

# 400GBASE-SR16 Cabling

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IEEE P802.3bs  
September 2014

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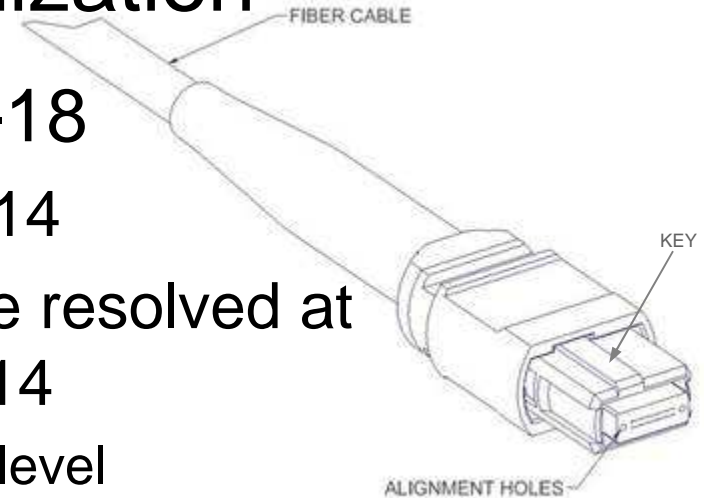
# Outline

- Cabling standardization update
- MDI lane assignment proposal
- Compatibility with structured cabling
- Rationale for choosing an MDI connector
- Proposed content for clause xx.m.n\*

\* Using xx for 400GBASE-SR16 clause number

# MPO-16 Standardization

- TIA TR-42 draft ANSI/TIA-604-18
  - First ballot completed in June 2014
  - Comments on second ballot to be resolved at TR-42.13 meeting in October 2014
    - Second ballot advanced to national level
  - Defines 16-fiber (1-row) and 32-fiber (2-row) plugs with flat end-faces only, and adapter
  - Keyed differently than MPO to prevent accidental mating attempts
- IEC 86B
  - New project initiated at May 2014 meeting
    - 32-fiber 2-row flat end-face plug, and adapter
  - Standard to become addition to IEC 61754 series



See  
backup slides  
for details

# Production Status and Performance Data for 16f and 32f MPO connectors

- To meet evolving application requirements, MT fiber count has grown from single row of 4, 8, or 12 fibers to versions with 2 to 6 rows of 12-fibers
  - Development of 1x16 and 2x16 MTs are another progression of technology
- US Conec has 1x16 and 2x16 MT ferrule production tooling
- Parts have been molded for performance qualification
  - Initial MM performance measurements are underway
  - Telcordia GR-1435 testing is scheduled

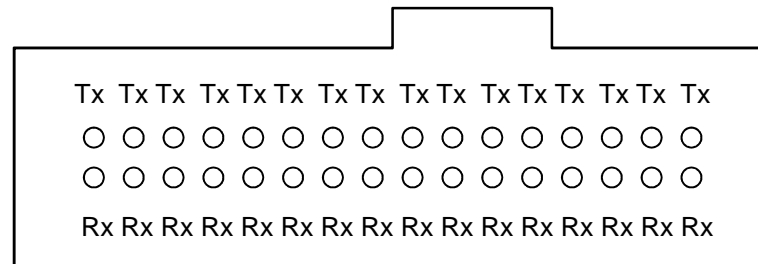
# Structured Cabling Standardization

- ANSI/TIA-568.3
  - Defines array cabling polarity methods and components for duplex and parallel links in structured cabling
  - In second ballot for D revision (to become ANSI/TIA-568.3-D)
    - Comments to be resolved at October TR-42 meeting
  - Comments submitted to allow other than 12-wide array cabling
    - 16-wide infrastructure would be standardized if accepted

# MDI Lane Assignment

- Definition required to ensure interoperability
  - Parallel optics introduce more degrees of freedom that must be constrained for interoperable connectivity
- Optimal lane assignment will be compatible with structured cabling and conventional optics
  - The same array polarity in cabling systems should support all array applications
    - without replacement of permanent link cabling
    - while adhering to standard signal routing conventions

# 400GBASE-SR16 Proposal for Lane Assignments



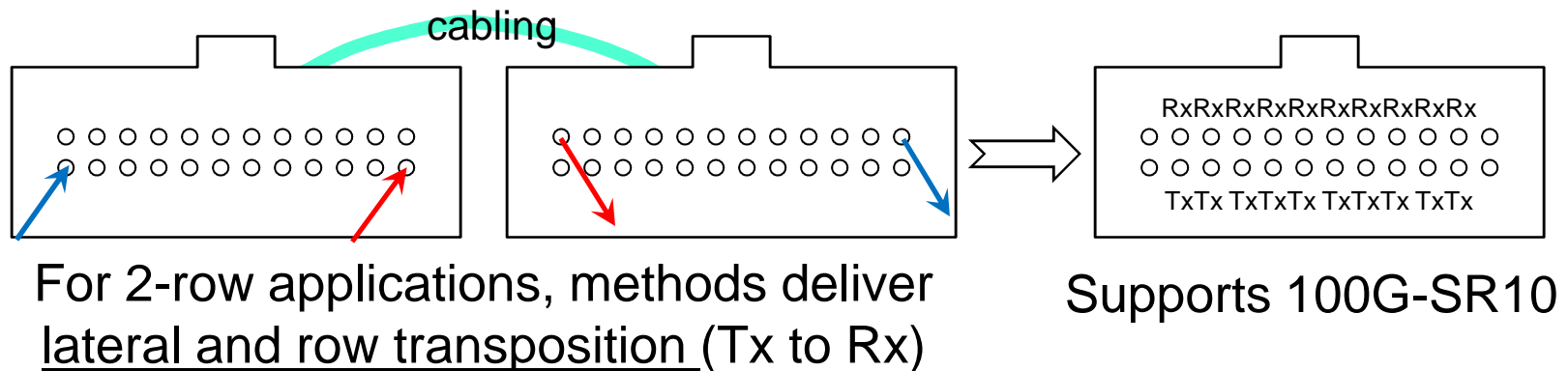
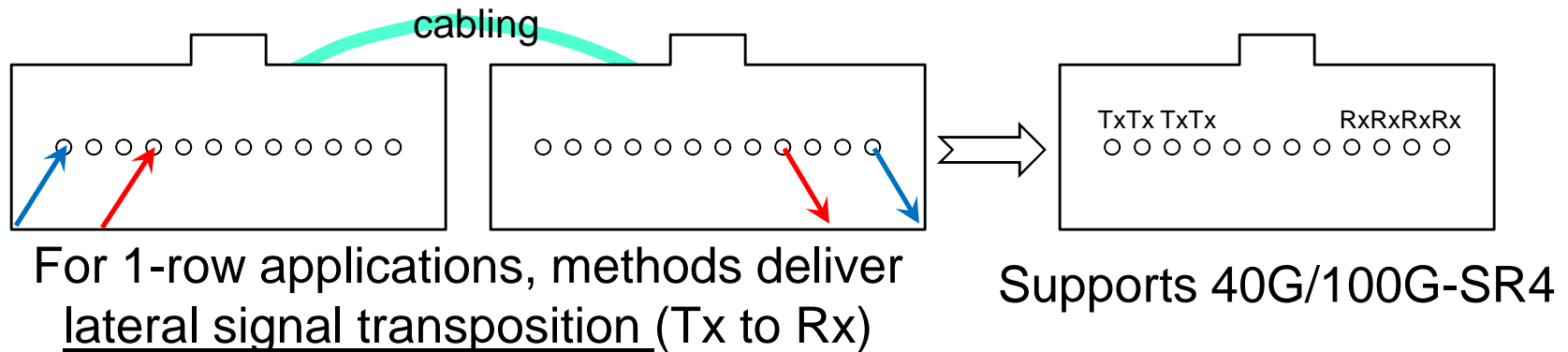
400G-SR16 optical lane assignments for MDI receptacle when viewed looking into the receptacle with keyway feature on top. Transmitters occupy the top row and receivers occupy the bottom row.

This is essentially a 16-wide version of 100G-SR10 MDI but with transmitters on top for better heat dissipation and no unused positions.



# How Array Polarity Works

- TIA-568 describes three methods: A, B, C. ISO & CENELEC one.
  - All produce the same signal routing with different sets of components
  - Key application examples:



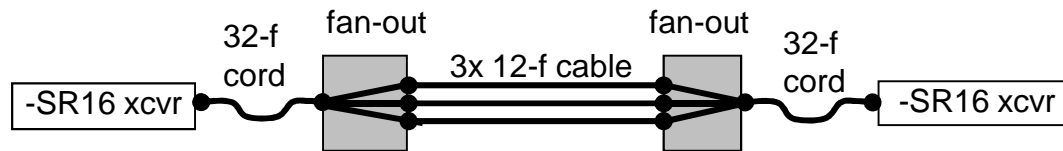
These signal routing conventions support all standard parallel applications

including INCITS T11 10GFC 1200-Mx-SN4P-I and HIPPI-6400

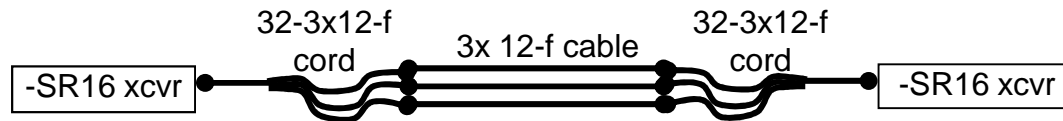
# -SR16 Compatibility with Cabling

- Legacy 12-fiber cabling can support 400G-SR16 consuming three cable subunits using:

- fan-out modules



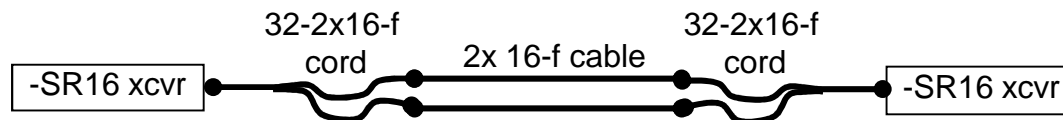
- tri-furcated equipment cords



89%  
fiber  
utilization

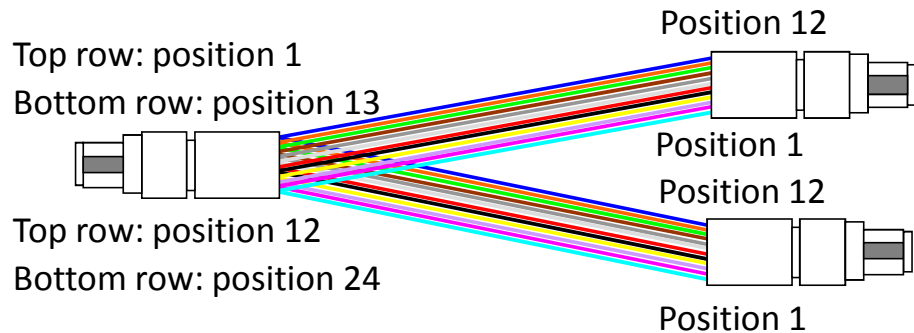
- Future 16-fiber cabling can support 400G-SR16 consuming two cable subunits using:

- bi-furcated equipment cords, analogous to 100G-SR10

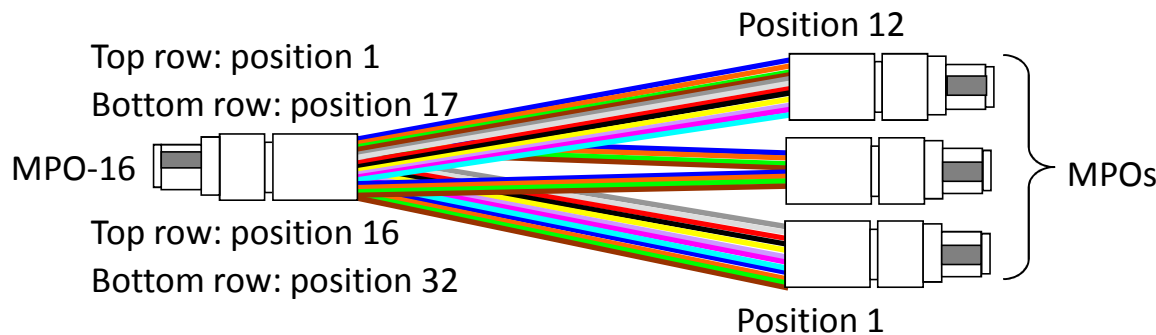


100%  
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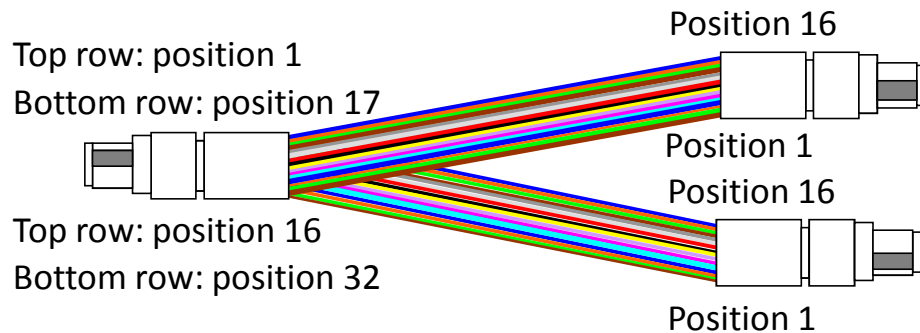
# Equipment Cords (Type-B)



1. Today's standard for 2-row applications on 12-fiber cabling



2. Example -SR16 cord for 12-fiber cabling

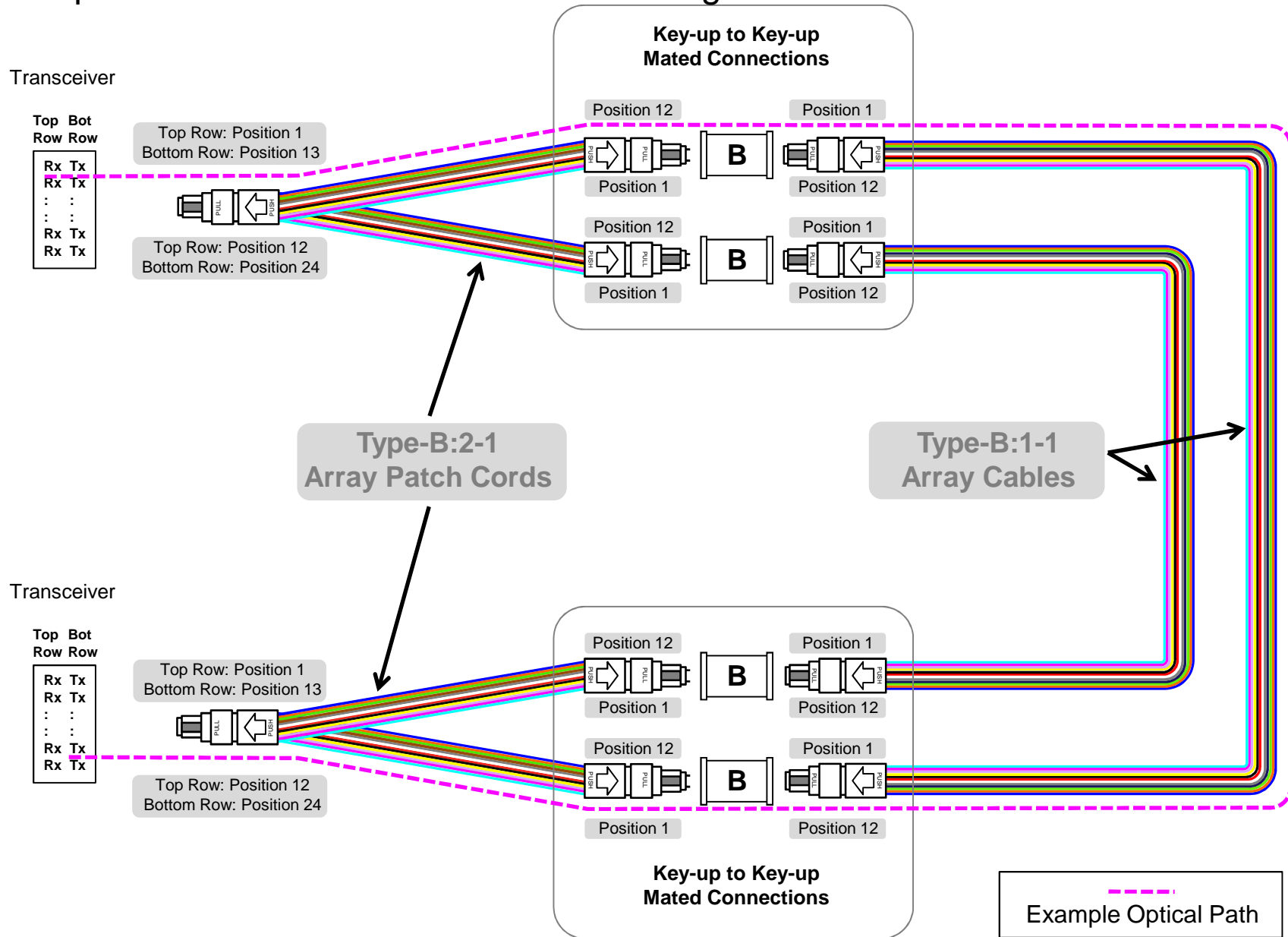


3. Analog of today's standard (1.) but for 16-fiber cabling

All adhere to standard of delivering lateral and row signal transposition

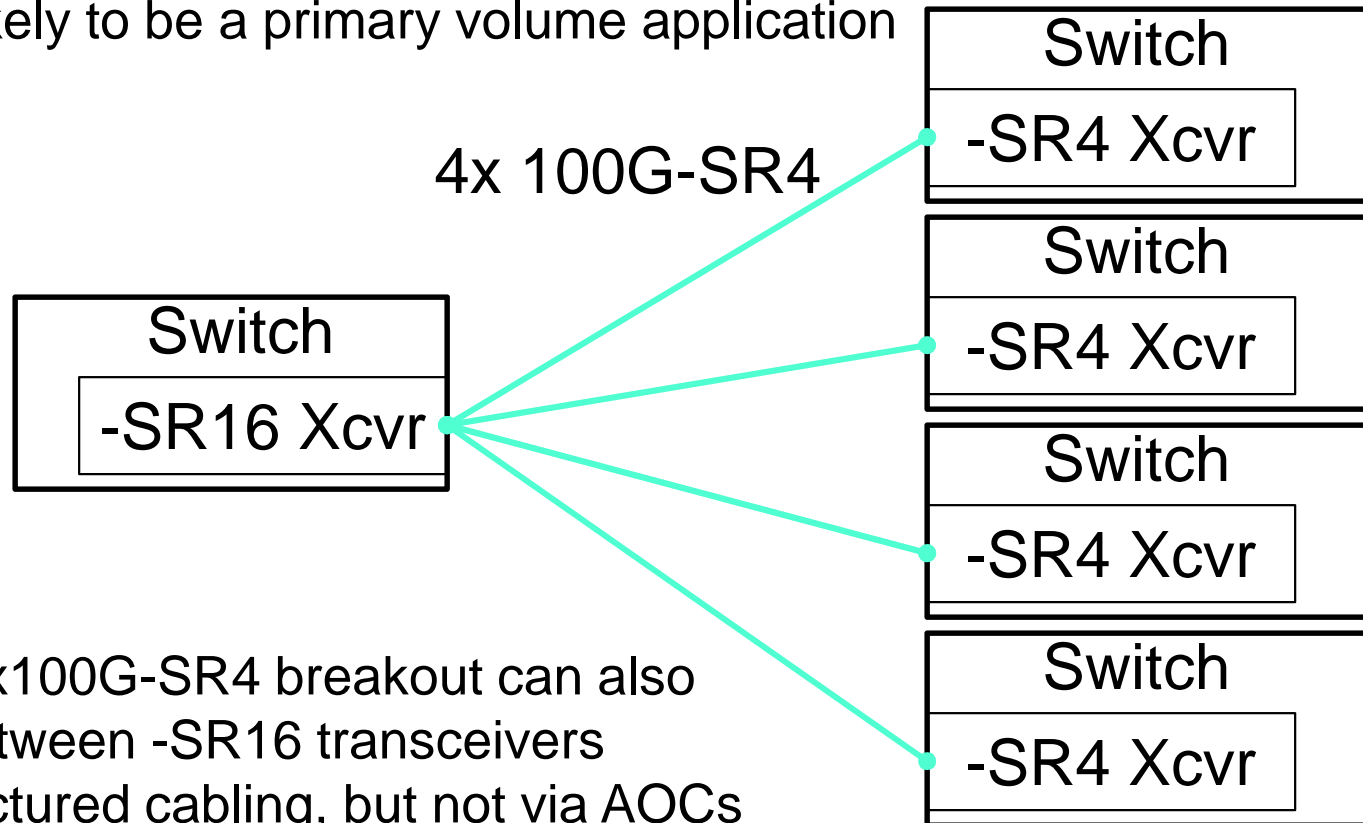
# Connectivity Method B Supporting Parallel Signals for 1-plug x 2-row Applications

Proposed -SR16 MDI on modulo-16 cabling would follow this same construct.



# Breakout = Likely Primary App for Gen 1

- The proposed -SR16 MDI can also function as a high-density (4x) 100G-SR4 interface
  - Increases switch radix at 100G
  - Facilitates densely interconnected DC architectures at 100G
  - Likely to be a primary volume application

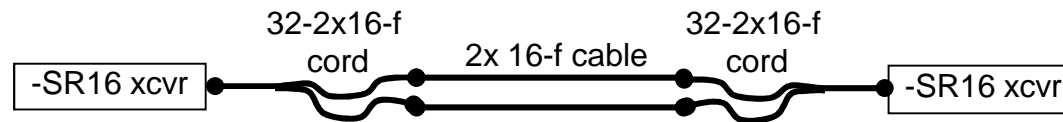


Note: 4x100G-SR4 breakout can also exist between -SR16 transceivers via structured cabling, but not via AOCs

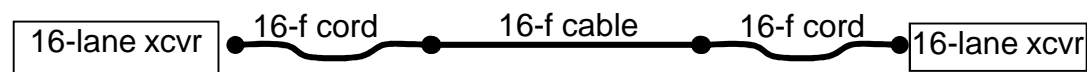
# 16-fiber Cabling Applications

- Modulo-16 cabling is a superior match to parallel applications compared to modulo-12 cabling
- Simpler or fewer fan-out assemblies for 100% utilization

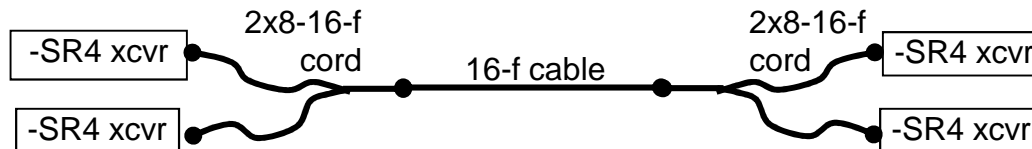
- 32-lane solutions, bi-furcated cords



- 16-lane solutions, simple cords

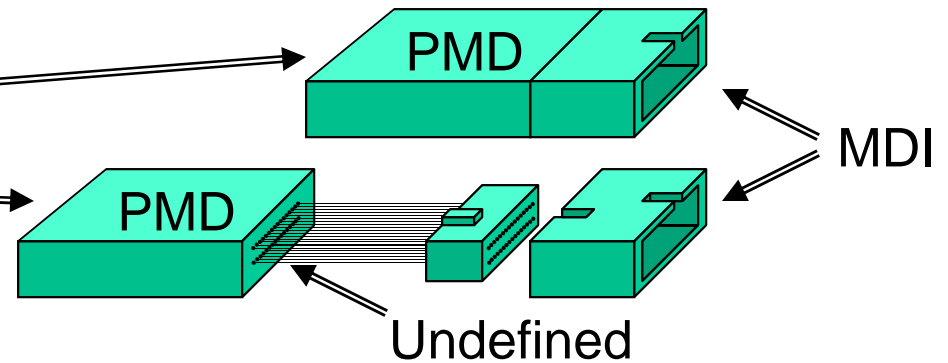


- 8-lane solutions, bi-furcated cords



# Why choose an array connector at the MDI?

- Precedent established in clauses 86 and 95
- Per proposed clause xx.m.n (see later), 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



# Content for Baseline Draft

The following 4 slides use clause 86 and 95 content as basis  
with modifications for 400GBASE-SR16 and MPO-16



# Content for Clause xx.m.n (1 of 4)

## **xx.m.n Medium Dependent Interface (MDI)**

The 400GBASE-SR16 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 xx-a). The 400GBASE-SR16 PMD is coupled to the fiber optic cabling through one connector plug into the MDI optical receptacle as shown in Figure xx-b. Example constructions of the MDI include the following:

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

# Content for Clause xx.m.n (2 of 4)

## xx.m.n.1 Optical lane assignments

The sixteen transmit and sixteen receive optical lanes of 400GBASE-SR16 shall occupy the positions depicted in Figure xx-b viewed looking into the MDI receptacle with the connector keyway feature on top. The interface contains 32 active lanes within 32 total positions. The transmit optical lanes occupy the top row. The receive optical lanes occupy the bottom row. See clause xx.m.n.2 for MDI optical connector requirements.

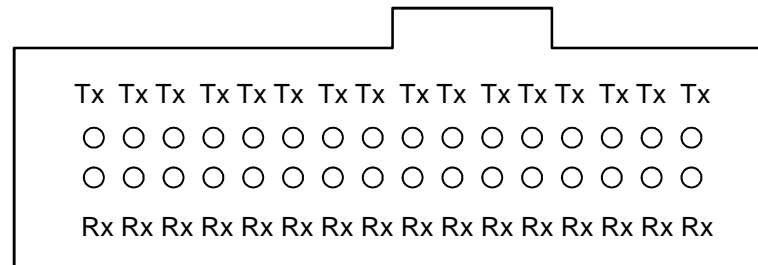


Figure xx-b -- 400GBASE-SR16 optical lane assignments viewed looking into the MDI receptacle with keyway feature on top.

# Content for Clause xx.m.n (3 of 4)

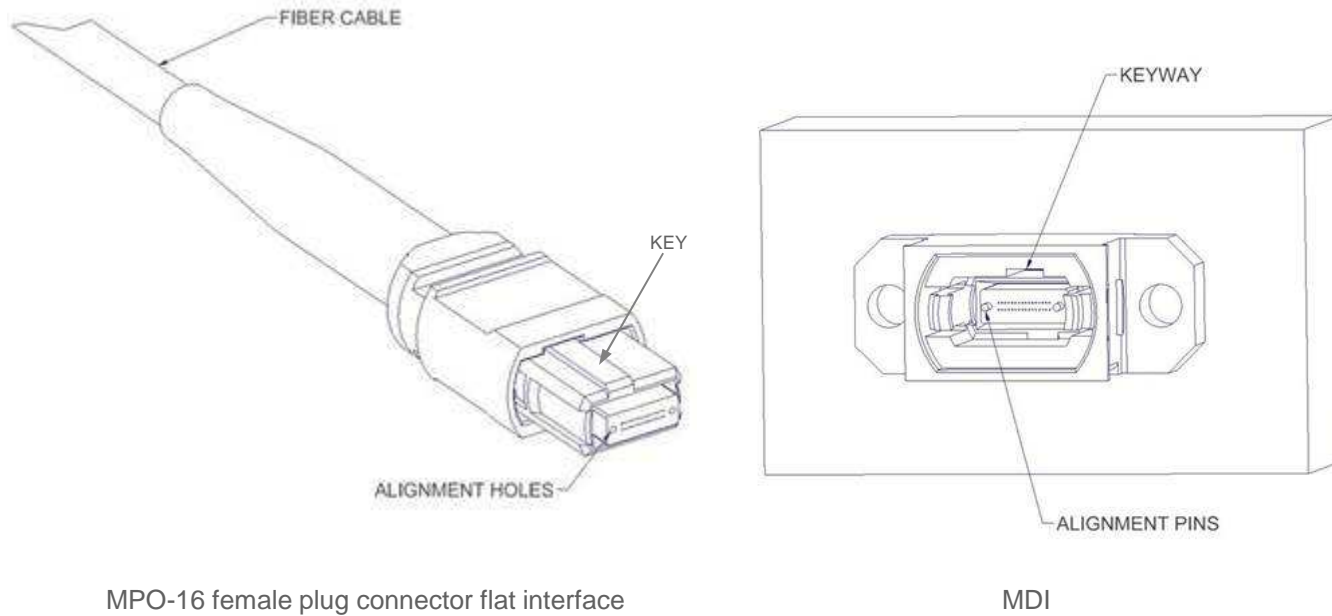
## **xx.m.n.2 Medium Dependent Interface (MDI) requirements**

The MDI adapter or receptacle shall meet the dimensional specifications of ANSI/TIA-604-18 adapter designation FOCIS 18A-k-0. The plug terminating the optical fiber cabling shall meet the dimensional specifications of ANSI/TIA-604-18 female plug connector flat interface designation FOCIS 18P-2x16-1-0-2-2. The MDI shall optically mate with the plug on the optical fiber cabling. Figure xx-c shows an MPO-16 female plug connector with flat interface, and an MDI.

The MDI connection shall meet the interface performance specifications of IEC 61753-1 and IEC 61753-022-2.

NOTE— Transmitter compliance testing is performed at TP2 as defined in xx.k.j, not at the MDI.

# Content for Clause xx.m.n (4 of 4)



MPO-16 female plug connector flat interface

MDI

Figure xx-c – MPO-16 female plug connector flat interface and MDI

# Conclusions

- 400GBASE-SR16
  - Is extension of existing technology\* → low risk, easy spec creation
  - Supports breakout to 4x 100G-SR4 → broad market potential
- MPO-16 standardization and development
  - Progressing at pace suitable for P802.3bs
- Proposed lane assignment
  - Is directly compatible with emerging MPO-16 standard
  - Can be supported on legacy structured cabling without violating signal routing conventions or replacing permanent link cabling
  - Can be easily supported on modulo-16 cabling
  - Will drive modulo-16 cabling development → better solution

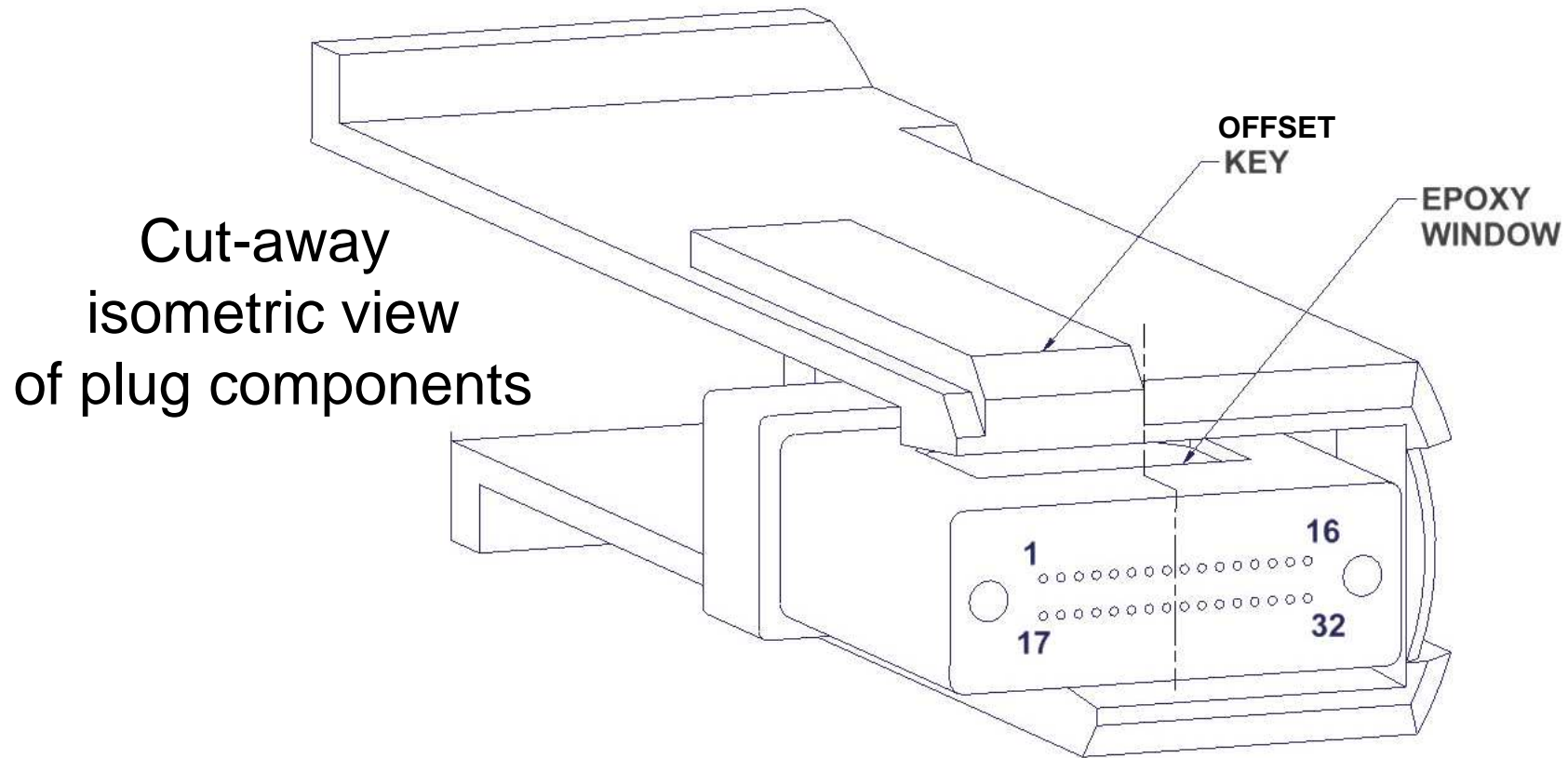
\* See king\_3bs\_01a\_0514

Thank You.

Questions?

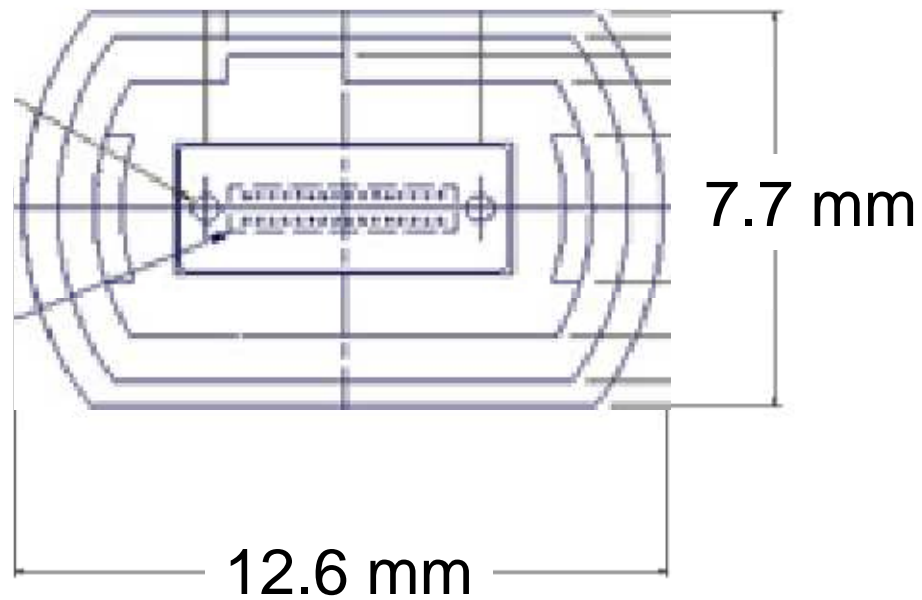
# Backup Slides

# MPO-16 2-row Plug Position Numbering Convention





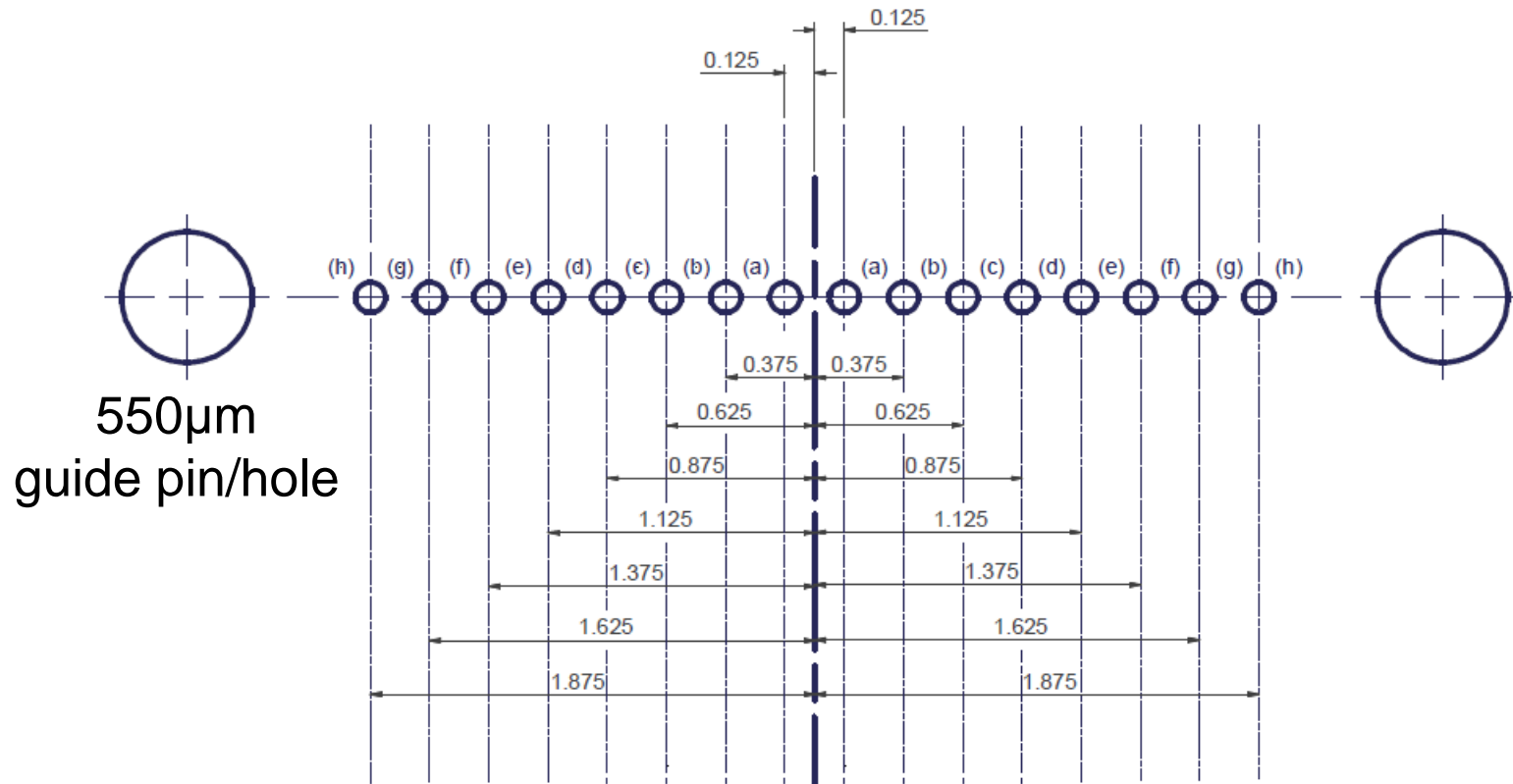
# MPO-16 Plug Outer Housing Dimensions



Outer dimensions are  
same as MPO

# Guide Pin/Hole and Fiber Hole

## 1-row ferrule end-face

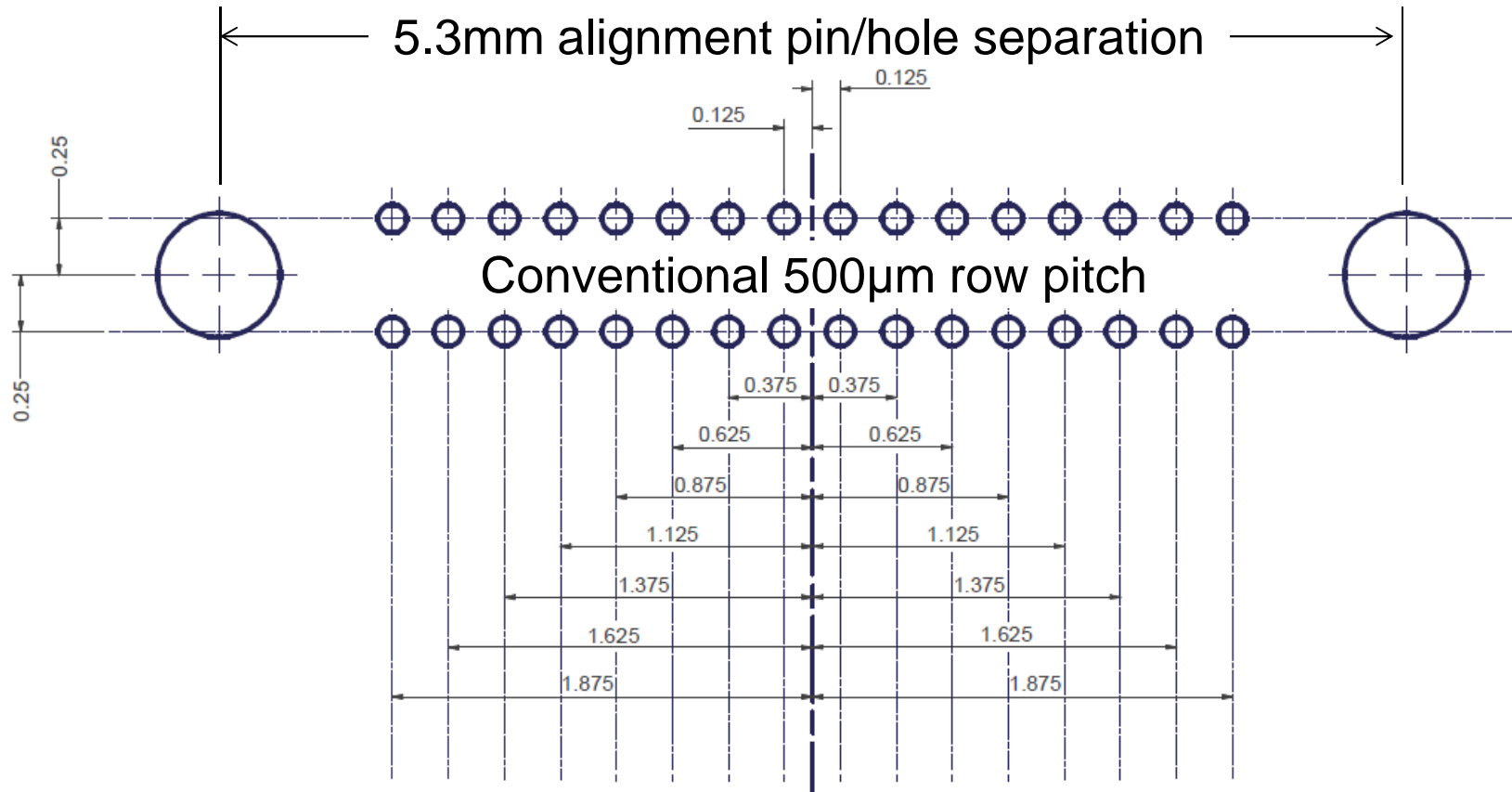


550 $\mu$ m  
guide pin/hole

Conventional 250 $\mu$ m fiber pitch

# Guide Pin/Hole and Fiber Hole

## 2-row ferrule end-face



# Array Polarity Methods' Distinguishing Characteristics

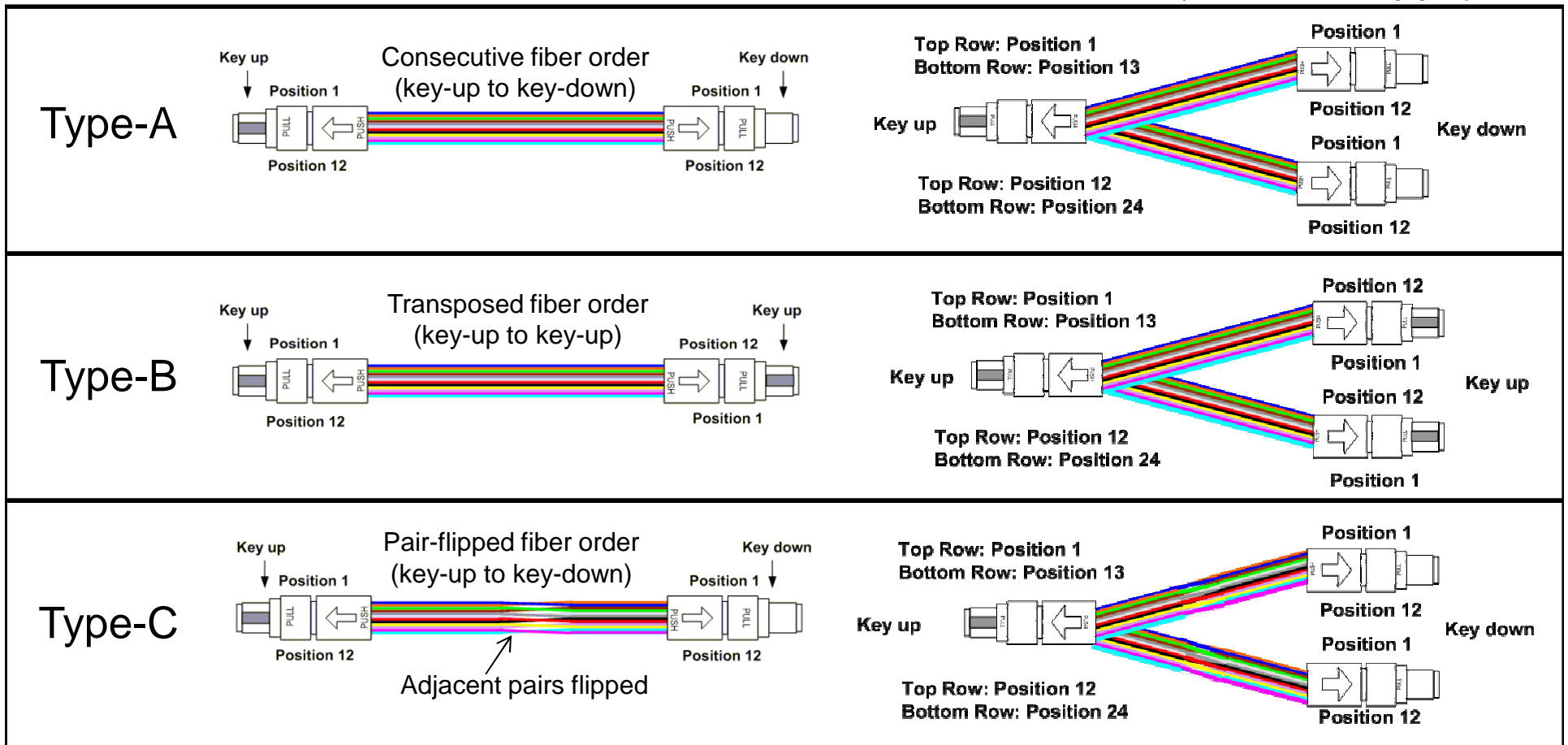
<b>Method</b>	<b><u>Char. 1)</u> Key orientations of array terminations</b>	<b><u>Char. 2)</u> Fiber order at array terminations</b>	<b><u>Char. 3a)</u> Array cable and cord Type(s) in parallel channels</b>	<b><u>Char. 3b)</u> 2-fiber cord Type(s) in multi-duplex channels</b>	<b><u>Char. 4)</u> Array adapter Type</b>
<b>A</b>	up / down <i>Type-A cables and cords</i>	consecutive	A + B	A-to-A + A-to-B	A
<b>B</b>	up / up <i>Type-B cables and cords</i>	transposed	B	A-to-B	B
<b>C</b>	up / down <i>Type-C cables and cords</i>	pair-flipped	C + B	A-to-B	A

*See next slide*

Extensions to the methods must follow these characteristics, as departure from these characteristics defines a new method.

# Array Cable & Cord Types

- TIA 568 defines three types (A, B, C) for 1-row and 2-row apps  
 cables and 1-row cords 2-row cords (for 2-row apps)



Specific concatenations of these assemblies define the three methods for parallel applications