

*The Inside Story:*

# Corning's New Bend-Insensitive Fiber is a Wow

**Corning offered little detail aside from a financial-community-oriented press release to support claims for its new fiber. But the excitement is warranted.**

By Steven S. Ross ■ *Editor-in-Chief*

Corning's July 25<sup>th</sup> announcement of a new way to produce bend-insensitive fiber has jolted the industry, raised the price of Corning's and Verizon's stock, and produced some cries of disbelief from competitors.

The new product, Corning says, will make it faster and less expensive to deploy FiOS and other fiber-based networks to MDU residents, especially in existing, older structures with quirky pathways through which fiber must be threaded.

"Continued innovation in advanced telecommunications networks is critical to the long-term success of Verizon and our ability to provide our FiOS service on a mass scale in the United States," said Paul Lacouture, executive vice president of Engineering and Technology, Verizon Telecom Group. "We are working closely with Corning to solve the challenges of providing fiber solutions to high-rise apartment complexes across the United States. This fiber technology will enable us to bring faster Internet speeds, higher-quality high-definition

content, and more interactive capabilities than any other platform which exists today."

"This is a game-changing technol-

**Does the new nanoStructures fiber qualify as a true breakthrough? Our verdict is that it, and the associated installation products Corning expects to announce next month, do indeed qualify. But when it comes to MDU deployments, the engineers warn, it is tough to build a magic bullet. Every building has its quirks, and presents a different target.**

ogy for telecommunications applications," said Peter F. Volanakis, president and chief operating officer at Corning. "We have developed an optical fiber cable that is as rugged as copper cable

but with all of the bandwidth benefits of fiber. By making fundamental changes in the way light travels in the fiber, we were able to create a new optical fiber that is over 100 times more bendable than standard fibers."

In the absence of hard information from Corning itself – the company closed its famously tight lips, and demanded technical people sign tough nondisclosure agreements in exchange for 25-foot samples of the stuff – there has been little the industry can use to judge the truth of the statements.

Also, the release was issued by Corning corporate headquarters, not by Corning Cable Systems or the fiber division. It included a contact for journalists and investors interested in the product's impact on the stock. When a company does this, the reason often has to do with worries that the Securities and Exchange Commission will look with disfavor on a new unannounced product that enough people know about to move the price of the stock. Companies in this situation often issue a skeletal release before a formal product announcement is ready.

At press time, in fact, Corning had not yet released specs for the new fiber, dubbed "nanoStructures." (In what must be one of the least forward-looking trademark plans of all time, Corning's optical fiber folks aren't using nanoFiber as a trademark, because it is already in use by someone else – Corning's own medical devices division – for a substrate that can grow biological assay cultures.)

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Despite the paucity of information and nay-saying from some competitors, however, Broadband Properties has confirmed that the product is, as Corning claims, a major advance in fiber technology. "It has better bending properties and is more forgiving of construction mistakes," said one engineer who has a sample, and "its thermal properties are better."

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installation products Corning expects to announce next month, do indeed qualify. But when it comes to MDU deployments, the engineers warn, it is tough to build a magic bullet. Every building has its quirks, and presents a different target.

Even so, the fiber will lower the cost and reduce deployment time for fiber in MDUs – where about a quarter of all Americans live.

### Bend-Insensitive Fiber

In a typical fiber strand, there are actually two kinds of glass. There's a super-thin inner fiber that carries the signal. That fiber is surrounded by some coatings and an outer sheath, also of glass. The light pulses that comprise the signal are reflected as they hit the internal surface of the thin inner fiber.

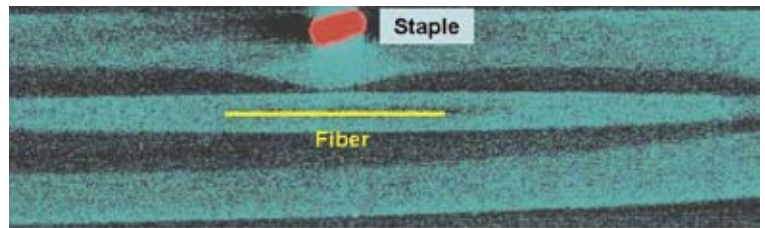
But when the fiber is bent sharply, the nature of the surface changes due to the stresses set up in the glass by the bending itself. Also, some of the light hits the inner surface at an angle too great to al-

low complete reflection. It "leaks away," reducing the signal strength.

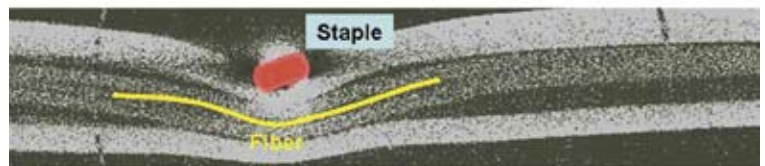
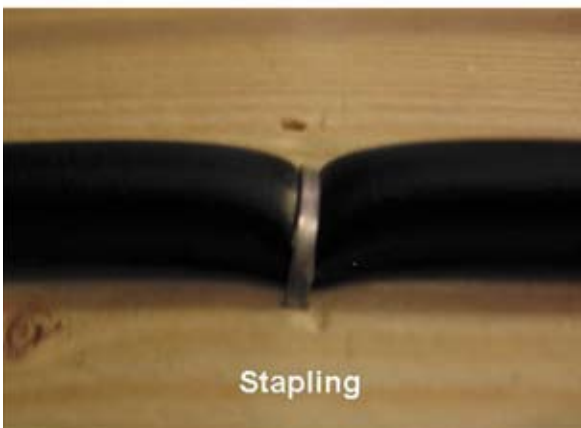
Patents in this area go back about 20 years. Guyton Swindell, manager of field applications at OFS, says "There is a white paper on my desk dated October 16, 1992, in which Sicom (now Corning Cables) makes the case against [bend-insensitive] fiber based upon the probability of mechanical failure in a tight bend. The paper is technical in nature, and does not specifically mention any non-Corning fibers. However, the underlying intent was to attack the BI fiber that Lucent (now OFS) was producing as far back as the late 80s."

Despite this early example, the first truly game-changing advance in bend-insensitive fiber came at the FTTH Council Europe meeting in Amsterdam early in 2005, when an NTT engineer demonstrated a tough fiber that could be tied into knots. As we reported in our March 2005 issue, the 700-person audience – mainly engineers and executives – rose to a standing ovation.

The NTT product is not meant to be actually fastened to a building's structure, however. It is meant for user-installed networks within a dwelling unit. It can bend around tight corners such as desktops, and snake under carpets,



Ruggedized Drop Cable with Staple



**Corning-supplied photos show the fiber is rugged enough to withstand stapling to building studs and perhaps to ceilings. Engineers we talked to were nervous about long-term reliability of stapling, however, especially when using metal staples to fasten the fiber to a ceiling.**

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much as Ethernet cable can.

The outer glass fiber, which surrounds the thin central glass core that actually carries the signal, is manufactured with a number of “holes” or tunnels parallel to the fiber’s long axis. The fiber is extruded with a material that is etched away to create the tiny holes,

which relieve stress on the outer glass as the fiber is bent.

NTT’s fiber is expensive because it is hard to make. It also requires special connectors to mate with other, more standard types of fiber.

The industry has come to call such fiber “hole-assisted” or “holey” fiber.

Because the NTT product is meant for in-unit use, failure is not a disaster. It is not meant to be part of a structure. Defective fiber in tough service can be easily detected and replaced. Its high cost is offset by the fact that the customer, rather than a trained technician or crew of technicians, handles most or all of the installation. For NTT, this is vital. The company adds too many new FTTH customers each month for its technicians to handle.

Another class of “bend-insensitive” fiber is offered by vendors such as OFS (which introduced the latest version of its product at our Broadband Summit

last year), Draka Comteq, Sumitomo, AFL’s corporate parent Fujikura, Em-telle and others – including Corning itself. In these products, the fiber is chemically modified to tolerate more stress. As we reported firsthand in our Summit roundup last year (October 2006 issue), the OFS product has almost no signal loss, even when tightly wrapped in multiple turns around a 12 mm (half-inch) mandrel.

“OFS has two mobile showrooms that have been traveling the country,” said Swindell. “Each is equipped with a working PON demonstration. Unit #2 has the AllWave FLEX fiber in both the distribution and drop cables exposed in a coil with a diameter about equal to that of a penny. Despite those bends, it is carrying IP video across a 1x32 split and an optical distance that exceeds the electronics vendor’s recommendation. Additionally, the network runs through an AllWave FLEX jumper that visitors

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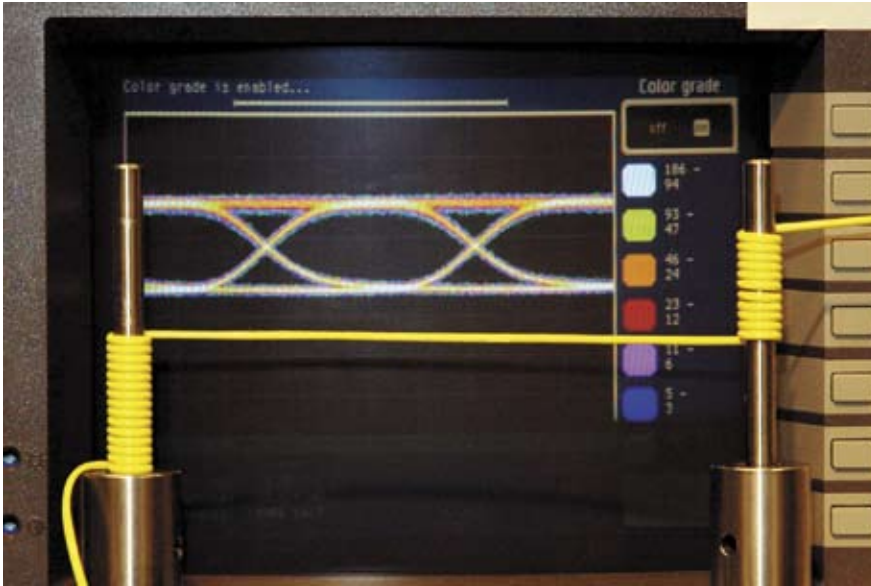


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The new Corning fiber certainly withstands a lot of mandrel turns.

are invited to repeatedly wrap around a 9 mm-diameter mandrel. The video stream never stops.”

Corning showed pictures of its product wrapped around a pencil-thin 6 mm.

As with the NTT product, however, it is easier to see kinks and harder to create them when you are not pulling the fiber but only winding it. And the issue of long-term reliability isn't addressed.

### The Corning Difference

Corning uses tube-like nanostructures to coat the inner fiber that carries the light pulses. This leaves what the company describes as “channels” between the light-carrying fiber and the outer fiber – providing the benefits of extruded holes without the high production cost.

In an actual construction environment, of course, the installation crew doesn't need to spool the fiber around a mandrel. The crew members need to fit it around tight corners, and need a fiber that withstands kinking as it is pulled, or at least behaves in such a way that they can quickly detect and cure the kinking. As with copper wire and coax, the kinks can occur when a loop of the fiber or fiber cable is pulled taut. Such kinks are a major failure point in fiber installations, although the fiber may work when it is

first installed.

To reduce the chance of kinking, and to support the fiber inside a building structure, most designers specify ducts, usually of fire-resistant plastic or fiber-glass, though which the fiber is pulled. The wide-diameter ducts must also bend gradually around corners, so that the fiber inside will bend gradually as well.

John George, Director, FTTX Solutions at OFS, noted, “fibers having very low loss at [bend] diameters below 12 to 15 mm can hide risky bends from network testers, which detect such bends by measuring [signal] loss.”

Third-party engineers who have been working with small amounts of Corning's new material say they have been told that Corning has extensively tested its thermal and mechanical performance in lab situations (including full-scale lab structures), but that testing in an actual building is not expected until mid-September.

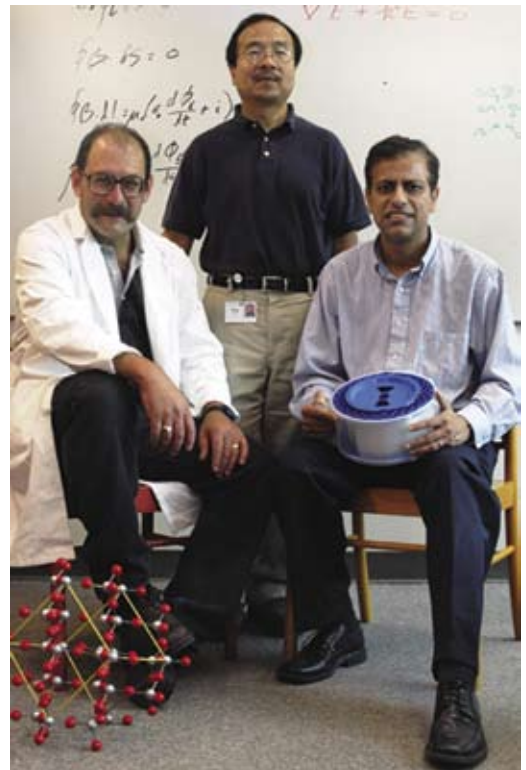
Their concern is that Corning has a great product but that it has not yet been fully tested. One photo distributed with the initial press release showed the

effect of stapling the fiber with a stapling gun firing conventional plain steel staples. The fiber inside kinks a bit, but the implication is that this kind of install will be acceptable.

Two Verizon inside-plant engineers working in New England told BBP in late July that they had not seen samples of the Corning fiber but had been informally briefed by superiors. They looked forward, they said, to being able to staple the stuff to walls and maybe ceilings or at least to the vertical sides of ceiling beams.

“That's probably not a good idea,” said Richard Holtz of InfiniSys, who has a sample but had not actually tested it that way when we talked. “We actually ban stapling guns at our worksites.” Stapled fiber, at least types used now, can pass initial tests, but then fail prematurely. “The installation must be designed to last 40 years, typically,” Holtz said. “You have to treat the wires, fiber or copper, gently to do that.”

InfiniSys Electronic Architects is



Dana Bookbinder, Ming-Jun Li and Pushkar Tandon (left to right) collaborated to create Corning's flexible fiber.

Corning will introduce a full suite of optical fiber, cable and hardware and equipment solutions based on its nanoStructures technology platform this fall at the Fiber-to-the-Home Conference in Orlando starting September 30. The fiber itself is expected to be ready for sale in quantity by late this year.

one of the best-known designers and installers of fiber systems in the world. Its inside-plant work is the stuff of legend among many of the MDU owners and managers we talk to.

Bend-insensitive fiber “is perfect ... for the application as long as it is used prudently,” he said. “But installation companies have a cable mentality. We absolutely need a system more tolerant of poor workmanship, but installers should not get too cocky about the fiber’s ability – or any cable’s ability, for that matter – to withstand abuse.”

**Advice from a Master**

“The new Corning nanoStructures Fiber will certainly alleviate some of the concerns in MDU fiber installation,” said Holtz, “particularly in retrofitting fiber in older properties. However, we would be very concerned about fiber, or any cabling, that is not properly installed and supported, particularly in harsh environments such as attic spaces or garages.

“My concerns about the ‘stapled’ concept is more about how it will handle temperature extremes over time in attic and crawl spaces. Yes, the cable can be free-run just like a Cat-5e wire or RG-6 coaxial cable. However, installers tell me that the sag factor in any [currently used] cable when run hori-

zontally and supported by J-hooks in temperature-extreme situations like attics, which can go from -10 degrees F to well over 150 degrees F in Verizon territory, is an issue. The installing contractor should not use metal staples but rather fully supporting (not structure-deforming) fasteners.

“If the fiber is hung during the winter or any cooler period of the year, the sags are so great later during the hot summer months that there have been issues. Further, if the supporting structure is many feet apart on center, as is the case in the way installers use J-hooks, the condition is typically exacerbated.

“Conversely, summer-hung fiber tends to go taut and has similar issues in the winter, plus added risk of breakage.

“Corning has not published any specifications for the product yet,” he said, so it is difficult to accurately predict how it will behave mechanically at extreme temperatures.

“Based upon what we have heard from the installer community, we are going to start recommending that horizontal runs be either in rigid plastic duct or in fully supported cable trays. Another method, which has also worked, is to use a supporting wire and then create a [weave] to support the fiber to that wire [similar to installing aerial cable by lashing to an existing wire]. We think the small additional cost of the better physical support system is worth it,” said Holtz.

“For normal short vertical runs,” Holtz said, “and even properly supported horizontal runs, we believe that following the same practice in cable management as used for normal video and data cabling will suffice.”

Corning itself said that “FTTH installers now must deal with tough environments such as MDUs where the bend diameters can go as low as 10 to 15 mm.”

Swindell said, “I think the tight-corner question has more to do with cable

design than fiber design.... I think it can be safely stated that no vendor would recommend putting a bare fiber in a 90-degree bend around a corner.”

He also said the 10 mm bend limit for his company’s product “is based on the 100 kpsi tensile stress test for fiber, and the calculated probability of mechanical failure in a tight bend based on that test standard [pulling on the fiber]. I think it is probably a conservative number.”

**Standards**

As Holtz noted, TIA has not created any standards to deal with these issues. “Interestingly, they have not dealt with air-blown fiber or microduct installation either,” said Holtz.

Standards are a sore point with some of Corning’s competitors. The company tends not to participate fully in standards-setting, because it would have to offer reasonable licensing terms for any technology it has patented that is incorporated into a standard.

Corning refused comment, with a spokeswoman saying “our policy is not to disparage competitors.” But a Wall Street observer said companies with Corning’s policy “tend to be one or two years ahead of competitors on the technology, otherwise nonparticipation is not worthwhile.” Corning competitors, of course, dispute that.

The new fiber also enables simpler and more aesthetically pleasing designs for the cable, hardware and equipment used in the deployment, Corning says.

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