White Paper

Monitor Links with Passive Optical Taps and Cisco QSFP 40G BiDi

What You Will Learn

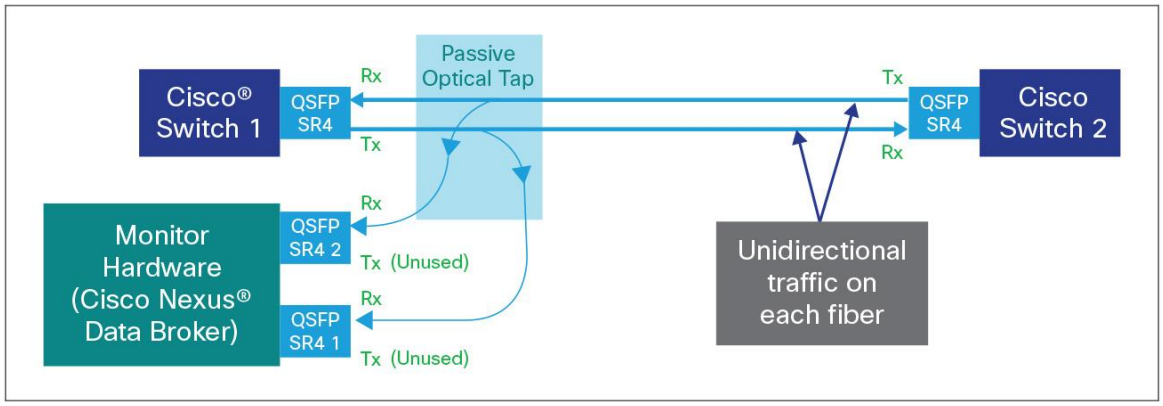
In this white paper, we discuss passive optical monitoring of networks that employ dedicated hardware monitor equipment and Cisco's Quad Small Form-Factor Pluggable (QSFP) bidirectional fiber-optic communication technology. Bidirectional (BiDi) optical communication means that both transmit and receive optical signals travel in the same fiber without interference from each other. The QSFP BiDi design uses this technique to provide 20-Gbps bandwidth in each fiber of a dual-fiber multimode fiber (MMF) cable, resulting in a 40 Gigabit Ethernet transceiver.

The BiDi technique allows instant gains in fiber capacity by using existing MMF infrastructure originally designed for 10GBASE-SR links. This is a quadrupling of fiber capacity. To monitor this MMF network, Cisco has created the Cisco® QSFP BiDi Monitor module, which allows network monitoring hardware such as the Cisco Nexus® Data Broker to monitor the 40-Gbps bidirectional traffic in a link.

Traditional Network Monitoring

In optical transmission, full duplex is required: one path for transmit and one path for receive. In standardized 40 Gigabit Ethernet protocols, there is typically a pair of fibers, one for each of the two directions of transmission. Network monitors can use the same transceivers to receive tapped signals for processing and analysis. The transmit signal from the network monitor's transceiver is unused, since the monitor's only purpose is to receive. This configuration is shown in Figure 1.

Figure 1. Configuration Used in Traditional Network Monitoring



In the case of QSFP BiDi links, the transmit and receive signals travel within the same fiber. This leads to a potential issue if one attempts to optically tap and monitor the link. The transmitted light from the monitor ports propagates back through the tap and into the live link path, thereby interfering with the live link itself. This is shown as the red and pink signals in Figure 2.

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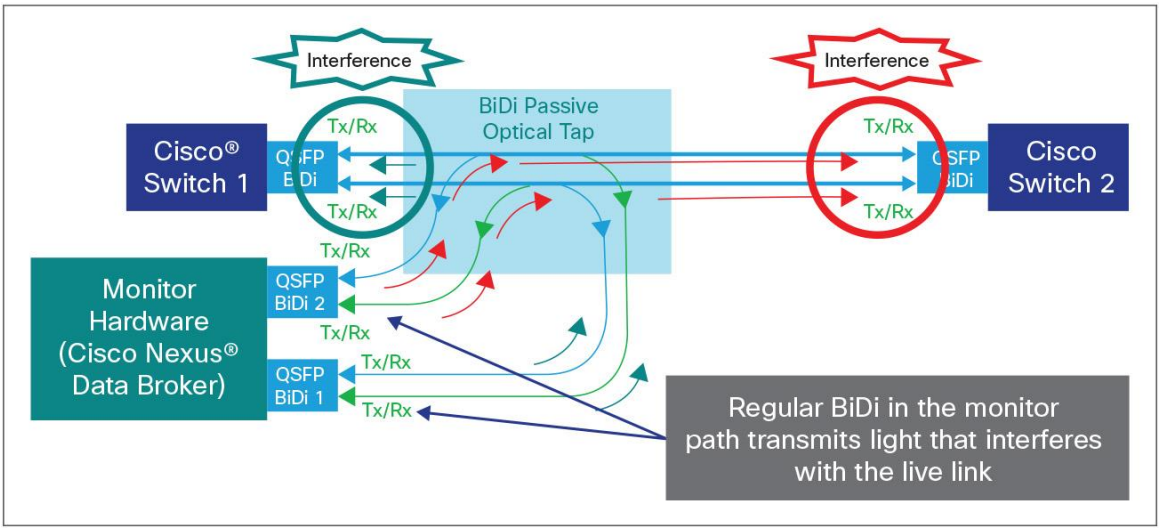
Figure 2. Interference Occurring When Monitoring QSFP BiDi Transmissions

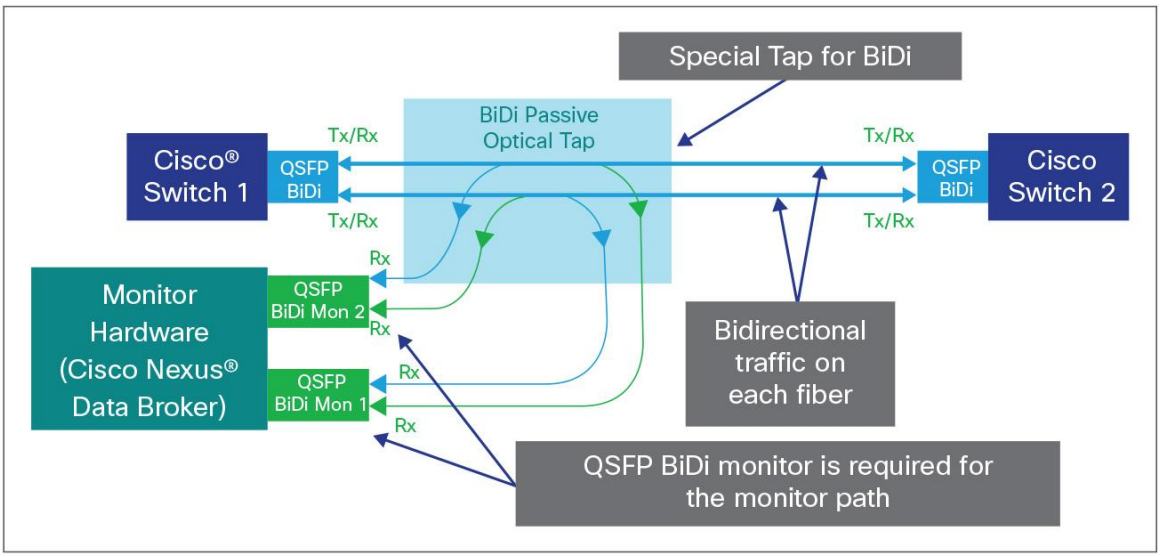


Note that the passive BiDi optical tap is different from the one in Figure 2. The passive BiDi optical tap must pull the signals of both directions from each fiber.

Bidirectional Network Monitoring

To solve the BiDi tap issue, a “BiDi monitor” transceiver is used in the monitor ports. Since the monitor hardware requires only the receive signal for its processing and analysis, the transmit signal is expendable. What if we remove the transmitter (or laser) of the bidirectional transceiver for tapping? There is then no transmitted signal to interfere with the live link. Hence, the Cisco QSFP BiDi Monitor is a QSFP BiDi transceiver with the transmitters removed. This solution is shown in Figure 3.

Figure 3. Cisco QSFP BiDi Monitor



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Cisco QSFP BiDi Monitor Module

The Cisco QSFP BiDi Monitor module complements the Cisco QSFP BiDi to allow network monitoring equipment to tap into the 40-Gbps single-fiber traffic for processing and analysis. The transmitter/laser is removed so there is no interference with the existing 20-Gbps transmit signal already in the single fiber. The Cisco QSFP BiDi Monitor works with any network monitoring hardware, thereby allowing the customer the flexibility to choose the network monitoring equipment vendor.

If the customer prefers to maintain an all Cisco solution in their Cisco Nexus network, Cisco offers the Cisco Nexus Data Broker, a dedicated piece of hardware that integrates with one or more OpenFlow-enabled Cisco Nexus switches. The traffic is tapped into this bank of switches in the same manner as in a traditional matrix network. However, with Cisco Nexus Data Broker, you can interconnect these Cisco Nexus switches to build a scalable tap/Switched Port Analyzer (SPAN) aggregation infrastructure.

QSFP BiDi Reach with Tap

Like all optical links, the QSFP BiDi link distance is limited by the insertion loss in the optical path. Consider a typical case in which the QSFP BiDi link contains multiple patch panels and a passive optical tap. Table 1 shows the allowable connector loss for links that contain a BiDi passive optical tap.

Table 1. Allowable Connector Loss for BiDi Passive Optical Tap

Allowable Connector Loss		
Distance (m)	**OM3**	**OM4**
20	1.5	1.5
50	1.0	1.2
75	-	1.0

The following assumptions apply:

1. The tap insertion loss is 3.5 dB.
2. Ethernet operation requires bit error rate (BER) of 10^{-12}.
3. Fiber loss at maximum distance is 0.4 dB.
4. All fiber and transceiver penalties are taken into account.

For more information on both the Cisco QSFP BiDi Monitor and the Cisco QSFP BiDi, visit http://www.cisco.com/en/US/products/ps11708/index.html.

For more information on the Cisco Nexus Data Broker, visit http://www.cisco.com/c/en/us/products/cloud-systems-management/nexus-data-broker/index.html.

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