



Things You Must Know About Gigabit Ethernet



**Network managers
should assess
their bandwidth
needs**

1. Understanding Gigabit Ethernet

Today's network managers know that modern demands on a network by its users can shrink bandwidth dramatically. Faster computers, increased network resources and greater access to the Internet can create an unbearable strain on networks with lowered bandwidth resources.

It used to be hard to believe that any network would require more than 10Mbit throughput. The capacity of a 10Mbit network long outpaced the capacity of most computers and applications. However, with today's powerful computers, applications and peripherals, we know how quickly the 10Mbit bandwidth is filled up. Fast Ethernet evolved to provide networks with 100Mbit throughput, and in fact, mixed 10/100 networks are the most commonly used in LANs. For a while, they successfully solved bottlenecks at the backbone of the network.

Just as Fast Ethernet was introduced to increase bandwidth on 10Mbit networks, Gigabit Ethernet is now being considered to again relieve the bottleneck caused by higher performing computers, applications and peripherals. However, the decision to upgrade a network's backbone requires careful consideration of cost, interoperability and other factors that may affect performance improvement.

The Decision to Upgrade

Most decisions to upgrade a network follow the overall reduction in performance of the network. Bottlenecks can occur at the backbone, servers, server connections and the connection to the Internet. Network managers should assess their bandwidth needs based on the following:

Shared Files—Large or numerous data systems have a serious impact on the overall performance of the network.

Shared Storage—Users must access the network to store or retrieve files, impacting network traffic.

Large Server/Printer Farms—Servers, print servers and other network resources must be taken into account in order to determine their individual bandwidth needs and evaluate their impact on the network.

Video and Audio over Ethernet—Improved video and audio technologies have increased users' abilities to see and hear movies and music, increasing the strain on the network. Also, businesses use these technologies for online training, meetings and teleconferencing.

Websites as Intranet/Internet Tools—Companies today use websites as a powerful sales and marketing tool, and internal websites sometimes replace the corporate server as a place to post company information. Interaction between the corporate intranet and the Internet add substantial traffic on the network backbone. Quick and reliable access to web and ftp servers is vital to workers and customers. Since these systems are most often connected directly to the network backbone, ensuring enough bandwidth for these servers can be a problem with networks that are nearing their bandwidth limits.

The Gigabit Solution

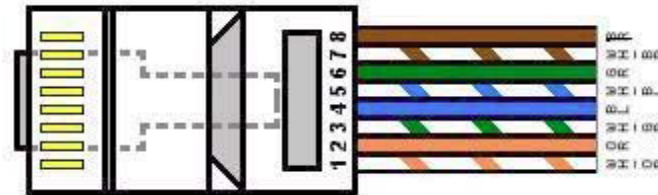
After having decided whether or not to upgrade, the network manager must decide which high-speed LAN can offer the best value. Asynchronous Transfer Mode (ATM) is a well-known alternative solution, but its higher costs associated with installation and maintenance has kept it from being widely accepted. The Gigabit solution, on the other hand, has stemmed from existing Ethernet standards with the same reliability and scalability of Fast Ethernet. IDC studies show that by the late 1990's, more than 85% of network connections were Ethernet, and Gigabit has become accepted as a logical next step for those seeking higher speeds.

The Cabling Question

Upgrading your network to Gigabit may be the logical choice, but there is still a choice to make regarding the types of Gigabit. Several cabling options are available.

1000BaseT Copper

Gigabit over copper may be the easiest, most cost-effective way to achieve Gigabit speeds. It utilizes Category 5 UTP (Unshielded Twisted Pair), or better, cabling, but requires that all 4 wire pairs be used.



For Gigabit compatibility, use all 4 wire pairs of your standard RJ-45 UTP Category 5 (or better) cable

Copper is less expensive than Fiber media, and is already widely used in many networks. Therefore, Gigabit over copper can offer all the benefits of Gigabit Ethernet without significantly restructuring existing cabling systems. UTP cabling is durable and easily maintained, but has the same distance limitations (100 meters maximum) as Fast Ethernet.

Deploying Gigabit over Category 5 UTP is not difficult, physically, but special precautions must be taken to prevent problems when adding 1000BaseT into a network.

As mentioned above, Gigabit requires the dedicated use of all four pairs of wires in the UTP cable. With Ethernet and Fast Ethernet, it was possible to use only 2 pairs of wires for data transmission, and the network manager could sometimes use the remaining pairs for secondary data transmission, or for a Voice connection. Using all 4 pairs is necessary to overcome the following

issues that arise with Gigabit over copper:

Attenuation—Signal loss of the cabling from the transmitter to the receiver. In order to maintain the 100m distance, attenuation increases with frequency; therefore, all 4 pairs are used to maintain a low frequency, thereby keeping attenuation at an acceptable level.

**Individual links
need to be tested
for compatibility
with Gigabit over
copper**

Echo—An unwanted signal generated where both the transmit and receive signal occupy the same wire pair. The signal bounces between the transmit and receive wires, and as echo builds, data transmission degrades until the signal is lost.

Return Loss—Amount of the power reflected due to a mismatch in cabling impedance.

Cross Talk—An unwanted signal between adjacent wire pairs. Since Gigabit Ethernet utilizes all 4 pairs, it is especially sensitive to cross talk of all kinds (near-end, far-end and equal level far-end cross talk).

Protection from outside signal emissions becomes critical under 1000BaseT specifications. That means that the network cabling must be installed in a manner that will avoid radiated energy sources. Generators, fluorescent lighting, elevator motors, medical diagnostic equipment (X-ray, MRI, etc.), AM and CB radio and other electrical devices can all affect wire signal quality, and therefore, network viability.

Another specification to note is that Gigabit Ethernet only supports one repeater per collision domain, whereas Fast Ethernet supports up to 2 repeaters, and 10Mbit Ethernet supports up to 4 repeaters in a collision domain.

Testing Your Existing Cable

Cabling runs conforming to current TIA/EIA-568A (1995) requirements should support 1000BaseT operation. Individual links should be tested per ANSI/TIA/EIA-TSB-67 "Transmission Performance Specifications for Field Testing of Twisted Pair Cabling System" with the additional tests parameters for FEXT (ELFEXT) loss and return loss. This is due to be included as an addendum to ANSI/TIA/EIA-568-A. The quality of the crimping job performed on cable ends is critical. For example, the amount of untwisting in a pair as a result of termination to connecting hardware cannot exceed 13mm (0.5in), or the connecting hardware may not meet current ANSI/TIA/EIA-568-A requirements and may need upgrading. Likewise, it should be verified that ALL 4 pairs are crimped.

It is also important to ensure that RJ45 wall jacks, horizontal cabling and connectors (including all wiring closet components) meet or exceed the ANSI/TIA/EIA-568-A requirements.

Any parts of the cabling system that fail the ANSI/TIA/EIA-TSB-67 field test should be repaired or replaced before continuing the migration to 1000BaseT.

1000BaseSX Fiber

One form of Gigabit over fiber is the 1000BaseSX specification, which employs short-wave light lengths to transmit data. It uses 62.5-micron multimode fiber for operation at 160-200MHz. It has a range of 2 to 275 meters (ISO/IEC 11801 building wiring standard). 1000BaseSX also operates using 50-micron multimode fiber for operation at 400-500MHz and has a range of 2 to 550 meters (ANSI Fibre Channel specification).

**Moving to Gigabit
Ethernet depends on
the existing
hardware**

1000BaseLX Fiber

This more costly form of Gigabit over fiber uses long-wave light lengths to transmit data, and uses both 62.5-micron and 50-micron multimode fiber. Its range is 2 to 550 meters for both media types.

Using 9-micron single mode fiber under 1000BaseLX, the maximum distance reaches 5 km.

Fiber has the obvious advantage in distance (and is not susceptible to the signal issues mentioned above), but the installation and maintenance of fiber-optic cabling is more difficult, and therefore expensive. It generally requires professional installation and extra training, and is more susceptible to breakage.

2. Assessing Interoperability

How the network manager implements the migration to Gigabit Ethernet will depend on the existing network hardware. The following network scenarios describe how the Gigabit Ethernet migration can be accomplished:

Legacy 10Mbit Networks

Virtually all 1000BaseT products on the market today support 100/1000 auto-negotiation. Adding a couple 10/100 switches and network cards will convert your 10Mbit network to a 100TX. From here, the network manager can continue to add Gigabit Ethernet switches as necessary to accomplish higher speeds. Alternatively, you could choose a newer Gigabit switch that supports 10/100/1000 auto-negotiation, allowing your legacy 10Mbit devices to be connected directly.

Mixed 10/100 Networks

This network scenario is one of the most common, and also most likely to benefit from upgrading to Gigabit. A Fast Ethernet backbone with multiple 10/100 switches can easily benefit from adding one, or more, Gigabit Ethernet switches. Because most Gigabit switches support 100TX, they can be linked to routers and other devices that support the 100TX link.

Vendor Compatibility

Some early Gigabit products that may exist in your network might have been on the market before the standard for Gigabit Ethernet had been finalized. Broadcom, in particular, has early products that may not now be compatible with standardized Physical Layer chip sets. Some companies might not support Broadcom PHYs because of this (namely, Intel). Asante still supports use of these early Broadcom PHYs, since you can work around the incompatibility by turning off the IEEE 802.3 compatibility in the driver of your Gigabit Ethernet network card.

IntraCore switches support GBIC or module expansion slots for fiber and copper media

3. Deploying Gigabit

A network employing both copper and fiber can benefit from Gigabit products that are now available, using fiber at the backbone of the network or between buildings, and Gigabit over copper to the desktop. Asante Technologies' IntraCore switches support GBIC or Module expansion slots for fiber and/or copper media.

Modules

The IntraCore 3524 Gigabit Ethernet switch is a 24-port 10/100 unit with 2 hardware expansion slots (type IC35). It supports the following Gigabit and 10/100Mbps media modules:

- 10/100/1000BaseT
- 1000BaseX GBIC
- 1000BaseSX
- 100BaseMMFX
- 100BaseSMFX



GBICs

Gigabit Interface Converters (GBICs) are Gigabit only, and both fiber and copper GBICs are supported on all IntraCore products.



4. Utilizing Multimedia Features

Now that your network will have such increased bandwidth, the next question becomes how to manage a network's higher priority traffic. Not every user requires sophisticated applications or runs mission-critical programs, nor do they need the highest speed connections to the Internet.

Quality of Service

Quality of Service (QoS) refers to a network's ability to provide improved and consistent services, helping to manage network congestion and ensuring that throughput is maintained, even under heavy traffic conditions. Multiple priority queues help shape the traffic to guarantee that mission-critical applications get the bandwidth and priority that they need, while other applications using the link still receive their fair service.

**Gigabit Ethernet
Features support
QoS, IGMP and per-
port Security**

QoS service models differ from one another in how they enable applications to transmit and networks to deliver data. A different service model applies to file transfer and e-mail applications than to video conferencing and IP telephony.

IGMP

Internet Group Management Protocol (IGMP) also is used to manage traffic on the network. It optimizes multicast bandwidth by allowing multicast traffic only to registered users.

Security

Per-port security may be configured with programmable action (i.e., new node detection trap) and trusted MAC address tables. Network managers can control unauthorized access to network devices by configuring "trusted" MAC addresses per port on switch models. When configured for security, the ports "learn" trusted addresses either automatically through the connected stations, or manually from the network manager. Only traffic from these trusted MAC addresses are allowed through the port. If a violation occurs, network managers are able to configure ports to ignore the violation, send a Simple Network Management Protocol (SNMP) trap, or block access.



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