Moving Forward on AUI C2M IL Target and Ref EQ

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Contributors

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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 and Reference EQ
- For convenience, I will use ILdd (differential) from host die to module die
  - (ILdd die-die or ILdd bump-bump)

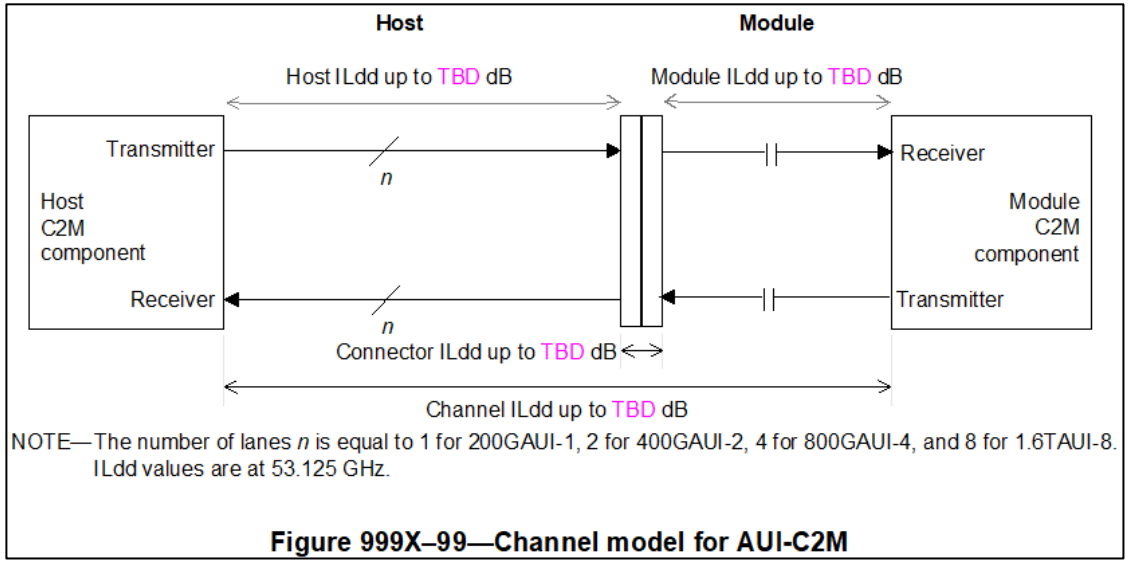

Figure 999X–99—Channel model for AUI-C2M

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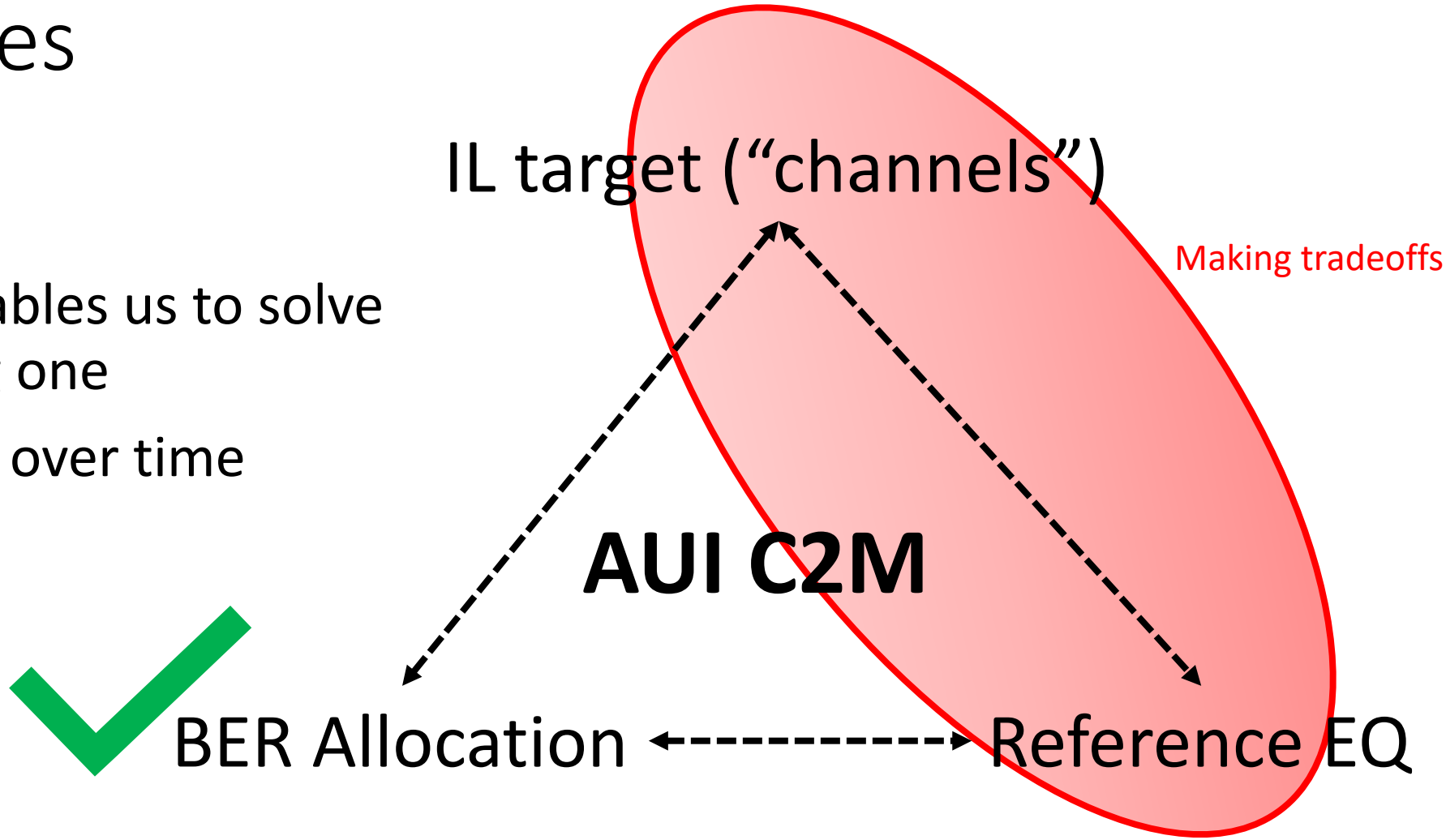
Dependencies

- All related
- Selecting two enables us to solve for the remaining one
- Refine as needed over time



Observations

- For 200G/lane, the AUI C2M ILdd target is much larger than in past projects
  - 3bs: Annex 120E ~13 dB (die-to-die)
  - 3ck: Annex 120G ~= 22dB (die-to-die)
  - 3dj: discussing the range of 30-36 dB (die-to-die)
- AUI C2M electrical interface is approaching the same complexity as a 200G/lane CR/KR-class solution

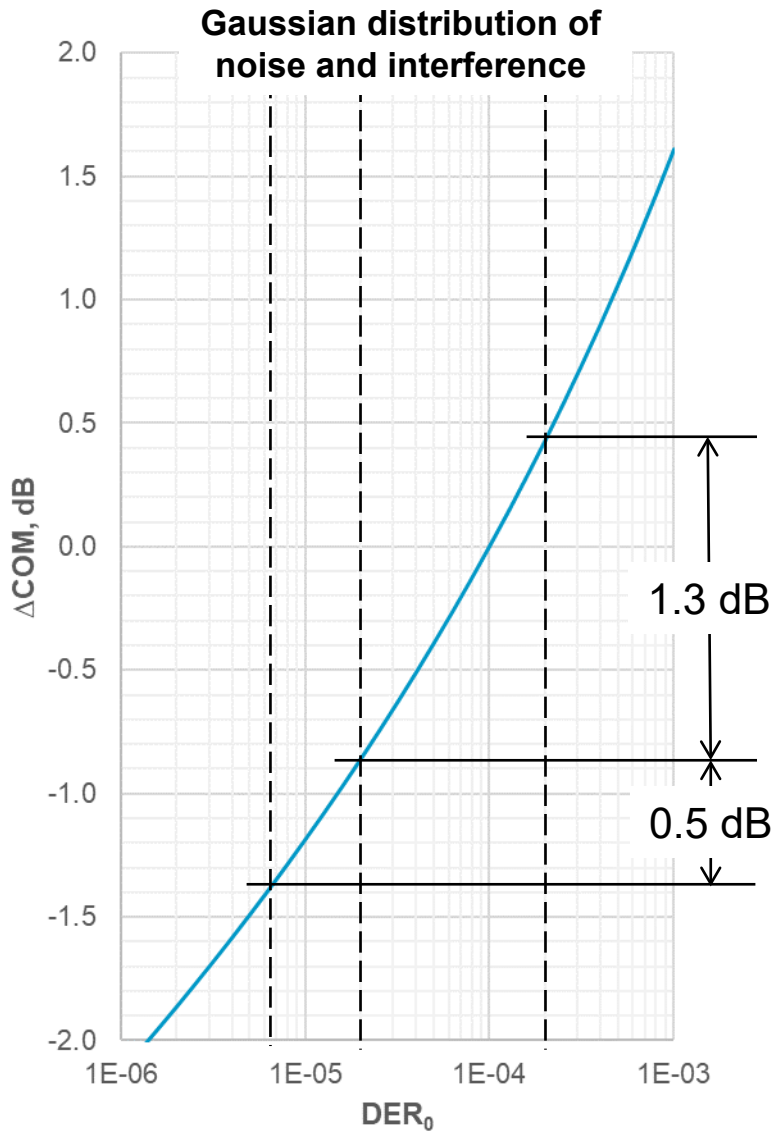
Upper Guardrail

- Do we agree that the 200G/lane AUI C2M should be no more complex than the CR/KR reference EQ under consideration?
  - I.e., the AUI C2M reference EQ could be the same complexity or less

Targets for 200G/lane electrical PHY and interface types

	CR, KR	AUI C2M	AUI C2C
IL (die-to-die, max.), dB	40	???	???
DER_0	2e−4	2e−5	0.67e−5
BER (a = 0)	1.5e−4	1.5e−5	0.5e−5
BER (a = 0.75, precoded)	3e−4	3e−5	1e−5
ΔCOM (vs. 2E-4), dB	0	−1.3	−1.8

- IL targets for AUI C2M and C2C are expected to be less than 40 dB due to COM penalties associated with lower DER_0



Content courtesy: Adam Healey

EQ Direction

- Discussion and debate continues around three key parameters and values for the CR/KR Reference EQ
  - RXFFE Type: floating or fixed
  - # of RXFFE taps
  - MLSE or equivalent function assumed

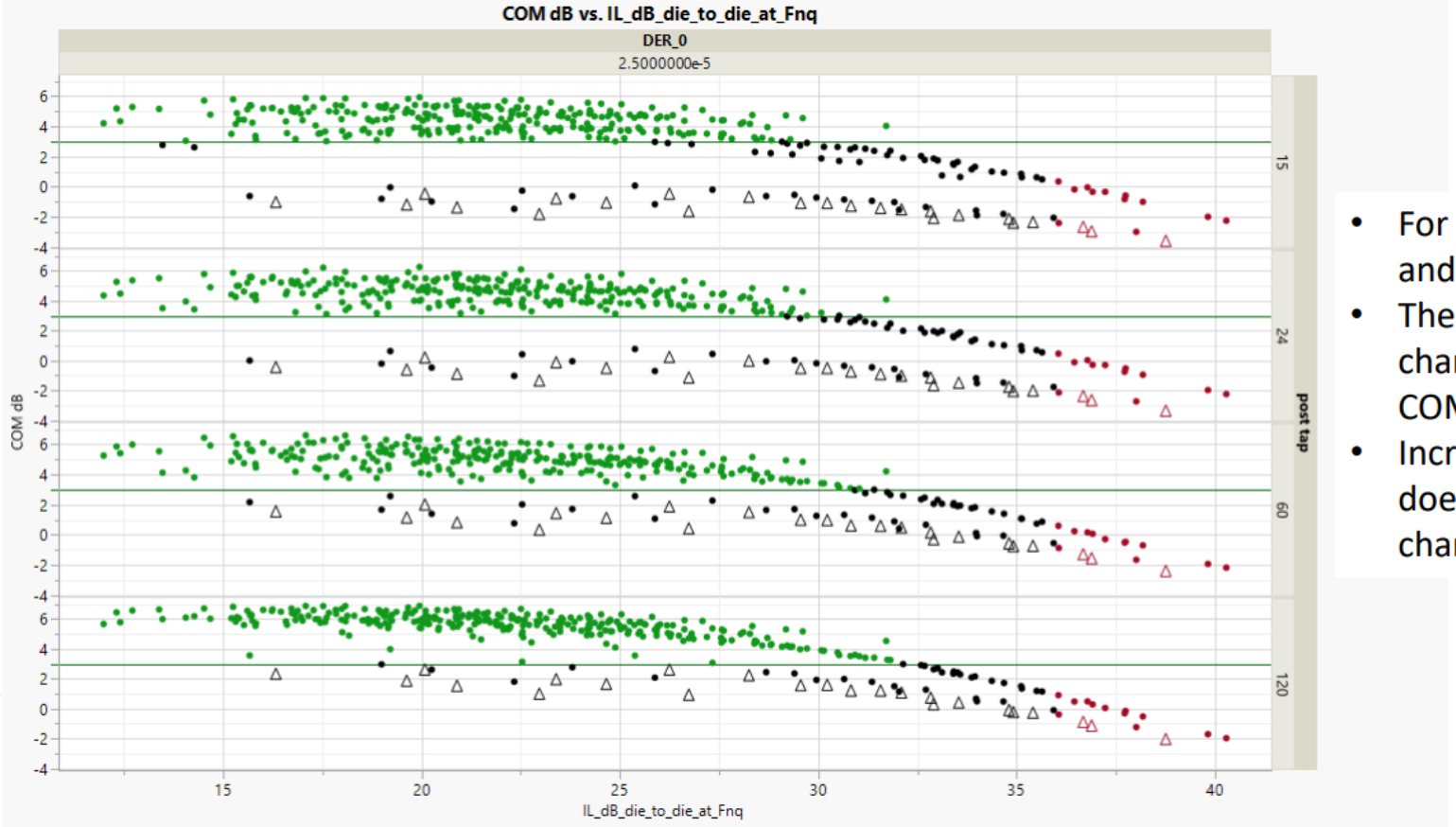
- Contributions on these topics are needed. No proposal on these topics is suggested or implied in this contribution.

Making an Extreme EQ Assumption
(For the purpose of setting a limit)

- For now, I assume that an RXFFE with 120 post cursor taps is at least as good as an RXFFE with floating taps
  - Not debating which is better
- Also, I assume that MLSE can reliably deliver delta-COM of 0.75dB over a non-MLSE receiver in real world conditions on high loss channels
  - COM limit = 3 dB (MLSE disabled)
  - COM limit = 2.25 dB (MLSE enabled)
  - MLSE improvement is much less for reflection dominated or crosstalk dominated channels

- **THIS EQ IS NOT A BASELINE PROPOSAL!!!!**
  - This EQ is used to explore agreement on a “brick wall” limit

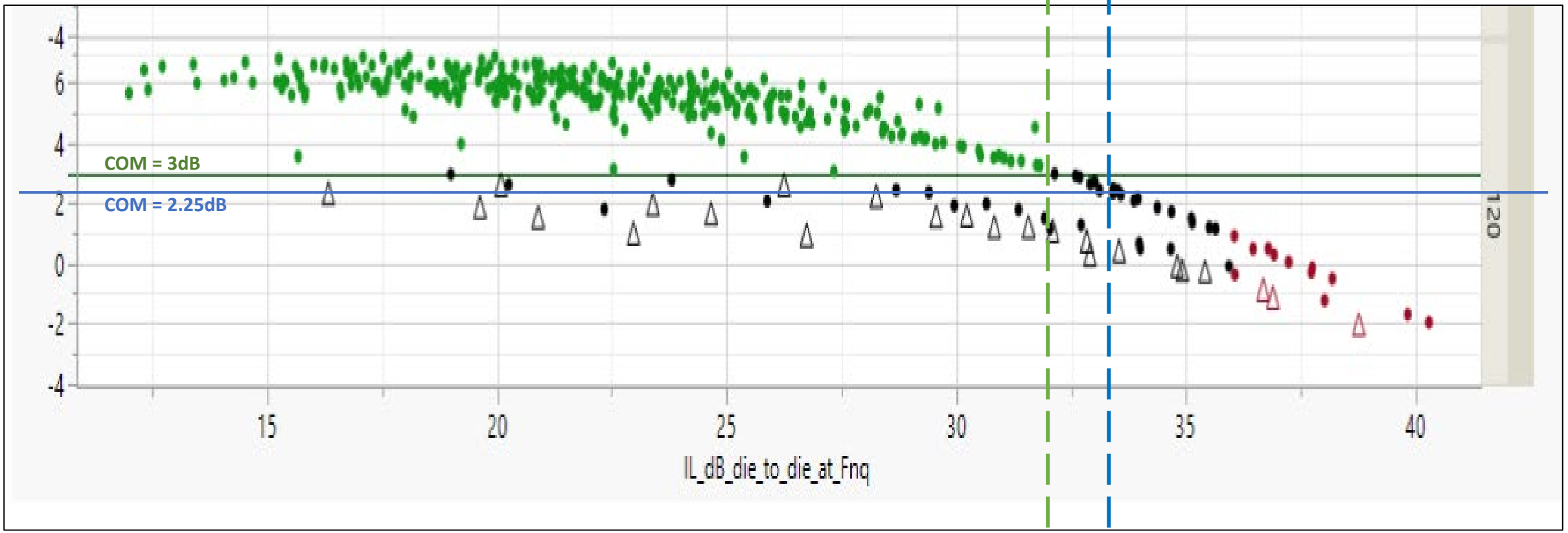
COM vs Rx FFE tap length (C2M)



- For this set of data, DER=2.5e-5 and eta0=1.25e-8 V^2/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

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

120 Post Cursor Taps w/ and w/o MLSE



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

~32dB ~33dB

Note: Rich Mellitz and I are working to get new data w/ DER_0 = 2E-5 (ETA Jan interim). The high loss performance is very sensitive to the ref EQ parameter values

Summary

- Need to set the informative AUI C2M ILdd target at the January’24 interim meeting
  - We need to close on Phase1 items to intercept the anticipated 3dj D1.0
- The AUI C2M reference EQ should be equal to or less than complex that the CR/KR reference EQ
- For the DER_0 = 2E-5 that we adopted, **a reasonable informative AUI C2M ILdd target is ~32.5dB**
- It is time to choose a target and move on. Refine it later as needed

Backup

Options to Increase AUI C2M Physical Reach

Extender Sublayer

- “Resets” the DER_0 Budget
- Increases cost, latency and power

In-Box Cables

- More physical reach per unit of loss, different connector impairments
- Increases cost, skew concerns

Better SERDES (host and module)

- Improved SNR performance
- Increases cost and power