Clause 86 MDI Optical Pin Layout and Connector

Paul Kolesar, CommScope
Sharon Lutz, USConec

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Outline

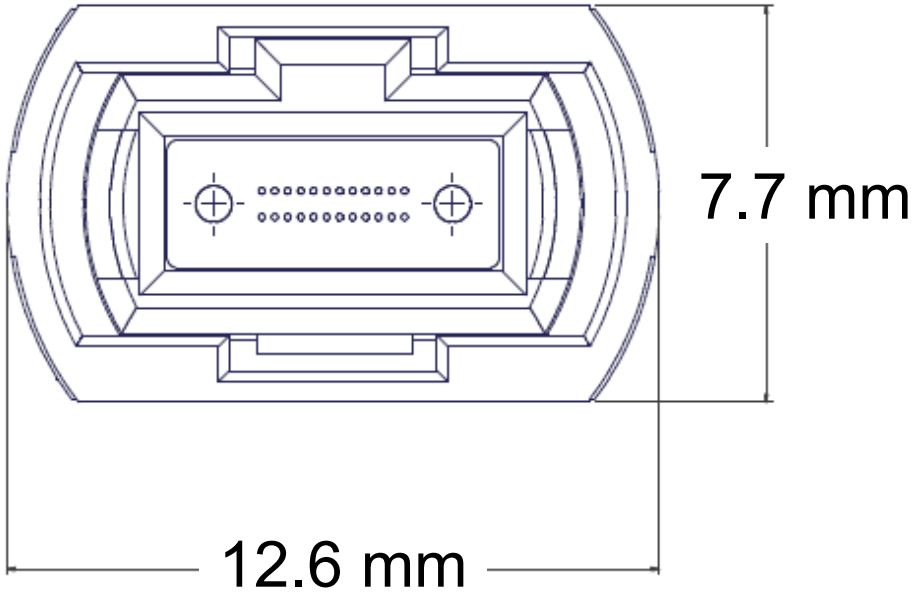
- MPO connector standards
- MDI Pin Layout
- Cabling Polarity Compatibility
- Rationale for Choosing an MDI Connector
- Proposed Content for Clause 86.5.1
- Proposed Content for Clause 86.5.2
- Proposed Content for Clause 86.10.2.3

MPO Intermateability Standardization

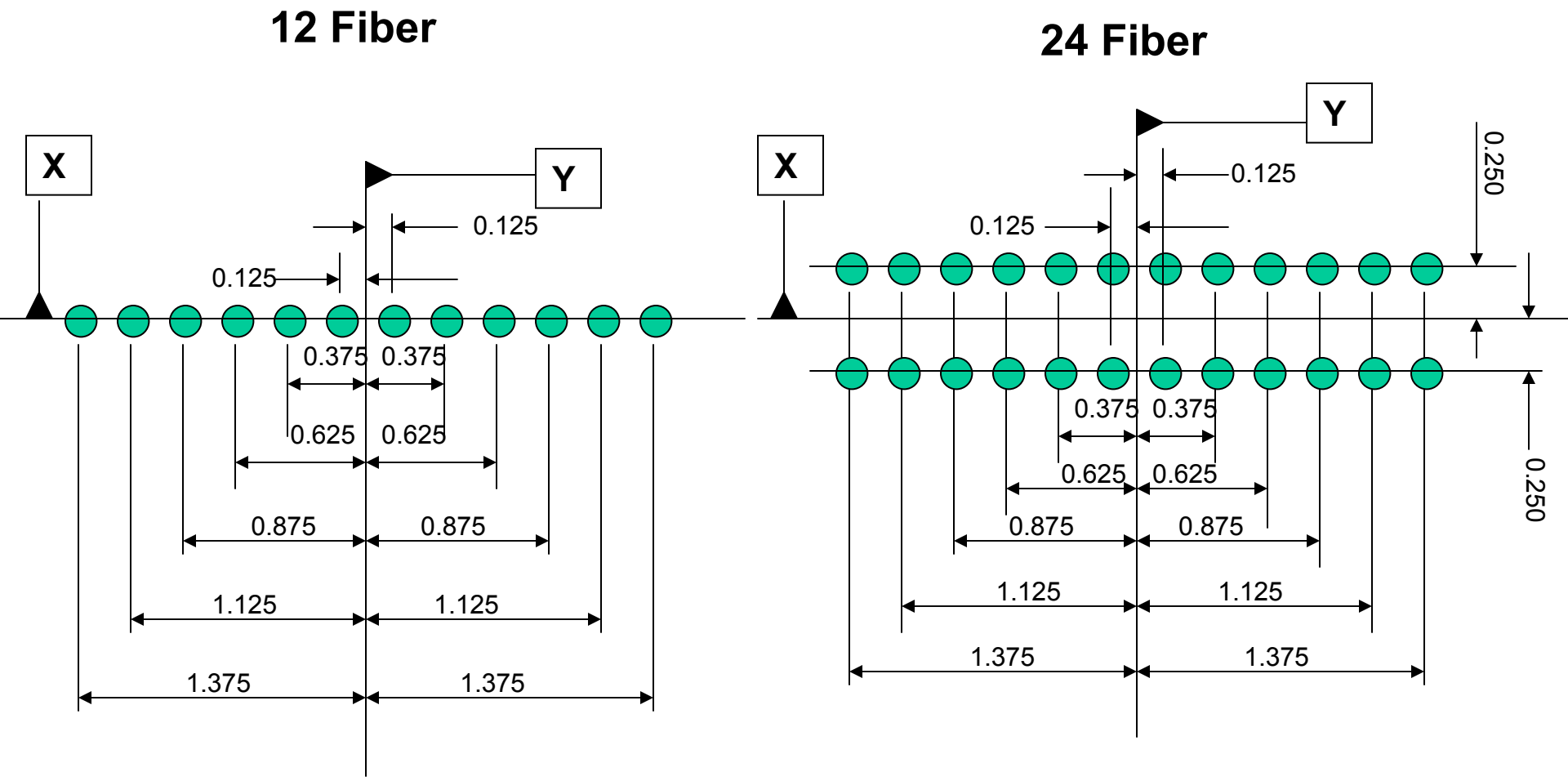
- IEC 61754-7
  - Within 61754-7, both 12- and 24-fiber variants of the MPO are standardized.
  - Fiber hole and required interface dimensions are defined
  - Guide pin & guide pin hole dimensions standardized for SM & MM

- TIA 604-5-D (FOCIS 5)
  - Harmonized with IEC intermateability requirements for 12- and 24-fiber MPOs.
  - Defines up to 72-fiber in standard MPO footprint

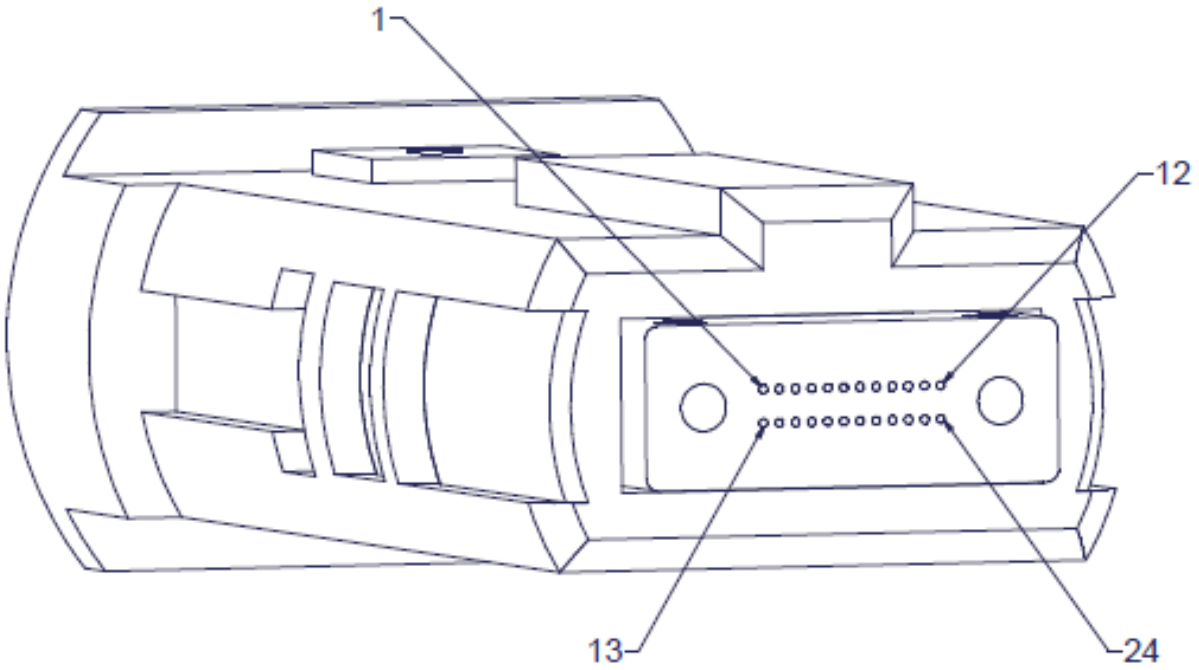
MPO Outer Housing Dimensions



IEC fiber hole location standardization



MPO Position Definition per TIA 604-5-D



MT Optical Interface Standardization

- IEC PAS 61755-3-31 & IEC 61755-3-32
  - Axial alignment, angular alignment, endface geometry dimensional requirements for SM physical contact MT to MT connections.
    - MM Optical Interface documents initiated in IEC SC86B, WG6

MPO Structured Cabling Standardization

- ISO/IEC 24764 (Data Centre Cabling)
  - Defines MPO as normative connector for interfaces with > 2 fibers
- TIA-568-C.0 & 568-C.3 / TIA-568-B.1-7
  - Define Array Cabling Polarity methods and components for duplex and parallel links in structured cabling
  - MPO is exemplary array connector

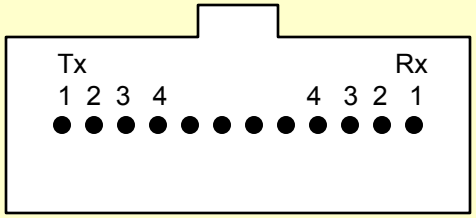
MDI Pin Layout

- Definition required to ensure interoperability
  - Parallel optics introduce more degrees of freedom that must be constrained for interoperable connectivity
- Optimal pin layout will be compatible with structured cabling
  - The same array polarity in cabling systems should support all array applications
    - without modification of permanent link cabling
    - with common patch cords
      - Implies common connector
- Begin by examining existing array applications

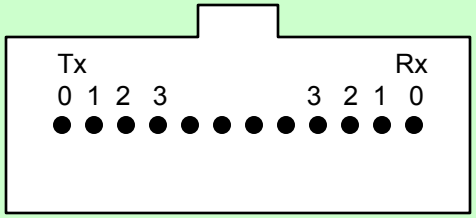
Existing 4-Lane Variants

All looking into the MDI receptacle with the keyway on top

QSFP MSA



POP4 MSA
InfiniBand 4x
OIF VSR4-03
10GFC



All specify
- 4 transmitters on left side
- 4 receivers on right side
- 4 unused positions in center

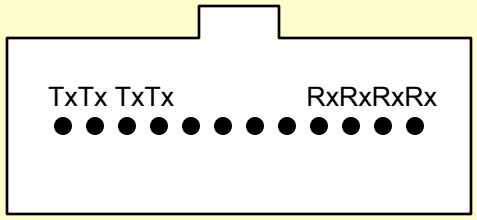
All specify the MPO connector
- Male (pinned) in MDI receptacle
- Female (unpinned) on patch cord

All require the same array cabling polarity that transposes signals laterally about a vertical center line

Differ in designation nomenclature
- Numbering starts from 0 or 1

40GBASE-SR4 Proposal

Looking into the MDI receptacle with the keyway on top



40GBASE-SR4

Follow common themes of existing 4-lane variants

Specify
- 4 transmitters on left side
- 4 receivers on right side
- 4 unused positions in center

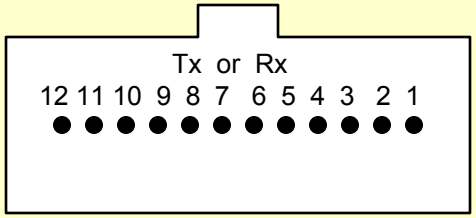
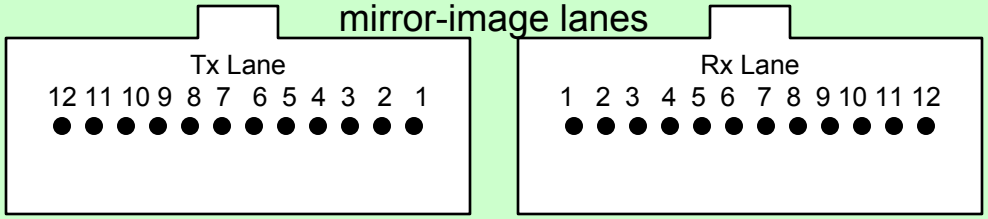
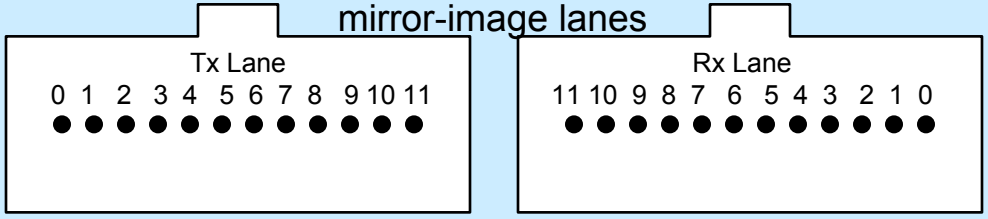
Specify the MPO connector
- Male (pinned) in MDI receptacle
- Female (unpinned) on patch cord

Requires same array cabling polarity as all existing 4-lane variants that transposes signals laterally

P802.3ba lane striping protocol sorts lanes at receiver
- no need to assign lane numbers, but
- assignment may be desirable for diagnostic or other purposes

Existing 12-Lane Variants

All looking into the MDI receptacle with the keyway on top

SNAP12 MSA OIF VSR4-01 OIF VSR5-01		Unspecified position of ➢ Tx relative to Rx module ➢ lanes in OIF, but handles reversals
HIPPI-6400		Unspecified Tx to Rx module position
IBpak InfiniBand 12x		Specifies module position: Tx on left, Rx on right

All specify
- Separate Tx and Rx connectors
- 12 lanes each, none unused

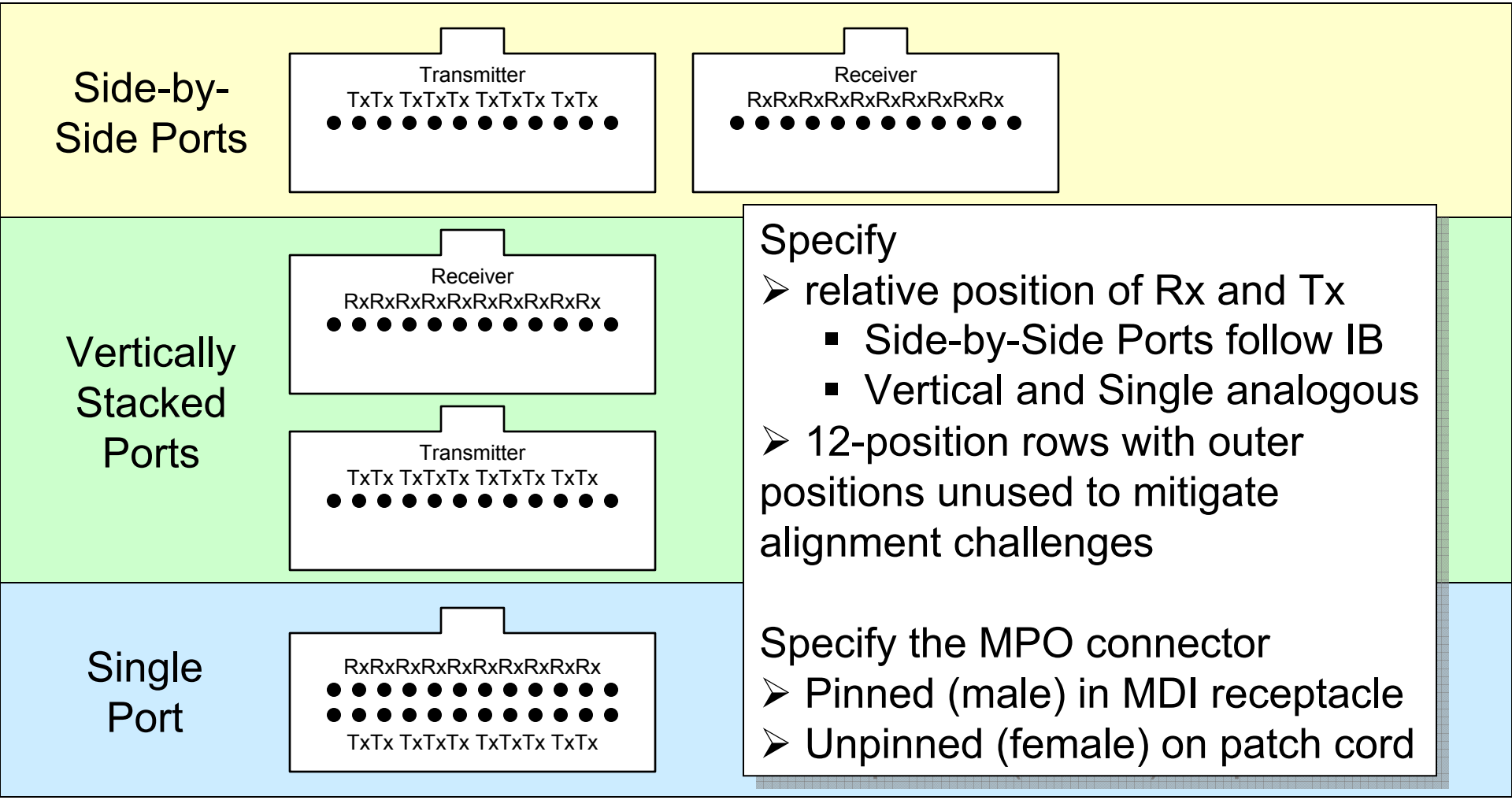
All apps can use array cabling polarity that transposes signals laterally; required by HIPPI and IB.

All specify the MPO connector
- Male (pinned) in MDI receptacle
- Female (unpinned) on patch cord

Differ in designation nomenclature
- Numbering starts from 0 or 1
- Start position varies (left or right)

100GBASE-SR10 Proposal

Three variants, all looking into the MDI receptacle with the keyway on top



Specify
- relative position of Rx and Tx
  - Side-by-Side Ports follow IB
  - Vertical and Single analogous
- 12-position rows with outer positions unused to mitigate alignment challenges

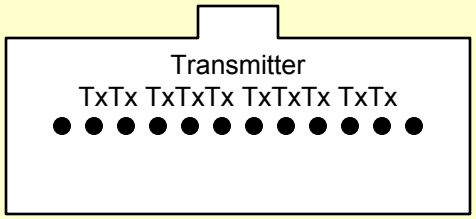
Specify the MPO connector
- Pinned (male) in MDI receptacle
- Unpinned (female) on patch cord

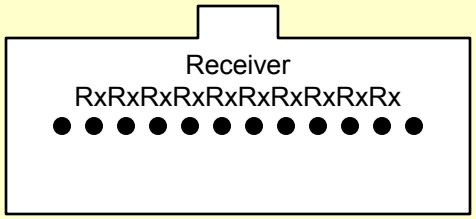
All variants can use the same 12-fiber array cabling polarity, required by HIPPI and IB, that transposes signals laterally, because lane striping sorts lanes. See examples in later slide.

100GBASE-SR10 Proposal

Why 3 different configurations?

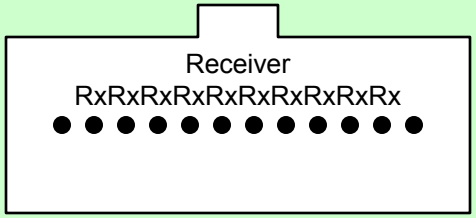
Side-by-Side Ports

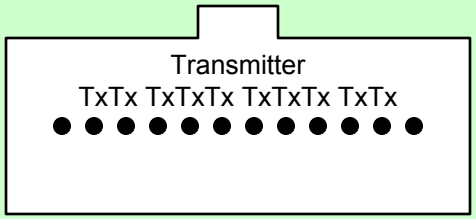




- Incumbent method
- SNAP12, IBpak
- CFP compatible

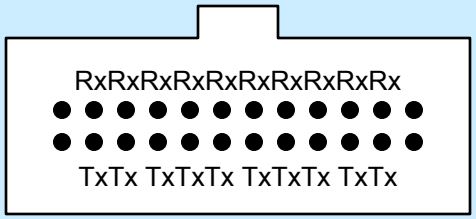
Vertically Stacked Ports





- Single-width linear pitch
- Compatible with traditional 12-fiber array patch cords
- High-density switch ports

Single Port

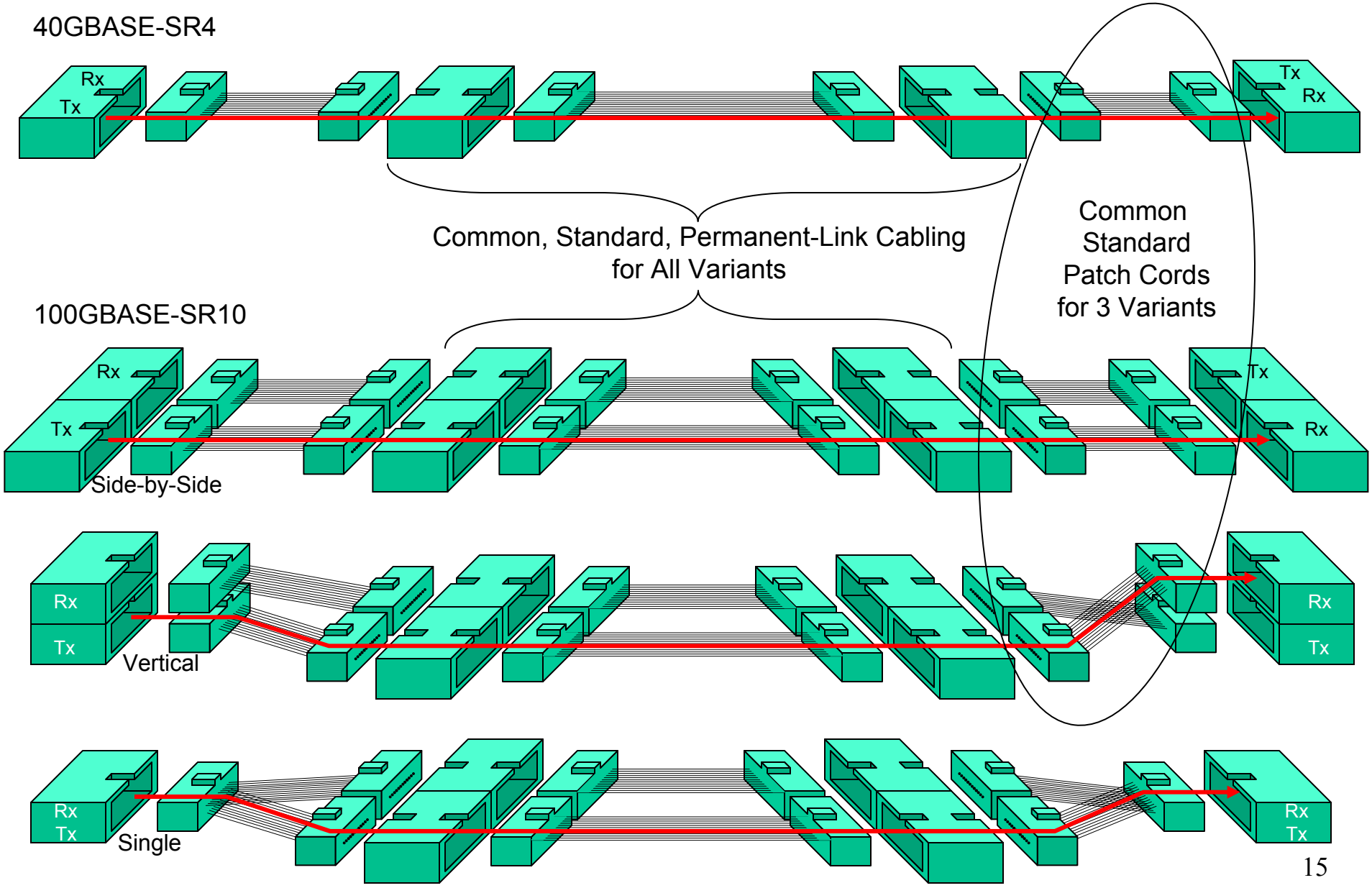


- Most compact
- CXP MSA compatible

These represent all the likely variants that may be used, and therefore collectively cover interoperability scenarios

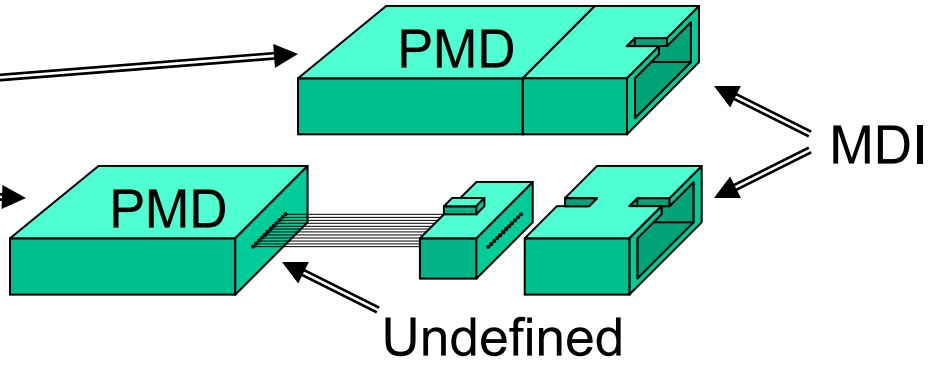
Polarity Examples Using TIA-568 Method B

Other polarity methods could also support these variants



Why choose an array connector at the MDI?

- Per clause 86.10.2.3, behind the MDI may be a
  - receptacled PMD
  - pigtailed PMD
- Selecting MDI connector does not restrict pigtail attachment to PMD
  - Open to innovation
- Choosing an MDI connector removes ambiguity
  - Assists in defining signal locations
  - Provides end-users with guidance for
    - cabling installation
    - patch cord selection



Why choose the MPO as the array connector?

- All known array applications have chosen the MPO
  - OIF VSR4-03, OIF VSR4-01, OIF VSR5-01,
  - InfiniBand 4x, InfiniBand 8x, InfiniBand 12x
  - INCITS 10GFC, INCITS HIPPI-6400
- All known parallel optic MSAs have chosen the MPO
  - QSFP, POP4, SNAP12, IBpak
- Fully standardized component in TIA and IEC
  - TIA FOCIS 5, IEC 61754-7
- Chosen by structured cabling standards
  - Exemplary array connector in TIA-568 (Generic Cabling)
  - The only array connector in draft ISO 24764 (Data Centre)
- Widely available from many cabling vendors
  - The array connector of virtually all vendors
  - MTP® is a brand of MPO

Content for Clause 86.5.1

86.5.1 Optical lane assignments for 40GBASE-SR4

The four transmit and four receive optical lanes of 40GBASE-SR4 shall occupy the positions depicted in Figure 86-3 when looking into the MDI receptacle with the connector keyway feature on top. The interface contains eight active lanes within 12 total positions. The transmit optical lanes occupy the leftmost four positions. The receive optical lanes occupy the rightmost four positions. The four center positions are unused. See 86.10.2.3 for MDI optical connector requirements.

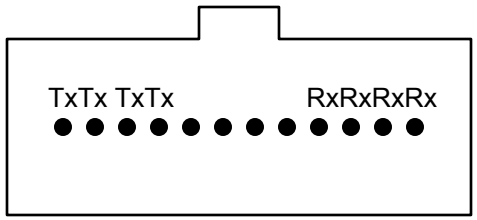


Figure 86-3 -- 40GBASE-SR4 optical lane assignments when viewed looking into the MDI receptacle with keyway feature on top.

Content for Clause 86.5.2 (1 of 4)

86.5.2 Optical lane assignments for 100GBASE-SR10

The ten transmit and ten receive optical lanes of 100GBASE-SR10 shall occupy the positions depicted in Figure 86-4a, or Figure 86-4b, or Figure 86-4c when looking into the MDI optical receptacle(s) with the connector keyway feature(s) on top. The interface contains 20 active lanes within up to 24 total positions arranged in two rows of at least 10 or 12 positions. One row is dedicated to transmit optical lanes and the other row to receive optical lanes. For the depicted 12-position rows, the optical signal lanes occupy the center ten positions of each row with the outermost positions unused. See 86.10.2.3 for MDI optical connector requirements.

Content for Clause 86.5.2 (2 of 4)

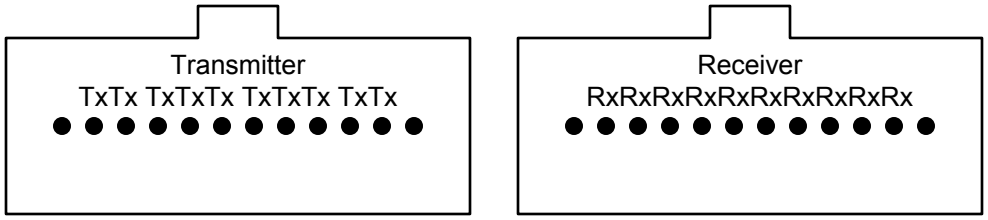


Figure 86-4a – 100GBASE-SR10 optical lane assignments for side-by-side MDI receptacles when viewed looking into the receptacles with keyway features on top. Transmitter is on the left and receiver on the right.

Content for Clause 86.5.2 (3 of 4)

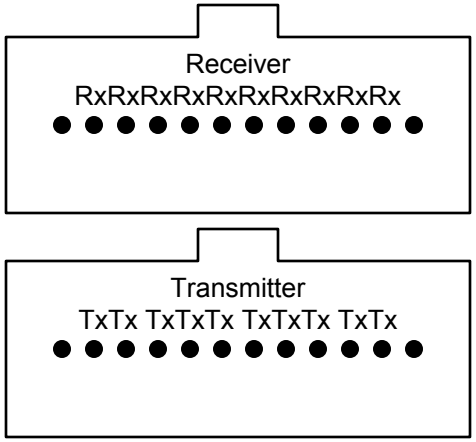


Figure 86-4b – 100GBASE-SR10 optical lane assignments for vertically stacked MDI receptacles when viewed looking into the receptacles with keyway features on top. Receiver is on the top and transmitter on the bottom.

Content for Clause 86.5.2 (4 of 4)

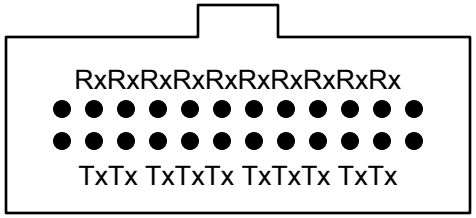


Figure 86-4c – 100GBASE-SR10 optical lane assignments for single MDI receptacle when viewed looking into the receptacle with keyway feature on top. Transmitter occupies the bottom row and receiver the top row.

Content for Clause 86.10.2.3 (1 of 2)

86.10.2.3 Medium Dependent Interface (MDI) requirements

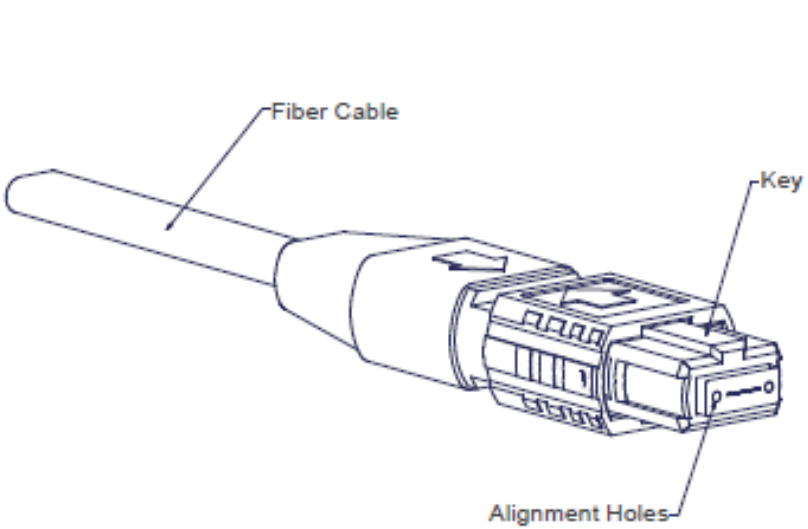
The MDI is the interface between the PMD and the "fiber optic cabling" (as shown in Figure 86–7). The 40GBASE–SR4 PMD is coupled to the fiber optic cabling through one connector plug into the MDI optical receptacle. The 100GBASE–SR10 PMD is coupled to the fiber optic cabling through one or two connector plugs into the MDI optical receptacle(s), depending on choice of implementation, as shown in Figures 86-4a, 86-4b, and 86-4c. Example constructions of the MDI include the following:

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

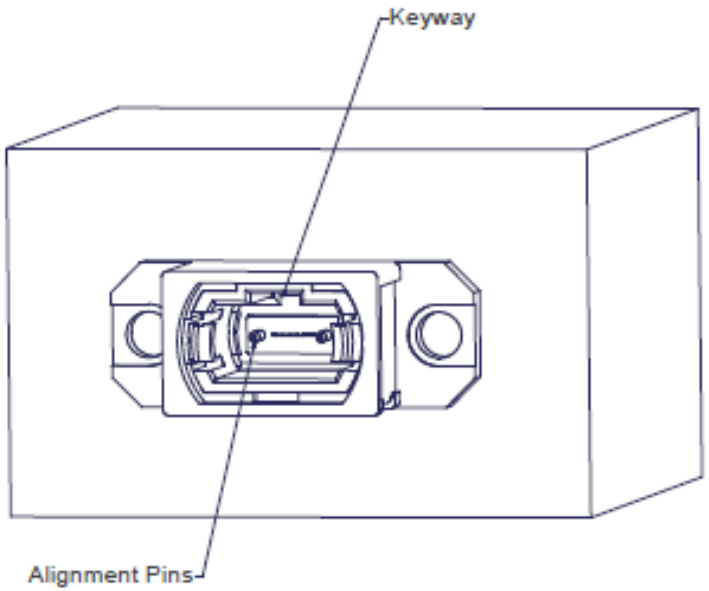
The MDI adapter or receptacle shall meet the dimensional specifications of IEC 61754-7 interface 7-3, the MPO adapter interface. The plug terminating the optical fiber cabling shall meet the dimensional specifications of IEC 61754-7 interface 7-4, MPO female plug connector flat interface. The MDI shall optically mate with the plug on the optical fiber cabling. See Figure 86-XX. The MDI connection shall meet the interface performance specifications of IEC 61753-1-1 and IEC 61753-022-2.

NOTE—Compliance testing is performed at TP2 and TP3 as defined in 86.4.1, not at the MDI.

Content for Clause 86.10.2.3 (2 of 2)



MPO female plug connector flat interface



MDI as a PMD receptacle
meeting MPO adapter interface

Figure 86-XX – MPO female plug connector flat interface and MDI as a PMD receptacle using MPO adapter interface.