Evaluating Dell PowerVault 770N and 775N

Storage Server Performance

Network attached storage (NAS) systems provide an easy way to add storage capacity to IT infrastructures. As storage demands multiply, however, administrators require higher performance from NAS systems. This article examines RAID configuration, optional software, network speed, processor capacity, and system memory to determine optimal settings for Dell™ PowerVault™ 770N and 775 NAS servers.

BY JULIA COURTNEY

Network attached storage (NAS) systems provide file server functionality on business networks. Initially, organizations used NAS systems because these devices are easy to deploy, enabling rapid expansion of storage capacity. Administrators paid little regard to NAS system performance. As demands for storage have increased, the requirement for performance has become very important when evaluating, selecting, and procuring a NAS system.

The high-performance, midrange-class Dell™ NAS systems include the PowerVault™ 770N and PowerVault 775N storage servers. Dell tested the PowerVault 770N and 775N in a variety of configurations to better understand performance characteristics of the midrange-class NAS systems. These performance tests examined how increasing the number of simultaneous users affected resource utilization, and the tests determined the optimal RAID configuration, processor and memory combination, and network configuration to produce the highest throughput and the best response time. Dell also tested NAS software options to understand their impact on system performance.

Configuring the test environment

The test environment consisted of 60 Dell OptiPlex™ GX1 desktop computers used as network clients. The clients generated network throughput and created the client load needed for each test. Each OptiPlex GX1 ran the Microsoft® Windows® XP operating system, a single Intel® Pentium® II processor at 450 MHz with 128 MB of RAM, and an Intel PRO/100 + single-port, 10/100 network interface card (NIC).

The PowerVault 770N is a tower system, and the PowerVault 775N is a rack system. Both of the tested systems were Windows Powered servers built using Windows 2000 Server Appliance Kit (SAK) and configured with an on-board RAID controller with 128 MB cache. The PowerVault 770N used an on-board Intel Gigabit Ethernet[1] NIC, while the PowerVault 775N used an on-board Broadcom® Gigabit NIC.

Dell ran each of the tests on both the PowerVault 770N and 775N systems. To maintain consistency, the test bed described in this section remained the same for all tests. Results showed that performance was equivalent for the two NAS systems. For convenience, this article will refer to the PowerVault 770N and 775N as the PowerVault 77xN system.

Benchmark software

Dell conducted the performance tests using version 7.02 of the Ziff Davis™ NetBench® file-server benchmarking tool.

[1]Gigabit Ethernet indicates compliance with IEEE® 802.3ab and does not connote speeds of 1 Gbps.

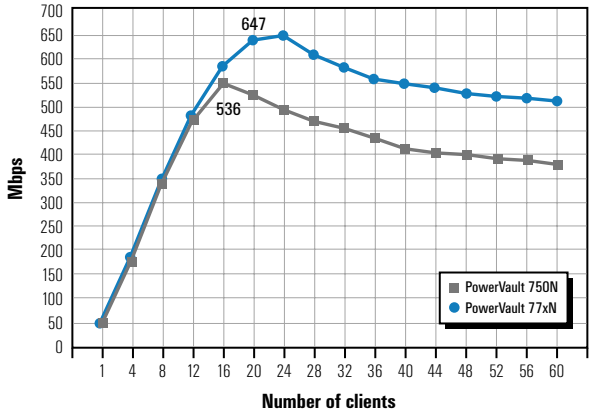

Figure 1. Throughput for the PowerVault 750N versus the PowerVault 77xN

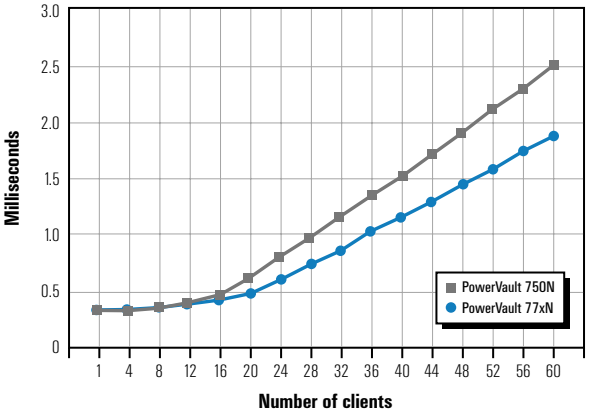

Figure 2. Average response time for the PowerVault 750N versus the PowerVault 77xN

NetBench produces performance data that can be easily plotted to represent overall throughput and average response times. This benchmark simulates the load of typical business users running word processors, spreadsheets, and other file-server applications. During each run, NetBench sent a sequence of operations to the server, such as "read a whole file, pause while it is edited locally, write a whole file," with randomly added make directory, rename file, and remove file operations. A built-in delay of 5 seconds and a simulated user think-time of 2 seconds occurred between each operation. These delays enabled the test to better simulate an actual user's pattern of writing and reading data to and from the server.

The Dell test team employed the Enterprise Disk Mix test, which is one of three offered by this benchmark. Each run consisted of only Common Internet File System (CIFS) data transactions and lasted 11 minutes. During the first run, 1 client came online for 11 minutes. In the second run, 4 clients came online for 11 minutes; in the third, 8 clients; in the fourth, 12 clients; and so forth for each iteration, until the maximum user load of 60 clients was reached for each performance test.

Testing PowerVault 77xN performance

The Dell PowerVault 77xN tests evaluated NAS performance by measuring throughput and average response times. Throughput, reported in megabits per second (Mbps), is the rate at which data is transferred between the NAS server and its network clients. To obtain a megabytes per second (MB/sec) value, divide the megabits per second value by eight. Greater throughput means faster performance.

The Dell PowerVault 77xN tests evaluated NAS performance by measuring throughput and average response times.

Average response time is the average amount of time taken by the storage server to respond to and complete network client requests at a given client load. Average response times have an inverse relationship to throughput: the higher the response time, the slower the performance.

PowerVault 750N performance

The first test compared the throughput and average response times of the PowerVault 77xN system, which was configured with dual Intel Pentium 4 processors at 2.4 GHz with 3 GB SDRAM and RAID-0, to its predecessor, the PowerVault 750N system, which was configured with dual Intel Pentium III processors at 1.4 GHz with 1 GB SDRAM and RAID-0.

Maximum throughput for the PowerVault 750N was measured at 536 Mbps. Maximum throughput for the PowerVault 77xN was measured at 647 Mbps, giving the PowerVault 77xN a 20 percent throughput improvement over the older 750N model (see Figure 1). Figure 2 shows the average response time for the same test.

RAID configuration types

The objective of the RAID test was to compare maximum throughput and best average response times for the PowerVault 77xN system for four different RAID types: RAID-0, RAID-1 + 0, RAID-5, and RAID-5 + 0. Test results showed only small differences in throughput between RAID types (see Figures 3 and 4). RAID-0 performance was just 2 percent better than that of RAID-1 + 0, 1.6 percent better than that of RAID-5 + 0, and 5.2 percent better than that of RAID-5. Average response times for each RAID type were virtually identical.

Optional software

The test team examined the PowerVault 77xN system with the optional Dell ActiveArchive™ software utility installed to observe whether the use of this software degraded performance. ActiveArchive, which runs on the PowerVault server, creates point-in-time copies, or snapshots, of volume images. Snapshots can be created manually or scheduled

PowerVault systems could achieve a maximum throughput of almost 650 Mbps when using the best-performing configuration.

to occur as regular events. Tests performed on the PowerVault 77xN in a RAID-0 configuration showed that ActiveArchive software did not significantly affect performance. Performance degraded 10 percent at peak throughput and 8 percent during a 60-client load, as shown in Figure 5. Average response times, shown in Figure 6, were similar to throughput performance. These test results indicate that snapshots should be performed at off-peak system loads to help prevent performance degradation.

Network configuration

The next test measured performance improvements gained by using a Gigabit Ethernet network instead of a 100 Mbps network. The network contained three Dell PowerConnect™ 3024 switches daisy-chained in full-duplex mode to create a virtual switch.

For this test, the Dell team established the baseline by setting the network switch to gigabit speed. The PowerVault 77xN was attached to the network using the on-board Gigabit Ethernet NIC, and the network clients were attached using 10/100 Intel NICs. Then the virtual switch was set to 100 Mbps, which forced the on-board server NIC to negotiate down to 100 Mbps.

As Figures 7 and 8 indicate, the network pushed through 195 percent more data when the switch was set to gigabit speed.

Processor and memory configurations

Dell engineers tested the PowerVault 77xN with varying processor and memory configurations. The team first tested two Intel Pentium 4 processors at 2.4 GHz with 512 KB of level 2 (L2) cache, and then repeated the test with just one processor installed. The Hyper-Threading feature of this processor was tested in both the enabled

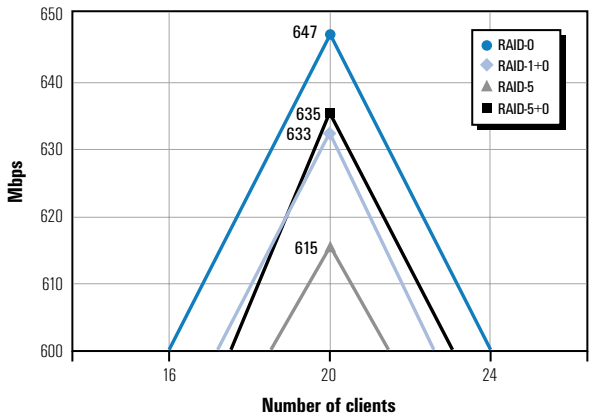

Figure 3. Throughput for different RAID types

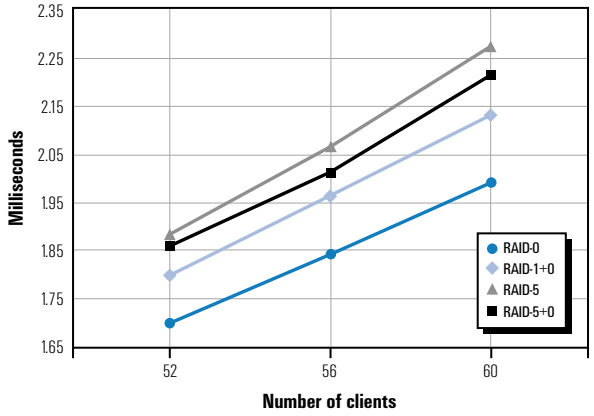

Figure 4. Average response time for different RAID types

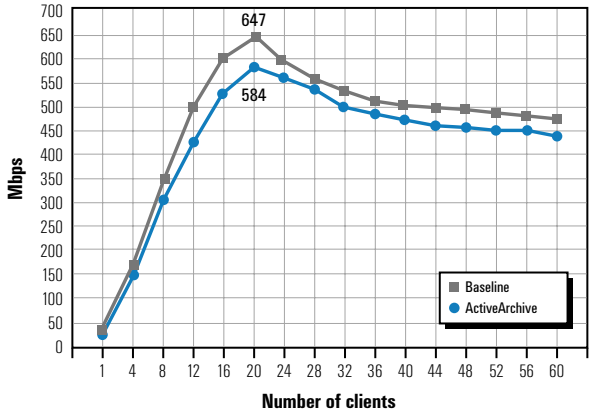

Figure 5. Throughput using ActiveArchive software in a RAID-0 configuration

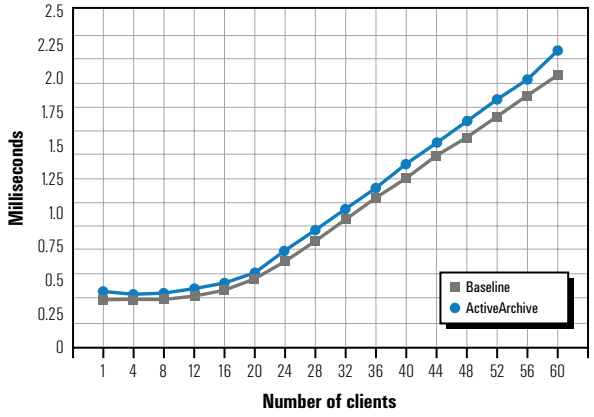

Figure 6. Average response time using ActiveArchive software in a RAID-0 configuration

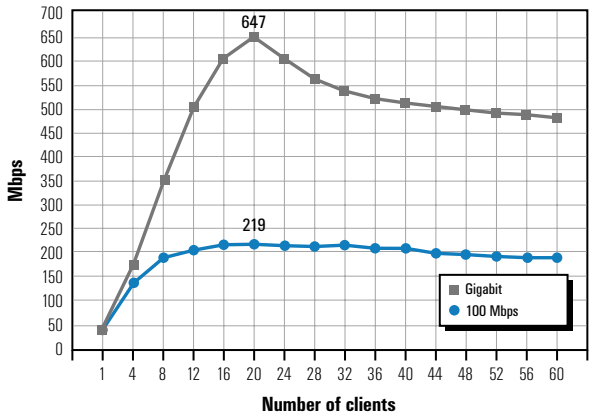

Figure 7. Throughput for Gigabit Ethernet versus 100 Mbps Ethernet network

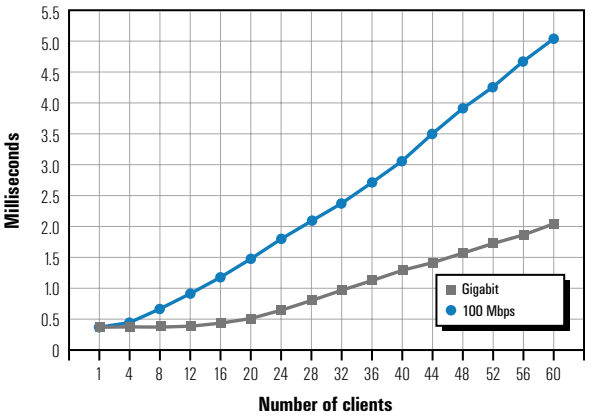

Figure 8. Average response time for Gigabit Ethernet versus 100 Mbps Ethernet network

and disabled state for each processor combination. This procedure was then repeated with 1.8 GHz processors. During all tests, the server's data logical unit number (LUN) was configured as RAID-0 and the on-board NIC was set for gigabit connections.

For all test runs, the PowerVault 77xN was configured with 512 MB, 1 GB, and 3 GB of memory. These configurations were used to show how contention for memory resources affects performance. Each network client used only 10 MB of memory during a test run; thus, the memory requirement for 60 clients was 600 MB. A system configured with 512 MB represented a server that did not have enough memory resources. Systems with 1 GB or 3 GB of memory had more than enough memory resources.

Each test run had two comparison points. The first was the peak performance number at the point where maximum throughput was achieved for the run. The second was the trend line tail at the point where all 60 clients were accessing the server. The test results (see Figures 9 through 16) showed the following performance deltas:

- Performance increased by 37 percent from the minimum possible configuration (one 1.8 GHz processor with 512 MB memory) to the maximum possible configuration (two 2.4 GHz processors with 3 GB memory), as shown in Figure 9.
- Adding a second processor improved performance by 25 percent.
- Increasing system memory from 512 MB to 3 GB resulted in a 5 percent performance gain at peak throughput and a 23 percent increase at a 60-client load, as shown in Figure 11. Only a 32 percent decrease in performance occurred from peak throughput to a full 60-client load when a maximum amount of memory was in the system, whereas performance decreased by 57 percent when a minimum amount of memory was in the system.

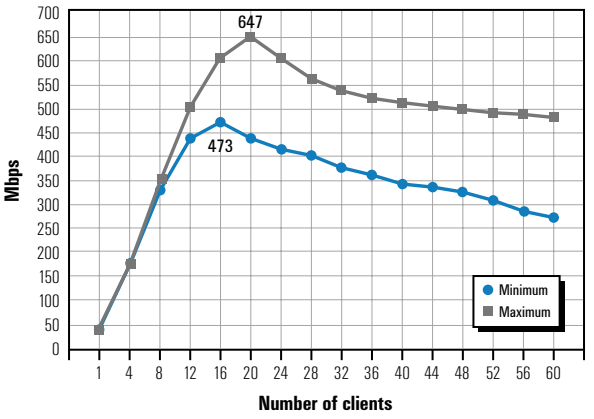

Figure 9. Throughput for minimum (one 1.8 GHz processor with 512 MB) and maximum (two 2.4 GHz processors with 3 GB) configurations

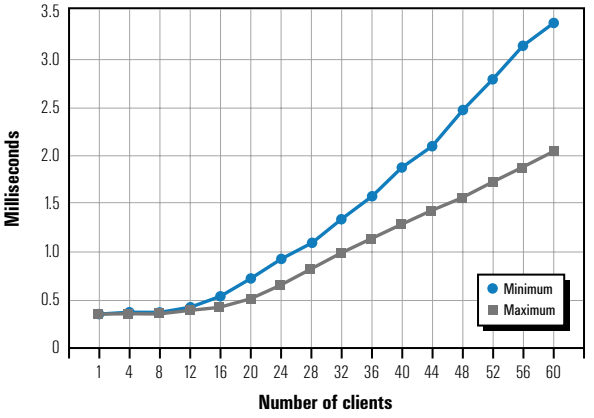

Figure 10. Average response time for minimum (one 1.8 GHz processor with 512 MB) and maximum (two 2.4 GHz processors with 3 GB) configurations

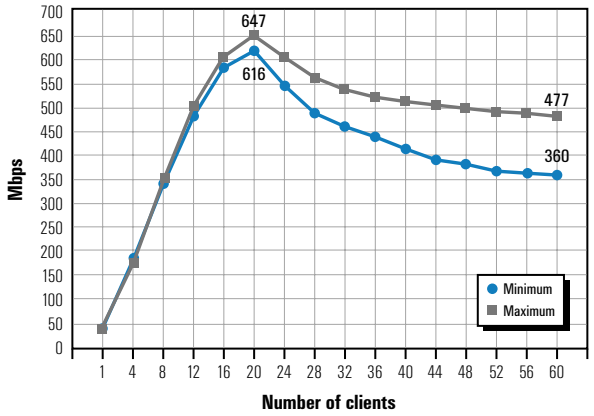

Figure 11. Throughput for minimum (two 2.4 GHz processors with 512 MB) and maximum (two 2.4 GHz processors with 3 GB) memory when processing power remains static

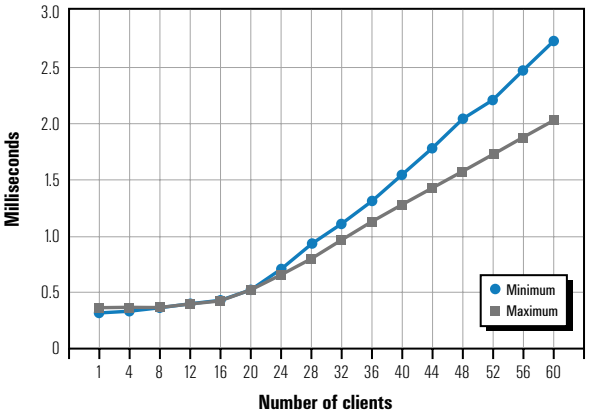

Figure 12. Average response time for minimum (two 2.4 GHz processors with 512 MB) and maximum (two 2.4 GHz processors with 3 GB) memory when processing power remains static

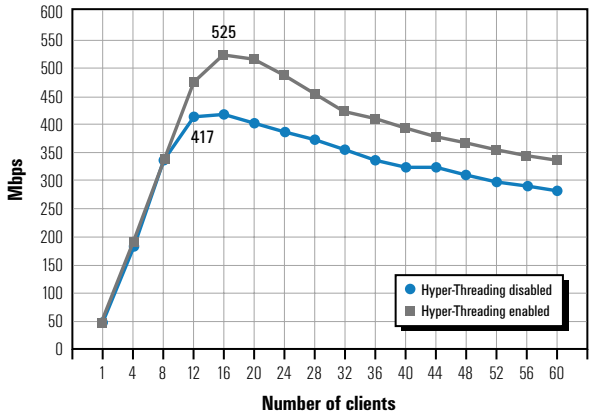

Figure 13. Throughput with Hyper-Threading disabled and enabled when processing power (one 2.4 GHz processor) and memory (3 GB) remain static

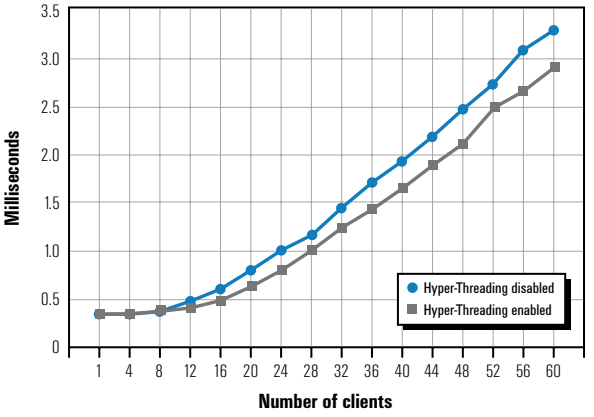

Figure 14. Average response time with Hyper-Threading disabled and enabled when processing power (one 2.4 GHz processor) and memory (3 GB) remain static

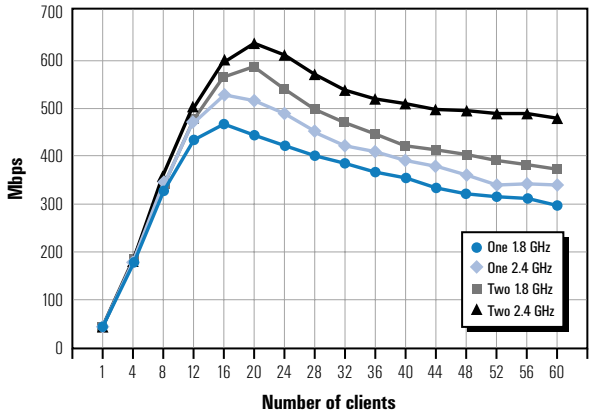

Figure 15. Throughput as a function of processing power with Hyper-Threading enabled

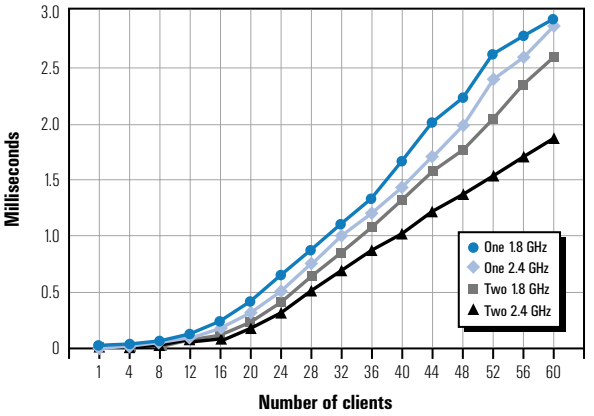

Figure 16. Average response time as a function of processing power with Hyper-Threading enabled

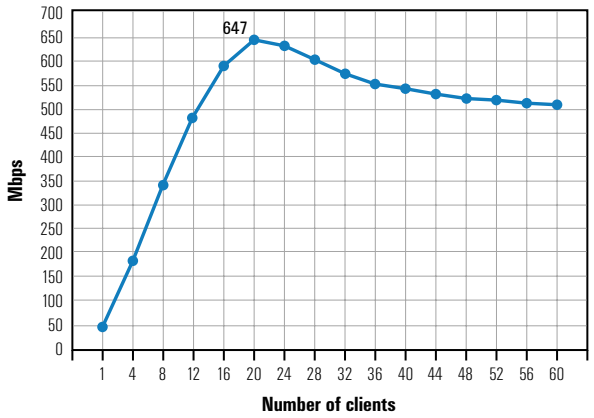

Figure 17. Throughput for best-performing configuration

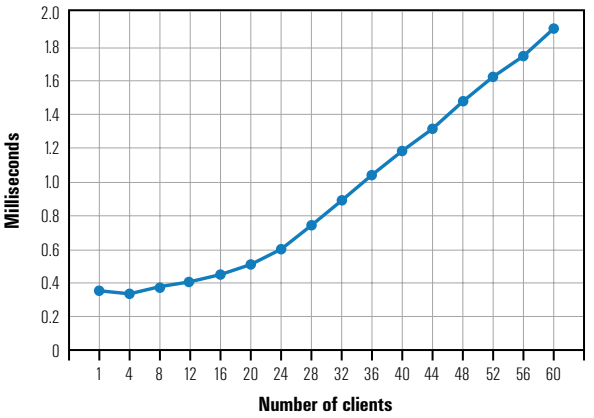

Figure 18. Average response times for best-performing configuration

- With Hyper-Threading enabled and memory capacity at the 3 GB maximum, performance increased by 26 percent, as shown in Figure 13.

Establishing best PowerVault 77xN performance

After testing various combinations of hardware, network, and RAID configurations available for the PowerVault 77xN storage servers, the test team showed that PowerVault systems could achieve a maximum throughput of almost 650 Mbps when using the following best-performing configuration:

- Two Intel Pentium 4 processors at 2.4 GHz
- Hyper-Threading enabled
- 3 GB system memory
- Internal Dell PowerEdge™ Expandable RAID Controller (PERC): RAID-1 operating system drive attached to Channel 0 and RAID-0 data drive attached to Channel 1
- Block size set to 64 KB, and write cache enabled during the creation of a data LUN
- Pagefile sized correctly and moved to the RAID-0 partition
- On-board Intel Advanced Server network card set to off-load checksum operations

The peak throughput of 647 Mbps, shown in Figure 17, occurred when the processor reached 100 percent utilization and then declined as this rate of utilization was maintained. At the same time, no outstanding I/Os were queued on any of the hardware devices, indicating that no bottlenecks occurred except at the processor. Figure 18 shows the average response time for the same configuration.

Configuring higher performing NAS systems

Test results showed that the current midrange-class Dell PowerVault NAS systems, the PowerVault 770N and the PowerVault 775N, performed significantly better than their predecessor, the PowerVault 750N. Performance of the PowerVault 77xN system was not significantly degraded by variations in RAID configuration or by the optional software embedded in the storage servers. To enhance NAS system performance, administrators can add more processing capacity and system memory. Organizations that have a Gigabit Ethernet network can also increase NAS system performance by using the networking power of the on-board Gigabit Ethernet NIC in each PowerVault 770N and 775N server. These PowerVault storage servers offer IT departments the opportunity to maintain scalable, high-performance storage for their expanding networks.

Test results showed only small differences in throughput between RAID types.

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FOR MORE INFORMATION

Dell PowerVault 770N:
http://www.dell.com/us/en/biz/products/model_nasto_1_nasto_770n.htm

Dell PowerVault 775N:
http://www.dell.com/us/en/biz/products/model_nasto_1_nasto_775n.htm

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