Higher Loss 200G/lane AUI C2M Specification Baseline Thoughts

Kent Lusted, Intel

Adee Ran, Cisco

Junqing (Phil) Sun, Credo

Introduction

- Initial thoughts on the parameters and solution space for the higher loss 200G/lane AUI C2M, not a baseline proposal
  - See Straw Poll #1, #2 in https://www.ieee802.org/3/df/public/22_10/motions_3df_221004.pdf
- Based extensively on ran_3df_elec_01b_220921 and ran_3df_01_220928
- Applies to 200GAUI-1, 400GAUI-2, 800GAUI-4, 1.6TAUI-8 interfaces

Recap from Oct 2022 Session

- Strong interest in two sets of AUI C2M specifications

Straw Poll #1

For the front panel pluggable use case, I am interested in 200 Gbps/lane AUI C2M specifications for:

A. medium loss only (e.g. up to ~22 dB IL die-die per lusted_3df_01_220927)
B. higher loss only (e.g. up to ~36 dB IL die-die per lusted_3df_01_220927)
C. both medium and higher loss
D. need more information

pick one

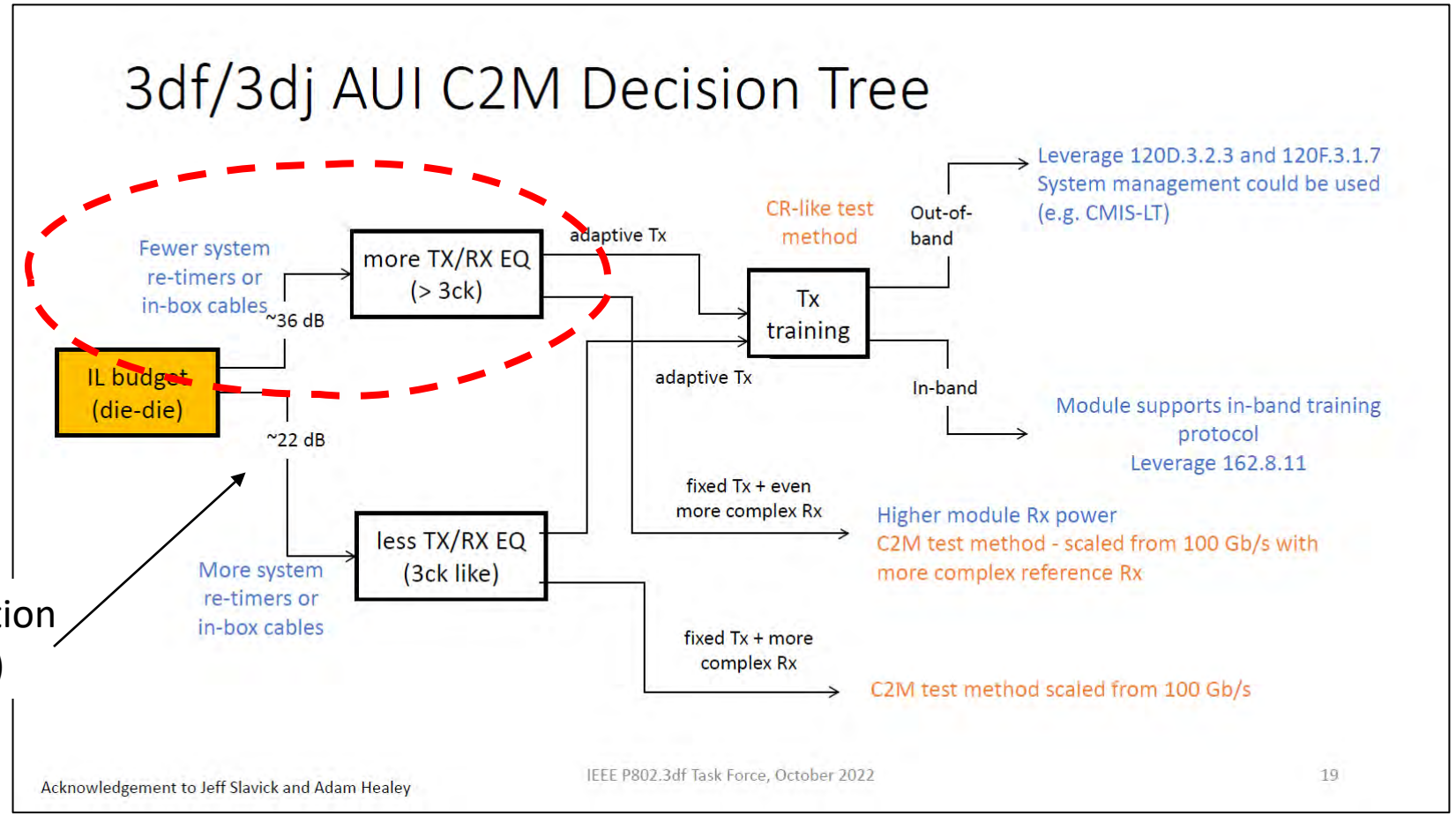
Results: A: 17, B: 11, C: 49, D: 12

https://www.ieee802.org/3/df/public/22_10/motions_3df_221004.pdf

Focus of this Presentation – Higher Loss

This presentation

The other presentation (cole_3df_01_2211)



https://www.ieee802.org/3/df/public/22_10/22_0927/lusted_3df_01_220927.pdf

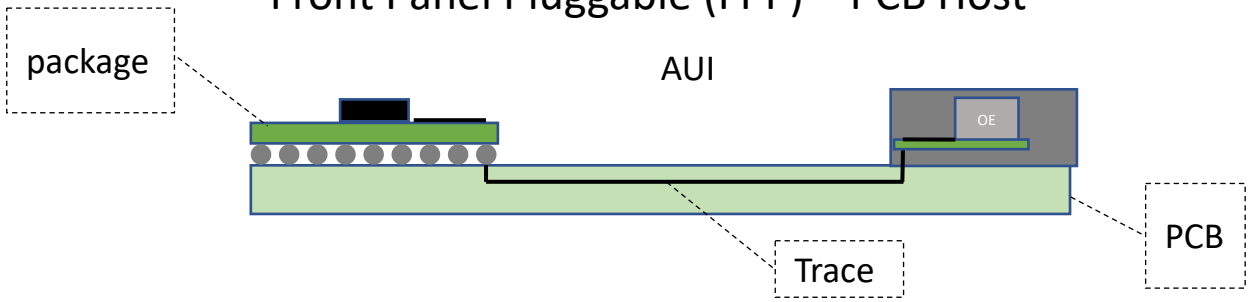
Key Points

- The proposed reference receiver and parameters are based on the backplane and copper cable receiver models from 3ck, scaled to the higher signaling rate
- Nominal signaling rate based on RS(544,514) FEC for the AUI interface
  - 106.25 GBd (+/-50 ppm)
  - PAM4 signaling
- Link training could be used for tuning the module-to-host output and the host-to-module output
  - Either in-band or out-of-band, pending TF discussion
- The RS(544, 514) FEC on the AUI is terminated inside the module
  - Protects up to two AUI segments in one PHY, such that BER of ~1e-4 on each segment (with adjustment for correlated errors) is possible
- Uses Segmented FEC scheme for the PMDs
  - For non-segmented FEC scheme, use the medium loss AUI C2M specification

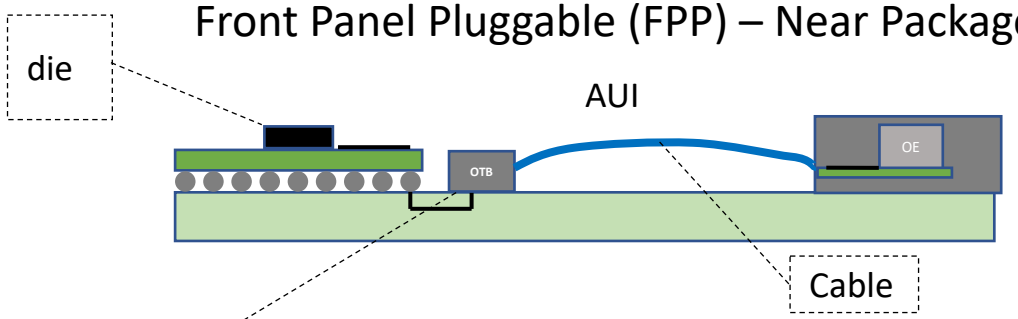
Higher loss AUI C2M Implementations

AUI channel includes the host package, host PCB/cable, pluggable connector, and pluggable module PCB and module package

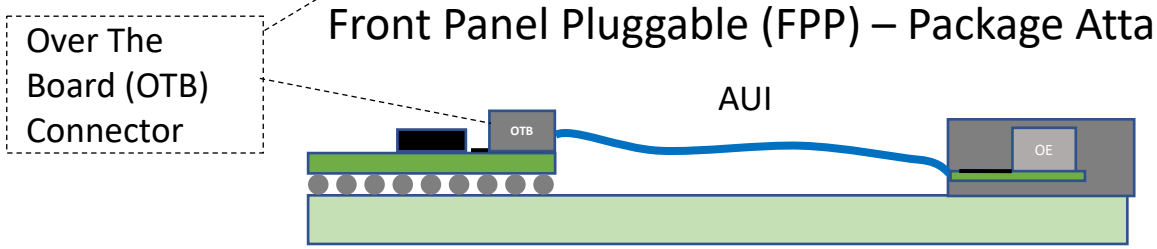
Front Panel Pluggable (FPP) – PCB Host



Front Panel Pluggable (FPP) – Near Package Attach Cabled Host

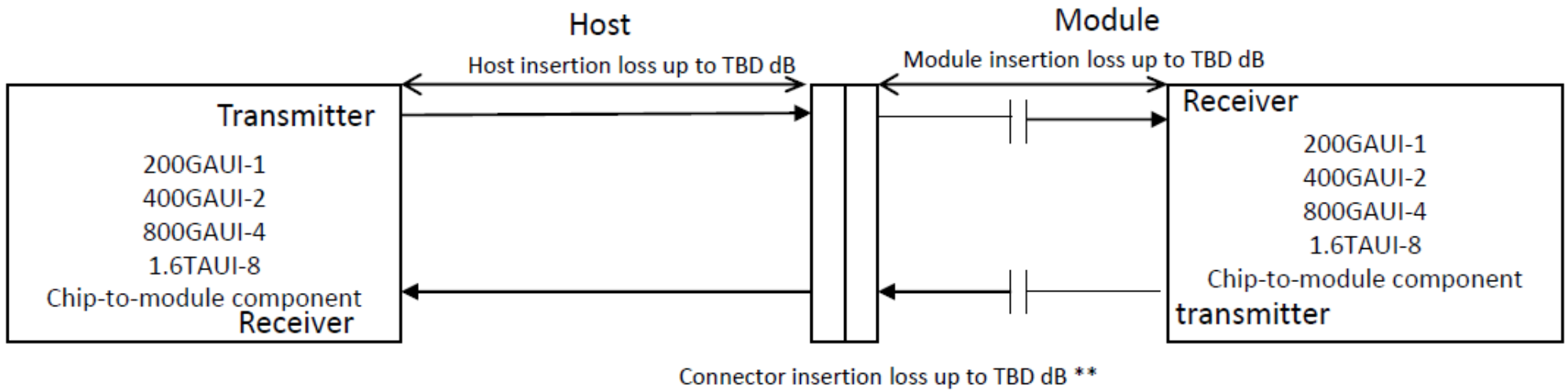


Front Panel Pluggable (FPP) – Package Attach Cabled Host



Not intended to be an exhaustive list.
Other implementations may exist.

Channel Insertion Loss Allocation



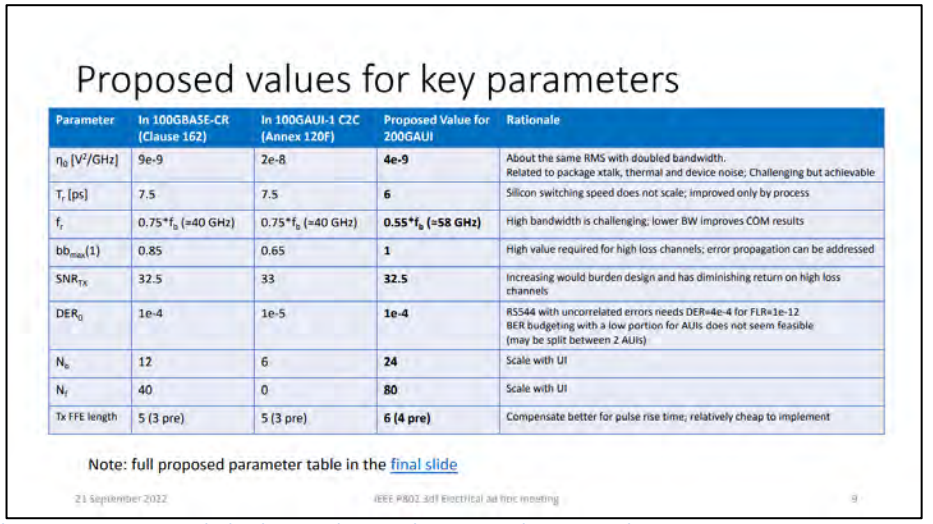
** The host connector mating interface is allocated TBD dB variation allowance, not including via.

Needs Exploration for a Baseline Proposal

- COM parameters and values
- Precoding capability and benefits/impacts
- Test methodology and host/module output setting details

COM Parameters & Values

- Need to build consensus on key parameters (e.g. DER_0 target value, eta_0,…)
- This is one recent contribution provided on the topic



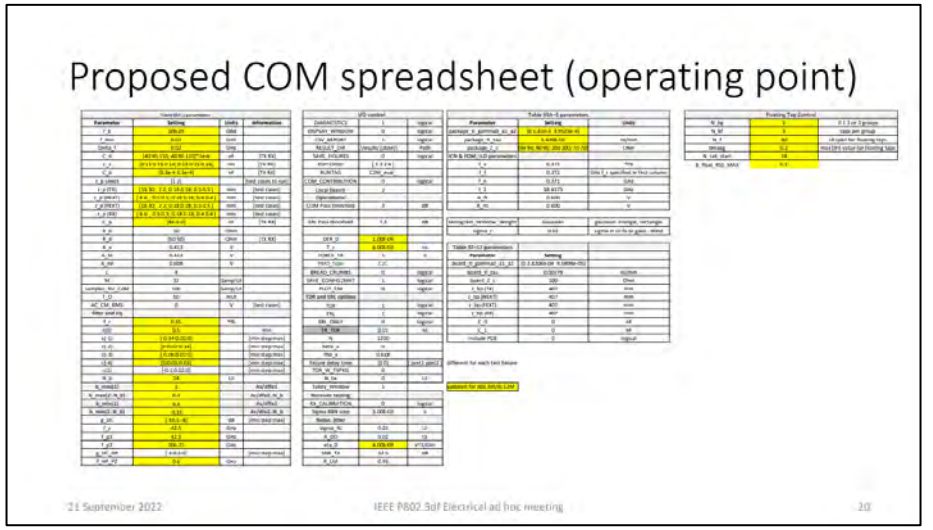
Proposed values for key parameters

Parameter	In 100GBASE-CR (Clause 162)	In 100GAUI-1 C2C (Annex 120F)	Proposed Value for 200GAUI	Rationale
η_0 [V²/GHz]	9e-9	2e-8	**4e-9**	About the same RMS with doubled bandwidth. Related to package xtalk, thermal and device noise; Challenging but achievable
T_r [ps]	7.5	7.5	**6**	Silicon switching speed does not scale; improved only by process
f_r	0.75*f_b (=40 GHz)	0.75*f_b (=40 GHz)	**0.55*f_b (=58 GHz)**	High bandwidth is challenging; lower BW improves COM results
bb_{max}(1)	0.85	0.65	**1**	High value required for high loss channels; error propagation can be addressed
SNR_{TX}	32.5	33	**32.5**	Increasing would burden design and has diminishing return on high loss channels
DER_0	1e-4	1e-5	**1e-4**	RS544 with uncorrelated errors needs DER=4e-4 for FLR=1e-12 BER budgeting with a low portion for AUIs does not seem feasible (may be split between 2 AUIs)
N_b	12	6	**24**	Scale with UI
N_f	40	0	**80**	Scale with UI
Tx FFE length	5 (3 pre)	5 (3 pre)	**6 (4 pre)**	Compensate better for pulse rise time; relatively cheap to implement

Note: full proposed parameter table in the final slide

21 September 2022 IEEE P802.3df Electrical ad hoc meeting 9

https://www.ieee802.org/3/df/public/adhoc/electrical/22_0921/ran_3df_elec_01b_220921.pdf



Proposed COM spreadsheet (operating point)

21 September 2022 IEEE P802.3df Electrical ad hoc meeting 10

https://www.ieee802.org/3/df/public/adhoc/electrical/22_0921/ran_3df_elec_01b_220921.pdf

Summary

- Uses RS(544,514) FEC for the AUI interface
  - 106.25 GBd (+/-50 ppm)
  - PAM4 signaling
- Segmented FEC scheme
- ~36 dB loss target (die-die)
- Reference receiver and transmitter models leveraged from 3ck backplane and copper cable, scaled appropriately
- More work to do to get to a baseline proposal in the future

Thanks!