

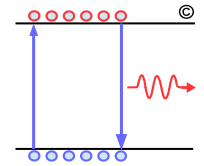
Issue with 50G PAM4 C2M Specification

Ali Ghiasi
Ghiasi Quantum LLC

IEEE 802.3cd Task Force Meeting

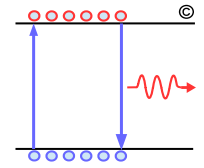
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Background



- ❑ In support of comment 116 against P802.3cd D1.1
- ❑ The IEEE 802.3bs C2M simulations have not demonstrated operation over 10.5 dB channel with max FEXT/NEXT
- ❑ The base simulations have consisted of
 - 6 TE channel with a hypothetical connector having crosstalk $\sim 1/5$ of QSFP28
 - 2 Cisco channels with no crosstalk
- ❑ History of comments on this issue
 - This issue was first raised with Comment 128 against P802.3bs draft 1.4 that mated board of CL92 crosstalk is excessive in support of 50G Cu cabling
 - Comments 83 and 86 are submitted against D2.0 related to excessive crosstalk not considered in the baseline C2M
 - Comments 135 against D2.1 related to excessive crosstalk not considered in the baseline C2M
- ❑ C2M simulations need to be repeated with representative QSFP28 channels otherwise we are building an standard based on a hypothetical MDI!

50G Mated Board References Legacy CL92 MCB/HCB Specifications



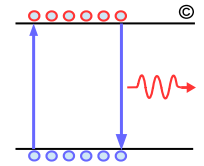
□ Currently CL 120E.4.1 MCB/HCB specifications references

- CL 92.11.1 for HCB specifications
- CL 92.11.2 for the MCB specifications
- CL 92.11.3.6 defines mated test fixture ICN
 - MDFEXT of 4.8 mV is excessive for 50G PAM4 link!

Table 92–13—Mated test fixtures integrated crosstalk noise

Parameter	100GBASE-CR4	Units
MDNEXT integrated crosstalk noise voltage	Less than 1.8	mV
MDFEXT integrated crosstalk noise voltage	Less than 4.8	mV

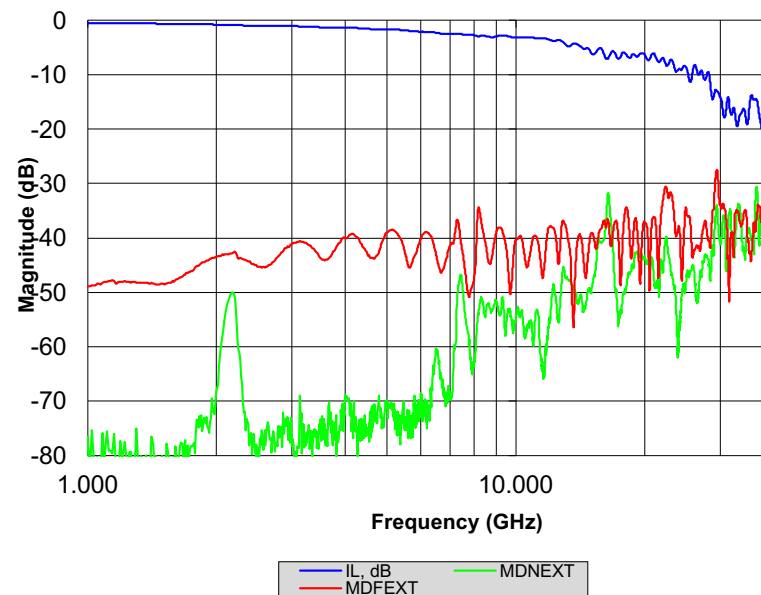
Bases for the Mated MCB/HCB MDFEXT/MDNEXT in CL92



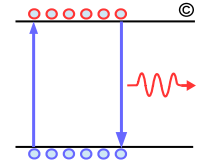
❑ QSFP+ connector provided bases for the CL92 MDFEXT and MDNEXT

- QSFP28 does provide slight improvement but in 802.3cd decided to stay with these legacy limits
- http://www.ieee802.org/3/bj/public/sep12/ghiasi_3bj_01a_0912.pdf

MCB-HCB Crosstalk	10.3125 GBd ICN (mV)	25.78 GBd ICN (mV)	28.0 GBd ICN (mV)
Rise Time 20-80% (ps)	24.000	9.600	8.840
MDNEXT	0.323	1.390	1.612
MDFEXT	3.593	4.562	4.673
ICN	3.607	4.769	4.943



Hypothetical Channel Used for C2M Analysis Has Significantly Lower NEXT/FEXT



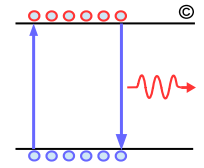
□ CDAUI-8/CCAUI-4 base channels

- http://www.ieee802.org/3/bs/public/adhoc/elect/24Aug_15/dallaire_01_082415_elect.pdf

CHANNEL	FEXT	NEXT	IL @ 13.28125 GHz (dB)	ILD (dBrms)
From IEEE 802.3bs shanbhag_3bs_14_0623:				
(1) Nelco 4000-13SI Host PCB + next gen 28Gb/s high density SMT IO	5	0	8.7	0.110
(2) EM-888 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	8.9	0.051
From IEEE 802.3bs shanbhag_3bs_01_1014:				
(3) 4in Megtron6 Host PCB + next gen 28Gb/s high density SMT IO	5	0	4.3	0.110
(4) 10in Megtron6 Host PCB + next gen 28Gb/s high density SMT IO	5	0	8.8	0.106
(5) 4in Megtron6 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	4.5	0.051
(6) 10in Megtron6 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	9.0	0.052
Cisco Channels:				
(7) Cisco 2in Stacked	0	0	8.5	0.237
(8) Cisco 5in Stacked	0	0	11.3	0.245

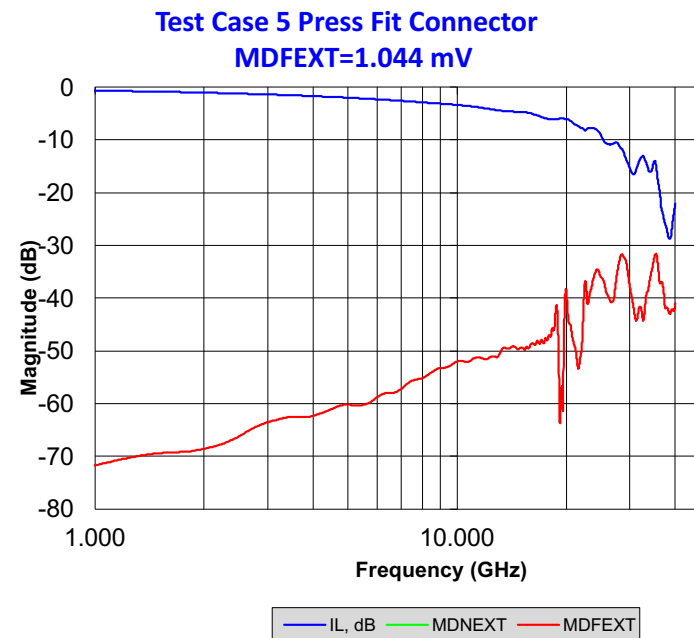
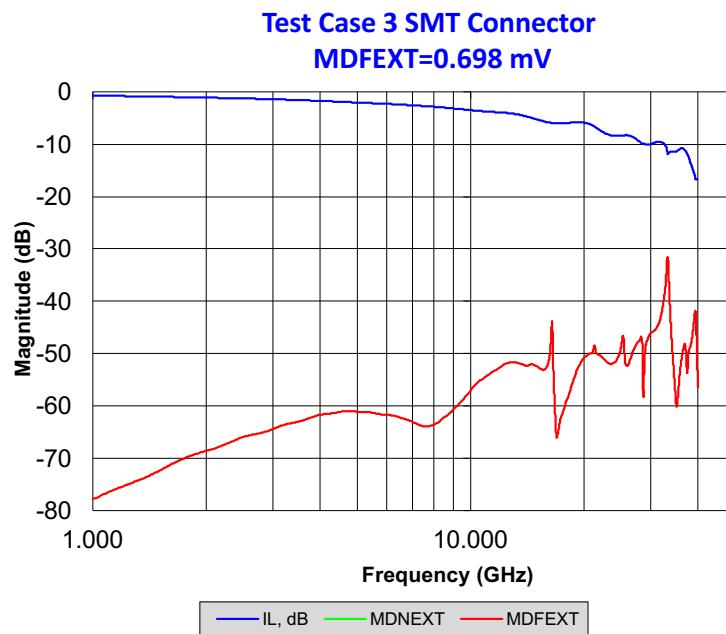
Test case 3 and 5
Having a loss similar
to mated board are
Used for Crosstalk
Analysis

Crosstalk for C2M Test Case 3 and 5

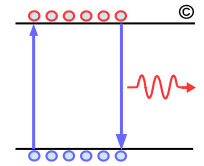


❑ Mated board had no NEXT and with excellent FEXT

- http://www.ieee802.org/3/bs/public/channel/TEC/shanbhag_3bs_01_1014.pdf
- C2M are based on channels with 5-7x lower crosstalk than mated board referenced currently!



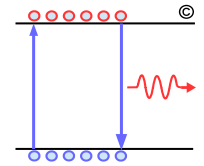
Baseline C2M Simulation Summary



- ❑ **Baseline C2M simulation COM analysis for the hypothetical channels with 5-7x lower crosstalk doesn't even have margin even with CTLE+TXFIR+LFEQ at 1E-5 BER!**
 - Increasing crosstalk by 5-7x on channels below with current link configuration and equalizer will be detrimental!
 - Summary results from http://www.ieee802.org/3/bs/public/adhoc/elect/24Aug_15/dallaire_01_082415_elect.pdf

Channel	1	2	3	4	5	6	7	8
CTLE	-0.07	-0.04	1.01	-0.45	1.24	-0.13	-1.37	-2.65
CTLE + TXFIR	1.47	1.53	1.43	0.84	2.08	1.35	0.84	0.55
CTLE + TXFIR + LFEQ (1E-6)	2.26	2.50	1.99	1.28	2.95	2.14	1.43	0.84
CTLE + TXFIR + LFEQ (1E-5)	3.15	3.39	2.89	2.15	3.87	3.03	2.33	1.72

Summary



- ❑ P802.3cd clause 135G 50GAUI-1 and 100GAUI-2 are referencing P802.3bs clause 120.E which reference CL92 having MDFEXT (4.8 mV) and MDNEXT (1.8 mV)
- ❑ 802.3bs C2M simulation in support of 50G/lane PAM4 were based on a TE hypothetical connector with 5-7x lower FEXT and NEXT and does not provided technical feasibility
- ❑ IEEE P802.3bs and cd need to collectively work together to resolve this issue sooner than later to minimize the impact
- ❑ Need to revisit the baseline simulation using representative connector
- ❑ Assuming MDI must remain compatible with SFP28/QSFP28 and receiver is limited to CTLE potential area to close the gap in link budget are:
 - The SFP28/QSFP28 crosstalk limit could be tighten by ~20%
 - TP5 EW1E-5=0.22 UI can't be tighten any further but EH1E-5=32 mV could be tighten by ~20%
 - Less desirable would be to reduce channel loss by 20-30%
 - The most promising area would be to improve transmitter jitter, RLM, and rise time, an eye mask at TP0a could allow trading off jitter, RLM, rise time, as well as other parameters.