31392mvpR1.qxp 9/20/2006 1:46 PM Page 1

The demands on customer-owned networks continue to increase, with companies requiring performance, flexibility, expandability and reliability. Convergence is increasingly a reality for companies who must now address bandwidth demands and the need to access data on a real-time basis. With email, data, voice and video all traveling over the same network, and new applications sure to emerge in the future, network managers must build non-blocking networks with enough "headroom" to meet emerging bandwidth demands.

Of course, bandwidth desires must be balanced with economic realities. Network managers are scrutinizing the bottom line, looking for infrastructure solutions that are economic to install and which offer the flexibility and performance to last for several years. For too long, this focus on installed first cost has meant that network designers dismissed fiber-based networks as too expensive to justify.

Fiber-based solutions are no longer expensive

Today, the myth that fiber-based solutions are significantly more expensive than UTP-based networks is no longer true. Fiber-based solutions are available at cost parity, or even less, than traditional UTP copper-based solutions. This fact surprises many users, who might not be aware of the changes that have occurred in the industry over the past three years. Several factors are influencing this change:

- New applications are pushing copper to the edge of performance capability.
- The cost of optoelectronics has been drastically reduced.
- New fiber-friendly architectures have been ratified (or standardized).
- Improved fiber interconnect technology is available.
- The costs for new grades of UTP copper are much higher.
- Testing of fiber optic cable links remains simple, while testing copper links has become increasingly complex.

To allow users to compare the installed first costs of copper and fiber standards-compliant architectures, the Fiber Optics LAN Section (FOLS) developed an interactive cost model that can be downloaded at no cost from our Web site (www.fols.org). The model includes hierarchical star, centralized cabling, and Fiber-to-the-Telecom Enclosure architectures and can be completely customized by the user to reflect the needs of their application.

The benefits of fiber

Comparing fiber to UTP cable on performance alone, there is little question that optical fiber offers significant benefits to users' networks. These include:

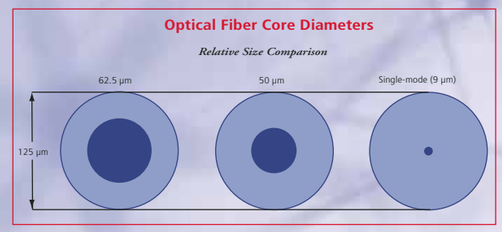
- Longer cable spans. Optical fiber's high bandwidth and error-free transmission supports cable runs of 300 meters (m) or more, at data rates from 10 Mbps to 10 Gbps. This is an advantage for applications with long cable runs, such as museums, airports and industrial plants. It also enables users to centralize electronics in a single location, thereby reducing costs by consolidating the electronics and improving port utilization.
- The ability to support higher data rates without recabling. UTP users typically must upgrade their cable plant to support new protocols every 2-5 years; fiber installations last 15 years or longer, saving companies the cost of pulling new cable and the cost of shutting down their networks during upgrades.
- Ease of handling, installation and testing. Compared to newer grades of UTP copper, optical fiber is easier to handle and install. Fiber cables are light in weight and small in diameter, which means that they fit easily in existing duct space. Fiber remains easy and straight forward to test, too. While newer UTP copper cables must be tested for attenuation, cable length, return loss, propagation delay, NEXT, FEXT, ELNEXT, ELFEXT, PSNEXT, ANEXT, AFEXT, etc., fiber cables need only be tested for attenuation. The remaining parameters for fiber cables are guaranteed by the manufacturer and, unlike UTP, are not affected by the installation process.
- Greater security. Fiber offers greater resistance to tapping making it more secure as a transmission medium. Fiber-based architectures, such as centralized cabling, also enable physically secured networks because there are fewer TRs to monitor and keep secure.
- Lower power consumption: High-speed copper solutions consume more power, driving up costs and reducing reliability.
- Non conductive: Unlike copper cables, fiber cables are immune to Electromagnetic or Radio Frequency interference. They also do not experience issues with alien cross-talk, which can affect UTP cables supporting high bandwidth applications.
- Non blocking. Now that convergence is becoming a reality at many companies, building non-blocking networks is increasingly important. While small delays in transmission may not affect data, they are unacceptable when transmitting video or voice.
- Lower maintenance. Studies have shown that fiber-based networks are more reliable than their copper counterparts, exhibiting error-free transmission. In addition, centralizing electronics facilitates maintenance and troubleshooting. In a business environment geared toward "zero downtime" fiber is the obvious choice.

Which type of fiber is right for your network?

Multimode fiber is the most common type of fiber deployed in customer-owned networks. It derives its name because the light-carrying region of the fiber, or core, is designed to carry multiple modes of light. Multimode fibers are described by the diameter of their core: 62.5/125 microns (µm) or 50/125 µm. Both fibers were developed to work with lower cost LED light sources, which emit a broad spectrum of light in the 850 nm transmission window. Laser-optimized multimode fiber, also known as OM3 (per ISO 11801 Generic Cabling for Customer Premises), is a 50 µm fiber designed specifically for use with 850 nm VCSELs to support 10 Gb/s and beyond.

Single-mode fiber carries only a single mode of light down its central core. It has a much smaller mode field, and is used with ultra-precise lasers, which emit a much narrower beam of light in either the 1310 or 1550 nm transmission windows. Single-mode fiber systems, although costly for short links, are sometimes used in building backbones because of their ability to support very high data rates and distances well beyond 300 m.

62.5/125 µm multimode fiber was the predominant fiber in North American customer applications for many years. It was optimized for Ethernet (10 MbE) and supported applications up to Gigabit Ethernet (1 GbE). The availability of low cost 850 nm vertical cavity surface emitting lasers (VCSELs) coupled with the need to support increased data transmission rates has encouraged a migration to 50 µm multimode fiber, which offers more bandwidth.



Bandwidth is specified as a bandwidth-distance product measured in units of Megahertz•Kilometer (MHz•km). The bandwidth needed to support an application depends on the data rate. As the data rate increases (MHz), the distance that higher rate can be transmitted decreases (km). Thus, a greater fiber bandwidth enables you to transmit at higher data rates or for longer distances. OM3 50 µm multimode fiber is optimized for use with lasers. It offers greater than 10 times more effective modal bandwidth (2000 MHz•km) than FDDI-grade 62.5 µm fiber (160 MHz•km) at 850 nm and is poised to support the next generation of Gigabit Ethernet speeds.

Network designers who need to transmit at higher speeds over longer distances, such as building backbones transmitting at 1 GbE, or who anticipate upgrading to 10 GbE, typically install laser-optimized OM3 50 µm fiber for this reason. OM3 fibers, combined with 850 nm VCSELs, provide the lowest-cost solution for today's most demanding local area networks.

New architectures leverage fiber's strengths

New technologies and evolving standards are combining to make it easier to take advantage of the benefits of fiber.

Centralized Cabling, defined by TIA-568-B3, supports cable runs up to 300 m using optical fiber. It enables network planners to take advantage of optical fiber's long transmission distances to centralize network electronics -- routers, bridges, hubs and switches -- in one cross-connect or communications room in their building. This architecture provides a migration path for users to evolve from a shared bandwidth environment to a more efficient, switched environment. In addition, centralizing electronics allows users to reallocate – or reduce – the size of TRs, and simplifies maintenance and security.

Fiber-to-the-Telecom Enclosure (FTTE) is another architecture that offers users both reduced cost and increased flexibility. FTTE implementation routes the fiber backbone from the equipment room through the riser and TR into the office area, where it terminates at the TE. From there, the final drop can be fiber, copper or wireless. The flexibility of this architecture allows users to bring bandwidth closer to the user and still maximize flexibility, simplifying issues such as Moves, Adds and Changes. This architecture is defined by TIA ANSI/TIA-568-B.1-5 and TIA-569-B.

These network architectures can significantly reduce installed first costs while increasing network flexibility, simplifying network management and reducing network outages. With both centralized cabling and FTTE, planners can reduce cost by reducing the number of ports and chassis throughout their networks, which reduces the number of electronic components.

Fiber is the right choice today

The introduction of new fiber architectures combined with technological improvements in fiber components is making optical fiber-based networks an even more economical solution than ever before — especially when users look at total network costs, rather than just individual components. FOLS encourages users to download our free, interactive cost model when making network infrastructure decisions and to consider the following:

- Cabling Component Costs: While the costs for fiber components (cable, wall outlets, patch panels, cords, and connectors) have steadily decreased, more stringent requirements for Category 5e UTP and future Category 6 and 6a cabling are increasing the cost of copper-based systems, components and testing.
- Electronics Costs: The cost for fiber-based hubs concentrators and network interface cards for fiber is falling. What's more, the industry is developing architectures that allow users to install fewer electronics, maximize port utilization, and reduce overall system costs.
- Productivity Costs: According to a Communications Week user survey, copper-based networks average 2.3 network outages per month, at an-average cost of $19,175. Installing fiber reduces the chance of outages by at least 17 percent because of its immunity to factors that affect copper.
- Maintenance Costs: Fiber networks typically cost less to maintain than copper networks because they exhibit fewer problems, often use fewer electronic components, and are easier to troubleshoot when electronics are centralized. In addition, reducing the number of TRs can help improve network security.
- Operating Costs: 10 Gb/s optical transceivers typically require ~2 watts of power to operate, whereas 10 Gb/s transceivers used with copper networks are expected to require between 8 and 15 watts. The reduced power consumption of optical transceivers results in lower power consumption and in reduced cooling costs vs. copper-based systems. The reduced heat dissipation with optical networks also allows for increased port density.
- Recabling Costs: Because multimode optical fiber has proven performance at 10 Gbps and beyond, there is no need to pull new cable to support higher data rates or emerging protocols. Therefore, optical fiber eliminates the expense and disruption associated with pulling new cable.

To learn more about optical fiber technology, to read case histories and applications stories or to download our free cost model, please visit ***www.fols.org***.

31392mvpR1.qxp 9/20/2006 1:46 PM Page 2

The FOLS focuses on educating end users and influencers about the technical advantages and affordability that optical transmission brings to customer-owned LANs. FOLS members are leading fiber cable, component and electronics companies including 3M, ADC, Berk-Tek, a Nexans Company, CommScope, Corning, Corning Cable Systems, Draka Comteq, Leviton Voice & Data, OFS, Ortronics/Legrand, Panduit, Sumitomo Electric Lightwave, and Tyco Electronics.

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The Benefits of Fiber: Enhanced Performance, Superior Reliability, and Lower Cost

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