NetWinder OfficeServer Performance/Capability Test

December, 1999

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Origin of report

ZD Labs prepared this report under contract from Rebel.com.

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1.0 Executive Summary

Rebel.com Inc. commissioned ZD Labs to measure and compare the file server, web server and e-mail server performance of their NetWinder OfficeServer with that of the Cobalt Qube 2 from Cobalt Networks, Inc. and the Whistle InterJet II from IBM using NetBench 6.0, WebBench 3.0 and the ZD Email Server Test Tool respectively. For purposes of this report, the NetWinder OfficeServer, Cobalt Qube 2 and Whistle InterJet II are referred to as the NetWinder, Qube and InterJet respectively.

In addition to the performance testing, ZD Labs performed a feature comparison between the three server products mentioned above. Rebel.com provided the list of features for the comparison. This comparison included, but was not limited to, quality of documentation as well as the pros and cons of setting up and working with all three of the aforementioned products.

NetWinder performance was measured in two sets of tests. The first set of tests was performed with DMA disabled. This is the default configuration of the NetWinder used in this test. A second set of identical tests was performed after enabling DMA on the NetWinder. The results in this report show NetWinder performance results with and without DMA enabled. On the charts below, the entries labeled simply NetWinder represent results generated with DMA disabled. According to engineers at Rebel.com, DMA will be enabled by default in a future release of the NetWinder.

With DMA disabled, the NetWinder finished first in the web server testing using the standard WebBench 3.0 STATIC test shortened to use 28 clients. Enabling DMA on the NetWinder resulted in a significant increase in the Web serving performance. This increase was in the range of 10 - 20 percent depending on client load. Refer to section 3.0 for details of the Web server performance testing.

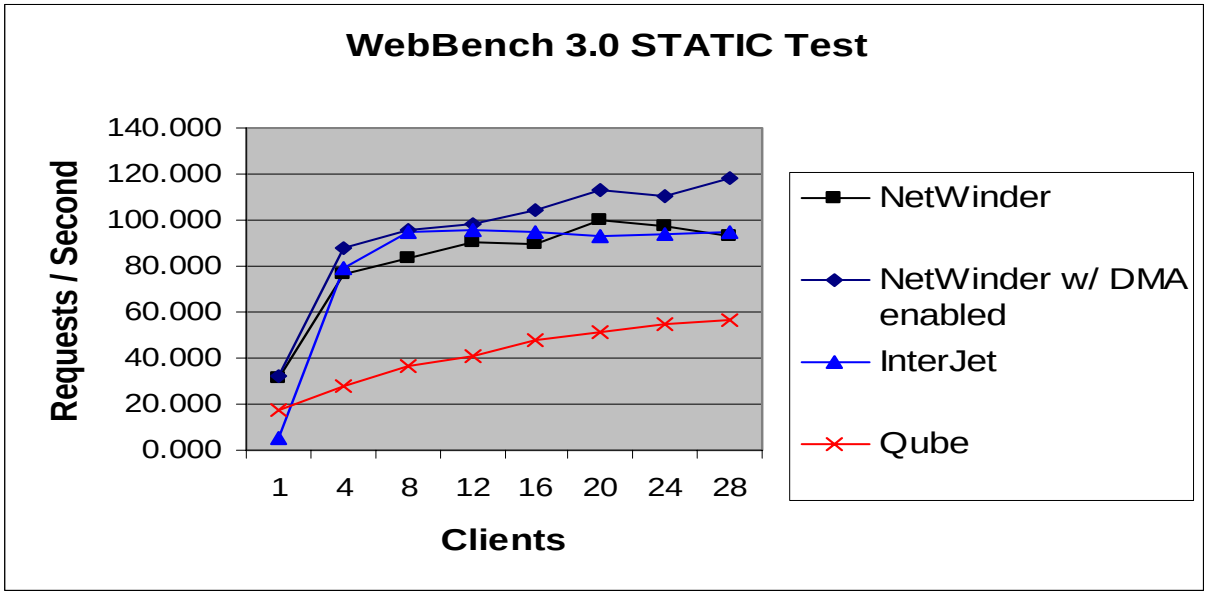

Figure 1

The graph in Figure 2 compares the file server performance of the NetWinder with and without DMA enabled to that of the Qube and the InterJet using a shortened version of the standard NetBench 6.0 disk Mix test.

Initially, we were unable to successfully complete a NetBench 6.0 test using the NetWinder. At loads between 8 and 12 clients, the server dropped the network connection with the test clients. At this point, the NetBench 6.0 clients no longer had access to their workload files causing he test to stop. After consulting with Rebel.com engineers, we downloaded and installed an updated OS kernel and ethernet driver that resolved the issues we saw while running NetBench 6.0.

Enabling DMA on the NetWinder caused a significant improvement in the file serving capabilities of the NetWinder on the order of 20%. Refer to section 4.0 for details of the file server performance testing.

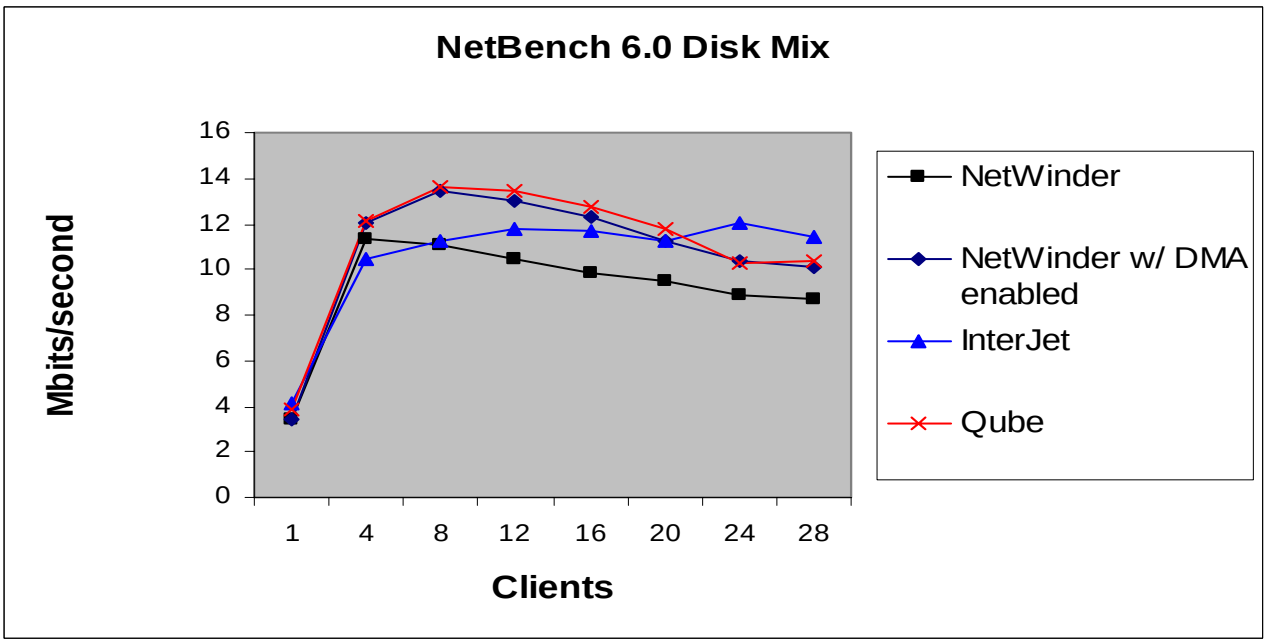

Figure 2

The graph in Figure 3 compares the response time of the NetWinder e-mail server with and without DMA enabled to those of the Qube and the InterJet using a mofidied version of the ZD E-mail Test Tool department POP test suite. The NetWinder obtained the best overall e-mail response time of the servers under test until the last mix in the test suite. Enabling DMA made no significant difference for the e-mail performance tests. Refer to section 5.0 for details of the e-mail performance testing.

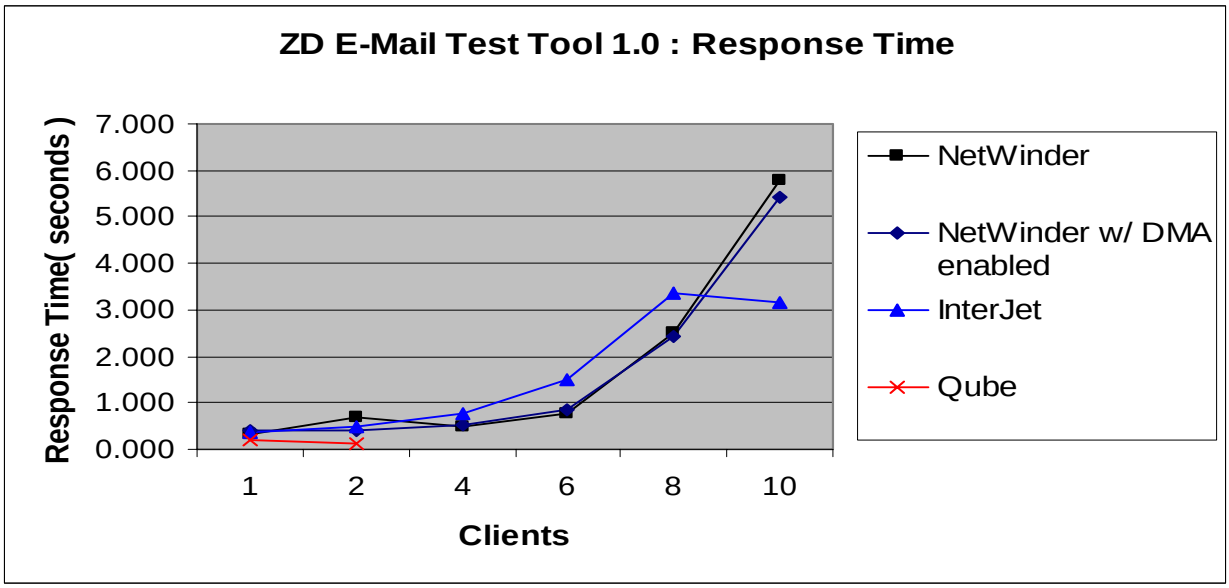

Figure 3

For the most part, all three servers tested provided a similar set of core features that allow them to function effectively as a general purpose internet server. In terms of the NetWinder's features and capabilities, we found them somewhat better than those of the Qube and noticeably better than those of the InterJet. Specifically, the ability to act as a print server, to receive automatic software updates and to support a local monitor and keyboard are features lacking on both the Qube and the InterJet. By comparison with the NetWinder, the InterJet also lacks software features such as document management, discussion forums, web page creation and a search engine. Refer to Section 6.0 for a table comparing the major features of the NetWinder with those of the Qube and InterJet.

While there is much to like with the NetWinder, we were asked to report on what we liked and didn't like during our testing. In addition to the OS access mentioned above, we found the NetWinder documentation clear and easy to use. The setup and configuration of the server was straightforward due, in large part, to the browser based administration interface. However, we did have some issues setting up the DNS and creating users for the e-mail performance tesing. Refer to Section 7.0 for an analysis of the pros and cons of using the NetWinder.

2.0 Testing Overview

For performance testing, we attached each server to a 30-client network testbed in our lab. Each network client was running Windows NT Workstation 4.0 with Service Pack 4 and included a single 10/100 Mbit/second network interface card (NIC). We connected each client to an Extreme Summit48 Fast Ethernet switch creating a single network segment. All ports on the Extreme switch were set to run at 100Mbits per second and half duplex.

Each of the servers under test included two on board network ports. The InterJet and Qube both contained two 10/100 Mbit/second ports while the NetWinder contained a single 10/100 Mbit/second port and a 10Mbit/second port. The primary 10/100 Mbit/second on each server was designated for use in the performance tests. The servers were connected to the Extreme switch to a port configured as 100 Mbit/second and half duplex.

Each of the three servers were initially set up in an “out of the box” configuration. No attempt was made to perform tuning on any server subsystem. After running a series of performance tests on the NetWinder in the default configuration, we repeated the same performance tests after enabling DMA on the NetWinder.

We used three different benchmark programs to measure the performance of the Web server, file server and e-mail server of the three machines.

To measure Web server performance, we used WebBench 3.0. WebBench lets you measure Web server software performance by having a number of clients make HTTP requests of the web server. WebBench's standard test suites produce two overall scores for the server: requests per second and throughput as measured in bytes per second. For this testing, we used test suites that made only static HTTP requests of the server.

To measure file server performance we used NetBench 6.0. NetBench 6.0 is a portable benchmark program that measures how well a file server handles file I/O requests from 32-bit Windows clients. These clients make requests for network file operations to the server under test. NetBench reports throughput and client response time measurements.

To measure performance of the e-mail server we used the ZD E-mail Server Test Tool 1.0(ZD ESTT). This program measures e-mail server performance by making a number of SMTP and POP requests. ZD ESTT reports statistics for overall response time and the number of messages sent and received during the test. Unlike WebBench and NetBench, ZD ESTT is not publicly available.

We created modified versions of the standard NetBench 6.0 Disk Mix, WebBench 3.0 STATIC and ZD E-mail Test Tool Department POP test suites for use during the performance tests. The standard test suites for all three benchmarks require a total of 60 clients. Because of the nature of the servers under test, it was not necessary to employ 60 clients to get valid performance data.

The NetBench 6.0 Disk Mix and WebBench 3.0 STATIC test suites were modified by removing test mixes that required more than 28 clients. The ZD E-mail Server Test Tool department POP test suite was modified by reducing the number of mailboxes accessed by a given client from 50 to 25. Additionally, the number of clients used during the test was reduced from 60 down to 10 and the number of threads used by each client during the test was increased from 2 to 3.

3.0 Web Server Performance Test Results

During the WebBench 3.0 STATIC test, the clients make only static HTTP requests of the web server. The workload for this test consists of 6011 individual files ranging in size from 223 bytes to about 550,000 bytes. The files are of varying types and include GIF images, HTML documents and binary. During the test, the clients randomly request files from the web server under test using percentages specified in a workload file which is part of the test suite.

The primary measure of Web server performance reported by WebBench 3.0 is requests/sec. A WebBench 3.0 request consists of the client making a connection to the Web server, requesting a file from the workload, receiving the file from the Web server and resetting the connection with the Web server.

Figure 4 below is the summary graph for the modified WebBench 3.0 STATIC test results for all three servers.

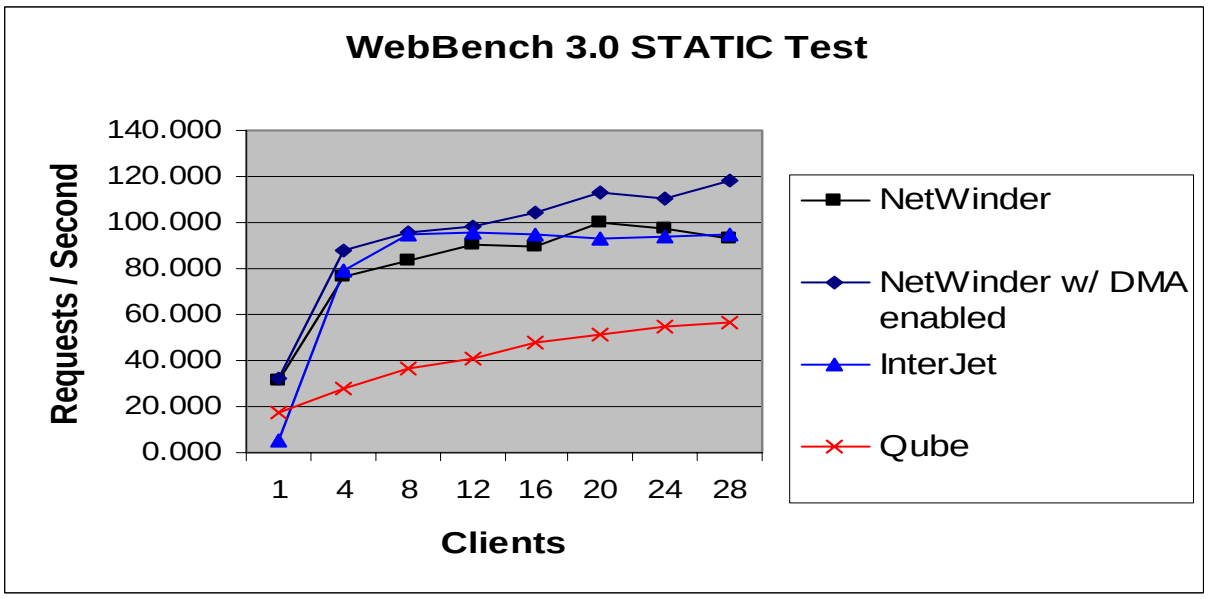

Figure 4

A primary factor in Web server performance, particularly when serving STATIC content, is the ability of the Web server to cache previously requested pages. This allows subsequent requests for these pages to be served from RAM instead of requiring an access of a relatively slow disk. None of the web servers tested provided a cache for the STATIC content served during the WebBench 3.0 testing. This means the speed and efficiency of the disk plays a more important role in the overall performance of the Web server.

The NetWinder OfficeServer peaked slightly ahead of the InterJet and well ahead of the Qube when tested with DMA disabled. After enabling DMA on the NetWinder, web serving performance improved significantly across the entire range of client loads, reflecting the improved disk performance. The performance increase was in the range of 10-20 percent depending on client load.

4.0 File Server Performance Testing

To test file server performance, we used a shortened version of the standard NetBench 6.0 Disk Mix test suite. This test suite was identical to the standard NetBench 6.0 Disk Mix test suite with the exception that we removed the test mixes that required more than 28 clients.

The NetBench 6.0 Disk Mix test provides two metrics to gauge overall file server performance. First, an overall throughput number is generated and reported in Mbits/second. This number provides a measure of how much data the server moved during the test. Because throughput does not give a complete picture of file server performance, NetBench 6.0 also provides an overall response time metric.

Figure 5 below shows the NetBench 6.0 throughput measurements for all three servers under test. In the early stages of the test, throughput increases dramatically until the file system runs out of resources to cache the data accessed by the NetBench clients during the test. At this point, the client requests are satisfied from disk and the throughput levels out as the disk becomes the primary bottleneck. Peak throughput is important. It's also important to note how a file server maintains that peak level of throughput during the later stages of the test as the clients put ever heavier loads on the server.

Initially, we were unable to successfully complete a NetBench 6.0 test using the NetWinder. At loads between 8 and 12 clients, the server dropped the network connection with the test clients. At this point, the NetBench 6.0 clients no longer had access to their workload files causing he test to stop. After consulting with Rebel.com engineers, we downloaded and installed an updated OS kernel and ethernet driver that resolved the issues we saw while running NetBench 6.0.

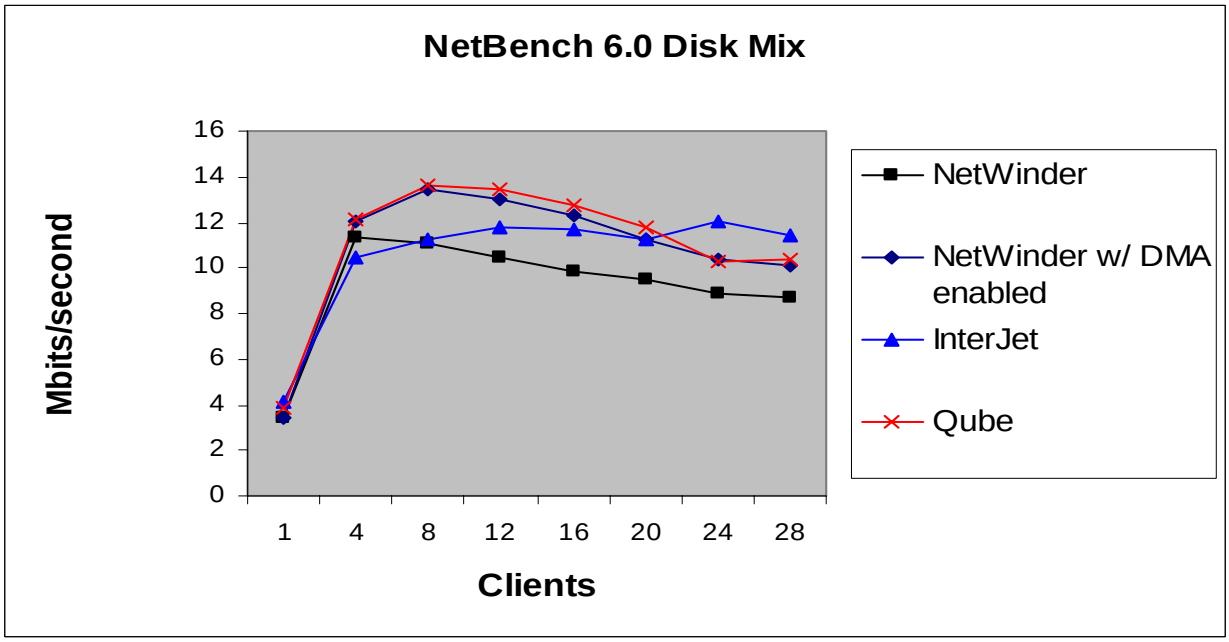

Figure 5

The Qube produced the highest peak throughput numbers of the servers tested. However, the throughput reported by the NetWinder differed dramatically depending on whether DMA was enabled or disabled. With DMA disabled, the NetWinder reported the lowest peak throughput and lowest overall throughput over the life of the test. With DMA enabled on the NetWinder, the throughput increases upwards of 20% to a virtual tie with the Qube. While the InterJet does not peak as high as the Qube or the NetWinder with DMA enabled, it is better able to maintain the level of throughput as the load on the server increases.

The graph in Figure 6 shows the NetBench 6.0 response time numbers for all three servers under test. Response time shows how long, on average, it takes the server to satisfy a file I/O request made by clients at different stages of the test. A response time graph typically shows excellent overall response time in the early stages of the test when only a few clients are making requests of the server. As the server load increases during the test, the server takes longer and longer to satisfy client requests. As a result, overall response times increase substantially.

These response time results correlate directly with the throughput numbers shown in Figure 5. With DMA enabled, the NetWinder and the Qube exhibit the best response times of all three servers. Like the throughput numbers, the NetWinder's response time improves significantly when DMA is enabled.

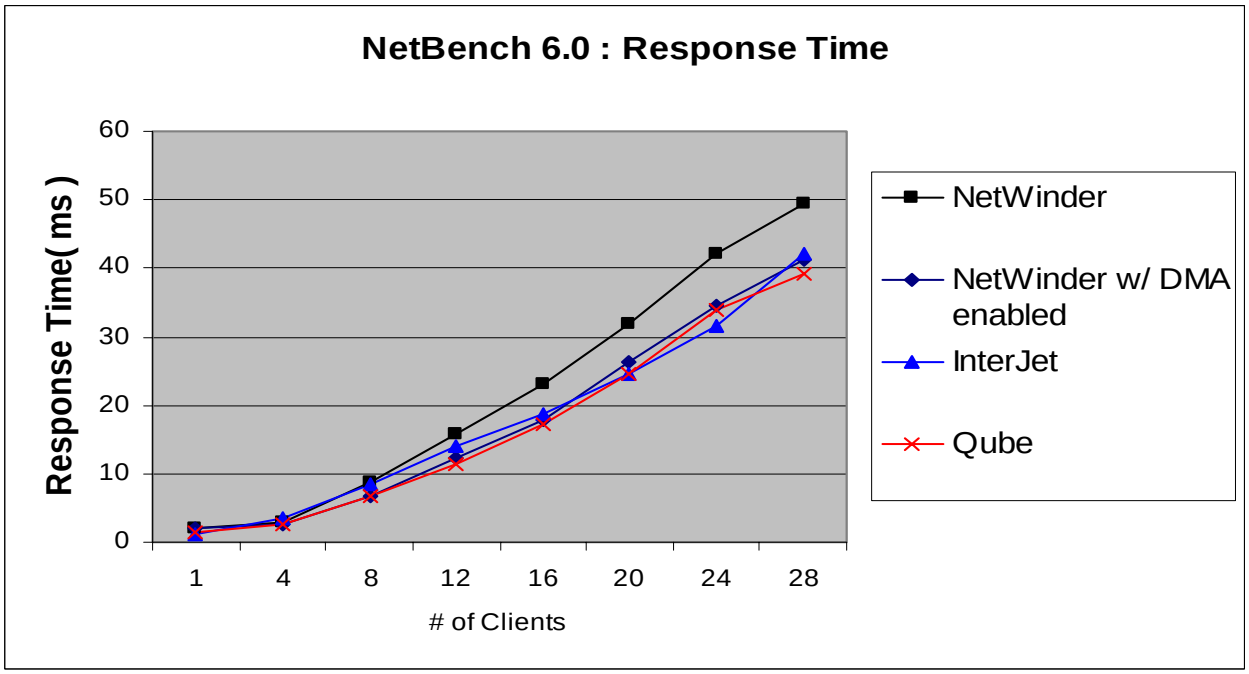

Figure 6

5.0 E-mail Server Performance Results

To test e-mail server performance we used a modified version of the standard department level POP test suite from the ZD Email Server Test Tool. The standard department POP test uses a total of 60 clients and requires a total of 3000 mailboxes. Each client in the test accesses 50 individual mailboxes using two threads.

We modified the test suite to use 10 clients and a total of 250 mailboxes. Each of the 10 clients accesses 25 individual mailboxes using three threads. This seemed reasonable based on the number of users these types of server are likely to support in actual practice.

The test suite spends 30 percent of the time sending e-mail messages of various sizes to the SMTP server and 70 percent of the time using the POP server to read e-mail from the range of mailboxes assigned to the client by the test suite.

Setting up an e-mail client to use DNS on the NetWinder was somewhat problematic. For our e-mail performance testing, we wanted to use the DNS server on the NetWinder. To test the e-mail setup before beginning the performance testing, we made several attempts to create a new domain, add users to the domain and send an e-mail message using Outlook Express from Microsoft. Initially, we received errors indicating that the e-mail server could not resolve the domain name of the client sending the e-mail. After checking the setup and referring to the documentation we determined the DNS setup on the NetWinder was correct

We got around the DNS issue above by having the e-mail client specify the entire domain name for the SMTP and POP servers. This meant that instead of specifying our e-mail server as “netwinder” and having DNS resolve the name, we had to specify the full domain name of “netwinder.ourdomain.com”.

Likewise, when specifying our e-mail address in Outlook Express, we were required to use client1@netwinder.ourdomain.com”. Normally all that is required is “client1@ourdomain.com”. Once this was done, the server was able to correctly identify the user as a member of the domain.

We relayed this information to engineers at Rebel.com. They acknowledged the problems and stated they will be fixed in a future product release.

Figure 7 below shows the relative e-mail server performance of the three servers under test. The ZD E-mail Server Test Tool measures the response time of an e-mail server as it receives and delivers mail. The response time is reported in seconds. As clients are added during the test, the load on the e-mail server increases and the response time increases accordingly. Once the response time approaches or exceeds 5 seconds, the e-mail server is generally saturated.

Despite repeated attempts, we were unable to get a complete test run on the Qube. The Qube handled a test mix of 2 clients with no problems, yet failed to successfully complete the initialization phase of the test using a load of 4 clients. During initialization, each client makes a series of connections to the e-mail server and deletes any messages remaining in the 25 mailboxes assigned to it.

Because there are usually a number of other clients in the initialization phase of the test at any given time, this portion of the test places considerable strain on the e-mail server. For this reason, there are times when a client is denied a connection to the e-mail server. A client that is refused a connection to the e-mail server during initialization will make a maximum of 100 more attempts to connect to the e-mail server. If the client is unsuccessful after 100 attempts, it is considered a fatal error.

With regard to the Qube, all 4 clients attempting initialization generated errors after being unable to connect to the e-mail server after 100 unsuccessful attempts. We employed a network sniffer to analyze the network traffic between the Qube and the test clients during initialization. The trace shows continued attempts by the clients to make a connection to the server. Each attempted client connection is reset by the server. We found no way to increase the number of simultaneous connections allowed by the Qube.

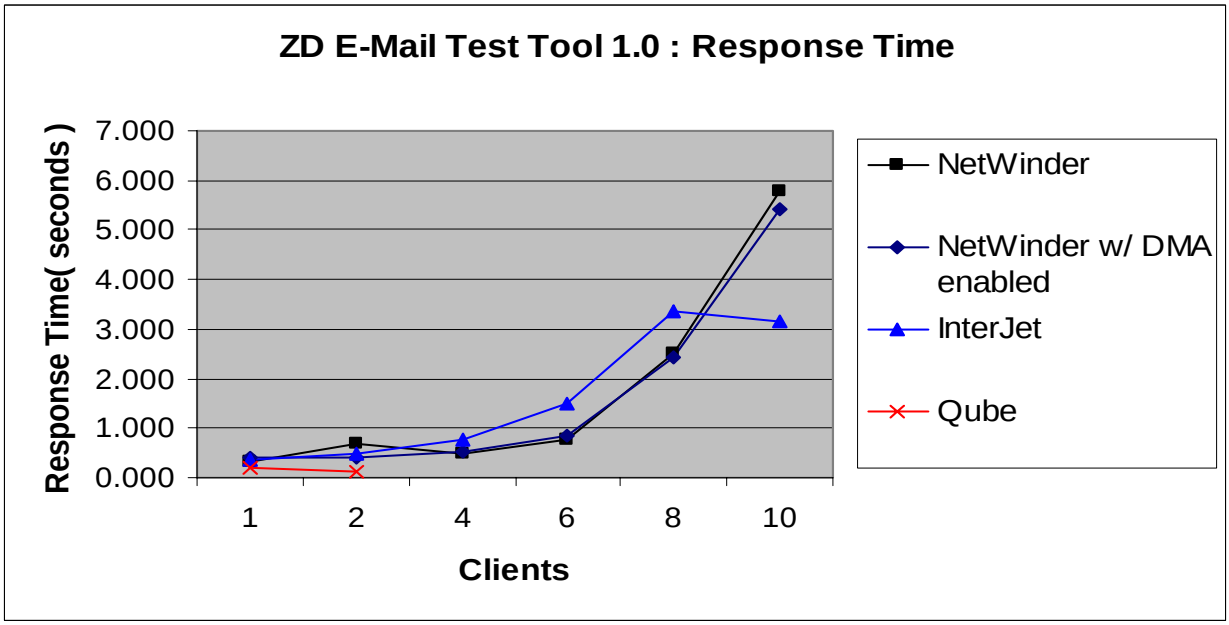

Figure 7

The NetWinder maintains the best response time until the last mix of the test suite. At this point the InterJet posts a better response time. Enabling DMA on the NetWinder did not result in any significant improvement in the response time metrics.

Another indicator of e-mail server performance is the rate at which the server receives and delivers messages as the load on the server increases. This is important data since different e-mail servers handle loads differently. Some may continue to receive messages from users and at the same time slow the delivery of mail. This allows them to maintain a good response time receiving mail at the expense of getting mail to users in a timely manner. Others might try to strike more of a balance between receiving messages and delivering mail. With the NetWinder and InterJet, we potentially see just such a situation.

Figures 8 and 9 below provide this information. With only a light load on the e-mail server, the number of messages received and delivered increases for both the Netwinder and the InterJet As the load increases to the point where the servers are saturated, the NetWinder is best able to maintain the level of messages received and delivered compared to the InterJet. However, it pays for this ability to maintain a high delivery rate with a corresponding increase in overall response time.

Enabling DMA on the NetWinder did not result in any significant improvements in the number of messages sent and received.

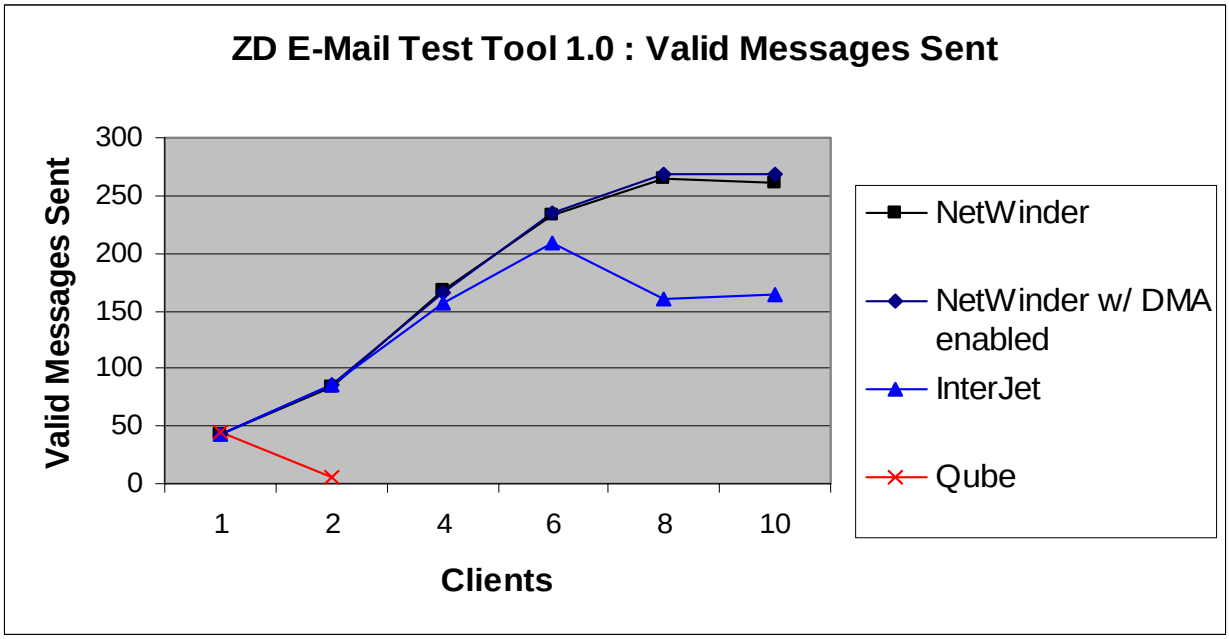

Figure 8

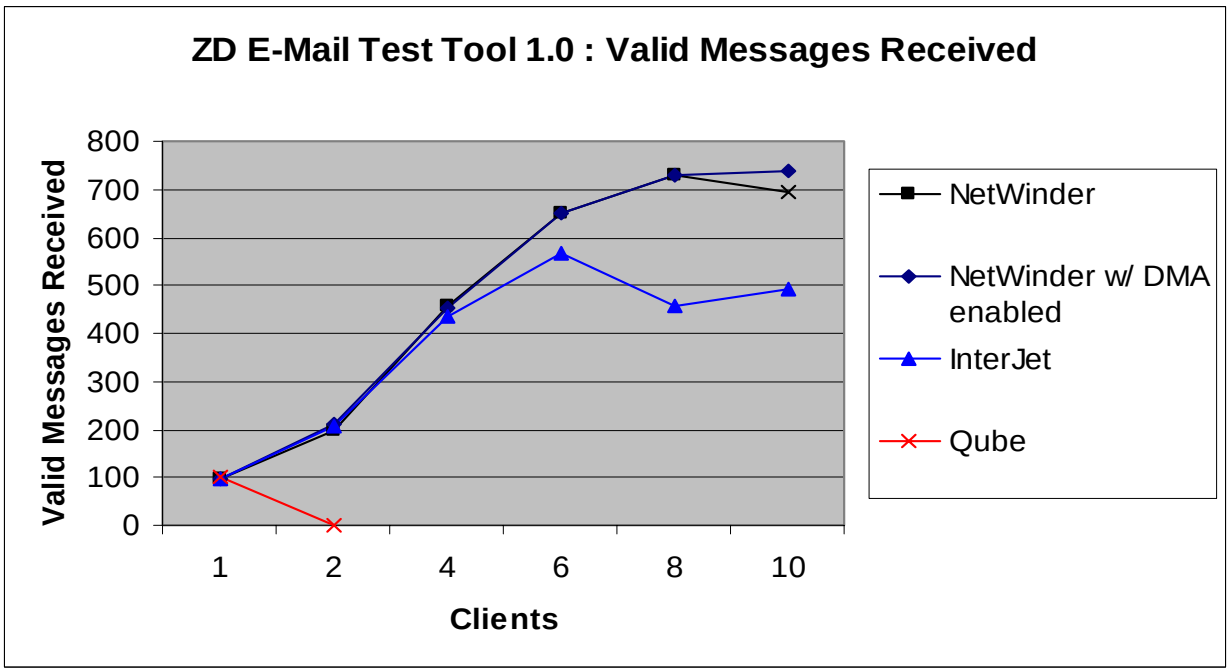

Figure 9

6.0 Capabilities and Features Testing

In addition to testing the performance of these servers, we were asked to compare the features of the three servers under test as well as provide some feedback on our experience using the NetWinder. Figure 10 below is a list of features, provided by Rebel.com, which they believe users should expect from an Internet device of this nature. All three servers under test provide support for the vast majority of these features.

Comparative Feature Table			
	NetWinder OfficeServer	IBM InterJet II	Cobalt Qube 2
Web Config System	Yes	Yes	Yes
VPN capable	Yes	Yes	Yes
Detailed Manual	Yes	Yes	Yes
Automatic s/w Upgrade	Yes	No	No
ISDN Support	Yes	Yes	No
NAT/Routing	Yes	Yes	Yes
Free s/w Updates	Yes	Yes	Yes
IP Firewall	Yes	Yes	Yes
Port Forwarding Service	Yes	Yes	Yes
E-mail Server	Yes	Yes	Yes
Transparent Proxying	Yes	Yes	Yes
Web Cache	Yes	Yes	Yes
User Web Pages	Yes	Yes	Yes
Virtual Web Hosting	Yes	Yes	Yes
User Manager	Yes	Yes	Yes
Telnet	Yes	Yes	Yes
Development Tools	Yes	No	No
DNS	Yes	Yes	Yes
DHCP Server	Yes	Yes	Yes
Print Server	Yes	No	No
Samba	Yes	Yes	Yes
AppleTalk	Yes	Yes	Yes
Mail Forwarding/Filtering	Yes	Yes	Yes
Web Page Creator	Yes	No	Yes
Discussion Forums	Yes	No	Yes
Performance Reports	Yes	Yes	Yes
Search Engine	Yes	No	Yes
Backup Facility	Yes	Yes	Yes
Dial on Demand	Yes	Yes	Yes
Document Management	Yes	No	Yes

Figure 10

7.0 Analysis of the NetWinder Office Server

Like the other servers under test, the NetWinder OfficeServer is a self contained device used to provide standard internet services like web access, file serving and e-mail to a small to medium sized group of clients. The test server contained a single processor, 64MB of RAM, a single IDE hard disk one 10/100 Base-T network interface port and one10 Base-T network interface port. The OS is a version of Linux.

The NetWinder OfficeServer comes with a browser-based setup and maintenance program that allows users to configure the device without knowing anything about the underlying OS. We found the interface very intuitive and easy to use. Out of the box setup was as easy as setting the IP address and plugging the device into the network.

Once on the network, we used the browser based administration interface to configure specific aspects of the server in preparation for our performance testing. This included creating users, setting up the Domain Name Service(DNS) for e-mail testing and creating shared volumes for file server testing.

The documentation dealt primarily with the details of the configuration and administration interface. We found the NetWinder OfficeServer documentation well organized and easy to use and understand. The documentation also provided plenty of background information on things like DNS and other areas likely to confuse the less experienced administrator.

Unlike the Qube and the InterJet, the NetWinder comes with a monitor port to allow administrators access to the underlying OS, in this case, Linux. This is an extremely nice feature for those users who feel comfortable working at a Linux console. Direct access to the OS allows easier development of CGI applications and scripts and makes it easier to correct configuration mistakes like entering an incorrect IP address through the administration interface.

One item we feel was lacking from the NetWinder, as well as the other two test servers, was the ability to allow the user to automatically create a reverse DNS record for each forward DNS record created. The concept of a reverse DNS entry is more complicated than that of a forward entry and easier to make mistakes with. If a checkbox was provided to allow users the choice to automatically create an associated reverse DNS entry at the time of creating the forward DNS entry it would greatly simplify DNS setup and configuration.

The NetWinder provides no method in the browser-based administrator for quickly creating a large number of user accounts. The test suite we used for e-mail server testing required 250 individual mailboxes. Mailboxes are created when new users are added. This meant that we needed to quickly create 250 new user accounts with similar names and passwords. Creating multiple, similar accounts one at a time is a time consuming process for any administrator.

Because we had direct access to the OS, we were able to run a shell script that automatically created the users. However, adding this functionality to the browser based administration interface is a cleaner solution. For example, the InterJet provides a way to create and manage any number of new users through the browser based administration interface. Users simply export the current list of users to a comma-separated value (CSV) that can then be opened in Excel or other product that understands this format. Any number of users and passwords can be added simply by making new entries in a spreadsheet. Once all the new users are added, the updated file is imported back into the system through the administration interface.

Engineers at Rebel.com stated that there is currently a plan to provide for the bulk creation of users as well as the option to automatically create a reverse DNS entry in a future version of their product.

Appendix

A. Server Configuration Information

NetWinder OfficeServer	
Machine Type	NetWinder OfficeServer
Host Processor	1 275Mhz StrongArm (SA110)
Memory	64 MB
Disk	1 6GB IDE
Network Adapter(s)	1 10 Base T and 1 10/100 Base T Ethernet interfaces
OS	Linux 2.2.12 kernel
OS Updates	None

Figure 11

IBM InterJet II	
Machine Type	IBM InterJet II
Host Processor	1 233 Mhz x86 compatible
Memory	32MB
Disk	1 6.4GB IDE
Network Adapter(s)	2 10/100 Base-TX Ethernet interfaces
OS	Based on FreeBSD Unix
OS Updates	None

Figure 12

Cobalt Qube 2	
Machine Type	Cobalt Qube 2
Host Processor	64-bit superscalar RISC
Memory	64MB
Disk	1 12.1 GB Ultra ATA
Network Adapter(s)	2 10/100 Base-TX Ethernet interfaces
OS	Linux 2.x
OS Updates	None

Figure 13

B. Network Testbed Configuration Information

Network Testbed Clients (6)	
Machine Type	Dell OptiPlex G6a
BIOS	Phoenix BIOS 1.1.A06
Processor(s)	1 233 Mhz Intel Pentium II
L2 Cache	512K
Expansion Bus	32-bit PCI
Memory	32MB
Disk(s)	1 1GB IDE
Network Adapter(s)	1 Intel Ether Express Pro 100+, version 3.35.10 driver
OS	Windows NT Workstation 4.0
OS Updates	Service Pack 4

Figure 14

Network Testbed Clients (16)	
Machine Type	Dell Dimension XPS Pro 200n
BIOS	AMI BIOS
Processor(s)	1 200Mhz Intel Pentium Pro
L2 Cache	512K
Expansion Bus	32-bit PCI
Memory	32MB
Disk(s)	1 1GB IDE
Network Adapter(s)	1 Intel Ether Express Pro 100+, version 3.35.10 driver
OS	Windows NT Workstation 4.0
OS Updates	Service Pack 4

Figure 15

Network Testbed Clients (6)	
Machine Type	Dell Dimension XPS P166s
BIOS	AMI BIOS
Processor(s)	1 166Mhz Intel Pentium
L2 Cache	512K
Expansion Bus	32-bit PCI
Memory	32MB
Disk(s)	1 1GB IDE
Network Adapter(s)	1 Intel Ether Express Pro 100+, version 3.35.10 driver
OS	Windows NT Workstation 4.0
OS Updates	Service Pack 4

Figure 16

Benchmark Controller	
Machine Type	HP NetServer LH Plus
BIOS	Phoenix 4.05.12 PE Plug and Play
Processor(s)	1 166Mhz Pentium
L2 Cache	512KB
Expansion Bus	32-bit PCI
Memory	64MB
Disk(s)	1 2GB IDE, 1 4GB IDE
Network Adapter(s)	5 Intel Pro 100B
OS	Windows NT Server 4.0
OS Updates	Service Pack 3

Figure 17

Network Configuration	
Switches	1 48 port Extreme Summit48 switch.
Segments	Single network segment of 28 clients

Figure 18

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