

IEEE P802.3df Electrical PMDs and AUIs Overview

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Agenda

- Review
- 100 Gbps/lane Signaling
- 200 Gbps/lane Signaling
 - AUIs
 - Copper cables
 - Other

This is not an exhaustive summary.
We are a contribution-led group.

Presentation Focus

Organization of Project Work

Logic	Electrical	Optical
<ul style="list-style-type: none">• Amendments to MAC, RS, and MAC PHY interfaces• RS and MII• Extender Sublayers?• PCS functions• PMA functions• Provide support to enable mapping over OTN	<ul style="list-style-type: none">• Extender Sublayer?• C2C AUIs• C2M AUIs• Copper PMDs• Channel characteristics for electrical interfaces and PMDs	<ul style="list-style-type: none">• Optical PMDs• MDIs?• Media Characteristics
FEC Architecture and Budget		
<ul style="list-style-type: none">• Overall Architecture	<ul style="list-style-type: none">• FEC related to electrical interfaces and PMDs	<ul style="list-style-type: none">• FEC related to Optical PMDs
<ul style="list-style-type: none">• Management related to Logic functions (Clauses 30, 45, etc.)	<ul style="list-style-type: none">• Management related to electrical interfaces and PMDs (Clauses 30, 45, etc.)	<ul style="list-style-type: none">• Management related to Optical PMDs (Clauses 30, 45, etc.)

Further insight to be provided by Track Leadership @ 18 Jan 2022 Meeting

Adopted Physical Layer Objectives

Electrical Focus

Technology Reuse

Ethernet Rate	Assumed Signaling Rate	AUI	BP	Cu Cable	MMF 50m	MMF 100m	SMF 500m	SMF 2km	SMF 10km	SMF 40km
200 Gb/s	200 Gb/s	Over 1 lane		Over 1 pair			Over 1 Pair	Over 1 Pair		
400 Gb/s	200 Gb/s	Over 2 lanes		Over 2 pairs			Over 2 Pair			
800 Gb/s	100 Gb/s	Over 8 lanes	Over 8 lanes	Over 8 pairs	Over 8 pairs	Over 8 pairs	Over 8 pairs	Over 8 pairs		
	200 Gb/s	Over 4 lanes		Over 4 pairs			Over 4 pairs	1) Over 4 pairs 2) Over 4 λ 's		
	TBD								Over single SMF in each direction	Over single SMF in each direction
1.6 Tb/s	100 Gb/s	Over 16 lanes								
	200 Gb/s	Over 8 lanes		Over 8 pairs			Over 8 pairs	Over 8 pairs		

Leverage existing or work-in-progress 100 Gb/s per lane (e.g. 3cu, 3ck, 3db) to higher lane counts

Develop 200 Gb/s per lane electrical signaling for 1/2/4/8 lane variants of AUIs and electrical PMDs

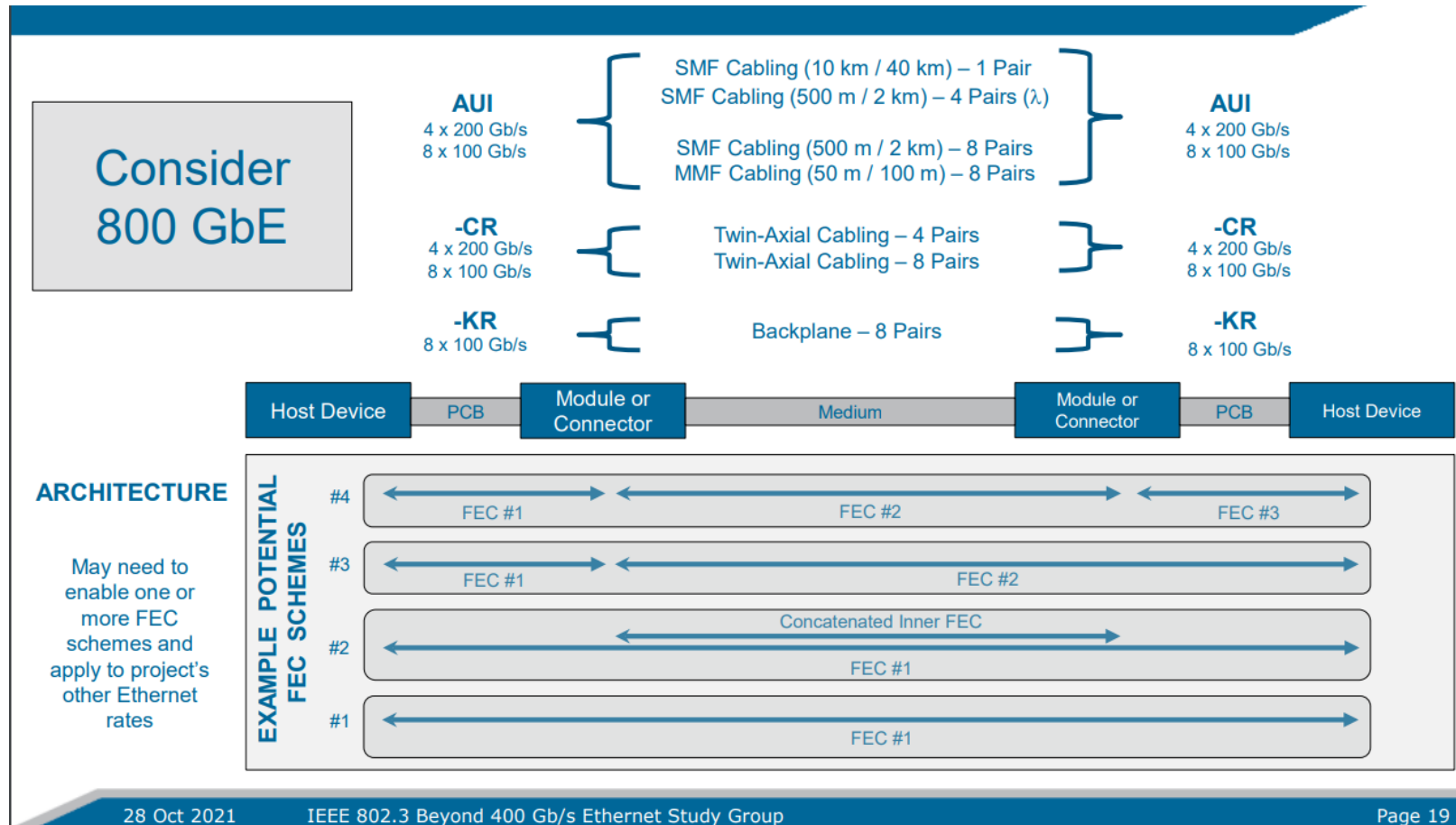
Develop 200 Gb/s per optical fiber for 1/2/4/8 fiber based optical PMDs and 4 lambda WDM optical PMD

Potential for either direct detect and / or coherent signaling technology

Making it all work together

https://www.ieee802.org/3/B400G/public/21_1028/B400G_overview_c_211028.pdf

FEC Schemes and Electrical Dependencies



Electrical interface and PMD parameters will vary widely across the media types and FEC schemes

100 Gbps/lane Signaling

Key Assumptions

- #1. No significant architecture, form factor, parametric or use case changes when compared to 3ck electrical interfaces and PMDs
 - Supporting a 200 Gbps/lane FEC structure on 100 Gbps/lane electrical interfaces could impact signaling rate

800GbE (8x100) Strategy

- Monitor progress of 3ck through SA ballot cycle
- Expand 3ck interfaces and PMDs for lane widths up to 8
 - AUI C2M
 - AUI C2C
 - Copper cable
 - Backplane
- Adopt/modify MDI, PMD form factors as required
- Update COM reference receiver and transmitter parameters, if needed

1.6TbE (16x100) Strategy

- Expand 3ck interfaces for lane widths up to 16
 - AUI C2M
 - AUI C2C
- Update COM reference receiver and transmitter parameters, if needed
- Adapt this plan if new PMDs surface

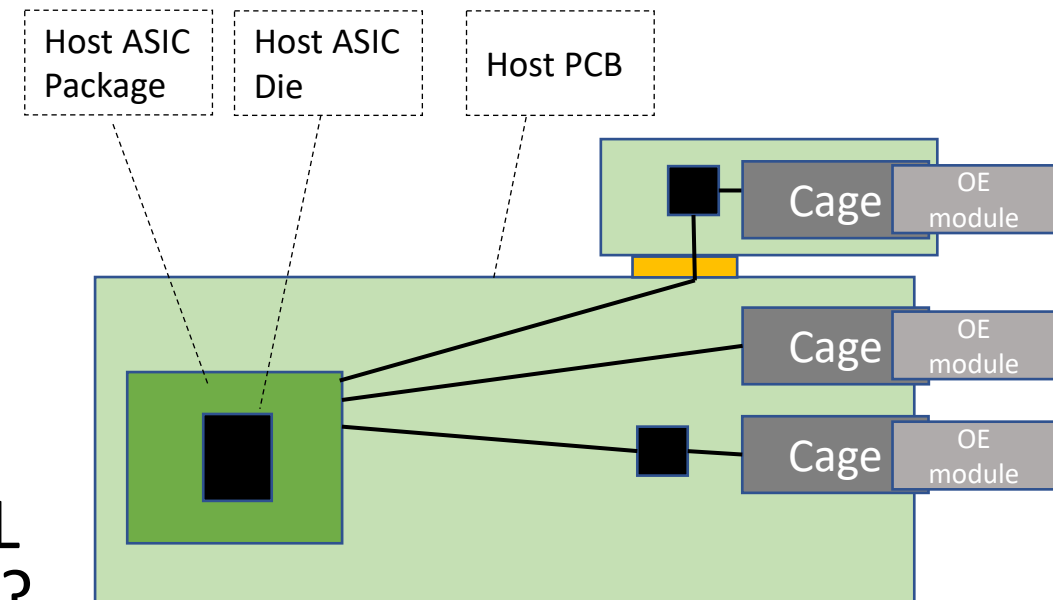
200 Gbps/lane Signaling

Key Assumptions

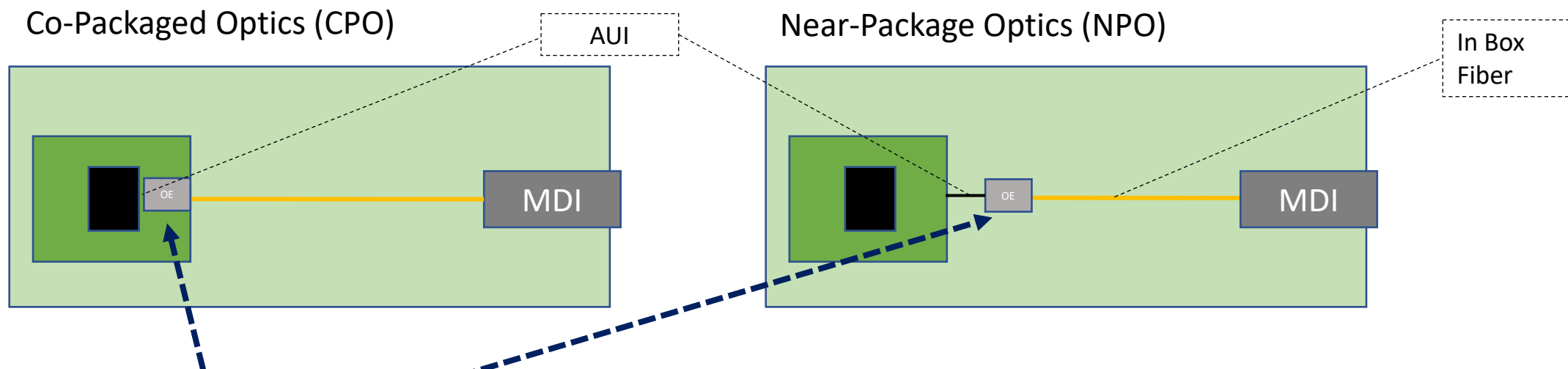
- #1. Broad engagement in developing 200 Gbps/lane electrical interfaces and PMDs is impacted by work within 3ck
- #2. PMD/AUI parameters affect FEC architecture, pre FEC BER target, FEC gain requirements, etc.
 - Balance power, complexity, cost, latency and encoded lane rates
 - Segmented and concatenated FEC schemes could require different bit rates
- #3. Electrical interfaces (e.g AUIs) might use a different FEC strategy than the electrical PMDs

AUIs (Nx200)

- Chip-to-module (C2M) and chip-to-chip (C2C) AUI objectives exist today to address the “traditional” front panel pluggable use case
- What is the desired physical reach and IL for front panel pluggable (FPP) AUI C2M?
 - Is it compatible with the copper cable PMD?
- Electrical modulation choice co-dependent upon optics
 - Optional TX precoder?
- Error statistics



New Use Cases Emerging: CPO, NPO



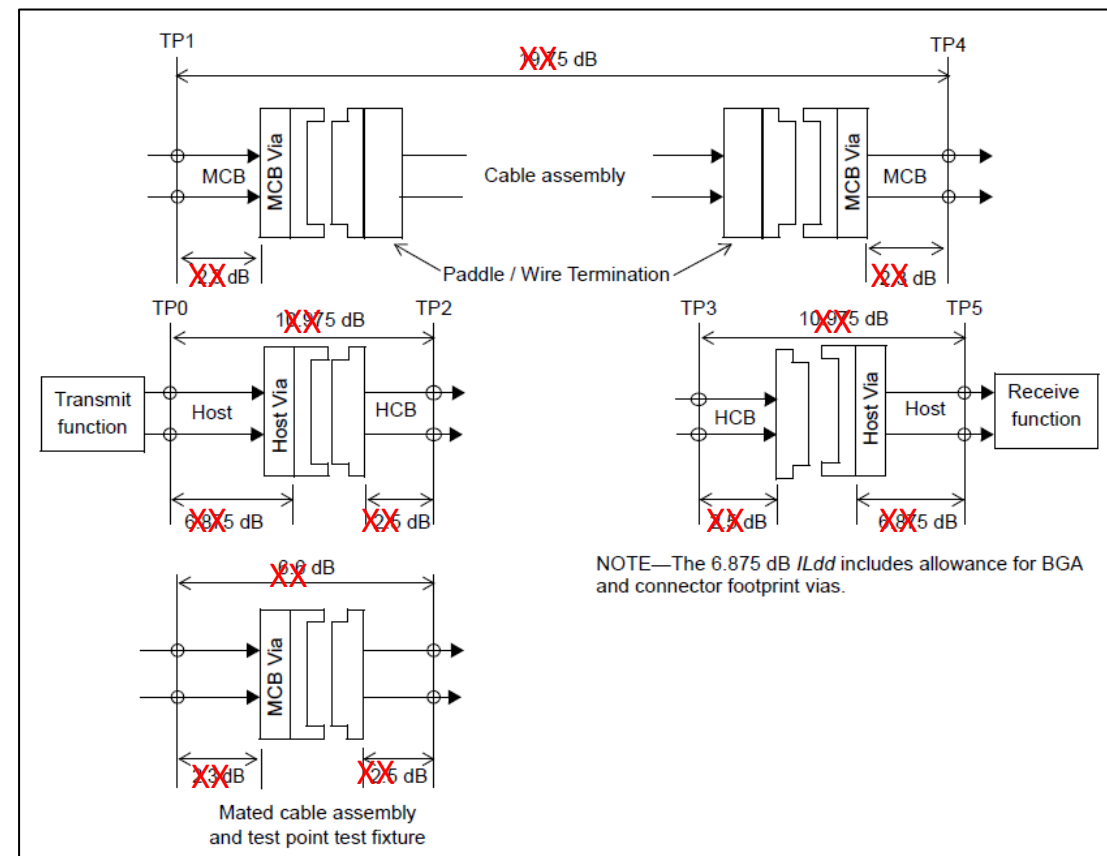
- Co-packaged/Near-Package optics may have fixed (soldered) and pluggable (e.g. socketed) instantiations
 - If possible, map these instantiations to the "traditional" AUI C2C and C2M compliance test models for maximum commonality
- Is there a need for specialized AUI variants for CPO and NPO?

More on AUIs

- Will module and host VEC/EH be sufficient or is a new method needed?
 - Existing VEC/EH methods appear to be strained at 3ck (100 Gbps/lane) rates
- Expand the number of module-to-host electrical output modes?
 - Or move to link_training-like process?
- Is there a market need for multiple-rates-per-lane?
- Need channel contributions to determine host and module equalization demands!

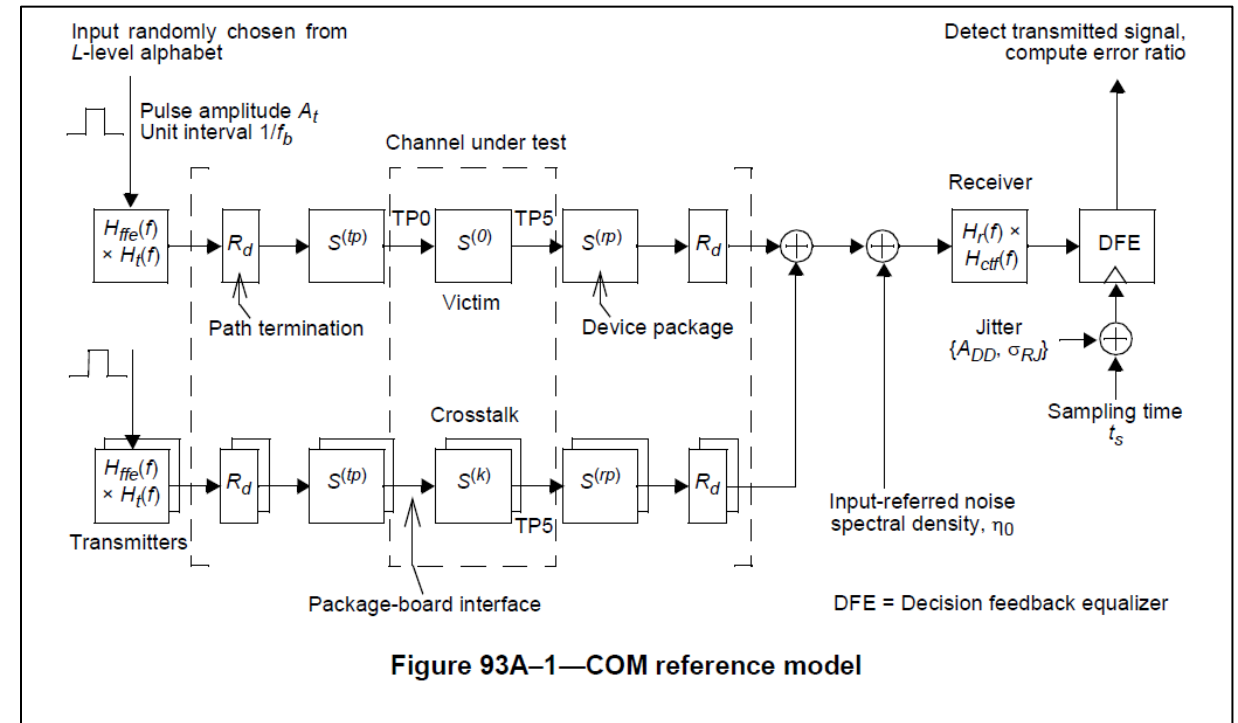
Copper Cable (Nx200)

- Modulation selection (PAM4 vs. PAM6) will be challenging
 - Both choices have merits and impacts
 - Optional TX precoder?
- What is the desired physical reach and IL for copper cable hosts?
 - Is it compatible with FPP AUI C2M, CPO, NPO?
- Revisit test fixtures (HCB, MCB, etc.) and methods
- Is there continued interest in specifying active copper cable types?
 - Fully retimed, half retimed, linear only?
- Error statistics
- Need channel contributions to determine equalization demands!



Reference Transmitter and Receiver

- COM used extensively for electrical interfaces and PMDs
 - Channel characterization and calibration
 - Receiver testing
- Update the DFE-based ref RX and TX
 - Is it still good enough?
 - Significant effort required if a new FOM or model is selected



Other

- Investigate host device package model parameters
 - Assess optical module package impacts for FPP, CPO, NPO cases
- Auto-Negotiation and Link Training
 - AN73 link codeword base page is out of space
 - Link Training extensions for more/new parameters
 - What is an acceptable value for link_fail_inhibit_timer?
- Backplane objective(s) & CSD supporting material?
 - Including reach/IL targets
- Control and management interface

Summary

- 100 Gbps/lane contributions needed
 - Baseline proposal thoughts for AUIs, BP, Cu cable, MDIs, etc.
- Initial 200 Gbps/lane contributions focus areas:
 - Host physical design/architecture
 - Use cases: FPP, CPO, NPO, combo AUI/CR port, Cu cable
 - “First order” channel contributions for equalization studies

Thanks!

AUI C2M

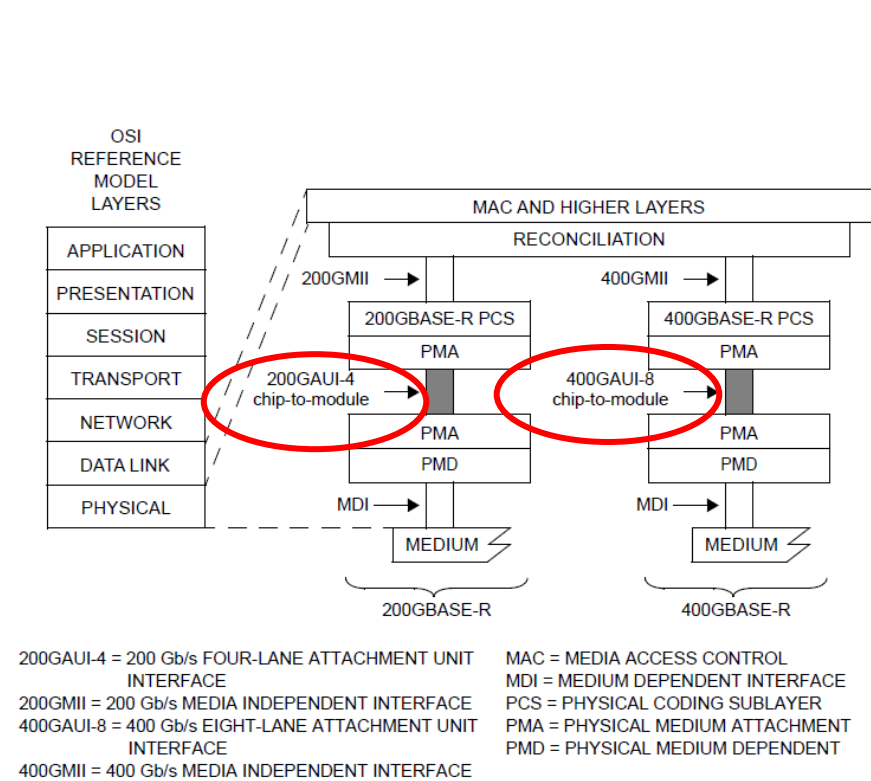
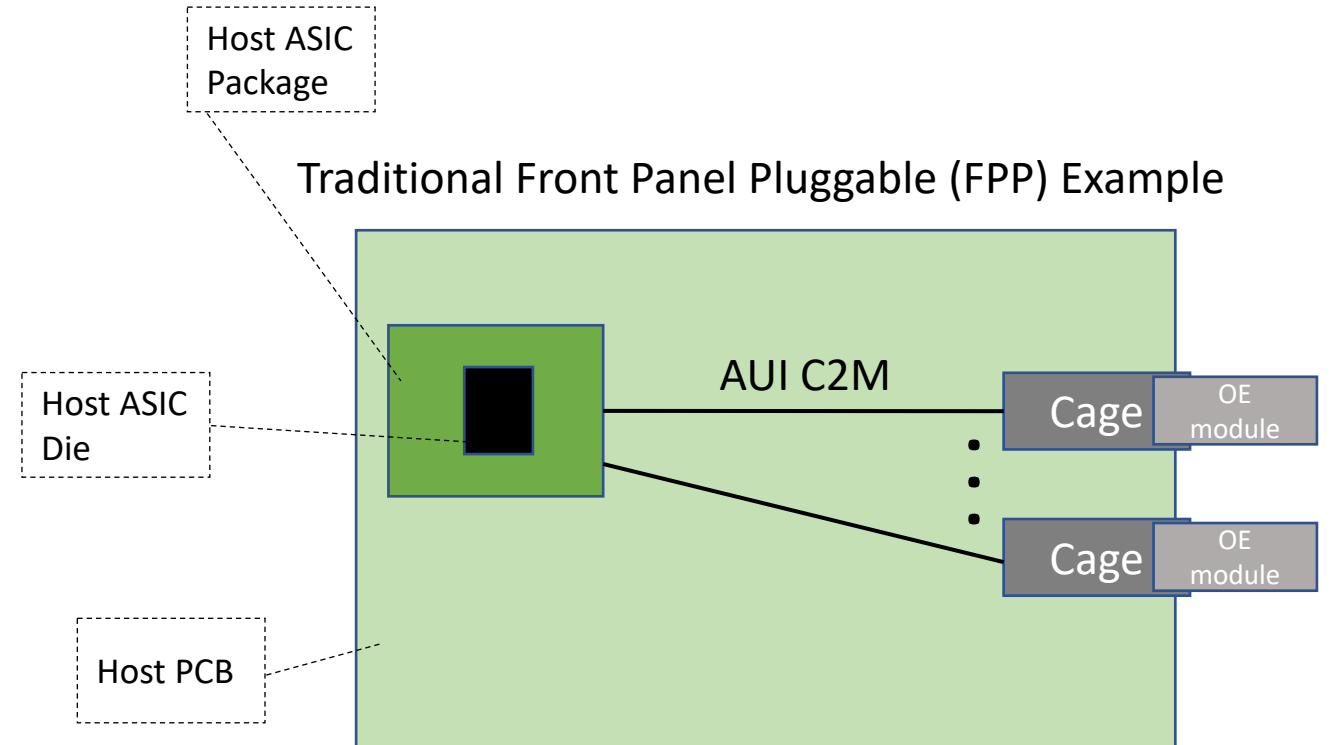


Figure 120E-1—Example 200GAUI-4 and 400GAUI-8 chip-to-module relationship to the ISO/IEC Open System Interconnection (OSI) reference model and the IEEE 802.3 Ethernet model

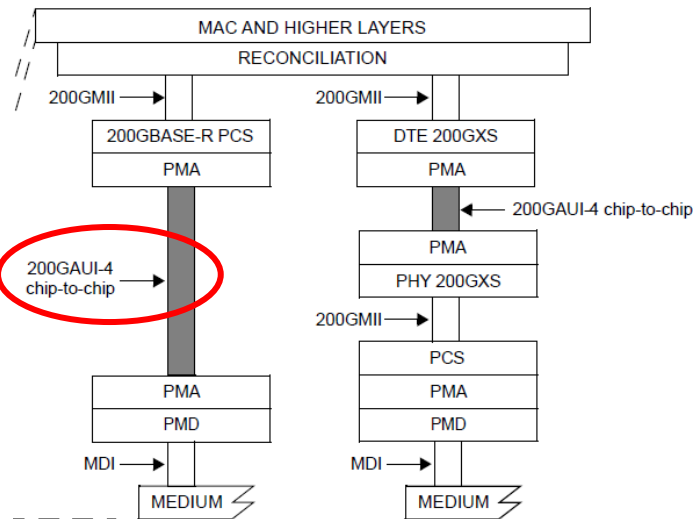
Figure above is an example architectural diagram of existing chip-to-module electrical interfaces and is not intended to represent the direction this group must take.



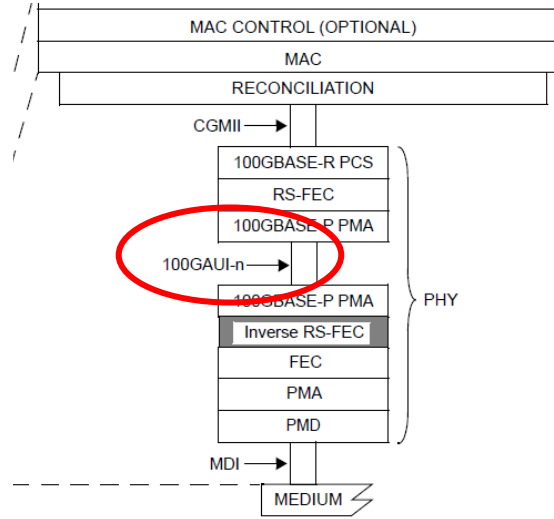
Compliance measurements are done at a separable connector

AUI C2C

Annex 120D:
Figure 120D-1



Clause 152:
Figure 152-1



Traditional Examples

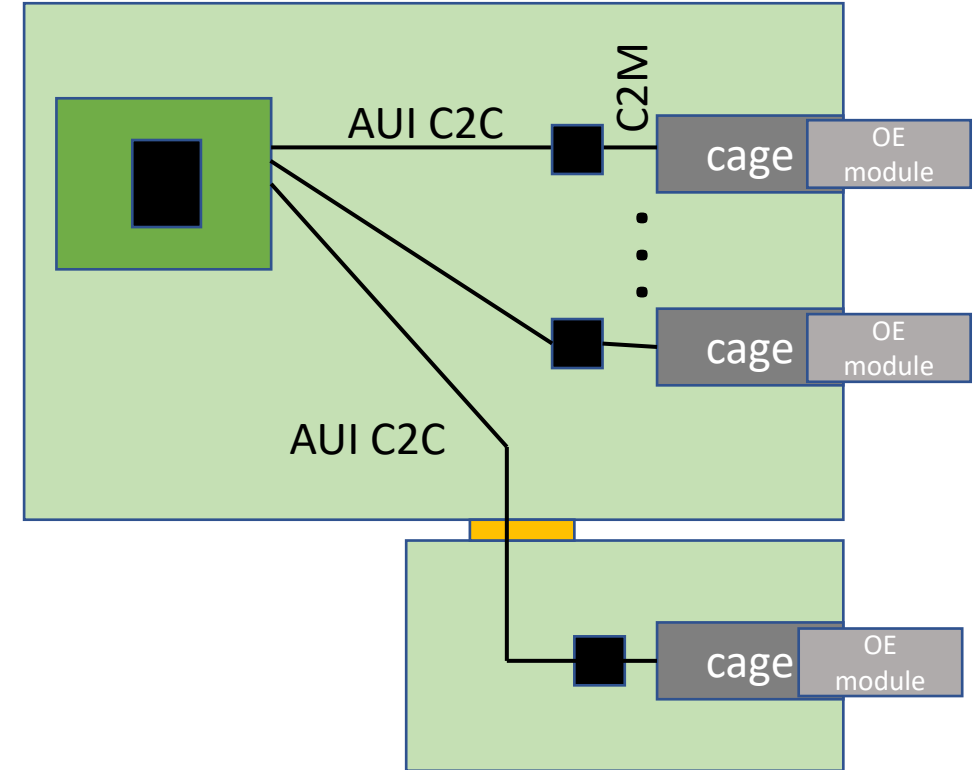


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