# C2M Next Steps

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Introduction

- AUI C2M continues to be a challenging interface to progress towards baseline proposals

- The goal of this contribution is to help the Task Force identify a 200G/lane AUI C2M ILdd target

- For convenience, I will use ILdd from host die to module die

  - (ILdd die-die or ILdd bump-bump)

Figure 999X–99—Channel model for AUI-C2M
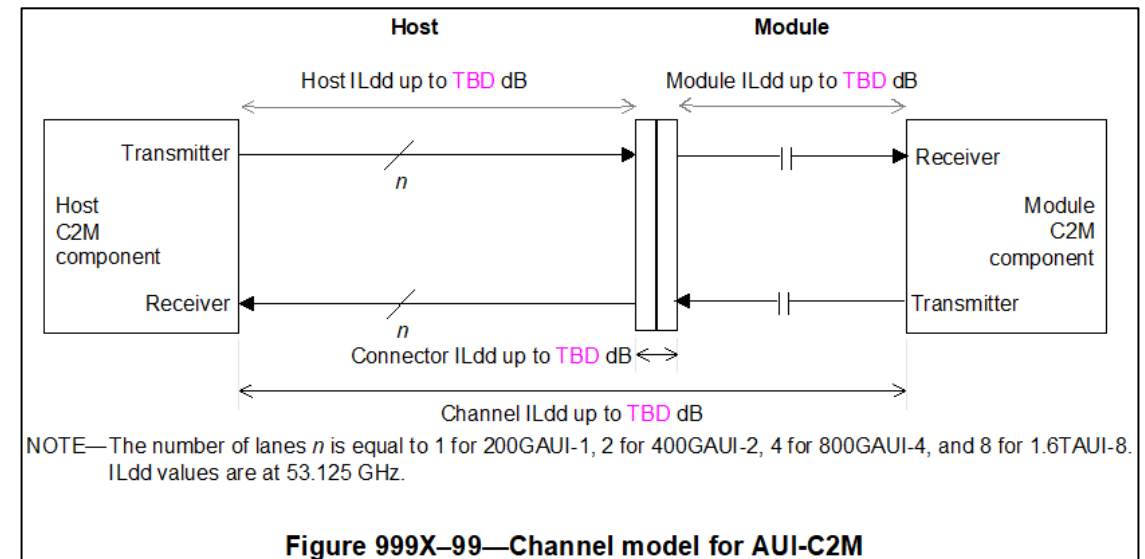
ran_3dj_01_2309

Dependencies

- All related

- Selecting two enables us to solve for the remaining one

- Refine as needed over time

IL target ("channels")

AUI C2M

✓ BER Allocation ←-------→ Reference EQ
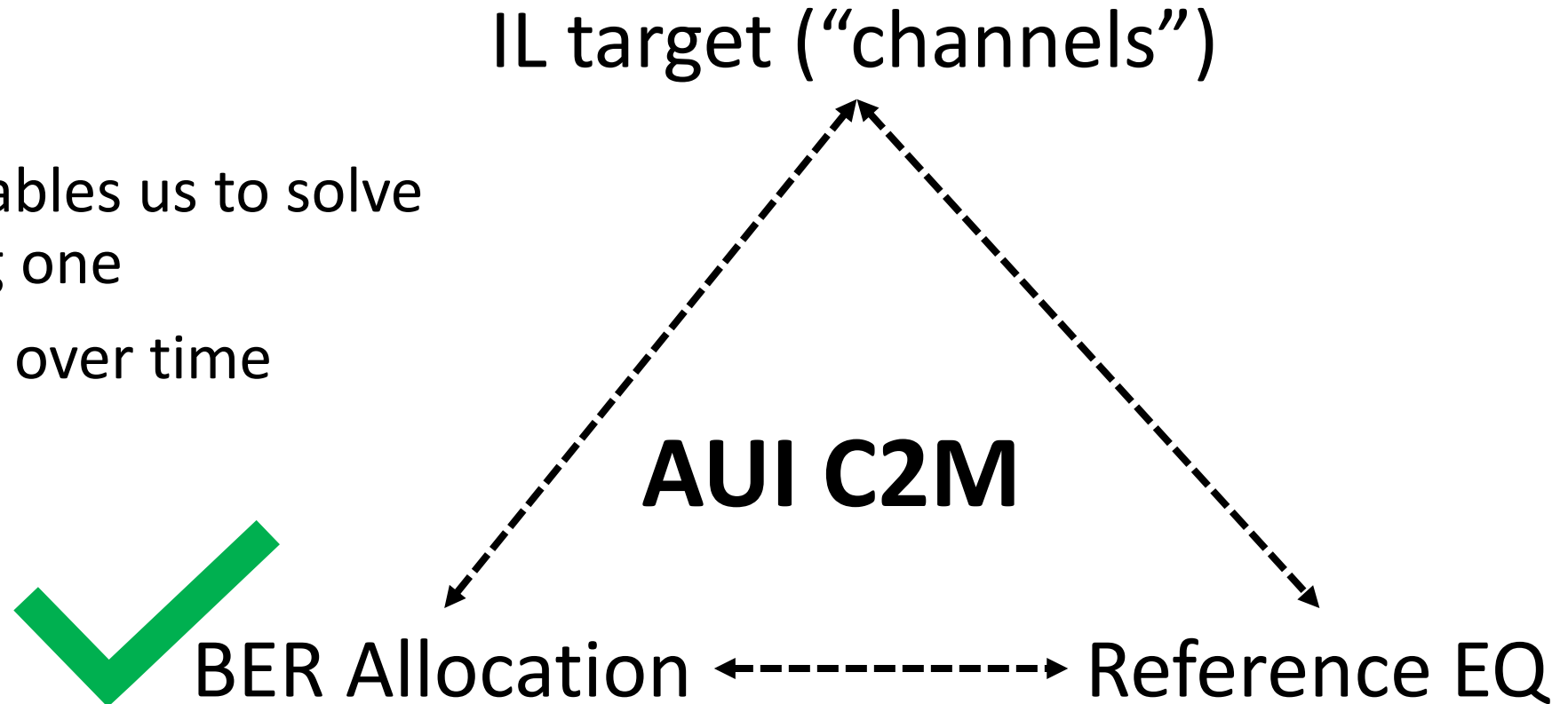
AUI C2M BER

- In September 2023, DER_0 set to 2E-5 for an AUI C2M inside of a Type 1 or Type 2 PHY
  - Not part of an extender sublayer

Motion #1

Move to adopt C2C DER_0 = 0.67E-5 and C2M DER_0 = 2E-5 for the case when the AUI DER_0 is split across the C2M and the C2C inside of a Type 1 or Type 2 PHY per lusted_3dj_01a_230921, slide 7

M: Matt Brown
S: Tobey P.-R. Li
Technical (>=75%)
802.3 voters only
Result: passed by unanimous consent 10:49 a.m.
Task Force: 3dj

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Motion #2 - one AUI C2M, Kent

Move to adopt C2M DER_0 = 2E-5 for the case when the AUI is only a C2M (no C2C) inside of a Type 1 or Type 2 PHY per choice A in lusted_3dj_01a_230921, slide 9

M: Matt Brown
S: Ali Ghiasi
Technical (>=75%)
802.3 voters only
Result: Y: 46, n: 4, A: 9. passed 11:21 a.m.
Task Force: 3dj

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https://www.ieee802.org/3/dj/public/23_09/motions_3cwdfdj_2309.pdf

AUI C2M Loss Straw Poll

- Two straw polls on the AUI C2M ILdd topic were taken in September 2023

- Preference for 32-36 dB range

Straw Poll #13:

For the initial 200G/lane AUI C2M ILdd (die-die) target, I believe we should support losses of at least:

A. 26 dB
B. 28 dB
C. 30 dB
D. 32 dB
E. 34 dB
F. 36 dB
G. 38 dB

(Chicago Rules)

Results (all): A: 23, B: 22, C: 29, D: 38, E: 24, F: 23, G: 6

Straw Poll #14:

For the initial 200G/lane AUI C2M ILdd (die-die) target, I believe we should support losses of at least:

A. 26 dB
B. 28 dB
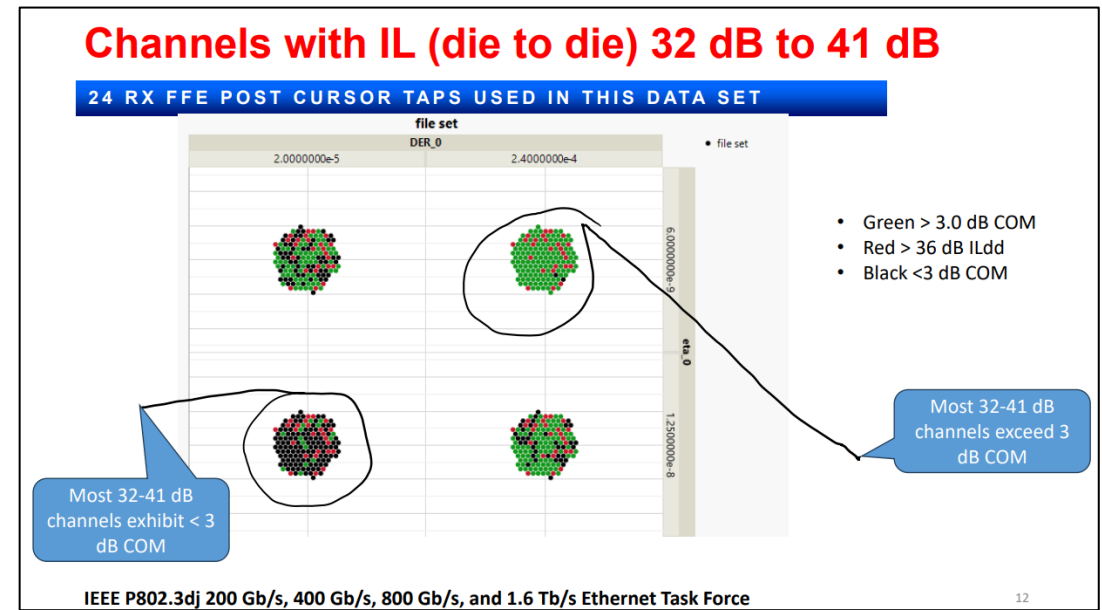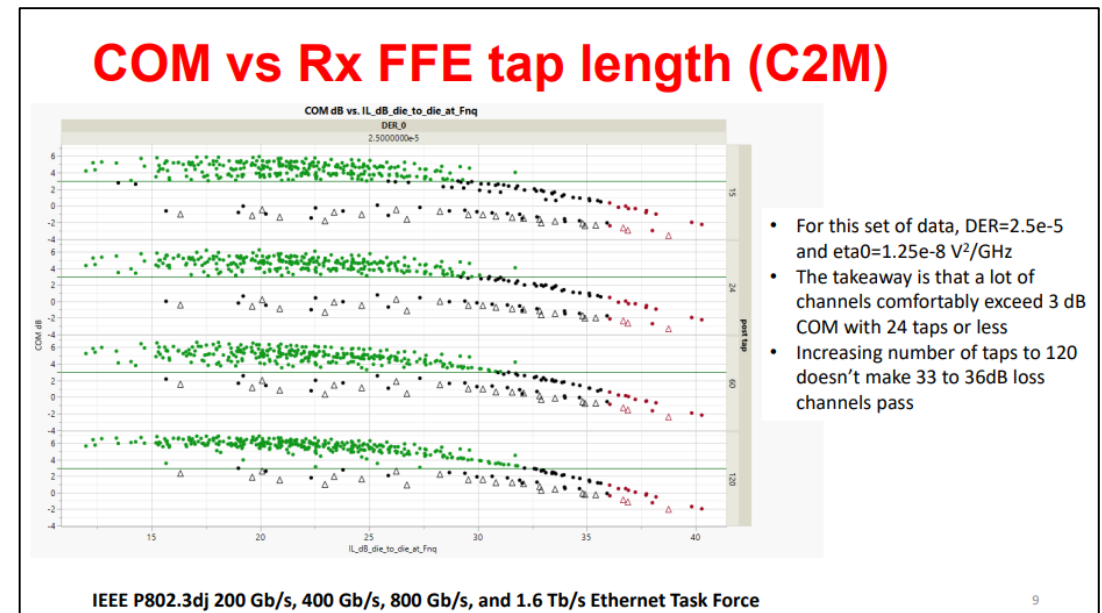C. 30 dB
D. 32 dB
E. 34 dB
F. 36 dB
G. 38 dB

(pick one)

Results (all): A: 0 , B: 4 , C: 13, D: 24, E: 9 , F: 16, G: 3

https://www.ieee802.org/3/dj/public/23_09/motions_3cwdfdj_2309.pdf

Contribution #1

- Supported AUI C2M loss limit is 29-32 dB for most contributed channels
  - Function of # post-cursor taps
  - Less loss for skewed channels
- Two big levers to increase loss
  - Change DER_0 (2E-5 -> ~2E-4)
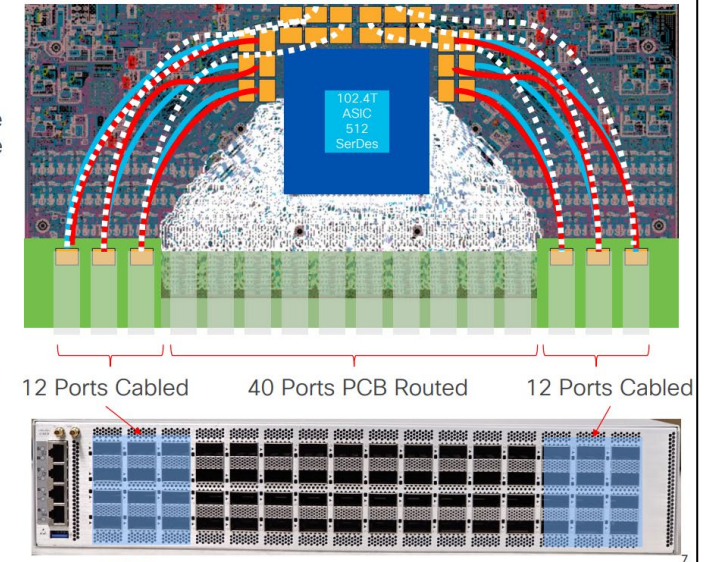 - Reduce eta_0 (1.25E-8 -> 6E-9)

COM vs Rx FFE tap length (C2M)

- For this set of data, DER=2.5e-5 and eta0=1.25e-8 V²/GHz
- The takeaway is that a lot of channels comfortably exceed 3 dB COM with 24 taps or less
- Increasing number of taps to 120 doesn't make 33 to 36dB loss channels pass

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Channels with IL (die to die) 32 dB to 41 dB

24 RX FFE POST CURSOR TAPS USED IN THIS DATA SET

- Green > 3.0 dB COM
- Red > 36 dB ILdd
- Black <3 dB COM

Most 32-41 dB channels exceed 3 dB COM

Most 32-41 dB channels exhibit < 3 dB COM

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https://www.ieee802.org/3/dj/public/adhoc/electrical/23_1026/mellitz_3dj_elec_01_231026.pdf

Contribution #2

- 36 dB channel loss needed to support all ports in the example
  - Supporting 32 dB channel loss requires a hybrid solution in the host
    - ~1/3 ports = cabled host

- 32 dB cabled host requires the same EQ capability as 36 dB PCB
  - Channels have 0.2 UI skew end-end (Host ASIC to module DSP)

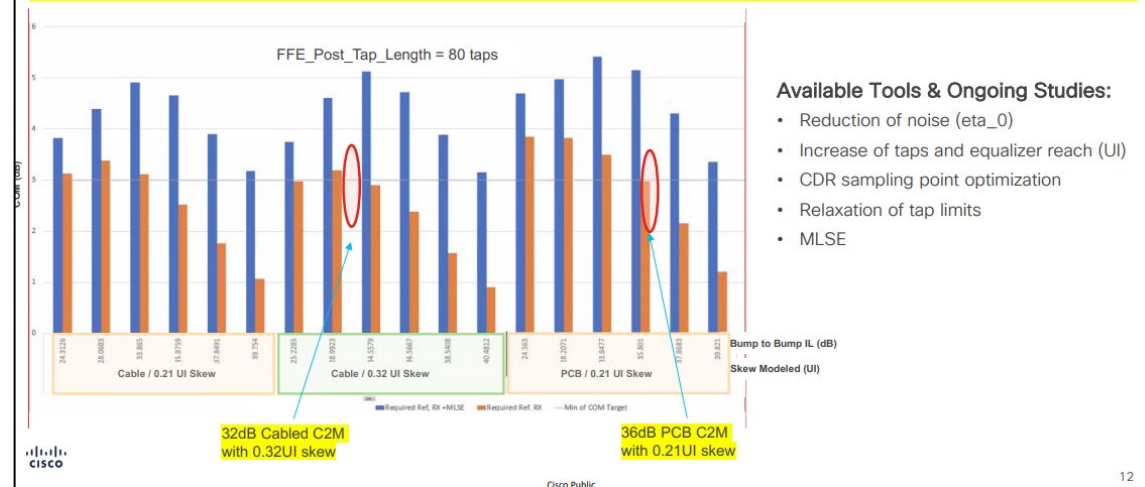https://www.ieee802.org/3/dj/public/23_11/tooyserkani_3dj_01_2311.pdf

Some COM Differences Between #1 and #2

Parameter	Contribution #1 Value	Contribution #2 Value
DER_0	2.5E-5	2.67E-5
MLSE	0	0 and 1 (depends on graph)
FFE_Post	15, 24, 60, 120	80
Eta_0	1.25E-8	6E-9
B_max(1)	0.75	1
A_v	0.386	0.5
C(-1)	-0.3:0.05:0	-0.4:0.02:-0.3
C(-2)	0:0.05:0.1	0:0.02:0.04
f_r	0.58	0.75

Note: Not a complete list

Some EQ Parameters to Increase Reach

- Change DER_0 (e.g. 2E-5 -> 2E-4)
  - Available via extender sublayer
- Reduce "noise" eta_0 (e.g. ~1.25E-8 -> ~6E-9)
- Use MLSE
- Increase # of post-cursor RXFFE taps
- Increase TX amplitude "A_v"
- Relax tap limits

Some System Choices to Increase Reach

- Use Extender Sublayer AUI C2M

- Retimers

- Cabled Host Ports

- Improved channel construction

Summary

- Need to set the ILdd target and reference EQ for a baseline proposal
- Current data shows a significant ILdd target gap between Contribution #1 and Contribution #2
- Recommend that the TF focus first on AUI C2M analysis with no-skew channels to establish a baseline starting point
  - AUIs inside Type 1 or Type 2 PHY
  - Look at the impact of skew later
    - Contribution of channels with various levels of skew are expected soon
- Recommend the TF work offline to build consensus on finding acceptable EQ parameters and channel/system choices
- Straw polls on tradeoffs to increase AUI C2M reach were requested