

Seeing the Light

Fiber optics proved essential for adequate bandwidth to serve four scattered campuses of the Collin County Community College District

By **David Hoyt**

As you drive north of Dallas on US-75, you will notice the rapid growth of retail and commercial enterprises in Plano, Allen, and McKinney, Texas. These Collin County cities are on the northeastern edge of the Dallas/Fort Worth Metroplex. Between 1990 and 2000, Collin County experienced an 86 percent growth in population, making it the eleventh fastest growing county in the United States. The Collin County Community College District (CCCCD) mirrored that growth, with an increase in credit enrollment of 42 percent over the same period.

CCCCD students are distributed among four campus locations. The

largest campus, Spring Creek, is in east Plano. It serves more than 10,000 students a semester in one sizable two-story structure. About six and a half miles west of Spring Creek is the Courtyard Center. This four-story structure houses central administration and the Continuing Education and Workforce Training arm of the college. Approximately 8,000 corporate and individual students are trained at this site annually. Six miles due north of the Courtyard Center, in Frisco, is the Preston Ridge Campus, the newest campus. Consisting of three two-story buildings and one single-story building, the campus serves about 3,500 students a semester. The northernmost campus, Central Park in McKinney, serves about 4,000 students a semester in one large building. The Central Park Campus lies about 14 miles northeast of the Preston Ridge Campus and 13 miles north of the Spring Creek Campus.

In the late 1990s the CCCCCD was running its voice, data, and video traffic among campuses over a 6-GHz microwave wide-area network (WAN). The microwave provided a total of 45 Mbps of bandwidth for all of these services for the four sites. The services, including the Internet load, were growing, but the bandwidth to handle the services was not.

The application servers were scattered among campuses, with each serving all four. The college's imaging solution could not be effectively used except on the campus on which it was housed. The faculty and staff were asking to experi-



Courtyard Center

Nick Young, Photographer, CCCCCD



Spring Creek

Nick Young, Photographer, CCCCCD

ment with desktop videoconferencing and streaming video, but the network could not support these services. The college was also beginning to discuss the move to a new Web-based administrative information system from an old terminal/midrange system. The effects of that move were also a concern with the existing network bandwidth.

What to Do?

Information technology staff began investigating the alternatives for providing more bandwidth among campuses. Our options were to

Preston Ridge



Nick Young, Photographer, CCCCD

Central Park



Nick Young, Photographer, CCCCD

- increase the capacity of the microwave,
- install an alternative wireless solution,
- acquire leased services between campuses, or
- build a fiber optic network.

The option of increasing the microwave network capacity quickly proved to be limited and costly, and it was unclear to the staff if the future capabilities of microwave would meet our bandwidth needs. This solution also involved continued rental of external tower space for the digital access cross-connect system (DACCS) that distributed the band-

width among sites. College representatives were uncomfortable with unknown costs for this service in the future. At the time, it cost the college \$26,000 a year to rent the tower space.

IT staff also investigated wireless WAN alternatives from companies like Cisco Systems and Wi-LAN. At the time, wireless WANs did not provide greater bandwidth, but it could have eliminated the external tower concern. Unfortunately, this solution could not provide the initial bandwidth needed among campuses or scale to meet future needs.

During the investigation, one of our network hardware vendors introduced us to a national broadband network provider. After discussing our needs with us, they proposed a system that would provide Gigabit Ethernet among our sites at an initial cost of \$1,000,000 to install and more than \$150,000 a month for the service. This was way too expensive, and any needed increases in capacity would have an incremental and ongoing cost.

We decided to investigate the option of buying dark fiber. Another vendor (hoping to sell us the hardware to light the fiber) introduced us to a firm that built fiber networks. Their initial approach was to develop an agreement between the college and a competitive local exchange carrier (CLEC) for excess dark fiber. The CLEC would sell us dark fiber that was already laid and co-located in the same sheath as their fiber. More in-depth research determined that they did not have fiber to all college locations, nor did they have plans to expand to those sites in the near future. It looked like our best bet was to build a fiber-optic network ourselves.

Building the Light

In July 2000 the CCCCD Board of Trustees approved the concept of creating a fiber-optic ring among the four campuses. Since we had no staff expertise in building WAN fiber-optic rings, we decided to look for a consulting firm.

With the help of many sample requests for proposals (RFPs) for this type of service, we crafted our own RFP and chose a consulting firm to help us build our fiber network. The consultants' tasks were to

- Develop the bid specifications for a fiber optic-based WAN.
- Review the responses to the RFP.
- Prepare the contracts between the college and the selected vendor.
- Manage the contracts for the creation of the WAN.

The consultants started their work in January 2001, and the RFP for the creation of the fiber WAN was released in February. We closed the RFP process near the end of March. Initially, 20 firms expressed interest in the project at our

mandatory pre-bid conference. During the time the RFP was open, we found out that many of the companies planned to propose a mostly aerial fiber solution. The sticky point to aerial fiber was that the majority of it ran on one electric company's poles. That company had more red tape than the federal government and turned out to be an impediment to some of the potential bidders.

When the RFP closed, we had three proposals to evaluate. All three provided a mostly aerial solution. We reviewed their responses in detail, met with the three firms, and even rode out the proposed route with those who requested it. After a great deal of investigation and negotiations with vendors, city agencies, and utility companies, the college signed an agreement in August 2001 to construct the 53-mile, 48-strand, fiber-optic network for an estimated cost of about \$3,000,000. The 48 strands are more fiber than the college currently needs, but the cost differential from 24 strands and unknown future requirements persuaded officials to string 48 strands.

The fiber-optic network was designed as a complete ring connecting the four campuses. The added cost of creating the complete ring was weighed against the possible loss of network and telephone connectivity if any of the fiber were compromised. We decided the additional cost was worth it. We wanted to build a totally redundant network that would still serve all sites even if one leg of the network went down.

The first (and, we thought, longest) step was securing right-of-way and pole-attachment agreements. Since the majority of the network (about 85 percent) was placed aurally on telephone poles, it required pole-attachment agreements from three local exchange carriers for the 1,400 poles in the route. An engineering firm employed by the utilities checked each of the 1,400 poles to determine any make-ready work needed before our fiber was hung on their poles.

"Make ready" is just like it sounds. We were basically cleaning up behind anyone who had attached any kind of cabling to the utility poles incorrectly in the past and "making it ready" for us to

attach it correctly. We, of course, had to pay the utility companies for any make-ready work that had to be completed on our behalf. With the large amount of fiber being hung in our area, we had to wait our turn to get the make-ready work completed by the utility's engineering firm. The worst-case scenario was \$300,000. Ours turned out to be closer to \$80,000.

CCCCD was also required to obtain right-of-way agreements with the four aforementioned cities and one local transit authority to cross their railroad tracks. Some agreements took as long as six months to complete. When the vendor could not negotiate an agreement with one small township, we had to reroute part of the network.

The first fiber was strung in February 2002, 19 months after we gained approval to start this project. The consultant had a staff member spot checking the construction on a daily basis. The firm used multiple crews to string fiber from multiple directions. They first had to string the steel cable called the messenger, and then wrap the fiber around it. The firm used directional boring machines to place the fiber four feet underground at all road crossings and any additional areas that required buried cable. All cable is buried with a locate wire that is terminated at a locate post. A locate post marks where the fiber enters the ground, and another where it comes out of the ground. Our maintenance contractor uses these posts to stake out the location of our buried fiber when anyone is digging in the area.

The aerial fiber has a 100-foot slack loop placed in "snow shoes" at every splice point and every half mile. These loops handle expansion of the fiber ring and any repairs needed in the future. A fiber marker stating "CCCCD Fiber" at every pole identifies the fiber to anyone working on the pole.

The fiber was lit right before the Fourth of July in 2002. We added Gigabit Ethernet interfaces to our existing Cisco 6500 Series switches at the four sites, and we were off and running! The fiber-optic solution eliminated the previous barriers caused by distance and lack of bandwidth. It has also provided

the needed conduit for the district's Internet traffic. We consolidated our Internet traffic into one partially lit T3 line and are peaking the meter at 18 Mbps with plenty of room to spare.

The combination of the fiber-optic ring and a scalable Internet connection allows our multicampus community college district to provide affordable and scalable services to students, faculty, and staff. Our imaging solution is truly a college-wide solution now, and we are beginning to investigate desktop videoconferencing and streaming video for instructional and administrative requirements. We are no longer concerned about the future bandwidth needs imposed by a Web-based administrative information system.

Maintenance for the fiber ring costs us about \$80,000 a year, but we are saving \$26,000 in tower rental and any maintenance costs we incurred for the microwave system. In 1999 we spent \$96,000 on the DACCS to make it Y2K compliant. We spent a total of \$38,000 for the Gigabit Ethernet interfaces, including two spare cards for redundancy. The best part of the solution is that if we need more bandwidth on the ring, we can just add more Gigabit Ethernet interface cards, up to a total of 4 Gbps.

What Have We Learned?

Even though this journey took longer than we expected, it was well worth the trip. The fiber network is stable and provides for our bandwidth needs today and in the future. The faculty and staff have forgotten about the past limitations and expect all applications to function as if the server is in the next room.

We were correct in hiring a consulting firm to help us with this project. Many questions would have been raised without qualified personnel available to answer them. Our specifications would not have been complete enough without the outside expertise. Another set of eyes was very helpful during construction of the network, as my staff would not have had any idea if it were being constructed as required.

A well-designed network makes it very easy to add new facilities. The cost relates

directly to the distance and availability of clean utility poles. Any institution can start small and expand a fiber network, as long as the whole network has been planned in advance.

Buried fiber-optic cable is about twice as expensive as aerial fiber. Both have their advantages and disadvantages. Aerial fiber is less susceptible to “backhoe fade,” but more susceptible to tornado damage.

What’s Next?

The fiber-optic WAN has virtually turned our four LANs into one. This gives us the opportunity to consolidate our services. Instead of replacing four mail servers, for example, we will buy one larger server. The same holds true for the majority of IT services.

During this process, we discovered that we still needed wireless. We just need it for a different purpose. The bandwidth to the desktop is more than we currently need—we built the infrastructure to add any services imaginable. The missing piece is mobility.

We have added 802.11b network access to all of the college’s open areas at the four sites. The access is currently for faculty and staff, but we are also investigating wireless access for our students. The obvious issue with student access is security. We have to make sure our internal applications stay safe from the risks of an unsecured network.

In conjunction with the wireless and the WAN, we will begin piloting voice over IP over the network. Most intriguing is the ability to use a wireless LAN phone on any campus and have your office number follow you. You could use a soft phone on your PC, and the same holds true.

Even given the large initial cost of creating this fiber network, the benefits in reliability, affordable scalability, and vastly expanded capabilities more than outweigh the cost and effort in creating it. We’d never go back! *e*

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