

The background of the cover is a dark, high-contrast photograph of a server room. Rows of server racks with glass doors are visible, reflecting the overhead lights. The perspective is from a low angle, looking down the length of the aisle.

FHD Fiber Cabling System Guide

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1. FS Fiber Cabling System

1.1 Overview

As the demand for high-density, high-performance, and continuously available fiber optic cabling in modern data centers surges, traditional fiber optic cabling systems are no longer adequate. These traditional systems are time-consuming to deploy, and more challenging to maintain, and making moves, adds, and changes (MAC) is more difficult. Additionally, conventional cabling systems consist of components designed for specific networks, which may result in a lack of flexibility and an inability to meet future needs.

FS FHD fiber optic cabling systems achieve these goals by offering optimal maintainability and manageability. Designed to enable data centers to perform MAC operations quickly and securely, the FHD system also provides scalability to increase density as business needs evolve.

1.2 Benefits

1.2.1 Making Fiber Installation and MACs Work Easier

FHD series is a versatile solution in multiple sizes and styles for building backbones, data centers, and enterprise applications.

Optimized Space

The FHD panel or cassette allows up to 144F LC connections in the 1U FHD enclosure.

Integrated Management

Cable management accessories or integrated structures enable flexible cabling during operation.

Versatile Solutions

It offers a versatile modular solution for patching, terminating, and splicing applications.

Saving Time

The plug-n-play design provides quick connection and deployment for network applications.

1.2.2 Seamless Migration to Higher Data Rates

MTP® cable, a cost-effective alternative to time-consuming field termination, is designed for high-density fiber patching in data centers that need space saving and reduce cable management troubles.

Bend Insensitive

Corning ClearCurve® and SMF-28® Ultra Fiber reduces optical loss in tight bends for slack storage and routing.

Fire Safety-Rated

Safe for use in plenum air spaces, as it can prevent flame propagation and smoke generation.

Low Insertion Loss

High-performance MT-based US Conec MTP® connector for data center and carrier-grade applications.

High Efficiency

Future updates, additions, and changes to the structured cabling are dramatically simplified.

1.2.3 Colored-Coded Components for Easy Identification

Color-coding is an integral part of our industry, as it helps to identify individual fibers, cable, and connectors.

Compliance with Standards

Ensures color consistency with industry standards when used with other manufacturers' products.

Aesthetics and Orderliness

Creates an organized environment by color-coding components according to their functions.



Improved Maintainability

By maintaining a consistent standard, it simplifies the installation and connection of new equipment.



Reduced Cabling Errors

Prevents confusion and channel loss in data centers with multiple fiber mode cabling.

1.3 Examples of Network Cabling

The following sections illustrate how FHD Enclosures, Cassettes, Adapter Panels, Trunks, Jumpers, Harnesses, and Patch Cords are used in common data center cabling configurations.

1.3.1 Interconnect

In this configuration, a permanent link is installed between FHD Enclosures in the switch/network cabinet and the server or storage cabinets. The most common, flexible, and upgradeable FHD Fiber Cabling Solution is shown in Figure 1, below:

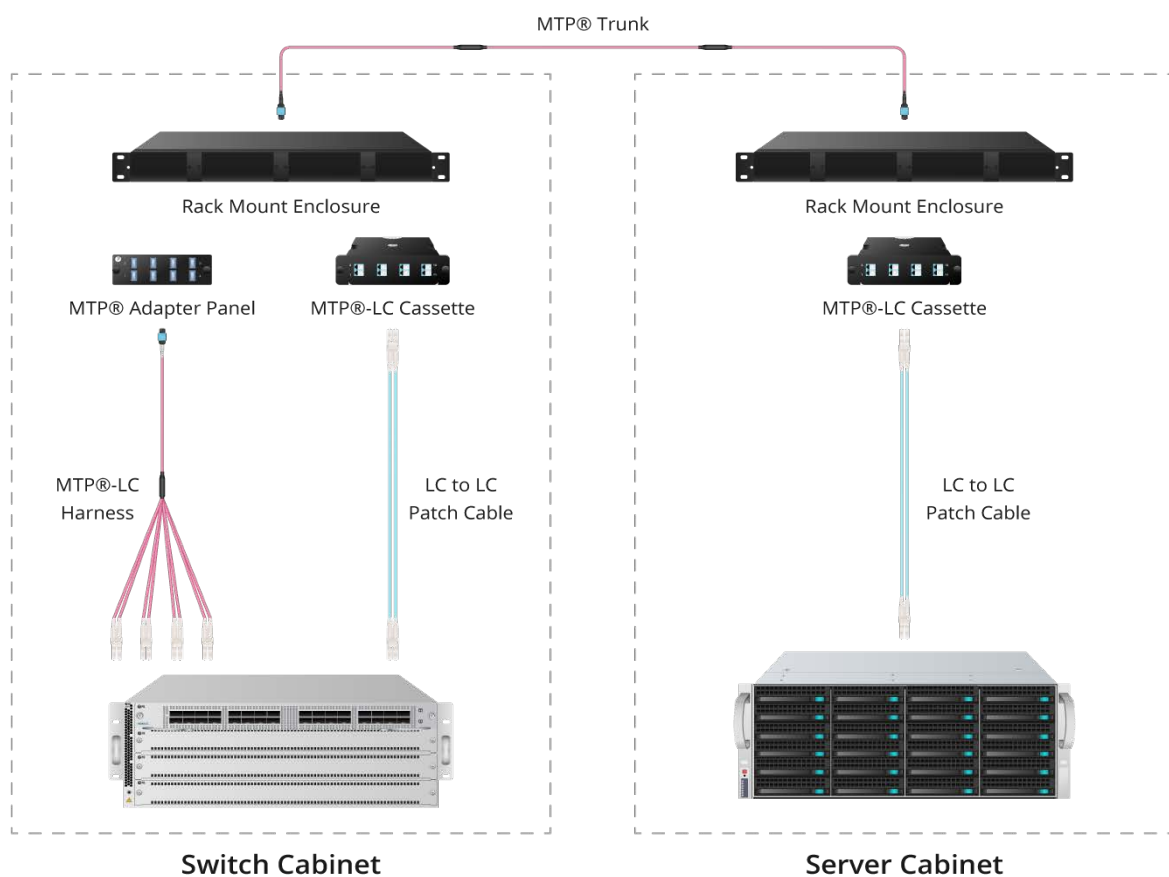


Figure 1: Interconnect

1.3.2 Cross Connect

In this configuration, permanent links are installed between FHD Enclosures in the switch/network cabinet and server or storage cabinets and a common cross-connect cabinet or rack. In this scenario, any fiber from any switch port or server uplink can be routed to anywhere within the data center. This option allows for easy moves, adds, or changes. The most common, flexible, and upgradeable FHD Fiber Cabling Solution is shown in Figure 2, below:

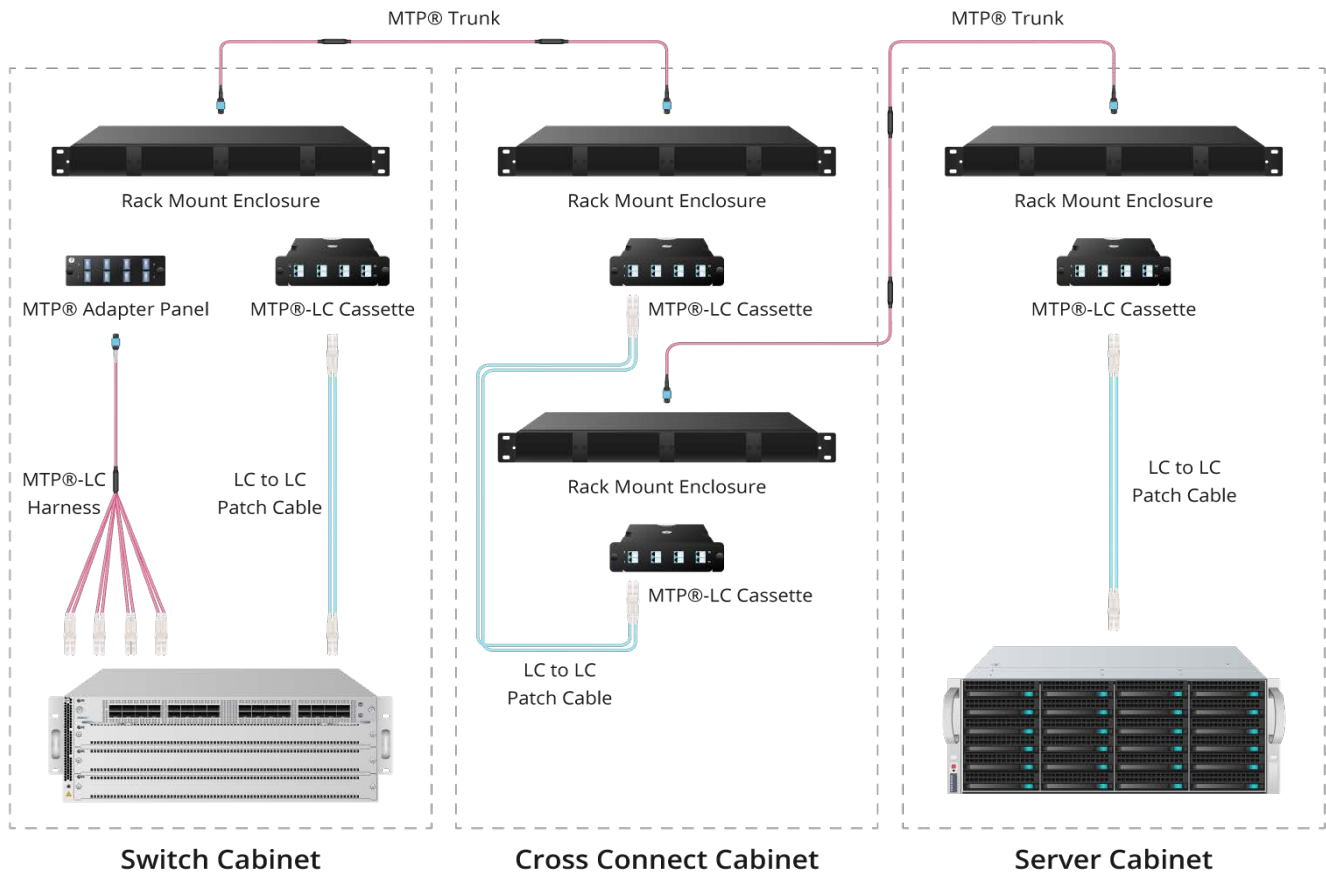
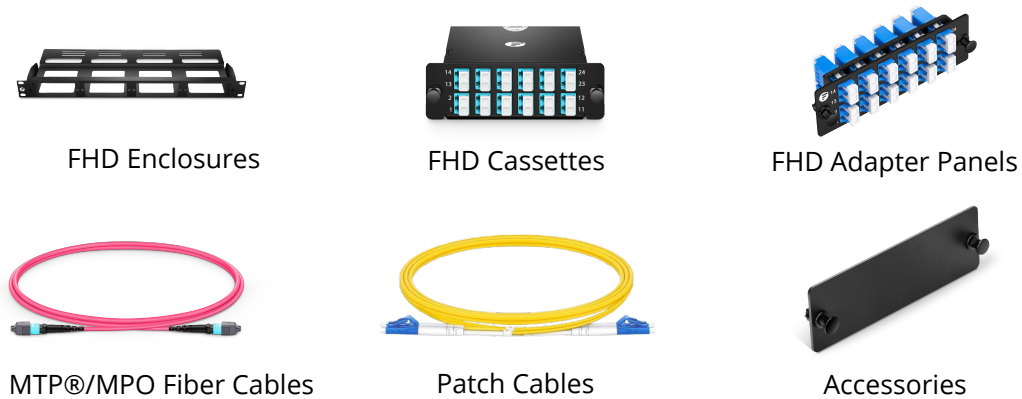


Figure 2: Cross Connect

2. FHD Series Components



2.1 FHD Fiber Enclosures

Available in 1-RU, 2-RU, and 4-RU, supporting 144 fibers per rack unit, and can be reconfigured to accept 4-port, 8-port, or 12-port, cassettes or adapter panels.

Provides a flexible and modular system for managing fiber connections and patching and makes cassettes or panels quickly snap in and pull out, making installation, moves, adds, and changes easier than ever. The detachable design, sliding drawer or tilt-down drawer provide multiple choices for your application.



Table 1. FHD Fiber Enclosures Configuration

Product	RU	Compatibility Cassettes/Adapter panels	Type
FHD-1UFMT-N	1U	4	Fixed
FHD-1UFCE	1U	4	Sliding Drawer
FHD-2UFCE	2U	8	Sliding Drawer
FHD-4UFCE	4U	12	Sliding Drawer
FHD-1UCMP400	1U	4	Fixed
FHD-FPP5DRL	1U	4	Fixed
FHD-1UFMT-S	1U	4	Sliding and Tilt-down Drawer

2.2 FHD Fiber Cassettes

Available in Base-8, Base-12, and Base-24 MTP® connectors' MTP®-LC/Conversion/Mesh cassettes that are fully compatible with all FHD enclosures.

- 0.35dB Ultra Low-loss MTP® Connectors for Longer Link Distances
- Offered in A Wide Range of Polarity Configurations (A/AF/U)
- Interface Color-coding Makes It Easy to Identify Fiber Type
- Snap-in Front Mount Allows for Easy Installation into Enclosures
- For Main, Horizontal, and Equipment Distribution Areas in Data Center Cabling



Table 2. FHD MTP®-LC Universal Polarity Cassettes

Product	Fiber Type	Fiber Count
FHD-1MTP4LCDOS2U	OS2	8F
FHD-1MTP4LCDOM4U	OM4	8F
FHD-1MTP6LCDOS2U	OS2	12F
FHD-1MTP6LCDOM4U	OM4	12F
FHD-2MTP8LCDOM4U	OM4	16F
FHD-3MTP12LCOS2U	OS2	24F
FHD-3MTP12LCOM4U	OM4	24F

Note: Universal Polarity are used at both ends of a Method B Trunk

Table 3. FHD MTP®-LC A/AF Polarity Cassettes

Product	Fiber Type	Fiber Count
FHD-1MTP6LCDOS2A	OS2	12F
FHD-1MTP6LCDOS2AF	OS2	12F
FHD-1MTP6LCDOM4A	OM4	12F
FHD-1MTP6LCDOM4AF	OM4	12F
FHD-2MTP12LCDOS2A	OS2	24F
FHD-2MTP12LCDOS2AF	OS2	24F
FHD-2MTP12LCDOM4A	OM4	24F
FHD-2MTP12LCDOM4AF	OM4	24F
FHD-1MTP12LCDOS2A	OS2	24F
FHD-1MTP12LCDOS2AF	OS2	24F
FHD-1MTP12LCDOM4A	OM4	24F
FHD-1MTP12LCDOM4AF	OM4	24F
FHD-3MTP18LCDOS2A	OS2	36F
FHD-3MTP18LCDOS2AF	OS2	36F
FHD-3MTP18LCDOM4A	OM4	36F
FHD-3MTP18LCDOM4AF	OM4	36F

Note: Type A and AF are used as a pair in a two cassette Method A link

Table 4. FHD MTP® Conversion & Mesh Cassettes

Product	Modular Type	Fiber Type
FHD-2MTP3MTP8OS2	2 x 12F MTP® to 3 x 8F MTP®	OS2
FHD-2MTP3MTP8OM5	2 x 12F MTP® to 3 x 8F MTP®	OM5
FHD-2MTP3MTP8OM4	2 x 12F MTP® to 3 x 8F MTP®	OM4
FHD-4MTP6MTP8OM4	4 x 12F MTP® to 6 x 8F MTP®	OM4
FHD-1MTP3MTP8OS2	1 x 24F MTP® to 3 x 8F MTP®	OS2
FHD-1MTP3MTP8OM4	1 x 24F MTP® to 3 x 8F MTP®	OM4
FHD-8MTPMESHOS2	8 x 8F MTP® to 8 x 8F MTP	OS2

Table 4. FHD MTP® Conversion&Mesh Cassettes

Product	Modular Type	Fiber Type
FHD-8MTPMESHOM4	8 x 8F MTP® to 8 x 8F MTP	OM4
FHD-4MTPMESHOS2	4 x 8F MTP® to 4 x 8F MTP®	OS2
FHD-4MTPMESHOM4	4 x 8F MTP® to 4 x 8F MTP®	OM4

2.3 FHD Adapter Panels

Available in LC/SC/ST/MDC/MTP® Connectors for employing a fiber infrastructure as you migrate to higher network speeds, panels are fully compatible with all FHD enclosures.

- Interface Color-coding Makes It Easy to Identify Fiber Type
- Clear Numbering for Quick Fiber Identification
- Tool-less Snap Installation for Easier MACs

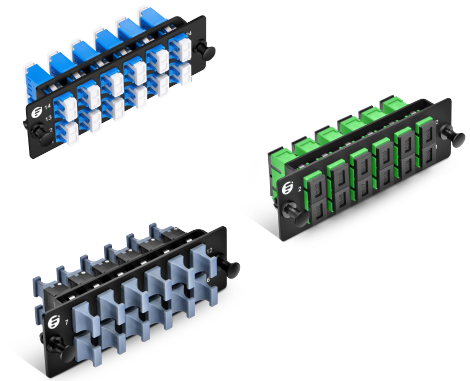


Table 5. FHD LC Adapter Panels

Product	Fiber Type	Fiber Count
FHD-FAP12LCDXSMF	OS2/UPC	24F
FHD-FAP12LCADZSMF	OS2/APC	24F
FHD-FAP12LCDOM5	OM5	24F
FHD-FAP12LCDX10GMM	OM4	24F
FHD-FAP18LCDXSMF	OS2/UPC	36F
FHD-FAP18LCDXMMF	OM4	36F

Table 6. FHD MTP® Adapter Panels

Product	Number of Ports	Key Orientation
FHD-FAP8MTPHB	8	Up-Up
FHD-FAP12MTPHA	12	Up-Down

2.4 Cable Assemblies

Available with Patch Cords/Jumper/Trunk/Harness in various jackets and fiber types to meet any application designed to interconnect or cross-connect fiber networks within structured cabling systems.

- Color-coded Connector Boots/Cable Jacket for Easy Identification
- Custom Polarities and Pins Available
- Cable Jacket Available in Riser, OFNP, and LSZH Flame Rating
- Optical Performance Test for Normal Network Connections



Table 7. LC/UPC Duplex Pre-terminated Patch Cords

Product	Fiber Type	Product Classification
SMLCDX	OS2	Fiber Patch Cables
OM5LCDX	OM5	Fiber Patch Cables
OM4LCDX	OM4	Fiber Patch Cables
OM3LCDX	OM3	Fiber Patch Cables
SMXXDX	OS2	Customized
OM5XXDX	OM5	Customized
OM4XXDX	OM4	Customized
OM3XXDX	OM3	Customized
HD-SMFULCDX	OS2	Flat Clip Uniboot
HD-OM4FULCDX	OM4	Flat Clip Uniboot
HD-SMXXULCDX	OS2	Customized
HD-OM4XXULCDX	OM4	Customized
HD-OM3XXULCDX	OM3	Customized

Table 8. MTP® Jumpers

Product	Fiber Type	Fiber Count	Polarity Type
8FMTPOM4	OM4	8F	Type A
8FMTPOM4	OM4	8F	Type B
8FMTPOM3	OM3	8F	Type A
8FMTPOM3	OM3	8F	Type B
12FMTPSMF	OS2	12F	Type A
12FMTPSMF	OS2	12F	Type B
12FMTPOM5	OM5	12F	Type A
12FMTPOM5	OM5	12F	Type B
12FMTPOM4	OM4	12F	Type A
12FMTPOM4	OM4	12F	Type B
12FMTPOM3	OM3	12F	Type A
12FMTPOM3	OM3	12F	Type B
16FMTPSMF	OS2	16F	Type B
16FMTPOM4	OM4	16F	Type B
24FMTPSMF	OS2	24F	Type A
24FMTPOM5	OM5	24F	Type A
24FMTPOM4	OM4	24F	Type A

Table 9. MTP®/MPO Trunks

Product	Fiber Type	Fiber Count	Polarity Type
8FMTPSMF	OS2	8F	Type A
8FMTPOM4	OM4	8F	Type A
12FMTPSMF	OS2	12F	Type A
12FMTPOM4	OM4	12F	Type A
12FMTPOM3	OM3	12F	Type A
16FMTPSMF	OS2	16F	Type A

Table 9. MTP®/MPO Trunks

Product	Fiber Type	Fiber Count	Polarity Type
16FMTPOM4	OM4	16F	Type A
24FMTPSMF	OS2	24F	Type A
24FMTPOM4	OM4	24F	Type A
24FMTPOM3	OM3	24F	Type A
32FMTPSMF	OS2	32F	Type A
32FMTPOM4	OM4	32F	Type A
36FMTPSMF	OS2	36F	Type A
36FMTPOM4	OM4	36F	Type A
36FMTPOM3	OM3	36F	Type A
48FMTPSMF	OS2	48F	Type A
HD-48FMTPLCSMF	OS2	48F	Type B
48FMTPOM4	OM4	48F	Type A
48FMTPOM4/HD-48FMTPLCOM4	OM4	48F	Type B
48FMTPOM3	OM3	48F	Type A
48FMTPOM3/48FMTPLCOM3	OM3	48F	Type B
72FMTPOM4	OM4	72F	Type B

Table 10. MTP® Harness

Product	Fiber Type	Fiber Count
8FMTPLCSMF	OS2	OS2
8FMTPLCOM4	OM4	OM4
16FMTPLCSMF	OS2	OS2
16FMTPLCOM4	OM4	OM4

2.5 Enclosure Accessories

Available in blanking adapter panel, modular panel, splice tray, and fiber slack management spool.

- Blank Fiber Adapter Panel Compatible with All FHD Series Fiber Enclosures
- Modular Panel Hybrid Solution for Mixing Fiber and Copper Cabling
- Splice Tray Stack 4 High, Up to 144 fibers in 1U FHD Enclosure
- Management Spool Effectively Manage and Organize Excess Fiber Cable Slack

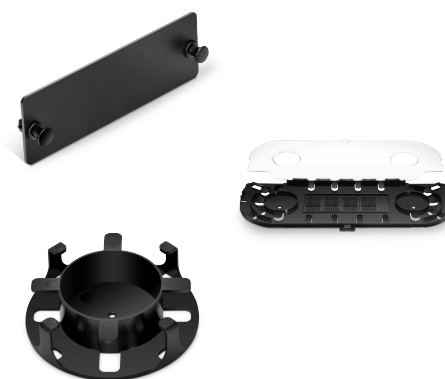


Table 11. Enclosure Accessories

Product	Description
FHD-FAPB	Blanking Fiber Adapter Panel for FHD Fiber Enclosure
FHD-FAPM6	6-Port Multimedia Copper/Fiber Modular Panel with 6 x Plastic Clips
FHD-FOSMF-24F	Fiber Optical Splice Tray 24 Fusion for FHD Rack Mount Fiber Enclosure
FHD-FOSMF-36F	Fiber Optical Splice Tray 36 Fusion for FHD Rack Mount Fiber Enclosure
FHD-FMS	Fiber Slack Management Spool for FHD Fiber Enclosure

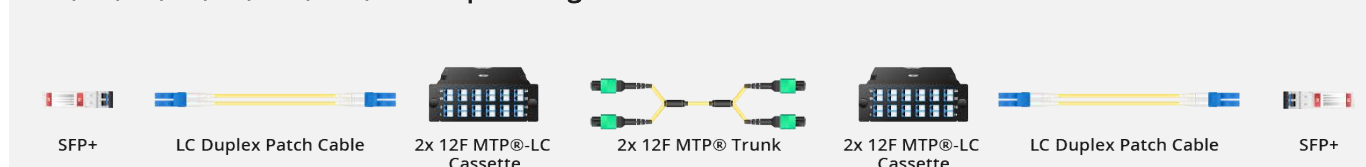
3. Fiber Migration Configuration

FHD Cabling System makes 10G to 40G to 100G to 200G to 400G to 800G migration easy. FS recommends using Method B polarity for single mode or multimode parallel fiber solutions. Method B (Key-Up to Key-Up array connectivity) is widely used throughout the industry and is discussed in TIA-568-C.1, it streamlines network deployment ensures consistent polarity, and reduces the complexity of a fiber network.

To assist with the array of polarity and gender, FS is offering the MTP® PRO, which is a gender/polarity changeable MTP® connector. MTP® PRO will allow for either male/female gender or Key-Up/Key-Down or Key-Up/Key-Up MTP® trunk configurations. At the same time, FS supports the customization of various types of connectors to meet your diverse needs.

3.1 Single Mode

For 1, 10, 25, 40, 50, 100, 200, 400 Gbps Configurations

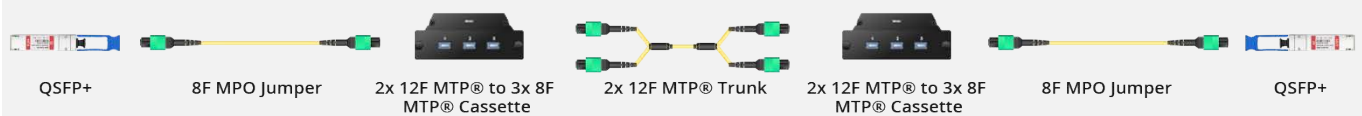


- 12-fiber MTP backbone
- Provides duplex (2 fibers) connectors for equipment
- Universal polarity cassettes allow for the same interchangeable cassette on both ends of a Method B trunk in a fiber channel

Supports the following modules:

- SFP28 25GBASE-ER/-LR-S
- QSFP+ 40GBASE-LR4/-ZR4
- QSFP28 50GBASE-ZR2
- QSFP28 100GBASE-ZR4/-ER/-FR/-LR/LR4/CWDM4
- SFPDD 100GBASE-DR/-FR/-LR
- QSFP56 200GBASE-LR4/-FR4
- QSFP-DD 400GBASE-FR4/-LR4/-ER4/-LR4L/-LR8

For 40, 100, 400, 800 Gbps Configurations



- 12-fiber MPO backbone stays in place
- Swap out MTP-LC cassettes for MTP-MTP conversion cassettes
- Provides Parallel (8-fiber) connections to equipment
- Universal polarity cassettes allow for the same interchangeable cassette on both ends of a Method B trunk in a fiber channel

Supports the following modules:

- QSFP28 100GBASE-PSM4-S/-PLR4L/-PLR4
- QSFP-DD 400GBASE-XDR4/-DR4/-FR, QDD-4X100G-LR
- QSFP112 400GBASE-DR4/-XDR4
- OSFP 400GBASE-DR4
- OSFP 800GBASE-DR8/-PLR8/-XDR8

For 40, 100, 400, 800 Gbps Configurations



- 12-fiber MTP Backbone stays in place
- Swap out MTP-LC/MTP-MTP cassettes with MTP pass-thru adapter panels
- Provides Parallel 12-fiber connections to equipment

Supports the following modules:

- QSFP28 100GBASE-PSM4-S/-PLR4L/-PLR4
- QSFP-DD 400GBASE-XDR4/-DR4/-FR, QDD-4X100G-LR
- QSFP112 400GBASE-DR4/-XDR4
- OSFP 400GBASE-DR4
- OSFP 800GBASE-DR8/-PLR8/-XDR8

3.2 Multimode

For 10, 25, 40, 50, 100 Gbps Configurations

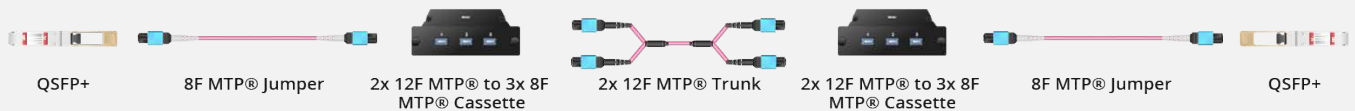


- 12-fiber MTP backbone
- Provides duplex (2 fibers) connectors for equipment
- Universal polarity cassettes allow for the same interchangeable cassette on both ends of a Method B trunk in a fiber channel

Supports the following modules:

- SFP28 25GBASE-SR/-CSR
- SFP56 50GBASE-SR
- QSFP28 40/100GBASE-SM4
- QSFP+ 40GBASE-SR/-SR Bi-Di

For 40, 100, 200, 400 Gbps Configurations

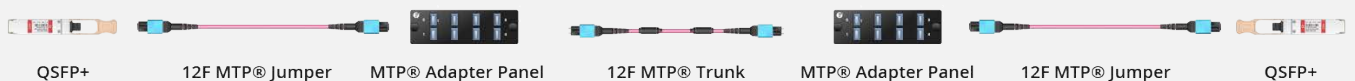


- 12-fiber MTP backbone stays in place
- Swap out MTP-LC cassettes for MTP-MTP conversion cassettes
- Provides Parallel (8-fiber) connections to equipment
- Universal polarity cassettes allow for the same interchangeable cassette on both ends of a Method B trunk in a fiber channel

Supports the following modules:

- QSFP28 100GBASE-SR4/-ESR4/-SL4
- QSFP28 100/112GBASE-SR4
- QSFP56 200GBASE-SR4
- QSFP-DD 400GBASE-SR4.2/-SR4
- QSFP112 400GBASE-SR4

For 40, 100, 200, 400 Gbps Configurations



- 12-fiber MTP backbone stays in place
- Swap out MTP-LC/MTP-MTP cassettes with MTP pass-thru adapter panels
- Provides Parallel 12-fiber connections to equipment

Supports the following modules:

- QSFP28 100GBASE-SR4/-ESR4/-SL4
- QSFP28 100/112GBASE-SR4
- QSFP56 200GBASE-SR4
- QSFP-DD 400GBASE-SR4.2/-SR4
- QSFP112 400GBASE-SR4

4. Technical Specifications

Table 12. Fiber Attenuation and Bandwidth Performance Metrics

Fiber Type	Core Diameter	Attenuation (dB/km)				Minimum Effective Modal Bandwidth (MHz·km)		Minimum Overfilled Launch Bandwidth (MHZ·km)		
		850	1300	1310	1550	850	953	850	953	1300
OM3	50μm	3.0	1.0	/	/	2000	/	1500	/	500
OM4	50μm	3.0	1.0	/	/	2000	/	3500	/	500
OM5	50μm	3.0	1.0	/	/	4700	2470	3500	1850	500
OS2	9μm	/	/	0.36	0.22	/	/	/	/	/

Table 13. Ethernet Speeds and Fiber Transmission Standards

Gigabit Ethernet	Ethernet Standard	Fiber Type	Maximum Channel Length
2G	1000BASE-SX	OM3/OM4	550m
	1000BASE-LX	OS2	10km
10G	10GBASE-SR	OM3/OM4	300m/400m
	10GBASE-LR	OS2	10km
40G	40GBASE-SR4	OM3/OM4	100m/150m
	40GBASE-SR	OM3/OM4	150m
	40GBASE-SM4	OM3/OM4	100m
	40GBASE-LR4	OS2	10km
	40GBASE-ZR4	OS2	80km
100G	100GBASE-SR4	OM3/OM4	70m/100m
	100GBASE-SL4	OM3/OM4	100m
	100GBASE-ESR4	OM3/OM4	300m
	100GBASE-SWDM4	OM5	150m
	100GBASE-CWDM4	OS2	2km
	100GBASE-DR	OS2	500m
	100GBASE-LR4	OS2	10km

Gigabit Ethernet	Ethernet Standard	Fiber Type	Maximum Channel Length
100G	100GBASE-FR	OS2	25km
	100GBASE-ER	OS2	40km
	100GBASE-ZR4	OS2	80km
200G	200GBASE-SR4	OM3/OM4	70m/100m
	200GBASE-2SR4	OM3/OM4	100m
	200GBASE-FR4	OS2	2km
	200GBASE-LR4	OS2	10km
400G	400GBASE-SR4	OS2	70m/100m
	400GBASE-SR4.2	OS2	70m/100m
	400GBASE-DR4	OS2	500m
	400GBASE-FR4	OS2	2km
	400GBASE-XDR4	OS2	10km
	400GBASE-LR8	OS2	10km
800G	800GBASE-DR8	OS2	500m
	800GBASE-PLR8	OS2	2km
	800GBASE-XDR8	OS2	10km

Table 14. Fiber Channel Speeds and Transmission Media Standards

Fiber Channel Data Rate	Medium Standard	Fiber Type	Channel Length
2G	200-M5E-SN-I	OM3	0.5m-500m
	200-SM-LL-I	OS2	2m-2km
	200-SM-LC-L	OS2	2m-10km
4G	400-M5E-SN-I	OM3	0.5m-380m
	400-M5F-SN-I	OM4	0.5m-400m
	400-SM-LL-I	OS2	2m-2km
	400-SM-LC-M	OS2	2m-4km
	400-SM-LC-L	OS2	2m-10km
8G	800-M5E-SN-I	OM3	0.5m-150m
	800-M5F-SN-I	OM4	0.5m-190m
	800-SM-LC-I	OS2	2m-1.4km
	800-SM-LC-L	OS2	2m-10km
16G	1600-M5E-SN-I	OM3	0.5m-100m
	1600-M5F-SN-I	OM4	0.5m-125m
	1600-SM-LZ-I	OS2	0.5m-2km
	1600-SM-LC-L	OS2	0.5m-10km
32G	3200-M5F--SN-I	OM4	0.5m-100m
	3200-SM-LC-L	OS2	0.5m-10km

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