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# Corning Cabled Fiber Distance and Link-Loss Budgets for Arista's QSFP-40G Universal Transceivers

This paper discusses the following topics for the Arista Universal transceiver:

- What is different about the Universal transceiver
- Arista and Corning collaborative testing
- Channel distances and budgets using OM3/OM4 and SM fiber
- Distance capabilities when using Corning preterminated solutions

**What is different about the Universal transceiver?**

There is a growing need in the data center for 40GbE switch connections due to server consolidation, virtualization, and performance improvements. Both rack-mount and blade servers are converting from 1 to 10 GbE at the leaf resulting in 1RU switches with dense 40GbE uplinks and data center spine tiers based solely on 40GbE. This insatiable appetite for higher network throughput is fueled by the attractive price points for high-performance fixed systems as measured in cost per gigabit. However, for many data center operators this upgrade and conversion is more challenging based on two primary factors. First, the potential for a reconfiguration of the physical layer of the network based on the reduced reach of the OM3/OM4 multimode optics from 10GBASE-SR (300/400 m) to 40GBASE-SR4 (100/150 m) and second, the existing fiber optic cabling plant may need to be upgraded based on the additional fiber count needed to support the IEEE-defined 40GBASE-SR4 parallel optics. These two factors are behind Arista working closely with optics technology suppliers to bring the 40GBASE-UNIV optical transceiver to market.

The defining attribute for the Arista Universal transceiver is built into its product name. The Arista Universal transceiver works over a single pair of fibers, with LC connectors. The ability to communicate over both OM3/OM4 multimode (MM) and single-mode (SM) transmission media creates the possibility to have a single universal optic for both fiber types. This is accomplished by combining four 10G optical channels at different wavelengths (1270, 1290, 1310, and 1330 nm) inside the module to transmit and receive an aggregate 40G signal over a single pair of MM or SM fibers.

The UNIV transceiver is fully compliant to the QSFP+ MSA SFF-8436 which defines the specification for QSFP optics, and as a result can be plugged into any Arista QSFP+ based switch port. In addition, the optical interface is defined to the IEEE 40GBASE-LR4 standard. As a result the QSFP-UNIV can interoperate with both 40GBASE-LR4 and 40GBASE-LRL4 for distances up to 500 m. Interoperability with other engineered WDM optics, such as the Cisco BiDi, is not possible since they operate in two different WDM spectrums (BiDi operates in the 850 nm region while UNIV operates in the 1310 nm region).

Addressing customer concerns around the reduced distances with 40GBASE-SR4, the Arista Universal optic has been designed to allow for seamless migrations from existing 10 to 40GbE networking without requiring a redesign or expansion of the fiber network. It supports operation over a full 150 m of OM3 or OM4, in environments with trunks, patch panels, and patching frames, in other words existing data centers. In both existing and new installations that are being designed around single-mode fiber, easing future migration to 100GbE, the Universal optic can be used for up to 500 m and interconnected with both 40GBASE-LR4 and 40GBASE-LRL4 for a multivendor system or migration.

**Collaborative testing**

Arista and Corning conducted joint experiments on 40GBASE-UNIV optics to validate the performance of the optics even in the presence of large connector offsets. The test setup included both single-trunk (two patch panels) and double-trunk links (four patch panels), as shown in Figures 1 and 2.

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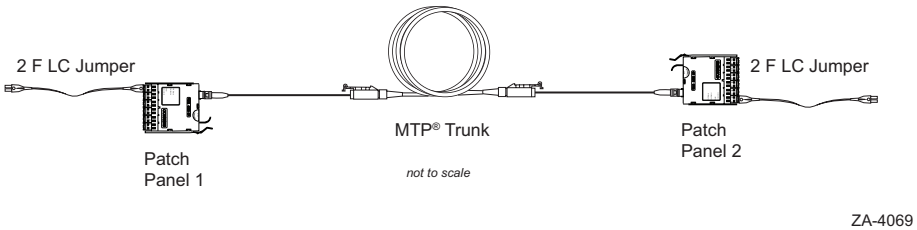


Figure 1: Single-Trunk (two patch panels) Link Setup

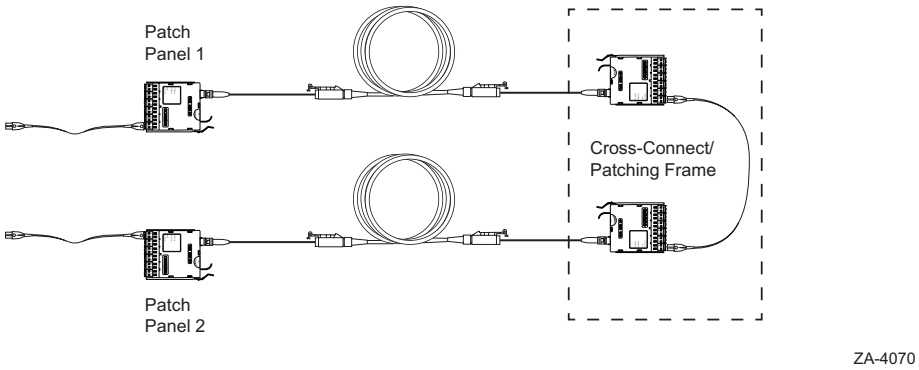


Figure 2: Double-Trunk (four patch panels) Link Setup

In this test setup the trunk cables were intentionally constructed with MTP® connectors with a 4 µm fiber offset in the X-axis in fiber positions 1, 2, 3, and 4. Likewise, the MTP/LC breakout modules were constructed with the same offset connectors on the MTP side. Thus, when the trunk and modules are mated in the Type-B (key-up to key-up) adapter, a 4 µm fiber core offset is created in the four outer fiber paths as shown in Figure 3. This was done in order to validate that multiple path interference (MPI) and coherent interference did not adversely impact transmission performance even in the presence of grossly exaggerated fiber offsets.

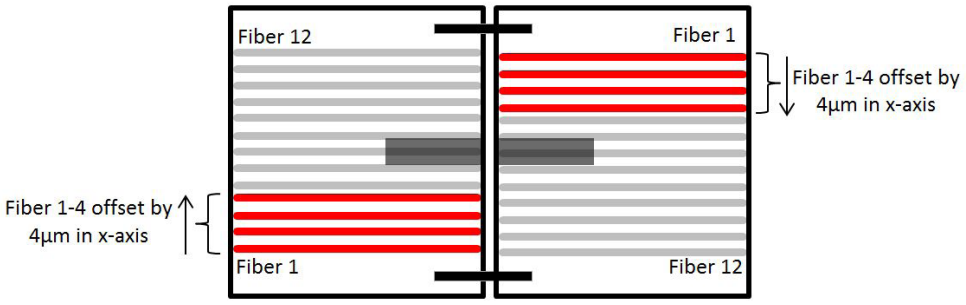


**Figure 3: Connector X-axis Offset**

Since fiber offset is not a traditionally measured value of a finished MTP® cable assembly, it was important to have an attribute (like insertion loss) to compare. For Corning preterminated Pretium EDGE® products, a typical MTP insertion loss is around 0.15 dB with a maximum specified value of 0.25 dB. In order to have a comparable value, we first had to condition the DFB laser source to have an encircled flux power distribution. This was accomplished using an Arden Photonics ModCon to condition the launch to meet the EF requirements of IEC 61280-4-1 at 1310 nm. This source was then used to quantify the attenuation of the short 100 m link. The link as shown in Figure 1 contains two LC pairs, two MTP pairs (with offsets), and fiber attenuation. The fiber and LC connector pairs contribute < 0.25 dB to the link, while the remaining loss is attributed to the MTP pairs with the offsets. The data shows that each MTP pair is contributing nearly 0.4 dB to the link, which is two to three times the typical attenuation of commercially available Corning products.

Once the links were characterized, bit error rate (BER) testing was performed to validate error-free transmission. All four channels (1270, 1290, 1310, and 1330 nm) were each driven at 10.3125 Gb/s using a pseudorandom binary duty cycle sequence (PRBS31). The transmission was measured via a BER device to determine if acceptable levels (1x10E-12) were achieved. Both the single and double links showed error-free performance over the 15 minute test. Note this performance was achieved despite the presence of large induced connector offsets.

**Channel distances and budgets**

As previously mentioned, the 40GBASE-UNIV optic can operate universally over both MM and SM cabling. To facilitate in planning a deployment, the associated optical attenuation budgets and length capabilities are summarized in Table 1.

| Fiber Type | Modal Bandwidth at 850 nm (MHz•km) | Operating Distance (m) | Link Budget at 1310 nm (dB) |
|---|---|---|---|
| OM3 | 2000 (OM3) | 150 m | 2.1 dB (1.95 dB connector + 0.15 dB fiber) |
| OM4 | 4700 (OM4) | | |
| SM | NA | 500 m | 3.7 dB (3.5 dB connector + 0.2 dB fiber) |

Table 1: Summary of Operating Distance and Link Budget

**Distance capabilities for Corning preterminated solutions**

When using Corning preterminated solutions like Pretium EDGE® Solutions or Plug and Play™ Systems, multiple modules can be placed in the link. This can be accomplished while still adhering to the link budgets in Table 1 due to industry-leading product specifications. Table 2 provides a summary of the various link length capabilities which can be achieved when deploying a preterminated solution.

| Number of Modules | | 2 | 3 | 4 |
|---|---|---|---|---|
| 40G Ethernet | OM4 | 150 m | 150 m | 150 m |
| | OM3 | 150 m | 150 m | 150 m |
| | SM | 500 m | 500 m | 500 m |

Table 2: Preterminated Solutions Link Capability

In conclusion, 40GBASE-UNIV optics from Arista Networks offer another choice for deploying 40G Ethernet. The advantages of being able to use the same optic for both SM and MM optical media and that a link requires only two fibers makes for an attractive solution for many data center operators. Referencing the tables in this document will help guide infrastructure decisions about link capabilities of various solutions when considering different network architectures. If you need more information on Corning products and solutions or design assistance, please call 800-743-2675.

**About ARISTA NETWORKS**

Arista Networks was founded to deliver software-driven cloud networking solutions for large data center and computing environments. Arista's award-winning 10/40/100GbE switches re-define scalability, robustness, and price-performance, with over 2,700 customers and more than three million cloud networking ports deployed worldwide. At the core of Arista's platform is EOS, an advanced network operating system. Arista Networks products are available worldwide through distribution partners, systems integrators, and resellers. Additional information and resources can be found at www.arista.com

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