Principled Technologies®

TEST REPORT
JUNE 2006

64-bit SunGard ACR financial workload performance and power consumption on uniprocessor Intel-processor-based servers

Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to measure the performance of the 64-bit SunGard Adaptiv Credit Risk (SunGard ACR) financial application-based workload on uniprocessor servers using the following three processors:

- Intel Pentium D processor 840
- Intel Pentium D processor 950
- Intel Xeon processor 3070

The SunGard ACR 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.) The optimum thread count for our testing was two on all servers. The reason is that each of these servers has one physical processor with two cores per processor, or two available execution units.

KEY FINDINGS

- The Intel Xeon processor 3070-based server delivered 69 percent more performance/watt than the Intel Pentium D processor 950-based server (see Figure 1). (We calculated performance/watt using system-level power measurements.)
- The Intel Xeon processor 3070-based server delivered almost 20.6 percent higher peak performance than the Intel Pentium D processor 950-based server (see Figure 2).
- The Intel Xeon processor 3070-based server had almost 12 percent lower average power usage while running the workload than the Intel Pentium D processor 840-based server (see Figure 4).

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.

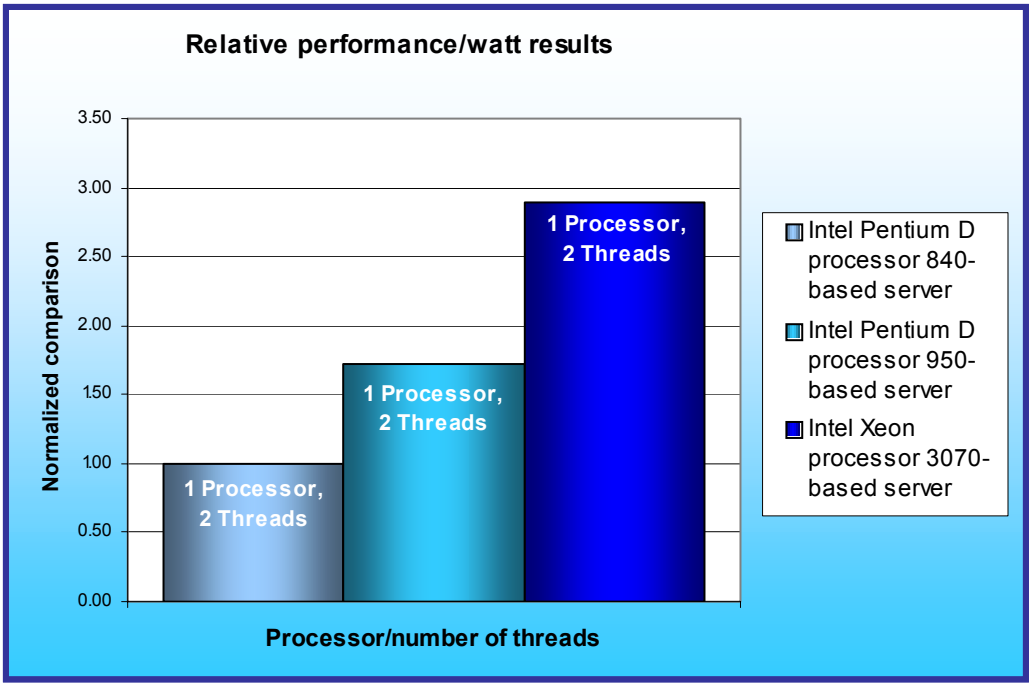

Figure 1: Performance/watt results of the test servers running the SunGard ACR workload. Higher numbers indicate better performance/watt.

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:

Performance/watt = (3600 / (the benchmark's duration in seconds)) / (average power consumption in watts during the time period in which the benchmark was delivering peak performance)

This formula converts the elapsed time the benchmark took to complete into a runs (or jobs) per hour metric, which we then use to compute the performance/watt.

As Figure 1 illustrates, the Intel Xeon processor 3070-based server delivered 69 percent more performance/watt than the Intel Pentium D processor 950-based server and 189.7 percent more performance/watt than the Intel Pentium D processor 840-based server.

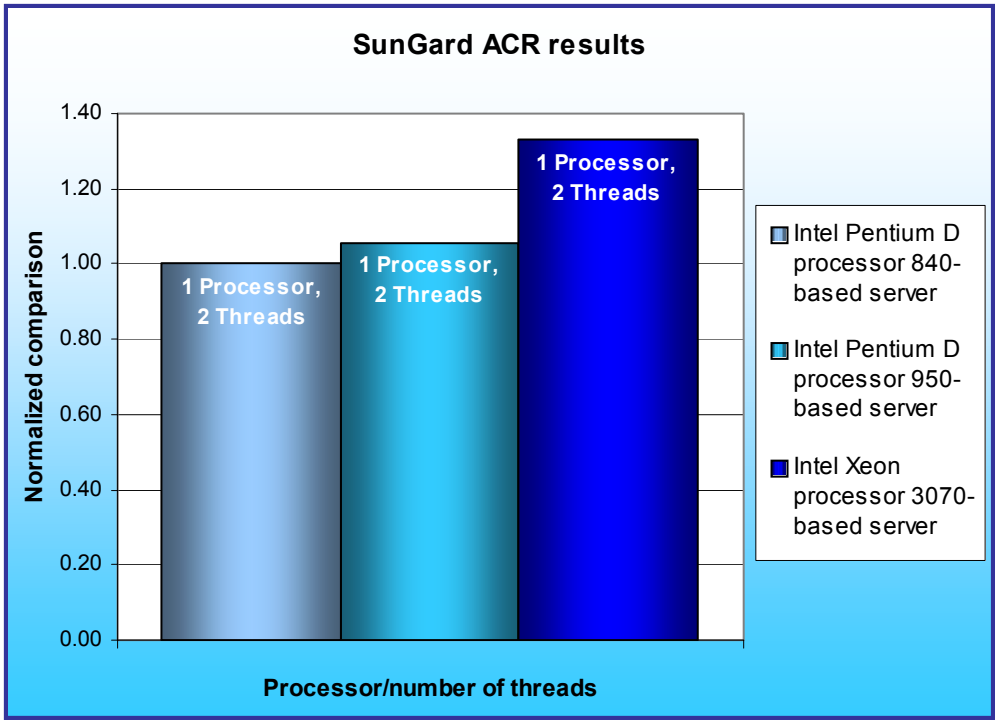

Figure 2: Normalized peak performance of the servers with optimum thread-to-processor configurations on the SunGard ACR workload. Higher numbers are better.

Figure 2 portrays the relative peak (two-thread) performance of each server. The Intel Xeon processor 3070-based server finished the SunGard ACR workload in 994.5 seconds, almost 21 percent faster than the Intel Pentium D processor 950-based server, which finished the same workload in 1,252.6 seconds. This speed difference means a user would receive a solution four minutes and 18 seconds faster with the Intel Xeon processor 3070 -based server. The Intel Xeon processor 3070-based server was almost 25 percent faster than the Intel Pentium D processor 840-based server, which took 1321.9 seconds to complete the same workload.

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 Intel Xeon processor 3070-based server achieved its peak performance while drawing less power—almost 25.5 percent less—than the Intel Pentium D processor 950-based server. (The drop in power consumption back to idle state for both the Intel Xeon processor 3070-based server and the Intel Pentium D processor 950-based server occurred when each of those servers finished the workload.)

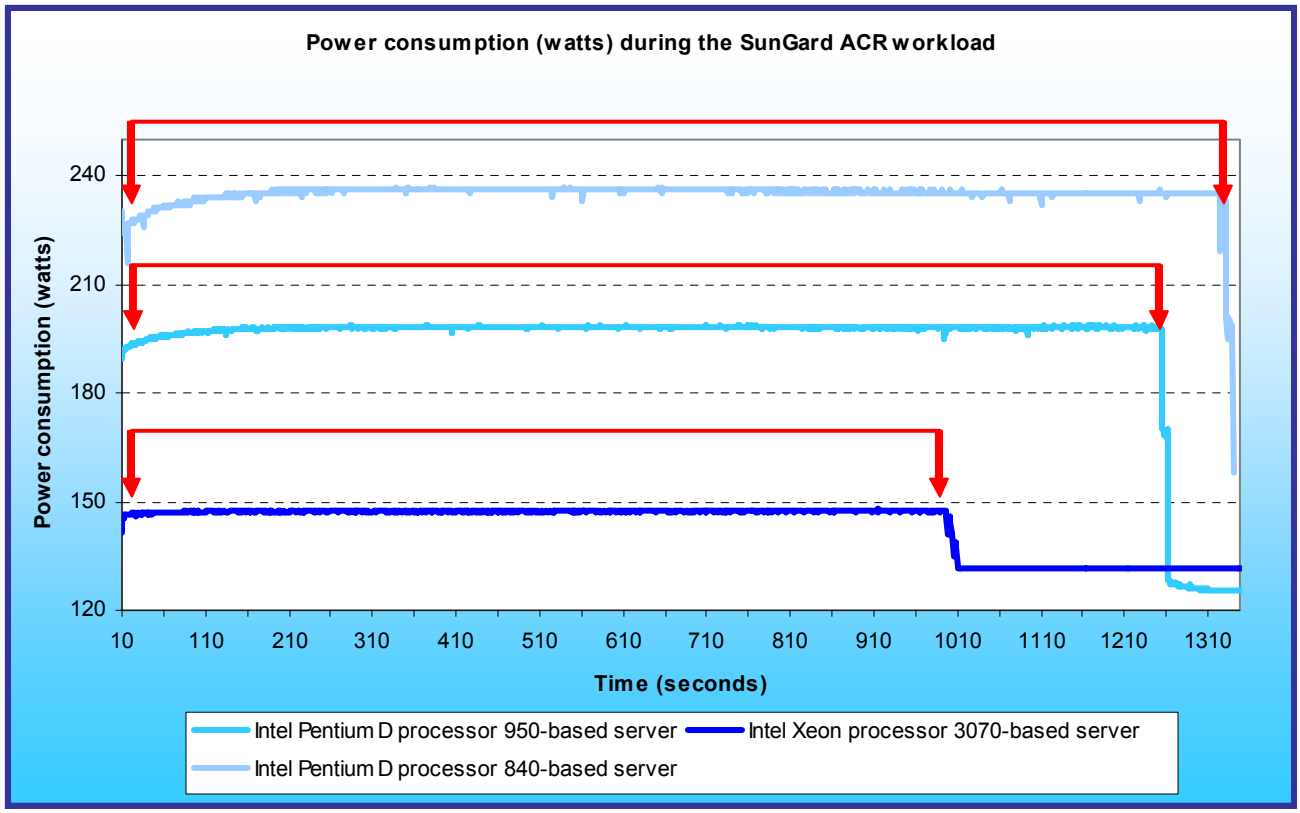

Figure 3: Power consumption (in watts) of each of the servers throughout the course of executing the SunGard ACR workload. Lower power consumption is better.

Workload

Per SunGard, "SunGard Adaptiv Credit Risk provides a total, real-time credit risk solution for counterparty credit exposure aggregation, global limit management, credit risk analytics and collateral management." This workload analyzes a large portfolio of client assets and generates a credit risk evaluation. The more quickly the workload completes, the more quickly the user receives the evaluation, so improving performance can improve productivity. SunGard developed the Adaptiv Credit Risk workload and supplied the computational engine and financial data.

Per SunGard, "With annual revenue of $4 billion, SunGard is a global leader in software and processing solutions for financial services, higher education and the public sector. SunGard also helps information-dependent enterprises of all types to ensure the continuity of their business. SunGard serves more than 25,000 customers in more than 50 countries, including the world's 50 largest financial services companies. SunGard Adaptiv Credit Risk is a risk management system that supports the credit risk management on all levels by combining comprehensive credit risk related functionality, powerful real-time analytic capabilities and sophisticated user interfaces and reporting. SunGard Adaptiv Credit Risk (www.sungard.com/adaptiv) provides global scalability, real-time performance and the capacity to handle vast trading volumes." SunGard Adaptiv Credit Risk has an open architecture and uses middleware, XML-based formats, and industry-standard data and technologies.

Test results

Figure 4 details the results of our tests with two, four, and eight threads using the SunGard ACR 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	4	8
Intel Pentium D processor 840-based server	1,321.9	1,333.4	1,338.7
Intel Pentium D processor 950-based server	1,252.6	1,265.8	1,278.1
Intel Xeon processor 3070-based server	994.5	1,015.7	996.3

Figure 4: Median completion times (in seconds) of the servers with varying thread counts using the SunGard ACR workload. Lower times are better.

As Figure 4 shows, all servers achieved their fastest completion times with two threads, which means two threads is the optimum thread-to-processor configuration for each server.

Server / # of threads	2	4	8
Intel Pentium D processor 840-based server	234.8	236.1	234.8
Intel Pentium D processor 950-based server	197.6	196.8	195.5
Intel Xeon processor 3070-based server	147.3	146.8	147.1

Figure 5: Average power usage (in watts) of the servers with varying thread counts running the SunGard ACR workload. Lower times are better.

Figure 5 details the average power consumption of the test servers during the median runs of our tests with two, four, and eight threads. The Intel Xeon processor 3070-based server had almost 25.5 percent lower average power usage during its fastest run of the workload (the one with two threads) than the Intel Pentium D processor 950-based server.

Figure 6 details the power consumption, in watts, of the test servers while idle and during the median peak runs of the benchmark.

Server	Idle power (watts)	Average power (watts)
Intel Pentium D processor 840-based server	132.6	234.8
Intel Pentium D processor 950-based server	123.4	197.6
Intel Xeon processor 3070-based server	128.1	147.3

Figure 6: Average power usage (in watts) of the test servers while idle and during the median peak runs of the SunGard ACR workload. Lower numbers are better

Test methodology

Figure 7 summarizes some key aspects of the configurations of the three server systems; Appendix A provides detailed configuration information.

Server	Intel Pentium D processor 840-based server	Intel Pentium D processor 950-based server	Intel Xeon processor 3070-based server
Processor frequency (GHz)	3.20GHz	3.40GHz	2.66GHz
Front-side bus frequency (MHz)	800MHz	800MHz	1066MHz
Single/Dual-Core processors	Dual	Dual	Dual
Motherboard	Intel 3000 Chipset-based internal reference board	Intel 3000 Chipset-based internal reference board	Intel 3000 Chipset-based internal reference board
Chipset	Intel 3010 Chipset	Intel 3010 Chipset	Intel 3010 Chipset
RAM (8GB in each)	4 x 2GB PC2-4200	4 x 2GB PC2-4200	4 x 2GB PC2-4200
Hard Drive	Western Digital WD1600YD	Western Digital WD1600YD	Western Digital WD1600YD

Figure 7: Summary of some key aspects of the server configurations.

Intel configured and provided all three servers.

The difference in front-side bus reflects the capabilities of the three processors: The Intel Xeon processor 3070 uses a front-side bus speed of 1066 MHz. The Intel Pentium D processor 950 and Intel Pentium D processor 840 each have a front-side bus speed of 800 MHz.

With the following exception, we used the default BIOS settings on each server: we disabled the HW Prefetcher on all servers.

We began our testing by installing a fresh copy of Microsoft Windows 2003 Server, x64 Enterprise Edition Service Pack 1 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 applied the following updates from the Microsoft Windows Update site:

- Security Update for Windows Server 2003 x64 Edition (KB908531)
- Cumulative Security Update for Internet Explorer for Windows Server 2003 x64 Edition (KB912812)
- 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 (KB913446)
- Security Update for Windows Server 2003 x64 Edition (KB908519)
- Security Update for Windows Server 2003 x64 Edition (KB912919)
- 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 (KB890046)
- 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 (KB896422)
- 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 (KB910437)
- Update for Windows Server 2003 x64 Edition (KB898715)

We then installed the Microsoft .NET Framework, version 2.0.50727, which SunGard recommends in the documentation that came with the SunGard Adaptiv Credit Risk workload. SunGard developed the SunGard Adaptiv Credit Risk application in Microsoft C#. The application executes as a process within the host Microsoft .NET framework and requires a specific version of .NET, so we downloaded and installed that version: Microsoft .NET Framework x64 Version 2.0.50727, 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 3 (power consumption over time), 5 (power consumption at different thread counts), and 6 (idle and average peak power) for the results of these measurements.

Installation of the SunGard Adaptiv Credit Risk 64-bit version workload

Intel supplied the SunGard Adaptiv Credit Risk 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 Credit Risk 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 Credit Risk 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 Credit Risk 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, or 8 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 8, 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 8 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.

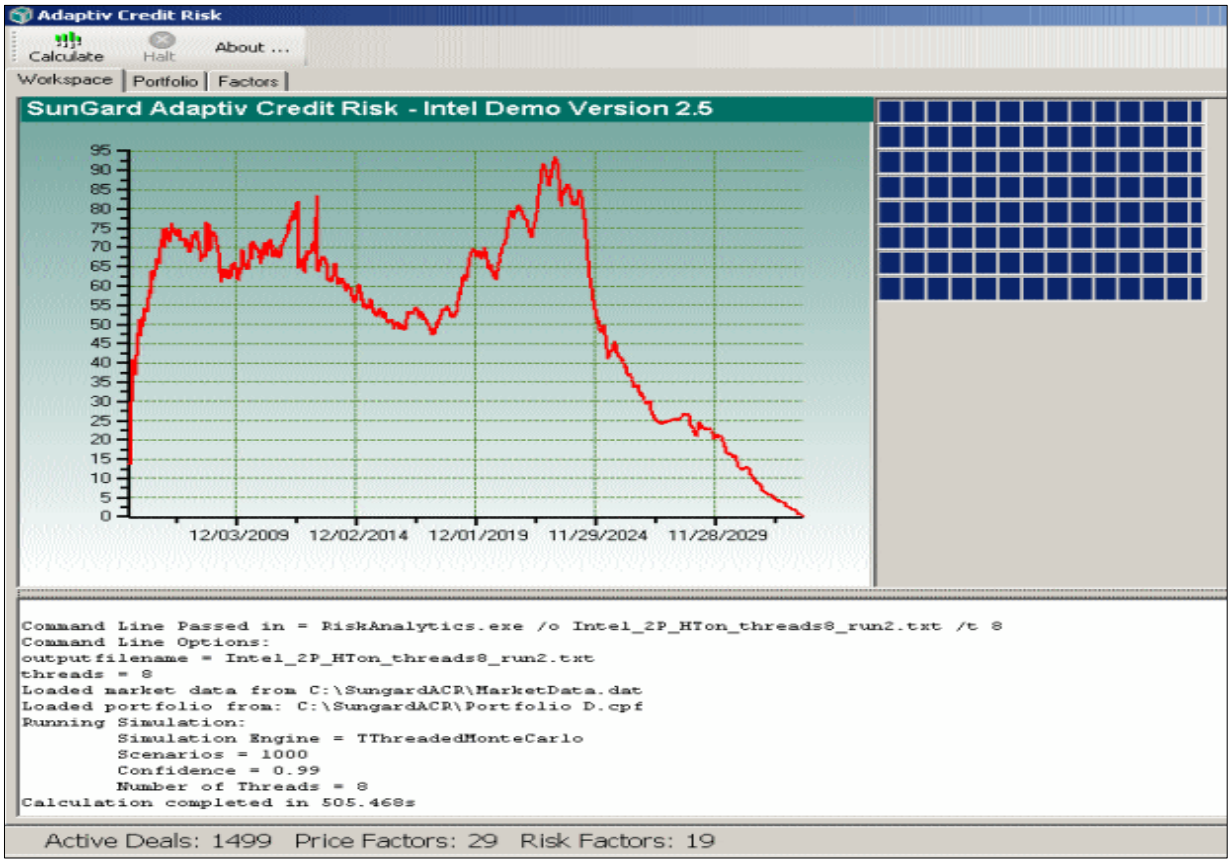

Figure 8: An example of the monitoring console after the SunGard ACR workload completes.

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.

Processors	Intel Pentium D processor 840	Intel Pentium D processor 950	Intel Xeon processor 3070
System configuration information			
General			
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P2C2L / UP	1P2C2L / UP	1P2C2L / UP
Number of physical processors	1	1	1
Single/Dual-Core processors	Dual	Dual	Dual
System Power Management Policy	Always On	Always On	Always On
CPU			
Vendor	Intel	Intel	Intel
Name	Intel Pentium D processor 840	Intel Pentium D processor 950	Intel Xeon processor 3070
Stepping	7	4	4
Socket type	LGA775	LGA 775	LGA775
Core frequency (GHz)	3.20 GHz	3.40 GHz	2.66 GHz
Front-side bus frequency (MHz)	800 MHz	800 MHz	1066 MHz
L1 Cache	16KB + 12KB	16KB + 12KB	32KB + 32KB
L2 Cache	2MB (1MB per core)	4MB (2MB per core)	4MB (Shared)
Platform			
Vendor and model number	Intel Pentium D processor 840 server	Intel Pentium D processor 950 server	Intel Xeon processor 3070 server
Motherboard model number	Intel 3000 Chipset-based internal reference board	Intel 3000 Chipset-based internal reference board	Intel 3000 Chipset-based internal reference board
Motherboard chipset	Intel 3010 Chipset	Intel 3010 Chipset	Intel 3010 Chipset
Motherboard revision number	C0	C0	C0
Motherboard serial number	8MWH61400065	8MWH61400065	8MWH61400139
BIOS name and version	American Megatrends Inc. EXTWM210.86P, 5/23/2006	American Megatrends Inc. EXTWM210.86P, 5/23/2006	American Megatrends Inc. EXTWM210.86P, 5/23/2006
BIOS settings	Default	Default	Default
Chipset INF driver	8.1.1.1001	8.1.1.1001	8.1.1.1001
Memory module(s)			
Vendor and model number	Kingston KVR533D2E4/2G	Kingston KVR533D2E4/2G	Kingston KVR533D2E4/2G
Type	PC2-4200	PC2-4200	PC2-4200
Speed (MHz)	533 MHz	533 MHz	533 MHz
Speed in the system currently running @ (MHz)	400 MHz	400 MHz	533 MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	3-3-3-9	3-3-3-9	4-4-4-12
Size	8192MB	8192MB	8192MB
Number of RAM modules	4	4	4
Chip organization	Double-sided	Double-sided	Double-sided
Channel	Dual	Dual	Dual
Hard disk			

Vendor and model number	Western Digital WD1600YD	Western Digital WD1600YD	Western Digital WD1600YD
Number of disks in system	1	1	1
Size	160GB	160GB	160GB
Buffer Size	16MB	16MB	16MB
RPM	7200	7200	7200
Type	SATA	SATA	SATA
Controller	Intel 82801GB Serial ATA	Intel 82801GB Serial ATA	Intel 82801GB Serial ATA
Controller driver	Intel 7.0.0.1020	Intel 7.0.0.1020	Intel 7.0.0.1020
Operating system			
Name	Microsoft Windows 2003 Server, x64 Enterprise Edition	Microsoft Windows 2003 Server, x64 Enterprise Edition	Microsoft Windows 2003 Server, x64 Enterprise Edition
Build number	3790	3790	3790
Service Pack	SP1	SP1	SP1
Microsoft Windows update date	6/7/2006	6/7/2006	6/7/2006
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
Graphics			
Vendor and model number	ATI ES1000	ATI ES1000	ATI ES1000
Chipset	ATI ES1000 PCI	ATI ES1000 PCI	ATI ES1000 PCI
BIOS version	01.00	01.00	01.00
Type	Integrated	Integrated	Integrated
Memory size	32MB	32MB	32MB
Resolution	1024 x 768	1024 x 768	1024 x 768
Driver	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830
Network card/subsystem			
Vendor and model number	Intel PRO/1000 PM Dual Port Network adapter	Intel PRO/1000 PM Dual Port Network adapter	Intel PRO/1000 PM Dual Port Network adapter
Type	Integrated	Integrated	Integrated
Driver	Intel 9.3.28.0	Intel 9.3.28.0	Intel 9.3.28.0
Additional card information	2 x Intel PRO/1000 PT Dual Port Server Adapter	2 x Intel PRO/1000 PT Dual Port Server Adapter	2 x Intel PRO/1000 PT Dual Port Server Adapter
Additional card type	PCI – Express	PCI – Express	PCI – Express
Additional card driver	Intel 9.3.28.0	Intel 9.3.28.0	Intel 9.3.28.0
Optical drive			
Vendor and model number	Sony DDU1615	Sony DDU1615	Sony DDU1615
Type	DVD-ROM	DVD-ROM	DVD-ROM
Interface	Internal	Internal	Internal
USB ports			
# of ports	4	4	4
Type of ports (USB 1.1, USB 2.0)	USB 2.0	USB 2.0	USB 2.0

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

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