# Choosing MPO Connectors for the Data Center

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# Agenda

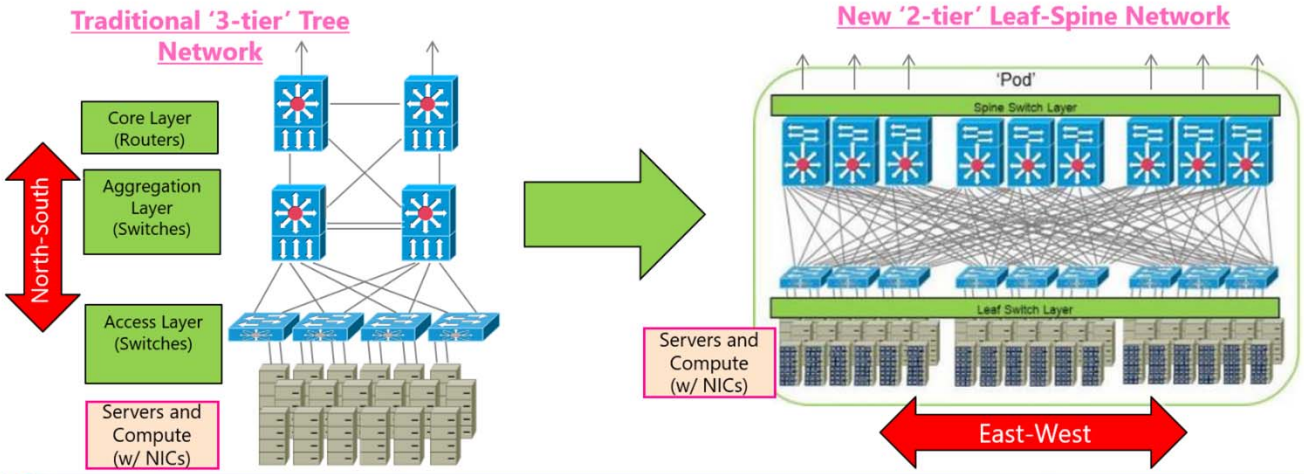
- Network Architecture changes
- Data Center & MPO Standards
- Application comparisons
- Additional considerations

# Architectural changes

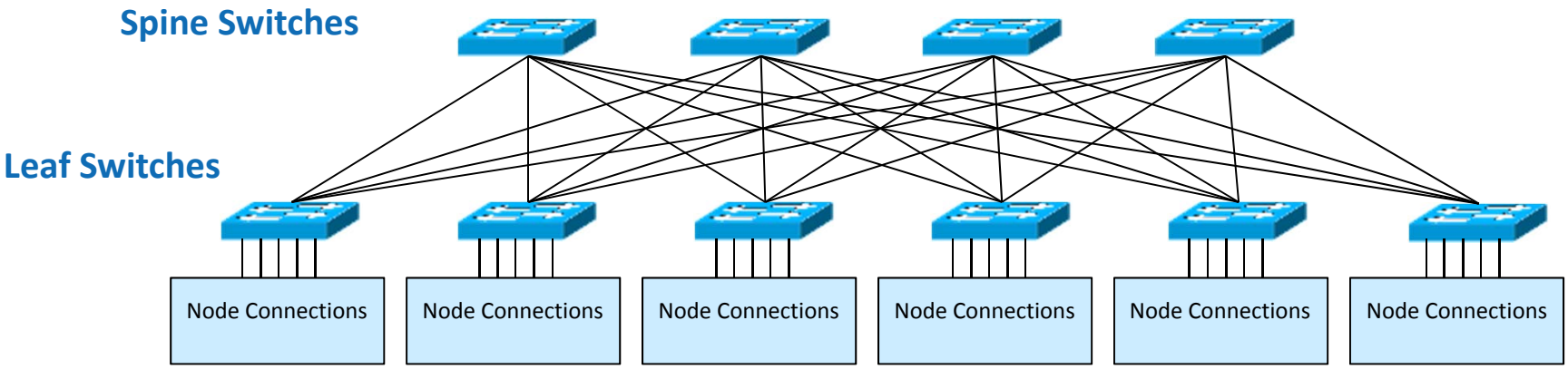
- Flatter Networks:  E-W vs. N-S
- Reduced Latency
- Increasing Data Rates
- Increasing Fiber Counts
- Duplex and parallel applications coexistence

# Mesh Networks adapted for Enterprise Data Centers

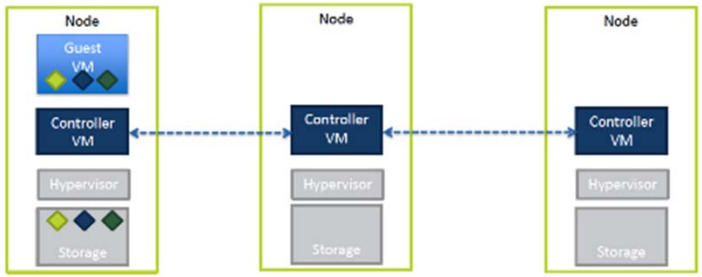
- Historically Enterprise has been a 3-tier topology – aggregation and blocking architecture
- Cloud data center networks are 2-tier topology
  - Optimized for East-West traffic
  - Workloads spread across 10s, 100s, sometimes 1000s of VMs and hosts
  - Higher degree (10-20X) of east-west traffic across network (server to server)

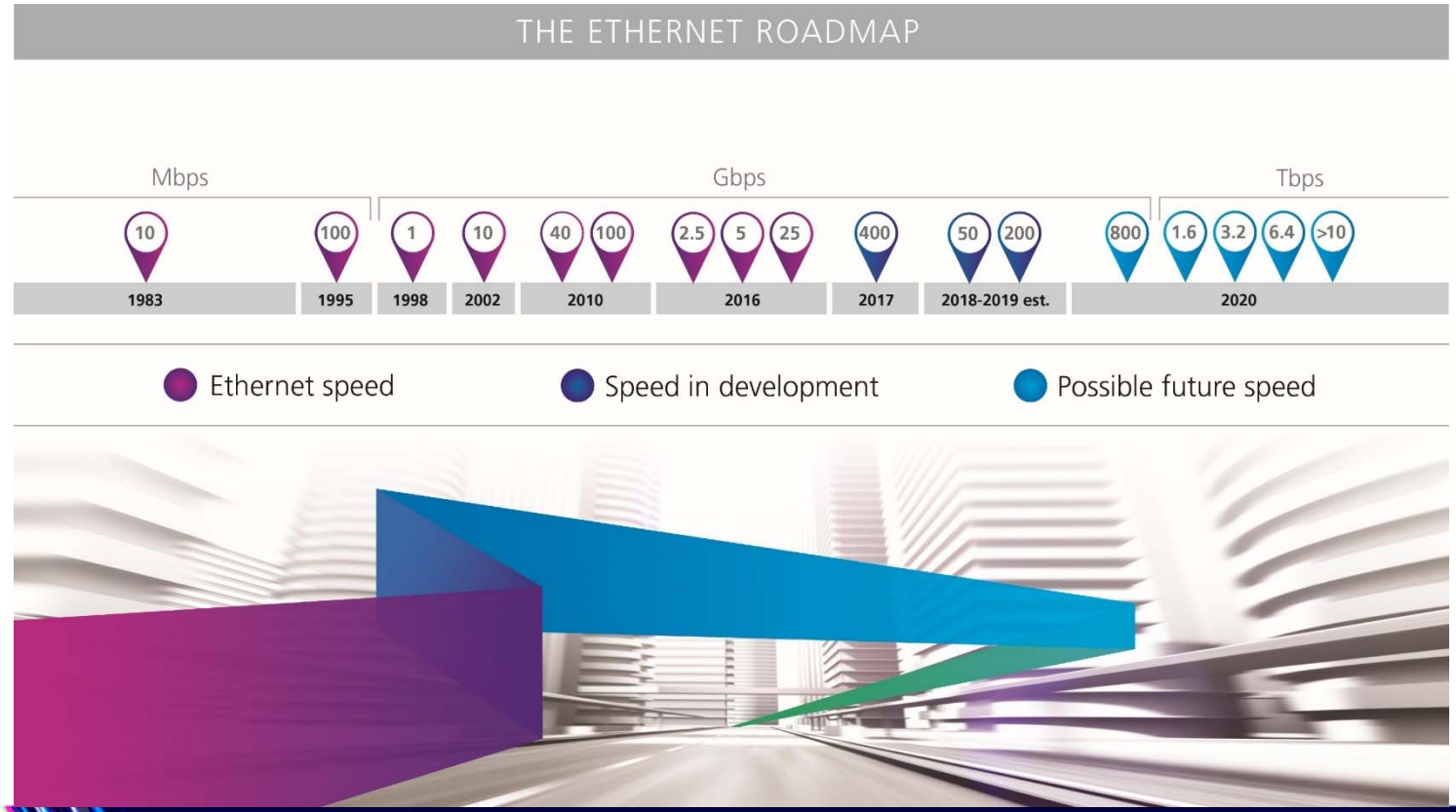


## Enterprise Scale Fabric Networks




Software ties Compute, storage and control networks together - SDN





# Related standards updates

## ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard

- Replaced ANSI/TIA-568-C.3 (published June 2008) and –C.3-1 (published Dec. 2011)
- Incorporates polarity of cords and connectivity methods supporting parallel optical signals for transceivers, array cords and cables employed over 2 rows of fibers per plug
- Raises minimum RL of singlemode connections and splices from 26dB to 35dB in harmony with ISO (IEEE RL requirements)

# TIA-942-B Updates/Revisions

- ANSI/TIA-942-B- June 2017 – Additional Updates to incorporate new technologies and practices: Section includes Data Center Switch Fabrics, Spine-Leaf, Mesh networks, and virtualized Switch Architecture

- Added MPO-24 (NSI/TIA-604-5) and MPO-16 and MPO-32 (ANSI/TIA-604-18) as options for termination of more than two fibers in addition to the MPO-12 connector.

- Added Wideband laser-optimized 50/125µm (OM5) as an allowed and recommended type of multimode fiber cable.
  - OM5 supports 4 wavelengths in a single-pair of fibers allowing applications which currently use 4-pairs of fibers to run on a single pair
  - TIA approved lime green as the color for OM5 cable

# Recent optical updates in 3rd Edition of ISO/IEC 11801

- Adoption of OM5 wideband multimode fiber
- Adoption of 12 and 24-fiber MPOs as the recognized connectors in 11801-5 for DC's
- Definition of OS1a singlemode fiber to support low water peak tight buffered constructions

# Market Evolution

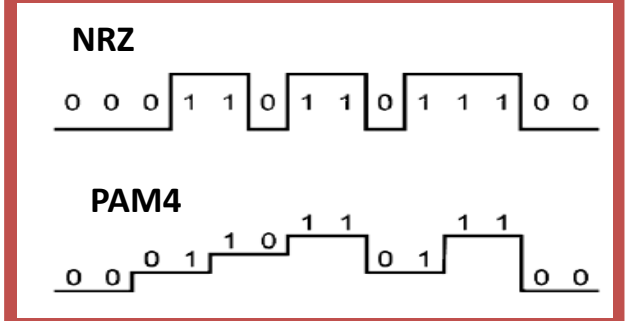
Proliferation of “Ultra Low Loss” MPO interfaces

- Enable design flexibility
- Enable more connections per channel
- Enable longer application distance support

# Technologies Enabling Higher Capacity per Multimode Fiber

## PAM4

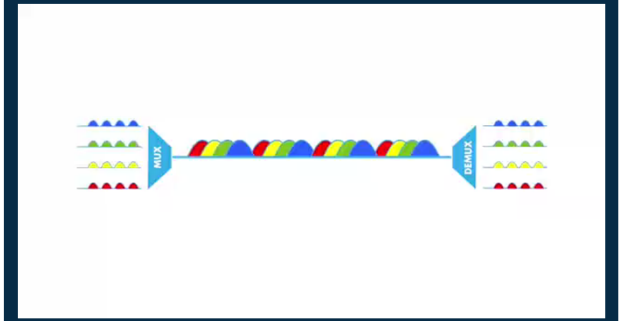
More Efficient Modulation




Enabling 50Gb per lane

## SWDM

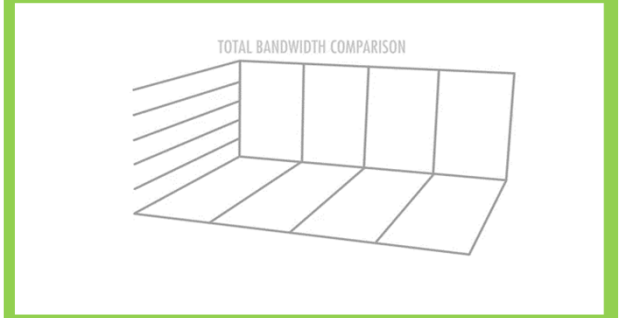
More Efficient Fiber Usage




Enabling 4 λ per fiber

## WBMMF OM5

More Efficient Fiber




Supporting 4 λ per fiber to practical distances

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# Data Center multimode speed roadmap

| # lanes | | | | |
|---|---|---|---|---|
| 16 | | **400GBASE-SR16** | | |
| 10 | **100GBASE-SR10** | | | 1 Tb/s? |
| 8 | | | | 800 Gb/s? |
| 4 | **40GBASE-SR4** | **400G-SWDM4?** | **800G-SWDM4?** | 400 Gb/s? |
| 2 | | | **400G-SWDM4?** | 200 Gb/s? |
| 1 | **40GBASE-SWDM4** | **100G-SWDM4** | **200G-SWDM4?** | 100 Gb/s? |
| Lane rate > | 10 Gb/s | 25 Gb/s | 50 Gb/s | 100 Gb/s |
| **Encoding >** | **NRZ** | | **PAM-4** | |

# IEEE Study Group - MMF options for 200G and 400G

| Technology (per fiber) | 1 fiber pair | 2 fiber pairs | 4 fiber pairs | 8 fiber pairs | 16 fiber pairs |
|---|---|---|---|---|---|
| 25G-λ NRZ | 25G-SR | | 100G-SR4 | | 400G-SR16 |
| 50G-λ PAM4 | 50G-SR | 100G-SR2 | 200G-SR4 | **400G-SR8** | |
| 2x50G-λ PAM4 | 100G-SR1.2 | **200G-SR2.2** | **400G-SR4.2** | | |
| 4x25G-λ NRZ | 100G-SR1.4 | **200G-SR2.4** | **400G-SR4.4** | | |
| 4x50G-λ PAM4 | **200G-SR1.4** | **400G-SR2.4** | 800G-SR4.4 | | |

**Technology options for 200 & 400 Gb/s links over fewer MMF fiber pairs**

Existing IEEE standard

In progress in 802.3bs, cd

Multi-Wavelength Nomenclature

SRm.n m = # fiber pairs

n = # wavelengths

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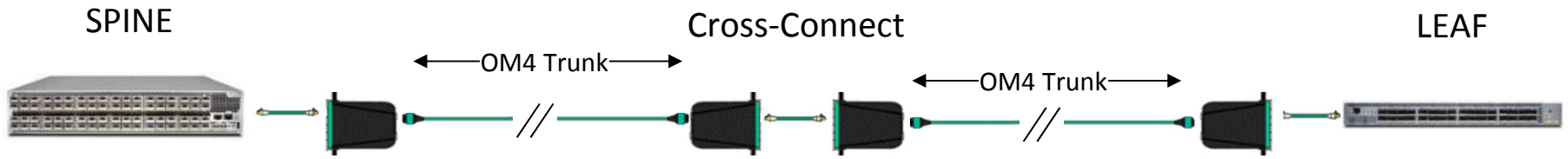
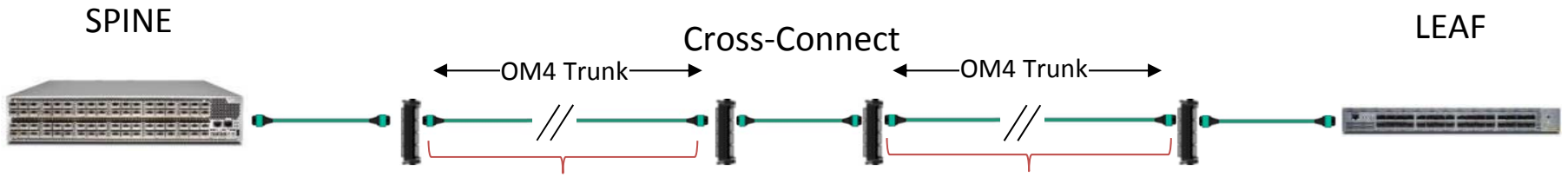
## Example Migration from Duplex to Parallel

### 10GBASE-SR

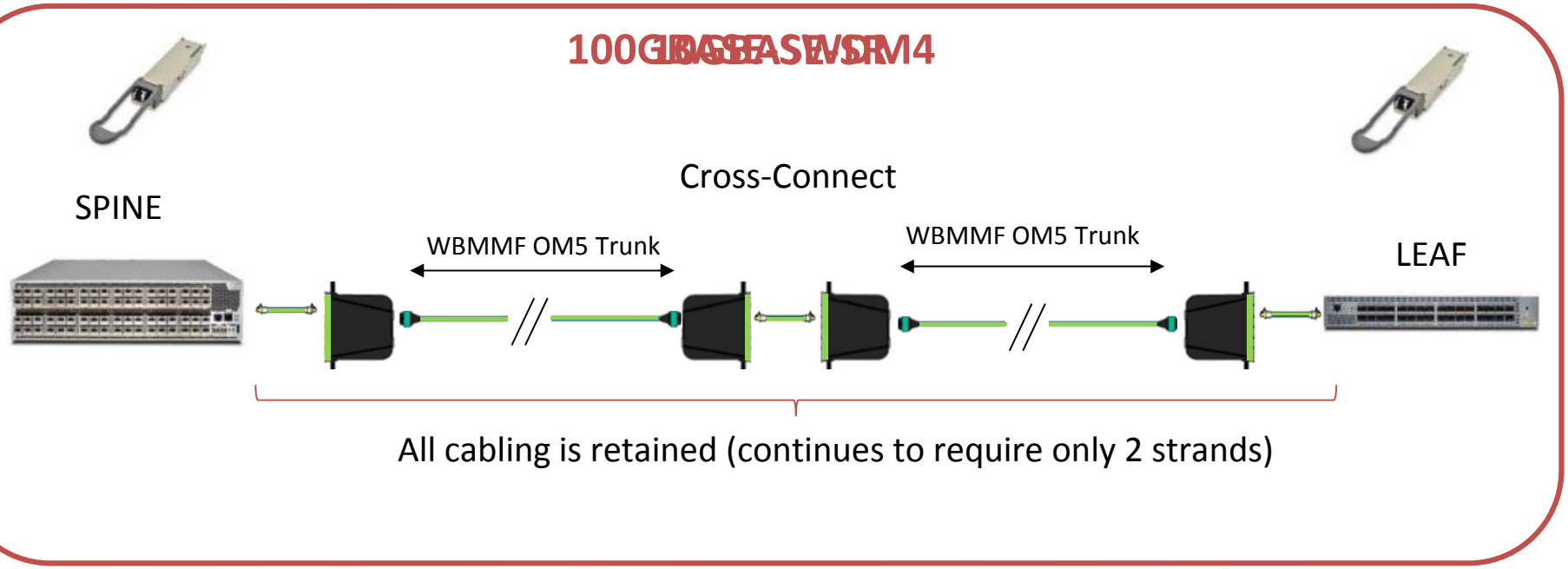



### 100GBASE-SR4




**Trunk cabling is retained**

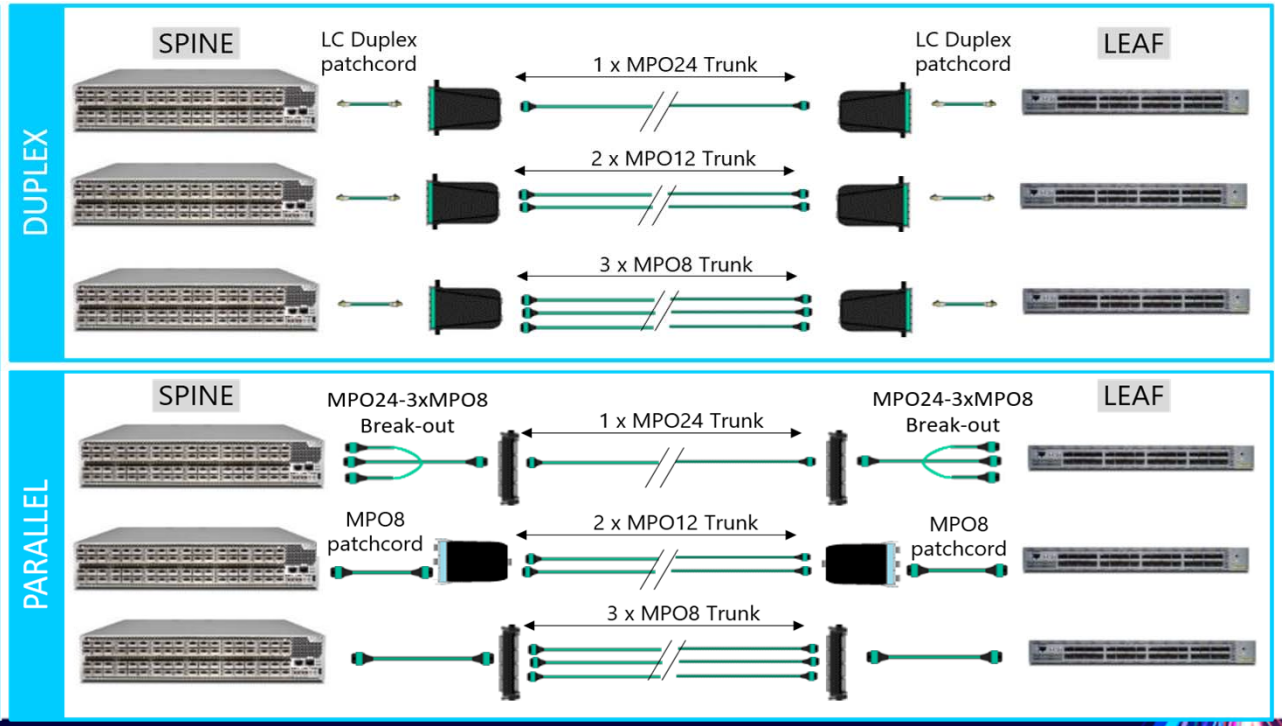
## Migration from 10G to 100G with SWDM and OM5 WBMMF



# MPO24 vs MPO12 vs MPO8 for multimode trunks

Leaf-Spine Applications on multimode fiber

| Application | #Fibers |
|---|---|
| **10GBASE-SR** | **2** |
| **40G-SR4** | **8** |
| 40G-BiDi | 2 |
| 40G-SWDM4 | 2 |
| **100G-SR4** | **8** |
| ***100G-SR2*** | ***4*** |
| 100G-SWDM4 | 2 |
| 100G-BiDi (?) | 2 |
| ***200G-SR4*** | ***8*** |
| 200G-SR1.2 (?) | 2 |
| 400G-SR4.2/4.4 (?) | 8 |
| 400G-SR2.4 (?) | 4 |
| 400G-SR1.4 (?) | 2 |



# Which MPO for High Speed Migration?

| MPO24 | MPO12 | MPO8 |
| --- | --- | --- |
|  |  |  |

Same Ferrule size
Same Loss Performance
Same Pin Alignment

MPO12:

Initially used for modular fiber optic cabling to duplex applications

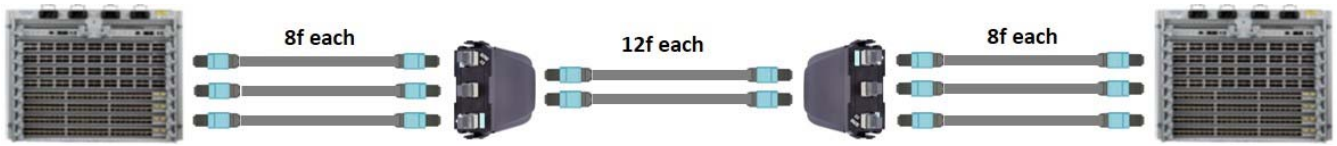
Rapid pluggable deployment for data center environments

Converge MPOs to fully utilize fibers for parallel applications

Duplex


Parallel

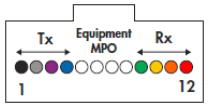

Parallel



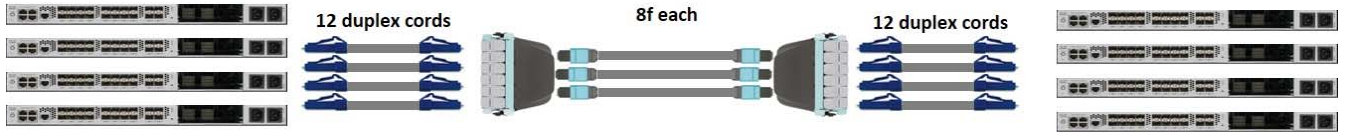
MPO8:

Primary use is for parallel applications to the transceiver

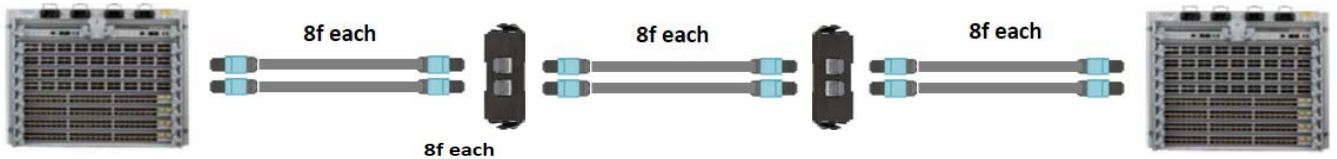
Outside-In fiber mapping delivers parallel lanes



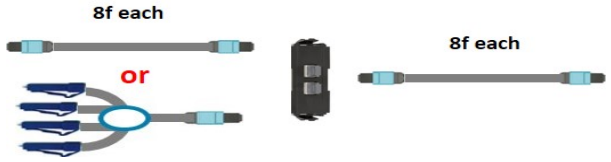

Duplex




Parallel




Parallel



MPO24:

Initially used for modular fiber optic cabling to duplex applications

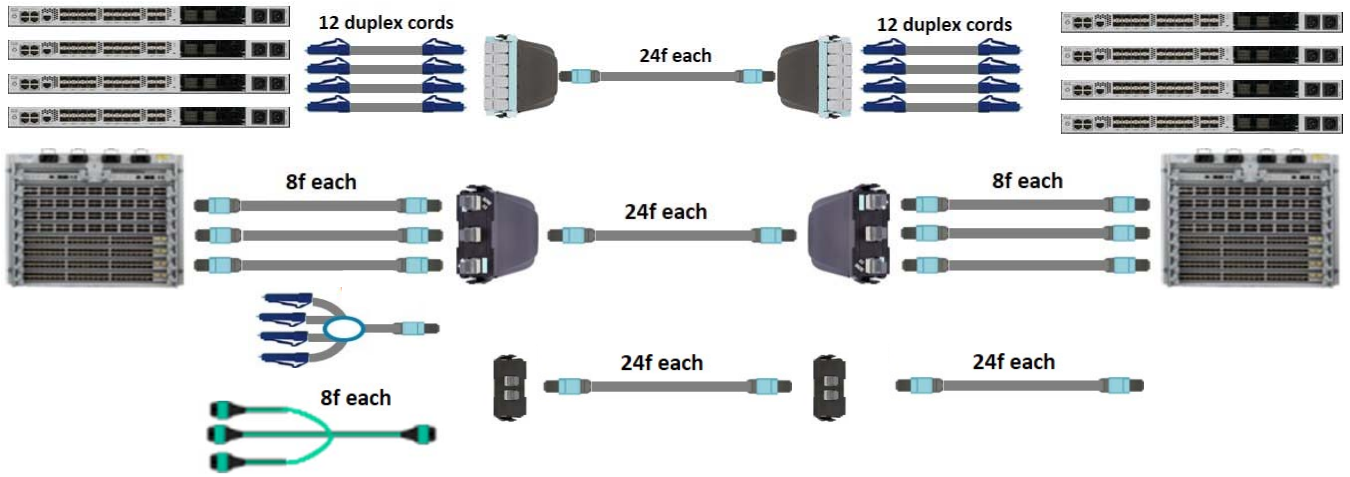
Additionally used for SR10 and 120G transceiver applications

Fiber count enables duplex, parallel, or a mix of both

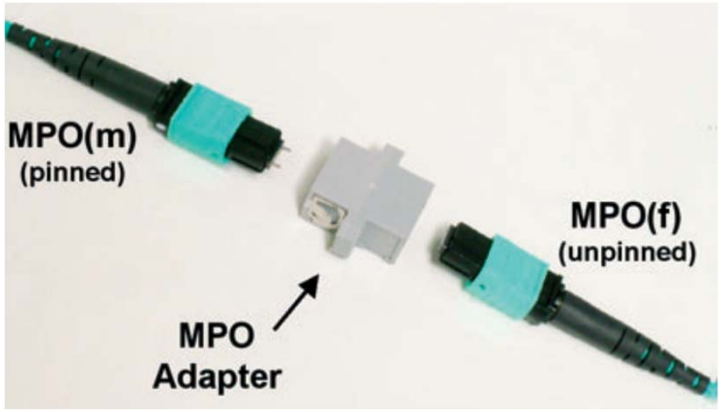
Duplex

Parallel

Parallel/
Duplex
Mix

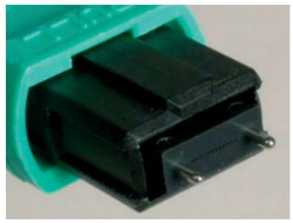


# Where should MPO alignment pins be located?



# Where should MPO alignment pins be located?

- In a Duplex world? Pin location doesn't really matter.
- **In a Parallel Application world? It matters!**
- QSFP, QSFP+, CXP transceivers house pins within the transceiver



| | Trunk | Equipment Cord |
|---|---|---|
| | √ | X |
| | ? | ? |
| | ? | √ |

# The Simplification Process has Begun!

As we migrate customers to their next level:

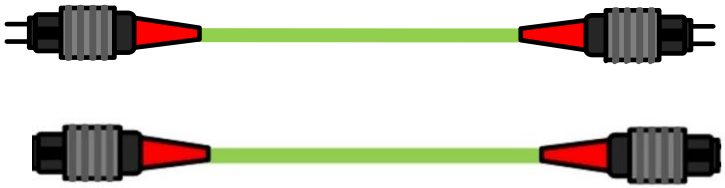
Pinned MPO trunks enables the use of the same unpinned patch cords throughout your channel.

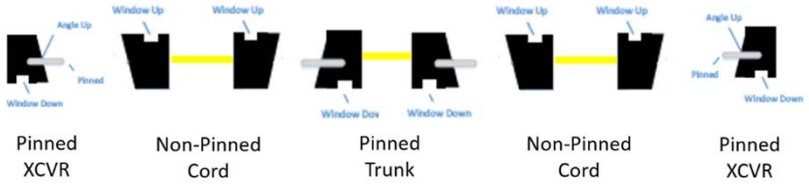
- Equipment
- Patching between trunks

The same design applies to singlemode.

Pinned singlemode trunks use the standard industry angle.

- Unpinned cords with the opposite angle on both ends can be used throughout the channel as well for equipment and patchcords





# Considerations of your MPO choice

- Day 1 design – duplex or parallel
- Space availability for Day 2
- Connections within channel: type, performance, and distance
- Media selection
- Architectural flexibility
- Application Support

# Thank you!

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