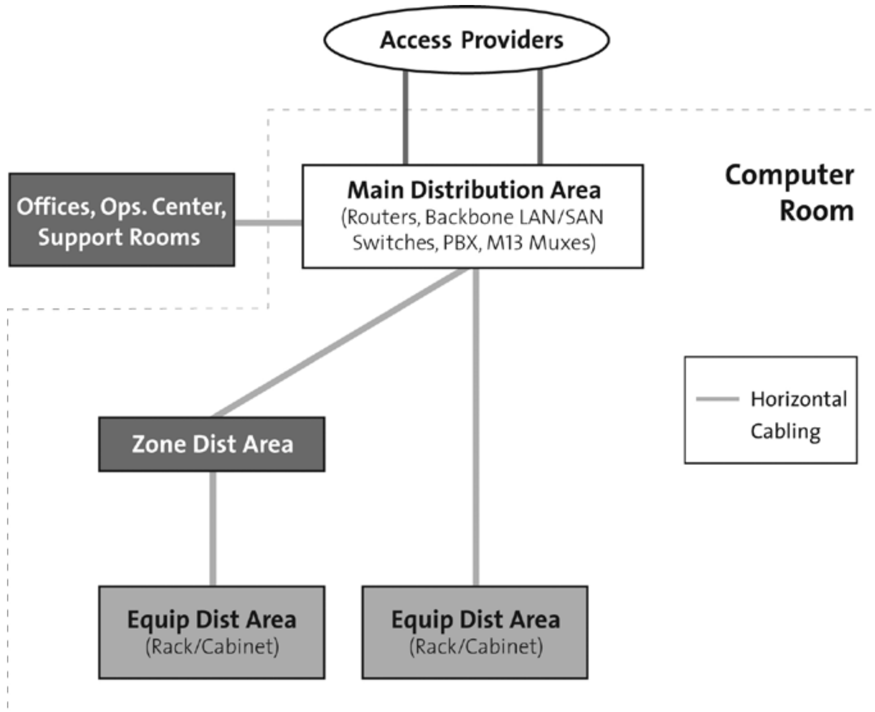
Planning Smart Solutions for the Data Center of Tomorrow

By David Hessong and Daryll Kerns



With the continued expansion and growth in the data center, a well-planned cabling infrastructure is critical for both present and future success. The fundamental concerns that a cabling infrastructure must address are reliability, manageability, scalability and flexibility. A well-planned optical cable infrastructure will typically be utilized for more than 20 years and will have to be operational through several iterations of system equipment solutions and multiple generations of protocol data-rate increases.

TIA-942

Managing the overall requirements for a data center can seem like a daunting task, but there are tools available to assist with the overall layout and design. TIA-942, *The Telecommunications Infrastructure Standard for Data Centers* provides a comprehensive synopsis for structured cabling within a data center. TIA-942 recommends using a star topology and defines the following areas and spaces within a typical enterprise data center.

ENTERPRISE DATA CENTER TOPOLOGY

The data center telecommunications spaces include the Main Distribution Area (MDA), Zone Distribution Area (ZDA) and Equipment Distribution Area (EDA). The MDA houses the main cross-connect (MC), which is the central point of distribution for the data center structured cabling solution. The ZDA is defined as the space used to implement zone distribution architecture. The ZDA, when utilized, acts as a consolidation point between the MDA and regional areas or zones within the data center. Incorporating this architecture into one's data center cabling design allows for a one-time installation of the backbone cabling and provides flexibility to accommodate frequent reconfigurations at the zone required for moves, adds and changes. The EDA is the space allocated for end equipment, including computer systems and telecommunications equipment. For optimized performance in meeting data center requirements, the topology of the cabling infrastructure should not be selected independently; infrastructure topology and product solutions must be considered in unison.

A structured cabling architecture, used in conjunction with a modular cabling solution to provide connectivity as defined by TIA-942, facilitates a flexible, manageable infrastructure. A modular cabling solution consists of distribution trunks preterminated with 12-fiber MPO connectors. These distribution trunks are then connected to modules or harnesses that break out the 12-fiber MPO connector to discrete single-fiber connectors. Patch cords are then used to connect the systems equipment to the breakout modules, thus completing the system.

By deploying a modular MPO-based cabling system, which can include MPO trunk assemblies, breakout modules and breakout harnesses, several benefits are realized. These benefits include a 50 percent cable-tray space savings, 80 percent improvement in deployment time and 70 percent bulk-cable reduction in cabinets and racks. A modular, high-density solution deployed in a structured wiring topology can easily scale to thousands of ports and significantly reduce the time to conduct moves, adds and changes in the data center, thus reducing operational costs.

THE STORAGE AREA NETWORK

While a system of trunks and modules works well in most spaces in the data center, the unique requirements of the Storage Area Network (SAN), in particular at the SAN director, often make a specialized solution desirable. Due to the extremely high port density of SAN directors, a solution utilizing modules and patch cords can require an abundance of rack space and a high density of jumpers that will require added jumper management. To deal with this unique requirement, customized harness solutions have been introduced to alleviate the aforementioned problems. A harness allows you to take advantage of the density of the MPO connector at the patch panel while still allowing discrete connectors to interface with the electronics. By utilizing a 12-fiber cable instead of individual patch cords, a harness greatly reduces congestion at the SAN director, as well as in the vertical cable managers and cable trays.

In addition to the benefits of structured cabling, the MPO-based cabling infrastructure can easily migrate to higher-data-rate technologies, including parallel optics. This technology will be utilized in 32, 64 and 128 Gigabit Fiber Channel, and 40 and 100 Gigabit Ethernet (GbE).

Serial transmission with a directly modulated 850 nm VCSEL is currently utilized for data rates up to 10 GbE. It becomes impractical to use duplex fiber serial transmission at data rates beyond 16 GbE due to the reliability concerns when the 850 nm VCSEL is directly modulated across extreme operating temperatures in the data center. As a result, 40 and 100 GbE will utilize parallel optics.

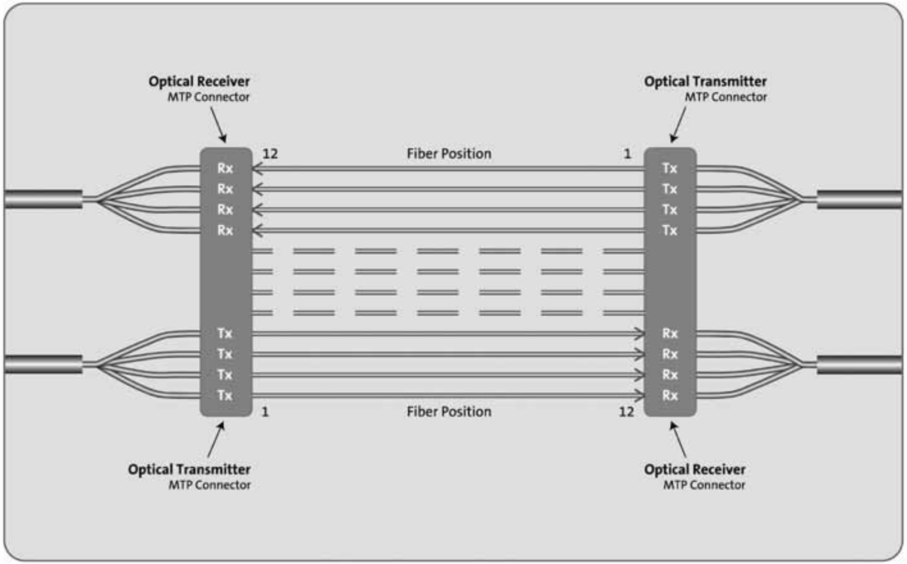
Parallel optics technology, including 850 nm VCSEL arrays and OM3 fibers, offers low-cost, high-data-rate solutions for Ethernet. Parallel optics transmission technology spatially multiplexes or divides a high-data-rate signal among several fibers that are simultaneously transmitted and received. At the receiver, the signals are de-multiplexed to the original high-data-rate signal. MPO connectivity is used throughout the parallel optic channel.

The Institute of Electrical and Electronics Engineers formed the IEEE 802.3ba task group in January of 2008 to address and develop guidance for 40 and 100 GbE data rates. The project authorization request (PAR) objectives included a minimum 100 m distance for laser-optimized 50/125 μm multimode (OM3) fiber. OM3 fiber is the only multimode fiber included in the PAR.

At the IEEE meeting in May, several baseline proposals were adopted to establish a foundation for generating the initial draft of the 40 and 100 GbE standard. Parallel optics transmission was adopted as a baseline proposal for 40 and 100 GbE over OM3 fiber. This proposal defines 40 and 100 GbE interfaces as 4x10 GbE channels on four fibers per direction, and 10x10 GbE channels on 10 fibers per direction, respectively.

Fiber bandwidth, skew and total connector insertion loss must also be considered to ensure the cabling infrastructure meets the future requirements of 40

Parrallel optics, 40GbE Drawing



and 100 GbE. By taking these factors into account, the system is assured of meeting the proposed operational distance of 100 m over OM3 fiber.

OM3 fiber is the only multimode fiber being considered for 40 and 100 GbE systems. The fiber is optimized for 850 nm transmissions and has a minimum 2,000 MHz·km effective modal bandwidth. Minimum effective modal bandwidth calculated (minEMBc) is a measurement of system bandwidth for OM3 fiber that offers the most desirable and precise measurement, compared to the differential modal delay (DMD) technique. With minEMBc, a true, scalable bandwidth value is calculated that reliably predicts system performance.

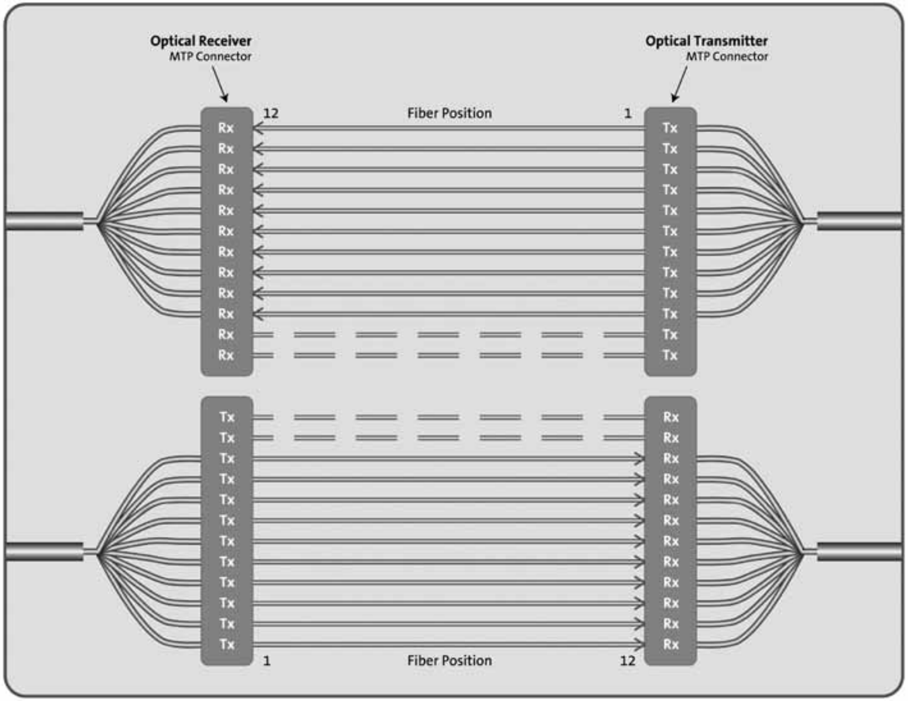
EXCESSIVE SKEW

Optical skew is defined as the time of flight difference between light signals traveling on different fibers, and it is an important consideration for parallel optics systems. Excessive skew, or delay, across the various channels can cause bit errors. Cabling skew requirements are still under consideration for 40 and 100 GbE. Deployment of a low-skew cabling infrastructure will ensure compliance across a variety of applications. For example, InfiniBand, a protocol using parallel optics transmission, has cabling skew criteria of 0.75 ns.

Insertion loss within a system channel impacts the ability of a system to operate over the maximum supportable distance for a given data rate. As total connector loss increases, the supportable distance at that data rate decreases. The currently adopted baseline proposal for multimode 40 and 100 GbE transmissions states a total connector loss of 1.5 dB for an operating distance up to 100 m. Because of this, you should evaluate the insertion loss specifications of connectivity components when designing data center cabling infrastructures. Low-loss connectivity components allow for maximum flexibility by enabling the option to introduce multiple connector matings into the system link.

A well-designed cabling architecture, implemented in accordance with TIA-942 and incorporating a modular cabling design, provides the reliability, manageability, scalability and flexibility needed within the data center. By design, the use of low-loss, high-quality products ensures your data center will not only meet the requirements of today, but requirements well into the future. ■

Parrallel optics, 100GbE Drawing



David Hessong is a private networks market support manager and Daryll Kerns is private networks systems engineer, both with Corning Cable Systems. They can be reached via Corning's Web site at www.corning.com.

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