Considerations for HSSG Cu cable assembly interconnect specifications

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Presentation objectives

• Considerations for 802.3ba Cu cable assembly interconnect specifications
Contributors

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• Jens Aumann, Leoni High Speed Cables
Supporters

• Dan Dove, ProCurve Networking by HP
HSSG Objectives

• Support full-duplex operation only
• Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
• Preserve minimum and maximum FrameSize of current 802.3 standard
• Support a BER better than or equal to $10^{-12}$ at the MAC/PLS service interface
• Provide appropriate support for OTN

• Support a MAC data rate of 40 Gb/s
  • Provide Physical Layer specifications which support 40 Gb/s operation over:
    – at least 100m on OM3 MMF
    – at least 10m over a copper cable assembly
    – at least 1m over a backplane

• Support a MAC data rate of 100 Gb/s
  • Provide Physical Layer specifications which support 100 Gb/s operation over:
    – at least 40km on SMF
    – at least 10km on SMF
    – at least 100m on OM3 MMF
    – at least 10m over a copper cable assembly
100GBASE-CRn and 40GBASE-CR4 link

Cable assembly

MDI

100GBASE-CRn or
40GBASE-CR4
Transmit Function

Signal<n>
Link shield

Signal shield

Signal<p>
Lane n

MDI

100GBASE-CRn or
40GBASE-CR4
Receive Function

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Cu cable assembly: considerations for 40 Gb/s

- Evaluate usage of 10GBASE-KR (Clause 72) and 10GBASE-CX4 to specify 40GBASE-CR4
  - For commonality with 40 Gb/s backplane proposal:
    - 64b/66b PCS
    - Signaling speed 10.3125 Gbd (per lane)
    - Optional FEC sublayer (TBD)

- Evaluate usage CX4 for commonality with twinaxial cable assembly usage and specifications (plug-and-play over all specified distances)
  - S-parameters (+ additional parameters i.e., group delay, etc.)

- QSFP MSA – 10 Gb/s lane operation demonstrated up to 10 meters of twinaxial cable

- Group delay differences between backplane and twinaxial cable assemblies (64b/66b spectra versus 8b/10b)
Copper cable assembly: PHY lane options discussed

- Support a MAC data rate of 100 Gb/s
- Provide Physical Layer specifications which support 100 Gb/s operation over:
  - at least 10m over a copper cable assembly
  - 10 x 10 Gb/s lane
  - 4 x 25 Gb/s lane (TBD)
  - 5 x 20 Gb/s lane (TBD)

- Support a MAC data rate of 40 Gb/s
- Provide Physical Layer specifications which support 40 Gb/s operation over:
  - at least 10m over a copper cable assembly
  - 4 x 10 Gb/s lane
Cu cable assembly: considerations for 100 Gb/s

- Commonality with 10 x 10 Gb/s lane option and 4 x 10 Gb/s lane option

- Commonality with SMF and MMF lane options
  - 4 x 25 Gb/s
  - 5 x 20 Gb/s
S-parameter interconnect specifications

- S-parameters are sufficient to specify interconnect-induced signal impairments e.g.,
- Measured:
  - Insertion loss
  - Return loss
  - Crosstalk
  - NEXT
  - FEXT
- Computed:
  - PSNEXT
  - PSELFEXT
- Limits:
  - Measurement based
  - InfiniBand

For 10GBASE-CX4 - All cable assembly measurements are to be made between TP1 and TP4 as shown in the Figure illustrated above.
802.3ap Channel Parameters

- Channel measurement reference: TP1 to TP4.

**Measured**
- Insertion Loss
- NEXT
- FEXT
- Return Loss

**Computed**
- Insertion loss deviation
- Insertion loss to crosstalk ratio
- PSNEXT, PSFEXT, PSXT

**Limits**
- To support existing platforms (ATCA)

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Infiniband Copper

Annex A5: Pluggable Interfaces: CATx, Copper and Optical
- Pluggable QSFP FOR 4x, 8x and 12x
- Multiple 4x QSFP pluggables used for 8x or 12x links

QSFP Module

QSFP Connector: 38-contact, right angle surface mount connector

32 - QSFP Ports
1U rack space

Source: Molex

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Cable – 24 AWG twinaxial

Insertion Loss-10 m-24 AWG

MHz

SDD12-PR1
SDD12-PR2
SDD12-PR3
SDD12-PR4
SDD12-PR5
SDD12-PR6
SDD12-PR7
SDD12-PR8

dB
Simulation modeling and test points

- MDI
- Twinaxial cable
- TP1
- TP2
- TP3
- TP4
- Tx driver
- Tx attributes e.g., Pre-emphasis
- Tx package
- pcb
- Twinaxial cable
- backplane connector
- backplane channel
- Rx attributes e.g., equalization, AC coupling
- Rx slicer
Cu cable assembly channel model


Worst-case Package Model (*.zip) Richard Mellitz Spec_RL_pkg_802_3.s4p
802.3ap – Channel parameters

- Insertion loss to crosstalk ratio (ICR) computed from S-parameter models and (measurements)

Insertion loss, 4 near-end crosstalk Disturbers multi-disturber NEXT

Insertion loss, 3 far-end crosstalk disturbers multi-disturber FEXT
Summary

• Channel models and simulation models in development to evaluate usage of 10GBASE-KR (Clause 72) for 10 Gb/s lane options.

• QSFP cable connector and 10 meters of twinaxial cable considered for 40GBASE-CR4 cable assembly.