Proposed IEEE 802.3cz PMD, MDI and Media Baseline Text

Steve Swanson
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IEEE P802.3cz Multi-Gigabit
Optical Automotive Task Force

Supporters

John Abbott, Corning Incorporated
Rubén Pérez-Aranda, KDPOF
Fernando Barbero, KDPOF
Jose Castro, Panduit
Mabud Choudhury, OFS
Emilio Cuesta, TE
Vincent Ferretti, Corning Incorporated
Doug Harshbarger, Corning Incorporated
Bernd Horrmeyer Phoenix Contact
Roger King, TRUMPF
Erwin Koeppendoerfer, Leoni
Dave Lewis, Lumentum
Kjersti Martino, Inneos
Joseph Pankert, TRUMPF
Carlos Pardo, KDPOF
Rick Pimpinella, Panduit
Preis Roland, MD-ELECTRONIK GmbH
Luisma Torres, KDPOF
Mike Yadlowsky, Corning Incorporated
John Yurtin, Aptiv

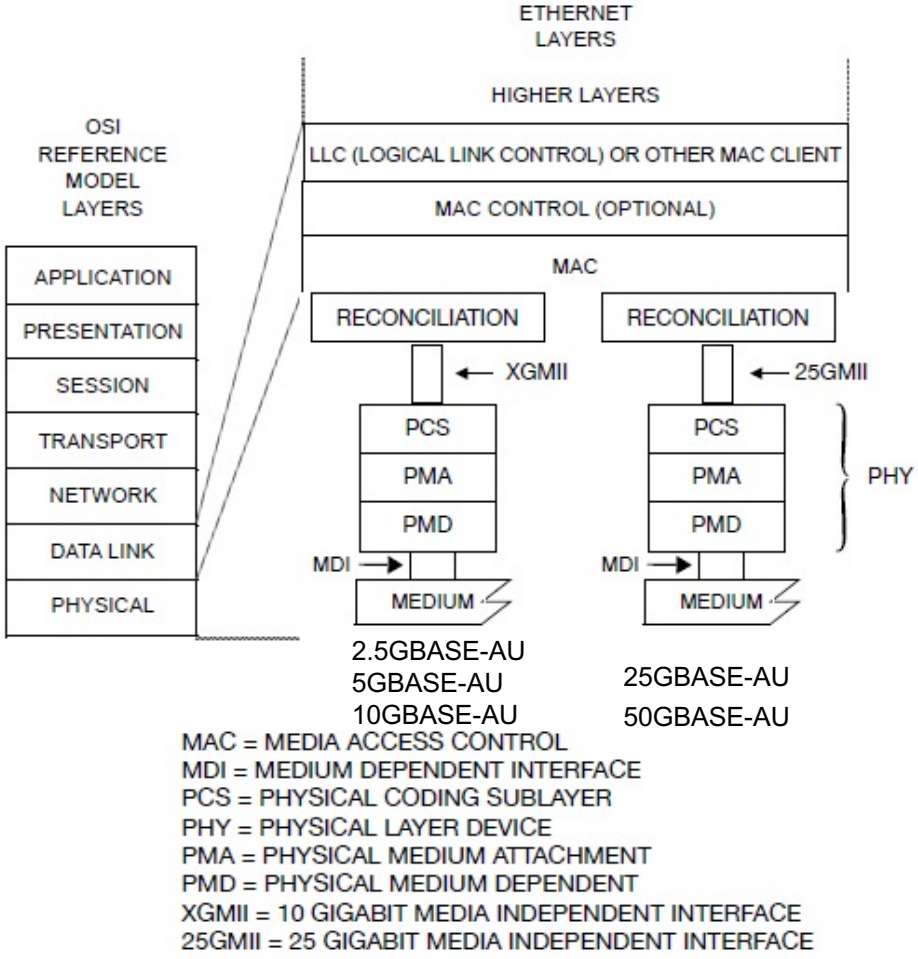
Overview

- This contribution is a baseline proposal for the **PMD and MDI** for **2.5, 5, 10, 25 and 50 Gb/s** consistent with the link budget analysis in perezaranda_3cz_01_210803_link_budget_proposal

Adopted physical layer specification objectives

- Define the performance characteristics of an automotive link segment and an optical PHY to **support 2.5 Gb/s** point-to-point operation over this link segment supporting up to **4 inline connectors for at least 40 m** on at least one type of automotive optical cabling
- Define the performance characteristics of an automotive link segment and an optical PHY to **support 5 Gb/s** point-to-point operation over this link segment supporting up **to 4 inline connectors for at least 40 m** on at least one type of automotive optical cabling
- Define the performance characteristics of an automotive link segment and an optical PHY to **support 10 Gb/s** point-to-point operation over this link segment supporting up to **4 inline connectors for at least 40 m** on at least one type of automotive optical cabling
- Define the performance characteristics of an automotive link segment and an optical PHY to **support 25 Gb/s** point-to-point operation over this link segment supporting up to **4 inline connectors for at least 40 m** on at least one type of automotive optical cabling
- Define the performance characteristics of an automotive link segment and an optical PHY to **support 50 Gb/s** point-to-point operation over this link segment supporting up to **2 inline connectors for at least 15 m** on at least one type of automotive optical cabling

Reference model



- Relationship of 802.3cz PMDs to the ISO/IEC OSI reference model and the IEEE 802.3 Ethernet Model

PMD to MDI optical specifications

166.7 PMD to MDI optical specifications for 2.5GBASE-AU, 5GBASE-AU, 10GBASE-AU and 25GBASE-AU

The operating range for the 2.5GBASE-AU, 5GBASE-AU, 10GBASE-AU, 25GBASE-AU and 50GBASE-AU PMDs is defined in Table 166–7. A compliant PMD operates on 50/125 µm multimode fibers, type A1-OM3 according to the specifications defined in Table 166–14. A PMD that exceeds the operating range requirement while meeting all other optical specifications is considered compliant (e.g., a 10GBASE-AU PMD operating at 60 m meets the operating range requirement of 0.5 m to 40 m).

Table 166-7 Operating range

PMD	Required operating range
2.5GBASE-AU 5GBASE-AU 10GBASE-AU 25GBASE-AU 50GBASE-AU	0.5- 40m

Illustrative power budget

166.7.1 Illustrative link power budget

The illustrative power budget and penalties 2.5GBASE-AU, 5GBASE-AU, 10GBASE-AU, 25GBASE-AU and 50GBASE-AU channels are shown in Table 166–10.

Table 166–10—Illustrative link power budget

Parameter	2.5G	5G	10G	25G	50G	Unit
Effective modal bandwidth			950			MHz▪km
Power budget	17.30	14.30	10.80	8.70	5.10	dB
Operating distance			40			m
Channel insertion loss [a]	10.28	10.28	10.28	8.28	4.28	dB
Allocation for penalties [b]	0.35	0.35	0.35	0.30	0.70	dB
Additional insertion loss allowed	6.67	3.67	0.17	0.12	0.12	dB

[a] The channel insertion loss is calculated using the maximum distance specified in Table 166–7 and cabled optical fiber attenuation of 2 dB/km at 980 nm plus an allocation for connection and splice loss given in 166.8.2.2.

[b] Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

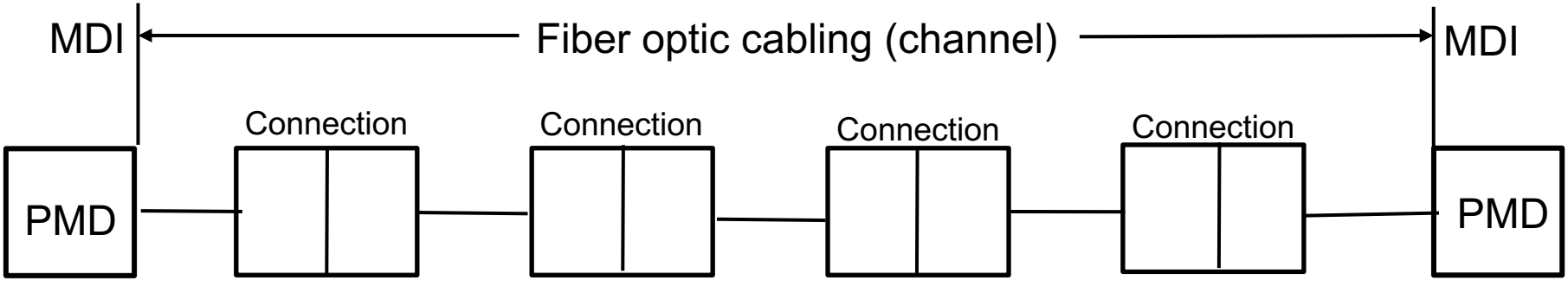
Cabling Model

166.8 Fiber optic cabling model

The fiber optic cabling (channel) contains 1 optical fiber for each direction to support 2.5GBASE-AU, 5GBASE-AU, 10GBASE-AU, 25GBASE-AU and , 50GBASE-AU, respectively. The fiber optic cabling interconnects the transmitter(s) at the MDI on one end of the channel to the receiver(s) at the MDI on the other end of the channel.

166.8.1 Fiber optic cabling model

The fiber optic cabling model is shown in Figure 166–5.



Note – The 50GBASE-AU power budget is based on 2 in-line connectors at 2.0 dB/connection. 4 in-line connections may be supported with lower loss connections.

Figure 166–5—Fiber optic cabling model

Cabling model (cont.)

The maximum channel insertion loss is given in Table 166–14. A channel may contain additional connectors as long as the optical characteristics of the channel (such as attenuation, modal dispersion, reflections and losses of all connectors and splices) meet the specifications.

Table 166-14 Channel Insertion Loss

Description	2.5G	5G	10G	25G	50G	Units
Nominal wavelength	980					nm
Operating distance (max.)	40					m
Channel insertion loss (max.)	10.28	10.28	10.28	8.28	4.28	dB

Characteristics of the fiber optic cabling

166.8.2 Characteristics of the fiber optic cabling (channel)

The fiber optic cabling shall meet the specifications defined in Table 166-14. The fiber optic cabling consists of one or more sections of fiber optic cable and any intermediate connections required to connect sections together.

166.8.2.1 Optical fiber and cable

The fiber shall meet the requirements of IEC 60793-2-10 or the requirements of Table 166-15 where they differ for fiber types A1-OM3 (50/125 µm multimode).

Table 166-15

Description	50 µm A1-OM3	Units
Nominal wavelength	980	nm
Cabled optical attenuation (max.)	2.0	dB/km
Modal bandwidth (min.)	950	MHz·km
Zero dispersion wavelength λ_0	1328	nm
Dispersion slope (max.) S_0	.093477	ps/nm^2·km

Optical fiber connection

166.8.2.2 Optical fiber connection

An optical fiber connection, as shown in Figure 166-5, consists of a mated pair of optical connectors.

166.8.2.2.1 Connection insertion loss

The insertion loss is specified for a connection, which consists of a mated pair of optical connectors.

The maximum link distances for multimode fiber are calculated based on an allocation of 4.0 dB total connection loss for 50GBASE-AU, 8.0 dB total connection loss for 25GBASE-AU operation and 10.0 dB for 10GBASE-AU, 5GBASE-AU and 2.5GBASE-AU.

For example, this allocation for 25GBASE-AU supports four connections with a maximum insertion loss equal to 2.0 dB per connection, or two connections with an insertion loss of 4.0 dB per connection.

Connections with different loss characteristics may be used provided the requirements of Table 166-14 are met.

Medium Dependent Interface (MDI) requirements

166.8.3 Medium Dependent Interface (MDI) requirements

The PMD is coupled to the fiber optic cabling at the MDI.

The MDI is the interface between the PMD and the “fiber optic cabling” (as shown in Figure 166–5).

Examples of an MDI include the following:

a) PMD with a connectorized fiber pigtail plugged into an adapter;

b) PMD receptacle

NOTE—Compliance testing is performed at TP2 and TP3 as defined in 166.5.1, not at the MDI.

CORNING

Backup

IEC 61753-1 Performance Standard

- Connector grades
  - Propose adding a new grade for Automotive
  - 3 options
    - Mean of 0.6, 97% of 1.2 (max ~1.5)
    - Mean of 0.7, 97% of 1.4 (max ~1.75)
    - Mean of 0.8, 97% of 1.6 (max ~2.0)

Table A.18 – Multi mode connectors

Optical performance criteria for multi mode connectors		
Test	**Requirement**	
Attenuation of random mated connectors IEC 61300-3-34 for single-fibre connector and IEC 61300-3-45 for multi-fibre connector (Note 1)	**Attenuation grades**	**Attenuation at 850 nm**
	Grade A_m	Not specified at this time
	Grade B_m	≤ 0,3 dB mean ≤ 0,6 dB max. for ≥ 97 % of the connections
	Grade C_m	≤ 0,5 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
	Grade D_m	Not specified at this moment
Random mated return loss: IEC 61300-3-6	**Return loss grades**	**Return loss at 850 nm**
	Grade 1_m	Not specified at this time
	Grade 2_m	≥ 20 dB (mated)