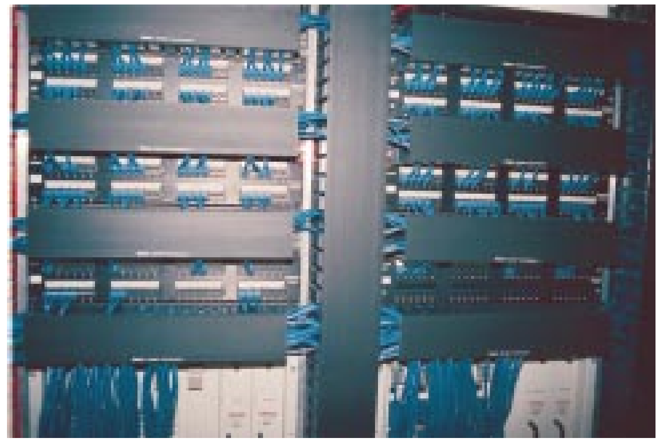
Cabling Installation & Maintenance

General Cable

Designing a 20-year network infrastructure

Tom Stammely / Dewberry & Davis Inc.

A financial-services firm is equipped to blow fiber to the desk, whenever that need arises.



Data-electronic racks maintain a blown-fiber infrastructure in which fiber will be blown from the intermediate crossconnect and terminated at each work area.

How do you design a network infrastructure to help a large financial-services call center keep pace with the speed of technology over the next 20 years? The answer does not come easily. If we have learned anything from the recent past, it is that even the near future is difficult to predict with any degree of certainty. Opinions and product claims are abundant, but clarity and consensus are rare. Now more than ever, change is a constant.

But that 20-year plan was the challenge for Dewberry & Davis Inc., a Raleigh, NC-based architectural and engineering firm. The solution in the case that follows was unusual, yet eminently sensible for this technology-intensive application. For the present and foreseeable future, we recommended a cost-efficient high-speed Category 5E copper-based cabling network coupled with a blown-fiber infrastructure that would be ready to adapt to contingencies as the network evolves in the years ahead.

The project became one of the largest commercial blown-fiber installations in the country. From it, we learned practical and useful lessons that also added to the cost savings and simplicity that characterize this innovative concept and technology. The lessons may also benefit you and others in future installations.

Central nervous system

Today's call center is the nexus of converging voice and data technologies, supporting dozens or even hundreds of workstations with computer, network, telephone, and often Internet access. Servicing the incoming calls requires 24-hour-per-day, 7-day-per-week real-time access to large server files and complex database-management tools. In this particular application, prominently displayed wall-mounted video monitors continuously show pertinent data and display the number of callers awaiting service.

The customer-service function is now inevitably tied to the call-center technology platform and supporting infrastructure, which represents a substantial investment. Any mistake in planning today for the lifecycle of the network could be painfully expensive in both dollars and lost work time, productivity, and customer loyalty. Preparing a network infrastructure for the future is similarly intended to protect and limit that investment.

Many might consider a call center with 50,000 sq ft of floor space as a fully wired facility of considerable size. In this case, however, our job was to design a network infrastructure for a center occupying 400,000 sq ft, where unplanned obsolescence a few years down the line could cause serious problems and jeopardize the entire infrastructure investment—an unacceptable risk.

Marketplace confusion causes problems

Virtually every cabling solution is touted as being "futureproof," as if the marketing term itself would erase any doubts and guarantee network capacity and compatibility with emerging technology standards well into the next decade. Unfortunately, design decisions have not been getting any easier these days, despite rapid development and real progress in the engineering of data-communications cabling systems.

As promised in recent years, proponents of unshielded twisted-pair (UTP) copper cabling have refused to surrender their territory to the potential unmatched speed and capacity of fiber-optic network connections. Upsetting industry experts' predictions of a decade ago, UTP continues in a state of flux and development from Category 5 to Category 5E, with Category 6 products and systems now becoming available and Category 7 on the drawing board. Not only are there good arguments for each of these options in terms of present and future demands, but also contractors and installers will tell you that most computer systems today are still being wired with Category 5 UTP cabling.

On the other hand, fiber-optic cable once appeared to be the simple and inexorably certain mode of leading-edge digital connections in the not-too-distant future. All of a sudden, there are new concerns and uncertainties about optical-fiber options as well. During the development of the 802.3z Gigabit Ethernet standard by the Institute of Electrical and Electronics Engineers (IEEE—New York City), research revealed that interaction between lasers and small defects in multimode fiber produced unexpected bit-error rates in lightwave transmission. This revelation once again called into question the timetable for transition from light-emitting diodes (LEDs) to lasers as the ultimate light source for fiber-optic communications.

Add to this revelation that 62.5/125-micron multimode fiber, now the most popular choice for multimode LAN connections in North America, may have performance and bandwidth problems over distances greater than 220 meters at gigabit speeds. Plus, the alternative 50/125-micron multimode fiber avoids these problems and is less expensive.

Nevertheless, there is much 62.5/125-micron multimode fiber already in place, installed with the intention of futureproofing network infrastructure and awaiting the expected move to fiber-optic systems. The common practice has been to install more-than-sufficient fiber for any possible contingency over the lifecycle of the network at the outset, leaving most unused, or "dark," until needed in the future. This method has been touted as saving on potential labor costs and the workplace disruptions associated with reinstalling fiber-optic cable when it is actually needed in the future.

Routed to the 18 intermediate crossconnects throughout the facility, empty Microduct tubes are capped and labeled, ready to receive optical fibers whenever needed.

Ready for future installation of blown optical fibers, Multiduct cables containing individual tubes are consolidated in wall boxes at the intermediate crossconnect.

Our experience and information from the field, however, suggest that adding plenty of dark fiber to the network infrastructure may still not always prove to be a foolproof strategy in the real world. Contrary to repeated instructions, requirements, and admonitions, dark fibers are not always tested when installed. Years later, during an office move or network upgrade, users may find that the cable was damaged, not installed properly, or otherwise unsuitable for their needs when the right moment has finally arrived.

With all those considerations and conflicting opinions, and with technology developing and changing at a rate few would have predicted even a few short years ago, Dewberry & Davis was challenged to recommend futureproofing a 20-year network infrastructure.

High-end UTP cabling

The first step in establishing such a network was to recommend Category 5E UTP cabling as the UTP component to serve as the network infrastructure. We believe Category 5E is a costeffective yet pragmatic solution compatible with present equipment and any foreseeable near-term performance requirements.

Since a majority of work areas at the call center are located on a raised floor, we specified consolidation points (CPs) from AMP (Harrisburg, PA). These CPs provide 24-port capacity for four groups of six jacks, with either 8-pin modular copper connectors or ST, SC, or MT-RJ fiber-optic connectors.

Three spiral-wrapped bundles, each containing six AMP Category 5E cables for voice and data plus spares, were fed to the CPs from the 18 intermediate crossconnects (ICs) throughout the facility.

This design allows for easy localized changes to offices or cubicles. The CP units also serve and support conference rooms, closed offices, and areas with power/data poles, offering extensive flexibility for installation under raised floor or above raised ceilings.

One of our most useful methods was to use the CPs to double as a consolidation and distribution framework for the blown-fiber tubing network as well. That practice led to specific and measurable cost savings for the customer.

Installing the blown-fiber infrastructure

With the IEEE's Higher Speed Study Group already working on a 10-Gigabit Ethernet standard, it seemed logical to us to assume that fiber-to-the-desk will inevitably supersede horizontal copper wiring in advanced premises data networks in the near future. Consequently, a sensible futureproofing strategy would require high-speed UTP wiring for today and tomorrow, plus the built-in capability to make a rapid transition to fiber optics in the future.

While our copper solution was fixed at Category 5E, though hardly controversial or dubious advice, the futureproofing fiber solution is unique and open-ended adaptable to future modifications and developments.

As the UTP copper-cabling infrastructure was installed, the contractor also installed 5-mm tubing known as Microduct, which is part of General Cable's (Highland Heights, KY) Blolite System of products and technology. Two empty Microduct tubes in a bundled cable, known as Multiduct, were installed to each CP from the ICs. This parallel infrastructure allows for efficient space management of hundreds of Microduct tubes from the CPs dispersed through the facility to every potential destination.

Labeled and capped in the boxes at the IC wall, the Microduct network represents a future infrastructure in the waiting. Whenever and wherever optical fibers of any type are needed in that multibuilding call center, a contractor or any trained on-site personnel can simply and quickly blow the fibers in through the Microduct tubes using pressurized dry air and portable installation equipment.

As many as eight fibers, which are specially coated, can be blown through each Microduct at speeds of 150 ft/min. These fibers can pass around many tight bends and can travel as far as 500 meters. But only then will the fibers need to be terminated and tested at the IC and CP. Of course, the end user will not have to purchase these fibers until they are needed.

We decided that open-office furniture, floor boxes, and wall outlets would each have a blank position to accommodate any type of current or future fiber-optic jack. Short transition cables connect the outlet plate to the CP. As an alternative, a Microduct at the CP can be extended with quick-connect couplers and delivered directly to the faceplate. Fibers would then be blown in from the IC and terminated at the faceplate.

Neither approach requires any special fiber-terminating enclosures or other hardware. The tubes containing installed fibers are easily and simply strain-relieved with a service loop in standard hardware. Optical fibers can be installed during work hours at the call center, without scheduling disruptions, placing ladders in the aisle, removing a multitude of ceiling or floor tiles, or leaving construction debris behind.

Blown 50/125-micron multimode fiber was used for all backbone fiber, which can just as easily be blown out and replaced with singlemode fiber in the future. In this case, jacketed seven-way Multiduct cables were used to connect the main crossconnect (MC) with all ICs in a logical star physical bus configuration.

One of our design goals and planned benefits was to establish a blown-fiber infrastructure that would enable the user/owner to create a continuous fiber path, with no intermediate splices or connectors, between any two stations within the facility by quickly coupling Microduct tubes and blowing in fiber. Reducing splice points will inherently reduce attenuation and improve system performance, integrity, and reliability.

Economy of cable pulls

Multiduct cables connecting ICs were linked through wallboxes in the ICs in a daisy-chain fashion. This topology allows for economy of cable pulls and shorter connections between ICs. Interconnecting the ICs also makes it easier to provide redundancy backup paths.

In addition, creating a Microduct path between any floor locations without routing back through the MC is possible, producing a path using both horizontal and backbone Microducts. For that reason, our design included plenty of spare backbone Microduct tubes.

Future cost savings are built into the basic blown-fiber network infrastructure, especially in a work environment so densely and critically wired to the technology platform. Because this call center and similar facilities use nearly every square foot of available floor space for workstations and personnel, any infrastructure that permits ongoing changes and modifications while minimizing disruptions in work areas will surely result in significant time and cost savings over the network's lifecycle.

While the extraordinary flexibility and future savings potential of the blown-fiber infrastructure may be immediately evident, a cost comparison must consider expenses other than the cable itself. Other savings are real, yet may not always be so obvious.

For example, the cost of purchasing and installing racks and termination hardware and the related cost of testing and terminating fiber are all deferred or eliminated as the copper cable racks will be transitioned to fiber when necessary. This results in smaller ICs, which may yield more available floor space to the user as well. And because a Microduct serves as its own innerduct, there is no need to purchase ductwork to house conventional cable.

Some users have reported that these features more than offset the cost of the blown-fiber infrastructure. Our experience suggests that initial investment cost alone may vary from 20% less to 20% more than conventional fiber-optic cabling installations, depending on complexity, amount of preinstalled spare-tube capacity, and quantity of fiber required at the outset.

But that's just the beginning. In hindsight, it now becomes apparent that many of the conventional fiber-optic cabling installations we have seen clearly would have benefited financially over the long term by avoiding the workplace disruptions and expense occasioned by moves, adds, and changes, misplaced and broken fiber, or simply the wrong type of material.

When completed, this call center became the largest commercial installation of General Cable's Blolite system on the East Coast. But we saw this solution as the best option for the customer because it embodies a strategy that does not depend on the designer's guesswork today about what tomorrow may bring.

It will be interesting to watch what kind of savings this project accrues in the future. CIM

Tom Stammely, RCDD, is a senior designer for Dewberry & Davis Inc. (Raleigh, NC), an architecture and engineering firm.