Introduction

Virtualization and cloud technologies have applied an incredible amount of pressure on the bandwidth within data center networks. In recent years, data center networks have grown from 100Mb to 40Gb to ease this burden. Staying ahead of this bandwidth issue is extremely important. The 40/100Gb BiDirectional (BiDi) transceiver can help data centers maintain a competitive advantage with its robust flexibility and bandwidth capabilities.

Panduit and Cisco both provide customers with prescriptive guidance on deploying 40/100Gig solutions to ensure investment protection and seamless technology migration solutions. These services delivered through a strong ecosystem of partners can help streamline designs and deployment by up to 30%. Additionally, alignment of network and physical architectures can extend the data center lifespan and avoid unnecessary CapEx expenditures.

40/100Gb BiDi

The Cisco® QSFP 40/100Gb dual-rate BiDi transceiver (Figure 1) is a pluggable optical transceiver with a duplex LC connector interface for short-reach data communication and interconnect applications using Multimode Fiber (MMF). It offers customers a compelling solution that enables reuse of their existing 10Gb duplex MMF infrastructure for migration to either 40 or 100 Gigabit Ethernet connectivity.

Figure 1. Cisco 40/100Gb BiDi transceiver
Only Cisco offers dual-rate capability that is backward compatible with native 40Gb BiDi transceivers. Therefore, the dual-rate 40/100Gb BiDi offers multiple migration options to customers who are currently operating either 10Gb or 40Gb links in their data center architectures.

The 40/100Gb BiDi is similar to the native 40Gb BiDi in that it transmits bidirectionally on both fibers, using nominal wavelengths of 850nm and 910nm and passive Wavelength Division Multiplexing (WDM) filters at either end to isolate Tx and Rx channels (Figure 2). The 40Gb BiDi transmits and receives 20Gb NRZ channels on each fiber, for a total aggregate bandwidth of 40Gb. In 100Gb mode, the 40/100Gb BiDi operates 50Gb PAM4 channels, for a total aggregate bandwidth of 100Gb.

The 40/100Gb BiDi is Cisco’s first dual-rate 40/100Gb QSFP pluggable optic. The software on the platforms at both ends of the link must be configured to operate the module at the same rate in order for the link to operate. Figure 3 shows the 100Gb BiDi transceivers deployed in a spine-leaf logical architecture.

PAM4 technology enables 50Gb data rate with signaling at 25Gbaud rates. The 40/100Gb BiDi contains a gearbox to translate the signal from a 4x25Gb format, native to the QSFP28 form factor, to the 2x50Gb format for the optical domain. It also employs onboard Forward Error Correction (FEC) to reduce bit error rate. This enables low-cost laser and receiver components to be used.

**Figure 2. Concept of QSFP28 100Gb BiDi transceiver**

**Figure 3. Spine-leaf logical deployment using 100Gb BiDi transceivers**
QSFP28 40/100Gbps BiDi switches

Cisco Nexus 9300 fixed-port QSFP28 40/100Gbps BiDi switches

The Cisco Nexus 9300 Series Switches are fixed switches built to provide 1/10Gbps and 40/100Gbps server access connectivity. The Cisco Nexus 93180YC-EX (Figure 4) and the 93180YC-FX (Figure 5) are 1RU fixed switches with 48 ports of 10/25Gbps (SFP28) and 6 ports of 40/100Gbps (QSFP28). The Cisco Nexus 9336C-FX2 (Figure 6) is a 1RU fixed switch with 36 ports of 10/25/40/100Gbps (QSFP28). The Cisco Nexus 9364C (Figure 7) is a 2RU fixed switch with 64 ports of 40/100Gbps (QSFP28). All 9300 switches are well suited for data center ToR, EoR, and collapsed aggregation and access while deployed with Cisco Nexus 2000 fabric extenders.

Figure 4. Cisco Nexus 93180YC-EX 1RU switch

Figure 5. Cisco Nexus 93180YC-FX 1RU switch

Figure 6. Cisco Nexus 9336C-FX2 1RU switch

Figure 7. Cisco Nexus 9364C 2RU switch

Cisco Nexus 9500 modular switches

The Cisco Nexus 9504 (Figure 8, left switch) is a 7RU switch offering 4 line-card slots. The Cisco Nexus 9508 (Figure 8, middle switch) is a 13RU switch offering 8 line-card slots with a comprehensive selection of modular line cards. The Cisco Nexus 9516 (Figure 8, right switch) is a 21RU switch offering 16 line-card slots with a comprehensive selection of modular line cards. All of these switches offer a comprehensive selection of QSFP28 line cards.

Figure 8. Cisco Nexus 9500 switches

40/100Gbps BiDi line cards

Cisco offers a comprehensive selection of QSFP28 line cards for the Cisco Nexus 9500 switches. The N9K-X9732C-EX line card (Figure 9) has 32 ports of QSFP28 and is ACI spine compliant. The N9K-X9736C-FX line card (Figure 10) has 36 ports of QSFP28 and is ACI spine compliant. The N9K-X9732C-FX line card (Figure 11) has 32 ports of QSFP28 and is ACI spine compliant.

Figure 9. N9K-X9732C-EX: 100 Gigabit Ethernet line card

Figure 10. N9K-X9736C-FX: 100 Gigabit Ethernet line card

Figure 11. N9K-X9732C-FX: 100 Gigabit Ethernet line card
Panduit products for use with 40/100Gbps BiDi

**Panduit push-pull LC duplex cables**

Panduit push-pull LC duplex fiber optic patch cords (Figure 12) containing the custom push-pull strain relief boot and duplex clip allow users easy accessibility when deploying very high-density LC patch fields in data center applications. The push-pull connector allows for the simplified installation and removal of LC duplex fiber optic patch cords in high-density applications. These cables are available in riser (OFNR) and Low-Smoke Zero-Halogen (LSZH)–rated jacket materials to comply with local cabling ordinances and OM4, OM3, or OS1/OS2 fiber types to meet the demands of today’s highest speed applications.

![Figure 12. Panduit push-pull LC duplex cable](image1)

**Panduit SFP28 direct-attach cables**

Next-generation data centers require high-bandwidth interconnects. Panduit offers SFP28 direct-attach copper cable assemblies (Figure 13). These passive cables provide a cost-effective solution for interconnecting high-speed 25GbE switches and servers. This high-speed data transport capability is ideal as server virtualization becomes more prevalent. With multiple virtual machines, server I/O consolidation topology requires 25Gbps interconnects between top-of-rack switches and servers. By incorporating SFP28 passive DAC cable assemblies into the physical infrastructure, businesses can achieve 25Gb performance port to port without additional signal processing or conversion, providing a low-power, low-latency server interconnect for top-of-rack switching applications.

![Figure 13. Panduit SFP28 direct-attach cable](image2)

**Panduit Signature Core fiber optic cabling system**

Panduit’s Signature Core fiber optic cabling system integrates ultrahigh-performance laser-optimized, modal and dispersion-compensated multimode fiber with low-loss LC duplex fiber connectivity solutions. This delivers the ultimate in design flexibility, performance, and signal integrity far beyond the requirements for 100Gb BiDi, making sure of consistent performance and reliability of critical systems.

As businesses continue to adopt virtualization, consolidation, and convergence initiatives, the demands placed on the physical infrastructure increase. Next-generation networking architectures deliver enhanced performance characteristics and capabilities to help reduce the risks associated with availability and reliability. Panduit’s Signature Core fiber optic cabling system and connectivity solutions deliver unmatched performance and reliability through a revolutionary advancement in multimode fiber and connectivity technology.

**Key Features and Benefits**

- Makes sure of 25Gbps performance when mated to any SFF-8402 SFP28-compliant host port
- Low-latency performance
- Ideal for high-performance computer clustering and other latency-sensitive applications
- Provides a low-cost short-reach interconnect option with no additional power draw
- Small diameter cable design
- 1m to 5m (1m increments) for design flexibility and optimum airflow

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Cisco 100Gb BiDi transceiver and Panduit wiring scenario

Figure 14 shows a wiring option for connecting a Cisco Nexus 93180YC-EX switch to a Cisco Nexus 9508 switch and to a Cisco Nexus 93180YC-FX switch using PanMPO interconnect cable assemblies. With Cisco QSFP-100G-SR-BD optics, this scenario is capable of distances of up to 100m on OM3 fiber or 125m with OM4 fiber for 40Gb operation, and distances of up to 70m on OM3 fiber or 100m with OM4 fiber for 100Gb operation.

From the Cisco Nexus 93180YC-EX port, the QSFP-100G-SR-BD optic connects to an LC duplex fiber interconnect cable to the front of the LC fiber optic cassette. The LC fiber optic cassette fits into the QuickNet patch panel. The PanMPO fiber trunk cable plugs into the back of the LC fiber optic cassette. On the remote end, the PanMPO fiber trunk cable plugs into the back of the LC fiber optic cassette. The LC duplex fiber interconnect cable plugs into the front of the LC fiber optic cassette and into the optics with the switch on the other end.

Table 1 shows the Cisco and Panduit optics and cabling options with corresponding part numbers for a BiDi multimode connection.

Figure 14. Panduit cabling components for 100Gb BiDi
### Table 1. Cisco 100Gb BiDi optics and cabling products

<table>
<thead>
<tr>
<th>Cisco product description</th>
<th>Cisco part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>100G and 40GBASE SR-BiDi QSFP Transceiver, LC, 100m OM4, 70m OM3</td>
<td>QSFP-40/100-SRBD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panduit product description</th>
<th>Panduit part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuickNet 24-port patch panel</td>
<td>QPP24BL</td>
</tr>
<tr>
<td>QuickNet SFQ Series PanMPO to (6) LC fiber optic cassette (OM4)</td>
<td>FQZO-12-10AS</td>
</tr>
<tr>
<td>QuickNet SFQ Series PanMPO to (6) LC fiber optic cassette (OM3)</td>
<td>FQXO-12-10AS</td>
</tr>
<tr>
<td>LC push-pull patch cords (OM4)</td>
<td>FZ2ERQ1Q1SNM***</td>
</tr>
<tr>
<td>LC push-pull patch cords (OM3)</td>
<td>FX2ERQ1Q1SNM***</td>
</tr>
<tr>
<td>QuickNet PanMPO trunk cable assembly (OM4) (configured with female to female, method A*)</td>
<td>FZTYP7E7EAAF**</td>
</tr>
<tr>
<td>QuickNet PanMPO trunk cable assembly (OM3) (configured with female to female, method A*)</td>
<td>FXTYP7E7EAAF**</td>
</tr>
</tbody>
</table>

* PanMPO cable assemblies can change polarity and gender as needed, but should be ordered with the polarity and gender configuration required to accelerate installation.

** Insert distance for correct Panduit product number (for example, a 20-foot cable is 020 or FZTYP7E7EBAF020).

### Conclusion

As virtualized and cloud environments continue to evolve, the pressure they apply on the data center network will continuously cause data center stakeholders to look to new technologies to lift the burden. The 40/100Gb BiDi transceiver optimizes network performance and allows flexibility in deployment. For a Cisco 40/100Gb BiDi transceiver network to operate at the highest level, it requires a physical infrastructure that helps ensure superior performance. The Panduit physical infrastructure solution gives the Cisco 40/100Gb transceiver the performance, flexibility, and reliability needed to operate without constraints.