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INNOVATORS

Bend It Like Corning

About the only thing optical fiber can't do is turn corners. Until now. A look at the latest breakthrough in glass. BY STEPHANIE N. MEHTA

Like any gigantic telecommunications company, Verizon is in love with optical fiber. It likes that the super-skinny tubes of glass are lightweight and durable. It appreciates that fiber can carry phone calls over long distances without needing lots of gear to keep the signals moving along. But what Verizon really loves is the material's ability to transmit 25 trillion bits of data per second; that's the equivalent of 400 million simultaneous phone calls, or 450 channels of high-definition television. (That's about 3.6 million times the capacity of Verizon's copper phone lines, which can deliver seven million bits per second, tops.) And so Verizon, which wants to sell not just phone service but lightning-fast Internet connections and TV as well, is spending $23 billion to deploy 80,000 miles of fiber directly to as many as 18 million customers' homes.

But no love affair is perfect, and Verizon has one big quibble with those wonderful glass filaments: They can't be bent the way copper can. The problem isn't breakage: Optical fiber is very flexible. But light, which is how data and calls are transmitted in fiber, travels in a straight line. As long as the glass is kept taut, everything's wonderful. Bend it a little, however, and the light—and therefore the data—starts to escape. Wrap the strand in a tight coil, and you lose the signal entirely.

This intolerance for bending can make fiber optics a nightmare to install in someone's home. Snaking the wiring along the floorboards is out of the question—just one tight turn around the bookcase, and the signal is kaput. So Verizon's installers have been forced to come up with alternate routes, such as drilling holes in walls to get the cabling from one room to another. The process is time-consuming, expensive, and potentially destructive. The problem is particularly acute in apartment buildings—and there are a lot of those in Verizon's East Coast territory—which are full of conduits, shafts, and corners that must be navigated in order to hook up each customer. (In most single-family homes Verizon just needs to connect the fiber to a special box on the outside of the customer's house.) Fun fact: To get a fiber connection to a typical basement apartment, installers encounter an average of 12 right-angle turns.

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Enter the brainiacs at Corning, a company best known to consumers for its sturdy cookware, a division it sold in 1998, and its Pyrex lab glass. Corning also happens to be the world's largest manufacturer of optical fiber (it is glass, after all), and when its executives learned that Verizon was planning to spend billions on the stuff, they sprang into problem-solving mode.

It turns out that Corning's researchers had been looking into developing new products specifically for fiber-to-the-home projects since 1998—long before Verizon announced its fiber-optic service, known as FiOS. This year Corning completed work on a breakthrough fiber it is announcing this summer. The company gave FORTUNE an exclusive look at the technology, which has the potential to eliminate many of the challenges that have slowed fiber deployments worldwide. "We're not always the fastest innovator, nor are we the cheapest," says Corning chairman and CEO Wendell P. Weeks. "So we have to solve big problems that really matter—and this is one of them." Many of its biggest advancements emanate from its upstate New York research center, Sullivan Park, a concrete and glass structure that looks more like an Eastern European housing project than a hotbed of innovation. And yet scientists there have invented everything from processes for making large

LCD TV screens to lenses for the Hubble telescope and, now, highly bendable fiber.

Corning's researchers figured out a way to keep the light going as it turns corners—lots and lots of corners. We can't go too deep into the technical details—the company exhibits CIA-levels of paranoia about its inventions. But essentially Corning's technology infuses the cladding that surrounds the fiber's narrow core with microscopic guardrails called nanostructures. They help keep the light from seeping out of the fiber, even when it is wound around a pencil—treatment that normally would render it completely useless.

Like many innovations at Corning, the discovery of "bend insensitive" fiber was a combination of serendipity and determination. A group of scientists from different disciplines—chemist Dana Bookbinder, chemical engineer Pushkar Tandon, and optical scientist Ming-Jun Li—had been thinking independently about nanostructures in their fields. Bookbinder, a sociable chap who says he spends a lot of his time "b.s.-ing" with other scientists, realized they needed to collaborate. They began brainstorming on Friday afternoons, and by the summer of 2004 they had started experimenting with nanostructures in fiber.

At first they conducted experiments on their own initiative, with Bookbinder rewarding his colleagues with homemade chocolates for coming in on weekends to help cook up early versions of the fiber. He also encountered skeptics. "We had several physicists who rolled their eyes and said, 'This will never work,'" Bookbinder recalls.

Corning's business executives were less disbelieving, and as soon as they got wind of the project in early 2006, they put it on the fast track for development. They even shared early findings with Verizon, which loves the idea. "When you see somebody tie a fiber cable in a knot and it is still able to transmit a signal, you initially think, 'There's something not right with that,'" says Paul Lacouture, the Verizon executive who has led its FiOS buildout. Lacouture (who announced his retirement in late June) says the company also is considering wireless technologies that could help it deliver broadband in apartments, but for now Verizon's money is on Corning and its bendable fiber. Corning just needs to apply its innovation skills to the manufacturing process: The first spools of nanostructure fiber for commercial use have yet to roll out of Corning's factories. "When they have it," says Lacouture, "we're ready to use it." F

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Locking in the Light

Corning's new fiber uses nanotechnology to bend light around corners. Here's how it works.