
802.3ba copper cable assembly proposal

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Summary

- **Considerations for 802.3ba Cu cable assembly specifications for 802.3ba baseline proposal.**
- **Measurement models and simulation models developed to validate usage of 10GBASE-KR (Clause 72) for 10 Gb/s lane options for both 40GBASE-CR4 and 100GBASE-CR10 cable assemblies.**
- **QSFP cable connector and 10 meters of twinaxial cable proposed for 40GBASE-CR4 cable assemblies.**
- **CX4 twinaxial cable assembly differential parameters proposed as basis for 40GBASE-CR4 and 100GBASE-CR10 link specification (i.e., S-parameters).**

802.3ba 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**

Copper cable assembly: PHY lane options discussed

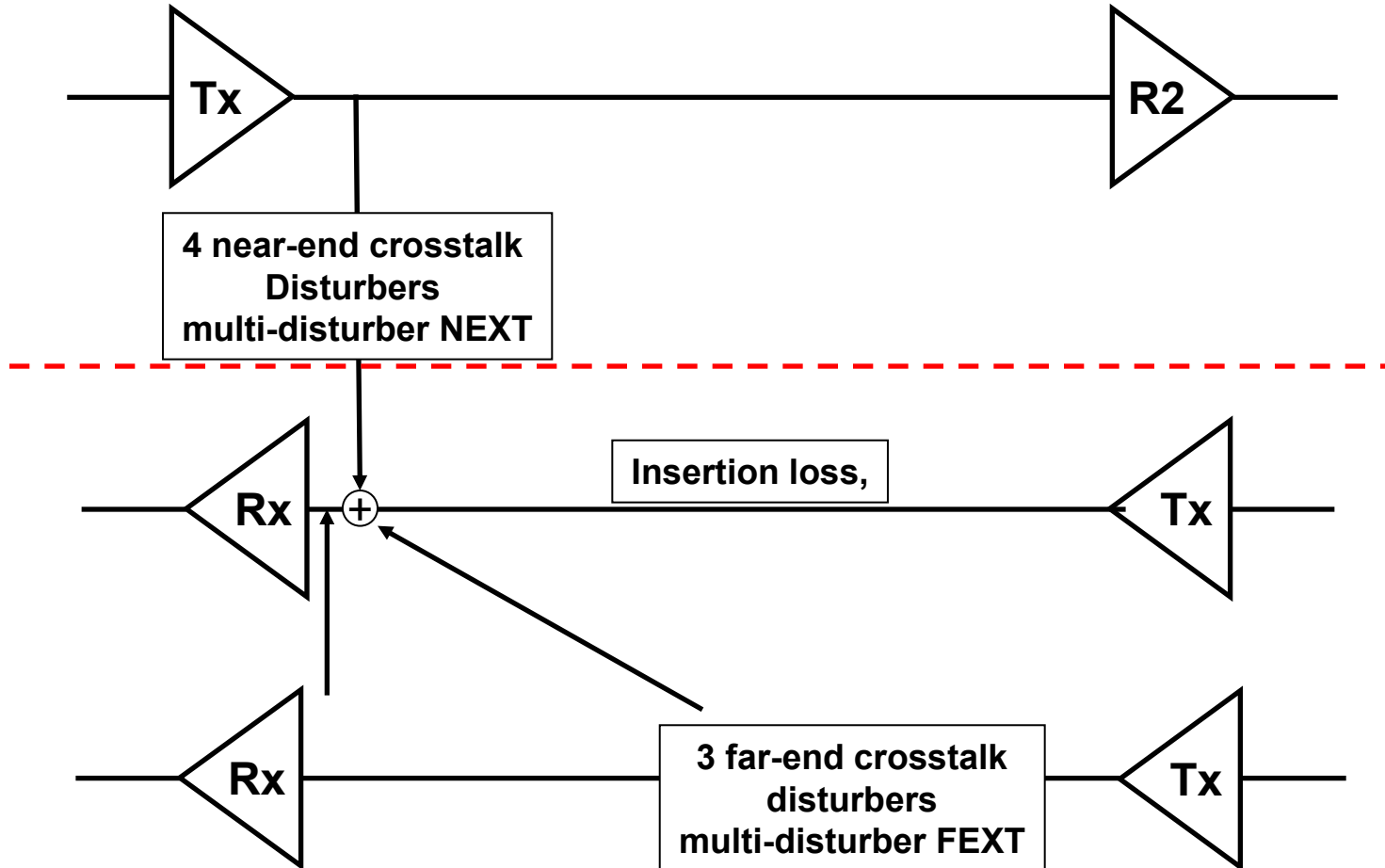
- Support a MAC data rate of 100 Gb/s
- Provide Physical Layer specifications which support 100 Gb/s operation over:
 - at least 10m over a copper cable assembly
 - **10 x 10 Gb/s lane**
 - 4 x 25 Gb/s lane (TBD)
 - 5 x 20 Gb/s lane (TBD)
- Support a MAC data rate of 40 Gb/s
- Provide Physical Layer specifications which support 40 Gb/s operation over:
 - at least 10m over a copper cable assembly
 - **4 x 10 Gb/s lane**

802.3ba Cu cable assembly proposal

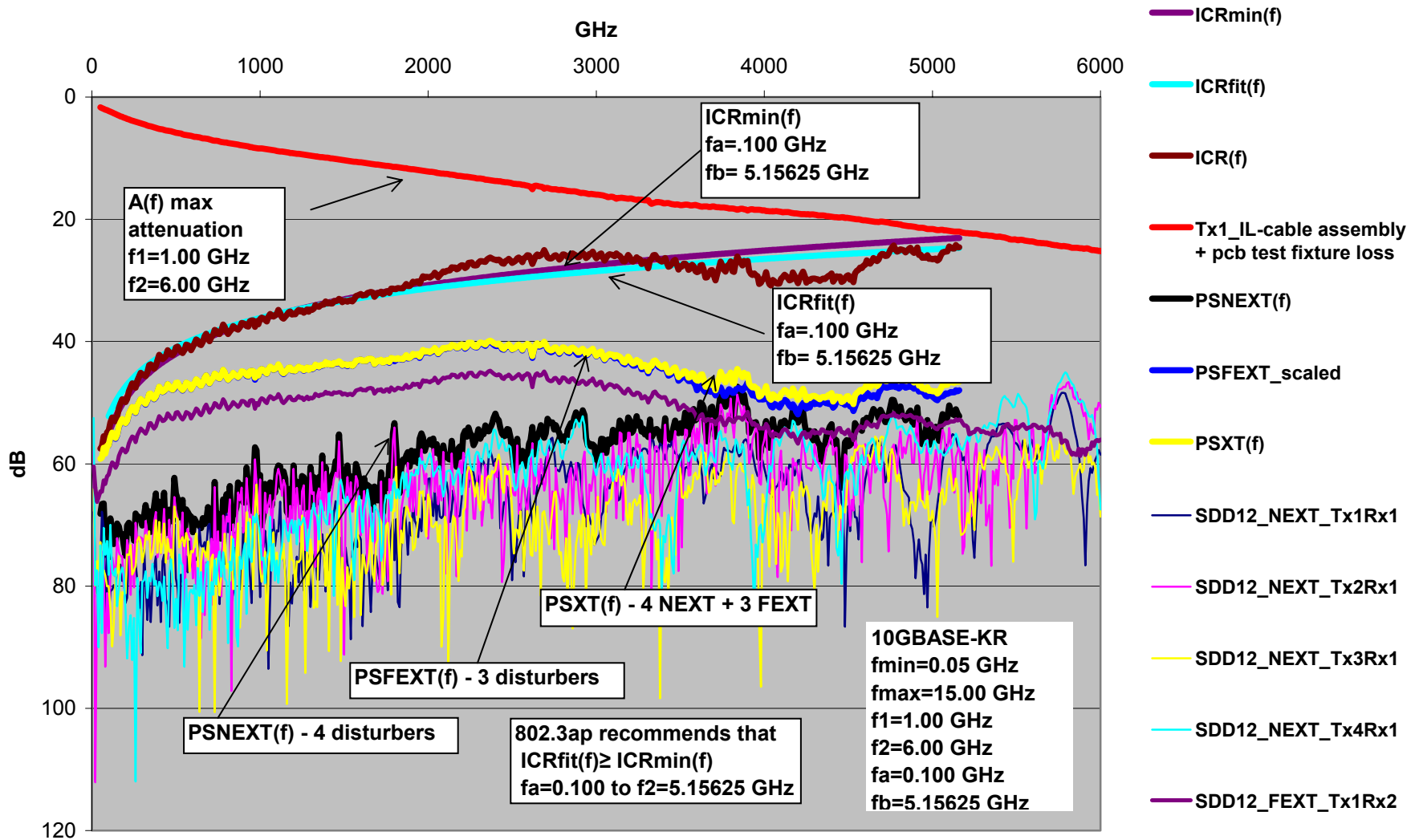
- **Utilize 10GBASE-KR (Clause 72) and 10GBASE-CX4 to specify 40GBASE-CR4 and 100GBASE-CR10.**
 - **64B/66B PCS**
 - **Signaling speed 10.3125 Gbd (per lane)**
 - **4x and 10x - KR transmit and receive functions**
 - **S-parameters - cable assembly differential parameter**
 - **QSFP copper cable assembly**
- **Commonality with 40 GbE backplane proposal.**

802.3ap – channel parameter comparisons

- Insertion loss to crosstalk ratio (ICR) computed from S-parameter measurements and models of QSFP 10 meter copper cable assembly (24 AWG).



802.3ap ICR limits versus 10 m QSFP cable assembly 24 AWG including test fixture

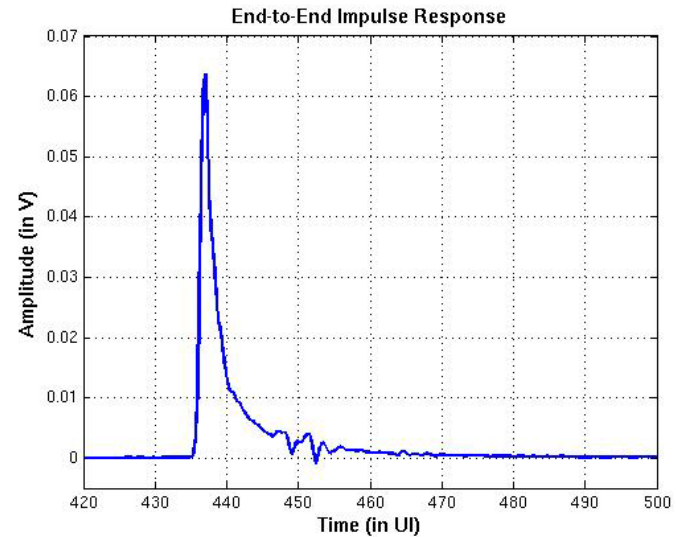
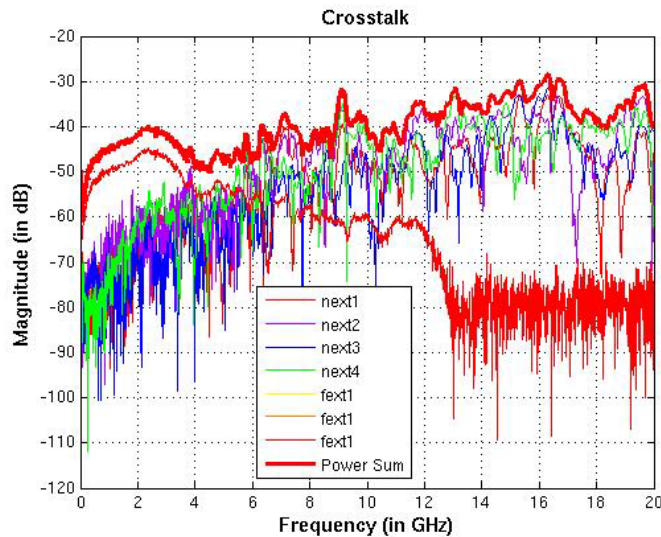
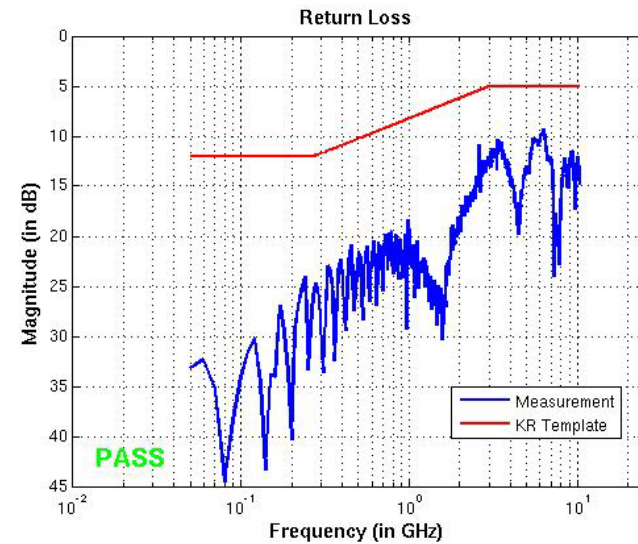
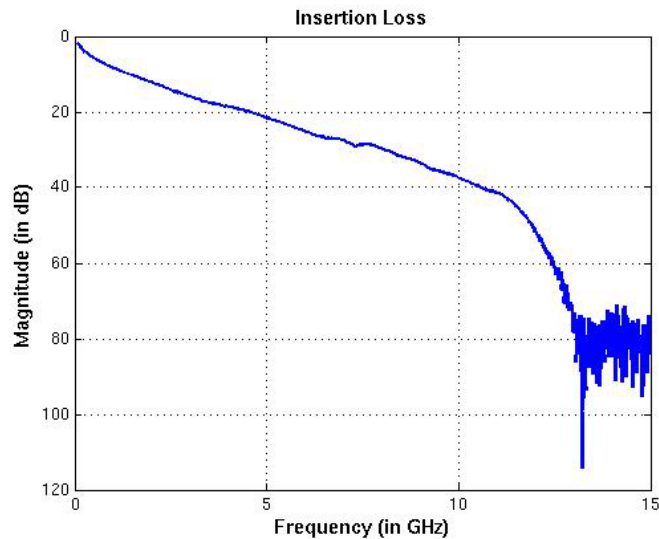


Simulation Setup

- **Insertion Loss, Return Loss, Crosstalk per data from Chris DiMinico**
- **Package models based on measured data**
- **Receiver architecture same as that used in KR group (802.3ap)**
- **MATLAB simulations**
 - **Pulse Response “Frequency-domain” Analysis, with MMSE optimization**
- **Performance evaluation based on detailed, worst-case error probabilities (not simple Gaussian assumption)**
- **On-chip impairments included**
 - **Clock jitter, Offsets, Front-end noise, Detailed analog circuit models, Detailed equalizer implementation penalties**
- **Worst-casing of ISI data patterns and crosstalk phase**

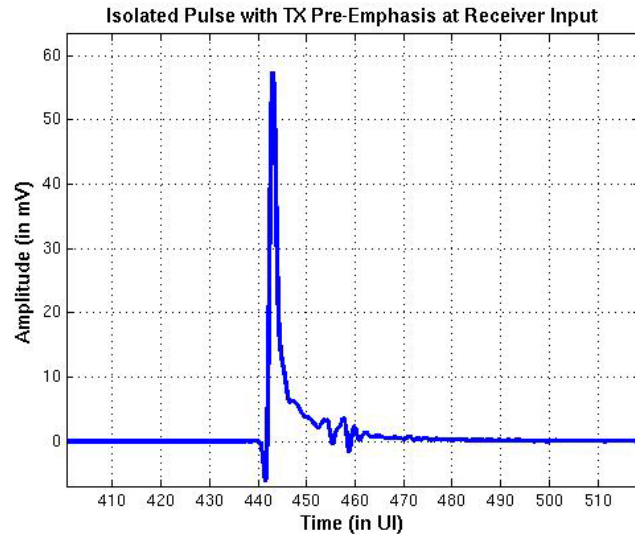
Source: Vivek Telang, Broadcom

Channel models

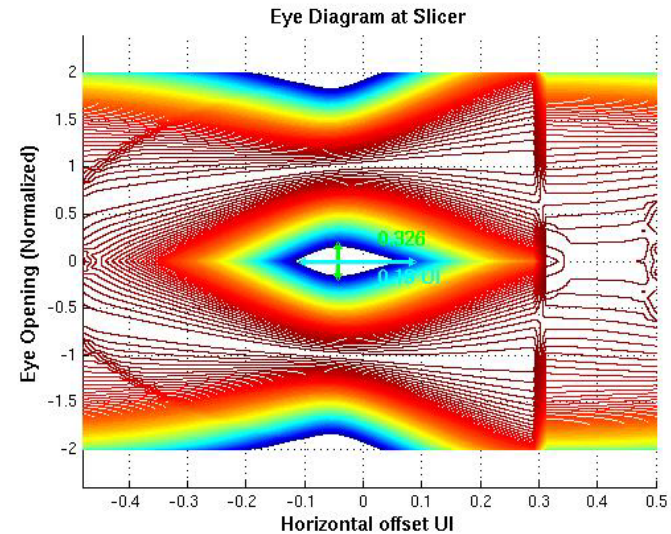
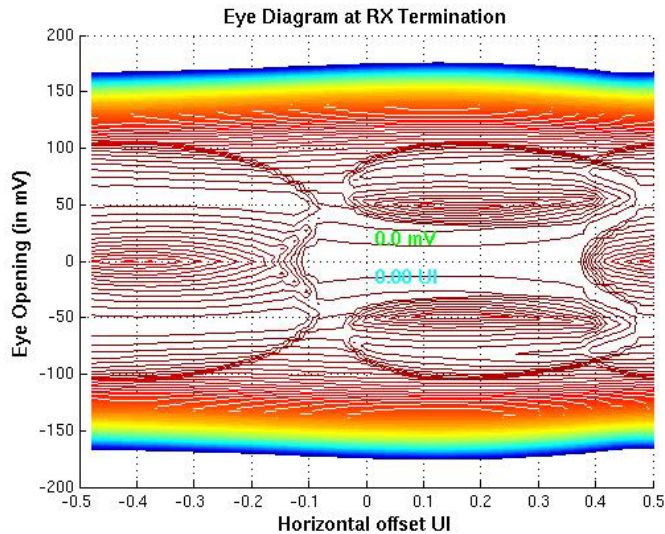


Source: Vivek Telang, Broadcom

Simulation results



Slicer SNR & BER	
SNR (dB)	BER
18.5	1.4×10^{-17}



Source: Vivek Telang, Broadcom

10GBASE-CX4 Link diagram

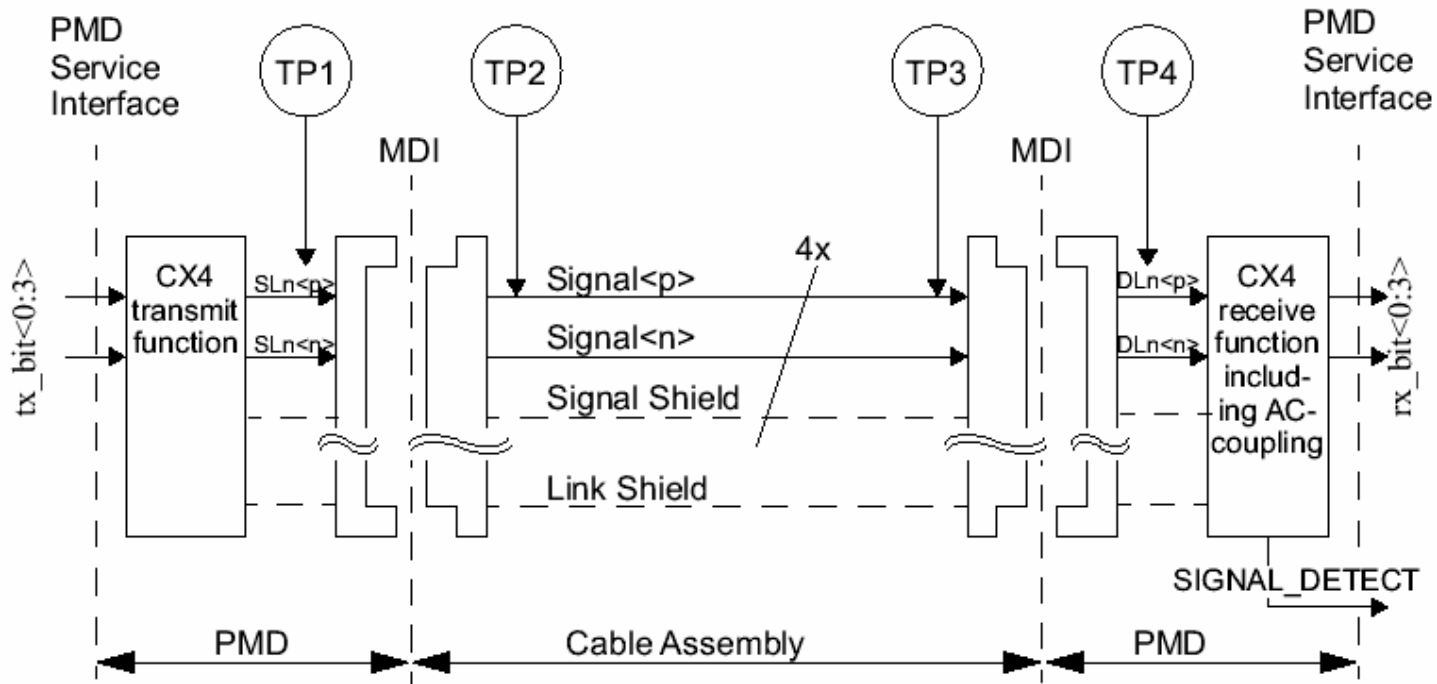


Figure 54-2—10GBASE-CX4 link (half link is shown)

802.3ba copper cable assembly link diagram

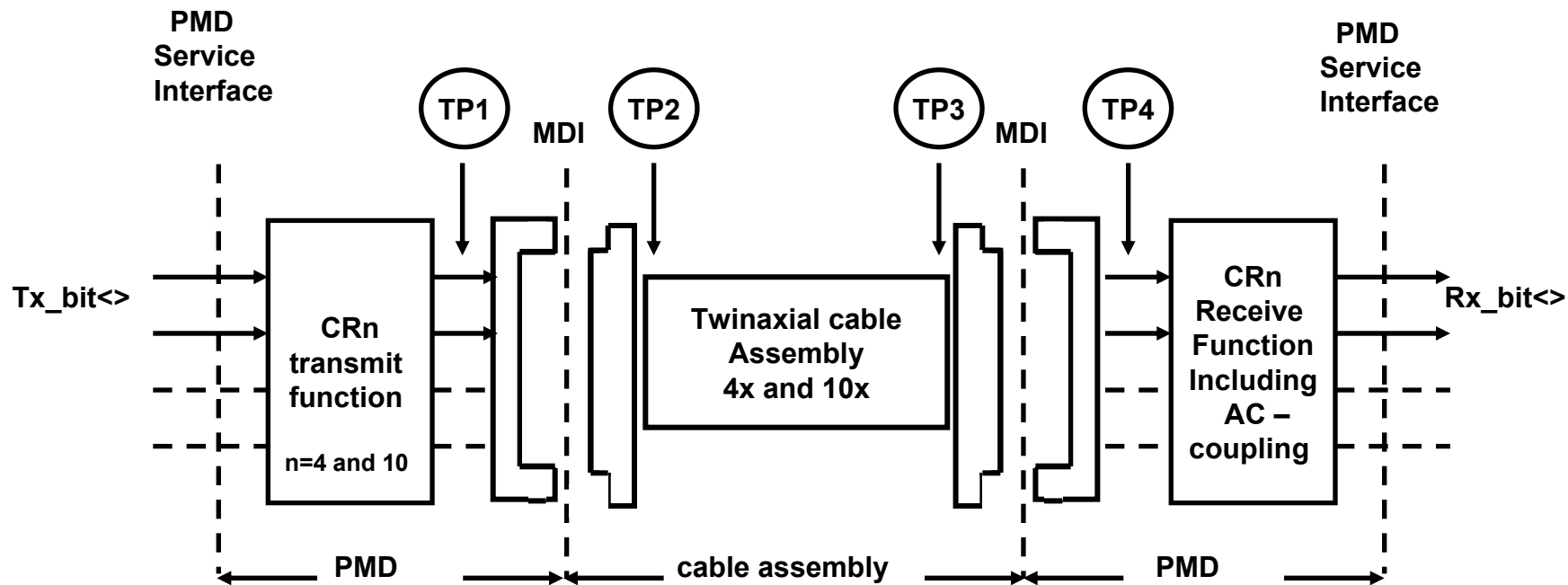


Figure XX-X—40GBASE-CR4 and 100GBASE-CR10 link

40GBASE-CR4 and 100GBASE-CR10 layer diagrams

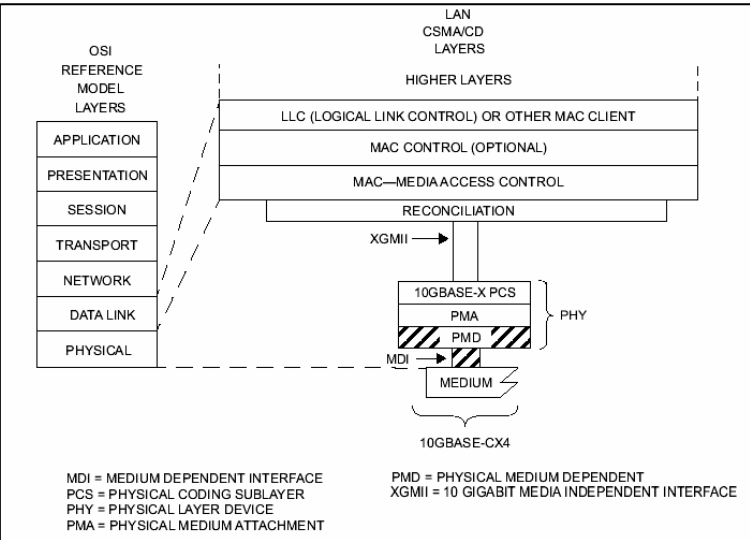


Figure 54-1—10GBASE-CX4 PMD relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 CSMA/CD LAN model

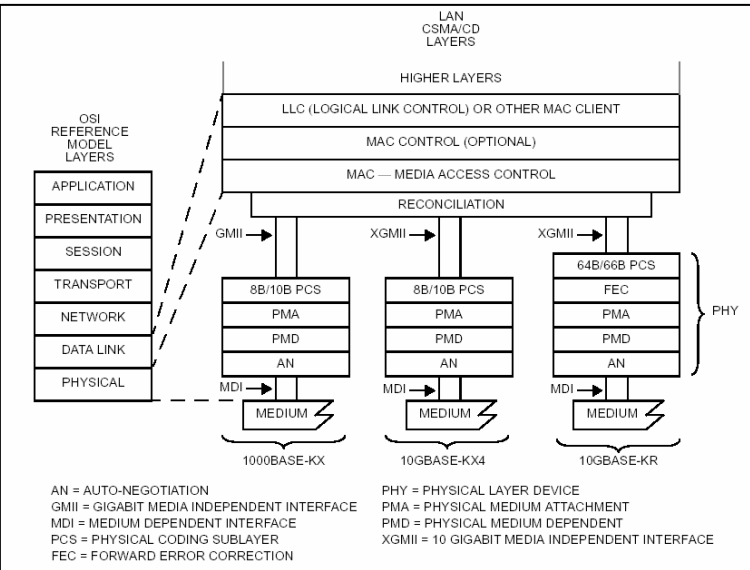
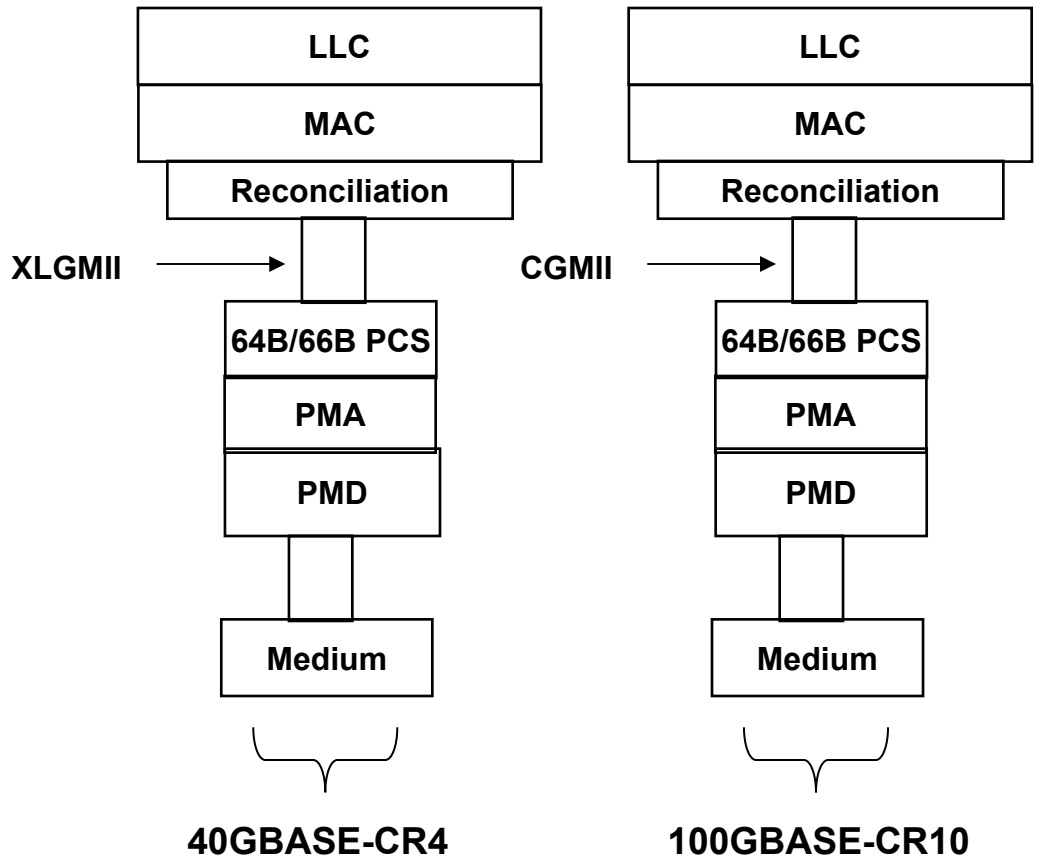


Figure 69-1—Architectural positioning of Backplane Ethernet



40GBASE-CR4 and 100GBASE-CR10 cable assembly

•Cable assembly differential parameters

Description	Value	Unit
$Insertion\ Loss(f) \leq TBD \sqrt{f} + TBD \times f + \frac{TBD}{\sqrt{f}}$	TBD	dB
$NextLoss(f) \geq TBD - TBD \times \log\left(\frac{f}{TBD}\right)$	TBD	dB
$ReturnLoss(f) \geq TBD$	TBD	dB
$MDNextLoss(f) \geq TBD - TBD \times \log\left(\frac{f}{TBD}\right)$	TBD	dB
$ELFEXT(f) \geq TBD - TBD \times \log\left(\frac{f}{TBD}\right)$	TBD	dB
$MDELNEXT(f) \geq TBD - TBD \times \log\left(\frac{f}{TBD}\right)$	TBD	dB

•TBD's determined from regression to measurement models

Conclusions

- **Measurements of 10 meter QSFP cable assembly compared to 10GBASE-KR (Clause 72) channel parameter limits used to validate 10 Gb/s lane operation over 10 meter QSFP cable assembly for 40GBASE-CR4.**
- **CX4 twinaxial cable assembly differential parameters proposed as basis for 40GBASE-CR4 and 100GBASE-CR10 link specification (i.e., S-parameters).**
- **Utilize 10GBASE-KR (Clause 72) and 10GBASE-CX4 to specify 40GBASE-CR4 and 100GBASE-CR10.**
 - **64B/66B PCS**
 - **Signaling speed 10.3125 Gbd (per lane)**
 - **4x and 10x - KR transmit and receive functions**
 - **S-parameters - cable assembly differential parameter**
 - **QSFP MSA**
 - **Commonality with 40 GbE backplane proposal**

Backup

Crosstalk 10 m QSFP cable assembly-24 AWG

