From Fast to Faster
A Journey Through Cutting-Edge Transceiver Tech,
Backbone Infrastructures, and AI/ML Connectivity

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Sales Manager Scandinavia
In-Building Networks & DC EMEA
Corning Optical Communications
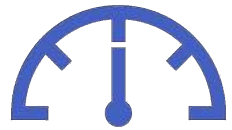Stockholm, December 7th , 2023

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What Are We Going to Talk About?

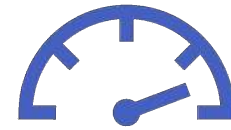## How much data can you transfer in 1 second?

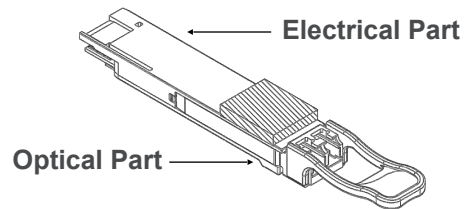● 10G   ● 40G   ● 100G   ● 200G   ● 400G   ● 800G   ● 1.6T

In simple words, how do we do it?

Electrical Part

Optical Part

Switches   **Transceiver**   **Optical Fiber Components**   **Transmit / Receive**

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Corning's Way of Working

Voice of Customer + **Voice of Technology** + **R&D** = **Future-ready**

Voice of Customer	Voice of Technology	R&D	Future-ready
Hyper	CISCO	EDGE™	TCO
MTDC	ARISTA	EDGE8®	🔴 10G
Enterprise	DELL EMC	Clean Advantage™	🟢 40G
	BROADCOM	EDGE™ Rapid Connect	⚪ 100G
		EDGE™ MDC	🔵 200G
			🟡 400G
			🟢 800G
			🟣 1.6T

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How Can The Cabling be Done?

Point-to-Point Cabling (Unstructured Cabling)

The cabling starts with a few connections . . .
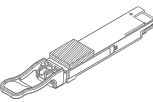

And this is how it ends up ...

Current methods can be complicated
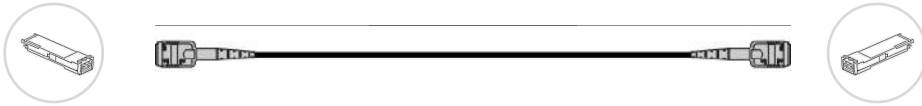
❯ No defined cable paths

❯ Problem determination difficult

❯ Changes made at active equipment

❯ System growth can be impacted

Structured Cabling

Spine Switch | 1 | 2 | 3 | Leaf Switch
5 | 6

■ MDA ■ Switch ■ EDA ■ Horizontal Cabling ■ Housing

MTP Patch Cords
MTP patch cords with MTP PRO to allow field management of pinning and polarity. MTP patch cords support parallel optics like QSFP, QSFP-DD and OSFP

MTP Adapter Panel
Reverse polarity adapter for field polarity management

Trunk
MTP trunk with 100 lb pulling grip to simplify installation

Module
MTP-LC cassette to support port breakout functionality

LC Uniboot Patch Cords
Reverse polarity uniboot patch cords minimize patch cord density and optimize routing

❯ Maximizes space and reduces installation time and cost

❯ Moves, adds, and changes (MACs) can be made easily

❯ A structured cabling system will provide the extra space needed for future growth

❯ A well-planned infrastructure can last 15-20 years and remain operational through multiple generations of system equipment and data-rate increases

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How Can The Cabling be Done?

Point-to-Point Cabling (Unstructured Cabling)

Switch Connectivity
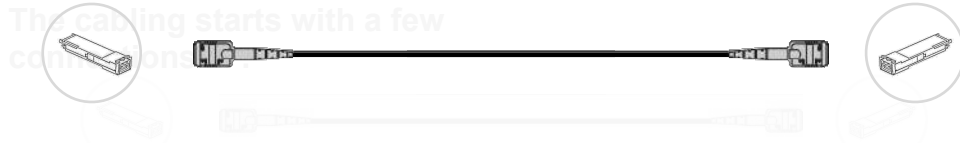
Duplex LC Interface	MPO-8/12 Interface	MPO-16 APC Interface	Quad SN Interface
Dual Duplex LC Interface	Dual MPO-12 Interface	MPO-12 Two-Row Interface	8x MDC and SN Interface
Dual Mini-LC Interface	Dual CS Interface	Quad MDC Interface	

LC Dup   Mini-LC

● Transceiver footprint available in the market

● Transceiver footprint not yet available

Structured Cabling

Backbone

Base-2	Base-8	Base-12	Base-16	Base-24
Trunks with 2-fiber increments	Trunks with 8-fiber increments	Trunks with 12-fiber increments	Trunks with 16-fiber increments	Trunks with 24-fiber increments
LC Dx Interface	MPO-12 Interface	MPO-12 Interface	MPO-16 Interface	MPO-12 Two Row

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Transceiver Roadmap and Backbone of Choice

Transceiver Speed	10G	25G	40G	40G	50G	100G	100G	100G	200G	200G	200G	400G	400G	400G	400G	800G	800G	800G	800G	1.6T
Pluggable Module	SFP	SFP	SFP / QSFP		SFP / QSFP	SFP / SFP-DD / QSFP / QSFP-DD / OSFP			QSFP / QSFP-DD / SFP-DD			QSFP / QSFP-DD / OSFP				QSFP / QSFP-DD / OSFP				QSFP / QSFP-DD / OSFP / OSFP-XD
SMF	LR	LR	LR4 FR4	PLR4 PLRL4	LR FR	LR FR DR LR4 CWDM4	*N/A*	PSM4	LR4 FR4 FR DR	*N/A*	DR4	LR8 FR8 FR4 LR4-6 LR4-10	2FR4	DR4 DR2 DR4-2	*N/A*	LR8 FR8	2LR4 2FR4 FR4	DR4 DR4-2	2DR4 2PLR4 8FR DR8 DR8-2	DR8 DR8-2
MMF	SR	SR	BiDi SWDM4	SR4 eSR4	SR	BiDi SWDM4 VR SR	SR2	SR4 eSR4	*N/A*	VR2 SR2	SR4	*N/A*	*N/A*	SR4.2 VR4 SR4	SR8	*N/A*	*N/A*	VR4.2 SR4.2	SR8 VR8 2VR4 2SR4	VR8.2 SR8.2
Fibers per transceiver	2	2	2	8	2	2	4 (2x2)	8	2	4 (2x2)	8	2	4 (2x2)	8	16 (16x1)	2	4 (2x2)	8	16 (8x2 or 16x1)	16 (8x2 or 16x1)
Base-2	●	●	●	○	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Base-8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Base-12	●	●	●	○	●	●	●	○	●	●	○	●	●	○	○	●	●	○	○	○
Base-16	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	●	⊙	⊙	⊙	●	●
Base-24	●	●	●	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○

Legend:

- ● Allow full scalability, 100% fiber utilization and migration
- ⊙ Allow scalability and migration. Limited backward compatibility with existing Base-8 and Base-12 backbones / installations
- ○ Scalability and migration complexity in some degree (base conversion components, partial fiber utilization)
- - Not recommended due to scalability limitations and high complexity

Backbone

Base-2	**Base-8**	**Base-12**	**Base-16**	**Base-24**
Trunks with 2-fiber increments	Trunks with 8-fiber increments	Trunks with 12-fiber increments	Trunks with 16-fiber increments	Trunks with 24-fiber increments
LC Dx Interface	MPO-12 Interface	MPO-12 Interface	MPO-16 Interface	MPO-12 Two Row

The connector in the backbone is relevant for: Flexibility, Migration to new technologies, Scalability, TCO

SFP — QSFP-DD — OSFP — QSFP — SFP-DD — OSFP-XD
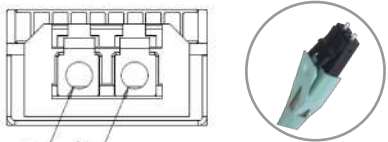
Picture source: Ethernet Alliance

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OSFP Optical Interfaces

2-Fiber Transceivers

Duplex LC Optical Interface

4-Fiber Transceivers

Dual Duplex LC Optical Interface

Dual Mini-LC Optical Interface

LC Dup   Mini-LC

Dual CS Optical Interface

8-Fiber Transceivers
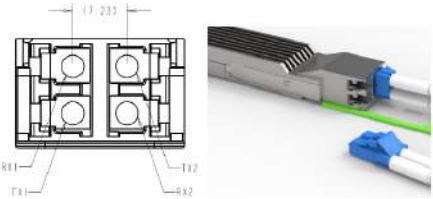
MPO-8/12 Optical Interface

Quad SN Optical Interface

Quad MDC Optical Interface

16-Fiber Transceivers
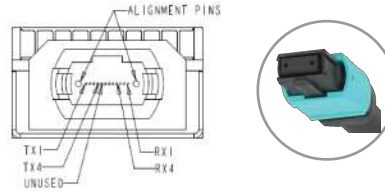
Dual MPO-12 Optical Interface
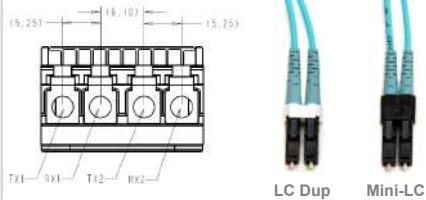
MPO-16 Optical Interface
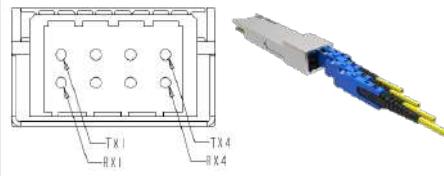
MPO-12 Two Row Optical Interface
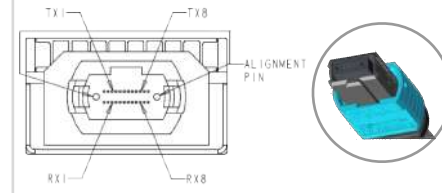
8x MDC and SN Optical Interface

MDC   SN
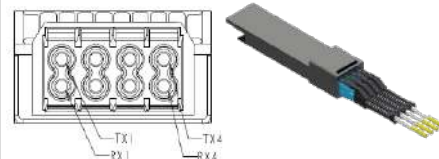
● Footprint available in the market   ● Footprint available and high adoption expected   ● Transceiver footprint **not** yet available

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Base - 8 Backbone

MPO-12 Interface

Backbone

ALIGNMENT PINS

TX1 — RX1
TX4 — RX4
UNUSED

Trunks with 8-fiber increments

Base-8 supports the following data rates

Migration

● 10G ● 40G ● 100G ● 200G ● 400G ● 800G ● 1.6T

Switch Connectivity

Duplex LC Interface	MPO-12 Interface	MPO-16 APC Interface	Quad SN Interface
Dual Duplex LC Interface	Dual MPO-12 Interface	MPO-12 Two-Row Interface	8x MDC and SN Interface
Dual Mini-LC Interface	Dual CS Interface	Quad MDC Interface	

MDC   SN

LC Dup   Mini-LC

● Transceiver footprint available in the market

● Transceiver footprint not yet available

Cabling Infrastructure

EDGE8 Solutions

Rotatable Strain-Relief Flex   EDGE8 TAP Modules   Tool-Less, Snap-On Integration Clip   Base-8 Pinned Trunk

Adjustable Mounting Bracket

Patch Cord Routing Guides

Top and Bottom Parking Locations

EDGE8® Harness

LC Duplex Uniboot Patch Cords   Grey Colour and Imprinted "8"   Port Breakout Module   4-Port MTP to MTP Panel with shuttered Adapters   8-Fiber MTP Patch Cord
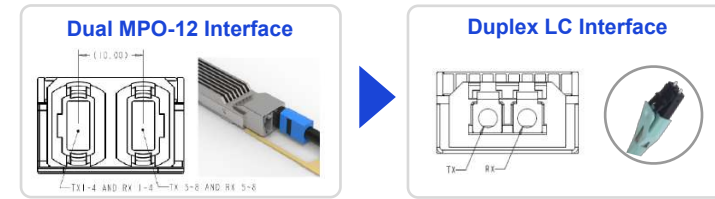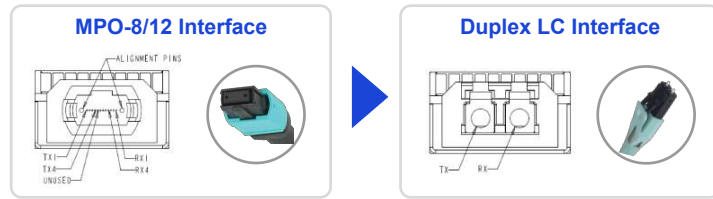
Where Used

- **Backwards compatible** with existing Base-8 and Base-12 architectures.

- Used in **small to large data centers**, enabling **migration to new transceiver technologies** with minimal to no change in existing structured cabling

- Widely believed to be the **most flexible option** to accommodate future industry trends, supporting deployments of new varieties of connectors at the transceiver, with full fiber utilization

✓ The best option supporting **migration** from 10G to 1.6T

✓ Supports Base-2, Base-8 and Base-16 connectivity with **duplex and parallel architectures**

✓ Support port **breakout solutions** to save space, power and cooling

✓ Supports **network monitoring** without adding separate space consuming hardware

✓ Supports keyed connectivity for **Secure Solutions**

✓ Supports **latency sensitive** applications

✓ **High Density** supporting **144F** per RU using **LC Dx** or **576F** per RU using **MTP-8**

✓ **Optical frames** available in single and dual versions: **5,760 duplex** or **23,040 parallel fibers**

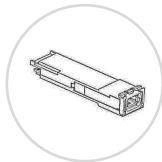*1.6T Transceivers using LC Duplex are also expected to be launched to the market

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Base-8 Infrastructure Scalability Adaptation

Example: MPO-12 to LC Duplex Across the Data Center With Trunk

MPO-8/12 Interface ➤ **Duplex LC Interface**

Near End Optic (Left)		Far End Optic (Right)		Reach
QSFP-40G-SR4	multimode	4 x 10GBASE-SR	multimode	150m
QSFP-40G-CSR4	multimode	4 x 10GBASE-SR	multimode	400m
QSFP-100G-SR4-S	multimode	4 x SFP-25G-SR-S	multimode	100m
QDD-400G-SR4.2-BD	multimode	4 x QSFP-100G-SR1.2	multimode	150m
QSFP-4X10G-LR-S	single-mode	4 x 10GBASE-LR	single-mode	10km
QDD-400G-DR4-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	500m
QDD-4X100G-FR-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	2km
QDD-4X100G-LR-S	single-mode	4 x QSFP-100G-LR-S	single-mode	10km

Dual MPO-12 Interface ➤ **Duplex LC Interface**

Near End Optic (Left)		Far End Optic (Right)		Reach
QDD-8X100G-FR	single-mode	8 x QSFP-100G-FR 8 x QSFP-100G-LR	single-mode	2km
		8 x QSFP-100G-DR		500m

Spine Switch

MTP-8 Patch-Cord
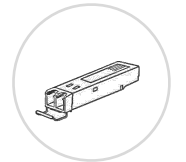
MTP-8/12 Adapter Panel

MTP-8 Trunk

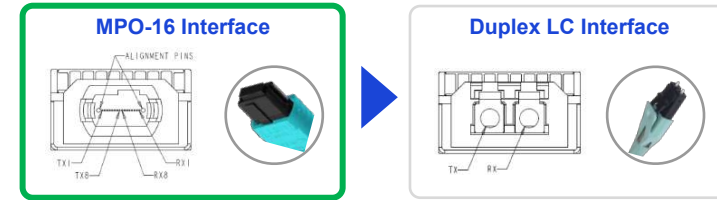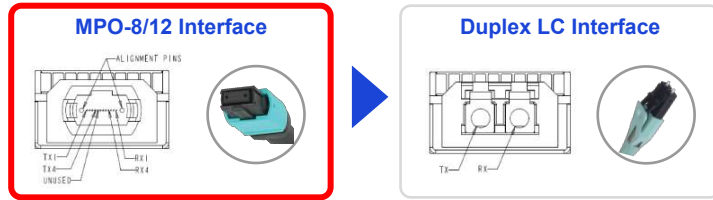**MTP-8 to LC Dx Module**

LC Uni Patch-Cord
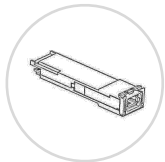
Leaf Switch

Infrastructure remains unchanged for SMF or MMF

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Base-8 Infrastructure Scalability Adaptation

What if the path of migration implies a different type of connector?

MPO-8/12 Interface   **Duplex LC Interface**   **MPO-16 Interface**   **Duplex LC Interface**

Near End Optic (Left)		Far End Optic (Right)		Reach
QSFP-40G-SR4	multimode	4 x 10GBASE-SR	multimode	150m
QSFP-40G-CSR4	multimode	4 x 10GBASE-SR	multimode	400m
QSFP-100G-SR4-S	multimode	4 x SFP-25G-SR-S	multimode	100m
QDD-400G-SR4.2-BD	multimode	4 x QSFP-100G-SR1.2	multimode	150m
QSFP-4X10G-LR-S	single-mode	4 x 10GBASE-LR	single-mode	10km
QDD-400G-DR4-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	500m
QDD-4X100G-FR-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	2km
QDD-4X100G-LR-S	single-mode	4 x QSFP-100G-LR-S	single-mode	10km

Near End Optic (Left)		Far End Optic (Right)		Reach
QDD-8X100G-FR	single-mode	8 x QSFP-100G-FR 8 x QSFP-100G-LR	single-mode	2km
QDD-400G-SR8-S	multimode	8 x SFP56-50G-SR	multimode	100m

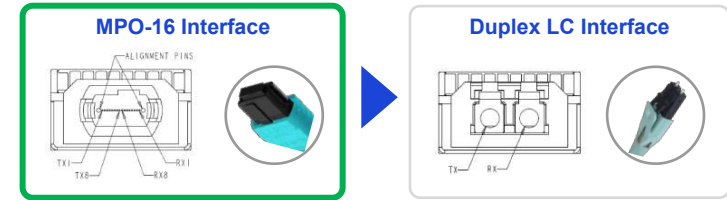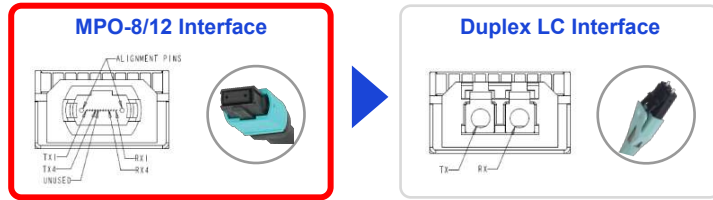**Spine Switch**   **MTP-8 Patch-Cord**   **MTP-8/12 Adapter Panel**   **MTP-8 Trunk**   **MTP-8 to LC Dx Module**   **LC Uni Patch-Cord**   **Leaf Switch**

CORNING
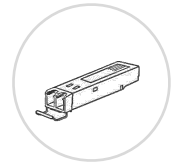
Base-8 Infrastructure Scalability Adaptation

Example: MPO-16 APC to LC Duplex Across the Data Center With Trunk

MPO-8/12 Interface	Duplex LC Interface

MPO-16 Interface	Duplex LC Interface

Near End Optic (Left)		Far End Optic (Right)		Reach
QSFP-40G-SR4	multimode	4 x 10GBASE-SR	multimode	150m
QSFP-40G-CSR4	multimode	4 x 10GBASE-SR	multimode	400m
QSFP-100G-SR4-S	multimode	4 x SFP-25G-SR-S	multimode	100m
QDD-400G-SR4.2-BD	multimode	4 x QSFP-100G-SR1.2	multimode	150m
QSFP-4X10G-LR-S	single-mode	4 x 10GBASE-LR	single-mode	10km
QDD-400G-DR4-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	500m
QDD-4X100G-FR-S	single-mode	4 x QSFP-100G-FR-S 4 x QSFP-100G-DR-S	single-mode	2km
QDD-4X100G-LR-S	single-mode	4 x QSFP-100G-LR-S	single-mode	10km

Near End Optic (Left)		Far End Optic (Right)		Reach
QDD-8X100G-FR	single-	8 x QSFP-100G-FR 8 x QSFP-100G-LR	single-	2km
QDD-400G-SR8-S	multimode	8 x SFP56-50G-SR	multimode	100m

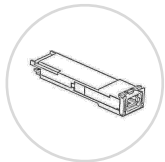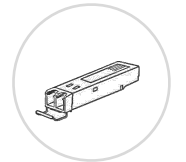|					
Spine Switch	MTP-16 to 2x MTP-8 Patch-Cord	MTP-8/12 Adapter Panel	MTP-8 Trunk	MTP-8 to LC Dx Module	LC Uni Patch-Cord	Leaf Switch

Rest of Infrastructure in MMF remains unchanged

Artificial Intelligence & Machine Learning


Image Source: ChatGPT

ChatGPT was trained using **10,000 of Nvidia's GPUs** clustered together in a supercomputer on Azure.

Moreover, there plans for significantly increased GPU usage, with speculation that their **upcoming AI model** may require as many as **10 million GPUs**.

NVIDIA dominates the market for chips used in AI systems, with about 95% of the GPU market for ML.

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NVIDIA - 800G and 400G - Switch to Switch

MPO-8/12 APC to MPO-8/12 APC Across DC with Trunk Application: Quantum-2 InfiniBand or Spectrum-4 Ethernet to a) Quantum-2 InfiniBand or Spectrum-4 Ethernet; b) ConnectX-7 and Bluefield-3; c) DGX H100/Cedar-7 links
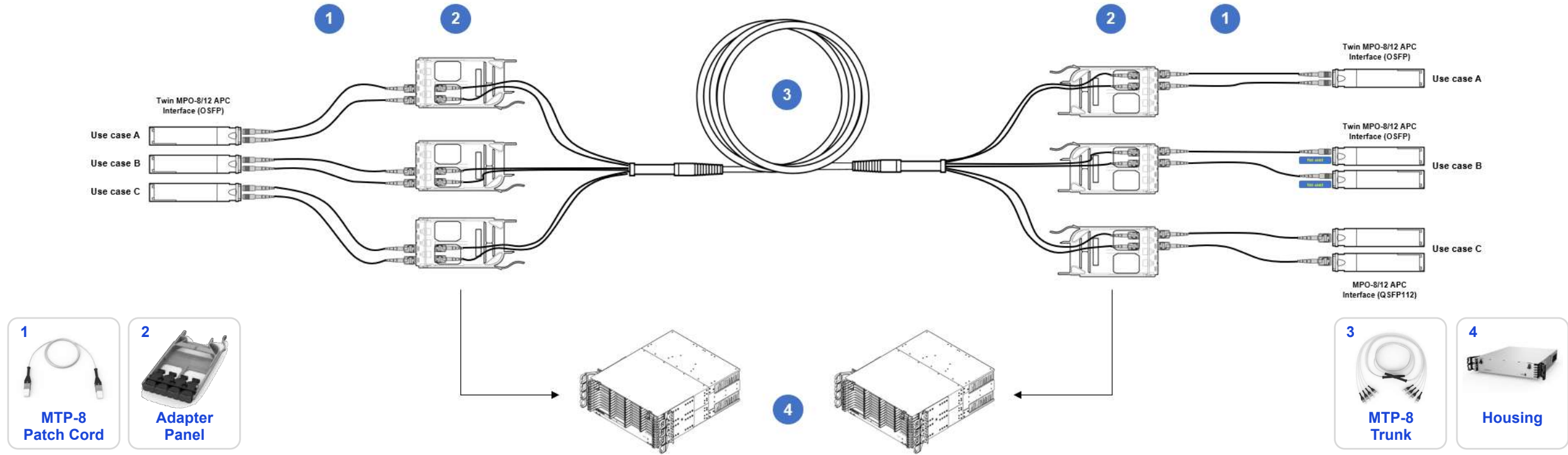
Use case	Near End Optic (Left)			Far End Optic (Right)			Reach	Fiber Type
	Speed	NVIDIA Port	Footprint - Fiber/ Transceiver	Speed	NVIDIA Port	Footprint - Fiber/ Transceiver		
A	800G-DR8	MMS4X00-NM	OSFP - 2x 8F	800G-DR8	MMS4X00-NM	OSFP - 2x 8F	500m	Single mode
A	800G-DR8	MMS4X00-NS	OSFP - 2x 8F	800G-DR8	MMS4X00-NS	OSFP - 2x 8F	100m	Single mode
A	800G-DR8	MMS4X00-NS-FLT	OSFP - 2x 8F	800G-DR8	MMS4X00-NS	OSFP - 2x 8F	100m	Single mode
B	800G-DR8	MMS4X00-NS	OSFP - 2x 8F	1x 400G-DR4	MMS4X00-NS400	OSFP - 8F	100m	Single mode
C	800G-DR8	MMS4X00-NS	OSFP - 2x 8F	1x 400G-DR4	MMS1X00-NS400	QSFP112 - 8F	100m	Single mode
A	800G-SR8	MMA4Z00-NS	OSFP - 2x 8F	800G-SR8	MMA4Z00-NS	OSFP - 2x 8F	50m	Multimode
A	800G-SR8	MMA4Z00-NS-FLT	OSFP - 2x 8F	800G-SR8	MMA4Z00-NS	OSFP - 2x 8F	50m	Multimode
B	800G-SR8	MMA4Z00-NS	OSFP - 2x 8F	1x 400G-SR4	MMA4Z00-NS400	OSFP - 8F	50m	Multimode
C	800G-SR8	MMA4Z00-NS	OSFP - 2x 8F	1x 400G-SR4	MMA1Z00-NS400	QSFP112 - 8F	50m	Multimode

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Planning for Migration

- ○ **The path to higher speeds** will always depend on your unique needs.

- ○ You may be happy with 40G now but planning to **upgrade to 100G** four years from now. Or maybe you are working with 400G and have your **eyes set on 800G** in five years: Migration will always vary based on your timeline and the available technologies in the market.

- ○ But in most cases, **Base-8 will provide the ideal level of flexiblity to meet your needs throughout your transition**.

- ○ Corning's **EDGE8 structured cabling solutions** will support your transition needs, doesn't matter if we talk about **Ethernet or InfiniBand**

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