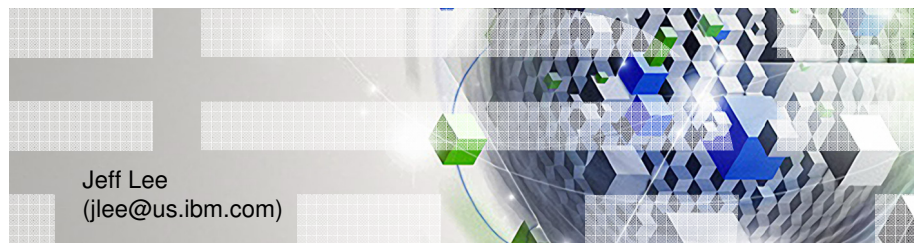




What Tools to Use to Improve Performance of Your Java Applications



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Abstract:

What tools to use to improve Java Application Performance

The newest WebSphere Application Server 6.1 comes with a new set of performance tools and wizards to monitor and tune the application environment. We will also discuss and demonstrate Java performance tools for the 32 bit and the new 64-bit JVM as well as the "classic 64 bit " JVM.

By the end of this session, attendees will be able to:

- Pick the right Java performance tool to solve a specific Java performance problem.

Agenda

- Overview of IBM performance tools for Java and WebSphere applications
- Tools that are included in IBM i, and tools for a fee
- Basic system tools
- Basic Java Virtual Machine tools
- Tools for in-depth analysis in Java and WebSphere



Introduction

- Lots of performance tools available for **IBM i**
- Lots of performance tools for the **IBM Technology for Java**
- Not always clear which tool is the "right" one for the job
- This presentation contains an **overview** of various performance tools which are useful in a Java or WebSphere environment

System Report

Pool ID	Cache	Size (MB)	Act Lvl	Util	Number Tns	Average Response	DB Fault	DB Pages	Non-DB Fault	Non-DB Pages	Act- Wait	Act- Inel
01	0	2,892	0	1.9	0	.00	.0	.0	.0	.0	32	0
02	0	28,710	395	67.6	0	.00	.0	.1	.1	1.0	51,242	0
Total		31,602		69.5	0	.00	.0	.1	.1	1.0	51,274	0
Average						.00	.0	.1	.1	1.0	51,274	0



Important Performance Tool Characteristics

- Type of tool
 - Monitoring, high-level analysis, low-level analysis, etc
 - Green-screen or GUI
- What it can be used for
- How to get the tool
 - Fee versus Free
- Complexity
 - How simple is the tool to learn and use?
- Overhead
 - Will use of the tool impact the performance of your application?
- Where to learn more



Performance tools

Basic System Commands

- WRKACTJOB
- WRKSYSSTS
- WRKDSKSTS
- WRKSYSACT
- WRKOBJLCK

System Monitoring Tools

- Collection Services
- IBM i Navigator System Monitor
- Performance Tools Reports

Lower Level Performance Tools

- Performance Explorer Trace
- PTDV
- iDoctor Job Watcher
- iDoctor PEX Analyzer

WebSphere Performance Tools

- Tivoli Performance Viewer
- Web Performance Advisor
- Web Performance Monitor
- ARM instrumentation

Database Performance Tools

- SQL Performance Monitor
- SQL Visual Explain

= Most Important tools

Java Performance Tools

- Verbose Garbage Collection
- DSPJVMJOB (4.5) + WRKJVMJOB (6.1)

<p>Classic JVM Tools</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> DMPJVM <input checked="" type="checkbox"/> ANZJVM <input checked="" type="checkbox"/> iDoctor Heap Analyzer 	<p>IBM Technology for Java VM Tools</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Thread Analyzer (parse javacore file) <input checked="" type="checkbox"/> PMAT (parse verbose GC data) <input checked="" type="checkbox"/> MDD4J (parse HeapDump file)
---	---



Basic System Tools

- IBM i system commands
- Generally useful for getting a quick snapshot of performance-related information
- Use to monitor the system and determine if something “unusual” happens
- First place to go when analyzing a performance issue
 - Gives you a general idea of what type of problem you are dealing with
 - Get an idea of what to look for next



Tool: WRKACTJOB

Full name	Work with Active Jobs
Type of tool	“Green screen” monitoring, high-level analysis
How to get it	Included in i5/OS
Complexity	Simple
Overhead	Minimal
What to use it for	Review and change the attributes and resource utilization of the jobs on your system.
Key things to look for	<ul style="list-style-type: none"> Jobs with excessive CPU utilization Details on threads in a job (including current state and stack)
Where to learn more	IBM i Information Center http://publib.boulder.ibm.com/infocenter/iserics/v7r1m0/topic/rzahg/icmain.htm



WRKACTJOB

```

Work with Active Jobs                                YL1567
CPU %: 75.2    Elapsed time: 00:00:28    Active jobs: 273
                                02/27/06 20:21:54

Type options, press Enter.
2=Change 3=Hold 4=End 5=
8=Work with spooled files

Opt Subsystem/Job User
Time options, press Enter.

Work with Threads                                System: YL1567
Job: TRADE60    User: QEJBSVR    Number: 021388

Display Call Stack                                System: YL1567
Job: TRADE60    User: QEJBSVR    Number: 021388
Thread: 00000167

Type Program Statement Procedure
5 QLESPI QSYS 17 LE_Create_Thread2__FP12crtt >
  QJVALIBJVM QSYS 7 startThread__FPv
  J com/ibm/ws/util/Threa > 0000529A run
  J com/ibm/ws/util/Threa > 000051B4 run
  J com/ibm/ws/tcp/channe > 000050C2 run
  J com/ibm/ws/tcp/channe > 00004F84 requestComplete
  J com/ibm/ws/http/chann > 00004DA6 complete
  J com/ibm/ws/http/chann > 00004B8C handleNewInformation
  J com/ibm/ws/http/chann > 00004A2A handleDiscrimination
  J com/ibm/ws/webcontain > 000048CC ready
  J com/ibm/ws/webcontain > 00004726 handleRequest
  J com/ibm/ws/webcontain > 00004570 handleRequest
  J com/ibm/ws/webcontain > 000043C2 handleRequest

F3=Exit F5=Refresh F11=Display activation group F12=Cancel
F16=Job menu F17=Top F18=Bottom F21=Include F22=Display entire field
    
```



Tool: WRKSYSSTS

Full name	Work with System Status
Type of tool	“Green screen” monitoring
How to get it	Included in i5/OS
Complexity	Simple
Overhead	Minimal
What to use it for	Provides an overview of current system activity. Specifically, it displays the number of jobs on the system and storage pool utilization information. Allows you to monitor and change system pool characteristics.
Key things to look for	<ul style="list-style-type: none"> • Pools with high paging rates • Pools with threads transitioning to ineligible state
Where to learn more	IBM i Information Center



WRKSYSSTS

```

Work with System Status                                YL1567
                                                    02/27/06 20:36:47
% CPU used . . . . . : 73.0  Auxiliary storage:
% DB capability . . . . . : 4.6  System ASP . . . . . : 1371 G
Elapsed time . . . . . : 00:00:01  % system ASP used . . . : 3.4277
Jobs in system . . . . . : 341    Total . . . . . : 1371 G
% perm addresses . . . . . : .007  Current unprotect used : 6008 M
% temp addresses . . . . . :

Type changes (if allowed), press Enter.

System Pool Reserved Max Active-> Wait-> Active->
Pool Size (M) Size (M) Active Wait Inel Inel
1 2892.32 596.36 +++++ 78.8 .0 .0
2 28709.92 2.46 395 50577 .0 .0

Command
====
F3=Exit F4=Prompt F5=Refresh
F19=Extended system status

Work with System Status                                YL1567
                                                    02/27/06 20:38:12
% CPU used . . . . . : 70.6  Auxiliary storage:
% DB capability . . . . . : 21.7  System ASP . . . . . : 1371 G
Elapsed time . . . . . : 00:01:26  % system ASP used . . . : 3.4289
Jobs in system . . . . . : 342    Total . . . . . : 1371 G
% perm addresses . . . . . : .007  Current unprotect used : 6024 M
% temp addresses . . . . . : .013  Maximum unprotect . . . : 7401 M

Type changes (if allowed), press Enter.

System Pool Reserved Max Active-> Wait-> Active->
Pool Size (M) Size (M) Active Wait Inel Inel
1 2892.32 596.30 +++++ 78.8 .0 .0
2 28709.92 2.46 395 50577 .0 .0

Command
====
F3=Exit F4=Prompt F5=Refresh F9=Retrieve F10=Restart F12=Cancel
F19=Extended system status F24=More keys

Bottom
    
```



Tool: WRKDSKSTS

Full name	Work with Disk Status
Type of tool	“Green screen” monitoring
How to get it	Included in i5/OS
Complexity	Simple
Overhead	Minimal
What to use it for	Display the performance information and attributes for system disk units.
Key things to look for	<ul style="list-style-type: none"> • Disks with high utilization (%Busy > 40) • Disks in FAILED or DEGRADED condition
Where to learn more	IBM i Information Center



WRKDSKSTS

```

Work with Disk Status                                YL1567
                                                    02/27/06  20:44:23
Elapsed time:  00:03:07

Unit  Type      Size  %   I/O  Request  Read  Write  Read  Write  %
      (M)  Used  Rqs  Size (K)  Rqs  Rqs    (K)  (K)  Busy
1  4326  35165  22.0  775.2  4.0    .0    .2    .0    4.0    0
2  4326  30769  3.0
3  4326  26373  3.0  10.4
4  4326  30769  2.8
5  4326  30769  3.0  4.4
6  4326  30769  3.0  4.4
7  4326  30769  3.0  4.4
8  4326  30769  2.8  2.4
9  4326  35165  2.8
10 4326  26373  3.0  4.4
11 4326  30769  2.8  1.4
12 4326  30769  2.8  10.4
13 4326  26373  3.1  4.4

Command
====>
F3=Exit  F5=Refresh  F12=Cancel

Work with Disk Status                                HGWELLS
                                                    02/27/06  20:42:55
Elapsed time:  00:00:00

--Protection--
Unit  ASP  Type  Status  Compression
14    1  DPY  ACTIVE
15    1  DPY  ACTIVE
16    2  DPY  DEGRADED
17    2  DPY  DEGRADED
18    2  DPY  DEGRADED
19    2  DPY  DEGRADED
20    2  DPY  DEGRADED
21    2  DPY  DEGRADED
22    2  DPY  DEGRADED
23    2  DPY  DEGRADED
24    2  DPY  DEGRADED
25    2  DPY  DEGRADED
26    2  DPY  DEGRADED

More...

Command
====>
F3=Exit  F5=Refresh  F12=Cancel  F24=More keys
    
```



Tool: WRKSYSACT

Full name	Work with System Activity
Type of tool	“Green screen” monitoring, high-level analysis
How to get it	Part of the Performance Tools licensed program (PT1)
Complexity	Simple/Moderate
Overhead	Minimal
What to use it for	Display information about the most active jobs and tasks currently running on the system.
Key things to look for	<ul style="list-style-type: none"> Jobs/tasks with high CPU or IO Current processing capacity (CPUs assigned to this partition)
Where to learn more	IBM i Information Center



WRKSYSACT

```

Work with System Activity                                YL1567
                                                    02/27/06 20:47:52
Automatic refresh in seconds . . . . . 5
Elapsed time . . . . . 00:00:05 Average CPU util . . . . . 71.9
Number of CPUs . . . . . 2 Maximum CPU util . . . . . 71.9
Overall DB CPU util . . . . . 4.2 Minimum CPU util . . . . . 71.8
                                                    Current processing capacity: 2.00

Authorization Type . .
Type options, press Enter.
  1=Monitor job  5=Work with job

Job or
Opt Task      User      Nu
TRADE60 QEJBSVR 02
TRADE60 QEJBSVR 02
TRADE60 QEJBSVR 02
TRADE60 QEJBSVR 02
TRADE60 QEJBSVR 02
QSQSRVR QUSER   02
QSQSRVR QUSER   02

F3=Exit  F10=Update list  F11=
F19=End automatic refresh  F24=

Work with System Activity                                YL1567
                                                    02/27/06 20:49:10
Automatic refresh in seconds . . . . . 5
Elapsed time . . . . . 00:00:05 Average CPU util . . . . . 73.3
Number of CPUs . . . . . 2 Maximum CPU util . . . . . 73.5
Overall DB CPU util . . . . . 4.3 Minimum CPU util . . . . . 73.1
                                                    Current processing capacity: 2.00

Authorization Type . .
Type options, press Enter.
  1=Monitor job  5=Work with job

-----Asynchronous-----
Opt Job or      User      Number Thread  DB  Write  Read  Write
TRADE60 QEJBSVR 021388 00000168 0 275 0 4
TRADE60 QEJBSVR 021388 00000167 0 233 0 0
TRADE60 QEJBSVR 021388 0000014B 0 229 0 0
TRADE60 QEJBSVR 021388 0000014A 0 239 0 0
TRADE60 QEJBSVR 021388 00000147 0 274 0 0
QSQSRVR QUSER   020479 00000020 0 92 0 4387
QSQSRVR QUSER   021116 00000095 0 113 0 4310
                                                    More...

F3=Exit  F10=Update list  F11=View 4  F12=Cancel
F19=End automatic refresh  F24=More keys
    
```




Tool: WRKOBJLCK

Full name	Work with Object Locks
Type of tool	“Green screen” high-level analysis
How to get it	Included in i5/OS
Complexity	Moderate
Overhead	Minimal
What to use it for	Work with and display locks on a specified object, including locks the application is waiting for. In Java applications, this usually means database locks.
Key things to look for	<ul style="list-style-type: none"> The current holder of a contentious lock
Where to learn more	IBM i Information Center



WRKOBJLCK

```

Work with Object Locks
System: YL1567
Object . . . . : QUOTEJOB      Type . . . . . : *FILE-PHY
Library . . . : TRADE51DB    ASP device . . : *SYSBAS

Type options, press Enter.
4=End job 5=Work with job 8=Work with job locks

Opt Job      User
  QSQSRVR   QUSER

  QSQSRVR   QUSER

  QSQSRVR   QUSER

F3=Exit F5=Refresh F6=Work

Work with Job Locks
System: YL1567
Job: QSQSRVR User: QUSER Number: 020479
Job status: ACTIVE

Type options, press Enter.
5=Work with job member locks 8=Work with object locks

Opt Object Library Type Lock Status Member ASP Device
  ACCOUNTEJB TRADE51DB *FILE-PHY *SHRRD HELD YES
  ACCOU00001 TRADE51DB *FILE-PHY *SHRRD HELD YES
  ACCOU00002 TRADE51DB *FILE-LGL *SHRRD HELD YES

More...
F3=Exit F5=Refresh F10=Display job record locks F11=Display thread data
F12=Cancel
    
```

Basic System Tools (recap)

Tool	Cost	Complexity	What it is used for
WRKACTJOB	Free	Simple	<ul style="list-style-type: none"> Determine which jobs are using the most resources Display the details on threads in a job (including current state and stack) Review and change attributes of individual jobs
WRKSYSSTS	Free	Simple	<ul style="list-style-type: none"> Overview of system activity, such as number of jobs on system and information about the storage usage on the machine. Determine paging rates of individual storage pools Determine if any threads are going into ineligible state
WRKDSKSTS	Free	Simple	<ul style="list-style-type: none"> Determine how busy your individual disk arms are. Determine if you have disk arms which are degraded or failed.
WRKSYSACT	5722PT1	Moderate	<ul style="list-style-type: none"> Display information about the most active threads and tasks running on the system Determine how much processing capacity is assigned the partition.
WRKOBJLCK	Free	Moderate	<ul style="list-style-type: none"> Determine OS level locks (not Java locks) for a specific object. Usually performed with database locks



Basic Java Virtual Machine Tools

- These tools provide basic diagnostics about a running Java job

- Focus in this presentation is on the newer "IBM Technology for Java" VM
 - Code name: The "J9" JVM
 - The "Classic" JVM has a different set of tools to look at the performance

Tool: DSPJVMJOB

Full name	Display Java Virtual Machine Jobs
Type of tool	"Green screen", high-level analysis
How to get it	Included in i5/OS (new in V5R4)
Complexity	Simple
Overhead	Minimal
What to use it for	List JVMs (Classic and J9) currently running on the system
Key things to look for	<ul style="list-style-type: none"> • Unexpected JVMs running on the system • Job name/user/number (for use as input into other tools)
Where to learn more	IBM i Information Center



DSPJVMJOB

```

Display Java Virtual Machine Jobs
                                YL1567
                                02/27/06 21:03:21
Java Virtual Machine Jobs: 4      Allow New JVM: Yes

Current
Job      User      Number  Type  User      Status  Subsystem
TRADE60  QEJBSVR  021388  BCH   QEJBSVR   JVAW    QWAS6

Display Java Virtual Machine Jobs
                                YL1567
                                02/27/06 21:03:21
Java Virtual Machine Jobs: 4      Allow New JVM: Yes

Job      User      Number  Type  Server Type
TRADE60  QEJBSVR  021388  BCH   QIBM_WSA_EJBSEVER
QJVACMDSRV QIBMHELP 015543  BCI
QSRVMON  QSYS     015524  BCI
QYFJSJSVR QYFJSJSVR 015548  BCH   QIBM_MGMTCENTRAL

F3=Exit  F5=Refresh  F11=Disp
    
```

Bottom

F3=Exit F5=Refresh F11=Display job status F12=Cancel



Tool: DMPJVM (Classic JVM Only)

Full name	Dump Java Virtual Machine
Type of tool	“Green screen”, mid-level analysis
How to get it	Included in i5/OS (Classic JVM)
Complexity	Moderate
Overhead	Intrusive
What to use it for	Dump information about a running JVM, including the classpath, heap information, thread information (state, locks and stacks), and a heap dump
Key things to look for	<ul style="list-style-type: none"> • Current heap size • Threads which are “stuck” (stack information) • Possible object leaks • Which class loader is used for different types of objects
Where to learn more	IBM i Information Center



DMPJVM (Classic JVM Only)

```

Dump Java Virtual Machine (DMPJVM)
Type choices, press Enter.
Job name . . . . . SERVER1      Name
User . . . . . QESBVR        Name
Number . . . . . 025783       000000-999999
Stack frames . . . . .         0000-9999, *ALL
    
```

WebSphere
Application
Server job ID

Thread information

```

Information for 20 thread(s) of 20 thread(s) processed
Thread: 000000E Thread-0
TDE: B002100009149000
Thread priority: 5
Thread status: Destroy wait
Thread group: main
Runnable: java/lang/Thread
Stack:
None
Locks:
None
Thread: 000001D Alarm : 0
TDE: B00210000AB83000
    
```

Mon Apr 07 14:25:31 2003
Java Virtual Machine Information 025783:QEJBSVR/SERVER1

```

. Classpath
-----
java.version=1.3
/QIBM/ProdData/WebASS/Base/java/ext/ibmorb.jar:/QIBM/ProdData/WebASS/Base/
ava/ext/ibmext.jar:/QIBM/ProdData/OS400/Java400/jdk/lib/jdkrt1.3.zip:/QIBM/
ProdData/OS400/Java400/jdk/lib/rt.jar:/QIBM/ProdData/OS400/Java400/jdk/lib/
i18n.jar:/QIBM/ProdData/OS400/Java400/jdk/lib/sunrsasign.jar:/QIBM/ProdData
/OS400/Java400/ext/IBMmisc.jar:/QIBM/ProdData/OS400/Java400/ext/jssl.jar:/Q
IBM/ProdData/OS400/Java400/ext/ibmjssl.jar:/QIBM/ProdData/OS400/Java400:/Q
IBM/ProdData/Java400:/QIBM/UserData/WebASS/Base/default/properties:/QIBM/P
rodData/WebASS/Base/properties:/QIBM/ProdData/WebASS/Base/lib/bootstrap.jar
:/QIBM/ProdData/WebASS/Base/lib/j2ee.jar:/QIBM/ProdData/WebASS/Base/lib/imp
roxy.jar
    
```

Garbage Collection

```

Garbage collector parameters
Initial size: 32768 K
Max size: 240000000 K
Current values
Heap size: 171232 K
Garbage collections: 26
Additional values
JIT heap size: 10880 K
JVM heap size: 62092 K
Last GC cycle time: 121 ms
    
```

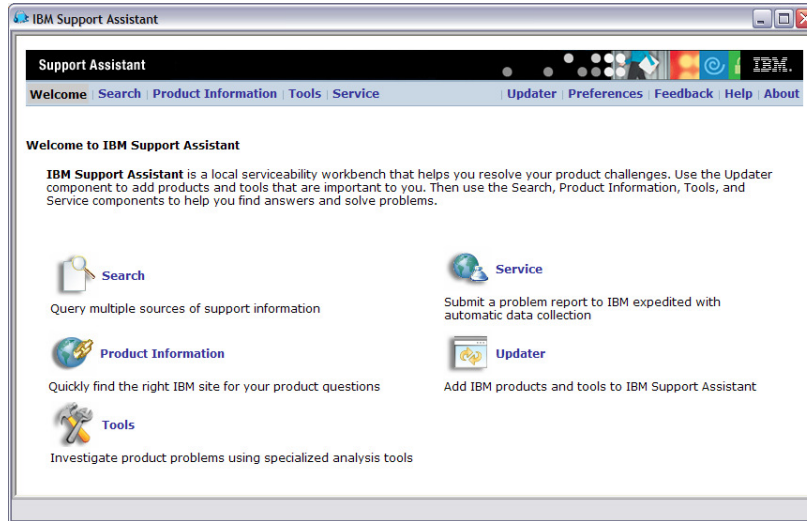


Tool: ANZJVM (Classic JVM Only)

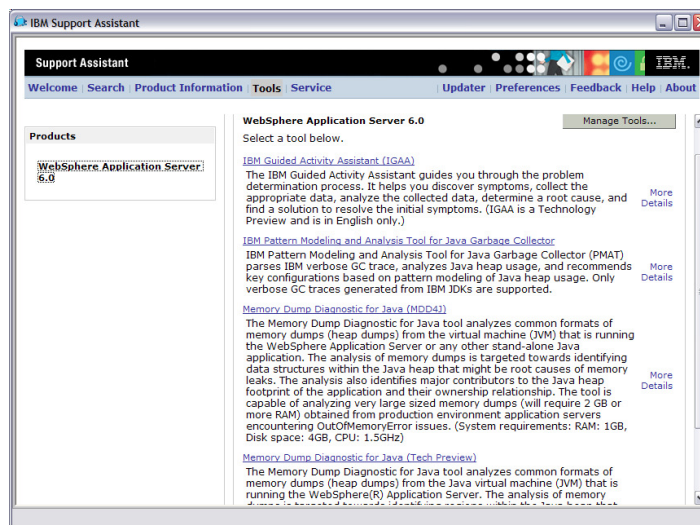
Full name	Analyze Java Virtual Machine
Type of tool	“Green screen”, mid-level analysis
How to get it	Included in i5/OS (Classic JVM)
Complexity	Moderate
Overhead	Intrusive
What to use it for	Generates a report diagnosing the differences in the JVM heap over specified amount of time. The report lists each object type (class) with the number of object instances and size in each snapshot, as well as the difference between the two snapshots. The report can be sorted in different ways to detect different types of leaks (either a leak of a lot of small objects or a slow leak of large objects).
Key things to look for	<ul style="list-style-type: none"> • Classes with a growing number of objects or size • Classes with a large number of instances or total size
Where to learn more	IBM i Information Center



IBM Support Assistant



IBM Support Assistant (Tools View)



"Health Center" Tool

Method profile - IBM Support Assistant Workbench

Support Assistant

Method profile

Samples	Self (%)	Self	Tree (%)	Tree	Method
1087	41.1		41.2		testApplicationSink.createLargeObjects()
523	19.8		19.8		java.lang.Thread.sleep(2)
428	16.2		44.1		testApplicationSink.get()
416	15.7		48.2		testApplicationSink.put()
49	1.85		46.7		testApplicationEmpty.run()
26	0.98		1.47		java.lang.String.lastIndexOf()
23	0.87		49.1		testApplicationFill.run()
15	0.57		0.83		com.ibm.os.vm.VM.findClassOrNull((java.lang.String,java.lang.ClassLoader,)
13	0.49		0.49		java.lang.String.lastIndexOf()

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"Health Center" Tool - *continued*

- Official name:
 - The IBM Monitoring and Diagnostic Tools for Java - Health Center
- Delivered in the IBM Support Assistant (ISA) Workbench -- *Free!*
- Very low overhead
- Optimize application performance
- Improve application stability and uptime
- Reduce system resource usage
- Reduce the time to resolve problems
- Drive down development and maintenance costs
- *Requires IBM Java 5 or Java 6*

For complete details, refer to the IBM i Information Center:

- <http://publib.boulder.ibm.com/infocenter/iserics/v7r1m0/topic/rzaha/colpdc.htm>
- <http://www.ibm.com/developerworks/java/jdk/tools/healthcenter>

Tool: Verbose GC

Full name	Verbose Garbage Collection
Type of tool	JVM log, mid-level analysis
How to get it	Specify <code>-verbose:gc</code> on the JVM command line (or configure through WAS admin console). Works with both Classic and IBM Technology for Java (although the format is different).
Complexity	Moderate
Overhead	Minimal
What to use it for	A simple way to monitor garbage collector behavior, and check for object leaks.
Where to learn more	IBM i Information Center –and– IBM Technology for Java Diagnostics Guide http://download.boulder.ibm.com/ibmdl/pub/software/dw/jdk/diagnosis/diag50.pdf
Key things to look for	<ul style="list-style-type: none"> • Cycles which begin for a reason other than “threshold allocation reached” • Heap growth over time (live objects or current heap size) • Long collection time, especially if one cycle starts as soon as the previous one ends

Verbose GC Output

```

<af type="tenured" id="72" timestamp="Sun Jun 04 22:53:26 2006" intervals="31630.253">
  <minimum requested bytes="112" />
  <time exclusiveaccessms="0.167" />
  <tenured freebytes="0" totalbytes="268435456" percent="0" >
    <soa freebytes="0" totalbytes="268435456" percent="0" />
    <loa freebytes="0" totalbytes="0" percent="0" />
  </tenured>
  <gc type="global" id="72" totalid="72" intervals="31630.598">
    <refs_cleared soft="0" weak="192" phantom="8" />
    <finalization objectsqueued="37" />
    <timesms mark="185.680" sweep="18.255" compact="0.000" total="204.267" />
    <tenured freebytes="209253016" totalbytes="268435456" percent="77" >
      <soa freebytes="209253016" totalbytes="268435456" percent="77" />
      <loa freebytes="0" totalbytes="0" percent="0" />
    </tenured>
  </gc>
  <tenured freebytes="209252128" totalbytes="268435456" percent="77" >
    <soa freebytes="209252128" totalbytes="268435456" percent="77" />
    <loa freebytes="0" totalbytes="0" percent="0" />
  </tenured>
  <time totalms="213.512" />
</af>

```

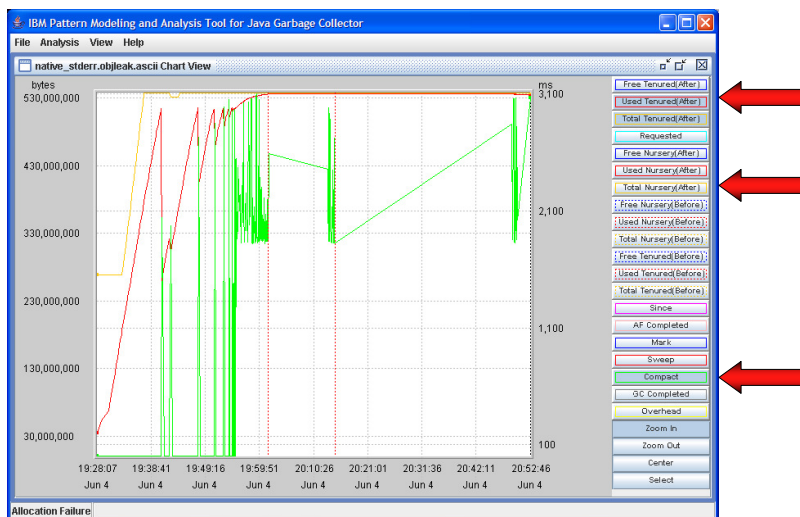
Tool: IBM PMAT tool

Verbose GC Output

Full name	IBM Pattern Modeling and Analysis Tool for Java Garbage Collector
Type of tool	Parsing tool of a Verbose GC collection
How to get it	Available through IBM Support Assistant, or AlphaWorks
Complexity	Simple
Overhead	Minimal (Verbose GC only)
What to use it for	Detecting object leaks and monitoring heap usage. View detailed information about generational GC to manually tune the best possible values for this.
Key things to look for	<ul style="list-style-type: none"> Gradual increase in used memory over time Keeping track of the generational GC and the nursery and tenured heaps.
Where to learn more	IBM Pattern Modeling and Analysis Tool for Java Garbage Collector http://www.alphaworks.ibm.com/tech/pmat

IBM Pattern Modeling and Analysis Tool for Java Garbage Collector

Verbose GC Output





Tool: Javacore file

Full name	J9 JVM can optionally take a dump of a core file (referred to as a javacore or javadump file).
Type of tool	JVM mechanism that generates a file that contains the current status of the JVM.
How to get it	Included in J9 JVM
Complexity	Moderate
Overhead	Minimal
What to use it for	Dump information about a running JVM, including the classpath, basic heap information and thread information (state, locks and stacks).
Key things to look for	<ul style="list-style-type: none"> • Current heap size • Threads which are “stuck” (stack information)
Where to learn more	J9 Diagnostic Guide



Javacore file

```

NULL -----
OSECTION TITLE subcomponent dump routine
NULL =====
1TISIGINFO Dump Event "uncaught" (00008000) Detail "java/lang/OutOfMemoryError" received
1TIDATETIME Date: 2006/06/04 at 20:13:07
1TIFILENAME Javacore filename:
/QIBM/UserData/WebSphere/AppServer/V61/Base/profiles/AVN7/javacore.20060604.200139.6881.txt
NULL -----
OSECTION GPINFO subcomponent dump routine
NULL =====
2XHOSLEVEL OS Level : OS400 5.4
2XHCPUS Processors -
3XHCPUARCH Architecture : ppc
3XHNUMCPUS How Many : 2
NULL
1XHERROR2 Register dump section only produced for SIGSEGV, SIGILL or SIGFPE.
NULL
NULL -----
OSECTION ENVINFO subcomponent dump routine
NULL =====
1CIJAVAVERSION J2RE 5.0 IBM J9 2.3 OS400 ppc-32 build 20060220_05389_bHdSMR (JIT enabled - 20060220_2133_r8)
1CIRUNNINGAS Running as an embedded JVM
1CICMDLINE [not available]
1CIJAVAHOMEDIR Java Home Dir: /QOpenSys/QIBM/ProdData/JavaVM/jdk50/32bit/jre
1CIJAVADLLDIR Java DLL Dir: /QOpenSys/QIBM/ProdData/JavaVM/jdk50/32bit/jre/bin
1CISYSCP Sys Classpath:
:
:

```

Unix style output to ease use for grep and other Unix utilities



Tool: ThreadAnalyzer

Full name	ThreadAnalyzer
Type of tool	Parsing tool of a javacore file
How to get it	Available through IBM Support Assistant
Complexity	Simple
Overhead	Minimal (client post processing of a javacore file)
What to use it for	<ul style="list-style-type: none"> Useful for detecting Java hangs and delays. You can open multiple javacore files to compare the dumps.
Key things to look for	<ul style="list-style-type: none"> Java thread state and stacks out of place. Deadlock situations that are occurring. Thread leaks
Where to learn more	IBM Support Assistant http://www.ibm.com/software/support/isa/



IBM ThreadAnalyzer

The screenshot shows the ThreadAnalyzer GUI with a table of thread statistics and a detailed view of a specific thread.

Method	#Same	Pct Of Pool	Weight
com.ibm.ws.util.BoundedBuffer.waitGet	56	40	21
com.ibm.ws.sib.msgrstore.persistence.dispatcher.PersistentDispatcher\$PersistentDispatcherThr...	8	7	8
com.ibm.ws.sib.msgrstore.persistence.dispatcher.SpillDispatcher\$SpillDispatcherThread.run	8	7	8
*** WARNING *** Thread with empty stack	6	6	6
java.util.TimerThread.mainLoop	4	4	4
java.lang.Thread.sleep	4	4	4
com.ibm.db2.jcc.app.DB2NTSXAResource.XACommit	4	4	4
sun.nio.ch.PollArrayWrapper.poll	3	3	3
java.net.PlainSocketImpl.socketAccept	3	3	3
com.ibm.ejs.util.am.AlarmManagerThread.run	2	2	2
org.eclipse.osgi.framework.eventmgr.EventManager\$EventThread.getNextEvent	2	2	2
com.ibm.ws.sib.tfm.general.thread.NotifiableThread.idle	1	1	1
com.ibm.ws.sib.msgrstore.persistence.impl.RangeManager.run	1	1	1

The detailed view shows thread information for a thread in state 'CW' (waiting for monitor):

```

Thread information:
Thread type: N/A or unknown
name: com.ibm.ws.util.BoundedBuffer.waitGet
thread id: 0x3B252700
priority: 5
state: CW
Waiting on monitor: java.lang.Object@8940E260/94C0E26C
Executing web or local EJB work: no
Waiting for remote orb work: no
Stack:
  java.lang.Object.wait(Native Method)
  java.lang.Object.wait(Object, java:231)
  com.ibm.ws.util.BoundedBuffer.waitGet_(BoundedBuffer, java:188)
  com.ibm.ws.util.BoundedBuffer.poll(BoundedBuffer, java:598)
  com.ibm.ws.util.ThreadPool.runTask(ThreadPool, java:819)
    
```

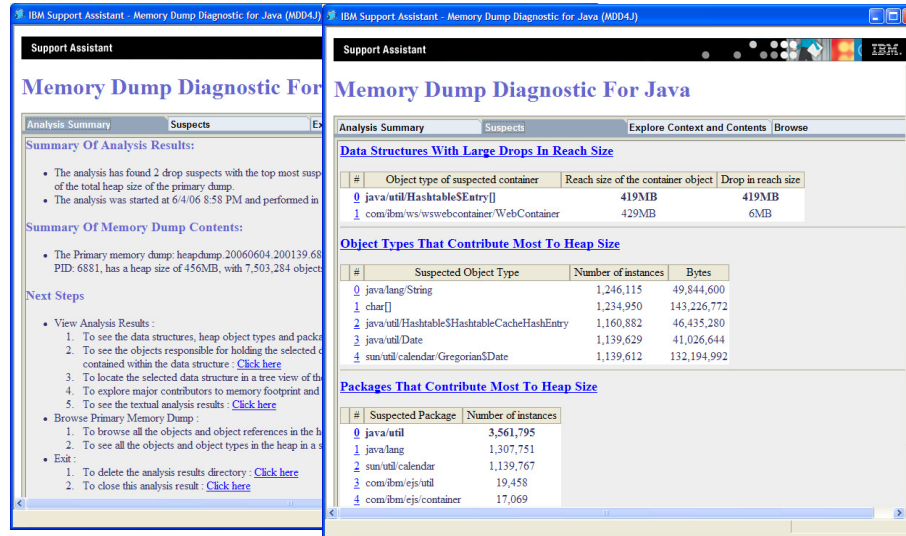
Tool: HeapDump file

Full name	JVM can optionally take a dump of the Java heap (Heapdump file)
Type of tool	Binary file that is only readable by parsing programs.
How to get it	Included in J9 JVM
Complexity	Complex
Overhead	Heavy
What to use it for	The heap dump will be generated (by default) when: <ul style="list-style-type: none"> • OutOfMemoryError occurs in the JVM • User code calls the <code>com.ibm.jvm.Dump.HeapDump()</code> method.
Key things to look for	<ul style="list-style-type: none"> • Analyze the file with tools, such as MDD4J. • Used only for debugging object leaks.
Where to learn more	J9 Diagnostic Guide.

Tool: MDD4J

Full name	Memory Dump Diagnostic for Java
Type of tool	Memory Leak Analysis tool.
How to get it	Download from the ISA tool: http://www.ibm.com/software/support/isa/
Complexity	Complex
Overhead	Heavy to collect trace file, and heavy to run on the client to parse.
What to use it for	Detecting object leaks
Key things to look for	<ul style="list-style-type: none"> • Increases in object counts • Potential object leaks in the code.
Where to learn more	http://www.ibm.com/software/support/isa/

Memory Dump Diagnostic for Java



Memory Dump Diagnostic For Java

Analysis Summary | **Suspects** | **Explore Context and Contents** | **Browse**

Data Structures With Large Drops In Reach Size

#	Object type of suspected container	Reach size of the container object	Drop in reach size
0	java/util/HashtableEntry[]	419MB	419MB
1	com.ibm.ws.webcontainer/WebContainer	429MB	6MB

Object Types That Contribute Most To Heap Size

#	Suspected Object Type	Number of instances	Bytes
0	java/lang/String	1,246,115	49,844,600
1	char[]	1,234,950	143,236,772
2	java/util/Hashtable\$HashtableCacheHashEntry	1,160,882	46,435,280
3	java/util/Date	1,139,629	41,026,644
4	sun/util/calendar/GregorianCalendar	1,139,612	132,194,992

Packages That Contribute Most To Heap Size

#	Suspected Package	Number of instances
0	java/util	3,561,795
1	java/lang	1,307,751
2	sun/util/calendar	1,139,767
3	com.ibm/ejs/util	19,458
4	com.ibm/ejs/container	17,069

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New JVM Performance Commands in 6.1

- **WRKJVMJOB** – work with JVM jobs
 - Primary interface into JVM performance analysis
- **PRTJVMJOB** – print JVM jobs
 - Allows to print a history of all garbage collection values and how it grew and changed during an extended period of time
 - Create options, environment variables, java lock reports, GC, thread report, etc.
- **GENJVMDMP** – generate JVM dumps
 - Primary interface to generate various dumps for further analysis
- Commands work for "IBM Technology for Java" only (not Classic JVM)

WRKJVMJOB – Work with JVM jobs

- Arguments and options with which the JVM was started
- Environment variables for both ILE and PASE
- Java lock requests outstanding for the JVM job
- Garbage collection information
- Properties with which the JVM was started
- Properties with which the JVM is currently running
- List of threads associated with the JVM
- Partially completed job log for the JVM job
- Ability to work with spooled input and output files for the JVM job
- Ability to generate JVM (System, Heap, Java) dumps from a panel option
- Ability to enable and disable verbose garbage collection

New Java Performance Tool in 6.1 – WRKJVMJOB

The screenshot displays the WRKJVMJOB panel in a terminal window. The main panel shows a list of active JVMs with columns for Job Name, User, and Number. A secondary panel is open, displaying a list of actions for the selected JVM (WAS61SVRGS). The actions include:

- 1. Disp
- 2. Disp
- 3. Disp
- 4. Disp
- 5. Disp
- 6. Disp
- 7. Disp
- 8. Disp
- 9. Disp
- 20. Work
- 30. Generate heap dump
- 31. Generate system dump
- 32. Generate Java dump
- 40. Enable verbose garbage collection
- 41. Disable verbose garbage collection

The panel also shows system information for the selected JVM: Job: WAS61SVRGS, User: OEJBSVR, Number: 020019, PID: 12966, JDK: 1.5.0, Bits: 32, System: SE150.

New Java Performance Tool in 6.1 – WRKJVMJOB .

Display Garbage Collection Information

System:	SEI5D		
Job	WAS61SVRGS	PID	12966
User	QEJBSVR	JDK	1.5.0
Number	020019	Bits	32

Garbage collected heap:

Initial heap size	50.000M
Maximum heap size	256.000M
Current heap size	
Heap in use	

Other memory:

Internal memory size	
JIT memory size	
Shared classes memory size	

F3=Exit F5=Refresh F6=Print F7=Print GC tables F12=Cancel Bottom

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New in 6.1 - PRTJVMJOB

- Arguments and options with which the JVM was started
- Environment variables for both ILE and PASE
- Java lock requests outstanding for the JVM job
- Garbage collection information
- Properties with which the JVM was started
- Properties with which the JVM is currently running
- List of threads associated with the JVM
- Garbage Collection Cycle Table



New in 6.1 - PRTJVMJOB



GENJVMDMP – Generating JVM Dump

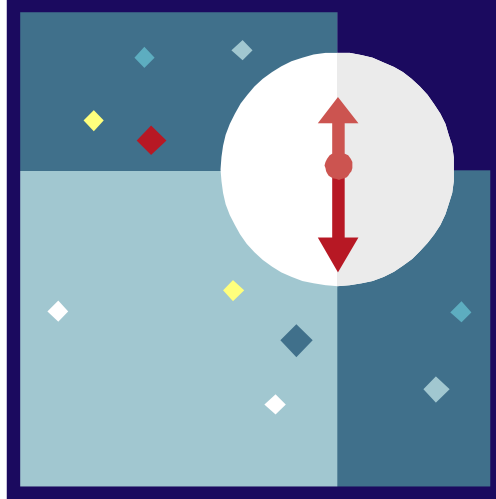
- Java dump ([javacore.20080218.232027.24.txt](#))
 - ***JAVA**
 - Generates multiple files that contain diagnostic information for the JVM and the Java applications running within the JVM
 - The IBM tool - IBM Thread and Monitor Dump Analyzer for Java Technology analyzes javacore and diagnoses monitor locks and thread activities in order to identify the root cause of hangs, deadlocks, and resource contention or monitor bottlenecks.
- System dump ([core.20080218.232209.24.dmp](#))
 - ***SYSTEM**
 - Generate a binary format raw memory image of the job that was running when the dump was initiated
 - This dump is primarily being used by service personnel to debug functional issues, but sometimes can give clues on performance problems as well, e.g. running out of memory
- Heap dump ([heapdump.20080218.232301.24.phd](#))
 - ***HEAP**
 - Generates a dump of all the heap space allocations which have not yet been freed
 - The IBM tool - Memory Dump Diagnostic for Java (MDD4J) can be used to further analyze the collected data with this dump

Basic Java Virtual Machine Tools (recap)

Tool	Cost	Complexity	What it is used for
DSPJVMJOB	Free	Simple	<ul style="list-style-type: none"> List all J9 (and classic) JVMs running on the system Determine the Job Name/User/Number of the JVMs, which can be used as input to other tools. Monitor for unneeded JVMs consuming resources
Verbose GC	Free	Moderate	<ul style="list-style-type: none"> For every garbage collection cycle, it will display vital information about the Java heap. Useful to determine if your application has memory leaks, monitor your current heap size, frequency and length of GC cycles, etc
Diagnostic Tool for Java GC	Free	Simple	<ul style="list-style-type: none"> Simple tool to diagnose Java object leaks from verbose GC output. Drill down to specific times and view the original verbose GC output
IBM Pattern Modeling and Analysis Tool	Free	Simple	<ul style="list-style-type: none"> Simple tool to diagnose Java object leaks from verbose GC output. More detailed information than previous tool for tuning generational gc.

Basic Java Virtual Machine Tools (recap... cont)

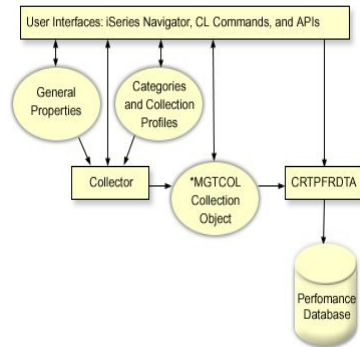
Tool	Cost	Complexity	What it is used for
IBM Support Assistant	Free	Simple	<ul style="list-style-type: none"> IBM portal for solving both functional and performance issues. Work in progress as tools are added. Provides searching, problem reporting, updating tools and managing dumps.
javacore file	Free	Moderate	<ul style="list-style-type: none"> Every J9 JVM can produce a javacore file. Also referred to as a JavaDump. The Javacore shows information about threads within the JVM (state, stack, locking)
IBM Thread and Monitor Dump Analyzer	Free	Simple	<ul style="list-style-type: none"> javacore parsing tool used to display and compare Javacore dumps. Analyze locking or slowdowns within the JVM Analyze thread leaks occurring in the JVM.
Heapdump file	Free	Complex	<ul style="list-style-type: none"> Binary dump file with the contents of the Java heap. Feed into tools to parse the output.
MDD4J	Free	Complex	<ul style="list-style-type: none"> Look at and analyze Heap dumps taken within the JVM. Pinpoint object leaks and who is rooting the object



System Monitoring Tools

- “Monitoring” refers to watching system attributes over time
 - Gauging system health, looking for evidence of performance problems before they get serious
- System-level monitoring data on IBM i is provided by **Collection Services**
 - Designed to be very low overhead, suitable for constant use even in production environments
 - Collection intervals and categories can be customized

Collection Services Data



- Disks
- Network/Communications
- Domino
- HTTP Server
- Jobs and Threads
- Wait States
- LPAR data
- Storage Pools
- CPU Usage
- User-defined data
- Lots more (around 50 database files)

Tool: Performance Tools Reports

Type of tool	Text reports, post-processed monitoring
How to get it	Part of the Performance Tools licensed program (PT1)
Complexity	Simple/Moderate
Overhead	Minimal
What to use it for	Create text reports of the data provided by Collection Services. Eight types of reports are supported, with several subsections available for each report type.
Key things to look for	<ul style="list-style-type: none"> • General overview of performance • The variety of metrics can point you at areas you might not have considered • Per-interval data shows changes over time
Where to learn more	IBM i Information Center http://publib.boulder.ibm.com/infocenter/iseries/v7r1m0/topic/rbam6/PT1.htm http://publib.boulder.ibm.com/infocenter/iseries/v7r1m0/topic/rzahx/rzahxreportperftools.htm



Performance Tools Reports

```

Print Performance Report - Sample data

Library . . . . . QMPGDATA

Type option, press Enter.
1=System report  2=Component
5=Resource report

Select Time Intervals
Library . . . . . : QMPGDATA  Performance data . . . . . : Q058000002

Type options, press Enter.
1=Select

Option  Member      Text

Job      CPU   /Hour  Jobs Per  Total  Synchronous  Asynchronous
Type     Util  Rate   Interval I/O    DBR   DBW   NDBR   NDBW   DBR   DBW   NDBR   NDBW
-----
PassThru .0    0      0         .0    .0    .0    .0    .0    .0    .0    .0    .0
Batch    .0    0      2         28.7  .0    .0    .0    .0    .0    28.5 .0    .0
-----
System Report
Storage Pool Utilization
Trade Performance
2/27/06 21:15:22
Page 0005

Member . . . . : Q058000002 Model/Serial . . : 570/10-50CAB Main storage . . : 31.0 GB Started . . . . : 02/27/06 00:00:02
Library . . . : QMPGDATA System name . . . : YL1567 Version/Release : 5/ 4.0 Stopped . . . . : 02/27/06 21:15:00
Partition ID : 001 Feature Code . . : 7747-8338 Int Threshold . : 100.00 %
Virtual Processors: 2 Processor Units : 2.0

----- Avg Per Second ----- Avg Per Minute -----
Pool Expert Size Act CPU Number Average DB Non-DB Act- Wait- Act-
ID Cache (MB) Lvl Util Tns Response Fault Pages Fault Pages Wait Inel Inel
-----
01 0 2,892 0 1.9 0 .00 .0 .0 .0 .0 32 0 0
02 0 28,710 395 67.6 0 .00 .0 .1 1.0 51,242 0 0
Total 31,602 69.5 0 .0 .1 .1 1.0 51,274 0 0
Average .00
    
```

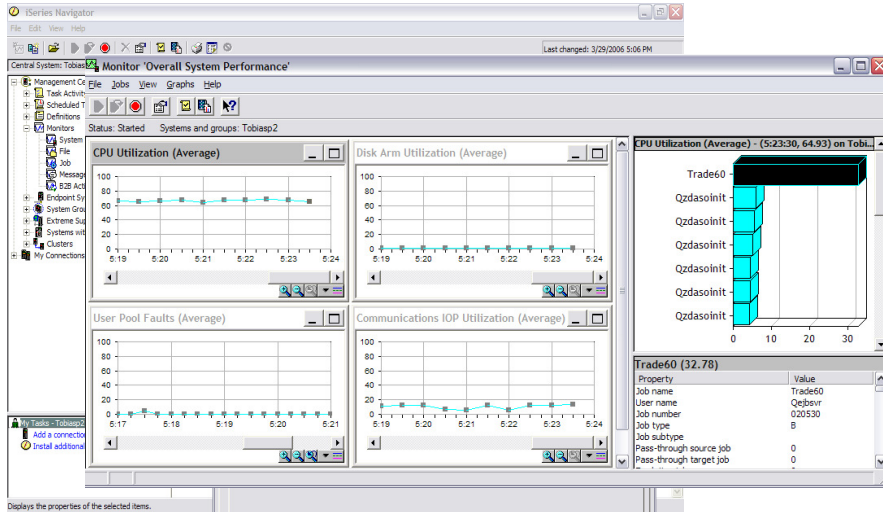


Tool: IBM i Navigator System Monitor

Type of tool	Real-time graphical monitoring
How to get it	Part of IBM i Navigator
Complexity	Simple
Overhead	Minimal
What to use it for	Viewing basic system performance metrics (like CPU, disk, and network utilization) in real-time. Includes support for alerts when user-specified thresholds are reached.
Key things to look for	<ul style="list-style-type: none"> • Changes in performance metrics over time • Correlations between various metrics
Where to learn more	IBM i Information Center



IBM i Navigator System Monitor



Tool: SQL Performance Monitor

Type of tool	GUI-based reports
How to get it	Part of IBM i Navigator
Complexity	Moderate
Overhead	Moderate
What to use it for	Identifying expensive SQL queries and what is causing them to take a long time to execute. STRDBMON/ENDDDBMON and custom queries is another way to collect this information.
Key things to look for	<ul style="list-style-type: none"> • Queries with long execution times • Advised indexes • Full opens
Where to learn more	IBM i Information Center



System Monitoring Tools (recap)

Tool	Cost	Complexity	What it is used for
Collection Services	Free		
Performance Tools Report	5722PT1	Moderate	<ul style="list-style-type: none"> • Create text reports from data from Collection Services • A general overview of the health of your system • Variety of metrics can point you at areas you may not have considered • Per-Interval data shows the peaks and valleys over time
IBM i Navigator	Free		
SQL Performance Monitor	Free	Moderate	<ul style="list-style-type: none"> • Identify expensive SQL queries and what is taking them a long time to execute. • Pay attention to queries doing full opens and advised indexes. • Using Visual explain can break down a query to specific subtasks.
Management Central	Free	Simple	<ul style="list-style-type: none"> • View basic system performance metrics (CPU, disk, network utilization, and paging rates) in real-time • Includes support for alerts when user-specified thresholds are reached.

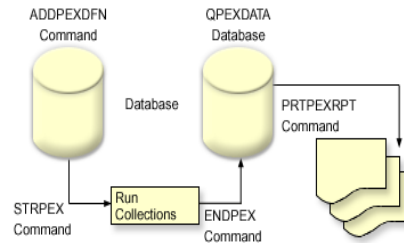


In-depth Analysis

- Some performance problems can be easily identified and fixed
- Other issues require more in-depth analysis to find the exact problem
- These tools are generally more complex than the previously discussed tools, and often have more performance overhead

Performance Explorer (PEX)

- Collects detailed performance data for various components of the system
- Basic collection types:
 - Profile
 - Statistics
 - Trace
- Data is stored in up to 52 database files for analysis by various tools
- Can range from small to very large amounts of data
- Analysis ranges from moderate to very complex



<http://publib.boulder.ibm.com/infocenter/iseres/v7r1m0/topic/rzahx/rzahxpexparent.htm>

PEX Trace Events (partial list)

Entry/Exit (Classic Only)	Java Events (Classic Only)	Heap Events	Other Event Categories
*MIENTRY/*MIEXIT	*OBJCRT	*SYSHEAP	SAR Events
*MISTR/*MIEND	*LCKSTR/*UNLCK	*RESHEAP	Disk Events
*JVAENTRY/*JVAEXIT	*THDCRT/*THDDL	*LCLHEAP	Page Fault Events
*PRCENTRY/*PRCEXIT	*CLSLOAD	*USRHEAP	Storage Events
*DBSVRREQ	*THDNFY	*ACTGRPHEAP	Task Switch Events
	*THDNFYALL	*HDLHEAP	Resource Affinity
	*THDWAIT		
	*GBGCOLSWEEP		
	*JVAEXCP		



Tool: PRTPEXRPT

Full name	Performance explorer reports
Type of tool	Text reports, post-processed PEX data
How to get it	Part of the Performance Tools licensed program (PT1)
Complexity	Moderate
Overhead	Minimal – Significant (depending on type of data)
What to use it for	Most useful for quick analysis of Stats and Profile collections. Other tools more appropriate for Trace collections and more in-depth analysis.
Key things to look for	<ul style="list-style-type: none"> • Depends on collection type • CPU Profiles: “hot” programs, modules, procedures, and statements • Stats: entities with high CPU, IO, etc
Where to learn more	IBM i Information Center



PRTPEXRPT: Job Profile

Print PEX Report (PRTPEXRPT)

Type choices, press Enter.

Member	Library	Type	Profile	Description	Task	Histogram	Hit Cnt	Hit %	Cum %	Start Addr	Map Flag	Stmt Nbr	Name
	Library . . .	OPEXDATA											
	Member . . .	TRADETPROF											
	Description :	Trade Tprof											
							2738	2.7	2.7	FFFFFFFF005C00	++	000C00	LLGLUE/_llglue
							1270	1.2	3.9	FFFFFFFFE02590	++	000E30	JVACBJLK/javalockmonitorenterweak
							1132	1.1	5.0	EFC76490E2440B04	==	0	JITC/com-ibm-ejs-container-EJ
													SContainer-postInvoke(Lcom-ibm-ejs-conta
													iner-EJSWrapperBase;ILcom-ibm-ejs-conta
													ner-EJSDeployedSupport;V
							1098	1.1	6.1	FFFFFFFFE5000000	++	000000	CFXLMB/cfxlmb
							966	0.9	7.1	21B7D11634001580	==	000001	QTNCRDAR
							869	0.9	7.9	FFFFFFFFE0FD354	++	000004	JAVADEEP/NewArrayInternal__13JavaNewObje
													ctFP9JavaClassIQ2_13JavaNewObject11Calle
													rsNode
							815	0.8	8.7	EFC76490E243AAA0	==	0	JITC/com-ibm-ejs-container-EJ
													SContainer-preInvokeActivate(Lcom-ibm-ej
													s-container-EJSWrapperBase;ILcom-ibm-ejs
													-container-EJSDeployedSupport;Lcom-ibm-e
													js-conta
							753	0.7	9.4	8000000000184B10	++	0009D0	HVProcess/HVProcessorCache
							659	0.6	10.1	FFFFFFFFE0974BC	++	000004	CFMIR/#cfmir
							648	0.6	10.7	EFC76490E20A9394	==	0	JITC/com-ibm-nio-cs-DirectEnc
													oder-encodeArrayLoop(Ljava-nio-CharBuffe
													r;Ljava-nio-ByteBuffer;Ljava-nio-charse
													t-CoderResult;
							640	0.6	11.4	FFFFFFFFE096840	++	000010	CFOCHKR/#cfochkr
							638	0.6	12.0	FFFFFFFFE001B70	++	000410	JVACBJLK/javaunlockmonitorexitweak
							631	0.6	12.6	FFFFFFFFE04C378	++	000000	CFSCV0A/syscall_A_portal
							631	0.6	13.2	FFFFFFFFE04C698	++	000000	CFSCV06/syscall_6_portal



Tool: PTDV

Full name	Performance Trace Data Visualizer for System i
Type of tool	Graphical, interactive analysis of PEX data
How to get it	Free download from IBM alphaWorks
Complexity	Moderate to Complex
Overhead	Minimal – Significant (depending on type of data)
What to use it for	<p>Analysis of PEX Trace and Job Profile collections.</p> <ul style="list-style-type: none"> • Profile processing includes support for comparing two collections • Supported trace events include entry/exit events, most Java events, and heap events (Classic only)
Key things to look for	Depends on collection type
Where to learn more	http://www.alphaworks.ibm.com/tech/ptdv



PTDV: Job Profile

Name	Occurrences as caller	Percent as caller
JITC/com-ibm-ejs-uti-cache-Cache.find(Ljava-lang-Object)Ljava-lang-Object	89	7.01%
JITC/com-ibm-db2-jdbc-app-DB2ResultSet.getBigDecimal()Ljava-math-BigDeci...	88	6.93%
JITC/com-ibm-db2-jdbc-app-DB2ResultSetMetaData.getScaleInternal()	65	5.12%
JITC/java-lang-String.<init>(Ljava-lang-StringBuffer;)V	55	4.33%
JITC/com-ibm-ejs-container-activator-OptEntityActivationStrategy.atPostInvoke(L...	55	4.33%
JITC/com-ibm-ejs-uti-cache-Cache.findAndFault(Ljava-lang-Object)Ljava-lang-O...	54	4.25%
JITC/com-ibm-db2-jdbc-app-DB2ResultSet.getString()Ljava-lang-String;	50	3.94%
JITC/com-ibm-ejs-container-EJSContainer.getCurrentTx(Ljava-lang-Object,Z)Lco...	43	3.39%

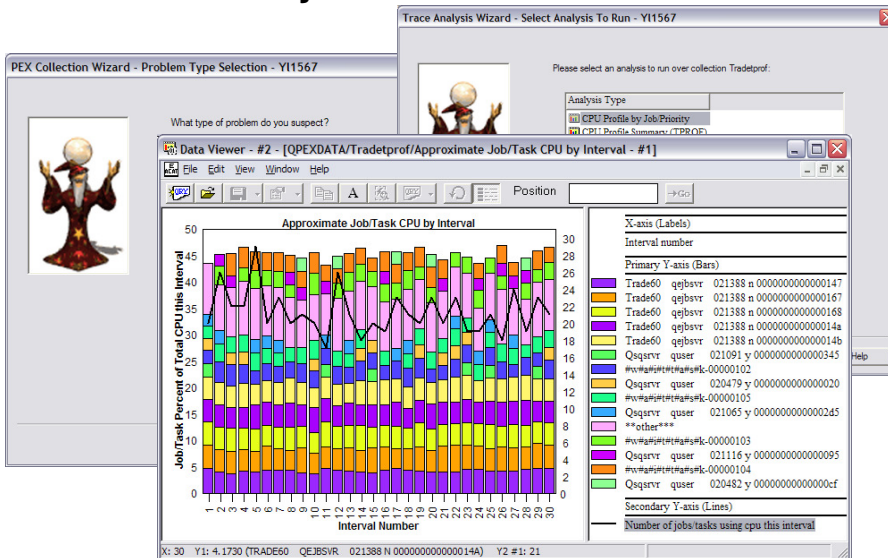


Tool: iDoctor PEX Analyzer

Full name	iDoctor for IBM i, PEX Analyzer
Type of tool	Graphical analysis of PEX data
How to get it	Fee-based offering from iDoctor web page
Complexity	Moderate to Complex
Overhead	Minimal – Significant (depending on type of data)
What to use it for	Simplified collection and analysis of PEX data (including Profile, Stats, and Trace data)
Key things to look for	<ul style="list-style-type: none"> Issues with CPU utilization, DASD operations, file space usage, waits, file opens, etc
Where to learn more	https://www-912.ibm.com/i_dir/idoctor.nsf



iDoctor PEX Analyzer





Tool: iDoctor Job Watcher

Full name	iDoctor for IBM i, Job Watcher
Type of tool	Graphical analysis of wait states
How to get it	Fee-based offering from iDoctor web page
Complexity	Moderate to Complex
Overhead	Minimal
What to use it for	Real-time and post-analyzed views of system activity. Shows both running and waiting threads, including what they are waiting on.
Key things to look for	<ul style="list-style-type: none"> • Finding a non-CPU bottleneck: what are my threads waiting on (disk, journal, Java garbage collection, locks, etc) • Snapshot of stack for each thread on each interval • Some indication of interactions between jobs/threads
Where to learn more	https://www-912.ibm.com/i_dir/idoctor.nsf



iDoctor JobWatcher

The screenshot displays the iDoctor JobWatcher interface. A window titled 'Job Watcher Wizard - Startup Options - Y1156' is open on the left. The main window, 'Data Viewer - #1 - [JOBWATCHER/TRADE/Job signatures ranked by CPU - #1]', shows a bar chart of 'Run/wait time sign' and a detailed view of a job signature. The job information includes: Job information: TRADE60 / QEJSVR / 021388: 0000168; Job subsystem: QWASS; Thread status: CHDW; Job function: COMMIT; Current user profile: QEJSVR; Current state: WAIT; Priority: 26; Pool: 2; Current or last wait: (S1/Mov) Reserved; Wait duration: 1.436 milliseconds; Object waited on: Segment type LIC HEAP (MWS) AREA DATA; Interval duration: 1.030 seconds; Holding job or task: None detected this interval; Interval end: 2006-02-27-23:06:16.895000. The call stack contents table is as follows:

Call level	Program	Module	Offset	Procedure
001			000000DC	qsde_block_trace
002			00000700	longWaitReceive__SqlCounterFR12RaspReceiverPQ0_STDQSEmanEi
003			00000220	waitForObject_13MasoConditionFUUITIRi
004			00000110	mainWaitforhandle
005			00000038	rcdgets
006			0000015C	syscall_6_portal
007	QSQROUTS	QSQRVRC	00005EBC	SQSERVER
008	QSQROUTX	QSQRUTX	00000540	QSQRUTX
009	QSQCCLI	SQLLEX	00007B7C	SQLExecute
010			000001D0	chlsbranch
011			00000048	sisser_procedure_call_portal
012	QVADJBC	QVACLII	000000BC	JDBCExecute
013	CVT32	CVT32	00000211	...



Tool: iDoctor Heap Analysis (Classic only)

Full name	iDoctor for IBM i, Heap Analysis Tools for Java
Type of tool	Graphical tool for analyzing Java heap issues
How to get it	Free offering from iDoctor web page
Complexity	Simple to Moderate
Overhead	Low
What to use it for	Getting a list of objects currently in the heap, finding where objects are being created (sampling), and identifying an object's "roots" (the other objects that reference this object, preventing it from being garbage collected).
Key things to look for	<ul style="list-style-type: none"> • Classes with large numbers of instances or total size • The creating methods for possibly leaking objects • The "root" objects preventing leaking objects from being collected
Where to learn more	https://www-912.ibm.com/i_dir/idoctor.nsf



iDoctor Heap Analysis (Classic Only)

The screenshot displays the iDoctor Heap Analysis software interface. A 'Data Viewer' window is open, showing a table of heap objects. The table has the following columns: Thread's Task Count, Java Thread Name (1st 128 chars), Total Objects, Total Objects Size (bytes), Object Size, Total Objects Heap Size (bytes), Heap Block Size (bytes), and Call Stack. The data is sorted by Thread's Task Count in descending order.

Thread's Task Count	Java Thread Name (1st 128 chars)	Total Objects	Total Objects Size (bytes)	Object Size	Total Objects Heap Size (bytes)	Heap Block Size (bytes)	Call Stack
57015		31333					
85784		31330					
86572		31362					
59109		31334					
114016		31363					
474		31244					
751		31336					
794		31364					
140		31391					
57		31301					
402		31337					
370		31231					



In Depth Analysis (recap)

Tool	Cost	Complexity	What it is used for
Analyze PEX events			
PRTPEXRPT	5722PT1	Depends	<ul style="list-style-type: none"> • Quick analysis of Stats and Profile collections • Easiest setup of three analysis tools, since all that is needed is green screen. • Determining "hot" programs, modules, procedures and statements.
PTDV	Free	Depends	<ul style="list-style-type: none"> • Analysis of PEX Trace and Job Profile collections • Compare two separate Profiling collections • Supports most Java events, heap events, and entry/exit events
iDoctor PEX Analyzer	iDoctor	Depends	<ul style="list-style-type: none"> • Simplified collection and analysis of PEX data (Including Profile, Stats and Trace data)
Tool	Cost	Complexity	What it is used for
iDoctor Job Watcher	iDoctor	Moderate	<ul style="list-style-type: none"> • Both real time and post processing of system activity. Shows not only threads in a running state, but also shows threads in the waiting state • Very useful for finding a non-CPU bottleneck, such as disk, garbage collector, journal, etc.



WebSphere Monitoring Tools

- System-level IBM i tools know little about WebSphere applications
- WebSphere tools can provide details about how a WebSphere application is running
- In addition to the tools listed here, several third-party tools are also available
 - Most of these will leverage WebSphere's Performance Monitoring Infrastructure (PMI) to collect the low-level details



Tool: Tivoli Performance Viewer

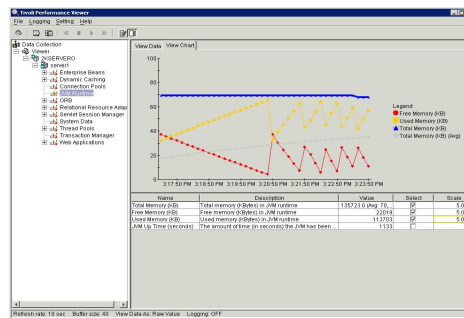
Full name	Tivoli Performance Viewer
Type of tool	Graphical real-time monitoring of WebSphere App Server
How to get it	Part of the WAS 6.0 and 6.1 Admin Console Part of the workstation tools for WAS 5.x
Complexity	Moderate
Overhead	Low (< 5%)
What to use it for	Monitor WebSphere performance metrics, such as number of calls to each servlet, number of transactions, number of prepared statement cache discards, and many more
Key things to look for	<ul style="list-style-type: none"> • Monitor web traffic (throughput, response time for various components) • Resource usage (database connections, statement cache, thread pools, etc)
Where to learn more	WebSphere for IBM i Information Center http://publib.boulder.ibm.com/infocenter/wasinfo/v7r0/index.jsp?topic=/com.ibm.websphere.base.iseries.doc/info/series/ae/prf_tpvmonitor.html



Tivoli Performance Viewer

Available Metric Categories		
Enterprise Beans	JDBC Connection Pools	J2C Connection Pools
JVM	Servlet Sessions	Thread Pools
Transaction Manager	Servlets	ORB
Web Services Gateway	System Data	Workload Management
Dynamic Cache	Web Services	Alarm Manager
Object Pool	Scheduler	JVMPI*

TPV for WAS 5.x:



*Tivoli Performance Viewer can leverage the JVM Profiler Interface (JVMPi). However, JVMPi has a high level of overhead, and should not be used in production environments.



Tool: OS/400 Heap Monitor (Classic Only)

Full name	OS/400 Heap Monitor
Type of tool	Sends messages to QSYSOPR when thresholds reached
How to get it	Included in WAS 6.0.2
Complexity	Simple
Overhead	Minimal
What to use it for	Monitors the size of the Java heap, reporting when it nears the size of the system storage pool WebSphere is running in, or the max heap size
Key things to look for	<ul style="list-style-type: none"> • Messages indicating that the heap is approaching the size of the memory pool • Messages indicating that the heap is approaching the max heap size • On by default for profiles created after WAS 6.0.2 installed
Where to learn more	WebSphere for IBM i Information Center

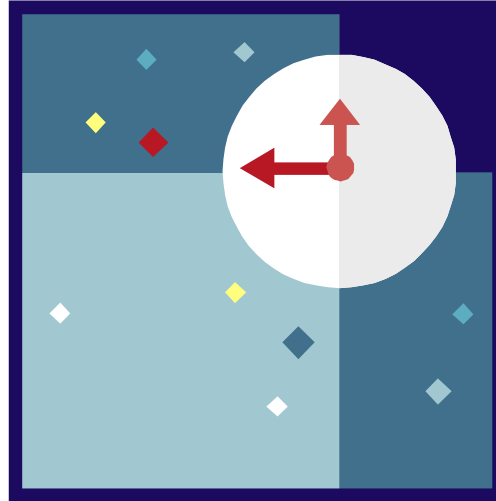


OS/400 Heap Monitor (Classic Only)

```

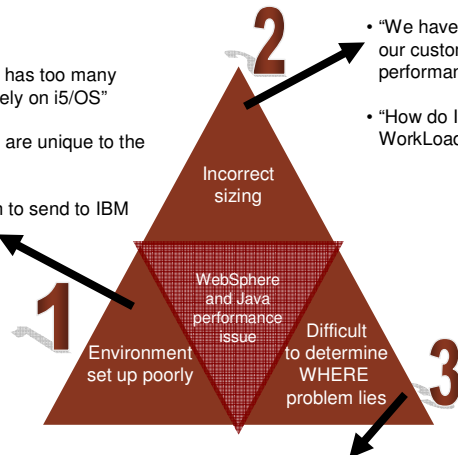
Display Messages
System: YL1567
Queue . . . . . : QSYSOPR          Program . . . . . : *DSPMSG
Library . . . . : QSYS             Library . . . . . :
Severity . . . . : 99              Delivery . . . . . : *HOLD

Type reply (if required), press Enter.
OS400.GC.HEAP.SIZE.MAX(KB) =240000000
Subsystem QCTL varied off work station DSP01.
Subsystem QCTL failed to vary off device DSP01.
Device DSP01 no longer communicating.
HEAP MONITOR STARTED FOR 022052/QEJBSVR/TRADE60 IN SUBSYSTEM QWAS6 IN POOL
*BASE POOL ID=2 POOL.SIZE(B)=30104543232 RESERVED(B)=3076096 HEAP
TOTAL(B)=286105600 FREE(B)=33465138 USEDHEAP=252640462
OS400.GC.HEAP.SIZE.MAX(KB) =240000000
HEAP MONITOR ENDED FOR 022052/QEJBSVR/TRADE60 IN SUBSYSTEM QWAS6 IN POOL
*BASE POOL ID=2 POOL.SIZE(B)=30104543232 RESERVED(B)=3076096 HEAP
TOTAL(B)=286900224 FREE(B)=33573722 USEDHEAP=253326502
OS400.GC.HEAP.SIZE.MAX(KB) =240000000
HEAP MONITOR STARTED FOR 022143/QEJBSVR/TRADE60 IN SUBSYSTEM QWAS6 IN POOL
More...
F3=Exit          F11=Remove a message      F12=Cancel
F13=Remove all   F16=Remove all except unanswered  F24=More keys
    
```

Most Common Java Performance Problem Descriptions

- "Tuning Java on IBM i has too many settings to run effectively on i5/OS"
- "The settings for IBM i are unique to the industry."
- "Gathering information to send to IBM takes a long time"



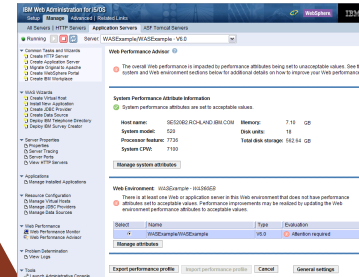
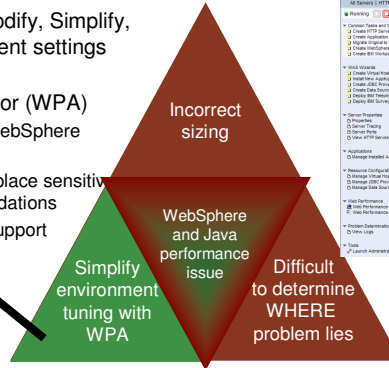
- "We have sized a system too small for our customer, and we now have a performance issue"
- "How do I answer the questions to WorkLoad Estimator correctly?"

- "I have a performance issue, but where do I start?"
- "How do I know if the problem resides on the Network or on the IBM i?"



Simplify Environment Tuning with Web Performance Advisor (WPA)

- Check, Recommend, Modify, Simplify, and/or export > 40 different settings using:
- Web Performance Advisor (WPA)
 - System, Apache, and WebSphere Settings
 - Portal Server and Workplace sensitive performance recommendations
 - Export system data to support



What is Web Performance Advisor

Web Performance Advisor is a comprehensive set of wizards and attribute management tools used to evaluate and improve the performance of a Web environment.

- Advisor wizard – Evaluates the values of many i5/OS system and WebSphere Application Server attributes. Based on the evaluation, it sets these attributes to values that have been recommended by the IBM System i performance experts.
- Manage attributes – Allows the user to view and modify all the attributes that can have a significant impact on the performance of a Web environment.
 - View and modify the value
 - View the current value's rating (is this value acceptable?)
 - View and set the 'recommended' value
- Import/Export - Save the performance attributes to an xml file that can be sent to IBM or an ISV for additional performance analysis. IBM or the ISV can update the XML file and return it to the customer. These updates can then be imported into the customer's Web environment.



Launch Web Performance Advisor



Joe User calls, Web Server is terribly slow! Fix now!



Joe Administrator uses Web Admin GUI to review and fix the problem.

From IBM Web Administration, select a server



Under the 'Web Performance' heading in the left navigation area, click on the

Web Performance Advisor



The screenshot shows the 'IBM Web Administration for i5/OS' interface. The left navigation pane is expanded to 'Web Performance', where 'Web Performance Advisor' is selected. The main content area displays the 'Manage WebSphere Application Server - V6.0.2.7' page for the 'WAS60PAW/WAS60PAW' server. It includes sections for 'Common Tasks and Wizards', 'Server Properties', 'Applications', 'Resource Configuration', 'Web Performance', 'Problem Determination', and 'Tools'. The 'Web Performance' section is highlighted.



Web Performance Advisor – Intro page

View the overall rating.

View system rating.

Manage the individual attributes that affect performance from the system perspective. Things like system values and other system resources.



View Web environment rating.

View all the servers that comprise this Web environment, review their ratings, and select and manage the individual attributes that effect performance for each server.

The screenshot shows the 'Web Performance Advisor' intro page. It features a red warning icon and text: 'The overall Web performance is impacted by performance attributes being set to unacceptable value environment sections below for additional details on Web performance improvements.' Below this is an 'Advisor wizard' button. The 'System Performance Attribute Information' section shows system details: Host name: rchawg3.rchland.ibm.com, Memory: 30.59 GB, Model: 550, Disk units: 8, Processor feature: 7155, Total disk storage: 564.52 GB, CPW: 14000. A 'Manage system attributes' button is present. A blue callout box points to the CPW value with the text 'Look at the CPW for this system!!!'. The 'Web Environment: wpatest3 - WAS51Exp' section shows a red warning icon and text: 'There is at least one Web or application server in this Web environment that does not have performance values. Performance improvements may be realized by updating the Web environment performance'. A table lists servers:

Select	Name	Type	Evaluation
<input checked="" type="radio"/>	wpatest3/wpatest3	V5.1 Express	Attention required
<input type="radio"/>	WPATEST3	Apache-HTTP/Apache/2.0.52	Improvements possible

Buttons for 'Manage attributes', 'Export performance profile', 'Import performance profile', and 'Cancel' are also visible.



Web Performance Advisor – Manage system attributes

Manage the System Performance Settings.

- *Hover text* provides additional rating severity
- *Icon* gives an easy to see indication of attribute rating
- Click on the 'Advise' link to learn more!

Web Performance Advisor
Host name: rchaswg3.rchland.ibm.com

Manage System Performance Attributes

System Resources Performance Settings PTF Groups Web PTFs

System performance settings

- Processor multitasking: Enabled [Advise](#)
- Parallel processing degree: None [Advise](#)
- Thread resources adjustment: Enabled [Advise](#)
- Performance adjustment: No adjustment [Advise](#)

Thread resources affinity

- Group: No group [Advise](#)
- Level: Best available resource [Advise](#)

Maximum activity level of system

- Number of threads: 5 [Advise](#)

5 - Immediate attention is required; attribute is not set to an acceptable value.

TCP/IP

- Send: 64.0 KB [Advise](#)
- Receive: 64.0 KB [Advise](#)

OK Apply Cancel



Web Performance Advisor – Manage system attributes

Advise – the advise window provides information about the attribute; and gives the 'what is it' and 'how is it used'. The attempt is to describe this in English, not 'techie mumbo jumbo'.

The other important feature is the 'Recommended value'. The best value for this attribute is presented to the user. Clicking on the 'Set value' link will automatically set that recommended value for that attribute!

Web Performance Advisor
Host name: rchaswg3.rchland.ibm.com

Manage System Performance Attributes

System Resources Performance Settings PTF Groups Web PTFs

System performance settings

- Processor multitasking: Enabled [Advise](#)
- Parallel processing degree: None [Advise](#)
- Thread resources adjustment: Enabled [Advise](#)
- Performance adjustment: No adjustment [Advise](#)

Thread resources affinity

- Group: No group [Advise](#)
- Level: Best available resource [Advise](#)

Maximum activity level of system

- Number of threads: 5 [Advise](#)

Advise

Maximum activity level of system - QMAXACTLVL Maximum activity level of the system represents the total number of threads across all subsystems on this system that can be actively competing for resources. If this value is set too small, threads queue up for the opportunity to compete for system resources. This means the thread is not running but waiting for the opportunity to be considered to be run. Maximum activity level should be set to a very high number to give all threads the best chance to run.

Recommended value: No maximum [Set value](#)

TCP/IP buffer size

- Send: 64.0 KB [Advise](#)
- Receive: 64.0 KB [Advise](#)

OK Apply Cancel



Web Performance Advisor – Manage Web Attributes

Click on the 'Manage attributes' button for the specified server.

Manage all the WebSphere Application Server attributes that have an affect on performance

- JVM attributes
- Web container settings
- Session Management
- Trace settings
- Plus many more



Web Performance Advisor

The overall Web performance is impacted by performance attributes being set to unacceptable value environment sections below for additional details on Web performance improvements.

Advisor wizard

System Performance Attribute Information

System performance attributes are set to acceptable recommended values.

Host name: rchaswg3.rchland.ibm.com Memory: 30.59 GB
 Model: 550 Disk units: 8
 Processor feature: 7155 Total disk storage: 564.52 GB
 CPW: 14000

Manage system attributes

Web Environment: wpatest3 - WAS51Exp

There is at least one Web or application server in this Web environment that does not have perform values. Performance improvements may be realized by updating the Web environment performance

Select	Name	Type	Evaluation
<input checked="" type="radio"/>	wpatest3/wpatest3	V5.1 Express	Attention required
<input type="radio"/>	WPATEST3	Apache-HTTP/Apache/2.0.52	Improvements possible

Manage attributes

Export performance profile Import performance profile Cancel



Web Performance Advisor – Manage Web Attributes

Manage only the attributes that affect performance!

Click on 'Advise' to learn more.

Web Performance Advisor

Web environment: wpatest3/wpatest3 - V5.1 Express

Manage Web Environment Performance Attributes

JVM Settings Resources JDBC Resources Additional Settings

Java comp...
 Memory p...
 JVM initial...
 JVM maxin...
 Debug mode: Enabled **Advise**
 Class garbage collection: Enabled **Advise**
 Verbose garbage collection: Enabled **Advise**
 Verbose class loading: Disabled **Advise**

OK Apply Cancel

Advise

Debug mode The debug mode attribute determines if the application server should be running in debug mode. This is a useful feature when developing an application to help determine problems and ensure an application is working correctly. This development feature is useful but is very processor intensive due to additional logging. A production application should not be running with debug mode enabled.

Recommended value: Disabled Set value

Web Performance Advisor – Export Performance Profile

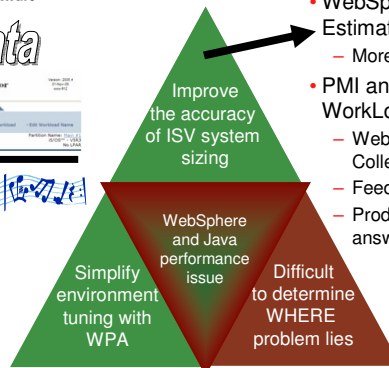
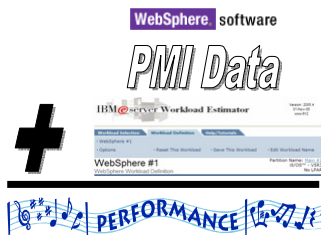
A performance profile is a complete snap shot of the values for all the attributes supported by Web Performance Advisor. A profile is created anytime a 'save' is done against an attribute or when the 'Export performance profile' button is selected from the Intro page. The profile is saved to an xml file that can be sent to IBM or an ISV for additional review. The profile can be modified, saved, and returned to the user. Using the 'Import performance profile' feature, that changed profile can be loaded and applied to this Web Environment.

Web Performance Advisor
Export Performance Profile

Export the performance profile for this Web environment. This profile can be used for backing up the current performance settings or sent to a performance professional for additional review.

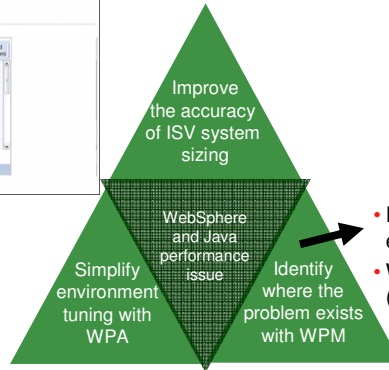
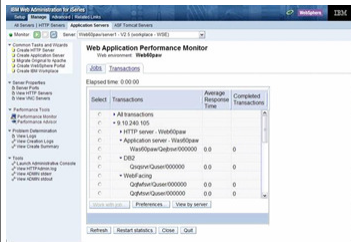
Specify location and name for the exported profile:

Improve the Accuracy of ISV System Sizing with WorkLoad Estimator and Collection Services Updates



- WebSphere Workload in WorkLoad Estimator Improvements
 - More tuning knobs asked for by our ISVs
- PMI and Collection Services input to WorkLoad Estimator
 - WebSphere will store some PMI data as Collection Services data
 - Feed this data into WLE
 - Produce automatic and more accurate answers to WLE questions

Identify where the problem exists with Web Performance Monitor (WPM)



- Find out WHERE problem exists using:
- Web Performance Monitor (WPM)
 - Simplify Problem detection on where problem is located
 - New interface to dissect a WebSphere transaction (from Apache to Database)
 - Look at Web Environment, not jobs

Web Performance Monitor - Overview

- Distributed Web applications are more difficult to manage because they consist of many different jobs on the system (HTTP, WAS, WebFacing server, RPG programs, DB2).
- Need a tool to:
 - Easily view all jobs associated with a Web application
 - Provide WRKACTJOB-like features
 - Link directly to WebNav WRKJOB
 - Monitor *end-to-end performance* making use of Application Response Measurement (ARM) instrumentation in middleware running on i5/OS
- Must be *integrated* with existing Web server administration and management tools.

Web Performance Monitor - Enable

Web Performance Monitor

Web Performance Monitor will help you analyze the performance of your Web applications. [?](#)

Before you can monitor the performance of your application, the performance monitoring environment must be enabled. Each of the servers listed below will be configured for performance monitoring, stopped, and restarted. This process may take several minutes to complete. Click Start to begin this process.

Note: Due to the extra system resources required to monitor Web application performance, run it only as long as necessary.

- Start ARM data collection
- Update HTTP server WEB60PAW configuration
- Update application server WAS60PAW/WAS60PAW configuration
- Restart HTTP server WEB60PAW
- Restart application server WAS60PAW/WAS60PAW

Start **Close**

Web Performance Monitor Statistics - Jobs

Web Performance Monitor

Elapsed time: 0:01:29 [?](#)

Jobs **Transactions**

Select	Servers and jobs	Current User	CPU %	Run Priority	Thread Count	Average Response Time	Completed Transactions
<input type="radio"/>	▼ HTTP server - WEB60PAW						
<input type="radio"/>	④ 112206/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
<input type="radio"/>	④ 112207/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
<input type="radio"/>	④ 112208/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
<input type="radio"/>	④ 112209/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	47	0.2	19
<input type="radio"/>	④ 112292/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	3	0.0	0
<input type="radio"/>	▼ Application server - WAS60PAW/WAS60PAW						
<input type="radio"/>	④ 112285/QEJBSVR/WAS60PAW	QEJBSVR	0.0	20	58	0.2	12
<input type="radio"/>	▼ DB2						
<input type="radio"/>	④ 112035/QUSER/QZDASOINIT	PAWOLF	0.0	20	1	0.0	12

Work with job...

Refresh **Restart statistics** **Close** **Quit**



Web Performance Monitor Statistics – Transactions by Server

Web Performance Monitor

Elapsed time: 0:06:04

Jobs Transactions

Select	Transactions	Average Response Time	Completed Transactions
<input type="radio"/>	▼ 112208/QTMHHTTP/WEB60PAW		
<input type="radio"/>	▼ 112209/QTMHHTTP/WEB60PAW		
<input type="radio"/>	🟢 All transactions	0.1	28
<input type="radio"/>	▼ 112292/QTMHHTTP/WEB60PAW		
<input checked="" type="radio"/>	🔗 Application server - WAS60PAW/WAS60PAW		
<input type="radio"/>	▼ 112285/QEJBSVR/WAS60PAW		
<input type="radio"/>	🟢 All transactions	0.3	14
<input type="radio"/>	▼ DB2		
<input type="radio"/>	▼ 112035/QUSER/QZDASOINIT		
<input type="radio"/>	🟢 All transactions	0.0	16

Work with job...

Preferences...

View by user

Refresh

Restart statistics

Close

Quit



Web Performance Monitor Statistics – Transactions by Server

Web Performance Monitor

Elapsed time: 0:01:25

Jobs Transactions

Select	Transactions	Average Response Time	Completed Transactions
<input type="radio"/>	▼ 112285/QEJBSVR/WAS60PAW		
<input type="radio"/>	🟢 All transactions	0.2	16
<input type="radio"/>	🟢 cosmo.rchland.ibm.com	0.2	13
<input type="radio"/>	🟢 pwolf	0.3	3
<input type="radio"/>	🟢 9.10.105.66	0	0
<input type="radio"/>	▼ DB2		
<input checked="" type="radio"/>	▼ 112035/QUSER/QZDASOINIT		
<input type="radio"/>	🟢 All transactions	0.0	16
<input type="radio"/>	🟢 cosmo.rchland.ibm.com	0.0	12
<input type="radio"/>	🟢 pwolf	0.0	4

Work with job...

Preferences...

View by user

Refresh

Restart statistics

Close

Quit

Closing Thoughts

- This has been just an overview of some of the available tools.
 - Many other tools exist.
 - We could spend hours talking about many of these tools.
- Nobody can be an expert on all of these tools.
 - Pick a couple of general tools to start with, learn more as needed.

Thank
You





Resources

Java and WebSphere Performance Information

Performance Management: www.ibm.com/systems/i/advantages/perfmgmt/resource.html

IBM Systems Workload Estimator: www-912.ibm.com/estimator/

Redbooks

www.redbooks.ibm.com/Redbooks.nsf/portals/systemi

SG24-6383: Maximum Performance with WebSphere Application Server V5.1 on iSeries

REDP-4026: IBM eServer iSeries Performance Management Tools

REDP-3646: WebSphere for IBM eServer iSeries Server Buying & Selling Guide

SG24-6474: IBM iDoctor IBM i Job Watcher: Advanced Performance Tool

General WebSphere on IBM i

IBM i Information Center: <http://publib.boulder.ibm.com/eserver/ibmi.html>

WebSphere App Server for OS/400 V6.0 Info Center:
<http://publib.boulder.ibm.com/infocenter/wsdoc400/v6r0/index.jsp>

IBM i Developer Roadmap: www.ibm.com/systems/power/software/i/resources.html

WebSphere Application Server for IBM i: www.ibm.com/systems/i/software/websphere/



Resources (continued)

Training and Education

IBM System i Training:
www-304.ibm.com/jct03001c/services/learning/ites.wss/us/en?pageType=page&c=a0000607

developerWorks: IBM's resource for developers: www.ibm.com/developerworks/

IBM System i Seminar:
www-304.ibm.com/jct03004c/services/weblectures/dlv/Gate.wss?handler=Offering&action=index&customer=ibm&offering=lsow

Services

IBM Global Services – IBM i: www.ibm.com/systems/i/support/rochesterservices/

IBM Systems Lab Services and Training: www.ibm.com/systems/services/labservices/

Please fill in the following information on your evaluation sheet:

Session Title: **What Tools to Use to Improve Java Performance**

Session ID: **520089**

Agenda Key: **26SN**

Speaker: **Jeff Lee**

Please fill in evaluation sheets and place in the bag

What's different in IBM i 7.1

JDKs and JVMs

- The LPP for "IBM Developer Kit for Java" is unchanged: **5761-JV1**
 - Same LPP number as in IBM i 6.1
- "Classic" JDK is not available in IBM i 7.1
 - Replaced by "IBM Technology for Java" (code name: "J9")
 - The no-longer-supported JV1 Options that had "Classic" JVMs:
 - JV1 Options 6, 7 and 10
- New Java Group PTF number for IBM i 7.1
 - **SF99572** (versus SF99562 for IBM i 6.1)

For complete details, refer to the IBM i Information Center

- <http://publib.boulder.ibm.com/infocenter/series/v7r1m0/topic/rzaha/rzahawhatsnew.htm>



What's different in IBM i 7.1 - *continued*

"PASE for i" – Changes for improved security

"IBM Portable Application Solutions Environment for i"

- Provides an AIX-like execution environment on IBM i.
- The "new" IBM i JVMs require a PASE environment.

- PASE now enforces stack execution disable protection.
- Default behavior of PASE programs has changed.
 - Instructions run from memory areas (stack & heap) of a process are blocked.
 - JIT-generated code is created in memory areas.
 - If call `JNI_CreateJavaVM()`: Must mark the program as needing to allow program execution from memory areas.

For complete details, refer to the IBM i Information Center

- <http://publib.boulder.ibm.com/infocenter/series/v7r1m0/topic/rzalf/rzalfwhatsnew.htm>



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