VeriTest®

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1001 Aviation Parkway, Suite 400 • Morrisville, NC 27560 • 919-380-2800 • Fax 919-380-2899
320 B Lakeside Drive • Foster City, CA 94404 • 650-513-8000• Fax 650-513-8099
www.veritest.com • info@veritest.com

Microsoft Windows Server 2003 vs. Linux Competitive File Server Performance Comparison

Test report prepared under contract from Microsoft

Executive summary

Microsoft commissioned VeriTest, a division of Lionbridge Technologies, Inc., to conduct a series of tests comparing the File serving performance of the following server operating system configurations running on a variety of server hardware and processor configurations:

- Windows Server 2003 Enterprise Edition Release Candidate 2 (subsequently referred to as Windows Server 2003 in the remainder of this report)
- Red Hat Linux Advanced Server 2.1
- Red Hat Linux 8.0 Professional

Key findings

- Windows Server 2003 delivered significantly better File server throughput compared to Red Hat Linux Advanced Server 2.1 and Red Hat Linux 8.0 on the configurations we tested.
- Windows Server 2003 delivered between 66 and 95 percent better File server throughput in our tests on a HP DL760 server using up to eight processors compared to Red Hat Linux Advanced Server 2.1
- Windows Server 2003 delivered 100 percent better File server throughput in our tests on a HP DL380 server using two processors compared to Red Hat Linux Advanced Server 2.1.
- Windows Server 2003 delivered 86 percent better File server throughput in our tests on a HP DL380 server using two processors compared to Red Hat Linux 8.0 Professional.

For these tests, Hewlett-Packard supplied three server systems as follows:

- HP ProLiant DL760 server configured with four 900MHz Pentium III Xeon processors, 4GB of RAM and four Intel PRO/1000 MF Server Adapters.
- HP ProLiant DL760 server configured with eight 900MHz Pentium III Xeon processors, 4GB of RAM and eight Intel PRO/1000 MF Server Adapters.
- HP ProLiant DL380 G2 server configured with two 1.4GHz Pentium III processors, 2GB of RAM and two Intel PRO/1000 MF Server Adapters.

Please refer to the Test Methodology section and Appendix A for complete details regarding the server systems used for these tests.

For the File server performance tests we used Ziff Davis Media's NetBench 7.02 benchmarking software. NetBench uses large numbers of physical test clients to generate a file I/O based workload using the CIFS protocol against a file server under test. These test clients make network based file requests to a file server and then record the amount of data moved during the test as a measure of the overall throughput capabilities

of the file server. Additionally, the test clients record and generate a measure of overall average response time for the file server as it responded to the various file I/O requests made by the test clients.

The File server performance testing consisted of executing a variety of standard and customized NetBench test suites against each server described above configured with each of the operating systems described above using the following processor combinations.

- DL380 server configured with 2 processors
- DL760 server configured with 1, 2, 4 and 8 processors.

For the File Server performance testing using Red Hat Linux Advanced Server 2.1 and Red Hat Linux 8.0 Professional, we installed SAMBA services during installation of each product. SAMBA is an application that allows Windows based systems to map and use shared volumes residing on Linux systems using the CIFS protocol. Using SAMBA, Windows based clients can map shared volumes on the Linux server and use them as if they resided on a Windows-based server.

Note: We attempted to conduct testing using Red Hat Linux 8.0 Professional on the HP DL760 server but were unsuccessful. Information provided on the Hewlett Packard Web site indicated that Red Hat Linux 8.0 was not a supported Operating System on the HP DL760 servers. As a result, there are no test results in this report for Red Hat Linux 8.0 Professional running on the HP DL760 server.

Please refer to the Test Methodology and Test Results sections for complete details of the NetBench test suites used during the testing, how we conducted the File server performance tests and complete NetBench test results.

File Server Performance Test Results

This section summarizes the File server performance results. Please refer to the Test Results section for complete test results.

Figure 1 shows the peak throughput values generated on both the HP DL380 and HP DL760 server using all operating system and processor combinations we tested. We found that, in all of our test configurations, Windows Server 2003 generated significantly better peak File server throughput compared to Red Hat Linux Advanced Server 2.1 on the HP DL760 server and compared to Red Hat Linux Advanced Server 2.1 and Red Hat Linux 8.0 on the HP DL380 server regardless of the server employed or the number of processors.

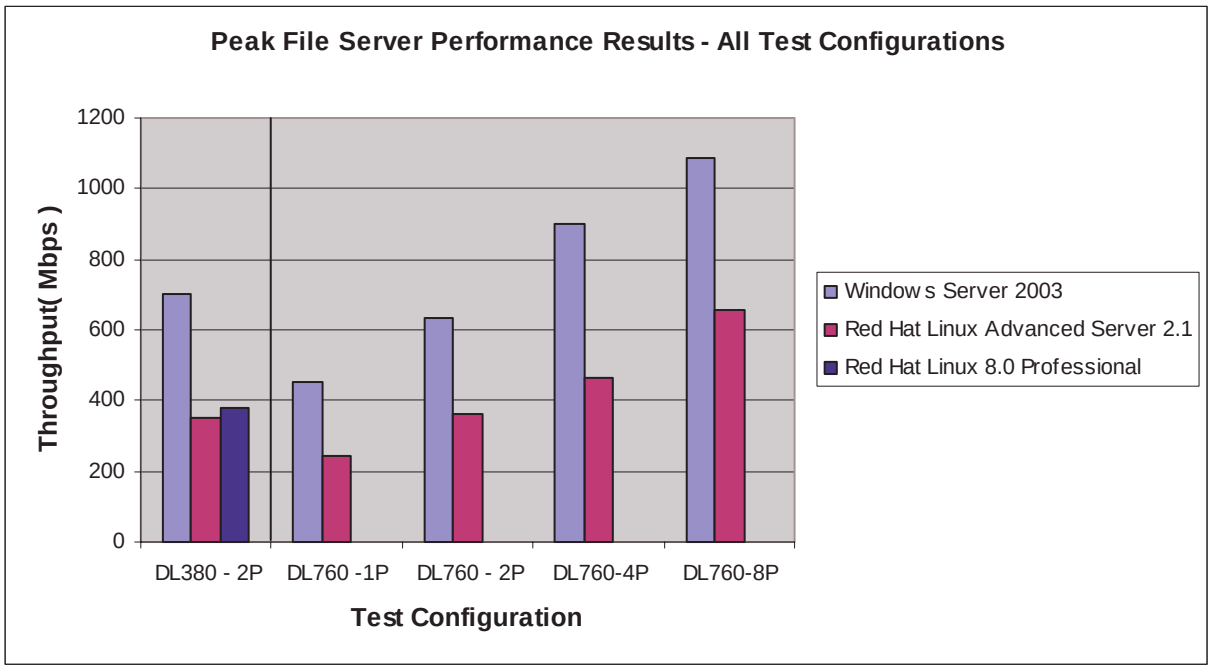

Figure 1. Peak File Server Performance On All Test Configurations

Figure 2 below shows the actual peak NetBench File server performance throughput results in megabits per second (Mbps) generated using Windows Server 2003 and Red Hat Linux Advanced Server 2.1 on both the HP DL380 and HP DL760 server using all tested processor combinations. These results show that Windows Server 2003 delivered between 66 and 100 percent better File serving performance compared to Red Hat Linux Advanced Server 2.1 in these test configurations.

Operating System	DL380 - 2P	DL760 -1P	DL760 - 2P	DL760-4P	DL760-8P
Windows Server 2003	700 Mbps	453 Mbps	632 Mbps	901 Mbps	1088 Mbps
Red Hat Linux Advanced Server 2.1	350 Mbps	244 Mbps	365 Mbps	462 Mbps	657 Mbps
Percent Improvement with Windows Server 2003 over Red Hat Linux Advanced Server 2.1	100%	86%	73%	95%	66%

Figure 2. Peak File Server Performance – Windows Server 2003 vs. Red Hat Linux Advanced Server 2.1

Figure 3 below shows the actual peak NetBench File server performance throughput results in megabits per second (Mbps) generated using Windows Server 2003 and Red Hat Linux 8.0 Professional on the HP DL380 server configured with two processors. These results show that Windows Server 2003 delivered 86 percent better File server performance compared to Red Hat Linux 8.0 Professional in this test configuration.

Operating System	DL380 - 2P
Windows Server 2003	700 Mbps
Red Hat Linux 8.0 Professional	377 Mbps
Percent Improvement with Windows Server 2003 over Red Hat Linux 8.0 Professional	86%

Figure 3. Peak File Server Performance – Windows Server 2003 vs. Red Hat Linux 8.0 Professional

Figure 4 shows the percentage increase in the peak File server throughput test results for all configurations tested as we added additional processors to the HP DL760 server. These results showed that both Windows Server 2003 and Red Hat Linux Advanced Server 2.1 delivered respectable processor scaling using our test configurations.

Operating System	DL760 - 1P - (Mbps)	DL760 - 2P - (Mbps)	% Increase	DL760 - 2P - (Mbps)	DL760 - 4P - (Mbps)	% Increase	DL760 - 4P - (Mbps)	DL760 - 8P - (Mbps)	% Increase
Windows Server 2003	453	632	**40%**	632	901	**43%**	901	1088	**21%**
Red Hat Linux Advanced Server 2.1	244	365	**50%**	365	462	**27%**	462	657	**42%**

Figure 4. File Server throughput Scaling Results from 1 to 8 processors on the HP DL760

Testing methodology

Microsoft commissioned VeriTest, a division of Lionbridge Technologies, Inc., to conduct a series of tests comparing the File serving performance of the following server operating system configurations running on a variety of server hardware and processor configurations:

- Windows Server 2003 Enterprise Edition RC2
- Red Hat Linux Advanced Server 2.1
- Red Hat Linux 8.0 Professional

Hewlett-Packard supplied the server hardware for these tests. Specifically, we used the following systems:

- HP ProLiant DL760 server configured with four 900MHz Pentium III Xeon processors, 4GB of RAM and four Intel PRO/1000 MF Server Adapters. This system contained an embedded SmartArray 5i RAID controller connected to four 36.4GB 15,000RPM Ultra3 SCSI disk drives. Additionally, we installed a second RAID subsystem consisting of a total of 28 18.2GB 15,000 RPM Ultra3 SCSI disk drives connected to a SmartArray 5300 RAID controller.

- HP ProLiant DL760 server configured with eight 900MHz Pentium III Xeon processors, 4GB of RAM and eight Intel PRO/1000 MF Server Adapters. This system contained an embedded SmartArray 5i RAID controller connected to four 36.4GB 15,000RPM Ultra3 SCSI disk drives. Additionally, we installed a second RAID subsystem consisting of a total of 28 18.2GB 15,000 RPM Ultra3 SCSI disk drives connected to a SmartArray 5300 RAID controller.

- HP ProLiant DL380 G2 server configured with two 1.4GHz Pentium III processors, 2GB of RAM and two Intel PRO/1000 MF Server Adapters. This system contained an embedded SmartArray 5i RAID controller connected to six 36.4GB 15,000RPM Ultra3 SCSI disk drives.

VeriTest provided the network test client hardware for these tests. Specifically, we used the following systems:

- 240 client systems configured with a single 850Mhz Pentium III processor, 256MB of RAM, 10GB IDE hard drive and single 100 Mbps Ethernet adapter.

Test Network Configuration

For the File server performance tests, we created two distinct test networks each using 120 physical clients. We connected the first 120-node network to the HP DL760 server containing four processors and four network adapters. We connected all 120 clients through four Extreme Networks Summit48 switches (30 clients per switch) using 100 Mbps, full duplex connections. We configured the 120 clients into four distinct subnets each containing 30 clients. We used the Gigabit ports on the Summit48 switch to connect each subnet of 30 clients to one of the four Intel PRO/1000 MF Gigabit Server Adapters installed in the HP DL760 server.

We connected the second 120-node network to the HP DL760 server containing eight processors and eight network adapters. We connected all 120 clients through four Extreme Networks Summit48 switches (30 clients per switch) using 100 Mbps, full duplex connections. We configured the 120 clients into eight distinct subnets each containing 15 clients. We used the Gigabit ports on the Summit48 switch to connect each subnet of 15 clients to one of the eight Intel PRO/1000 MF Gigabit Server Adapters installed in the HP DL760 server.

Because the HP DL380 server contained only two network adapters, we used two of the 30-client network segments configured in the first 120-client network described above for all tests involving the DL380 server. We connected each 30-client network segment through a separate Extreme Networks Summit48 switch using

100 Mbps, full duplex connections. We used the Gigabit ports on each Summit48 switch to connect each subnet of 30 clients to one of the two Intel PRO/1000 MF Gigabit Server Adapters installed in the HP DL380 server. Please refer to Appendix C of this report for visual representations of the network configurations used for these tests.

File Server Performance Testing

For the File Server performance tests we used Ziff Davis Media's NetBench 7.02 benchmarking software. NetBench uses large numbers of physical test clients to generate a file I/O based workload using the CIFS protocol against a file server under test. These test clients make network based file requests to a file server and then record the amount of data moved during the test as a measure of the overall throughput capabilities of the file server. Additionally, the test clients record and generate a measure of overall average response time for the file server as it responded to the various file I/O requests made by the test clients.

To test the HP DL380 system, we used the standard NetBench 7.02 Enterprise Disk Mix test suite to conduct all testing. The standard NetBench Enterprise Disk Mix test suite uses a total of 60 physical clients. Each test suite starts using a single load-generating client and slowly increases the load on the file server by adding test clients in increments of four until a total of 60 clients have participated in the test.

Because the HP DL760 systems contained more memory and processing power compared to the HP DL380 system, we created a new set of test suites using the workloads from the standard NetBench Enterprise Disk Mix test suites to test the HP DL760 systems. Like the standard Enterprise Disk Mix test suite, this new test suite started with a single test client but increased the load on the File server by adding test clients in groups of eight until a total of 120 clients had participated in the test. These new test suites used identical workloads compared to the standard Enterprise Disk Mix test suite, but were designed to put roughly twice the load on the server compared to the standard Enterprise Disk Mix test suite.

The File server performance testing consisted of running the modified Enterprise Disk Mix test suite against the HP DL760 servers using 1, 2, 4 and 8 processor configurations running each of the following operating systems:

- Windows Server 2003
- Red Hat Linux Advanced Server 2.1 running SAMBA version 2.2.7

Additionally, we ran the standard Enterprise Disk Mix test suite against the HP DL380 server using a two-processor configuration against the following operating systems:

- Windows Server 2003
- Red Hat Linux Advanced Server 2.1 running SAMBA version 2.2.7
- Red Hat Linux 8.0 Professional running SAMBA version 2.2.5 (installed by default)

When testing the HP DL760 servers using Windows Server 2003, we modified the boot.ini file on the HP DL760 server containing four processors and four network segments to allow us to start the server using 1, 2, or 4 processors. For the one processor testing on the HP DL760 server, we loaded the appropriate uni-processor kernel and HAL for Windows Server 2003 found on the Windows Server 2003 media sent by Microsoft for these tests.

When testing the HP DL760 servers running Red Hat Linux Advanced Server 2.1, we used the Enterprise SMP kernel (2.4.9-e.3enterprise) when testing with 2, 4 and 8 processors and the single processor kernel (2.4.9-e.3) when testing using a single processor. When conducting testing using two processors, we used the Linux boot option "maxcpus=2" to restrict the operating system to use only two processors.

When testing the HP DL380 server running Red Hat Linux Advanced Server 2.1, we used the Enterprise SMP kernel (2.4.9-e.3enterprise). When testing the HP DL380 server running Red Hat Linux 8.0 Professional, we used kernel version 2.4.18-14smp. This is the default SMP kernel installed by Red Hat Linux 8.0 Professional.

Please refer to Appendix B of this report for details on how we installed and configured each of the operating systems listed above for the File Server performance testing.

SAMBA is an application that allows Windows based systems to map and use shared volumes residing on Linux systems using the CIFS protocol. Using SAMBA, Windows based clients can map shared volumes on the Linux server and use them as if they resided on a Windows-based server. Initially, we ran into issues conducting File Server performance testing using the default version of SAMBA that ships by default with Red Hat Linux Advanced Server 2.1. These issues resulted in the server appearing to stop accepting file I/O requests from the NetBench clients and becoming unresponsive to keyboard and mouse input. As a result, we downloaded the SAMBA version 2.2.7 RPM for Red Hat Linux 7.2 (Samba-2.2.7-1.7.3.i386.rpm) from the following URL:

http://speakeasy.rpmfind.net/

After installing this newer version of SAMBA, the issues we encountered previously disappeared and we were able to complete all File Server performance testing on Red Hat Linux Advanced Server 2.1.

For all testing, each of the test suites described above were executed twice for each specific configuration to ensure the accuracy and repeatability of the test results. We then computed the average of these two test runs at each client load point to determine the results presented in this report.

For all File server performance testing, the 240 network test clients ran Windows XP and Service Pack 1.

For the File server performance testing using Windows Server 2003, we performed a series of operating system and testbed client tunings as specified by documentation provided from Microsoft.

Additionally, we spent considerable time investigating and testing potential performance tuning options for improving the File server performance on the Red Hat Linux platforms tested using SAMBA. While investigating tuning options for SAMBA, we looked at a number of items including previous competitive tests comparing Windows operating systems to Linux, as well as a variety of books and Web sites with information about tuning the performance of SAMBA. We gathered what appeared to be the most likely candidates to maximize the performance of SAMBA and then spent several days running a series of tests designed to determine which, if any of these tuning options actually made a difference in our File server performance tests using SAMBA.

Our investigation showed that, with some minor tweaks, the default configuration values set for SAMBA generated the best overall performance in our configuration. Please refer to Appendix C of this report for complete details of the tuning conducted for the File server performance testing.

Test results

This section shows the results of the File server performance testing we conducted. Please refer to the Testing Methodology section for complete information on the tests we performed.

Figure 5 shows the peak throughput values generated on both the HP DL380 and HP DL760 server using all operating system and processor combinations we tested. We found that regardless of the server employed or the number of processors, Windows Server 2003 generated significantly better peak File serving throughput compared to Red Hat Linux Advanced Server 2.1 on the HP DL760 server and compared to Red Hat Linux Advanced Server 2.1 and Red Hat Linux 8.0 on the HP DL380 server.

We did not conduct tests using Red Hat Linux 8.0 on the HP DL760 server as information on the Hewlett Packard Web site indicated that Red Hat Linux 8.0 was not a supported configuration on the HP DL760 servers.

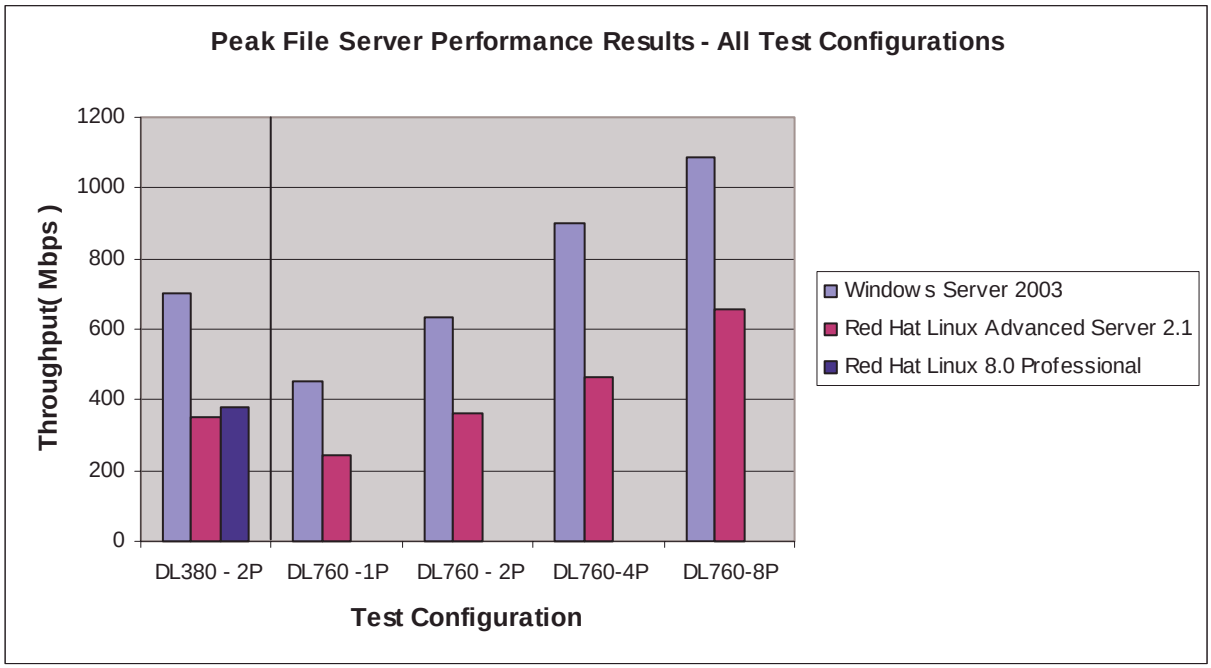

Figure 5. Peak File Server Performance On All Test Configurations

Figure 6 below shows the actual peak NetBench File server performance throughput results in megabits per second (Mbps) generated using Windows Server 2003 and Red Hat Linux Advanced Server 2.1 on both the HP DL380 and HP DL760 server using all tested processor combinations. These results show that Windows Server 2003 delivered between 66 and 100 percent better File Serving throughput compared to Red Hat Linux Advanced Server 2.1 in these test configurations.

Operating System	DL380 - 2P	DL760 -1P	DL760 - 2P	DL760-4P	DL760-8P
Windows Server 2003	700 Mbps	453 Mbps	632 Mbps	901 Mbps	1088 Mbps
Red Hat Linux Advanced Server 2.1	350 Mbps	244 Mbps	365 Mbps	462 Mbps	657 Mbps
Percent Improvement with Windows Server 2003 over Red Hat Linux Advanced Server 2.1	100%	86%	73%	95%	66%

Figure 6. Peak File Server Performance – Windows Server 2003 vs. Red Hat Linux Advanced Server 2.1

Figure 7 below shows the actual peak NetBench File server performance throughput results in megabits per second (Mbps) generated using Windows Server 2003 and Red Hat Linux 8.0 Professional on the HP DL380 server configured with two processors. These results show that Windows Server 2003 delivered 86 percent better File Server throughput compared to Red Hat Linux 8.0 Professional in this test configuration.

Operating System	DL380 - 2P
Windows Server 2003	700 Mbps
Red Hat Linux 8.0 Professional	377 Mbps
Percent Improvement with Windows Server 2003 over Red Hat Linux 8.0 Professional	86%

Figure 7. Peak File Server Performance – Windows Server 2003 vs. Red Hat Linux 8.0 Professional

While Windows Server 2003 delivered better peak File Server throughput, we found that the peak File Server throughput of both Windows Server 2003 and Red Hat Linux Advanced Server 2.1 scaled well when more processors were added to the test configuration. Figure 8 shows the percentage improvement in peak File Server throughput as we increased the number of processors in the HP DL760 test server from one to eight..

Operating System	DL760 - 1P - (Mbps)	DL760 - 2P - (Mbps)	% Increase	DL760 - 2P - (Mbps)	DL760 - 4P - (Mbps)	% Increase	DL760 - 4P - (Mbps)	DL760 - 8P - (Mbps)	% Increase
Windows Server 2003	453	632	**40%**	632	901	**43%**	901	1088	**21%**
Red Hat Linux Advanced Server 2.1	244	365	**50%**	365	462	**27%**	462	657	**42%**

Figure 8. File Server throughput Scaling Results from 1 to 8 processors on the HP DL760

Figure 9 below shows the NetBench results of the File server performance testing on the HP DL380 server platform for all operating systems tested using the standard NetBench Enterprise Disk Mix Test suite. These results show that, using our test configurations, Windows Server 2003 delivered the best overall File serving throughput of all platforms tested on the HP DL380 server configured with two processors.

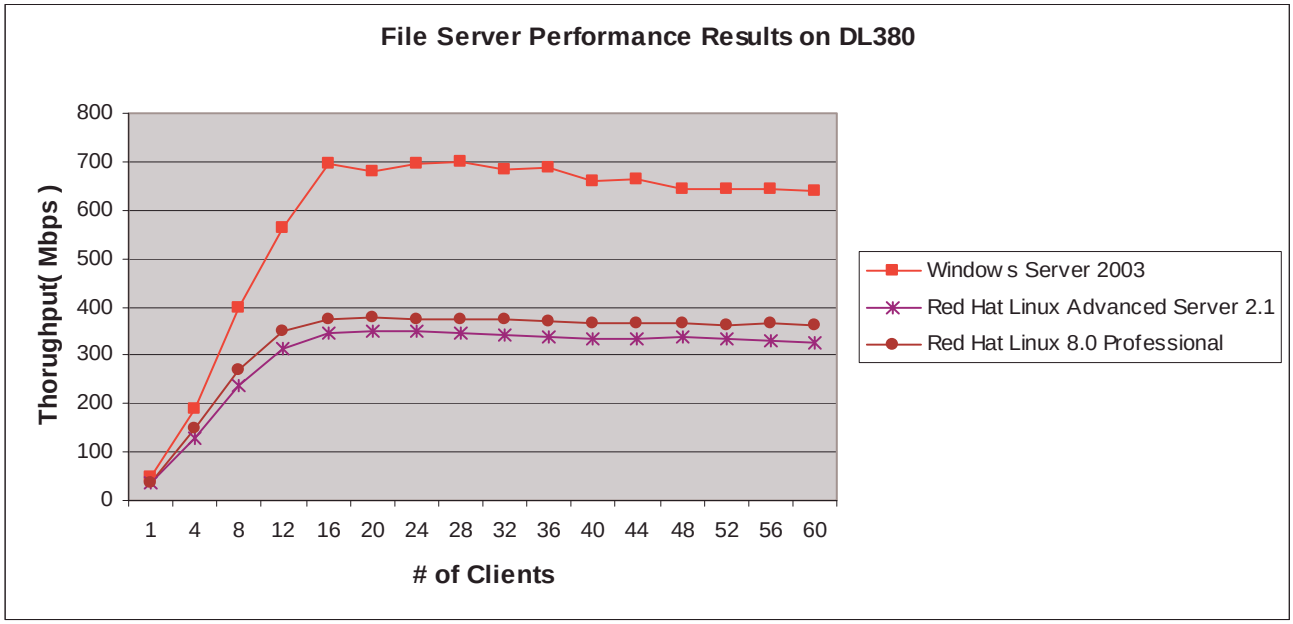

Figure 9. File Server Performance Results on HP DL380

Figures 10-13 below display the full set of NetBench data for the File server performance results on the HP DL760 server platform for all operating systems using 1, 2, 4 and 8 processors. These results show that Windows Server 2003 generated significantly better File server throughput at lower, medium and high client loads compared to Red Hat Linux Advanced Server 2.1 on the configurations we tested.

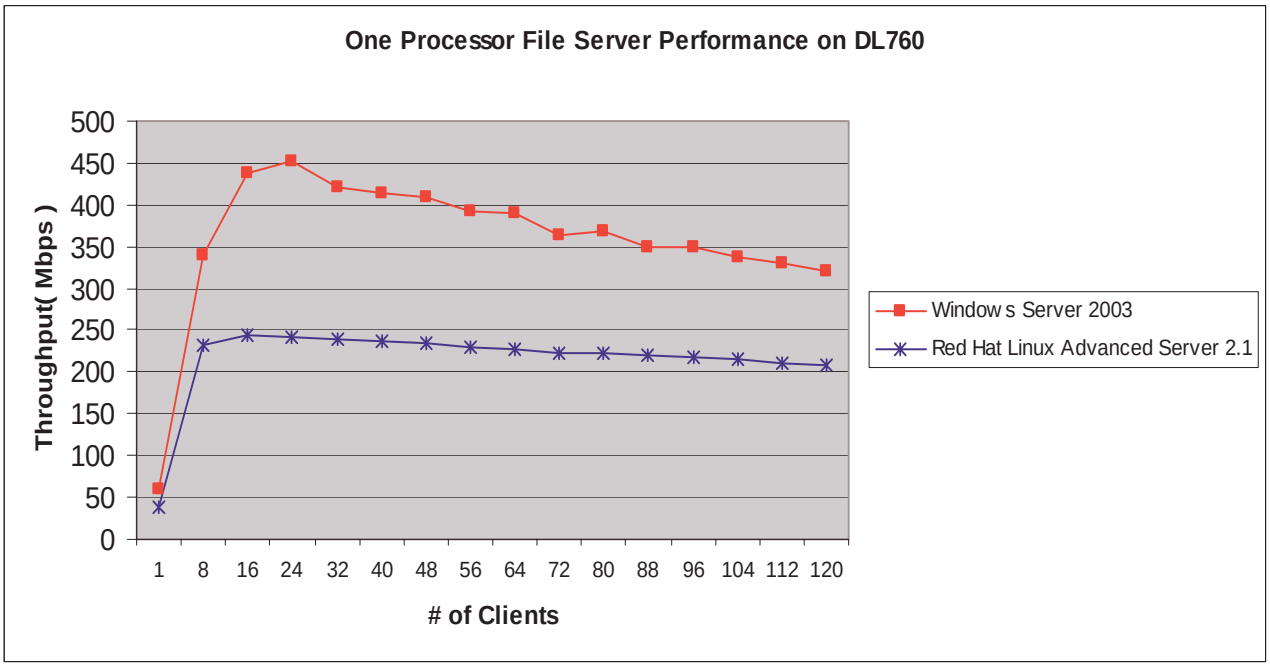

Figure 10. One Processor File Server Performance Test Results on DL760

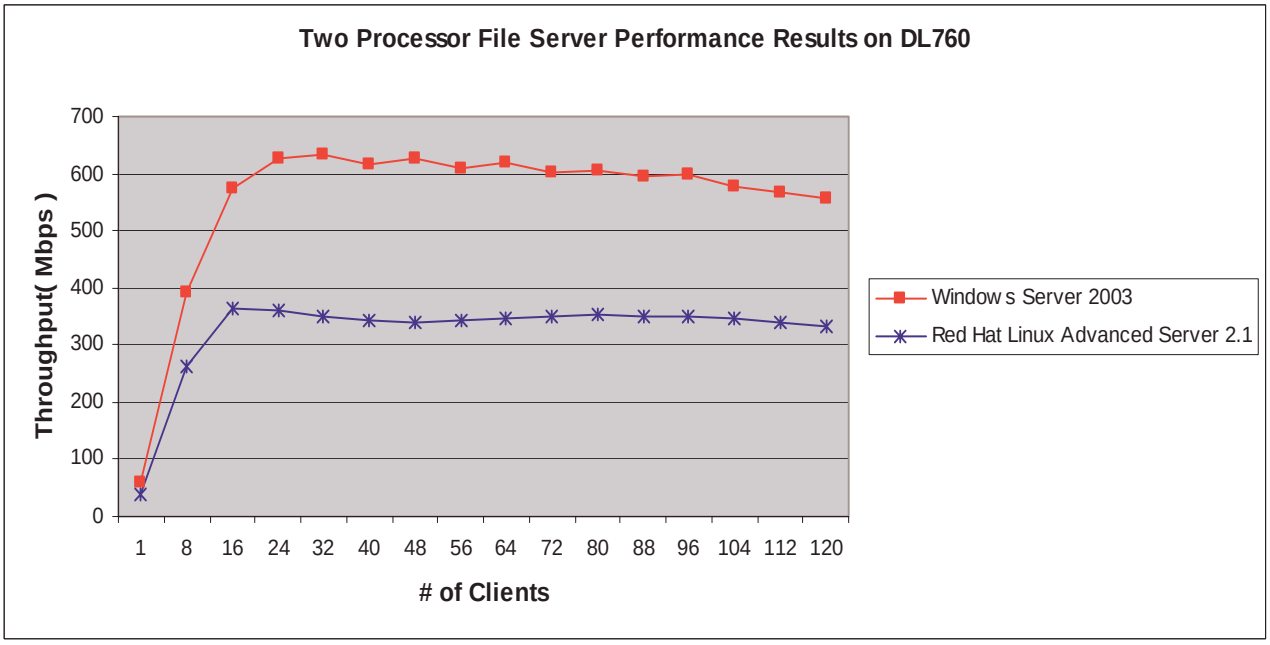

Figure 11. Two Processor File Server Performance Test Results on DL760

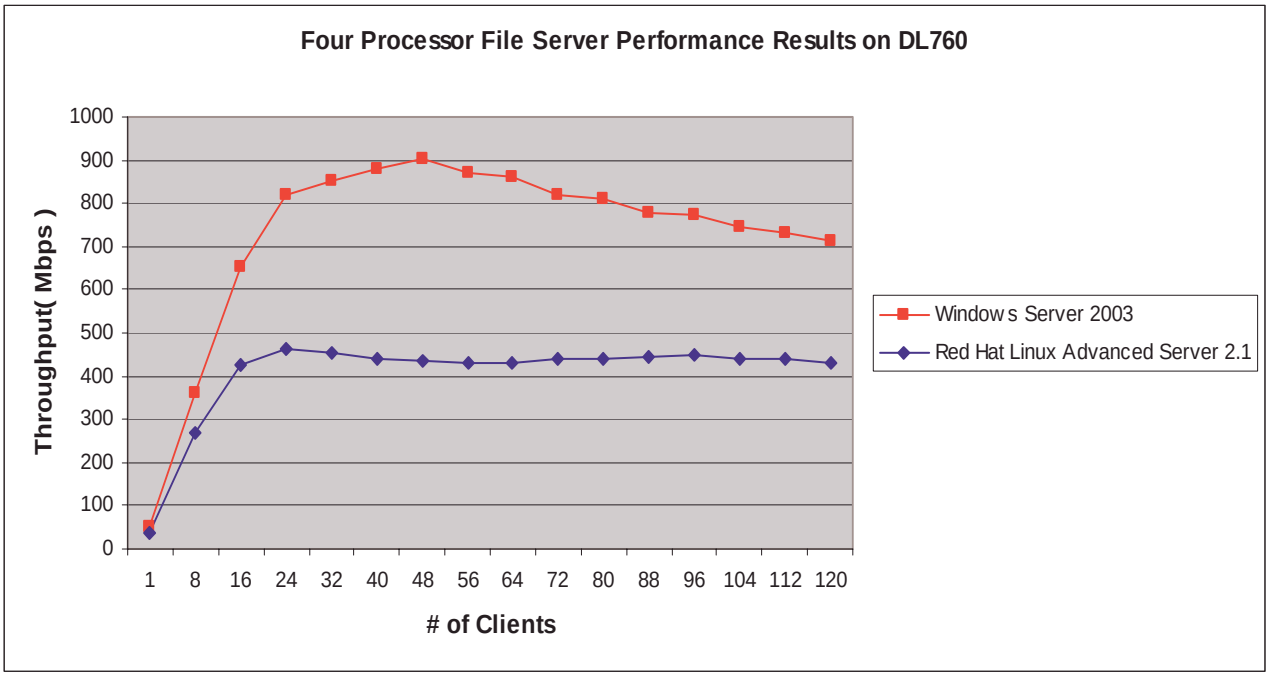

Figure 12. Four Processor File Server Performance Test Results on DL760

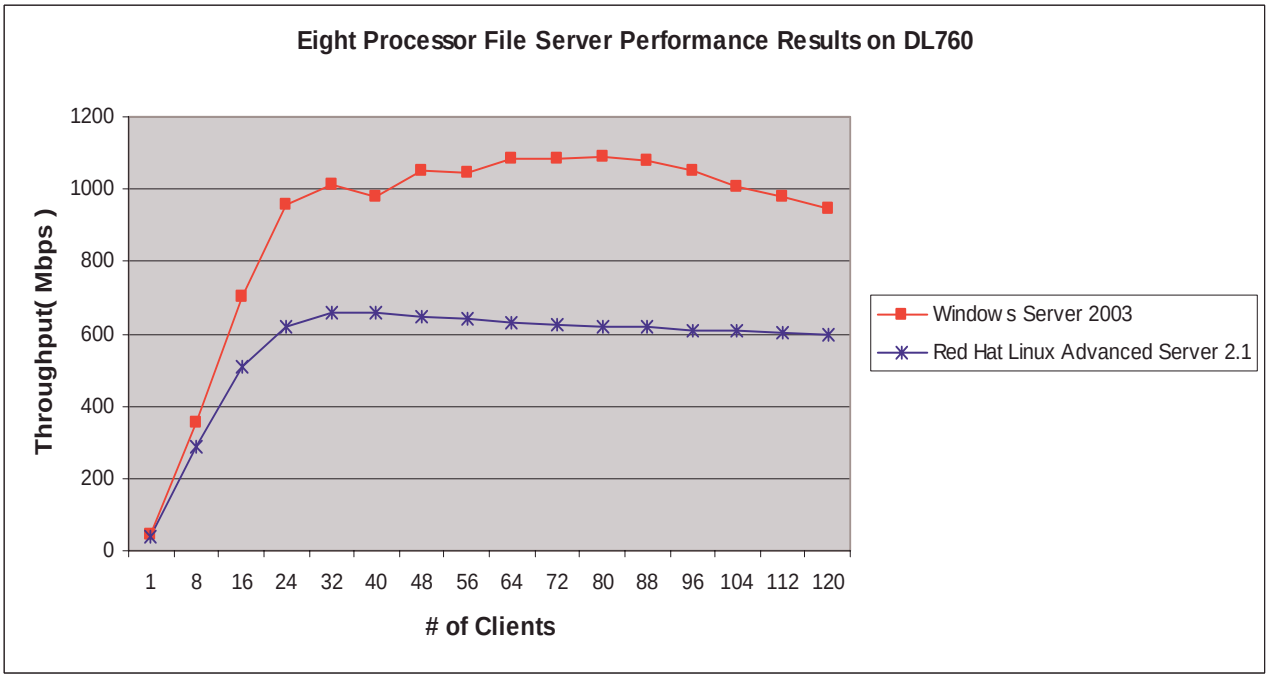

Figure 13. Eight Processor File Server Performance Test Results on DL760

Appendix A. Test Server and Network Client Configuration Information

Network Testbed Clients	
Machine Type	Dell PowerEdge 350
BIOS	Intel
Processor(s)	Intel PIII 850MHz
Hard Drive	10GB IDE
Memory	256MB
L2 Cache	256K
Motherboard	Intel
Network Adapter(s)	Intel Pro100 Management Adapter
Video Card	NVIDIA GeForce2 MX
OS	Windows XP/SP1

Figure 14. Network Testbed Client Disclosure Information

DL760 – 8P Configuration Information	
Machine Type	HP ProLiant DL760
BIOS	Compaq
Hard Drive	4 x 36GB 15,000 RPM Ultra3 SCSI
Processor(s)	8 x Intel PIII 900Mhz Pentium III Xeon
Memory	4GB
L2 Cache	2MB
Motherboard	Intel
Network Adapter(s)	8 x Intel PRO 1000 MF Server Adapters
Video Card	ATI 3D RAGE II PCI
OS	Windows Server 2003, Red Hat Linux Advanced Server 2.1

Figure 15. DL760 – 8P Server Disclosure Information

DL760 – 1, 2 , and 4P Configuration Information	
Machine Type	HP ProLiant DL760
BIOS	Compaq
Hard Drive	4 x 36GB 15,000 RPM Ultra3 SCSI
Processor(s)	4 x Intel 900Mhz Pentium III Xeon
Memory	4GB
L2 Cache	2MB
Motherboard	Intel
Network Adapter(s)	4 x Intel PRO 1000 MF Server Adapters
Video Card	ATI 3D RAGE II PCI
OS	Windows Server 2003, Red Hat Linux Advanced Server 2.1

Figure 16. DL760 – 1P, 2P, and 4P Server Disclosure Information

DL380 – 2P Configuration Information	
Machine Type	Compaq DL380 G2
BIOS	Compaq
Processor(s)	2 x 1.4Ghz Pentium III
Hard Drive	6 x 36GB 15,000 RPM Ultra3 SCSI
Memory	2GB
L2 Cache	512K
Motherboard	Intel
Network Adapter(s)	2 x Intel PRO 1000 MF Server Adapters
Video Card	ATI 3D RAGE II PCI
OS	Windows Server 2003, Red Hat Linux Advanced Server 2.1

Figure 17. DL380-2P Server Disclosure Information

Appendix B. Operating System Installation and Configuration

This Appendix describes the basic steps we performed to install each of the operating systems used during these tests. Regardless of the operating system used, we configured the RAID subsystems on each server the same way for all testing using HP's SmartStart 6.0 utility and selecting the defaults as shown in figure 18 below.

RAID Controller Parameter	Value
Expanded Priority	Low
Rebuild Priority	Low
Cache Ratio	50% READ / 50% WRITE
Stripe Size	128K

Figure 18. Default RAID Controller Parameters

For the HP DL760 server configured with eight processors, we configured the 28 drives connected to the SmartArray 5300 controller into four logical RAID 0 data volumes of approximately 121 GB each. Each logical volume was created using the default RAID controller parameters listed in figure 18. During installation of the specific operating system, we used the appropriate disk management utilities to create two volumes on each of the four 121GB logical RAID 0 volumes for a total of eight volumes of approximately 60GB each. Figure 19 below shows the file system parameters used for each of the operating systems tested on the HP DL760 server configured with eight processors.

Operating System	# of Volumes	Volume Size	Format Type	Block Size
Windows Server 2003	8	60GB	NTFS	64K bytes
Red Hat Linux Advanced Server 2.1	8	60GB	ext3	default

Figure 19. File system parameters for HP DL760 server configured with eight processors

For the HP DL760 server configured with four processors, we configured the 28 drives connected to the SmartArray 5300 controller into four logical RAID 0 data volumes of approximately 120 GB each. Each logical volume was created using the default RAID controller parameters listed in figure 18. After installing the specific operating system, we used the disk management utilities to create one volume on each of the four 120GB logical RAID 0 volumes for a total of four volumes of approximately 120 GB each. Figure 20 below shows the file system parameters used for each of the operating systems tested on the HP DL760 server configured with four processors.

Operating System	# of Volumes	Volume Size	Format Type	Block Size
Windows Server 2003	4	120GB	NTFS	64K bytes
Red Hat Linux Advanced Server 2.1	4	120GB	ext3	default

Figure 20. File system parameters for HP DL760 server configured with four processors

Additionally, for the DL760 servers, we configured one of the four physical drives connected to the embedded SmartArray 5i RAID controller as a volume of approximately 36GB using default RAID controller parameters. The operating system was installed on this single 36GB volume.

For the DL380 server, we configured one of the six physical drives into a logical volume of approximately 36GB using the default RAID controller parameters. The operating system was installed on this volume. We then configured four drives connected to the SmartArray 5i controller into a single logical RAID 0 data volume of approximately 140 GB using the default RAID controller parameters described above. After installing the specific operating system, we used the disk management utilities to create four basic volumes on the single logical RAID 0 volume for a total of four volumes of approximately 36GB each. Figure 21 below shows the file system parameters used for each of the operating systems tested on the DL380 server.

Operating System	# of Volumes	Volume Size	Format Type	Block Size
Windows Server 2003	4	36GB	NTFS	32K
Red Hat Linux Advanced Server 2.1	4	36GB	ext3	default
Red Hat Linux 8.0 Professional	4	36GB	ext3	default

Figure 21. File system parameters for DL380 server

For all Windows Server 2003 configurations tested, we increased the size of the NTFS log file to 64K bytes for each data volume using the following command:

```
Chkdsk /x <drive>: /l:65536
```

The following sections describe the specific steps we took to install the operating systems used in these tests.

Client Operating System configurations

We used client systems running Windows XP Professional with Service Pack 1 and post XP SP1 Redirector hot fixes provided by Microsoft when conducting the File server performance testing.

Windows Server 2003

Microsoft provided a fully functional copy of Windows Server 2003 for these tests. To install this operating system, we performed the following steps:

- Using SmartStart 6.0, selected Microsoft .NET (Windows Server 2003) as the operating system to install and began the installation process
- During installation, configured the network parameters to match the client testbed segments.
- Installed the intfltr.sys processor affinity module and configured it such that each network adapter in the server was bound to one and only one processor.
- Configured the RAID subsystem as described above.

Red Hat Linux Advanced Server 2.1

Red Hat Linux Advanced Server 2.1 is the enterprise solution offering from Red Hat. This software is designed for the enterprise for use with large departmental and datacenter deployments. There is generally a long release cycle between versions of this operating system and it is billed as being a very stable product

that is tuned specifically for improved performance on SMP systems using up to eight processors and 16GB of RAM.

The list below shows the basic steps we took to install Red Hat Linux Advanced Server 2.1 for the File Server performance testing.

- Configured the RAID subsystem as described above.
- Rebooted server to start installation process
- Selected “custom” installation option and accepted all pre-selected items
- Selected to install Windows File Server (SAMBA)
- Selected to install tools for software development
- Selected to install tools for kernel development
- Selected the kernel-enterprise and kernel-smp packages to load kernel sources
- Selected the SAMBA Swat package to provide Web interface to SAMBA
- Downloaded and installed the latest Linux version of the Intel PRO/1000 Gigabit NIC drivers available from Intel Web site (driver version 4.4.19). Used the default settings per recommendations in the README file.
- During installation, configured the network parameters to match the client testbed segments.
- Configured processor affinity to bind the interrupts from the NIC’s to a specific processor where appropriate. This was only performed on configurations that utilized multiple processors.

We checked the Red Hat Web site for available updates and errata for the Red Hat Linux Advanced Server 2.1 product and found no bug fixes or enhancements related to File Server performance using SAMBA. As a result, we applied no additional patches and made no additional modifications to the Red Hat Linux Advanced Server 2.1 distribution used for these tests.

To maximize File Server performance on the DL760 server running Red Hat Linux Advanced Server 2.1, we configured the processor affinity feature available through the operating system to bind individual IRQ values associated with individual network interface cards (NIC’s) in the server under test to a specific processor in the server under test. When configuring processor affinity for use with Red Hat Linux Advanced Server 2.1 on the DL760 server configured with four processors and four network segments, we were only able to associate a total of three specific IRQ’s with the four NIC’s in the server.

To try and alleviate this, we located the four NIC’s in the DL760 server using a variety of different slot combinations spread over the two PCI busses in the DL760 server. In the end we were not able to associate more than three distinct IRQ’s with the four NIC’s when conducting File Server performance tests with Red Hat Linux Advanced Server 2.1 on the DL760 server configured with four processors. This meant that two of the four processors in the DL760 server serviced only individual NICs while the remaining two processors in the DL760 server combined to service the remaining two NIC’s that shared the same IRQ.

We did not encounter this situation on the DL760 server configured with eight NIC’s or the DL380 server configured with two NIC’s. In both of these configurations, a unique IRQ value was associated with each of the NIC’s in the server. This allowed us to map each of the NIC’s in the server to a separate processor for optimal use of the processor affinity feature.

Red Hat Linux 8.0 Professional

Red Hat Linux 8.0 Professional is the Red Hat offering for Small Office Home Office (SOHO) users as well as other non-enterprise installations. For the File Server performance testing, we installed the Red Hat Linux 8.0 Professional product using a custom installation and selected the following installation options:

- Rebooted server to start installation process
- Configured the RAID subsystem as described above.
- Selected to install Windows File Server (SAMBA)
- Selected to install tools for software development
- Selected to install tools for kernel development

- Selected to install Editors
- Selected to install Administration Tools
- Selected to install System Tools
- Selected to install Server Configuration Tools
- During installation, configured the network parameters to match the client testbed segments.
- Used default NIC driver and settings per recommendations in the Intel driver README
- Configured processor affinity to bind the interrupts from the NIC's to a specific processor where appropriate. This was only performed on configurations that utilized multiple processors.

We checked the Red Hat Web site for available updates and errata for the Red Hat Linux 8.0 Professional product. We found a number of security related updates, but found no bug fixes or enhancements related to File Server performance using SAMBA. As a result, we applied no additional patches and made no additional modifications to the Red Hat Linux 8.0 Professional distribution used for these tests.

Appendix C. File Server Performance Tuning

The following sections described the specific changes we made to the default operating configurations for each platforms tested.

Windows Server 2003

File server performance testing under Windows Server 2003 consisted of making the following registry modifications to the server systems under test

- HKLM\System\CurrentControlSet\Control\SessionManager\MemoryManagement\PagedPoolSize set to 192,000,000.
- HKLM\System\CurrentControlSet\Control\FileSystem\NtfsDisable8dot3NameCreation to 1.
- Created HKLM\System\CurrentControlSet\Control\FileSystem\Disablelastaccess and set to 1.
- Created HKLM\System\CurrentControlSet\Services\tcpip\Parameters\NumTcbTablePartitions and set to 8.
- Created HKLM\System\CurrentControlSet\Services\tcpip\Parameters\TcpAckFrequency and set to 13.

Red Hat Linux Advanced Server 2.1

To test File Server performance using SAMBA under Red Hat Linux Advanced Server 2.1, we made the following modifications to the SAMBA configuration file:

- Set SAMBA logging level to 0 to disable logging functions
- Set the socket option SO_SNDBUF to 16384
- Set the socket option SO_RCVBUF to 16384

We made the following modifications to the file system when conducting File server performance testing using Red Hat Linux Advanced Server 2.1:

- Set /proc/sys/fs/file-max to 65536

Red Hat Linux 8.0 Professional

To test File server performance using SAMBA under Red Hat Linux Advanced Server 2.1, we made the following modifications to the SAMBA configuration file:

- Set SAMBA logging level to 0 to disable logging functions
- Set the socket option SO_SNDBUF to 16384
- Set the socket option SO_RCVBUF to 16384

We made the following modifications to the file system when conducting File server performance testing using Red Hat Linux Advanced Server 2.1:

- Set /proc/sys/fs/file-max to 65536

Client Operating System Tunings for both Linux and Windows Server configurations

We made the following registry changes on the testbed client systems running Windows XP Professional when conducting the File server performance testing:

- Created HKLM\System\CurrentControlSet\Services\tcpip\Parameters\TcpAckFrequency and set to 13.
- HKLM\System\CurrentControlSet\Services\Lanmanworkstation\Parameters\DisableByteRangeLockingOnReadOnlyFiles set to 1.
- HKLM\System\CurrentControlSet\Services\Lanmanworkstation\Parameters\DormantFileLimit set to 100.
- HKLM\System\CurrentControlSet\Services\Lanmanworkstation\Parameters\ScavengerTimeLimit set to 100.

Note: Our initial tests showed that using the TcpAckFrequency registry value on the testbed clients running Windows XP Professional resulted in lower File server performance when testing with Red Hat Linux Advanced Server 2.1 and Red Hat Linux 8.0 Professional. As a result, we removed the TcpAckFrequency registry setting from the testbed client systems running Windows XP Professional when testing the Linux configurations. With the exception of TcpAckFrequency, all other client registry changes listed above were in effect during testing with the Linux configurations.

Appendix D. Test Network Diagrams

Figures 22-24 below show the testbed configurations for testing the servers described above for all processor configurations.

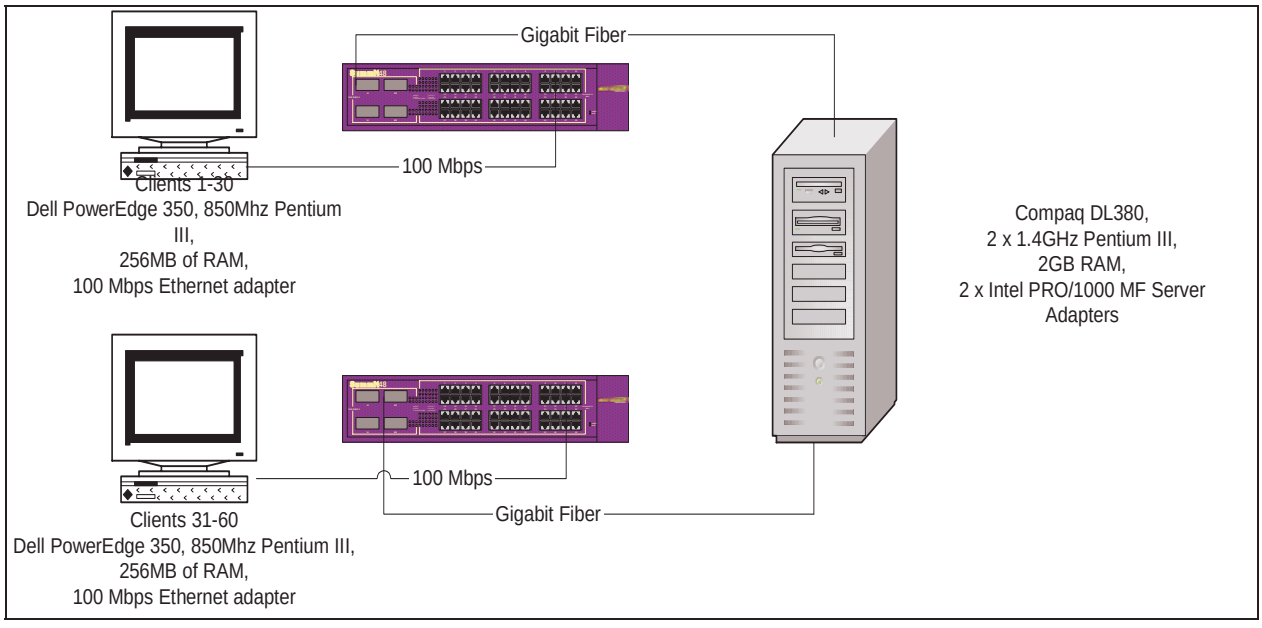

Figure 22. DL380 Test Configuration

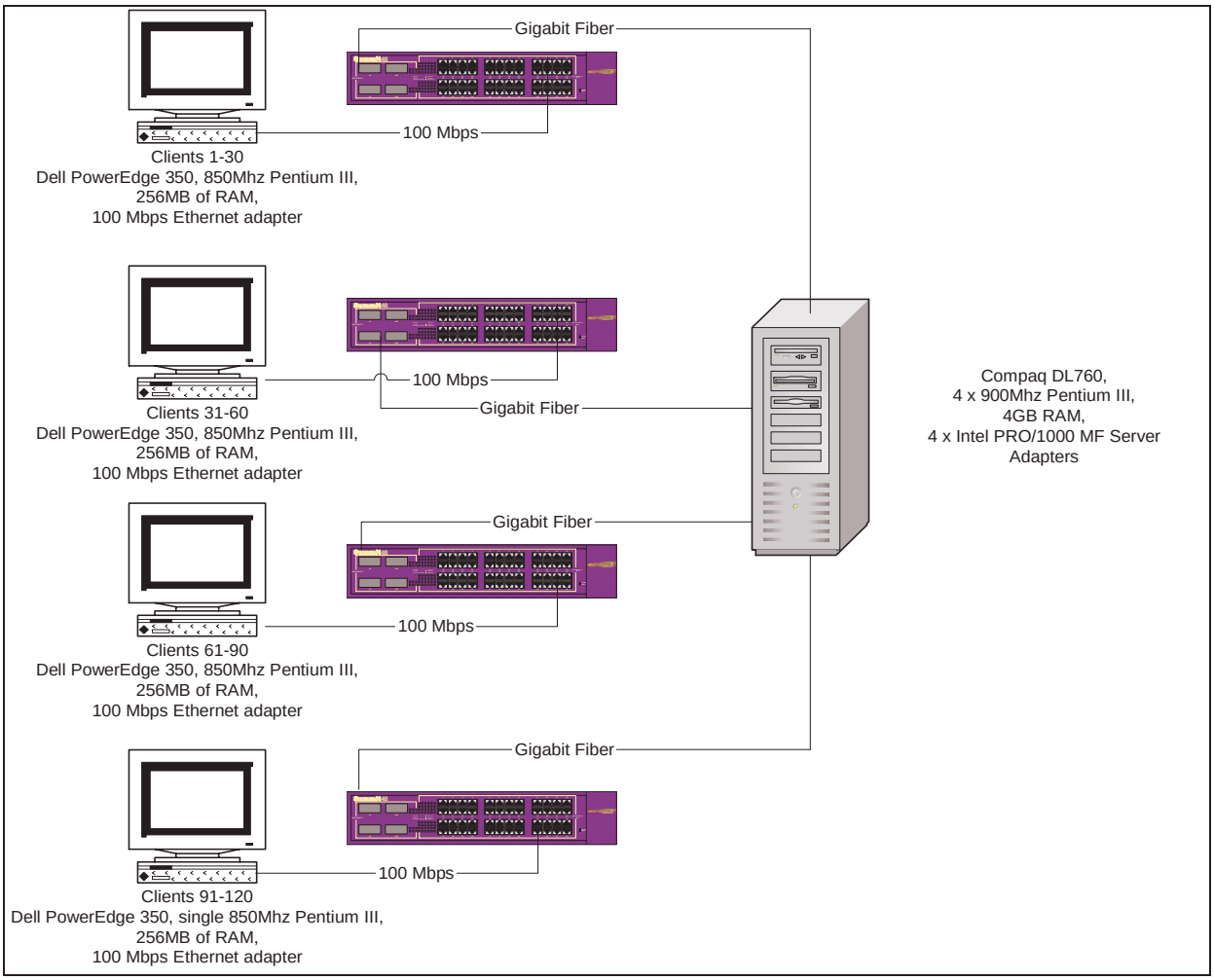

Figure 23. DL760 Test Configuration using 1, 2 and 4 Processors

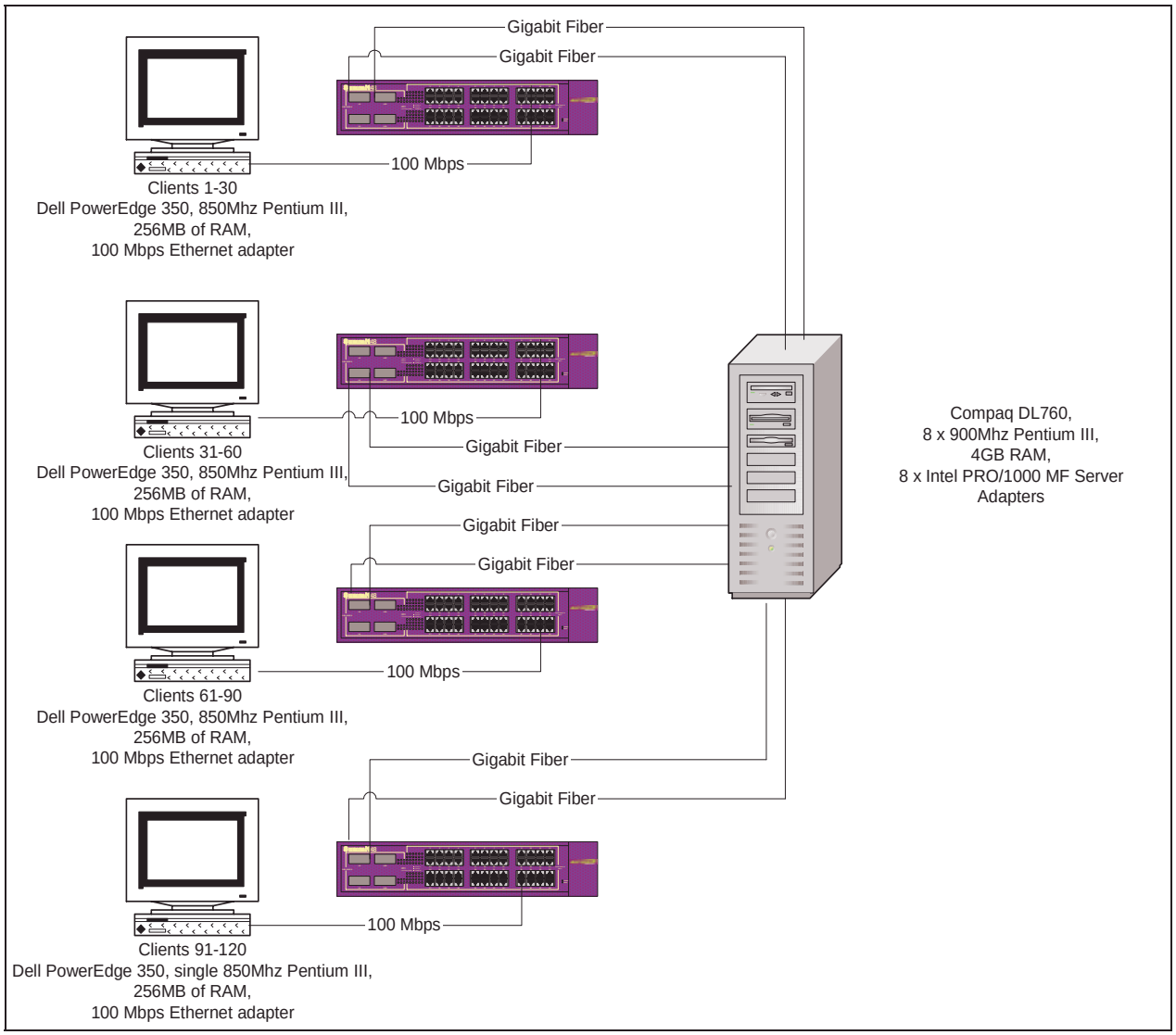

Figure 24. DL760 Test Configuration using 8 Processors

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