Migrating to 40G Ethernet…and Beyond
What is 40 Gigabit (40G) Ethernet?
40 Gigabit Ethernet used for aggregation
Polarity and gender
Migrating from 10 Gigabit to 40 Gigabit Ethernet
What about 100 Gigabit Ethernet?
Panduit’s recommended migration path
Questions
Server and desktop virtualization

- Drives up bandwidth requirements
  - More virtual machines per server per network connection
  - Virtual desktops require more bandwidth to maintain end-user experience
- Network infrastructure even more critical
  - Server link now carries traffic for more than one virtual machine

Adopting the cloud – Another form of virtualization
Virtualization
47%
4 socket servers with virtualization

Consolidation
15:1
Average Server Consolidation

Performance
20X
Increase in 4 socket server performance
What is 40G Ethernet?

Made up of 4 lanes of 10G
What is 40G Ethernet?

Made up of 4 lanes of 10G

Physical media

40GBASE-SR4  Multimode
Uses 8 fibers of a 12 fiber cable

40GBASE-LR4  Singlemode
Uses 4 wavelengths over duplex fiber
What is 40G Ethernet?

Based on QSFP+ Module

Front Side

Back Side

MTP Socket With Pins

0.33"
8.5mm

2.8"
72mm

0.75"
18.4mm
What is 40G Ethernet?

Cisco’s Bidi

BiDi: Short for bidirectional

40G Ethernet module using only two fibers

Uses existing 10G infrastructure for 40G
What is 40G Ethernet?

Cisco’s Bidi

BiDi Optical Module

Detector

VCSEL

850nm

900nm

Signature Core MMF

Each wavelength carries 20G

BiDi Optical Module

VCSEL

900nm

850nm

Detector

VCSEL

Detector
Cisco’s Bidi

BiDi: Short for bidirectional

40G Ethernet module using only two fibers

Uses existing 10G infrastructure for 40G

Save money

Multimode and BiDi less expensive than singlemode for 40G Ethernet

BiDi saves ~$4K per 40G link vs. 40GBASE-SR4
## Comparing 40G Options

<table>
<thead>
<tr>
<th>Media</th>
<th>40GBASE-CR4</th>
<th>40GBASE-SR4</th>
<th>40G-BiDi</th>
<th>40GBASE-LR4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twinax</td>
<td></td>
<td>MMF</td>
<td>MMF</td>
<td>SMF</td>
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</table>

<table>
<thead>
<tr>
<th>Upgrade path</th>
<th>100GBASE-CR4</th>
<th>100GBASE-SR4</th>
<th>100GBASE-SR10</th>
<th>100GBASE-LR4</th>
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<tbody>
<tr>
<td>40GBASE-CR4</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Physical lanes</th>
<th>4 GB</th>
<th>4 GB</th>
<th>1 GB</th>
<th>4 GB</th>
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</table>

<table>
<thead>
<tr>
<th>Distance</th>
<th>Passive: 7m</th>
<th>OM3: 125m</th>
<th>OM3: 110m</th>
<th>OM3: 110m</th>
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</thead>
<tbody>
<tr>
<td>Active: 15m</td>
<td>OM4: 150m</td>
<td>OM4: 150m</td>
<td>OM4: 150m</td>
<td>OM4: 150m</td>
</tr>
<tr>
<td>Sig Core: 200m</td>
<td>Sig Core: 210m</td>
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<td>Sig Core: 210m</td>
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<tr>
<td>Sig Core: 200m</td>
<td>Sig Core: 210m</td>
<td>Sig Core: 210m</td>
<td>10km</td>
<td></td>
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<thead>
<tr>
<th>Cable patching</th>
<th>Point-to-point</th>
<th>Structured cabling</th>
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</table>

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<tr>
<th>Power consumption</th>
<th>&lt;1W</th>
<th>1.5W</th>
<th>3.5W</th>
<th>3.5W</th>
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<table>
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<tr>
<th>Predominant form factor</th>
<th>QSFP+</th>
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</table>

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<tr>
<th>Connector</th>
<th>MPO</th>
<th>Dual LC</th>
<th>Dual LC</th>
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</thead>
</table>

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<tr>
<th>Main application</th>
<th>ToR server - switch</th>
<th>Switch - switch</th>
<th>Switch - switch</th>
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</tr>
</thead>
</table>
What about 100G?

100GBASE-SR10 – 10 lanes of 10G

- Requires 20 fibers
- No breakout capability

New game in town - 100GBASE-SR4

- 4 lanes of 25G
- Same infrastructure as 40G
- 100G to 25G breakout
# Comparing 100G Standards

<table>
<thead>
<tr>
<th></th>
<th>100GBASE-CR4</th>
<th>100GBASE-SR10</th>
<th>100GBASE-SR4</th>
<th>100GBASE-LR4</th>
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<td>MMF</td>
<td>MMF</td>
<td>SMF</td>
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<tr>
<td><strong>Upgrade path</strong></td>
<td>×</td>
<td>×</td>
<td>400GBASE-SR16</td>
<td>TBD</td>
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<tr>
<td><strong>Physical lanes</strong></td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>Passive: 5m</td>
<td>OM3: 125m</td>
<td>OM3: 80m</td>
<td>10km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OM4: 150m</td>
<td>OM4: 115m</td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td><strong>Power consumption</strong></td>
<td>1.5W</td>
<td>12W</td>
<td>3.5W (Target)</td>
<td>24W</td>
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<tr>
<td><strong>Predominant form factor</strong></td>
<td>QSFP28</td>
<td>CFP</td>
<td>QSFP28</td>
<td>CFP</td>
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<tr>
<td><strong>Connector</strong></td>
<td>×</td>
<td>MPO</td>
<td>MPO</td>
<td>Dual SC</td>
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Transmit lanes of one module connect with receive lanes of other module

Simple direct connection - MTP patch cord with “key up” at both ends

Not as simple in real life deployment when reusing MTP trunks

Method A  *Key up to key down*
Method B  *Key up to key up*
Method C  *Pair-wise flip*
10 Gig – Method A Day Two

- SFP Optical Module
- LC Connectors
- 12 LC to 12 Fiber MPO Cassette
- Key Down to Key Up Adapter
- Position 1
- Position 12
- Key Down MPO
- Key Up MPO
- Position 11
- Position 12
- Key Down to Key Up Adapter
- 12 Fiber Ribbon

POWERED BY WERNER ELECTRIC
40 Gig – Method A Day Two

Type "B" Patch Cord

Position 12
Position 1
Position 12
Position 1

Type "A" Patch Cord

Position 12
Position 1
Position 12
Position 1

Key Up/Key Down Adapters
Key Up MPO

12 Fiber Ribbon

POWERED BY WERNER ELECTRIC
Problem with method “A” – Two different types of patch cords
  Easy to use the wrong patch cord
  Need to keep two different patch cords in inventory
40 Gig – Method B Day Two

Type "B" Patch Cord

Key Down MPO
Position 12
Position 1
Position 12

Key Down MPO

Key Down to Key Down Adapter

Key Down MPO
Position 12
Position 1

Position 1

12 Fiber Ribbon

Key Up MPO

Key Up MPO

Type "B" Patch Cord

Key Up MPO
Position 12
Position 1
Position 1

Position 1

Key Up to Key Up Adapter
Method B advantage — Uses same patch cord throughout

Problems with both Method A & Method B

- Patch cords have exposed male pins
- Trunks were originally used with cassettes that had male pins
What About Method C?

“Pair-wise flip” in the trunk

Does not work
Migrating 10G to 40 Gig Ethernet
Panduit’s PanMPO™ Connector

Most flexible MPO connector
  Change from key-up to key-down
  Change from with pins to without pins

Can bring trunks terminated with PanMPO™ Connector back into standards compliance
Questions?