

Berk-Tek Leviton Technologies' Connectivity Performance with Cisco® QSFP BiDi Transceivers

Berk-Tek Leviton Technologies recently evaluated its **premium OM3/OM4** and **OM4+** components for 40 Gb/s Ethernet transmission using Cisco QSFP BiDi transceivers. Several channel configurations were tested, with Berk-Tek's Micro Data Center Plenum (MDP) trunk cables and Leviton's HDX MTP-LC multi-fiber cassettes.

The objective was to simulate typical data center channel configurations and see if it was possible to achieve longer reach and more connections using premium grade OM4+ cabling.

The results indicate that the Berk-Tek Leviton Technologies data center products offer superior performance with Cisco QSFP BiDi transceivers. The reach and attenuation of the OM4+ channels exceed Cisco's maximum recommendations for 40 Gb/s BiDi transceivers.

Introduction

With capacity requirements increasing rapidly, more data centers are upgrading servers to 10 GbE from 1 GbE, and 40 GbE has become the most popular connection from the access switch to the aggregation layer. This migration is driving a need for higher port density on the switches, and several switch manufacturers are offering aggregation layer switches with only QSFP ports. One way to implement 40 Gb/s is through IEEE-standardized 40GBASE-SR4 technology, which uses four 10 Gb/s lanes each on an individual fiber and a multi-fiber cabling infrastructure. The complexity of transitioning the infrastructure from two-fiber duplex to multi-fiber cable might create some challenges for data center managers. However, Cisco is offering a 40 Gb/s transceiver that uses only two fibers and an LC duplex connection, instead of multi-fiber cable and connectivity with 40GBASE-SR4.

The Cisco BiDi transceiver is named after the bi-directional transmission in the optical channel. As shown in **Figure 1**, 20 Gb/s data on two different wavelengths (between 832 nm and 918 nm) is transmitted in each fiber bi-directionally. The aggregated capacity of both the fibers is 40 Gb/s per direction.

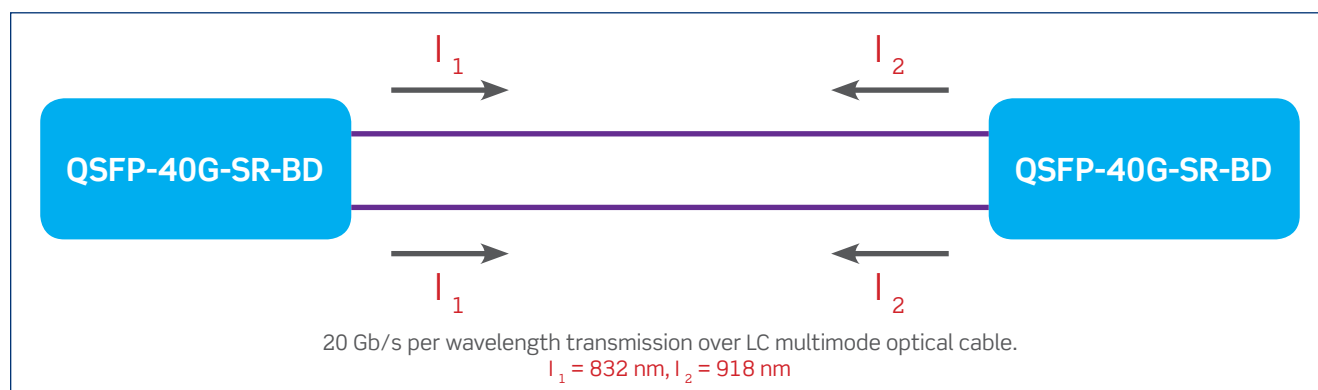


Figure 1: Schematic of bi-directional optical communication using Cisco's BiDi transceiver.

The BiDi transceiver operates at a wavelength where the bandwidth is not specified in the ISO/IEC 60793 OM3/OM4 standard, and a direct correlation between fiber bandwidth (typically specified at 850 nm) and performance cannot be assumed. Cisco specifies a maximum transmission distance of 100 meters and 150 meters over OM3 and OM4 multimode fibers, respectively.

In the TEK Center at Berk-Tek's Pennsylvania headquarters, several tests were performed under various channel configurations on OM3, OM4 and OM4+ multimode fiber components to understand the maximum reach and connection limitations. The OM4+ fiber uses Berk-Tek GIGAlite-10XB glass.

¹ For a total channel insertion loss of 1 dB.

² Cisco 40 Gigabit Modules QSFP Data Sheet.

Test Methodology

Two channel configurations were implemented to test the performance of the BiDi transceiver with Berk-Tek Leviton Technologies optical components, as shown in **Figure 2(a)** and **(b)**. **Figure 2a** depicts a typical link between two switches in a data center, whereas the **Figure 2b** depicts two sectors of a data center that are interconnected using patch panel. The total number of connections, channel lengths, and fiber types are listed in **Table 1**.

When testing a single MDP trunk as shown in **Figure 2(a)**, engineers connected the QSFP BiDi transceivers to the MTP-LC module panel (cassette) using a 5-meter LC-LC patch cord on each side. The trunk lengths in the testing varied from 90 meters (OM3) to 300 meters (OM4+). Similarly, for testing concatenated trunks, the transceivers were connected to the trunks via a module panel (cross connect) using 5-meter patch cords. The trunks were concatenated using an MTP®-MTP patch panel, as shown in **Figure 2(b)**.

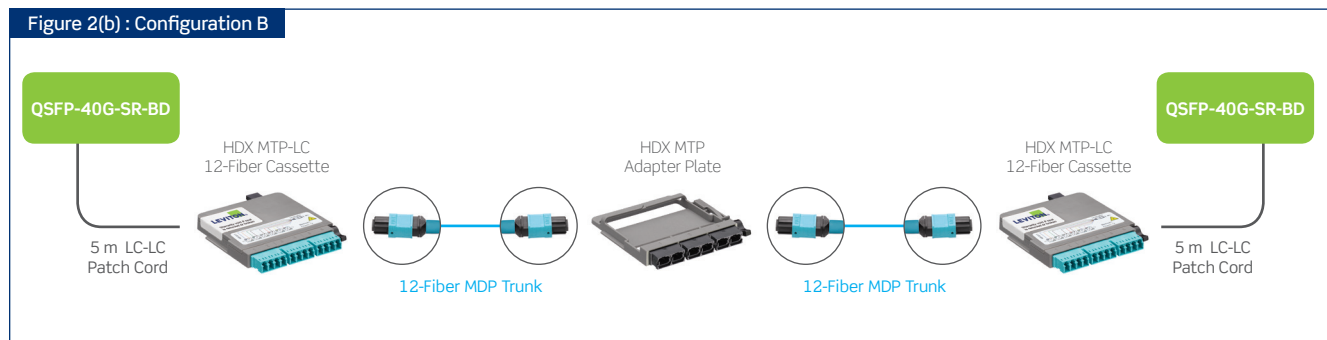


Figure 2: Schematic of test configurations for evaluating the Cisco BiDi transceiver performance. BiDi-A configuration is for testing a single trunk, and BiDi-B is to test concatenated trunks with increased number of connectors.

Table 1: Fiber System Channel Configurations, Maximum Reach, and Respective Insertion Losses				
TEST CONFIGURATION	PRODUCT TYPE	TOTAL CHANNEL LENGTH	IL (A/B) ⁴ dB	NUMBER OF CONNECTORS
Configuration A	OM3	100 m	1.1/1.8	4
	OM4	150 m	1.2/2	4
	OM4	240 m	1.7/1.8	4
	OM4+	240 m	1.6/1.6	4
	OM4+	260 m	1.7/1.7	4
Configuration B	OM4+	200 m	1.8/1.7	5
	OM4+	225 m	1.8/1.7	5

³ The total number of connections does not include the connections made to and from the QSFP modules.
⁴ A/B denotes the two fibers of the LC-LC patch cords that are at both the ends of the channel.

Once the channels were set up, channel insertion loss and return loss measurements were taken using JDSU MAP 2000 optical measurement equipment. The 40 Gb/s traffic was generated using the IXIA IP tester and was transmitted over the channel under test in both directions.

To qualify the performance of the link, Bit Error Ratio (BER) was measured and a link pass or fail was determined by the Cisco's BER threshold of 10^{-12} or lower. The total signal transmission time of the 40 Gb/s signal was set to transmit at least 10^{14} bits to ensure measurement accuracy. The following section describes in detail the results obtained.

Results

The data transmission results using both the transceivers and the insertion loss of the corresponding channels are summarized in **Table 2**. The BER was measured after counting the total number of errors recorded and the path loss was measured at both 850 nm and 1310 nm.

Table 2: Performance of Various Fiber Systems Over Cisco 40 Gb/s BiDi QSFP Links

TEST CONFIGURATION	PRODUCT TYPE	REACH	NUMBER OF CONNECTORS	TEST RESULTS
Configuration A	OM3	100 m	4	PASS
	OM4	150 m	4	PASS
	OM4+	240 m	4	PASS
Configuration B	OM4+	200 m	5	PASS

Only cases exhibiting error-free transmission over the maximum reach are shown. The results show that error-free transmission of up to 150 meters with four connections was achieved with OM4 channels in Configuration A. In addition, error free transmission of up to 240 meters with four connections was achieved with OM4+ channels in Configuration A. Note that transmission over the equivalent configuration with OM4 is not error free.

With Configuration B, where two trunks were concatenated with five connectors, the BiDi transmission achieved 200 meters over OM4+ fiber — far exceeding the 150-meter specification by Cisco for OM4.

Conclusions

Extensive tests were carried out using Berk-Tek Leviton Technologies' channel configurations with Cisco's BiDi 40G QSFP transceivers. The results indicate superior error-free transmission performance for both the test cases at distances specified by Cisco over Berk-Tek Leviton Technologies optical components. The Cisco BiDi link on both the channel configurations (A and B) resulted in error-free transmission for the specified lengths of 100 meters for OM3 fiber and 150 meters for OM4 fiber. Using the OM4+ channel with GIGAlite-10XB glass, a 240-meter transmission was successfully achieved.