CEI-28G-VSR Project
Initial Thoughts
Contribution Number: PLL
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SOURCE: John D'Ambrosia, Force10
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Abstract: Initial Thoughts on issues associated with CEI-28G-VSR Project

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This presentation considers a number of issues to be addressed for CEI-28G-VSR. CEI-28G-VSR will define an electrical specification for future 25/28G I/O interfaces for potential common use by multiple applications:

- **Ethernet:** 26G (4x26G => 103G)
- **Telecom:** 28G (4x28G => 112G)
- **InfiniBand:** 25G (4x25G, 12x25G)
- **Fibre Channel:** 28G (N x 28G)

This presentation doesn’t make any recommendations at this time.
Industry Bodies Need to Work Together

- It is desirable to define a new 25/28G connector technology for potential common use by multiple applications and multiple form factors:
  - Enables common CEI-28G-VSR channel models
  - Minimizes connector R&D
  - Minimizes cost
- Beneficial if any group making a connector selection process considers needs all applications
An Optics Roadmap

CFP supports 100GE-SR10, and CFP2 will support 100GE-SR4
# 100G SMF Optical Module Roadmap

## Module Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Current Gen</th>
<th>Next Gen CFP2</th>
<th>Next Gen QSFP2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optics</strong></td>
<td>Discrete or Integrated</td>
<td>Integrated</td>
<td>Integrated</td>
</tr>
<tr>
<td><strong>Electrical I/O</strong></td>
<td>Re-timed</td>
<td>Re-timed or Asymmetric</td>
<td>Re-timed, Asymmetric or un-retimed</td>
</tr>
<tr>
<td><strong>Data Rates</strong></td>
<td>10 x 10.3 (103.125 Gb/s) 10 x 11.2 (111.81 Gb/s)</td>
<td>4 x 25.78 (103.125 Gb/s) 4 x 27.95 (111.81 Gb/s)</td>
<td>4 x 25Gb/s (100Gb/s) 4 x 25.78 (103.125 Gb/s) 4 x 27.95 (111.81 Gb/s) 4 x 28Gb/s (112Gb/s)</td>
</tr>
</tbody>
</table>

* Preliminary

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**Diagram:**

- **CFP**
  - 100GBASE-LR4
  - 4x25G LAN-WDM

- **CFP2**
  - CEI-28G-VSR
  - 4x25G
  - 100GBASE-LR4
  - 4x25G LAN-WDM

- **QSFP2**
  - CEI-28G-VSR
  - 4x25G
  - 100GBASE-LR4
  - 4x25G LAN-WDM

**Notes:**

- CFP, CFP2, and QSFP2 are optical module types.
- Current Gen, Next Gen, and Next Next Gen indicate different generations of technology.
- Optics and Electrical I/O characteristics are key factors in module performance.
- Data Rates specify the throughput capacity of each module.
Next Gen 100G SMF Optical Module Power Dissipation

These lines approximate “Isotherms”

The position of these lines are a result of:
- Ambient Temperatures
- Heatsink Efficiency / Size
- Module Case Temperature

Suggested power consumption and module area ranges of next gen CFP2 and QSFP2 pluggable form factors based on CFP and QSFP isotherms

SOURCE: MSA public web-page
Starting Point: Channel Budget

- Max connector loss: <1.4 dB from 10 MHz-14 GHz
- Max connector ripple: <0.05 + 0.025*f where *f* is in GHz, per SFF-8431 A.4, fitted from 0.25GHz to 14 GHz

Proposal: $0.114+0.8914f^{(1/2)} + 0.460f \quad 0.25 \leq f < 28$

<table>
<thead>
<tr>
<th>Traces</th>
<th>FR4-6</th>
<th>N4000-13</th>
<th>Megtron 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss at 14 GHz /in</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>Connector loss at 14 GHz</td>
<td></td>
<td></td>
<td>1.4</td>
</tr>
<tr>
<td>Loss allocation for 2 Vias in the channel</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Max Module PCB Loss</td>
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<td></td>
<td>2.1</td>
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<td>PCB Trace Length Assuming 10 dB Loss Budget</td>
<td>2.7500</td>
<td>3.6667</td>
<td>5.5000</td>
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<tr>
<td>PCB Trace Length Assuming 12 dB Loss Budget</td>
<td>4.2500</td>
<td>5.6667</td>
<td>8.5000</td>
</tr>
</tbody>
</table>
Connector Crosstalk Target

- ICN defined same as 802.3ba CL85.10.7 when measured with mated HCB and MCB, except:
  - ICN receiver BW increased from 7.5 GHz to 18 GHz
  - HC B PCB loss at 14 GHz is 2.1 dB
  - MC B PCB loss at 14 GHz is 1 dB
  - 802.3ba Eq 86A-4 loss can be scaled for the MCB and HC B loss
- MDNEXT=1 mV (RMS)
- MDFEXT=2.8 (RMS)
- IC N=3 mV (RMS)
Remembering: Passive Direct-attach copper cabling

NOTE 1 – Only one direction of transmission shown
NOTE 2 – Channel insertion loss is \( C = A + 2 \times (H - F) \)

- **Host channel insertion loss allotment also has a direct impact on cable reach**
- **Consider the CEI-25G-LR loss budget of 25.4 dB, a 3 dB/m bulk cable attenuation, and paddle card losses on the order of the HCB PCB loss**
  - For \( H = 8 \) dB, the cable reach \( R \) is \( (25.4 - 2 \times 8)/3 = 3.1 \) m
  - For \( H = 10 \) dB, the cable reach \( R \) is \( (25.4 - 2 \times 10)/3 = 1.8 \) m
Manual Tuning of Tx?

- **10G SFP+ issues in an un-retimed Tx module interface**
  - Currently host Tx de-emphasis filter settings needs to be manually tuned
  - **Stacked SFP+ connectors requires a different pre-emphasis optimization**
  - Different channel lengths require different optimization
  - Cannot accommodate manufacturing and temperature variations

- Is this manual method scalable for 25G?
Summary

Areas of further investigation

- Industry Efforts
- Module Power / form factor
- Channel
  - Crosstalk
  - Connector
  - Consideration for impact on Cu Twin-ax solutions
- Is manual tuning acceptable in the future?