OCC WHITEPAPER

RAPID OPTICAL SIGNAL PATCHING

REDUCE SETUP TIME AND LABOR, INCREASE FLEXIBILITY, AND ADD REDUNDANCY TO COMPLEX MULTI-FIBER SYSTEMS.

Fiber optic communications networks are growing at incredible rates, and they are growing into more diverse uses every day. Whether the content transmitted is Ethernet data, passive optical networking, audio/video including 4K video, or remote sensor data, the need to rapidly deploy and patch numerous fibers is a growing problem for many users in many industries due to the ever-present need to accomplish more in less time. Along with this growth comes a number of challenges that, while present in smaller networks, become exponentially more difficult as fiber counts increase.

A significant challenge with rapidly deploying and patching large numbers of individual fibers is the high cost of labor to do so. A skilled technician must, one-at-a-time, clean and connect a fiber optic patch cord for each fiber channel. This is time consuming, expensive, and provides many opportunities for mistakes to be made. For example, when patching 48 fibers, the technician must clean 96 connections, one on each end of each patch cord, and manually route 48 fibers from point A to point B. A typical installation may take one minute to read the next line on the diagram, clean, inspect, and connect one end, then clean, inspect, and connect the other end. Therefore, this connection process for 48 fibers would take about 48 minutes. 48 fibers can be a small installation – with some projects requiring hundreds or thousands of fiber connections, the time requirement multiplies quickly. Often times this patch is not 1-to-1, as content coming in on channel 12 may need to be routed to fiber 3. Reading the patching diagram and making all of these patches by hand requires extreme attention-to-detail in order to get it right on the first attempt.

Discrete connectors for each patch cable also take up a fixed amount of space. While connectors are getting smaller and densities are increasing, this has its own challenges. Connectors must be spaced far enough apart so that a technician's fingers can insert and remove them; higher density discrete connectors are often too dense for technicians with larger fingers to work on comfortably or accurately. Significant amount of valuable rack space is required to house the connectivity required for a complicated optical network, and the resulting installation can be disorganized and hard to troubleshoot when problems arise. Currently, using standard LC connectors, it is possible to terminate 144 LC's into one 19" x 1.75" rack unit. While physically possible, getting in there to remove a single fiber later on is quite difficult without specialized tools. To address this problem, many connector manufacturers have started adding pull tabs to their LC connectors, but this further crowds an already crowded front panel area.

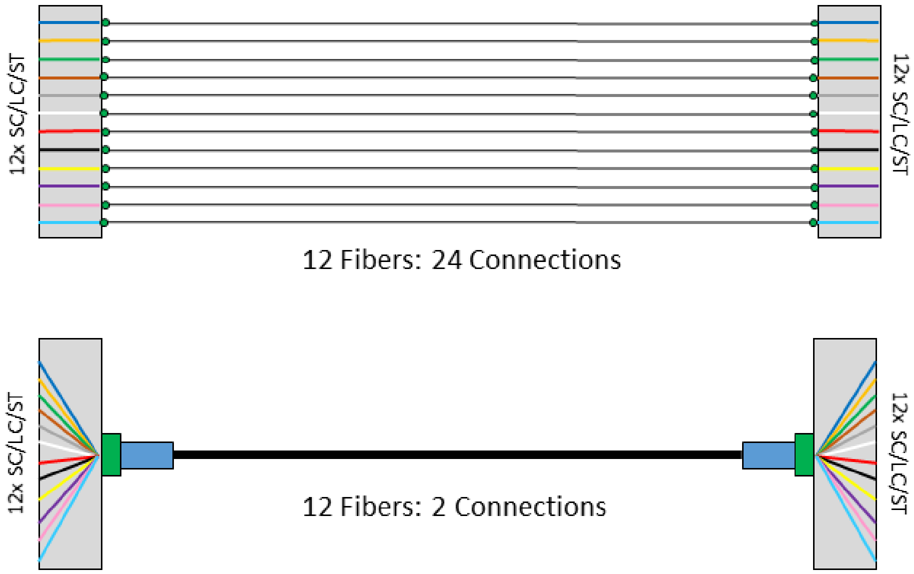

Figure 1: 12 fibers being connected individually with 24 discrete connectors vs. 12 fibers being connected through 2 multi-fiber connectors.

To address fiber density issues, the MPO connector has become the de-facto standard as an aggregate fiber connector, increasing fiber density and reducing connection time, but it has also introduced tremendous complexity. A single MPO connector can replace 12- or 24- SC or LC connections, providing space savings with 12 or 24 times the fiber density in an equivalent footprint size while simplifying and speeding up installation. Instead of simple 1:1 patching afforded by simplex patch cords and discrete connectors, the MPO has three different polarity options and 2 genders so installers must know which polarity and gender they need in order to patch the 12 fibers correctly to pass content. Some MPO connectors are designed to allow the user to change the polarity or gender in the field. However, this further adds confusion because the MPO patch cord that has been changed is no longer interchangeable with other similar-looking MPO patch cords which may even have the same factory identification labeling. The solution to this is to use hermaphroditic multi-fiber connectors on trunk cables. By using hermaphroditic multi-fiber connectors, concerns about cable polarity and gender are eliminated, nor does a technician ever end up holding the “wrong” end of the cable.

The two biggest challenges to overcome are that of individual fiber testing and usage, and contingency recovery. If a user needs to test one fiber out of the 12, getting into that one fiber requires disconnecting the other 11 fibers in order to be able to hook up test equipment to the MPO connector. Alternatively, in our example, content coming in on channel 12 may need to be routed to fiber 3, this simply cannot be done with the MPO solution. Similarly, if an MPO connector gets damaged, all 12 fibers in that connector are affected and possibly rendered useless. So how can a multi-fiber system protect against these concerns?

The solution for these problems is a system that integrates fiber aggregation and breakout technology in order to rapidly patch cables to streamline installation, testing, and troubleshooting efforts. As an example, current trunk cables and circular connectors commonly carry up to 48 fibers in one small diameter, flexible, yet durable cable assembly. This further saves time over a 12 fiber connector because 2 or 4 times as many fibers can be cleaned and connected in one operation. As the scale of the fiber optic system grows, this time savings becomes more and more significant. However, should the user need to test one fiber, it is not desirable to have to disconnect the other fibers, as those may already be active and passing content. Rather, it is advantageous to design into the system a method to rapidly patch individual fibers without disturbing the other fibers.

A rapid patching system allows individual fibers to be accessed for testing and routing of content to other fibers in the trunk cable. This capability is critical for reliability and contingency management. If a channel goes down for any reason, content flowing over that channel can be quickly re-routed to bring that channel back up. One concern with using multi-fiber connectors is that all 12, 24, or 48 fibers are subject to failure all at the same time should the connector or cable be damaged. A rapid patching system allows patching around broken or damaged fibers and cables by routing content onto other trunk cables quickly. In a worst-case scenario, it is possible to completely route content into legacy discrete systems. Thus, the versatility created by a rapid patching system overcomes many challenges and keeps content flowing where it needs to go.

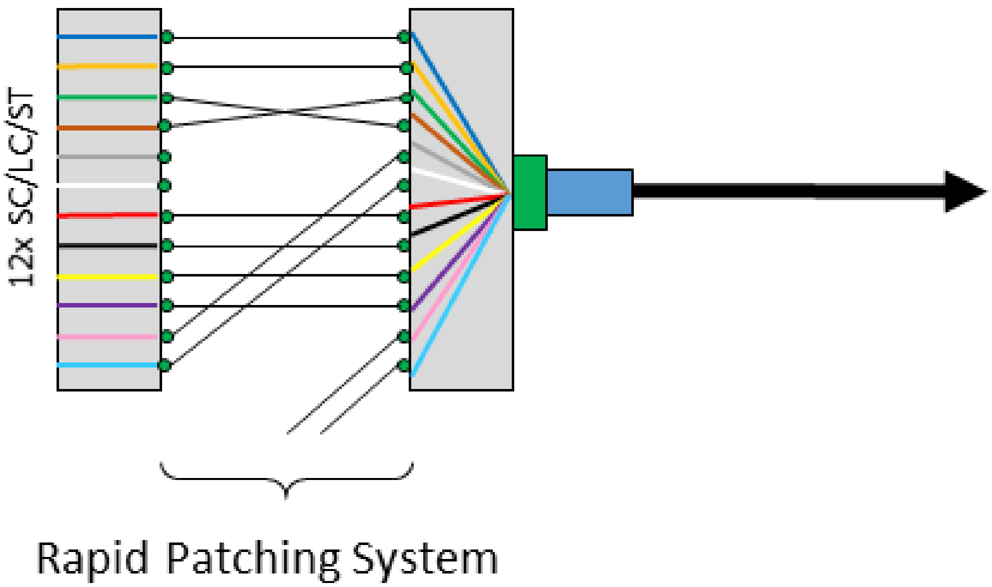

Figure 2: Rapid Patching System Concept. Any input can be routed to any fiber within the multi-fiber connector via the rapid patching system for flexibility and contingency recovery. Any fiber can be independently pulled out of the system for testing (bottom 2 fibers on diagram)

A complementary solution to the rapid patching system is a field-deployable breakout box which breaks out multiple fibers from the trunk cables. This is well suited for applications such as a fiber installation in a mine, where sensors or other data-producing devices are arranged in series from the opening of the mine to the current operating point. In this case, a breakout box could be used to break 12 fibers out of a 48 fiber trunk cable, then pass the remaining 36 fibers on to the next breakout box in series, and so on, until all 48 fibers are accessed. This provides a more versatile alternative to breaking out all 48 fibers in one location and running patch cords or other cables out to the devices in a star topology. Some industries refer to this breakout box as a "throwdown" box, as it can be rapidly deployed for breaking out individual fibers from a cable, and then quickly thrown back in the truck after the event.

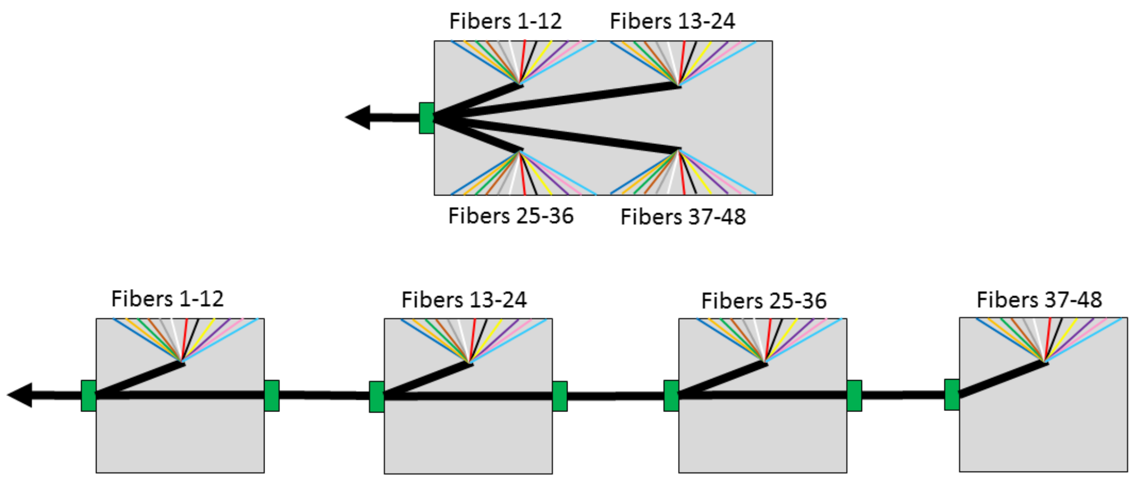

Figure 3: Multi-fiber breakouts at one point vs in series. The distances between the breakout boxes in series may be hundreds or thousands of feet, depending on the needs of the specific situation.

The use of multi fiber deployable trunk cables with a rapid patching systems and breakout boxes also provides inherent ability to grow and expand as the network grows and expands. Following the example of an installation in a mine, as a mine digs deeper, more trunk cables can be added to extend the network further into the ground. Another example is for mobile TV broadcast systems. When a mobile broadcast team is covering a golf tournament one weekend and a basketball game the next, they can deploy only the amount of trunk cable needed and the number of breakout boxes needed to match the physical size and scope of each event and venue. The list of possible uses for such a configurable and flexible system are endless.

OCC has developed a rapid patching system and throwdown box that is built upon the reliability and flexibility of our MHC-T3 multi-fiber hermaphroditic connector. Together, this system can help decrease setup time, decrease labor costs, and preserve the ability to test or re-route a single fiber when necessary. For more information, please contact your OCC sales representative.