Will Technicians 'Bend' the Rules of Fiber Management with New Fibers?

With all of the real benefits associated with reduced-bend-radius fiber, it's important to remind technicians that proper fiber cable management techniques still apply

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Fiber that bends around pencils and sharp corners without a significant increase in attenuation has captured the collective imaginations of fiber pundits everywhere. In discussions on conference floors, in meeting rooms and even around the proverbial water cooler, these fibers are touted as virtually indestructible – and therein lie many potential issues.

The new breed of reduced-bend-radius fibers can reduce minimum bend radius requirements from the traditional 10 times the outside diameter of the jacketed cable (about 38 mm) to as low as 5 to 10 mm without increasing attenuation. This capability is a monumental breakthrough in the fiber community and conjures up all kinds of possibilities for technicians and installers, particularly in fiber-to-the-premises (FTTP) applications.

Uses for reduced-bend-radius fibers have existed for many years, beginning in the 1990s with specialized applications in optical subassemblies and dense wavelength division multiplexing (DWDM) systems, including oceanic repeaters where reduced space is critical. Today the greatest need for these fibers is in high-density cable management products for FTTP applications. They will also be used in new and legacy wavelength division multiplexing (WDM) installations, which are also gaining traction within the access segments of the network, including WDM passive optical networks (WDM-PONs).

What's new today is the progression from a controlled laboratory and manufacturing environment, which use only coated optical fibers, to outside plant, central office, headend and premises locations where installers and technicians work with cabled fibers. It is now possible to use reduced-bend-radius fibers in these settings because cable structures have evolved to provide physical protection for the internal fibers and also to maintain their optical performance characteristics for high signal quality.

It's Still Glass

The danger is that technicians may believe these new fibers are impervious to the forces that increase attenuation or cause optical links to fail. Even the names given to some of these fibers – bend insensitive, bend resistant, bend optimized – can lead technicians to make false assumptions about the fiber's durability and performance capabilities – assumptions that could have serious impacts on long-term network performance.

The fact that a fiber can be bent beyond traditional limits does not mean that it cannot be damaged. It's still fiber and, in the end, still glass – subject to fracturing and even breaking with improper handling or due to a variety of outside forces. Not all types of cables ensure against kinking, although ad-

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vances are being made in cable structures as well. Some new cable designs will actually provide built-in bend limits to protect the glass within.

What is most exciting about these fibers is that they will make installation, particularly routing of cables inside structures, much easier. For example, in a multiple dwelling unit it will be much easier to route and conceal the fiber cable between rooms and around sharper corners. However, even with simplified fiber cable management techniques, it is necessary to plan carefully for a robust, reliable network. The way fiber cables are connected, terminated, routed, spliced, stored and handled will still have a direct and substantial impact on network performance and, more importantly, profitability.

There are four elements of good fiber cable management: bend radius protection, cable routing paths, accessibility and physical protection. Each element should be considered in light of the capabilities of the latest reduced-bend-radius fibers.

Bend Radius Protection

In the past, bend radius protection was arguably the most important aspect of good fiber management because it prevented the macrobends that drastically reduce the network's long-term performance. Reduced-bend-radius fiber and improved jacketing techniques now allow much sharper bends without attenuation penalties. However, bend radius protection is far from a thing of the past.

Although the new fibers enable less stringent parameters, there still remains a minimum bend radius that technicians must consider. Proper slack storage is still a critical step in alleviating potential problem areas on frames and along cable pathways.

Technicians must understand that these new fibers do not diminish the need for solid fiber cable management practices. Rather, the increase in the number of fibers being added to optical access networks to accommodate broadband upgrades makes bend radius protection as important as ever. This in turn requires good cable routing, since improper fiber routing is a major cause of bend radius violations.

Cable Routing Paths

Technicians may believe neatness is no longer required because new fibers make bend radius protection obsolete. Nothing could be further from the truth. First, as we've discussed above, bend radius protection is far from obsolete. Second, good cable routing is needed for more than simply reducing bend radius violations. Technicians are still required to perform rapid circuit routing, cable tracing, and reconfigurations.

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Reduced-bend-radius fibers will magnify the benefits of good cable routing. While defined routing paths make it easier to access individual fibers, the new fibers will enable technicians to actually put their hands into a fiber bundle to physically trace a particular fiber. This will make cable tracing much easier and reduce the time required for reconfigurations. However, any benefit provided by reduced-bend-radius fibers will depend on how well the cables were routed in the first place.

Cable/Connector Access

Cable access, the third element of good fiber cable management, refers to the accessibility of the installed fibers and connectors. If technicians assume that bending fibers to gain access is no longer a problem with reduced-bend-radius fibers, they can actually make cable access more difficult.

In FTTP architectures, connectors are closely packed together, making the possibility of accidentally disconnecting a wrong cable much more likely. Whatever type of fiber is used, connector access is critical for reconfigurations, rapid service turn-up, testing, troubleshooting and dealing with customer churn.

In the past, an active equipment rack might have had 50 fibers exiting it, so the management of individual fibers was much less of an issue. But as that same rack is fitted for broadcast services, the number of fibers increases to upwards of 500, making proper management and accessibility techniques critically important. The bottom line is that reduced-bend-radius fibers will have little effect on reducing the need for ensuring good cable and connector access for technicians.

Physical Fiber Protection

The physical protection of fiber cannot be stressed enough to technicians and installers. The tighter bending capabilities of new fiber products do not diminish the need to protect fibers from outside forces. Optical fiber is still glass, and damaged or even broken fibers are

still a possibility if the fiber is handled roughly or improperly.

Whether or not fibers bend around corners, they will always have the physical limitations imposed by their cladding and cover materials, which are still covering a glass core. They are still subject to serious damage from nails, screws, staples and external pressure or mishandling that causes pinching, binding or bending the fiber beyond its capabilities. Therefore, all fibers traversing from one piece of equipment to another must be physically protected, for example by raceway systems.

Technical Skill Levels

Service providers have asked whether they can employ less-skilled technicians to deploy these new fibers, since sensitivity to the special handling of these cables is less of an issue. But the issue isn't really whether reduced-bend-radius fibers should be handled differently from other fibers – they should not. Rather, the issue is the installer's experience. Even though copper cable is simpler to handle, very few people prefer having it installed by an inexperienced technician. They prefer to have the job done correctly and in accordance with building codes, standards and specifications.

Today's users already have difficulties identifying fiber optic cable types and characteristics. As densities continue to increase with a mix of older and newer cable plants installed, it will become even more difficult for technicians to determine which fibers may be more bend resistant.

This leads us to the issue of standards. Although some standards have emerged for the fibers themselves, standards concerning installation techniques are lacking. This leaves technicians and installers at the mercy of the manufacturer's specifications. Technicians cannot, and should not, make assumptions about fiber, since the fiber and cabling could come from different manufacturers. Therefore, until standards are written for proper installation and handling of these new fibers, the potential exists for confusion about what is acceptable and what is not – and erring on the side of caution should be the rule.

Even technicians with many years of experience in fiber installation face the challenge of proper fiber handling and cable management techniques for all types of fiber. There is currently no way to identify which optical cables contain reduced-bend-radius fibers and which do not. Therefore, technicians and installers should always use prudence with good cable installation disciplines regardless of the fiber and cable types installed. If this point is minimized, long-term performance is jeopardized. Problems could occur in many legacy fiber installations that are not designed with these new fibers and, that are therefore not as bend resistant.

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termine which fibers may be more bend resistant. Therefore, the safest practice would logically be to apply traditional fiber management techniques across the board regarding bend radius, securing and routing of optical cables, jumpers and fibers.

In fact, some new fibers call for special attention or knowledge on the part of technicians. For example, some types of reduced-bend-radius fibers, known as "holey fiber," are manufactured with nanostructures, or small airholes around the core of the fiber. These airholes can actually wick water or alcohol on the endface while they are being cleaned in preparation for splicing or connectorization. If the technician is aware of these fibers, he or she will know to cut the fiber back a bit before immediately splicing it. Similarly, in field connectorizations, there are some new techniques required for the new reduced-bend-radius fibers. Technicians must be aware of any special requirements associated with different types of fiber.

Educating Technicians

Reduced-bend-radius fiber is not a completely new phenomenon – some types have been on the market for several years. However, these fibers are steadily being improved to enable technicians to install them faster, more easily, and with the same or better reliability. But, as with all their predecessors, these new fibers have limits that technicians must understand and adhere to.

Reducing the traditional bending radius allows many benefits to installers. New jacket materials will likely improve these fibers even more. With each improvement, however, comes the responsibility to ensure that technicians are aware – not only of the benefits of a new fiber but, more importantly, of its limitations. Good fiber and cable management techniques, along with the use of quality cable management products designed with the long-term viability of network performance, will become even more critical in the days ahead as fiber densities reach an all-time high.

New reduced-bend-radius fibers, together with all the elements of good fiber cable management, will significantly enhance long-term performance and efficiency for optical access networks. If technicians "bend" the rules and practices of managing the fiber because they believe new fibers allow them to do it, network efficiency and performance is jeopardized in the process. It all starts with education – and ensuring that the network designer, installers, and technicians are acutely aware of the capabilities of the products placed into their hands. **BBP**

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