SIGNAL
AFCEA's INTERNATIONAL JOURNAL
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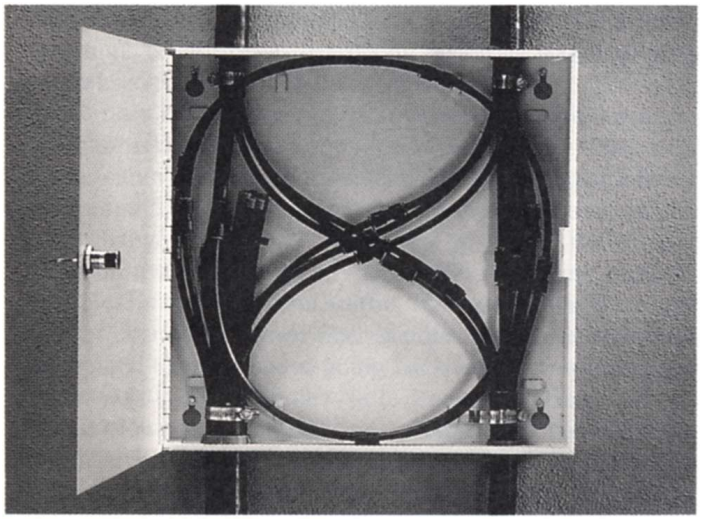
The use of a new air blown optical fiber installation technology is helping to remove the guesswork in designing complex local area networks for military facilities. This air blown technique can accommodate larely unknown future requirements for expanding local area networks at various facilities.

The air blown fiber technology uses compressed air or nitrogen to literally blow lightweight optical fiber bundles through predefined routes at rates up to 150 feet per minute. Standard blowing distances are 3,300 feet for 2- to 6-fiber bundles and 1,650 feet for 12- to 18-fiber bundles. Distances can be doubled by running two sets of blowing equipment in tandem. Developed by British Telecom. this technology is under license for U.S. manufacturing by Sumitomo Electric Lightwave. Research Triangle Park. North Carolina. The air blown fiber's registered name is FutureFlex.

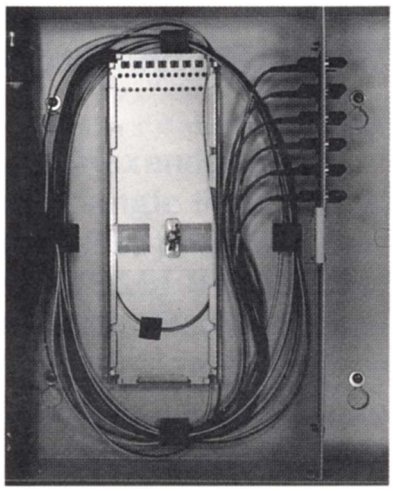
The fiber's routing structure is a tube bundle manufactured of tough. flexible materials that can be installed above ground or underground, with or without conduit, or throughout the building envelope. In the latter case, innerduct. or established duct work. may not be required. Tube bundles contain up to 19 individual, coded tube cells through which the optical fiber bundles are blown. No fiber is in the cells when the tube bundles are being installed.

Using push-fit tube couplers. installers connect individual cells together in tube distribution units, or junction boxes, to provide routes through which fiber is blown to achieve a splice-free. point-to-point installation. A splice-free installation improves overall system reliability, which further is enhanced because no strain is placed on the fiber during the installation process. Moreover, if needs change, fiber can be blown out of the tube cells and new fiber installed with-Out causilig undue workplace disruption.



Splice-free, point-to-point runs of optical fiber bundles are possible using a tube distribution unit. Push-fit connectors are used to interconnect tube cells. The tube distribution units replace traditional junction boxes where mechanical or fusion splicing is necessary

The primary advantage of air blown fiber over conventional systems is that it allows users to install only the fiber needed to accomplish the tasks at hand. Add-oils. moves and changes need not he forecast other than the normal practice of installing hackhone network tube bundles containing more cells than required initially.



The fiber termination unit provides a transition point between the air blown optical fiber infrastructure and fiber jumpers connected to servers, computers or other network equipment

Network reconfiguration and growth can be accommodated simply by extending tube bundles from the nearest tube distribution unit or by blowing fiber through vacant tube cells.

One of the first military organizations to adopt air blown fiber is the Naval Air Systems Command, Arlington. Virginia. This Navy technology application helped to consolidate 39 separate organizations using 19 different electronic-mail (e-mail) systems and four network operating systems into a single. state-of-the-art, pervasive. expandable network. The command used the subordinate organization with the most robust of the 39 networks to develop an integration proposal for secretary of the Navy and chief of naval operations approval.

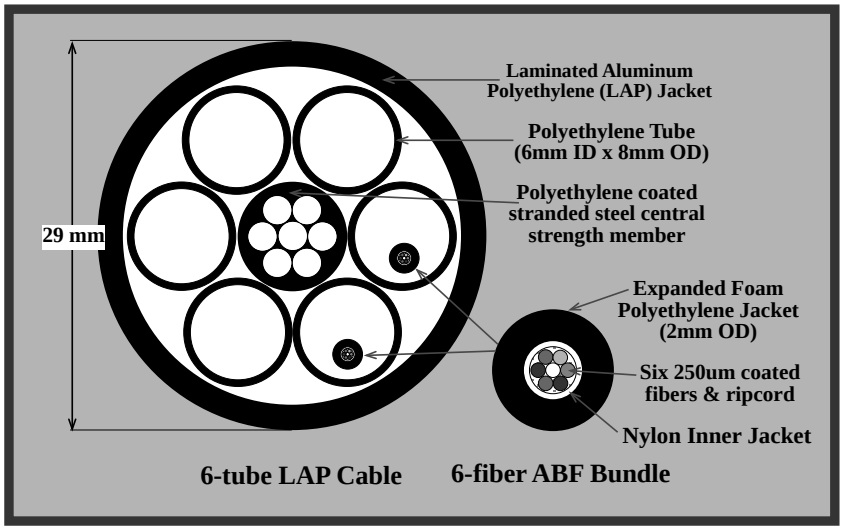
The Naval Air Systems Command's networks extend across 40 floors in six buildings in the Crystal City area of Arlington. Trying to patch the networks together obviously was not a solution. Instead, plans called for a new network based on optical fiber routed to the floor and category live copper wire routed to the work station.

A conventional fiber optic local area network was envisioned until the command learned of the University of Utah's success with air blown fiber in an 80-building campus local area network. Discussions with university personnel and Sumitomo Electric Lightwave convinced the Navy's team that this solution, ill line with the Navy's belief in building for the future and pushing the technical envelope, was right for the Crystal City project.

According to Navy officials, air blown fiber labor and installation costs were between 60 percent and 70 percent lower than estimates for a conventional. pulled-fiber system. Moreover, while some 27,000 feet of optical fiber were blown

through 7000 feet of tube bundles, no breakage xcurred during installation. The commands standard operating procedure-incorporating a 15-percent performance margin to accommodate fiber performance degradation resulting from stresses and breakage during installation-proved unnecessary with air blown fiber.

The savings are continuing because the Naval Air Systems Command installation is never complete. Continuing add-ons. moves and changes, re-routings and expansions are handled by inhouse personnel. Navy officials claim that any local area network installation normally requiring steel conduit or long-ten support is a candidate for air blown fiber technology.



A cross section of a tube bundle contains six tube cells, through which fiber bundles can be air blown at rates of 150 feet per minute.

Another military organization using air blown fiber is the U.S. Army's military occupational specialty school for automatic switching operations and maintenance line-of-sight radio operators. This school at Fort Gordon, Georgia. known as the GTE resident school, is an Army-contracted telecommunications trainin facility.

Local area network administrators needed to provide online access to GTE's conputer-based training programs in Taunton. Massachusetts. The administrators also wanted to provide a campus-wide local area network to serve 52 temlinals in 11 of the 24 increase from 12 terminals in a single building. The school's new local area network can access GTE's wide area network, replacing a dial-up T-1system that served only 10 percent of the base population.

The school's new local area network also supports campus-wide document management. various toniis, e-mail and cooperative development work at the home office in Massachusetts. where much of the school's publishing is done for classroom work. Real-time collaboration is another tunelion as sites at both Taunton and Fort Gordon work on development of classroom schedules, changes. student progress and the inclusion of new features to the computer-based training program.

At Fort Gordon. copper wire was not a viable alternative for use as a transport medium. This is because external installations are subject to electromagnetic interference, such as lightning. which could cause a network failure. Estimates to install a conventional optical fiber backbone network reached $226,000. most of which represented labor costs. According to L. C. Myles, electronic maintenance superviser, estimates for a training program to prepare GTE personnel at Fort Gordon for installation of a conventional fiber optic backbone would have taken from tour to six weeks. This was more time than the schedule allowed.

AIDCO. with headquarters in an authorized installer of air blown fiber systems. This company. which routinely works with GTE on various projects. offered a three-day air blown fiber training program for GTE technicians at Fort Gordon. As a result, providing optical fiber to the wiring closet for all of the 24 buildings involved was accompushed at a cost of $60,000, including servers. A continuing benefit is that GTE technicians now handle ongoing maintenance and network expansion.

The initial installation involved 6,000 feet of dielectric 2 cell tube bundles, using exterior above-ground installation. The initial fiber blowing process consisted of 8,000 feet of 6 pair optical fiber bundles through one cell. Half of the installed fiber is reserved for expansion. Additional growth can be accomnlodated by using the spare cell.

A strong point of air blown fiber. Myles its accommodation in end-to-end testing as it is being installed. No problems were experienced during or after the Fort Gordon installation, he adds.

Myles also believes that air blown fiber is very compatible with GTE's budgeting procedures. The school could install what was necessary for the immediate job and provide some excess capacity. Upgrades and modifications can be treated as separate budget items whenever they are required.

At the Naval Air Warfare Center. Patuxent River, Maryland. the command is in the midst of a major expansion program. This effort is driven, in the licility being on the receiving end of several base realignment and closure commission actions. The addition of 5,000 people from other closed facilities. together with the saturation and age of the existing voice and data networks, required the center to undertake installation of a new integrated system supporting voice, ideo. data and secure communications.

This communications upgrade. designed by the government services group of EDS. Herndon. Virginia. completely replaces the existing local area network infrastructure. Because the network carries large amounts of data, optical fiber was the only transport medium considered. The upgrade consists of two parallel local area networks. The first. which was completed in mid-1996. supports corporate information such as e-mail. finance and other business communications. The second network. currently under construction, supports the Navy's research. development, test and evaluation aircraft program.

When completed. these new local area networks will involve approximately 26 miles of buried 19-cell and 7-cell tube bundles. These bundles contain 18-strand single mode fiber and multimode fiber for backbone and subdistribution applications.

In addition to EDS recommending air blown fiber. Patuxent River personnel's own long-term analysis verified that the solution would deliver a more cost-effective system than would a conventional fiber network installation. These longterm economies largely are the result of eliminating the high cost of add-ons. moves and changes when fiber must be pulled through conduits and innerducts.

Patuxent River fiber optic program team leader Dennis

Spencer offers that, because of the nature of business at the facility, requirements constantly are changing to meet the naval aircraft research, development, test and evaluation missions. As an example, buildings that serve as warehouses today could become laboratories tomorrow. Air blown fiber gives the air facility the flexibility to add, remove or reroute fibers to meet these new and changing requirements quickly and at minimum costs, he asserts.

An example of cost savings, Spencer explains, is a two-person team that installed four bundles of fiber in splice-free runs of 1,200 meters within 32 minutes and 1,500 meters within 45 to 50 minutes. While this rate exceeds the manufacturer's guidelines, no problems were encountered, he adds. He maintains that conventional optical fiber installations of this magnitude would take several days and require a crew of eight to 10 workers.

The Naval Command. Control and Ocean Surveillance Center's research, development, test and evaluation division, San Diego. California, evaluated conventional and air blown fiber technology to augment an existing coaxial-based network. This network runs through conduits connecting more than 200 buildings across a 5-square-mile site. Traffic being carried or planned includes multimedia, video and large file transfers.

A technology evaluation at the research and development division supports air blown fiber as the optimum solution. This will maximize the use of the existing conduit infrastructure and minimize construction and engineering costs, according to network engineer John Wood. While tube bundles supporting air blown fiber could be snaked through existing conduit, a conventional fiber system would require building a parallel 4-inch conduit system, estimated at a cost of approximately $30 per foot.

Wood reports that the air blown solution also provides the dynamic flexibility to meet changing requirements of the more than 5,000 technical personnel using the network without having to invest from the outset in a large fiber infrastructure. This research and development division installation called for 28,000 feet of tube bundles. Exterior applications used 19 cell, 7-cell and 2-cell configurations. Indoor installations required 7-cell and 2-cell configurations. Approximately 35,000 feet of single mode and multimode multistrand fiber was installed for the division's network. Much of the network junctions or terminates in existing pedestals, which originally were used for earlier coaxial installation.

The air blown fiber system proved flexible enough to accommodate the numerous loops required to connect tube cells within pedestal confinement. The longest splice-free run measured 5.500 feet and transited 12 pedestals over an elevation change of 300 feet. According to Wood, the air blown solution makes sense in any installation requiring continuing changes in topology and traffic. He asserts that the slightly higher cost of air blown fiber bundles quickly is offset when compared to the costs of going back into a conventional network to pull and splice new, or to remove old, fiber.

Air blown fiber can offer cost-performance benefits to government installations seeking new ways to improve efficiencies and responsiveness, while reducing costs of local area network administration. Decisions on whether to employ either air blown or conventional fiber technology, according to those involved, require careful evaluation of all options, including copper-based systems.

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