Multi-Port Implementations of 50/100/200GbE

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Supporters

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- Jonathan King, Finisar
The 2016 Ethernet Roadmap

- Source: www.ethernetalliance.org/roadmap
17 (or 18) New Ethernet Interfaces Shown in Green
At least 14 in the 802.3cd project
Another 6 in 802.3bs
200G and 400G Form Factors Explosion

Today's Interfaces
- RJ45
- SFP
- QSFP
- CFP2
- Twisted Pair
  - Cat “x”
- Twinax
- Duplex and Parallel Optical Fiber

0.01-40Gb/s
1-100Gb/s
40-400Gb/s
40-800Gb/s

Tomorrow's Possible Interfaces
- CFP8
- OSFP
- QSFP-DD
- 6-lane Module Concept

0.12-1.2Tb/s
40-400Gb/s
200-800Gb/s
400-800Gb/s

SOURCE: WWW.ETHERNETALLIANCE.ORG/ROADMAP
## Ethernet Fragmentation at 50/100/200GbE

<table>
<thead>
<tr>
<th>Form Factor</th>
<th>CR</th>
<th>SR</th>
<th>DR</th>
<th>FR</th>
<th>LR</th>
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<tbody>
<tr>
<td>SFP56</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>QSFP56 and uQSFP</td>
<td>4 X 50</td>
<td>4 X 50</td>
<td>4 X 50</td>
<td>2 X 100</td>
<td>2 X 100</td>
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<tr>
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<td>2 X 100</td>
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<td>1 X 200</td>
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<tr>
<td></td>
<td>1 X 200</td>
<td>1 X 200</td>
<td>1 X 200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QSFP-DD and OBO-8</td>
<td>8 X 50</td>
<td>8 X 50</td>
<td>8 X 50</td>
<td>2 X 200</td>
<td>2 X 200</td>
</tr>
<tr>
<td></td>
<td>4 X 100</td>
<td>4 X 100</td>
<td>4 X 100</td>
<td></td>
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<tr>
<td></td>
<td>2 X 200</td>
<td>2 X 200</td>
<td>2 X 200</td>
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</tbody>
</table>

*Blue Text = No current IEEE objective*
50/100/200GbE Potential

- 200G Port and OBO should support:

**Electrical Interfaces:**
- 50GAUI
- 100GAUI-2
- 200GAUI-4

**Modules:**
- QSFP
- microQSFP
- QSFP-DD
- OBO

**Network Interfaces:**
- 50GBASE-CR/SR/DR/LR
- 100GBASE-CR2/SR2/DR2/LR2
- 200GBASE-CR4/SR4/DR4
- 200GBASE-FR4/LR4

**Blue Text** = No current IEEE objective

Demonstrated at Ethernet Alliance booth at OFC
Switch/Router Configurations

- Each switch vendor needs to select between module form factors and switch configurations.
- This shows 1U switches while module switches and routers have more flexibility.
- QSFP-DD same as QSFP.

Port Density Comparison

- 56 RJ45s/1U
- 56 SFP/1U
- 36 QSFP/1U
- 8 CFP2/1U
- 72 µQSFP/1U
- 100 OBO/1U
- 24QSFP +16 OBO

OBO = On Board Optics

Graphics available at www.ethernetalliance.org/roadmap
Possible Next Generation Switches

128 Port 50G Switch ASIC

6.4Tb/s ASIC

32 200G QSFP56 Port Switch

1X4 Copper Breakout

Optical Breakout

2X50GbE SFP56 Server

256 Port 50G Switch ASIC

12.8Tb/s ASIC

32 400G QSFP-DD Port Switch

1X8 Copper Breakout

Optical Breakout

2X50GbE SFP56 Server
Multi-Port Copper Breakout

25GbE Consortium already has a 50GbE (2x25G) Interface Defined

• Breakout to single Lanes
  QSFPxx capable of running at 4X 10GbE, 25GbE or 50GbE
  – xx = +, 28 or 56

• Breakout to Dual Lanes
  QSFPxx capable of running at 2X50GbE, or 100GbE
  – xx = +, 28 or 56

To 10GbE, 25GbE or 50GbE SFP Ports

To 50GbE (2X25G) or 100GbE (2X50GbE) QSFP Ports
Multi-port Optics to 10/25/50GbE

Figure 20 — QSFP Optical Receptacle and Channel Orientation

Fiber Number: 12 11 10 9 ...... 4 3 2 1
Transmit Channels: 1 2 3 4
Receive Channels: 4 3 2 1

QSFP56 running at 10, 25 and 50GbE per lane

25GbE Server
50GbE Server
10GbE Server
50GbE Switch
Multi-Ports to 50GbE and 100GbE

Optical Breakout

Figure 20 — QSFP Optical Receptacle and Channel Orientation

Fiber Number: 12 11 10 9 ...... 4 3 2 1
Transmit Channels: 1 2 3 4
Receive Channels: 4 3 2 1

QSFP56 running at 2X100GbE or 2X50GbE

100GbE Server (2X50G)

50GbE Server (2X25G) – Not IEEE Standard
One Port of 200GbE or 100GbE

Optical Breakout

Figure 20 — QSFP Optical Receptacle and Channel Orientation

Fiber Number: 12 11 10 9 .... 4 3 2 1
Transmit Channels: 1 2 3 4
Receive Channels: 4 3 2 1

200GbE Module (4X50G)

Possibly 100GbE Module (4X25G) at reduced speed

QSFP56 running at 1X100GbE or 1X200GbE
Parallel Port and Module Highly Flexible

One Module – 3 Cabling Configurations

• Industry can reach high volume by using 1 module with different cabling
  – Applies to parallel solutions like CR, SR and DR

• Higher volume equals lower cost

Could even do this:
4. 1X100GbE and 2X50GbE

3 Cabling Configurations

1. 4X50GbE Breakout
2. 2X100GbE Breakout
3. 1X200GbE
Cabling and Fiber Lanes Summary

3 Configurations

• Duplex LC – 2 fibers

• New Quadplex MPO – 4 fibers

• Octalplex MPO – 8 fibers

QUADPLEX AND OCTALPLEX ARE NAMES I MADE UP

=Dark or Removed fibers
100GBASE-SWDM2 and LR2 Limitations

100GBASE-SWDM2 or CWDM2 has two wavelengths over one fiber

- μQSFP, QSFP56 and QSFP-DD can’t support two Dual LC connectors without compromising density, so it will probably use MPO
  - Solution may be forthcoming
- MPO would be in Quadplex configuration and would only connect to similar modules – No SFPs

- Quadplex MPO – 4 fibers

=Dark or Removed fibers
100GBASE-SWDM2 and LR2 Limitations

100GBASE-SWDM2 has two wavelengths over one MMF

- If the task force develops 100GBASE-SWDM2 instead of 100GBASE-SR2, then the solution will have less configurability – It can only be SWDM2
- A server with a QSFP56 that only uses two lanes is suboptimal (only uses 2 or 4 lanes) or a new depopulated module
- New breakout cables will be needed with 2 dual LCs or fiber will be wasted
- SWDM2 is only supported in a multi-port module like QSFP56 (2X100GbE) or QSFP-DD (4X100GbE) – No SFP56

THE ORANGE FIBERS SHOULD BE AQUA TO REPRESENT OM3/4 OR SMF 17
## 100GBASE-SWDM2 vs 100GBASE-SR2

<table>
<thead>
<tr>
<th></th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>100GBASE-SWDM2</strong></td>
<td>Requires half the fiber</td>
<td>Requires new module types in fractured market</td>
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<tr>
<td></td>
<td></td>
<td>Less Configurable</td>
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<tr>
<td></td>
<td></td>
<td>Requires mux and demux – higher power lasers</td>
</tr>
<tr>
<td><strong>100GBASE-SR2</strong></td>
<td>Highly configurable</td>
<td>Requires double the fiber</td>
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<tr>
<td></td>
<td>Higher volumes and lower cost</td>
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</table>
Conclusion – Configurability Key to Success

Multi-Port Switch Implementations will be widely deployed

- With ASIC port counts rising, switch designs are changing
- CR/SR/DR multi-lane modules can support multiple configurations of 50/100/200G by changing the cabling
- Module configurability leads to higher volume and thus lower cost
- WDM Ports can't be broken out

- New Quadplex (4-fiber instead of 8 or 12) cabling infrastructure is needed for either MMF solution
- Multi-Port implementations do need different cabling and this could affect the MDI
  - MPO has different characteristics than LC connectors
Thank you!