Healthcare Facilities

HMO Expands Cabling Coverage

At Kaiser Permanente, a novel strain of fiber optic cabling delivers more bandwidth and flexibility-with fewer headaches. Cabling isn't usually the first thing that comes to mind when you think of state-of-the-art medical care, but an anemic network with insufficient data transmission capacity can be a serious health hazard for a hospital or clinic. Left untreated, this condition can progress into an acute case of data saturation.

DATA REPLICATION

By fortifying its cabling infrastructure, Kaiser Permanente has warded off many of the ills of information overload. Kaiser's roots reach back to the 1930s, when it emerged as a series of health care programs for employees of Kaiser's industrial companies. The programs were open to public enrollment in 1945. Today, this nonprofit health maintenance organization (HMO) is among the country's largest, with facilities in 11 regions covering 16 states. Kaiser's program office headquarters are located in Oakland, CA.

The organization provides health care programs for more than 7 million enrolled members and operates nearly 30 large hospitals and medical centers throughout the country. An independent group of more than 9,000 physicians provides treatment services for members of Kaiser's HMO programs. Like other HMOs, Kaiser was overloaded with data in the early 1990s. Treatment technologies were racing forward, and the availability and variety of new services were on the upswing. The financial burden of handling this information was tapping out many health care organizations' centralized, mainframe-based data communications systems. The solution was clear: a distributed client-server architecture.

CODE BLUE

Several years ago, it was determined that facilities in Kaiser's southern California region would need an information infrastructure overhaul to efficiently serve its 2-million-plus members. To support 10 major medical centers, more than 90 outpatient offices, and 2,650 physicians, the organization would have to augment its centralized, SNA-based structure with a distributed client-server configuration.

"More bandwidth was being required for the workstations," says Jim Smith, a senior telecommunications planner at Kaiser in Pasadena, CA. "More capable computing machines were becoming available, and we needed a medium [to] transport their data."

Smith is responsible for fulfilling the telecommunications needs of two hospitals in southern California's Inland Empire region, including San Bernardino and Riverside counties. These facilities are the Riverside Medical Center and the Fontana Medical Center.

"Kaiser realized that is former cabling systems were probably not going to do a very good job supporting the migration to client-server technology," says Pat Gorrell, chief systems designer at AIDCO (Chino, CA), a telecommunications consulting and integration firm Kaiser selected for cabling projects. "They launched a program to rebuild the telecommunications infrastructure in a manner that would better support their needs."

Meanwhile, Kaiser's IT services department was generating more and more software-based medical applications, creating additional demand for network services.

These factors, combined with anticipation of upcoming requirements, steered Kaiser's telecommunications division's planning unit toward a fiber optic cabling infrastructure.

FIBER WITH A TWIST

In 1993, members of the telecommunications planning unit's IS department started searching for alternatives. After exploring various options, they chose a new type of cabling manufactured by Sumitomo Electric Lightwave (Research Triangle Park, NC).

Called FutureFlex Air-blown fiber (ABF), the system consists of tube cables, each with up to 19 individual cells, or tubes, into which bundles of fiber optic strands are inserted. Compared with conventional fiber cabling, which is 0.5 inches to 1 inch in diameter, ABF bundles are 0.06 inches to 0.125 inches in diameter. Each ABF tube cable is about 0.25 inches in diameter.

The bundles are installed either through underground conduit or via a facility's internal routes. Once cabling paths are established, the installer uses compressed air to propel fiber bundles through the cells at rates of up to 150 feet per minute. If necessary, the process can be reversed to remove the fiber from the cells so it can be reused.

ANATOMY OF A NETWORK

Supporting the data communications needs of Kaiser's southern California region is no small task. The foundation of the region's infrastructure is its wide area network, which is based on leased T-1 lines as well as ATM technology.

The region's local area networks are linked to telco service providers, remote medical clinics, and the regional data center in Corona, CA. These LANs support more than 10,000 users and have a total of nearly 36,000 nodes. On average, each network has 300 workstations.

Most of the facilities' LANs are based on standard configurations that include a 10BaseT Ethernet backbone. A legacy SNA-based network links thousands of 3270-equipped workstations on Token Ring LANs to devices on these networks.

The regional facilities' LANs support multiple protocols, including IPX, TCP/IP, and AppleTalk. Network operating systems include NetWare, AIX, and Windows NT.

Among the networks' hardware components are Cisco and UB Networks Ethernet hubs and Cisco Ethernet switches. There are more than 300 servers, including Compaq ProLiants, IBM RS/6000s and AS/400s, Sun SparcStations, Digital Equipment machines, and Data General systems. Many of the facilities' applications are developed in-house. Administrative applications include patient accounting systems, appointment scheduling, and employee payroll programs. A radiology image management system, pharmaceutical programs, laboratory information programs, clinical decision support systems, and numerous others wound out the mix.

Many of these applications reside on mainframes and minicomputers located at the regional data center and accessed via terminal emulation-equipped workstations.

INFORMATION IMMUNIZATION

By 1994, some facilities in Kaiser's southern California region were using ABF, but the organization hadn't formally evaluated how feasible it would be to implement the technology on a widespread basis.

Kaiser's Accelerated Infrastructure Project provided an opportunity for a test run in the region. The project was created to facilitate the upgrade of all data communications systems in the region's campuses.

The recently installed fiber backbone at the three-building Green Street campus in Pasadena made this locale a prime candidate for evaluation. Many of its departments were experimenting with new data systems and application software, which raised requirements above their original limits. If the ABF system could support this facility, it should be able to handle the region's other campuses.

Kaiser established an extensive set of goals for the project. One of the main objectives was to compare ABF's costs with those of conventional fiber cabling. On a strand-for-strand basis, the initial of both media were almost head to head, so Kaiser determined that ABF's capacity for future expansion made it the more economical option.

To ensure that the evaluation process was tailored to its requirements, Kaiser built a set of infrastructure-related specifications into the project.

The importance of versatile design options is magnified in medical care facilities, such as hospitals and clinics. The evolving nature of their requirements-and that of medical technology itself-means that an area that's refurbished today could house a different department just a few years down the road. Regardless of the solution used to combat this problem, a data communications infrastructure with plenty of growing room is a must.

The project's requirements specified that the larger facilities, including regional headquarters, major medical centers, and the regional data center, would have an ABF backbone. Fiber would be run only to areas where it was absolutely necessary.

The backbone would need the capacity to support up to roughly a tenfold expansion, and all fiber would be FDDI-compliant multimode cabling.

Although multimode fiber often contains distortion that reduces its bandwidth capacity compared with that of single-mode fiber, the former is much more widely used. Due to its relatively high bandwidth capacity, however, single-mode fiber is frequently used for long distance, high-speed data transfer.

The multimode cables would be installed in a point-to-point configuration, with no patching or splicing. Where possible, the product team would provide multiple routes, and joint upgrades would be minimized.

There would be a new hub wiring concentration every wiring closet, with 350Mbps labeling linking each workstation to its respective closet. Most locations would also need a new fiber backbone of their own to link wiring closets to each other, to the computer room or mainframe distribution unit, and to other network components.

AIDCO, the firm awarded the project contact provided CAD-based drawings that illustrated the cabling system's capacity, and subsequent infrastructure changes. AIDCO also assumed responsibility for ongoing maintenance and upgrades.

TREATMENT OF CHOICE

By the end of 1995 the Accelerated Infrastructure Project was complete, and 15 major campuses in Kaiser's Southern California region were using ABF. More than 1.6 million feet of the cable had been run, with less than 10 percent of its total capacity in use. There would be plenty of room for future expansion.

The project also yielded other payoffs. The fact that very few conduits or other cable routing infrastructures had to be accessed caused much less disruption than is typically associated with conventional fiber optic cabling.

The minimal patching and splicing required for the project resulted in lower ongoing maintenance, upgrade, administration, and staffing costs. The cabling's structure for improved signal quality and reduced the number of cabling outages and network downtime. ABF's ability to support many types of media, fiber applications, and cable sizes gave Kaiser more versatile options for upcoming projects.

In light of the increasing demand for bandwidth, it's essential that all components of a data communications system be capable of accelerating in step with its users and their applications." An ABF backbone is truly a high-speed highway," says Gorrell. "It's the future."

Kaiser's Smith recalls an unexpected test of the system's rapid-response potential. In the implementation phase of the program, a telephone conference meeting between Smith, Gorrell, and other members of the project team was interrupted by an incoming call. It was a staff member from the security department at Kaiser's Fontana site, where an AIDCO crew was installing cabling. In a last-minute design change, the team had decided to add a hub to a wiring closet. The technician needed to know if additional fiber cold be run between buildings for this revision.

Gorrell dropped out of the conference call to find out if AIDCO could fulfill the request. The company's dispatch center sent a crew from another site to the Fontana facility, about 20 miles away. Before the meeting ended about an hour later, says Smith, the cabling had already been run.

MANAGED CARE

In addition to its successes, the project posed some challenges. Any installation or upgrade is more difficult in a medical care facility, so it was essential that the installation be as unobtrusive as possible. Doctors, nurses, and other hospital personnel simply don't have time to clear hurdles in the hallways, particularly when delivering critical, time-sensitive treatment to patients.

The introduction of a conduit-based infrastructure often causes some undesirable side effects among a facility's personnel. "Conduit is very difficult to install," says Gorrell. "In a hospital, this kind of disruption is intolerable."

To complicate matters, there are unique challenges in planning and executing a cabling installation in an older facility. One of the hospitals that Smith oversees was among the first Kaiser built. "We just did not have any conduit space," says Smith. "I think the cost would've probably sunk the project if we'd had to put in conventional fiber with new conduits."

This scenario is common in large-scale implementations, Gorrell says. "If there's a constant in campus environments, it's that there's not enough conduit," he notes. "It's a very pervasive problem, and Kaiser was no exception."

Another drawback attached to conduit is its rather hefty price tag. "In many cases, conduit can cost more than what you put inside it," says Gorrell.

But before Smith could even begin to think about tackling installation strategies, he had to cost-justify the ABF project to management. "When you run into something that looks too good to be true, you figure there's a 'gotcha' someplace," he says. For this reason, Smith needed an airtight cost analysis.

Unfortunately, compiling cost figures wasn't as easy as it might seem. Because of the differences between ABF and conventional fiber cable, says Smith, it was difficult to get an apples-to-apples cost comparison. When asked what a configuration with 12 ABF cables per closet would run, the example, the ABF sales representative told Smith it would be very hard to come up with accurate numbers. Because an ABF configuration would require fewer individual cables than a conventional fiber configuration, she explained, the bid wouldn't represent an equivalent comparison.

Eventually, however, Smith got the estimates he needed and then honed them by factoring in other variables, such as capacity for future expansion.

Throughout the installation phase, the team had to overcome various timing issues. At some sites, AIDCO staff had to wait for subcontractors to finish their tasks before the staff could complete their portion of the project. "There were some stragglers," says Gorrell, but none that caused a devastating delay. Most of the project deadlines were met, many with time to spare.

BYPASS OPERATION

The initial ABF installations quickly set other projects in motion. The Fontana site's security department, for example, developed a plan to beef up its primary security systems. The goal was to enhance two key components of the security system. This would require connectivity between several fiber cabling links within the hospital and the security facilities, which are about 3,000 feet from the hospital.

The first component of the upgrade plan was an alarm system wired to specific doors and tamper switches in the hospital. This system would require a fiber link based on a ring topology. The second component was a closed-circuit TV system that would need additional cameras in corridors and other critical locations. This part of the system mandated a star topology.

To implement its initial plan, which was based on conventional cabling, the security department needed some real estate in the hospital facility. "[The security department] wanted to know if they could get some closet space from us to mount some of their equipment," says Smith. "Basically, I told them I didn't really have any to give them."

But this wasn't the only roadblock in the security department's original scheme. The configuration would have been able to support only a ring configuration-and this would have required at least nine splice points.

After finding out more about the department's game plan, however, Smith determined that the security department didn't need the complex infrastructure it had mapped out. The department could just tap into the hospital's existing ABF backbone, which would accommodate both the ring and the star topologies the project required.

Using the main facility's backbone eliminated many cost and time pressures. In California, construction or modification of medical facilities usually requires a permit from the Office of Statewide Health Planning and Development (OSHPD), the agency responsible for regulating these projects in such buildings.

OSHPD permits can be quite costly and time-consuming to obtain, and they can be acquired only by licensed professionals such as architects. Because the security department was able to use the hospital's existing infrastructure, it avoided such problems.

The original plan required $250,000 to $300,000 worth of conduit, which would have taken three to six months to install, says Gorrell. The ABF cable was run in two days.

According to Smith, the final price tag on the security project was about $80,000. If they'd used conventional cabling, he says, "the cost would have just been enormous."

The alternative cabling technology also provides some less tangible, albeit very significant, benefits. "Instead of having to react to problems, now we're in a brokering relationship with our customers," says Michael Dohm, area manager for information technology, client services, at the Fontana Medical Center.

The additional capacity for future expansion means the IT department can be proactive as opposed to reactive. Instead of waiting for customers to approach the department for solutions, the IT staff can now anticipate and plan for these customers' needs. "It makes the MIS manager a problem-solver," says Dohm. (For an account of another ABF implementation, see "Remote Diagnostics.")

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Remote Diagnostics

Before Kaiser Permanente implemented a new fiber optic cabling-based diagnostic program at its Fontana Medical Center, many radiologists had been given their marching orders-to the other end of the parking lot, that is.

The teleradiology project eliminated the facility's previous X-ray transmission scheme, which gave new meaning to the term "sneakernet." Before the hospital's radiology department linked to the medical center's Primary Care Center via a fiber optic cabling-based backbone, doctors from the hospital often had to run across the parking lot to consult with technicians performing ultrasound examinations at the OB/GYN clinic in the Primary Care Center.

This setup was inefficient for a number of reasons, says Michael Dohm, area manager for information technology, client services, at the Fontana Medical Center. In addition to the obvious drawbacks, it meant pulling radiologists away from other X-ray readings or from more complex diagnostic procedures.

Now, if an ultrasound technician sees something in an image that he or she feels needs immediate diagnosis, the technician can simply call a radiologist at the hospital and transmit that image to the radiology department over the fiber-based network. The radiologist sits down at a workstation and views the image in real time while conferring with the technician.

In addition to the primary benefit of enabling more timely diagnosis of potentially serious conditions, teleradiology eliminates the need to process and store conventional film-based X-rays. The savings in time and money enable the radiology department and the clinic to direct their assets toward other critical projects and services.

A POSITIVE PROGNOSIS

The Fontana Medical Center's network backbone is based on FutureFlex air-blown fiber (ABF) cabling, manufactured by Sumitomo Electric Lightwave in Research Triangle Park, NC. The cabling's flexibility dramatically simplified the teleradiology system's implementation, says Jim Smith, senior telecommunications planner for Kaiser Permanente in Pasadena, CA.

"We can route the fiber wherever we have tubing without having to take the fiber back to the telecommunications room, as we would have to do with conventional fiber," Smith says. "There's no patching involved."

Although deciding which cabling technology to use for this type of application might not sound that difficult, numerous variables can quickly muddy the waters.

First, Smith had to determine whether single-mode fiber would be needed in the future-and, if so, when and where it should be deployed. (Single-mode fiber is often used for higher-speed transmission over relatively long distances. The more commonly used multimode fiber cabling frequently contains distortion, which is why its bandwidth capacity is lower than that of single-mode cabling.)

If the project team went with conventional fiber cabling, Smith would have had to specify how much of it to allot for multimode technology and how much for single-mode. "I was really debating with myself," he says. "We didn't know that might be coming down the road."

One basic reality helped to streamline the decision-making process: In the long run, a conventional fiber backbone would have been much more expensive than an ABF-based network, says Smith.

Now the network can easily be expanded to accommodate upcoming applications and technologies. And according to Smith, that's the type of insurance that will help Kaiser keep its data communications lifelines primed for tomorrow's requirements. "If we need more ABF someplace we can have it in a day's time," he says. "It future-proofs you."

Blown fiber technology developed by British Telecommunications PLC
and manufactured by Sumitomo Electric.
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