

White Paper

Gigabit Ethernet

Applications Driving
Network Growth

Technology

Migration

Strategic
Alternative

IEEE 802.3z

New Capabilities



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Introduction

Modern organizations are dependent upon their local-area networks (LANs) to provide connectivity for a growing number of complex, mission-critical desktop computing applications. As the corresponding volume of network traffic increases, however, the bandwidth offered by a typical 10-Mbps Ethernet LAN quickly becomes inadequate to maintain an acceptable level of performance for a growing number of desktop/server computing environments. These traffic jams are fueling the need for higher speed networks.

Among the high-speed LAN technologies available today offering greater bandwidth and improved client/server response times, Fast Ethernet, or 100Base-T, has become the leading choice. Building on the near-universal acceptance of 10Base-T Ethernet, Fast Ethernet technology provides a smooth, non-disruptive evolution to 100-Mbps performance. The growing use of 100Base-T connections to servers and desktops, however, is creating a clear need for an even higher-speed network technology at the backbone and server level. Ideally, this technology should also provide a smooth upgrade path, be cost effective and not require any retraining.

The most appropriate solution, now in development, is Gigabit Ethernet. Gigabit Ethernet will provide 1-Gbps bandwidth for campus networks with the simplicity of Ethernet. Gigabit Ethernet will offer a natural upgrade path for current Ethernet installations, leveraging existing end stations, management tools and training. Gigabit Ethernet connections will cost less than other technologies of comparable speed. Gigabit Ethernet will be simple, leveraging the existing Ethernet frame format, management objects and Ethernet understanding in the industry.

Gigabit Ethernet employs the same CSMA/CD protocol, same frame format and same frame size as its predecessors. For the vast majority of network users, this means their network investment is sound and can be extended to gigabit speeds at reasonable initial cost without the need to re-educate their support staffs and users, and without the need to invest in additional protocol stacks or middleware. The result is low cost of ownership for the user.

Because of these attributes, as well as support for full-duplex operation, Gigabit Ethernet will be an ideal backbone interconnect technology for use between 10/100Base-T switches, as a connection to high-performance servers and as an upgrade path for future high-end desktop computers requiring more bandwidth than 100Base-T can offer.

This paper presents an overview of Gigabit Ethernet, including Ethernet's current position in the industry, applications driving the need for more bandwidth, Gigabit Ethernet as a strategic evolution for networks, Gigabit Ethernet technology fundamentals, network migration scenarios, cost of ownership expectations and the status of the Gigabit Ethernet Standard IEEE 802.3z.

Gigabit
Ethernet
1000 MBPS
Isocw.net
Highly Reliable

Ethernet: The Dominant Network Technology

Ethernet technology is ubiquitous. More than 80 percent of the installed network connections will be Ethernet by the end of 1996 according to IDC. This represents over 120 million interconnected PCs, workstations and servers. The remaining network connections will be a combination of Token Ring, FDDI, ATM, and other protocols. All popular operating systems and applications are Ethernet-compatible, as are upper-layer protocol stacks such as TCP/IP, IPX, Netbeui, DECnet, and others.

1996 will be a milestone year for Ethernet network equipment as the technology captures 82% of shipments. IDC projects Ethernet network interface card (NIC) shipments will exceed 31 million units, Ethernet hub shipments will exceed 43 million ports. In contrast, ATM, FDDI/CDDI and Token Ring network interface card shipments combined are expected to reach just 6 million in 1996, 17% of the total. ATM, FDDI/CDDI and Token Ring hub ports are expected to be 7 million, 14% of the total. IDC projects the Ethernet dominance will continue beyond 1998.

Several factors have contributed to making Ethernet the most popular network technology in use today. Among the most important ones are:

- High reliability
- Availability of Tools and Management
- Scalability
- Cost

Network Reliability Highly reliable networks are critical to the success of the enterprise. As a result, the installation and support of any network technology are paramount considerations. Since star-wired hubs using 10Base-T were introduced in 1986, structured wiring systems have continued to evolve with hubs and switches becoming increasingly reliable. Today, Ethernet networks are rapidly approaching the reliability level associated with their telephone ancestors, and are relatively simple to understand and administer.

Availability of Management and Troubleshooting Tools Network management and network troubleshooting are the most important contributors to this reliability. Management tools for Ethernet, made possible by widespread adoption of management standards including Simple Network Management Protocol and its successors, allow an administrator to view an entire enterprise network from a central station. The view includes the status of all desktops and network elements, including redundant elements.

Ethernet troubleshooting tools span a range of capabilities, from simple link indicator lights to sophisticated network analyzers. Due to the popularity of Ethernet, many industry people have been trained on its installation, maintenance and/or troubleshooting.

Scalability The Fast Ethernet standard, approved in 1995, established Ethernet as a scalable technology. The emergence of standardized 10-Mbps and 100-Mbps versions offered the opportunity for low cost, scalable network interfaces. Now, the development of Gigabit Ethernet extends the scalability of Ethernet even further.

Independent market research has indicated a strong interest among network users in adopting Gigabit Ethernet technology, specifically Fast Ethernet hubs and switches with Gigabit Ethernet uplinks, Gigabit Ethernet switches and repeaters, and Gigabit Ethernet server NICs.

Low Cost InStat, IDC and Dell'Oro Group analysis of Ethernet and Fast Ethernet indicates a rapid decrease in price per port for both technologies is shown in Table 1.

Intelligent Hub Per-Port Average Price	1996	1998
Ethernet	\$101	\$ 94
Fast Ethernet	\$200	\$145
Ratio	2.0	1.5

Source: Instat, 1996

Switch Per-Port Average Price	1996	1998
Ethernet	\$427	\$200
Fast Ethernet	\$785	\$500
Ratio	1.8	2.5

Source: Dell'Oro, 1996

NIC Per-Port Average Price	1996	1998
Ethernet	\$ 68	\$ 26
Fast Ethernet	\$122	\$ 57
Ratio	1.8	2.2

Source: IDC, 1996

Table 1. Ethernet Network Equipment Price Trends

The overall decrease in the per-port price for Fast Ethernet and Ethernet products is rapid, and the difference between their cost is narrowing. Although it is premature to speculate on per-port costs for Gigabit Ethernet, Gigabit Ethernet is expected to track Fast Ethernet in a similar fashion.

Ethernet's popularity is bound to increase – along with the market – as the technology evolves and as the benefits of Ethernet over competitive technologies continue.

Applications Driving Network Growth

As new and existing network applications evolve to embrace high-resolution graphics, video and other rich media data types, pressure is growing at the desktop, the server, the hub and the switch for increased bandwidth. Table 2 summarizes the applications and their impact on the network. The combination of these applications and the increasing number of network users is fueling the need for higher bandwidth networking equipment.

Application	Data Types/Size	Network Traffic Implication	Network Need
Scientific Modeling, Engineering	• Data files • 100's of Megabytes to Gigabytes	• Large files increase bandwidth required	• Higher bandwidth for desktops, servers and backbone
Publications, Medical Data Transfer	• Data files • 100's of Megabytes to Gigabytes	• Large files increase bandwidth required	• Higher bandwidth for desktops, servers and backbone
Internet/Intranet	• Data files now • Audio now • Video will emerge • High Transaction Rate • Large Files, 1 MB to 100 MB	• Large files increase bandwidth required • Low transmission latency • Class of service reservation • High volume of data streams	• Higher bandwidth for servers and backbone • Low Latency
Data Warehousing	• Data files • Gigabytes to terabytes	• Large files increase bandwidth required • Search and access require low latency	• Higher bandwidth for servers and backbone • Low Latency
Network Backup	• Data files • Gigabytes to terabytes	• Large number of large files • Transmitted during fixed time period	• Higher bandwidth for servers and backbone • Low Latency
Desktop Video Conferencing, Interactive Whiteboarding	• Constant Data Stream • 1.5 to 3.5 Mbps at the desktop	• Class of service reservation • High volume of data streams	• Higher bandwidth for servers and backbones • Low Latency • Predictable Latency

Table 2. Summary of Applications Driving Network Growth

Many of these applications require large files to be transmitted over the network. Scientific applications demand ultra-high bandwidth networks to communicate 3D visualizations of molecules, aircraft and other complex objects. Magazines, brochures and other complex, full-color publications prepared on desktop computers are transmitted directly to digital-input printing facilities. Many medical facilities are transmitting complex images over WAN and LAN links, enabling expensive equipment like CAT scanners and specialized medical expertise to be shared. Engineers are using electronic and mechanical design automation tools to work interactively in distributed development teams, sharing files in the hundreds of gigabytes.

Now, many companies are employing Internet technologies to build private intranets, enabling users in an organization to go beyond electronic mail and access critical data through familiar web browsers, opening the door to a new generation of multimedia client/server applications. While intranet traffic is currently composed primarily of text, graphics and images, this is expected to expand in the near future to also include more bandwidth-demanding audio, video and voice.

Data warehousing has become popular as a way of making enterprise data available to decision makers for reporting and analysis without sacrificing the performance, security or integrity of production systems. These warehouses may comprise gigabyte or terabytes of data distributed over hundreds of platforms and accessed by thousands of users, and must be updated regularly to provide users near-real-time data for critical business reports and analyses.

Network backup of servers and storage systems is popular in many industries which require enterprise information to be archived. Such backups usually occur during off hours and require large amounts of bandwidth during a fixed amount of time (4 to 8 hours). The backup involves gigabytes or terabytes of data distributed over hundreds of servers and storage systems throughout an enterprise.

A recent survey of video applications conducted by a leading industry analyst shows interest in video increasing rapidly as computers offer native MPEG decoding capability and as low-cost encoding chip sets become more widely available. The survey looked at a number of video-based applications, including video conferencing, education and human resources from several companies, including InSoft, Parallax, Starlight Networks, Network Connection, Vtel, and Videoserver.

As these applications proliferate and demand ever greater shares of bandwidth at the desktop, organizations will need to migrate critical portions of their networks to high-bandwidth Gigabit Ethernet.

Gigabit Ethernet: The Strategic Alternative for LANs and Intranets

The incredible growth of traffic over local area networks is pushing network administrators to look to higher speed network technologies to solve their bandwidth crunch. These administrators -- who typically have either Ethernet or FDDI backbones today -- have several alternatives they can choose from. Although each one faces different issues, some common criteria for choosing a high-speed network emerge:

- Easy, straightforward migration without disruption
- Scalability to higher performance levels
- Low cost of ownership -- both purchase cost and support cost
- Flexibility to handle new applications and data types

One of the most important questions network administrators face is "How do I get higher bandwidth without disrupting my existing network?" The solution is a series of non-disruptive steps -- ideally, transparent to network users -- that gradually move to a higher-speed network. For users of Ethernet networks this process is straightforward.

Ethernet is currently available in two scalable versions: 10-Mbps Ethernet and 100-Mbps Fast Ethernet. Gigabit Ethernet will provide another order of magnitude increase in bandwidth and a "third step" to Ethernet's already strong scalability story. Yet, it is simple to connect existing lower-speed Ethernet users and devices using LAN switches or routers. Because the frame format and size are the same for all Ethernet technologies, no other network changes are necessary. This evolutionary upgrade path makes Gigabit Ethernet a better choice from both the financial and management aspects than other high-speed network technologies that require revolutionary change.

Cost of ownership is another major concern for network administrators. While the initial purchase cost is a major factor in any decision, the cost to support a network often overshadows the initial cost. Users of Ethernet today have developed expertise and tools that allow their networks to operate at peak capacity. Gigabit Ethernet extends this investment. Although network analyzers will need to be updated to handle the higher speed, the frame format and network topology are the same. Training for personnel will be minimal.

Applications Driv

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Technology

Low Cost

IEEE 802.3

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Applications, Data Types and New Capabilities The emergence of intranet applications portends a migration to new data types, including video and voice. In the past it was thought video might require a different networking technology designed specifically for multimedia. But today it is possible to mix data and video over Ethernet through a combination of:

- Increased bandwidth provided by Fast Ethernet and Gigabit Ethernet, enhanced by LAN switching,
- The emergence of new protocols, such as RSVP, that provide bandwidth reservation,
- The emergence of new standards such as 802.1Q and/or 802.1p which will provide VLAN and explicit priority information for packets in the network,
- The widespread use of advanced video compression, such as MPEG-2.

These technologies and protocols combine to make Gigabit Ethernet an extremely attractive solution for the delivery of video and multimedia traffic as illustrated in Table 3.

Capabilities	Gigabit Ethernet	Fast Ethernet	ATM	FDDI
IP Compatibility	Yes	Yes	Requires RFC 1557 and IP over LANE today, I-PNNI and/or MPOA in future	Yes
Ethernet Packets	Yes	Yes	Requires LANE 1.0 or routing from cells to packets	No
Handle Multimedia	Yes	Yes	Yes, but application needs to change	Yes
Quality of Service	Yes, with RSVP and 802.1Q	Yes with RSVP and 802.1Q	Yes with SVCs	Yes, with RSVP and 802.1Q
VLANs with 802.1Q/p	Yes	Yes	Requires mapping SVCs to 802.1Q/p	Yes

Table 3. High Speed Network Capabilities

Internetworking and Network Design with Gigabit Ethernet Network administrators today face a myriad of internetworking choices and network design options. They are combining routed and switched networks, and building intranets of increasing scale. Ethernet networks are shared (using repeaters) and switched, based on bandwidth and cost requirements. The choice of a high-speed network, however, should not restrict the choice of internetworking or network topology.

Gigabit Ethernet will be switched, routed and shared. All of today's internetworking technologies, as well as emerging technologies such as IP-specific switching and layer 3 switching, are fully compatible with Gigabit Ethernet, just as they are with Ethernet and Fast Ethernet. Gigabit Ethernet will be available in a shared, repeated hub (with the accompanying low cost per port) as well as on LAN switches and routers.

The simple migration and support offered by Ethernet combined with the scalability and flexibility to handle new applications and data types makes Gigabit Ethernet the strategic choice for high-speed, high-bandwidth networking.

Gigabit Ethernet Technology

Gigabit Ethernet is an extension to the highly successful 10-Mbps and 100-Mbps IEEE 802.3 Ethernet standards. Offering a raw data bandwidth of 1000 Mbps, Gigabit Ethernet maintains full compatibility with the huge installed base of Ethernet nodes.

Gigabit Ethernet supports new full-duplex operating modes for switch-to-switch and switch-to-end-station connections and half-duplex operating modes for shared connections using repeaters and the CSMA/CD access method. Initially operating over optical fiber, Gigabit Ethernet will also be able to use Category 5 unshielded twisted-pair (UTP) cabling and coax. Figure 1 illustrates the functional elements of Gigabit Ethernet.

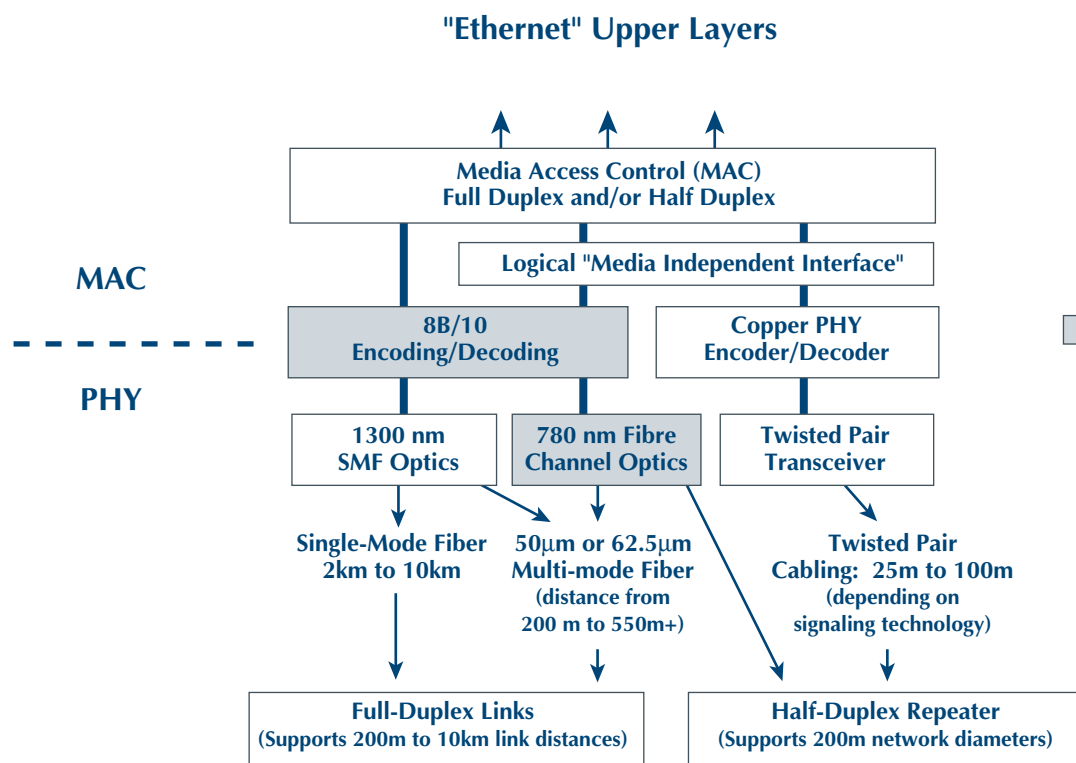


Figure 1. Functional Elements of Gigabit Ethernet Technology

The use of existing, available, proven technologies and methods will minimize time-to-market for Gigabit Ethernet products. Current efforts in the IEEE 802.3z standards activity draw heavily on the use of Fibre Channel and other high-speed networking components. Fibre Channel encoding/decoding ICs and optical components are readily available and are specified and optimized for high performance at relatively low costs.

Initial implementations of Gigabit Ethernet will employ Fibre Channel's high-speed, 780-nm (short wavelength) optical components for signaling over optical fiber and 8B/10B encoding/decoding schemes for serialization and deserialization. Current Fibre Channel technology operating at 1.063 Gbps is being enhanced to run at 1.250 Gbps, thus providing the full 1000-Mbps data rate. For longer link distances -- up to at least 2 km using single mode fiber and up to at least 550 meters on 62.5-micron multimode fiber -- 1300-nm (long wavelength) optics will also be specified.

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Fibre Channel
Technology

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The IEEE 802.3z standards activity is planning ahead for the expected advances in silicon technology and digital signal processing that will enable Gigabit Ethernet to eventually operate over unshielded twisted-pair (UTP) cabling. To accommodate this, a logical interface will be specified between the MAC and PHY layers (see Figure 1) that will decouple the Fibre Channel 8B/10B encoding, thus allowing other encoding schemes that more readily support cost-effective UTP cabling to be used. Technical contributions at IEEE are investigating mechanisms to support short link distances for use in computer room/wiring closet applications, as well as distances up to 100 meters over Category 5 UTP cabling.

Gigabit Ethernet Migration

The initial applications for Gigabit Ethernet will be for campuses or buildings requiring greater bandwidth between routers, switches, hubs, repeaters, and servers. Examples include switch-to-router, switch-to-switch, switch-to-server and repeater-to-switch connections. In its early phase, Gigabit Ethernet is not expected to be deployed widely to the desktop. The five most likely upgrade scenarios are outlined below.

- 1
- 2
- 3
- 4
- 5
- Upgrading switch-to-server connections

➤ Achieve high-speed access to applications and file servers
- Upgrading switch-to-switch connections

➤ Obtain 1000 Mbps pipes between 100/1000 switches
- Upgrading a switched Fast Ethernet backbone

➤ Aggregate Fast Ethernet switches with a Gigabit Ethernet switch or repeater
- Upgrading a shared FDDI backbone

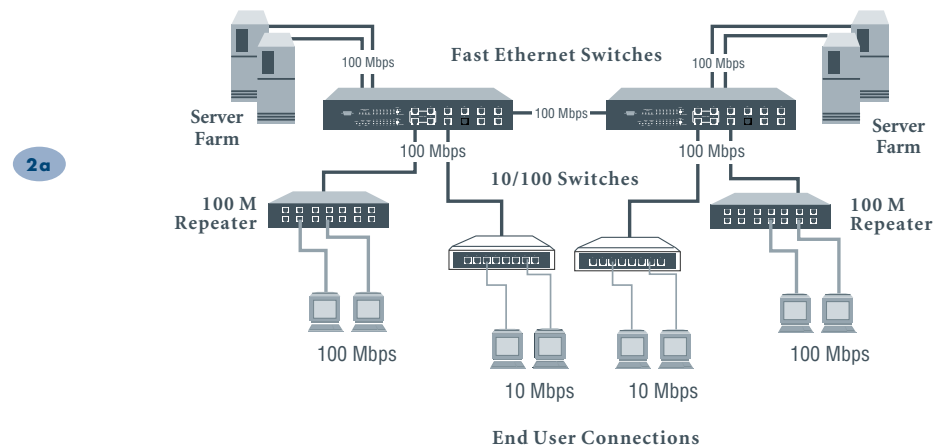
➤ Install FDDI switch or Ethernet-to-FDDI switches/routers with Gigabit Ethernet switches or repeaters
- Upgrading high-performance desktops

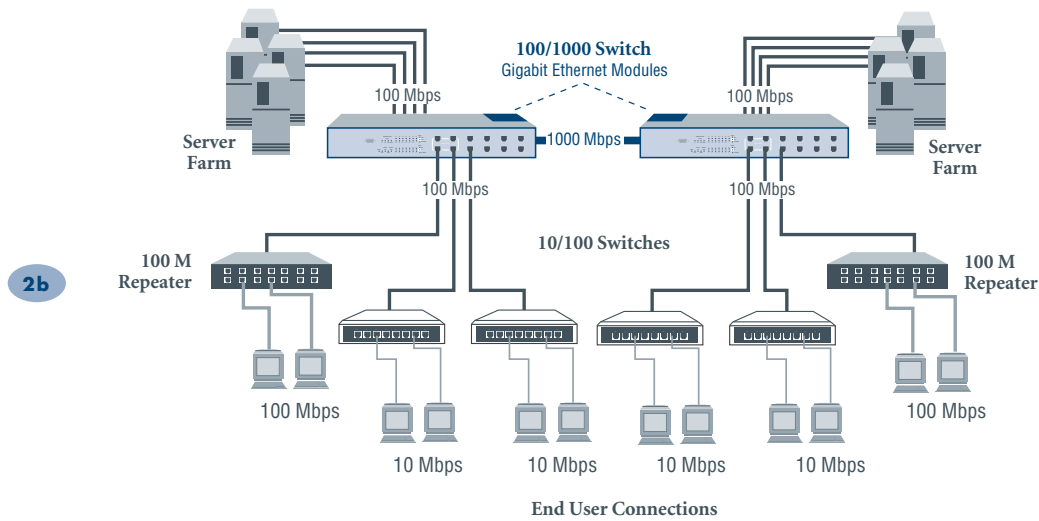
➤ Gigabit Ethernet NICs for connection to Gigabit Ethernet switches or repeaters

Table 4. The Five Most Likely Upgrade Scenarios

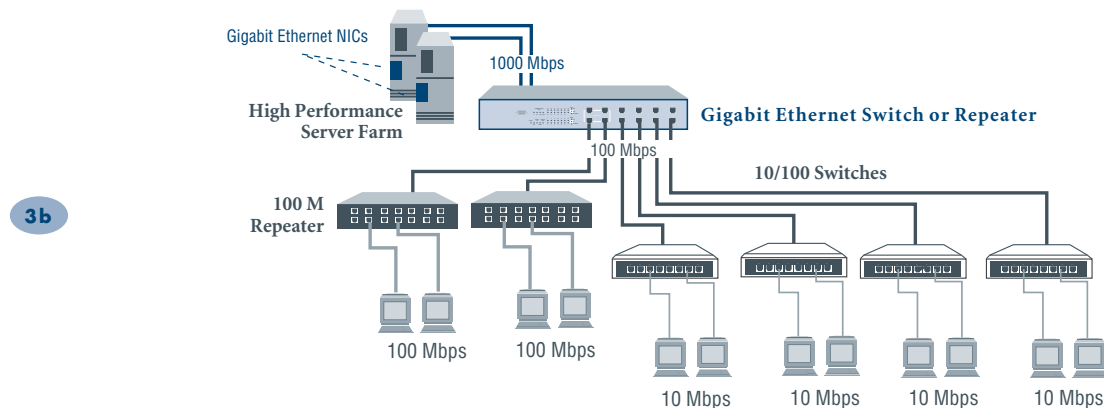
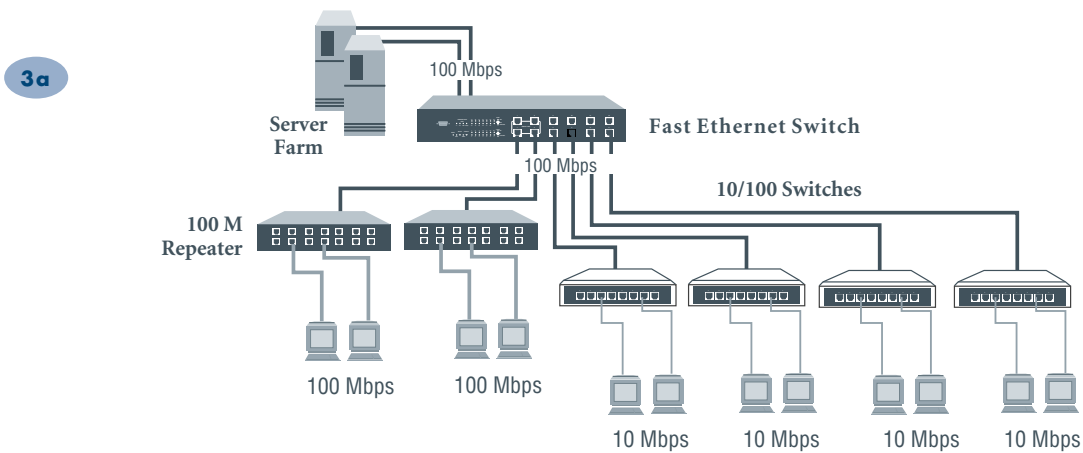
In all scenarios the NOS, applications, and NIC drivers at the desktop would remain unchanged. The MIS manager can also leverage not only his or her existing multimode fiber but also the current investment in network management applications and tools.

Upgrading Switch-to-Switch Links A very straightforward upgrade scenario is upgrading 100-Mbps links between Fast Ethernet switches or repeaters to 1000-Mbps links between 100/1000 switches. Such high-bandwidth, switch-to-switch links would enable the 100/1000 switches to support a greater number of both switched and shared Fast Ethernet segments. Figure 2a illustrates the network prior to upgrade, while Figure 2b illustrates the network after upgrading to Gigabit Ethernet.



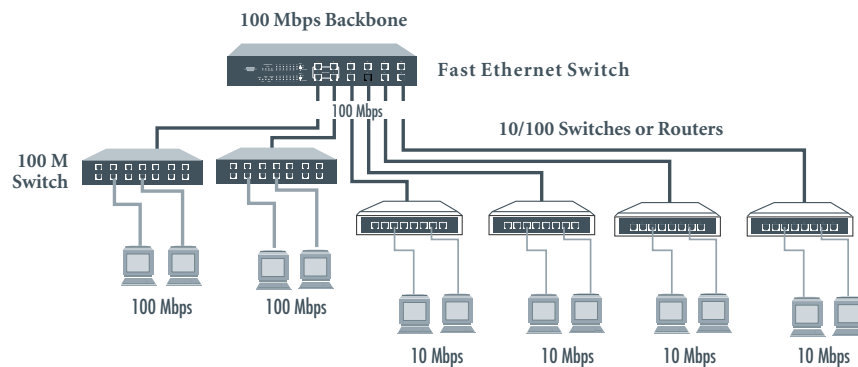


Upgrading Switch-to-Server Links The simplest upgrade scenario is upgrading a Fast Ethernet switch to a Gigabit Ethernet switch to obtain high-speed, 1000-Mbps interconnection to a server farm of high-performance super servers with Gigabit Ethernet NICs installed. Figure 3a illustrates the network prior to upgrade, while Figure 3b illustrates the network after upgrading to Gigabit Ethernet.

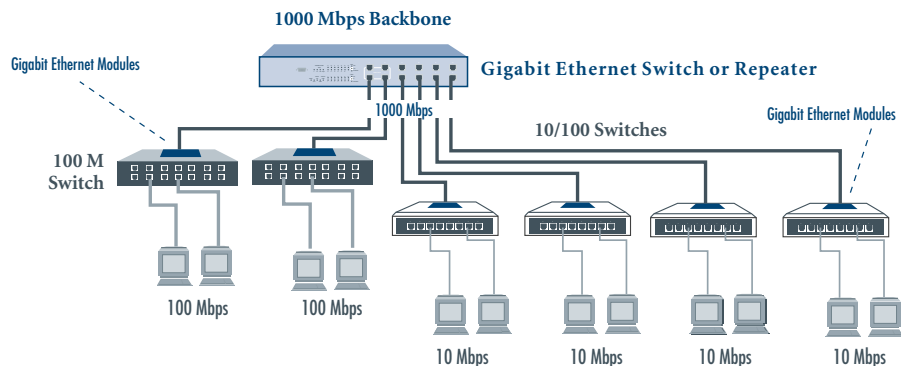


Upgrading a Switched Fast Ethernet Backbone A Fast Ethernet backbone switch that aggregates multiple 10/100 switches can be upgraded to a Gigabit Ethernet switch supporting multiple 100/1000 switches as well as other devices such as routers and hubs with Gigabit Ethernet interfaces and uplinks. Gigabit repeaters can also be installed as needed. Once the backbone is upgraded to a Gigabit Ethernet switch, high-performance server farms can be connected directly to the backbone with Gigabit Ethernet network interface cards, increasing throughput to the servers for users with high-bandwidth applications. Also, the network can now support a greater number of segments, more bandwidth per segment, and hence a greater number of nodes per segment. Figure 4a illustrates the network prior to upgrade, while Figure 4b illustrates the network after upgrading to Gigabit Ethernet.

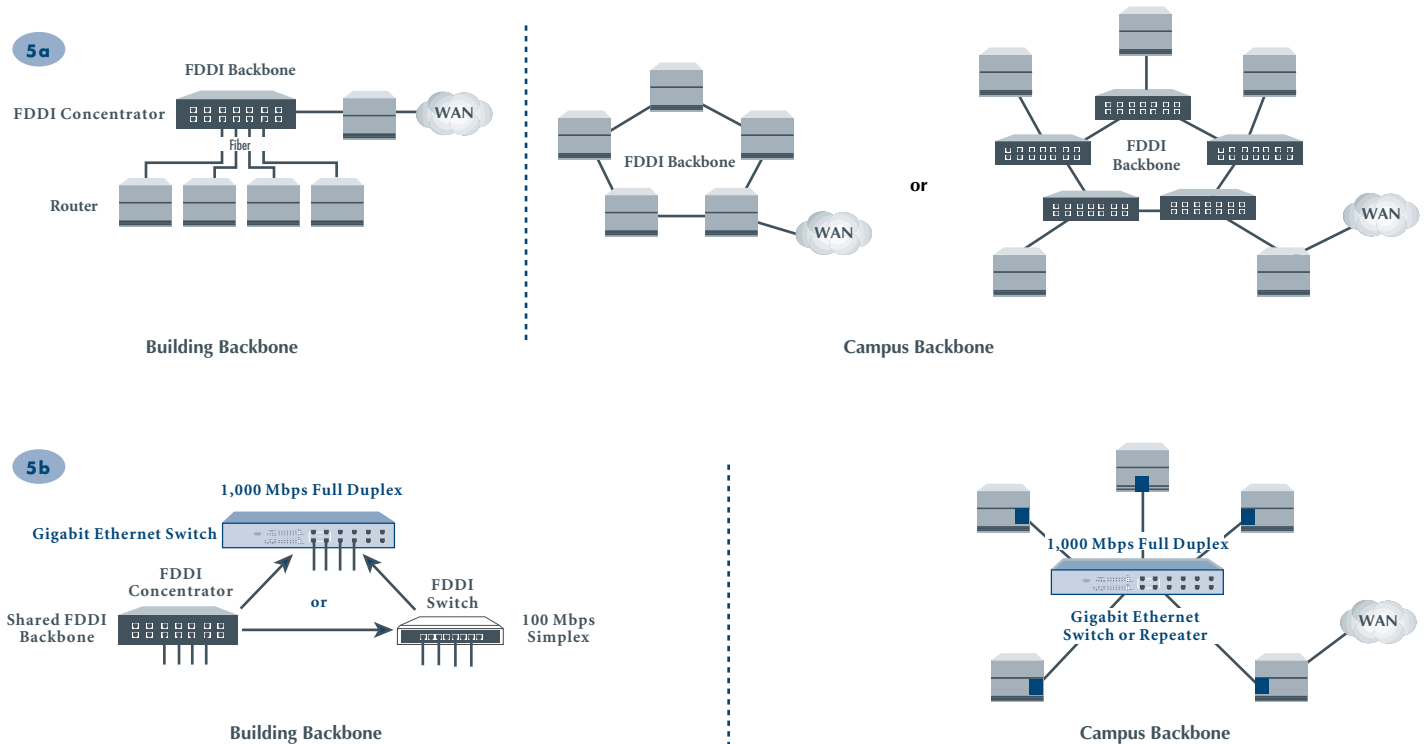
4a



4b



Upgrading a Shared FDDI Backbone An FDDI campus or building backbone can be upgraded by replacing the FDDI concentrator or hub or Ethernet-to-FDDI router with a Gigabit Ethernet switch or repeater. (As an intermediate step, some users might migrate to an FDDI switch before installing a Gigabit Ethernet Switch.) The only upgrade required is the installation of new Gigabit Ethernet interfaces in the routers, switches or repeaters. All the investment in fiber-optic cabling is retained, and the aggregate bandwidth is increased at least tenfold for each segment. Figure 5a illustrates the network prior to upgrade, while Figure 5b illustrates the network after upgrading to Gigabit Ethernet.



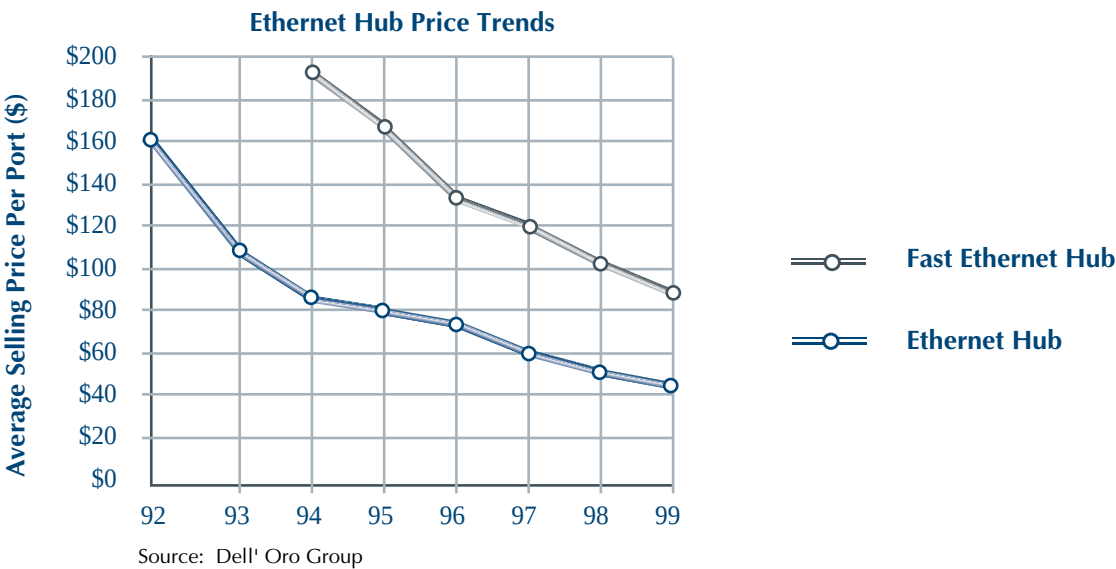
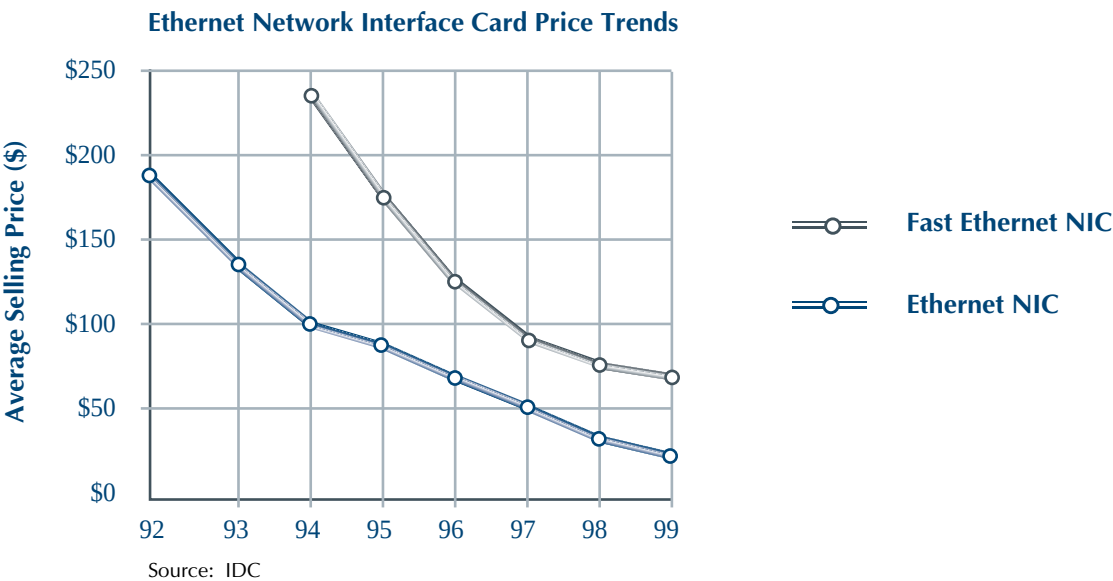
Upgrading High Performance Desktops In the later phases of Gigabit Ethernet adoption, as Fast Ethernet or FDDI connected desktops run out of bandwidth, Gigabit Ethernet NICs will be used to upgrade high-performance desktop computers with Gigabit Ethernet connectivity. The high-performance desktop computers are then connected to Gigabit Ethernet switches or repeaters. Figure 6a illustrates the network prior to upgrade, while Figure 6b illustrates the network after upgrading to Gigabit Ethernet.

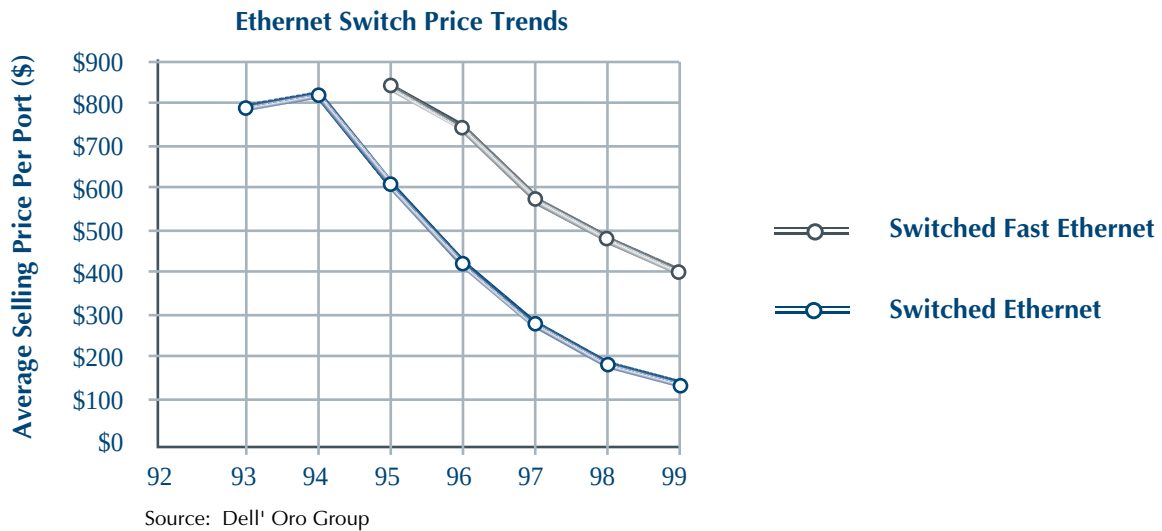


Gigabit Ethernet Cost of Ownership Expectations

Cost of ownership is an important factor to consider when evaluating new networking technology. The factors comprising cost of ownership include not only the purchase price of equipment, but also the cost of training, maintenance and troubleshooting.

Competition and economies of scale have significantly driven down the purchase price of Ethernet connections. Though Fast Ethernet products have been shipping only since 1994, even these products have experienced significant price declines over the past two years. These historical trends and forward projections are illustrated in the following charts.





Gigabit Ethernet will follow the same price trends as Fast Ethernet. Even early products will provide cost-effective connections for gigabit transmission rates. The IEEE's goal is to provide Gigabit Ethernet connections at two to three times the cost of the 100Base-FX interface. As volume builds, reduced line width IC processes are implemented (small line width reduces the size of the IC and therefore cost) and low-cost opto-electronic devices are developed, the cost for Gigabit Ethernet interfaces will decline.

Switched Gigabit Ethernet connections are expected to be lower in cost than 622-Mbps ATM interfaces, assuming identical physical media interfaces. This is due to the simplicity of Ethernet and the resulting reduced IC functionality required. Gigabit Ethernet repeater interfaces will be significantly lower in cost than 622 Mbps ATM connections due to the simpler nature of these half-duplex systems, providing users with cost-effective alternatives for data center network backbone and server connections. Table 5 illustrates current prices for Ethernet, Fast Ethernet, FDDI, 622 ATM multimode and the target range for Gigabit Ethernet based on the IEEE 802.3z goals.

Technology	Equipment Type	1996 Equipment Price/Port	1998 Equipment Price/Port	Change %
Shared Fast Ethernet	Hub	\$137	\$102	-25%
Switched Fast Ethernet	Switch	\$785	\$500	-36%
Shared FDDI	Concentrator	\$835	\$680	-19%
Switched FDDI	Switch	\$4000	\$3200	-20%
ATM 622 Mbps (multimode fiber)	Switch	\$6600	\$4200	-36%
Shared Gigabit Ethernet Estimates Based on IEEE Goals (multimode fiber)	Hub	N.A.	\$920 to \$1400 ** (2x to 3x Fast Ethernet MM)	
Switched Gigabit Ethernet Estimates Based on IEEE Goals (multimode fiber)	Switch	N.A.	\$1850 to \$2800 ** (2x to 3x Fast Ethernet MM)	

Source: Dell'Oro Group

** Estimates based on Dell'Oro Group info and IEEE Goals

Table 5. Network Connections Price For Backbones

Over time, advances in silicon, including 0.35-micron CMOS ASIC technology, will provide even greater performance gains and cost reduction opportunities that will result in a new, even more cost-effective generation of Ethernet technology. Current 0.5-micron technology can accommodate about 0.5 million gates and is limited to transmission rates of about 500 Mbps. As the industry moves to 0.35-micron processes the cost benefits are obvious. Industry analysis indicates that 0.35-micron processes will achieve 1250 Mbps operation and economically fit one million gates on a single die, more than enough to fit a complete Ethernet switch -- including management, a significant amount of buffer memory, and an embedded 32-bit controller -- on a single die.

Finally, the cost of training, maintenance and troubleshooting for Gigabit Ethernet will be far lower than other technologies because the installed base of users is already familiar with Ethernet technology, maintenance and trouble shooting tools. Gigabit Ethernet requires only incremental training of personnel and incremental purchase of maintenance and troubleshooting tools. Not only will training costs will be lower, but deployment of Gigabit Ethernet will be faster than alternative technologies. Once upgraded with training and tools, network support personnel will be able to confidently install, troubleshoot and support Gigabit Ethernet installations.

The Emerging Gigabit Ethernet Standard -- IEEE 802.3z

One of the primary objectives of the Gigabit Ethernet Alliance is to accelerate the standards activity for Gigabit Ethernet. Similar to 100Base-T and Fast Ethernet, Gigabit Ethernet is expected to be an extension to the familiar, well established Ethernet standard, IEEE Std 802.3.

The standards effort for Gigabit Ethernet is expected to be completed much faster than comparable high-speed networking alternatives. Fast Ethernet took approximately 13 months to go from first draft to final approval. Gigabit Ethernet should require approximately the same amount of time reach similar milestones. The goal of the IEEE 802.3z Gigabit Ethernet Task Force is to complete the Gigabit Ethernet standard by 1998, although pre-standard products are expected to appear in 1997. Interim milestones include basic concept agreement by the end of 1996 and start of the 802.3 working group ballot in mid-1997.

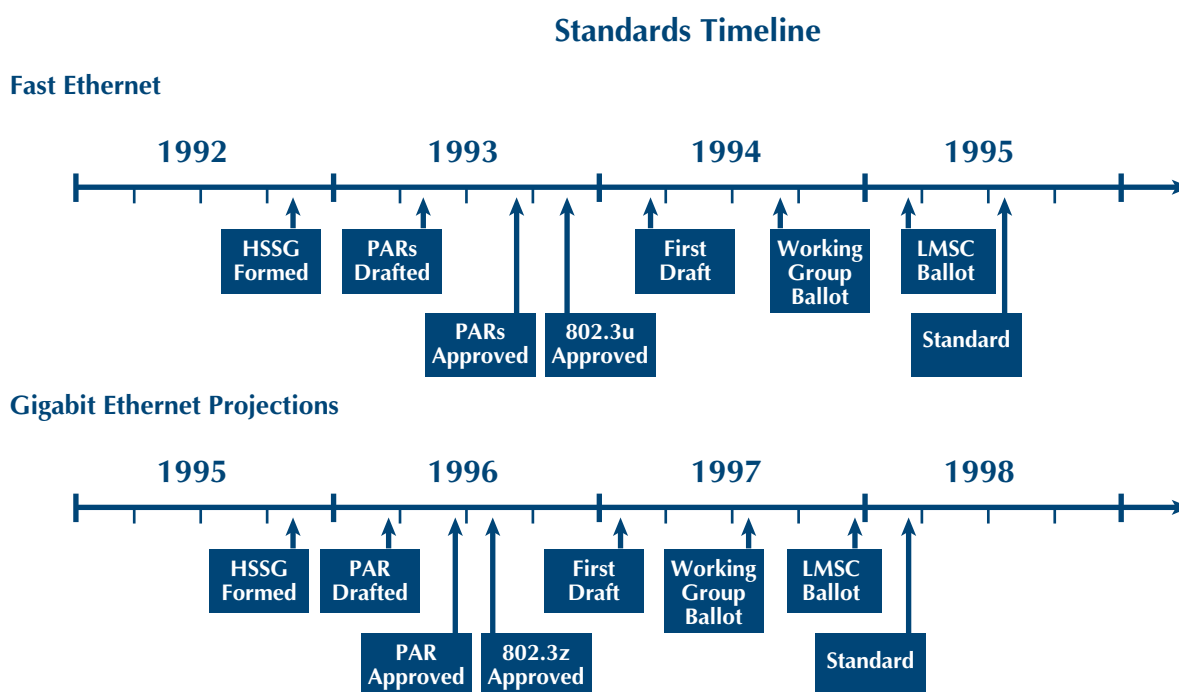


Figure 7. Fast Ethernet and Gigabit Ethernet Standards Time Lines

Gigabit Ethernet is already well into the standards process. In November 1995, the 802.3 Working Group commissioned the Higher Speed Study Group to consider scaling Fast Ethernet to a higher speed. During their deliberations, the study group considered the feasibility and viability of many different approaches to 1000-Mbps Ethernet. On June 20, 1996, the IEEE Standards Board approved the Gigabit Ethernet Project Authorization Request (PAR), and an IEEE 802.3 plenary session took place during the week of July 8 at the University of Twente in Enschede, Netherlands. At that plenary session, the 802.3 Working Group created the 802.3z Gigabit Ethernet Task Force.

The key objectives of the 802.3z Gigabit Ethernet Task Force are to develop a Gigabit Ethernet standard that:

- allows half and full duplex operations at speeds of 1000 Mbps,
- uses the 802.3/Ethernet frame format,
- uses the CSMA/CD access method with support for one repeater per collision domain,
- addresses backward compatibility with 10Base-T and 100Base-T technologies.

In addition, the task force also identified three specific objectives for link distances: a multimode fiber-optic link with a maximum length of 500 meters; a single-mode fiber-optic link with a maximum length of 2 kilometers; and a copper based (coaxial cable, for example) link with a maximum length of at least 25 meters. The IEEE is also actively investigating technology that would support link distances of at least 100 meters over Category 5 UTP wiring. In addition, the task force has decided to include a specification for an optional Media Independent Interface (MII) in the scope of their work.

The IEEE 802.3 Working Group, through the IEEE 802.3x Task Force, has also been developing a standard for full-duplex operation. In full-duplex modes of operation, Gigabit Ethernet media access controllers will interoperate with the recently finalized technical specifications for IEEE 802.3x Full Duplex operation. The 802.3z Gigabit Ethernet Task Force has also adopted the 802.3x specified flow control mechanism for use on Gigabit Ethernet interfaces.

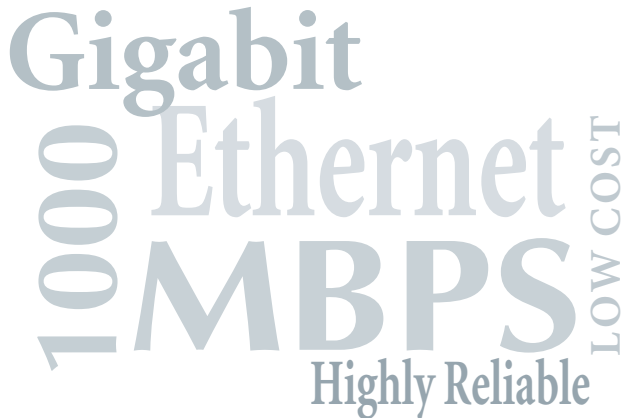
Further, the Gigabit Ethernet MAC will be specified for half-duplex, repeater-based operation at network diameters to 200 meters through a single repeater. Contributions at the IEEE 802.3z have focused on methods for extending the current 512-bit "slot time" (51.2 μ s for 10 Mbps, 5.12 μ s for 100 Mbps) used for collision detection and recovery in CSMA/CD so that larger network diameters can be supported.

The IEEE 802.3z standard will evolve over the coming months to become the basis for equipment supplier implementations of Gigabit Ethernet. The Gigabit Ethernet Alliance membership is committed to accelerating the development and implementation of the IEEE 802.3z standard.

Gigabit
Ethernet
1000 MBPS
10 Gbps
Highly Reliable

About the Gigabit Ethernet Alliance

Objectives The Gigabit Ethernet Alliance is an open forum whose purpose is to promote industry cooperation in the development of Gigabit Ethernet. The primary objectives of the Alliance are:



- Fully support the Gigabit Ethernet standards activities being conducted in the IEEE 802.3z working group.
- Contribute technical resources to facilitate convergence and consensus on technical specifications.
- Provide resources to establish and demonstrate product interoperability.
- Foster two-way communications between potential suppliers and consumers of Gigabit Ethernet products.
- Recruit new members to participate in the Alliance.

Scope and Membership The Gigabit Ethernet Alliance builds on its members' past experience and success with the Fast Ethernet Alliance. The Alliance has the following organizational structure:

- A Steering Committee which is responsible for oversight of all Alliance activities
- A Technical Sub-group
- A Marketing and Communications Sub-group

Gigabit Ethernet Alliance Web Site Membership in the Alliance and participation in Alliance activities is open to all interested parties. For more information on Gigabit Ethernet and the Gigabit Ethernet Alliance visit our web site at: <http://www.gigabit-ethernet.org>

Applications Driving
Network Growth

New Capabilities

Technology

Migration

IEEE 802.3z

Gigabit
1000 Ethernet
1000 MBPS
LOW COST
Highly Reliable



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