

## SPECjbb2005 performance/watt on three servers with dual-core processors

### Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to measure the SPECjbb2005 performance and power consumption of the following three servers, which we list in alphabetical order, that use the Intel Xeon processor 5148:

- Dell PowerEdge Energy Smart 2950
- HP ProLiant DL380 G5
- IBM System x3650

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. Per 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](http://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", which is 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](http://www.spec.org).)

In this section, we discuss 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 test servers. In this chart, we normalized the results to those of the lowest performance/watt configuration. The lowest system's performance/watt result is thus 1.00. By normalizing, we make each

### KEY FINDINGS

- The Dell PowerEdge Energy Smart 2950 server delivered over 15 percent more performance/watt than the HP ProLiant DL380 G5 server (see Figure 1).
- The Dell PowerEdge Energy Smart 2950 server delivered almost 10 percent more performance/watt than the IBM System x3650 server (see Figure 1).
- The Dell PowerEdge Energy Smart 2950 server achieved its peak performance while drawing between 12.3 and 16.0 less power than the other two servers.

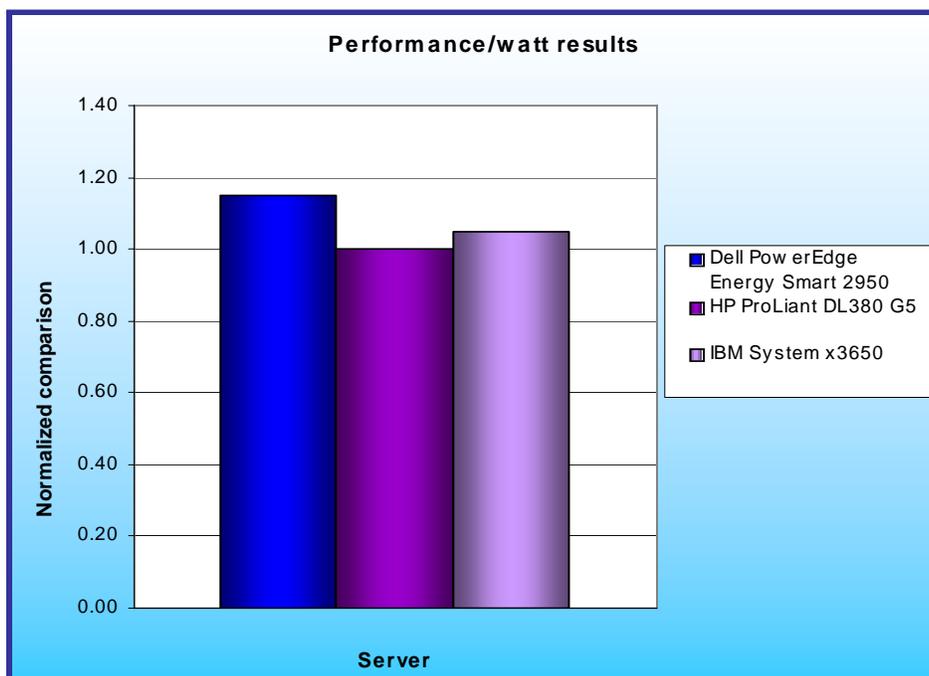


Figure 1: Performance/watt (dual-processor) results of the test servers running SPECjbb2005. Higher numbers indicate better performance/watt.

data point in the chart a comparative number, with higher results indicating better performance/watt.

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 Dell PowerEdge Energy Smart 2950 server delivered 15.1 percent more performance/watt than the HP ProLiant DL380 G5 server and 9.6 percent more performance/watt than the IBM System x3650 server.

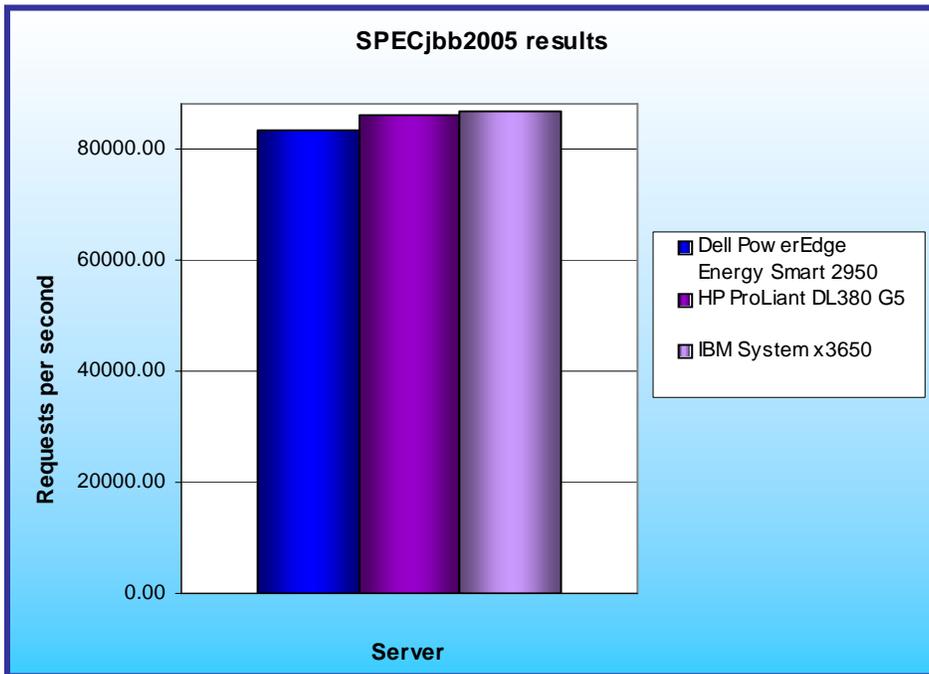


Figure 2: SPECjbb2005 business operations per second (dual-processor) results for the test servers. Higher numbers of operations per second are better.

Figure 2 shows the SPECjbb2005 results, in bops, of the test servers. Each result is the maximum peak score of five runs of the benchmark. See the "Test Results" section for the scores from all five runs. A higher SPECjbb2005 score indicates the server is able to handle more Java requests and thus deliver greater throughput.

The IBM System x3650 server produced the highest results, 86,525 bops, while the Dell PowerEdge Energy Smart 2950 server achieved 83,145 bops. The IBM System x3650 server thus delivered a 4.1

percent performance increase over the Dell PowerEdge Energy Smart 2950 server. The HP ProLiant DL380 G5 server, which achieved 85,999 bops, delivered a 3.4 percent performance increase over the Dell PowerEdge Energy Smart 2950 server.

Figure 3 shows a plot of the power usage of the three servers as they were running the benchmark. The red lines indicate the power measurement interval, the time during which the server was delivering peak performance and during which we captured power measurements. Lower power consumption is better.

The Dell PowerEdge Energy Smart 2950 server achieved its peak performance while drawing less power than the other two systems: 16.0 percent less than the HP ProLiant DL380 G5 server and 12.3 percent less than the IBM System x3650.

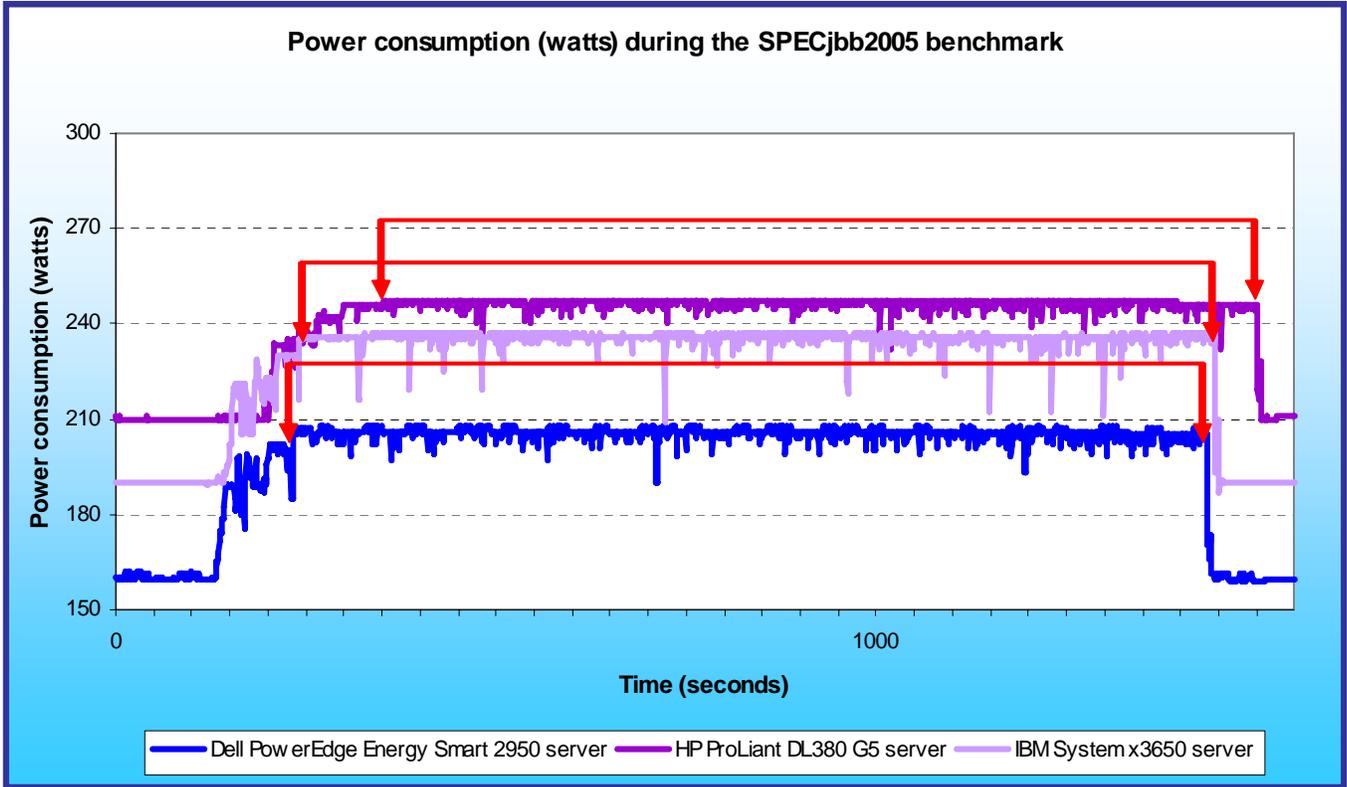


Figure 3: Power consumption (in watts) of each of the servers throughout the course of executing the SPECjbb2005 benchmark. Lower power consumption is better.

## Test results

Figure 4 shows the maximum SPECjbb2005 results for each server. SPECjbb2005 computes the score 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.)

Operations per second			
	Dell PowerEdge Energy Smart 2950 server	HP ProLiant DL380 G5 server	IBM System x3650 server
<b>Warehouse</b>	<b>JVM 1</b>		
1	20,420	21,783	22,922
2	44,848	48,546	47,892
3	66,703	69,695	70,569
4	84,233	87,423	87,694
5	84,490	87,481	88,165
6	83,607	86,511	87,038
7	82,248	84,747	85,673
8	81,148	83,835	84,057
<b>Score</b>	<b>83,145</b>	<b>85,999</b>	<b>86,525</b>

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

Figure 5 shows the results by warehouse for the Dell PowerEdge Energy Smart 2950 server for all five runs. Run 1 produced the maximum results.

Dell PowerEdge Energy Smart 2950 server					
	Run 1	Run 2	Run 3	Run 4	Run 5
Warehouse	JVM 1				
1	20,420	20,537	21,099	21,044	21,009
2	44,848	46,270	46,133	45,619	44,683
3	66,703	65,618	67,018	66,818	66,882
4	84,233	84,211	83,996	83,669	83,809
5	84,490	84,211	83,857	83,306	83,834
6	83,607	83,066	82,903	82,474	83,219
7	82,248	82,227	81,885	80,492	82,052
8	81,148	81,441	81,403	79,008	80,005
<b>Total Score</b>	<b>83,145</b>	<b>83,031</b>	<b>82,809</b>	<b>81,790</b>	<b>82,584</b>

Figure 5: SPECjbb2005 results for the Dell PowerEdge Energy Smart 2950 server. Higher numbers are better.

Figure 6 shows the results by warehouse for the HP ProLiant DL380 G5 server for all five runs. Run 3 produced the maximum results.

HP ProLiant DL380 G5 server					
	Run 1	Run 2	Run 3	Run 4	Run 5
Warehouse	JVM 1				
1	22,324	22,457	21,783	22,660	21,674
2	47,627	48,126	48,546	47,448	47,643
3	69,635	69,381	69,695	69,518	69,057
4	87,134	87,025	87,423	86,699	86,114
5	86,848	87,027	87,481	86,301	86,399
6	85,320	85,974	86,511	85,595	84,709
7	84,678	83,277	84,747	83,281	83,957
8	82,864	83,138	83,835	83,076	82,742
<b>Total Score</b>	<b>85,369</b>	<b>85,288</b>	<b>85,999</b>	<b>84,990</b>	<b>84,784</b>

Figure 6: SPECjbb2005 results for the HP ProLiant DL380 server. Higher numbers are better.

Figure 7 shows the results by warehouse for the IBM System x3650 server for all five runs. Run 1 produced the maximum results.

IBM System x3650 server					
	Run 1	Run 2	Run 3	Run 4	Run 5
Warehouse	JVM 1				
1	22,922	22,278	22,104	22,908	22,353
2	47,892	48,081	47,417	47,911	47,658
3	70,569	70,531	69,065	70,118	69,205
4	87,694	87,350	86,057	87,168	85,653
5	88,165	87,876	86,865	86,418	86,196
6	87,038	86,674	84,708	85,542	85,330
7	85,673	85,151	83,052	84,124	84,491
8	84,057	84,228	82,793	82,861	83,559
<b>Total Score</b>	<b>86,525</b>	<b>86,256</b>	<b>84,695</b>	<b>85,223</b>	<b>85,046</b>

Figure 7: SPECjbb2005 results for the IBM System x3650 server. Higher numbers are better.

Figure 8 details the power consumption, in watts, of the test servers while idle and during the maximum peak runs of the benchmark.

Server	Idle power (watts)	Average power (watts)
Dell PowerEdge Energy Smart 2950 server	160.4	206.6
HP ProLiant DL380 G5 server	210.0	246.0
IBM System x3650 server	189.9	235.7

Figure 8: Average power usage (in watts) of the test servers while idle and during the maximum peak runs of SPECjbb2005. Lower numbers are better.

## Test methodology

Figure 9 summarizes some key aspects of the configurations of the server systems; Appendix A provides detailed configuration information.

Server	Dell PowerEdge Energy Smart 2950 server	HP ProLiant DL380 G5 server	IBM System x3650 server
Processor frequency (GHz)	2.33 GHz	2.33 GHz	2.33 GHz
System bus	1333	1333	1333
Single/Dual-Core processors	Dual	Dual	Dual
Motherboard	Dell PowerEdge Energy Smart 2950	HP ProLiant DL380 G5	IBM System x3650
Chipset	Intel 5000X Chipset	Intel 5000P Chipset	Intel 5000P Chipset
RAM (4GB in each)	PC2-5300 FBDIMM	PC2-5300 FBDIMM	PC2-5300 FBDIMM
Hard Drive	Fujitsu MAY2073RC	Fujitsu MAY2036RC	Fujitsu MAY2073RC
NICs	Dual port Broadcom BCM5708C NetXtreme II Gigabit adapter	Dual port HP NC373i Multifunction Gigabit Server Adapter	Dual port Broadcom BCM5708C NetXtreme II Gigabit adapter

Figure 9: Summary of some key aspects of the server configurations.

Dell configured and provided all three servers.

With the following exceptions, we used the default BIOS settings on each server: we disabled the HW Prefetcher and Adjacent Cache Line Prefetcher on all servers.

We began by installing a fresh copy of Microsoft Windows 2003 Server R2 Enterprise x64 Edition on each server. For the installation we used each manufacturer's setup and installation disk and procedures. 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 log on.
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:

- Windows Internet Explorer 7.0 for Windows Server 2003 (x64) and Windows XP 64-bit Edition Version 2003
- Cumulative Security Update for Internet Explorer for Windows Server 2003 x64 Edition (KB922760)
- Security Update for Windows Server 2003 x64 Edition (KB920213)
- Security Update for Windows Server 2003 x64 Edition (KB922819)

- Security Update for Windows Server 2003 x64 Edition (KB924191)
- Security Update for Windows Server 2003 x64 Edition (KB923191)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 x64 Edition (KB924496)
- Security Update for Windows Server 2003 x64 Edition (KB923414)
- Security Update for Windows Server 2003 x64 Edition (KB925486)
- Security Update for Windows Server 2003 x64 Edition (KB920685)
- Security Update for Windows Server 2003 x64 Edition (KB921883)
- Update for Windows Server 2003 x64 Edition (KB922582)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 x64 Edition (KB921398)
- Security Update for Outlook Express for Windows Server 2003 x64 Edition (KB920214)
- Security Update for Windows Server 2003 x64 Edition (KB917422)
- Security Update for Windows Server 2003 x64 Edition (KB922616)
- Security Update for Windows Server 2003 x64 Edition (KB920683)
- Security Update for Windows Server 2003 x64 Edition (KB920670)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 x64 Edition (KB914388)
- Security Update for Windows Server 2003 x64 Edition (KB911280)
- Security Update for Windows Server 2003 x64 Edition (KB917953)
- Security Update for Windows Server 2003 x64 Edition (KB918439)
- Security Update for Windows Server 2003 x64 Edition (KB917344)
- Update for Windows Server 2003 x64 Edition (KB914784)
- Security Update for Windows Server 2003 x64 Edition (KB914389)
- Security Update for Windows Server 2003 x64 Edition (KB917734)
- Security Update for Windows Server 2003 x64 Edition (KB911562)
- Cumulative Security Update for Outlook Express for Windows Server 2003 x64 Edition (KB911567)
- Security Update for Windows Media Player Plug-in (KB911564)
- Security Update for Windows Server 2003 x64 Edition (KB911927)
- Security Update for Windows Server 2003 x64 Edition (KB908519)
- Security Update for Windows Server 2003 x64 Edition (KB912919)
- Update for Windows Server 2003 x64 Edition (KB910437)
- Security Update for Windows Server 2003 x64 Edition (KB896424)
- Security Update for Windows Server 2003 x64 Edition (KB900725)
- Security Update for Windows Server 2003 x64 Edition (KB902400)
- Security Update for Windows Server 2003 x64 Edition (KB904706)
- Security Update for Windows Server 2003 x64 Edition (KB901017)
- Security Update for Windows Server 2003 x64 Edition (KB899587)
- Security Update for Windows Server 2003 x64 Edition (KB899591)
- Security Update for Windows Server 2003 x64 Edition (KB893756)
- Security Update for Windows Server 2003 x64 Edition (KB899588)
- Security Update for Windows Server 2003 x64 Edition (KB901214)
- Security Update for Windows Server 2003 x64 Edition (KB896358)
- Security Update for Windows Server 2003 x64 Edition (KB896428)
- Update for Windows Server 2003 x64 Edition (KB898715)

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 did the following:

- Select Control Panel→Administrative Tools→Local Security Policy.
- Select Local Policies→User Rights Assignment.

- Select “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](http://www.extech.com)) 380803 Power Analyzer / Datalogger. We connected the power cord from one power supply on the server under test to the Power Analyzer’s output load power outlet. We did not connect the second power supply in each server during the tests. 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 ensure that each system was completely idle, we waited eight minutes after rebooting before we began capturing the idle power. Following this time period, 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 started running the benchmark and recorded the power usage (in watts) for each server at one-second intervals during the testing. 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 8 (idle and average peak power) for the results of these measurements.

## Facility temperature management

To guarantee the most accurate results, we used a climate-controlled lab room for this testing. We kept this room at a constant temperature of 21°C +/- 1°C during testing. This cooling strategy ensures that the servers will not overheat and subsequently produce less accurate test results. Our facility temperature meets the standards outlined by the Technical Committee (TC 9.9) of the American Society of Heating Refrigerating Air-conditioning Engineers (ASHRAE). ASHRAE’s book, “Thermal Guidelines for Data Processing Environments”, defines environmental conditions and protocols for increasing reliability in data testing centers.

## 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](http://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 (JVM) on the system under test. We used the BEA JRockit 5.0 (P26.4.1 build P26.4.1-12-67782-1.5.0\_06-20061003-1632-win-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 edited the runit.bat batch file, which resides in the root SPECjbb2005 directory with the default installation, to issue the Java run command to launch the benchmark. During testing, we used the command prompt window within Microsoft Windows Server 2003 R2 Enterprise x64 Edition to run this batch file. Figure 10 shows the contents of this file.

```

runit.bat - Notepad
File Edit Format View Help
@echo off

:: Set JAVA to Java.exe path.
set JAVA=C:\jrockit-jdk1.5.0_06\bin\java.exe

:: if JAVA not set, let's find it.
if %JAVA% == "" goto findjava

goto foundjava

:findjava
:: Note, this algorithm finds the last occurrence of java.exe in path.
echo Attempting to find java...
for %p in ( %PATH% ) do if exist %p\java.exe set JAVA=%p\java
if %JAVA% == "" goto nojava
echo Found java: %JAVA%

:foundjava
@echo on
%JAVA% -fullversion
@echo off
goto stage1

:nojava
echo No java? Please make sure that the path to java is set in your environment!
echo Current PATH: %PATH%
goto egress

:stage1
set PROFILE=SPECjbb.props
set JAVAOPTIONS=-Xms2700m -Xmx2700m -XXaggressive -XXthroughputCompaction -XXallocPrefetch -XXcompressedRefs -XXlazyUnlocking -XXtlasize128k
set JBBJARS=jbb.jar;.\check.jar
if "%CLASSPATHPREV%" == "" set CLASSPATHPREV=%CLASSPATH%
set CLASSPATH=
if %1 == %CDROM% goto findcdrom
goto stage2

:stage2
set CLASSPATH=%JBBJARS%;%CLASSPATHPREV%
echo Using CLASSPATH entries:
for %c in ( %CLASSPATH% ) do echo %c
@echo on
%JAVA% %JAVAOPTIONS% spec.jbb.JBBmain -propfile %PROFILE%
@echo off
goto egress

:findcdrom
if not %CDROM% == "" goto foundcdrom
echo Attempting to find your CDROM drive letter...
set DRIVES=C D E F G H I J K L M N O P Q R S T U V W X Y Z
for %d in ( %DRIVES% ) do if exist %d:\jbb.jar set CDROM=%d:
if %CDROM% == "" goto nocdrom
echo Aha... I think I've found your CDROM drive letter: %CDROM%

:foundcdrom
if not exist %CDROM%\jbb.jar goto nocdrom
set JBBJARS=%CDROM%\jbb.jar;%CDROM%\check.jar
set PROFILE=%CDROM%\cdrunwin.prp
%CDROM%
goto stage2

:nocdrom
echo I cannot find your CDROM drive. Perhaps the SPECjbb CDROM is not loaded in
echo the drive. Make sure the SPECjbb CDROM is loaded in your CDROM drive and
echo check that the environmental variable CDROM is set to your cdrom's drive
echo letter. Then, try run.bat again.

:egress

```

Figure 10: The text of the batch file we used to execute the SPECjbb2005 benchmark on all servers.

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

- **-Xms2700m** 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 2700MB. (The heap size of 2700MB was the maximum size that could be used on the IBM System x3650 system. For comparability of results, all three servers were run at that heap size. The other two servers, however, were capable of running at a heap size of 3300MB.)
- **-Xmx2700m** This option sets the maximum heap size. (See comment above.)
- **-XXaggressive** This option basically tells the JVM to perform at maximum speed.
- **-XXthroughputCompaction** This option adjusts the compaction ratio dynamically based on live data in the heap.
- **-XXallocPrefetch** This option tells the JVM to prefetch a chunk of data when it uses a related, earlier bit of data.
- **-XXcompressedRefs** This option turns on compressed references.
- **-XXlazyUnlocking** This option affects when the JVM releases locks.
- **-XXtlasize128k** This option sets the thread-local area size the JVM uses.

## Appendix A – Test server configuration information

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

Servers	Dell PowerEdge Energy Smart 2950	HP ProLiant DL380 G5	IBM System x3650
<b>System configuration information</b>			
<b>General</b>			
Processor and OS kernel: (physical, core, logical)	2P4C4L	2P4C4L	2P4C4L
Number of physical processors	2	2	2
Single/Dual-Core processors	Dual	Dual	Dual
System Power Management Policy	Always On	Always On	Always On
<b>CPU</b>			
Vendor	Intel	Intel	Intel
Name	Dual-Core Intel Xeon processor 5148	Dual-Core Intel Xeon processor 5148	Dual-Core Intel Xeon processor 5148
Stepping	5	5	5
Socket type	LGA 771	LGA 771	LGA 771
Core frequency (GHz)	2.33 GHz	2.33 GHz	2.33 GHz
Front-side bus frequency (MHz)	1333MHz Dual Independent Busses (DIB)	1333MHz Dual Independent Busses (DIB)	1333MHz Dual Independent Busses (DIB)
L1 Cache	32 KB +32 KB	32 KB +32 KB	32 KB +32 KB
L2 Cache	4 MB (Shared)	4 MB (Shared)	4 MB (Shared)
<b>Platform</b>			
Vendor and model number	Dell PowerEdge Energy Smart 2950	HP ProLiant DL380 G5	IBM System x3650
Motherboard model number	Dell LS-36	DP 407749-001	42C4252
Motherboard chipset	Intel 5000X Chipset	Intel 5000P Chipset	Intel 5000P Chipset
Motherboard revision number	12	93	92
Motherboard serial number	CN-0NH-278-13740-61N-005Q	AS#012516-001	510713F00
BIOS name and version	Dell, Inc. 1.2.0 10/18/2006	HP P56 06/13/2006	IBM-[GGE116AUS-1.01]-07/20/2006
BIOS settings	HW Prefetcher and Adjacent Cache Line Prefetcher Disabled	HW Prefetcher and Adjacent Cache Line Prefetcher Disabled	HW Prefetcher and Adjacent Cache Line Prefetcher Disabled
Chipset INF driver	Intel 7.3.0.1010	Microsoft 5.2.3790.1830	Intel 7.3.1.1011
<b>Memory module(s)</b>			
Vendor and model number	Qimonda HYS72T128420HFN-3S-B	2 x Samsung M395T2953CZ4-CE60 2 x Elpida EBE11FD8AGFD	Hynix HYMP512F72BP8D2-Y5
Type	PC2-5300 FBDIMM	PC2-5300 FBDIMM	PC2-5300 FBDIMM
Speed (MHz)	667 MHz	667 MHz	667 MHz

Speed in the system currently running @ (MHz)	533 MHz	667 MHz	667 MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	4-4-4-15	5-5-5-15	5-5-5-15
Size (total memory)	4096 MB	4096 MB	4096 MB
Number of RAM modules	4	4	4
Chip organization	Double-sided	Double-sided	Double-sided
<b>Hard disk</b>			
Vendor and model number	Fujitsu MAY2073RC	Fujitsu MAY2036RC	Fujitsu MAY2073RC
Number of disks in system	2	2	2
Size	73.4 GB	36 GB	73.4 GB
Buffer Size	8 MB	8 MB	8 MB
RPM	10,000	10,000	10,000
Type	SAS	SAS	SAS
Controller	Dell SAS 5/i Integrated Controller	Smart Array E200 Controller	IBM ServRAID 8k/8k-l Controller
Controller driver	Dell 1.21.8.0	HP 5.8.0.64	Adaptec 5.1.0.9206
<b>Operating system</b>			
Name	Microsoft Windows Server 2003 R2 Enterprise x64 Edition	Microsoft Windows Server 2003 R2 Enterprise x64 Edition	Microsoft Windows Server 2003 R2 Enterprise x64 Edition
Build number	3790	3790	3790
Service Pack	SP1	SP1	SP1
Microsoft Windows update date	12/11/2006	12/11/2006	12/11/2006
File system	NTFS	NTFS	NTFS
Kernel	ACPI Multiprocessor x64-based PC	ACPI Multiprocessor x64-based PC	ACPI Multiprocessor x64-based PC
Language	English	English	English
Microsoft DirectX version	DirectX 9.0c	DirectX 9.0c	DirectX 9.0c
<b>Graphics</b>			
Vendor and model number	ATI ES1000	ATI ES1000	ATI ES1000
Chipset	ATI ES1000 PCI	ATI ES1000 PCI	ATI ES1000 PCI
BIOS version	BK-ATI VER008.005.028.000	BK-ATI VER008.005.013.000	BK-ATI VER008.005.028.000
Type	Integrated	Integrated	Integrated
Memory size	16 MB	32 MB	16 MB
Resolution	1024 x 768 x16-bit color	1024 x 768 x 16 bit-color	1024 x 768 x 16 bit-color
Driver	ATI 8.19.4.0	ATI 8.19.4.0	ATI 8.19.4.0
<b>Network card/subsystem</b>			
Vendor and model number	Dual port Broadcom BCM5708C NetXreme II Gigabit adapter	Dual port HP NC373i Multifunction Gigabit Server Adapter	Dual port Broadcom BCM5708C NetXreme II Gigabit adapter
Type	Integrated	Integrated	Integrated
Driver	Broadcom 2.6.14.0	HP 2.6.14.0	Broadcom 2.6.14.0
<b>Optical drive</b>			
Vendor and model number	HL-DT-ST DVD-ROM GDR8084N	None	HL-DT-ST RW/DVD GCC-4244N
Type	DVD-ROM	NA	DVD/CD-RW
Interface	Internal	NA	Internal
Dual/Single layer	Dual	NA	Dual

<b>USB ports</b>			
Number	4	4	6
Type	USB 2.0	USB 2.0	USB 2.0
<b>Power-supply</b>			
Number of power supplies	2	2	2
Rating of each	750 Watts	850 Watts	835 Watts
Number of fans	4	12	8

Figure 11: Detailed configuration information for the test servers.

## Appendix B – SPECjbb2005 output

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

Dell PowerEdge Energy Smart 2950 server

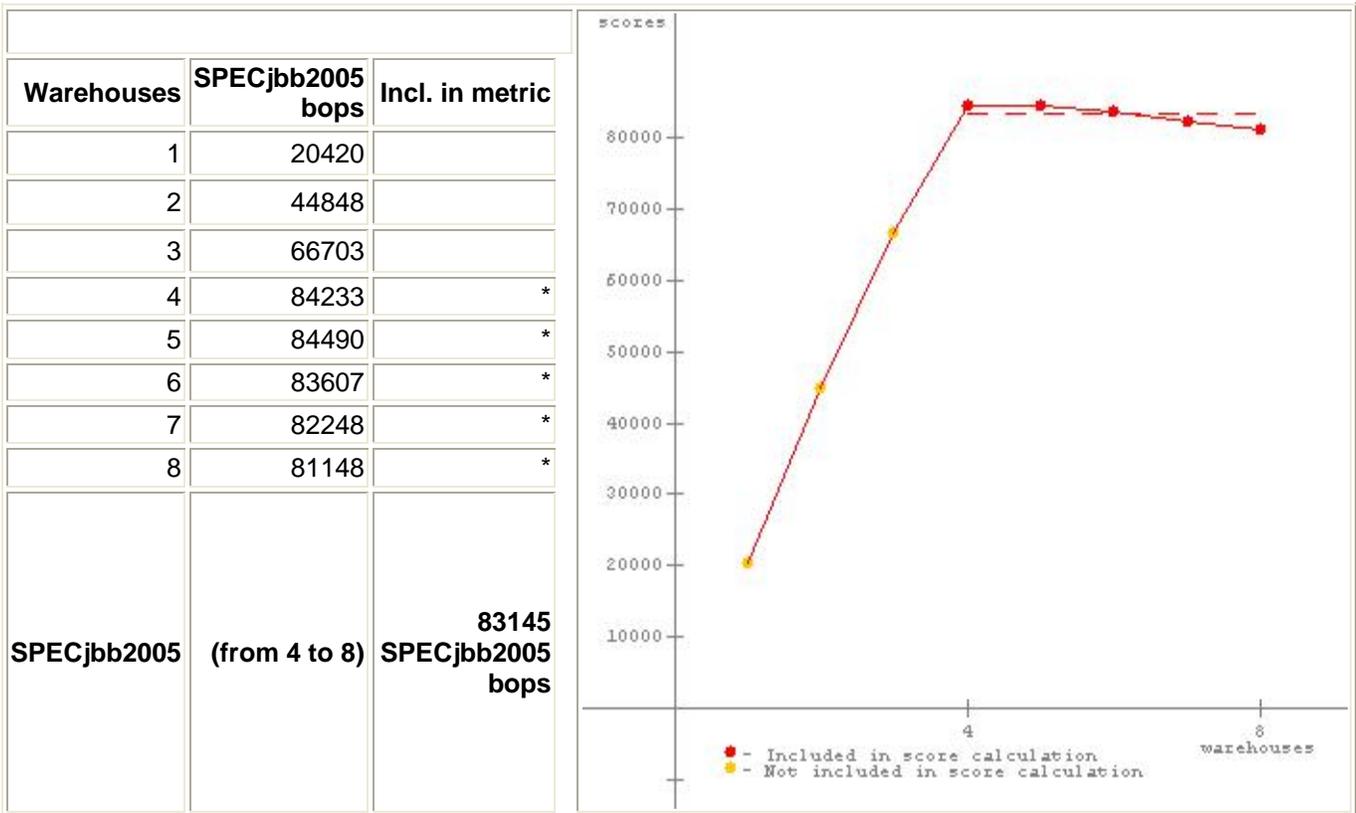
SPECjbb2005

**SPECjbb2005 bops = 83145,  
SPECjbb2005 bops/JVM = 83145**

Dell PowerEdge Energy Smart 2950

BEA JRocket 5.0, jrocket-jdk1.5.0\_06-win\_x86\_64

**No errors. Valid run.**



SPEC license # 3184

Tested by: Principled Technologies, Inc.

Test date: Dec 13, 2006

Hardware		Software	
Hardware Vendor	Dell Inc.	Software Vendor	BEA
Vendor URL	<a href="http://www.dell.com">http://www.dell.com</a>	Vendor URL	<a href="http://www.bea.com">http://www.bea.com</a>
Model	Dell PowerEdge Energy Smart 2950	JVM Version	JRocket 5.0, jrocket-jdk1.5.0_06-win_x86_64
Processor	Dual-Core Intel Xeon Processor 5148	JVM Command Line	java -Xms2700m -Xmx2700m -XXaggressive -XXthroughputCompaction -XXallocPrefetch -XXcompressedRefs -XXlazyUnlocking -XXtlasize128k spec.jbb.JBBmain -propfile SPECjbb.props
MHz	2333	JVM Initial Heap	2700
# of Chips	2		

# of Cores	4
# of Cores/Chip	2
HW Threading Enabled?	N/A
Procs Avail to Java	4
Memory (MB)	4096
Memory Details	4x1GB FBDIMMs FB-DDR2 PC2-5300
Primary cache	32KB+32KB
Secondary cache	4MB (shared)
Other cache	
Filesystem	NTFS
Disks	2 x 73.4GB SAS
Other hardware	

Memory (MB)	
JVM Maximum Heap Memory (MB)	2700
JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; \check.jar;
JVM BOOTCLASSPATH	C:\jrockit-jdk1.5.0_06\jre\bin\jrockit\jrockit.jar; C:\jrockit-jdk1.5.0_06\jre\bin\jrockit\managementapi.jar; C:\jrockit-jdk1.5.0_06\jre\lib\managementapi.jar; C:\jrockit-jdk1.5.0_06\jre\lib\rt.jar; C:\jrockit-jdk1.5.0_06\jre\lib\i18n.jar; C:\jrockit-jdk1.5.0_06\jre\lib\sunrsasign.jar; C:\jrockit-jdk1.5.0_06\jre\lib\jsse.jar; C:\jrockit-jdk1.5.0_06\jre\lib\jce.jar; C:\jrockit-jdk1.5.0_06\jre\lib\charsets.jar; C:\jrockit-jdk1.5.0_06\jre\classes
OS Version	Microsoft Windows Server 2003 R2 Enterprise x64 Edition
Other software	

Test Information	
Tested by	Principled Technologies, Inc.
SPEC license #	3184
Test location	Durham, NC
Test date	Dec 13, 2006
H/w available	
JVM available	
OS available	
Other s/w available	

AOT Compilation	
Tuning	
In the local security settings, "lock pages in memory" was enabled	
Notes	

**No errors. Valid run.**

### Details of Runs

Warehouses	Thrput	Total heap (MB)		Thread spread %	% > 120s	transaction type	Count	Time (in seconds)	
		Size	Used					total	max
1	20420	2700	1270	<0.01%	<0.01	new_order	269269	13.3	.313
						payment	185830	4.76	.016
						order_status	18583	.535	.016
						delivery	18583	5.41	.016
						stock_level	18582	.626	.016
						cust_report	102386	4.81	.016

2	44848	2700	1449	4.37%	<0.01	new_order	591518	25.2	.187
						payment	407929	9.29	.187
						order_status	40794	1.07	.016
						delivery	40793	12.1	.016
						stock_level	40793	1.50	.016
						cust_report	224342	9.36	.171
3	66703	2700	967	5.37%	<0.01	new_order	880015	37.2	.157
						payment	606715	14.2	.156
						order_status	60673	1.42	.016
						delivery	60671	19.5	.157
						stock_level	60671	2.30	.157
						cust_report	333415	13.3	.125
4	84233	2700	2121	4.09%	.052	new_order	8887028	389	.578
						payment	6129227	134	.250
						order_status	612922	16.7	.344
						delivery	612923	231	.750
						stock_level	612924	22.4	.234
						cust_report	3371423	145	.297
5	84490	2700	811	24.7%	.033	new_order	8913141	489	.391
						payment	6146706	173	.718
						order_status	614672	19.7	.266
						delivery	614671	277	.531
						stock_level	614671	29.6	.391
						cust_report	3380276	188	.484
6	83607	2700	845	28.3%	.078	new_order	8824600	578	.766
						payment	6085289	213	.750
						order_status	608529	24.1	1.20
						delivery	608526	335	.969
						stock_level	608529	31.6	.500
						cust_report	3345976	224	.766
7	82248	2700	1944	24.3%	.039	new_order	8677491	679	1.28
						payment	5984014	258	1.72
						order_status	598399	26.8	.594
						delivery	598400	393	2.25
						stock_level	598402	32.9	.953
						cust_report	3290546	252	1.89
8	81148	2700	1913	20.9%	.026	new_order	8560212	768	1.17
						payment	5903210	312	1.03
						order_status	590321	35.8	.797

						delivery	590322	424	2.77
						stock_level	590322	46.4	1.09
						cust_report	3246209	293	1.17

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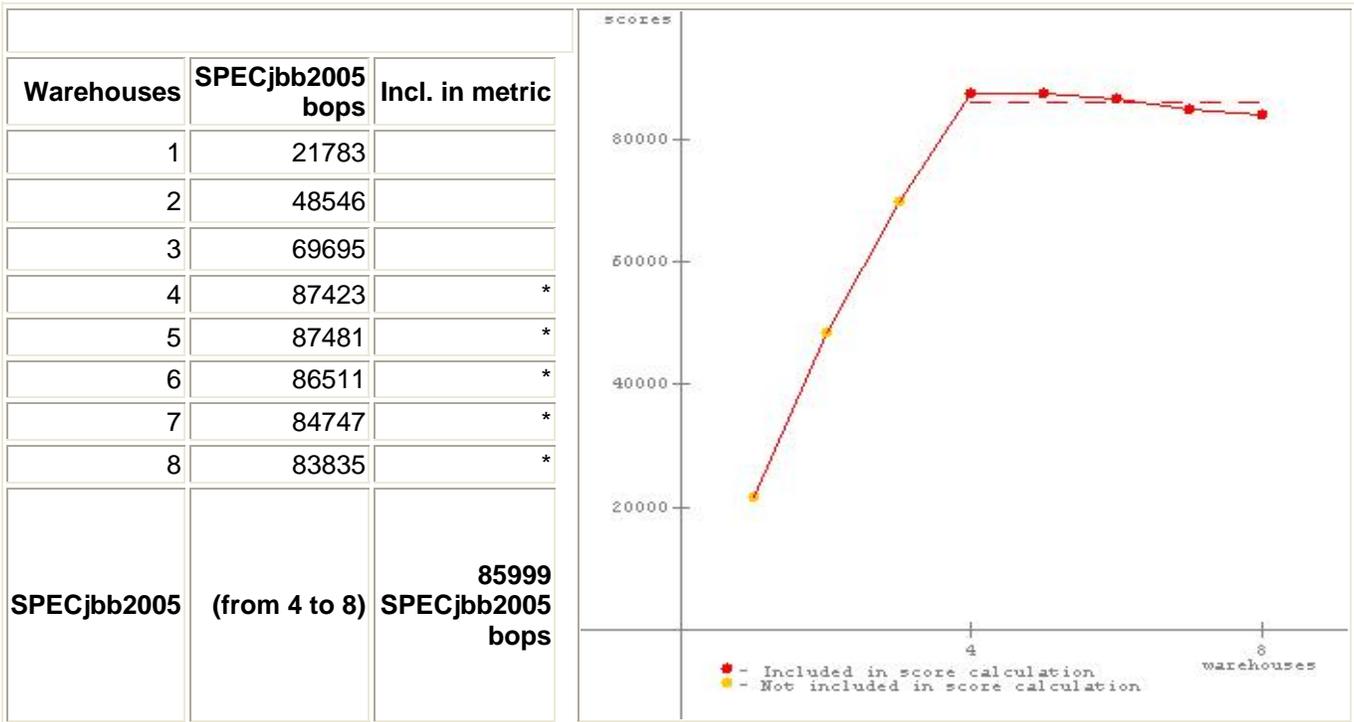
HP ProLiant DL 380 G5 server

SPECjbb2005

**SPECjbb2005 bops = 85999,  
 SPECjbb2005 bops/JVM = 85999**

Hewlett-Packard, HP ProLiant DL 380 G5  
 BEA JRocket 5.0, jrocket-jdk1.5.0\_06-win\_x86\_64

**No errors. Valid run.**



SPEC license # 3184      Tested by: Principled Technologies, Inc.      Test date: Dec 13, 2006

Hardware		Software	
Hardware Vendor	Hewlett-Packard	Software Vendor	BEA
Vendor URL	<a href="http://www.hp.com">http://www.hp.com</a>	Vendor URL	<a href="http://www.bea.com">http://www.bea.com</a>
Model	HP ProLiant DL 380 G5	JVM Version	JRocket 5.0, jrocket-jdk1.5.0_06-win_x86_64
Processor	Dual-Core Intel Xeon Processor 5148	JVM Command Line	java -Xms2700m -Xmx2700m -XXaggressive -XXthroughputCompaction -XXallocPrefetch -XXcompressedRefs -XXlazyUnlocking -XXtlasize128k spec.jbb.JBBmain -profile

MHz	2333
# of Chips	2
# of Cores	4
# of Cores/Chip	2
HW Threading Enabled?	N/A
Procs Avail to Java	4
Memory (MB)	4096
Memory Details	4x1GB FBDIMMs FB-DDR2 PC2-5300
Primary cache	32KB+32KB
Secondary cache	4MB (shared)
Other cache	
Filesystem	NTFS
Disks	2 x 36GB SAS
Other hardware	

	SPECjbb.props
JVM Initial Heap Memory (MB)	2700
JVM Maximum Heap Memory (MB)	2700
JVM Address bits	64
JVM CLASSPATH	.\jbb.jar; .\check.jar;
JVM BOOTCLASSPATH	C:\jrocket-jdk1.5.0_06\jre\bin\jrocket\jrocket.jar; C:\jrocket-jdk1.5.0_06\jre\bin\jrocket\managementapi.jar; C:\jrocket-jdk1.5.0_06\jre\lib\managementapi.jar; C:\jrocket-jdk1.5.0_06\jre\lib\rt.jar; C:\jrocket-jdk1.5.0_06\jre\lib\i18n.jar; C:\jrocket-jdk1.5.0_06\jre\lib\sunrsasign.jar; C:\jrocket-jdk1.5.0_06\jre\lib\jsse.jar; C:\jrocket-jdk1.5.0_06\jre\lib\jce.jar; C:\jrocket-jdk1.5.0_06\jre\lib\charsets.jar; C:\jrocket-jdk1.5.0_06\jre\classes
OS Version	Microsoft Windows Server 2003 R2 Enterprise x64 Edition
Other software	

Test Information	
Tested by	Principled Technologies, Inc.
SPEC license #	3184
Test location	Durham, NC
Test date	Dec 13, 2006
H/w available	
JVM available	
OS available	
Other s/w available	

AOT Compilation	
Tuning	
In the local security settings, "lock pages in memory" was enabled	
Notes	

**No errors. Valid run.**

### Details of Runs

Warehouses	Thrput	Total heap (MB)		Thread spread %	% > 120s	transaction type	Count	Time (in seconds)	
		Size	Used					total	max
1	21783	2700	1558	<0.01%	<0.01	new_order	287275	12.8	.094
						payment	198133	4.79	.266
						order_status	19814	.537	.016
						delivery	19813	5.57	.016

						stock_level	19813	.714	.016
						cust_report	108993	4.89	.016
2	48546	2700	547	4.36%	<0.01	new_order	640303	24.8	.203
						payment	441549	11.2	.157
						order_status	44155	1.01	.172
						delivery	44156	11.2	.078
						stock_level	44154	1.34	.016
						cust_report	242793	8.85	.016
3	69695	2700	2700	2.35%	<0.01	new_order	919448	36.8	.250
						payment	633926	13.3	.141
						order_status	63393	1.46	.016
						delivery	63392	20.0	.250
						stock_level	63393	2.10	.141
						cust_report	348413	13.9	.235
4	87423	2700	2075	4.03%	.020	new_order	9222650	383	.485
						payment	6359258	146	.485
						order_status	635924	15.1	.031
						delivery	635927	226	.485
						stock_level	635926	22.3	.281
						cust_report	3495866	145	.313
5	87481	2700	830	24.2%	.072	new_order	9232729	481	.515
						payment	6366833	182	.609
						order_status	636684	18.7	.375
						delivery	636683	276	.391
						stock_level	636685	27.8	.391
						cust_report	3500930	186	.500
6	86511	2700	2606	24.4%	<0.01	new_order	9123497	575	.953
						payment	6291702	219	.828
						order_status	629168	25.0	.593
						delivery	629170	339	1.52
						stock_level	629172	33.8	.594
						cust_report	3459913	216	.750
7	84747	2700	2514	24.7%	.058	new_order	8942534	664	1.14
						payment	6167030	273	.953
						order_status	616703	28.1	.719
						delivery	616702	393	1.17
						stock_level	616700	40.1	1.11
						cust_report	3391503	248	1.13
8	83835	2700	1438	10.7%	.039	new_order	8844127	767	1.72

						payment	6099498	331	1.13
						order_status	609951	38.5	1.44
						delivery	609949	410	1.19
						stock_level	609948	41.6	2.19
						cust_report	3354877	291	1.81

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IBM System x3650 server

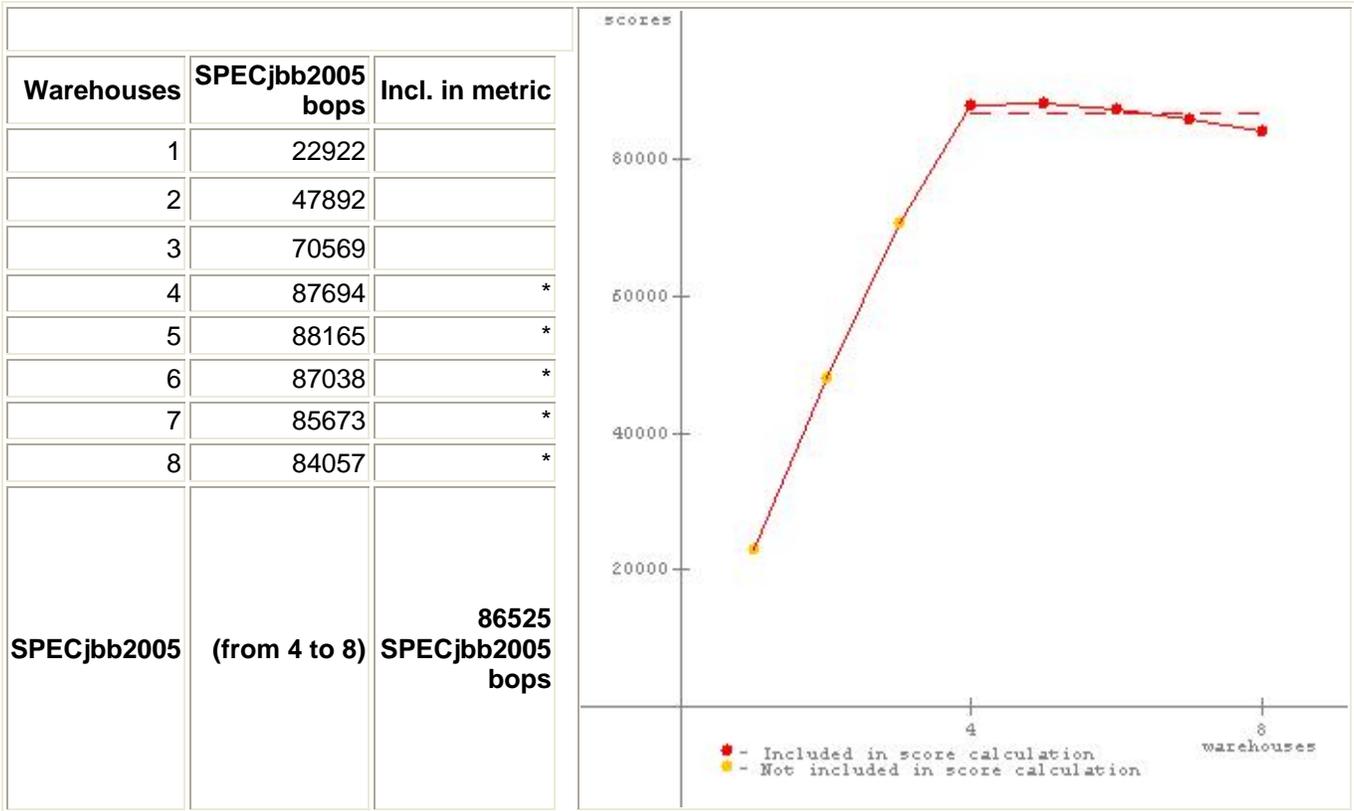
SPECjbb2005

**SPECjbb2005 bops = 86525,  
 SPECjbb2005 bops/JVM = 86525**

IBM IBM System x3650

BEA JRocket 5.0, jrocket-jdk1.5.0\_06-win\_x86\_64

**No errors. Valid run.**



SPEC license # 3184      Tested by: Principled Technologies, Inc.      Test date: Dec 14, 2006

Hardware		Software	
Hardware Vendor	IBM	Software Vendor	BEA
		Vendor URL	<a href="http://www.bea.com">http://www.bea.com</a>

Vendor URL	<a href="http://www.ibm.com">http://www.ibm.com</a>
Model	IBM System x3650
Processor	Dual-Core Intel Xeon Processor 5148
MHz	2333
# of Chips	2
# of Cores	4
# of Cores/Chip	2
HW Threading Enabled?	N/A
Procs Avail to Java	4
Memory (MB)	4096
Memory Details	4x1GB FBDIMMs FB-DDR2 PC2-5300
Primary cache	32KB+32KB
Secondary cache	4MB (shared)
Other cache	
Filesystem	NTFS
Disks	2 x 73.4GB SAS
Other hardware	

JVM Version	JRocket 5.0, jrocket-jdk1.5.0_06-win_x86_64
JVM Command Line	java -Xms2700m -Xmx2700m -XXaggressive -XXthroughputCompaction -XXallocPrefetch -XXcompressedRefs -XXlazyUnlocking -XXtlasize128k spec.jbb.JBBmain -propfile SPECjbb.props
JVM Initial Heap Memory (MB)	2700
JVM Maximum Heap Memory (MB)	2700
JVM Address bits	64
JVM CLASSPATH	.jbb.jar; .\check.jar;
JVM BOOTCLASSPATH	C:\jrocket-jdk1.5.0_06\jre\bin\jrocket\jrocket.jar; C:\jrocket-jdk1.5.0_06\jre\bin\jrocket\managementapi.jar; C:\jrocket-jdk1.5.0_06\jre\lib\managementapi.jar; C:\jrocket-jdk1.5.0_06\jre\lib\rt.jar; C:\jrocket-jdk1.5.0_06\jre\lib\i18n.jar; C:\jrocket-jdk1.5.0_06\jre\lib\sunrsasign.jar; C:\jrocket-jdk1.5.0_06\jre\lib\jsse.jar; C:\jrocket-jdk1.5.0_06\jre\lib\jce.jar; C:\jrocket-jdk1.5.0_06\jre\lib\charsets.jar; C:\jrocket-jdk1.5.0_06\jre\classes
OS Version	Microsoft Windows Server 2003 R2 Enterprise x64 Edition
Other software	

Test Information	
Tested by	Principled Technologies, Inc.
SPEC license #	3184
Test location	Durham, NC
Test date	Dec 14, 2006
H/w available	
JVM available	
OS available	May-2000
Other s/w available	

AOT Compilation	
Tuning	
In the local security settings, "lock pages in memory" was enabled	
Notes	

**No errors. Valid run.**

### Details of Runs

Warehouses	Thrput	Total heap (MB)		Thread spread %	% > 120s	transaction type	Count	Time (in seconds)	
		Size	Used					total	max
1	22922	2700	1910	<0.01%	<0.01	new_order	302017	13.5	.016

						payment	208382	4.88	.109
						order_status	20837	.815	.016
						delivery	20838	4.33	.016
						stock_level	20838	.675	.016
						cust_report	114743	4.98	.250
2	47892	2700	547	4.74%	<0.01	new_order	631154	25.3	.157
						payment	435384	9.50	.047
						order_status	43540	1.14	.157
						delivery	43538	11.8	.109
						stock_level	43539	1.29	.016
						cust_report	239616	9.23	.156
3	70569	2700	932	3.47%	<0.01	new_order	930613	38.1	.141
						payment	641875	13.7	.125
						order_status	64188	1.76	.125
						delivery	64188	19.0	.141
						stock_level	64188	1.97	.016
						cust_report	353147	13.2	.016
4	87694	2700	2080	3.40%	<0.01	new_order	9248462	378	.578
						payment	6377748	144	.578
						order_status	637776	16.6	.500
						delivery	637774	228	.797
						stock_level	637776	22.0	.187
						cust_report	3507037	146	.578
5	88165	2700	1747	23.2%	.052	new_order	9301416	485	.469
						payment	6415318	180	.578
						order_status	641532	19.5	.188
						delivery	641531	275	.750
						stock_level	641533	26.4	.375
						cust_report	3529212	183	.406
6	87038	2700	1940	28.2%	.013	new_order	9181303	563	1.14
						payment	6330879	230	.844
						order_status	633088	22.8	.671
						delivery	633088	332	1.06
						stock_level	633087	34.7	.953
						cust_report	3480451	222	.968
7	85673	2700	682	28.8%	.072	new_order	9042560	666	1.16
						payment	6235207	276	1.20
						order_status	623519	26.5	.781
						delivery	623523	384	8.16

						stock_level	623520	35.8	1.03
						cust_report	3427851	256	1.25
8	84057	2700	746	8.15%	.072	new_order	8870674	760	1.64
						payment	6117611	336	1.94
						order_status	611761	33.3	1.34
						delivery	611761	416	2.67
						stock_level	611761	41.6	1.33
						cust_report	3364554	292	1.36

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