Principled Technologies®

TEST REPORT
SEPTEMBER 2007

SysBench performance on Intel®-based SMB servers

Executive summary

Intel® Corporation (Intel) commissioned Principled Technologies (PT) to measure the SysBench performance on three dual- and quad-core small and medium-sized business (SMB) focused servers:

- Intel Pentium® Dual-core processor E2160-based server
- Quad-Core Intel Xeon® processor X3220-based server
- Quad-Core Intel Xeon processor E5335-based server

KEY FINDINGS

- The Quad-Core Intel® Xeon® processor E5335-based server delivered 229.1 percent more SysBench performance than the Intel Pentium® Dual-core processor E2160-based server (see Figure 1) at an additional cost of about $1,222 (see Appendix B).
- The Quad-Core Intel Xeon processor X3220-based server delivered 133.3 percent more SysBench performance than the Intel Pentium Dual-core processor E2160-based server (see Figure 1) at an additional cost of about $256 (see Appendix B).

For testing, we found the true peak performance of the lowest speed processor, Intel Pentium Dual-core processor E2160-based server, measured the processor utilization, and made sure that it reached or approached 100 percent during the test. Then we ran the same workload on the other two servers for testing. For more information on processor utilization during the runs refer to the Test results section.

Figure 1 shows the median SysBench peak results, in transactions per second (tps), of the three test servers. To obtain the median results, we performed three runs with each server and selected the middle peak result of each. A higher number of transactions per second is better, because the more transactions a server can handle, the better.

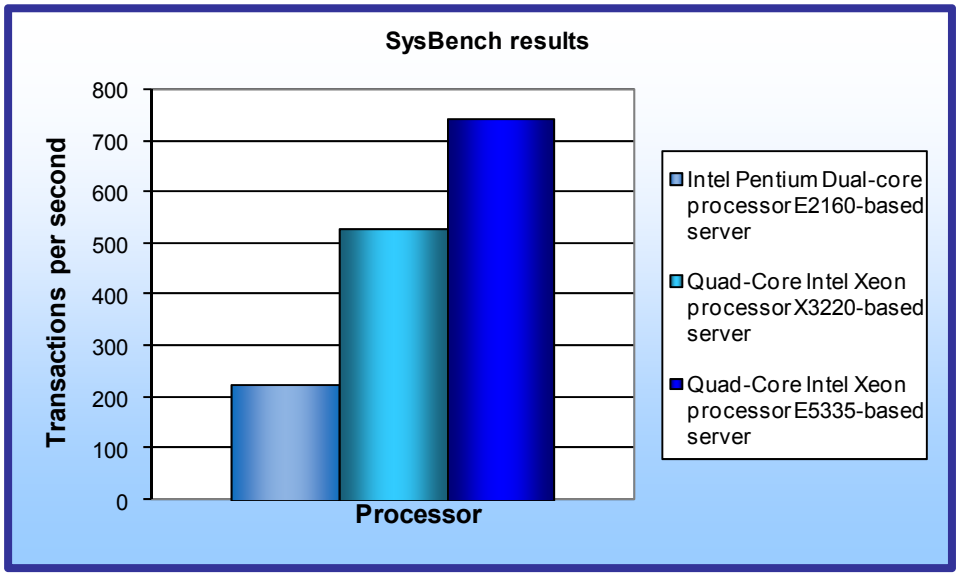

Figure 1: Peak performance of the test servers running SysBench. More transactions per second are better.

As Figure 1 illustrates, the Quad-Core Intel Xeon processor E5335-based server produced the highest result, 746.3 tps. This result is a 229.1 percent performance increase over the Intel Pentium Dual-core processor E2160-based server, which achieved 226.8 tps.

The Quad-Core Intel Xeon processor X3220-based server, with a score of 529.1 tps, delivered 133.3 percent more SysBench performance than the Intel Pentium Dual-core processor E2160-based server.

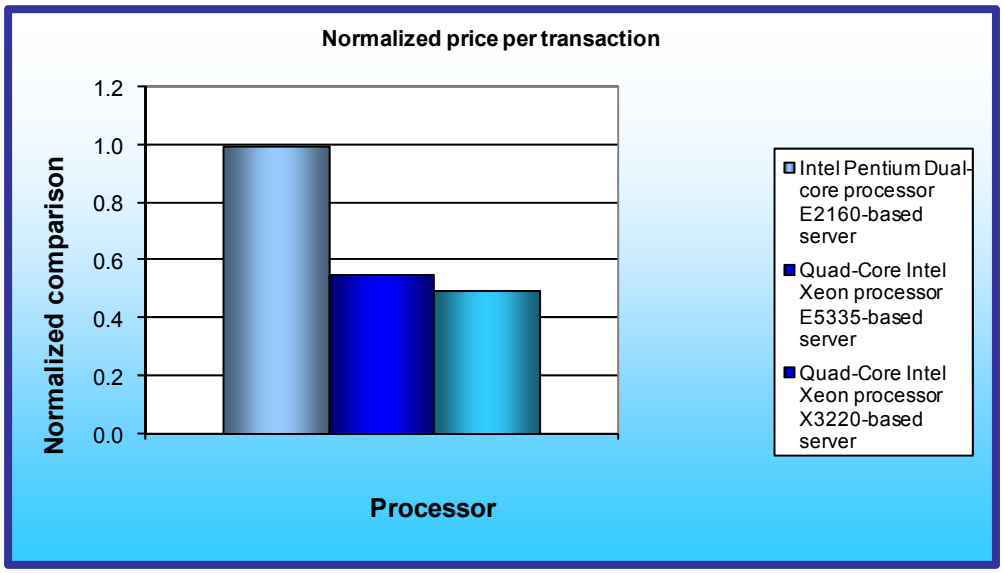

Figure 2: Normalized price per transaction of the test servers running SysBench. Lower numbers are better.

Figure 2 illustrates the price per transaction for each of the three servers. We calculated the price per transaction by dividing the system price by the number of transactions per second. (Details on system cost appear in Appendix B). We then normalized the results to those for the system with the highest price per transaction, assigning that system's result a value of 1.00. By normalizing, we make each data point in this chart a comparative number, with lower results indicating a better, or lower, price per transaction.

As Figure 2 illustrates, the Quad-Core Intel Xeon processor X3220-based server produced a 50 percent lower price per transaction than the Intel Pentium Dual-core processor E2160-based server.

The Quad-Core Intel Xeon processor E5335-based server produced a 45 percent lower price per transaction than the Intel Pentium Dual-core processor E2160-based server.

Workload

The developers at SourceForge.net (www.sourceforge.net) created SysBench to test various aspects of the performance of servers running database systems. The benchmark's original target was the MySQL database system (see www.mysql.com). Intel created a version of SysBench 0.4.0 that would work with Microsoft* SQL Server* 2005 Enterprise Edition (www.microsoft.com/sql/editions/enterprise/default.mspx). We ran that version in our test. SysBench created a 100,000-row SQL database and executed a batch of online transaction processing (OLTP) transactions against that data.

Test results

For testing, each system performed 10,000 transactions as quickly as possible. The output shows the completion time in seconds for the system to perform the task. We calculated the transactions per second by using the following formula:

$$\frac{\text{10,000 transactions}}{\text{completion time in seconds}} = \text{transactions per second}$$

Figure 3 shows the median SysBench results and processor utilization for all three test servers. Worth noting, the Quad-Core Intel Xeon processor E5335-based server and Quad-Core Intel Xeon processor X3220-based server performed more transactions per second with less processor utilization that the Intel Pentium Dual-core processor E2160-based server. This means both systems had resources available to perform additional tasks.

Server	Intel Pentium Dual-core processor E2160-based server	Quad-Core Intel Xeon processor X3220-based server	Quad-Core Intel Xeon processor E5335-based server
Completion time (seconds)	44.10	18.90	13.40
Transactions completed	10,000	10,000	10,000
Transactions per second	226.76	529.10	746.27
Processor utilization (percentage)	99.49	94.53	91.69

Figure 3: Median transactions per second for the three servers running SysBench. Higher number of transactions per second are better.

Figure 4 shows the results and processor utilization for the Intel Pentium Dual-core processor E2160-based server for all three runs. Run 2 produced the median results.

Intel Pentium Dual-core processor E2160-based server			
Server	**Run 1**	**Run 2**	**Run 3**
Completion time (seconds)	44.10	43.80	44.30
Transactions completed	10,000	10,000	10,000
Transactions per second	226.76	228.31	225.73
Processor utilization (percentage)	99.49	99.43	98.91

Figure 4: SysBench results for the Intel Pentium Dual-core processor E2160-based server. More transactions per second are better.

Figure 5 shows the results and processor utilization for the Quad-Core Intel Xeon processor X3220-based server for all three runs. Run 3 produced the median results.

Quad-Core Intel Xeon processor X3220-based server			
Server	**Run 1**	**Run 2**	**Run 3**
Completion time (seconds)	18.50	19.00	18.90
Transactions completed	10,000	10,000	10,000
Transactions per second	540.54	526.32	529.10
Processor utilization (percentage)	95.07	94.60	94.53

Figure 5: SysBench results for the Quad-Core Intel Xeon processor X3220-based server. More transactions per second are better.

Figure 6 shows the results and processor utilization for the Quad-Core Intel Xeon processor E5335-based server for all three runs. Run 3 produced the median results.

Quad-Core Intel Xeon processor E5335-based server			
Server	**Run 1**	**Run 2**	**Run 3**
Completion time (seconds)	13.10	13.40	13.80
Transactions completed	10,000	10,000	10,000
Transactions per second	763.36	746.27	724.64
Processor utilization (percentage)	92.56	91.69	89.86

Figure 6: SysBench results for the Quad-Core Intel Xeon processor E5335-based server. More transactions per second 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 Dual-core processor E2160-based server**	**Quad-Core Intel Xeon processor X3220-based server**	**Quad-Core Intel Xeon processor E5335-based server**
Processor frequency (GHz)	1.8 GHz	2.4 GHz	2.0 GHz
System bus	800 MHz	1,066 MHz	1,333 MHz
Dual/Quad-Core processors	Dual	Quad	Quad
Motherboard	S3000AH	S3000AH	S3000AH
Chipset	Intel 3000 Chipset	Intel 3000 Chipset	Intel 5000P Chipset
RAM	Kingston* KVR667D2E5K2/1G 2 x 512 MB SDRAM	Kingston KVR667D2E5/1G 2 x 1024 MB SDRAM	Kingston KVR667D2D8F5/1G 4 x 1024 MB FBDIMM
Hard drive	Samsung* SP2004C	Samsung SP2004C	Samsung SP2004C
NICs	Intel PRO/1000 PM & Intel PRO/1000 MT	Intel PRO/1000 PM & Intel PRO/1000 MT	2 x Intel PRO/1000 EB

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

Intel provided and configured all three servers with one exception. We added an LSI Logic MegaRaid SAS 8888ELP RAID controller to each system to minimize the disk bottleneck we encountered using the onboard controllers. The LSI controller produced higher performance and more transactions per second on all systems. We configured the controllers with two Samsung 200GB hard disks in a RAID 1 configuration.

We began our testing by installing a fresh copy of Microsoft Windows* Server 2003 R2, 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 applied the following updates from the Microsoft Windows Update site:

- Windows Server 2003 Cumulative Security Update for Internet Explorer* 7 for Windows Server 2003 (KB937143)

- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB936021)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB938127)
- Windows Update Windows Server 2003 Cumulative Security Update for Internet Explorer 6 for Windows Server 2003 (KB937143)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB921503)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB936782)
- Windows Update Windows Server 2003 Windows Malicious Software Removal Tool - August 2007 (KB890830)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB926122)
- Windows Update Windows Server 2003 Security Update for Microsoft .NET Framework, Version 1.1 Service Pack 1 (KB933854)
- Windows Update Windows Server 2003 Security Update for Windows Media Player 6.4 (KB925398)
- Windows Update Windows Server 2003 Update for Windows Server 2003 (KB936357)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB935839)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB935840)
- Windows Update Windows Server 2003 Cumulative Security Update for Outlook Express for Windows Server 2003 (KB929123)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB924667)
- Windows Update Windows Server 2003 Update for Windows Server 2003 (KB927891)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB932168)
- Windows Update Windows Server 2003 Windows Internet Explorer 7.0 for Windows Server 2003
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB931784)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB930178)
- Windows Update Windows Server 2003 Security Update for Windows Server 2003 (KB925902)
- Windows Update Windows Server 2003 Update for Windows Server 2003 Service Pack 2 (KB931836)

Installing Microsoft Internet Information Server

To run SysBench, Microsoft SQL Server must be installed. This requires installing Windows Internet Information Services, which we did with the following procedure:

1. Select Start→Administrative Tools→Manage Your Server.
2. Select Add or remove a role.
3. At the preliminary steps screen, click Next.
4. At the Server Role screen, select Application Server, and click Next.
5. At the Summary of Selections screen, click Next.
6. When the installation software prompts you to do so, insert the OS CD, and click OK.
7. When the installation completes, click Finish.
8. Close the Manage Your Server window.

Installing Microsoft SQL Server 2005

We used the following steps to install Microsoft SQL Server 2005:

1. Insert the SQL Server 2005 CD into the server.
2. Click the Server Components link under the Install section to begin the installation.
3. Accept the license agreement, and click Next.
4. Click Next to install the prerequisites.
5. After the prerequisites complete installing screen, click Next.
6. At the Welcome screen, click Next.
7. At the System Configuration Check, assuming everything has a status of success click Next.
8. Enter the registration information, and click Next.
9. At the Components to Install screen, select SQL Server Database Services, then click Advanced.
10. Instruct the software to install both the Database Services and Client Components by clicking the drop-down arrow on both and selecting Entire feature will be installed on local hard drive.

11. Click Next to start the installation.
12. For Instance Name, leave the default option, and click Next.
13. At the Service Account screen, select Use the built-in system account (Local account), and click Next.
14. Keep the default option for Authentication Mode, and click Next.
15. For Collation Settings, leave the defaults, and click Next.
16. Accept the default Error and Usage Report Settings, and click Next.
17. At the Ready to Install screen, click Install to begin the installation.
18. When the installation software prompts you to do so, insert Microsoft SQL Server 2005 disk 2, and click OK.
19. When the setup process completes, click Next.
20. Click Finish to complete the installation.

Creating the test database and generating data

A database must be created before running SysBench. We used the following steps to create the database:

1. Select Start→Microsoft SQL Server 2005→SQL Server Management Studio.
2. In the Connect to Server window, use the drop-down menu next to Server name to select <Browse for more>.
3. In the Browse for Server window, select the Network Servers tab, and wait for it to retrieve data.
4. When Database Engine appears, expand the menu, select server, and click OK.
5. At the Connect to Server window, the server name should be present.
6. Click Connect to connect to the server.
7. Right-click the Database folder in the left-hand window, and select New Database from the pop-up menu.
8. In the Database name field, type sbtest, and click OK

Generating test data

The SysBench benchmark is a self-contained executable with a list of options for the type of workload to run and the parameters under which to run it. It does not require a special installation process. Instead, we simply copied the SysBench executable to the root C: drive

1. Open a command prompt by selecting Start→Run, type cmd, and click OK.
2. In the command prompt, type cd to change to C:\.
3. To prepare the database, type “sysbench.exe --test=oltp --oltp-table-size=100000 prepare”, and press Enter.

Running SysBench

We used a batch file with the following parameters to launch the SysBench benchmark with the database throughput performance settings:

```
c:\sysbench.exe --test=oltp --oltp-table-size=100000 --num-threads=32 --max-requests=10000 run
1>>sysbench.log 2>>sysbench.err
```

This performed a single SysBench run and put the results into a log file. Once the run finished we executed another batch file with the following parameters to clean up the test data, “c:\sysbench.exe --test=oltp cleanup”. We rebooted the system under test and then generated the test data for the next run. This allowed us to begin each test with a fresh database.

Appendix A – Test system configuration information

This appendix provides detailed configuration information about each of the test server systems.

Server	Intel Pentium Dual-core processor E2160-based server	Quad-Core Intel Xeon processor X3220-based server	Quad-Core Intel Xeon processor E5335-based server
General			
Number of processor packages	1	1	2
Number of cores per processor package	2	4	4
Number of hardware threads per core	1	1	1
System Power Management Policy	Always on	Always on	Always on
CPU			
Vendor	Intel	Intel	Intel
Name	Intel Pentium E2160	Intel Xeon X3220	Intel Xeon E5335
Stepping	2	7	7
Socket type	Socket 775 LGA	Socket 775 LGA	Socket 771 LGA
Core frequency (GHz)	1.8 GHz	2.4 GHz	2.0 GHz
Front-side bus frequency (MHz)	800 MHz	1,066 MHz	1,333 MHz
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	1 MB (shared)	8 MB (2 x 4 MB)	8 MB (2 x 4 MB)
Platform			
Vendor	Intel	Intel	Intel
Motherboard model number	S3000AH	S3000AH	S5000PSL
Motherboard chipset	Intel 3000	Intel 3000	Intel 5000P
Motherboard revision number	00	00	B1
Motherboard serial number	AZAX71300522	AZAX71200495	QTFMHN63al800588
BIOS name and version	Intel Corporation S3000.86B.02.00.0043 .061820070639	Intel Corporation S3000.86B.02.00.0043 .061820070639	Intel Corporation S5000.86B.07.00.0079 .060520071732
BIOS settings	Default	Default	Default
Chipset INF driver	Intel 8.1.1.1010	Intel 8.1.1.1010	Intel 8.1.1.1010
Memory module(s)			
Vendor and model number	Kingston KVR667D2E5K2/1G	Kingston KVR667D2E5/1G	Kingston KVR667D2D8F5/1G
Type	PC2-5300 DDR2 SDRAM ECC unbuffered	PC2-5300 DDR2 SDRAM ECC unbuffered	PC2-5300 DDR2 FBDIMM
Speed (MHz)	667 MHz	667 MHz	667 MHz
Speed in the system currently running @ (MHz)	333 MHz	333 MHz	333 MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15	5-5-5-15	5-5-5-15

Server	Intel Pentium Dual-core processor E2160-based server	Quad-Core Intel Xeon processor X3220-based server	Quad-Core Intel Xeon processor E5335-based server
Size	1,024 MB	2,048 MB	4,096 MB
Number of RAM modules	2 x 512 MB	2 x 1024 MB	4 x 1024 MB
Chip organization	Single-sided	Double-sided	Double-sided
Channel	Dual	Dual	Dual
Hard disk			
Vendor and model number	Samsung SP2004C	Samsung SP2004C	Samsung SP2004C
Number of disks in system	2	2	2
Size	200 GB	200 GB	200 GB
Buffer size	8 MB	8 MB	8 MB
RPM	7,200	7,200	7,200
Type	SATA	SATA	SATA
Controller	LSI Logic MegaRaid SAS 8888ELP	LSI Logic MegaRaid SAS 8888ELP	LSI Logic MegaRaid SAS 8888ELP
Controller driver	LSI Logic Corp. 2.8.0.32	LSI Logic Corp. 2.8.0.32	LSI Logic Corp. 2.8.0.32
Operating system			
Name	Microsoft Windows Server 2003 R2, Enterprise Edition	Microsoft Windows Server 2003 R2, Enterprise Edition	Microsoft Windows Server 2003 R2, Enterprise Edition
Build number	3790	3790	3790
Service Pack	2	2	2
Microsoft Windows update date	8/9/07	8/9/07	8/9/07
File system	NTFS	NTFS	NTFS
Kernel	ACPI Multiprocessor PC	ACPI Multiprocessor PC	ACPI Multiprocessor PC
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	ATI ES1000	ATI ES1000	ATI ES1000
BIOS version	BK-ATI VER008.005.023.000	BK-ATI VER008.005.023.000	BK-ATI VER008.005.023.000
Type	Integrated	Integrated	Integrated
Memory size	16 MB	16 MB	16 MB
Resolution	1,024 x 768	1,024 x 768	1,024 x 768
Driver	ATI 8.24.3.0	ATI 8.24.3.0	ATI 8.24.3.0
Network card/subsystem			
Vendor and model number	Intel PRO/1000 PM & Intel PRO/1000 MT	Intel PRO/1000 PM & Intel PRO/1000 MT	2 x Intel PRO/1000 EB
Type	Integrated	Integrated	Integrated
Driver	Intel PRO/1000 PM v9.7.34.0 Intel PRO/1000 MT v8.8.1.0	Intel PRO/1000 PM v9.7.34.0 Intel PRO/1000 MT v8.8.1.0	Intel 9.9.13.0

Server	Intel Pentium Dual-core processor E2160-based server	Quad-Core Intel Xeon processor X3220-based server	Quad-Core Intel Xeon processor E5335-based server
Optical drive			
Vendor and model number	Sony* CRX230ED	Sony CRX230ED	Sony CRX230ED
Type	CD-RW	CD-RW	CD-RW
Interface	IDE	IDE	IDE
Dual/single layer	Single	Single	Single
USB ports			
Number of ports	4	4	6
Type of ports (USB 1.1, USB 2.0)	USB 2.0	USB 2.0	USB 2.0

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

Appendix B – Price information

Figure 8 below presents the price information for the test systems as of September 5, 2007.

System	Intel Pentium Dual-core processor E2160-based server	Quad-Core Intel Xeon processor X3220-based server	Quad-Core Intel Xeon processor E5335-based server
Price as of September 5, 2007			
Motherboard[1]	$259.99	$259.99	$579.99
Processor[2]	85.99	299.99	707.98
Hard drives[2]	109.98	109.98	109.98
Memory[2]	49.99	91.98	329.96
RAID controller[2]	826.99	826.99	826.99
Intel SC5250-E case[3]	179.00	179.00	179.00
Total price[4]	**$1,511.94**	**$1,767.93**	**$2,733.90**

Figure 9: Price information for the test systems.

Notes:
[1] Price from www.cdw.com.
[2] Price from www.newegg.com.
[3] Price from www.hypermicro.com.
[4] Cost does not include shipping or tax.

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