200 Gbps/lane AUI C2M Channel Selection Criteria Update

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Introduction

- This is an update to “200 Gbps/lane AUI C2M Channel Selection Criteria” from May 2023
  - https://www.ieee802.org/3/dj/public/23_05/lusted_3dj_02a_2305.pdf
- Includes revised and new channel contributions for AUI C2M
  - See P802.3dj Task Force Tools and Channel Website (https://www.ieee802.org/3/df/public/tools/index.html)

Goals

- The goals of this contribution are to:
  - Provide a relative comparison using COM with a reduced channel set
  - Start discussions in the Task Force on which contributed AUI C2M channels should pass versus which should fail
    - Discuss the ones that fall in the middle
- Not debating the C2M specification parameters at this time, including the reference receiver model, package parameters and COM, etc.
  - Please look for the high-level trends, not at the minutiae

Reference EQ & Params Highlights – By Class

- Class I/II/III

Parameter	802.3ck C2M	802.3ck CR	802.3ck KR	Exploratory of 802.3dj Medium Loss AUI C2M: 802.3ck C2M-like + FLT	Exploratory of 802.3dj High Loss AUI C2M: 802.3ck CR-like	802.3ck CR-like + MLSE
DER_0	1E-5	1E-4	1E-4	1.33E-5 / 2.67E-5	1.33E-5 / 2.67E-5	1.33E-5 / 2.67E-5
SNR_TX	32.5	32.5	33	32.5	33	33
R_LM	0.95	0.95	0.95	0.95	0.95	0.95
TxFIR Length	4 (2 pre)	5 (3 pre)	5 (3 pre)	5 (3 pre)	6 (4 pre)	6 (4 pre)
eta_0	4.10E-08	9E-09	8.2E-09	2.05E-08	1.25E-08	1.25E-08
N_b	4	12	12	8	1	1
	-	-	-	0	4	4
	-	-	-	0	24	24
N_bg	0	3	3	3	6	6
N_bf	-	3	3	3	3	3
N_f	-	40	40	60	60	60
MLSE	0	0	0	0	0	1
Ref TX/RX Class				**I**	**II**	**III**

RXFFE pre-cursor taps
RXFFE post-cursor taps

Note: these classes are starting points, not specific recommendations.

(Mild) (Spicy!)

Reducing the # of Channels

- Across the inventory of AUI C2M channels available, we attempted to reduce the total number of channels down to ~10-15 unique, representative channels
  - Decrease analysis time
  - Assess the outliers
  - Eliminate obviously bad channels
- Channel parameters that we used include: Fit IL, ERL, ICN, ICR

802.3dj C2M Channel Contributions

Contribution	Channel List	Host Type
akinwale_3dj_02_2307 (28x)	C2M_PCB_85ohms_XpYin_20230620_v3_thru1	CONV PCB
akinwale_3dj_03_2307 (27x)	C2M_PCB_93ohms_XpYin_20230620_v3_thru1	CONV PCB
akinwale_3dj_04_2307 (28x)	C2M_PCB_100ohms_XpYin_20230620_v3_thru1	CONV PCB
rabinovich_3df_01_2209 (3x) rabinovich_3dj_02_230116 (1x)	Rabinovich_C2M_200G_Ortho_[19, 67, 93]mil_092122_Thru.s4p Rabinovich_C2M_200G_Ortho_135mil_011723_Thru.s4p	CONV PCB
rabinovich_3df_02_2209 (3x) rabinovich_3dj_03_230116 (1x)	Rabinovich_C2M_200G_Paral_[19, 67, 93]mil_092122_Thru.s4p Rabinovich_C2M_200G_Paral_135mil_011723_Thru.s4p	CONV PCB
shanbhag_3dj_03_2305 (6x)	C2M_TP0TP1a_XpYdB_PCBHost_3p7dB_THRU	CONV PCB
	C2M_TP0TP1a_XpYdB_CabledHost_7p85dB_THRU	NCC
lim_3dj_01_2307 (1x) lim_3dj_02_2307 (1x)	li_dj_C2M_DesignA_Rev1_THRU	CONV PCB
	li_dj_C2M_DesignB_Rev1_THRU	CONV PCB

https://www.ieee802.org/3/df/public/tools/index.html

Expanded List of Channels

IL (dB)	<= 16	16 < X <= 28	> 28

	Max	Q3	Med	Q1	MIN
ERL	17.79	16.35	15.73	15.29	12.03

Channel	IL (dB)	Fit IL (dB)	ILD (dB)	ERL (dB)	ICN (mV)	ICR (dB)
akinwale_3dj_02_2307/C2M_PCB_85ohms_0p5in	6.78	7.15	0.25	12.75	4.47	27.39
akinwale_3dj_02_2307/C2M_PCB_85ohms_1p0in	8.51	7.97	0.26	13.34	4.17	27.13
akinwale_3dj_02_2307/C2M_PCB_85ohms_1p5in	9.05	8.84	0.24	13.85	3.91	26.48
akinwale_3dj_02_2307/C2M_PCB_85ohms_2p0in	9.26	9.68	0.23	14.29	3.68	26.22
akinwale_3dj_02_2307/C2M_PCB_85ohms_2p5in	10.35	10.52	0.23	14.74	3.49	26.41
akinwale_3dj_02_2307/C2M_PCB_85ohms_3p0in	11.57	11.35	0.23	15.01	3.33	26.18
akinwale_3dj_02_2307/C2M_PCB_85ohms_3p5in	12.21	12.18	0.23	15.07	3.19	25.65
akinwale_3dj_02_2307/C2M_PCB_85ohms_4p0in	12.78	13.01	0.23	15.11	3.07	25.38
akinwale_3dj_02_2307/C2M_PCB_85ohms_4p5in	13.76	13.84	0.23	15.15	2.97	25.32
akinwale_3dj_02_2307/C2M_PCB_85ohms_5p0in	14.75	14.66	0.23	15.19	2.89	25.05
akinwale_3dj_02_2307/C2M_PCB_85ohms_5p5in	15.48	15.48	0.24	15.24	2.81	24.61
akinwale_3dj_02_2307/C2M_PCB_85ohms_6p0in	16.20	16.30	0.24	15.27	2.74	24.33
akinwale_3dj_02_2307/C2M_PCB_85ohms_6p5in	17.11	17.12	0.24	15.30	2.68	24.13
akinwale_3dj_02_2307/C2M_PCB_85ohms_7p0in	18.01	17.94	0.25	15.34	2.63	23.82
akinwale_3dj_02_2307/C2M_PCB_85ohms_7p5in	18.78	18.75	0.25	15.36	2.58	23.43
akinwale_3dj_02_2307/C2M_PCB_85ohms_8p0in	19.57	19.56	0.26	15.39	2.54	23.12
akinwale_3dj_02_2307/C2M_PCB_85ohms_8p5in	20.44	20.38	0.26	15.42	2.50	22.84
akinwale_3dj_02_2307/C2M_PCB_85ohms_9p0in	21.30	21.19	0.27	15.44	2.46	22.50
akinwale_3dj_02_2307/C2M_PCB_85ohms_9p5in	22.10	21.99	0.27	15.46	2.43	22.10
akinwale_3dj_02_2307/C2M_PCB_85ohms_10p0in	22.92	22.80	0.28	15.48	2.39	21.75
akinwale_3dj_02_2307/C2M_PCB_85ohms_10p5in	23.77	23.61	0.29	15.51	2.36	21.39
akinwale_3dj_02_2307/C2M_PCB_85ohms_11p0in	24.61	24.41	0.30	15.53	2.33	20.99
akinwale_3dj_02_2307/C2M_PCB_85ohms_11p5in	25.43	25.22	0.30	15.55	2.30	20.57
akinwale_3dj_02_2307/C2M_PCB_85ohms_12p0in	26.25	26.02	0.31	15.57	2.27	20.20
akinwale_3dj_02_2307/C2M_PCB_85ohms_12p5in	27.10	26.82	0.32	15.58	2.25	19.71
akinwale_3dj_02_2307/C2M_PCB_85ohms_13p0in	27.93	27.62	0.33	15.59	2.22	19.24
akinwale_3dj_02_2307/C2M_PCB_85ohms_13p5in	28.76	28.42	0.33	15.61	2.19	18.76
akinwale_3dj_02_2307/C2M_PCB_85ohms_14p0in	29.59	29.21	0.34	15.62	2.17	18.26
akinwale_3dj_02_2307/C2M_PCB_93ohms_0p5in	6.34	7.17	0.23	14.14	4.47	27.09
akinwale_3dj_02_2307/C2M_PCB_93ohms_1p0in	7.64	7.96	0.25	14.89	4.17	27.30
akinwale_3dj_02_2307/C2M_PCB_93ohms_1p5in	8.95	8.78	0.24	15.83	3.90	27.18
akinwale_3dj_02_2307/C2M_PCB_93ohms_2p0in	10.00	9.60	0.23	16.16	3.67	26.86
akinwale_3dj_02_2307/C2M_PCB_93ohms_2p5in	10.77	10.42	0.23	16.29	3.47	26.45
akinwale_3dj_02_2307/C2M_PCB_93ohms_3p0in	11.36	11.24	0.23	16.33	3.30	26.05
akinwale_3dj_02_2307/C2M_PCB_93ohms_3p5in	11.94	12.05	0.22	16.35	3.16	25.75
akinwale_3dj_02_2307/C2M_PCB_93ohms_4p0in	12.64	12.86	0.23	16.36	3.03	25.58
akinwale_3dj_02_2307/C2M_PCB_93ohms_4p5in	13.49	13.67	0.23	16.37	2.92	25.46
akinwale_3dj_02_2307/C2M_PCB_93ohms_5p0in	14.43	14.47	0.23	16.38	2.83	25.31
akinwale_3dj_02_2307/C2M_PCB_93ohms_5p5in	15.34	15.28	0.23	16.40	2.75	25.07
akinwale_3dj_02_2307/C2M_PCB_93ohms_6p0in	16.19	16.08	0.23	16.40	2.67	24.76
akinwale_3dj_02_2307/C2M_PCB_93ohms_6p5in	16.97	16.88	0.24	16.41	2.61	24.41
akinwale_3dj_02_2307/C2M_PCB_93ohms_7p0in	17.73	17.68	0.24	16.43	2.55	24.08
akinwale_3dj_02_2307/C2M_PCB_93ohms_7p5in	18.49	18.47	0.24	16.43	2.50	23.78
akinwale_3dj_02_2307/C2M_PCB_93ohms_8p0in	19.29	19.27	0.25	16.44	2.45	23.50
akinwale_3dj_02_2307/C2M_PCB_93ohms_8p5in	20.12	20.06	0.25	16.44	2.41	23.22
akinwale_3dj_02_2307/C2M_PCB_93ohms_9p0in	20.96	20.86	0.26	16.45	2.37	22.92
akinwale_3dj_02_2307/C2M_PCB_93ohms_9p5in	21.79	21.65	0.26	16.46	2.33	22.58
akinwale_3dj_02_2307/C2M_PCB_93ohms_10p0in	22.61	22.44	0.27	16.47	2.30	22.22
akinwale_3dj_02_2307/C2M_PCB_93ohms_10p5in	23.41	23.23	0.28	16.47	2.27	21.85
akinwale_3dj_02_2307/C2M_PCB_93ohms_11p0in	24.21	24.01	0.28	16.48	2.24	21.47
akinwale_3dj_02_2307/C2M_PCB_93ohms_11p5in	25.01	24.80	0.29	16.48	2.21	21.08
akinwale_3dj_02_2307/C2M_PCB_93ohms_12p0in	25.82	25.58	0.30	16.48	2.18	20.68
akinwale_3dj_02_2307/C2M_PCB_93ohms_12p5in	26.64	26.37	0.30	16.48	2.15	20.26
akinwale_3dj_02_2307/C2M_PCB_93ohms_13p0in	27.46	27.15	0.31	16.49	2.13	19.82
akinwale_3dj_02_2307/C2M_PCB_93ohms_13p5in	28.27	27.93	0.32	16.50	2.10	19.35

Channel	IL (dB)	Fit IL (dB)	ILD (dB)	ERL (dB)	ICN (mV)	ICR (dB)
akinwale_3dj_02_2307/C2M_PCB_100ohms_0p5in	6.44	7.16	0.25	13.51	4.48	26.73
akinwale_3dj_02_2307/C2M_PCB_100ohms_1p0in	7.33	7.96	0.25	14.09	4.16	26.70
akinwale_3dj_02_2307/C2M_PCB_100ohms_1p5in	8.21	8.76	0.24	14.64	3.88	26.63
akinwale_3dj_02_2307/C2M_PCB_100ohms_2p0in	9.09	9.57	0.23	15.15	3.65	26.53
akinwale_3dj_02_2307/C2M_PCB_100ohms_2p5in	9.97	10.38	0.23	15.62	3.44	26.40
akinwale_3dj_02_2307/C2M_PCB_100ohms_3p0in	10.84	11.17	0.23	15.67	3.27	26.25
akinwale_3dj_02_2307/C2M_PCB_100ohms_3p5in	11.69	11.97	0.23	15.69	3.11	26.08
akinwale_3dj_02_2307/C2M_PCB_100ohms_4p0in	12.54	12.76	0.23	15.70	2.98	25.90
akinwale_3dj_02_2307/C2M_PCB_100ohms_4p5in	13.39	13.56	0.23	15.72	2.86	25.70
akinwale_3dj_02_2307/C2M_PCB_100ohms_5p0in	14.22	14.35	0.23	15.73	2.76	25.48
akinwale_3dj_02_2307/C2M_PCB_100ohms_5p5in	15.05	15.14	0.23	15.73	2.67	25.25
akinwale_3dj_02_2307/C2M_PCB_100ohms_6p0in	15.87	15.92	0.23	15.74	2.59	25.02
akinwale_3dj_02_2307/C2M_PCB_100ohms_6p5in	16.69	16.71	0.24	15.75	2.52	24.76
akinwale_3dj_02_2307/C2M_PCB_100ohms_7p0in	17.51	17.49	0.24	15.76	2.45	24.50
akinwale_3dj_02_2307/C2M_PCB_100ohms_7p5in	18.32	18.28	0.24	15.76	2.40	24.23
akinwale_3dj_02_2307/C2M_PCB_100ohms_8p0in	19.12	19.06	0.25	15.77	2.35	23.95
akinwale_3dj_02_2307/C2M_PCB_100ohms_8p5in	19.93	19.84	0.25	15.77	2.30	23.65
akinwale_3dj_02_2307/C2M_PCB_100ohms_9p0in	20.73	20.62	0.26	15.77	2.26	23.37
akinwale_3dj_02_2307/C2M_PCB_100ohms_9p5in	21.53	21.39	0.26	15.77	2.22	23.02
akinwale_3dj_02_2307/C2M_PCB_100ohms_10p0in	22.33	22.17	0.27	15.78	2.18	22.69
akinwale_3dj_02_2307/C2M_PCB_100ohms_10p5in	23.13	22.94	0.27	15.78	2.15	22.34
akinwale_3dj_02_2307/C2M_PCB_100ohms_11p0in	23.93	23.72	0.28	15.78	2.12	21.98
akinwale_3dj_02_2307/C2M_PCB_100ohms_11p5in	24.73	24.49	0.28	15.78	2.09	21.60
akinwale_3dj_02_2307/C2M_PCB_100ohms_12p0in	25.52	25.26	0.29	15.78	2.06	21.20
akinwale_3dj_02_2307/C2M_PCB_100ohms_12p5in	26.32	26.03	0.30	15.79	2.03	20.79
akinwale_3dj_02_2307/C2M_PCB_100ohms_13p0in	27.12	26.80	0.30	15.79	2.01	20.35
akinwale_3dj_02_2307/C2M_PCB_100ohms_13p5in	27.91	27.56	0.31	15.79	1.99	19.90
akinwale_3dj_02_2307/C2M_PCB_100ohms_14p0in	28.71	28.33	0.32	15.79	1.96	19.42
Rabinovich_C2M_200G_Ortho_19mil	12.38	13.57	0.70	15.80	1.79	28.68
Rabinovich_C2M_200G_Ortho_67mil	14.70	14.87	0.69	15.53	2.71	27.00
Rabinovich_C2M_200G_Ortho_93mil	14.17	14.81	0.95	12.96	2.83	24.90
Rabinovich_C2M_200G_Ortho_135mil	13.35	14.99	0.96	13.13	3.39	22.24
Rabinovich_C2M_200G_Paral_19mil	12.27	13.16	0.47	15.04	2.35	26.93
Rabinovich_C2M_200G_Paral_67mil	13.32	13.91	0.50	15.41	2.87	26.79
Rabinovich_C2M_200G_Paral_93mil	13.44	14.12	0.67	12.03	3.17	24.32
Rabinovich_C2M_200G_Paral_135mil	12.93	14.44	0.49	13.49	3.78	22.23
C2M_TP0TP1a_11p7dB_CabledHost_7p85dB_THRU.s4	11.68	12.10	0.15	14.21	1.65	25.34
C2M_TP0TP1a_8p4dB_PCBHost_3p7dB_THRU.s4p	8.35	8.83	0.30	17.05	2.48	36.64
C2M_TP0TP1a_12p1dB_PCBHost_7p3dB_THRU.s4p	12.13	12.53	0.30	17.43	1.72	37.72
C2M_TP0TP1a_14p6dB_PCBHost_9p8dB_THRU.s4p	14.61	14.99	0.31	17.58	1.39	37.43
C2M_TP0TP1a_17p1dB_PCBHost_12p2dB_THRU.s4p	17.12	17.43	0.31	17.70	1.14	37.48
C2M_TP0TP1a_19p6dB_PCBHost_14p6dB_THRU.s4p	19.60	19.87	0.32	17.79	0.95	37.60
li_dj_C2M_Design_A_Rev1_THRU.s4p	11.61	11.69	0.18	14.75	4.06	24.23
li_dj_C2M_Design_B_Rev1_THRU.s4p	11.57	11.59	0.38	15.48	2.46	27.78

- This presentation does not intend to propose any channel specifications
- The relative ERL, ICN, and ICR are compared under largely channel commonality:
  - OSFP connector (possibly from the same contributor)
  - Host type: CONV PCB (except one is NCC)

Relative COM Comparison with Reduced List of Channels

- Evaluated with the high-loss AUI value of DER_0 = 2.67E-5 and 1.33E-5
  - For division discussions
- Of course, the reported COM results will change depending on the channel, Cd, Cp, host and module package trace lengths, reference receiver model architecture & settings, etc.
- One package scenario: 30mm + 8mm (~9 dB IL)

Motion #8

Move to:

- adopt a DER0 value of 2.67e-5 (equivalent to measured BER of 4e-5 with precoding ON) as the total allocation for higher-loss AUIs within a PHY (BER division between C2C and C2M as well as the measurement method to be determined later)

M: Adee Ran
S: Kishore Kota
Technical (>=75%) Procedural (>50%)
802.3 voters only
Results: Y: 75, N: 3, A: 20 passed 10:33 a.m.

https://www.ieee802.org/3/dj/public/23_05/motions_3cwdfdj_2305.pdf

A Relative Comparison: Med-Loss AUI C2M Candidates

IL (dB)	<= 16	16 < X <= 28	> 28
COM (dB)	>= 3.5	2.5 <= X < 3.5	< 2.5

Channel sorted by IL

Channel	IL (dB)	Fit IL (dB)	Bump-Bump IL (dB)	ILD (dB)	ERL (dB)	ICN (mV)	ICR (dB)	COM (DER_0 = 1.33E-5, 30mm/8mm)			COM (DER_0 = 2.67E-5, 30mm/8mm)		
								I	II	III	I	II	III
akinwale_3dj_02_2307/C2M_PCB_93ohms_0p5in	6.34	7.17	15.86	0.23	14.14	4.47	27.09						
akinwale_3dj_02_2307/C2M_PCB_100ohms_0p5in	6.44	7.16	16.10	0.25	13.51	4.48	26.73						
akinwale_3dj_02_2307/C2M_PCB_85ohms_0p5in	6.78	7.15	15.93	0.25	12.75	4.47	27.39						
akinwale_3dj_02_2307/C2M_PCB_100ohms_1p0in	7.33	7.96	16.93	0.25	14.09	4.16	26.70						
akinwale_3dj_02_2307/C2M_PCB_93ohms_1p0in	7.64	7.96	16.80	0.25	14.89	4.17	27.30						
akinwale_3dj_02_2307/C2M_PCB_100ohms_1p5in	8.21	8.76	17.76	0.24	14.64	3.88	26.63						
C2M_TP0TP1a_8p4dB_PCBHost_3p7dB_THRU.s4p	8.35	8.83	17.26	0.30	17.05	2.48	36.64						
akinwale_3dj_02_2307/C2M_PCB_85ohms_1p0in	8.51	7.97	17.05	0.26	13.34	4.17	27.13						
akinwale_3dj_02_2307/C2M_PCB_93ohms_1p5in	8.95	8.78	17.82	0.24	15.83	3.90	27.18						
akinwale_3dj_02_2307/C2M_PCB_85ohms_1p5in	9.05	8.84	17.55	0.24	13.85	3.91	26.48						
akinwale_3dj_02_2307/C2M_PCB_100ohms_2p0in	9.09	9.57	18.59	0.23	15.15	3.65	26.53						
akinwale_3dj_02_2307/C2M_PCB_85ohms_2p0in	9.26	9.68	18.35	0.23	14.29	3.68	26.22						
akinwale_3dj_02_2307/C2M_PCB_100ohms_2p5in	9.97	10.38	19.42	0.23	15.62	3.44	26.40						
akinwale_3dj_02_2307/C2M_PCB_93ohms_2p0in	10.00	9.60	18.71	0.23	16.16	3.67	26.86						
akinwale_3dj_02_2307/C2M_PCB_85ohms_2p5in	10.35	10.52	19.91	0.23	14.74	3.49	26.41						
akinwale_3dj_02_2307/C2M_PCB_93ohms_2p5in	10.77	10.42	19.44	0.23	16.29	3.47	26.45						
akinwale_3dj_02_2307/C2M_PCB_100ohms_3p0in	10.84	11.17	20.25	0.23	15.67	3.27	26.25						
akinwale_3dj_02_2307/C2M_PCB_93ohms_3p0in	11.36	11.24	20.12	0.23	16.33	3.30	26.05						
akinwale_3dj_02_2307/C2M_PCB_85ohms_3p0in	11.57	11.35	21.16	0.23	15.01	3.33	26.18						
li_dj_C2M_Design_B_Rev1_THRU.s4p	11.57	11.59	20.32	0.38	15.48	2.46	27.78						
li_dj_C2M_Design_A_Rev1_THRU.s4p	11.61	11.69	20.54	0.18	14.75	4.06	24.23						
C2M_TP0TP1a_11p7dB_CabledHost_7p85dB_THRU	11.68	12.10	21.17	0.15	14.21	1.65	25.34						
akinwale_3dj_02_2307/C2M_PCB_100ohms_3p5in	11.69	11.97	21.07	0.23	15.69	3.11	26.08						
akinwale_3dj_02_2307/C2M_PCB_93ohms_3p5in	11.94	12.05	20.89	0.22	16.35	3.16	25.75						
C2M_TP0TP1a_12p1dB_PCBHost_7p3dB_THRU.s4p	12.13	12.53	22.06	0.30	17.43	1.72	37.72						
akinwale_3dj_02_2307/C2M_PCB_85ohms_3p5in	12.21	12.18	21.72	0.23	15.07	3.19	25.65						
Rabinovich_C2M_200G_Paral_19mil	12.27	13.16	20.63	0.47	15.04	2.35	26.93						
Rabinovich_C2M_200G_Ortho_19mil	12.38	13.57	20.86	0.70	15.80	1.79	28.68						
akinwale_3dj_02_2307/C2M_PCB_100ohms_4p0in	12.54	12.76	21.89	0.23	15.70	2.98	25.90						
akinwale_3dj_02_2307/C2M_PCB_93ohms_4p0in	12.64	12.86	21.83	0.23	16.36	3.03	25.58						
akinwale_3dj_02_2307/C2M_PCB_85ohms_4p0in	12.78	13.01	22.14	0.23	15.11	3.07	25.38						
Rabinovich_C2M_200G_Paral_135mil	12.93	14.44	21.82	0.49	13.49	3.78	22.23						
Rabinovich_C2M_200G_Paral_67mil	13.32	13.91	21.60	0.50	15.41	2.87	26.79						
Rabinovich_C2M_200G_Ortho_135mil	13.35	14.99	22.40	0.96	13.13	3.39	22.24						
akinwale_3dj_02_2307/C2M_PCB_100ohms_4p5in	13.39	13.56	22.71	0.23	15.72	2.86	25.70						
Rabinovich_C2M_200G_Paral_93mil	13.44	14.12	22.63	0.67	12.03	3.17	24.32						
akinwale_3dj_02_2307/C2M_PCB_93ohms_4p5in	13.49	13.67	22.86	0.23	16.37	2.92	25.46						
akinwale_3dj_02_2307/C2M_PCB_85ohms_4p5in	13.76	13.84	22.85	0.23	15.15	2.97	25.32						
Rabinovich_C2M_200G_Ortho_93mil	14.17	14.81	23.34	0.95	12.96	2.83	24.90						
akinwale_3dj_02_2307/C2M_PCB_100ohms_5p0in	14.22	14.35	23.52	0.23	15.73	2.76	25.48						
akinwale_3dj_02_2307/C2M_PCB_93ohms_5p0in	14.43	14.47	23.89	0.23	16.38	2.83	25.31						
C2M_TP0TP1a_14p6dB_PCBHost_9p8dB_THRU.s4p	14.61	14.99	24.04	0.31	17.58	1.39	37.43						
Rabinovich_C2M_200G_Ortho_67mil	14.70	14.87	23.06	0.69	15.53	2.71	27.00						
akinwale_3dj_02_2307/C2M_PCB_85ohms_5p0in	14.75	14.66	23.65	0.23	15.19	2.89	25.05						
akinwale_3dj_02_2307/C2M_PCB_100ohms_5p5in	15.05	15.14	24.33	0.23	15.73	2.67	25.25						
akinwale_3dj_02_2307/C2M_PCB_93ohms_5p5in	15.34	15.28	24.84	0.23	16.40	2.75	25.07						
akinwale_3dj_02_2307/C2M_PCB_85ohms_5p5in	15.48	15.48	24.43	0.24	15.24	2.81	24.61						
akinwale_3dj_02_2307/C2M_PCB_100ohms_6p0in	15.87	15.92	25.14	0.23	15.74	2.59	25.02						

Some of these channels could work with a Medium complexity SerDes (class I) if given the full DER_0 budget of 2.67E-5

Package loss is ~7dB per 30mm, ~9dB total for 30mm+8mm.
Source: https://www.ieee802.org/3/df/public/22_11/benartsi_3df_01a_2211.pdf

A Relative Comparison: High-Loss AUI C2M Candidates

IL (dB)	<= 16	16 < X <= 28	> 28
COM (dB)	>= 3.5	2.5 <= X < 3.5	< 2.5

Channel sorted by IL

Channel	IL (dB)	Fit IL (dB)	Bump-Bump IL (dB)	ILD (dB)	ERL (dB)	ICN (mV)	ICR (dB)	COM (DER_0 = 1.33E-5, 30mm/8mm)			COM (DER_0 = 2.67E-5, 30mm/8mm)		
								I	II	III	I	II	III
akinwale_3dj_02_2307/C2M_PCB_93ohms_6p0in	16.19	16.08	25.68	0.23	16.40	2.67	24.76						
akinwale_3dj_02_2307/C2M_PCB_85ohms_6p0in	16.20	16.30	25.39	0.24	15.27	2.74	24.33						
akinwale_3dj_02_2307/C2M_PCB_100ohms_6p5in	16.69	16.71	25.94	0.24	15.75	2.52	24.76						
akinwale_3dj_02_2307/C2M_PCB_93ohms_6p5in	16.97	16.88	26.44	0.24	16.41	2.61	24.41						
akinwale_3dj_02_2307/C2M_PCB_85ohms_6p5in	17.11	17.12	26.49	0.24	15.30	2.68	24.13						
C2M_TP0TP1a_17p1dB_PCBHost_12p2dB_THRU.s4	17.12	17.43	27.06	0.31	17.70	1.14	37.48						
akinwale_3dj_02_2307/C2M_PCB_100ohms_7p0in	17.51	17.49	26.75	0.24	15.76	2.45	24.50						
akinwale_3dj_02_2307/C2M_PCB_93ohms_7p0in	17.73	17.68	27.15	0.24	16.43	2.55	24.08						
akinwale_3dj_02_2307/C2M_PCB_85ohms_7p0in	18.01	17.94	27.42	0.25	15.34	2.63	23.82						
akinwale_3dj_02_2307/C2M_PCB_100ohms_7p5in	18.32	18.28	27.55	0.24	15.76	2.40	24.23						
akinwale_3dj_02_2307/C2M_PCB_93ohms_7p5in	18.49	18.47	27.85	0.24	16.43	2.50	23.78						
akinwale_3dj_02_2307/C2M_PCB_85ohms_7p5in	18.78	18.75	28.14	0.25	15.36	2.58	23.43						
akinwale_3dj_02_2307/C2M_PCB_100ohms_8p0in	19.12	19.06	28.35	0.25	15.77	2.35	23.95						
akinwale_3dj_02_2307/C2M_PCB_93ohms_8p0in	19.29	19.27	28.58	0.25	16.44	2.45	23.50						
akinwale_3dj_02_2307/C2M_PCB_85ohms_8p0in	19.57	19.56	28.82	0.26	15.39	2.54	23.12						
C2M_TP0TP1a_19p6dB_PCBHost_14p6dB_THRU.s4	19.60	19.87	29.18	0.32	17.79	0.95	37.60						
akinwale_3dj_02_2307/C2M_PCB_100ohms_8p5in	19.93	19.84	29.15	0.25	15.77	2.30	23.65						
akinwale_3dj_02_2307/C2M_PCB_93ohms_8p5in	20.12	20.06	29.35	0.25	16.44	2.41	23.22						
akinwale_3dj_02_2307/C2M_PCB_85ohms_8p5in	20.44	20.38	29.57	0.26	15.42	2.50	22.84						
akinwale_3dj_02_2307/C2M_PCB_100ohms_9p0in	20.73	20.62	29.96	0.26	15.77	2.26	23.37						
akinwale_3dj_02_2307/C2M_PCB_93ohms_9p0in	20.96	20.86	30.13	0.26	16.45	2.37	22.92						
akinwale_3dj_02_2307/C2M_PCB_85ohms_9p0in	21.30	21.19	30.37	0.27	15.44	2.46	22.50						
akinwale_3dj_02_2307/C2M_PCB_100ohms_9p5in	21.53	21.39	30.75	0.26	15.77	2.22	23.02						
akinwale_3dj_02_2307/C2M_PCB_93ohms_9p5in	21.79	21.65	30.93	0.26	16.46	2.33	22.58						
akinwale_3dj_02_2307/C2M_PCB_85ohms_9p5in	22.10	21.99	31.22	0.27	15.46	2.43	22.10						
akinwale_3dj_02_2307/C2M_PCB_100ohms_10p0i	22.33	22.17	31.55	0.27	15.78	2.18	22.69						
akinwale_3dj_02_2307/C2M_PCB_93ohms_10p0in	22.61	22.44	31.74	0.27	16.47	2.30	22.22						
akinwale_3dj_02_2307/C2M_PCB_85ohms_10p0in	22.92	22.80	32.14	0.28	15.48	2.39	21.75						
akinwale_3dj_02_2307/C2M_PCB_100ohms_10p5i	23.13	22.94	32.35	0.27	15.78	2.15	22.34						
akinwale_3dj_02_2307/C2M_PCB_93ohms_10p5in	23.41	23.23	32.55	0.28	16.47	2.27	21.85						
akinwale_3dj_02_2307/C2M_PCB_85ohms_10p5in	23.77	23.61	33.07	0.29	15.51	2.36	21.39						
akinwale_3dj_02_2307/C2M_PCB_100ohms_11p0i	23.93	23.72	33.15	0.28	15.78	2.12	21.98						
akinwale_3dj_02_2307/C2M_PCB_93ohms_11p0in	24.21	24.01	33.39	0.28	16.48	2.24	21.47						
akinwale_3dj_02_2307/C2M_PCB_85ohms_11p0in	24.61	24.41	33.93	0.30	15.53	2.33	20.99						
akinwale_3dj_02_2307/C2M_PCB_100ohms_11p5i	24.73	24.49	33.95	0.28	15.78	2.09	21.60						
akinwale_3dj_02_2307/C2M_PCB_93ohms_11p5in	25.01	24.80	34.23	0.29	16.48	2.21	21.08						
akinwale_3dj_02_2307/C2M_PCB_85ohms_11p5in	25.43	25.22	34.71	0.30	15.55	2.30	20.57						
akinwale_3dj_02_2307/C2M_PCB_100ohms_12p0i	25.52	25.26	34.75	0.29	15.78	2.06	21.20						
akinwale_3dj_02_2307/C2M_PCB_93ohms_12p0in	25.82	25.58	35.08	0.30	16.48	2.18	20.68						
akinwale_3dj_02_2307/C2M_PCB_85ohms_12p0in	26.25	26.02	35.47	0.31	15.57	2.27	20.20						
akinwale_3dj_02_2307/C2M_PCB_100ohms_12p5i	26.32	26.03	35.55	0.30	15.79	2.03	20.79						
akinwale_3dj_02_2307/C2M_PCB_93ohms_12p5in	26.64	26.37	35.93	0.30	16.48	2.15	20.26						
akinwale_3dj_02_2307/C2M_PCB_85ohms_12p5in	27.10	26.82	36.26	0.32	15.58	2.25	19.71						
akinwale_3dj_02_2307/C2M_PCB_100ohms_13p0i	27.12	26.80	36.35	0.30	15.79	2.01	20.35						
akinwale_3dj_02_2307/C2M_PCB_93ohms_13p0in	27.46	27.15	36.77	0.31	16.49	2.13	19.82						
akinwale_3dj_02_2307/C2M_PCB_100ohms_13p5i	27.91	27.56	37.15	0.31	15.79	1.99	19.90						
akinwale_3dj_02_2307/C2M_PCB_85ohms_13p0in	27.93	27.62	37.08	0.33	15.59	2.22	19.24						
akinwale_3dj_02_2307/C2M_PCB_93ohms_13p5in	28.27	27.93	37.59	0.32	16.50	2.10	19.35						
akinwale_3dj_02_2307/C2M_PCB_100ohms_14p0i	28.71	28.33	37.95	0.32	15.79	1.96	19.42						
akinwale_3dj_02_2307/C2M_PCB_85ohms_13p5in	28.76	28.42	37.94	0.33	15.61	2.19	18.76						
akinwale_3dj_02_2307/C2M_PCB_85ohms_14p0in	29.59	29.21	38.82	0.34	15.62	2.17	18.26						

These channels need more equalization and noise improvements (class II or better) than the previous page.

DER_0 allocation has little impact on Class II or III equalizers.

Package loss is ~7dB per 30mm, ~9dB total for 30mm+8mm.
Source: https://www.ieee802.org/3/df/public/22_11/benartsi_3df_01a_2211.pdf

Selected List of Channels

IL (dB)	<= 16	16 < X <= 28	> 28
COM (dB)	>= 3.5	2.5 <= X < 3.5	< 2.5

Channel	IL (dB)	Fit IL (dB)	ILD (dB)	ERL (dB)	ICN (mV)	ICR (dB)	COM (DER_0 = 1.33E-5, 30mm/8mm)			COM (DER_0 = 2.67E-5, 30mm/8mm)		
							I	II	III	I	II	III
akinwale_3dj_02_2307/C2M_PCB_93ohms_1p0in	7.64	7.96	0.25	14.89	4.17	27.30						
akinwale_3dj_02_2307/C2M_PCB_93ohms_5p0in	14.43	14.47	0.23	16.38	2.83	25.31						
akinwale_3dj_02_2307/C2M_PCB_93ohms_9p0in	20.96	20.86	0.26	16.45	2.37	22.92						
akinwale_3dj_02_2307/C2M_PCB_93ohms_11p0in	24.21	24.01	0.28	16.48	2.24	21.47						
C2M_TP0TP1a_11p7dB_CabledHost_7p85dB_THRU	11.68	12.10	0.15	14.21	1.65	25.34						
C2M_TP0TP1a_8p4dB_PCBHost_3p7dB_THRU.s4p	8.35	8.83	0.30	17.05	2.48	36.64						
C2M_TP0TP1a_12p1dB_PCBHost_7p3dB_THRU.s4p	12.13	12.53	0.30	17.43	1.72	37.72						
C2M_TP0TP1a_14p6dB_PCBHost_9p8dB_THRU.s4p	14.61	14.99	0.31	17.58	1.39	37.43						
C2M_TP0TP1a_17p1dB_PCBHost_12p2dB_THRU.s4p	17.12	17.43	0.31	17.70	1.14	37.48						
C2M_TP0TP1a_19p6dB_PCBHost_14p6dB_THRU.s4p	19.60	19.87	0.32	17.79	0.95	37.60						
Rabinovich_C2M_200G_Ortho_19mil	12.38	13.57	0.70	15.80	1.79	28.68						
Rabinovich_C2M_200G_Ortho_93mil	14.17	14.81	0.95	12.96	2.83	24.90						
Rabinovich_C2M_200G_Ortho_67mil	14.70	14.87	0.69	15.53	2.71	27.00						
Rabinovich_C2M_200G_Ortho_135mil	13.35	14.99	0.96	13.13	3.39	22.24						
li_dj_C2M_Design_B_Rev1_THRU.s4p	11.57	11.59	0.38	15.48	2.46	27.78						
li_dj_C2M_Design_A_Rev1_THRU.s4p	11.61	11.69	0.18	14.75	4.06	24.23						

Contribution
~~akinwale_3dj_02_2307 (28x)~~
akinwale_3dj_03_2307 (4x, [1 5 9 11]in)
~~akinwale_3dj_04_2307 (28x)~~
rabinovich_3df_01_2209 (3x) rabinovich_3dj_02_230116 (1x)
~~rabinovich_3df_02_2209 (3x)~~ ~~rabinovich_3dj_03_230116 (1x)~~
shanbhag_3dj_03_2305 (6x)
lim_3dj_01_2307 (1x) lim_3dj_02_2307 (1x)

Summary

- Provided an update of COM results for the new or revised 200G/lane AUI C2M channels
  - Two example values of DER_0
- Next steps:
  - Agree on which 200G/lane AUI C2M channels are to “pass” vs. “fail”
    - Where do we draw the line?
  - Perform more analysis (as required) when:
    - Reference EQ parameters/values change
    - AUI C2C vs. C2M BER division solidifies

Thanks!

BACKUP

COM Reference Sheets for Class I/II/III

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	106.25	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[0.4e-4 0.9e-4 1.1e-4 ;0.4e-4 0.9e-4 1.1e-4]	nF	[TX RX]
L_s	[0.13 0.15 0.14; 0.13 0.15 0.14]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[15 30 45; 1 1 1; 1 1 1; 0.5 0.5 0.5]	mm	[test cases]
z_p (NEXT)	[8 8 8; 0 0 0; 0 0 0 ; 0 0 0]	mm	[test cases]
z_p (FEXT)	[15 30 45; 1 1 1; 1 1 1; 0.5 0.5 0.5]	mm	[test cases]
z_p (RX)	[8 8 8; 0 0 0; 0 0 0; 0 0 0]	mm	[test cases]
PKG_Tx_FFE_preset	0		
C_p	[0.5e-4 0.5e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.413	V	vp/vf=
A_fe	0.413	V	vp/vf=
A_ne	0.45	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.4:0.02:0]		[min:step:max]
c(-2)	[0:.02:0.2]		[min:step:max]
c(-3)	[-0.04:.02:0]		[min:step:max]
c(-4)	[0:.02:0.02]		[min:step:max]
c(1)	[-0.12:0.02:0.04]		[min:step:max]
N_b	1	UI	
b_max(1)	0.85		As/dffe1
b_max(2..N_b)	[0.3 0.2*ones(1,22)]		As/dfe2..N_b
b_min(1)	0		As/dffe1
b_min(2..N_b)	[-0.2 -0.2*ones(1,22)]		As/dfe2..N_b
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	42.5	GHz	
f_p1	42.5	GHz	
f_p2	106.25	GHz	
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	1.328125	GHz	
Butterworth	1	logical	include in fr
Raised_Cosine	0	logical	include in fr
RC_Start	6.70E+10	Hz	start freq for RCos
RC_end	7.97E+10	Hz	end freq for RCos

I/O control		
DIAGNOSTICS	0	logical
DISPLAY_WINDOW	0	logical
CSV_REPORT	0	logical
RESULT_DIR	.\results\CAKR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	CAKR_RCos_eval_	
COM_CONTRIBUTION	0	logical
Operational		
ERL Pass threshold	9.7	dB
COM Pass threshold	3	db
DER_0	1.33E-05	
T_r	4.00E-03	ns
FORCE_TR	1	logical
PMD_type	C2C	
FW	1	
TDR and ERL options		logical
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	ns
TR_TDR	0.01	
N	800	logical
TDR_Butterworth	1	
beta_x	0	
rho_x	0.618	
TDR_W_TXPKG	0	UI
N_bx	0	
fixture delay time	[0 0]	
Tukey_Window	1	
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	1.25E-08	V^2/GHz
SNR_TX	33	dB
R_LM	0.95	
Enforce Causality	1	
S-parameter magnitude extrapolation policy	trend_to_DC	
Filter: RxFFE		
ffe_pre_tap_len	4	UI
ffe_post_tap_len	24	UI
ffe_tap_step_size	0	
ffe_main_cursor_min	0.7	
ffe_pre_tap1_max	0.7	
ffe_post_tap1_max	0.7	
ffe_tapn_max	0.7	
ffe_backoff	0	

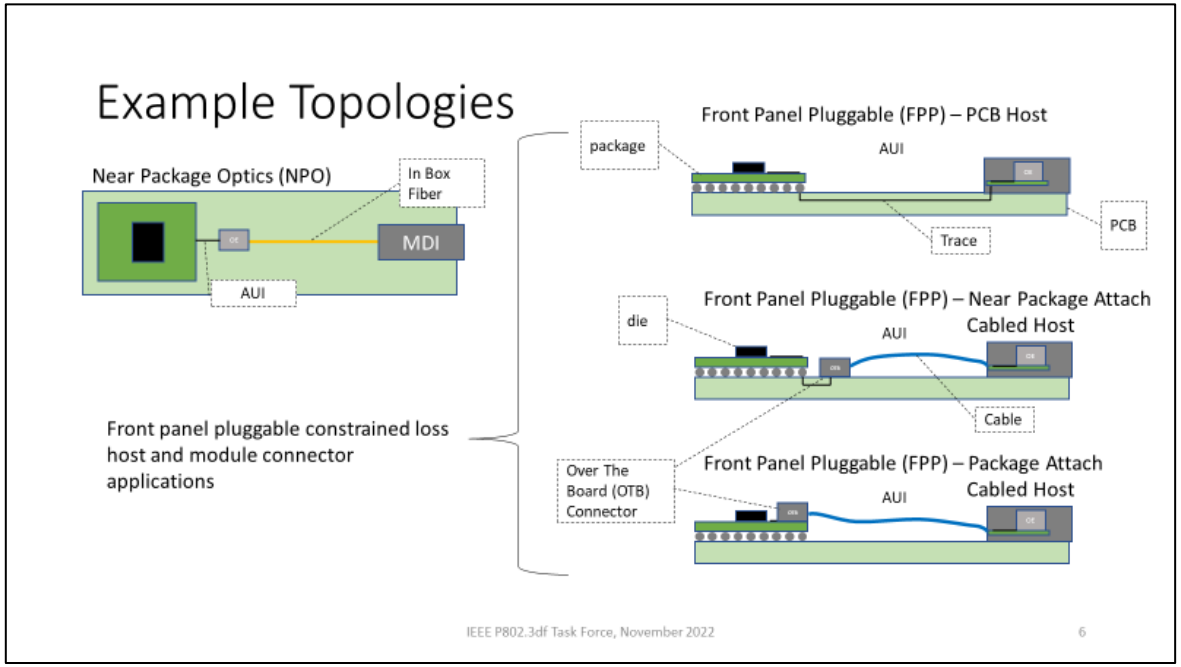
Table 93A-3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0008455 0.000340225]	
package_tl_tau	0.00644805	ns/mm
package_Z_c	[92 92 ; 70 70; 80 80; 100 100]	Ohm
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 6.44084e-4 3.6036e-05]*	1.5 db/in @ 56G
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*125*	mm
z_bp (NEXT)	0	mm
z_bp (FEXT)	*125*	mm
z_bp (RX)	0	mm
C_0	[0.2e-4 0]	nF
C_1	[0.2e-4 0]	nF
Include PCB	**0**	**logical**
Seletions (rectangle, gaussian,dual_rayleigh,triangle		
Histogram_Window_Weight	gaussian	selection
Qr	0.02	UI
ICN parameters		
f_v	0.594	Fb
f_f	0.594	Fb
f_n	0.594	Fb
f_2	79.688	GHz
A_ft	0.450	V
A_nt	0.450	V
Floating Tap Control		
N_bg	6	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	60	UI span for floating taps
bmaxg	0.2	max DFE value for floating taps
MLSE	1	logical
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V

**ERL and ICN parameters*

*** Make changes of Class I/II/III based on parameters listed in slide 5*

AUI C2M Loss Reminder

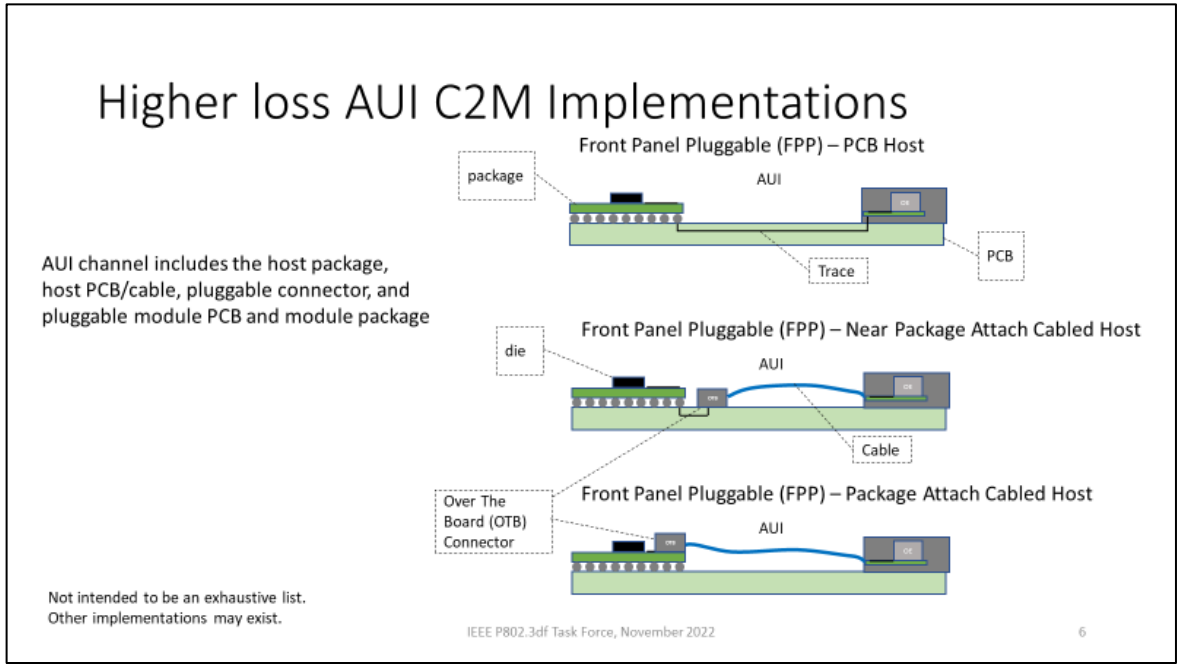
Medium Loss AUI C2M



- Targets ~22 dB IL die-die
- NPO and constrained loss FPP
- The COM reference transmitter and receiver models and parameters are an evolution from 3ck, scaled to the higher signaling rate

https://www.ieee802.org/3/df/public/22_11/lusted_3df_03a_2211.pdf

High Loss AUI C2M



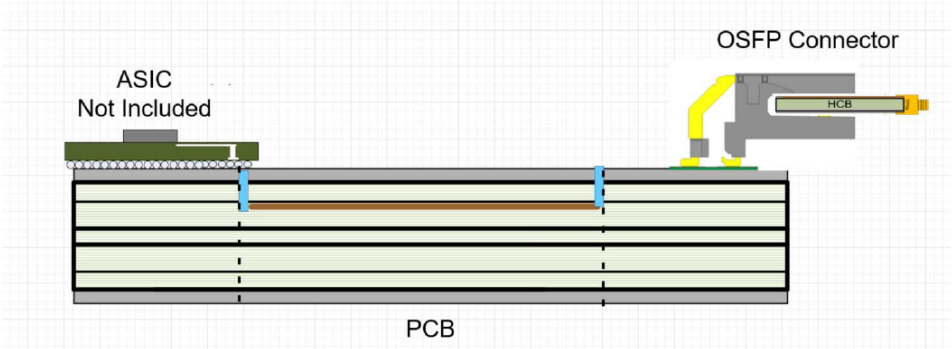
- Targets ~36 dB IL die-die
- Primarily FPP
- Reference receiver and transmitter models leveraged from 3ck backplane and copper cable, scaled appropriately

https://www.ieee802.org/3/df/public/22_11/lusted_3df_02_2211.pdf

C2M Channel Summaries (1/3)

- TP0 to TP1a IL range from ~7 dB to ~29 dB in two different model variants
  - Host PCB length
  - Host PCB impedance

Convention C2M Host (TP0 to TP1a)



- **Updated** SMT OSFP 200Gbps/lane Connector
- Host Via Length: Tx (10 mils) and Rx (20 mils),uVias, no stub
- Host Loss: Swept from 0.5in to 13in, ~1.6dB/in loss @53.125GHz, (85 ohms/ 93 ohms/100 ohms)
- Module Loss: 2in, ~1.6dB/in loss @53.125GHz, 93 ohms
- BGA footprint and escape included. BGA ball **is not included**
- 4 Tx and 4 Tx Pairs. 3 FEXT and 4 NEXT Aggressors

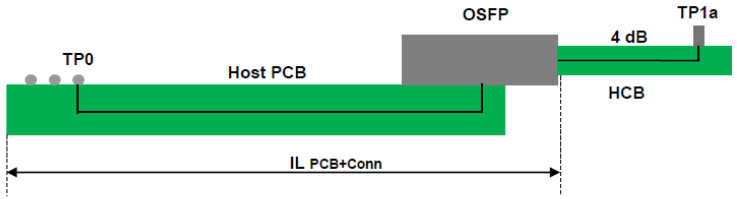
Contribution: heck_3dj_01_2307
Channel: akinwale_3dj_02_2307, akinwale_3dj_03_2307, akinwale_3dj_04_2307

C2M Channel Summaries (2/3)

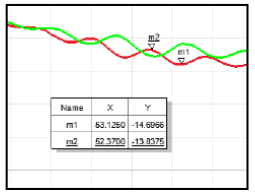
- TP0 to TP1a IL range from 10.64dB to 14.99dB in two different model variants
  - ASIC breakout topology
  - Via length

200G PAM4 C2M Via Length Effect Study

Structure View & Insertion Losses



- Full Structure:
  - Two adjacent channels
    - Matching segmentation meshing (i.e., common minimum element size)
  - Connector integrated with PCB
  - HCB is ideal transmission line with IL = 4 dB @ Nyquist
  - NEXT is evaluated at the ASIC model for more realistic results
- Vias = 19/67/93 mil long
- Blind Vias
- Frequency Sweep Range = 10 MHz to 120 GHz



Reflections Effect

IL @ Nyquist (53.125 GHz)

Parallel Breakout

- IL PCB+Conn = 8.24/9.32/10.31 dB
- IL HCB = 4 dB
- IL TP0-to-TP1a = 12.27/13.32/13.44 dB

Orthogonal Breakout

- IL PCB+Conn = 8.34/10.69/10.14 dB
- IL HCB = 4 dB
- IL TP0-to-TP1a = 12.38/14.69/14.17 dB

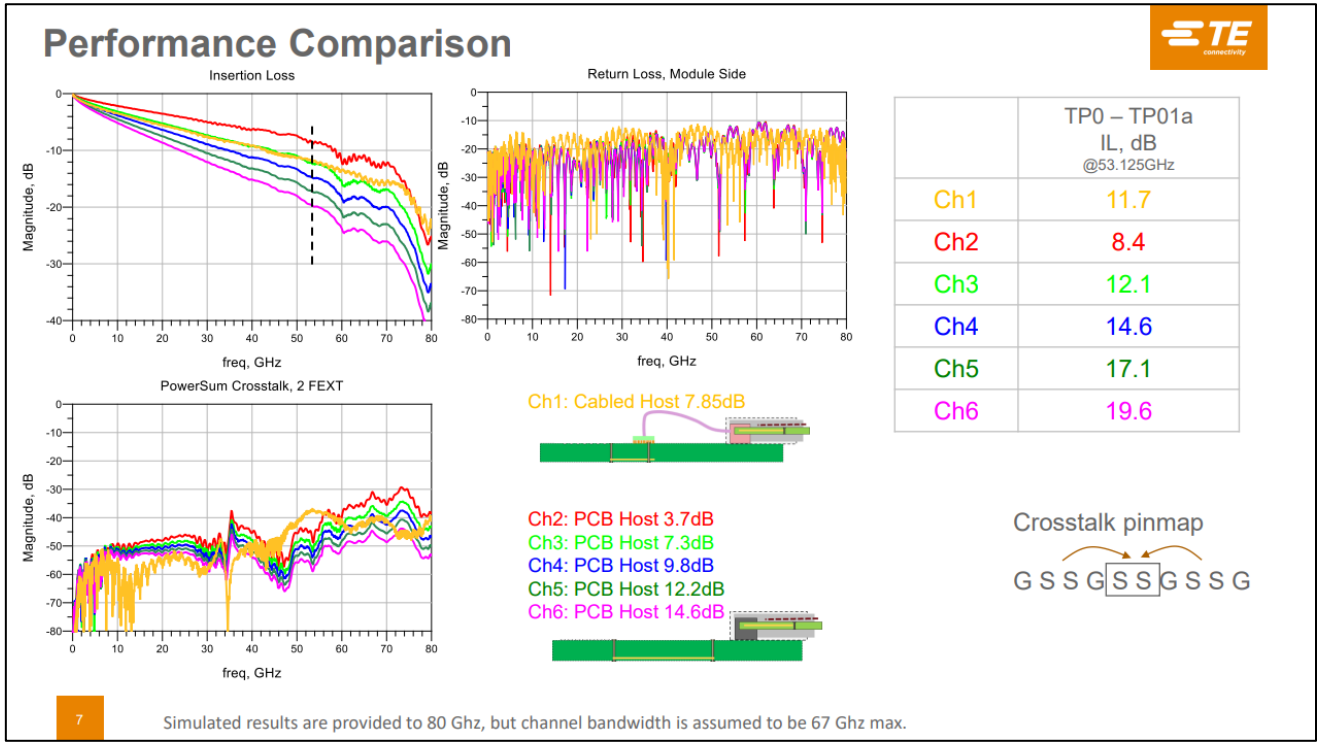
KEYSIGHT TECHNOLOGIES

Page 5

Contribution: rabinovich_3df_elec_01b_220921, rabinovich_3dj_01_230116
Channel: rabinovich_3df_01_2209, rabinovich_3df_02_2209, rabinovich_3dj_02_230116, rabinovich_3dj_03_230116

C2M Channel Summaries (3/3)

- TP0 to TP1a IL range from 8.4dB to 19.6dB in two different model variants
  - Host type
  - Host PCB length



Contribution: shanbhag_3dj_03a_2305.pdf
Channel: shanbhag_3dj_03_2305_sparameters