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Application Note

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# SN® Connectors Versus MPO in Today's Networks

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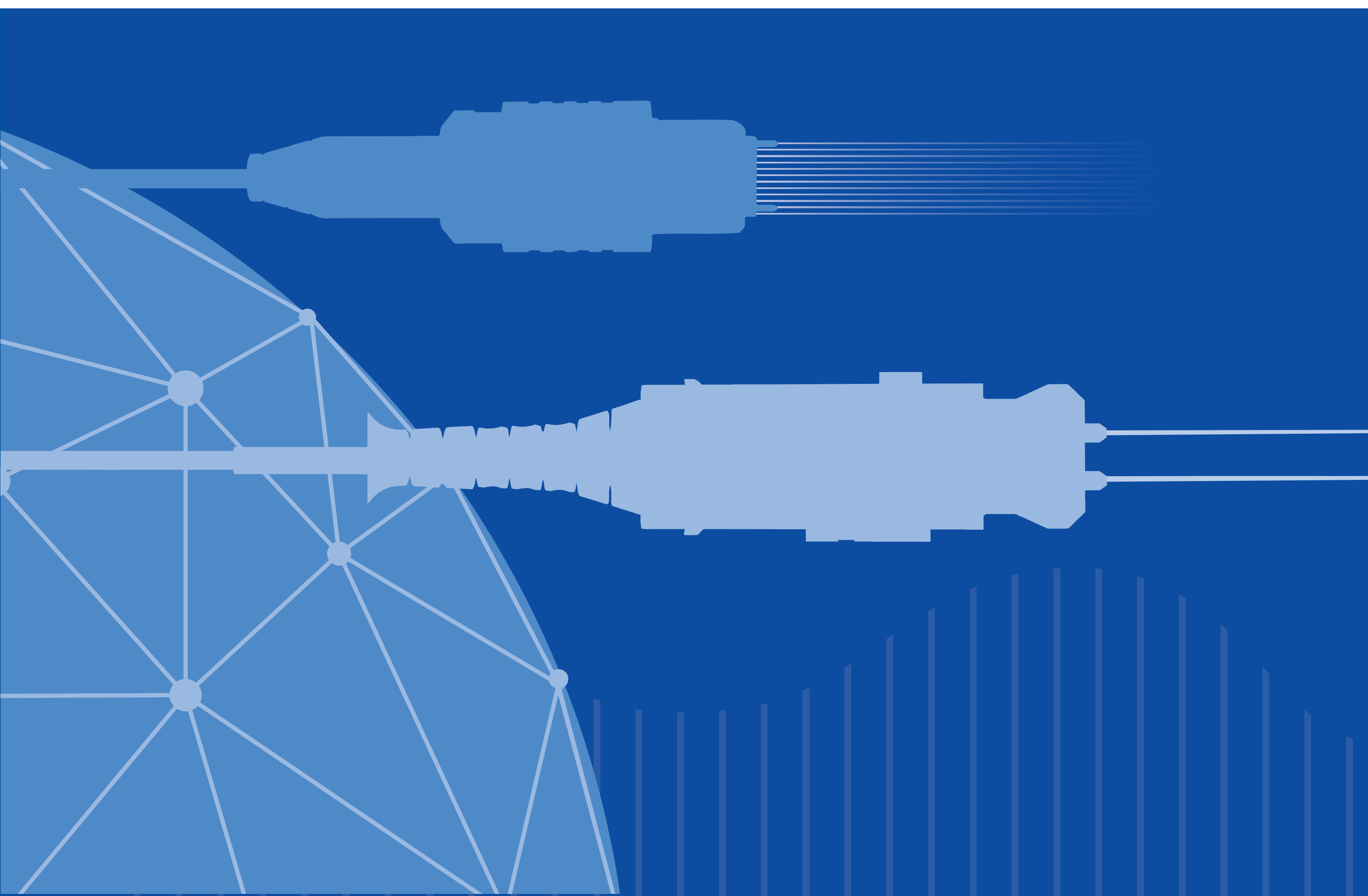

# SN® Connectors Versus MPO in Today's Networks

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## Where MPO Connectors are Used Today

MPO (Multi-Fiber Push-On) connectors are primarily used in telecommunications networks for various applications, specifically in scenarios where multiple fibers need to be connected simultaneously. One of the main applications for which MPO is used is in Data Centers.

In the past, typical Data Center connectivity with multiple fibers utilized a splicing fiber approach that did not offer users flexibility for reconfiguring connections. This limitation led to the popularity of MPO connectors, as they feature non-permanent connections, allowing for easier reconfiguration.

As data rates grew from 10G to 40G, the industry began considering MPO transceivers over traditional SFP ceramic-based transceivers. This shift occurred because the easiest way to aggregate data was to use multiple lanes of existing 10G technology and quadruple it using MPO's 4 transmit and 4 receive channels.

Today, MPO connectors are extensively utilized in Data Center environments for high-density fiber optic connections, in addition to being used in transceivers. They serve as the backbone of structured cabling systems, facilitating the connection of equipment such as servers, switches, and storage devices to optical networking infrastructure. These connectors are deployed for interconnecting switches and routers in network backbones, as well as in hydra assemblies within cassettes and patch panels. They are also commonly found in CPO switch faceplates and mid-board backplane connectivity. Moreover, they play an important role in directly connecting optical transceivers point-to-point in high-speed data transmission systems, although direct transceiver connections are not common. *Please refer to the figure below outlining typical MPO-Based Structured Cabling in Data Centers.*

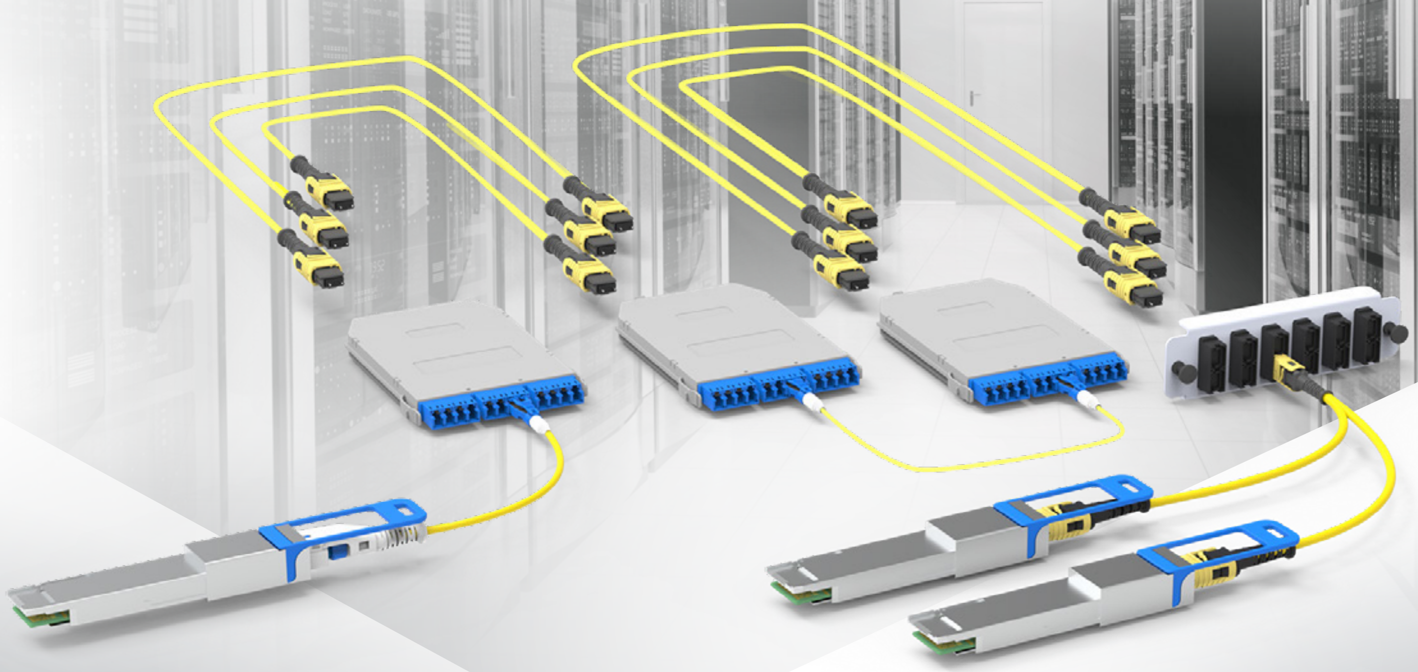
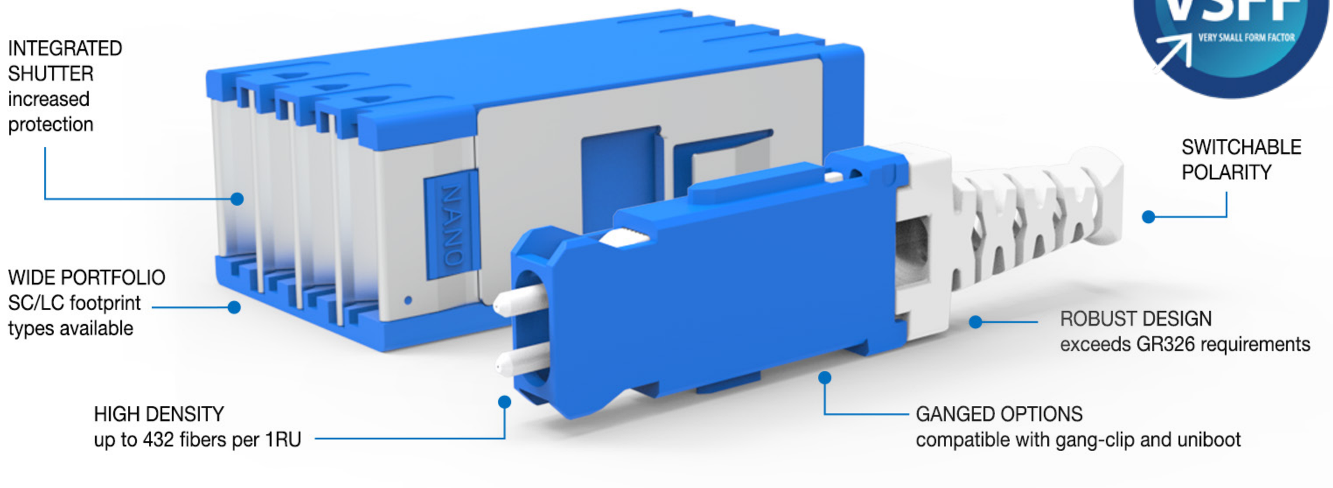


**Figure 1** *MPO-based structured cabling in data centers.*

## What is an SN® Connector?




SENKO SN® connector is a next-generation Very Small Form Factor (VSFF) duplex optical connector, tailored for terminating single-mode and multimode fiber cables up to 2.0mm in diameter. Utilizing the established 1.25mm ferrule technology found in the industry-standard LC connector, the SN® connector distinguishes itself with substantially reduced outer housing dimensions. This compact design offers network operators a three-fold increase in packing density across both passive and active hardware. Additionally, unlike previous generations of LC and SC connectors known for their horizontal orientation, the SN® connector features a vertical mount, enhancing flexibility and space utilization in network configurations.

In addition to the duplex SN® connector, SENKO has developed a quadruple duplex SN® connector, housing 8 fibers within a single connector body, named the SN® Uniboot. The SN® Uniboot represents a ground breaking advancement of the Very Small Form Factor (VSFF) Fiber Optic connectors, enabling the simultaneous ganging of four duplex SN® into one SN® Uniboot connector in a single unit. This innovation provides the same level of connectivity as an MPO 8-fiber connector, eliminating the requirement for breakout cassettes or fanout cables to transition from Base-8 to Base-2. This dual functionality makes the SN® Uniboot ideal for duplex server connections, optimized for high-density trunks, and perfectly compatible with high data rate transceivers utilizing four optical lanes (8-fibers).

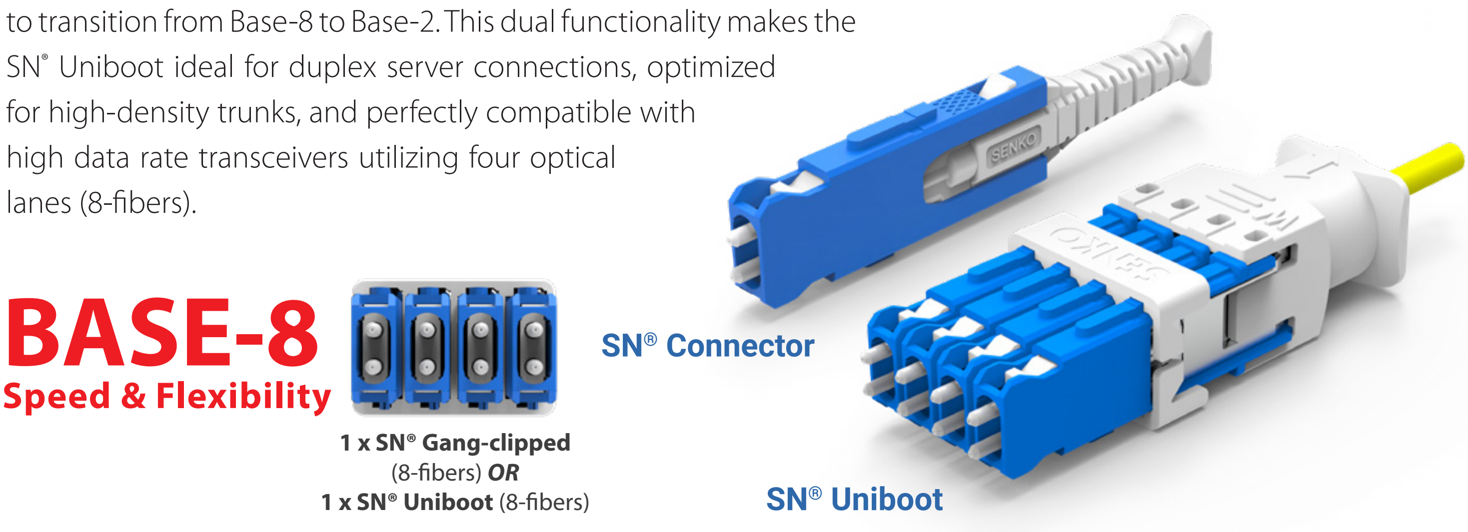



**Figure 2** *SN® Duplex 2-fiber and SN® Uniboot 8-fiber connectors.*

## When, Where and Why MPO can be Replaced with SN®

In many scenarios where MPO interconnects are traditionally used, they can often be effectively substituted with Duplex SN® (2-fiber) or SN® Uniboot (8-fiber) connectors. Several factors contribute to this versatility. Transceivers designed for MPO connections, such as QSFP modules, typically feature an equal number of transmit and receive channels (4+4), also referred to as QSFP-DD MDI. The easiest way to increase the data rate is to use parallel transmissions. We witnessed the evolution from 10G to 40G coming from aggregating 4 fibers of 10G each making it a total of 40G. Similarly achieved transmissions for 100G, 400G, 800G, and even 1.6T. All these high data rate transceivers are based on 8 or 16-fiber solutions with the MPO interface. The 8-fiber count became a prolific number, leading to the development of SN® ceramic-based uniboot connector that features 8-fibers. The transceiver with the SN® interface also shares the same configuration as an MPO transceiver.

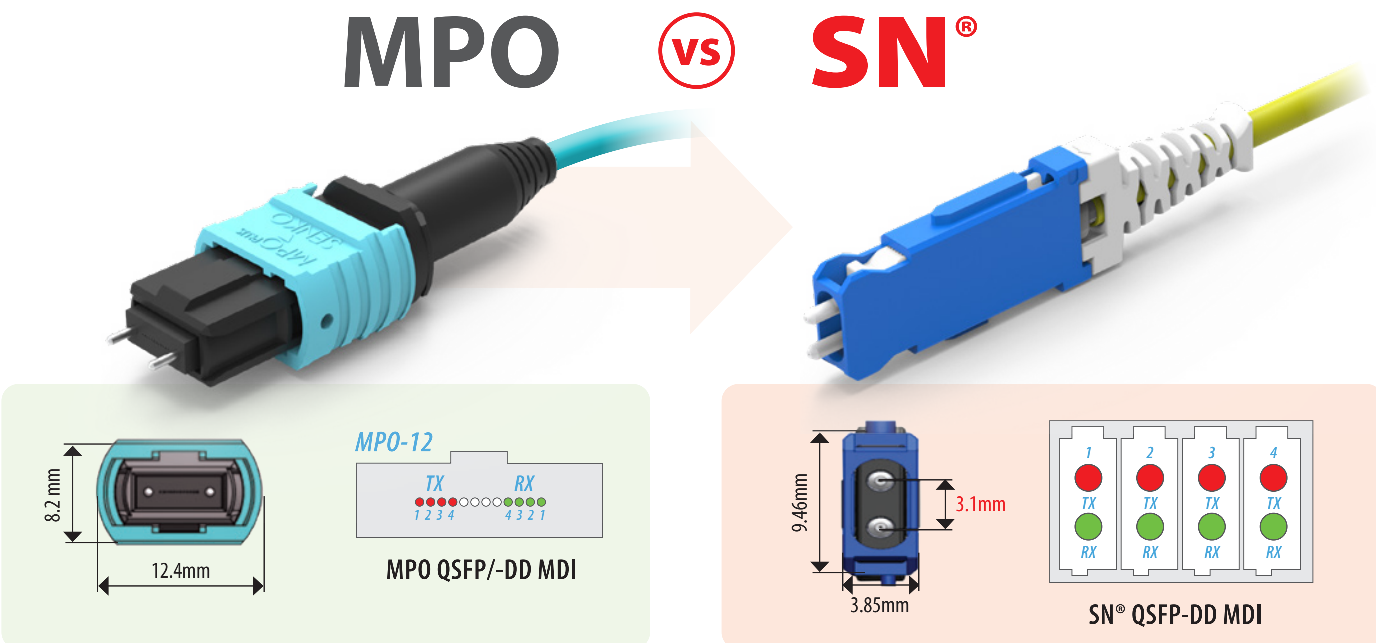



**Figure 3** *MPO vs. SN® QSFP-DD MDI*

That is the main reason why SN® Uniboot can be considered equivalent to an MPO connector, as Data Center connectivity often uses MPO connectors that utilize only 8 or 16-fibers instead of all that could be available in the MT ferrule. *Refer to Figure 3 above for clarification.*

400G
800G
1.6TB

**Note:** Next Generation 800G/1.6T SN® transceivers are not yet available (only 400G). Consequently, traditional MPO connectors would remain a practical choice for 800G and up in the transceiver domain. In this scenario, SENKO offers an MPO interconnect with industry-leading optical losses, surpassing competitor products. *Please refer to the loss distribution graph in Figure 4 comparing SENKO MPO with other leading brands' MPOs.*

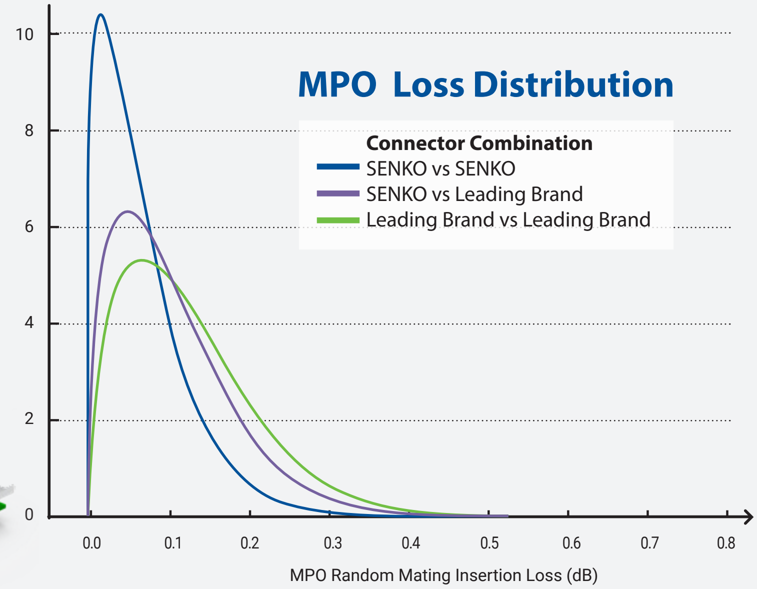



**Figure 4** *Loss Distribution graph comparing SENKO MPO with other leading brand's MPO.*

Given the similarities in 400G transceiver configurations between MPO and SN®, let's explore the scenario of replacing traditional MPO interconnects with the newer VSFF SN® solution. In straightforward networks that don't necessitate a large number of switches and primarily feature point-to-point (or transceiver-to-transceiver) interconnections, SN® offers a unique advantage with its Base-2 and Base-8 compatibility. This means it can efficiently link 4-lane pluggable optics like QSFP-DD or conventional single-lane optics such as SFP+ via a duplex assembly. With up to 4 x SN® connectors connectable to a QSFP-DD or QSFP transceiver, these duplex connections can be easily broken out into 4 different transceivers without the requirement for transition cassettes or fan-outs.

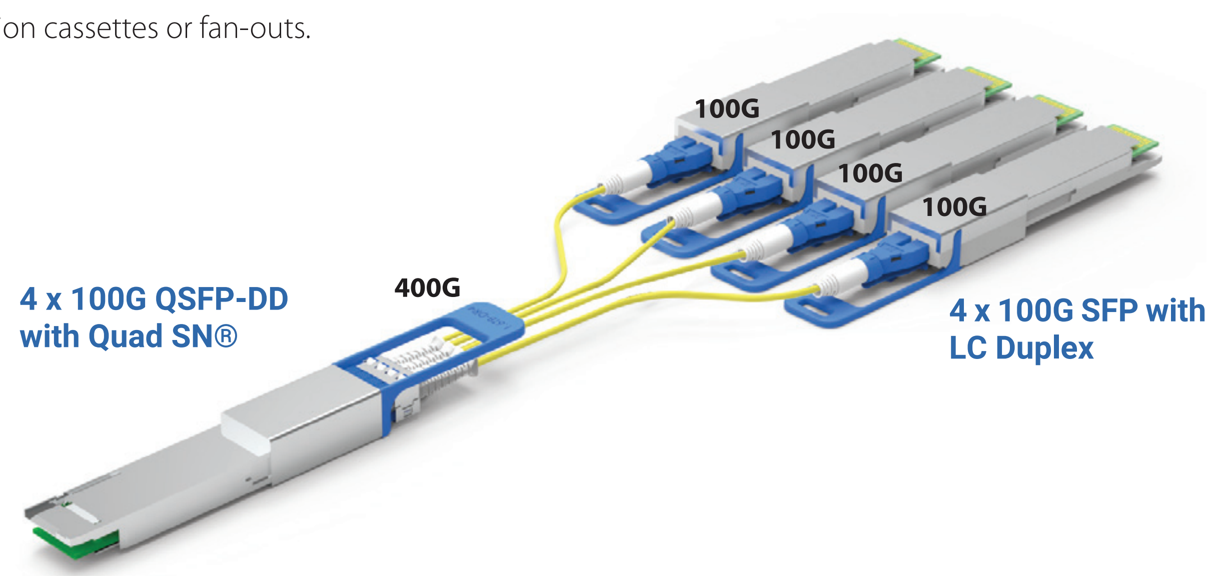
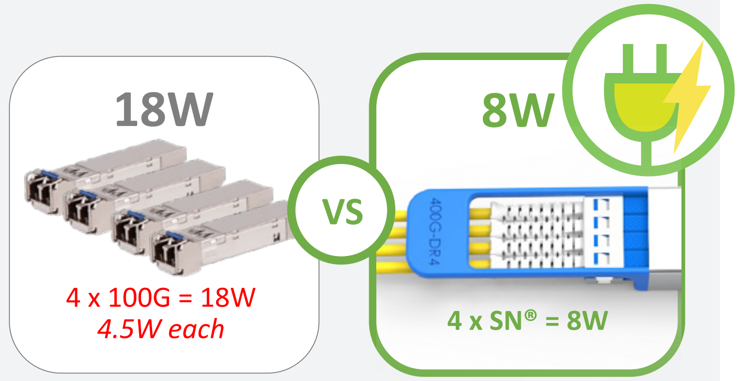



**Figure 5** *QSFP-DD to SFP+ SN® transceivers direct connection.*

## Energy Savings Note:

It's worth highlighting the significant energy savings achieved by utilizing SN®-based transceivers compared to standard SFP transceivers. Each 2-lane SPF 100G transceiver draws approximately 4.5W for each active pair, resulting in a total power consumption of 18W. In contrast, an 8-lane SN® transceiver has an overall power consumption totalling only 8W. These substantial 10W per 100G energy savings play a crucial role in addressing the energy demands of hyperscale data centers.




Data Centers commonly employ the Leaf-Spine Architecture, a network topology designed to offer high-speed and scalable interconnection between servers, storage systems, and networking devices. This architecture comprises two layers: the leaf layer and the spine layer.

In the leaf layer, multiple leaf switches are deployed, each connecting to every spine switch in the spine layer. Typically, each leaf switch is connected to a subset of servers or other devices within the data center. These leaf switches aggregate traffic from connected devices and direct it to the spine switches. Meanwhile, the spine layer consists of multiple spine switches interconnected in a full mesh topology. Each spine switch is linked to every leaf switch in the leaf layer. The spine switches facilitate high-bandwidth, non-blocking connectivity between the leaf switches, ensuring efficient data transmission throughout the network.

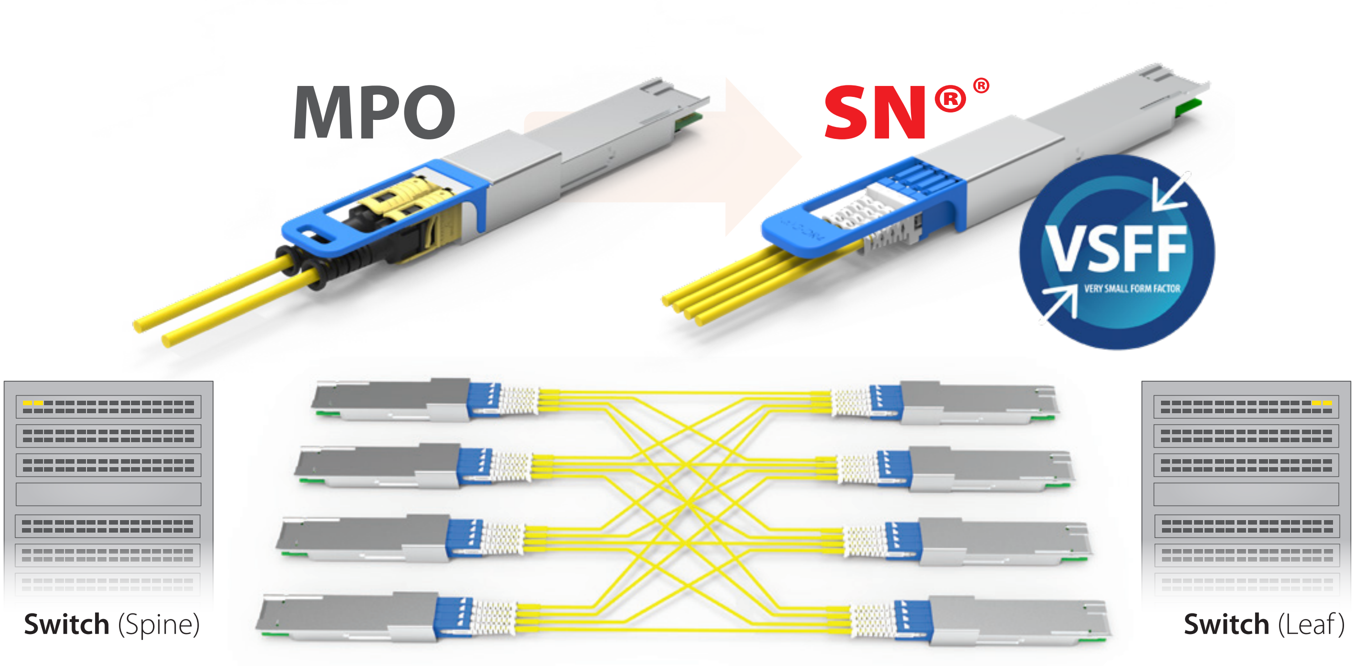
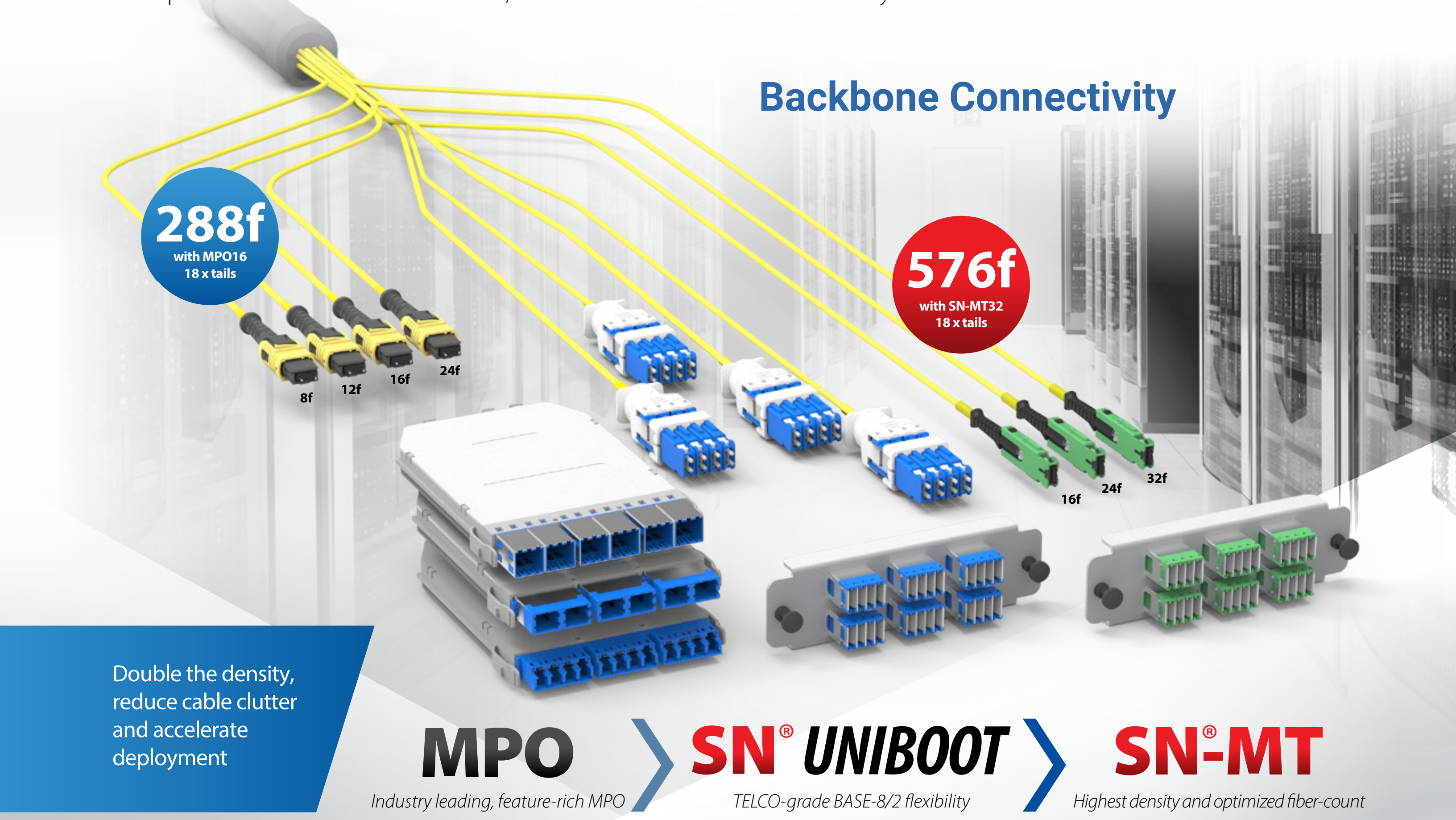



**Figure 6** *QSFP-DD SN® transceivers direct connection.*

In hyperscale data centers, utilizing MPO in switching equipment installed within racks is a practical approach, particularly in scenarios where cable trunks can contain 144 fibers or more simultaneously. This setup is often referred to as Data Center backbone connectivity. Trunk deployment serves to connect racks to racks or extends to building deployment, facilitating the connection between racks and high-density DC interconnects that span across buildings. The consolidation points marks where fiber enters the building and is subsequently distributed within it, forming the backbone of the network infrastructure. Backbone connectivity plays a pivotal role in linking various patch panels that connect to servers, switches, or optical cross-connects, providing access points for users. Building a robust backbone at the outset ensures flexibility for network evolution to meet future needs and provides peace of mind regarding its reliability and scalability.

When deploying a backbone infrastructure intended to endure for several years, there are key considerations to prioritize. As the term "backbone" implies, the goal is to establish a foundation that is robust, scalable, and reliable. While technology advancements may lead to frequent upgrades and replacements of active equipment, the backbone interconnect infrastructure should remain the same. While equipment evolves rapidly, the infrastructure should provide a stable framework for sustained operation. Rapidly changing the infrastructure is neither practical nor cost-efficient, especially considering the limited space and time available. Therefore, the focus is on establishing an infrastructure designed to serve reliably over an extended period, minimizing the need for frequent overhauls and ensuring long-term viability and efficiency.

When considering backbone connectivity, the choice of connectors plays a crucial role in optimizing efficiency and performance. In Data Centers, multi-fiber trunks are commonly used to maximize fiber count within a



single cable, minimizing the number of cables required and reducing operational time during deployment. As fiber counts increase, the connectors must shrink in size to accommodate the higher density.

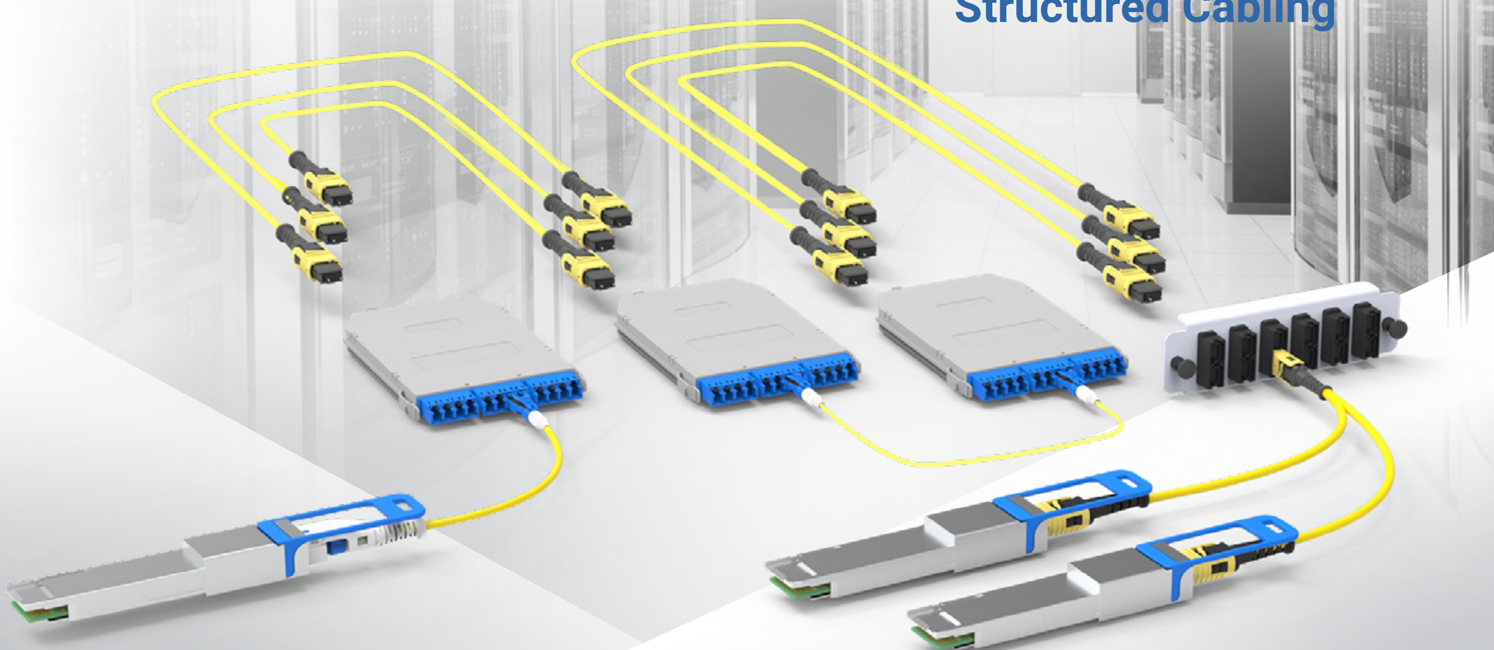
Typically, MPO connectivity emerges as the most logical connector choice for backbone applications due to its ability to accommodate multiple fibers in one ferrule. However, MPO connectors may pose challenges in rerouting channels, requiring additional MPO to duplex interconnect fanouts, which can increase cost, complexity, and optical losses.

In contrast, SN® ferrules are individual and ceramic, offering reduced insertion loss and easy channel rerouting, providing a higher degree of flexibility across long, complex, high-data-rate links. SN® connectors feature high precision 1.25mm ceramic ferrules, identical to the well-known LC ferrule, making them familiar to installers and easier to install due to their resistance to debris accumulation compared to MPOs.

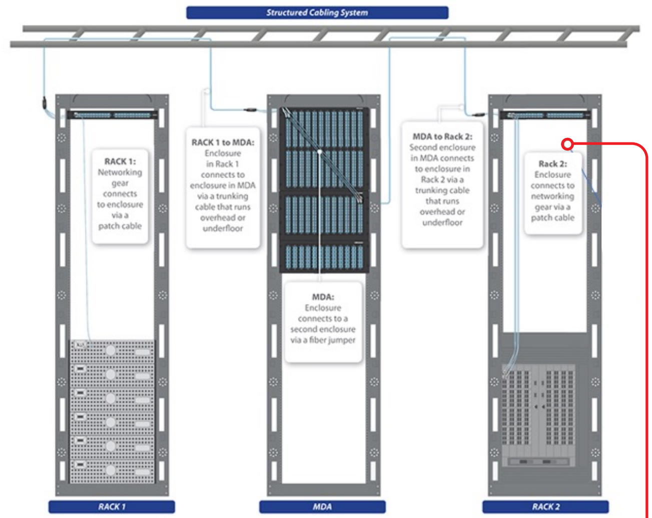
**1.25 mm Ceramic Ferrule**

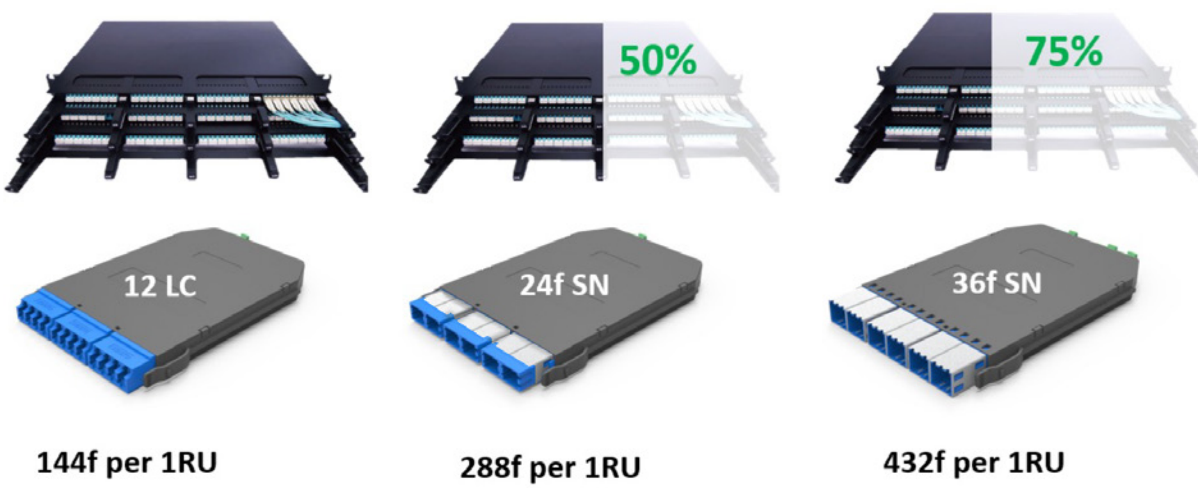
In hyperscale environments with MPO connectivity serving as the backbone of the network, it's common to require ceramic connectivity on one server end, utilizing standard SPF+ ceramic 2-lane base transceivers, to connect to QSFP-DD MDI MPO 8-lane base transceivers on the opposite end. In such scenarios, transitioning channels from a high-density switch to a server end with lower density necessitates shuffling the fibers through a cross-connect where proper routing of the channels is executed. The most straightforward implementation of this cross-connect involves duplex-based lanes that can be reconfigured, allowing signals to be transferred from 8-base to four 2-base transceivers. This setup facilitates easy replacement or rerouting of signals during repairs and upgrades, making it a preferred choice for managing cross-connects due to its logical and straightforward implementation and maintenance.

## Typical MPO-Based Structured Cabling



At the enterprise level, where data rates are typically lower, a traditional approach utilizing cassettes with MPO fanouts breaking into duplex ceramic base interconnects remains a viable option. However, there is also a growing demand for alternatives to MPO interconnects at the cassette level, driven by the need to accommodate additional transceivers in the infrastructure. VSFF SN® interconnects offer an easy channel routing solution that aligns well with these requirements, saving space on the cassette adapter interface side. This makes them a sensible choice for accommodating upgrades while maintaining ease of management.




Moreover, SN® connectors offer advantages in maintenance and repair. If a channel fails with an MPO connector, all 8 or more channels that share the failed MPO will need replacement, whereas with SN®, only one cable, one fiber pair requires replacement.

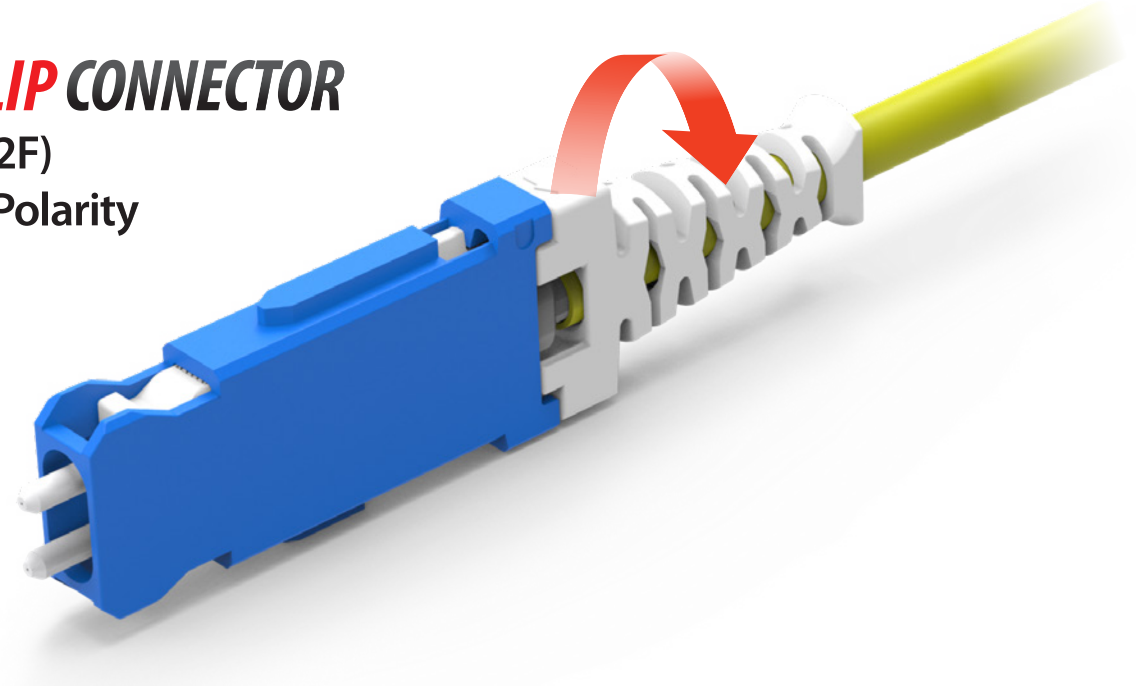
In the era of densification, SN® connectors offer others significant advantages. They can accommodate more fibers in a single adapter panel or cassette compared to other connectors due to their smaller size and vertical alignment, allowing for mega-densification without sacrificing accessibility and traceability. This reduction in patch panels and racks optimizes and increases available space, which can be utilized for cable management or enhanced port identification, streamlining the patching process and enhancing overall efficiency.

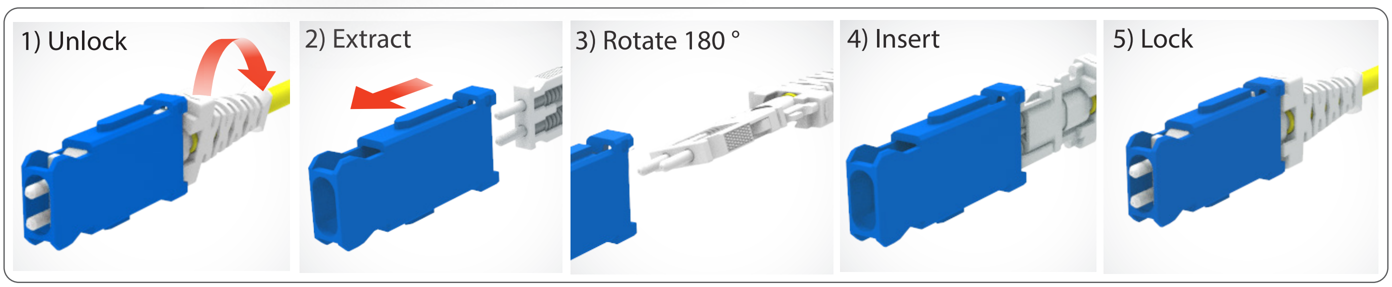
SN® duplex presents an ideal alternative to the LC duplex in the front of the cassette, offering a footprint three times denser than LC. This increased density is attributed to the shorter distance between 1.25mm diameter ceramic ferrules and the vertical configuration of SN®, as opposed to the traditional horizontal layout of LC connectors.

Finally, when dealing with cassettes and multi-transition points, it's crucial not to overlook polarity, ensuring proper connection of transmit to receive signals. To simplify field installation and network configuration, SENKO introduces the SN® EZ-Flip connector. This innovative connector offers the convenience of quick polarity reversal on the fly, if required. The SN® EZ-Flip connector features a unique design that allows for the polarity of the connector to be reversed simply by flipping the outer housing. This capability to change polarity without the need for re-terminating fibers can save valuable time and reduce the risk of errors during installation or maintenance. The SENKO SN® polarity changeable connector stands among several types of polarity changeable connectors available in the market, renowned for its ease of use and reliability.

## SN® EZ-FLIP CONNECTOR

### 1-Channel (2F) Switchable Polarity





## Conclusion and Summary

Ultimately, the decision between SN® and MPO connectors hinges on several factors including transceiver types used, cost, performance requirements, scalability, and compatibility with existing infrastructure. Careful evaluation of these factors is essential to determine the most suitable option for a specific use case.

SN® interconnect presents a compelling alternative to traditional MPO solutions in modern data centers that demand high performance, scalability, resilience, and simplicity in network infrastructure. While both SN® duplex and MPO connectors have their place in Data Centers, there are many scenarios where SN® duplex connectors may be preferred:

### Cost

SN® connectors can offer cost-effectiveness, particularly in scenarios requiring numerous connections. The manufacturing complexity of MPO connectors often results in higher costs.

### High Performance

SN® connectors, featuring ceramic base SN® ferrules, provide high-performance, low-loss connectivity within data centers. Their lower insertion loss compared to MPO connectors can be advantageous in high-performance networking environments.

### Flexibility and Scalability

SN® connectors offer greater flexibility and scalability, enabling easier customization of connectivity options and accommodating various network designs without the limitations of pre-defined MPO configurations.

### Resilience

SN® interconnects offer inherent resilience, with a full mesh topology in the spine layer ensuring fast traffic rerouting in case of link failure, facilitating easier replacement of SN® jumpers compared to multifiber MPO cables.

### Reliability and Durability

SN® connectors are renowned for their robustness and durability, withstanding harsh environmental conditions and repeated mating cycles better than MPO connectors.

### Compatibility

SN® connectors may offer better compatibility with existing single-mode fiber infrastructure, simplifying integration of new equipment or network expansion without extensive reconfiguration or upgrades.

### Simplicity:

The SN® connector's design bears resemblance to the familiar LC connector, making installations straightforward for installers accustomed to working with LC connectors. Moreover, the SN® interconnect architecture simplifies network design and management by facilitating direct connections between QSFP-DD SN®-based transceivers. This streamlined approach enhances provisioning, troubleshooting, and maintenance processes, ultimately contributing to overall network efficiency and reliability.

Regardless of the connector chosen, SENKO offers comprehensive technical support throughout the entire process, from termination to final installation, testing, and assurance. Our dedicated team is committed to ensuring that deployments are efficient, reliable and timely. With SENKO's support, you can have confidence in the performance and longevity of your network infrastructure for years to come.

## References

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## Biography

Andrei Vankov, is an Application Engineer at SENKO Advanced Components. He received his BS from Thomas Edison State College and his MSEE from Pennsylvania State University. He began his career in 1993 at Sumitomo Electric Lightwave Corp as a Fiber Optic Manufacturing Engineer where he worked on active and passive components using Kaizen methods in Yokohama, Japan. As a Senior Optical Design Engineer in Franklin, MA (founded as Advanced Interconnect) Andrei Vankov developed various passive optical components and packaging integration to meet Telcordia industry standards. He designed optical interconnects, including optical backplanes (MTP, HBMT, PHD, OGI), and a fiber optic SMPTE compatible Broadcast Connector for HD applications. In 2013-2020 Andrei worked at Nokia division Radio Frequency Systems (RFS) where he provided leadership for an LTE RAN launch project team. Andrei holds several US and European Patents in fiber optics interconnect technology.

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