A Fork in the Road
OM5 vs. Single-Mode in the Data Center

Gary Bernstein, Sr. Director, Product Management, Network Solutions
Outline

• Definition of Enterprise and Cloud Data Centers
• The Growth of Cloud Computing
• Market forecast for 25G/50G/100G/200G/400G Ethernet
• Trends with Multimode vs. Single-mode Optics
• Use case: 40G for Enterprise data centers
• Use case: 100G+ for Cloud data centers
• What about OM5?
### Enterprise vs. Cloud Data Centers

#### Major Characteristics of Data Centers

<table>
<thead>
<tr>
<th></th>
<th>SMB</th>
<th>Large Enterprise</th>
<th>Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Servers</td>
<td>&lt;500</td>
<td>10,000</td>
<td>&gt;100,000</td>
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<tr>
<td>Number Of Customers</td>
<td>&gt;1,000,000</td>
<td>&lt;5,000</td>
<td>&lt;100</td>
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<tr>
<td>Number of Top-of-Rack / Leaf Switches</td>
<td>&lt;25</td>
<td>&lt;500</td>
<td>&gt;2,000</td>
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<tr>
<td>Number of Spine / Aggregation Switches</td>
<td>1-2</td>
<td>&lt;25</td>
<td>&gt;100</td>
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<tr>
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<td>&lt;12</td>
<td>&gt;12</td>
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<td>Deal Size</td>
<td>&lt;$100,000</td>
<td>&lt;$5,000,000</td>
<td>&gt;$20,000,000</td>
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<tr>
<td>Ethernet Switch Vendor Margin</td>
<td>&gt;60%</td>
<td>&gt;50%</td>
<td>&lt;25%</td>
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</tbody>
</table>

#### Total Ethernet Switch Data Center Revenue

- **Top 7 Cloud Providers**
- **Rest of Cloud and SPs**
- **Enterprise and SMB Market**

Source: Dell'Oro, 2015
PRIVATE
Used for a single organization.
Can be externally or internally hosted.

COMMUNITY
Shared by several organizations.
Typically externally hosted.

HYBRID
Two or more clouds bound together.
Usually part internally and part externally hosted.

PUBLIC
Provisioned for open use by the hosting company which operates the data centers.
Global Cloud Traffic Growth

Cloud Traffic **Will Grow 3.7-Fold** from 2015 to 2020

Cloud Accounts for **92% of Traffic** by 2020, **up from 82%** in 2015

Source: Cisco Global Cloud Index, 2015-2020

[Graph showing growth from 2015 to 2020 with Zettabytes per Year values: 3.9 in 2015, 5.6 in 2016, 7.7 in 2017, 9.8 in 2018, 11.9 in 2019, 14.1 in 2020]
Trends in the Data Center

• Many traditional enterprise data centers are moving to the cloud
• Flatter network designs...3-tier to Leaf-Spine
• Data Centers are getting larger
• More companies are outsourcing to co-location providers
• Creation of a new 25Gb/s ecosystem
• New cost-effective 100G switches
The Need for Speed
Ethernet Speed Market Forecast

Transceiver modules by speed, percent of total

Dramatic Growth of 100G Expected...

Shipments - ≥25GbE total

- 25 GbE
- 40 GbE
- 50GbE
- 100GbE
- 200GbE
- 400 GbE

100G in Cloud DCs

40G in Enterprise DCs

The IEEE802.3ba standard, published in June 2010 defined 10Gb/s lanes for 40G & 100G transmission

On April 29 2015, IEEE published the new IEEE802.3bm standard

Primary objectives of standard
- Reduce cost of 100Gb/s
- Reducing power requirements
- Reduce # of lanes required

The standard defines 100G-SR4
- Uses 4 x 25Gb/s lanes in each direction
- MTP connector with 8-fibers is required
- Same requirements as 40G-SR4

IEEE Std 802.3bm-2015 Amendment 3 to IEEE Std 802.3-2012: Ethernet

100GBASE-SR4 Optical Lane Assignments
25G Lane Ecosystem is starting... with 100G/200G & 400G

- 1st phase will likely use 25G down to server + 100G Uplinks
- 75% of 100G options will utilize MPO connectors with 4 or 8 fibers
- Very little adoption of SR16 expected...no need for OM5
- Majority of options use single-mode

<table>
<thead>
<tr>
<th>Rate</th>
<th>Fiber Type</th>
<th># fibers</th>
<th>Connector</th>
<th>Reach</th>
<th>IEEE Std</th>
<th>Est. Release</th>
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<tr>
<td>100GBASE-SR4</td>
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<td>MPO</td>
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<td>802.3bm</td>
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<td>OM4</td>
<td>4</td>
<td>MPO</td>
<td>100m</td>
<td>802.3cd</td>
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<td>OS2</td>
<td>4</td>
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<td>500m</td>
<td>802.3cd</td>
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<td>2</td>
<td>LC</td>
<td>2km</td>
<td>802.3cd</td>
<td>Sep-18</td>
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<tr>
<td>200GBASE-DR4</td>
<td>OS2</td>
<td>8</td>
<td>MPO</td>
<td>500m</td>
<td>802.3bs</td>
<td>Dec-17</td>
</tr>
<tr>
<td>200GBASE-FR4</td>
<td>OS2</td>
<td>2</td>
<td>LC</td>
<td>2km</td>
<td>802.3bs</td>
<td>Dec-17</td>
</tr>
<tr>
<td>400GBASE-SR16</td>
<td>OM4 / OM5</td>
<td>32</td>
<td>MPO</td>
<td>100m</td>
<td>802.3bs</td>
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<tr>
<td>400GBASE-FR8</td>
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<td>2</td>
<td>LC</td>
<td>2km</td>
<td>802.3bs</td>
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</table>
50G Lane Ecosystem is not far off
100G/200G & 400G

- Most options use single-mode cabling

<table>
<thead>
<tr>
<th>Rate</th>
<th>Fiber Type</th>
<th># fibers</th>
<th>Connector</th>
<th>Reach</th>
<th>IEEE Std</th>
<th>Est. Release</th>
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</thead>
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<tr>
<td>100GBASE-DR</td>
<td>OS2</td>
<td>2</td>
<td>LC</td>
<td>500m</td>
<td>802.3cd</td>
<td>Sep-18</td>
</tr>
<tr>
<td>100GBASE-FR</td>
<td>OS2</td>
<td>2</td>
<td>LC</td>
<td>2km</td>
<td>802.3cd</td>
<td>Sep-18</td>
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<tr>
<td>200GBASE-SR4</td>
<td>OM4</td>
<td>8</td>
<td>MPO</td>
<td>100m</td>
<td>802.3cd</td>
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<td>OS2</td>
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<td>500m</td>
<td>802.3bs</td>
<td>Dec-17</td>
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<tr>
<td>400GBASE-FR8</td>
<td>OS2</td>
<td>2</td>
<td>LC</td>
<td>2km</td>
<td>802.3bs</td>
<td>Dec-17</td>
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</table>
# Enterprise vs. Cloud Network Speeds

## Current vs. Future Network Configurations

<table>
<thead>
<tr>
<th></th>
<th>Enterprise Data Centers</th>
<th>Cloud Data Centers</th>
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<tbody>
<tr>
<td></td>
<td>SERVER</td>
<td>UPLINKS</td>
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<tr>
<td>Current Network</td>
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<td>Speeds</td>
<td>1G</td>
<td>10G</td>
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<td>Future Network</td>
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<tr>
<td>Speed Options</td>
<td>10G</td>
<td>40G</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>10G</td>
<td>25G</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>100G</td>
<td>40G</td>
</tr>
</tbody>
</table>
SM vs. MM Transceiver Estimated Volumes
100G – 400G Ethernet

SM will account for 65% of volume

Market Leaders Setting an Example

99% Single-mode

Source: The Next Platform

2015

- 24%
- 38%
- 36%

Increased with CWDM4

Parallel continues to be #1 use-case

Reducing multi-mode

2016

- 1%
- 53%
- 43%

Duplex single-mode

AOC

Parallel single-mode (e.g. PSM over MTP)

Multi-mode

Source: The Next Platform
Cost of SMF Optics expected to decline
Closer to MMF Optics

Source: Facebook presentation at IEEE Optical Interconnects Conference, 2016
End-to-end 40G Channel Cost Comparison
MMF vs. SMF (August 2016)

Parallel SM now 50% more than SR4

- **SWDM4** 40% more than Bidi

## Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Optics</th>
<th>Cabling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR4</strong></td>
<td>$1,500</td>
<td>$1,500</td>
</tr>
<tr>
<td><strong>Bidi</strong></td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td><strong>UNIV</strong></td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td><strong>SWDM4</strong></td>
<td>$3,000</td>
<td>$3,000</td>
</tr>
<tr>
<td><strong>LRL4</strong></td>
<td>$3,500</td>
<td>$3,500</td>
</tr>
<tr>
<td><strong>PLRL4</strong></td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
</tbody>
</table>

- **SR4**: MM: Parallel, Dist.: 150m
- **Bidi**: MM: Duplex, Dist.: 150m
- **UNIV**: MM: Duplex, Dist.: 150m
- **SWDM4**: WBMMF: Duplex, Dist.: 150m
- **LRL4**: SM: Duplex, Dist.: 1km/2km
- **PLRL4**: SM: Parallel, Dist.: 1 km
Estimated List Prices: 100G Transceivers


100G-SR4(MM)
100G-PSM4(SM)
100G-CWDM4(SM)
100G-LR4(SM)
High Density 40/100G Switches
QSFP+ ports

Arista 7300 Series
Juniper 9214
Cisco Nexus 6004
Cisco Nexus 7700
## 40G Optical Transceivers – Aug 2017

<table>
<thead>
<tr>
<th>Transceiver</th>
<th>Switch Mfrs</th>
<th>Form Factor</th>
<th>IEEE Compliant</th>
<th>Fiber Type</th>
<th>Distance</th>
<th># of fibers</th>
<th>Power (W)</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 40G-SR4</td>
<td>All</td>
<td>QSFP+</td>
<td>Yes</td>
<td>OM3/OM4</td>
<td>100m/150m</td>
<td>8</td>
<td>1.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>2 40G-C/X/ESR4</td>
<td>Cisco, Arista, Juniper</td>
<td>QSFP+</td>
<td>No</td>
<td>OM3/OM4</td>
<td>300m/400m</td>
<td>8</td>
<td>1.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>3 40G-BIDI</td>
<td>Cisco, Arista</td>
<td>QSFP+</td>
<td>No</td>
<td>OM3/OM4</td>
<td>100m/150m</td>
<td>8</td>
<td>1.5</td>
<td>LC</td>
</tr>
<tr>
<td>4 40G-LX4</td>
<td>Juniper</td>
<td>QSFP+</td>
<td>No</td>
<td>OM3/OM4</td>
<td>100m/150m</td>
<td>2</td>
<td>3.5</td>
<td>LC</td>
</tr>
<tr>
<td>5 40G- UNIV</td>
<td>Arista</td>
<td>QSFP+</td>
<td>Yes</td>
<td>OM3/OM4, OM5</td>
<td>150m, 500m</td>
<td>2</td>
<td>3.5</td>
<td>LC</td>
</tr>
<tr>
<td>6 40G-LR4</td>
<td>All</td>
<td>QSFP+</td>
<td>Yes</td>
<td>OS2</td>
<td>10 km</td>
<td>2</td>
<td>3.5</td>
<td>LC</td>
</tr>
<tr>
<td>7 40G-LRL4/IR4</td>
<td>Cisco, Arista, Juniper</td>
<td>QSFP+</td>
<td>Yes</td>
<td>OS2</td>
<td>1km/2km</td>
<td>2</td>
<td>3.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>8 40G-PLR4</td>
<td>Arista</td>
<td>QSFP+</td>
<td>No</td>
<td>OS2</td>
<td>1 km</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
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<tr>
<td>9 4x10G-IR</td>
<td>Juniper</td>
<td>QSFP+</td>
<td>No</td>
<td>OS2</td>
<td>1.4 km</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
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<tr>
<td>10 4x10G-LR</td>
<td>Cisco</td>
<td>QSFP+</td>
<td>No</td>
<td>OS2</td>
<td>10km</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>11 40G-PLR4</td>
<td>Arista</td>
<td>QSFP+</td>
<td>No</td>
<td>OS2</td>
<td>10 km</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>12 40G-SWDM4</td>
<td>TBA?</td>
<td>QSFP+</td>
<td>No</td>
<td>OM3/OM4/OM5</td>
<td>TBD</td>
<td>2</td>
<td>TBD</td>
<td>LC</td>
</tr>
</tbody>
</table>

More Than 12 Choices Available!
Switches now have 100G ports available

High Density QSPF28 ports

Cisco 3232C
Cisco 92160
Cisco 9508
Arista 7512R
<table>
<thead>
<tr>
<th>Transceiver</th>
<th>Switch Mfrs</th>
<th>Form Factor</th>
<th>IEEE Compliant</th>
<th>Fiber Type</th>
<th>Distance</th>
<th># of fibers</th>
<th>Power (W)</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>100G-SR10</td>
<td>All</td>
<td>CFP/CFP2/CPAK</td>
<td>Yes</td>
<td>OM3/OM4</td>
<td>100m/150m</td>
<td>20</td>
<td>4.0-6.0</td>
<td>24F MTP</td>
</tr>
<tr>
<td>100G-SR10 MXP</td>
<td>Arista</td>
<td>Embedded optics</td>
<td>No</td>
<td>OM3/OM4</td>
<td>100m/150m</td>
<td>24</td>
<td>3-4</td>
<td>24F MTP</td>
</tr>
<tr>
<td>100G-XSR10</td>
<td>Arista</td>
<td>CFP2</td>
<td>No</td>
<td>OM3/OM4</td>
<td>300/400m</td>
<td>20</td>
<td>4.0-6.0</td>
<td>24F MTP</td>
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<tr>
<td>100G-XSR4</td>
<td>Arista</td>
<td>QSFP28/CPAK</td>
<td>Yes</td>
<td>OM3/OM4</td>
<td>70/100m</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>100G-XSR4</td>
<td>Arista, Juniper</td>
<td>QSFP28</td>
<td>No</td>
<td>OM3/OM4</td>
<td>300m</td>
<td>8</td>
<td>3.5</td>
<td>12F MTP</td>
</tr>
<tr>
<td>100G-LRL4</td>
<td>Arista</td>
<td>QSFP28</td>
<td>Yes</td>
<td>OS2</td>
<td>2km</td>
<td>2</td>
<td>4.0</td>
<td>LC</td>
</tr>
<tr>
<td>100G-CWDM4</td>
<td>All</td>
<td>QSFP28/CPAK</td>
<td>Yes</td>
<td>OS2</td>
<td>2km</td>
<td>2</td>
<td>3.5</td>
<td>LC</td>
</tr>
<tr>
<td>100G-LR</td>
<td>All</td>
<td>CFP2/CPAK/QSFP28</td>
<td>No</td>
<td>OS2</td>
<td>10km</td>
<td>2</td>
<td>4.5</td>
<td>LC/SC</td>
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<tr>
<td>100G-PSM4- NEW</td>
<td>Cisco</td>
<td>CPAK</td>
<td>No</td>
<td>OS2</td>
<td>500m</td>
<td>8</td>
<td>3.5</td>
<td>24F MTP</td>
</tr>
<tr>
<td>40/100G-SRBD (BiDi), Est. Dec-2017</td>
<td>Cisco</td>
<td>QSFP28</td>
<td>No</td>
<td>OM3/OM4</td>
<td>TBD</td>
<td>2</td>
<td>TBD</td>
<td>LC</td>
</tr>
</tbody>
</table>
Enterprise Data Center Migration Strategy
Enterprise Data Centers

- Most are using 1G down to servers with 10G uplinks
- Considering to migrate to 10Gdown/40GUp or 25G/100G if costing looks attractive
- Majority of DCs have multi-mode cabling installed
- 85% of optical links are 150m or less
Migration Path for 40/100G Enterprise Networks
Multimode Solution

10G
- MTP-LC Modules
- Duplex LC Patch Cords
- 10G-SR

40G
- MTP 24-F to 3x8-F Modules
- 8-Fiber MTP Array Cords
- 40G-SR4

100G
- MTP 24-F to 3x8-F Modules
- 8-Fiber MTP Array Cords
- 100G-SR4

Leviton introduced January 2011
First in the Market
Multimode Migration Path
10G or 40G Duplex Channel

- 24-F MTP backbone
- Provides Duplex (2-fiber) connections at equipment
- Will support 1G/10GbE in SFP+ form factors

- Supports 40G using Wave Division Multiplexing Technology (WDM) like the Cisco/Arista BiDi in QSFP+ form factors
Multimode Migration Path

40G-SR4 Channel

- Same 24F MTP Backbone stays in place
- Swap out MTP-LC cassettes for MTP-MTP conversion cassettes
- Provides Parallel (8-fiber) connections at equipment

- 100% fiber utilization
- Support 40GBASE-SR4 in QSPF+
Multimode Migration Path
100G-SR4 Channel

- Same 24F MTP Backbone stays in place
- Swap out MTP-LC cassettes for MTP-MTP conversion cassettes
- Provides Parallel (8-fiber) connections at equipment

- 100% fiber utilization
- Supports 100GBASE-SR4 in QSFP+
Cloud Provider Migration Solution
Cabling Strategy for Cloud Providers

- Most are either already using or planning to move to Single-mode
  - 97% of single-mode links are 350m or less
- Key reasons why single-mode is being selected:
  - Requirements for reach beyond 150m
  - Transceivers costs have lowered significantly in last 2 years
  - Increasing bandwidth requirements
  - Majority of next gen speeds will use SMF
  - Need to “futureproof” cabling infrastructure
  - More flexibility to add more “hops” in channel
Single-Mode Migration Path

2-Fiber Channels: 10G, 40G, 100G, 200G or 400G

- 24-F MTP backbone
- Provides Duplex (2-fiber) connections at equipment
- Supports the following optics:
  - 10GbE in SFP+
  - 40GBASE-LR4/LRL4 in QSFP+
  - Arista 40G Universal in QSFP+
  - 100GBASE-LR4/LRL4 in CFP2/CPAK or QSFP28
- Will support future applications of 100G-FR2, 200G-FR4, 400G-FR8
Single-Mode Migration Path

8-Fiber Channels: 40G, 100G, 200G or 400G

- Same 24F MTP Backbone stays in place
- Swap out MTP-LC cassettes for MTP-MTP conversion cassettes
- Provides Parallel (8-fiber) connections at equipment
- 100% fiber utilization
- Supports the following optics:
  - 40GBase-PLRL4/PLR4 in QSFP+
  - 40G: 4x10G-LR/IR in QSFP+
  - 100G-PSM4 in QSFP28
- Will support future applications of 200G-DR4, 400G-DR4
Single-Mode Migration Path
20-Fiber Channel: 100G

- Same 24F MTP Backbone stays in place
- Swap out MTP-LC/MTP-MTP cassettes with MTP pass-thru cassettes
- Provides Parallel (20-fiber) connections at equipment
- Will support Cisco 10x10-LR in CPAK
Single-Mode Cabling System

- MTP-MTP Low Loss Trunks – 12F MTP and 24F MTP/APC
- MTP-LC cassettes
- MTP-MTP conversion cassettes
- MTP pass-thru adapter plates
- MTP-MTP Array cords and harnesses
  - 8F, 12F, 24F
End-Face Geometry Testing is Required for Single-Mode to Assure Consistent Quality

- End-face geometry testing with Interferometer
- 100% testing of single fiber single-mode connectors
- Tested to IEC-61755
  - Apex offset
  - Radius of curvature
  - Fiber protrusion
Laser Cleaving Recommended for SMF

- High-precision equipment used for single and multi-fiber connectors
- Required for consistent, high-quality terminations
- Hand Cleaving 8.3 µm SMF very difficult
Single-Mode Test Equipment is Critical
Must Test Both IL and RL

- Single-mode must be tested in both Return Loss & Insertion Loss
- Multi-channel tester required to test 12 and 24F MTPs
What about OM5?

Is OM5 Fiber a Good Solution for Data Centers?
Background on OM5 Fiber

- **Wideband multimode fiber (WBMMF)** is a new fiber medium specified in ANSI/TIA-492AAAE, published in June 2016.
- OM5 specifies wider range of wavelengths between 850nm and 953nm.
- It was created to support **Shortwave Wavelength Division Multiplexing (SWDM)**, which is being developed for 40 Gb/s, 100 Gb/s, and beyond.
- OM5 is being presented as a potential new option for data centers that require greater link distances and higher speeds.
- Many enterprise IT and data center managers are increasingly adopting **single-mode fiber systems** to solve these challenges.
Why would a data center consider OM5?

- Longer cabling reach
- Reduce costs
- Required for higher speeds
- Higher density at switch ports
Does OM5 offer a longer reach than OM4?

- **Not true. The difference is minimal.**
  - OM5 and OM4 **max reach are the same** for current and future IEEE applications
    - Including 40GBASE-SR4, 100GBASE-SR4, 200GBASE-SR4, and 400GBASE-SR16
    - With 40G-SWDM4 transceivers OM4 supported 400-meter reach and OM5 supported 500-meter
    - With non-IEEE-compliant 100G-SWDM4 transceivers OM5 reach is 150-meters — only 50 meters more than OM4.
- **Most cloud data centers running 100 Gb/s or greater with cabling runs over 100 meters are likely using single-mode already**
Does OM5 offer a longer reach than OM4?

- SWDM Testing Shows OM4 Reach over 350m

- Leviton BER Testing done with Arista 40G SWDM4 modules had following results:
  - OM3 Channel: 300 meter reach
  - OM4 Channel: 390 meter reach
  - OM5 Channel: 500 meter reach

- Most cloud data centers running 40 Gb/s with cabling runs over 300 meters are likely using single-mode already
Does OM5 reduce costs?

• It won't.
  – OM5 cabling costs about 60%-90% more than OM4
  – 40G channel with SWDM transceivers, 50% more than 40GBidi/OM4 channel
  – Single-mode transceivers cost has declined considerably in last 12-18 months
    • Due to silicon photonics technologies and hyperscale data centers buying in volume

• 100G-PSM4 transceivers using single-mode fiber is the same price as 100GBASE-SR4 using multimode fiber.
Is OM5 required for higher speeds?

- **Not true.**
  - All IEEE standards for 100/200/400 Gb/s will work with either single-mode (OS2) or multimode (OM4)
  - The majority of next-generation speeds will require single-mode
  - IEEE strives to develop future standards that work with the primary installed base of cabling infrastructure so customers can easily migrate to new speeds

- **None of the active IEEE standards addressing next-gen speeds (802.3bs or 802.3cd) will use SWDM technology.**
Does OM5 allow higher density from switch ports?

- It won't.
  - Data centers commonly use 40GBASE-SR4 to increase port density by breaking out 40 Gb/s ports into 10 Gb/s channels
  - This is also a benefit of new 100GBASE-SR4 modules, which use OM4 cabling

- With 100G-SWDM4 modules, OM5 cabling cannot break out into 25 Gb/s channels. This would become a real issue as the 25 Gb/s ecosystem fully develops with more 25 Gb/s to the server.
Leviton Recommendation to Clients on OM5...

- Leviton sees no reason to recommend OM5 for large data centers.
- For enterprise data centers looking at migrating to 40GBASE-SR4 or 100GBASE-SR4, OM5 offers no additional benefit over OM4 or OM4+.
- Cloud data centers are either already using single-mode or planning to move to single-mode for migration to 800 Gb/s and 1 Tb/s without changing out their cabling.
Summary

- Enterprise and Cloud DCs are very different
- 25G and 50G ecosystems are coming soon
- MMF and SMF Transceiver costs are getting closer
- Cloud data centers are migrating to single-mode