

How successful
schools are making
wireless work for them

WIRELESS TECHNOLOGY IN HIGHER EDUCATION

The University of Tennessee at Knoxville and Charleston Southern University have something in common: Highly successful wireless networks that attract students, yet are affordable and secure. Here's how they did it.

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The Challenge of Wireless

To remain competitive in today's tough higher education environment, it's a given that schools need to spend on technology. One place where technology dollars can garner a large return is in Wi-Fi – wireless networks that use the current 802.11 standard. Today's students, accustomed to anywhere, any time access at home and in public places, are arriving at residence halls and campus classrooms expecting no less.

To enhance and enrich the educational experience, and to attract students, schools are turning more and more to installing new – or enhancing existing -- wireless networks.

If you're considering how to use wireless technologies more effectively and efficiently at your school, you're not alone. According to *Campus Technology* magazine's 2004 survey of 52 colleges and universities across the country, "Wireless access to campus networks continues to spread as the use of laptop computers accelerates across the campus." The executives and directors surveyed rated mobile, wireless and broadband technologies among their top five concerns for the second year in a row.

According to research by technology market research group InfoTech, campus network budgets are projected to grow to \$6.9 billion by 2005. That means your competition is spending on wireless networks, among other things, to provide both a more enriching learning environment, and to draw students.

In short, you can't afford not to spend money on a wireless network. The challenge then becomes: How to grow your wireless network while staying within tight budget constraints, maintaining existing wired networks, and keeping all of your campus networks secure.

Calculating the Cost of Wireless

Consider that the basic infrastructure cost of a wireless network can be less than expanding the wired network. For one thing, campuses often have older facilities that are challenging to wire in the first place – and then expensive to renovate. When the cost of upgrading a wired system is compared to the expense of a wireless network, schools sometimes choose to move to wireless.

That was true at Charleston Southern University, with just 2,900 students, where estimates to upgrade residence halls from dialup access to a wired system ran over half a million dollars. Instead, the school experimented with wireless for a handful of students for a semester, then extended a wireless network throughout the halls – a decision that proved enormously popular with students. The total cost, including issuing wireless network adapters to each student: Less than half the wired estimates.

A wireless infrastructure can save money in other ways. Wireless can be a key enabling technology in the increased use of mobile technologies in the classroom, for example. With a wireless network in place, schools can take advantage of money-saving arrangements like "computers on a cart," also used at Charleston Southern, among many others. In that scenario, mobile computers are wheeled into a wireless classroom for use during that session, then can be used in another class at another time. The result: Better use of resources, since a single batch of computers can be used in a multitude of classrooms as needed, and less theft and vandalism, since computers are kept under tight control. (Eventually wireless computer carts will become obsolete as more and more students entering college bring their own laptop computers. The wireless infrastructure in place in the classroom, however, will continue to be useful.)

Addressing Wireless Security Concerns

Security is always a consideration in IT, and wireless networks are no exception. The University of Tennessee in Knoxville, the flagship school for the UT system with 27,000 students, is known as an early pioneer in higher education for its large wireless network. Senior network engineer Philippe Hanset, who speaks at conferences about his network, is experimenting with a new

wireless standard, 802.1x, that tightens security through authentication and encryption at the client end.

He also counsels that some of the best security comes from simply providing adequate wireless coverage, which discourages students from installing their own unauthorized access points.

At Charleston Southern, the school has now had a wireless network in place for over four years, and has successfully addressed security – and bandwidth – concerns as they've arisen.

In this paper, we talk with IT administrators at both Charleston Southern University and the University of Tennessee. Both are schools that moved early to wireless systems and can offer lessons in successfully and affordably setting up and sustaining a wireless network.

Making Wireless Affordable: Charleston Southern University

For smaller schools, one of the challenges of wireless is figuring out how to budget for it. After all, most administrators stress that wireless doesn't replace wired, it augments it. That means you can't divert funds from the wired network, since you'll be maintaining that as well. Here's how one school with under 3,000 students made wireless affordable.

At Charleston Southern University in South Carolina, CIO Rusty Bruns sees the school's wireless network as a definite enticement to students. "It's a big plus. I can show parents [that] the whole campus is wireless." Bruns says that when he mentions at open-house presentations that the campus is wireless, "students' ears perk up."

But financing a wireless network isn't always easy for schools the size of Charleston Southern, a Christian college in Charleston with about 2,900 students.

Working with Proxim, Bruns came up with a plan that gave Charleston Southern its first wireless network: access throughout its residence halls at a very affordable cost.

When Bruns initially considered moving student housing off the school's dial-up Internet access, bids for wired systems approached half a million dollars, Bruns said – a hopelessly unaffordable sum for his IT budget. The cost included the added expense of opening each student's computer to install a network interface card (NIC).

Although going wireless was a cutting-edge prospect at the time, the school selected a single residence hall and 10 students and conducted a one-semester wireless access test. Students who participated loved the system – and passed the word so that soon, "everyone wanted [wireless]," Bruns said.

Brun's challenge then was coming up with an affordable plan for extending wireless throughout student housing, and selling it to management. The cost of a wireless network interface card for each student, at the time over \$200 a card, made the idea prohibitive at first.

But working with Proxim, Bruns came up with a plan that would give Charleston Southern wireless access throughout its residence halls for just \$216,000, including access points and

network cards or adapters for students. Just over 40 percent of the project's overall cost was for a network card from Proxim for each student. The cost of the cards was considerably less than those from other providers, making the choice to go with Proxim an easy one for Bruns and the school. The expense of the wireless network itself made up the other 60 percent of the project price – for 28 Proxim enterprise-class ORiNOCO AP-1000 access points running the 802.11b wireless standard. (When the school adds access points to its wireless network now, it uses Proxim's ORiNOCO AP-700s, a newer model with comparable features, but with a cost far less than the original APs.)

Another critical way that the school saved money on the new network: The Proxim network adapters plugged into existing USB ports in each student computer, keeping Bruns' staff from having to open every box – a tremendous labor savings.

Extending the network to make the entire campus wireless, as the school did in 2001, made Charleston Southern the first campus in South Carolina with wireless access extended to every building. The approximate cost of adding additional access points and network adapters for the entire campus, all from Proxim: a very affordable \$75,000.

Pioneering Challenges

When CSU first rolled out its wireless network, wireless on campus was still relatively rare; the school did some pioneering work in figuring out what would and wouldn't work.

When Bruns and his staff initially launched the network, a few savvy students immediately began gobbling up bandwidth at an alarming rate – so much so that the wireless network wasn't working for anyone. With some research, Bruns' wireless administrator, Tony Boone, pinpointed the problem – excessive downloading of huge music files. They then found a traffic management and optimization tool from a third-party software vendor that allows them to control bandwidth usage by monitoring and limiting bandwidth allocation, and by banning access to select sites as needed. Certain music downloading sites were banned immediately, and the list is updated periodically when the staff spots bandwidth spikes and traces them to specific activities. Using the traffic management software, Bruns says, "We can throttle up or down so our bandwidth functions for everyone." The hardware and software's cost of about \$14,000, he says, proved well worth the expense.

Boone stresses that the majority of students don't need patrolling – "just the mega-users" -- and says the software is used only to monitor the bandwidth by MAC address (the unique hardware address set by the wireless card for a particular machine), not to monitor individual activities.

Making the System Secure

Security is part of the discussion with any network. By learning as they've gone along, Bruns and his staff have taken steps to make Charleston Southern's wireless network secure.

First, Bruns keeps the wired and wireless networks at the school completely separate. The wired system is used by staff and faculty, but not by students. "We wanted students never to have contact with wired side -- the administrative computer [systems]," he says. To set that up initially, Bruns added additional equipment -- a router to break out the two networks. (The router handles the individual traffic from the separated networks, allowing for intranet communication.)

As a baseline, the school requires that students have up-to-date virus protection in place before it will issue the wireless network adapter card necessary to get on the network. That doesn't mean users automatically keep the software current, of course, since students tend to be less than disciplined about keeping their virus software and operating system patches up-to-date. Not only

is that a threat to the wireless network, but it can become especially lethal when someone plugs a wireless computer into the wired network, as occasionally happens.

To address the problem, Boone is installing a security product that works like this: When a user logs on to the network, the software intercepts the request and sends the computer to a special Web site first, where it is scanned for current operating system patches and security software. If the software isn't current, the user is sent to the appropriate sites for updates.

Making Wireless Work

As CIO of a small school with limited technology funds, Bruns used a number of tricks to make a wireless network affordable for CSU.

- **Shop Carefully**

First, Bruns did his homework – he shopped around initially to find the absolute best deal. That meant not necessarily going with the biggest vendor. Proxim has been at the forefront of wireless access technology since 1979, introducing innovative solutions and helping set standards for the wireless industry. And the company's pricing package was absolutely the best, Bruns said. In fact, the access points Proxim offered at the time were dual-bay, designed to accept two wireless access cards at once, not just one. That effectively doubled the number of concurrent users per access points without increasing cost. (That particular feature is no longer a consideration in building out a wireless network – the Proxim access points Bruns is using today, for example, can handle 256 concurrent users or more at a time.)

- **Design for Minimal Support**

Another way Bruns saved money was by insisting that the wireless network be designed for implementation without needing anyone on his staff to open a single student computer to insert a network interface card or make other changes. He managed that by choosing Proxim wireless PC cards for laptops and USB adapters for desktops that connected externally to each computer. By refusing to "crack a single case," Bruns says, he saved huge amounts on staff labor costs.

In presenting the case for wireless to the school's president and cabinet, Bruns calculated that if he had to open each student's computer to insert a network card, he'd need two more technicians a year, at a cost of \$60,000 annually, for support purposes. Instead, he now supports the network with a single staff member, plus the extra help of several technicians when students first arrive on campus each spring and fall.

- **Choose the Right Solution**

Bruns chose to go with a traditional access point network at Charleston Southern. A common misconception with wireless networks is that a switched wireless architecture is needed to manage, monitor and maintain access points from a central location. That isn't true; in fact, switched systems are much more expensive than a traditional access point configuration. In an academic environment like Bruns' where budgets are tight, a traditional access point installation, along with central management software, provides the same benefits (if not more) as a switched architecture. And an access point configuration typically costs less than half what a switched solution costs.

Wireless Success: University of Tennessee, Knoxville

Larger schools often face different challenges than smaller ones. With 27,000 students, the University of Tennessee at Knoxville was a pioneer in wireless, beginning its network in 2000. Yet some of its challenges mirrored Charleston Southern's: fast growth, and figuring out how to keep the new network secure. Here's how a school that's well known for its wireless network advances is making it all work.

Like Charleston Southern, the University of Tennessee at Knoxville was an early adopter of wireless, starting its network project in 2000. That made them the first school after Carnegie

Mellon University to have campus-wide coverage – and with about 27,000 students and 4,000 faculty and staff, the largest in academia for some time.

According to Philippe Hanset, senior network engineer at UT, it took 18 months to cover the entire campus with approximately 1,250 access points spread across two large subnets and seven or so smaller subnets. The tab: about \$2.5 million, including the cost of some initial assistance from a local wireless consultant.

The subnets are designed for possible future growth into voice over IP, Hanset says, since they will allow roaming under the same IP address. “We’re planning with total mobility in mind,” Hanset says.

Growth of the Network

Hanset stresses that the wireless network at UT hasn’t replaced the wired system in any sense – rather, it complements it. Nevertheless, the wireless network has been hugely popular, and that’s been one of the school’s challenges, ironically. After a successful user pilot in 2000 with 45 access points and 200 users, the school decided to take advantage of the pilot’s success and a one-time funding source for the wireless network, and move forward to install a campus-wide system. The network now serves up to 1,500 users at any one time and has about 10,000 unique registered users. An average of 2,000 users access the network daily.

To encourage students to purchase standard, higher quality enterprise-grade wireless network cards from Proxim, rather than lower-quality consumer-grade cards elsewhere, the school subsidizes the cards. They reimburse students about 50 percent of the cost, thereby making troubleshooting and support easier. Hanset says the subsidy has paid for itself in what he’s saved in customer support.

Experimenting with 802.1x

Security is a top consideration with the wireless network at the University of Tennessee, of course. Hanset isolates the wired and wireless networks virtually, for example, and blocks critical wired-side applications like finance from the wireless network.

The school is also experimenting with a new wireless standard, 802.1x, that requires per-user per-session user authentication and encryption. It requires users to load a client on their systems.

The standard is optional during the current testing phase, Hanset says, but may be adopted school-wide. “We want to balance between security and service,” he says.

Hanset emphasizes that the new solution provides wireless encryption over the air via authentication, but that doesn’t mean end-to-end security. “Remember,” he cautions, “you’re still unencrypted at the access points. Be sure to do end-to-end encryption [such as SSL, SSH and VPN] in addition.” He calls the 802.1x solution “just the tip of the iceberg... You’re only securing over the air... It’s one element of an overall security strategy.”

A Layered Wireless Design

In order to let UT students make use of the school’s layered model of wireless access, students network interface cards need to support three wireless standards, 802.11a, 802.11b, and 802.11g, as the Proxim cards do.

Hanset’s creative wireless network design addresses a problem some campuses struggle with: A high density of use in certain areas, primarily classrooms. The entire campus is covered with a layer of 802.11b/g access points for basic connectivity. For high-use classroom areas, Hanset has layered additional access points with 802.11a capabilities on top of the wireless network. “One classroom has up to 180 laptops [in use at once],” Hanset says. In those situations, “We’ve noticed that we have to add density [by adding 802.11a-capable access points]. That also

alleviates some interference issues.”

The flexibility of Proxim’s access points were a key feature right from the time UT began planning its wireless network, Hanset says. “At the time, we talked a lot with Proxim – we wanted to invest our money [as wisely] as we could.” A key decision point, since Hanset could see that wireless technology was evolving rapidly, was this: Could the 802.11b access points be extended in the future to support 802.11a and 802.11g, without mandating a “forklift upgrade” that involved replacing all the points? Proxim guaranteed that support, Hanset says, so “we planned around that... We designed the network for b, with a and g in mind.”

The decision to go with Proxim has proved to be a hugely important one in terms of cost savings, Hanset says.

That decision has proved to be a hugely important one in terms of cost savings, Hanset says. When the school later migrated to 802.11g, they were able to keep the same Proxim access points and simply change a swappable radio card within each device. That allowed them to upgrade the entire campus to the g standard for \$120,000 – a fraction of the cost if the school had replaced every access point. “That cost could have been a million,” Hanset says.

The flexible design of the access points “made it a sustainable development,” Hanset says, and the school remains a Proxim wireless network throughout. All but 40 of its 1,200 access points are still the original ORiNOCO AP-2000s; the remainder, in classrooms that need an 802.11a overlay, are Proxim’s ORiNOCO AP-4000 access points, which support all three access modes simultaneously.

Another attractive feature was pricing, Hanset says. Proxim doesn’t charge the school when it updates its code, unlike some wireless companies, and that can translate into big savings – yearly code updates, Hanset says, can cost up to 30 percent of the original cost of the network.

The Challenge of Success

The rapid growth in popularity of the network was a huge challenge from the beginning. With a staff of about 18 people, the network services group at UT supports the wired network (but not user devices). Hanset himself manages the wireless network, along with two full-time staff and two students.

Based on demand, the school is now considering expanding the wireless system to student housing, at a projected cost of about \$280,000. For one thing, Hanset and his staff have discovered an interesting fact about wireless: Providing adequate coverage helps prevent the appearance of so-called “rogue” access points. (A rogue access point is any unauthorized connection to the network.) “It’s security by good coverage,” Hanset says. “You don’t have many rogue access points in places where you provide decent wireless service.”

Because of the network’s rapid growth, Hanset says he could have used more staff as he quickly expanded the network. Requests for additional coverage came in rapidly once the original network was in place: “We were swamped by our own success.”

advice to administrators undertaking a similar project: Be braced for the onslaught of expansion requests right from the start. Wireless networks, he says, generally prove to be hugely popular.

Conclusion

Studies show that most higher education institutions in the U.S. have some sort of wireless coverage in place, although it may be minimal. Many are planning to expand what they already

have. Clearly, administrators and governing boards have heard the call for this hugely popular technology and are working to meet demand.

There are at least two benefits to schools that are just beginning to spend heavily on a wireless infrastructure: First, you can learn from the experiences of schools that already have extensive wireless networks in place, such as Charleston Southern and the University of Tennessee. Second, wireless is becoming more and more accessible as the cost of the technology drops. The expense of a wireless network has dropped a great deal in recent years. The kinds of project costs faced by the schools mentioned here are now much less, thanks to lower prices on wireless equipment overall.

As wireless spreads and is integrated with wired systems on your campus, the challenge remains: How to make the wireless network affordable and secure. The two examples in this paper, Charleston Southern University and the University of Tennessee, are from schools that differ greatly in size and mission. Yet both were pioneers in installing wireless networks. In the ways they worked through some of the same wireless challenges, both show how wireless networks can be a secure, affordable investment for schools of any size.

ABOUT US

Campus Technology, the only higher education publication focusing exclusively on the use of technology across all areas of the campus, launched in October 2004, replacing the highly respected *Syllabus* magazine. **Campus Technology** provides in-depth, aggressive coverage of specific technologies, their uses and implementations, including enterprise resource planning, e-learning, and course management systems; presentation technologies; and communication, portal, and security solutions – all the important issues and trends for campus IT decision makers.

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