

Corning Distance and Link-Loss Budgets for the Cisco® 40GbE BiDi Transceiver

This paper discusses the following topics for the Cisco bidirectional (BiDi) transceiver:

- Cisco quad small-form-factor pluggable (QSFP) BiDi transceiver
- Channel distances using OM3 and OM4 fiber
- BiDi distance capabilities using Corning preterminated solutions
- BiDi distance capabilities using Corning field-terminated solutions
- BiDi distance capabilities using Corning tap modules

Cisco QSFP BiDi Transceiver

Cisco has developed a QSFP duplex fiber 40G Ethernet BiDi transceiver (Cisco part number [QSFP-40G-SR-BD](#)). This transceiver is targeted for short-reach data center applications using OM3/OM4 multimode (MM) fiber. The Cisco QSFP 40G BiDi transceiver offers customers a connectivity solution that uses a duplex MM infrastructure for 40G Ethernet versus eight MM fibers for standard 40G-BASE-SR4 QSFP. Corning worked closely with Cisco to perform validation testing of the Cisco BiDi optics with Corning's connectivity solutions, including BiDi tap modules for monitoring of network links.

BiDi Distance Capabilities Using Corning Preterminated Solutions

A data center cabling infrastructure can use preterminated cable methods or field-termination methods to achieve a structured cabling architecture. Structured cabling in the data center is most commonly achieved by using preterminated MTP® connector-based cabling solutions. These include Corning Pretium EDGE® or Plug & Play™ indoor MTP cabling solutions. When deploying these preterminated solutions, Table 1 can be used to define the distance capabilities.

To use the table, first determine if the network protocol is Ethernet or Fibre Channel over Ethernet (FCoE). The Cisco BiDi optics can support both, however they have different reach capabilities based on a different bit-error-rate (BER) requirements. Next consider the number of MTP components (MTP-LC modules or harnesses) that are in the link, along with the type of fiber being deployed. Then use the table to determine the maximum length of the link. For example, for an Ethernet application with OM4 fiber, the network could support six MTP-LC modules in the link and still achieve the 150 m reach. (Table 1)

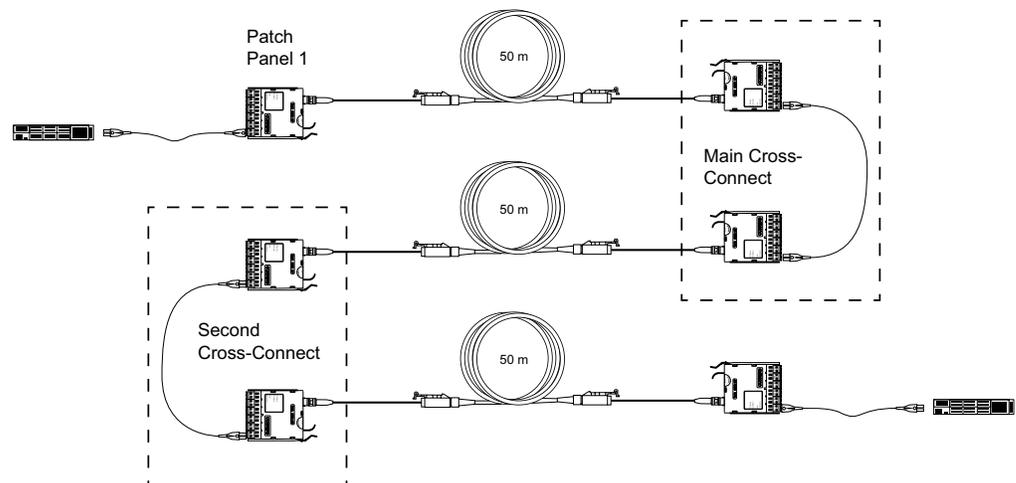


Figure 1: Six MTP-LC Module Links

Corning Preterminated MTP® Systems Distance Capability with 40G BiDi								
Number of Modules*		2	3	4	5	6	7	8
40G Ethernet	OM4	168 m	164 m	157 m	153 m	150 m	146 m	142 m
	OM3	126 m	123 m	119 m	118 m	115 m	112 m	109 m
40 FCoE	OM4	154 m	150 m	141 m	137 m	132 m	127 m	122 m
	OM3	118 m	115 m	108 m	104 m	100 m	96 m	92 m

Table 1: Corning Preterminated MTP® Solution Distance Capability

Note: Distances are based on statistical loss distribution of Corning’s 0.5 dB MTP/LC modules.

BiDi Distance Capabilities Using Corning Field-Terminated Solutions

Structured cabling can also be accomplished with field-terminated methods. Specifically, Corning’s UniCam® connectors, anaerobic epoxy-and-polish connectors, FuseLite® splice-on connectors, or pigtail splicing connectors are all viable field-termination options to consider. When using field-termination methods, there will be a trade-off between distance and connector loss.

When considering a field-termination method, a link-loss budget must be measured to ensure the link will operate properly. Table 2 shows the acceptable amount of loss at each given distance.

	Ethernet Allowable Loss Connector/Channel* (dB)		FCoE Allowable Loss Connector/Channel* (dB)	
	OM4	OM3	OM4	OM3
10 m	4.1	4.1	3.4	3.4
20 m	4.0	4.0	3.3	3.3
30 m	4.0	3.9	3.3	3.2
40 m	3.9	3.8	3.2	3.1
50 m	3.8	3.7	3.1	3.0
60 m	3.7	3.54	3.0	2.8
70 m	3.6	3.3	2.9	2.6
80 m	3.54	3.0	2.5	2.3
90 m	3.3	2.7	2.6	2.0
100 m	3.1	3.0	2.4	1.6
110 m	2.9		2.2	
120 m	2.6		1.9	
130 m	2.3		1.6	
140 m	2.0		1.3	
150 m	1.6		0.9	

Table 2: Connector Loss vs. Distance for Corning Field-Terminated Solutions

*Channel loss is the total attenuation including the fiber, connector, splice, etc.

To provide data center operators with more visibility into the traffic flow, many data analysis tools have been created. This data monitoring requires a replication of the traffic which can be achieved via optical tap modules. These passive optical splitter devices divide the light power into two outputs; one which will continue on through the network while the second output is diverted to monitoring tools for analysis. Due to the nature of bidirectional traffic on the 40G BiDi optic, special considerations must be taken in order to capture both wavelengths of traffic. Corning has developed a BiDi tap module in coordination with Cisco to validate field performance.

Corning has developed two different BiDi tap module configurations:

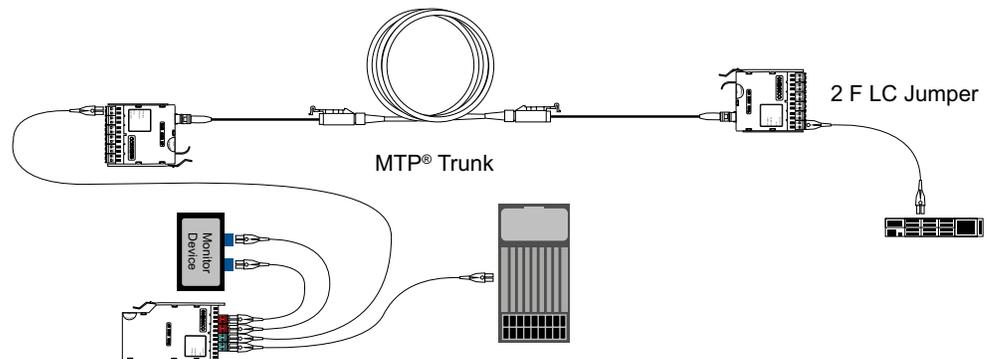
- **Configuration A** – This is a non-integrated BiDi tap module that can service a single BiDi link. This configuration works with any cabling solution.
- **Configuration B** – This integrated BiDi tap module becomes part of the structured cabling and services six BiDi links. This product requires MTP® connector-based backbone cabling with a Corning universal wired module on the other end to complete the polarity management.

Below are four common link examples for tap deployment; two single-trunk and two double-trunk links. Other deployment architectures are possible and further analysis can be provided if required.

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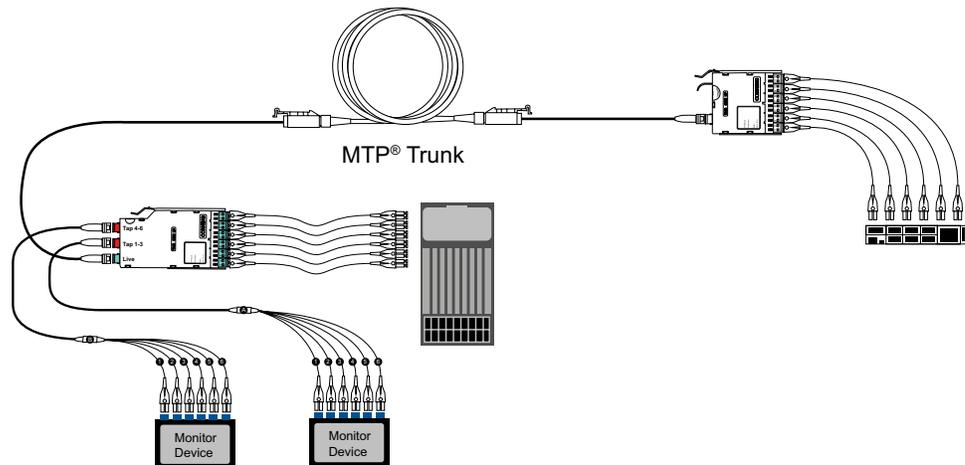
- **Configuration A-1: Non-Integrated Tap Module with Single Trunk (Interconnect)**

This configuration does not require MTP cabling, although what is shown in the diagram is Corning’s Pretium EDGE® MTP cabling. However, this configuration would also work with other connectivity solutions, like field-installed LC cabling.



- **Configuration B-1: Integrated Tap module with Single Trunk (Interconnect)**

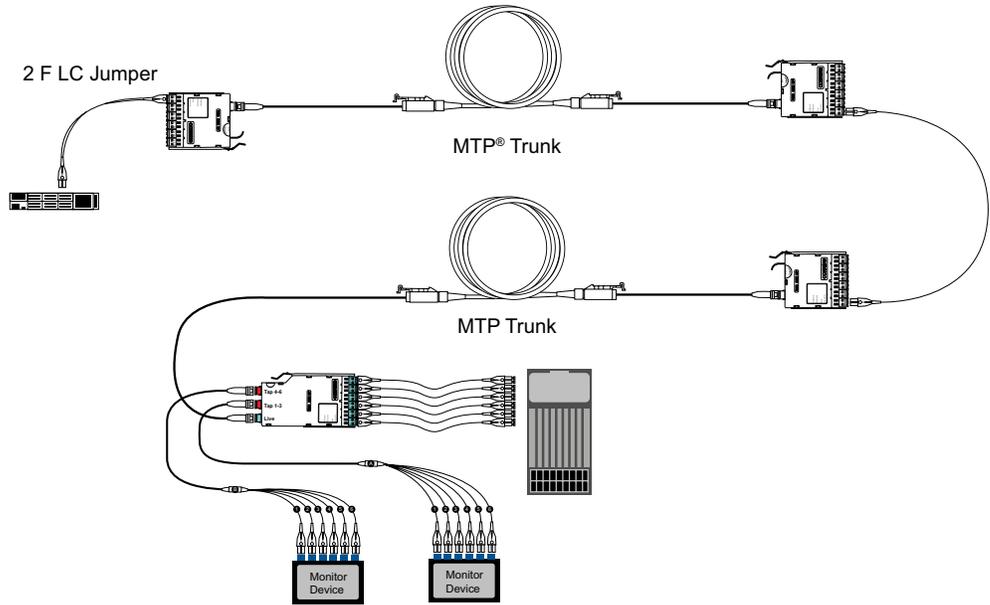
This configuration requires Corning’s MTP cabling for polarity to be maintained. The value of this solution is there is no additional rack space for the tap modules.



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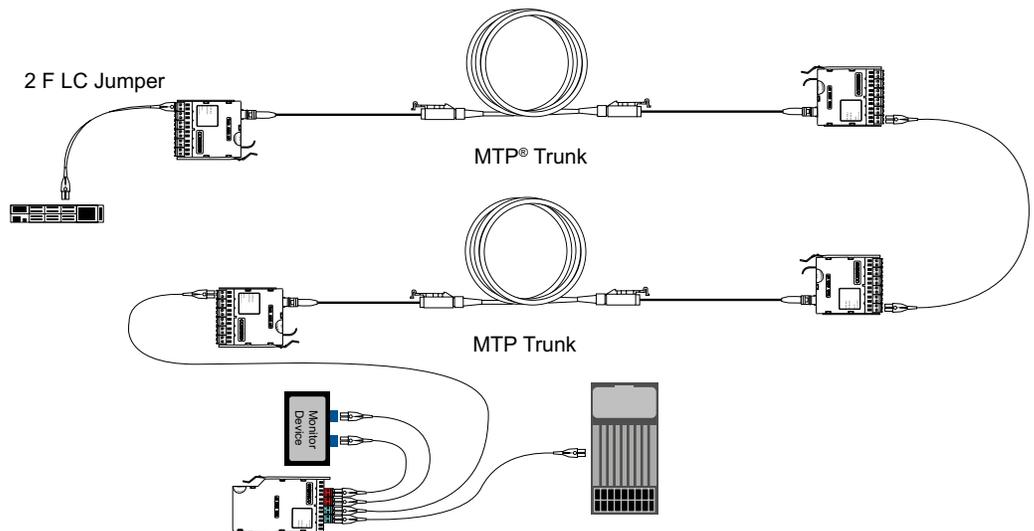
- **Configuration A2: Non-Integrated Tap Module with Double Trunk (Cross-connect)**

This configuration does not require MTP® cabling, although what is shown in the diagram is Corning’s EDGE MTP cabling. However, this configuration would also work with other connectivity solutions, like field installed LC cabling. The cross-connect configuration allows for more flexibility in connection of servers to multiple switches.



- **Configuration B-2: Integrated Tap module with Double Trunk (Cross-connect)**

This configuration requires Corning’s MTP cabling for polarity to be maintained. The cross-connect configuration allows for more flexibility in connection of servers to multiple switches. The value of this solution is there is no additional rack space for the tap modules.



The distance capabilities of each of these links are summarized in Table 3 below.

Configuration	Ethernet Distance (m)*	
	OM4	OM3
A-1	90 m	70 m
B-1	90 m	70 m
A-2	65 m	50 m
B-2	65 m	50 m

Table 3: Link Distance Capability of Cisco BiDi Transceiver with TAP

* Channel loss is limited to 4.7dB

In conclusion, 40G BiDi optics offer another choice for deploying 40G Ethernet. Referencing the tables in this document will help guide infrastructure decisions about link capabilities of various solutions when considering different network architectures.

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