC: Memory Allocation Problems

Symptom

Under the operating system OSF/1 from the Digital Equipment Corporation and under UNIX operating systems (64-bit), R/3 processes are terminated with the following error message: "mprotect failed, rc = 12 error code ENOMEN (not enough core)".

Corrective action

The cause of the problem may be that the value of the OSF/1 kernel parameter VPAGEMAX has not been increased. You must increase this parameter value so that the SAP memory management system can be used.

You can find detailed information on increasing the parameter VPAGEMAX under OSF/1 in the R/3 installation guide *OS Dependencies*. You receive this document with all R/3 installation and upgrade packages.

IBM AIX: Background Processing Problems due to Segment Size Limitations

You can find additional information on VPAGEMAX in the man-page **mprotect** under OSF/1, return code ENOMEN.

The value for VPAGEMAX is calculated in the following way: The sum of values for all R/3 system profile parameters em/initial_size_MB on all R/3 application servers of the host system divided by its page size:

$$\Sigma \text{ (initial\_size\_MB of all R/3 servers)/page size}$$

IBM AIX: Background Processing Problems due to Segment Size Limitations

Symptom

Under AIX, the heap memory may not exceed 256 MB. Extensive background processing jobs that exceed this limit may allocate R/3 extended memory; however, the extended memory may be used up.

Corrective action

Try to solve the problem using the following procedures. Note the sequence they are given in. If the problem cannot be corrected with one of these procedures, try the next procedure.

- For reports started in the background, use more restrictive selection criteria to process smaller amounts of data.

- On servers that process large jobs, administrate lists and simple tables using the ABAP paging system. To do this, use the system profile parameter *abap/use_paging*.

For the AIX configuration and a list of important notes, refer to Configuration for AIX [Page 23].

IBM AIX: Start or Enqueue Problems or No Connection to Programs SAPOSCOL

Help: These symptoms can occur if the maximum number of 10 shared memory descriptors is exceeded. You can find more detailed information under Shared Memory IDs under IBM AIX [Page 34] and in SAP note 28992 in SAPNet.

Platform-specific Problems: Windows NT

Platform-Specific Problems (AS/400)

On AS/400, problems may occur in the following areas:

*   Main storage pools on AS/400 [Page 83]
*   Temporary storage on AS/400 [Page 51]