Tx Function to Rx Function AdHoc

Chris DiMinico, (MC Communications/PHY-SI LLC)

May 10, 2019

Scope

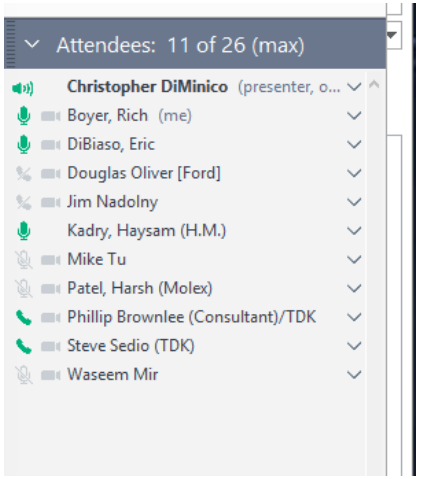
- This Ad Hoc was chartered at the April 2019 Interim with primary focus to consider Tx Function to Rx Function channel characteristics and possible refinements to the alien crosstalk specifications.

Meeting Agenda – 5-10-19

- Patent policy
- Review Minutes
- Review contributions
    - *Tx-Rx Channel Ad Hoc 5-10-19.pdf (Chris DiMinico)*

May 3 Meeting Minutes:

Attendance:



•11:22 AM EST call for patents was made and no one responded

•Review of Tx-Rx Channel Ad Hoc.pdf and discussion

Next Meeting: May 10 (action items)
++++++++++++++++++++++++++++++++++++
•Insertion diagram from TPO (TX)----TP5(RX) Objective 802.3ch topology – (Chris DiMinico)
•FR4 insertion loss – measurements, Haysam (next meeting)
•Length (4.5” max and (<1in min) TPO-TP1 (Haysam)
•MDI/ECU connector IL – Cable IL – Eric (Next Meeting)
Future: May 17 (action items)
++
•Refinements to the alien crosstalk specifications – Chris DiMinico, Eric, Thomas..
•Return loss tradeoff - Rich Mellitz, Haysam
++++++++++++++++++++++++++++++++++++

IEEE Patent Material – slide#1

Participants have a duty to inform the IEEE

- Participants shall inform the IEEE (or cause the IEEE to be informed) of the identity of each holder of any potential Essential Patent Claims of which they are personally aware if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents

- Participants should inform the IEEE (or cause the IEEE to be informed) of the identity of any other holders of potential Essential Patent Claims

Early identification of holders of potential Essential Patent Claims is encouraged

IEEE Patent Material – slide#2

Ways to inform IEEE

- Cause an LOA to be submitted to the IEEE-SA (patcom@ieee.org); or
- Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible; or
- Speak up now and respond to this Call for Potentially Essential Patents

If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance, please respond at this time by providing relevant information to the WG Chair

IEEE Patent Material – slide#3

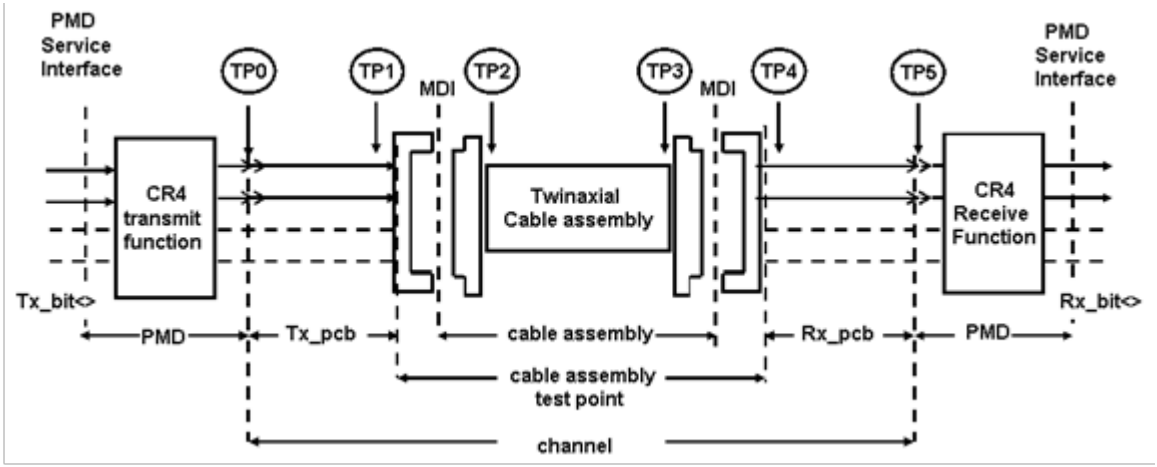
Other guidelines for IEEE WG meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - Don't discuss the interpretation, validity, or essentiality of patents/patent claims.
  - Don't discuss specific license rates, terms, or conditions.
    - Relative costs of different technical approaches that include relative costs of patent licensing terms may be discussed in standards development meetings.
      - Technical considerations remain the primary focus
  - Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.
  - Don't discuss the status or substance of ongoing or threatened litigation.
  - Don't be silent if inappropriate topics are discussed … do formally object.

For more details, see *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and *Antitrust and Competition Policy: What You Need to Know* at http://standards.ieee.org/develop/policies/antitrust.pdf

100GBASE-CR4 Channel and link Definitions

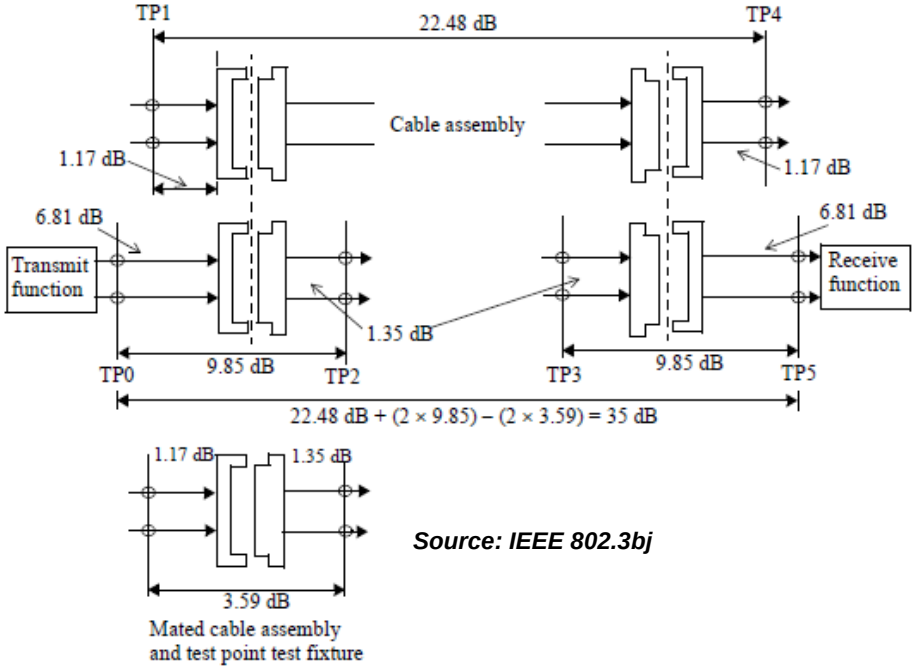
- The channel is defined between the transmitter and receiver blocks to include the transmitter and receiver differential controlled impedance printed circuit board and the cable assembly.
- The Media dependent interfaces (MDIs) refer to the connector interfaces. 100GBASE-CR4 specifies the quad small form factor pluggable (QSFP28) plug and receptacle.



100GBASE-CR4 Channel Parameters and Insertion Loss Budgets

- TP0 and TP5 may not be accessible in an implemented system
- Information (not required for conformance) of channel transmission characteristics and insertion loss budgets provided in Annex's.

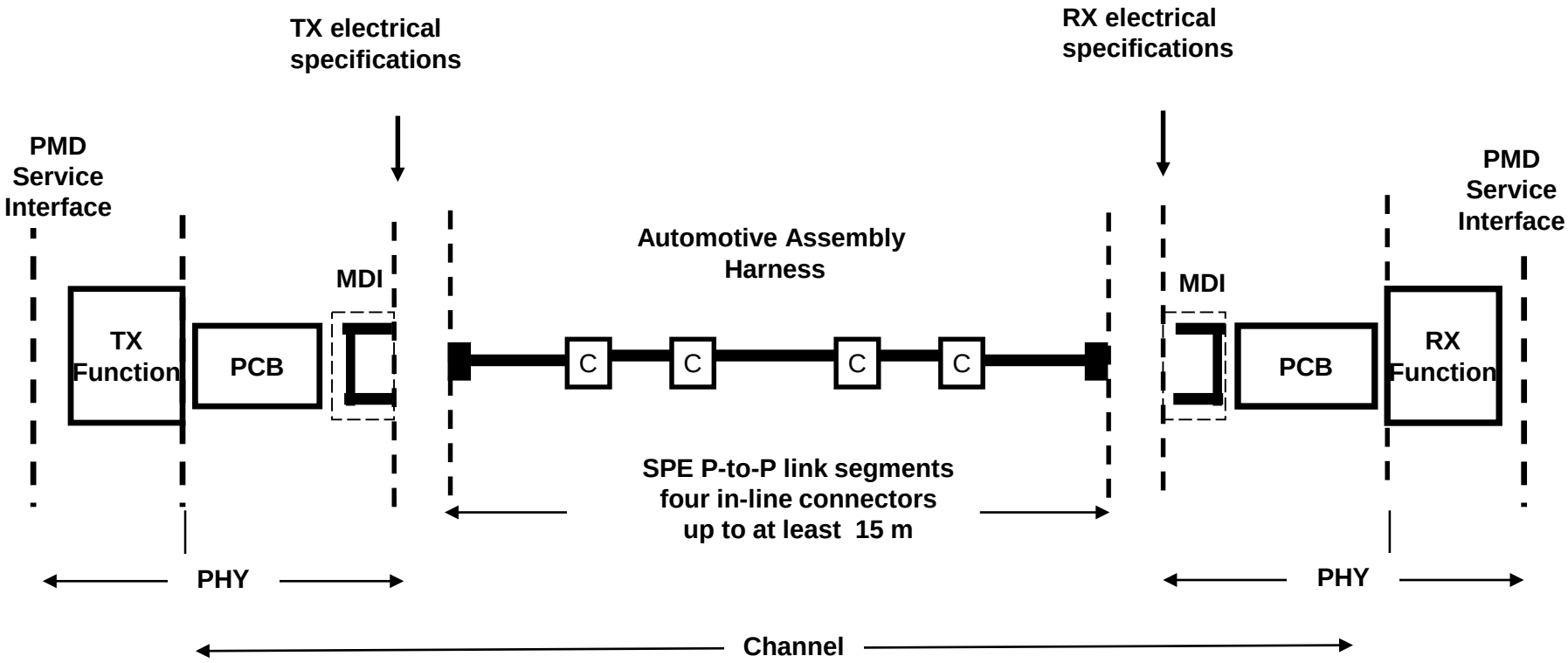
Parameter description	f(GHz)	Unit
Transmitter and receiver differential printed circuit board trace loss (host PCB insertion loss 6.81 dB @12.89 GHz)	0.05≤f≤19	**dB**
Channel Insertion Loss (6.81 dB @12.89 GHz)	0.05≤f≤19	**dB**
Maximum channel insertion Loss (35 dB @12.89 GHz)	**0.05≤f≤19**	**dB**



Source: IEEE 802.3bj

Insertion loss budget @ 12.89 GHz

Channel and link definition



Automotive Ethernet PHYs

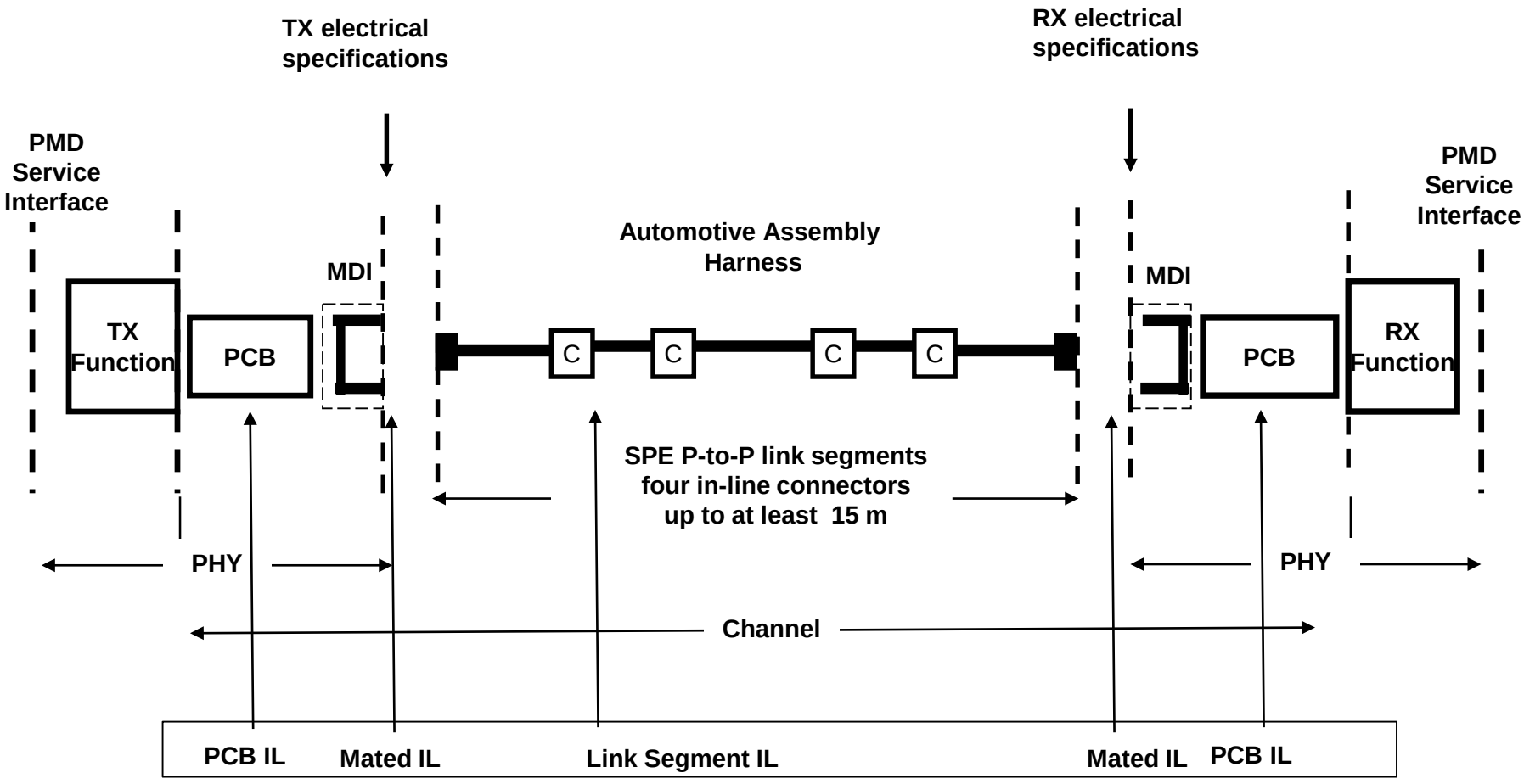
- *10M – 802.3cg*
- *100M - 802.3cw*
- *1G - 802.3bp*
- *2.5G/5G/10G - 802.3ch*

Link Segment (2.5/5/10 Gb/s) – 2.5/5/10GBASE-T1

- Link transmission parameters (up to at least 15 m)
  - Frequency range specified
    - Characteristic impedance
    - Insertion loss - 1 MHz ≤ f ≤ S*fmax MHz
    - Return loss
      - 2.5GBASE-T1 - 1 MHz ≤ f ≤ 1000 MHz
      - 5GBASE-T1 - 1 MHz ≤ f ≤ 2000 MHz – RL mag limit is specified in relationship to IL@1.5 GHz
      - 10GBASE-T1 - 1 MHz ≤ f ≤ 4000 MHz – RL mag limit is specified in relationship to IL@3 GHz
    - Coupling Attenuation - 1 MHz ≤ f ≤ 5500 MHz
    - Shielding Effectiveness - 30 MHz ≤ f ≤ S*fmax MHz
    - Maximum Link Delay - 2 MHz ≤ f ≤ S*fmax MHz

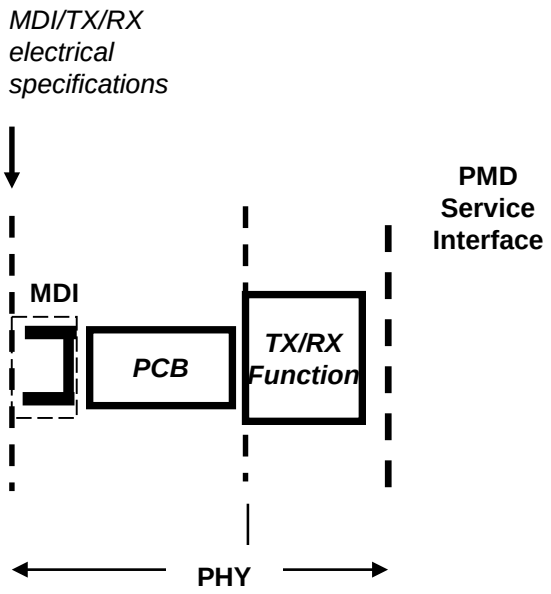
- For 2.5GBASE-T1, 5GBASE-T1, and 10GBASE-T1, the maximum applicable frequency for the Link Segments specifications is 4000 MHz × S. For 2.5GBASE-T1, S = 0.25; for 5GBASE-T1, S = 0.5; and for 10GBASE-T1, S = 1.

Insertion Loss Budgets



MDI – Medium Dependent Interface

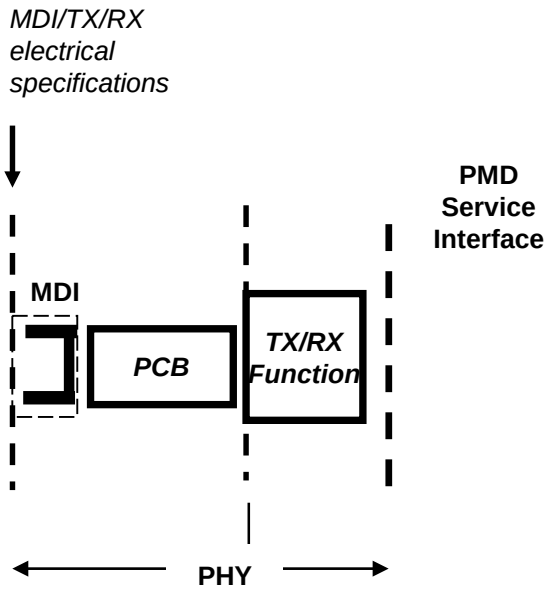
- **802.3cg 10BASE-T1S (10 Mb/s) - MDI connector**
  - **3-pin connector and optional SHIELD or alternatively a 2-pin connector with an optional additional mechanical shield connection .**
- **802.3cg 10BASE-T1L (10 Mb/s) – MDI jack connector and plug**
  - **IEC 63171-1 or IEC 61076-3-125 connectors; plug connector on cabling and MDI jack connector on the PHY.**
- **802.3bw 100BASE-T1 (100 Mb/s) - MDI connector**
  - **The mechanical interface to the balanced cabling is a 2-pin connector or 2 pins of a multi-pin connector**
- **802.3bp 1000BASE-T1 (1000 Mb/s- MDI connector type A and type B**
  - **The mechanical interface to the balanced cabling is a 2-pin connector or 2 pins of a multi-pin connector**
- **<u>802.3ch 2.5/5/10GBASE-T1 - MDI connector</u>**
  - **<u>The mechanical interface to the balanced cabling is a 2-pin connector or 2 pins of a multi-pin connector</u>**



MDI = *PHY is coupled to the cabling at the MDI.*
= MDI requirements: mechanical (to ensure complete compatibility) and electrical.

MDI – Medium Dependent Interface

- **802.3cg**
  - **10BASE-T1L - MDI connector**
    - **Return Loss 100 KHz ≤ f ≤ 20 MHz**
  - **10BASE-T1S - MDI connector**
    - **Impedance 300 KHz ≤ f ≤ 40 MHz**
- **802.3bw 100BASE-T1 - MDI connector**
  - **Return Loss 1 MHz ≤ f ≤ 66 MHz**
  - **Mode conversion 1 MHz ≤ f ≤ 200 MHz**
- **802.3bp 1000BASE-T1 - MDI connector**
  - **Return Loss 2 MHz ≤ f ≤ 600 MHz**
  - **Mode conversion 55 MHz ≤ f ≤ 600 MHz**
- **802.3ch 2.5/5/10GBASE-T1 - MDI connector**
  - **Return Loss 1 MHz ≤ f ≤ 4000 x S* MHz**
  - **MDI coupling attenuation (place holder)**



* For 2.5GBASE-T1, 5GBASE-T1, and 10GBASE-T1, the maximum applicable frequency for the MDI return loss is 4000 MHz × S. For 2.5GBASE-T1, S = 0.25; for 5GBASE-T1, S = 0.5; and for 10GBASE-T1, S = 1.

IEEE Std 802.3™-2015 - MDI

- 1.4.269 Medium Dependent Interface (MDI): The mechanical and electrical or optical interface between the transmission medium and the MAU (e.g., 10BASE-T) or the PHY (e.g., 1000BASE-T) and also between the transmission medium and any associated (optional per IEEE Std 802.3, Clause 33) Powered Device (PD) or Endpoint Power Sourcing Equipment (PSE).

- 1.1.3.2 Compatibility interfaces: The following important compatibility interfaces are defined within what is architecturally the Physical Layer.

  a) *Medium Dependent Interfaces (MDI).* To communicate in a compatible manner, all stations shall adhere rigidly to the exact specification of physical media signals defined in the appropriate clauses in this standard, and to the procedures that define correct behavior of a station. The medium-independent aspects of the LLC sublayer and the MAC sublayer should not be taken as detracting from this point; communication in an Ethernet Local Area Network requires complete compatibility at the Physical Medium interface (that is, the physical cable interface).

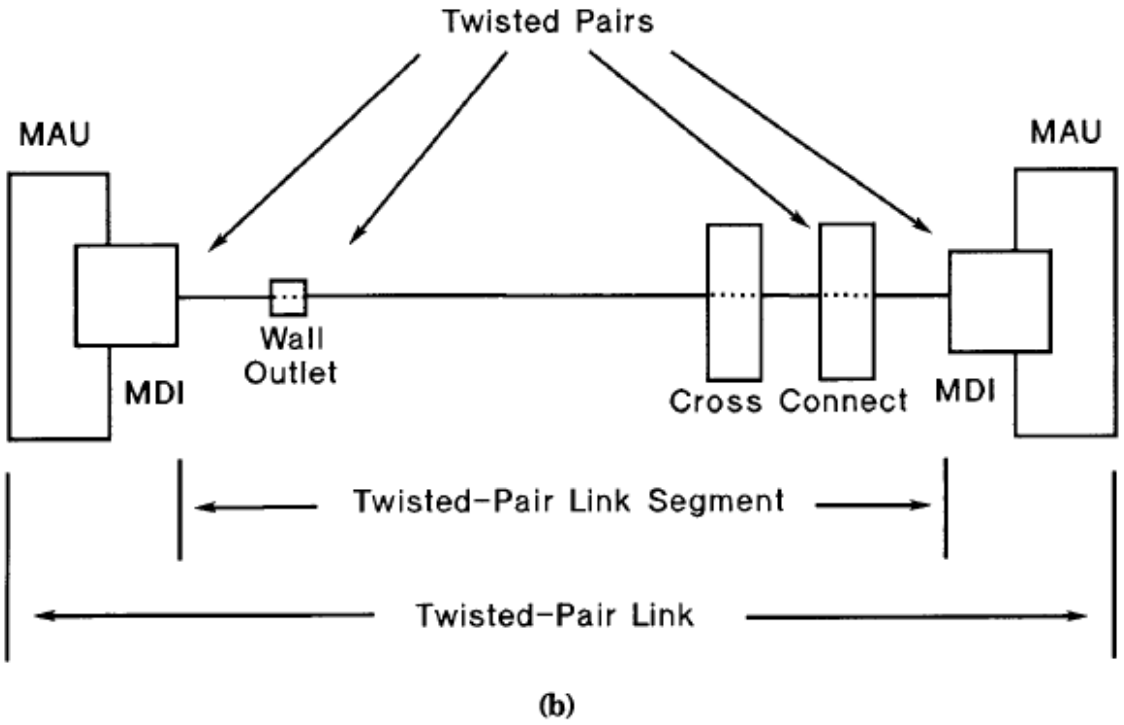
- PMD is coupled to the cabling at the MDI.

- MDI requirements: mechanical (to ensure complete compatibility) and electrical.

Link Segment

1.4.242 link segment: The point-to-point full-duplex medium connection between two and only two Medium Dependent Interfaces (MDIs).

- **Example 10BASE-T**



(b)

Figure 14–2—Twisted-pair link