Principled Technologies®

TEST REPORT
SEPTEMBER 2008

64-bit SunGard Adaptiv Analytics Benchmark financial workload performance and power consumption on multiprocessor Intel- and AMD-based servers

Executive summary

Intel® Corporation (Intel) commissioned Principled Technologies (PT) to measure the 64-bit SunGard Adaptiv Analytics Benchmark financial application-based workload performance and power consumption on multiprocessor servers using the following three processors:

- AMD® Opteron® 8360 SE
- Intel Xeon® processor X7350
- Intel Xeon® processor X7460

The SunGard Adaptiv Analytics Benchmark workload is multithreaded and allows users to specify the number of threads the program should run. Performance of the workload can increase as it runs with more threads, up to an optimum thread count, generally equal to the number of logical and physical processors available on the server. (We refer to this as the optimum thread-to-processor configuration.)

KEY FINDINGS

- The Intel Xeon processor X7460-based server delivered 57.3 percent more performance/watt than the AMD Opteron 8360 SE-based server and 43.7 percent more performance/watt than the Intel Xeon processor X7350-based server (see Figure 1). (We calculated performance/watt using system-level power measurements.)
- The Intel Xeon processor X7460-based server delivered 64.9 percent more SunGard jobs per hour than the AMD Opteron 8360 SE-based server and 23.4 percent more SunGard jobs per hour than the Intel Xeon processor X7350-based server (see Figure 2).

The optimum thread count for our testing was 16 on the AMD Opteron 8360 SE-based server and the Intel Xeon processor X7350-based server and 24 on the Intel Xeon processor X7460-based server. The difference in thread counts between the servers is due to the different number or execution units (logical processors) on those servers.

In this section, we discuss the best results for each server. For complete details of the performance of each server with varying thread counts, see the Test results section.

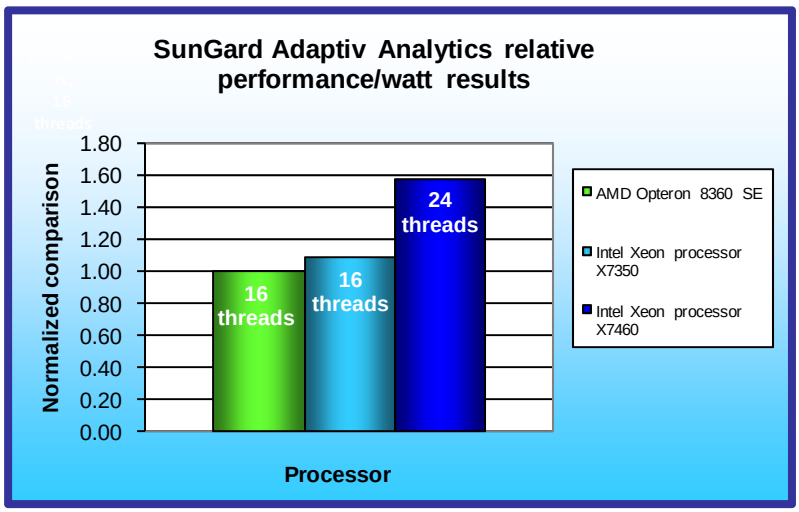

Figure 1: Performance/watt results of the test servers running the SunGard Adaptiv Analytics Benchmark workload. Higher numbers indicate better performance/watt.

Figure 1 illustrates the performance/watt for each of the three servers. In this and the other performance charts in this section, we 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., faster times to complete the workload with the specified number of threads).

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

$$\frac{3{,}600/\text{the benchmark's duration in seconds}}{\text{average power consumption in watts during the period the benchmark was delivering peak performance}}$$

As Figure 1 illustrates, the Intel Xeon processor X7460-based server delivered 57.3 percent more performance/watt than the AMD Opteron 8360 SE processor-based server and 43.7 percent more performance/watt than the Intel Xeon processor X7350-based server.

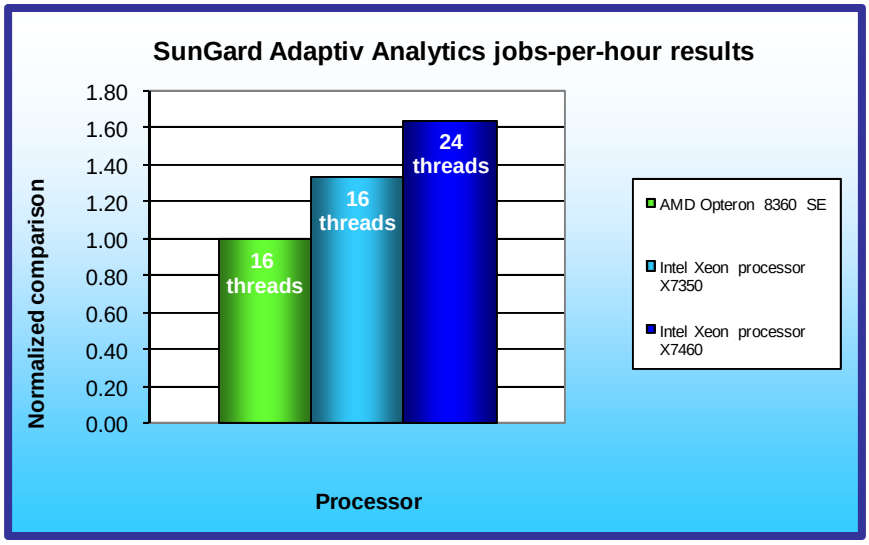

Figure 2: Normalized jobs-per-hour of the servers with optimum thread-to-processor configurations on the SunGard Adaptiv Analytics Benchmark workload. Higher numbers are better.

Figure 2 portrays the relative peak performance of each server at the optimum thread count using the jobs-per-hour metric. We took the number of seconds each system took to perform the workload and divided 3,600 (the number of seconds in an hour) by that number. We then normalized the scores to the lowest-performing system. The Intel Xeon processor X7460-based server performed 64.9 percent more SunGard Adaptiv Analytics jobs per hour than the AMD Opteron 8360 SE processor-based server. The Intel Xeon processor X7460-based server performed 23.4 percent more SunGard Adaptiv Analytics jobs per hour than the Intel Xeon processor X7350-based server.

Workload

Per SunGard, "Adaptiv Analytics is SunGard's architecture for complex simulation-based financial calculations. Built upon a modular, extensible architecture it leverages modern technologies to deliver a grid-enabled solution to meet the demands faced by today's risk managers.

"Adaptiv assists institutions of varying size and complexity to deploy technology to meet both internal and regulatory requirements for risk management and operational control. We help financial services institutions from the banking, hedge fund, asset management, insurance and corporate sectors with our deep understanding of risk management and operational processes."

Test results

Figure 3 details the results of our tests with 2, 4, 8, 16, and 24 threads using the SunGard Adaptiv Analytics Benchmark workload. For each test, we present the median run of the three individual test runs we executed. The test produces the time, in seconds, the server took to complete the workload; lower completion times are better.

Server / # of threads	2 threads	4 threads	8 threads	16 threads	24 threads
AMD Opteron 8360 SE	1,222.91	644.72	344.92	**172.95**	218.70
Intel Xeon processor X7350	892.42	448.78	228.42	**129.44**	133.83
Intel Xeon processor X7460	864.20	436.67	222.20	126.16	**104.89**

Figure 3: Median completion times (in seconds) of the servers with varying thread counts using the SunGard Adaptiv Analytics Benchmark workload. Lower times are better. The result for the optimum thread count for each server appears in bold.

As Figure 3 shows, the Intel Xeon processor X7460-based server achieved its fastest completion time with 24 threads and both the AMD Opteron 8360 SE-based server and the Intel Xeon processor X7350-based server achieved their fastest completion time with 16 threads.

Figure 4 details the average power consumption of the test servers during the median runs of our tests with 2, 4, 8, 16, and 24 threads. The Intel Xeon processor X7460-based server had 14.1 percent lower average power usage during its fastest run of the workload (the one with two threads) than the Intel Xeon processor X7350-based server.

Server / # of threads	2 threads	4 threads	8 threads	16 threads	24 threads
AMD Opteron 8360 SE	478.0	518.9	577.2	662.5	625.7
Intel Xeon processor X7350	580.8	637.2	721.3	808.9	806.4
Intel Xeon processor X7460	543.6	568.7	613.2	675.5	694.6

Figure 4: Average power usage (in watts) of the servers with varying thread counts running the SunGard Adaptiv Analytics Benchmark workload. Lower times are better.

Figure 5 details the power consumption, in watts, of the test servers while idle and during the median optimum thread count peak runs of the benchmark.

Server	Idle power (watts)	Average power (watts)
AMD Opteron 8360 SE	428.1	662.5
Intel Xeon processor X7350	511.2	808.9
Intel Xeon processor X7460	505.9	694.6

Figure 5: Average power usage (in watts) of the test servers while idle and during the median optimum thread count peak runs of the SunGard Adaptiv Analytics Benchmark workload. Lower 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	AMD Opteron processor 8360 SE-based server	Intel Xeon processor X7350-based server	Intel Xeon processor X7460-based server
Processor frequency (GHz)	2.50	2.93	2.66
Front-side bus frequency (MHz)	2,000 with HyperTransport	1,066	1,066
Number of processor packages	4	4	4
Number of cores per processor package	4	4	6
Number of hardware threads per core	1	1	1
Motherboard	HP 013241-001	Intel S7000FC4UR	Intel S7000FC4UR
Chipset	NVIDIA nForce Pro 2050	Intel ID3600	Intel ID3600
RAM	Micron MT36HTF25672PY-667D1 ELPIDA EBE21AD4AJFA-6E-E	Kingston KVR667D2D4F5/2G	Kingston KVR667D2D4F5/2G
Hard drive	HP DG072BABCE	Seagate ST973401SS	Seagate ST973401SS

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

Intel configured and provided the two Intel Xeon processor-based servers. PT purchased the AMD Opteron processor-based server.

We used the default BIOS settings on the Intel Xeon processor X7460-based server and the Intel Xeon processor X7350-based server. We used the default BIOS settings on the AMD Opteron processor 8360 SE-based server except for one change, which was to change the HP Power Regulator for ProLiant setting from Dynamic Power Savings Mode to Static Performance Mode.

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 log on.
4. Select Eastern Time Zone.
5. Use typical settings for the Network installation.
6. Use “Testbed” for the workgroup.

We then installed the Microsoft .NET Framework, version 3.5 with the default options; it is available at http://msdn.microsoft.com/netframework/.

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 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 4 (power consumption at different thread counts) and 5 (idle and average peak power) for the results of these measurements.

Installation of the SunGard Adaptiv Analytics 64-bit version workload

Intel supplied the SunGard Adaptiv Analytics 64-bit application and workload compressed in a zip file on CD-ROM. We unzipped the file's contents into the folder C:\Sungard on each system. The files in that folder contained both the SunGard Adaptiv Analytics executable (RiskAnalytics.exe) and the two data files the workload uses:

- *MarketData.dat* – sample data representing a fictional set of financial market conditions
- *Portfolio D.cpf* – sample data representing a fictional customer's investment portfolio

SunGard Adaptiv Analytics workload switches/parameters

This workload provides the following switches, which we set as appropriate for each test run:

- */numThreads* or */t* This option designates the number of threads the workload should run. We set this to the number of threads we wanted in each test.
- */outputFileName or /o* This option saves the results in a text file and overwrites that file if the file already exists. We saved each test's results in a separate file.

Running the SunGard Adaptiv Analytics workload

We rebooted the server before each individual test and then followed this process to run the test:

1. Open a DOS command window.
2. Navigate to the C:\Sungard folder.
3. Enter the following command:
   "RiskAnalytics /o <server name >_<# of threads>_<run no.>.txt /t <# of threads>", where
   - <server name> is as appropriate
   - <# of threads> is either 2, 4, 8, 16, or 24 as appropriate
   - <run no.> is either 1, 2, or 3 (we ran each test three times)
4. The workload then starts and opens a monitoring console like the one in Figure 7, but without the results graph (see step 7 for more on that graph).
5. Click Calculate at the top left corner of the window.
6. A "Percentage Complete" progress message displays in the bottom left corner of the status bar.
7. When the workload completes, the monitoring console presents a graph of the results over the course of the test; Figure 7 shows an example. The text below the graph in the display describes the parameters the workload used for this run and the time (in seconds) it took to complete the test. Record this time as the primary result of each test.

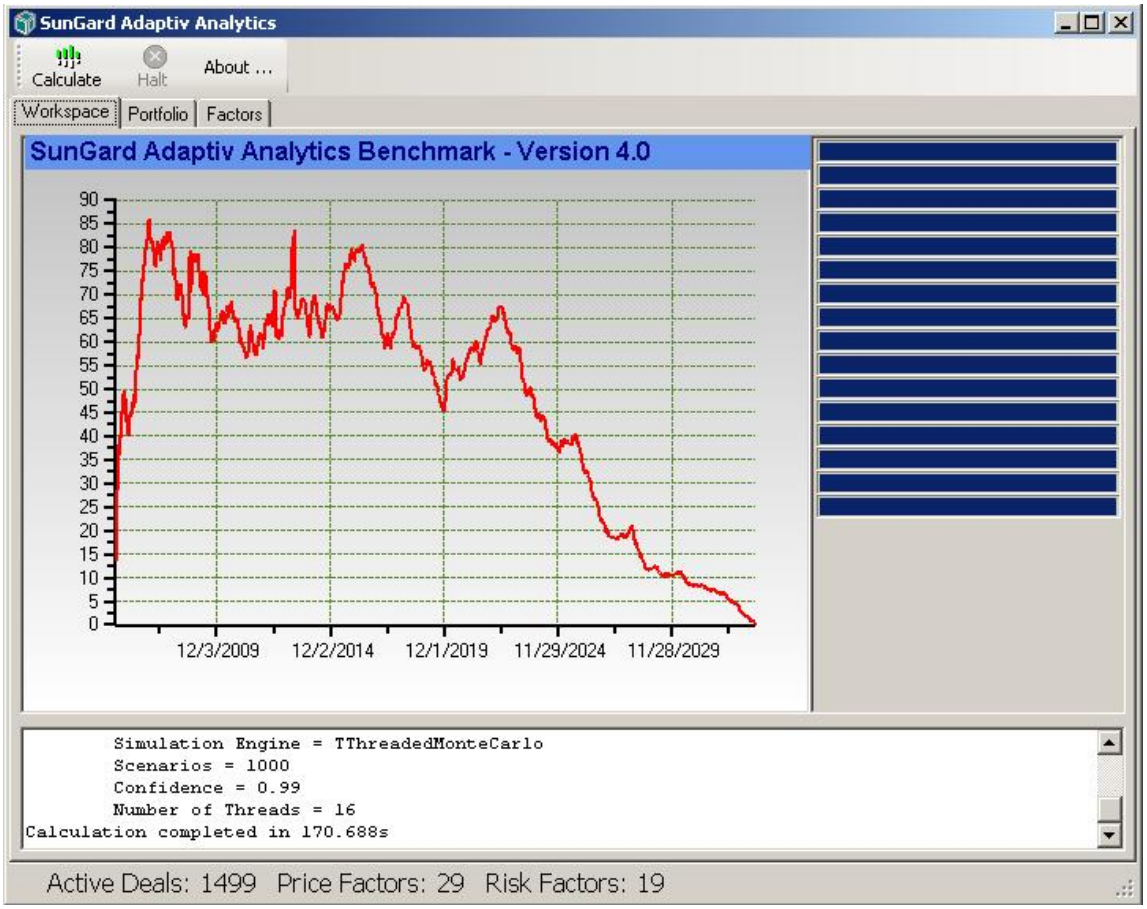

Figure 7: An example of the monitoring console after the SunGard Adaptiv Analytics Benchmark workload completes.

Appendix A – Test server configuration information

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

Servers	AMD Opteron processor 8360 SE-based server	Intel Xeon processor X7350-based server	Intel Xeon processor X7460-based server
General processor setup			
Number of processor packages	4	4	4
Number of cores per processor package	4	4	6
Number of hardware threads per core	1	1	1
System Power Management Policy	Always On	Always On	Always On
CPU			
Vendor	AMD	Intel	Intel
Name	Opteron 8360 SE	Intel Xeon X7350	Intel Xeon X7460
Stepping	3	B	1
Socket type	Socket F (1207)	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.50	2.93	2.66
Front-side bus frequency (MHz)	2,000 with HyperTransport	1,066	1,066
L1 cache	64 KB x 64 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	4 x 512 KB (512 KB per core)	2 x 4 MB (each 4 MBs shared by 2 cores)	3 x 3 MB (each 3 MB shared by 2 cores)
L3 cache	2MB	N/A	16 MB
Platform			
Vendor and model number	HP DL585 G5	Intel Fox Cove	Intel Fox Cove
Motherboard model number	013241-001	S7000FC4UR	S7000FC4UR
Motherboard chipset	NVIDIA nForce Pro 2050	Intel ID3600	Intel ID3600
Motherboard revision number	0H	01	01
BIOS name and version	HP A07 (06/27/2008)	Intel SFC4UR.868.01.00.0024.061320082253 (06/13/2008)	Intel SFC4UR.868.01.00.0024.061320082253 (06/13/2008)
BIOS settings	Power Regulator for ProLiant set to Static Performance Mode	Default	Default
Chipset driver	Microsoft 5.2.3790.1830	Intel 8.4.0.1015	Intel 8.4.0.1015
Memory module			
Vendor and model number	8 x Micron MT36HTF25672PY-667D1, 8 x ELPIDA EBE21AD4AJFA-6E-E	Kingston KVR667D2D4F5/2G	Kingston KVR667D2D4F5/2G
Type	PC2-5300 DDR2	PC2-5300 FB-DDR2	PC2-5300 FB-DDR2
Speed (MHz)	667	667	667
Speed in the system currently running @ (MHz)	667	667	667

Servers	AMD Opteron processor 8360 SE-based server	Intel Xeon processor X7350-based server	Intel Xeon processor X7460-based server
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15	5-5-5-15	5-5-5-15
Size	32 GB	32 GB	32 GB
Number of RAM modules	16 x 2 GB	16 x 2 GB	16 x 2 GB
Chip organization	Double-sided	Double-sided	Double-sided
Hard disk			
Vendor and model number	HP DG072BABCE	Seagate ST973401SS	Seagate ST973401SS
Number of disks in system	2	2	2
Size	72 GB	73.4 GB	73.4 GB
Buffer size	16 MB	8 MB	8 MB
RPM	10,000	10,000	10,000
Type	SAS	SAS	SAS
Controller	Smart Array P400 Controller	Integrated Intel RAID Controller SROMBSASFC	Integrated Intel RAID Controller SROMBSASFC
Driver version	HP 6.8.0.64	Intel 2.20.0.64	Intel 2.20.0.64
Operating system			
Name	Microsoft Windows Server 2003 Enterprise x64 Edition	Microsoft Windows Server 2003 Enterprise x64 Edition	Microsoft Windows Server 2003 Enterprise x64 Edition
Build number	3790	3790	3790
Service Pack	SP2	SP2	SP2
File system	NTFS	NTFS	NTFS
Kernel	ACPI	ACPI	ACPI
Language	English	English	English
Microsoft DirectX version	9.0c	9.0c	9.0c
Graphics			
Vendor and model number	ATI ES1000	ATI ES1000	ATI ES1000
Chipset	ES1000	ES1000	ES1000
BIOS version	BK-ATI VER008.005.013.000	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000
Type	Integrated	Integrated	Integrated
Memory size	32 MB	32 MB	32 MB
Resolution	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Network card/subsystem			
Vendor and model number	HP NC371i Multifunction Gigabit Server Adapter	Intel PRO/1000 EB	Intel PRO/1000 EB
Type	Integrated	Integrated	Integrated
Driver version	HP 4.4.15.0	Intel 9.12.18.0	Intel 9.12.18.0
Optical drive			
Vendor and model number	HL-DT-ST RW/DVD GCC-C10N	Optiarc DVD-ROM DDU810A	Optiarc DVD-ROM DDU810A
USB ports			
Number	4	5	5
Type	USB 2.0	USB 2.0	USB 2.0

Servers	AMD Opteron processor 8360 SE-based server	Intel Xeon processor X7350-based server	Intel Xeon processor X7460-based server
Power supplies			
Total number	2	2	2
Wattage of each	1,300W	1,570W	1,570W
Cooling fans			
Total number	6	8	8
Dimensions	5" x 5"	4 x 80mm + 4 x 120mm	4 x 80mm + 4 x 120mm
Voltage	12V	12V	12V
Amps	3.3A	4 x 1.76 A + 4 x 3.3 A	4 x 1.76 A + 4 x 3.3 A

Figure 8: Detailed system configuration information for the three test servers.

Principled Technologies, Inc.
4813 Emperor Blvd., Suite 100
Durham, NC 27703
www.principledtechnologies.com
info@principledtechnologies.com