64-bit SunGard ACR financial workload performance on quad-core and dual-core dual-processor 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 dual-processor servers using the following three processors:

- dual-core AMD Opteron processor model 2220 SE
- Dual-Core Intel Xeon processor 5160
- Quad-Core Intel Xeon processor X5355

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.)

KEY FINDINGS

- The Quad-Core Intel Xeon processor X5355-based server delivered over 52 percent higher peak performance than the dual-core AMD Opteron processor model 2220 SE-based server (see Figure 1).

- The Quad-Core Intel Xeon processor X5355-based server delivered over 42 percent higher peak performance than the Dual-Core Intel Xeon processor 5160-based server (see Figure 1).

The optimum thread count for our testing was 4 on the dual-core AMD Opteron processor model 2220 SE-based server and Dual-Core Intel Xeon processor 5160-based server, because both servers have 2 physical processors with 2 cores per processor, or 4 available execution units. The Quad-Core Intel Xeon processor X5355-based server has 2 physical processors with 4 cores per processor, or 8 available execution units, so its optimum thread count was 8.

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.
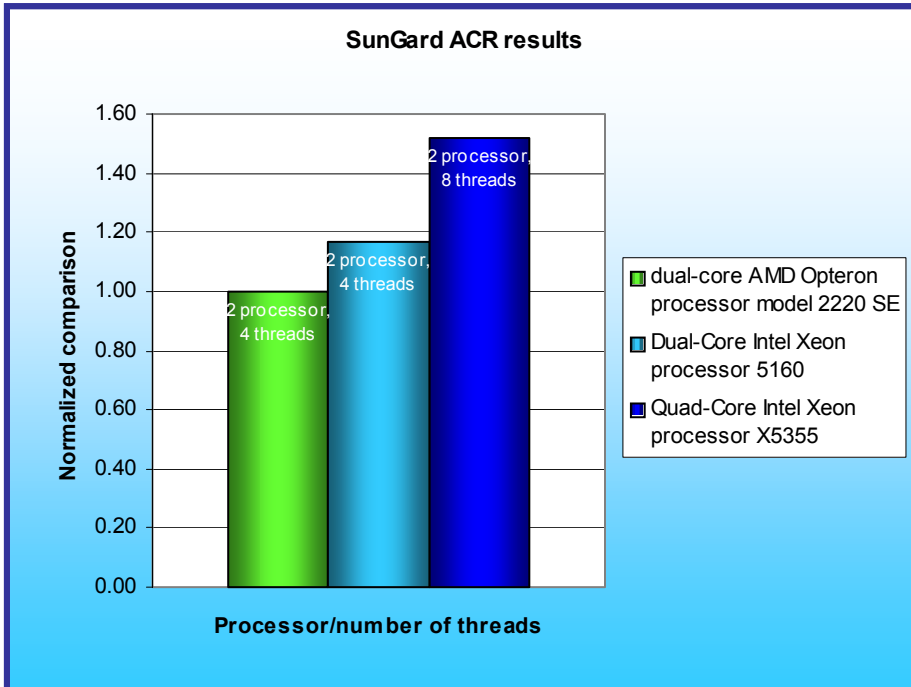

Figure 1: Normalized peak (dual-processor) performance of the servers with optimum thread-to-processor configurations on the SunGard ACR workload. Higher numbers are better.

Figure 1 portrays the relative peak (dual-processor) performance of each server. In this chart, 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).

The Quad-Core Intel Xeon processor X5355-based server finished the SunGard ACR workload in 252.3 seconds, 52.1

percent faster than the dual-core AMD Opteron processor model 2220 SE-based server, which finished the same workload in 526.9 seconds. This speed difference means a user would receive a solution 4 minutes and 37 seconds faster with the Quad-Core Intel Xeon processor X5355-based server. The Quad-Core Intel Xeon processor X5355-based server was 42.5 percent faster than the Dual-Core Intel Xeon processor 5160-based server, which took 438.8 seconds to complete the same workload.

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 2 details the results of our tests with 2, 4, 8, and 16 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	16
dual-core AMD Opteron processor model 2220 SE-based server	1066.3	526.9	533.3	531.5
Dual-Core Intel Xeon processor 5160-based server	873.1	438.8	456.7	450.3
Quad-Core Intel Xeon processor X5355-based server	985.6	493.5	252.3	263.6

Figure 2: Median completion times (in seconds) of the servers with varying thread counts using the SunGard ACR workload. Lower times are better.

As Figure 2 shows, the dual-core AMD Opteron processor model 2220 SE and Dual-Core Intel Xeon processor 5160-based servers achieved their fastest completion times with 4 threads, which means 4 threads is the optimum thread-to-processor configuration for these servers. The Quad-Core Intel Xeon processor X5355-based server achieved its fastest time with 8 threads, which means 8 threads is its optimum thread-to-processor configuration.

Test methodology

Figure 3 summarizes some key aspects of the configurations of the three server systems; Appendix A provides detailed configuration information.

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Server	dual-core AMD Opteron processor model 2220 SE-based server	Dual-Core Intel Xeon processor 5160-based server	Quad-Core Intel Xeon processor X5355-based server
Processor frequency (GHz)	2.8 GHz	3.0 GHz	2.66 GHz
System Bus	2000 MHz HyperTransport	1333 MHz	1333 MHz
Dual/Quad-Core processors	Dual	Dual	Quad
Motherboard	Tyan h2000M (S3992)	Intel Server Board S5000PSL	Intel Server Board S5000PSL
Chipset	Broadcom BCM5780 (HT2000) + BCM5785 (HT1000) chipset	Intel 5000P Chipset	Intel 5000P Chipset
RAM (8GB in each)	PC2-5300	PC2-5300 FBDIMM	PC2-5300 FBDIMM
Hard Drive	Western Digital WD1600YD	Western Digital WD1600YD	Western Digital WD1600YD
NICs	Broadcom NetXtreme Gigabit Dual Port Network Connection / Intel PRO/100 Server Adapter	Intel PRO/1000 EB Network Dual Port Network Connection	Intel PRO/1000 EB Network Dual Port Network Connection

Figure 3: Summary of some key aspects of the server configurations.

Intel configured and provided all three servers.

We began our testing by installing a fresh copy of Microsoft Windows Server 2003 Enterprise x64 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 (KB922819)
- Security Update for Windows Server 2003 x64 Edition (KB924191)
- Security Update for Windows Server 2003 x64 Edition (KB923191)
- 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)
- 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)

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- Cumulative Security Update for Internet Explorer for Windows Server 2003 x64 Edition (KB918899)
- 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 (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 (KB896358)
- Security Update for Windows Server 2003 x64 Edition (KB896428)
- 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/.

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.

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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, 8, or 16 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 4, 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 4 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.
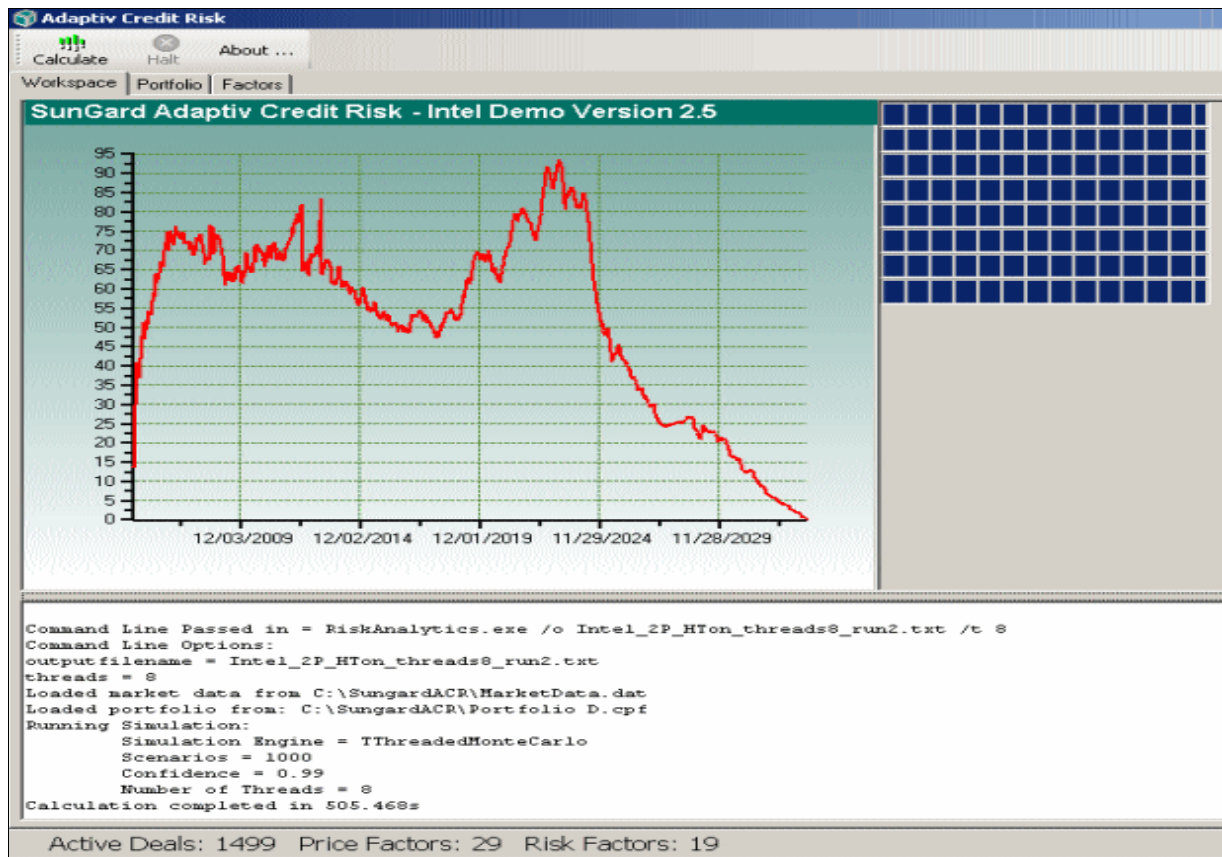

Figure 4: An example of the monitoring console after the SunGard ACR workload completes.

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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.

Processors	dual-core AMD Opteron processor model 2220 SE-based server	Dual-Core Intel Xeon processor 5160-based server	Quad-Core Intel Xeon processor X5355-based server
System configuration information			
General			
Processor and OS kernel: (physical, core, logical)	2P4C4L	2P4C4L	2P8C8L
Number of physical processors	2	2	2
Dual/Quad-Core processors	Dual	Dual	Quad
System Power Management Policy	Always On	Always On	Always On
CPU			
Vendor	AMD	Intel	Intel
Name	dual-core AMD Opteron processor model 2220 SE	Dual-Core Intel Xeon processor 5160	Quad-Core Intel Xeon processor X5355
Stepping	2	4	7
Socket type	F	LGA 771	LGA 771
Core frequency (GHz)	2.8 GHz	3.0 GHz	2.66 GHz
System bus	2000 MHz HyperTransport	1333 MHz	1333 MHz
L1 Cache	64 KB + 64 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 Cache	2 x 1MB	4 MB (shared by 2 cores)	2 x 4MB (each 4MB shared by 2 cores)
Platform			
Vendor and model number	dual-core AMD Opteron processor model 2220 SE-based server	Dual-Core Intel Xeon processor 5160-based server	Quad-Core Intel Xeon processor X5355-based server
Motherboard model number	Tyan h2000M (S3992)	Intel Server Board S5000PSL	Intel Server Board S5000PSL
Motherboard chipset	Broadcom BCM5780 (HT2000) + BCM5785 (HT1000) chipset	Intel 5000P Chipset	Intel 5000P Chipset
Motherboard revision number	G3NR	B1	B1
Motherboard serial number	TC62423A0149	QSSL63800874	QSSL63800874
BIOS name and version	American Megatrends Inc. AMIBIOS 08.00.11	Intel Corporation S5000.86B.04.00.0065.092920061534	Intel Corporation S5000.86B.04.00.0065.092920061534
BIOS settings	Default	Default	Default
Chipset INF driver	N/A	8.1.1.1001	8.1.1.1001

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Memory module(s)			
Vendor and model number	Micron MT18HTF12872PDY	Micron MT18HTF12872FDY	Micron MT18HTF12872FDY
Type	PC2-5300	PC2-5300 FBDIMM	PC2-5300 FBDIMM
Speed (MHz)	667 MHz	667 MHz	667 MHz
Speed in the system currently running @ (MHz)	667 MHz	667 MHz	667 MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15	5-5-5-15	5-5-5-15
Size	8192 MB	8192 MB	8192 MB
Number of RAM modules	8	8	8
Chip organization	Double-Sided	Double-Sided	Double-Sided
Hard disk			
Vendor and model number	Western Digital WD1600YD-01NVB1	Western Digital WD1600YD-01NVB1	Western Digital WD1600YD-01NVB1
Number of disks in system	1	1	1
Size	160 GB	160 GB	160 GB
Buffer Size	16 MB	16 MB	16 MB
RPM	7200	7200	7200
Type	SATA-II	SATA-II	SATA-II
Controller	Integrated IDE ATA/ATAPI	Integrated IDE ATA/ATAPI	Integrated IDE ATA/ATAPI
Controller driver	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830
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	SP1	SP1	SP1
Microsoft Windows update date	10/13/2006	10/13/2006	10/13/2006
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	BK-ATI VER008.005.019.000	BK-ATI VER008.005.023.000	BK-ATI VER008.005.023.000
Type	Integrated	Integrated	Integrated
Memory size	32 MB	16 MB	16 MB
Resolution	1024 x 768	1024 x 768	1024 x 768
Driver	ATI 6.14.10.6553	ATI 8.24.3.0	ATI 8.24.3.0
Network card/subsystem			

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Vendor and model number	Broadcom NetXtreme Gigabit Dual Port Network Connection / Intel PRO/100 Server Adapter	Intel PRO/1000 EB Network Dual Port Network Connection	Intel PRO/1000 EB Network Dual Port Network Connection
Type	Integrated	Integrated	Integrated
Driver	Broadcom 8.39.1.0 / Intel 8.0.27.0	Intel 9.5.12.0	Intel 9.5.12.0
Optical drive			
Vendor and model number	TSSTcorp CD/DVDW TS-H552B	Sony DVD RW DW-Q120A	Sony DVD RW DW-Q120A
Type	DVD-RW	DVD-RW	DVD-RW
Interface	Internal	Internal	Internal
Dual/Single layer	Dual	Dual	Dual
USB ports			
# of ports	4	6	6
Type of ports (USB 1.1, USB 2.0)	USB 2.0	USB 2.0	USB 2.0

Figure 5: Detailed system configuration information for the test servers.

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