QSFP addition to SAS

Supports longer distances and all PMD types

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QSFP Overview

- QSFP was originally developed for 4G FC
- Updated QSFP specification is being formally standardized within the SFF group.
  - Current MSA exists as INF-8438
  - New spec will be SFF-8436
  - Electrical support for higher data rates (up to 12G?) will be added
  - Management I/F support for higher speed variants will be added
QSFP – Quad Small Form-factor Pluggable

The QSFP MSA was released 12/4/2006

- The MSA defines an (8) Differential Pair / 4x Pluggable Copper & Optical Module
- 4 lanes @ up to 10 Gbps each per connector
- Uses only 30% more PCB space over SFP to get 10x data density

Optional hole in top of cage

Optional Heat Sink (74750) & Light Pipe (74750)

Optical Module (reference only)

Optical Cable (106283)

Loopback (74763)

38 ckt iPass Connector (same as PCI Express 4x) (75586)

Single Cage (74750) Optional Cage with Solid Top

Gasket or Spring finger EMI solutions

4x Passive (74757) or Active (74758) Pluggable Copper Cable

Optical Loopback (106283)
QSFP module
Electrical I/F support

- Support ‘new’ Electrical I/F: 8G to 10G
  - SFF-8431 (8G-11.1G)
  - XFI (10.3-11.1G)
  - FC-PI-4 (8.5G)
  - 40G Ethernet? (4x10.3G?)
  - IB QDR (10G)
  - 10GBASE-KR (10.3G)
  - SAS 2.0 (6G)
  - SAS 3.0 (12G?)
  - PCI Exp 3 (8G)

- Support legacy I/F: 1G to 5G
  - IB –SDR and DDR (2.5G and 5G)
  - Ethernet/SFP – (1G)
  - FC-PI-2 – (1,2,4.25G)
QSFP return loss measurements support 12G

\[
\begin{align*}
\text{m1} \quad & \quad \text{freq} = 5.000 \text{GHz} \\
SDD33 &= -15.778 \\
\text{m2} \quad & \quad \text{freq} = 5.000 \text{GHz} \\
SDD11 &= -30.778
\end{align*}
\]
Media support:

- Passive copper cable
- Active copper cable
- Active optical cable
- Parallel fiber
  - SM
  - MM
**SFF-8376 Coordinators**

- Scott Kipp (Brocade) Co-chair
- Jay Neer (Molex) Co-chair
- Tom Palkert (Luxtera) Editor
Why add QSFP to SAS?

- Supports
  - longer lengths of interconnects
  - Multiple user selectable PMDs with a single connector:
    - Passive copper cables
    - Active copper cables
    - Active optical cables
    - Connectorized optical/copper cables

- Multiple vendor support
  - 3 passive copper cables
  - 3 active copper cables
  - 3 active optical cables
  - 2 connectorized optical cable
Who specifies QSFP today?

- IB (DDR (5G) and QDR (10G) applications)
- 802.3ba: Not directly specified but presented to show technical feasibility of 40G rate. Also used for link simulations.
- Fibre Channel: Origin of MSA and supporting use at 8G
- Others?
Blazar – 4x10Gbps Optical Active Cable

- Available as an optical active cable at multiple lengths up to 300 meters
- Four lane, full duplex XCVR, multi-rate
  - 10 Gbps per line rate supported
  - Total cable bandwidth up to 42 Gbps
- Target market
  - Infiniband, Ethernet, Fibre Channel
- Potential other applications
  - PCI-Express extender
  - SAS extender
- QSFP MSA form factor compatible
- SFP+ standards compliant electrical interface
- Single-Mode Ribbon Fiber Cable
  - Up to 300 meter reach
  - Permanently attached to transceivers
- Power consumption
  - 2W typical per end (at 4x10Gbps)
- Hot pluggable

Sampling to Customers Q4 2007
## Estimated distances supported

<table>
<thead>
<tr>
<th></th>
<th>Direct attach copper</th>
<th>Active copper</th>
<th>Active optical</th>
<th>MM optical</th>
<th>SM Optical LC-I</th>
<th>SM optical LC-L</th>
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<tbody>
<tr>
<td>FC-PI-4 delta</td>
<td>7m</td>
<td>20m</td>
<td>.1-2km</td>
<td>50-100m</td>
<td>1.4km</td>
<td>10km</td>
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<tr>
<td>FC-PI-4 Beta</td>
<td>5m</td>
<td>20m</td>
<td>.1-2km</td>
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<tr>
<td>8431</td>
<td>7m</td>
<td>20m</td>
<td>.1-2km</td>
<td></td>
<td>NA</td>
<td>10km</td>
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<tr>
<td>XFI</td>
<td>1m</td>
<td>20m</td>
<td>.1-2km</td>
<td></td>
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<td>6G SAS</td>
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<td>20m</td>
<td>.1-2km</td>
<td>&gt;50</td>
<td>1.4km</td>
<td>10km</td>
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<td>10-12G SAS</td>
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<td>20m</td>
<td>.1-2km</td>
<td>50m</td>
<td>1.4km</td>
<td>10km</td>
</tr>
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</table>
What needs to be done?

- Add QSFP connector and card cage to SAS specification
  - SAS 3.0 is too far out to meet the industry requirements for optical links in the next 1-3 yrs.
  - Will there be a SAS 2.x?
  - No changes to SAS electrical/jitter specs.
  - Add optical specs as needed.
    - This should be considered for next SAS spec.