Fast Ethernet Performance White Paper

The EtherExpress™ PRO/100 is the first 10/100Mbps card available which supports both the existing 10BaseT Ethernet standard and the emerging IEEE 802.3 100BaseT Fast Ethernet standard. This paper discusses Fast Ethernet and EtherExpress PRO/100 Adapter performance testing, and assumes the reader understands the conceptual difference between a shared and a switched hub. For more information on this topic, please refer to FaxBack* documents listed at the end of this paper.

Deploying Fast Ethernet brings real benefits to both servers and clients in terms of throughput as well as the ability to safely increase the load on the network. For example, a 10Mbps network running at an average of fifty percent utilization can handle only a limited number of additional nodes and server-based applications without additional segmentation and complexity. But that same network traffic placed on a 100Mbps wire would represent only a 5% utilization; by deploying Fast Ethernet, the network would still have 95% of its bandwidth available for additional workgroups and new, bandwidth-intensive applications.

Three performance tests were conducted to show different aspects of Fast Ethernet performance:

Throughput: Perform3 shows raw throughput, measured in Kbps.

Network response time: Response time shows how fast a network can respond to a specific client request. This test reflects the benefits of Fast Ethernet to clients running various server-based applications.

Multimedia: Multimedia performance refers to how well a network runs real-time, high bandwidth applications like video playback or video conferencing.

Fast Ethernet Throughput & CPU Utilization

Novell's Perform3 benchmark was used for the throughput test because it measures the throughput available from various parts of the networking infrastructure (NIC architecture, NIC drivers, bus speed and type, NOS overhead, and system memory subsystem). This popular benchmark test establishes a cached file of a user-determined size and copies it repeatedly from the server to the client, recording performance at distinct intervals. Although Perform3 does not reflect real-life performance, it is a good indicator of NIC performance in a given environment.

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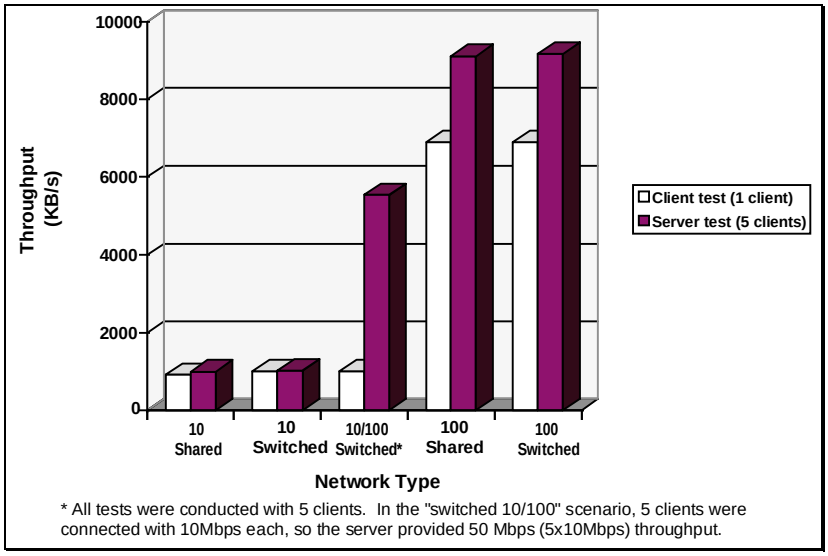
A Perform3 throughput test focuses on one aspect of a network and pushes it as fast as it can go - until that aspect becomes the bottleneck. With only one client, the server can provide fast service, and therefore the client is usually the bottleneck. With multiple clients, the server has more work to handle, and therefore the server is the bottleneck. With this in mind, we set up a Perform3 *client test* with one server and one client, and a *server test* with one server and five clients.

The tests were run with a Pentium™ processor-based server and high speed Intel486™ and Pentium processor-based clients on a Novell Netware* 4.01 network. The test was conducted in four different network environments: 100Mbps switched, 100Mbps shared, 10/100 switched (clients at 10Mbps, server at 100Mbps), and 10Mbps shared (see Appendix A for detailed configuration).

Figure 1: Fast Ethernet Throughput Comparison



* All tests were conducted with 5 clients. In the "switched 10/100" scenario, 5 clients were connected with 10Mbps each, so the server provided 50 Mbps (5x10Mbps) throughput.

The results in Figure 1 show that shared or switched Fast Ethernet networks provide 7-10 times the Perform3 throughput of 10Mbps Ethernet networks.

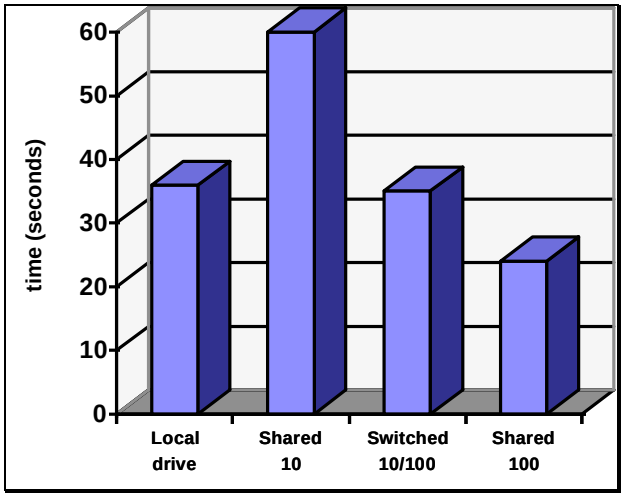
In all of the Perform3 tests, the server CPU never went above 26% average utilization. This allows the file server to take advantage of the 100Mbps wire and still have 75% of its power available for other tasks.

Fast Ethernet Network Response Time

Fast Ethernet not only provides additional throughput and network load capability, it also improves response time for clients in everyday Windows* 3.1-based work environments. To demonstrate this, a test was run in which a client PC opened and closed Microsoft Word 6.0, Excel 5.0, and PowerPoint 4.0. The response time was measured with the applications residing on the client's local hard drive, and then with the applications residing on a file server in the following network configurations: 100Mbps switched, 100Mbps shared, 10/100 switched (clients at 10Mbps, server at 100Mbps), and 10Mbps shared. The test network used a Pentium processor-based server and four Intel486 processor-based clients on a Novell Netware 3.12 network (see Appendix B for detailed configuration).

As shown in Figure 2, the test took twice as long to run from a shared 10Mbps LAN than from the client's hard disk. The 10/100 switched environment provided better response time than the shared 10Mbps connections, but no increase in performance compared to the local hard drive.

Figure 2: Network response time test results



The case for server-based applications becomes truly compelling when both servers and clients are connected at 100Mbps - response time was even faster than from the local hard drive.

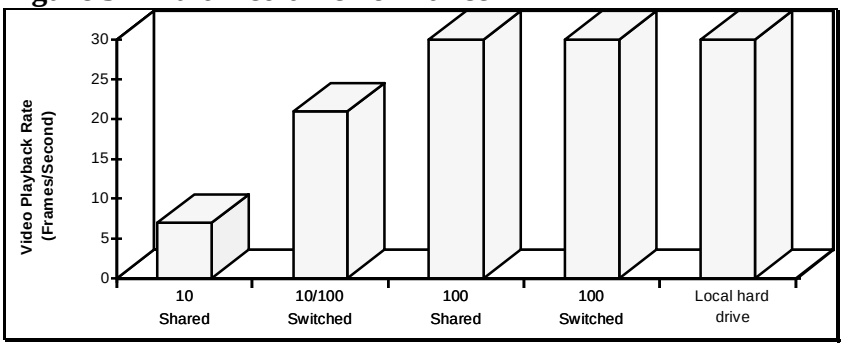
With this level of performance, Fast Ethernet is an enabling technology, allowing companies to do what is not feasible with 10Mbps Ethernet: *run applications from the server.* In this age of strict software licensing, frequent updates, and piles of diskettes for every upgrade, the advantages of server-based applications are considerable for administrators, users, and the environment alike.

Fast Ethernet Multimedia Performance

Many LAN managers want to configure their network to increase worker productivity with multimedia applications such as video playback and conferencing. This test benchmarks video performance by running Indeo™ 3.22 Video for Windows over the network. Video clips were captured at 30 frames per second (30 FPS is television quality) which corresponds to 3-4Mbps of traffic per video stream.

Two clients played simultaneous 30 second video clips from one server, and the test was conducted in four different network environments: 100Mbps switched, 100Mbps shared, 10/100 switched (clients at 10Mbps, server at 100Mbps), and 10Mbps shared (see Appendix C for detailed configuration). To calculate the video playback rate, an MCI string command (CTL-F5) displayed the dropped video frames (30 FPS minus dropped frames equals playback rate).

Figure 3 - Multimedia Performance



As shown in Figure 3, the 10Mbps networks can't provide enough bandwidth for even television quality video playback. A 10Mbps network could realistically handle only low bandwidth network video, such as video with a small window size or a low frames-per-second playback rate. In contrast, 100Mbps Fast Ethernet networks provide ample bandwidth to support television quality video streams and still have bandwidth left for other types of traffic.

Fast Ethernet Performance Summary

For comparing Fast Ethernet to 10Mbps Ethernet, three performance types were examined: throughput, client response time, and multimedia performance. The tests demonstrated not only that Fast Ethernet provides superior performance, but also that Fast Ethernet is an enabling technology. With Fast Ethernet's 100Mbps performance, companies can use their networks for tasks such as running applications from the file server and video conferencing - tasks that can't be done adequately with either switched or shared 10Mbps networks.

For more information on Fast Ethernet, the Intel EtherExpress PRO/100 Adapter, or other Intel products, please contact Intel or your reseller.

Product Information Numbers

	U.S. & Canada	Europe	Asia–Pacific
Product Information	800-538-3373 or	+44-1793-431155	Singapore +65-735-3811
	503-264-7354		Australia +61-2-975-3300
			Japan +81-298-47-1841
Automated Support			
FaxBack*	800-525-3019	+44-1793-432509	Singapore +65-256-5350
	503-264-6835		Australia +61-2-975-3922
TalkBack	800-368-3160	503-264-7777	503-264-7777
Intel BBS	503-264-7999	+44-1793-432955	Singapore +65-256-4776
			Australia +61-2-975-3066
			Hong Kong +852-530-4116
			Korea +822-784-3430
			Taiwan +886-2-718-6422
CompuServe	GO INTELFORUM	GO INTELFORUM	GO INTELFORUM

In Singapore and Australia, request FaxBack document 9000 for a list of dealers and distributors.

Available FaxBack documents

	Document Number
Intel EtherExpress PRO/100 Data Sheet	6285
Introduction to Fast Ethernet and the EtherExpress PRO/100 Adapter	6354
Intel branded products price list	9000

Appendix A: Test Configuration for Perform3 Throughput Test

Network hubs used:

1) 10Mbps shared: SynOptics 2813 hub
2) 10Mbps switched: Grand Junction FastSwitch* 100 hub
3) 10/100Mbps switched (clients running 10Mbps, server running 100Mbps): Grand Junction FastSwitch 100 hub
4) 100Mbps shared: Grand Junction FastSwitch AG hub
5) 100Mbps switched: SynOptics 28115 LattisSwitch* hub

Perform3 command line options used:

15	test time
1	end size
65535	start size
4096	step size

Server:

Gateway 2000 P90, 90 MHz Pentium PCI system, 16MB RAM
server speed=4953
NetWare 4.01
Frame 802.2
EtherExpress PRO/100 PCI

Clients:

1 Micron Desktop D4/100, 100 MHz 486DX4, 8 MB RAM
Norton SI CPU Rating=197.7
VLM 1.1
EtherExpress PRO/100 PCI Adapter

2 90 MHz Pentium 'Plato' PCI system, 8 MB RAM
Norton SI CPU Rating=286.1
VLM 1.1
EtherExpress PRO/100 PCI Adapter

3 Gateway 2000 P5-60, 60 MHz Pentium PCI, 8MB RAM
Norton SI CPU Rating=190.3
VLM 1.1
EtherExpress PRO/100 PCI Adapter

4 Gateway 2000 P5-60, 60 MHz Pentium PCI, 16MB RAM
Norton SI CPU Rating=190.3
VLM 1.1
EtherExpress PRO/100 PCI Adapter

5 Professional GX, 66 MHz 486DX2 EISA, 8 MB RAM
VLM 1.1
EtherExpress PRO/100 PCI Adapter

	Network type	Perform3 (KB/s)	Perform3 (Mbps)	CPU Utilization
1 client	100 Shared	6901	55.2	about 10%
5 clients	100 Shared	9114	72.9	26%
5 clients	100 Switched	9177	73.4	26%
5 clients	10/100 Switched	5536	44.3	20%
5 clients	10 Shared	997	8.0	22%

Appendix B: Test Configuration for Response Time Test

Network hubs used:

1) 10Mbps shared: SynOptics 2813 hub
2) 10Mbps switched: Grand Junction FastSwitch 100 hub
3) 10/100Mbps switched (clients running 10Mbps, server running 100Mbps): Grand Junction FastSwitch 100 hub
4) 100Mbps shared: Grand Junction FastSwitch AG hub
5) 100Mbps switched: SynOptics 28115 LattisSwitch hub

1 Server:

Premiere/PCI Expandable Desktop (SIO/60) system, 60 Mhz Pentium processor, 3 PCI Slots, 32 MB DRAM
NetWare 3.12
NCR PCI IDE
EtherExpress PRO/100 PCI Adapter (for 100Mbps)
EtherExpress 16 Adapter (as representative of the installed base for 10Mbps testing)

4 Clients:

Professional GX EISA - 486DX2-66, 8 MB DRAM
MACH32 local bus graphics
DOS 6.2, Windows 3.1
Video for Windows 1.1
Indeo Drivers v3.22
VIDEO2.EXE Video playback monitor
NETX.EXE
EtherExpress PRO/100 EISA Adapter (for 100Mbps)
EtherExpress Flash32 EISA Adapter (as representative of the installed base for 10Mbps testing)

Appendix C: Test Configuration for Multimedia Test

Network hubs used:

1) 10Mbps shared: SynOptics 2813 hub
2) 10Mbps switched: Grand Junction FastSwitch 100 hub
3) 10/100Mbps switched (clients running 10Mbps, server running 100Mbps): Grand Junction FastSwitch 100 hub
4) 100Mbps shared: Grand Junction FastSwitch AG hub
5) 100Mbps switched: SynOptics 28115 LattisSwitch hub

1 Server:

Premiere/PCI Expandable Desktop (SIO/60) system, 60 MHz Pentium processor
3 PCI Slots
32 MB DRAM
NetWare 3.12
NCR PCI IDE
EtherExpress PRO/100 PCI Adapter (for 100Mbps testing)
EtherExpress PRO/100 PCI Adapter (in 10Mbps mode for 10Mbps testing)

4 Clients:

Professional GX EISA - 486DX2-66, 8 MB DRAM
MACH32 local bus graphics
DOS 6.2, Windows 3.1
Video for Windows 1.1, Indeo Drivers v3.22
VIDEO2.EXE Video playback monitor
NETX.EXE
EtherExpress PRO/100 EISA Adapter (for 100Mbps testing)
EtherExpress Flash32 EISA Adapter (as representative of the installed base for 10Mbps testing)