

Java Performance Tuning for Beginners



Applies to:

SAP NetWeaver Application Server Java for Beginners. For more information, visit the [Java homepage](#).

Summary

This document will guide you to configure the SAP NetWeaver Application Server Java.

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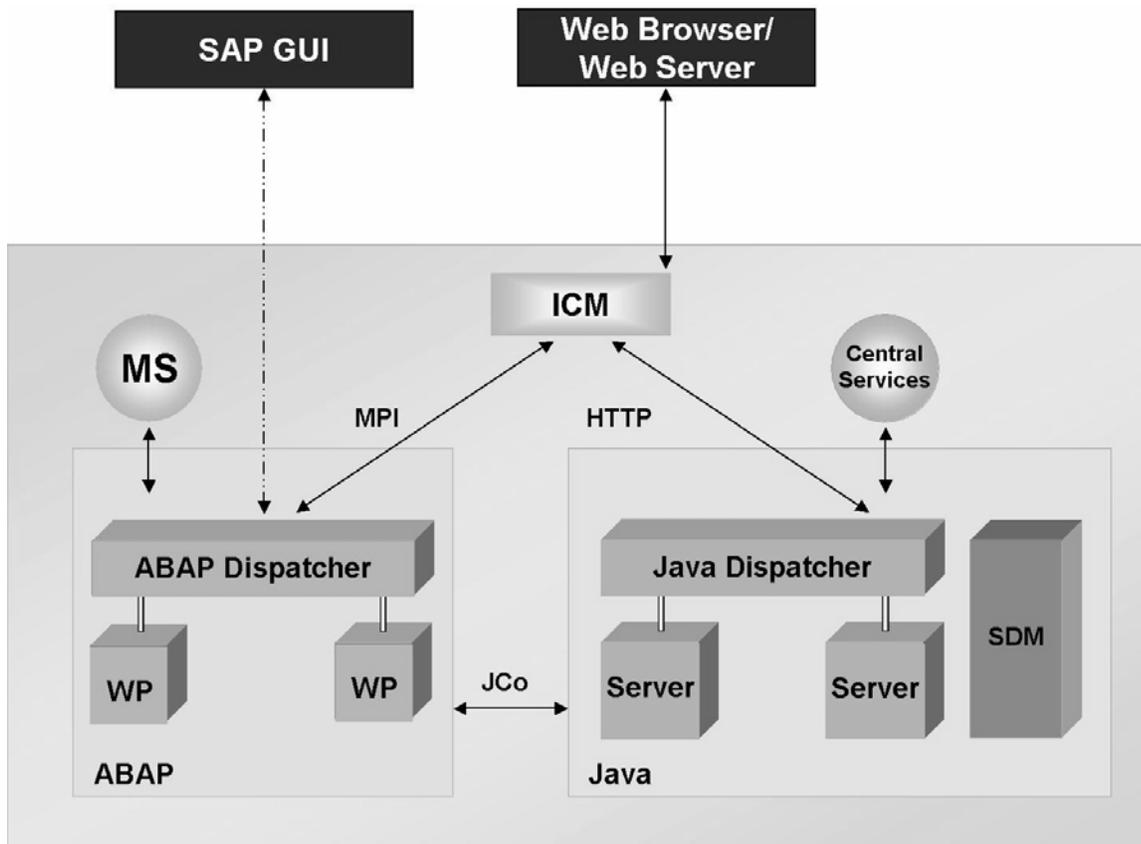
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Introduction

J2EE Engine forms the Java basis of Web Application Server. It consists of a Java kernel part, which provides and manages the runtime environment of all Java-based SAP services and applications, and a J2EE part to ensure the J2EE compliance of Web Application Server.

I will start with the Web AS architecture and Java cluster and deal with some of the important J2EE parameters with relevant SAP Notes which will help in tuning the system for better performance.

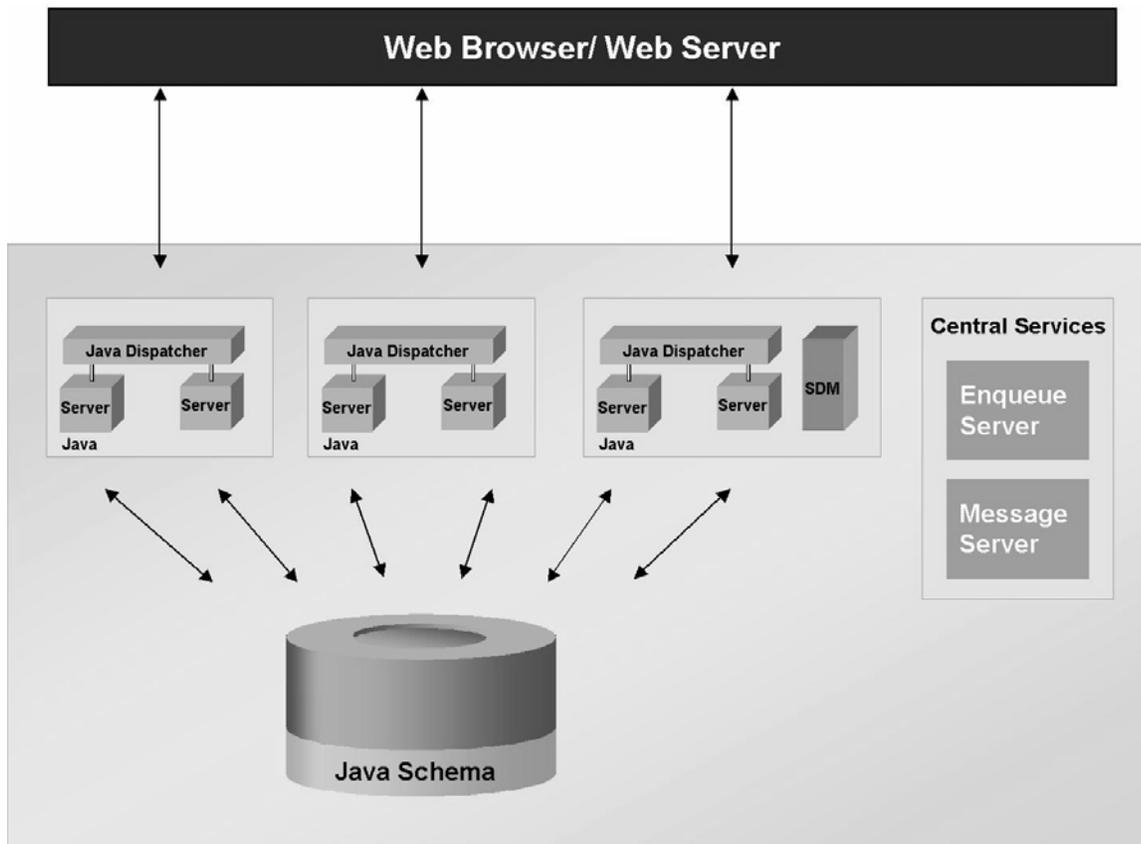
Structure of SAP Web Application Server



The individual components and their tasks are briefly in the following:

- The Internet Communication Manager (ICM) creates contact with the Internet. It can process both server and client Web requests. It supports the protocols HTTP, HTTPS, and SMTP. SAP Web AS can act either as a Web server or as a Web client.
- The ABAP dispatcher distributes the requests to the work processes. If all processes are occupied, the requests are stored in the dispatcher queue.
- The ABAP work processes execute the ABAP code
- The message server is used to exchange messages and to balance load in the SAP system.
- In the Java part of SAP Web AS, there are the components Java dispatcher, server process, and Software Deployment Manager (SDM) as well as the Central Services.

Cluster with Multiple SAP Web AS Java Instances



- The Java dispatcher distributes the client requests to the free server processes of the instance.
- The server processes provide the infrastructure in which the J2EE applications run.
- The Central Services form a special Java instance. They provide the basis of communication and synchronization within a Java cluster.
 - The message service administers a list of the dispatchers and the server processes of the Java cluster
 - The enqueue service administers logical locks that are set in a server process by the executed application program.
- The central instance is another special instance. This runs on a physical server with the Central Services and the database

The Template Configuration Tool

You use the Template Configuration Tool to make the fundamental technical settings for SAPWeb AS Java. You call the Template Configuration Tool using a batch file or shell script. These files are in the directory `/usr/sap/<SID>/SYS/global/TemplateConfig`.

The tool is based on templates that are delivered by SAP. These templates are available for different scenarios in which an SAP Web AS Java can be operated, such as .SAP

Enterprise Portal., .SAP Exchange Infrastructure., pure .SAP Web AS Java., and many others. Configuration templates are only applicable to newly installed systems based on the J2EE Engine 6.40 SP7 (corresponds to NetWeaver'04 SP Stack 04) or above. Some of them are listed below:-

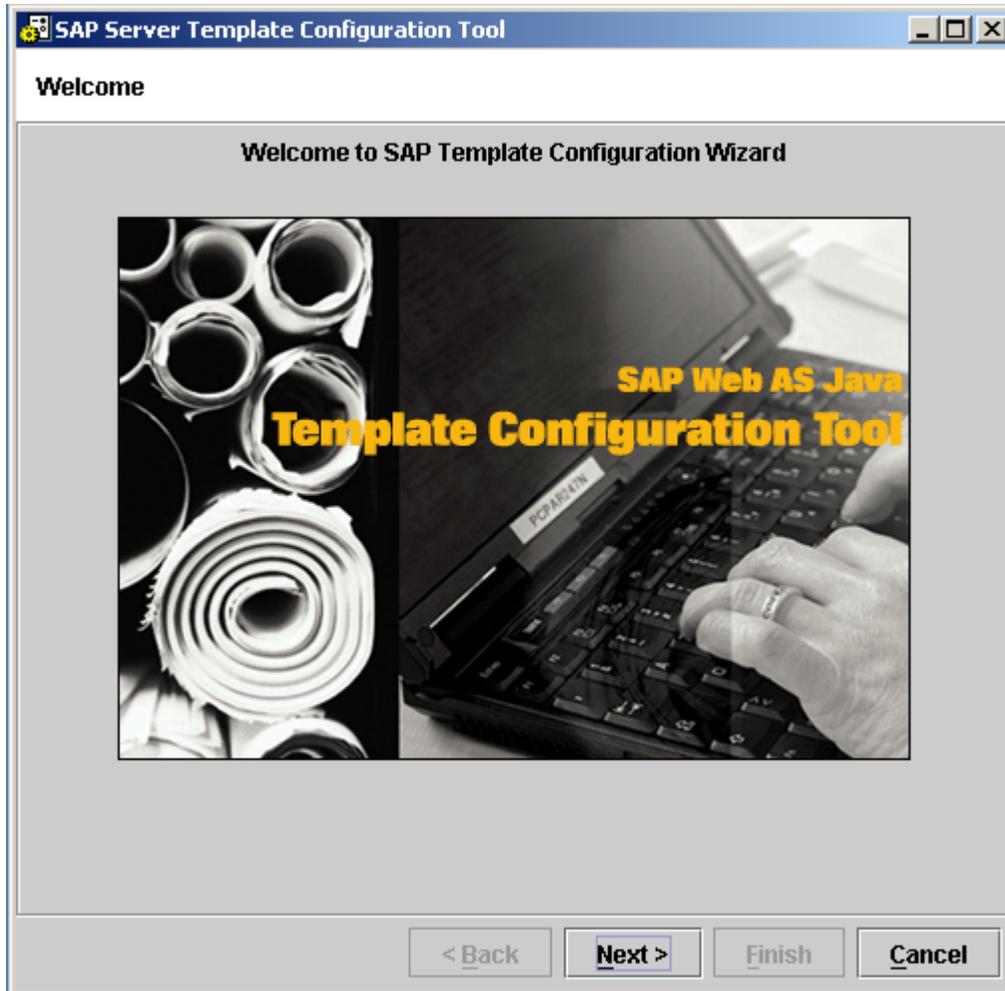
Scenario	System Description	Template
J2EE Application	System on which only J2EE applications will run	<i>J2EE-Engine-only.zip</i>
System Landscape Directory (SLD)	System on which SLD is active	<i>J2EE-Engine-only.zip</i>
SAP NetWeaver Java Development Infrastructure (JDI)	Central development system with DTR, CBS, CMS	<i>JDI-DTR-and-CBS.zip</i>
SAP NetWeaver Java Development Infrastructure (JDI)	Central development system where DTR and CBS are used on different systems	<i>JDI-DTR-only.zip</i> . system with DTR; <i>JDI-DTR-and-CBS.zip</i> . system with CBS
SAP Exchange Infrastructure (XI), SAP Partner Connectivity Kit (SAP PCK) and Adapter Engine	Production system	<i>XI.zip</i>
SAP Enterprise Portal (EP)	SAP EP production system on multi-processor servers	<i>Portal.zip</i>
SAP Enterprise Portal (EP)	SAP EP production system on single-processor servers	<i>Portal-1CPU.zip</i>

SAP Business Information Warehouse (BW)	Production system for BW front end applications MMR and UDI	<i>BW.zip</i>
SAP Knowledge Warehouse	Production system	<i>J2EE-Engine-only.zip</i>

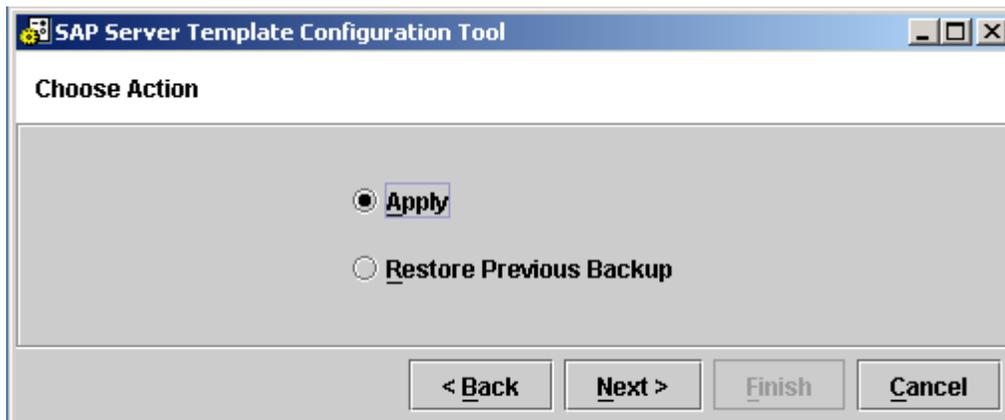
The Template Configuration Tool adjusts the VM memory parameters, the number of server processes, and manager settings such as the number of threads in your SAP Web AS Java instance to the selected scenario. If services are set to manual start during the standard installation, but are required for the selected scenario, the Template Configuration Tool sets them to .Start: always.

Note: You must always stop the SAP Web AS instances to use the Template Configuration Tool. Using the Configuration Tool is part of the installation postprocessing. It must only be used directly after the installation, since it deletes existing settings. For more information, see SAP Note [739788](#).

Move to folder /usr/sap/<SID>/SYS/global/Templateconfig. Run the cfgtemplategui.bat file to get Template configuration wizard which looks as below.



Click next to get the below screen. You have to choose whether you want to apply the template or restore the configuration using a previous backup.



Clicking on next it will take you to the below screen where you we have to mention the template file which you can find in the template folder within the template configuration and corresponding instance directory if there are more than one instance in a system.

The screenshot shows the 'Initial Data' screen of the SAP Server Template Configuration Tool. It contains three input fields, each with a 'Browse...' button to its right:

- Template filename:** TemplateConfig\templates\J2EE-Engine-only.zip
- Working dir:** C:\usr\sap\SM4\SYS\global\TemplateConfig\work
- Instance dir:** (empty)

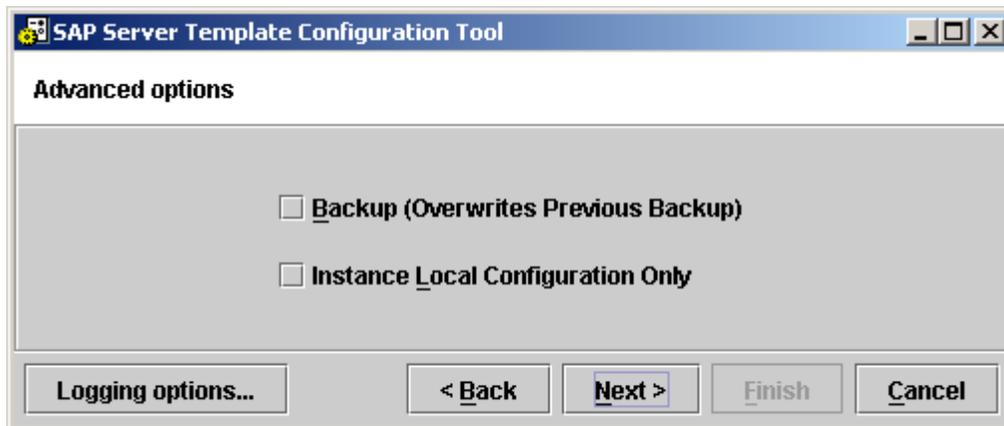
At the bottom of the window, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

Template configuration wizard will come up with the system parameters which are set in the system.

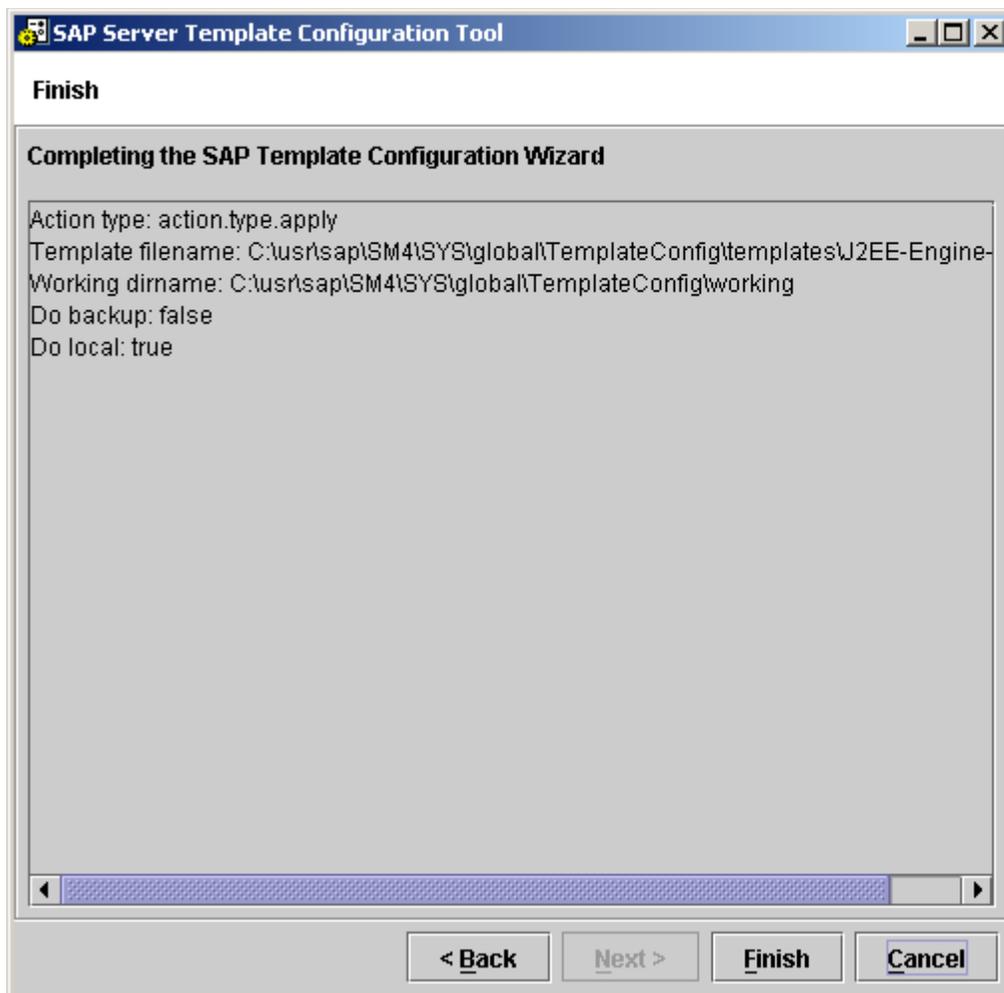
The screenshot shows the 'Edit system dependencies' screen of the SAP Server Template Configuration Tool. It features a table with two columns: 'Property' and 'Value'. Below the table are two input fields labeled 'Property:' and 'Value:', and two buttons: 'Add' and 'Remove'. At the bottom, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

Property	Value
\${SYS_DS_ALIASES}	
\${GLOBAL_SAP_SHARE_DIR}	\\TESTING\sapmnt\SM4\SYS\global\sap...
\${INSTANCE_ID}	00
\${OS_BIT_LENGTH}	32
\${SYSNAME}	SM4
\${OS_NAME}	ntintel
\${JAVA_HOME}	C:\j2sdk1.4.2_13
\${CENTRAL_SERVICES_INSTANCE_ID}	01
\${USR_SAP_DIR}	C:\usr\sap
\${INSTANCE_HOST}	TESTING
\${R3_ENV_YES_NO}	no
\${CENTRAL_SERVICES_MSPORT}	3901
\${OS_UNICODE}	true
\${RDBMS_DRIVER_LOCATION}	C:\usr\sap\SM4\DVEBMGS00\exe\mssjd...
\${CENTRAL_SERVICES_HOST}	TESTING
\${DI_PREFIX_NAME}	DVEBMGS
\${TSHIRT_SIZE}	5

Choose the relevant check box, so that template configuration will act accordingly.



After clicking the next button it will take to the last screen as shown below



Tuning the Operating System

Each operating system (OS) has different tuning switches. Most general tuning considerations for an operating system that will run Java and WAS must include:

- OS version and patch level of the OS according to the SAP installation guides and OS documentation,
- Network check in terms of response time between proxies, packages lost rate, and so on.
- TCP/IP connection handling at OS level to ensure that the OS can handle the desired number of connections. Prevention from the CLOSE_WAIT problem and so on.
- Memory buffers for disk I/O can be tuned to handle the amount of I/O, which is expected on the system. For example, for a WAS central instance with a database we recommend bigger I/O buffers and also several separate physical hard drives where the database files and log files are spread.
- Number of opened file descriptors, and so on.

Configuring J2EE Engine Cluster

The decision about the cluster setup can be the one with the biggest influence on the performance for a defined hardware environment. When planning the cluster, based on the SAP “Quick Sizer” estimations (<http://service.sap.com/quicksizing>), you should base your decision not only on the available CPU but also on the available physical memory.

The Java infrastructure and applications are mainly memory bound. This means that all physical memory allocated to a server process will be used most of the time. To prevent paging, which slows down performance enormously, the physical memory of the machines must exceed the sum of the memory configured as maximum heap size for all server processes, dispatchers, central services, and database if they are configured on the same machine. Normally, a machine with 4 GB is the minimum required for production if the customer wants to install one dialog instance with two server processes on it, and it is below the requirement if the customer wants to install a central instance with two server nodes on this machine.

Performance Parameters

There are numerous parameters, which can be adjusted with the SAP Web Dispatcher. The documentation is available at:

help.sap.com/nw04 -> *SAP Library* -> *SAP Netweaver* -> *SAP NetWeaver Technical Operations Manual* -> *Management of the SAP Web Dispatcher*

The most important parameters that influence the performance are:

```
wdisp/HTTP/max_pooled_con = 3000
wdisp/HTTPS/max_pooled_con = 3000
icm/min_threads = 100
icm/max_threads = 1024
icm/max_conn = 3000
icm/max_sockets= 6000
wdisp/force_dest=java
wdisp/max_servers=100
mpi/total_size_MB = 350
mpi/buffer_size = 32728
icm/req_queue_len = 1300
wdisp/lb/load_decrement= 1
wdisp/lb/auto_reset = 1
ipc/mtx_yield_count = 100000000
icm/keep_alive_timeout = 60
```

JDK Upgrade

It should be the most actual one from the 1.4 family. J2EE Engine 6.40/7.0 is not supported on 1.3 or 1.5 Java platform. Details can be found in the below OS-specific notes. Refer to note [718901](#) about changing of the JDK, see also [731269](#). Please apply note [754699](#) after JDK upgrade.

Setting the Java VM Parameters

The below notes are the basic setting required for respective operating system before starting the J2EE manual configuration.

[716604](#) for the Sun JDK (Windows, Linux, Solaris)

[716926](#) for the HP JDK (HP-UX)

[716927](#) for the IBM JDK (AIX)

[717376](#) for the IBM JDK (iSeries, OS/400)

[746299](#) for the IBM JDK (Linux for zSeries)

[810008](#) for the IBM JDK (Linux on POWER)

[861215](#) for the IBM JDK (Linux on AMD64/EM64T)

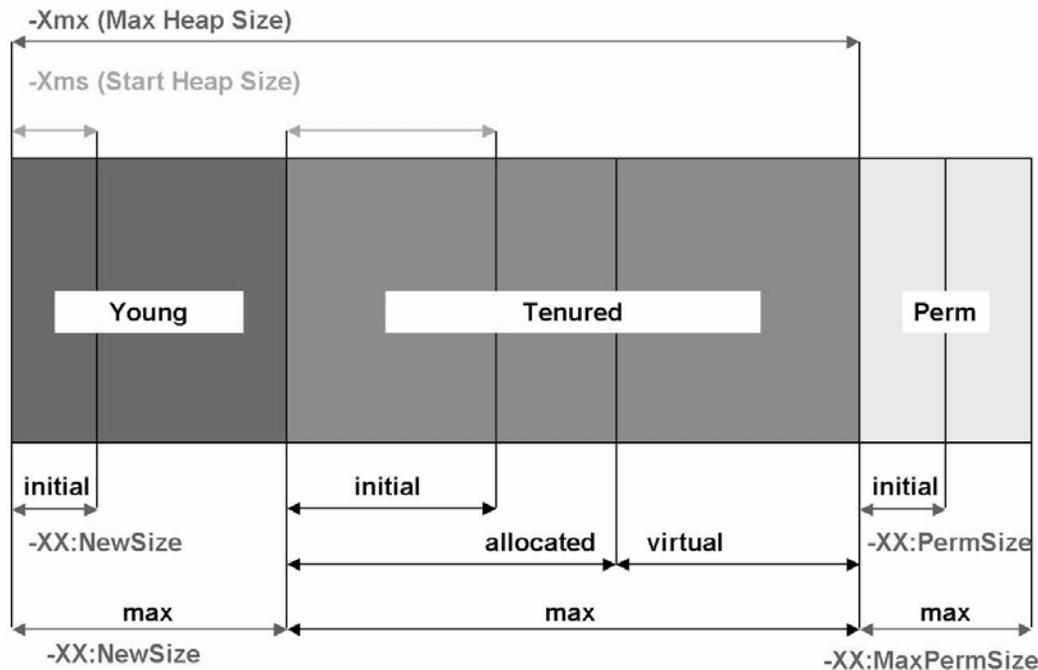
The java parameters have to be set via ConfigTool which is located in the J2EE Engine directory tree under j2ee/configtool (e.g. C:\usr\sap\C11\JC00\j2ee\configtool). Start the configtool.bat (.sh on unix), select cluster_data/instance_ID.../server_ID... and make the change in the "Java parameters" field. If you have more than one server node, you need to apply the change to every server node and also to the dispatcher node.

After changing the values, click on the disk icon to save the new values and restart the cluster is a must.

Note: It should be the most actual one from the 1.4 family. J2EE Engine 6.40/7.0 is not supported on 1.3 or 1.5 Java platform. Refer to note [718901](#) about changing of the JDK, see also [731269](#) and apply SAP note [754699](#) after JDK upgrade.

The three main memory areas of the VM, the young, tenured, and permanent generations differ from one another because of the data stored in them. The objects that have been newly created by the applications are stored in the young generation. Objects that have been required for a longer period of time by an application are automatically moved to the tenured generation.

Objects that are no longer required by the applications are automatically removed from the generation. This process is known as garbage collection.



Heap Size

For 32 bit platforms SAP recommend to start the server nodes with 1GB

Where by the initial and the maximal heap size should be equal: -Xmx1024m and -Xms1024m

Higher values may cause troubles, for example see notes 736462 and 664607 about Windows DLLs preventing big java heap. SAP recommends using additional server nodes instead of huge heaps.

For 64 bit platforms (that means not only your OS but also your JDK Supports 64 bit) SAP recommend using 2GB: -Xmx2048m -Xms2048m.

Take into account while planning your productive landscape: for NW 7.0 (04s) There is a general recommendation to use 64bit systems, see note [996600](#).

The max heap size (plus max perm size) of all Java server nodes must fit completely into the physical memory in order to avoid heavy paging on OS level which leads to dip in performance. You must also consider the space needed for OS and other processes.

Note: For adjusting of the SDM Heap see note [879377](#).

New Generation

MaxNewSize to approximately 1/6 of the heap, for example:

- -XX:NewSize=171m -XX:MaxNewSize=171m for 1 GB heap size and
- -XX:NewSize=341m -XX:MaxNewSize=341m for 2 GB heap site

Permanent Space

For 6.40 on 32 bit: -XX:MaxPermSize=192m -XX:PermSize=192m

For 6.40 on 64 bit: -XX:MaxPermSize=384m -XX:PermSize=384m

For 7.0 on 32 bit: -XX:MaxPermSize=256m -XX:PermSize=256m

For 7.0 on 64 bit: -XX:MaxPermSize=512m -XX:PermSize=512m

Remark 1: Be aware of the fact that more permanent space is needed if additional applications are deployed or the complexity of the applications (roughly speaking number of classes) grows.

Increasing of the heap size or permanent space is harmless on 64 bit systems (given that enough physical memory is available) however on 32 bit ones (especially Windows) one should take into account limitations of the virtual address space.

For **Garbage Collector options, SoftReferences, to disable canonicalization optimization** see 723909 which have complete details to work on the same.

Tuning the Engine for J2EE Scenarios

When running particular J2EE applications on the J2EE Engine, you can tune it to better fit the particular needs or your business scenario. To configure the system for a particular business scenario, you must be aware of which server components the application uses.

You can find the corresponding information in the below link:-

help.sap.com/nw04 → *SAP NetWeaver* → *Application Platform (SAP Web Application Server)*
→ *Java Technology in SAP Web Application Server* → *Administration Manual* → *Server Administration*
→ *J2EE Engine Configuration* → *Tuning the Engine for J2EE Scenarios*

SAP NetWeaver Configuration

To adapt SAP NetWeaver to the requirements of your enterprise, you can configure the system. You can find the corresponding configuration depending on the scenarios like

SAP Exchange Infrastructure (XI), SAP Web Application Server etc in below link.

help.sap.com/nw04 → SAP Netweaver → SAP Netweaver Configuration.

Configuring Database Connections

JDBC connections pooling is part of the J2EE specification. Moreover, SAP defines a system connections pool, which is used not only by applications but also by SAP services.

For all pools (application-specific and system pools), the values of the initial connections and maximum connections can be set to the same value to prevent performance problems when the pool resizing is done under load. When configuring the number of connections, make sure that there will be enough configured connections on the database that can satisfy the requirements of the complete cluster (the number of server processes and dispatchers multiplied by the required number of connections). The connections expiration control should be also set to unlimited.

It is a minor problem if the connections remain opened and are not used at runtime, compared to the problem if they are opened under load, because opening a new connection is very resource consuming and could become the reason for the formation of waiting tasks. Also, if the database refuses to open a connection for some reason (limit exceeded, too busy timeout, and so on), this can cause even bigger problems under load.

Performance Impact of the Monitoring Infrastructure

There are plenty of monitoring services available with the J2EE Engine 6.40. Most of them are suitable for analyzing problems that can happen on a customer system. Anyway, on a well-running system you can afford some adjustments to minimize the performance impact of the monitoring infrastructure.

If the customer does not have a configured CCMS system, then

- *Visual Administrator -> Services -> DSR* can be stopped by default,
- Parameters *CCMS_System_Mode* and *CCMS_Mapping of Visual Administrator -> Services -> Monitoring -> Properties* can be set to *false*.

In all cases, the history of monitoring data can be persisted on the hard disk and not kept in the memory. To do so:

- Change *Visual Administrator -> Services -> Monitoring -> Properties -> History* to *false*
- Change *Visual Administrator -> Services -> Monitoring -> Properties -> jarm_history.started* to *false*
- Apply SAP Note [766598](http://support.sap.com/766598) to activate persistency of monitoring data on hard disk.

Thread Dump

A java application is hanging, not responding, or consuming too much CPU. If your java application hangs or it is consuming much CPU even though there is not much traffic, the java application must be analyzed in more detail. One approach for this is to trigger a dump of all java threads and their call stacks in the VM.

How to trigger a full thread dump depends on the way the J2EE engine is started and on which operating system the engine runs is completely explained in the note [599539](#).

Symptom-Driven Troubleshooting

If you face any problem regarding slow response time which leads to performance problems the below link will be help full in finding the cause for the same.

help.sap.com/nw04 -> SAP Library -> SAP NetWeaver -> SAP NetWeaver Technical Operations Manual -> Troubleshooting for SAP Web Application Server

Some of the known issues which I came across during projects involved. [SAP Notes](#):

- 710146 How to change J2EE Engine JVM Settings
- 1095476 - Information for troubleshooting of the AS Java
- 823906 Oracle database parameters tuning - EP in NW
- 940893 Analysis of errors within the startup of J2EE Engine 6.40
- 763789 Improve Portal Performance by Changing Log Levels
- 625509 Enterprise Portal hangs with almost 100% CPU usage
- 861333 Very slow start of the j2ee engine on AIX with 64bit IBM JDK
- 764215 Problems with big java heap when started via jlaunch.exe
- 1016241 J2EE Engine hangs because of insufficient system threads
- 855213 Deadlock in start up of dispatcher process
- 742395 Analyzing High CPU usage by the J2EE Engine
- 599539 J2EE Engine: How to create a full thread dump
- 743207 Analyzing High CPU usage by the J2EE Engine: Windows
- 686254 Thread dump from J2EE Engine 6.20 running as Windows service

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