Memory Management
Webinar

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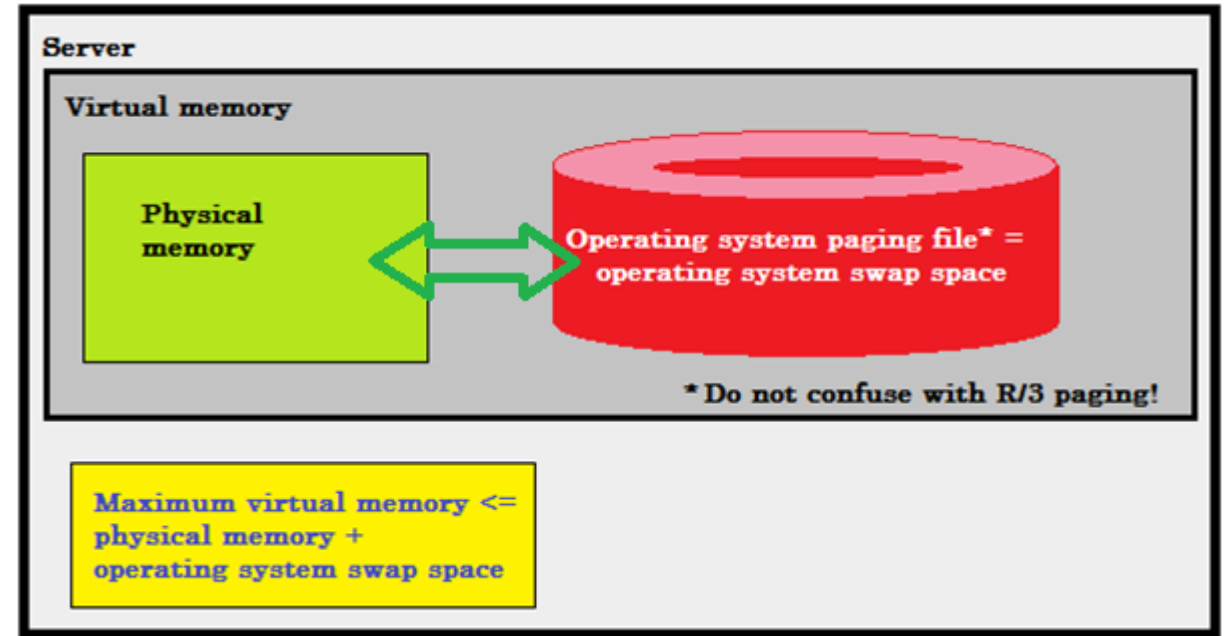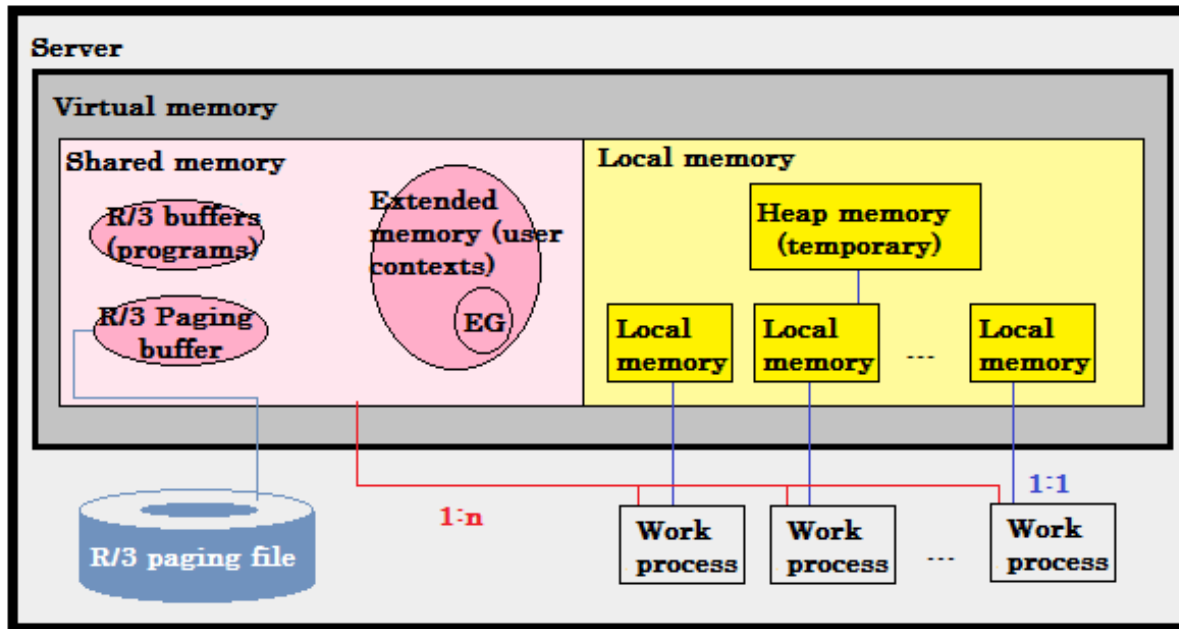
SAP Run Simple

Agenda

- Memory types

- Relevant Parameters

- OS specific differences

- Memory monitoring

- Dumps and troubleshooting

Memory types

Memory types

➤ physical main memory + OS swap = virtual memory

➤ virtual memory = shared memory + local memory (heap)

Server

Virtual memory

Physical memory ⟷ Operating system paging file* = operating system swap space

*Do not confuse with R/3 paging!

Maximum virtual memory <= physical memory + operating system swap space

Server

Virtual memory

Shared memory

R/3 buffers (programs)

Extended memory (user contexts)

R/3 Paging buffer

EG

Local memory

Heap memory (temporary)

Local memory | Local memory | --- | Local memory

R/3 paging file

1:n

1:1

Work process | Work process | --- | Work process

Memory types

The different SAP memory types are:

- Extended Memory
- Local memory (heap memory)
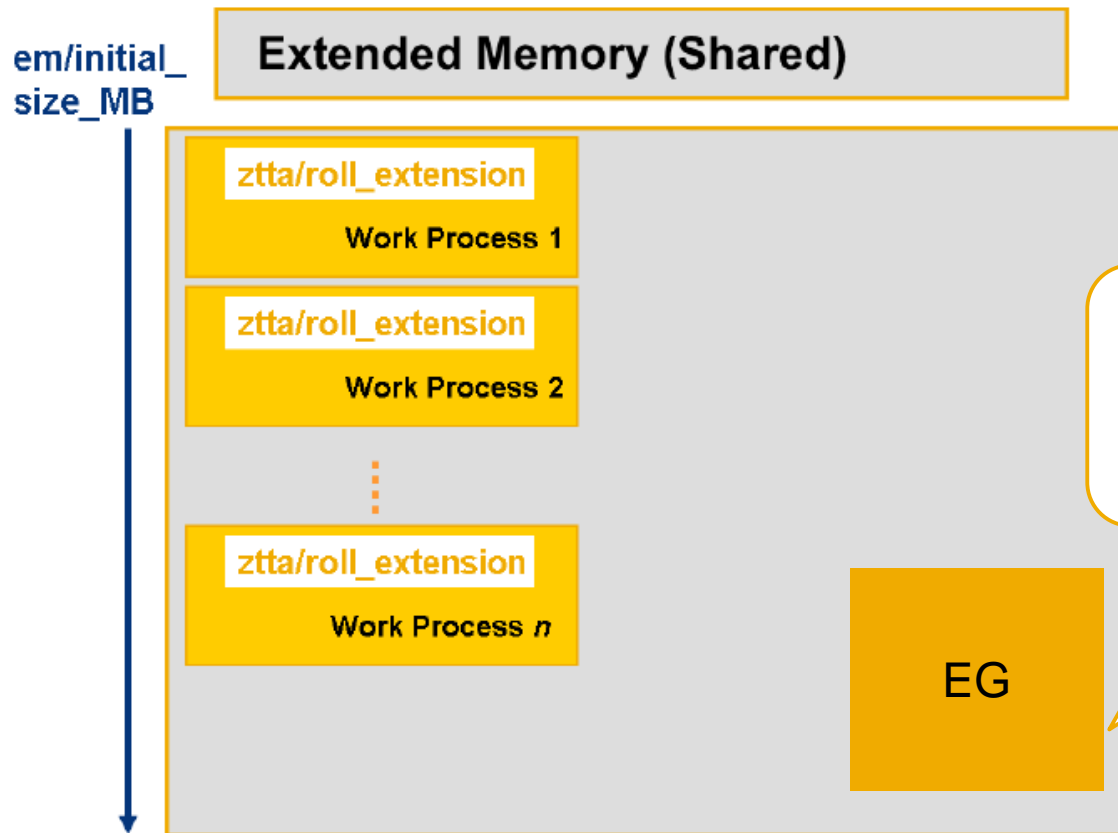- Paging memory

Relevant Parameters

Relevant parameters

Resources & Quotas

- Extended Memory

Resource size is defined by:
em/initial_size_MB or **EM/TOTAL_SIZE_MB** (AIX)

Each individual WP is able to allocate the **quota** defined by
ztta/roll_extension_(non)dia

Additional quota for a user context in the Extended Memory is
em/address_space_MB (Windows and Linux_map)

em/initial_size_MB

| Extended Memory (Shared) |

ztta/roll_extension
Work Process 1

ztta/roll_extension
Work Process 2

ztta/roll_extension
Work Process _n_

EG

Extended Global (EG) memory is also stored in the EM pool and its size is defined by **em/global_area_MB** and other few areas.

Relevant parameters
Resources & Quotas

- Heap (local) memory
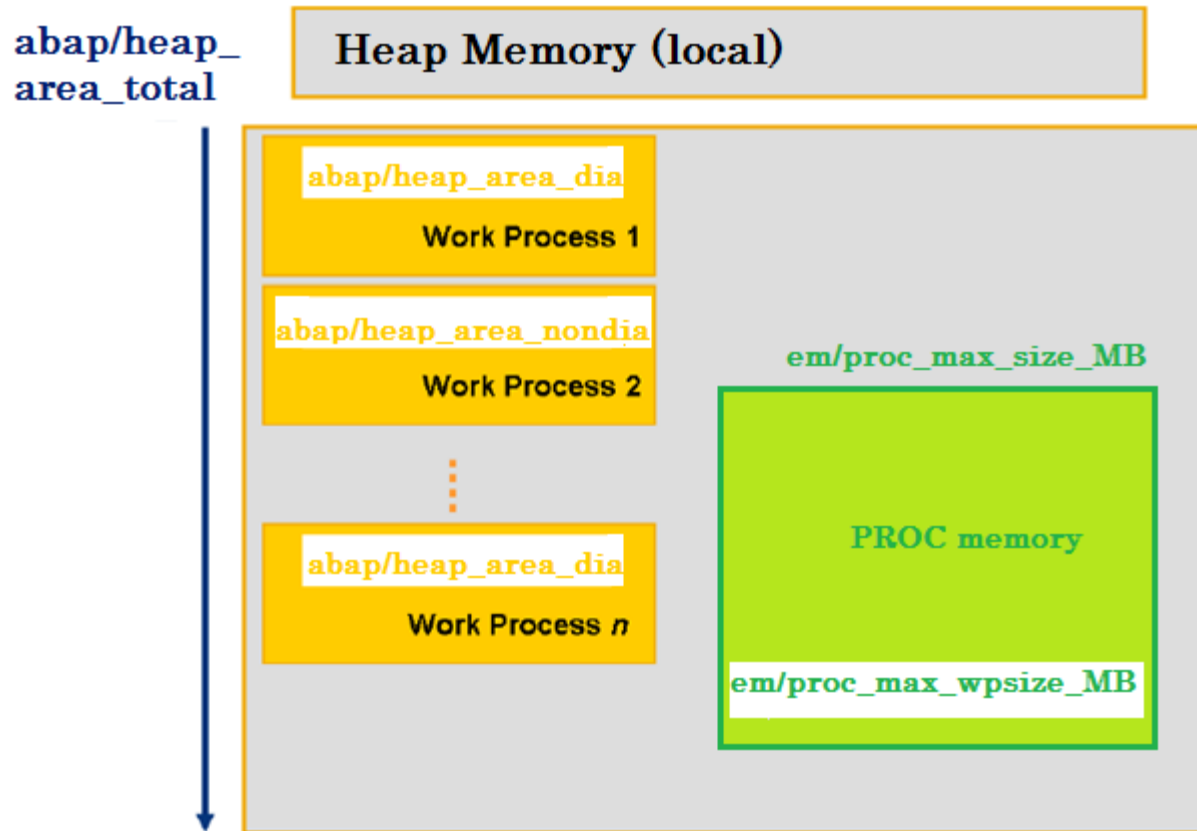
PRIV size is defined by:
 abap/heap_area_total

Each individual WP is able to allocate the **quota** defined by
 abap/heap_area_(non)dia

To release memory from OS perspective: **abap/heaplimit**
 #_2360519_ - _abap/heaplimit increased for kernel releases 7.42 and higher_
 #_1571845_ - _Error: "WP has reached abap/heaplimit" - What does it mean?_

PROC size is defined by:
 em/proc_max_size_MB

Each individual WP is able to allocate **em/proc_max_wpsize_MB**

Relevant parameters

Paging memory

- rdisp/PG_SHM: Size of the Paging Buffer
- rdisp/PG_MAXFS: Maximum Size of the SAP Paging File

#1081722 - SAP Paging in shared memory

rdisp/PG_SHM

rdisp/PG_MAXFS

ST02:

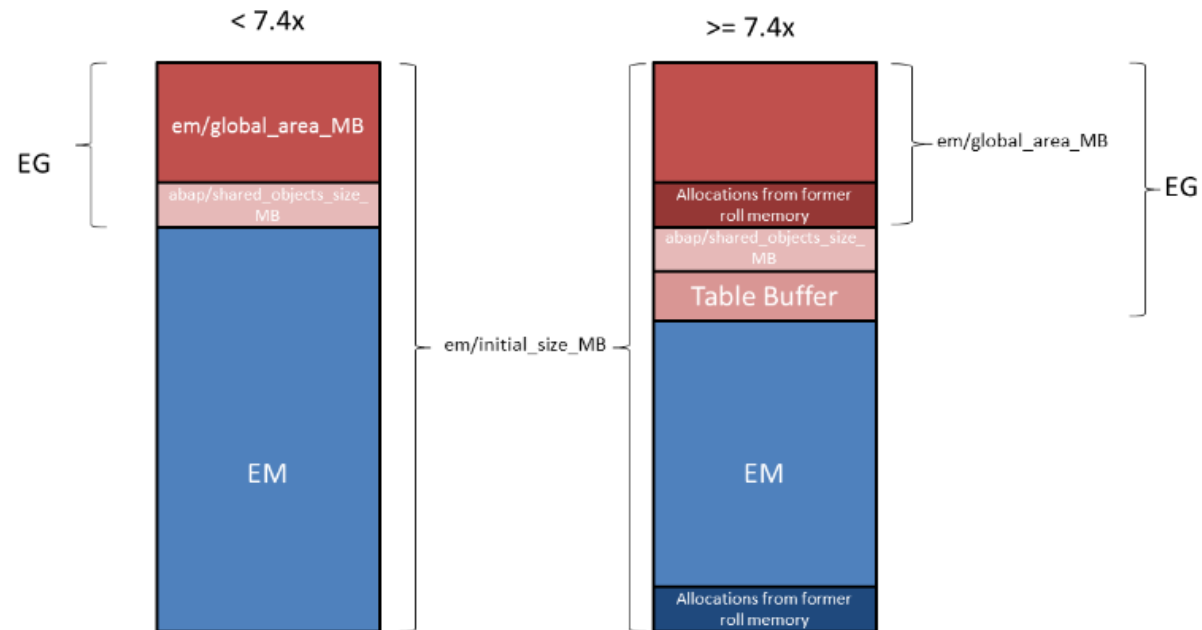| SAP Memory	Curr.Use %	CurUse[KB]	MaxUse[KB]	In Mem[KB]	OnDisk[KB]	SAPCurCach	HitRatio %
Page area	0,02	64	23.472	263.040	0	Statement	83,00
Extended memory	19,33	2.228.224	3.641.344	11.526.144	0	IDs	98,32
Heap memory		0	24.165	0	0		0,00

rdisp/PG_SHM = rdisp/PG_MAXFS

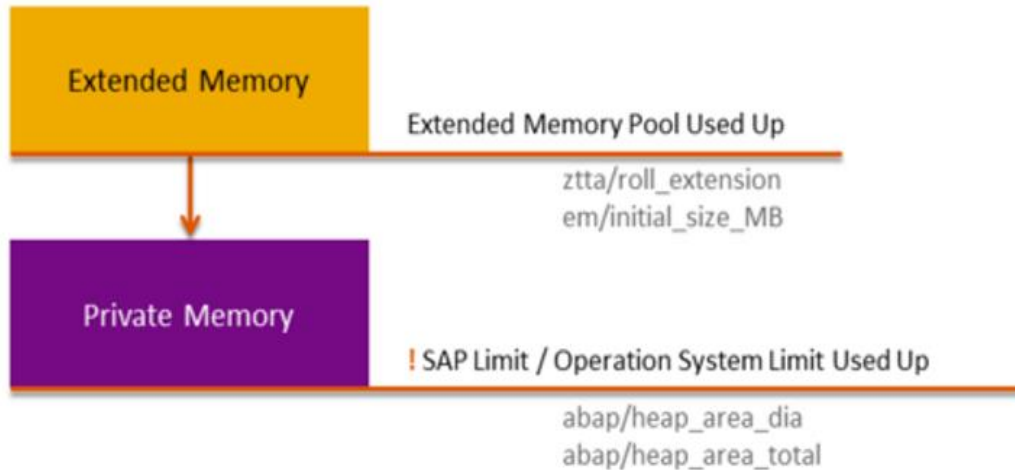**rdisp/PG_MAXFS** = 32880

Relevant parameters

New features

- #2085980 - New features in memory management as of Kernel Release 7.40
  - Zero administration memory management
  - Abolition of "classic" ROLL memory
  - Introduction of the new memory class "PROC-Memory" ("PROCess-Local Memory")

- #2148571 - Explanation for higher Extended Memory (EM) and Extended Global Memory (EG) consumption after upgrade to SAP Kernel 7.4x
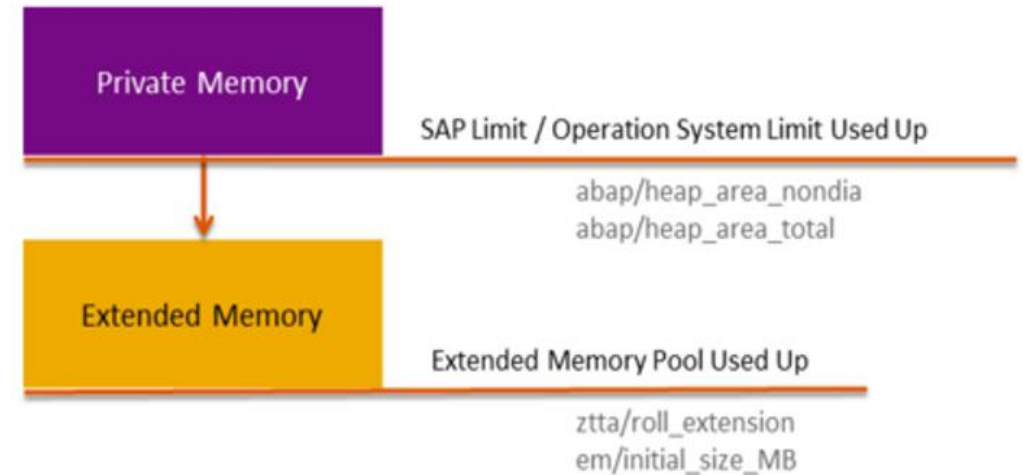
Relevant parameters

Allocation sequence

DIA WP

Extended Memory

Extended Memory Pool Used Up

ztta/roll_extension
em/initial_size_MB

Private Memory

! SAP Limit / Operation System Limit Used Up

abap/heap_area_dia
abap/heap_area_total

nonDIA WP (not only BTC,
but also UPD, UPD2, SPO)

Private Memory

SAP Limit / Operation System Limit Used Up

abap/heap_area_nondia
abap/heap_area_total

Extended Memory

Extended Memory Pool Used Up

ztta/roll_extension
em/initial_size_MB

Relevant parameters on those involved memory types can be found here

It is possible to change memory allocation order and its quotas in RSMEMORY report

OS specific differences

OS specific differences

OS	ES/TABLE	es/implementation	Parameters
AIX	SHM_SEGS		EM/TOTAL_SIZE_MB ES/SHM_SEG_SIZE ES/SHM_PROC_SEG_COUNT ES/SHM_MAX_SHARED_SEGS ES/SHM_MAX_PRIV_SEGS ES/SHM_USER_COUNT ES/SHM_SEG_COUNT
Linux	UNIX_STD	std / map	em/initial_size_MB es/max_seg_size_MB es/max_segments - em_adress_space_MB
Solaris	UNIX_STD	std / map	em/initial_size_MB es/max_seg_size_MB es/max_segments - em/address_space_MB
HP-UX	UNIX_STD	std	em/initial_size_MB es/max_seg_size_MB es/max_segments
Windows	UNIX_STD	view / flat	em/initial_size_MB em/max_size_MB em/address_space_MB
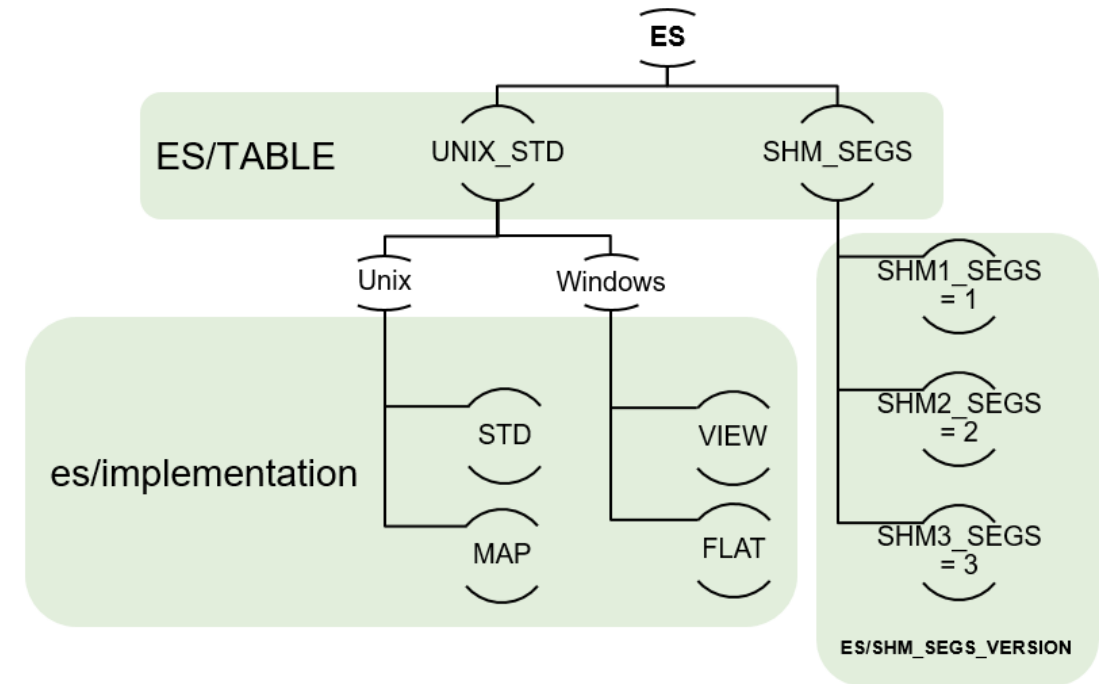
OS specific differences
AIX

ES/TABLE = SHM_SEGS

#789477 - Large extended memory on AIX (64-bit) as of Kernel 6.20

EM/TOTAL_SIZE_MB
ES/SHM* parameters

abap/shared_objects_size_MB < ES/SHM_SEG_SIZE
rsdb/tbi_buffer_area_MB < ES/SHM_SEG_SIZE

#2362949 - AIX: Calculation of ES/SHM_SEG_SIZE

#2224372 – Remove the limit on maximum segment size on AIX

ES/SHM_SEGS_VERSION=3

OS specific differences

Windows

#88416 - Zero administration memory management for the ABAP server

em/address_space_MB = $(em/initial_size_MB)

em/initial_size_MB = 0.7 * $(PHYS_MEMSIZE)
em/max_size_MB = 1.5 * $(PHYS_MEMSIZE)

PHYS_MEMSIZE

OS specific differences

Linux

<mark>es/implementation = std</mark>

#941735 – SAP memory management for 64-bit Linux system => std
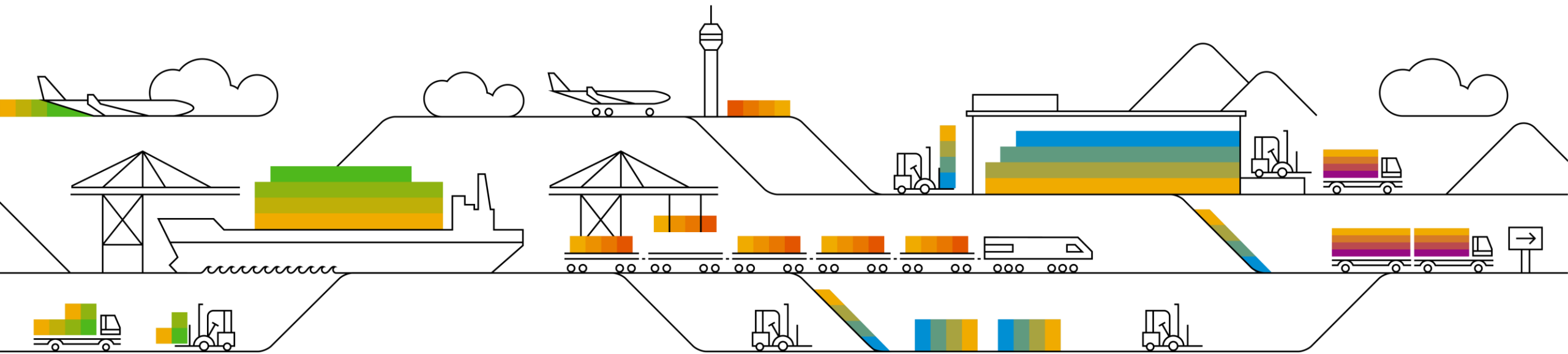#386605 - SAP Memory Management for Linux (32-bit) => map

Memory monitoring tools

Memory monitoring tools

✓ sappfpar check pf=<path to instance profile>

✓ ST22 dump

✓ SE38 → RSMEMORY → Allocation sequence & quotas & EG/PROC Overview

✓ ST02 → General overview

✓ ST06 → OS resources

✓ SM04 → snapshot of memory being used but no history

✓ SM50 & SM66 (PRIV)

✓ /SDF/MON

✓ RZ20

Dumps and troubleshooting

Dumps and troubleshooting

MEMORY_NO_MORE_PAGING

The R/3 page buffer is made up of 2 parts:
- the first part always uses shared memory (rdisp/PG_SHM)
- and then uses disk if it needs more (rdisp/PG_MAXFS).

dev_w<nr>:
  M <timestamp>
  *P *** ERROR => <**PAGE-FL> get block: no more free blocks** [rpag.c   2186]*
  *M ***LOG P0B=> 045000 [rpag.c   785]*

SAP Memory	Curr.Use %	CurUse[KB]	MaxUse[KB]	In Mem[KB]	OnDisk[KB]	SAPCurCach	HitRatio %
Page area	0.01	27	359,992	131,072	393,216	Statement	100.00
Extended memory	2.65	610,304	860,160	23,064,576	0		0.00
Heap memory		0	0	0	0		0.00

#1563748 - MEMORY_NO_MORE_PAGING" dump occurs
#133909 - Maximum value for PG_MAXFS, PG_SHM, ROLL_MAXFS, ROLL_SHM
#2210107 - Default value for parameter rdisp/PG_MAXFS is 250000 8k blocks (2 GB)

Dumps and troubleshooting

TSV_TNEW_BLOCKS_NO_ROLL_MEMORY /
TSV_TNEW_PAGE_ALLOC_FAILED

#scenario 1

Extended memory (EM)........... " EM quota"
Assigned memory (HEAP)......... "HM quota"

> ztta/roll_extension_(non)dia

> abap/heap_area_(non)dia

dev_w<nr>:
  M <timestamp>
  A SelMemClass: **heap quota (DIA) exceeded 2000000000** *2002751168*
       or
  A SelMemClass: **heap quota (NONDIA) exceeded 2000000000** *2002751168*

#2180736 - TSV_TNEW_PAGE_ALLOC_FAILED

✓ Memory low. Leave the transaction before taking a break!

SAP

Dumps and troubleshooting

TSV_TNEW_BLOCKS_NO_ROLL_MEMORY /
TSV_TNEW_PAGE_ALLOC_FAILED

#scenario 2

Extended memory (EM)........... "less than EM quota"
Assigned memory (HEAP)......... "less than HM quota"

EM exhausted?

Heap area exhausted?

dev_w<nr>:
  M <timestamp>
  A Wed Aug 02 13:10:00 2017
  *A *** ERROR => User <USERNAME>   reached avail. heapsize = 2000 MB: see ST22 [abstor.c   1904]*
  *A *** ERROR =>* **Increase abap/heap_area_total** *[abstor.c   1905]*

  *A *** ERROR => heap memory WP0: 453 MB [abstor.c   1909]*
  *A *** ERROR => heap memory WP8: 31 MB [abstor.c   1909]*
  …..
  *A *** ERROR => heap memory WP37: 945 MB [abstor.c   1909]*
  *A *** ERROR => heap memory WP45: 24 MB [abstor.c   1909]*

#2180736 - TSV_TNEW_PAGE_ALLOC_FAILED

Dumps and troubleshooting
LOAD_NO_ROLL

Points to EM shortage (EM Exhausted):

Component............ EM
Location.......... SAP-Server <hostname_SID_nr> on host <hostname> (wp <nr>)
Version............. 37
Error code........... 7
Error text........... Warning: EM-Memory exhausted: Workprocess gets PRIV

SAP Memory	Curr.Use %	CurUse[KB]	Max.Use[KB]	In Mem[KB]	OnDisk[KB]	SAPCurCach	HitRatio %
Page area	0.10	814	639,720	131,072	655,360	Statement	99.00
Extended memory	92.92	33,300,480	35,835,904	35,835,904	0		0.00
Heap memory		456,948	39,653,839	0	0		0.00

#2417223 - LOAD_NO_ROLL dump and Extended Memory exhausted as of Kernel 74x

Dumps and troubleshooting
RESIZE_EM_ALLOC_ERROR/
shortage on EG

em/global_area_MB: Size of the Extended Global Memory

dev_w<nr>:

* *** ERROR => EgAlloc: MmxMalloc failed (9).*
*   see also file 'eg_oom_mm.dump' [egxx.c   605]*
* *** ERROR => EmIAllocMmResourceEg: EgAlloc(165440) failed 5[emxx.c 3641]*

#2152126 - RESIZE_EM_ALLOC_ERROR short dump
#1514752 - Extended Global Memory configuration

Dumps and troubleshooting

SYSTEM_NO_ROLL

ztta/max_memreq_MB: maximum size of an individual memory request

dev_w<nr>:

A *** ERROR => max. memrequest size exceeded 469185630 268435455 [abstor.c 693]

#353579 - SYSTEM_NO_ROLL

Dumps and troubleshooting

Memory leaks ➡ what to do?

1. Check involved regression Note for system PL:
   "Known regressions in kernel 7.xx patch level xx"
    #1802333 - Finding information about regressions in the SAP kernel

2. Check from OS perspective which process is allocating the memory, to identify where does the problem comes from.

Client-Server Technology wiki
Memory Management online documentation

IMPORTANT STEPS TO REMEMBER

➢ Check which is OS platform

➢ RSMEMORY: Memory allocation order, defined quotas

➢ ST02: Overview of memory resources on the server (since last restart)

➢ Any specific OS-dependant parameter?

➢ Always go to involved Application server and work process trace (dev_w<nr>) to get more information

➢ Not only <u>increasing memory resources</u>; but also **check from application perspective** if the selection criteria can be reduced to reduce the amount of memory being consumed.

Thank you.

Contact information:

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