COMMSCOPE®

New Innovations Help Data Centers Adapt to Higher Fiber Counts

2023 saw the unleashing of artificial intelligence in all its guises—generative AI, machine learning, artificial neural networks, deep learning, natural language processing and more. In its wake, data center managers and their teams are scrambling to figure out how to provide ever-increasing capacity.

Supporting higher data rates and port counts to handle the additional petabytes of new data flooding the data center requires exponentially higher fiber counts. Data center interconnect (DCI) trunk cabling for connecting multiple hyperscale facilities has increased to 3,000+ fibers, and some operators are already doubling that designed capacity. Inside the data center, singlemode and multimode fiber have progressed from 2 to 8 and 16 fibers per switch port.

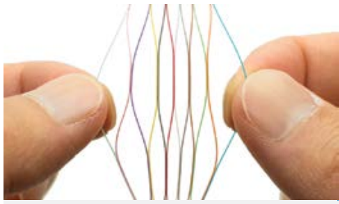
While fiber counts have increased by at least 4x or 8x, the pathways and spaces between and around the equipment have not. Data center managers must take into account innovations in fiber cable construction and connectivity that make more efficient use of the available space. Let's look at some of these key innovations.

Rethinking the fiber package

As fiber counts for interconnecting data centers have surged, how fiber is designed and packaged within the cable has evolved—allowing data centers to increase the number of fibers in a cable construction without necessarily increasing the cabling footprint. Rollable ribbon fiber cabling is one of the more recent links in this chain of innovation.

Rollable ribbon fiber cable is based, in part, on the earlier development of the central tube ribbon cable. Introduced in the mid-1990s, primarily for outside plant (OSP) networks, the central tube ribbon cable featured ribbon stacks of up to 864 fibers within a single, central buffer tube. The fibers are grouped and continuously bonded down the length of the cable, which increases its rigidity. While this has little effect when deploying the cable in an OSP application, a rigid cable in a data center limits the more flexible routing required to navigate narrow and congested pathways.

In a rollable ribbon fiber cable, the optical fibers are attached intermittently to form a loose web. This configuration makes the ribbon more flexible, allowing as many as 3,456 fibers to be loaded into a 2-in. duct—twice the density of conventionally packed fibers. This construction reduces the bend radius, making these cables easier to work with inside the tighter confines of the data center.



Rollable ribbon 250 µm

- Partially bonded individual 250-micron fibers
- Reduces time using mass fusion splicing
- 20-40% smaller cable OD than matrix ribbon, offering better duct utilization

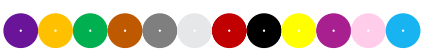
Inside the cable, the intermittently bonded fibers take on the physical characteristics of loose fibers that easily flex and bend, making it easier to manage in tight spaces. In addition, rollable ribbon fiber cabling also uses a completely gel-free design, which helps reduce the time required to prepare for splicing—reducing labor costs. The intermittent bonding maintains the fiber alignment required for typical mass fusion ribbon splicing.

Reducing cable diameters

For decades, nearly all telecom optical fiber has had a nominal coating diameter of 250 microns. With growing demand for smaller cables, that too has started to change. Many cable designs have reached practical limits for diameter reduction with standard fiber. But a smaller fiber allows additional reductions. Fibers with 200-micron coatings are now being used in rollable ribbon fiber and micro-duct cable.

A SMALLER ROLLABLE RIBBON

250µm x 250µm Pitch



200µm x 200µm Pitch

Partially bonded individual 200µm fibers
~25% smaller cable OD than 250µm rollable ribbon constructions

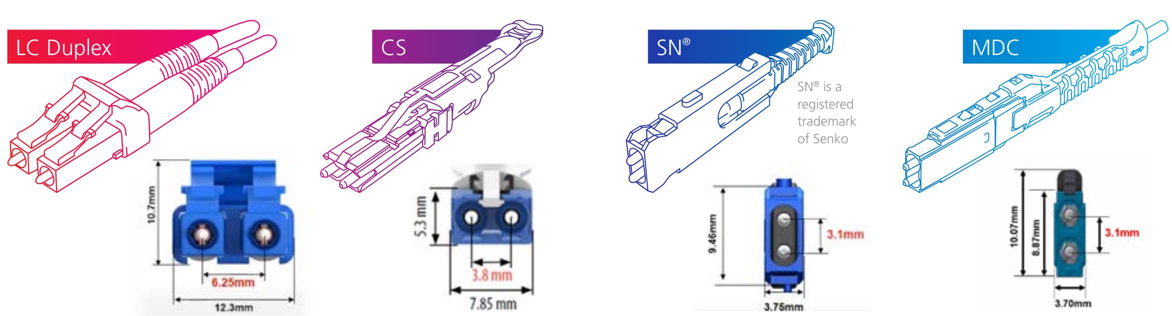
It is important to emphasize that the buffer coating is the only part of the fiber that has been altered. 200-micron fibers retain the 125-micron core/cladding diameter of conventional fibers for compatibility in splicing operations. Once the buffer coating has been stripped, the splicing procedure for 200-micron fiber is the same as for its 250-micron counterpart. Fixtures are also available to enable "up-pitching" from 200-micron to 250-micron for the transition to multifiber connectors, if necessary, at the endpoints.

While duplex applications can be supported by any of the available 8-, 12-, 16- or 24-fiber subunit counts, migration to 8- or 16-fiber applications is best supported by MPO8 or MPO16 fiber trunk units. Should 16-fiber applications be the network team's current or possible future plan, 16-fiber trunks will provide the most efficient Day 1 installation. This configuration can support all existing applications without wasting fibers or needing to bridge trunk cables on site in the future. Additional benefits from these reduced-diameter cable constructions include the associated reduction of pathway space required for the fiber count and reduced cabling materials used, which deliver sustainability values.

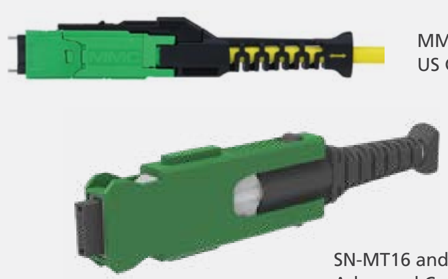
New very small form factor connectors

Connectors are also evolving to support higher cabling densities, with new VSFF (very small form factor) configurations available to provide duplex or parallel application support. Common fiber counts for higher speed connectors include 2, 8 or 16 fibers in both singlemode and multimode. For some applications, 24-fiber cabling remains an option as well. Decisions on which cable subunits to use for the trunks should consider current and possible future connector requirements.

Recently introduced VSFF duplex connectors aligned with transceivers have entered the market over the past several years. They provide better density and, in some cases, breakout options directly at the transceiver. The intent is to enable higher fiber counts for full capacity utilization at the network equipment. Shown below for size reference is the legacy LC duplex, along with new VSFF SN, MDC and CS connectors. While aligning with transceiver applications, these connectors can also provide manageable higher density at the patch panel for structured cabling applications.



Other soon-to-be-available multifiber options in the SN and MDC footprint will pack even more manageable fibers in a smaller size. As shown below, these VSFF multifiber connectors include the MMC16 and MMC24 and the SN-MT16 and SN-MT24 that house 16 or 24 fibers in the same space as the SN and MDC duplex solutions. The enabling technology for these connectors is a smaller type of MT ferrule (similar to those found in MPO connectors) that can house more fibers within the highly compact connector body. These connectors are not intermateable but are currently developing in the market.



MMC16 and MMC24—
US Conec Ltd

SN-MT16 and SN-MT24—SENKO
Advanced Components

VSFF fiber connectors also enable smaller and lighter preterminated high fiber-count trunks to be pulled through conduits more easily. When deployed using low-profile rollable ribbon cable, preterminated high fiber-count VSFF connectors simplify and accelerate installation, saving valuable time and space. Having been assembled in a carefully controlled factory setting, these preterminated cables also provide added performance assurance. As a result, rollable ribbon cable preterminated with the new VSFF connectors provides some unique benefits compared to field-terminated or spliced alternatives.

Not surprisingly, initial applications for VSFF connectors target preterminated high fiber-count trunk cables designed to be pulled through innerducts or raceway systems. Future VSFF applications could include equipment interface, breakouts or structured cabling.

CommScope's modular, ultra-low loss, high speed fiber platform—Propel™—is designed to help data center operators easily scale and adapt cabling infrastructure to support higher fiber counts. Propel's high-density fiber panels and interchangeable modules and adapters maximize design options while reducing deployment time, cost and complexity. 16-fiber connectivity provides easier migration to more efficient 400G/800G deployments while fully supporting legacy 8-, 4- and 2-fiber applications.

To help data center managers customize an infrastructure platform that addresses immediate needs and takes them through multiple generations of upgrades, CommScope's Propel design guide provides an at-a-glance reference of Propel components, configurations, and channel designs for various high-fiber-count applications. Local CommScope sales engineers are also available to help data center managers navigate solutions for adapting to higher fiber counts.

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