Choosing the Right Multimode MPO System for Your Data Center

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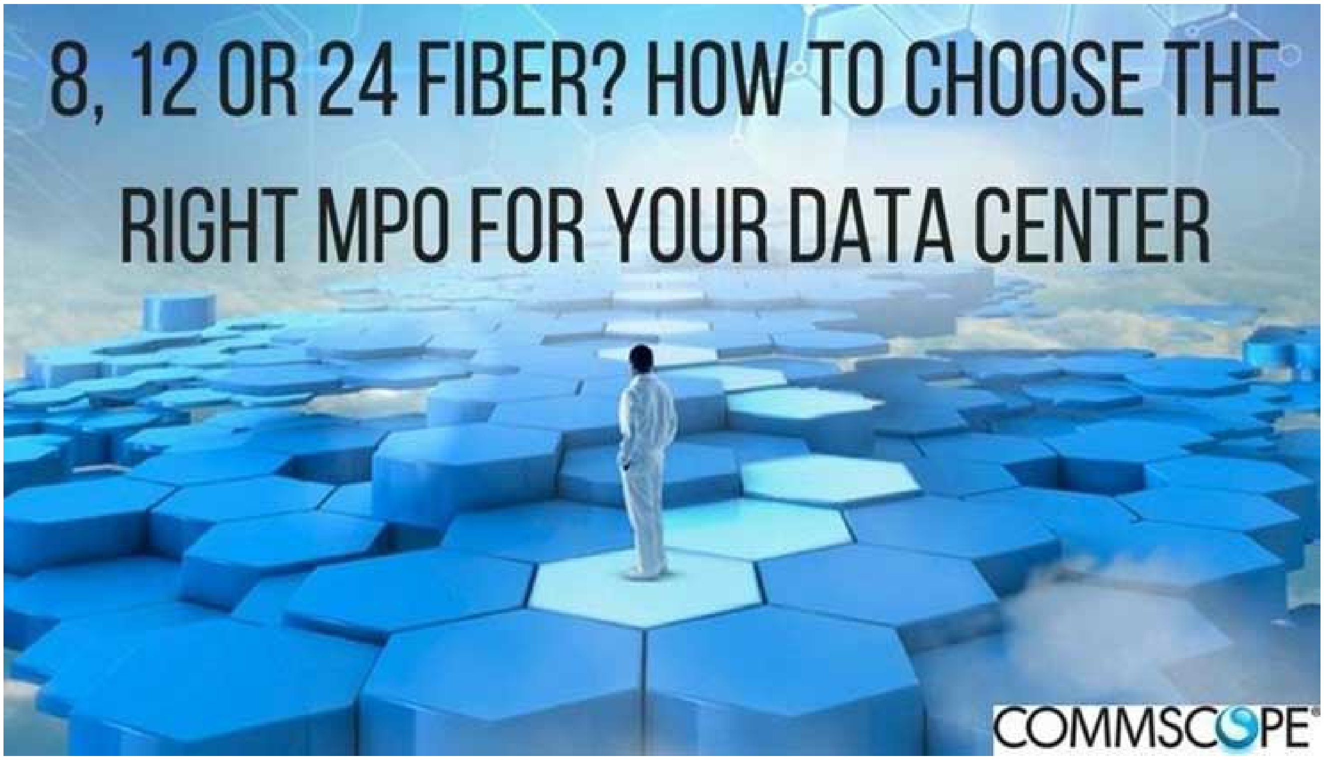
Voices of the Industry



The ultimate objectives are speed, flexibility and scalability, which MPO connections deliver in varying degrees, depending on configuration. Which setup is ideal for your organization?

In the edition of Voices of the Industry, Jim Young, Director of CommScope's Enterprise Data Center division, explores how to choose the right multimode multi-fiber push on system — or MPO system — for your data center.

The need to deliver higher speeds is placing increasing demands on data center networks. To maximize throughput and density, recent considerations are favoring multi-fiber interfaces, which has prompted a reassessment of a high-speed migration strategy now involving both duplex and parallel optic transmission applications.

Because that mix of connections will change as new applications are deployed, the optimal strategy must consider the expected evolution of network equipment, as well as the advantages of deploying an infrastructure based on duplex and/or parallel fiber, MPO-based (8-, 12- and 24-fiber) connections.

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Let's take a closer look.

James Young, Director of CommScope's Enterprise Data Center division

The Ethernet Roadmap

Data centers house many types of applications, connecting storage devices to application servers that require a variety of connectivity topologies. While most network links utilize a single pair of fibers (duplex links), the need for higher speeds and capacity requires combining duplex links into groups of links (parallel links). Such an arrangement mandates that cabling designs support both options along with the resulting migration that occurs from duplex to parallel (and back again).

We see numerous examples of such arrangements: While most Fibre Channel applications for storage area networks remain duplex, as we migrate beyond 32G Fibre Channel, new parallel link options are being introduced; and some Ethernet applications are evolving from duplex to parallel (and then back to duplex).

Parallel optics also require lower operating costs. In network equipment, 8-fiber parallel quad small form-factor pluggable ports provide higher connectivity densities while reducing power consumption compared to SFP interfaces. These parallel ports are typically broken out as duplex connections, providing connectivity to four-end devices.

Meanwhile, as the Ethernet evolves to deliver ever-increasing speeds, interface designers have moved from the tradition of 10x increases in speed for every iteration to a more gradual approach that incorporates separate transmission "lanes." These lanes combine to increase throughput by using additional fibers and/or multiplexing over a single fiber.

When moving to higher speeds, parallel applications are often the most economical. As technology evolves, implementing higher speeds on a single pair of fibers is the most cost-effective strategy.

All of these factors will influence your choice of the fiber media and cabling options best suited for your data center. If your data center is growing quickly, for instance, with the life cycle of your network equipment relatively short, your strategy will favor either duplex or parallel optics, which will impact your cabling choice. But if your future requirements are uncertain, you must consider options that can provide robust support of a variety of potential outcomes.

[clickToTweet tweet=”James Young – When moving to higher speeds, parallel applications are often the most economical. #datacenters” quote=”James Young – When moving to higher speeds, parallel applications are often the most economical. #datacenters”]

The prudent strategy balances the cost/benefit of optoelectronics against the investment choices—parallel and duplex fiber links—with an eye toward long-term requirements.

Planning Considerations

As a first step, consider the capacity that your data center will require in the future along with the following:

- Is your organization an early adopter of new technology?
- Are your applications and compute/storage structures changing?
- Is the growth of your organization slow/fast or unpredictable?
- What are the capital vs operational cost tradeoffs?
- Service for internal networks, multi-tenant data center (MTDC), private/public cloud?

These will help guide your design choices while providing valuable insights for your fiber infrastructure designer.

Your data center team will play an active role in this process, evaluating various technologies, platforms, and fabric and routing/switching strategies.

If thoughtfully considered and selected, the preterminated MPO-based fiber cabling system will enable rapid deployment and configuration flexibility, along with a cabling topology that aligns with your data center direction.

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Fiber Media

For most, multimode fiber is the primary media choice for the enterprise data center. There are various types of multimode fiber (MMF), each impacting the scale and scope of the data center that can be supported when speeds escalate as well as when duplex optical technology becomes available.

Some large enterprise data centers are deploying single mode optics and infrastructure in their data centers with parallel optics/fiber. While not all cabling options available for MMF are available for singlemode fiber (SMF), the principles below apply to both MMF and SMF fiber.

Network optics

In addition to combining "lanes" to provide for greater link speeds, multiplexing several wavelengths on a single pair of fibers achieves the same result, as illustrated in figure 2 with 40G-SWDM4 and 100G-SWDM4. These transceivers provide four 25G lanes over a duplex pair of multimode fibers using four different wavelengths. 100G-SWDM duplex can now be aggregated into a parallel 400G link using eight fibers.

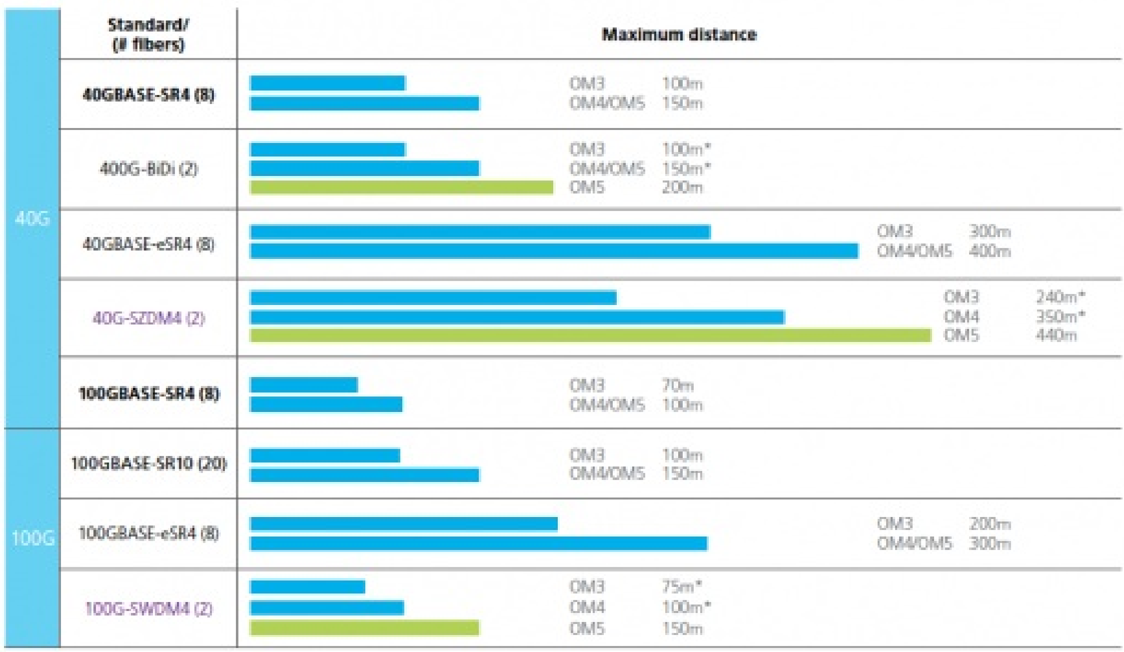

Figure 2: Ethernet network optic application – * OM3/OM4 effective modal bandwidth is only specified at 850nm. (Chart courtesy of CommScope)

Note, too, the fiber counts for common applications in the chart below. Any of the multi-pair applications can break-out, allowing for migrations between duplex and parallel optics. The fiber cabling system should thus be provisioned to accommodate these capabilities.

Cabling density

After the initial installation of a rack or cabinet, the amount of space allocated to cabling remains fairly restricted, making your cabling choice a paramount consideration.

A two-fiber duplex LC port occupies the same space as a single MPO port, but the latter can contain up to 24 fibers, providing much higher connection density. However, designing only for parallel applications carries its own limitations: Changing to duplex requires at least four times the panel space in the rack or cabinet to accommodate the duplex LC ports. And MPO-LC break-out assemblies can convert MPO trunks to LC duplex connections, but only if employing proper cable management techniques.

Duplex LC ports can be exchanged for MPO ports as needed. And if the optics can be supported by a single duplex pair, then MPO ports can support up to twelve times as many links as LC ports.

As shown in figure 3, MPO connectors are available with 8, 12 or 24 fibers.

Figure 3: MPO-24, MPO-12 and MPO-8 configurations. (Photo courtesy of CommScope)

Designing the fiber infrastructure with MPO systems

8-fiber MPO (MPO-8) designs

The MPO-8 supports up to four duplex channels and is used in the QSFP transceivers that utilize the eight fibers to provide four lanes per MPO port.

The MPO-8 interface uses eight of the 12 fiber positions of the industry standard MPO-12 (a QSFP transceiver does not use the center four fiber positions). Because leaving fibers unused is undesirable, cables and connectors can be constructed with MPO-12 connectors that omit or do not terminate the center four fibers (see figure 4).

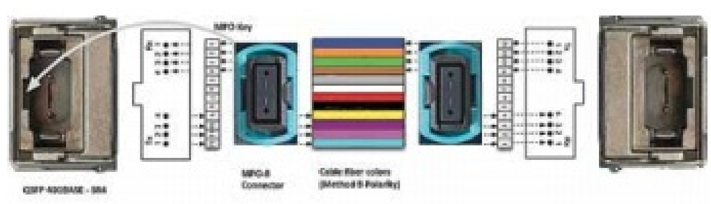

Figure 4: MPO-8 – QSFP applications with method B polarity management. (Photo courtesy of CommScope)

In some cases, the QSFP application is used as a grouped link or trunk between network switches, which is supported by MPO- 8, MPO-12 or MPO-24 systems. The number of fibers in the MPO connector determines how many ports the MPO trunk can support.

Regardless of the number of fibers in the connector, the routing of a transmitted signal is critical. I prefer method B — see figs. 4 and 5 — which uses aligned key adapters.

One other common form of the QSFP application incorporates a breakout of one transceiver to four devices (fig. 6), which often occurs within a cabinet or rack.

A final option involves using the MPO-8 trunks to support duplex applications (fig. 7), though such an arrangement requires at least 50 percent more connectors and panel space compared to MPO-12 and three times the connectors and panel space compared to MPO-24.

12-Fiber (MPO-12) Designs

The MPO-12 is a standard interface for multimode and singlemode applications and is used with both duplex and simplex applications. When used as a duplex trunk (fig. 9), two trunks are combined to support 24 fiber LC breakout modules (12 duplex ports). I recommend the method B polarity control scheme. The breakout modules can be varied with modules designed to provide breakout to MPO-8.

Additionally, fan-out assemblies can replace modules and connect directly with MPO-12 trunks, providing the same functionality as the breakout modules (fig. 10). Either way, breakout assemblies and modules can be mixed to suit the application.

Finally, as noted above, MPO-12 systems can support 8-fiber parallel applications. In such an arrangement, the center four (unused) fibers can combine from the two 12-fiber trunks to provide an additional QSFP 8-fiber port. See fig. 11, which illustrates QSFP MPO-8 ports supported by MPO-12 trunks (all 24 fibers in the MPO-12 trunks are utilized).

24-Fiber (MPO-24) Designs

The most cost-effective method to deploy both parallel and duplex fiber optic applications is the MPO-24 connector (fig. 12). Its 24 fibers provide more density than three MPO-8 connectors or two MPO-12 connectors, expediting cleaning and inspection time during its installation. While the method B trunk cables manage the port polarity in MPO-124 similar to in the MPO-8 and MPO-12, the cross connection of the MPO-24 trunks provides much higher port densities, drastically reducing panel space requirements (3:1 compared to MPO-8; 2:1 compared to MPO-12). The MPO-24 and its 144-fiber trunk cable requires 30 percent less space than its MPO-12 equivalent (see figs. 13 and 14 for additional configuration options—MPO-24 LC duplex and fan-out arrays).

MPO-24 can also support more parallel applications compared to MPO-8 or MPO-12 systems. For instance, the 100G SR-10 application requires 10 pairs of MMF in a 10x10G configuration, whereas MPO-24 provides simple, direct support for 100G and 120G applications (see figs. 15 and 16).

MPO Review

MPO-24 offers the most efficient connector/trunk combination, along with the lowest per-port deployment costs. It offers a high degree of flexibility for all duplex and parallel optical applications.

MPO-12 is the most common connector/trunking cabling interface, which offers lower density for duplex applications versus MPO-24 systems and better density for duplex applications compared to MPO-8 systems.

Finally, MPO-8 is an efficient choice for point-to-point QSFP trunking applications, offering the lowest panel density of all MPO systems. However, it is the least efficient choice for duplex applications.

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MPO System Costs

The total cost of an MPO system reflects the applications that it supports. Flexible designs to accommodate both parallel and duplex applications require adequate rack space, cable routing and management, as well as a combination of the correct media and performance levels.

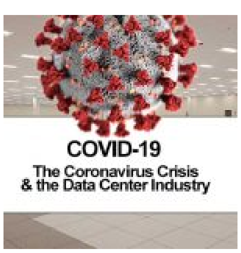
Reducing the number of connections in the network reduces the capital cost of the network as well as the installation and commissioning costs (see fig. 17).

Conclusion

Data centers must continue to evolve to support increasing bandwidth requirements. Optimizing the fiber infrastructure is a paramount pursuit, with an infrastructure transition that is unique for each organization.

The underlying objectives are speed, flexibility and scalability, which MPO cabling systems address to varying degrees. Assessing the potential applications that your data center will utilize, along with an MPO system that supports an array of options, will help maximize the return on your fiber infrastructure investment.

James Young is Director of CommScope's Enterprise Data Center division.



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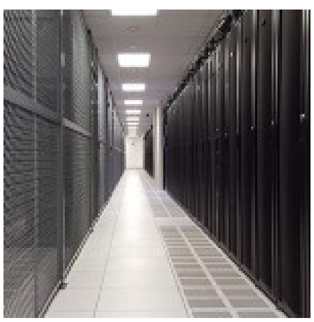

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