

Industry Need for Higher Capacity MDI Connectors

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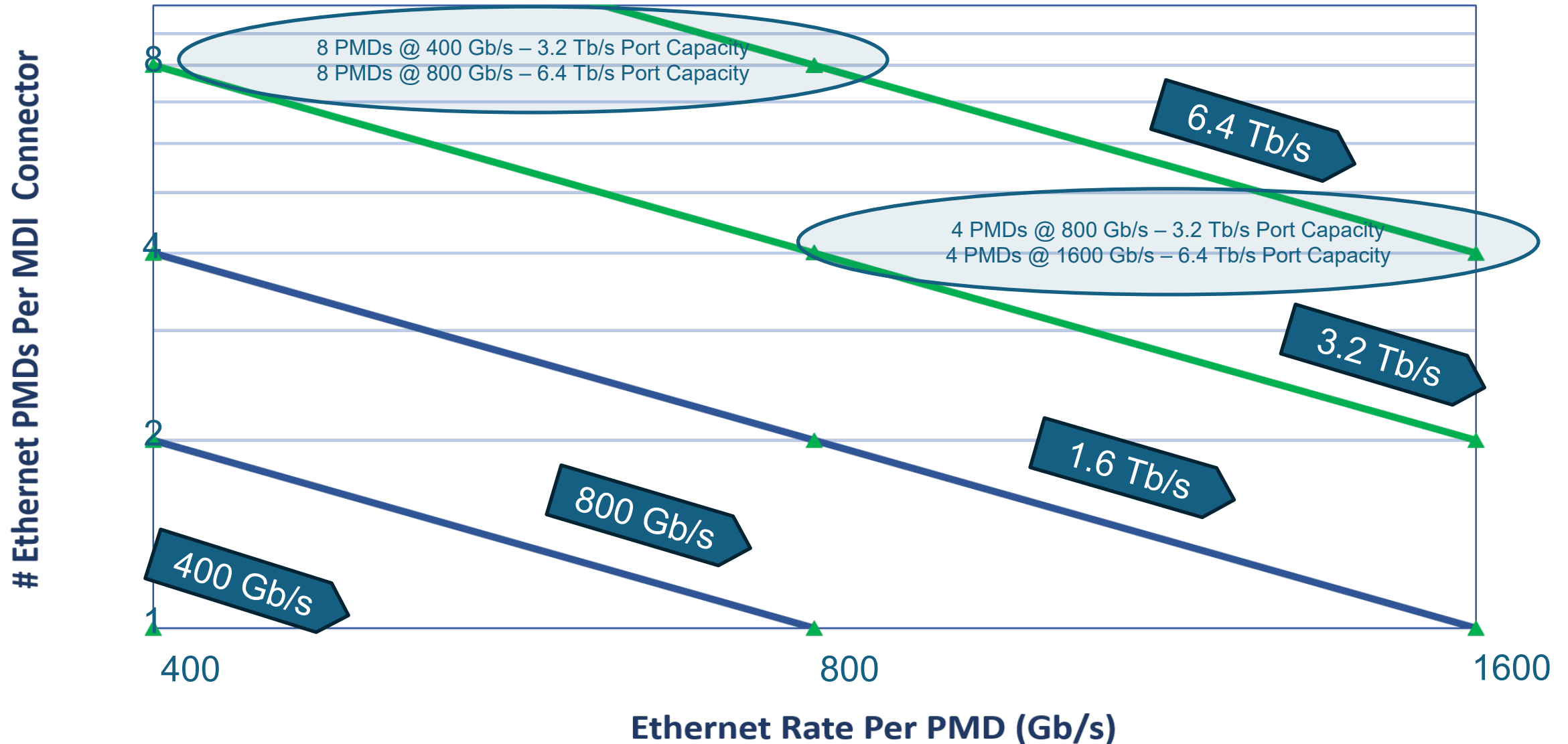
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Let's Start with Some Basic Definitions

- For today's presentation and the sake of subsequent conversations during the meeting, the following terms with the noted definitions will be used:
 - Lane - from one PMD to another across the transmission medium (e.g. optical fiber, optical wavelength, wire pair). A PMD may be made up of 1 to "n" lanes, where **the lane rate**, the effective data rate of operation not including any FEC overhead, across each lane is defined. The rate that the PMD supports is the number of lanes * the lane rate and is equivalent to the **MAC rate**.
 - PMD - Within 802.3, that portion of the Physical Layer responsible for interfacing to the transmission medium. The PMD is located just above the Medium Dependent Interface (MDI). A PMD supports a single **MAC rate**.
 - Port – In this presentation, a "port" will be the MDI Connector. In IEEE P802.3dj D3.2 there are specifications for an MDI connector that has multiple PMD instantiations
 - "Breakout" is supported
 - The port can support a maximum "**port capacity**" (which may or may not match the MAC rate of the PMDs implemented). For example, an MDI connector defined to support a maximum of 4 PMDs, each operating at a 200 GbE MAC rate, would have a maximum port capacity of 800 Gb/s.
- **For the sake of clarity, please be careful to specify what you mean.**
- The presenters recognize that subsequent standards related conversations to these definitions may be necessary at a later date.

PMD Rate vs Port Capacity per MDI Connector



Electrical PMDs– MDI Connector Capacity

Table 179C-1—Number of PMDs supportable for each connector type

MDI connector type	200GBASE-CR1	400GBASE-CR2	800GBASE-CR4	1.6TBASE-CR8	Reference
QSFP224	1, 2, 4	1, 2	1	—	179C.2.1
QSFP-DD1600	1, 2, 4, 8	1, 2, 4	1, 2	1	179C.2.2
OSFP1600	1, 2, 4, 8	1, 2, 4	1, 2	1	179C.2.3

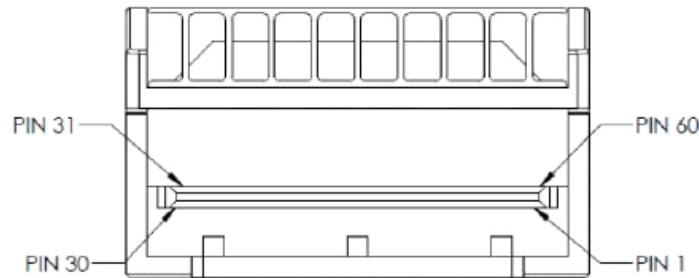


Figure 179C-5—OSFP1600 cable assembly plug

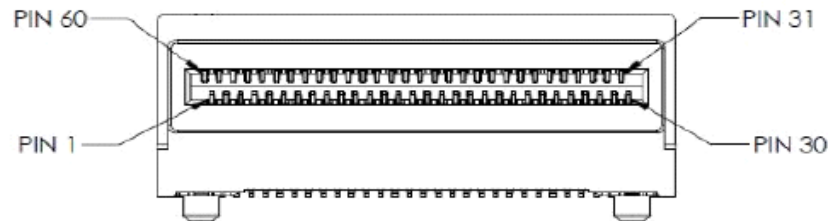


Figure 179C-6—OSFP1600 PMD receptacle

- An MDI connector can support multiple # of PMDs and different PMD types
 - Note - # in PMD suffix indicates # of lanes
- OSFP1600 (8-lane) MDI connector type supports up to 1.6 Tb/s capacity, based on combinations:
 - 200GBASE-CR1
 - 400GBASE-CR2
 - 800GBASE-CR4
 - 1.6TBASE-CR8
- An MDI connector type could be specified for multiple PMDs to achieve a higher capacity without supporting the maximum capacity as a new MAC rate (e.g. OSFP800 in 802.3ck)
- Explicit assignment of PMD signals to connector signals with common naming definitions maintains interoperability at a chassis-level
- Could leverage KR solutions defined electrically via insertion loss, return loss and crosstalk budgets across the channel plug connector

Table and figures from IEEE P802.3dj D3.2

Optical PMDs– MDI Connector Capacity

Table 180A-1—Number of PMDs supported by each MDI connector type

MDI connector type	200GBASE-DR1, 200GBASE-DR1-2	400GBASE-DR2, 400GBASE-DR2-2	800GBASE-DR4, 800GBASE-DR4-2	1.6TBASE-DR8, 1.6TBASE-DR8-2
Single-fiber connector	1	—	—	—
Single-row 12-fiber	1, 2, or 4	1 or 2	1	—
Single-row 16-fiber	1, 2, 4, or 8	1, 2, or 4	1 or 2	1

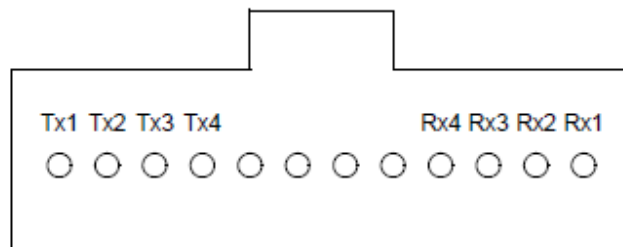


Figure 180A-2—Optical lane assignments for a single-row 12-position connector

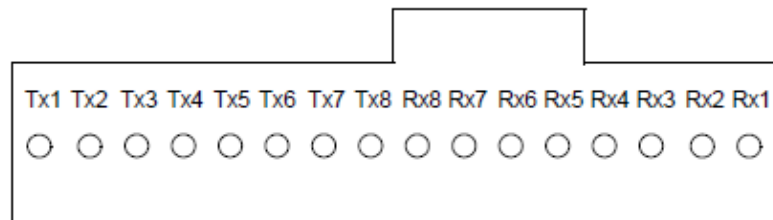


Figure 180A-3—Optical lane assignments for a single-row 16-position connector

Table and figures from IEEE P802.3dj D3.2

- An MDI connector can support multiple # of PMDs and different PMD types
 - Note - # in PMD suffix indicates # of lanes
- Single-row 12 fiber MDI connector type supports up to 800 Gb/s capacity, based on combinations:
 - 200GBASE-DR1 / DR1-2
 - 400GBASE-DR2 / DR2-2
 - 800GBASE-DR4 / DR4-2
- Single-row 16 fiber MDI connector type supports up to 1.6 Tb/s capacity, based on combinations:
 - 200GBASE-DR1 / DR1-2
 - 400GBASE-DR2 / DR2-2
 - 800GBASE-DR4 / DR4-2
 - 1.6TBASE-DR8 / DR8-2
- An MDI connector type could be specified for multiple PMDs to achieve a higher capacity without supporting the maximum capacity as a new MAC rate
- Could leverage FR / LR1 / ER1 / ER1-20 solutions per fiber, as well as DR solutions

12 Position Optical Connector

1.6Tb/s Port Capacity based on 400 Gb/s/lane

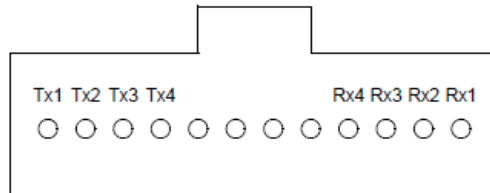


Figure 180A-2—Optical lane assignments for a single-row 12-position connector

1.6 Tb/s (Full Duplex) Capacity

4 Ports – 400GBASE-xR1
2 Ports – 800GBASE-xR2
1 Ports - 1.6TBASE-xR4

In this instance, the MDI connector capacity equals the Max Ethernet Rate supported @ time of specification (1.6 TbE)

400GBASE-DR1	800GBASE-DR2	1.6TBASE-DR4	Connector Position
0:SL0	0:SL0	0:SL0	Tx1
1:SL0	0:SL1	0:SL1	Tx2
2:SL0	1:SL0	0:SL2	Tx3
3:SL0	1:SL1	0:SL3	Tx4
0:DL0	0:DL0	0:DL0	Rx1
1:DL1	0:DL1	0:DL1	Rx2
2:DL0	1:DL0	0:DL2	Rx3
3:DL0	1:DL1	0:DL3	Rx4

16 Position Optical Connector

1.6Tb/s Port Capacity based on 400 Gb/s/lane

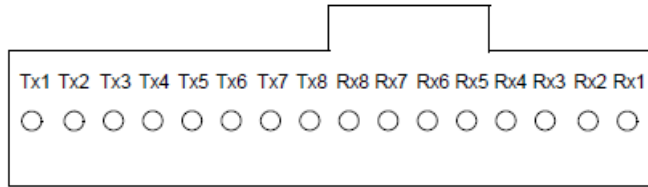


Figure 180A-3—Optical lane assignments for a single-row 16-position connector

3.2 Tb/s (Full Duplex) Capacity

8 Ports – 400GBASE-xR1

4 Ports – 800GBASE-xR2

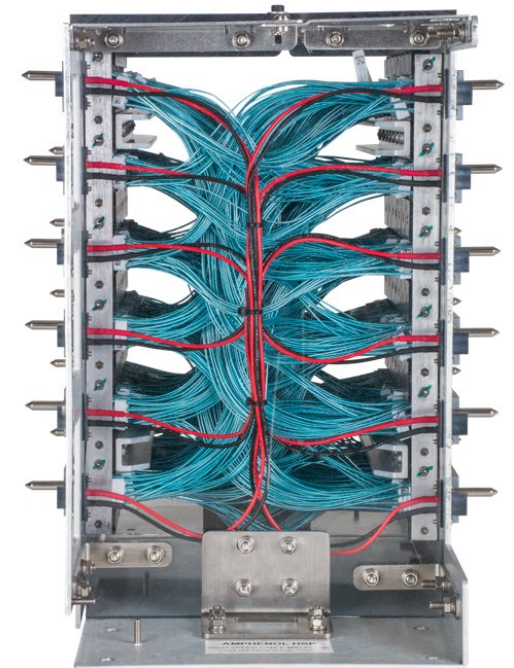
2 Ports - 1.6TBASE-xR4

In this instance, the MDI connector (Port) capacity > Max Ethernet Rate supported

400GBASE-DR1	800GBASE-DR2	1.6TBASE-DR4	Connector Position
0:SL0	0:SL0	0:SL0	Tx1
1:SL0	0:SL1	0:SL1	Tx2
2:SL0	1:SL0	0:SL2	Tx3
3:SL0	1:SL1	0:SL3	Tx4
4:SL0	2:SL0	1:SL0	Tx5
5:SL0	2:SL1	1:SL1	Tx6
6:SL0	3:SL0	1:SL2	Tx7
7:SL0	3:SL1	1:SL3	Tx8
0:DL0	0:DL0	0:DL0	Rx1
1:DL1	0:DL1	0:DL1	Rx2
2:DL0	1:DL0	0:DL2	Rx3
3:DL0	1:DL1	0:DL3	Rx4
4:DL0	2:DL0	1:DL0	Rx5
5:DL0	2:DL1	1:DL1	Rx6
6:DL0	3:DL0	1:DL2	Rx7
7:DL0	3:DL1	1:DL3	Rx8

Industry Trend

- Higher Port Capacity Solutions being introduced
 - Example XPO MSA (<https://xpomsa.com/>)
 - 12.8T XPO (32 x 400GbE / 16 x 800GbE / 8 x 1.6TbE)
 - 25.6T XPO (64 x 400GbE / 32 x 800GbE / 16 x 1.6TbE)
 - Intra-rack copper cabling via backplane cartridges aggregates multiple copper links pushes per-slot capacity beyond what discrete pluggable modules can support
- Further innovation anticipated!
 - New approaches, new MSAs, new optical connectors, etc
- Maximize Port Capacity!!!



Defining the MDI Connector

- MDI Normative references have been dependent to other organizations' connector specifications (physical specification, pinout, etc)
- Future Normative specification approach
 - Electrical MDI connectors
 - Electrical performance requirements
 - Generic pinout grouping
 - Optical MDI connectors
 - Optical performance requirements
 - Generic fiber-position (including polarity) groupings
- Propose pinout / fiber-position groupings of 1, 2, 4, & 8
- Maximum capacity to be discussed

Looking Ahead

- Innovation is underway and will rapidly change things in the coming years
- IEEE 802.3 needs to embrace the trend of maximizing port capacity going forward
- An Ethernet rate to support the maximum capacity is not necessary
- Consistent terminology needed