Optical fiber cabling infrastructure for Data Center

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TRENDS AND ISSUES ON OPTICAL CABLING
IP Traffic Growth, 2016-2021

1 ExaByte = 10^{18} \text{ Bytes}

Source: Cisco Visual Networking Index, 2017

Exabytes of Traffic Per Month

- 2016: 96
- 2017: 122
- 2018: 151
- 2019: 186
- 2020: 228
- 2021: 278

24% CAGR
Transition From 100G To 200G/400G in OTT Cloud: Amazon, Google and Microsoft

Cable/cord convergence in Data Center
Trouble in Data Center

Man-made calamity

Fiber cable damage

Connector problems
**Trends and Issues on Optical Cabling in DC**

**High speed**
- 10G → 40/100G→200/400G

**Maintenance**
- Cable/cord convergence

**Availability**
- Avoiding connection down and fibre damage

**Cost reduction**
- Reduce Material & Installation cost
- Save space
- Avoidance of double investment

**Scalability**
- On demand expansion

**Extension of link distance**
- DC upsizing
- Cabling between buildings

**Reduction of wiring volume**
- Air conditioning efficiency
SOLUTIONS
Solution

1. High speed, multi-core & high density
   - MPO cabling system

2. Cable/Cord Convergence
   - Field installable connector
   - Low friction cable

3. Trouble Prevention
   - Fibre Identification
   - Connector Cleaning
Outline of MPO connector

- MPO (Multi-fiber Push On) is multiple fiber connector for 40/100GbE transmission

- Used trunk cable deployed in backbone Data Center

- Standardized IEC 61754-7 and TIA 604-5
## Newtwork system & applicable optic fibre

<table>
<thead>
<tr>
<th>Speed</th>
<th>Standard</th>
<th>Fiber</th>
<th>No. of fiber</th>
<th>Distance</th>
<th>Link budget of tranciever</th>
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<tbody>
<tr>
<td>1Gb/s</td>
<td>1000BASE-SX</td>
<td>OM2,OM3,OM4</td>
<td>2</td>
<td>550m</td>
<td>3.56dB</td>
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<td>1000BASE-LX</td>
<td>SM</td>
<td>2</td>
<td>5000m</td>
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<td>10Gb/s</td>
<td>10GBASE-SR</td>
<td>OM3</td>
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<td>300m</td>
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<td></td>
<td></td>
<td>OM4</td>
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<td>400m</td>
<td>2.9dB</td>
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<tr>
<td></td>
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<td>SM</td>
<td>2</td>
<td>10000m</td>
<td>6.2dB</td>
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<tr>
<td></td>
<td>10GBASE-ER</td>
<td>SM</td>
<td>2</td>
<td>40000m</td>
<td>10.9dB</td>
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<tr>
<td>40Gb/s</td>
<td>40GBASE-SR4</td>
<td>OM3</td>
<td>8</td>
<td>100m</td>
<td>1.9dB</td>
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<tr>
<td></td>
<td></td>
<td>OM4</td>
<td>8</td>
<td>150m</td>
<td>1.5dB</td>
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<tr>
<td>100Gb/s</td>
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<td>OM3</td>
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<td>70m</td>
<td>1.9dB</td>
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<td>OM4</td>
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<td>100m</td>
<td>1.5dB</td>
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<td>100m</td>
<td>1.9dB</td>
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<td>150m</td>
<td>1.5dB</td>
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<tr>
<td></td>
<td>100GBASE-LR4</td>
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<td>10000m</td>
<td>8.3dB</td>
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<td>100GBASE-ER4</td>
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<td>100G-PSM4 (*)</td>
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<td>8</td>
<td>500m</td>
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</table>

*Required MPO connector:

**QFSP tranciever (40G)**

*Reference value*
40GbE/100GbE interface (MMF)

40G & 100G Ethernet – MDI Recommendations

References MPO interface req's/specs of IEC 61754-7.

40GBASE-SR4
100GBASE-SR4
100GBASE-SR10

Option A (recommended)

Option B

Option C
40GbE/100GbE transmission (MMF)

High Speed Short Reach Technologies: Multiple Fiber Parallel Systems on MMF

**40GBASE-SR4**
1. Two 12 Fiber Cables, or 24 fiber Cable
   - 20 Active
   - Duplex link
2. 10 x 10 Gb/s
3. MPO connector
   - 2 x 12 fiber
   - 1 x 24 fiber
4. One wavelength per fiber

**100GBASE-SR10**
1. One 12-fiber cable
   - Duplex link
   - 8 active fibers
2. 4 x 10 Gb/s
3. 12 Fiber MPO connector
4. One wavelength per fiber
Upgrade 10G→40G/100

10GBASE-SR cabling structure

40GBASE-SR4, 100GBASE-SR4 cabling structure

- LC patch cord + connecormodule → MPO panel + MPO patch cord (12MPO/12MPO)
- Method A: Required both straight & cross type MPO patch cord
- Method B: Required only cross type MPO patch cord
Upgrade 10G→100G

10GBASE-SR cabling structure

100GBASE-SR10 cabling structure

LC patch cord + connector module → MPO panel + MPO patch cord (24MPO/2x12MPO)

Method A: Required only one type of MPO patch cord
Method B: Required two types of MPO patch cord
40GbE-10GbE x 4 solution

○ Direct connection
- QSFP transceiver
- SFP+ Transceiver

○ Connection via trunk cable (example)
- 12MPO(8core use)/DxLC cord
- Connector module
- Key-up to Key-down connection
- Trunk cable (TypeA)
- 12MPO connector
- Example of Optical Transmission Path

A-to-A Patch Cord

12MPO(8core use)/DxLC cord
100GbE-10GbE x 10 solution

100GbE-10GbE x 10 solution

100G transceiver

24MPO (unpinned)

24MPO (unpinned)

24MPO (pinned)

24MPO cable

24MPO/LC module

DxLC adapter

DxLC/DxLC cord (2c, A to B)

10G TR

10G TR
Useful on server virtualization

Solution: MPO connectorized cable

Multiple high speed interfaces are required to one physical server

- VM FT
- VMotion
- VM communication
- VM storage
Reduction of wiring volume

Approx. 50mm

CAT6A cable x 48

13.3mm

96fiber MPO trunk cable

Reduce installation cost & Save space
Solution

1. High speed, multi-core & high density
   - MPO cabling system

2. Cable/Cord Management
   - Field installable connector
   - Low friction cable

3. Trouble Prevention
   - Fibre Identification
   - Connector Cleaning
Field installable connector

- Able to inspect integrity of bare fibers before splicing
- Only requires basic training
- Eliminates excess cable issue
Field installable connector

- Enable to improve cable/cord convergence
  - Reduction of cable/cord slacks
  - No need to check cable/cord length in advance  Installation cost down
  - Cable/cord cost down

- Cord slack reduction
Low Friction Cord

Benefits:
- Providing reliability, availability and serviceability
- Higher mechanical performance

Low friction

Comparison of bending loss

Standard SM cord
Low friction, High strength cord
R=7.5mm

Improve low friction ratio more than 50%
Solution

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Prevent connector unplug by mistake

**Step 1:** Check the target port which is removed

**Step 2:** Pull out the connector
Transparent adapter

- Easy to identify target port using visible light
- Enable to prevent miss-remove of patch cord
CONTAMINATION is the root cause of network failure. Connector cleaning before mating is one of the best practices.
Conclusion

• MPO Connector will become a norm in the Data Center

• Cable/Cord management will be a key concern in the Data Center