



# Web Application Server Performance Analysis

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## Learning Objectives

**As a result of this workshop, you will be able to:**

- n Describe key performance metrics**
- n Understand the NetWeaver toolset for performance monitoring and systems management**
- n Use the capabilities of NetWeaver to establish a consistent performance monitoring practice**
- n Analyze Web Application Server Performance**



## Java Performance Analysis

The Netweaver Toolset

Proven Methodology

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**n Java performance analysis has elements unique to Java, but the practice is predominantly driven by standard computing performance analysis concepts**

**n response time**

**n stability**

**n throughput**

**n resource utilization**

**n We can re-use our knowledge from J2EE 6.20 and EP6**

**n architectural changes improve performance but don't significantly alter our analysis of it**

**n new tools are introduced that improve our capabilities**

**Java performance is typically analyzed by monitoring three key areas**

- 1. Garbage collection and VM performance**
- 2. Response times and throughput (bandwidth)**
- 3. Thread behavior**

## Garbage Collection

**Garbage Collection is monitored for frequency and efficiency**

**GC Throughput is a measurement of the time the JVM spends working vs. the time it spends in GC.**

**In the 1.4 JDK we no longer have a full JVM stoppage while GC is ongoing, though there is still some performance degradation during GC.**

**Follow OSS note guidelines (see appendix) for tuning recommendations.**

**Always use verbose GC to explicitly show GC details in your logs.**

## Garbage Collection Recommended Reading

**Sun publishes excellent Java documentation for tuning and optimization (big surprise!)**

**Read the guide for Garbage Collection in the 1.4.2 JDK!!!**

**<http://java.sun.com/docs/hotspot/gc1.4.2/>**

**Note these flags for getting GC data from the VM**

**-verbose:gc**

**-XX:+PrintGCDetails**

## Response Times and Throughput

**Java performance is “inside” the VM, but the most significant aspect of that performance is measured “outside” the VM.**

**Performance matters most to end-users.**

**Their perception of performance begins and ends with response time of the application/server.**

**Throughput (bandwidth) is a critical performance metric because all content comes via the network and will necessarily be constrained by a variety of factors, many of which are external to the VM.**



## Thread Behavior

**Examining thread behavior is required to diagnose poor performance that may be the result of deadlocks or poorly optimized code.**

**Thread dumps are created differently in the 6.40 J2EE Engine**

## OSS 710154 – Creating Thread Dumps

Use the JCMon tool to initiate a thread dump.

1. Start the JCMon program with the profile of the instance.

The JCMon binary is located in the `/usr/sap/<SID>/<Instance>/j2ee/os_libs` directory or in the `/usr/sap/<SID>/SYS/exe/run` directory.

2. Enter "20" to go to the "Local Administration Menu".

3. Choose the "Dump stacktrace" menu item by entering its number.

4. Select the Java node from the list of processes above and enter the value from the "Idx" column.

5. Confirm the command with a "y" if the selected node is correct.

After completion, you will find the thread dump:

in the `/usr/sap/<SID>/<Instance>/work/std_<node name>.out` file (for JDK's from SUN and HP)

in the `/usr/sap/<SID>/<Instance>/j2ee/cluster/javacore<PID>.<timestamp>.txt` file (for JDK's from IBM).

## What to Watch - System Performance

**Related performance metrics at the system level include:**

**n Network Throughput**

**n Disk Throughput**

**n Memory Utilization (OS and JDK)**

**n CPU Utilization**

# Network Monitoring

Value	Reported by
TCP connection statistics	OS
Connections manipulator (connections count)	J2EE Engine monitoring
Database pools (connections count)	J2EE Engine monitoring
TCP connections to R/3, LDAP, other backend	<i>sapinfo</i> and niping tools
Byte transfer rate	OS, niping
Body length of http responses	J2EE Engine monitoring
Cluster communication and number of bytes	J2EE Engine monitoring

# Disk Monitoring

Value	Reported by
% disk busy time	OS
Time for single disk read/ write operation	OS
Amount of data transferred (KB) per second	OS
Number of transfers per second	OS
Paging	OS
Disk queue length	OS
Log and trace levels	Administration tools of J2EE Engine and EP6 – (see Troubleshooting Guide [1])
System threads and client threads	J2EE Engine monitoring

# Memory Monitoring

<b>Value</b>	<b>Reported by</b>
Used, free memory	OS
Paging	OS



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## Application Tools

### n CCMS

- u CCMS is the primary mechanism for centralized monitoring from R/3 or ABAP Web AS

### n J2EE Visual Administrator

- u The Visual Administrator provides a variety of tools and interfaces such as JARM and tracing

### n Log Viewer

- u new to 6.30/6.40
- u can run as a client/server tool to monitor logs across all nodes
- u filters and searching capability

## Environment Tools

### n Commercial Testing Suites

### n OS Native Performance Analysis Capabilities



### CCMS

n This system monitor enables you to check the status and performance of the various system components. For example, you can monitor the availability of a system.

### JARM

n The Java Application Response Time Measurement (JARM) is a method for collecting response time data from Java applications. The data delivers an overview of components passed by a thread and the time left in the corresponding component. The JARM displays not only the response time, but also the user who sent the request and the amount of data that was transferred.

### Tracing and Performance

- n Performance Tracing
- n Application Tracing
- n Session Tracing
- n Single Activity Tracing

**You can sequentially record the activities of individual requests and their components for a specified time for each user and then analyze the performance and errors of these activities in the Log Viewer of the SAP J2EE Engine.**

**To access the JARM views in the Visual Admin use:**

***Server*® *Services*® *Performance Tracing*® *Runtime*® *JARM*.**

**You can configure filters for requests, components, threads, and users.**

**You may use the filter configuration to restrict very precisely the records you want to display. For each column you can enter a filter value and select a mathematical sign from the drop down menu to specify that the value of the records to be displayed has to be equal to, greater, or less than the entered value.**



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**SDN has excellent guides for tuning and analysis.**

**How to Analyze Performance Problems is published for EP6 SP2 but is certainly relevant for the 6.40 J2EE engine.**

**Troubleshooting Notes are published for 6.30/6.40 Engine**

**All methodologies are based on implementation of a consistent and reliable test practice.**

**Your test practice must be focused on generating good data.**

**Good record-keeping is a critical success factor.**

**The practice of baselining requires that you have good historical data and analysis from the whole product life-cycle (implementation and continuing during productive use).**

**Underneath the JDK/JVM use standard practice for systems performance analysis to understand:**

- n Network Performance**
- n I/O (Disk) Performance**
- n Memory Performance**



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**A Baseline is a documented procedure that will measure the time needed by a computer system to execute a well-defined computing task.**

**It is assumed that this time is related to the performance of the computer system and that somehow the same procedure can be applied to other systems, so that comparisons can be made between different hardware/software configurations.**

**From the definition of a benchmark, one can easily deduce that there are two basic procedures for Baselining:**

- n Measuring the time it takes for the system being examined to loop through a fixed number of iterations of a specific piece of code.**
- n Measuring the number of iterations of a specific piece of code executed by the system under examination in a fixed amount of time.**

Source - <http://www.linuxgazette.com/issue22/bench.html> , André D. Balsa

# Purpose of Baselineing

## **Baseline Performance and Capacity**

- n Provide documented sizing and constraint data

## **Rationalize Design Criteria and Constraints**

- n Provide basis for analyzing project deliverable and expectations

## **Quality Assurance and Reliability**

- n Provide a framework for testing and baseline data

## **Solution Management**

- n Integrate testing and quality assurance into a comprehensive solution management plan early in the implementation



## Inputs

### **Design and Requirements**

- n Your test plan should be designed to test and validate the design and requirements definition**

### **Current Metrics and Histories**

- n Your test plan must consider current metrics and historical analysis of your current landscape**

## Outputs

### **System Engineering**

- n Baselining should provide a basis for recommendations regarding Systems Engineering and design of the application landscape**

### **Reliability**

- n Baselining can provide a basis for evaluating system reliability and can be used to improve the Service Level Agreements for the application**

### **Change Management**

- n Baselining provides a valuable baseline data-set for input into a comprehensive Change Management practice**

## Simple Process

**Test basic functionality**

**Test static and dynamic content types**

**Enable autonomous testing**

## Simple Principles

**Test metrics that matter**

**Publish data that makes sense**

**Make recommendations based on factual analysis**

## Testing

- n **Plan appropriate tests**
  - u **Tests must be designed for specific purposes**
  - u **Understand your tests and the intended utility of the test**

## Analysis

### **Keep it simple!**

- n Tests should have intended purposes and expected outcomes, keep your analysis confined to those topics**
- n If unintended results occur provide analysis for root cause**

### **Present data graphically**

- n Focus your presentation on simple graphs with the minimum data required to validate your conclusions or discussions**

### **Present current and historical data**

- n It may be appropriate to compare and contrast your findings to historical data to validate conclusions or discussions**
- n Trend analysis requires accurate and reliable data that was gathered using tests and methodologies applicable to your current frame of reference**

# Testing Tools Requirements

**Basic testing tools must fulfill minimum functional requirements to provide benefit to your testing practice.**

- n Test Functional Behavior**
- n Track Performance Metrics**
- n Generate Load (multiple users)**
- n Reliable and Consistent Operation**
- n Extensible**
- n Simple to Use**

**Don't overlook your most familiar tool!**

**Your browser is an important tool in your testing practice.**

**If you have different browsers in use within your organization then you should have every version available to your Baselineing team.**



# Baselining Enterprise Portal Login

**Login is typically the most expensive portal action.**

**n Baselining portal logins is essential in order to provide a baseline of key performance metrics**

## **Key Performance Indicators**

**n Capacity (hits/second)**

**n Throughput (bytes/sec or bits/sec)**

**n Concurrency (simultaneous active users)**

**n Average Response Times**

## **Key Findings and Results**

**n Cost of Content**

**n System Capacity**

### Hits / sec

- n This metric provides a reference for maximum capacity as it relates to file I/O (typically a finite resource) and involves a synchronous process (i.e. users see the resource starvation/utilization as increased response time)

### Connections / sec

- n This metric provides a reference for TCP/IP connection handling. Socket creation and handling is resource intensive for both the server and the client. At the system level, sockets are both a thread and a file I/O. Excessive socket handling causes increased response times, especially when SSL is used.

### Throughput (bytes/sec)

- n Every network has some finite capacity for bandwidth. Also, every user is some physical distance from the server. Both of these factors influence latency, which users feel in increased response times.



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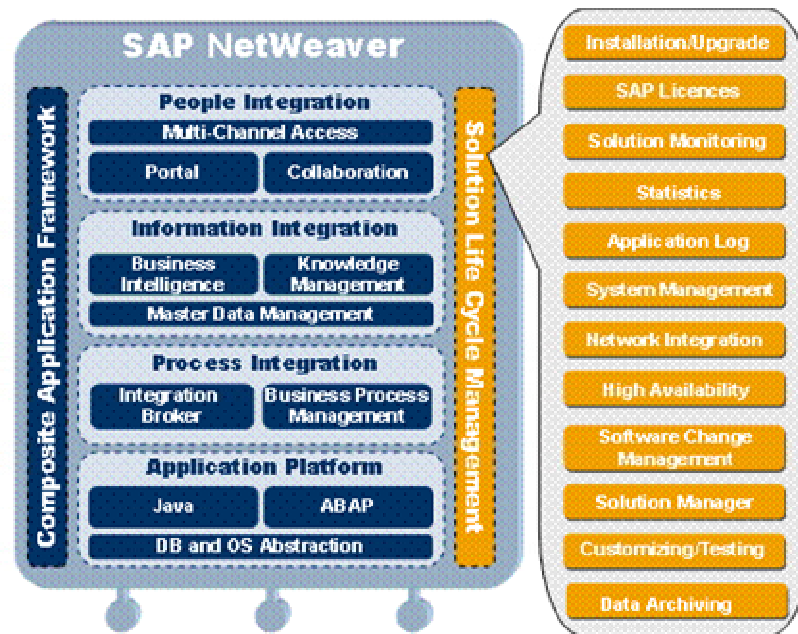
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# Solution Management

**Solution Life Cycle Management (SLCM) is one of the key areas of SAP NetWeaver.**

**It provides you with the technology required for the entire life cycle of your solution, from its implementation through running a live system, to continuous modifications and upgrades.**



**Developing a “Standard Practice” for Baseline testing includes publication of detailed guidelines and rules for use of testing tools and appropriate test parameters.**

### **n Testing Tools**

- u Each tool used should have comprehensive documentation detailing configuration and operation to ensure repeatable use.**

### **n Testing Guidelines**

- u Each test should have explicit goals and each resulting data set should have a documented analysis methodology.**
- u You must ensure that the tests and test configurations are used consistently and within the “rules” over time in order to make certain that your data and analysis is reliable over time.**
- u New tests or changed parameters should be documented and appropriate changes to corresponding data analysis practices should be made.**

**Quality Assurance and Reliability are typically integrated into the Key Performance Indicators (KPIs) for your Portal implementation.**

**A reliable Baseline practice can:**

- n Improve support responsiveness (proactive monitoring)**
- n Reduce downtime for maintenance**
  - u By providing reliable frameworks and data for assurance**
  - u By simplifying assurance testing**

**Knowing how your system performed BEFORE you apply changes is the ONLY WAY to provide assurance that the changes have not adversely affected a range of application metrics (both functional and performance).**

## Documentation

**Test data should be archived and made available for review. The testing guidelines and practice manuals should also be managed to ensure that your testing practice remains consistent and reliable throughout the solution life cycle.**

## Importance of Historical Data

**Historical records enable you to track performance and reliability trends over time. They also provide a reliable reference point for comparing system behavior across a variety of operating scenarios.**

## n Consistent and Repeatable Assurance Process

- u Testing practice must be isolated from the inevitable changes in resources which occur over time in any IT organization
- u If someone different runs the next test set are you CERTAIN their results are valid?

## n Improve Reliability and Supportability

- u When you have confidence in your testing practice you are empowered to proactively manage your solution
- u Tracking historical performance data allows you to identify trends
  - l Use Distributed Statistics Records and track historical data throughout the lifetime of your solution

## n Coherent Solution Management

- u Integrating application Baselining into your application management provides an explicit link between performance, reliability, and supportability
- u Integrate your Portal into your broader Solution Management practice



**Baselining is simple**

**Baselining provides immediate benefits**

**Baselining is the beginning point of comprehensive change management practice**

**Reliability and Assurance are important KPIs that are positively impacted by a sound Baselining methodology**

## Consider this....

**Performance analysis is not a purely orthogonal process**

**<http://www.research.ibm.com/journal/sj/391/alexander.html>**

**Common sense means something!**

**Performance itself is a dynamic – always changing as your system changes, that's why good record keeping is critical**

**Understand the relationship between internals (JDK/JVM stuff) and externals (OS/Network/Client stuff)**

**Learn a test tool and stick with it!**



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## Further Information

### è Public Web:

[www.sap.com](http://www.sap.com)

SAP Developer Network: [www.sdn.sap.com](http://www.sdn.sap.com) è xxx è xxx

SAP Customer Services Network: [www.sap.com/services/](http://www.sap.com/services/)

### è Related SAP Education Training Opportunities

<http://www.sap.com/education/>



### Related Workshops/Lectures from SAP TechEd 2004

ABAP353 Quick-Start on Performance Analysis

CI202 Performance and Scalability of SAP Business Solutions

JAVA201 Troubleshooting on the SAP Web AS for Java Developers

LCM151 Initial Setup of CCMS Monitoring Infrastructure

LCM201 Software Lifecycle Management by SAP - An Overview

LCM204 Troubleshooting for Administrators: Problem Detection and Analysis for SAP Web AS Java

LCM253 Monitoring Infrastructure for SAP Web Application Server Java: Setup and Usage

LCM255 SAP NetWeaver Availability Monitoring and Reporting with CCMS and BI

NW101 Introduction to SAP NetWeaver as an Integration Platform “Across IT Landscapes

NW204 Performance Analysis and Tuning of SAP NetWeaver



701385 SAP J2EE Engine 6.30, 6.40 Release Information

710663 Central note for SAP J2EE Engine 630/640 bootstrap process

709140 Recommended JDK and VM Settings for the WebAS630/640 SP4

723909 Java VM settings for EP6 on J2EE 6.30/6.40

710146 How to change J2EE Engine JVM Settings

764417 Troubleshooting guide for 6.40

710154 How to create a thread dump for the J2EE Engine 6.30

742395 Analyzing High CPU usage by the J2EE Engine

724719 How to enable HTTP tracing in SAP J2EE Engine 6.30/6.40

719778 Troubleshooting for dbpool service

# SAP Developer Network

Look for SAP TechEd '04 presentations and videos on the SAP Developer Network.

Coming in December.

<http://www.sdn.sap.com/>

The screenshot shows the SAP Developer Network website. At the top, there is a navigation bar with the SAP logo, the text "SAP DEVELOPER NETWORK", and links for "About", "Contact Us", "Submit Content", "Profile Management", and "Log Off". A "POWERED BY SAP NetWeaver" logo is also present. Below the navigation bar, there is a search bar with a "GO" button and a dropdown menu for "SDN Content". A "Developer Areas" sidebar lists various topics like "SAP NetWeaver Platform", "Enterprise Portal", and "Knowledge Management". The main content area features several articles and announcements, including "Inside SDN" with a "EP 6.0 Optimization Workshop" (09 Sep 2004), "SAP Developer Network Exclusive Series!" (09 Sep 2004) featuring "SAP NetWeaver™ in the REAL WORLD PART 1: OVERVIEW", and "New eBook: Composite Application Framework 1.0" (09 Sep 2004). A "What's New" section lists links to "NET Interoperability Developer Area", "SDN Contributor Recognition Program", "SAP NetWeaver Consultant's Corner", and "Enterprise Services Architecture (ESA) Today". A "NW Know-How DVD" section highlights a comprehensive knowledge source with 35+ hours of technical eLearning sessions. The bottom of the page includes a "CONTRIBUTOR" badge and a "What's New" section with a "GET IT NOW!" button.

■ Questions?

# Q&A



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