

WebBench performance on Intel®-based SMB servers

Executive summary

Intel® Corporation (Intel) commissioned Principled Technologies (PT) to measure the WebBench* 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

Figure 1 shows the median WebBench peak results, in requests per second (rps), 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 requests per second is better, because the more Web requests a server can handle the better.

As Figure 1 illustrates, the Quad-Core Intel Xeon processor E5335-based server produced the highest result, 48,188.3 rps. This result is a 273.7 percent performance increase over the Intel Pentium Dual-core processor E2160-based server, which achieved 12,894.0 rps. The Quad-Core Intel Xeon processor E5335-based server produced a 51.7 percent increase over the 31,765.1 rps score of the Quad-Core Intel Xeon processor X3220-based server.

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 44 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 26 percent lower price per transaction than the Intel Pentium Dual-core processor E2160-based server.

KEY FINDINGS

- The Quad-Core Intel® Xeon® processor E5335-based server delivered 274 percent higher peak WebBench* 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 146 percent higher peak WebBench performance than the Intel Pentium Dual-core processor E2160-based server (see Figure 1) at an additional cost of about \$256 (see Appendix B).

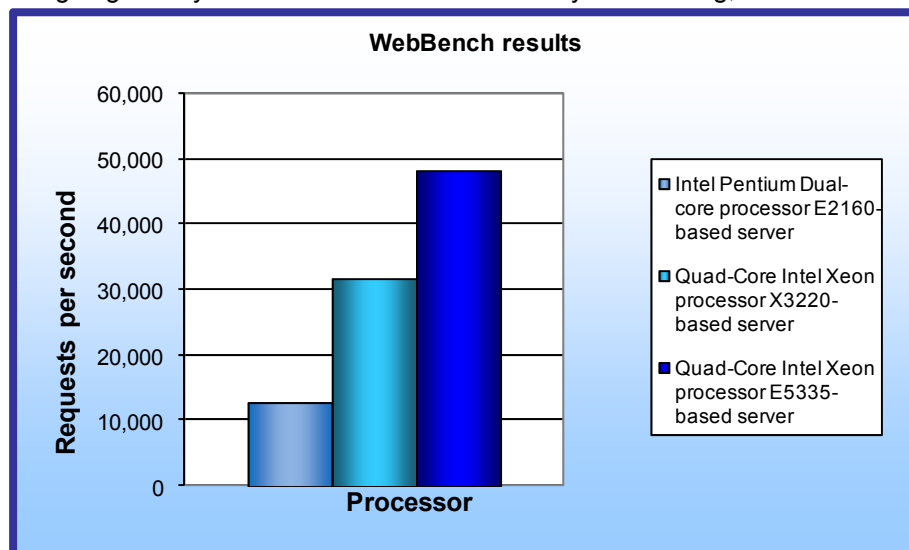


Figure 1: Median requests per second results for the three servers running WebBench. Higher numbers are better.

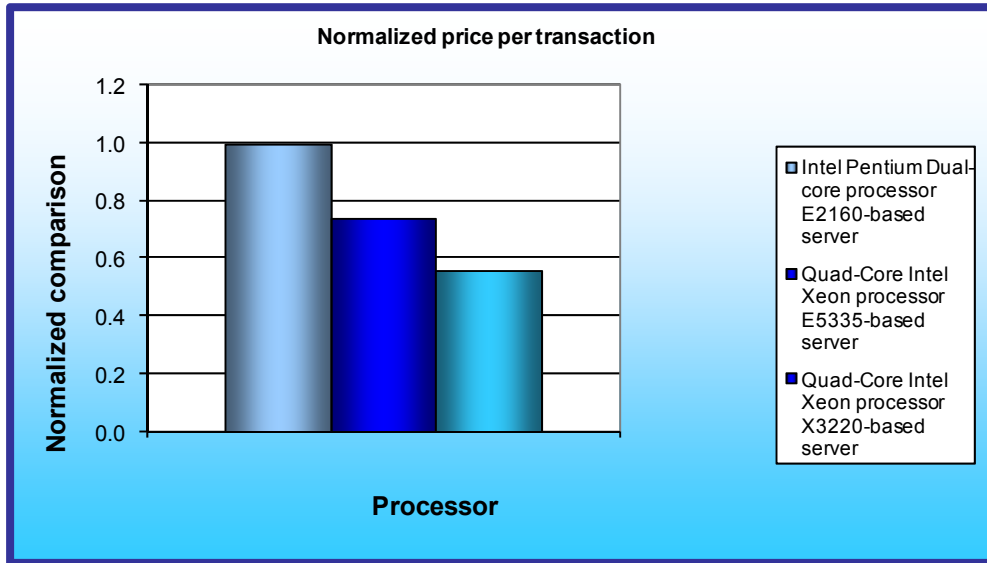


Figure 2: Normalized price per transaction of the test servers running WebBench. Lower numbers are better.

Workload

WebBench 5.0 (128-bit U.S. version) is an industry-standard benchmark for Web server software and hardware. It uses PC clients to send Web requests to the server under test. It generates performance results by incrementally increasing the number of clients making HTTP 1.0 GET requests to the Web server; the result is a curve showing the performance of the server under test. The peak of that curve represents the peak throughput of the server. WebBench reports results

in both the total number of requests per second the server handled and its total throughput in bytes per second. To be certain that we found the true peak performance in our testing, we measured the processor utilization on the server and made sure that it reached or was extremely close to 100 percent during the test.

Test results

We ran WebBench’s default ecommerce API test suite, which generates both secure and non-secure static and dynamic HTTP 1.0 GET requests. While running the ecommerce suite, the clients must negotiate to a secure Web server port using the Secure Socket Layer (SSL) protocol. WebBench incrementally increases the number of clients making the HTTP 1.0 GET requests to the Web server. As the workload increases the number of clients, the Web server’s processor utilization also increases, until the processor in the Web server is saturated with work. Each workload point with a fixed number of clients is a WebBench “mix.” The ecommerce API test suite begins with a mix that involves one client; the next mix has four clients, and each subsequent mix increases the number of clients by four to a total of 60 clients. We modified the test suite to perform 11 mixes since we used a 40-client test bed. A standard WebBench run consist of 16 mixes.

A WebBench run reports the total requests per second a server can perform and the total throughput, in bytes per second, that the server delivered. WebBench reports these results for each mix. A graph of these results yields a performance curve with a peak at some number of clients.

Figure 3 shows the WebBench peak results in requests per second and in throughput (bytes per second) of the three test servers. Each result is the median of three runs.

Server	Requests per second	Throughput (Bytes per second)
Intel Pentium Dual-core processor E2160-based server	12,894.0	52,335,064.4
Quad-Core Intel Xeon processor X3220-based server	31,765.1	128,534,989.1
Quad-Core Intel Xeon processor E5335-based server	48,188.3	194,996,193.4

Figure 3: Median requests per second and throughput results for the three servers running WebBench. Higher numbers are better.

Figure 4 shows a graph of the WebBench requests per second results for all three servers. This graph illustrates the server's performance under load for each of the 11 client mixes. As the number of clients increases, so does the load on the server and the number of requests per second the server must perform. During the first couple of mixes, the client count is low, so all three servers can handle the load with capacity to spare. As the load increases, however, the server reaches its maximum capacity and the processor utilization becomes 100 percent (or very close to that). The curves peak and flatten at those points. A higher peak indicates better performance, so the Quad-Core Intel Xeon processor E5335-based server clearly yielded the best performance.

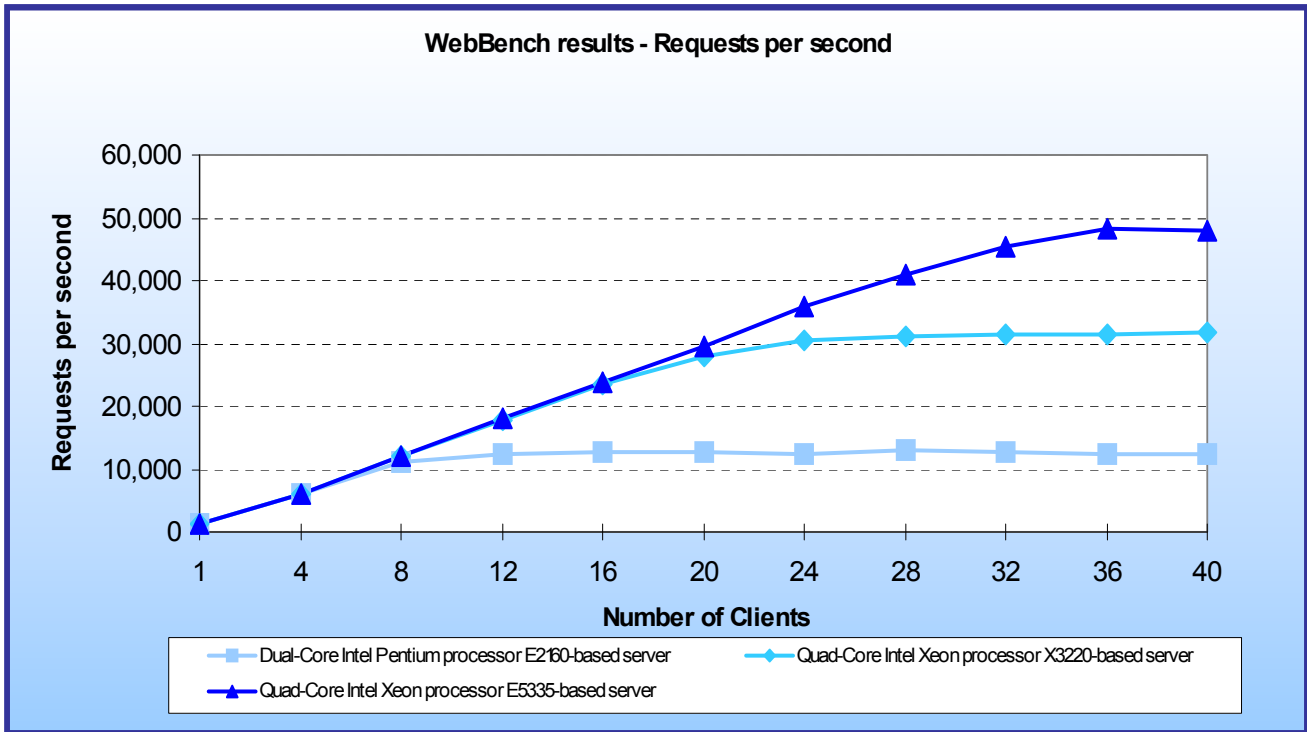


Figure 4: Line graph of the WebBench requests per second results for the three servers. Higher numbers are better.

Figure 5 shows the WebBench throughput results, in bytes per second, for all three servers; a higher peak is better. Again, the Quad-Core Intel Xeon processor E5335-based server clearly yielded the best performance.

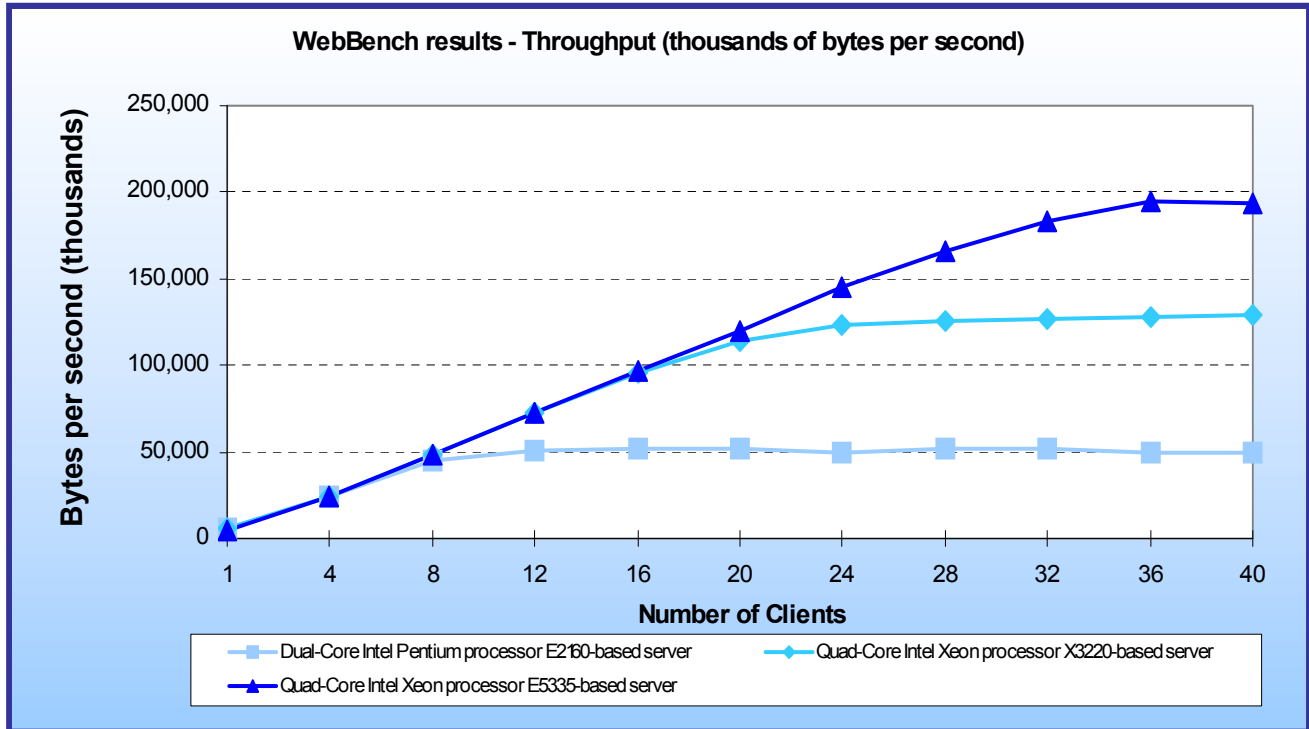


Figure 5: Line graph of the WebBench throughput results for the three test servers. A higher peak indicates better performance.

Test methodology

Figure 6 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	S5000PSL
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 6: 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 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 Internet Information Services

WebBench requires a Web server, so we installed the Windows Internet Information Services with the following procedure:

1. Click Start→Control Panel→Add/Remove Programs.
2. Select Add/Remove Windows Components.
3. Highlight Application Server and click the Details button.
4. Check the Internet Information Services (IIS) item, and Click OK.
5. Make sure you select enable ASP during the IIS installation.
6. Click the Next button.
7. Click Finish when the installation completes.
8. Close the Add or Remove Programs window.

Deploying WebBench data

WebBench includes data that must reside on the server and that the Web server must use. We loaded that data and set the Web server to use it with the following procedure:

1. Copy the file wbtrees.exe from the WebBench CD to the wwwroot directory on the server under test. (The wbtrees.exe file is on the WebBench CD at \wb50\workload).
2. On the server, execute the wbtrees.exe file. This program will copy the WebBench workload to the server.
3. In the wwwroot folder on the server, create a new folder with the name CGI-BIN.
4. Copy the file simisapi.dll to the CGI-BIN folder.
5. Click Start button→Programs→Administrative Tools→Computer Management to open the management console.
6. Go to Services and Application→Internet Information Services→Default Web Site→CGI-BIN, and right click to bring up a menu. Select Properties.
7. Go to the Directory Tab, and Set Execute Permissions to Scripts and Executables.
8. When the IIS WWW Configuration popup window displays, click Yes.
9. Close the Computer Management window.

Configuring Internet Information Services (IIS)

We configured the Windows Internet Information Services Web server as follows:

1. Open Computer Management.
2. Go to Services and Application→Internet Information Services.
3. Right click to bring up a menu. Select Properties.
4. Click the MIME Types button.
5. In the MIME Types window, click the New button.
6. In the Extension field, type “*”.
7. In the MIME type field, type “application/octet-stream”. Click the OK button.
8. Click the OK button to exit the MIME Types window.
9. Click the OK button to exit the Internet Information Services (IIS) Manager Properties window.
10. In the Computer Management window, go to Web Sites→Default Web Site under Internet Information Services. Right click it to bring up a menu. Select Properties.
11. Select the Home Directory tab.
12. Check the following boxes: Script source access, Read, Write, and Directory browsing.
13. Uncheck the following boxes: Log visits and Index this resource.
14. In the Execute permissions field, select Scripts and Executables.
15. Click the Apply button.
16. Select the Web Site tab.
17. Uncheck Enable Logging.
18. Click the OK button to close the Default Web Site Properties window.
19. In the Computer Management window, go to the Web Service Extensions item under Internet Information Services.
20. In the right panel, highlight All Unknown ISAPI Extensions and click the Allow button. Acknowledge the IIS Manager warning that appears by clicking the Yes button.
21. In the right panel, highlight All Unknown CGI Extensions and click the Allow button. Acknowledge the IIS Manager warning that appears by clicking the Yes button.
22. Close the Computer Management window.

Installing certificate services

Because WebBench includes tests that involve security, we installed Windows Certificate Services as follows:

1. Click Start→Control Panel→Add/Remove Programs.
2. Select Add/Remove Windows Components.
3. Put a check mark by Certificate Services.
4. Accept the notice that the server’s name cannot be changed after you install this service.

5. Press Next.
6. Select Stand Alone Root CA, and click Next.
7. On the CA Identifying Information window, enter the server name in the Common name for this CA field, and click Next.
8. Leave the default Certificate Database Settings as they are, and click Next.
9. Click Yes at the prompt asking if you want to enable Active Server Pages (ASP) in IIS.
10. Click yes at the prompt that explains that Internet information Services will be temporarily stopped.
11. Click Next.
12. Click Finish.
13. Click Close.

Setting up Internet Explorer

We had to set up Internet Explorer on the server as follows to be able to get the necessary certificates:

1. Click the Internet Explorer icon on the Quick Launch toolbar.
2. Select the Tools→Internet Options menu item.
3. On the Connections tab, click the LAN Settings button.
4. Check Automatically detect settings, and click OK.
5. Click OK to exit the Internet Options window.

Requesting the server certificate

We had to set up Internet Explorer on the server as follows to be able to get the necessary certificates:

1. Open Internet Explorer and enter the following website, <http://server/certsrv>. This should bring up a page entitled "Microsoft Certificate Services – server".
2. Select Request a Certificate link.
3. Select Advanced Certificate Request link.
4. Select "Create and submit a certificate request to this CA" link.
5. Fill out the appropriate Identifying Information details on the Advanced Certificate Request.
 - Name: Performance
 - Company: PT
 - Type of certificate needed: Server Authentication Certificate
 - Key Options:
 - CSP: Microsoft Base Cryptographic Provider v1.0
 - Usage: Exchange and Signature – select both
 - Key size: 512
 - Check "Automatic key container name"
 - Check "Store certificate in the local computer certificate store"
 - Additional Options:
 - Hash Algorithm: SHA-1
 - Otherwise use default
6. Click [Submit]. Acknowledge the "Potential Scripting Violation" by clicking the [Yes] button.
7. There should now be a page informing that there is a Certificate Pending.

Issuing the server certificate

Next we had to issue a server certificate as follows:

1. Select Start→Programs→Administrative Tools→Certification Authority.
2. Click the server's name.
3. Select Pending Requests.
4. Right click Pending Requests, select All Tasks, and choose Issue.
5. Close Certification Authority.

Installing the server certificate

We then installed the server certificate as follows:

1. Open Internet Explorer.
2. Go to the page <http://server/certsrv> again.
3. Click the View the status of a pending certificate link.
4. Click the Server Authentication Certificate link.
5. Click the Install this Certificate link.
6. Acknowledge the Potential Scripting Violation warning by clicking the OK button.
7. A message will note that a certificate has been successfully installed.
8. Close Internet Explorer.

Setting IIS to use the server certificate

We then set IIS to use the server certificate as follows:

1. Click Start→Programs→Administrative Tools→Computer Management to open the management console.
2. Select Services and Applications→Internet Information Services→Web Sites.
3. Right click the Default Web site, and select Properties.
4. Select the Directory Security tab, and Click the Server Certificate button.
5. The Welcome to the Web Server Certificate Wizard window appears. Click Next.
6. Select Assign an Existing Certificate, and click Next.
7. Select your server certificate (Intended Purpose: Server Authentication). Click Next.
8. Accept the default SSL port (443) in the next window that appears, and click Next.
9. On the Certificate Summary screen click Next.
10. Click Finish.

Creating SSL Communication

Finally, we had to enable SSL communication as follows:

1. Go to Computer management→Services and Application→Internet Information Services.
2. Expand the Default Web site.
3. Expand wbtree.
4. Right click Wbssl, and select properties.
5. Select the Directory Security tab.
6. Click the Edit button under Secure communications.
7. Check Require secure channel (SSL).
8. Check Require 128-bit encryption.
9. Click OK.
10. Click OK.

We then set the following operating system tuning parameters to reflect the WebBench recommendation in the Microsoft performance Tuning Guidelines for Windows Server 2003 document, which is available on Microsoft's Web site. When creating the following parameters, ensure that they are DWORD files, with decimal coding (rather than hexadecimal):

- HKLM\System\CurrentControlSet\Services\Inetinfo\Parameters\MaxCachesFileSize to 1048576
- HKLM\System\CurrentControlSet\Services\HTTP\Parameters\UriMaxUriBytes to 1048576
- HKLM\System\CurrentControlSet\Control\FileSystem\NtfsDisableLastAccess to 1
- HKLM\System\CurrentControlSet\Services\Tcpip\Parameters\MaxHashTableSize to 65535

Network test bed configuration

To generate the WebBench workload, we used a network with 40 client PCs. Each PC contained an Intel Pentium 4 3.0 GHz with HT Technology (or faster) processor, 512 MB of system memory, a 40 GB hard drive, and a Gigabit Ethernet network adapter. We configured each client with Windows XP Professional with Service Pack 2 and all critical updates available as of June 7, 2007.

We split the 40 clients into four segments, or subnets, of 10 clients each. We connected each segment to the server under test via one NETGEAR* GS724T Gigabit Smart Switch.* To balance the load on the server and to prevent a network throughput bottleneck, we connected each segment to a separate port of the Intel PRO/1000 PT Dual Gigabit Server adapters. Figure 7 illustrates the test bed configuration.

Each subnet contains 10 PCs. Each has an Intel Pentium 4 3.0-GHz with HT Technology (or faster) processor, 512MB of RAM, a 40GB (or larger) hard disk, and a Gigabit Ethernet network adapter.

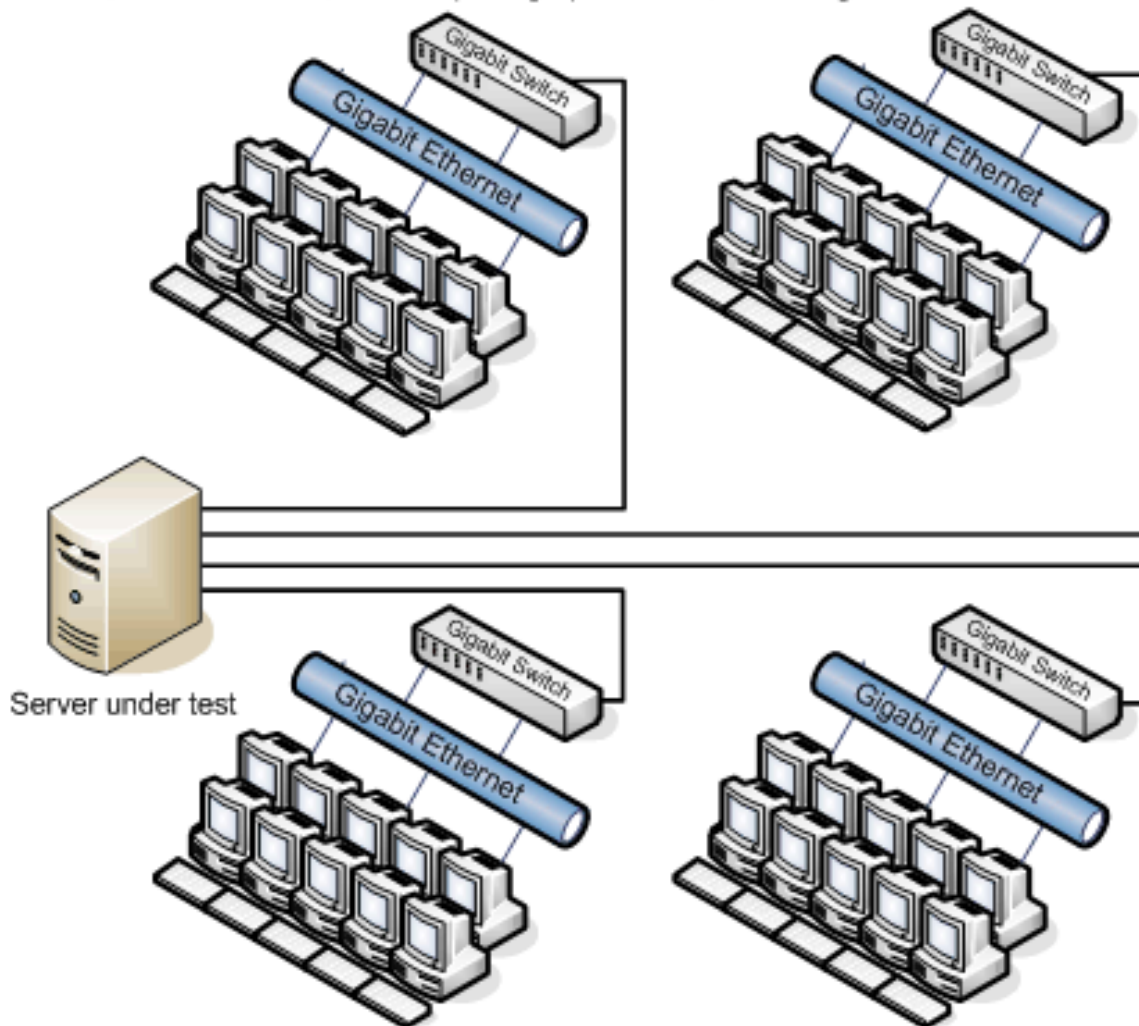


Figure 7: Illustration of the test network we used to generate the WebBench workload.

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.

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 and model number	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	QTFMHN63a1800588
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

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
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15	5-5-5-15	5-5-5-15
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	Intel 82801GB (ICH7)	Intel 82801GB (ICH7)	Intel 6321ESB
Controller driver	Intel 7.6.0.1011	Intel 7.6.0.1011	LSI 7.15.209.2007
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	1,024x768	1,024x768	1,024x768
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
Additional network adapter	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
Driver	Intel 9.9.13.0	Intel 9.9.13.0	Intel 9.9.13.0
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 layer	Single layer	Single layer
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

This appendix 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
Intel SC5250-E case ³	179.00	179.00	179.00
Total price⁴	\$684.95	\$940.94	\$1,906.91

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.

Appendix C – Test network configuration

This appendix provides configuration information about the test network we used to run WebBench 5.0 against the servers under test.

Client #	Make/model	Processor speed	Memory size/type
Segment/Subnet 1			
Client 1	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 2	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 3	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 4	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 5	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 6	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 7	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 8	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 9	Custom built	Intel Pentium 4 3.2GHz w/HT	512MB PC2-5300
Client 10	HP d4100y	Intel Pentium D 3.2GHz (DC)	1GB PC2-4300
Segment/Subnet 2			
Client 11	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 12	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 13	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 14	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 15	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 16	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 17	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 18	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 19	Custom built	Intel Pentium 4 3.2GHz w/HT	512MB PC3200
Client 20	HP a750y	Intel Pentium 4 3.2GHz w/HT	512MB DDR2-400
Segment/Subnet 3			
Client 21	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 22	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 23	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 24	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 25	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 26	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 27	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 28	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 29	HP dc5100mt	Intel Pentium 4 3.2GHz w/HT	512MB PC4200
Client 30	HP m1050Y	Intel Pentium 4 3.2GHz w/HT	1GB PC3200
Segment/Subnet 4			
Client 31	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 32	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 33	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 34	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 35	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 36	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 37	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 38	Dell Optiplex GX270	Intel Pentium 4 3.2GHz w/HT	512MB PC2700
Client 39	Custom built	Intel Pentium 4 3.0GHz w/HT	1GB PC3200
Client 40	IBM ThinkCentre 842243U	Intel Pentium 4 3.4GHz w/HT	512MB PC3200

Figure 10: Configuration information about the test network.



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