TEST REPORT
MAY 2006

Windows Media Load Simulator performance and power consumption on Intel- and AMD-processor-based servers

Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to measure the Microsoft Windows Media Load Simulator (WMLS) performance of dual-processor servers using the following three processors:

- 64-bit Intel Xeon Processor 3.60 GHz
- Dual-Core Intel Xeon Processor 5160
- Dual-Core AMD Opteron 285

WMLS is a tool that tests a server's ability to accommodate a large number of streaming connections from Microsoft's Windows Media Server. WMLS runs on one or more client desktop systems, each of which opens a tester-designated number of streaming connections to the server under test. Each connection streams a tester-designated video. Testers typically increase the number of simultaneous streams until the streaming video no longer plays smoothly and the connections begin to fail.

In our testing, we used WMLS testing to determine the maximum number of streams of our test video that each server could handle acceptably.

KEY FINDINGS

- The Dual-Core Intel Xeon Processor 5160-based server delivered 32.6 percent more performance/watt than the Dual-Core AMD Opteron 285-based server (see Figure 1). (We calculated performance/watt using system-level power measurements.)
- The Dual-Core Intel Xeon Processor 5160-based server delivered almost 12 percent higher peak performance than the Dual-Core AMD Opteron 285-based server (see Figure 2).
- The Dual-Core Intel Xeon Processor 5160-based server had over 15 percent lower average peak power usage while running the benchmark than Dual-Core AMD Opteron 285-based server (see Figures 3 and 5).

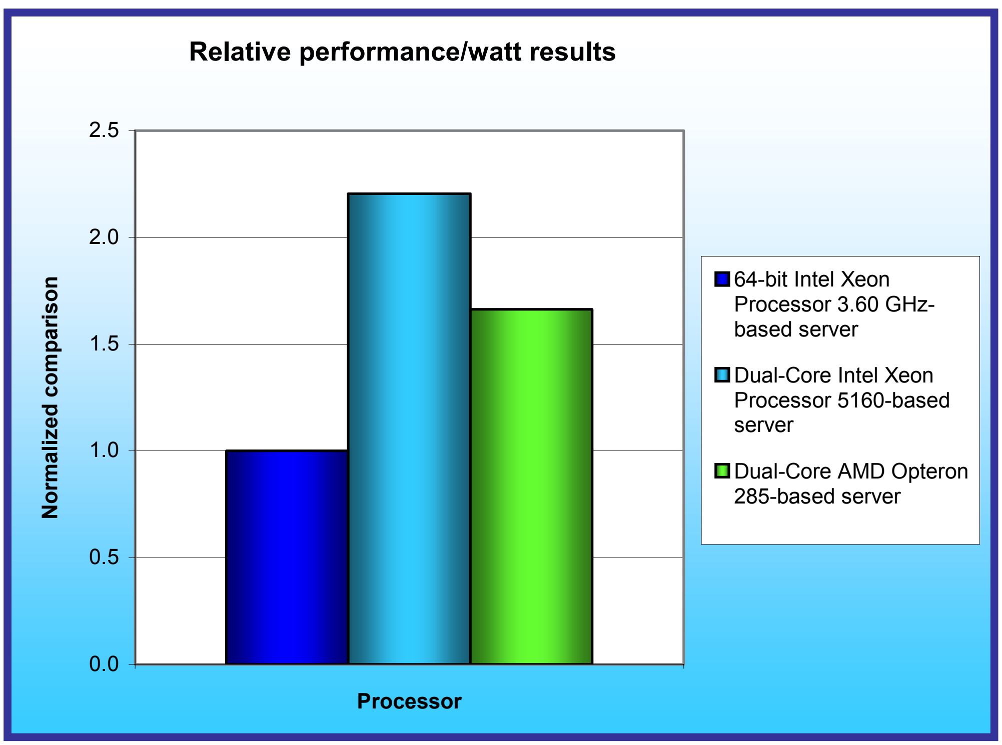

Figure 1: Performance/watt (dual-processor) results of the test servers running the WMLS test tool. Higher numbers indicate better performance/watt.

In this section, we discuss the best results for each server. Figure 1 illustrates the performance/watt for each of them. In this chart, we normalized the results for each system to the lowest performance/watt configuration. The lowest system's performance/watt 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/watt.

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

Performance/watt = the benchmark's score / average power consumption in watts during the time period in which the benchmark was delivering peak performance

As Figure 1 illustrates, the Dual-Core Intel Xeon Processor 5160-based server delivered almost 33 percent more performance/watt than the Dual-Core AMD Opteron 285-based server and over 120 percent more performance/watt than the 64-bit Intel Xeon Processor 3.60 GHz-based server.

Figure 2 shows the WMLS peak results of the three test servers. Each result is the median of three test runs and is the number of streaming media players the server under test was able to support. A higher number of streaming players means that the server can handle a heavier workload and supply more media connections. Higher numbers of streaming players thus indicate better performance.

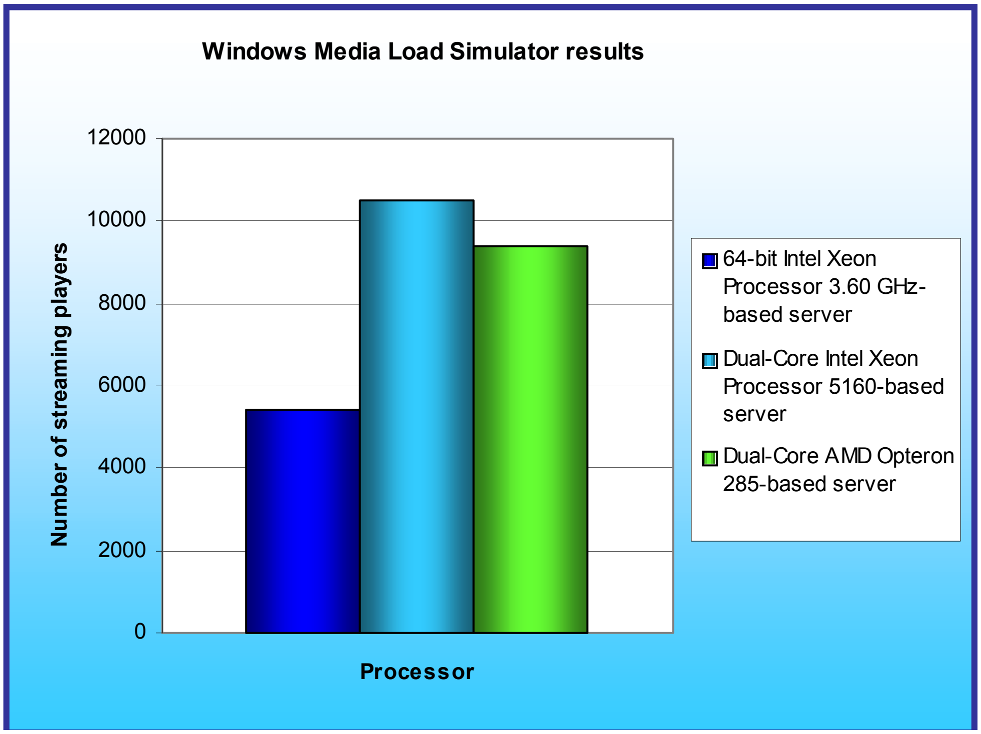

Figure 2: Peak (dual-processor) performance of the servers with optimum thread-to-processor configurations running WebBench. Higher numbers of streaming players are better.

As Figure 2 shows, the Dual-Core Intel Xeon Processor 5160-based server achieved a peak of 10,490 streaming players. This is an 11.6 percent performance increase over the Dual-Core AMD Opteron 285-based server, which achieved a peak performance of 9,400 streaming players, and a 94.4 performance increase over the 64-bit Intel Xeon Processor 3.60 GHz-based server, which delivered a peak performance of 5,397 streaming players.

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 Dual-Core Intel Xeon Processor 5160-based server both started with a lower power consumption while idle and achieved its peak performance while drawing less power—about 15 percent less—than the Dual-Core AMD Opteron 285-based server.

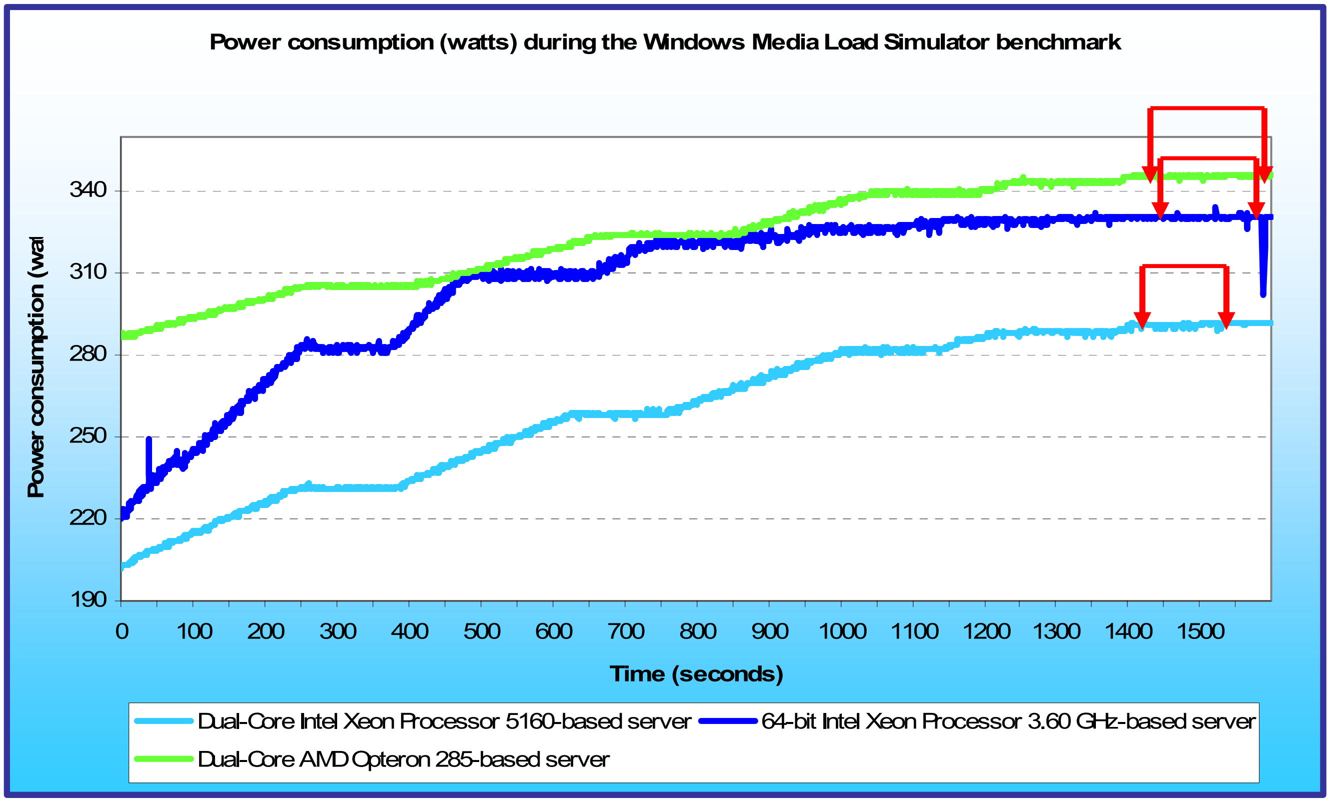

Figure 3: Power consumption (in watts) of each of the servers throughout the course of running WebBench. Lower power consumption is better.

Test results

We used Microsoft Windows Media Load Simulator 9 to simulate multiple instances of Microsoft Windows Media Player accessing the server under test. The benchmark starts with only a few clients and then slowly increases the number of clients streaming video from the server under test. When a server can no longer successfully handle the test load, it begins producing late sends, which we record with the Windows Performance monitor. A late send causes the client Media Player that received it to have to wait for the data it requested. Figure 4 shows the median results for all three servers. Each result is the total number of streaming players the server could support.

Server system	Number of video streams
64-bit Intel Xeon Processor 3.60 GHz-based server – 2 processors	5397
Dual-Core Intel Xeon Processor 5160-based server – 2 processors	10490
Dual-Core AMD Opteron 285-based server – 2 processors	9400

Figure 4: Median number of WMLS test video streams each server successfully supported. Higher numbers are better.

The Dual-Core Intel Xeon Processor 5160-based server achieved a peak of 10,490 streaming players. This result represents an 11.6 percent performance increase over the Dual-Core AMD Opteron 285-based server and a 94.4 performance increase over the Dual-Core Intel Xeon Processor 5160-based server.

Server system	Idle power (watts)	Average power (watts)
64-bit Intel Xeon Processor 3.60 GHz-based server – 2 processors	221.6	330.2
Dual-Core Intel Xeon Processor 5160-based server – 2 processors	202.9	291.1
Dual-Core AMD Opteron 285-based server – 2 processors	287.5	345.8

Figure 5: Average power usage (in watts) of the test servers during the median runs of the WMLS test tool. Lower numbers are better.

Figure 5 details the power consumption, in watts, of the test servers while idle and during the median peak runs of the benchmark. The Dual-Core Intel Xeon Processor 5160-based server used over 15 percent less power during the time period in which it was delivering peak performance than the Dual-Core AMD Opteron 285-based server. Its power consumption while idle was over 29 percent lower than that of the Dual-Core AMD Opteron 285-based server.

Test Methodology

Figure 6 summarizes some key aspects of the configurations of the three server systems; Appendix A provides detailed configuration information.

Server	64-bit Intel Xeon Processor 3.60 GHz-based server	Dual-Core Intel Xeon Processor 5160-based server	Dual-Core AMD Opteron 285-based server
Processor frequency (GHz)	3.6GHz	3.0GHz	2.6GHz
Single/Dual-Core processors	Single	Dual	Dual
Motherboard	Intel SE7520AF2	Intel S5000PSL	UNIWIDE Technologies SS232-128-03
Chipset	Intel E7520 Chipset	Intel 5000P Chipset	NVIDIA nForce4 Chipset
RAM (8GB in each)	8 x 1GB PC2-3200	8 x 1GB PC2-5300 FBDIMM	8 x 1GB PC-3200
Hard Drive	Western Digital WD1600YD	Western Digital WD1600YD	Western Digital WD1600YD

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

Intel configured and provided all servers.

The difference in RAM types reflects the capabilities of the three motherboards: The Intel SE7520AF2 motherboard offered a shared front-side bus speed of 800 MHz and contained DDR2 PC2-3200 400 MHz memory components. The Intel S5000PSL motherboard offered two independent front-side busses at a speed of 1333 MHz and contained Fully-Buffered DIMM (FBDIMM) modules that used commodity DDR2 PC2-5300 667MHz memory components. The UNIWIDE motherboard supported 184-pin DDR memory, and the highest memory speed available for the Dual-Core AMD Opteron 285-based server was DDR PC3200 400MHz RAM.

Another hardware difference between the servers was the number of processor cores, though all three systems offer four processing threads. The 64-bit Intel Xeon Processor 3.60 GHz-based server contained single-core processors with HT Technology. The Dual-Core Intel Xeon Processor 5160- and Dual-Core AMD Opteron 285-based server contained dual-core processors.

With the following exceptions, we used the default BIOS settings on each server: we disabled the HW Prefetcher and the Adjacent Cache Line Prefetcher on the Dual-Core Intel Xeon Processor 5160-based server. These options were disabled by default on the 64-bit Intel Xeon processor 3.60 GHz-based server and were not available on the Dual-Core AMD Opteron 285-based server.

We began 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 Internet Explorer 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)

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) and 8 (idle and average peak power) for the results of these measurements.

Creating the video content

To use the WMLS test tool, the Windows Media Server must have a source video to stream to the clients. We created our own video so that we could control the specific size and bit-rate format of the video. Prior to testing, we ran preliminary tests and determined the optimal bit rate size was 500 Kbps.

To create this streaming file, we pulled content from the DVD video, "Stevie Ray Vaughan and Double Trouble: Live at the El Mocambo" (www.amazon.com/gp/product/6305019681/qid=1148058106/sr=1-2/ref=sr_1_2/102-0027141-8108150?s=dvd&v=glance&n=130) and created an AVI file using AutoGK, from the Doom 9 AGK Development Forum (www.autogk.me.uk).

We then used Windows Media Encoder 9 (www.microsoft.com/windows/windowsmedia/forpros/encoder/default.mspx) to convert the AVI file into a streaming video (WMV) file for the Windows Media Server. We used the following compression settings to convert the streaming video:

- Destination: Windows Media server (streaming)
- Video: Multiple bit rates video (CBR)
- Audio: Voice quality audio (CBR)
- Bit rates: 504 Kbps, 29.97 fps, 320 x 240 Output Size

Installing and setting up Windows Media Services

We performed the following steps to install and configure Windows Media Services on the server under test:

1. Use the Manage Your Server wizard to install Windows Media Services.
2. When this installation completes, the Windows Media Services root directory will be C:\WMPub\WMRoot. Copy the test WMV file into this root directory.
3. The installation process will create several .asf files in the Windows Media Services root directory. Copy one of these files and place it in the same directory with the test WMV file. (Which file you select is not important, because the WMLS client is hard coded to look for a particular file when you start it.) Rename the copy wmload.asf.
4. Open the Windows Media Services management console by clicking Start -> Administrative Tools -> Windows Media Services.
5. Select the server name, then choose Properties -> Control Protocol -> ENABLE WMS HTTP Server Control Protocol. Figure 7 below provides a visual reference for this process.

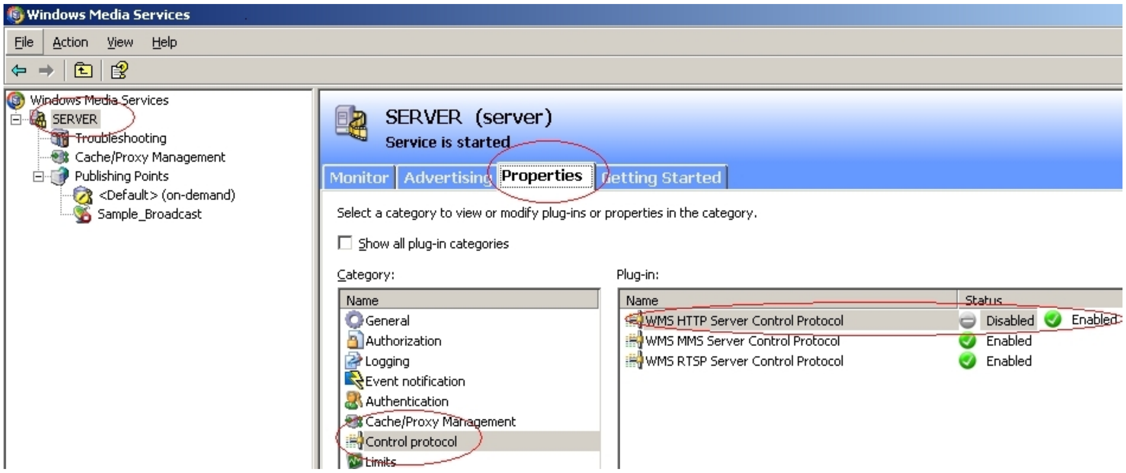

Figure 7: Enabling the WMS HTTP Server Control Protocol using the Windows Media Services management console.

6. Select the Publishing Point: <Default> (on-demand) ->Properties->DISABLE FAST CACHE. (See Figure 8.)

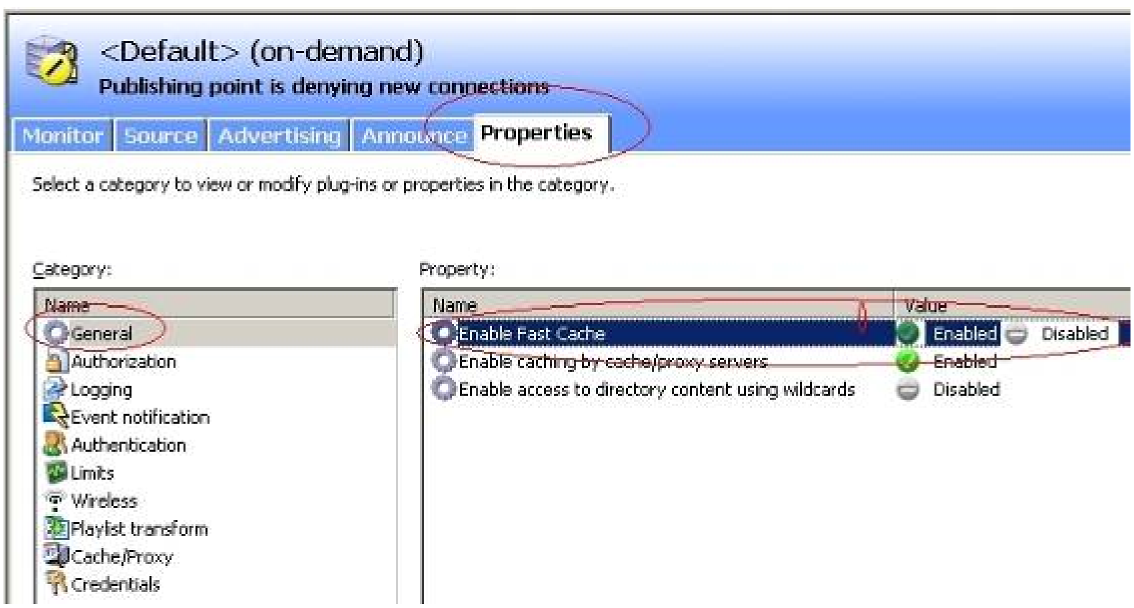

Figure 8: Disabling Fast Cache using the Windows Media Services management console.

7. To start the media server, select the Publishing Point: <Default> (on-demand)>Monitor>. Click the Button to allow new connections. (See Figure 9.)

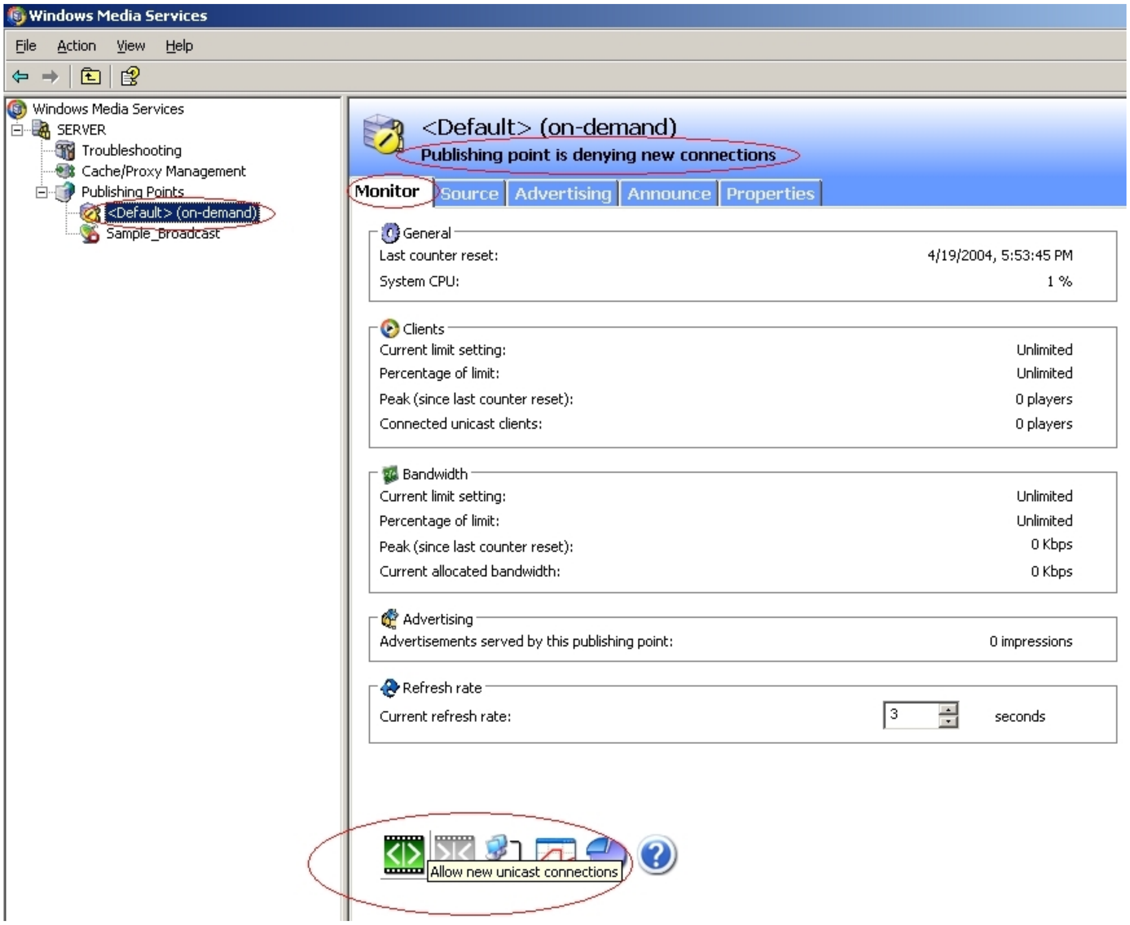

Figure 9: Allowing new connections using the Windows Media Services management console.

Windows Media Services is now ready for testing.

Installing the workload simulator on each client system

We performed the following steps to prepare the clients to run the WMLS test tool:

1. Download the test tool from Microsoft's Web site: www.microsoft.com/downloads/details.aspx?FamilyID=0304afa3-e414-4dec-82a4-2d58ac75c833&displaylang=en&Hash=NY6FCJ9
2. Place the executable file (wmloadsetup.exe) on each client.
3. Start the installation by double clicking on the file.
4. Click Yes at the EULA agreement box.
5. After the installation process has completed, start the simulator by clicking Start->All Programs->Windows Media Load Simulator->Windows Media Load Simulator.

Test bed configuration

To generate the workload we used a total of 36 clients in the configuration in Figure 10.

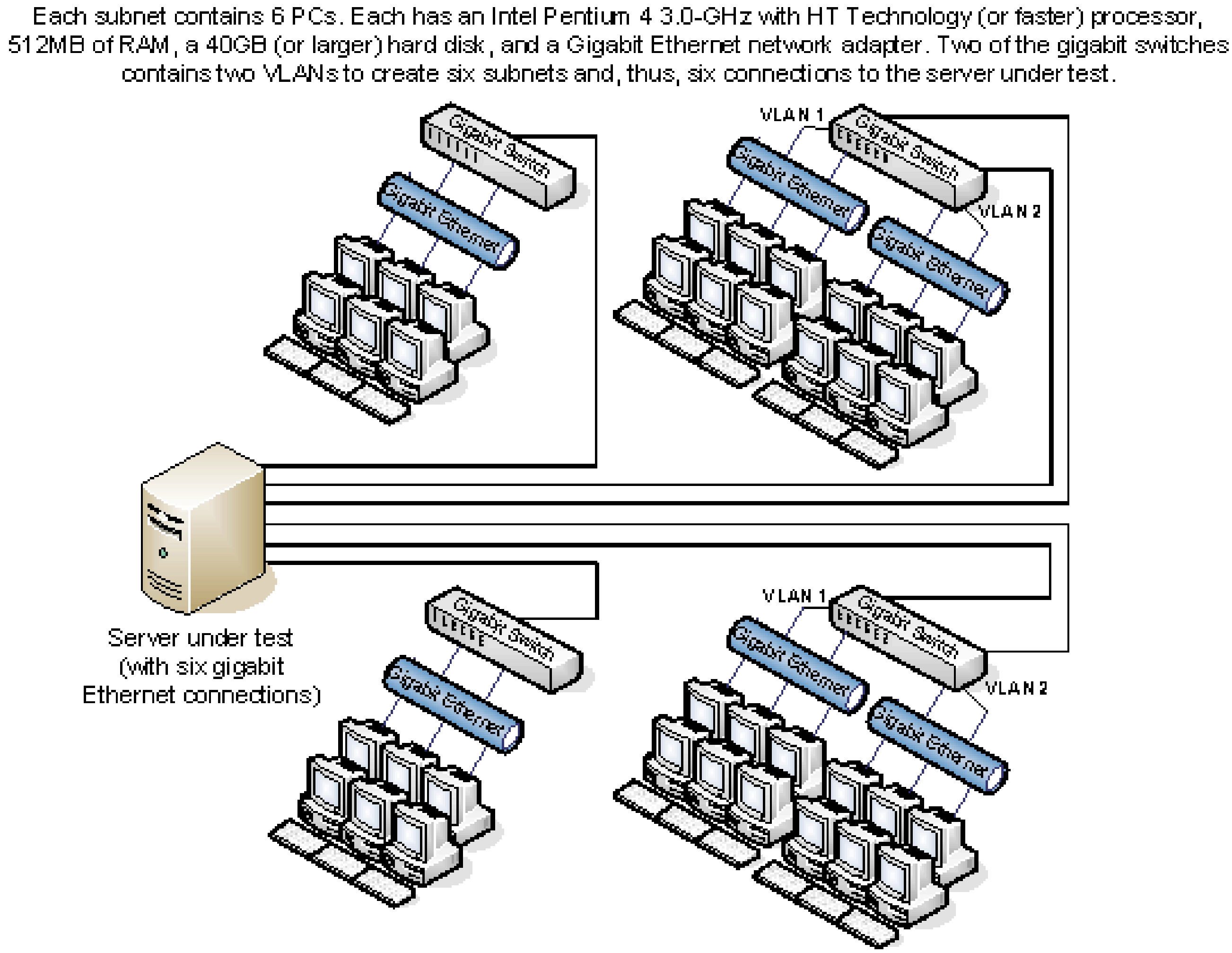

Figure 10: Illustration of the network test bed configuration for the WMLS test.

We split the 36 clients into six segments, or subnets, of six clients each. We connected two of the six segments through one NETGEAR GS724T Gigabit Smart Switch. For the other four segments, we used two more NETGEAR GS724T switches, this time splitting each into two separate VLANs. To balance the load on the server and prevent a network throughput bottleneck, we configured each segment by connecting a Gigabit Ethernet port in each six-client network segment to a separate port of the Intel PRO/1000 PT Dual Gigabit Server adapters and the two onboard Gigabit network adapters on each server.

Running the WMLS test tool

Because our objective was to determine the highest number of streams the server under test could handle, we had to monitor the server's performance carefully. We used the Performance Monitor in Windows 2003 Server and added counters to monitor the following aspects of the server under test:

- *Processor utilization* This let us detect when the server's processors were fully subscribed.
- *Network utilization* This let us monitor the bandwidth available between the clients and the server under test to ensure that the network connections did not cause a performance bottleneck.
- *Number of streaming clients* This let us monitor the number of active clients so we would know how many streams the server was supporting when it first failed to handle all of them without delay.
- *Late sends* This let us monitor the number of video streaming connections that failed to play due to the server being unable to keep up with the load.

After starting the server under test and the 36 clients, we began the test by launching the WMLS tool on six of the clients, one on each subnet. We then initiated a large number of connections on each of these six clients to load the server to approximately 50 percent processor utilization. Once the server was handling these connections, we waited at least two minutes to allow the server to stabilize. We then initiated the second group of six clients and launched another group of connections to bring the server closer to 100 percent processor utilization. We again waited two minutes for the server to stabilize. With each group of six clients we added, we decreased the number of threads each individual client was streaming so the overall load on the server grew gradually.

We constantly evaluated the server's status throughout the test with Performance Monitor. When the Late sends counter showed one late send, we stopped the workload and we recorded the number of streaming clients successfully active at that point.

Appendix A – Test server configuration information

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

Processors	64-bit Intel Xeon Processor 3.60 GHz-based server	Dual-Core Intel Xeon Processor 5160-based server	Dual-Core AMD Opteron 285-based server
System configuration information			
General			
Processor and OS kernel: (physical, core, logical) / (UP, MP)	2P2C4L / MP	2P4C4L / MP	2P4C4L / MP
Number of physical processors	2	2	2
Single/Dual-Core processors	Single	Dual	Dual
System Power Management Policy	Always On	Always On	Always On
CPU			
Vendor	Intel	Intel	AMD
Name	64-bit Intel Xeon Processor 3.60 GHz	Dual-Core Intel Xeon Processor 5160	Dual-Core AMD Opteron 285
Stepping	3	4	2
Socket type	mPGA-604	LGA 775	940
Core frequency (GHz)	3.6 GHz	3.0 GHz	2.6 GHz
Front-side bus frequency (MHz)	800 MHz	1333 MHz Dual Independent Busses (DIB)	2000 MHz HyperTransport
L1 Cache	16KB + 12KB	32KB + 32KB	64KB + 64KB
L2 Cache	2MB	4MB (Shared)	2MB (1MB per core)
Platform			
Vendor	64-bit Intel Xeon Processor 3.60 GHz server	Dual-Core Intel Xeon Processor 5160 server	Dual-Core AMD Opteron 285 server
Motherboard model number	Intel SE7520AF2	Intel S5000PSL	UNIWIDE SS232-128-03
Motherboard chipset	Intel E7520 Chipset	Intel 5000P Chipset	NVIDIA nForce4 Chipset
Motherboard revision number	C4	92	A3
Motherboard serial number	KRA145100053	QTFMHN61400072	WTOPHTSA01020
BIOS name and version	American Megatrends Inc. SE7520AF20.86B.P.10.00.0109.02082006139	American Megatrends Inc. S5000.86B.01.00.0036, 4/4/2006	American Megatrends Inc. 080012, 3/21/2006
BIOS settings	Default	HW Prefetcher and Adjacent Cache Line Prefetcher disabled	Default
Chipset INF driver	7.2.2.1006	7.3.0.1010	6.7
Memory module(s)			
Vendor and model number	Infineon HYS72T128000HR-5-A	Micron MT18HTF12872FDY	Corsair CMX1024RE-32000

Type	PC2-3200	FB-DIMM using PC2-5300 components	PC-3200
Speed (MHz)	400MHz	667MHz	400MHz
Speed in the system currently running @ (MHz)	400MHz	667MHz	400MHz
Timing/Latency (tCL-tRCD-iRP-tRASmin)	3-3-3-11	5-5-5-12	3-3-3-8
Size	8192MB	8192MB	8192MB
Number of RAM modules	8	8	8
Chip organization	Double-sided	Double-sided	Double-sided
Channel	Single	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 82801EB Ultra ATA	Intel 631xESB Serial ATA	NVIDIA nForce4 Serial ATA
Controller driver	Intel 6.3.0.1005	Intel 7.3.0.1010	NVIDIA 5.10.2600.552
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	5/5/2006	5/5/2006	5/5/2006
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 Rage XL	ATI ES1000	ATI Rage XL
Chipset	ATI Rage XL PCI	ATI ES1000 PCI	ATI Rage XL PCI
BIOS version	GR-xlints3y.019-4.333	BK-ATI VER008.005.023.000	GR-xlacrs3p.003-4.328
Type	Integrated	Integrated	Integrated
Memory size	8MB	8MB	8MB
Resolution	1024 x 768	1024 x 768	1024 x 768
Driver	ATI 6.14.10.6024	ATI 6.14.10.6553	ATI 6.14.10.6025
Network card/subsystem			
Vendor and model number	Intel PRO/1000 MT Dual Port Network adapter	Intel PRO/1000 EB Network Connection	Broadcom dual NetXtreme Gigabit
Type	Integrated	Integrated	Integrated
Driver	Intel 8.6.17.0	Intel 9.3.28.0	Broadcom 8.48.0.0

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	Samsung TS-H325A	LITE-ON SOHD-16P9SV	Samsung SN-124
Type	DVD/CD-ROM	DVD/CD-ROM	CD-ROM
Interface	Internal	Internal	Internal
USB ports			
# of ports	5	6	4
Type of ports (USB 1.1, USB 2.0)	USB 2.0	USB 2.0	USB 2.0

Figure 11: Detailed configuration information for the three test servers.

Appendix B – Test network configuration

This appendix provides configuration information about the test network we used to run WMLS 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
Segment/Subnet 2			
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	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 10	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
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
Segment/Subnet 3			
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
Segment/Subnet 4			
Client 19	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 20	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
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
Segment/Subnet 5			
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	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Client 30	Intel Desktop Board D915GMH	Intel Pentium 4 3.0GHz w/HT	512MB PC3200
Segment/Subnet 6			
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

Figure 12: Configuration information about the test network.

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