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CABLING, WIRING AND ENCLOSURES

Made for speed

Fiber-optic cabling extends enterprise network.

by Anthony Cicero

The cabling industry faces the critical point where improving the technology supporting high-bandwidth applications over copper backbones will become more costly than accomplishing the same speeds over fiber. As enterprises deploy more bandwidth-hungry applications like voice over IP and multicast video, bandwidth limitations will need to increase 40% within five years to support growing demands from mission-critical applications.

To make fiber affordable, the industry has developed solutions extending the distance Gigabit Ethernet can travel between nodes before being enhanced. With the bulk of fiber's cost residing in electronic components, a fiber-optic cable that transmits data further reduces the number of active electronics and greatly lowers the costs associated with fiber networks.

Optical multimode 3 (OM3) fiber supports extended gigabit drive distances, pushing the evolution and extension of enterprise networks. By allowing companies more flexibility in Gigabit Ethernet systems, such fiber solutions are paving the way for 10G+ Ethernet and fiber-to-the-desktop (FTTD) solutions.

The two most important factors businesses should consider when installing all-fiber networks are bandwidth needs and the total cost of ownership for fiber vs. copper systems. Although copper has generally been more cost effective for networking horizontal runs from the data closet to the desktop, it will run into a dead end when businesses require 10-gigabit speeds and beyond. For companies continuing to use only megabit data speeds, such as Ethernet (10 Mbps), Fast Ethernet (100 Mbps) and Gigabit Ethernet (1Gbps), copper will remain the better choice.

In addition, vertical data speeds, which are typically five years ahead of horizontal speeds, are accelerating at rates beyond normal expectations. The vertical cabling that runs to data rooms from each floor in the building is expected to reach 10 Gbps by 2003, 100 Gbps by 2005 and 1 Tbps by 2008. Since 80% of mission-critical data travels over the vertical backbone, network planners should develop vertical networks capable of supporting terabits, petabits and beyond.

When deploying an all-fiber network, there are three types of

optical mode (OM), multimode fiber that are designed for vertical and horizontal usage: OM1, which is 62.5/125 micron; OM2, which is 50/125 micron; and OM3, which is high-bandwidth 50/125 micron.

OM3 fiber offers the highest bandwidth and is the newest approved standard from the International Organization for Standardization and the International Engineering Consortium. It is essentially a multimode fiber that can utilize lower-cost light sources, such as light-emitting diodes or vertical cavity surface-emitting lasers (VCSEL), to achieve speeds and distances previously only possible through more expensive single-mode fiber solutions. It is also the most robust, highest-bandwidth multimode fiber solution, allowing network designers increased flexibility and functionality in data network design.

Using OM3 fiber allows network designers to design a fiber network robust enough to handle emerging technologies, while utilizing lower-cost optical light sources. In new installations, using OM3 multimode fiber will extend drive distances with lower-cost 850-nm optical transceivers, instead of the expensive high-end lasers associated with single-mode fiber solutions. The cost of high-end 1550-nm laser transceivers is approximately 10 times more than 850-nm VCSEL transceivers.

OM3 fiber is different from other multimode fibers, due to the quality of its glass. In standard multimode fiber, there are small imperfections called index depressions on the axis of the glass. These index depressions alter the refractive index and parabolic profile across the diameter of the fiber. With advances in fiber technology, these imperfections had no effect because LED systems use the whole parabolic profile across the full diameter of the glass.

By contrast, VCSEL technology guides light into the central region of the fiber, and index depressions have a negative effect on performance. For OM3 fiber, a refined manufacturing process called modified chemical vapor deposition is used to eliminate index depressions, creating a perfect circumference in the radial position of the glass. Modal dispersion is reduced, and a cleaner optical signal is transmitted.

This procedure improves bandwidth, allowing for greater speeds and extended drive distances. With OM3 fiber, the VCSEL transceiver can guide light into the central region of the core, which can guarantee up to 2,000 MHz of bandwidth up to 1,000 meters. OM1 fiber can only provide 200 MHz up to 275 meters and OM2 fiber only provides 500 MHz of bandwidth up to 500 meters.

OM3 fiber is being made flexible enough to support FTTD applications. With MT-RJ and VF-45 small form factor (SFF) connector technology, terminating fiber is faster and more durable than before. Fiber components and distribution

equipment are easier to manage and take up less real estate.

Using SFF technology makes terminating and patching fiber as quick and easy as in a copper environment. VF-45 connectors, which are fiber's version of RJ-45 connectors for copper, are used for patching and desktop connectivity. The durable connectors are suited for areas in which they typically could be kicked or ripped away accidentally from a wall socket.

In addition, with fiber's ability to extend drive distances in vertical runs, several floors can be connected to a common data room and the same electronic components. With a copper solution, active equipment and a data room are generally used on every floor.

Fiber-optic backbones will play an increasingly important role in the evolution and extension of the enterprise network. As the technology becomes more practical, robust and cost effective, companies will find that switching to fiber is necessary as they max out the bandwidth of their current copper networks.

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Extending performance

New net apps–streaming video, high-resolution graphics and complex scientific modeling–continue to pressure bandwidth requirements at the desktop and backbone. Many customers have turned to Gigabit Ethernet (1,000 Mbps) to maintain acceptable LAN performance levels.

Gigabit Ethernet and 10 Gigabit Ethernet (10GigE) demand faster optical sources to support the rapid modulation rates necessary for intelligible bit streams, yet they still need the low-cost advantages that propelled Ethernet to be the most popular LAN application.

The industry has developed and refined a cost-effective laser technology called the vertical cavity surface-emitting laser (VCSEL) for short-wavelength (850 nm), high-speed data applications. The standard 62.5/125-micron and 50/125-micron fibers can support VCSELs used for Gigabit Ethernet and similar data rates for LAN networks. To take advantage of 10-Gbps VCSEL technology, however, a higher bandwidth fiber was needed.

The challenge is to create a premises cabling infrastructure capable of providing a migration path from 10 Mbps to 10 Gbps on the same fiber, using the same wavelength for the complete horizontal and riser network. With 850-nm laser-optimized

50/125-micron fiber, this is now possible.

This 10-Gbps standards-based fiber supports the applications of today, and provides protection from the expense and disruptions of re-cabling network infrastructures to support bandwidth upgrades. Fiber cable containing 850-nm laser-optimized 50/125-micron multimode fiber can reliably support 10-Gbps applications running over a 300-meter distance of structured cabling building backbones.

The fiber delivers laser bandwidth of 2,000 MHz km at 850 nm. This complies with the optical fiber performance requirements of the newest 10-Gbps laser-based standards, but its inherent 1,500/500 MHz km OFL, or overfilled launch, bandwidth also supports legacy systems using light-emitting diodes.

Because this optical fiber cable supports electronics that use low-cost 850-nm optical laser sources, customers no longer have to choose higher-cost electronics or re-cable facilities as they migrate to faster data rates. In addition, the expanded laser bandwidth at 850 nm provides extended distances of up to 900 meters for Gigabit Ethernet, offering users greater network design flexibility.

Cicero is director of technology-Americas, Network Systems & Services, ITT Industries, White Plains, NY.

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