# Update from the fiber front

## Faster, smaller and more efficient are the overriding trends that set the pace for what is to come in the networking industry.

For this issue's article I wanted to focus on optical fiber networks and cabling requirements to support 10 Gigabit Ethernet and beyond.

It is important to understand the capabilities of different fiber types when choosing the right fiber to support existing and future applications.

At the same time, I wanted to summarize some of the deliberations going on in the IEEE 802.3 Higher Speed Study Group (HSSG) for future 40 Gb/s and 100 Gb/s Ethernet networks.

As a starting point, let's look at the fiber types that are recognized in the TIA standards. Annex E of TIA 568 B.1 Standard provides optical fiber applications support information for conventional 62.5/125 µm and 50/125 µm multimode fiber, commonly designated as OM1 and OM2 fibers respectively, as well as single-mode fiber.

For the 1000BASE-SX (Gigabit Ethernet) application, the maximum supportable distance is 220 metres for OM1 multimode fiber and 550 metres for OM2 multimode fiber.

In February 2003, TIA published Addendum 4 to TIA 568 B.1 standard. This recognizes Laser-Optimized 50/125 µm Multimode Optical Fiber, commonly designated as OM3 fiber. The requirements for this fiber are specified in ANSI/TIA/EIA-568-B.3-1.

At the same time, TIA published Addendum 3 to TIA 568 B.1. This provides additional support information for the 10 Gigabit Ethernet application for different fiber types.

10GBASE-S uses VCSEL lasers operating at 850 nm wavelength over multimode fiber. It is a more cost effective technology than 10GBASE-L and 10GBASE-E for in-building applications. Multimode OM3 fiber is the preferred choice for in building cabling. The manufacturing process for this type of fiber is optimized to minimize pulse spreading (also called differential mode delay) for high-speed laser applications.

The limiting distance for OM3 fiber is 300 metres at 10 Gb/s with an effective modal bandwidth of 2000 MHz. km. This fiber also supports extended reach for the 1000BASE-SX application of 1000 metres.

There are better performing laser optimized multimode fibers on the market with an effective modal bandwidth of up to 4700 MHz km and supportable distances of up to 550 metres for 10GBASE-S.

These fibers types, commonly referred to as OM3+, are not yet recognized in the standards.

They can be considered for special cases where a longer reach or a higher channel attenuation is required. In a presentation at the Canadian Regional BICSI Conference in March, Andrew Oliviero of OFS showed that the improved Inter-symbol Interference (ISI) for this type of fiber can be used to allocate a higher channel attenuation for the 10GBASE-S application of 4.5 dB compared to the 2.6 dB limit that is specified for OM3 fiber at 300 meters.

This can allow for additional connection points in a fiber channel. It should be noted that although this is theoretically possible, this additional allocation is not officially sanctioned in the IEEE 802.3 standard and would need to be validated in practice.

The IEEE 802.3 higher speed study group (HSSG) is currently studying different technologies to support higher data rates of 40 Gb/s and 100 Gb/s over multimode and single mode fiber.

The current objectives include support for at least 100 metres over OM3 multimode fiber and 10 km to 40 km over singlemode fiber. The technologies under consideration include:

For 100Gb operation:

- 64b/66b or 8b/10b coding per lane
- 10-lane configuration option to support 10 x 10 Gb/s
- or 4-lane configuration option to support 4 x 25Gb/s

For 40Gb operation:

- Will use the same coding
- Will use the 4-lane configuration to support 4x10Gb/s

The 40 Gb/s or 100 Gb/s would likely use parallel optics or a combination of parallel optics and Wavelength Division Multiplexing (WDM) to support these higher data rates using one or two 12-fiber ribbon cable(s).

Market studies show that there is a need for 100 Gb/s speeds in the backbone, especially in the financial sector with the large number of transactions that are increasing exponentially.

Also, when 10GBASE-T becomes established in the marketplace in the next three to five years, the volume of traffic will increase substantially, making it essential to have 100 Gb/s pipes for interswitch connections in the backbone and for storage gateway/server clustering.

As a sideline, I was looking at one of the contributions to the IEEE 802.3 HSSG for the supercomputing application. In one of those pictures it showed bundles of multimode fiber interconnections on four racks of that looked as congested and as dense as some installations that I have seen with copper cable.

Parallel computing requires a lot of high speed networking connections in a small physical space. In summary, faster, smaller and more efficient is the overriding trend that sets the pace for what is to come in the networking industry. CNS

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