



SPECjbb2005 performance on Red Hat Enterprise Linux 5.1 and 3 AS Intel-based servers

Executive summary

Red Hat, Inc. (Red Hat) commissioned Principled Technologies (PT) to measure the SPECjbb2005 performance of the following three systems:

- Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based (3.4 GHz) server
- Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based (2.93 GHz) server
- Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based (2.93 GHz) server

In this section, we present the best results for each server. For complete details of the performance of each Java Virtual Machine (JVM) by warehouse for each server, see the Test results section.

Figure 1 shows the SPECjbb2005 results, in bops, of the test servers. Each result is the median peak score of three runs of the benchmark. See the Test results section for the scores from all three runs. A higher SPECjbb2005 score indicates the server is able to handle more Java requests and thus deliver greater throughput.

Red Hat Enterprise Linux 5.1 on the Quad-Core Intel Xeon processor X7350-based server produced the highest results, 380,450 bops, while Red Hat Enterprise Linux AS 3 Dual-Core Intel Xeon processor 7140M-based server

achieved 208,888 bops. The Red Hat Enterprise Linux 5.1 server thus delivered an 82.1 percent performance increase over the Red Hat Enterprise Linux AS 3 server. Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 on the Quad-Core Intel Xeon processor X7350-based server achieved 339,376 bops, which is only 12.1 percent slower than running native, but a 62.4 percent performance increase over the Red Hat Enterprise Linux AS 3 server.

KEY FINDINGS

- Red Hat Enterprise Linux 5.1 on the Quad-Core Intel Xeon processor X7350-based server delivered 82.1 percent more performance than Red Hat Enterprise Linux AS 3 Dual-Core Intel Xeon processor 7140M-based server (see Figure 1).
- Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 on the Quad-Core Intel Xeon processor X7350-based server delivered a 62.4 percent performance increase over Red Hat Enterprise Linux AS 3 on the Dual-Core Intel Xeon processor 7140M-based server (see Figure 1).
- Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 on the Quad-Core Intel Xeon processor X7350-based server only delivered 10.8 percent less performance than running native on Red Hat Enterprise Linux 5.1 on the same server (see Figure 1).

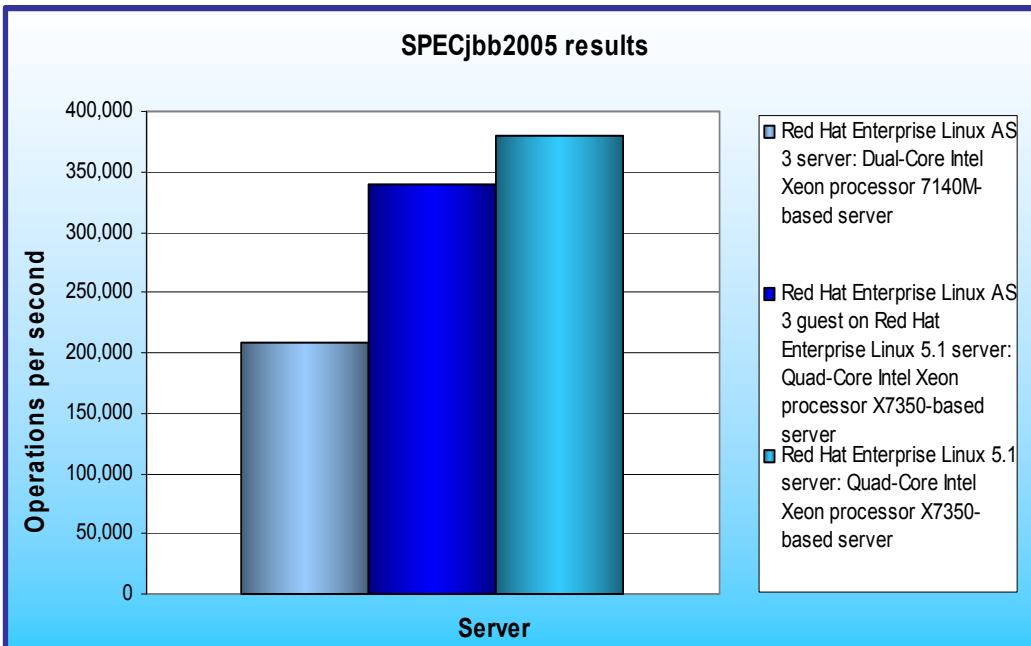


Figure 1: SPECjbb2005 business operations per second (quad-processor) results for the test servers. Higher numbers of operations per second are better.

Workload

SPECjbb2005 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server's Java performance. SPEC modeled SPECjbb2005 on the three-tier client/server architecture, with the middle layer as the primary focus. According to SPEC, "Random input selection represents the first (user) tier. SPECjbb2005 fully implements the middle tier business logic. The third tier is represented by tables of objects, implemented by Java Collections, rather than a separate database."

(www.spec.org/jbb2005/docs/UserGuide.html).

SPECjbb2005 utilizes multiple special data groups and multiple threads as it runs. Each data unit is a "warehouse," a roughly 25MB collection of data objects. Each thread represents an active user posting transaction requests within a warehouse. The benchmark run begins with one warehouse and then increases the number of warehouses; its goal is to saturate the server's processor capacity. As the number of warehouses increases, so does the number of threads. The benchmark's results portray the server's throughput in business operations per second or SPECjbb2005 bops. A higher number of SPECjbb2005 bops is better. (For more information on SPECjbb2005, go to www.spec.org.)

Test results

Figure 2 shows the median SPECjbb2005 results for all three servers. In each test, we ran four JVMs at the same time, a common practice on servers with many processors. To compute the overall score for the system, SPECjbb2005 sums the scores of all the JVMs. SPECjbb2005 computes the score of each JVM by taking the average of the results during mixes when the server is running at peak performance. In our testing, all servers achieved peak performance during mixes 4 through 8. (In SPEC's terms, these results are from "compliant" runs, which means we can disclose them publicly though we are not posting them on the SPEC Web site with all the files SPEC requires. We do present here all the data necessary to reproduce these results.)

	Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server	Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server	Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server
JVM 1	52,097	86,632	95,596
JVM 2	52,008	84,480	94,628
JVM 3	52,275	84,663	94,706
JVM 4	52,508	83,601	95,520
Total Score	208,888	339,376	380,450

Figure 2: SPECjbb2005 results for each server by JVM. Higher numbers are better.

Figure 3 shows the results by warehouse for the Red Hat Enterprise Linux AS 3 server for all three runs. Run 1 produced the median results.

Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server			
	Run 1	Run 2	Run 3
Warehouse	JVM 1		
1	15,454	16,377	15,545
2	36,086	34,543	37,170
3	48,582	49,091	49,227
4	53,170	53,170	53,447
5	52,475	52,655	52,722
6	52,044	52,275	52,318
7	51,633	51,679	51,875
8	51,160	51,460	51,448
Score	52,097	52,248	52,362
Warehouse	JVM 2		
1	15,707	17,834	16,337
2	32,499	40,996	34,620
3	48,268	48,787	48,865
4	53,118	53,559	53,330
5	52,314	52,846	52,724
6	51,890	52,316	52,316
7	51,397	51,957	51,811
8	51,320	51,548	51,351
Score	52,008	52,445	52,306
Warehouse	JVM 3		
1	17,830	15,506	16,302
2	37,171	33,911	35,248
3	49,286	48,270	48,797
4	53,410	53,059	53,192
5	52,726	52,523	52,377
6	52,193	51,958	51,815
7	51,610	51,388	51,324
8	51,437	51,155	50,996
Score	52,275	52,017	51,941
Warehouse	JVM 4		
1	18,114	15,298	17,150
2	33,090	35,357	41,177
3	49,448	47,273	49,070
4	53,607	53,454	53,401
5	52,829	52,825	52,430
6	52,510	52,173	52,260
7	52,037	51,558	51,751
8	51,560	51,171	51,523
Score	52,508	52,236	52,273
Total Score	208,888	208,946	208,882

Figure 3: SPECjbb2005 results for the Red Hat Enterprise Linux AS 3 server. Higher numbers are better.

Figure 4 shows the results by warehouse for the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 for all three runs. Run 2 produced the median results.

Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server			
	Run 1	Run 2	Run 3
Warehouse	JVM 1		
1	26,015	24,899	26,083
2	58,387	38,349	35,361
3	77,762	79,787	79,375
4	86,813	87,012	84,178
5	87,744	88,076	86,353
6	86,422	86,817	86,259
7	85,965	86,179	85,135
8	84,789	85,075	84,033
Score	86,347	86,632	85,191
Warehouse	JVM 2		
1	25,508	25,593	26,021
2	60,764	39,602	43,162
3	79,312	77,345	77,921
4	87,154	82,434	83,622
5	86,404	85,496	86,529
6	86,756	85,562	85,882
7	85,357	84,762	84,994
8	84,925	84,147	84,175
Score	86,119	84,480	85,040
Warehouse	JVM 3		
1	26,552	26,226	25,880
2	59,615	31,158	35,146
3	78,522	77,810	77,836
4	84,221	84,389	84,302
5	84,652	85,432	85,219
6	85,390	85,300	85,421
7	84,760	84,612	84,724
8	84,313	83,584	84,207
Score	84,667	84,663	84,775
Warehouse	JVM 4		
1	25,672	24,762	25,644
2	44,765	38,679	39,426
3	77,479	75,836	78,254
4	83,400	82,144	83,085
5	86,004	83,502	85,236
6	85,003	84,988	85,046
7	84,201	84,185	84,347
8	83,525	83,185	83,473
Score	84,427	83,601	84,237
Total Score	341,560	339,376	339,243

Figure 4: SPECjbb2005 results for the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server. Higher numbers are better.

Figure 5 shows the results by warehouse for the Red Hat Enterprise Linux 5.1 server for all three runs. Run 1 produced the median results.

Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server			
	Run 1	Run 2	Run 3
Warehouse	JVM 1		
1	33,097	33,556	33,351
2	69,983	69,447	69,007
3	86,296	86,017	86,199
4	96,957	96,376	96,424
5	96,263	95,435	95,614
6	95,527	95,014	95,161
7	95,001	94,372	94,881
8	94,232	93,911	93,988
Score	95,596	95,022	95,213
Warehouse	JVM 2		
1	33,371	33,197	33,567
2	69,360	69,687	69,772
3	85,711	85,883	86,298
4	95,778	96,489	96,821
5	95,268	95,829	95,904
6	94,705	95,239	95,510
7	93,976	94,620	94,802
8	93,412	93,940	94,121
Score	94,628	95,223	95,432
Warehouse	JVM 3		
1	33,076	32,727	33,648
2	69,270	69,681	69,793
3	85,828	86,267	85,979
4	95,847	96,363	97,107
5	95,255	95,686	96,295
6	94,810	95,391	95,581
7	93,853	94,536	94,941
8	93,764	94,106	94,334
Score	94,706	95,216	95,652
Warehouse	JVM 4		
1	32,963	33,401	33,604
2	69,618	69,048	69,426
3	86,227	85,826	85,405
4	97,032	96,052	96,092
5	96,266	95,729	95,547
6	95,582	95,090	95,029
7	94,543	94,164	94,424
8	94,175	93,650	93,931
Score	95,520	94,937	95,005
Total Score	380,450	380,398	381,302

Figure 5: SPECjbb2005 results for the Red Hat Enterprise Linux 5.1 server. Higher numbers are better.

Test methodology

Figure 6 summarizes some key aspects of the configurations of the three server systems; Appendix A provides detailed configuration information.

Server	Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server	Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server	Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server
Processor frequency (GHz)	3.4 GHz	2.93 GHz	2.93 GHz
Front-side bus frequency (MHz)	800 MHz	1,066 MHz	1,066 MHz
Number of processor packages	4	4	4
Number of cores per processor package	2	4	4
Number of hardware threads per core	2	1	1
Motherboard	Intel SE8500HW4	Intel S7000FC4UR	Intel S7000FC4UR
Chipset	Intel SE8500	Intel ID3600	Intel ID3600
RAM (16 GB in each)	16 GB (16 x 1GB) PC2-5300 DDR2	16 GB (16 x 1GB) PC2-5300 FB-DDR2	16 GB (16 x 1GB) PC2-5300 FB-DDR2
Hard Drive	Seagate ST3146854LC	Seagate ST973401SS	Seagate ST973401SS

Figure 6: Summary of some key aspects of the server configurations.

Red Hat configured and provided all servers.

We began by installing a fresh copy of Red Hat Enterprise Linux on the test systems. For the RHEL 3 installation, we used all default settings except for disabling the firewall. For the RHEL 5 installation, we installed only the Software Development package, and disabled the firewall and SELinux. We used the same installation method for the RHEL 3 guest on RHEL 5; however, during this installation we elected to install virtualization. We made no additional changes to the default installation options.

With the following exceptions, we used the default BIOS settings on each server: disabling HW Prefetcher and Adjacent Cache Line Prefetcher and enabling High Bandwidth on the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server and Red Hat Enterprise Linux 5.1 server. We disabled HW Prefetcher and enabled Adjacent Cache Line Prefetcher on the Red Hat Enterprise Linux AS 3 server.

SPECjbb2005 configuration

We used SPECjbb2005 version 1.07, dated March 15, 2006. We followed SPEC's run rules. (For more information about SPECjbb2005 and its run rules, see www.spec.org/jbb2005/docs/RunRules.html.) We installed SPECjbb2005 by copying the contents of the SPECjbb2005 CD to the directory \SPECjbb2005v1.07 on the server's hard disk.

SPECjbb2005 requires a Java Virtual Machine on the system under test. We used the BEA JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64) JVM for this testing and left the default installation settings.

After installation, as per the run rules, we edited the SPECjbb_config.props file in the root SPECjbb2005 directory to include disclosure information about the server and our license information. SPECjbb2005 uses this file when

generating the results output for each run. We also modified the SPECjbb.props file to change the number of JVM instances to four. This change allows a server to run four JVM instances during testing.

We created a shell script, which we placed in the root SPECjbb2005 directory, to issue the Java run command to launch the benchmark. During testing, we used the command prompt to run this shell script. Figure 7 shows the contents of the script used on the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 and Red Hat Enterprise Linux 5.1 server. Figure 8 shows the script file used for the Red Hat Enterprise Linux AS 3 server.

We did not use the same scripts on all systems because of the server architecture, which needed different processor affinity mapping by using the Taskset command. The Red Hat Enterprise Linux AS 3 server running on a Dual-Core Intel Xeon processor 7140M-based server has four physical processors with two cores per processor. Each core uses Hyper-Threading Technology for a total of sixteen logical processors. The Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 and Red Hat Enterprise Linux 5.1 servers, both running on Quad-Core Intel Xeon processor X7350-based servers, contained four physical processors with four cores per processor. While all systems have sixteen logical cores, the operating system assigns the processor IDs differently for the processors with Hyper-Threading than those with physical cores, so we assigned the Taskset command differently for each system.

We set hugepages on all systems except Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1, because hugepages is not supported within virtualization. Therefore we used the same shell script shown in figure 7, but commented out the following lines for testing.

```
mkdir -p /mnt/hugepages
mount none /mnt/hugepages -t hugetlbfs
chmod 777 /mnt/hugepages
cat /proc/meminfo | grep Huge
```

In addition, we used a different heap and nursery size on the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server due to the amount of memory available in the virtualized environment. We used a 3000m heap and 2500m nursery. Therefore the JVM options for the Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server run was the following: `java.exe -Xms3000m -Xmx3000m -Xns2500m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlsize:min=16k,preferred=128k spec.jbb.JBBmain`


```
taskset_run_multi.sh - WordPad
File Edit View Insert Format Help
echo
echo Setting OS tuning options...
mkdir -p /mnt/hugepages
mount none /mnt/hugepages -t hugetlbfs
chmod 777 /mnt/hugepages
cat /proc/meminfo | grep Huge

sleep 2

echo
PATH=/jrockit-jdk1.5.0_10/jre/bin:$PATH
echo PATH="$PATH"

sleep 1

JVM_OPTIONS="-Xms3500m -Xmx3500m -Xns2900m -XXaggressive -XXlargepages
-Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=
16k,preferred=128k"

echo Starting Controller
java -cp jbb.jar:check.jar -Xms256m -Xmx256m -Xgc:parallel
spec.jbb.Controller -propfile SPECjbb.props &

sleep 5

echo "Starting instance 1"
taskset 0x00000303 java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 1 > multi.1 &

echo "Starting instance 2"
taskset 0x00000C0C java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 2 > multi.2 &

echo "Starting instance 3"
taskset 0x00003030 java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 3 > multi.3 &

echo "Starting instance 4"
taskset 0x0000C0C0 java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 4 > multi.4 &

For Help, press F1
```

Figure 7: The text of the batch file we used to execute the SPECjbb2005 benchmark on Red Hat Enterprise Linux 5.1 and Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 servers.

In the shell script we set the Java options that control the performance of the JVM. We found through experimental testing the following Java option settings provided the best performance:

- **-Xms3500m** This option sets the minimum heap size. We set the minimum and maximum heap sizes to be the same, so the heap size would stay a constant 3500MB.
- **-Xmx3500m** This option sets the maximum heap size.
- **-Xns2900m** This option sets the JVM nursery size.
- **-XXaggressive** This option basically tells the JVM to perform at maximum speed.
- **-XXlargepages** This option tells the JVM to use large pages.
- **-Xgc:genpar** This option sets generational parallel garbage collection.

- `-XXthroughputCompaction` This option adjusts the compaction ratio dynamically based on live data in the heap.
- `-XXlazyUnlocking` This option affects when the JVM releases locks.
- `-XXtlsize:min=16k,preferred=128k` This option sets the thread-local area size the JVM uses.

```

echo
echo Setting OS tuning options...
mkdir -p /mnt/hugepages
mount none /mnt/hugepages -t hugetlbfs
chmod 777 /mnt/hugepages
cat /proc/meminfo | grep Huge

sleep 2

echo
PATH=/jrockit-jdk1.5.0_10/jre/bin:$PATH
echo PATH="$PATH"

sleep 1

JVM_OPTIONS="-Xms3500m -Xmx3500m -Xns2900m -XXaggressive -XXlargepages
-Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlsize:min=
16k,preferred=128k"

echo Starting Controller
java -cp jbb.jar:check.jar -Xms256m -Xmx256m -Xgc:parallel
spec.jbb.Controller -propfile SPECjbb.props &
sleep 5

echo "Starting instance 1"
taskset 0x00004441 -- java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 1 > multi.1 &

echo "Starting instance 2"
taskset 0x00008888 -- java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 2 > multi.2 &

echo "Starting instance 3"
taskset 0x00001112 -- java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 3 > multi.3 &

echo "Starting instance 4"
taskset 0x00002224 -- java -cp jbb.jar:check.jar $JVM_OPTIONS
spec.jbb.JBBmain -propfile SPECjbb.props -id 4 > multi.4 &

```

Figure 8: The text of the batch file we used to execute the SPECjbb2005 benchmark on Red Hat Enterprise Linux AS 3 server.

Appendix A – Test system configuration information

This appendix provides detailed configuration information about each of the test server systems, which we list in alphabetical order.

Servers	Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server	Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server	Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server
General processor setup			
Number of processor packages	4	4	4
Number of cores per processor package	2	4	4
Number of hardware threads per core	2	1	1
CPU			
Vendor	Intel	Intel	Intel
Name	Dual-Core Intel Xeon MP 7140M	Quad-Core Intel Xeon X7350	Quad-Core Intel Xeon X7350
Stepping	8	B	B
Socket type	mPGA604	mPGA604	mPGA604
Core frequency (GHz)	3.4 GHz	2.93 GHz	2.93 GHz
Front-side bus frequency (MHz)	800 MHz	1,066 MHz	1,066 MHz
L1 Cache	12 KB + 16 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 Cache	2 x 1 MB	2 x 4 MB (each 4 MBs shared by 2 cores)	2 x 4 MB (each 4 MBs shared by 2 cores)
L3 Cache	16 MB	NA	NA
Platform			
Vendor and model number	Intel	Intel	Intel
Motherboard model number	SR4850HW4x	S7000FC4UR	S7000FC4UR
Motherboard chipset	Intel SE8501	Intel ID3600	Intel ID3600
Motherboard revision number	11	01	01
BIOS name and version	Intel Corporation SHW40.86B.P.12.00.0 076, 02/15/2007	Intel SFC4UR.86B.01.00.0 010.050420071510	Intel SFC4UR.86B.01.00.0 010.050420071510
BIOS settings	Disabled HW Prefetcher/enabled adjacent cache line Prefetcher	Disabled HW Prefetcher and adjacent cache line Prefetcher/enabled high bandwidth	Disabled HW Prefetcher and adjacent cache line Prefetcher/enabled high bandwidth
Memory module(s)			
Vendor and model number	ELPIDA EBE10RD4AGFA-6E-E	Kingston KVR667D2D8F5/1G	Kingston KVR667D2D8F5/1G
Type	PC2-5300 DDR2	PC2-5300 FB-DDR2	PC2-5300 FB-DDR2
Speed (MHz)	667 MHz	667 MHz	667 MHz
Speed in the system currently running @ (MHz)	400 MHz	667 MHz	667 MHz

Servers	Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server	Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server	Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server
Timing/Latency (tCL-tRCD-iRP-tRASmin)	3-3-3-9	5-5-5-15	5-5-5-15
Size	16,382 MB	16,382 MB	16,382 MB
Number of RAM modules	16	16	16
Chip organization	Double-sided	Double-sided	Double-sided
Hard disk			
Vendor and model number	Seagate ST3146854LC	Seagate ST973401SS	Seagate ST973401SS
Number of disks in system	1	1	1
Size	146.8 GB	73.4 GB	73.4 GB
Buffer Size	8 MB	8 MB	8 MB
RPM	15,000	10,000	10,000
Type	SCSI	SAS	SAS
Controller	LSI Logic PCI-X Ultra320 SCSI	Intel 631xESB/6321ESB/3100 Chipset Serial ATA Storage Controller – 2680	Intel 631xESB/6321ESB/3100 Chipset Serial ATA Storage Controller – 2680
Operating system			
Name	Red Hat Enterprise Linux 3 Advanced Server	Red Hat Enterprise Linux 5 Advanced Server	Red Hat Enterprise Linux 5 Advanced Server
Build number	RHEL 3 update 9	RHEL 5.1/RHEL 3 update 9	RHEL 5.1
File system	ext3	ext3	ext3
Kernel	2.4.21-50.EL (x86_64)	2.4.21-50.EL (x86_64)	2.6.18-36.el5 (x86_64)
Language	English	English	English
Graphics			
Vendor and model number	ATI Radeon 7000	ATI ES1000	ATI ES1000
Chipset	ATI Radeon 7000 PCI	ES1000	ES1000
BIOS version	BK-ATI VER008.004.037.001	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000
Type	Integrated	Integrated	Integrated
Memory size	16 MB	32 MB	32 MB
Resolution	1024x768	1024x768	1024x768
Network card/subsystem			
Vendor and model number	Broadcom BCM5704 dual NetXtreme Gigabit Adapter	Intel PRO/1000 EB/Intel 82575EB	Intel PRO/1000 EB/Intel 82575EB
Type	Integrated	Integrated	Integrated
Optical drive			
Vendor and model number	Philips SDR089	Optiarc DVD-ROM DDU810A	Optiarc DVD-ROM DDU810A

Servers	Red Hat Enterprise Linux AS 3 server: Dual-Core Intel Xeon processor 7140M-based server	Red Hat Enterprise Linux AS 3 guest on Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server	Red Hat Enterprise Linux 5.1 server: Quad-Core Intel Xeon processor X7350-based server
USB ports			
Number	5	5	5
Type	USB 2.0	USB 2.0	USB 2.0

Figure 9: Detailed system configuration information for the four test servers.

Appendix B – SPECjbb2005 output

This appendix provides the output of the benchmark for each of the test servers.

Red Hat Enterprise Linux AS 3 Dual-Core Intel Xeon processor 7140M-based server

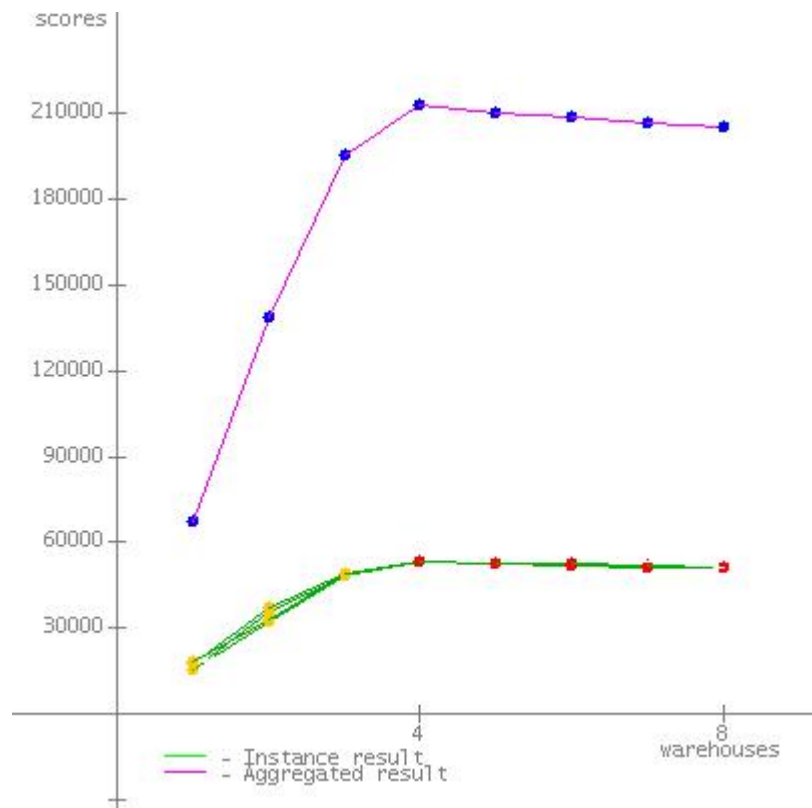
SPECjbb2005

**SPECjbb2005 bops = 208888,
SPECjbb2005 bops/JVM = 52222**

Intel SR4850HW4x

BEA JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)

JVM run	JVM Scores
1	52097
2	52008
3	52275
4	52508
SPECjbb2005 bops = 208888, SPECjbb2005 bops/JVM = 52222	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	SR4850HW4x
Processor	Dual-Core Intel Xeon processor 7140M
MHz	3400
# of Chips	4
# of Cores	8
# of Cores/Chip	2

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)
JVM Command Line	taskset -- java.exe -Xms3500m -Xmx3500m -Xns2900m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap	3500

HW Threading Enabled?	Yes
Procs Avail to Java	16
Memory (MB)	16384
Memory Details	16 x 1GB DDR2-667 DIMM
Primary cache	12KB + 16KB
Secondary cache	1MB
Other cache	16MB
Filesystem	ext3
Disks	1 x 146.8GB SCSI
Other hardware	

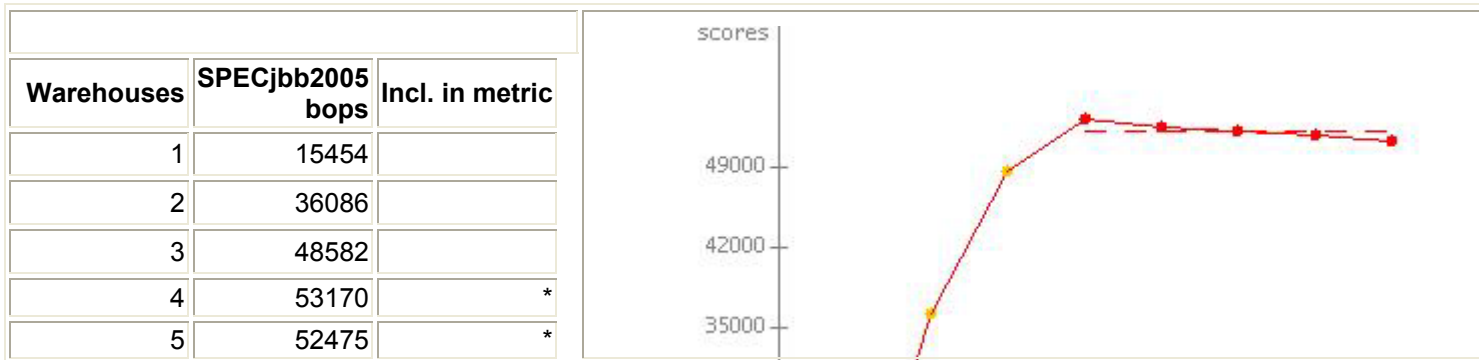
Memory (MB)	
JVM Maximum Heap Memory (MB)	3500
JVM Address bits	64
JVM CLASSPATH	jbb.jar: check.jar
JVM BOOTCLASSPATH	/jrocket-jdk1.5.0_10/jre/lib/amd64/jrocket/jrocket1.5.0.jar: /jrocket-jdk1.5.0_10/jre/lib/amd64/jrocket/managementapi.jar: /jrocket-jdk1.5.0_10/jre/lib/amd64/jrocket/jmxmapi.jar: /jrocket-jdk1.5.0_10/jre/lib/amd64/jrocket/rmp.jar: /jrocket-jdk1.5.0_10/jre/lib/rt.jar: /jrocket-jdk1.5.0_10/jre/lib/i18n.jar: /jrocket-jdk1.5.0_10/jre/lib/sunrsasign.jar: /jrocket-jdk1.5.0_10/jre/lib/jsse.jar: /jrocket-jdk1.5.0_10/jre/lib/jce.jar: /jrocket-jdk1.5.0_10/jre/lib/charsets.jar: /jrocket-jdk1.5.0_10/jre/classes
OS Version	Red Hat Enterprise Linux AS 3 (Update 9) - kernel 2.4.21-50.EL (x86_64)
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Aug 31, 2007
H/w available	
JVM available	2007
OS available	2007
Other s/w available	

AOT Compilation
Tuning
Set vm/hugetlb_pool=14400 in /etc/sysctl.conf
Notes
Disabled "Hardware Prefetcher" and enabled "Adjacent Cache Line Prefetch" in the BIOS

JVM 1 Scores:

No errors. Valid run.

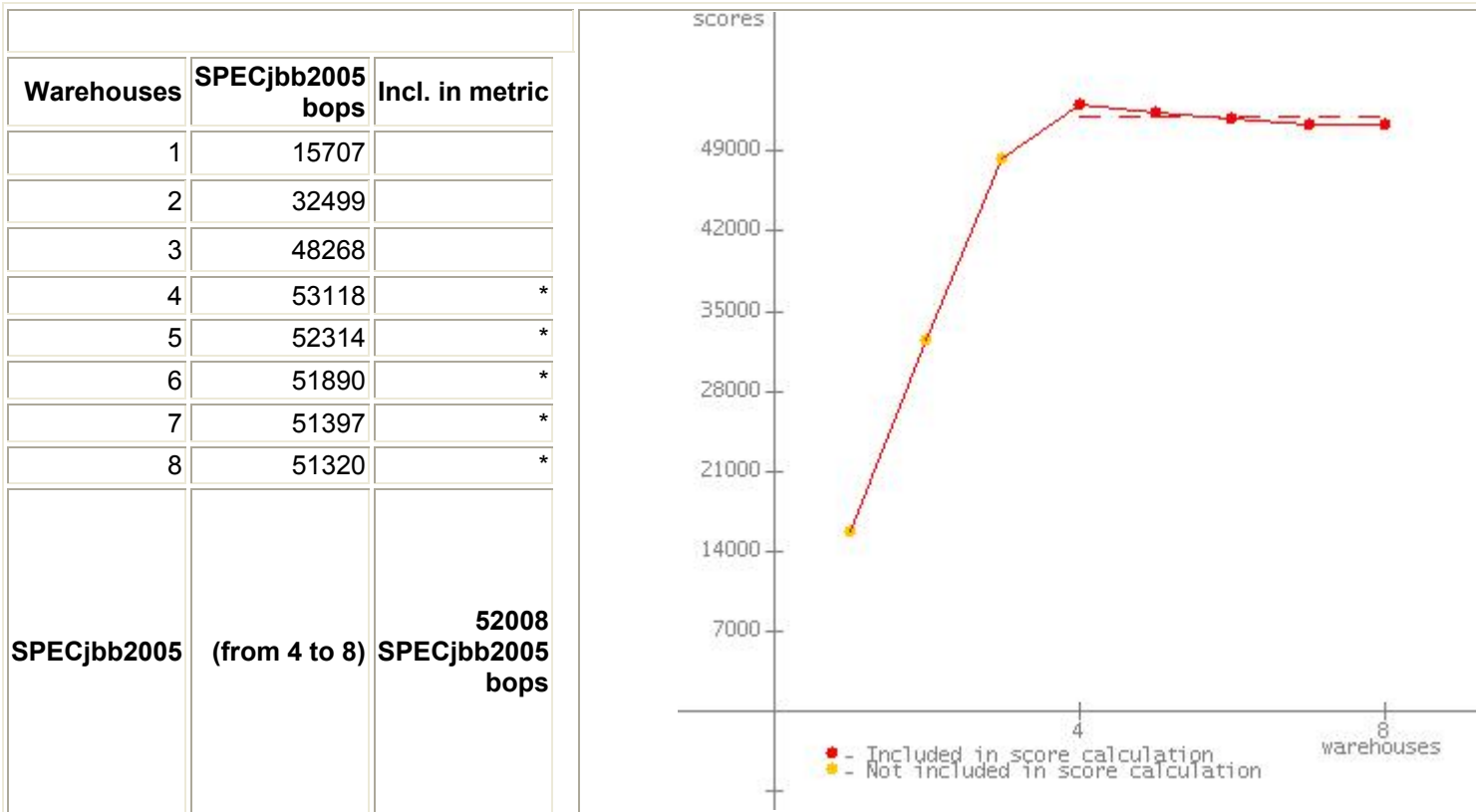


6	52044	*
7	51633	*
8	51160	*
SPECjbb2005	(from 4 to 8)	52097 SPECjbb2005 bops

SPEC license # 3184 Tested by: Principled Technologies Test date: Aug 31, 2007

JVM 2 Scores:

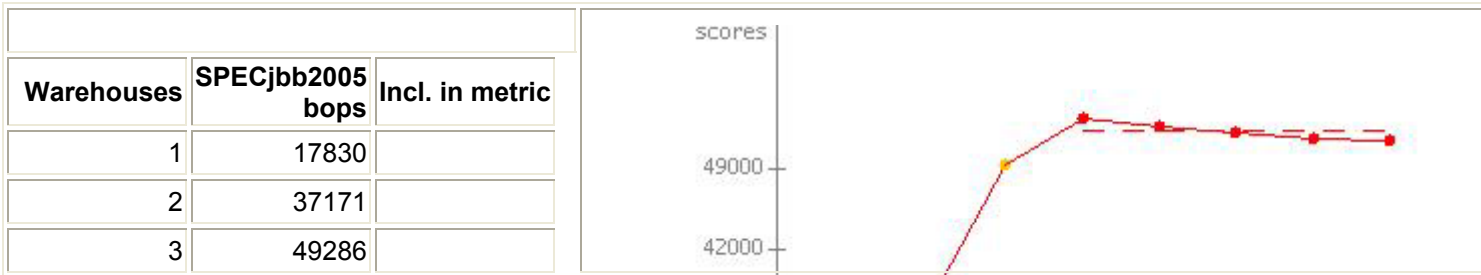
No errors. Valid run.



SPEC license # 3184 Tested by: Principled Technologies Test date: Aug 31, 2007

JVM 3 Scores:

No errors. Valid run.

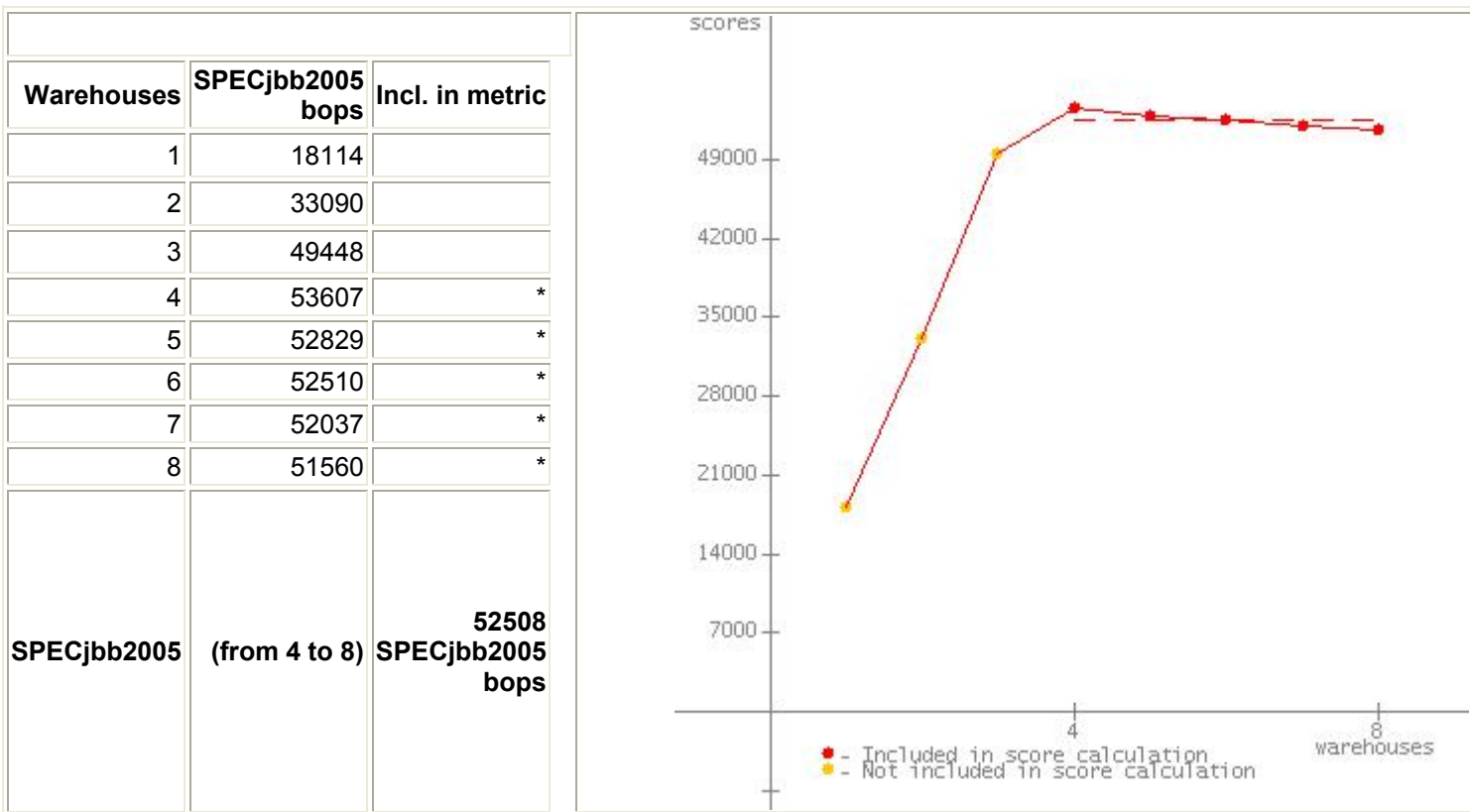


4	53410	*
5	52726	*
6	52193	*
7	51610	*
8	51437	*
SPECjbb2005	(from 4 to 8)	52275 SPECjbb2005 bops

SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Aug 31, 2007

JVM 4 Scores:

No errors. Valid run.



SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Aug 31, 2007

SPECjbb2005 Version: [SPECjbb2005 1.07, March 15, 2006]
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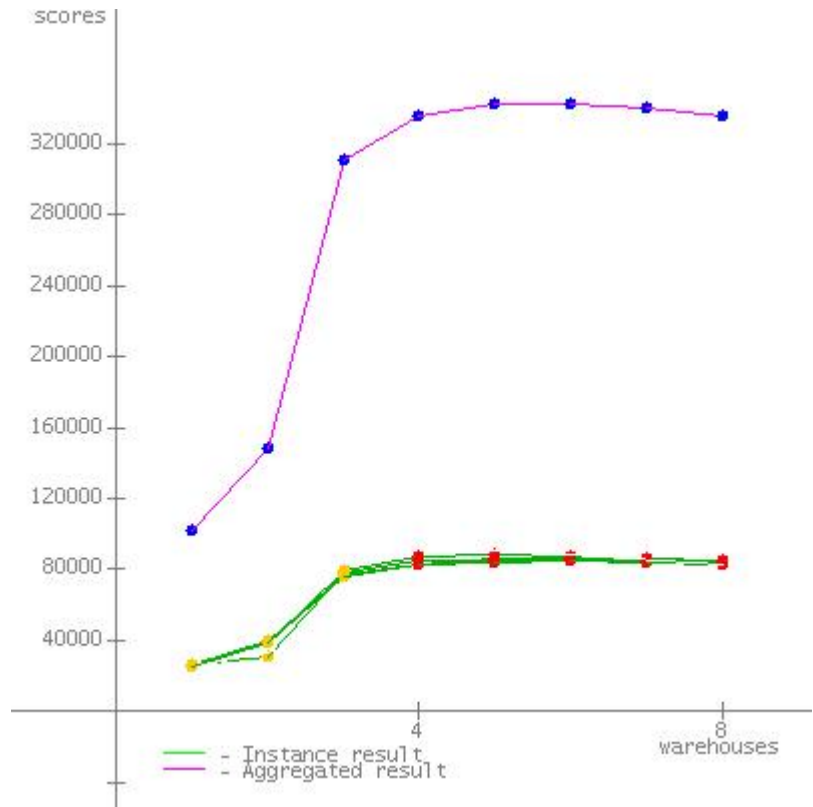
SPECjbb2005

**SPECjbb2005 bops = 339376,
SPECjbb2005 bops/JVM = 84844**

Intel S7000FC4UR

BEA JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)

JVM run	JVM Scores
1	86632
2	84480
3	84663
4	83601
SPECjbb2005 bops = 339376, SPECjbb2005 bops/JVM = 84844	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	S7000FC4UR
Processor	Quad-Core Intel Xeon processor
MHz	2930
# of Chips	4
# of Cores	16
# of Cores/Chip	4
HW	No

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)
JVM Command Line	taskset -- java.exe -Xms3000m -Xmx3000m -Xns2500m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap Memory (MB)	3000
JVM Maximum	3000

Threading Enabled?	
Procs Avail to Java	16
Memory (MB)	16384
Memory Details	16 x 1GB DDR2-667 FBDIMM
Primary cache	32KBI+32KBD (per core)
Secondary cache	2 x 4MB (4MB shared by 2 cores)
Other cache	
Filesystem	ext3
Disks	1 x 73GB SAS
Other hardware	

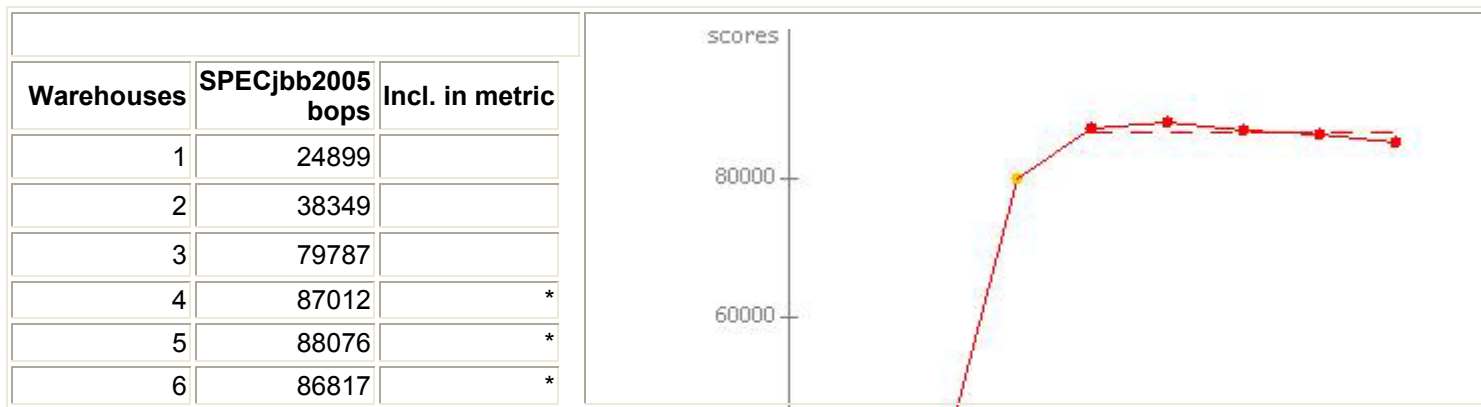
Heap Memory (MB)	
JVM Address bits	64
JVM CLASSPATH	jbb.jar: check.jar
JVM BOOTCLASSPATH	/jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/jrockit1.5.0.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/managementapi.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/jmxmapi.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/rmp.jar: /jrockit-jdk1.5.0_10/jre/lib/rt.jar: /jrockit-jdk1.5.0_10/jre/lib/i18n.jar: /jrockit-jdk1.5.0_10/jre/lib/sunrsasign.jar: /jrockit-jdk1.5.0_10/jre/lib/jsse.jar: /jrockit-jdk1.5.0_10/jre/lib/jce.jar: /jrockit-jdk1.5.0_10/jre/lib/charsets.jar: /jrockit-jdk1.5.0_10/jre/classes
OS Version	Red Hat Enterprise Linux AS 3 (Update 9) - kernel 2.4.21-50.EL (x86_64)
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Aug 31, 2007
H/w available	
JVM available	2007
OS available	2007
Other s/w available	

AOT Compilation	
Tuning	
Notes	
Disabled "Hardware Prefetcher" and "Adjacent Cache Line Prefetch" in the BIOS	

JVM 1 Scores:

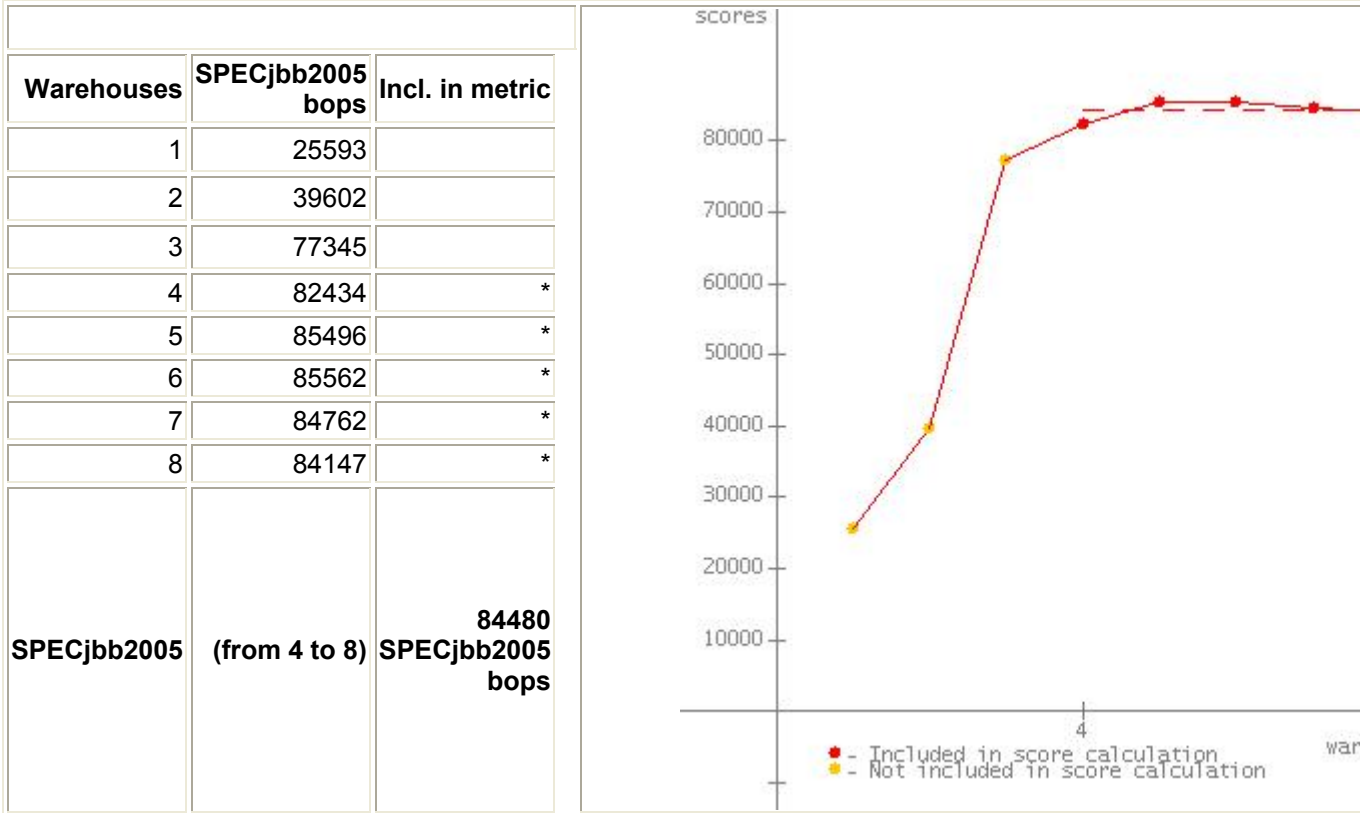
No errors. Valid run.



7	86179	*
8	85075	*
SPECjbb2005	(from 4 to 8)	86632 SPECjbb2005 bops
SPEC license # 3184		Tested by: Principled Technologies Test date: Aug 31, 2007

JVM 2 Scores:

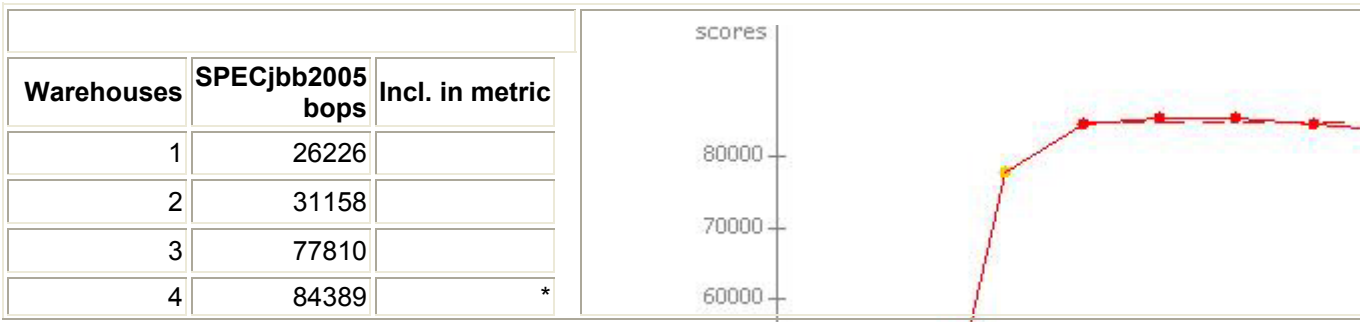
No errors. Valid run.



SPEC license # 3184	Tested by: Principled Technologies	Test date: Aug 31, 2007
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JVM 3 Scores:

No errors. Valid run.

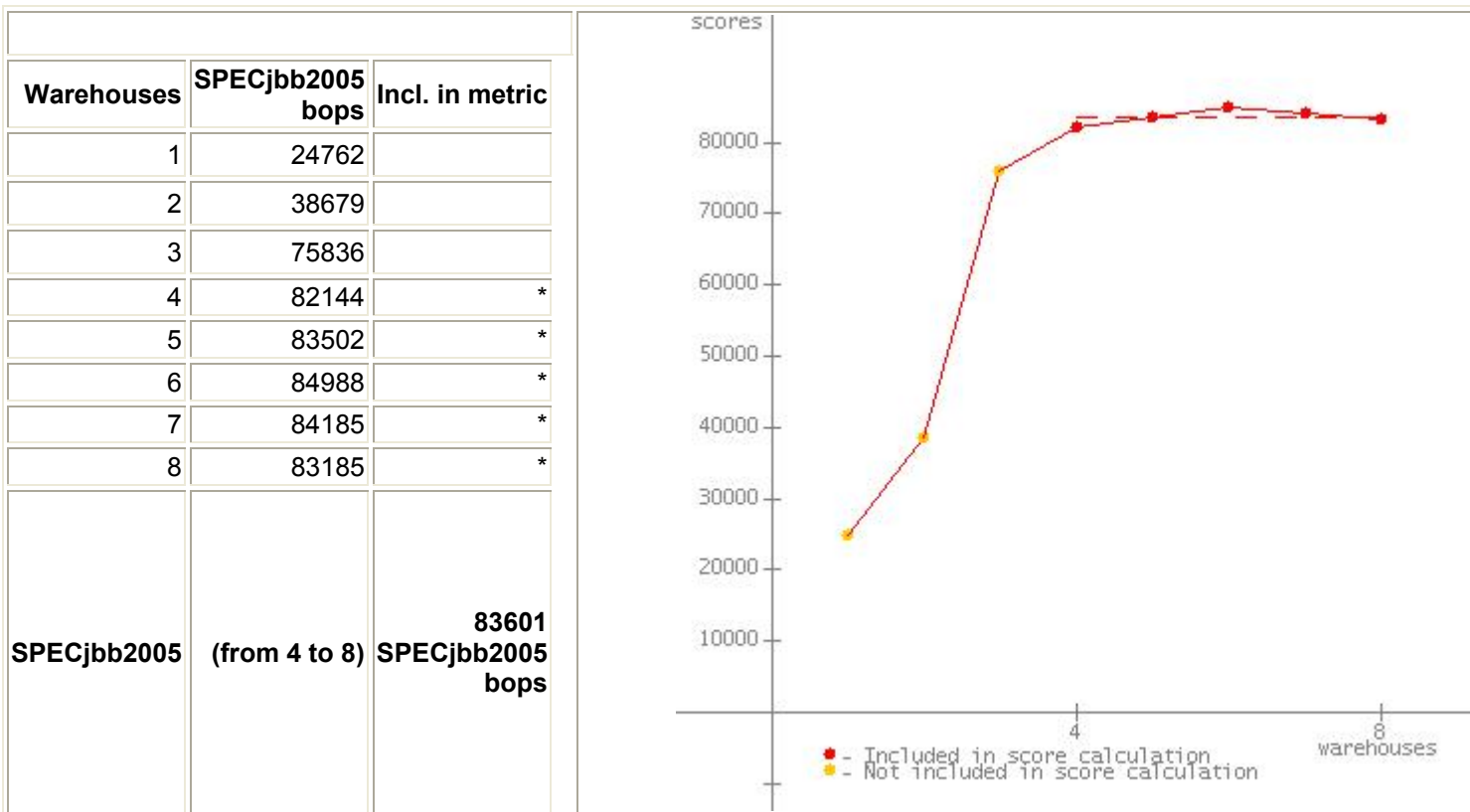


5	85432	*
6	85300	*
7	84612	*
8	83584	*
SPECjbb2005	(from 4 to 8)	84663 SPECjbb2005 bops

SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Aug 31, 2007

JVM 4 Scores:

No errors. Valid run.



SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Aug 31, 2007

SPECjbb2005 Version: [SPECjbb2005 1.07, March 15, 2006]
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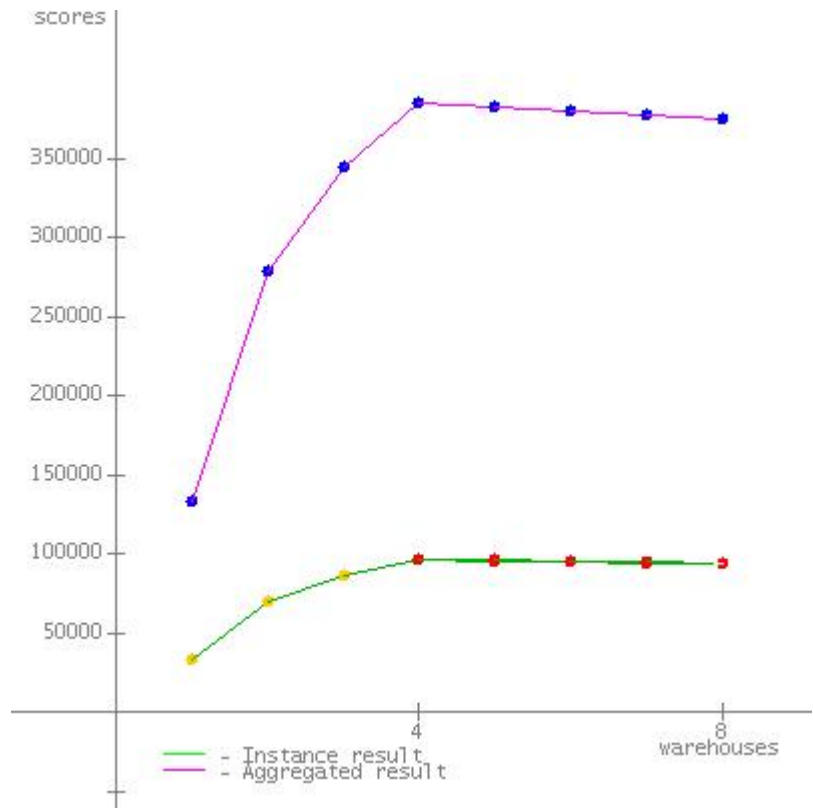
SPECjbb2005

**SPECjbb2005 bops = 380450,
SPECjbb2005 bops/JVM = 95113**

Intel S7000FC4UR

BEA JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)

JVM run	JVM Scores
1	95596
2	94628
3	94706
4	95520
SPECjbb2005 bops = 380450, SPECjbb2005 bops/JVM = 95113	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	S7000FC4UR
Processor	Quad-Core Intel Xeon processor
MHz	2930
# of Chips	4
# of Cores	16
# of Cores/Chip	4

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-19-82330-1.5.0_10-20070515-1627-linux-x86_64)
JVM Command Line	taskset java.exe -Xms3500m -Xmx3500m -Xns2900m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap Memory (MB)	3500

HW Threading Enabled?	No
Procs Avail to Java	16
Memory (MB)	16384
Memory Details	16 x 1GB DDR2-667 FBDIMM
Primary cache	32KBI+32KBD (per core)
Secondary cache	2 x 4MB (4MB shared by 2 cores)
Other cache	
Filesystem	ext3
Disks	1 x 73GB SAS
Other hardware	

JVM Maximum Heap Memory (MB)	3500
JVM Address bits	64
JVM CLASSPATH	jbb.jar: check.jar
JVM BOOTCLASSPATH	/jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/jrockit1.5.0.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/managementapi.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/jmxapi.jar: /jrockit-jdk1.5.0_10/jre/lib/amd64/jrockit/rmp.jar: /jrockit-jdk1.5.0_10/jre/lib/rt.jar: /jrockit-jdk1.5.0_10/jre/lib/i18n.jar: /jrockit-jdk1.5.0_10/jre/lib/sunrsasign.jar: /jrockit-jdk1.5.0_10/jre/lib/jsse.jar: /jrockit-jdk1.5.0_10/jre/lib/jce.jar: /jrockit-jdk1.5.0_10/jre/lib/charsets.jar: /jrockit-jdk1.5.0_10/jre/classes
OS Version	Red Hat Enterprise Linux 5.1 - Kernel 2.6.18-36.el5 (x86_64)
Other software	

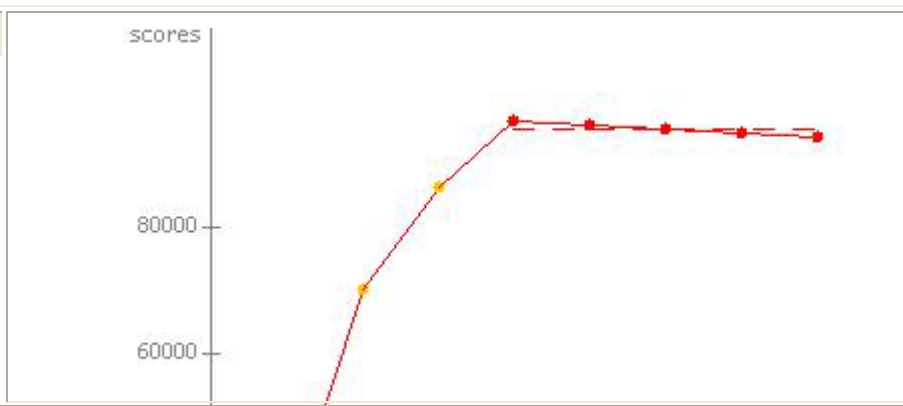
Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Sep 1, 2007
H/w available	
JVM available	2007
OS available	2007
Other s/w available	

AOT Compilation
Tuning
Set vm/nr_hugepages=7300 in /etc/sysctl.conf
Notes
Disabled "Hardware Prefetcher" and "Adjacent Cache Line Prefetch" in the BIOS

JVM 1 Scores:

No errors. Valid run.

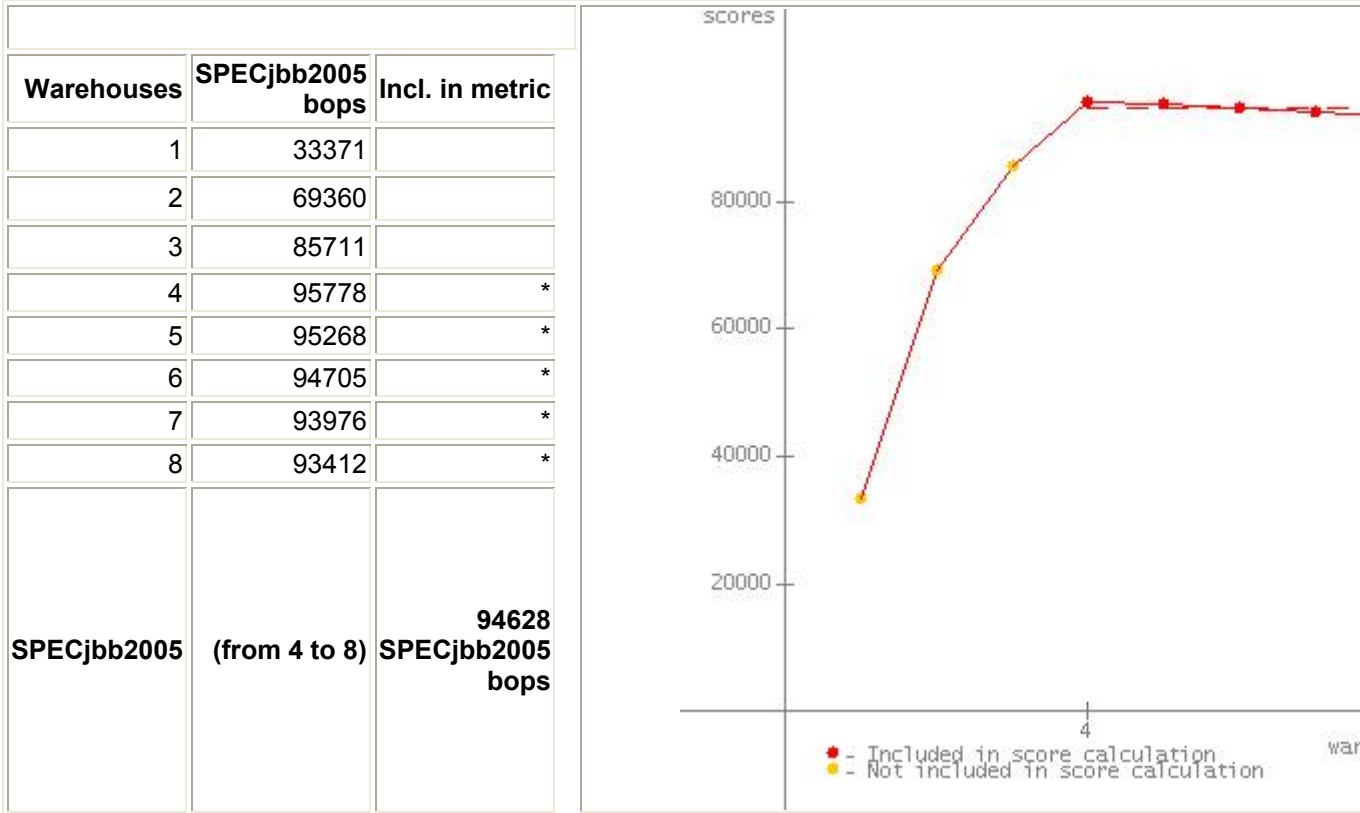
Warehouses	SPECjbb2005 bops	Incl. in metric
1	33097	
2	69983	
3	86296	
4	96957	*
5	96263	*
6	95527	*



7	95001	*
8	94232	*
SPECjbb2005	(from 4 to 8)	95596 SPECjbb2005 bops
SPEC license # 3184		Tested by: Principled Technologies Test date: Sep 1, 2007

JVM 2 Scores:

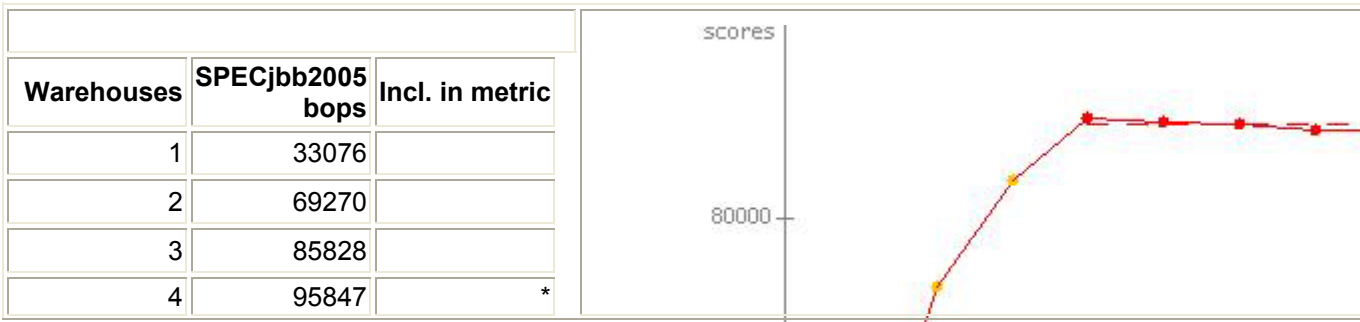
No errors. Valid run.



SPEC license # 3184	Tested by: Principled Technologies Test date: Sep 1, 2007
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JVM 3 Scores:

No errors. Valid run.



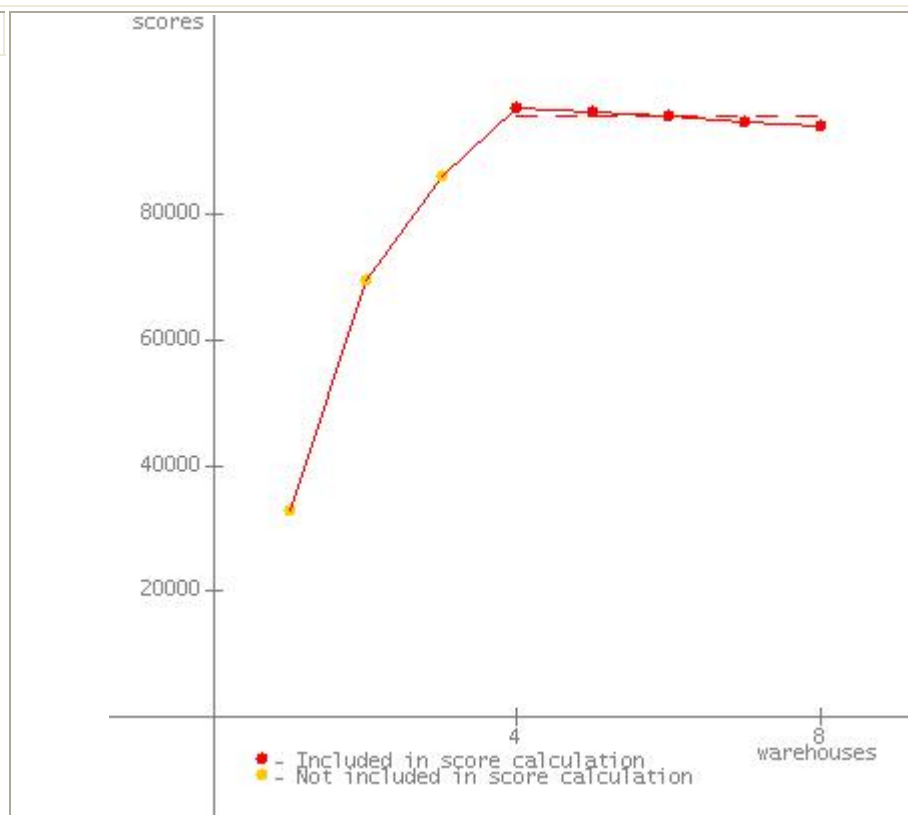
5	95255	*
6	94810	*
7	93853	*
8	93764	*
SPECjbb2005	(from 4 to 8)	94706 SPECjbb2005 bops

SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Sep 1, 2007

JVM 4 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	32963	
2	69618	
3	86227	
4	97032	*
5	96266	*
6	95582	*
7	94543	*
8	94175	*
SPECjbb2005	(from 4 to 8)	95520 SPECjbb2005 bops



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SPECjbb2005 Version: [SPECjbb2005 1.07, March 15, 2006]
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