Principled Technologies®

TEST REPORT
AUGUST 2007

SPECjbb performance and power consumption on multi-processor Intel- and AMD-based servers

Executive summary

Intel® Corporation (Intel) commissioned Principled Technologies (PT) to measure the SPECjbb*2005 performance of multi-processor servers using the following four processors:

- Dual-Core AMD* Opteron* processor 8220 (2.80GHz, 95W)
- Dual-Core Intel Xeon processor 7140M (3.40GHz, 150W)
- Quad-Core Intel Xeon processor E7340 (2.40GHz, 80W)
- Quad-Core Intel Xeon processor L7345 (1.86GHz, 50W)

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).

KEY FINDINGS

- The Quad-Core Intel® Xeon® processor E7340-based server delivered 173.4 percent more performance/watt than the Dual-Core Intel Xeon processor 7140M-based server (see Figure 1). (We calculated performance/watt using system-level power measurements.)
- The Quad-Core Intel Xeon processor L7345-based server delivered 176.8 percent more performance/watt than the Dual-Core Intel Xeon processor 7140M-based server (see Figure 1).
- The Quad-Core Intel Xeon processor E7340-based server delivered 128.1 percent more performance/watt than the Dual-Core AMD* Opteron* processor 8220-based server (see Figure 1).
- The Quad-Core Intel Xeon processor L7345-based server delivered 130.9 percent more performance/watt than the Dual-Core AMD Opteron processor 8220-based server (see Figure 1).

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 bops (business operations per second). Because bops is a rate, a higher number of bops is better. (For more information on SPECjbb2005, go to www.spec.org.)

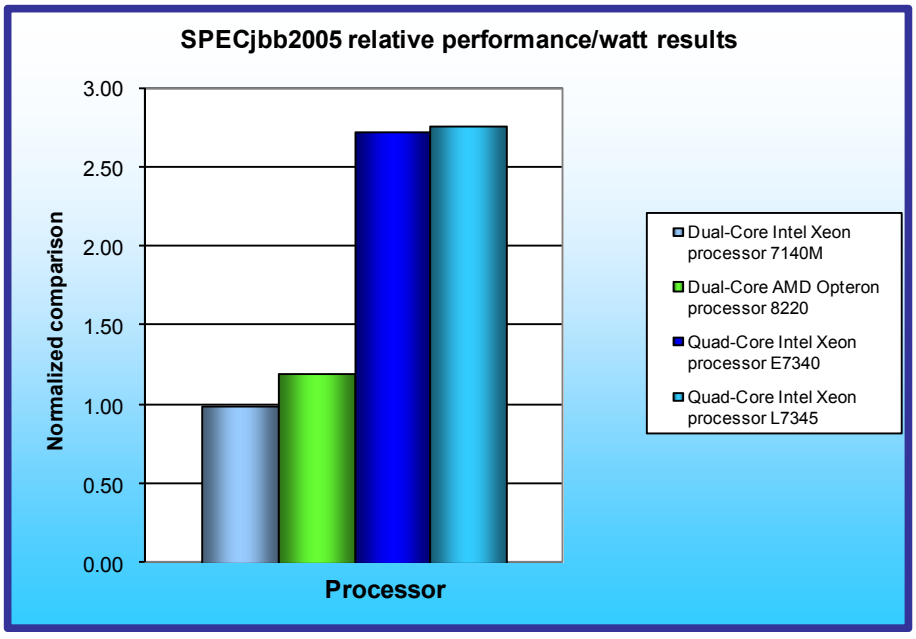


Figure 1: Performance/watt results for the test servers. Higher numbers are better.

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 illustrates the performance/watt for each of the four servers. In this chart, we have normalized the results for each workload to the time the slowest configuration took to complete that workload. The slowest system's result is thus always 1.00. By normalizing, we make each data point in these charts a comparative number, with higher results indicating better performance (i.e., less time to complete the workload with the specified number of threads).

To calculate the performance/watt we used the following formula:

Performance/watt = the benchmark's score/average power consumption in watts during the time period in which the benchmark was delivering peak performance.

As Figure 1 illustrates, the Quad-Core Intel Xeon processor E7340-based server delivered 173.4 percent more performance/watt than the Dual-Core Intel Xeon processor 7140M-based server and 128.1 percent more performance/watt than the Dual-Core AMD Opteron processor 8220-based server. The Quad-Core Intel Xeon processor L7345-based server delivered 176.8 percent more performance/watt than the Dual-Core Intel Xeon processor 7140M-based server and 130.9 percent more performance/watt than the Dual-Core AMD Opteron processor 8220-based server.

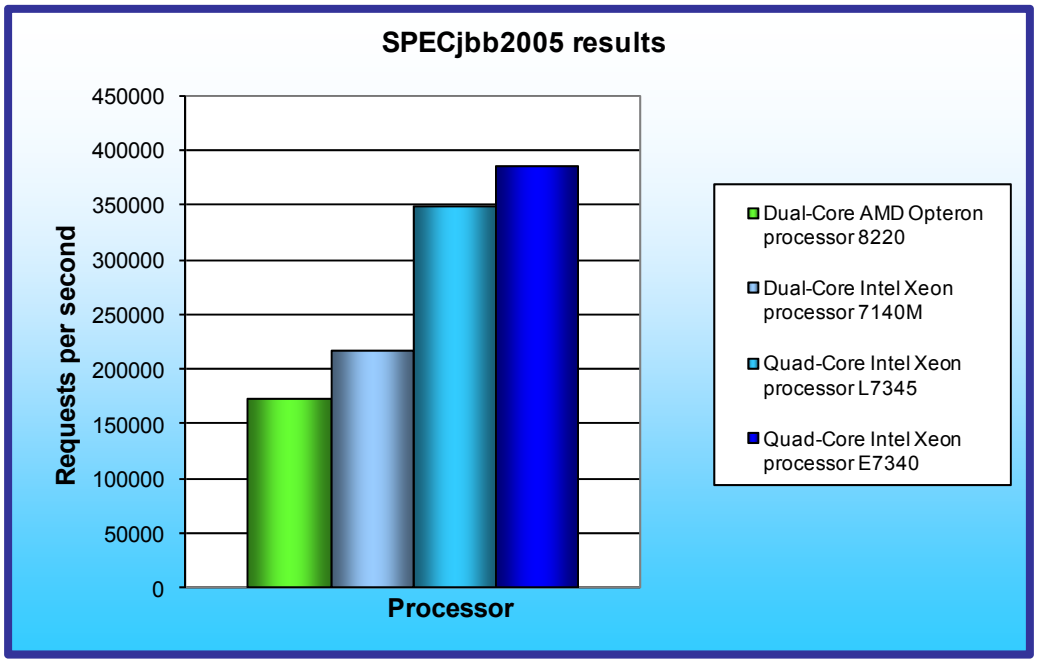


Figure 2: Normalized peak performance of the servers with the SPECjbb2005 workload. Higher numbers are better.

Figure 2 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.

The Quad-Core Intel Xeon processor E7340-based server produced the highest results, 386,169 bops, while the Dual-Core Intel Xeon processor 7140M-based server achieved 217,511 bops. The Quad-Core Intel Xeon processor E7340-based server thus delivered a 77.5 percent performance increase over the Dual-Core Intel Xeon processor 7140M-based server. The Quad-Core Intel Xeon processor E7340-based server delivered a 124.0 percent increase over the Dual-Core AMD Opteron processor 8220-based server, which achieved 172,363 bops.

The Quad-Core Intel Xeon processor L7345-based server achieved 348,858 bops, while the Dual-Core Intel Xeon processor 7140M-based server achieved 217,511 bops. The Quad-Core Intel Xeon processor E7340-based server thus delivered a 60.4 percent performance increase over the Dual-Core Intel Xeon processor 7140M-based server. The Quad-Core Intel Xeon processor L7345-based server delivered a 102.4 percent increase over the Dual-Core AMD Opteron processor 8220-based server, which achieved 172,363 bops.

Figure 3 plots the power usage of the four servers as they ran the benchmark. The increase in total power indicates the measurement interval, the period of peak performance during which we captured power measurements. Lower power consumption is better. (The drop in power consumption back to idle state for all servers occurred when they finished the workload.)

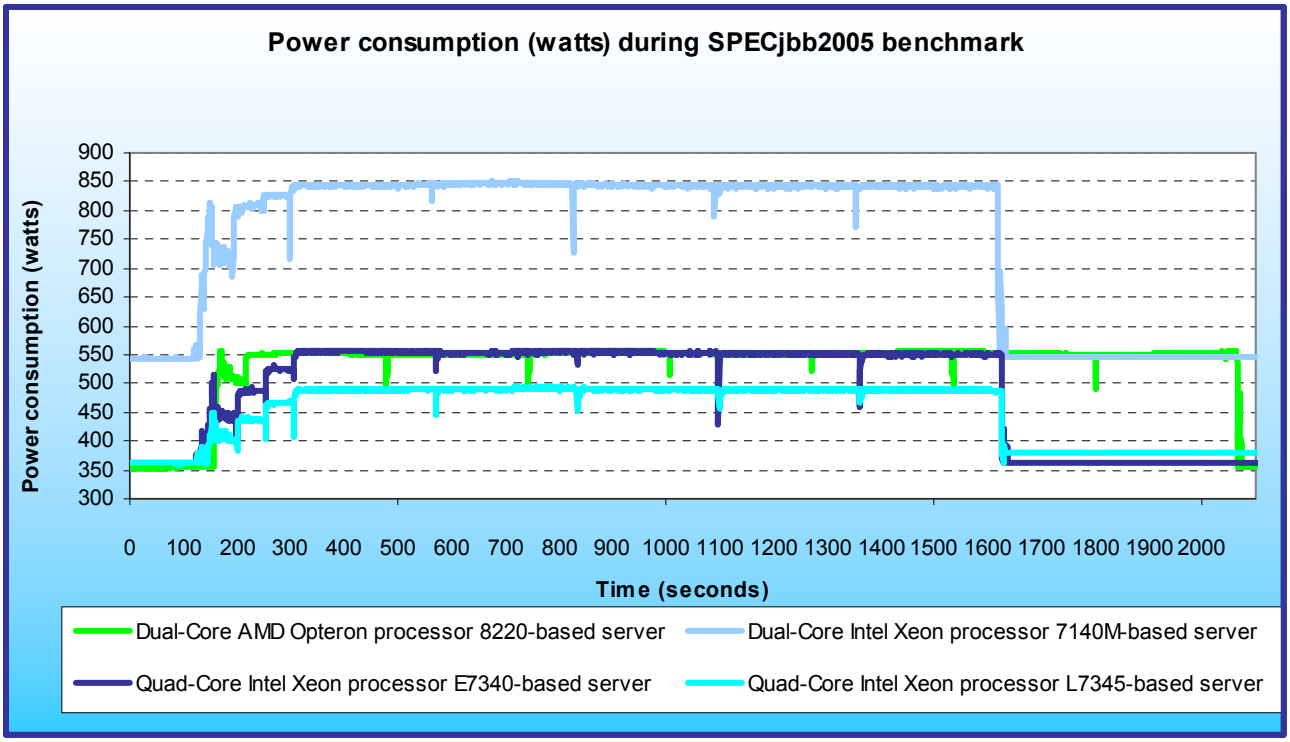


Figure 3: Power consumption (in watts) of the servers throughout the course of executing the SPECjbb2005 benchmark. Lower numbers are better.

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

Before starting the SPECjbb2005 benchmark, we logged into the system and allowed the servers to sit idle for 8 minutes. We then started recording power for 2 minutes. This process meant that all systems were idle for 10 minutes before we began the benchmark.

Figure 4 shows the median SPECjbb2005 results for all four 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 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.)

	Dual-Core AMD Opteron processor 8220	Dual-Core Intel Xeon processor 7140M	Quad-Core Intel Xeon processor E7340	Quad-Core Intel Xeon processor L7345
JVM 1	43,060	54,547	96,757	87,057
JVM 2	43,197	54,409	96,382	87,663
JVM 3	43,065	54,349	95,970	87,116
JVM 4	43,156	54,409	97,143	87,206
Total Score	**172,363**	**217,511**	**386,169**	**348,858**

Figure 4: SPECjbb2005 results for each server by JVM. Higher numbers are better.

Figure 5 shows the results by warehouse for the Dual-Core AMD Opteron processor model 8220-based server for all three runs. Run 2 produced the median results.

Dual-Core AMD Opteron processor model 8220			
	Run 1	**Run 2**	**Run 3**
Warehouse		**JVM 1**	
1	19,214	18,484	18,589
2	43,389	42,937	43,219
3	43,352	43,100	43,037
4	43,059	42,798	42,925
5	42,957	42,655	42,653
6	42,524	42,501	42,455
7	41,871	41,773	41,596
8	41,676	41,288	41,603
Score	**43,266**	**42,945**	**43,060**
Warehouse		**JVM 2**	
1	19,236	18,885	18,993
2	43,344	43,390	43,181
3	43,407	43,278	42,903
4	43,204	42,925	42,808
5	42,850	42,775	42,475
6	42,626	42,647	42,464
7	41,811	41,858	41,440
8	41,814	41,629	41,400
Score	**43,318**	**43,197**	**42,964**
Warehouse		**JVM 3**	
1	18,715	18,263	19,167
2	43,329	42,986	43,175

3	43,085	43,249	43,141
4	42,992	42,959	42,645
5	42,563	42,816	42,504
6	42,480	42,537	42,128
7	41,421	41,708	41,445
8	41,441	41,555	41,371
Score	**43,135**	**43,065**	**42,987**
Warehouse	**JVM 4**		
1	18,048	18,866	19,043
2	43,206	43,461	43,083
3	43,452	43,060	43,129
4	43,246	42,947	42,858
5	42,923	42,862	42,844
6	42,596	42,704	42,768
7	41,817	41,940	41,662
8	41,354	41,532	41,558
Score	**43,301**	**43,156**	**43,023**
Total Score	**173,020**	**172,363**	**172,034**

Figure 5: SPECjbb2005 results for the Dual-Core AMD Opteron processor model 8220-based server. Higher numbers are better.

Figure 6 shows the results by warehouse for the Dual-Core Intel Xeon processor 7140M-based server for all three runs. Run 1 produced the median results.

Dual-Core Intel Xeon processor 7140M			
	Run 1	**Run 2**	**Run 3**
Warehouse	**JVM 1**		
1	17,278	17,514	16,465
2	43,750	43,042	42,515
3	49,825	50,203	49,511
4	54,629	55,146	54,956
5	54,348	54,827	54,863
6	53,929	54,687	54,595
7	53,657	54,258	54,308
8	53,423	53,819	54,042
Score	**53,997**	**54,547**	**54,553**
Warehouse	**JVM 2**		
1	16,735	16,296	16,389
2	43,684	43,838	43,695
3	49,452	49,746	49,940
4	54,705	54,589	54,851
5	54,766	54,403	54,764
6	54,575	54,074	54,511
7	54,082	53,543	54,123
8	53,918	53,315	53,923
Score	**54,409**	**53,985**	**54,434**
Warehouse	**JVM 3**		
1	15,885	16,715	16,571
2	44,946	42,110	44,301
3	50,531	49,782	49,562
4	55,199	54,764	54,869
5	54,847	54,446	54,525

6	54,757	54,217	54,392
7	54,251	53,769	54,101
8	54,001	53,409	53,856
Score	**54,611**	**54,121**	**54,349**
Warehouse		**JVM 4**	
1	16,856	16,331	17,439
2	44,428	44,664	44,616
3	50,139	50,027	49,833
4	54,949	54,774	54,958
5	54,747	54,374	54,685
6	54,608	54,365	54,465
7	54,246	53,872	54,088
8	53,921	53,502	53,847
Score	**54,494**	**54,178**	**54,409**
Total Score	**217,511**	**216,831**	**217,745**

Figure 6: SPECjbb2005 results for the Dual-Core Intel Xeon processor 7140M-based server. Higher numbers are better.

Figure 7 shows the results by warehouse for the Quad-Core Intel Xeon processor E7340-based server for all three runs. Run 2 produced the median results.

Quad-Core Intel Xeon processor E7340			
	Run 1	**Run 2**	**Run 3**
Warehouse		**JVM 1**	
1	28,599	27,923	29,176
2	64,691	64,110	64,614
3	84,703	84,320	84,565
4	98,240	97,501	98,414
5	97,368	96,862	96,860
6	97,001	95,673	96,767
7	96,200	95,350	95,990
8	95,633	95,332	95,754
Score	**96,888**	**96,144**	**96,757**
Warehouse		**JVM 2**	
1	29,017	28,826	28,555
2	63,839	65,110	64,874
3	84,306	84,376	83,810
4	97,945	97,670	97,571
5	97,188	96,978	96,397
6	96,962	95,827	96,103
7	96,346	95,963	96,004
8	95,885	95,498	95,606
Score	**96,865**	**96,382**	**96,336**
Warehouse		**JVM 3**	
1	28,352	28,486	28,926
2	65,087	65,291	64,498
3	84,378	83,684	83,535
4	97,179	97,516	96,878
5	96,758	96,788	95,979
6	95,664	95,348	95,803
7	95,313	95,524	95,501
8	94,938	95,214	95,114

Score	95,970	96,078	95,855
Warehouse		JVM 4	
1	28,617	28,728	29,103
2	65,259	65,705	65,219
3	84,219	85,195	84,307
4	98,322	98,783	97,486
5	97,910	98,101	96,446
6	96,975	97,247	95,775
7	96,423	96,912	95,442
8	96,086	96,785	95,587
Score	**97,143**	**97,565**	**96,147**
Total Score	**386,866**	**386,169**	**385,095**

Figure 7: SPECjbb2005 results for the Quad-Core Intel Xeon processor L7340-based server. Higher numbers are better.

Figure 8 shows the results by warehouse for the Quad-Core Intel Xeon processor L7345-based server for all three runs. Run 3 produced the median results.

Quad-Core Intel Xeon processor L7345			
	Run 1	Run 2	Run 3
Warehouse		JVM 1	
1	23,653	23,624	23,240
2	54,457	54,596	54,386
3	73,419	73,781	73,567
4	88,268	88,429	97,952
5	87,553	87,634	87,388
6	86,895	87,413	86,857
7	86,374	86,721	86,310
8	86,198	86,549	85,858
Score	**87,057**	**87,349**	**86,873**
Warehouse		JVM 2	
1	23,385	23,775	23,608
2	54,835	55,266	54,112
3	73,694	74,624	73,560
4	88,707	89,395	88,634
5	87,793	88,914	88,000
6	87,266	88,184	87,671
7	87,141	87,762	86,975
8	86,846	87,414	87,035
Score	**87,551**	**88,334**	**87,663**
Warehouse		JVM 3	
1	23,108	23,502	23,954
2	54,070	53,346	54,853
3	72,821	72,848	73,656
4	87,228	88,101	87,866
5	86,819	87,635	87,686
6	86,207	87,237	87,188
7	85,863	86,902	86,593
8	85,354	86,359	86,248
Score	**86,294**	**87,247**	**87,116**
Warehouse		JVM 4	
1	24,005	23,070	23,677

2	54,576	54,204	53,736
3	73,356	73,220	73,324
4	88,608	88,219	88,196
5	87,923	87,684	87,607
6	87,034	87,022	87,191
7	87,012	86,504	86,695
8	86,682	86,141	86,339
Score	**87,452**	**87,114**	**87,206**
Total Score	**348,354**	**350,044**	**348,858**

Figure 8: SPECjbb2005 results for the Quad-Core Intel Xeon processor L7345-based server. Higher numbers are better.

Figure 9 details the power consumption, in watts, of the test servers while idle and during the median run of the SPECjbb2005 benchmark.

Server	Idle power (watts)	Average power (watts)
Dual-Core AMD Opteron processor 8220	353.5	549.8
Dual-Core Intel Xeon processor 7140M	545.0	831.8
Quad-Core Intel Xeon processor E7340	361.5	540.1
Quad-Core Intel Xeon processor L7345	361.3	482.0

Figure 9: Average power usage (in watts) of the test servers while idle and during the median run of SPECjbb2005. Lower numbers are better.

Test methodology

Figure 10 summarizes some key aspects of the configurations of the four server systems; Appendix A provides detailed configuration information.

Server	Dual-Core AMD Opteron processor 8220	Dual-Core Intel Xeon processor 7140M	Quad-Core Intel Xeon processor E7340	Quad-Core Intel Xeon processor L7345
Processor frequency (GHz)	2.8 GHz	3.4 GHz	2.4 GHz	1.86 GHz
Front-side bus frequency (MHz)	2000 MHz HyperTransport	800 MHz	1066 MHz	1066 MHz
Number of processor packages	4	4	4	4
Number of cores per processor package	2	2	4	4
Number of hardware threads per core	1	2	1	1
Motherboard	HP* PB729AE9QUDO49	Intel SE8500HW4	Intel S7000FC4UR	Intel S7000FC4UR
Chipset	NVIDIA* nForce4	Intel SE8500	Intel ID3600	Intel ID3600
RAM (16 GB in each)	16GB (16 x 1GB) PC2-5300 DDR2	16GB (16 x 1GB) PC2-5300 DDR2	16GB (16 x 1GB) PC2-5300 FB-DDR2	16GB (16 x 1GB) PC2-5300 FB-DDR2
Hard Drive	HP DH072ABAA6	Seagate* ST3146854LC	Seagate ST973401SS	Seagate ST973401SS

Figure 10: Summary of some key aspects of the server configurations.

Intel configured and provided all four servers.

We began our testing by installing a fresh copy of Microsoft* Windows 2003 Server*, x64 Enterprise Edition Service Pack 2 on each server. We followed this process for each installation:

1. Assign a computer name of "Server".
2. For the licensing mode, use the default setting of five concurrent connections.
3. Enter a password for the administrator logon.
4. Select Eastern Time Zone.
5. Use typical settings for the Network installation.
6. Use "Testbed" for the workgroup.

We applied the following updates from the Microsoft Windows Update site:

- Security Update for Internet Explorer* 7 for Windows Server 2003 x64 Edition (KB933566)
- Security Update for Outlook* Express for Windows Server 2003 x64 Edition (KB929123)
- Security Update for Windows Server 2003 x64 Edition (KB935839)
- Security Update for Windows Server 2003 x64 Edition (KB935840)
- Security Update for Internet Explorer 6 for Windows Server 2003 x64 Edition (KB933566)
- Security Update for Windows Server 2003 x64 Edition (KB924667)
- Update for Windows Server 2003 x64 Edition (KB927891)
- Security Update for Windows Server 2003 x64 Edition (KB932168)
- Windows Internet Explorer 7.0 for Windows Server 2003 (x64)
- Security Update for Windows Server 2003 x64 Edition (KB930178)
- Security Update for Windows Server 2003 x64 Edition (KB925902)
- Update for Windows Server 2003 Service Pack 2 x64 Edition (KB931836)

With the exception of disabling HW Prefetcher and Adjacent Cache Line Prefetcher, we used the default BIOS settings on all servers.

To improve Java performance, we enabled large pages in memory on all servers. To enable this service, the administrator must first assign additional privileges to the user who will be running the application. We assigned this privilege only to the administrator, because we used that account for our tests. To enable large pages, we selected the following:

- Control Panel→Administrative Tools→Local Security Policy
- Local Policies→User Rights Assignment
- "Lock pages in memory," add users and/or groups

Power measurement procedure

To record each server's power consumption during each test, we used an Extech* Instruments (www.extech.com) 380803 Power Analyzer/Datalogger. We connected the power cord from the server under test to the Power Analyzer's output load power outlet. We then plugged the power cord from the Power Analyzer's input voltage connection into a power outlet.

We used the Power Analyzer's Data Acquisition Software (version 2.11) to capture all recordings. We installed the software on a separate Intel–processor-based PC, which we connected to the Power Analyzer via an RS-232 cable. We captured power consumption at one-second intervals.

To gauge the idle power usage, we recorded the power usage for two minutes while each server was running the operating system but otherwise idle.

We then recorded the power usage (in watts) for each server during the testing at one-second intervals. To compute the average power usage, we averaged the power usage during the time the server was producing its peak performance results. We call this time the power measurement interval. See Figures 3 (power consumption over time) and 9 (idle and average peak power) for the results of these measurements.

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 C:\SPECjbb2005v1.07 on the server's hard disk.

SPECjbb2005 requires a Java Virtual Machine on the system under test. We used the BEA JRockit 5.0 (P27.1.1 build P27.2.0-19-82330-1.5.0_10-20070515-1627-Windows-x86_64 JDK for Microsoft Windows) 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 4. This change allows a server to run 4 JVM instances during testing.

We created a batch file, 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 window within Microsoft Windows Server 2003 x64 Edition to run this batch file. Figure 11 and 12 shows the contents of the files used on all Intel servers and the AMD server, respectively.

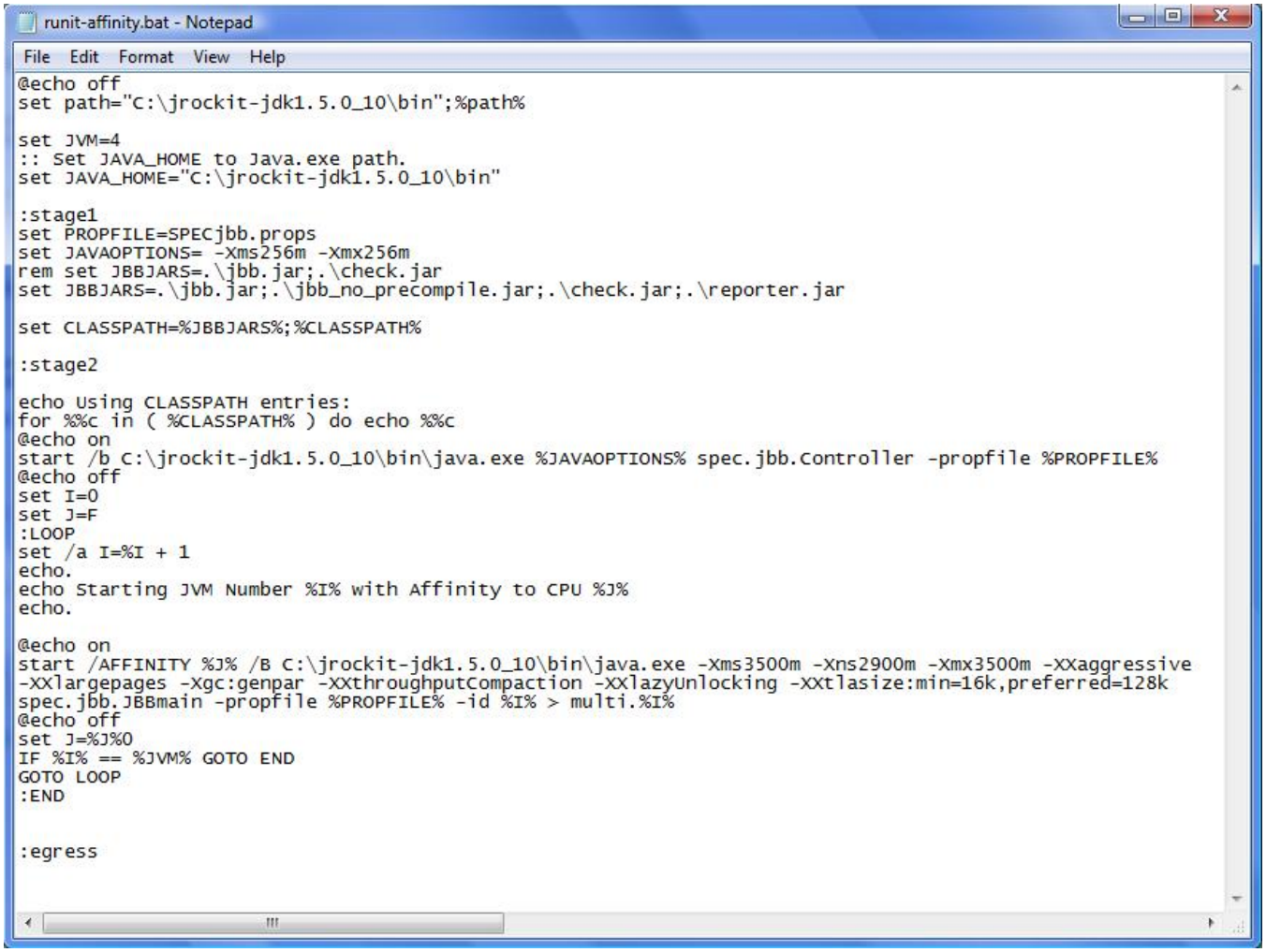


Figure 11: The text of the batch file we used to execute the SPECjbb2005 benchmark on all Intel processor-based servers.

In the batch file we set the Java options that control the performance of the JVM.

- *-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.
- *-Xns2900m* This option sets the JVM nursery size.
- *-Xmx3500m* This option sets the maximum heap 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.
- *-XXtlasize* This option sets the thread-local area size the JVM uses.

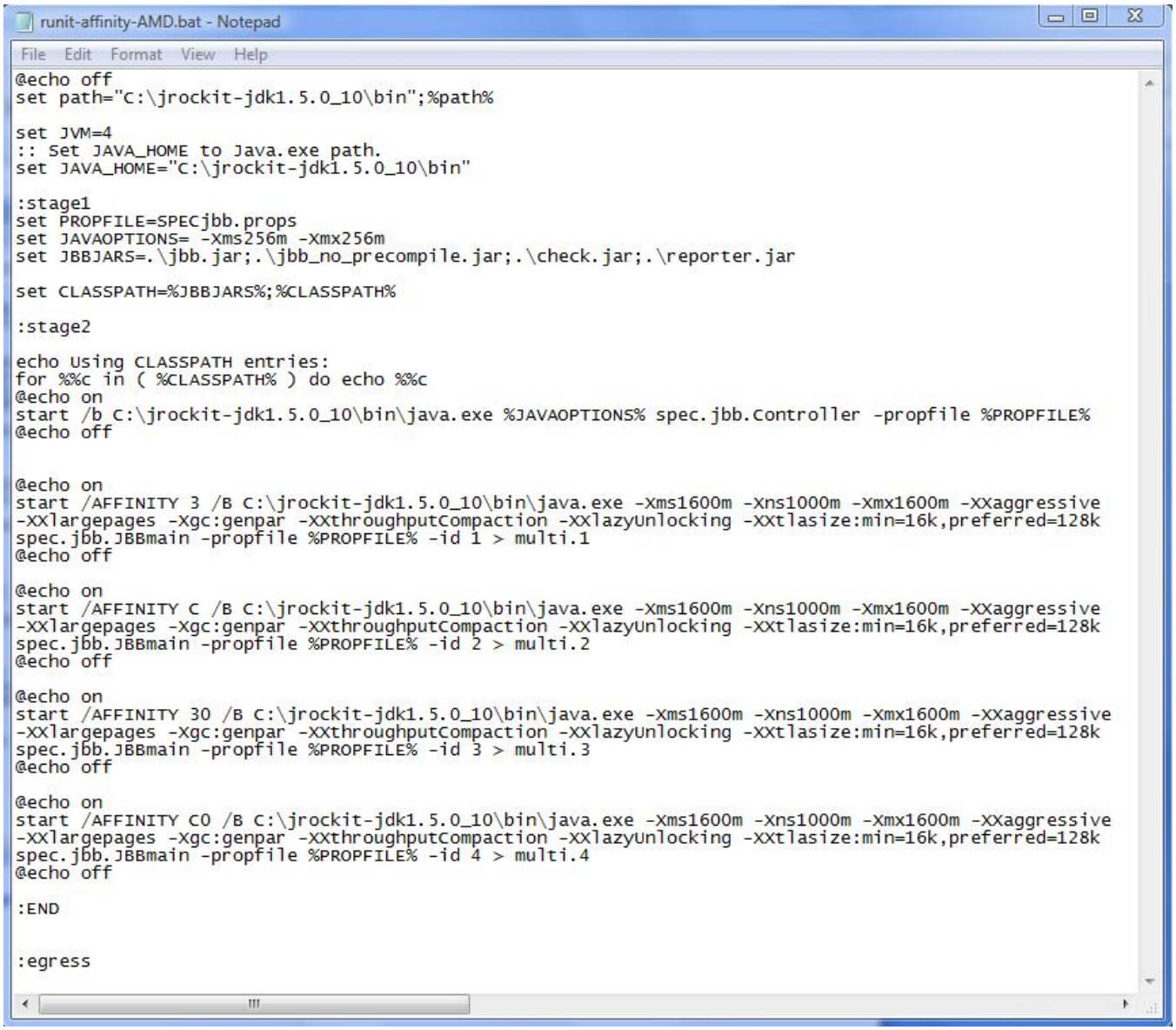


Figure 12: The text of the batch file we used to execute the SPECjbb2005 benchmark on the Dual-Core AMD Opteron processor 8220-based server.

Due to differences in the number of available execution units in the systems, we had to use a different batch file for the Dual-Core AMD Opteron processor 8220-based server. Setting processor affinity maps an active process to an assigned execution unit. The Dual-Core AMD Opteron processor 8220-based server has 4 physical processors with 2 cores per processor, or 8 total execution units. All Intel Xeon-based servers used in testing have 16 total execution units.

For testing, we used Java options to achieve the highest results on all servers. During some experimental testing we tried various heap sizes for all servers. The Dual-Core AMD Opteron processor 8220-based server achieved the highest score with a 1600m heap size, while all Intel Xeon-based servers achieved the highest results with 3500m heap size. Therefore the two batch files use different heap sizes between the two batch files. All other Java options were the same for testing.

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	Dual-Core AMD Opteron processor 8220	Dual-Core Intel Xeon processor 7140M	Quad-Core Intel Xeon processor E7340	Quad-Core Intel Xeon processor L7345
General processor setup				
Number of processor packages	4	4	4	4
Number of cores per processor package	2	2	4	4
Number of hardware threads per core	1	2	1	1
System Power Management Policy	Always on	Always on	Always on	Always on
CPU				
Vendor	AMD	Intel	Intel	Intel
Name	AMD Opteron 8220	Dual-Core Intel Xeon MP 7140M	Quad-Core Intel Xeon E7340	Quad-Core Intel Xeon L7345
Stepping	3	8	B	B
Socket type	Socket F (1207)	mPGA604	mPGA604	mPGA604
Core frequency (GHz)	2.8 GHz	3.4 GHz	2.4 GHz	1.86 GHz
Front-side bus frequency (MHz)	2000 MHz HyperTransport	800 MHz	1066 MHz	1066 MHz
L1 Cache	64 KB + 64 KB (per core)	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 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	NA	16 MB	NA	NA
Thermal Design Power (TDP, in watts)	95	150	80	50
Platform				
Vendor and model number	HP ProLiant* DL585 G2	Intel	Intel	Intel
Motherboard model number	PB729AE9QUDO49	SR4850HW4x	S7000FC4UR	S7000FC4UR
Motherboard chipset	NVIDIA nForce4	Intel SE8501	Intel ID3600	Intel ID3600
Motherboard revision number	A4	11	01	01
BIOS name and version	HP BIOS A07 (v2.10)	Intel Corporation SHW40.86B.P.12.00.0076, 02/15/2007	Intel SFC4UR.86B.01.00.0010.050420071510	Intel SFC4UR.86B.01.00.0010.050420071510
BIOS settings	Default	Disabled HW prefetcher/enabled adjacent cache line prefetcher	Disabled HW prefetcher and adjacent cache line prefetcher	Disabled HW prefetcher and adjacent cache line prefetcher
Chipset INF driver	HP 1.0.0.0	Intel 8.3.0.1013	Intel 8.4.0	Intel 8.4.0

Servers	Dual-Core AMD Opteron processor 8220	Dual-Core Intel Xeon processor 7140M	Quad-Core Intel Xeon processor E7340	Quad-Core Intel Xeon processor L7345
Memory module(s)				
Vendor and model number	Micron* MT18HTF12872PDY-667D2	ELPIDA* EBE10RD4AGFA-6E-E	Kingston* KVR667D2D8F5/1G	Kingston KVR667D2D8F5/1G
Type	PC2-5300 DDR2	PC2-5300 DDR2	PC2-5300 FB-DDR2	PC2-5300 FB-DDR2
Speed (MHz)	667 MHz	667 MHz	667 MHz	667 MHz
Speed in the system currently running @ (MHz)	667 MHz	400 MHz	667 MHz	667 MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15	3-3-3-9	5-5-5-15	5-5-5-15
Size	16382 MB	16382 MB	16382 MB	16382 MB
Number of RAM modules	16	16	16	16
Chip organization	Double-sided	Double-sided	Double-sided	Double-sided
Hard disk				
Vendor and model number	HP DH072ABAA6	Seagate ST3146854LC	Seagate ST973401SS	Seagate ST973401SS
Number of disks in system	1	1	1	1
Size	72 GB	146.8 GB	73.4 GB	73.4 GB
Buffer Size	16 MB	8 MB	8 MB	8 MB
RPM	15,000	15,000	10,000	10,000
Type	SAS	SCSI	SAS	SAS
Controller	Smart Array* P400 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
Driver version	HP 6.6.0.64	Microsoft 5.2.3790.3959	LSI 2.8.0.64	LSI 2.8.0.64
Operating system				
Name	Microsoft Windows Server 2003 Enterprise x64 Edition	Microsoft Windows Server 2003 Enterprise x64 Edition	Microsoft Windows Server 2003 Enterprise x64 Edition	Microsoft Windows Server 2003 Enterprise x64 Edition
Build number	3790	3790	3790	3790
Service Pack	SP2	SP2	SP2	SP2
File system	NTFS	NTFS	NTFS	NTFS
Kernel	ACPI	ACPI	ACPI	ACPI
Language	English	English	English	English
Microsoft DirectX version	9.0c	9.0c	9.0c	9.0c
Graphics				
Vendor and model number	ATI* ES1000	ATI Radeon* 7000	ATI ES1000	ATI ES1000

Servers	Dual-Core AMD Opteron processor 8220	Dual-Core Intel Xeon processor 7140M	Quad-Core Intel Xeon processor E7340	Quad-Core Intel Xeon processor L7345
Chipset	ES1000	ATI Radeon 7000 PCI	ES1000	ES1000
BIOS version	BK-ATI VER008.005.013.000	BK-ATI VER008.004.037.001	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000
Type	Integrated	Integrated	Integrated	Integrated
Memory size	32 MB	16 MB	32 MB	32 MB
Resolution	1024x768	1024x768	1024x768	1024x768
Driver version	ATI 8.24.3.0	ATI 6.14.10.6508	ATI 8.24.3.0	ATI 8.24.3.0
Network card/subsystem				
Vendor and model number	HP NC371i Multifunction Gigabit Server Adapter	Broadcom* BCM5704 dual NetXtreme* Gigabit Adapter	Intel PRO/1000 EB/Intel 82575EB	Intel PRO/1000 EB/Intel 82575EB
Type	Integrated	Integrated	Integrated	Integrated
Driver version	HP 3.0.5.0	Microsoft 7.98.0.0	Intel 9.9.8.0/Intel 10.0.15.0	Intel 9.9.8.0/Intel 10.0.15.0
Optical drive				
Vendor and model number	TEAC* DW-224E-R	Philips* SDR089	Optiarc* DVD-ROM DDU810A	Optiarc DVD-ROM DDU810A
USB ports				
Number	4	5	5	5
Type	USB 2.0	USB 2.0	USB 2.0	USB 2.0
Power supplies				
Total number	1	1	1	1
Wattage of each	1300	1470	1570	1570
Cooling fans				
Total number	6	4	8	8
Dimensions	120 mm	120 mm	4x80 mm + 4x120mm	4x80 mm + 4x120mm
Voltage	12 V	12 V	12 V	12 V
Amps	3.9 A	3.3 A	4 x 1.76 A + 4 x 3.3 A	4 x 1.76 A + 4 x 3.3 A

Figure 13: Detailed system configuration information for the four test servers.

Appendix B – SPECjbb2005 output

This appendix provides the SPECjbb2005 output files from the median run for all test servers.

Dual-Core AMD Opteron processor 8220-based server

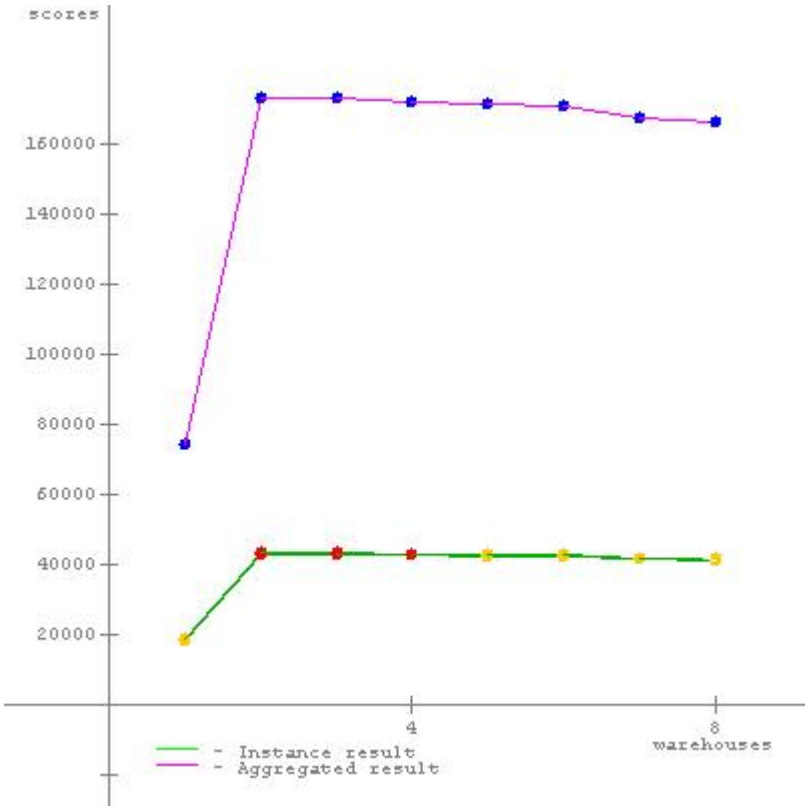
SPECjbb2005

SPECjbb2005 bops = 172363, SPECjbb2005 bops/JVM = 43091

HP ProLiant DL585 G2

BEA JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)

JVM run	JVM Scores
1	42945
2	43197
3	43065
4	43156
SPECjbb2005 bops = 172363, SPECjbb2005 bops/JVM = 43091	



Hardware	
Hardware Vendor	HP
Vendor URL	http://www.HP.com
Model	ProLiant DL585 G2
Processor	Dual-Core AMD Opteron processor 8220
MHz	2800
# 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 P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)
JVM Command Line	start /AFFINITY /B java.exe –Xms1600m –Xns1000m -Xmx1600m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap	1600

HW Threading Enabled?	No
Procs Avail to Java	8
Memory (MB)	16384
Memory Details	16 x 1GB DDR2-667 DIMM
Primary cache	64KBI+64KBD (per core)
Secondary cache	2 x 1MB
Other cache	
Filesystem	NTFS
Disks	1 x 72GB SAS
Other hardware	

Memory (MB)	
JVM Maximum Heap Memory (MB)	1600
JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; .\jbb_no_precompile.jar; .\check.jar; .\reporter.jar;
JVM BOOTCLASSPATH	C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jrockit1.5.0.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\managementapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jmxmapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\rmp.jar; C:\jrockit-jdk1.5.0_10\jre\lib\rt.jar; C:\jrockit-jdk1.5.0_10\jre\lib\i18n.jar; C:\jrockit-jdk1.5.0_10\jre\lib\sunrsasign.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jsse.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jce.jar; C:\jrockit-jdk1.5.0_10\jre\lib\charsets.jar; C:\jrockit-jdk1.5.0_10\jre\classes
OS Version	Microsoft Windows 2003 Server, x64 Enterprise Edition Service Pack 2
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Mar 18, 2007
H/w available	
JVM available	2007
OS available	2003
Other s/w available	

AOT Compilation

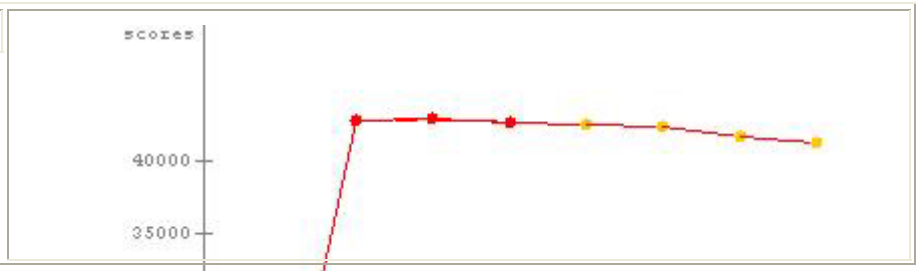
Tuning
In the local security settings, "Lock pages in memory" was enabled

Notes

JVM 1 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	18484	
2	42937	*
3	43100	*



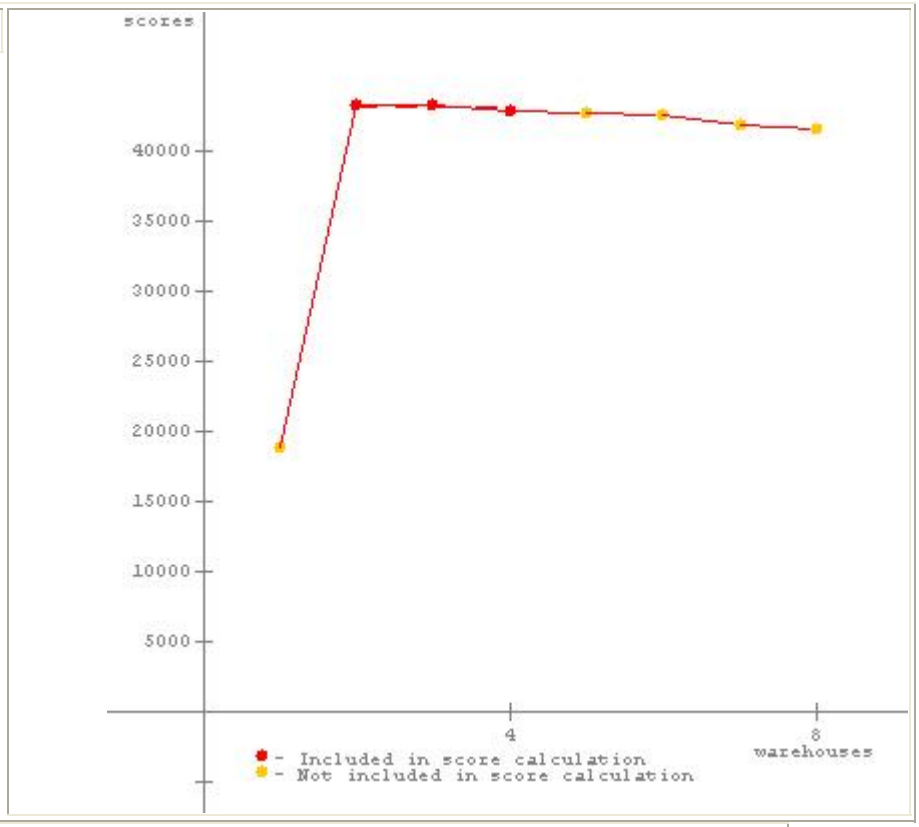
4	42798	*
5	42655	
6	42501	
7	41773	
8	41288	
SPECjbb2005	**(from 2 to 4)**	**42945 SPECjbb2005 bops**

SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Mar 18, 2007

JVM 2 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**
1	18885	
2	43390	*
3	43278	*
4	42925	*
5	42775	
6	42647	
7	41858	
8	41629	
SPECjbb2005	**(from 2 to 4)**	**43197 SPECjbb2005 bops**



SPEC license # 3184 **Tested by:** Principled Technologies **Test date:** Mar 18, 2007

JVM 3 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**

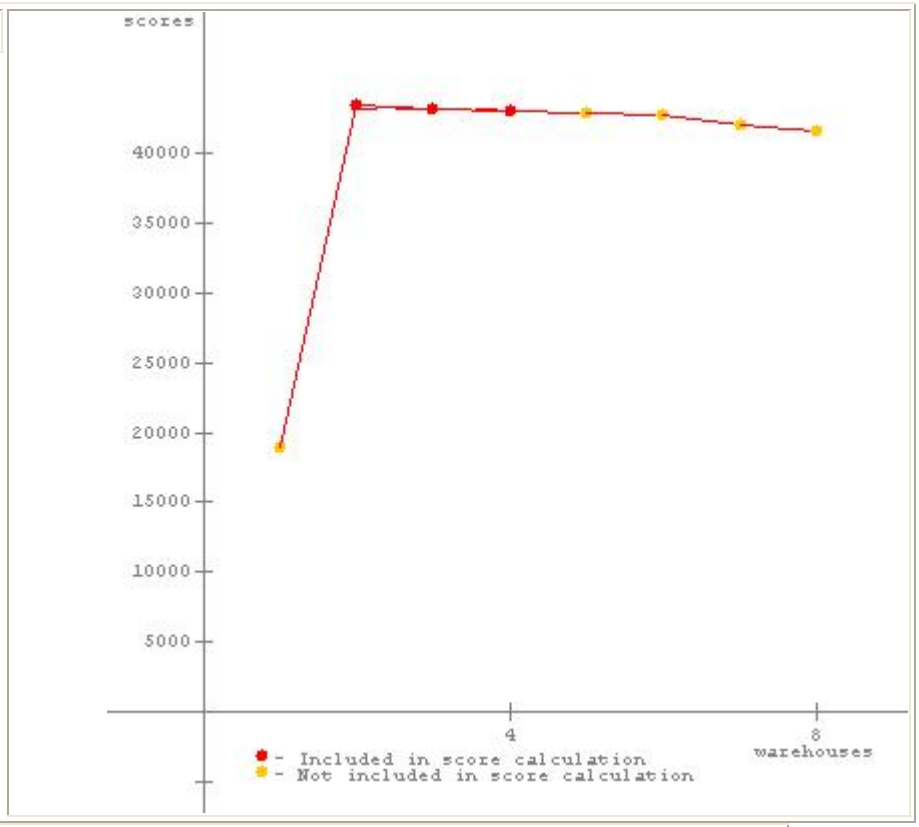
1	18263	
2	42986	*
3	43249	*
4	42959	*
5	42816	
6	42537	
7	41708	
8	41555	
SPECjbb2005	**(from 2 to 4)**	**43065 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Mar 18, 2007

JVM 4 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**
1	18866	
2	43461	*
3	43060	*
4	42947	*
5	42862	
6	42704	
7	41940	
8	41532	
SPECjbb2005	**(from 2 to 4)**	**43156 SPECjbb2005 bops**



SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Mar 18, 2007

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

Dual-Core Intel Xeon processor 7140M-based server

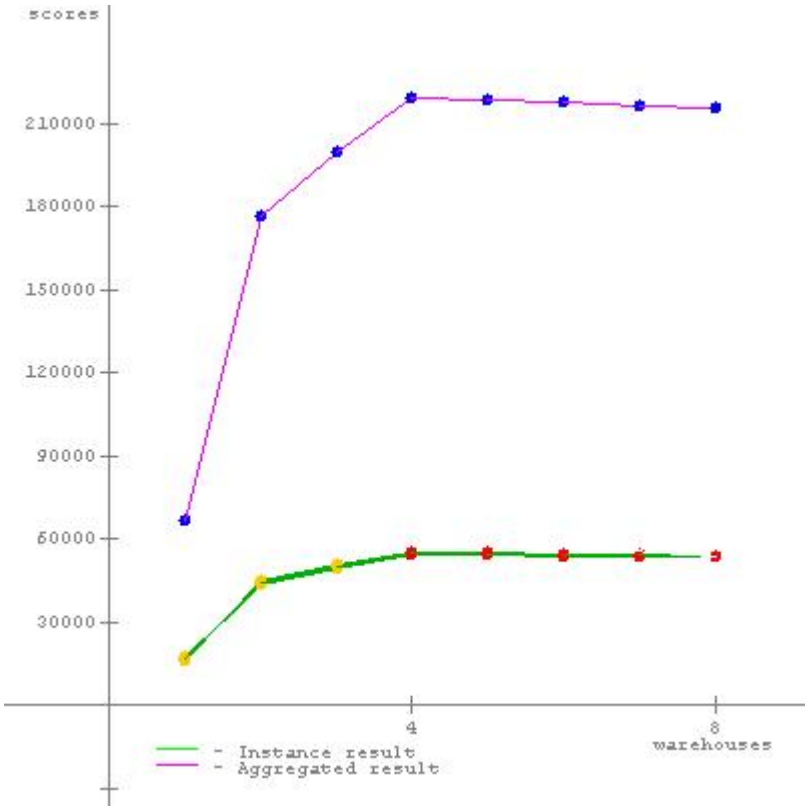
SPECjbb2005

SPECjbb2005 bops = 217511, SPECjbb2005 bops/JVM = 54378

Intel SR4850HW4x

BEA JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)

JVM run	JVM Scores
1	53997
2	54409
3	54611
4	54494
SPECjbb2005 bops = 217511, SPECjbb2005 bops/JVM = 54378	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	Intel SR4850HW4x
Processor	Dual-Core Intel Xeon processor 7140M
MHz	3400
# of Chips	4
# of Cores	8
# of Cores/Chip	2
HW Threading Enabled?	Yes
Procs Avail to	16

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)
JVM Command Line	start /AFFINITY /B java.exe -Xms3500m –Xns2900m –Xmx3500m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap Memory (MB)	3500
JVM Maximum Heap Memory	3500

Java	
Memory (MB)	16384
Memory Details	16 x 1GB DDR2-667 DIMM
Primary cache	12KB + 16KB
Secondary cache	1MB
Other cache	16MB
Filesystem	NTFS
Disks	1 x 146.8GB SCSI
Other hardware	

(MB)	
JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; .\jbb_no_precompile.jar; .\check.jar; .\reporter.jar;
JVM BOOTCLASSPATH	C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jrockit1.5.0.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\managementapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jmxmapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\rmp.jar; C:\jrockit-jdk1.5.0_10\jre\lib\rt.jar; C:\jrockit-jdk1.5.0_10\jre\lib\i18n.jar; C:\jrockit-jdk1.5.0_10\jre\lib\sunrsasign.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jsse.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jce.jar; C:\jrockit-jdk1.5.0_10\jre\lib\charsets.jar; C:\jrockit-jdk1.5.0_10\jre\classes
OS Version	Microsoft Windows 2003 Server, x64 Enterprise Edition Service Pack 2
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Jan 2, 2001
H/w available	
JVM available	2007
OS available	2003
Other s/w available	

AOT Compilation

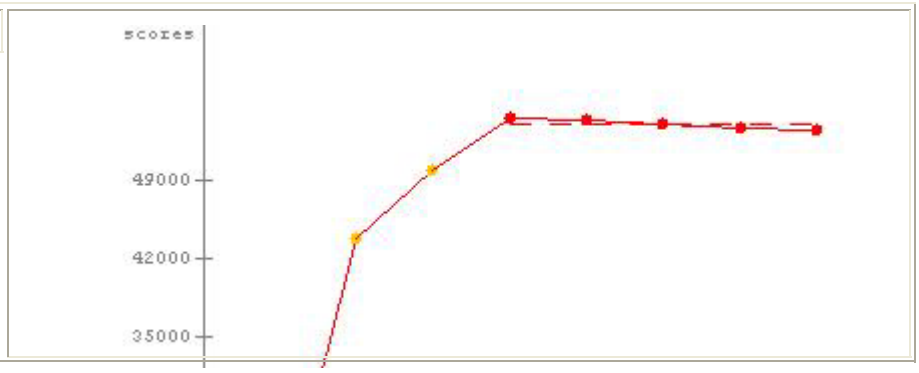
Tuning
In the local security settings, "Lock pages in memory" was enabled

Notes
Disabled "Hardware Prefetching" and enabled "Adjacent Cache Line Prefetch" in the BIOS

JVM 1 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	17278	
2	43750	
3	49825	
4	54629	*
5	54348	*



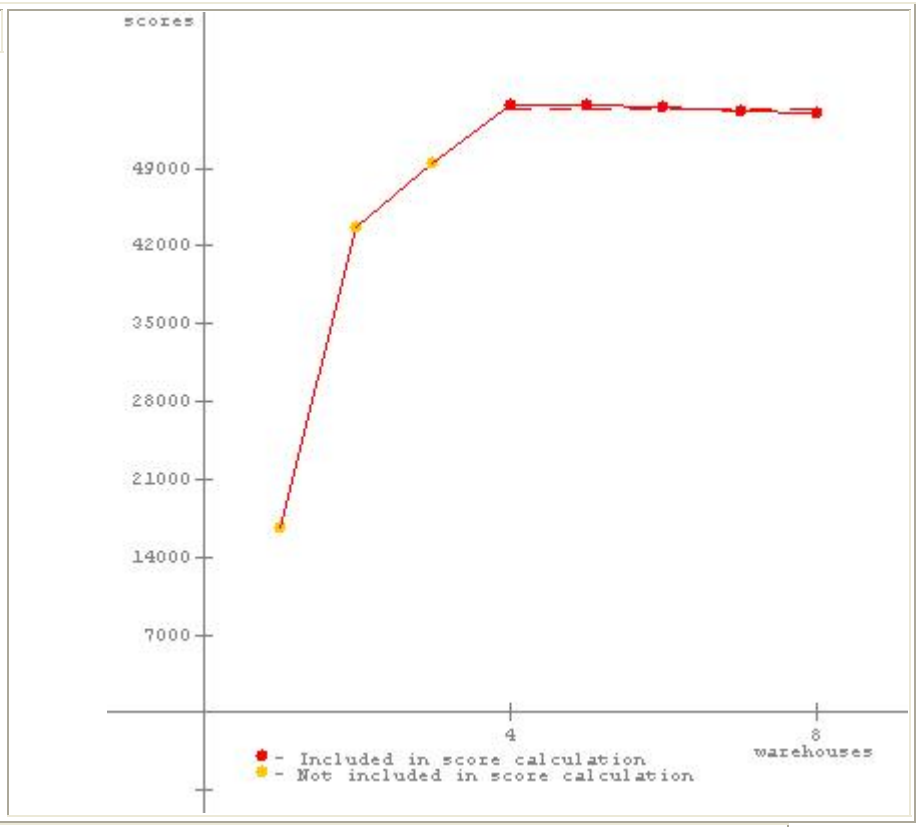
6	53929	*
7	53657	*
8	53423	*
SPECjbb2005	**(from 4 to 8)**	**53997 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 2, 2001

JVM 2 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**
1	16735	
2	43684	
3	49452	
4	54705	*
5	54766	*
6	54575	*
7	54082	*
8	53918	*
SPECjbb2005	**(from 4 to 8)**	**54409 SPECjbb2005 bops**

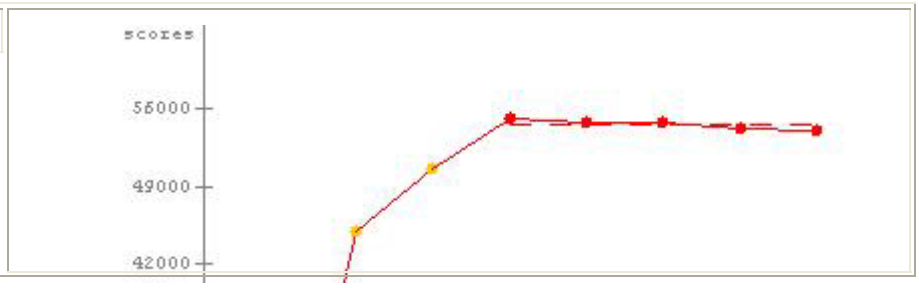


SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 2, 2001

JVM 3 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**
1	15885	
2	44946	
3	50531	



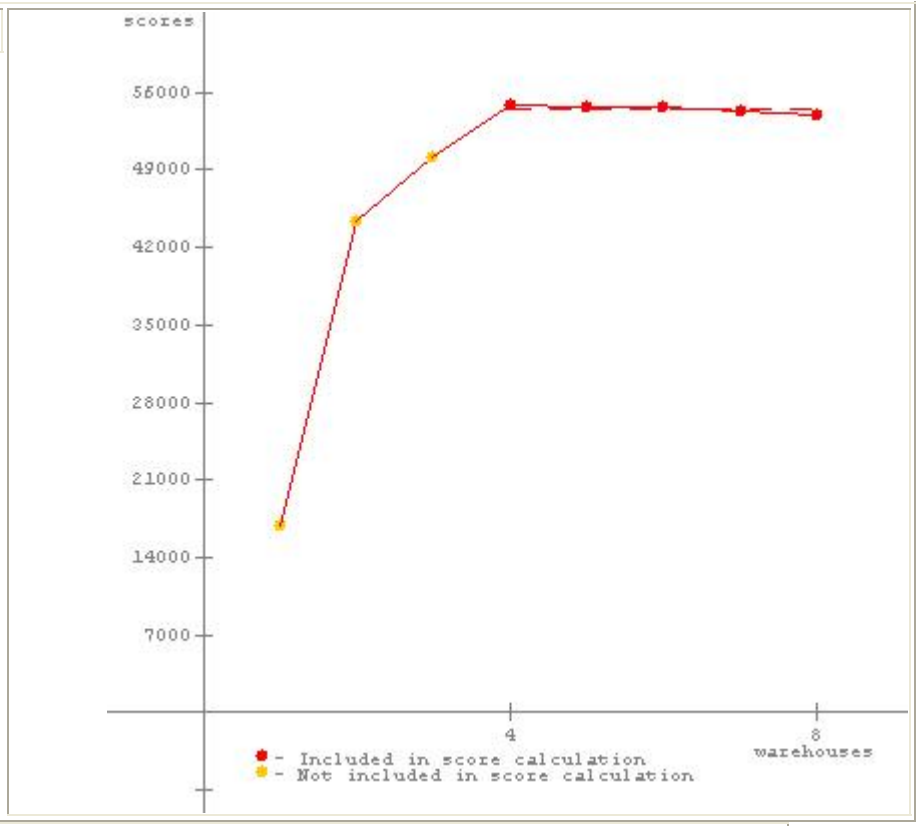
4	55199	*
5	54847	*
6	54757	*
7	54251	*
8	54001	*
SPECjbb2005	**(from 4 to 8)**	**54611 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 2, 2001

JVM 4 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	16856	
2	44428	
3	50139	
4	54949	*
5	54747	*
6	54608	*
7	54246	*
8	53921	*
SPECjbb2005	**(from 4 to 8)**	**54494 SPECjbb2005 bops**



SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 2, 2001

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

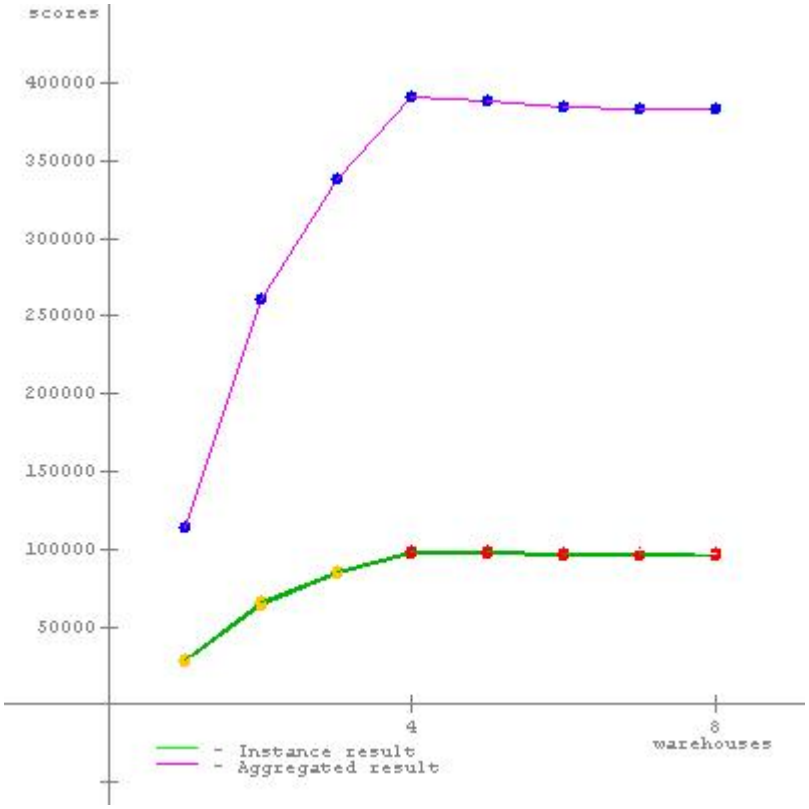
SPECjbb2005

SPECjbb2005 bops = 386169, SPECjbb2005 bops/JVM = 96542

Intel S7000FC4UR

BEA JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)

JVM run	JVM Scores
1	96144
2	96382
3	96078
4	97565
SPECjbb2005 bops = 386169, SPECjbb2005 bops/JVM = 96542	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	S7000FC4UR
Processor	Quad-Core Intel Xeon processor E7340
MHz	2400
# of Chips	4
# of Cores	16
# of Cores/Chip	4
HW Threading Enabled?	No
Procs Avail to Java	16

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)
JVM Command Line	start /AFFINITY /B java.exe -Xms3500m –Xns2900m -Xmx3500m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap Memory (MB)	3500
JVM Maximum Heap Memory (MB)	3500

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	NTFS
Disks	1 x 73GB SAS
Other hardware	

JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; .\jbb_no_precompile.jar; .\check.jar; .\reporter.jar;
JVM BOOTCLASSPATH	C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jrockit1.5.0.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\managementapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jmxmapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\rmp.jar; C:\jrockit-jdk1.5.0_10\jre\lib\rt.jar; C:\jrockit-jdk1.5.0_10\jre\lib\i18n.jar; C:\jrockit-jdk1.5.0_10\jre\lib\sunrsasign.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jsse.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jce.jar; C:\jrockit-jdk1.5.0_10\jre\lib\charsets.jar; C:\jrockit-jdk1.5.0_10\jre\classes
OS Version	Microsoft Windows 2003 Server, x64 Enterprise Edition Service Pack 2
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Aug 9, 2007
H/w available	
JVM available	2007
OS available	2003
Other s/w available	

AOT Compilation

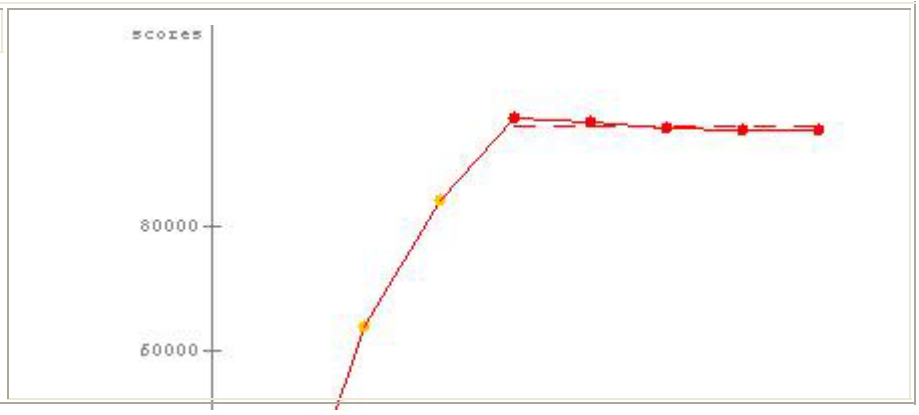
Tuning
In the local security settings, "Lock pages in memory" was enabled

Notes
Disabled "Hardware Prefetching" and "Adjacent Cache Line Prefetch" in the BIOS

JVM 1 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	27923	
2	64110	
3	84320	
4	97501	*
5	96862	*
6	95673	*



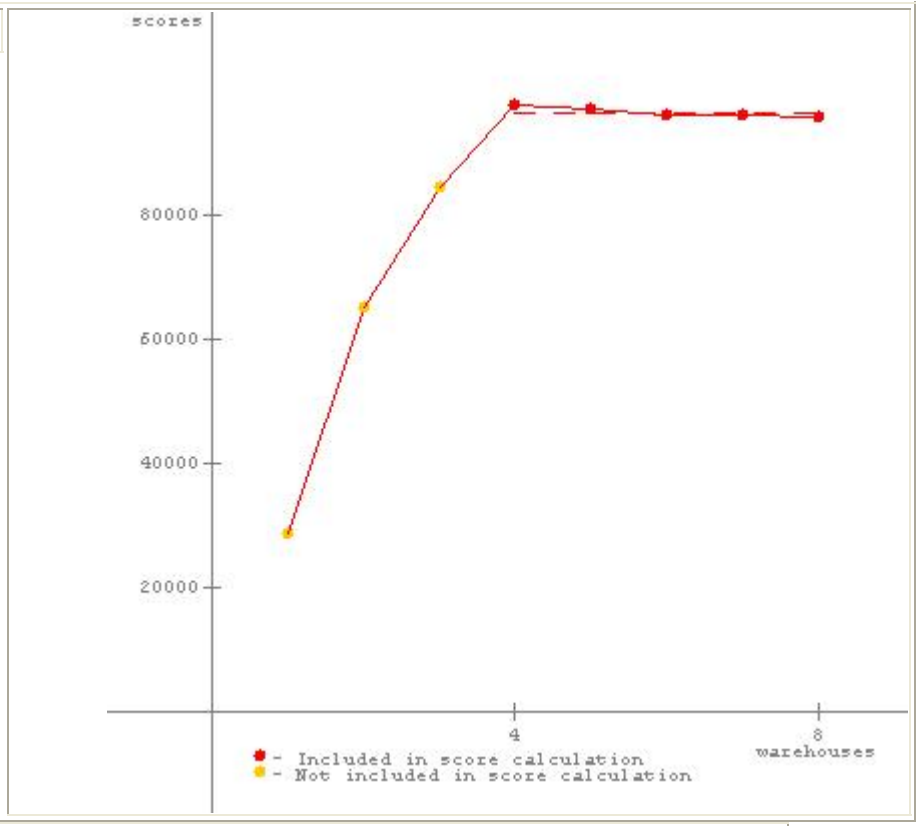
7	95350	*
8	95332	*
SPECjbb2005	**(from 4 to 8)**	**96144 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Aug 9, 2007

JVM 2 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	28826	
2	65110	
3	84376	
4	97670	*
5	96978	*
6	95827	*
7	95936	*
8	95498	*
SPECjbb2005	**(from 4 to 8)**	**96382 SPECjbb2005 bops**

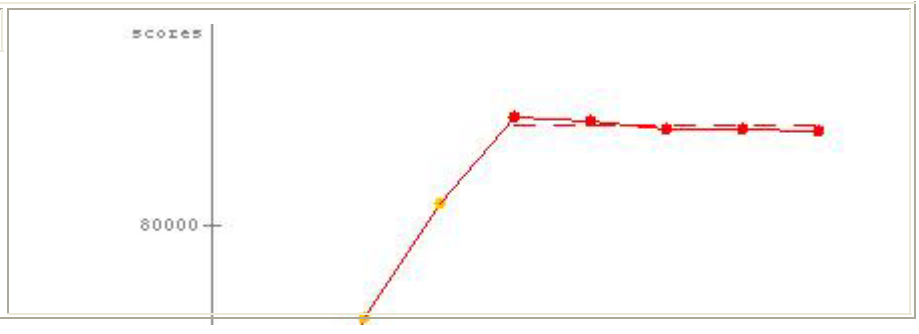


SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Aug 9, 2007

JVM 3 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	28486	
2	65291	
3	83684	
4	97516	*



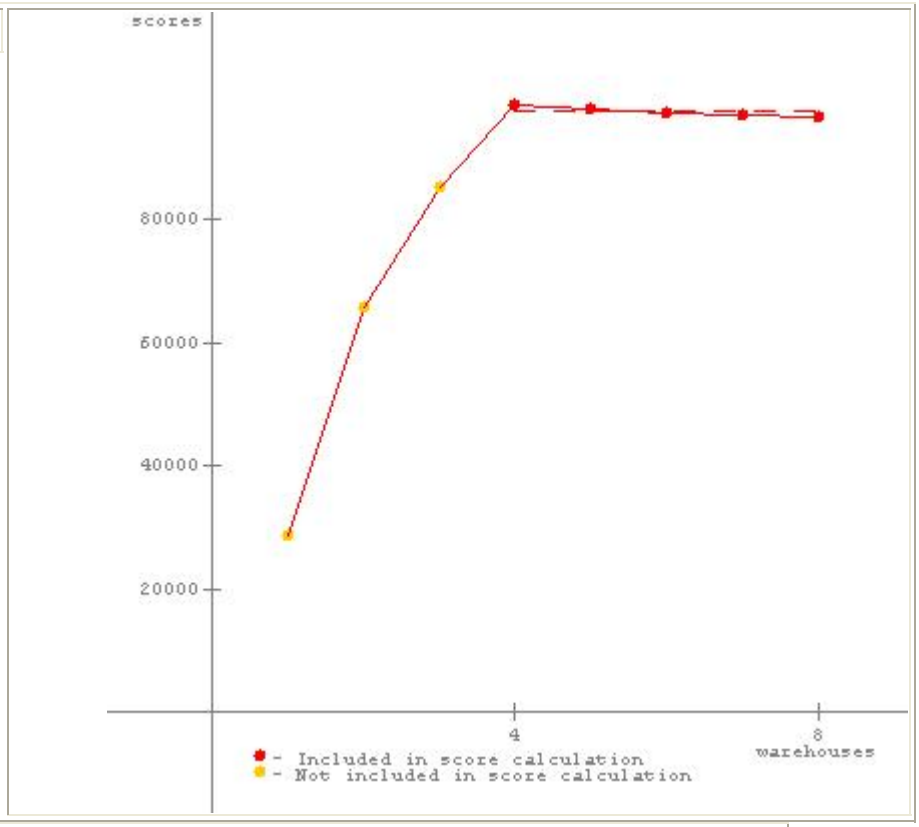
5	96788	*
6	95348	*
7	95524	*
8	95214	*
SPECjbb2005	**(from 4 to 8)**	**96078 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Aug 9, 2007

JVM 4 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	28728	
2	65705	
3	85195	
4	98783	*
5	98101	*
6	97247	*
7	96912	*
8	96785	*
SPECjbb2005	**(from 4 to 8)**	**97565 SPECjbb2005 bops**



SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Aug 9, 2007

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

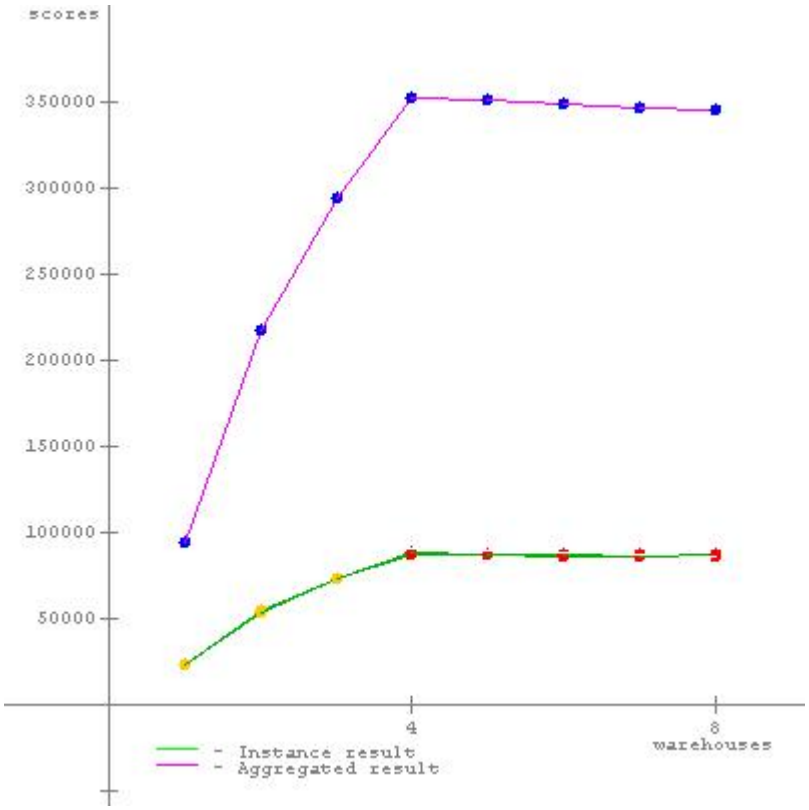
SPECjbb2005

SPECjbb2005 bops = 348858, SPECjbb2005 bops/JVM = 87215

Intel S7000FC4UR

BEA JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)

JVM run	JVM Scores
1	86873
2	87663
3	87116
4	87206
SPECjbb2005 bops = 348858, SPECjbb2005 bops/JVM = 87215	



Hardware	
Hardware Vendor	Intel
Vendor URL	http://www.intel.com
Model	S7000FC4UR
Processor	Quad-Core Intel Xeon processor L7345
MHz	1860
# of Chips	4
# of Cores	16
# of Cores/Chip	4
HW Threading Enabled?	No
Procs Avail to	16

Software	
Software Vendor	BEA
Vendor URL	http://www.bea.com
JVM Version	JRockit 1.5.0 (build P27.2.0-10-82330-1.5.0_10-20070515-1627-windows-x86_64)
JVM Command Line	start /AFFINITY /B java.exe -Xms3500m –Xns2900m –Xmx3500m -XXaggressive -XXlargepages -Xgc:genpar -XXthroughputCompaction -XXlazyUnlocking -XXtlasize:min=16k,preferred=128k spec.jbb.JBBmain
JVM Initial Heap Memory (MB)	3500
JVM Maximum Heap Memory	3500

Java	
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	NTFS
Disks	1 x 73GB SAS
Other hardware	

(MB)	
JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; .\jbb_no_precompile.jar; .\check.jar; .\reporter.jar;
JVM BOOTCLASSPATH	C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jrockit1.5.0.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\managementapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\jmxmapi.jar; C:\jrockit-jdk1.5.0_10\jre\bin\jrockit\rmp.jar; C:\jrockit-jdk1.5.0_10\jre\lib\rt.jar; C:\jrockit-jdk1.5.0_10\jre\lib\i18n.jar; C:\jrockit-jdk1.5.0_10\jre\lib\sunrsasign.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jsse.jar; C:\jrockit-jdk1.5.0_10\jre\lib\jce.jar; C:\jrockit-jdk1.5.0_10\jre\lib\charsets.jar; C:\jrockit-jdk1.5.0_10\jre\classes
OS Version	Microsoft Windows 2003 Server, x64 Enterprise Edition Service Pack 2
Other software	

Test Information	
Tested by	Principled Technologies
SPEC license #	3184
Test location	Durham, NC
Test date	Jan 27, 2001
H/w available	
JVM available	2007
OS available	2003
Other s/w available	

AOT Compilation

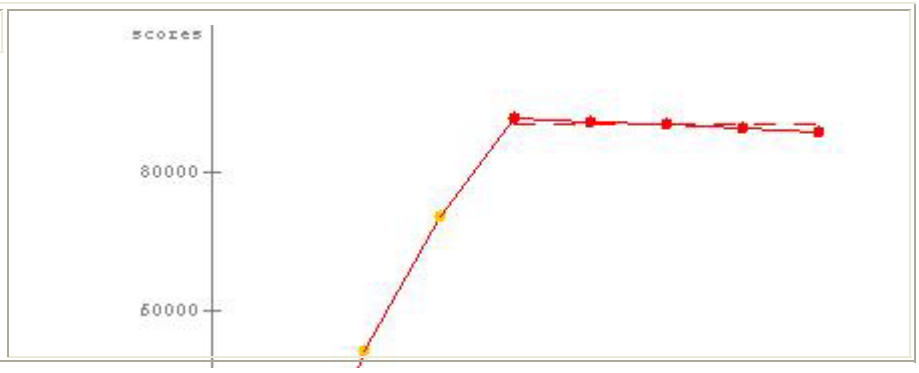
Tuning
In the local security settings, "Lock pages in memory" was enabled

Notes
Disabled "Hardware Prefetching" and "Adjacent Cache Line Prefetch" in the BIOS

JVM 1 Scores:

No errors. Valid run.

Warehouses	**SPECjbb2005 bops**	**Incl. in metric**
1	23240	
2	54386	
3	73567	
4	87952	*
5	87388	*



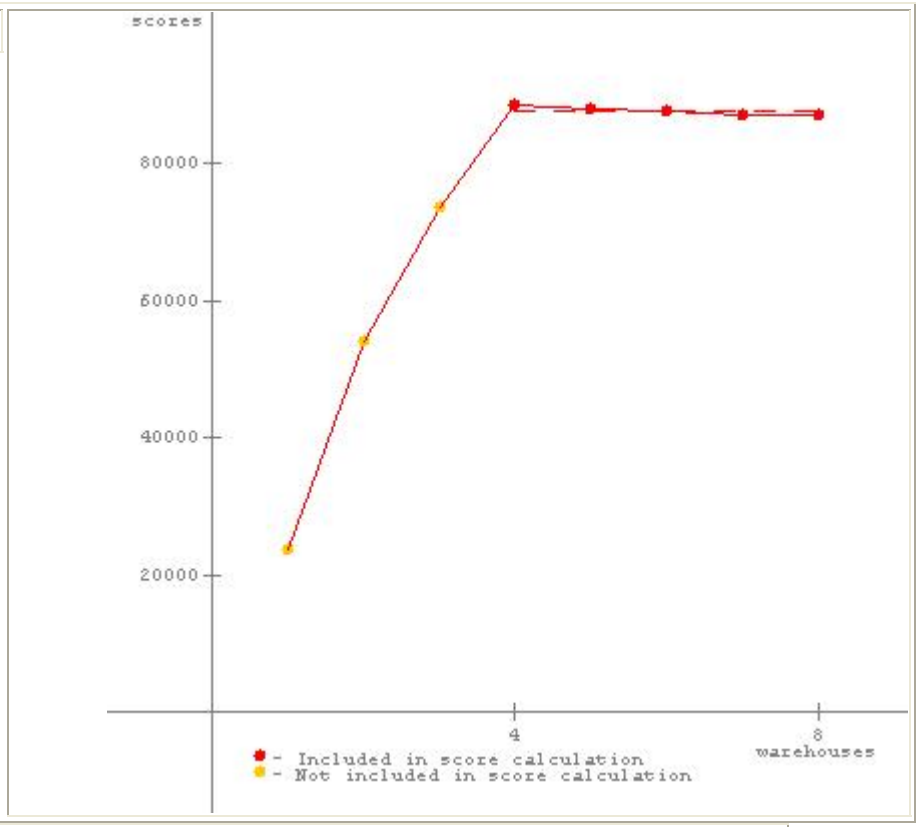
6	86857	*
7	86310	*
8	85858	*
SPECjbb2005	**(from 4 to 8)**	**86873 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 27, 2001

JVM 2 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	23608	
2	54112	
3	73560	
4	88634	*
5	88000	*
6	87671	*
7	86975	*
8	87035	*
SPECjbb2005	**(from 4 to 8)**	**87663 SPECjbb2005 bops**

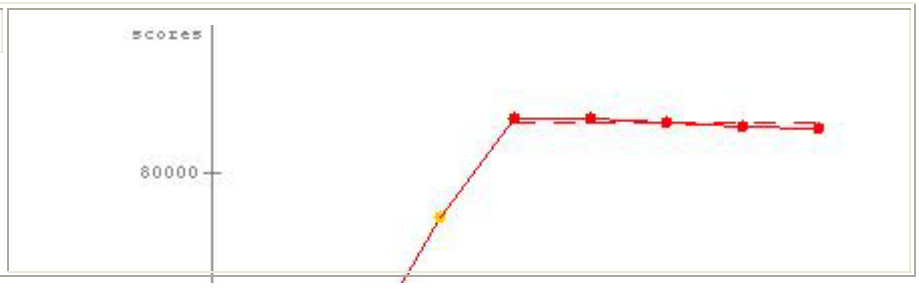


SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 27, 2001

JVM 3 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	23954	
2	54853	
3	73656	



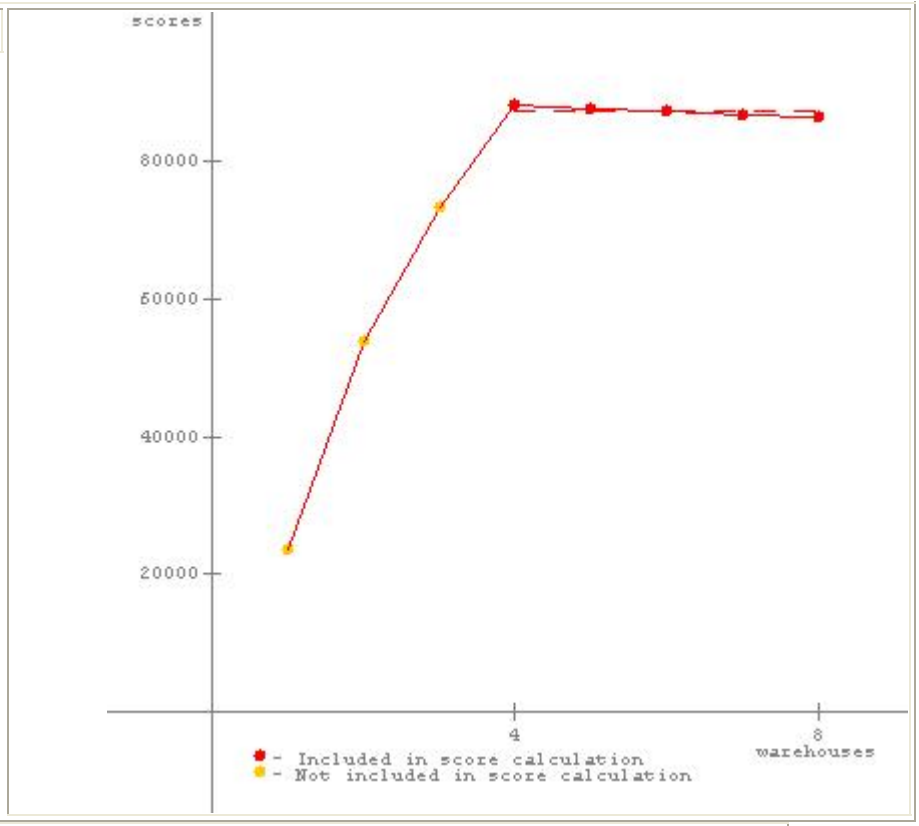
4	87866	*
5	87686	*
6	87188	*
7	86593	*
8	86248	*
SPECjbb2005	**(from 4 to 8)**	**87116 SPECjbb2005 bops**

SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 27, 2001

JVM 4 Scores:

No errors. Valid run.

Warehouses	SPECjbb2005 bops	Incl. in metric
1	23677	
2	53736	
3	73324	
4	88196	*
5	87607	*
6	87191	*
7	86695	*
8	86339	*
SPECjbb2005	**(from 4 to 8)**	**87206 SPECjbb2005 bops**



SPEC license # 3184	**Tested by:** Principled Technologies	**Test date:** Jan 27, 2001

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

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