What is Fiber Technology?

An overview describing how fiber cables differ from copper and who uses fiber. Can fiber cables be safely built and maintained on interstate rights of way?

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Fiber-optic communication technology uses ultrapure strands of glass fiber to transmit information from one point to another. These strands of glass are approximately the size of human hair. Pulses of light are passed through these strands of glass at present rates as high as 1.12 billion pulses per second. Today these signals can travel upwards of 50 miles before they become so weak that they must be amplified. The only limit today on the speed at which these pulses can be transmitted is the speed at which the light emitting diodes or lasers can be turned on and off at the transmission end of the fiber cable, and the accuracy that the receivers, at the other end, can detect the signals. Because of the purity of the glass fibers, very low-power light signals may be used. Their most important quality is their ability to turn on and off rapidly. Predictions are that signal rates will continue to increase and, while capacity goes up, price will continue to come down. It should be noted that no changes in the fiber cables themselves will be necessary to carry these higher signal rates. Only the light source and light receiver equipment will change.

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How are Fiber Cables Different from the Traditional Copper Cables that have been Used for over 50 Years in the Communications Industry?

Fiber cables use light signals, which transmit information using the same technology as computers use to communicate with each other. Copper cables use electricity to transfer similar signals, but due to various electrical loss and interference problems, a copper wire can not carry *anywhere near* the capacity of a fiber.

As a comparison, 2 copper wires, equipped with electronics at each end, will carry 12 normal telephone conversations. Today, 2 fiber strands can carry 8,064 telephone conversations. A fully equipped 144-fiber *cable* can therefore carry 290,300 telephone conversations. This includes the necessary spare fibers to provide for normal maintenance. To carry that capacity, a copper facility would contain twelve 1,100-pair cables. The *single* fiber cable would be about 1 inch in diameter, while the *twelve* copper cables would *each* be about 3.5 inches in diameter. Also, with that many copper cables a conduit and manhole system would most likely be required. The cross-section of the conduit system would be 15 inches wide and 30 inches high. The fiber cable could be directly buried without conduit.

Due to its small size, fiber cable can be obtained in lengths upwards of 20,000 feet. Maximum lengths for copper cable are about 1,200 feet. Fiber's long cable lengths greatly reduce the labor intensive job of cable splicing.

Although we have only been placing fiber cables for 4 or 5 years, every indication is that fiber cables will have significantly better maintenance records than copper facilities. The main reason is that fiber cables have no electrical signals going though them to cause electrolysis or corrosion. Also, fiber cables will have only one splice; whereas a similar length of copper cable would require approximately 15 splices. Whenever a cable of any kind is spliced or otherwise opened and reclosed there is a much greater potential for future maintenance problems at that location.

In summary, even though the fiber cable and associated electronics are expensive, the overall installed cost is very reasonable because of the advantages of:

- long splicing intervals
- little or no conduit cost
- high capacity
- potential for increased capacity
- low maintenance cost

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Communications is becoming increasingly important to our society, and fiber is becoming the most important part of the communications network. Fiber communications provides cost effective, dependable, high capacity, and secure services that other transmission mediums, such as copper, microwave, satellite, radio, and cellular facilities cannot provide.

Who Uses Fiber Cables?

The local telephone company

The local telephone companies use fiber in several ways. It is used for the limited long-distance and central-office-to-central-office routes which are still maintained by the local telephone companies. Usually these cables are no longer than 50 to 100 miles in length and do not cross state lines.

Fiber is also used by the local telephone companies for the feeder facilities from the telephone switching centers out to the customer neighborhoods and business areas.

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From these locations, copper cables are extended on to the customer's premise.

Field trials are now being conducted to take the fiber all the way to the customer premise. Southern Bell estimates that fiber will be used exclusively for new cable placements within 5 years. And, we estimate that existing copper cables will be removed starting around the year 2000—maybe before.

Long-distance companies

Long-distance companies use fiber to connect the various serving areas of the local telephone companies. These fiber cables generally extend across state lines and as in the cases of AT&T, MCI, and US Sprint, the cables may extend across the nation.

Private networks

Fiber cables are used for private networks to connect a variety of computer and office locations for a company or governmental agency. In particular, local governments are connecting their various buildings together with their own cables. Although local regulations prevent these private systems in many areas, we must expect that they could become more common and possibly even extend across the nation in the future.

CATV companies

Fiber is especially suited for transmission of CATV signals. Fiber is beginning to be placed in the feeder networks of local CATV systems. Telephone companies are currently working with CATV companies to deliver the CATV signals to the customer's premise on the telephone company's fiber networks.

National television networks could use fiber to build their own private networks to distribute their TV signals across the nation. Today, they use satellites and other communications companies to distribute their signal.

Safety?

Since the general public and even the telephone industry does not always understand fiber technology, fiber optic and laser safety questions have arisen.

The fiber cable, itself, is not known to be dangerous. Of course, if you stick it in your eye or somehow get the glass fibers under your skin, it could be a problem. However, copper wires can cause similar problems.

The light emitting diodes or laser light sources, that generate the light signals, concern many people also. Burns or eye damage from coming in contact with these light sources is generally the issue. However, the AT&T Fiber Safety Coordinator, who works at AT&T's fiber cable plant in Atlanta, assures us that the laser light used in fiber transmission systems is harmless. Even if the lasers were twice as strong as they are today, they would not be harmful. The coordinator also advised that the laser power will need little or no increases in strength in the future because the receiver technology is improving rapidly and, therefore, existing power levels will be satisfactory in most cases.

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How can this fiber technology be installed on interstate right of way?

Although we generally place fiber cables below ground, they can also be placed on aerial pole lines. However, pole lines would certainly be unacceptable on the interstate rights of way.

Below ground cables can be *directly buried* or placed in conduit systems. Since a *single fiber cable* can usually satisfy a communications company's long-term needs, conduit systems are not necessary.

There is no doubt in my mind that very stringent rules will be applied to *any* utility facility that is placed on interstate right of way.

- The extreme outer edges of the right of way will be designated for utility use. This should reduce interference with future road improvements and minimize the hazards to the driving public.
- The use of the median will be strongly discouraged.
- Any points of routine maintenance, for the utility facility, will be required to be located such that they can be accessed from other than the Interstate roadway or ramps.
- The facilities must be placed at a depth that will not interfere with normal interstate maintenance operations.
- Facilities placed within the "limit of access" will not be able to be accessed without strict DOT controls.

I believe that fiber cables can be safely built and maintained on the outer edge of interstate rights of way. Since equipment sites are 25 to 50 miles apart, they could be placed in locations that would allow for routine maintenance from side roads or crossroads and the fiber cable, actually placed on the right of way, would require no maintenance unless there happened to be some type of physical damage.

Direct burial of cable is a relatively fast and simple operation with some placement methods allowing up to 5 miles of cable placement per day. With proper warning signs and with the construction work being done at the edge of the right of way, the roadway traffic should be only slightly affected. If necessary, direct DOT supervision could be provided to assure that construction and safety considerations are met.

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