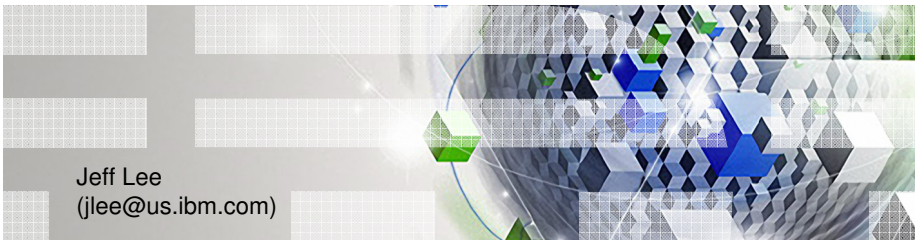
Session Number: 520089

What Tools to Use to Improve Performance of Your Java Applications



Jeff Lee
(jlee@us.ibm.com)

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Acknowledgements

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  - Gottfried Schimunek – IBM Senior IT Architect
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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:

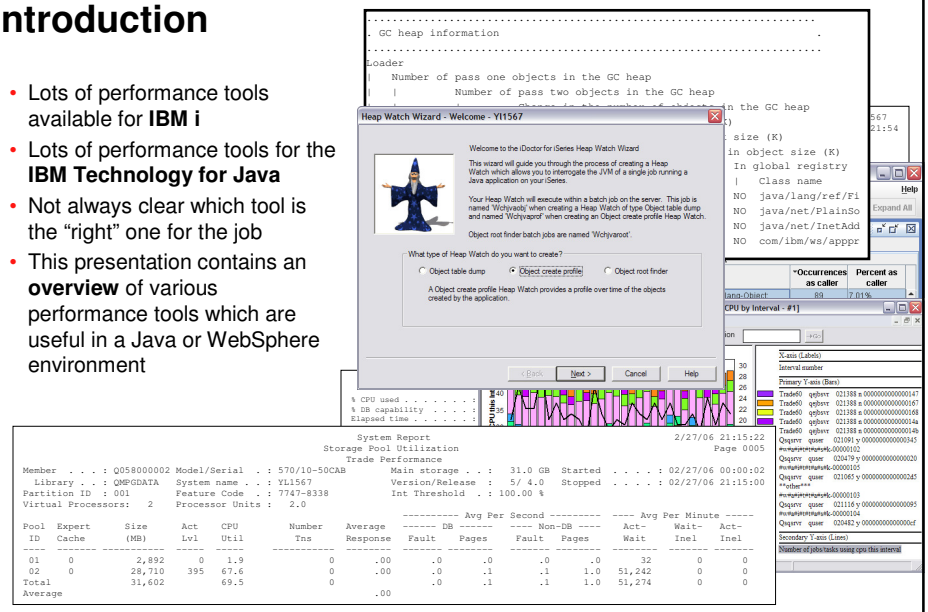
- Pick the right Java performance tool to solve a specific Java performance problem.

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



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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**

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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)

Classic JVM Tools
- ☑ DMPJVM
- ☑ ANZJVM
- ☑ iDoctor Heap Analyzer

IBM Technology for Java VM Tools
- ☑ Thread Analyzer (parse javacore file)
- ☑ PMAT (parse verbose GC data)
- ☑ 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	• 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/iseries/v7r1m0/topic/rzahg/icmain.htm

WRKACTJOB

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

Type options, press Enter.
  2=Change   3=Hold   4=End   5
  8=Work with spooled files   1

Opt  Subsystem/Job  User
```

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

Type options, press Enter
```

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

Type  Program                 Statement        Procedure
      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
                                                                  More...
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	• 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), pres

System    Pool    Reserved    M
 Pool   Size (M)  Size (M)  Act
   1     2892.32    596.36   ++
   2    28709.92      2.33



Command
===>
F3=Exit   F4=Prompt   F5=Refres
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



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

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	• 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

                Size    %     I/O   Request   Read  Write   Read  Write    %
Unit  Type       (M)  Used    Rqs  Size (K)    Rqs   Rqs     (K)   (K)   Busy
   1  4326     35165  22.0     .2       4.0     .0    .2      .0   4.0      0
   2  4326     30769   3.0   775.
   3  4326     26373   3.0    10.
   4  4326     30769   2.8      .
   5  4326     30769   3.0     4.
   6  4326     30769   3.0     4.
   7  4326     30769   3.0     4.
   8  4326     30769   2.8     2.
   9  4326     35165   2.8      .
  10  4326     26373   3.0     4.
  11  4326     30769   2.8     1.
  12  4326     30769   2.8    10.
  13  4326     26373   3.1     4.

Command
===>
F3=Exit    F5=Refresh    F12=Canc
```

```
                          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	• 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 jo

     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--------
     Job or                                         DB      DB    Non-DB  Non-DB
Opt  Task         User        Number  Thread       Read   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	• The current holder of a contentious lock
Where to learn more	IBM i Information Center

WRKOBJLCK

```
                          Work with Object Locks
                                                        System:   YL1567
Object . . . . :   QUOTEEJB             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

                                  Object                        Member  ASP
Opt  Object      Library     Type       Lock     Status  Locks   Device
     ACCOUNTEJB  TRADE51DB   *FILE-PHY  *SHRRD    HELD    YES
                                        *SHRRD    HELD
                                        *SHRRD    HELD
                                        *SHRRD    HELD
     ACCOU00001  TRADE51DB   *FILE-PHY  *SHRRD    HELD    YES
                                        *SHRRD    HELD
                                        *SHRRD    HELD
                                        *SHRRD    HELD
     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	• 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	• 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	• Determine how busy your individual disk arms are. • Determine if you have disk arms which are degraded or failed.
WRKSYSACT	5722PT1	Moderate	• 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	• Determine OS level locks (not Java locks) for a specific object. • Usually performed with database locks

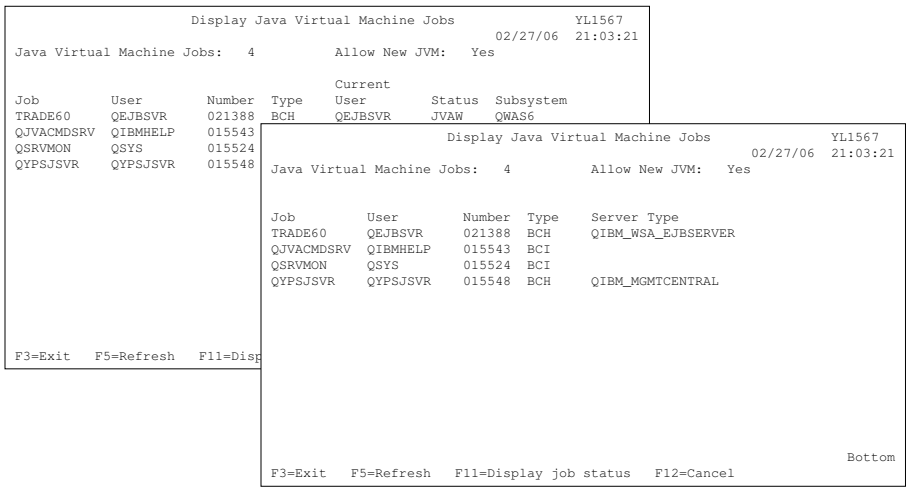
Basic Java Virtual Machine Tools

- 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	• 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



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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	• 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

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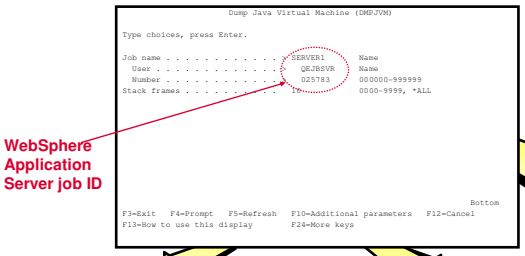
DMPJVM (Classic JVM Only)



WebSphere Application Server job ID

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

. Classpath .

java.version=1.3
/QIBM/ProdData/WebAS5/Base/java/ext/ibmorb.jar:/QIBM/ProdData/WebAS5/Base/java/ext/ibmext.jar:/QIBM/ProdData/OS400/Java400/jdk/lib/jdkptf13.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:/QIBM/ProdData/OS400/Java400/ext/ibmjssl.jar:/QIBM/ProdData/OS400/Java400/:/QIBM/ProdData/Java400/:/QIBM/UserData/WebAS5/Base/default/properties:/QIBM/ProdData/WebAS5/Base/properties:/QIBM/ProdData/WebAS5/Base/lib/bootstrap.jar:/QIBM/ProdData/WebAS5/Base/lib/j2ee.jar:/QIBM/ProdData/WebAS5/Base/lib/Improxy.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

Thread information

Information for 20 thread(s) of 20 thread(s) processed
Thread: 0000000E Thread-0
TDE: B002100009149000
Thread priority: 5
Thread status: Destroy wait
Thread group: main
Runnable: java/lang/Thread
Stack:
None
Locks:
None
Thread: 0000001D Alarm : 0
TDE: B00210000AB83000

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	• 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

ANZJVM Example

```
                    Analyze Java Virtual Machine (ANZJVM)

Type choices, press Enter.

Job name . . . . . . . . . . . . > SERVER1        Name
  User . . . . . . . . . . . . . > QEJBSVR        Name
  Number . . . . . . . . . . . . > 025783         000000-999999
Time interval  . . . . . . . . . > 15             0-3600
Force garbage collection . . . .   *YES           *YES, *NO
Sort by . . . . . . . . . . . .   *NUMOBJCHG      *NUMOBJCHG, *NUMOBJ...




Bottom
 F3=Exit    F4=Prompt    F5=Refresh    F10=Additional parameters    F12=Cancel
 F13=How to use this display          F24=More keys
```

WebSphere Application Server job ID

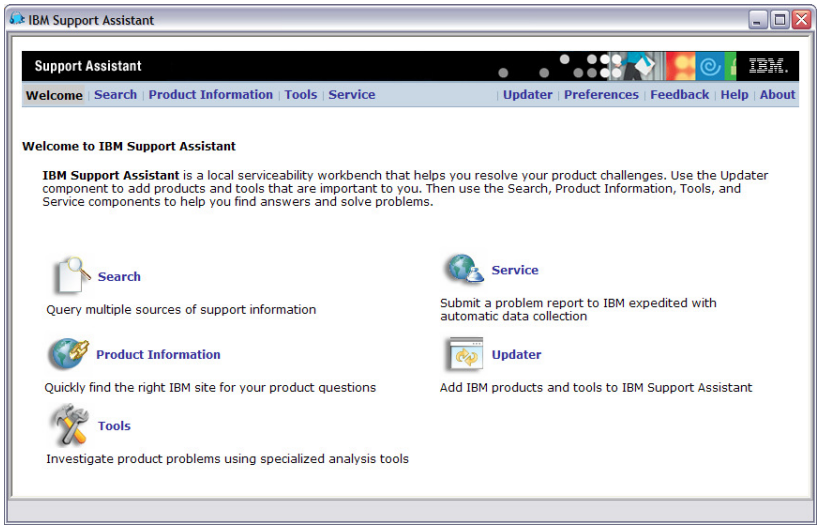
```
.....................................................................
. GC heap information                                               .
.....................................................................
Loader
|   Number of pass one objects in the GC heap
|   |         Number of pass two objects in the GC heap
|   |         |         Change in the number of objects in the GC heap
|   |         |         |         Pass one object size (K)
|   |         |         |         |       Pass two object size (K)
|   |         |         |         |       |       Change in object size (K)
|   |         |         |         |       |       |       In global registry
|   |         |         |         |       |       |       |   Class name
0   534       539       5         41      42      1       NO  java/lang/ref/Fi
0   23        28        5         1       1       0       NO  java/net/PlainSo
0   12        13        1         0       0       0       NO  java/net/InetAdd
2   7         7         0         0       0       0       NO  com/ibm/ws/apppr
```

Output is written to spooled file

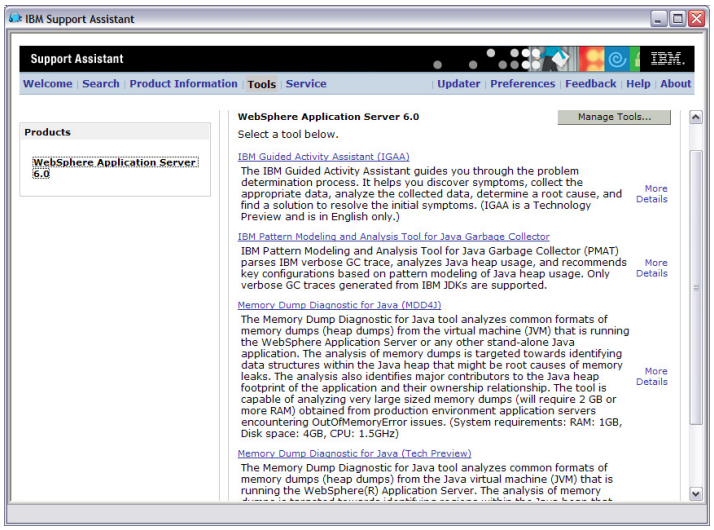
Tool: ISA

Full name	IBM Support Assistant Workbench
Type of tool	The convergence spot for all J9 tools and information from IBM. Based on Eclipse technology and product updater.
How to get it	Download from the web: http://www.ibm.com/software/support/isa/
Complexity	Moderate
Overhead	None to heavy, depending on the activity.
What to use it for	Supposed to be the spot for the latest tools.
Key things to look for	• Support documentation and troubleshooting guides • Limited tooling so far, but will be added on in the future. • Problem submission into IBM
Where to learn more	http://www.ibm.com/software/support/isa/

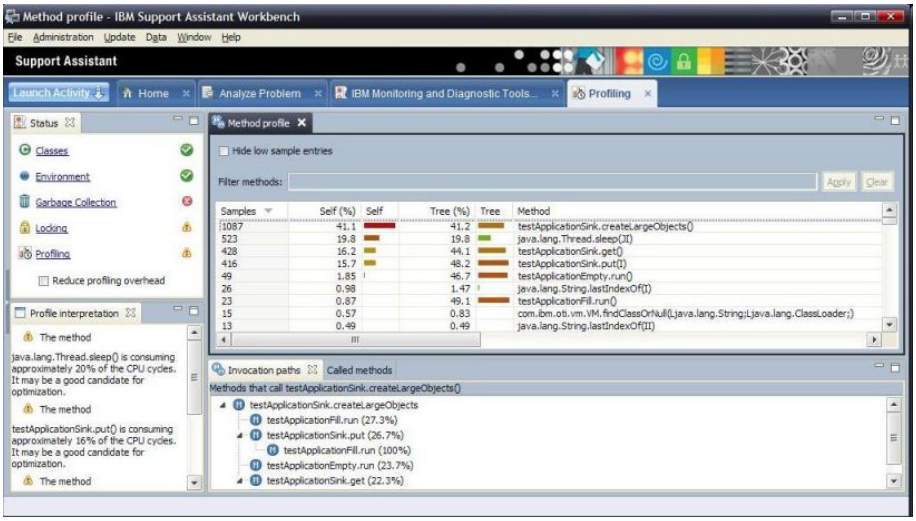
IBM Support Assistant



IBM Support Assistant (Tools View)



"Health Center" Tool



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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/iseries/v7r1m0/topic/rzaha/colpdc.htm
- http://www.ibm.com/developerworks/java/jdk/tools/healthcenter

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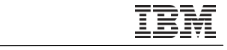
Tool: Verbose GC

Full name	Verbose Garbage Collection
Type of tool	JVM log, mid-level analysis
How to get it	Specify `-verbose:gc` 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	• 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

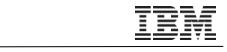
Verbose GC Output

```
<af type="tenured" id="72" timestamp="Sun Jun 04 22:53:26 2006" intervalms="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" intervalms="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

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	• 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

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	• Current heap size • Threads which are “stuck” (stack information)
Where to learn more	J9 Diagnostic Guide

Javacore file

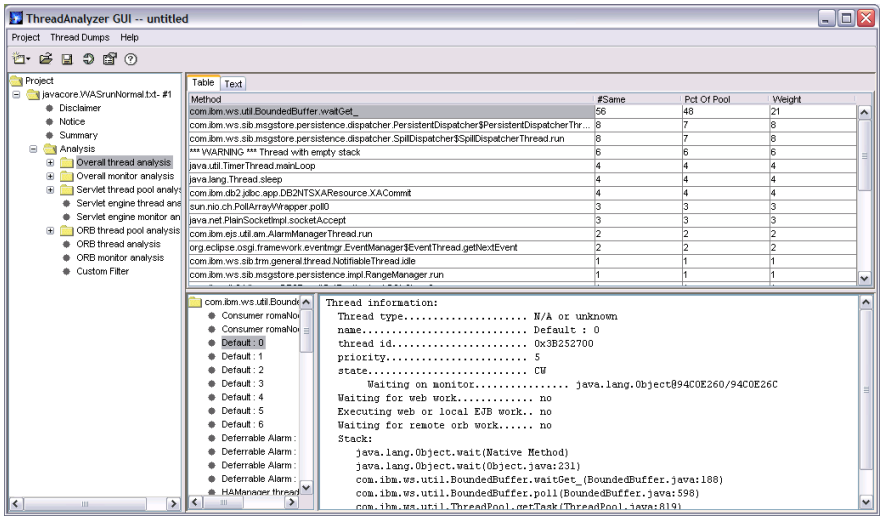
```
NULL            ------------------------------------------------------------------------
0SECTION        TITLE subcomponent dump routine
NULL            ===============================
1TISIGINFO      Dump Event "uncaught" (00008000) Detail "java/lang/OutOfMemoryError" received
1TIDATETIME     Date:                2006/06/04 at 20:13:07
1TIFILENAME     Javacore filename:
  /QIBM/UserData/WebSphere/AppServer/V61/Base/profiles/AVN7/javacore.20060604.200139.6881.txt
NULL            ------------------------------------------------------------------------
0SECTION        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            ------------------------------------------------------------------------
0SECTION        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	• Useful for detecting Java hangs and delays. • You can open multiple javacore files to compare the dumps.
Key things to look for	• 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



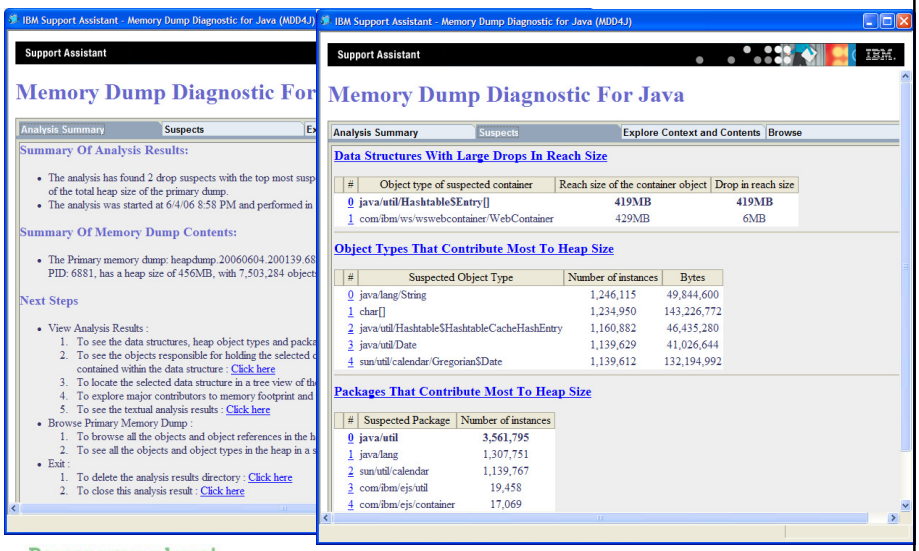
Tool: HeapDump file

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: • OutOfMemoryError occurs in the JVM • User code calls the `com.ibm.jvm.Dump.HeapDump()` method.
Key things to look for	• 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	• 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



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New JVM Performance Commands in 6.1

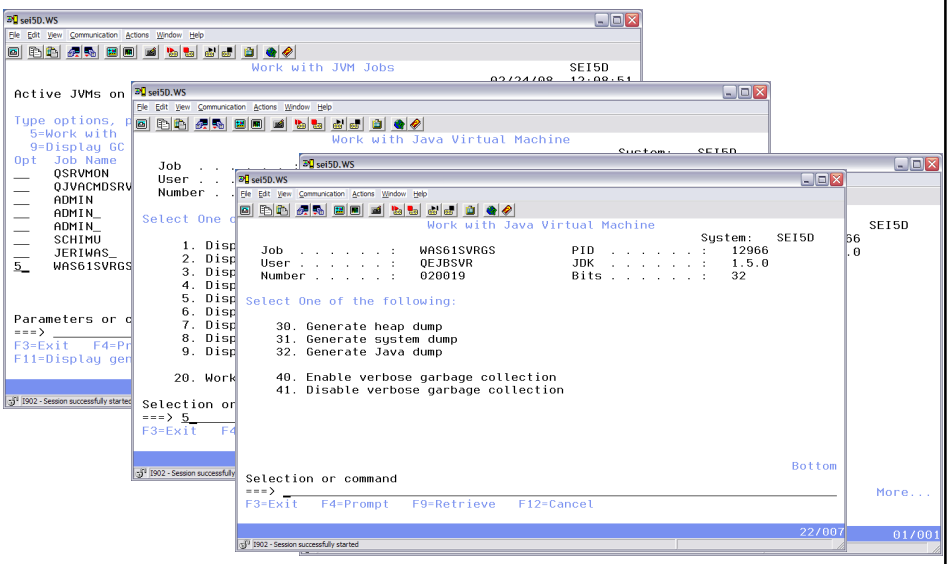
- **WRKJVMJOB** – work with JVM jobs
  - Primary interface into JVM performance analysis
- **PRTJVMJOB** – print JVM jobs
  - Allows to print a history of all garbage collection values and how it grew and changed during an extended period of time
    - Create options, environment variables, java lock 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)

Power your planet.

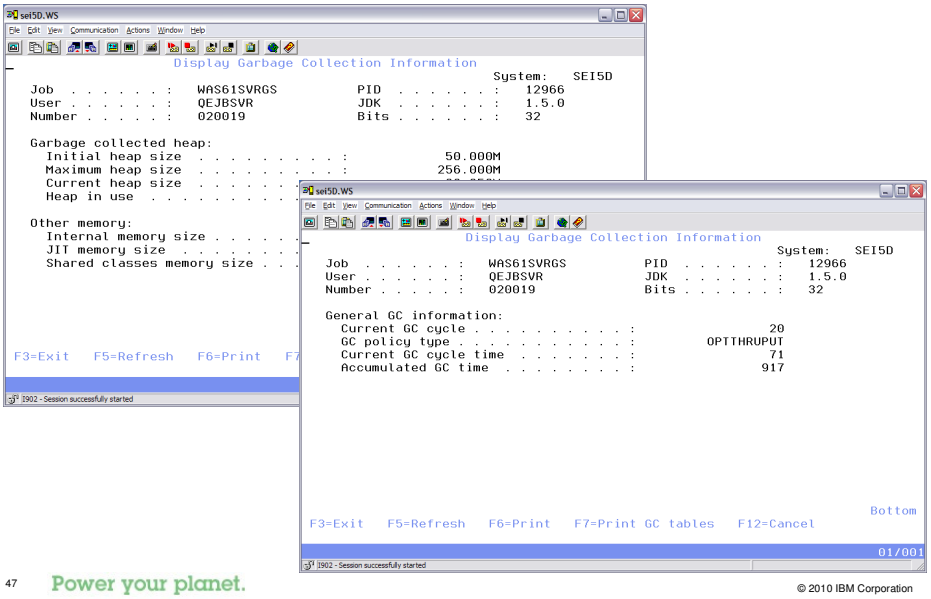
WRKJVMJOB – Work with JVM jobs

- 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 .



New Java Performance Tool in 6.1 – WRKJVMJOB .



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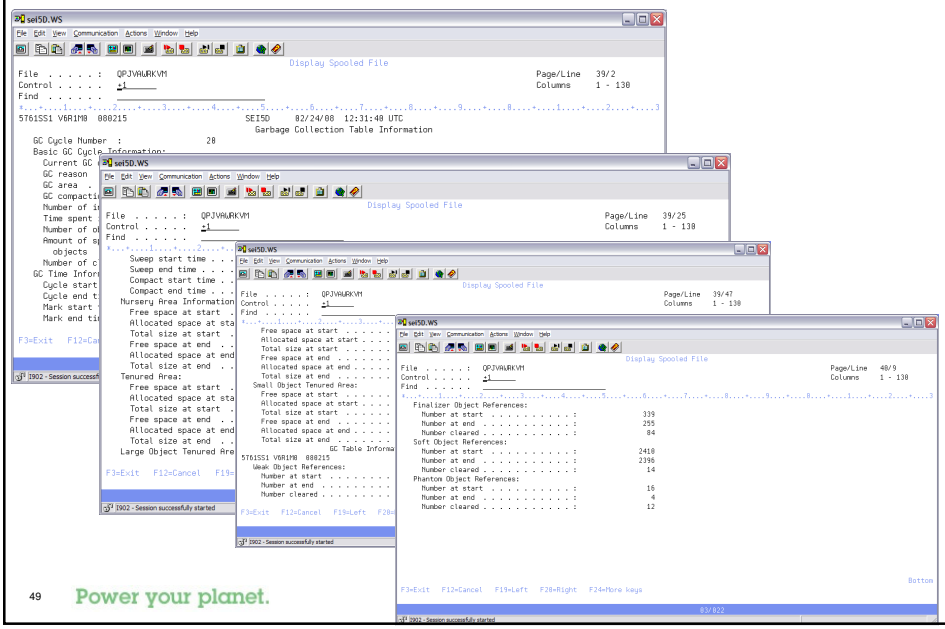
New in 6.1 - PRTJVMJOB

- 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

 Power your planet.

New in 6.1 - PRTJVMJOB



GENJVMDMP – Generating JVM Dump

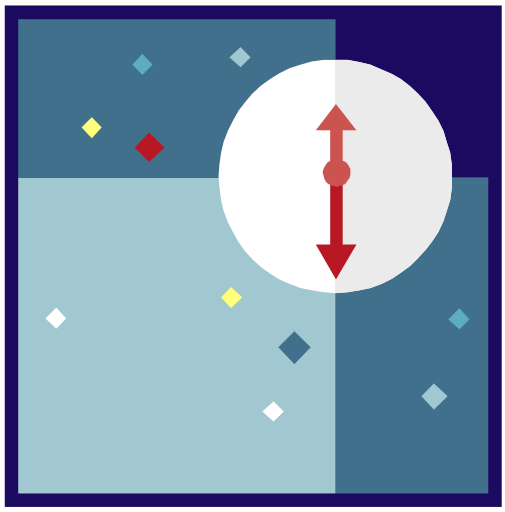
- Java dump (javacore.20080218.232027.24.txt)
  - ***JAVA**
    - Generates multiple files that contain diagnostic information for the JVM and the Java applications running within the JVM
    - The IBM tool - IBM Thread and Monitor Dump Analyzer for Java Technology analyzes javacore and diagnoses monitor 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	• 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	• 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	• 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	• Simple tool to diagnose Java object leaks from verbose GC output. • More detailed information then previous tool for tuning generational gc.

Basic Java Virtual Machine Tools (recap… cont)

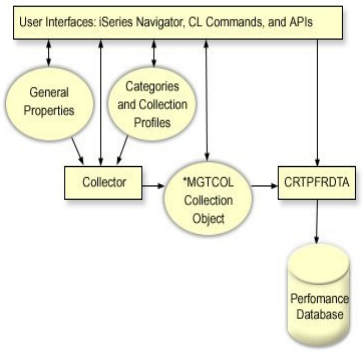
Tool	Cost	Complexity	What it is used for
IBM Support Assistant	Free	Simple	• IBM portal for solving both functional and performance issues. Work in progress as tools are added. • Provides searching, problem reporting, updating tools and managing dumps.
javacore file	Free	Moderate	• Every J9 JVM can produce 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	• 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	• Binary dump file with the contents of the Java heap. • Feed into tools to parse the output.
MDD4J	Free	Complex	• 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

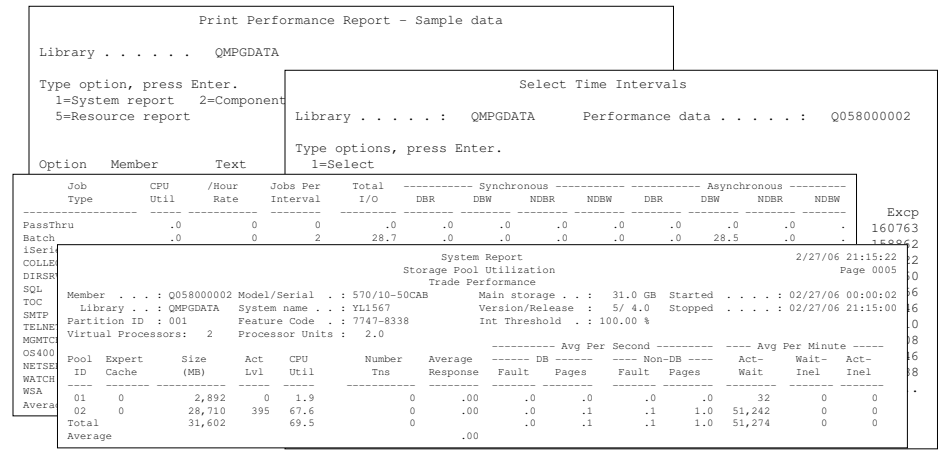


- Disks
- Network/Communications
- Domino
- HTTP Server
- Jobs and Threads
- Wait States
- LPAR data
- Storage Pools
- CPU Usage
- User-defined data
- Lots more (around 50 database files)

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	• 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



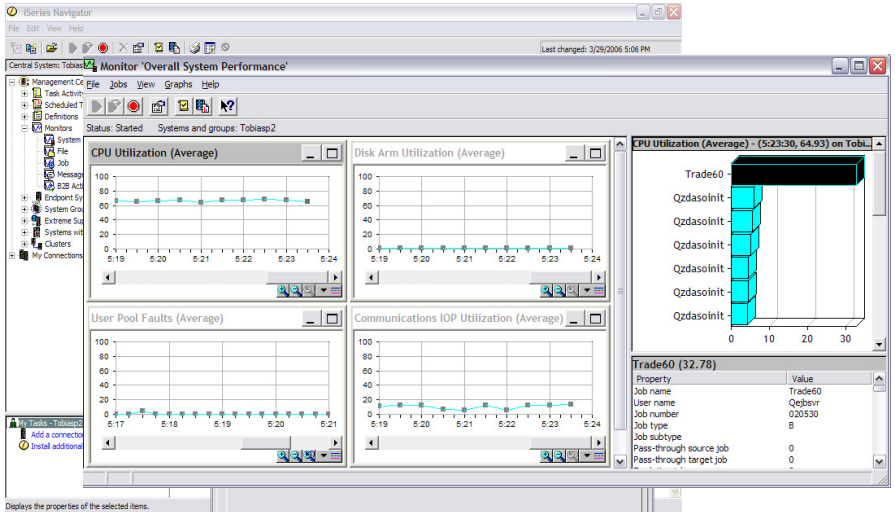
 Power your planet.

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	• Changes in performance metrics over time • Correlations between various metrics
Where to learn more	IBM i Information Center

 Power your planet.

IBM i Navigator System Monitor



Power your planet.

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/ENDDBMON and custom queries is another way to collect this information.
Key things to look for	• Queries with long execution times • Advised indexes • Full opens
Where to learn more	IBM i Information Center

Power your planet.

System Monitoring Tools (recap)

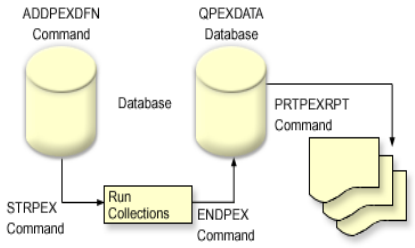
Tool	Cost	Complexity	What it is used for
Collection Services	Free		
Performance Tools Report	5722PT1	Moderate	• Create text reports from data from Collection Services • A general overview of the health of your system • Variety of metrics can point you at areas you may not have considered • Per-Interval data shows the peaks and valleys over time
IBM i Navigator	Free		
SQL Performance Monitor	Free	Moderate	• 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	• 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/iseries/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/*THDDLT	*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	• 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

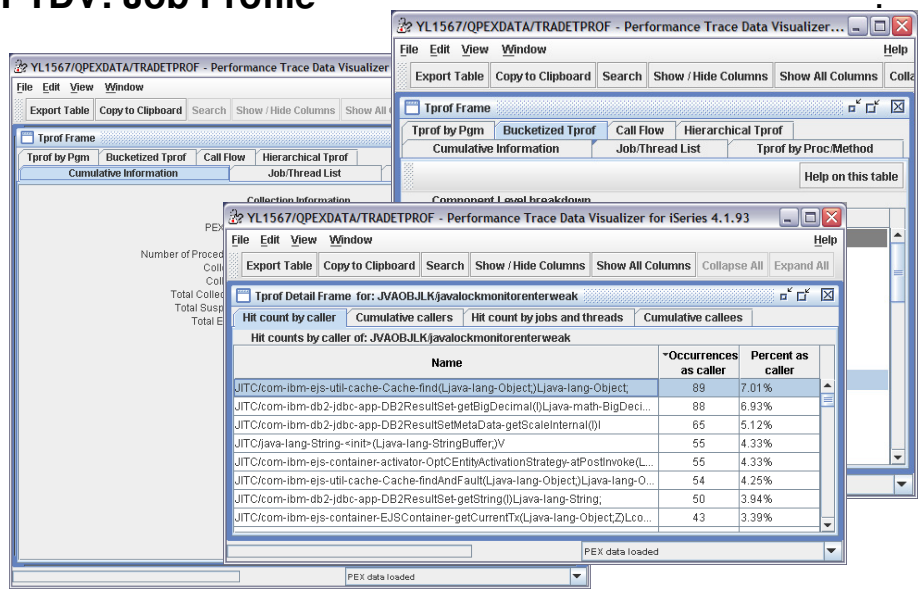
```
                        Print PEX Report (PRTPEXRPT)

Type choices, press Enter.

Member
Librar
Type
Profil
  Sort
  Summ
  Filt
Order
Task i
```

```
                                        Performance Explorer Report                    2/27/06 22:29:58
                                           Profile Information                              Page   35
Library . . : QPEXDATA
Member. . . : TRADETPROF
Description : Trade Tprof
                    Histogram     Hit   Hit   Cum   Start            Map   Stmt   Name
                                  Cnt    %     %    Addr             Flag  Nbr
                                                                                                  -
                                 2738   2.7   2.7 FFFFFFFFFF005C00  ++    000C00  LLGLUE/_1lglue
                                 1270   1.2   3.9 FFFFFFFFFE002590  ++    000E30  JVAOBJLK/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-contai
                                                                                  ner-EJSDeployedSupport;)V
                                 1098   1.1   6.1 FFFFFFFFFE500000  ++    000000  CFXLMB/cfxlmb
                                  966   0.9   7.1 21B7D11634001580  ==    000001  QTNCRDAR
                                  869   0.9   7.9 FFFFFFFFFE0FD354  ++    000004  JAVADEEP/NewArrayInternal__13JavaNewObje
                                                                                  ctFP9JavaClasslQ2_13JavaNewObject11Calle
                                                                                  rsMode
                                  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  HvProces/HvProcessorCache
                                  659   0.6  10.1 FFFFFFFFFE0974BC  ++    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 FFFFFFFFFE096840  ++    000010  CFOCHKR/#cfochkr
                                  638   0.6  12.0 FFFFFFFFFE001B70  ++    000410  JVAOBJLK/javaunlockmonitorexitweak
                                  631   0.6  12.6 FFFFFFFFFF04C378  ++    000000  CFSCV0A/syscall_A_portal
                                  631   0.6  13.2 FFFFFFFFFF04C698  ++    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	Analysis of PEX Trace and Job Profile collections. • 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

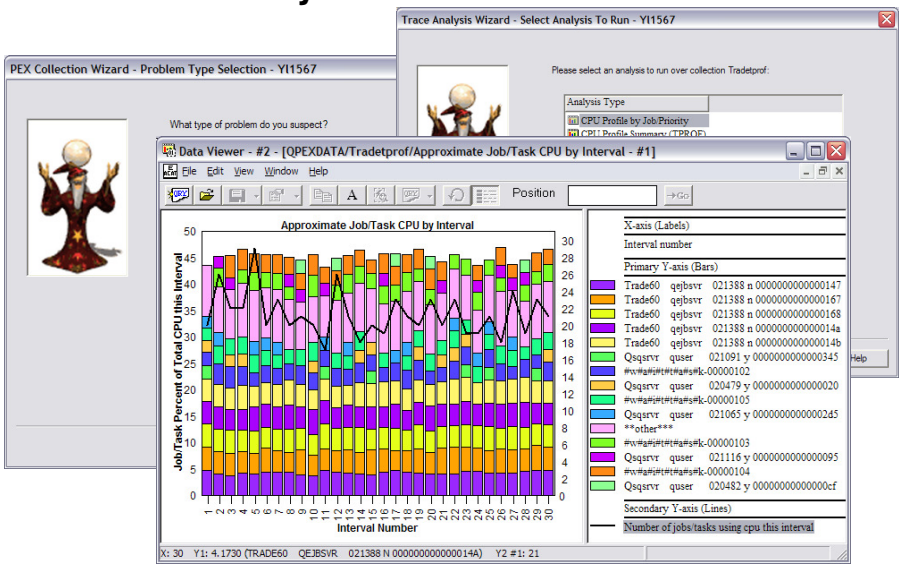
PTDV: Job Profile



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	• 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

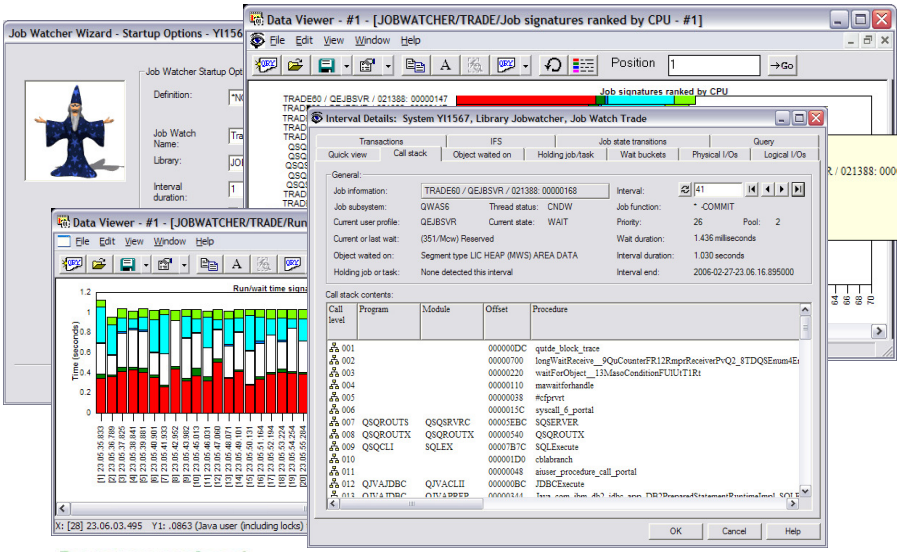
iDoctor PEX Analyzer



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	• 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

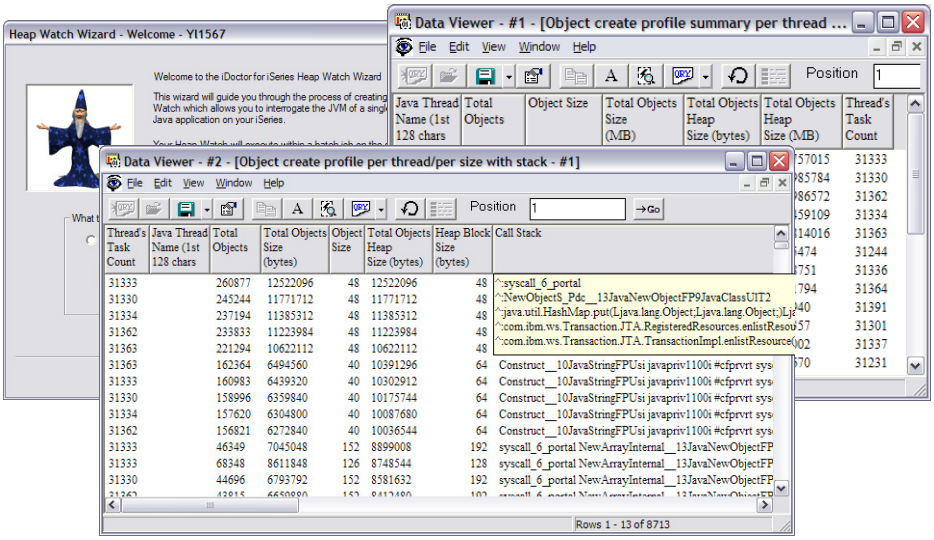
iDoctor JobWatcher



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	• 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)



In Depth Analysis (recap)

Tool	Cost	Complexity	What it is used for
Analyze PEX events			
PRTPEXRPT	5722PT1	Depends	• 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	• 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	• 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	• 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

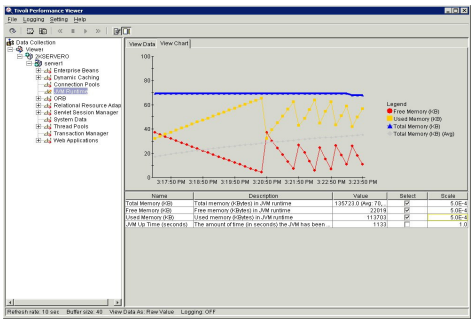
Full name	Tivoli Performance Viewer
Type of tool	Graphical real-time monitoring of WebSphere App Server
How to get it	Part of the WAS 6.0 and 6.1 Admin Console Part of the workstation tools for WAS 5.x
Complexity	Moderate
Overhead	Low (< 5%)
What to use it for	Monitor WebSphere performance metrics, such as number of calls to each servlet, number of transactions, number of prepared statement cache discards, and many more
Key things to look for	• 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/iseries/ae/tprf_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*

*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.

TPV for WAS 5.x:

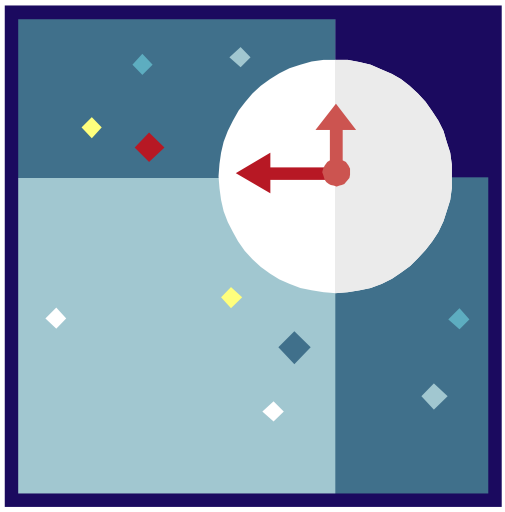


Tool: OS/400 Heap Monitor (Classic Only)

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	• 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

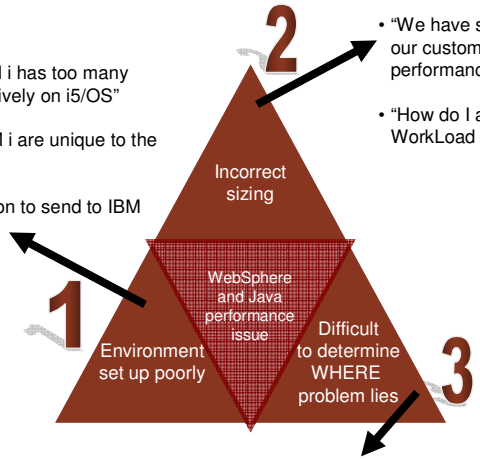
OS/400 Heap Monitor (Classic Only)

```
                              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 POOLSIZE(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 POOLSIZE(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"

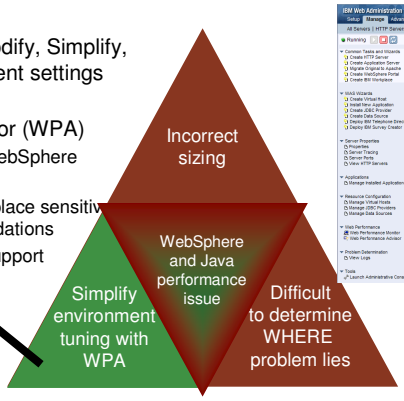


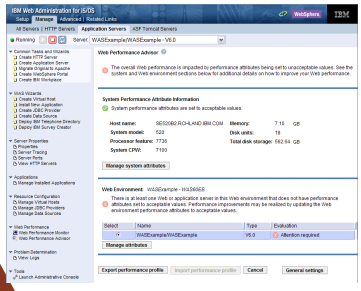
- "We have sized a system too small for our customer, and we now have a performance issue"
- "How do I answer the questions to WorkLoad Estimator correctly?"

- "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 sensitiv 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

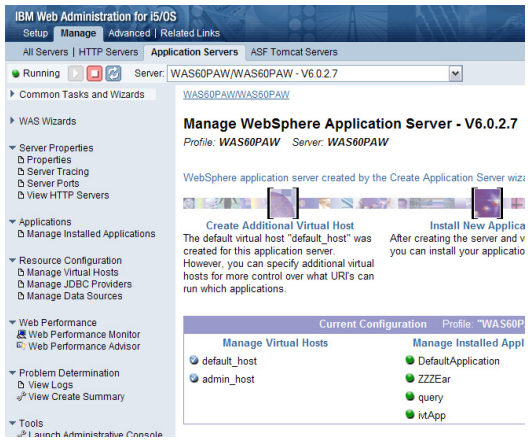
Joe User calls, Web Server is terribly slow! Fix now!

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



Power your planet.

Web Performance Advisor – Intro page

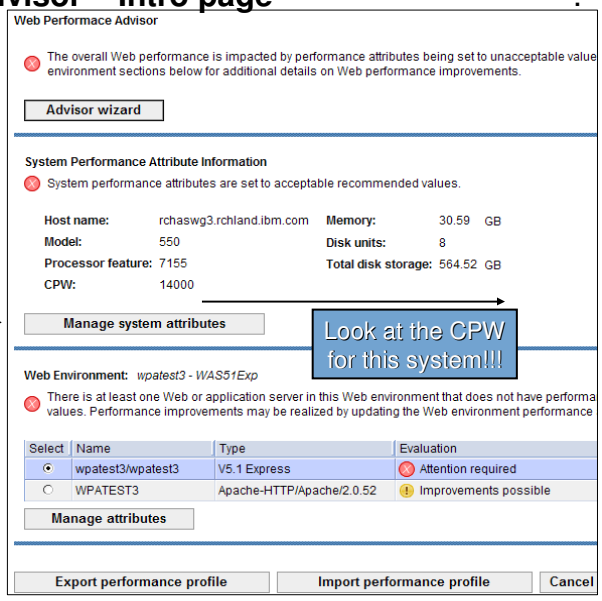
View the overall rating.

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.

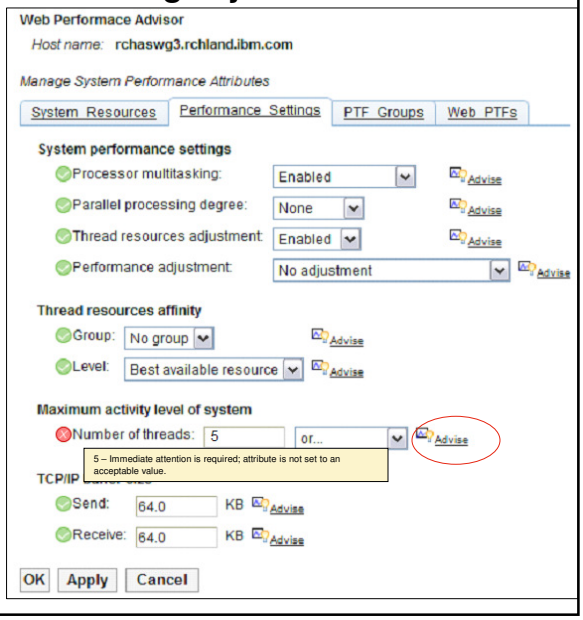


Power your planet.

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!

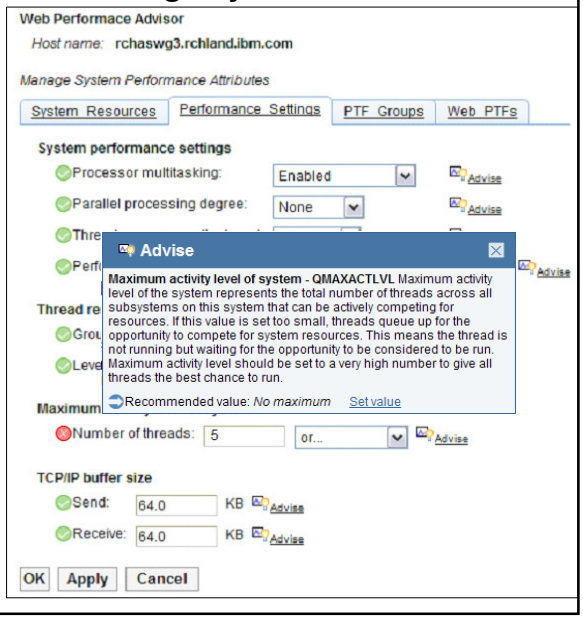


Power your planet.

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!



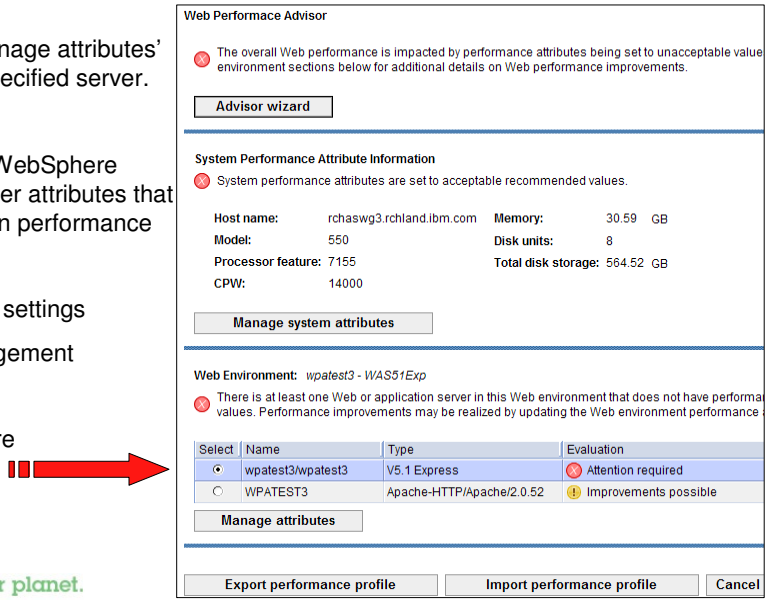
Power your planet.

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

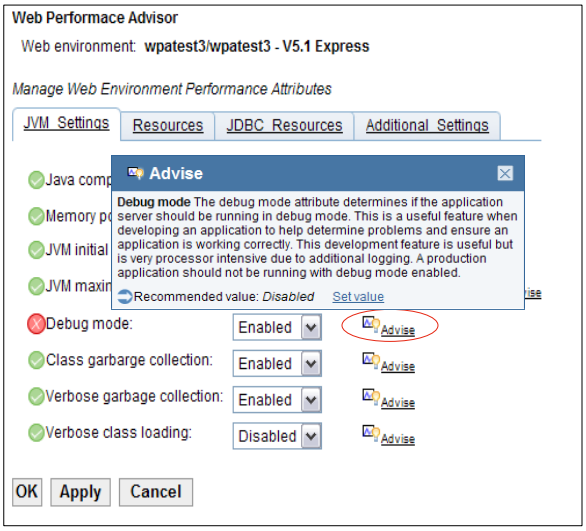


Power your planet.

Web Performance Advisor – Manage Web Attributes

Manage only the attributes that affect performance!

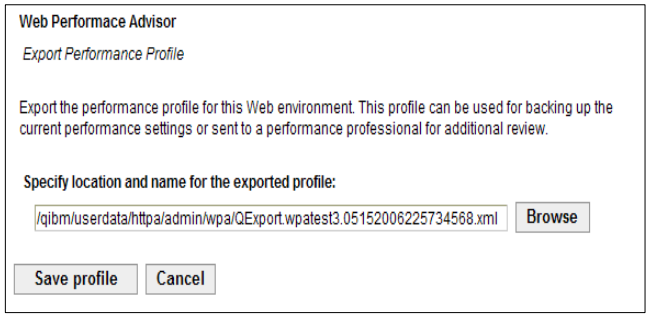
Click on 'Advise' to learn more.



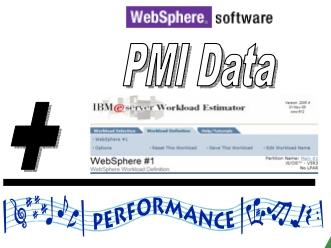
Power your planet.

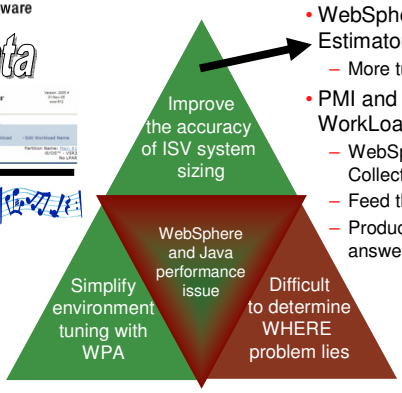
Web Performance Advisor – Export Performance Profile

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.



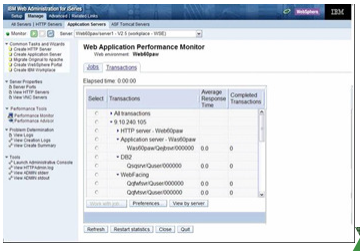
Improve the Accuracy of ISV System Sizing with WorkLoad Estimator and Collection Services Updates

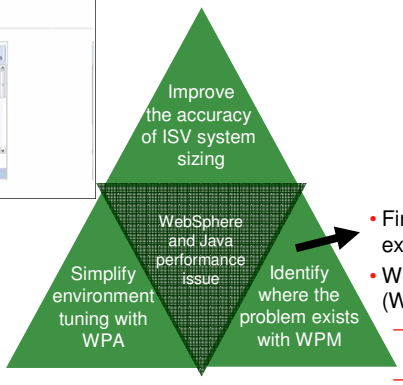




- WebSphere Workload in WorkLoad Estimator Improvements
  - More tuning knobs asked for by our ISVs
- PMI and Collection Services input to WorkLoad Estimator
  - WebSphere will store some PMI data as Collection Services data
  - Feed this data into WLE
  - Produce automatic and more accurate answers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

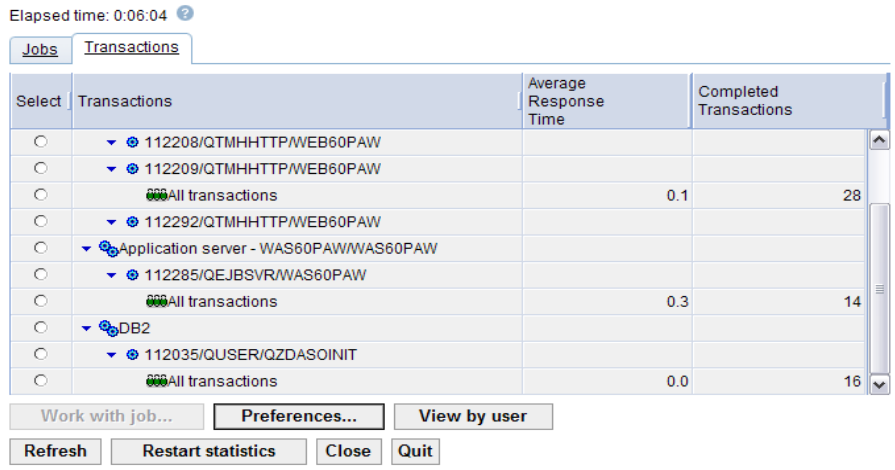
Select	Servers and jobs	Current User	CPU %	Run Priority	Thread Count	Average Response Time	Completed Transactions
○	HTTP server - WEB60PAW						
○	112206/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
○	112207/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
○	112208/QTMHHTTP/WEB60PAW	QTMHHTTP	0.0	25	1	0.0	0
○	112209/QTMHHTTP/WEB60PAW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

Work with job...

Refresh | Restart statistics | Close | Quit

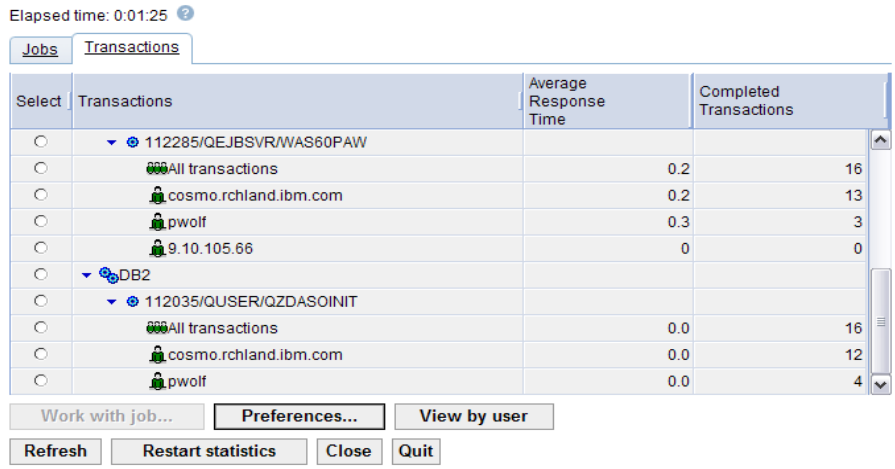
Web Performance Monitor Statistics – Transactions by Server

Web Performance Monitor



Web Performance Monitor Statistics – Transactions by Server

Web Performance Monitor



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.

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=Isow
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/iseries/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/iseries/v7r1m0/topic/rzalf/rzalfwhatsnew.htm

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Revised September 26, 2006

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