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SN® and SN®-MT Polarity Cabling Guide

40G, 100G, 400G, 800G and 1.6T

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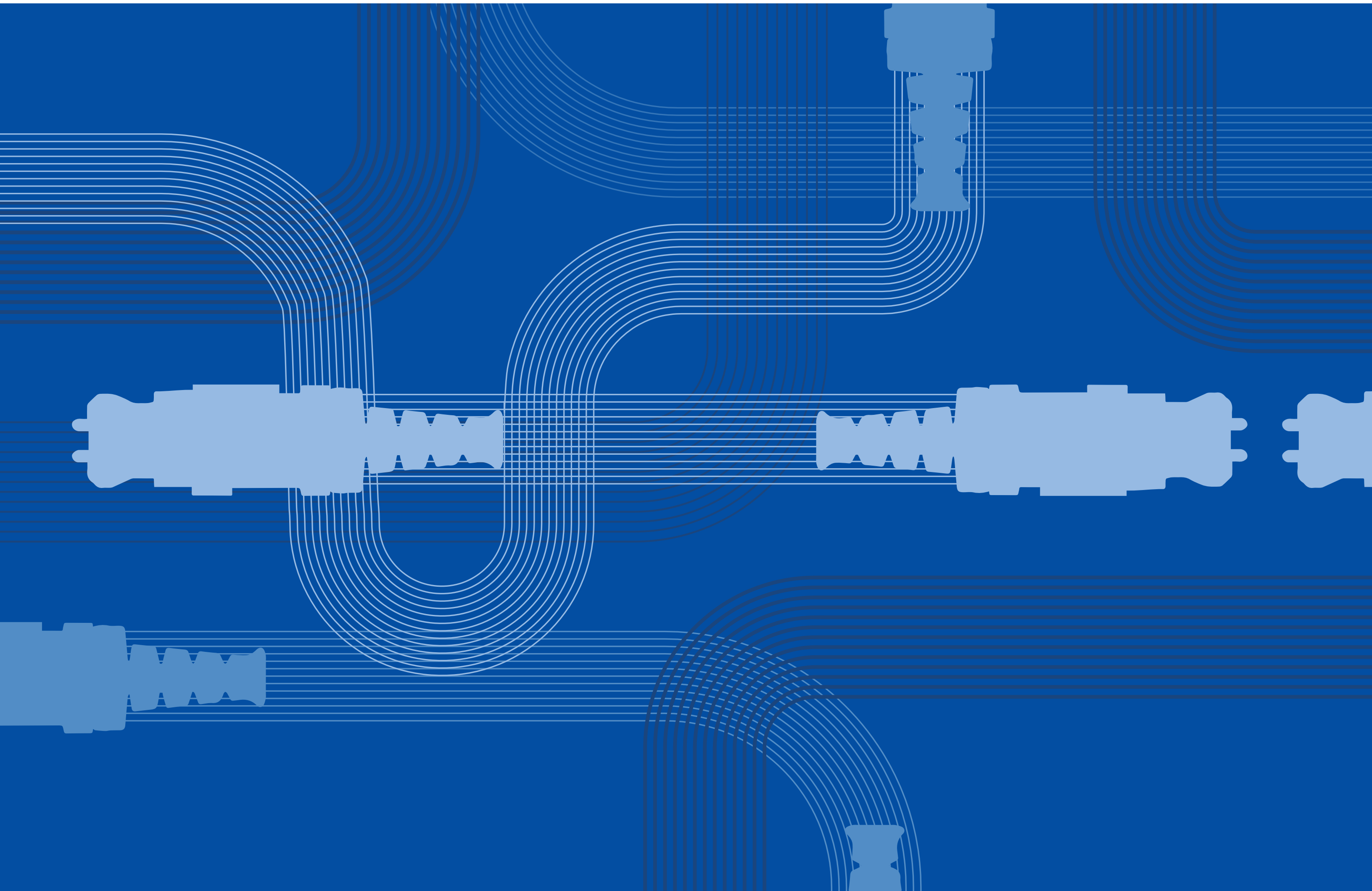


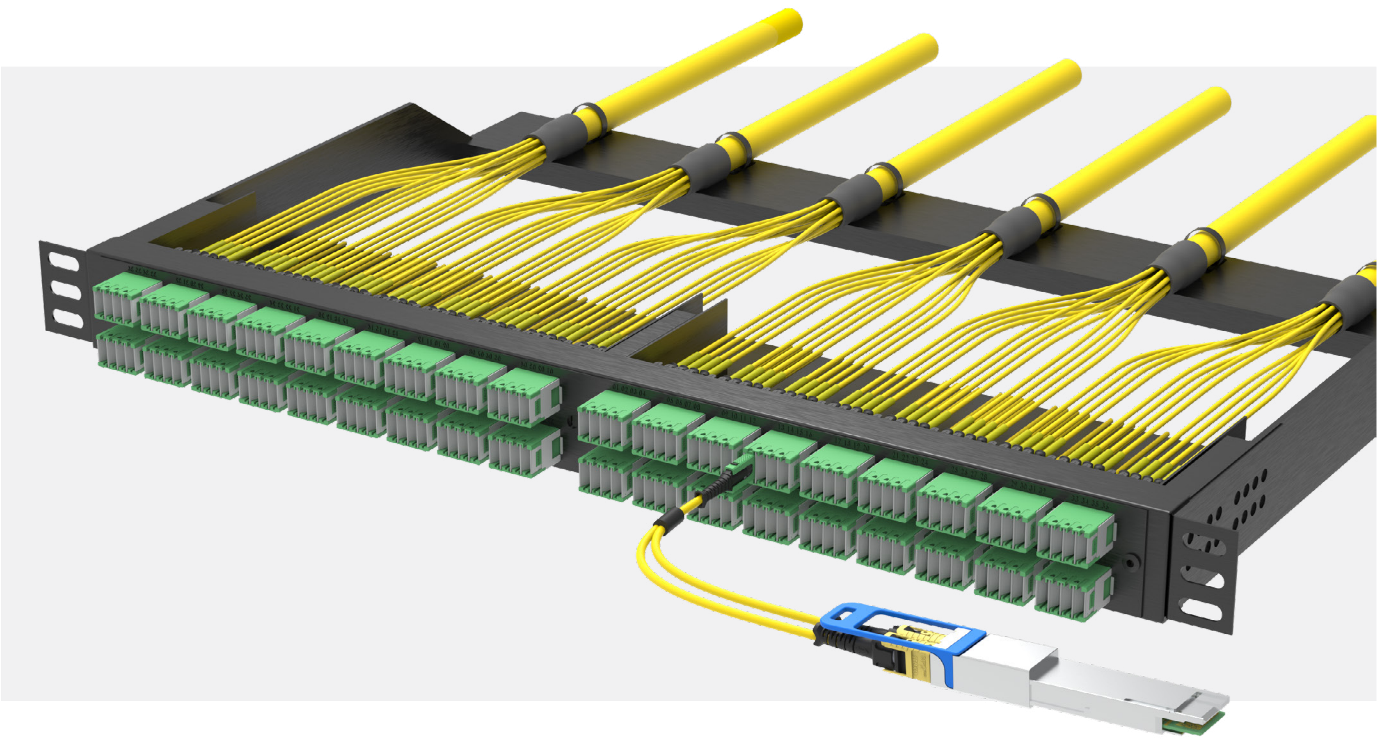
SN® and SN®-MT Polarity Cabling Guide

Contents

SENKO SN® and SN®-MT Connector Solutions

The rapid evolution of optical interconnects from 40G to 1.6T is driving demand for higher fiber density, improved cable management, and scalable breakout architectures. Traditional duplex and MPO connectivity approaches are increasingly challenged by port density, airflow, and migration requirements in hyperscale and enterprise data centers.

SENKO's SN® and SN®-MT connector ecosystem addresses these challenges through compact duplex, quad, and multi-fiber interfaces optimized for next-generation transceivers including QSFP, QSFP-DD, OSFP, and future 1.6T form factors.

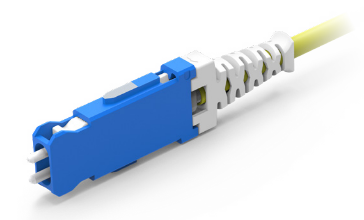


As data center optical interfaces evolve from duplex to parallel and co-packaged architectures, correct Tx to Rx fiber routing becomes a primary system design risk. This reference guide provides practical structured cabling examples for 40G, 100G, 400G, 800G, and 1.6T applications, illustrating polarity management, transceiver interoperability, breakout architectures and migration paths between SN®, SN®-MT, and MPO-based connectivity with a focus on standards-compliant lane alignment, polarity control and scalable migration paths from 40G through 1.6T.

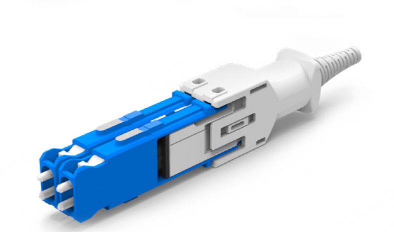
SN® Connector Ecosystem

SENKO's SN® connector family is designed for next-generation transceivers and cabling. The evolution of high-speed optical networks demands connector solutions that deliver superior density, performance, and flexibility. SENKO's SN® Connector Ecosystem is engineered to meet these challenges, enabling next-generation transceiver designs and cabling architectures for data centers, telecom, and high-performance computing environments.

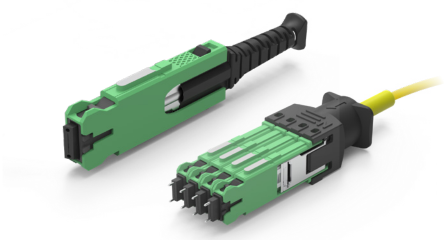
The SN® family offers a comprehensive range of options tailored for diverse applications:



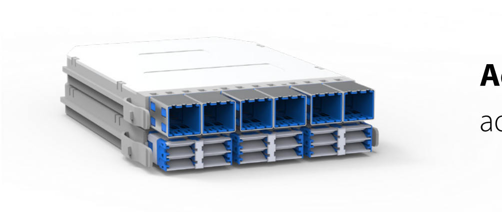
SN® Duplex: A compact 2-fiber solution designed as a high-density replacement for LC connectors.



SN® Quad: A 4-fiber format optimized for breakout and aggregation scenarios.



SN®-MT: A multi-fiber connector supporting 8F, 16F, and 32F configurations for maximum density.



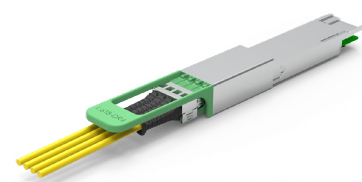
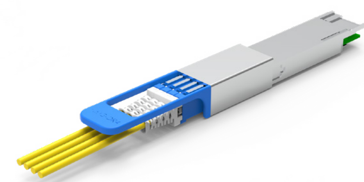
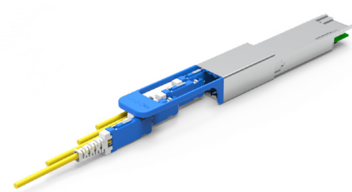
Adapter Panels & Cassettes: Featuring dual and quad SN® adapters, available in shuttered or non-shuttered designs.

The ecosystem simplifies polarity management with A-A aligned adapters, ensuring consistent orientation and reducing design complexity. Additionally, fiber optic trunks and jumpers leverage 200 µm coatings for improved agility and reduced cable bulk compared to traditional 250 µm solutions.

Together, these innovations position the SN® connector platform as a cornerstone for scalable, high-density optical connectivity in modern network infrastructures.

SN® and SN®-MT Transceiver Connector Types

As data center architectures evolve toward higher speeds and denser connectivity, selecting the right transceiver interface becomes critical. Several transceiver manufacturers offer a broad portfolio of 400G and 100G transceivers that support SENKO SN® and SN®-MT connectors, enabling seamless integration with modern structured cabling designs. These options provide flexibility for direct connections, breakout configurations, and migration paths between different interface types. The following section outlines examples of transceiver connector types highlighting compatibility with SN® and SN®-MT solutions.
The following list shows compatible transceiver interfaces:

Form Factor	Connector	Example Transceivers
OSFP-400G	SN®-MT 16F / SN® Quad	OSFP-400G-DR4 OSFP-400G-XDR4 OSFP-400G-PLR4 
QSFP-100G	SN® Duplex / SN® Quad	QSFP-100G-DR QSFP-100G-FR QSFP-100G-LR 
QSFP-40G	SN® Duplex	QSFP-40G-SR4 QSFP-40G-PLR4 

With SN®-MT emerging as a high-density fiber interface standard, data centers can leverage multiple interconnect strategies to optimize performance and scalability. From simple straight-through links to complex breakout and hybrid configurations, SN®-MT enables efficient fiber utilization while supporting diverse transceiver technologies.

Design Rule 1 – Always Preserve Tx/Rx Polarity: Throughout the optical channel, transmitter (Tx) lanes must always be routed to the corresponding receiver (Rx) lanes. Proper polarity management through trunk selection, adapter orientation, and breakout cable design is essential to ensure standards-compliant lane alignment, reliable link operation, and interoperability across SN®, SN®-MT, and MPO-based infrastructures.
The next section explores eight practical interconnect scenarios, illustrating how SN®-MT can be deployed across patch panels, backbone cabling, and mixed connector environments while maintaining correct polarity to meet the demands of 400G, 800G, and future 1.6T networks.

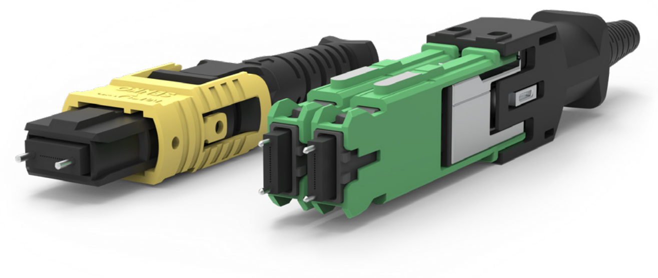


Table 1. MPO and SN®-MT Polarity and Adapter Types

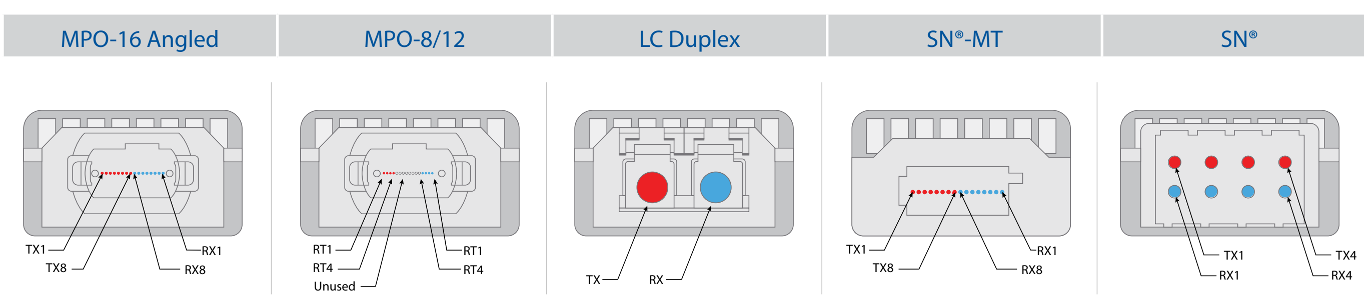
Type	Connector Orientation	Fiber Mapping	Description
Type A	MPO: Key-Up to Key-Down SN®-MT: Key-Up to Key-Up only	1⇨1 (No transposition)	Type-A adapters preserve fiber position alignment at the mating interface.
Type B	MPO: Key-Up to Key-Up	Reversed (1⇨N)	Type-B cables or adapters introduce full fiber position inversion.
Type C	MPO: Key-Up to Key-Down	Pairwise (1⇔2)	Type-C cables perform pairwise fiber transposition.

Note 1: Table 1 is based on the TIA 568 MPO polarity convention (also aligned with IEC 61754 7 terminology for MPO interfaces)

Note 2: SN®-MT vs MPO connector orientation (vertical vs horizontal) means MPO Type-A adapter alone does not guarantee system polarity. SN®-MT connectors use vertical fiber orientation while MPO connectors use horizontal fiber orientation as it also depends on Cable type A vs B. For both interfaces, a Type-A adapter preserves fiber position alignment (1⇨1 mapping) at the mating interface. Due to connector orientation differences:

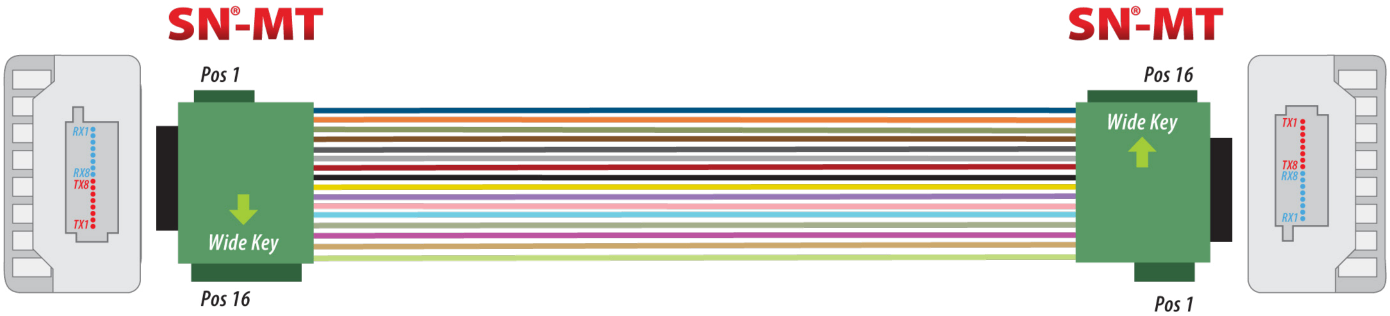
- MPO (horizontal) Type-A adapters mate key-up to key-down
- SN®-MT (vertical) Type-A adapters mate key-up to key-up

In both cases, this results in positional alignment (fiber 1 to fiber 1 through fiber 16 to fiber 16) across the adapter interface.



SCENARIO 1: SN®-MT to SN®-MT Across Data Center

Type-B trunk, A adapters, direct patching



The simplest configuration is a direct connection from Transceiver to transceiver. In this scenario, a Type-B SN®-MT trunk cabling runs across rows, connecting SN®-MT transceivers on each end. This configuration is primarily a theoretical example, as most production deployments include patching, breakout, or structured cabling infrastructure.

Example: A 400G-XDR4 QSFP module connected via an SN®-MT 16-fiber trunk, using SN®-MT transceivers on both ends.

Benefits

- Low Complexity: Minimal components and straightforward installation.
- Reduced Latency: Fewer connection points mean lower insertion loss and latency.
- Ideal for Short Runs: Works well in small-scale or lab environments.

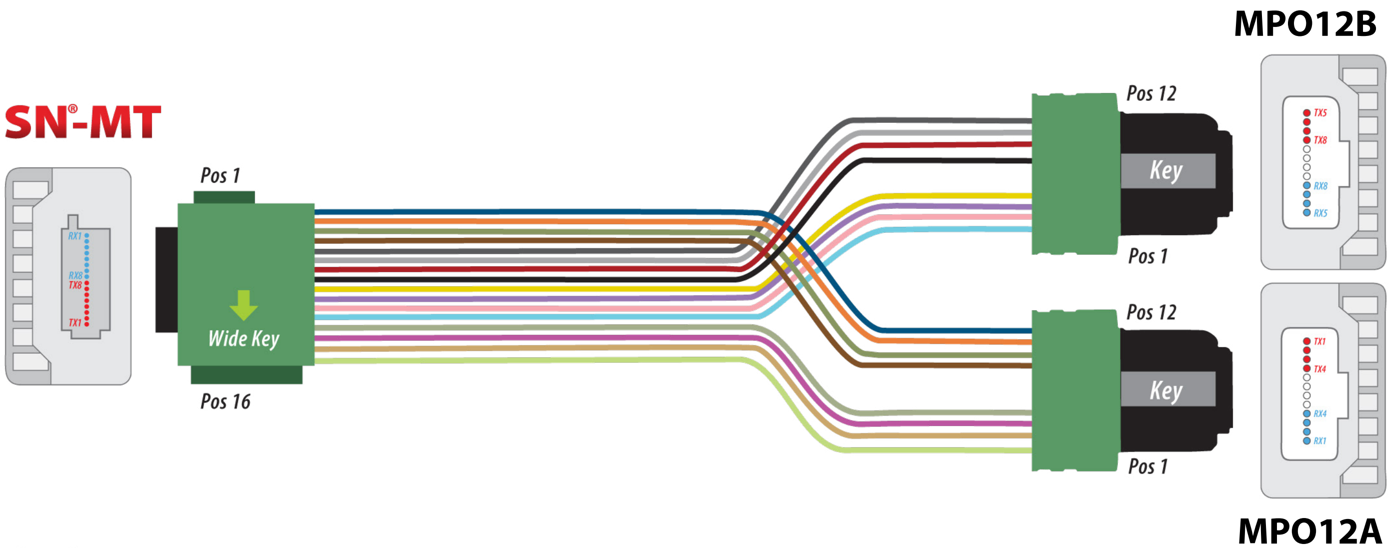
Limitations

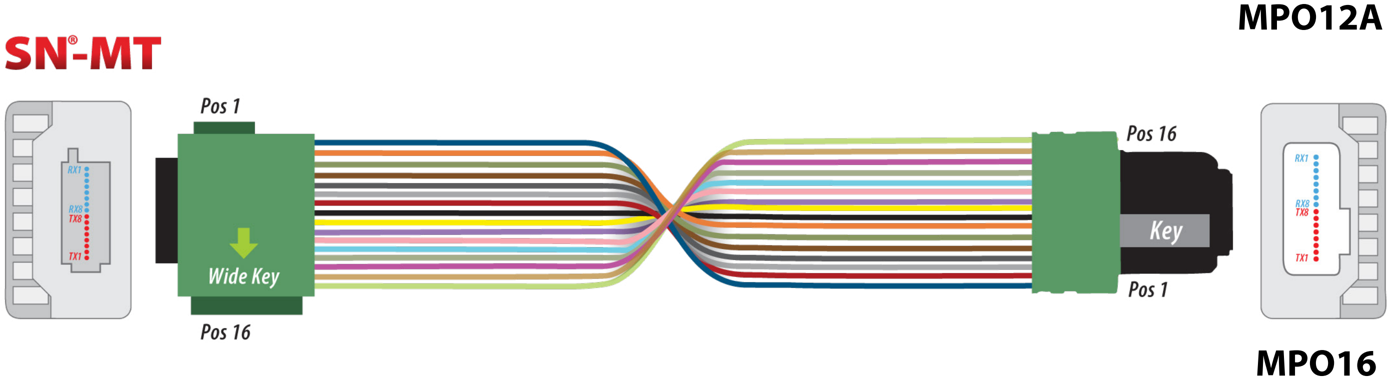
- Limited Flexibility: No breakout capability for mixed-speed environments.
- Scalability Issues: Difficult to adapt for large-scale deployments with diverse connectivity needs.
- Less Common in Production Environments: Most data centers require patching or breakout for structured cabling.

Diagram Description

- Two SN®-MT transceivers (Tx/Rx) on opposite ends.
- A single SN®-MT 16F trunk cable connecting them.

SCENARIO 2: The transceiver (SN®-MT interface) to transceiver (dual MPO 12 interface or single MPO interface) e.g break out to 800G to 2x400 or 1.6T to 800G Hybrid breakout





This scenario involves connecting an SN®-MT interface on one transceiver to an MPO-based interface on another transceiver, enabling breakout configurations such as 800G to 2×400G or 1.6T to 800G. The connection uses SN®-MT to MPO trunks to manage polarity and fiber mapping.

Breakout options:

- 800G ⇨ 2×400G
- 1.6T ⇨ 800G

Example 1 (Top):

- Near-end optic: SN®-MT transceiver (Tx/Rx)
- Far-end optic: Dual MPO-8/12 transceivers where SN®-MT fibers 1-4 + 13-16 mapped to MPO-12 A and SN®-MT and SN®-MT fibers 5-8 + 9-12 to MPO-B

Example 2 (Bottom):

- Near-end optic: SN®-MT transceiver (Tx/Rx)
- Far-end optic: single MPO-16 transceiver

Benefits

- High-Density Connectivity: Supports large-scale deployments with efficient fiber utilization.
- Breakout Flexibility: Enables migration from higher-speed ports to multiple lower-speed ports.
- Standards-Based Polarity: Maintains proper Tx/Rx alignment across complex paths.

Limitations

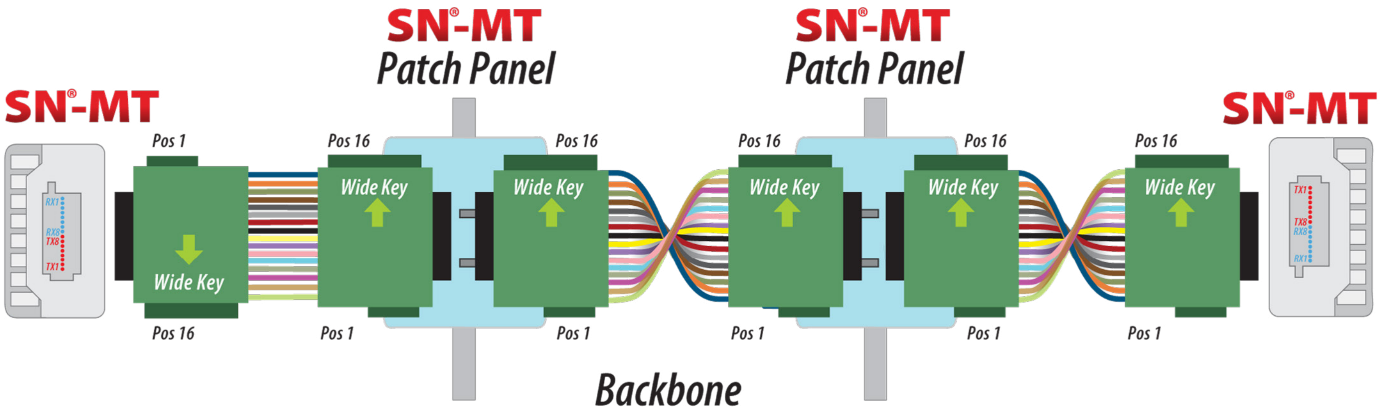
Complex Mapping in Example 1 requires careful polarity planning and lane assignment. Lane reversal occurs at the trunk level.

Diagram Description

- Left: SN®-MT transceiver connected to SN®-MT trunk.
- Middle: Custom trunk cable with custom breakout for Example 1 or Trunk B cable for Example 2.
- Right: MPO-based transceivers (dual MPO-8/12 or single MPO-16).
- Fiber mapping ensures correct Tx/Rx alignment for breakout.

SCENARIO 3: Transceiver (SN®-MT), patch panel, backbone cable and transceiver (SN®-MT) Three SN®-MT B-type cables and 2 A-type adapters

Method B compliant (Type-B trunks, Type-A adapters)



This scenario introduces a structured cabling approach using patch panels and backbone cables for improved manageability and scalability. The connection consists of three SN®-MT B-type cables and 2 A-type adapters, ensuring proper polarity alignment across the link. B trunk reverses positions and A adapters preserve orientation

Configuration:

- Near End: SN®-MT transceiver connected to patch panel via SN®-MT B-type cable.
- Middle: Backbone SN®-MT B-type cable runs through the data center.
- Far End: Patch panel connected to SN®-MT transceiver via another SN®-MT B-type cable.
- Adapters: Two A-type adapters at patch panels maintain correct polarity.

Benefits

- Structured Cabling: Simplifies moves, adds, and changes (MACs).
- Polarity Assurance: Standardized A/B method ensures Tx/Rx alignment.
- Scalability: Supports modular growth and backbone extensions.

Limitations

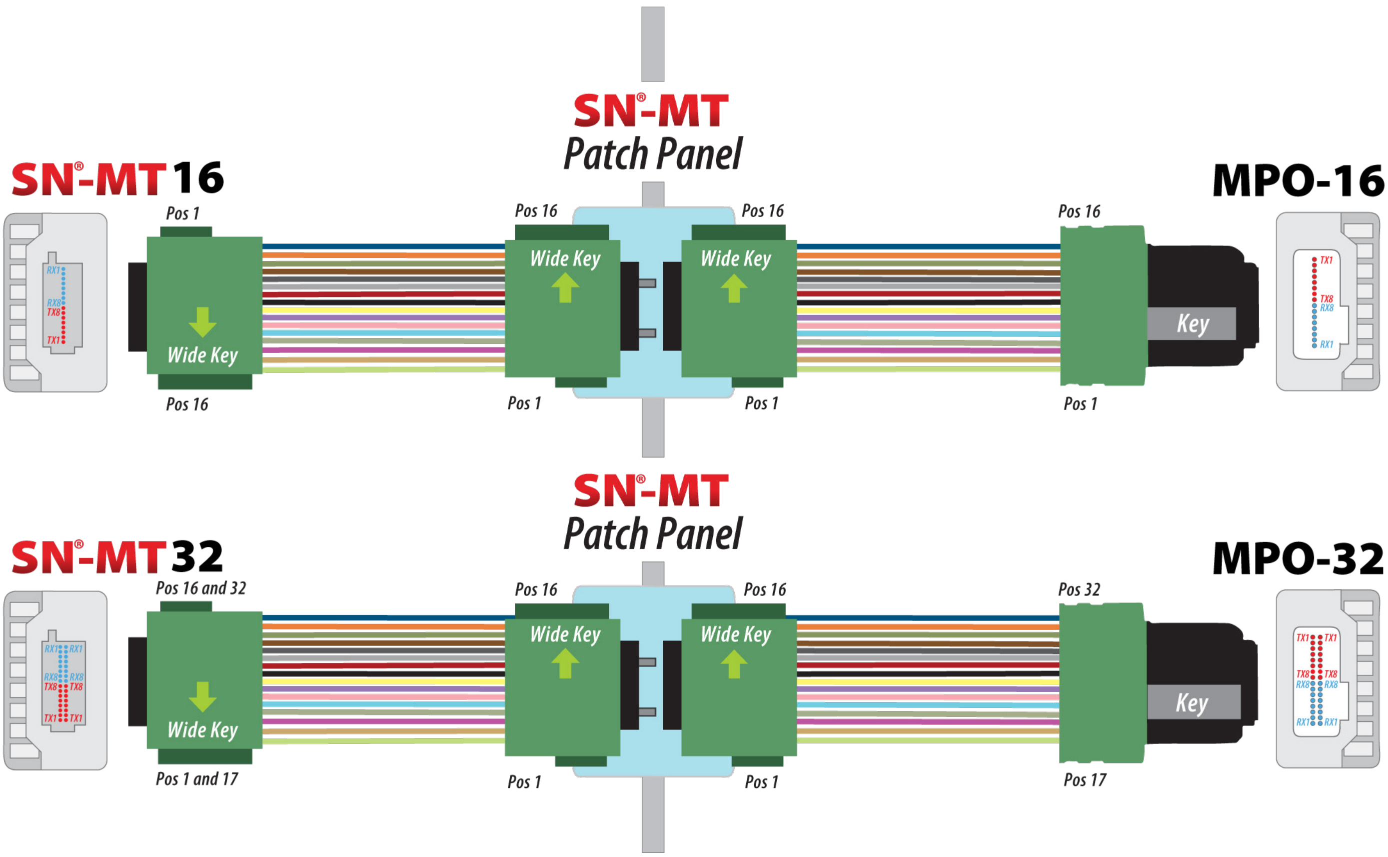
- Higher Component Count: More connectors and adapters increase insertion loss.
- Cost: Additional panels and adapters add to material and labor costs.

Diagram Description

- Left: SN®-MT transceiver connected to patch panel via B-type cable.
- Middle: Backbone SN®-MT B-type cable.
- Right: Patch panel connected to SN®-MT transceiver via B-type cable.
- Two A-type adapters at patch panels for polarity preservation.

SCENARIO 4: Transceiver (SN®-MT), patch panel, backbone cable and transceiver (MPO)

Hybrid Method B with MPO transition



This scenario combines SN®-MT connectivity on one end with MPO connectivity on the other, using structured cabling for flexibility and migration between different interface types. The link includes patch panels and backbone cabling to maintain polarity and fiber mapping.

Configuration:

- Near End: SN®-MT transceiver connected to patch panel via SN®-MT cable.
- Middle: Backbone cable (SN®-MT or hybrid) routed through the data center.
- Far End: Patch panel connected to MPO transceiver via MPO cable.
- A-type adapter: SN®-MT adapter at patch panel for polarity preservation

Benefits

- Interface Flexibility: Supports mixed environments (SN®-MT and MPO).
- Migration Path: Enables transition from SN®-MT-based optics to MPO-based optics.
- Structured Design: Simplifies MACs and polarity management.

Limitations

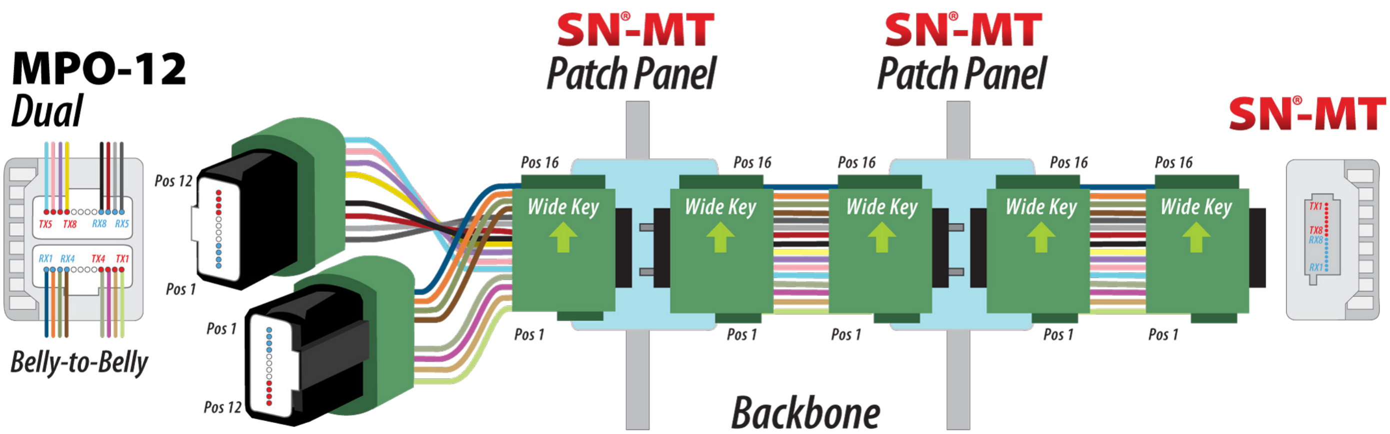
- Complex Fiber Mapping: Requires careful planning for SN®-MT to MPO breakout.
- Higher Loss Budget: Additional adapters and transitions increase insertion loss.
- Cost: More components compared to direct connections.

Diagram Description

- Left: SN®-MT transceiver connected to patch panel.
- Middle: Backbone cable (SN®-MT or hybrid).
- Right: Patch panel connected to MPO transceiver.
- Adapters at both ends for polarity and interface conversion.

SCENARIO 5: Transceiver (SN®-MT), backbone cable directbreak out to transceiver (MPO)

Direct hybrid breakout, equivalent to Method B



This scenario utilizes dual MPO-12 breakout connectivity over an SN®-MT structured cabling backbone. The design maintains end-to-end polarity and supports high-density optical applications, providing a flexible platform for MPO-to-MPO, MPO-to-SN®-MT, and SN®-MT-to-SN®-MT connectivity deployments.

Configuration:

- Near End: SN®-MT transceiver.
- Backbone: Hybrid cable designed for SN®-MT to MPO mapping.
- Far End: MPO transceiver (single or dual MPO interface).
- Breakout Options: 800G ⇨ 2×400G, 1.6T ⇨ 800G

Benefits

- Ideal for High-Speed Links: Supports direct migration paths for 400G/800G/1.6T optics.

Limitations

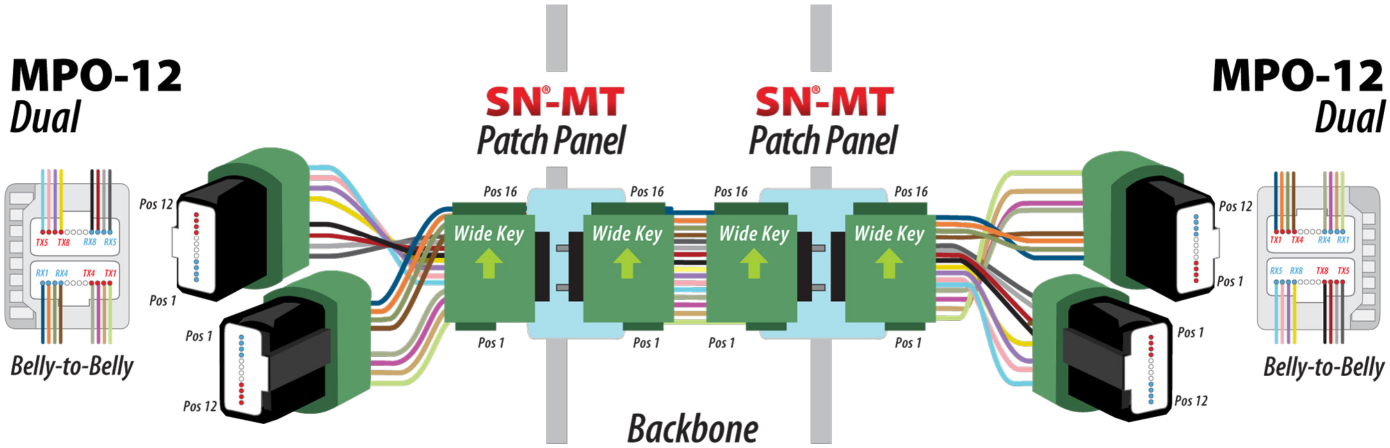
- Limited Flexibility: Harder to manage MACs without patch panels.
- Complex Fiber Mapping: Requires precise SN®-MT to MPO polarity planning.
- Not Ideal for Large-Scale Structured Cabling: Best suited for point-to-point links.

Diagram Description

- Left: MPO transceiver
- Middle: Backbone hybrid cable (MPOs to SN®-MT and SN®-MT to SN®-MT).
- Right: SN®-MT transceiver
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation
- Fiber mapping ensures correct Tx/Rx alignment for breakout.

SCENARIO 6: Transceiver (dual MPO)- patch panel (SN®-MT), backbone cable, patch panel (SN®-MT)- transceiver (dual MPO)

MPO to SN®-MT using Method B Backbone



This scenario utilizes dual MPO-12 breakout connectivity over an SN®-MT structured cabling backbone. The design maintains end-to-end polarity and supports high-density optical applications, providing a flexible platform for MPO-to-MPO, MPO-to-SN®-MT, and SN®-MT-to-SN®-MT connectivity deployments.

Configuration:

- Near End: Dual MPO transceiver connected to SN®-MT patch panel via MPO-to-SN®-MT breakout cable.
- Middle: Backbone SN®-MT cable routed through the data center.
- Far End: SN®-MT patch panel connected to dual MPO transceiver via MPO-to-SN®-MT breakout cable.
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation

Benefits

- Hybrid Connectivity: Supports MPO optics while leveraging SN®-MT backbone for scalability.
- Structured Design: Simplifies MACs and polarity alignment.
- Migration Path: Ideal for transitioning from MPO-based systems to SN®-MT-based systems.

Limitations

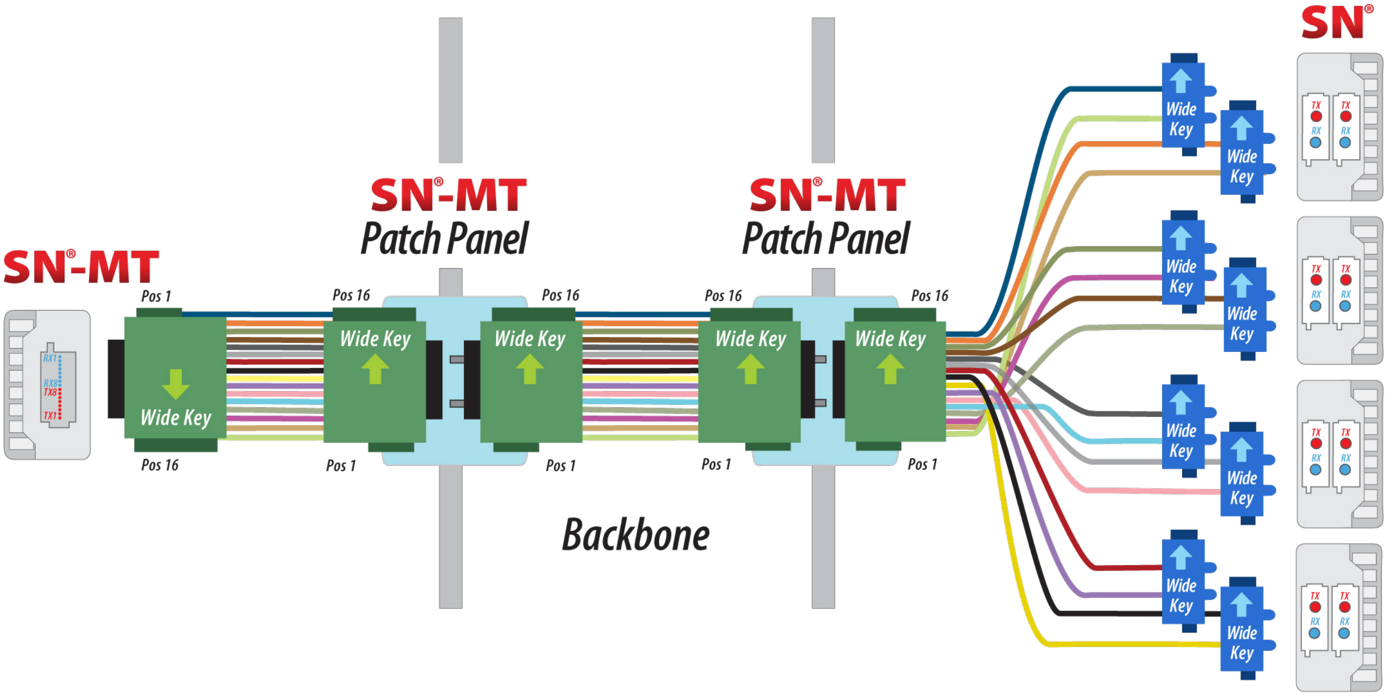
- Complex Mapping: MPO-to-SN®-MT breakout requires precise fiber assignment.
- Higher Loss Budget: Multiple adapters and transitions increase insertion loss.
- Cost: Additional panels and hybrid cables add expense.

Diagram Description

- Left: Dual MPO transceiver connected to SN®-MT patch panel.
- Middle: SN®-MT backbone cable.
- Right: SN®-MT patch panel connected to dual MPO transceiver.
- Breakout cables and adapters clearly labeled.

SCENARIO 7: Transceiver (SN®-MT), patch panel, backbone cable, patch panel, 4 or 8 transceivers (SN®)

SN®-MT to SN® breakout using Type-A Backbone



This scenario connects an SN®-MT transceiver on one end to a multiple SN® transceivers on the other, using structured cabling with patch panels and backbone cable. It is commonly used for breakout or migration from high-density SN®-MT interfaces to individual SN® ports.

Configuration:

- Near End: SN®-MT transceiver connected to SN®-MT patch panel.
- Middle: Backbone SN®-MT cable routed through the data center.
- Far End: SN®-MT patch panel connected to SN® transceiver via SN® patch cords.
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation

Benefits

- Breakout Capability: Enables SN®-MT to SN® conversion for lower-loss optics.
- Structured Design: Simplifies MACs and polarity alignment.
- Migration Path: Ideal for transitioning from high-density SN®-MT to single SN® connectivity.

Limitations

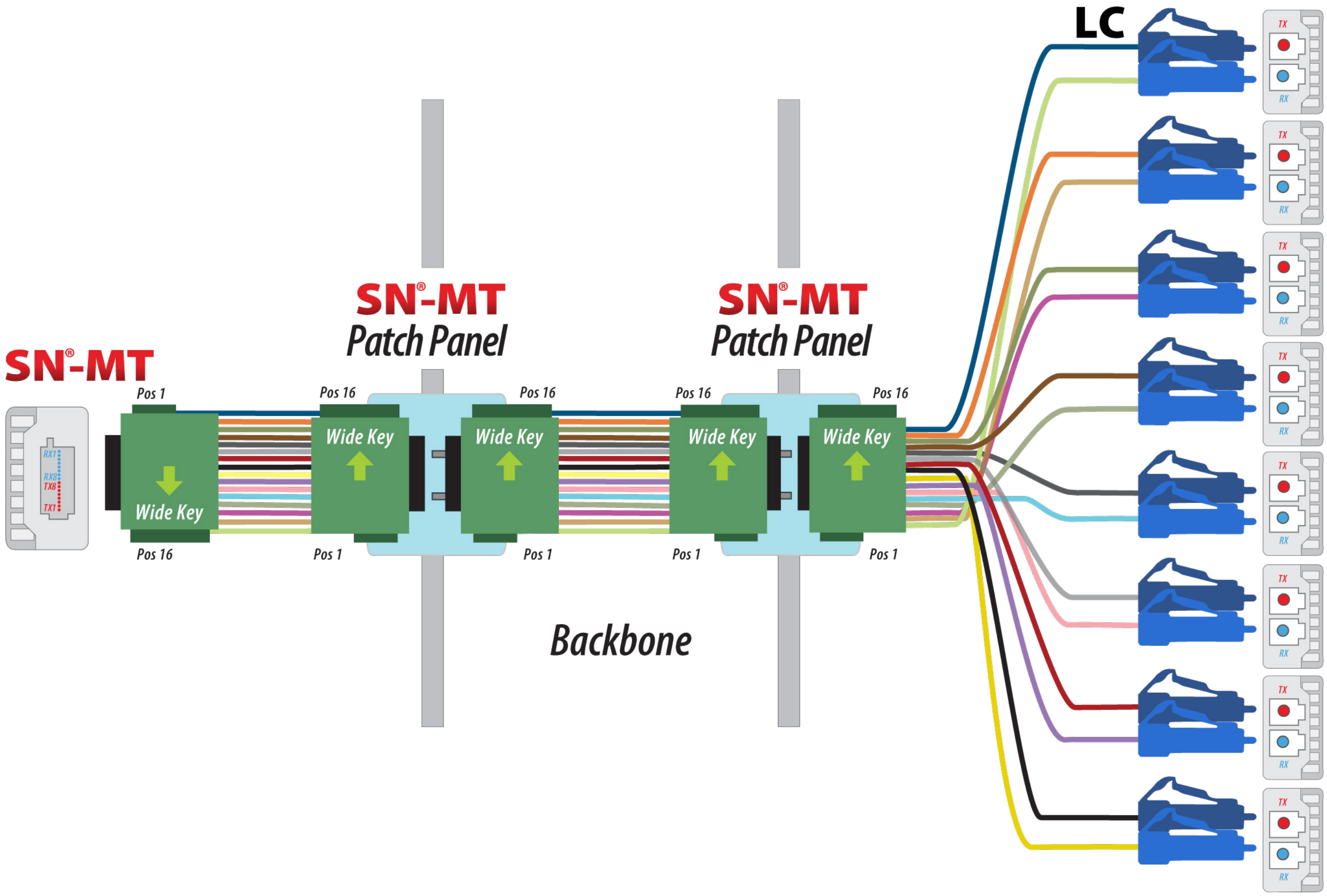
- Higher Component Count: Multiple adapters and patch cords increase insertion loss.
- Complex Fiber Mapping: Requires careful planning for SN®-MT to SN® breakout.
- Cost: Additional panels and adapters add expense.

Diagram Description

- Left: SN®-MT transceiver connected to SN®-MT patch panel.
- Middle: Backbone SN®-MT cable.
- Right: SN®-MT patch panel connected to 4 SN® transceiver via SN® fanouts B-cables.
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation

SCENARIO 8: Transceiver (SN®-MT), patch panel, backbone cable, patch panel, 8 transceivers (LC)

SN®-MT to LC breakout using Type-A backbone



This scenario connects an SN®-MT transceiver on one end to multiple LC transceivers on the other, using structured cabling with patch panels and backbone cable. It is typically used for breakout or migration from high-density SN®-MT interfaces to legacy LC-based optics.

Configuration:

- Near End: SN®-MT transceiver connected to SN®-MT patch panel.
- Middle: Backbone SN®-MT cable routed through the data center.
- Far End: SN®-MT patch panel connected to LC transceiver via LC patch cords.
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation

Benefits

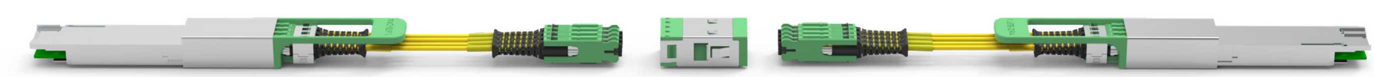
- Legacy Support: Enables SN®-MT to LC conversion for older optics.
- Structured Design: Simplifies MACs and polarity alignment.
- Migration Path: Ideal for transitioning from high-density SN®-MT to LC connectivity.

Limitations

- Higher Component Count: Multiple adapters and patch cords increase insertion loss.
- Complex Fiber Mapping: Requires careful planning for SN®-MT to LC breakout.
- Cost: Additional panels and adapters add expense.

Diagram Description

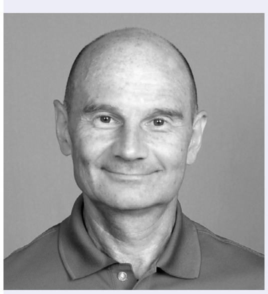
- Left: SN®-MT transceiver connected to SN®-MT patch panel.
- Middle: Backbone SN®-MT cable.
- Right: SN®-MT patch panel connected to LC transceiver via LC patch cords.
- A-type adapters: SN®-MT adapters at both patch panels for polarity preservation



Conclusion

As optical networks evolve toward 800G and 1.6T architectures, connector density, polarity management, and migration flexibility become increasingly critical. The SN® and SN®-MT ecosystem provides scalable options for direct interconnects, structured cabling and breakout architectures while enabling interoperability with existing MPO infrastructures. By applying standardized polarity methods at the trunk and adapter level, network designers can support straight-through, hybrid and breakout architectures without introducing transceiver-dependent routing risks. The scenarios in this guide are intended to serve as repeatable design patterns that align with OSFP and SN®-MT interface specifications while simplifying migration to higher-speed parallel optics.

Biography



Andrei Vankov is a Senior Application Engineer at SENKO Advanced Components with over 30 years of experience in fiber optic communications and optical interconnects. He supports global customers across hyperscale data centers, telecom providers, OEMs and system integrators, provides customer training and solves their technical challenges, with expertise in VSFF interconnects, MPO and single-fiber solutions, co-packaged optics and high-density fiber systems. He holds a BS from Thomas Edison State College and an MSEE from Pennsylvania State University, began his career at Sumitomo Electric Lightwave in Yokohama Japan and later worked as a Senior Optical Design Engineer at Advanced Interconnect where he developed passive components and optical backplanes. Prior joining SENKO team he worked at Nokia RFS supporting LTE RAN deployments and he holds several US and European patents in fiber optic interconnect technology.

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2. International Electrotechnical Commission, **IEC 61754-7**, Fiber Optic Interconnecting Devices and Passive Components – Fiber Optic Connector Interfaces – Type MPO Connector Family, defining MPO connector interface requirements and terminology.
3. Institute of Electrical and Electronics Engineers, **IEEE 802.3 Ethernet Standards**, including optical interface specifications for:
   - 100GBASE-DR
   - 400GBASE-DR4
   - 400GBASE-FR4
   - 400GBASE-LR4
   - 800G and future 1.6T parallel optical architectures
4. OSFP MSA Group, **OSFP Specification**, defining mechanical, electrical, and optical requirements for OSFP transceivers used in 400G, 800G, and future 1.6T applications.
5. QSFP-DD MSA Group, **QSFP-DD Hardware Specification**, defining QSFP-DD transceiver interfaces and cabling architectures for high-density Ethernet deployments.

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