Choosing MPO Connectors for the Data Center

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Data Center Architect
CommScope
Agenda

• Network Architecture changes
• Data Center & MPO Standards
• Application comparisons
• Additional considerations
Architectural changes

- Flatter Networks: E-W vs. N-S
- Reduced Latency
- Increasing Data Rates
- Increasing Fiber Counts
- Duplex and parallel applications coexistence
Mesh Networks adapted for Enterprise Data Centers

- Historically Enterprise has been a 3-tier topology – aggregation and blocking architecture
- Cloud data center networks are 2-tier topology
  - Optimized for East-West traffic
  - Workloads spread across 10s, 100s, sometimes 1000s of VMs and hosts
  - Higher degree (10-20X) of east-west traffic across network (server to server)
Enterprise Scale Fabric Networks

Spine Switches

Leaf Switches

Node Connections

Node Connections

Node Connections

Node Connections

Node Connections

Node Connections

Software ties
Compute, storage and control networks together - SDN
### The Ethernet Roadmap

<table>
<thead>
<tr>
<th>Year</th>
<th>Mbps</th>
<th>Gbps</th>
<th>Tb/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>10</td>
<td>1</td>
<td>800</td>
</tr>
<tr>
<td>1995</td>
<td>100</td>
<td>10</td>
<td>1.6</td>
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<tr>
<td>2002</td>
<td>1</td>
<td>2.5</td>
<td>8.2</td>
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<td>2010</td>
<td>40</td>
<td>5</td>
<td>6.4</td>
</tr>
<tr>
<td>2016</td>
<td>100</td>
<td>25</td>
<td>&gt;10</td>
</tr>
<tr>
<td>2017</td>
<td>400</td>
<td>50</td>
<td>8.2</td>
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<tr>
<td>2018-2019 est.</td>
<td>500</td>
<td>200</td>
<td>6.4</td>
</tr>
<tr>
<td>2020</td>
<td>800</td>
<td>800</td>
<td>10</td>
</tr>
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</table>

- **Ethernet speed**
- **Speed in development**
- **Possible future speed**
Related standards updates
ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard

- Incorporates polarity of cords and connectivity methods supporting parallel optical signals for transceivers, array cords and cables employed over 2 rows of fibers per plug
- Raises minimum RL of singlemode connections and splices from 26dB to 35dB in harmony with ISO (IEEE RL requirements)
TIA-942-B Updates/Revisions

- ANSI/TIA-942-B- June 2017 – Additional Updates to incorporate new technologies and practices: Section includes Data Center Switch Fabrics, Spine-Leaf, Mesh networks, and virtualized Switch Architecture.

- Added MPO-24 (NSI/TIA-604-5) and MPO-16 and MPO-32 (ANSI/TIA-604-18) as options for termination of more than two fibers in addition to the MPO-12 connector.

- Added Wideband laser-optimized 50/125µm (OM5) as an allowed and recommended type of multimode fiber cable.
  - OM5 supports 4 wavelengths in a single-pair of fibers allowing applications which currently use 4-pairs of fibers to run on a single pair.
  - TIA approved lime green as the color for OM5 cable.
Recent optical updates in 3rd Edition of ISO/IEC 11801

- Adoption of OM5 wideband multimode fiber
- Adoption of 12 and 24-fiber MPOs as the recognized connectors in 11801-5 for DC’s
- Definition of OS1a singlemode fiber to support low water peak tight buffered constructions
Market Evolution

Proliferation of “Ultra Low Loss” MPO interfaces

• Enable design flexibility
• Enable more connections per channel
• Enable longer application distance support
Technologies Enabling Higher Capacity per Multimode Fiber

PAM4
More Efficient Modulation
Enabling 50Gb per lane

SWDM
More Efficient Fiber Usage
Enabling 4 λ per fiber

WBMMF OM5
More Efficient Fiber
Supporting 4 λ per fiber to practical distances
## Data Center multimode speed roadmap

<table>
<thead>
<tr>
<th># lanes</th>
<th>400GBASE-SR16</th>
<th>100GBASE-SR10</th>
<th>800G-SWDM4?</th>
<th>400G-SWDM4?</th>
<th>200G-SWDM4?</th>
<th>100G-SWDM4</th>
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</thead>
<tbody>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>10</td>
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</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>40GBASE-SR4</td>
<td>400G-SWDM4?</td>
<td>800G-SWDM4?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>400G-SWDM4?</td>
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<td>200G-SWDM4?</td>
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<table>
<thead>
<tr>
<th>Lane rate</th>
<th>10 Gb/s</th>
<th>25 Gb/s</th>
<th>50 Gb/s</th>
<th>100 Gb/s</th>
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<tbody>
<tr>
<td>Encoding</td>
<td>NRZ</td>
<td>PAM-4</td>
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</tbody>
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## IEEE Study Group - MMF options for 200G and 400G

<table>
<thead>
<tr>
<th>Technology (per fiber)</th>
<th>1 fiber pair</th>
<th>2 fiber pairs</th>
<th>4 fiber pairs</th>
<th>8 fiber pairs</th>
<th>16 fiber pairs</th>
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</thead>
<tbody>
<tr>
<td>25G-λ NRZ</td>
<td>25G-SR</td>
<td></td>
<td>100G-SR4</td>
<td></td>
<td>400G-SR16</td>
</tr>
<tr>
<td>50G-λ PAM4</td>
<td>50G-SR</td>
<td>100G-SR2</td>
<td>200G-SR4</td>
<td>400G-SR8</td>
<td></td>
</tr>
<tr>
<td>2x50G-λ PAM4</td>
<td>100G-SR1.2</td>
<td>200G-SR2.2</td>
<td>400G-SR4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4x25G-λ NRZ</td>
<td>100G-SR1.4</td>
<td>200G-SR2.4</td>
<td>400G-SR4.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4x50G-λ PAM4</td>
<td>200G-SR1.4</td>
<td>400G-SR2.4</td>
<td>800G-SR4.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Technology options for 200 & 400 Gb/s links over fewer MMF fiber pairs**

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**Multi-Wavelength Nomenclature**

\[ \text{SRm.n} \]

- \( m \) = # fiber pairs
- \( n \) = # wavelengths
Example Migration from Duplex to Parallel

10GBASE-SR

SPINE → Cross-Connect ← LEAF

OM4 Trunk

100GBASE-SR4

SPINE → Cross-Connect ← LEAF

OM4 Trunk

Trunk cabling is retained

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Migration from 10G to 100G with SWDM and OM5 WBMMF

- 10GBASE-SR
- 100GBASE-SWDM4
- WBMMF OM5 Trunk

All cabling is retained (continues to require only 2 strands)

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MPO24 vs MPO12 vs MPO8 for multimode trunks

<table>
<thead>
<tr>
<th>Application</th>
<th>#Fibers</th>
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<tr>
<td>10GBASE-SR</td>
<td>2</td>
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<tr>
<td>40G-SR4</td>
<td>8</td>
</tr>
<tr>
<td>40G-BiDi</td>
<td>2</td>
</tr>
<tr>
<td>40G-SWDM4</td>
<td>2</td>
</tr>
<tr>
<td>100G-SR4</td>
<td>8</td>
</tr>
<tr>
<td>100G-SR2</td>
<td>4</td>
</tr>
<tr>
<td>100G-SWDM4</td>
<td>2</td>
</tr>
<tr>
<td>100G-BiDi (?)</td>
<td>2</td>
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<tr>
<td>200G-SR4</td>
<td>8</td>
</tr>
<tr>
<td>200G-SR1.2 (?)</td>
<td>2</td>
</tr>
<tr>
<td>400G-SR4.2/4.4 (?)</td>
<td>8</td>
</tr>
<tr>
<td>400G-SR2.4 (?)</td>
<td>4</td>
</tr>
<tr>
<td>400G-SR1.4 (?)</td>
<td>2</td>
</tr>
</tbody>
</table>
Which MPO for High Speed Migration?

<table>
<thead>
<tr>
<th>MPO24</th>
<th>MPO12</th>
<th>MPO8</th>
</tr>
</thead>
</table>

- Same Ferrule size
- Same Loss Performance
- Same Pin Alignment
MPO12:
Initially used for modular fiber optic cabling to duplex applications
Rapid pluggable deployment for data center environments
Converge MPOs to fully utilize fibers for parallel applications
MPO8:
Primary use is for parallel applications to the transceiver
Outside-In fiber mapping delivers parallel lanes
MPO24:
Initially used for modular fiber optic cabling to duplex applications
Additionally used for SR10 and 120G transceiver applications
Fiber count enables duplex, parallel, or a mix of both

- **Duplex**
- **Parallel**
- **Parallel/Duplex Mix**
Where should MPO alignment pins be located?
Where **should** MPO alignment pins be located?

- In a Duplex world? Pin location doesn’t really matter.
- **In a Parallel Application world? It matters!**
- QSFP, QSFP+, CXP transceivers house pins within the transceiver
The Simplification Process has Begun!

As we migrate customers to their next level:

Pinned MPO trunks enables the use of the same unpinned patch cords throughout your channel.
• Equipment
• Patching between trunks

The same design applies to singlemode.

Pinned singlemode trunks use the standard industry angle.
• Unpinned cords with the opposite angle on both ends can be used throughout the channel as well for equipment and patchcords.
Considerations of your MPO choice

• Day 1 design – duplex or parallel
• Space availability for Day 2
• Connections within channel: type, performance, and distance
• Media selection
• Architectural flexibility
• Application Support
Thank you!

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