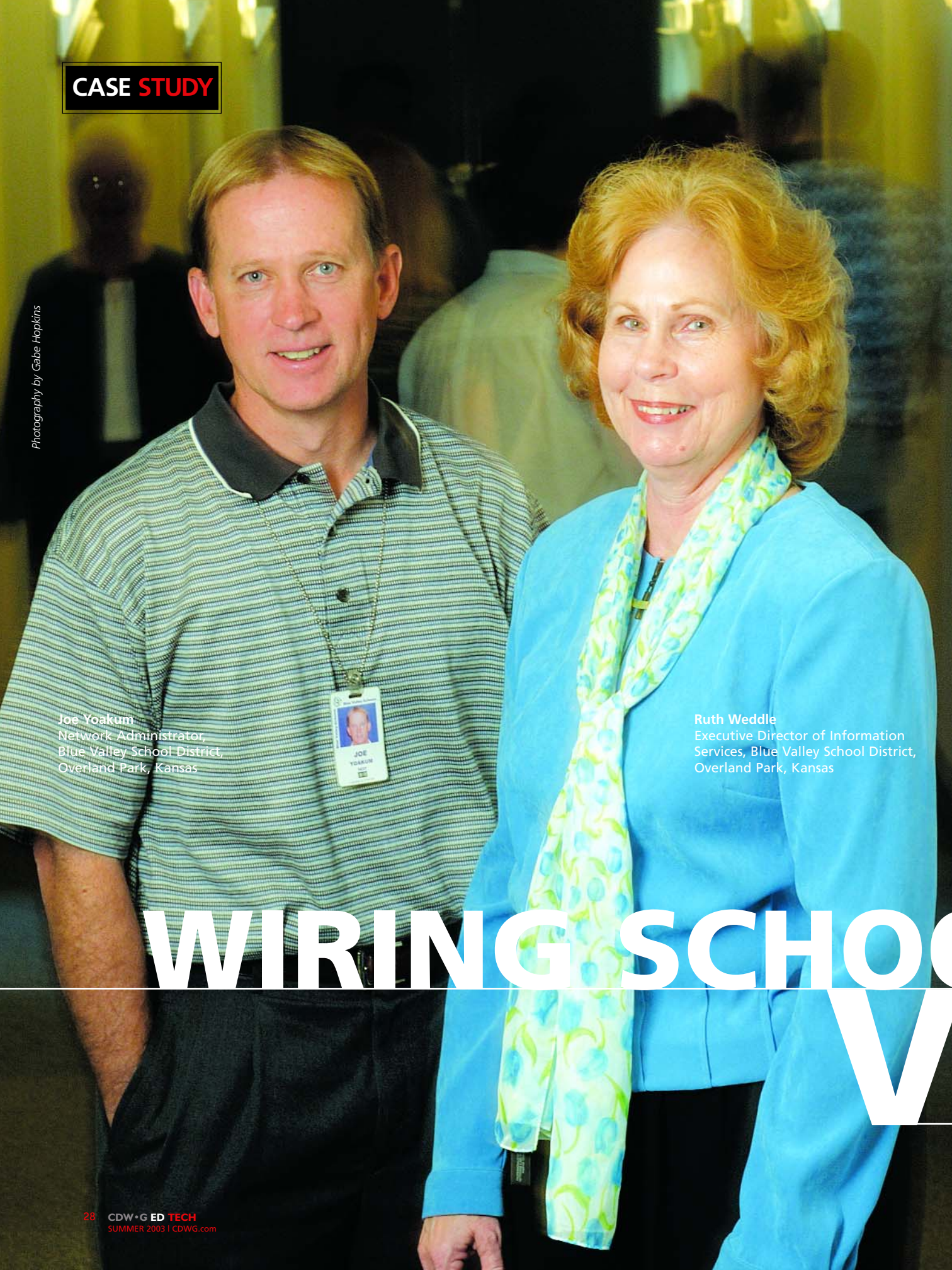
CASE STUDY



Photography by Gabe Hopkins

Joe Yoakum
Network Administrator,
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WIRING SCHO

By David Spark

Antiquated phone systems are a burden. Recurring line charges from local telephone companies and expensive-to-maintain outdated equipment make expansion difficult and costly. They used a PBX (private branch exchange) to route calls through an entire organization. Older PBXs used very inefficient, bandwidth-hogging analog communications. Newer PBXs can convert our analog conversations to digital, which are more efficient than analog, but not the best, because a PBX still must dedicate lines to voice-only traffic. For years, network managers have lived with it. That's because fears of inadequate service kept many away from the alternative, voice over Internet Protocol (VoIP).

With a VoIP system, the data and voice network is shared. All communications, now a mishmash of voice and data packets, travel over an Internet-like network that uses IP or Internet Protocol to route traffic. It is the job of the switches, routers and call managers to siphon out the voice traffic from the data traffic and then put the packets of voice information together so it makes sense to the person on the other end of the phone. And it has to do this constantly as both parties speak. This constant juggling of information introduces a lag or delay. Those in the telephone business refer to this as inadequate service.

Today, VoIP quality of service fears are slowly subsiding, thanks to the proliferation of high-bandwidth gigabit data networks and guaranteed quality communications. And unlike a PBX-only phone network, a VoIP solution is more malleable while simultaneously offering services simply not available with digital or analog phone systems. Best of all, a voice over IP network evolves as you evolve.

Starting in 1997, the Blue Valley School District in Overland Park, Kansas, wired its 29 schools with 30 miles of dark fiber, which is an inactive fiber-optic network that waits to be lit or activated. By 2001, the district lit the network. A year and a half later, what was once a maze of non-operational wires became a gigabit network capable of sustaining the entire school district's voice and data traffic. The decision six years ago was a forward-thinking move. "The vision of the district was to be able to offer data, voice and video throughout the district by using the fiber network," says Ruth Weddle, Blue Valley's executive director of information technology services.

Purchasing a fiber network for the district made fiscal sense. Leasing from a telephone company would be an ongoing expense. "By laying our own fiber network, we were able to use money from our capital outlay budget. This was a one-time expense," Weddle says. "By owning the fiber, we are only limited by the electronics as to the amount of bandwidth that is available." By purchasing its own fiber, the school district could capitalize its costs more, in addition to freeing it up to make creative implementations.

Weddle and Joe Yoakum, network administrator for the school district, chose a pure VoIP architecture for Blue Valley. That means from school phone to school phone, all analog conversations are digitized, converted into packets of data and sent over the same IP network as the school's Internet data traffic. No channels are specifically delegated for voice traffic. All packets, data and voice, travel together in harmony on the same pipe. Instead of routing calls through a traditional PBX, Blue Valley's IP-based phone calls are routed and managed through Cisco data switches and call managers or servers. This equipment is also responsible for VoIP's quality of service.

OLS for oIP

Relieving bottlenecks, utilizing bandwidth, saving money and adding data services integrated with voice. It's all happening as schools across the country make the migration to voice over IP.

Quality of service is an important issue because VoIP suffers from latency issues. Unlike an analog conversation, all VoIP transmitted conversations must be encoded and decoded in real time. To decrease and eliminate noticeable delays, quality of service gives voice traffic higher transmission priority than time-insensitive data traffic.

Blue Valley's VoIP decision came about through a combination of concerns about security, scalability, cost and outdated technology. Four years ago, after the Columbine disaster, Blue Valley realized that teachers didn't have the most basic safety devices, like a phone, in their classrooms. The district wanted to give each teacher his or her own phone, but realized that PBXs were becoming outdated, bloated in terms of network demands, and costly to maintain. At the same time, VoIP was coming to market. School officials kept their eyes on the technology, and made an early move to switch all the district's phones to IP. It was a calculated risk, but there was no point in going with outdated technology.

For 18 months, Sprint and Cisco installed and configured routers, switches, call managers and 2,268 IP-based phones throughout the school district. Weddle currently knows of no other K-12 school system that implemented such a large VoIP network. Thanks to her network's scalability, Blue Valley is already looking at the next phase, data services. If one wants, VoIP can be more than just a telephone system. An IP-phone can be an information appliance. Any data that can be delivered through a Web browser can also be sent to the LCD screen of an IP-based phone. Currently in testing, Weddle's team plans on releasing a content transformation engine that enables them to send emergency alerts to any and all phones.

Before You Get a VoIP

Before you install a VoIP system at your school, here are some things you should know.

1. Quality of Service Assessment. Make sure you have enough bandwidth available to handle voice over IP. If there's not enough bandwidth available, vendors won't recommend a VoIP implementation.

2. One Thing at a Time. "Do not change your data infrastructure right before you're putting in a voice over IP system," says Michelle Gonzalez, senior account manager for Sprint. Although Blue Valley did migrate its data network to gigabit and installed a VoIP simultaneously, Sprint highly recommends you don't do this because there would be no opportunity to verify adequate bandwidth.

3. Be Prepared for Increased Call Volume. Blue Valley had to add more trunks (communications channels between two points) coming into the main district switch because the volume of calls went up more than expected. It was a good problem to have, because it meant people were using the new phone system. Still, the transition came as a surprise.

4. IP-only WAN. Make sure you don't have any other protocols like IPX (Internetwork Packet Exchange) on the wide area network. You want your school-to-school WAN communication to be purely IP. Older protocols can cause problems with the network. Isolate alternative protocols within individual schools on the local area networks (LAN).

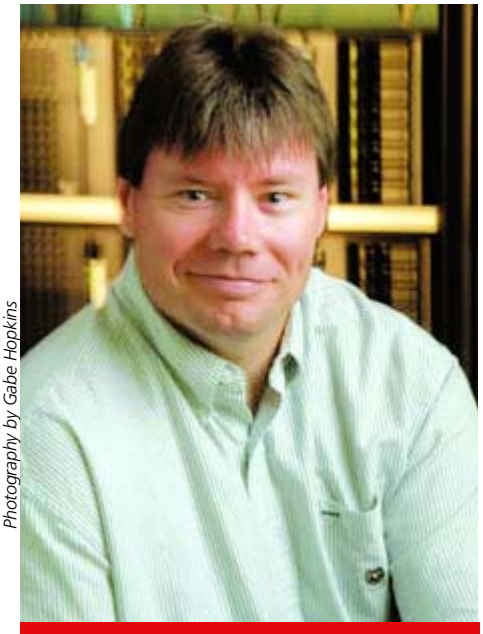
Kansas City is Choking

The internal network at the Kansas City, Missouri School District (KCMSD), is oversubscribed. It's a classic scenario of trying to stuff 20 pounds of potatoes into a 10-pound bag. In KCMSD's case, that 10-pound potato bag is an outdated bandwidth splitter. The device's purpose is to split the fat data pipes (T1 lines) into voice and data channels. The bottleneck does not lie with the voice traffic, whose delegated voice channels are automatically delivered to and routed by the district's PBXs. The problem lies with the district's data traffic.

More than 70 schools and administrative buildings are connected to one of three different core points on the district network. At each core point is a splitter, which acts as a gatekeeper. It's configured in such a way that for every four schools connecting with information, only two schools' worth of traffic gets through. This results in an oversubscription of about 2-to-1.

To relieve the congestion, KCMSD is replacing the splitters with Siemens IP-based communication equipment and Nortel Data equipment, thereby eliminating both the Internet data choke point and the need to split T1 lines into exclusive voice and data channels. Once the network conversion is complete, all traffic, data and voice, will coexist over the same pipe. "Which means that at times when schools aren't receiving any phone calls, they have more data bandwidth available to them now than they had previously, and we removed the bottleneck," explains Dennis Peterson, KCMSD's manager of technical services. The pipes are still the same. All that's changed is the equipment serving them. The result is an exponential increase in capacity.

Unlike Blue Valley's phone system, KCMSD is not pure voice over IP. It's a hybrid or converged solution. The data between the PBXs is purely IP-based, but the phones connected



Photography by Gabe Hopkins

Dennis Peterson
Manager of Technical Services, Kansas City, Missouri School District

to the PBXs are digital, thus requiring an IP-to-digital conversion. The Siemens HiPath HG 3800 will handle that conversion and all the VoIP at KCMSD.

With the impending installation of the HiPath HG 3800, KCMSD will be positioned to move to a pure IP telephony solution. If Peterson wants, he can make a slow migration, 16 users at a time, simply by pulling one digital line card for digital phones and replacing it with an IP telephony card for IP-based phones. But it'll be quite some time before he makes that switch. Installing an IP telephony card would also require him to buy 16 IP telephones.

IP, Digital and Analog

Outdated technology can be a real drag. The Ridley School District in Folsom, Pa. knows all about it—multiple leases for lines, service contracts that constantly changed hands, and costly maintenance due to user-unfriendly equipment.

It was time for Ridley to change. And after analyzing costs, the district decided to lease dark fiber, which meant migrating from a fiber ring network—where all the buildings are connected in a circle, with 100 megabits of bandwidth to a 1 gigabit star topology, where there's a core building and all others are connected like spokes.

Don Otto, the district's network and data processing manager, beta-tested Alcatel's OmniPCX 4400—a hybrid IP and traditional PBX. He wanted a solution that could handle all kinds of phones: IP, digital and analog. In addition, Otto knew that a delay in a decision would be very costly. "We like to get in on the ground floor because that's generally where you find the cost benefit," Otto says. So after a successful beta test, Otto immediately deployed the unit along with a router and switches to the data network, thus connecting 11 schools and administrative buildings. All the elementary schools and the middle schools are 100 percent IP, the high-school and administrative buildings also have copper lines running alongside the fiber. The OmniPCX 4400 can handle all the communications: IP, digital and analog. To assist the Alcatel switches in its management of QoS, Otto created a virtual local area network (Virtual LAN) for the 151 IP-phones on the network. To the eyes of the routers and call managers, the Virtual LAN partitions off the voice traffic from the rest of the data network, thus making them appear to be separate. This separation eases possible congestion issues.

For Otto and the district, the decision to build the new network was centered on improving communication and safety within schools. His next two VoIP projects will be unified messaging (voice and e-mail) and wireless handhelds to replace the district's costly-to-operate-and-maintain two-way radios. That's the benefit of VoIP networks. They can evolve. An IP-phone never has to stay static. Network managers can move to complete convergence and deliver more services. There's always a next stage with voice over IP. .

Parts of the VoIP Puzzle for the Blue Valley School District

1. Laying Fiber—Sprint laid 30 miles of fiber at a cost of $2.4 million.

Every case is different depending on the mileage of the fiber and whether electronics are included. Other examples:

25 miles with electronics (rural area)	*$810,000*
25 miles with electronics (city)	*$2.3 million*
47 miles with electronics (city)	*$6.2 million*

2. Convert to Gigabit Network— Replaced old Cisco Catalyst 5500 switches, which used dedicated connection switching technology, with Cisco Catalyst 6500 switches. Also used 3524 and 2950 switches.

3. Call Managers—These are actually servers designed to manage calls. The district placed a Cisco AVVID Call Manager in each of the four high schools and two at the district office.

4. Routers—Cisco 2600 and 4500 are responsible for routing traffic through the network.

5. Phones—Cisco 7910s, 7940s, 7960s, 7935s

6. Emergency leased lines and phones—Leased line for Internet usage, plus 317 Plexar phones in case of power outage. The Plexar phone lines are also used with modems, security alarms, elevators, pools and fax machines.

7. Staff Hours—Blue Valley had two people working full time on the project from May 2001 to August 2002. Installation was performed by Sprint employees working with Blue Valley employees.

8. Help desk—Sprint set one up at each building along with a voice-mail box. In addition, Blue Valley's help desk was in operation and continues to this day.