OHIO STATE UNIVERSITY MEDICAL CENTER

EXECUTIVE SUMMARY

THE OHIO STATE UNIVERSITY MEDICAL CENTER

- The OSU Medical Center includes the College of Medicine and Public Health, five hospitals, two free-standing research institutes and a network of more than 30 community-based primary and specialty care facilities throughout central Ohio
- More than 800,000 patient visits take place each year
- The OSU College of Medicine and Public Health is the fourth largest teaching institution in the U.S.
- The College offers more than 20 academic programs and 19 residency training programs
- Biomedical research at the OSU Medical Center exceeds US$100 million annually

CISCO HELPS OHIO STATE UNIVERSITY MEDICAL CENTER ADDRESS STAFFING SHORTAGES—WITH ROBOTS

A fleet of robots carrying medical supplies from one hospital floor to another; rapid transmission of ultrasound, radiology and echocardiographic images; time-sensitive entry of ongoing operative data during surgical procedures; easier, more accurate entry of patient data—these are just a few of the ways the Ohio State University Medical Center is using its wireless network to improve patient care. At the center of these developments are Cisco® Aironet® 1200 Series access points.

BACKGROUND

The Ohio State University (OSU) Medical Center is located in central Ohio, and includes the College of Medicine and Public Health, University Hospitals, the James Cancer Hospital and Solove Research Institute, University Hospitals East, OSU Harding Behavioral Healthcare and Medicine, the Dorothy M. Davis Heart and Lung Research Institute, a federally designated Comprehensive Cancer Center, a network of community care sites, and the Richard M. Ross Heart Hospital, to be completed in the fall. The OSU Medical Center has consistently been named one of the best hospitals in the United States by *U.S. News & World Report* magazine. The Medical Center is widely recognized for programs in heart care, cancer, orthopedics, organ transplantation, rehabilitation, women's services, and neuroscience.

OSU Medical Center caregivers serve some 800,000 patients per year, providing a level of treatment services that is beyond the scope typically found in community hospitals.

CHALLENGE

The OSU Medical Center was one of the first large medical campuses to adopt a wireless strategy. “Interest developed early, back in the late 1990s and was widespread.” says Greg Telles, OSU Medical Center network engineer. ”There was a lot of talk about the flexibility and close-to-the-patient convenience that wireless would give us.

“For the most part, caregivers wanted a means of electronic order entry right at the bedside where they wouldn’t be tied to PCs out in the hallway,” he explains. “This was the key driver, but others saw wireless’s potential in additional areas, such as bringing critical data to a surgeon in the middle of an operation. The more we looked at wireless, the broader the potential implications became.”

The challenge in 1999 was to select the best wireless solution in terms of immediate performance; in subsequent years, the challenge has been to ensure this wireless system keeps pace with new technological options emanating from the scientific and medical communities.

Figure 1
A robot used for delivering laboratory specimens awaits the elevator, which it summons and controls through a WLAN link to the elevator control unit.

SOLUTION

The solution to both challenges has been wireless technology from Cisco Systems®.

In 1999, OSU Medical Center engineers began a survey of the three main buildings and many associated buildings. They also took an in-depth look at the wireless market. “This was our initial venture with wireless, so we conducted a lot of upfront research,” Telles explains. “In the final analysis, we judged the Aironet product to be the clear leader. When Cisco acquired Aironet, it simply reinforced our decision, because these products could easily be integrated into our existing Cisco infrastructure.”

The Medical Center’s infrastructure includes a broad array of Cisco Catalyst® Series switches—6500 Series switches in the core, and 4500 and 3500 series switches at the edge.

In 2000, Cisco Aironet access points were installed in the three main buildings. Upgrades were made in some areas as newer access points—the Cisco Aironet 340 Series and then the Cisco Aironet 350 series—were introduced. Gradually, the wireless network embraced the entire Medical Center campus.

With the announcement in 2002 of the release of the Cisco Aironet 1200 Series access point, OSU Medical Center engineers decided on a full-scale replacement program.

Cisco Aironet 1200 Series access points support the IEEE 802.11b standard, which has an 11-Mbps data rate and operates in an unlicensed portion of the 2.4 GHz radio frequency spectrum. This band provides for three operating channels. Cisco Aironet 1200 Series access points also provide a migration path to the IEEE 802.11a and IEEE 802.11g standards, a feature that adds scalability and investment protection.

The 802.11a standard, with a data rate of up to 54 Mbps, offers greatly enhanced performance and eight distinct channels for enhanced scalability, making it particularly appropriate for high density deployments. Although this standard is not backwardly compatible with 802.11b devices, the 802.11a standard has the additional benefit of not being subject to interference from devices that operate in the 2.4 GHz band, such as cordless phones, Bluetooth devices, microwave ovens, and hand-held barcode scanners.

The IEEE 802.11g standard provides backward compatibility with IEEE 802.11b equipment, preserving users' investment in their existing 802.11b WLAN infrastructure increase both 802.11b and 802.11g offer 3 non-overlapping channels.

To get the most out of the newer, high-performance standards and take full advantage of future multi-mode 802.11a/b/g clients, many organizations are designing their WLANs using two or three bands. The Cisco Aironet 1200 Series access point is capable of single-band or dual-band operation to simultaneously accommodate one radio for 802.11b or future 802.11g clients and another for high-speed 802.11a clients. These access points can be upgraded in the field; customers can order one with the 802.11b radio, for instance, and then add or swap out radios to the new standards as their application and bandwidth requirements evolve.

The Aironet 1200 Series supports all 802.1X authentication types, including Extensible Authentication Protocol (EAP) Cisco Extensible Authentication Protocol (LEAP), Protected Extensible Authentication Protocol (PEAP), Extensible Authentication Protocol Transport Layer Security (EAP-TLS), and types that take advantage of EAP-TLS. When coupled with a RADIUS that supports the same authentication types, such as the Cisco Secure Access Control Server (ACS), the result is a scalable, centrally managed security solution. This solution includes strong, mutual authentication to ensure that only legitimate clients associate with legitimate and authorized wireless access points. Dynamic per-user, per-session encryption keys can be set to automatically change on a regular basis to protect the privacy of transmitted data.

By the close of 2003, Cisco Aironet 1200 Series access points had been installed in the 11-story James Comprehensive Cancer Center and the Level 1 Trauma Unit Emergency Department inside Rhodes Hall. OSU network engineers expect installation of the remaining facilities to be completed by the end of 2004.

"The 1200 Series gives us some exciting options. We are now implementing both the 802.11a and g standards in hopes of using General Electric's wireless, portable ultrasound device," Telles says. "We are presently trialing the wireless transmission of ultrasound images so that physicians and radiologists can view them quickly. For them, time is critical, and we think the new standards available with the 1200 access point will make this possible. We also hope to begin using the 'a' and 'g' very soon in the Trauma Unit."

Figure 2
A robot used in the ATS (automated transport system) carries one of many specialized carts on which hospital materiel is transported.

In addition, the OSU Medical Center plans to use the CiscoWorks Wireless LAN Solution Engine (WLSE) to manage its wireless system. "We have been experimenting with the 2.0 version but have decided to switch to the WLSE. 2.5 once installation of Cisco Aironet 1200 Series access points throughout the entire campus is completed, late in 2004," says Telles.

CiscoWorks WSLE provides intelligent management and configuration capabilities with user-defined groups to effectively manage a large number of access points and bridges, eliminating the need for individual management. It monitors the Cisco LEAP server

and further enforces security policies by detecting misconfigurations on access points and bridges. In addition, CiscoWorks WLSE provides proactive monitoring, troubleshooting, notification of performance degradation including interference detection and mitigation, capabilities to improve capacity planning on an ongoing basis, and security policy enforcement.

This emphasis on a multi-layered security approach is pervasive in Cisco technologies, enforcing security best practices that enable compliance with the Health Insurance Portability and Accountability Act (HIPAA) of 1996. In addition to mandating changes in federal regulations governing the provision of health benefits and the delivery of and payment for health care services, HIPAA requires the security and confidentiality of patient health information.

The functionality of the WLSE is enhanced through the Cisco Structured Wireless Aware Network (SWAN) architecture. Capabilities include intrusion detection services such as rogue access point detection, radio frequency (RF) scanning and monitoring as well as high availability with interference detection, black hole mitigation, WAN outage survivability, and self-healing wireless capabilities,. The new capabilities within the SWAN architecture, coupled with the current capabilities of the WLSE, will provide preemptive and proactive wireless networking monitoring, thus increasing the resilience, reliability, and availability of the wireless network.

RESULTS

One of the most valuable and innovative implementations of wireless is in the Medical Center's Automatic Transport System (ATS), a network of nearly 50 robot transporters. Each is capable of carrying up to 1,000 pounds of nursing paraphernalia, linens, meals, and other items between patient wings and a service floor. The robots stop at programmed, dedicated pickup and drop-off points, and use special elevators, which were purpose-built for the exclusive use of the robots, to travel between floors of the hospitals.

The battery-powered robots are controlled by a central computer using FMC Technologies' Automated Guided Vehicle (AVG) Manager software, which operates on a Microsoft Windows-based platform. AVG interfaces with FMC Phar Lap software on board each robot, transmitting all instructions via Cisco Aironet 1200 Series access points.

"We grew our wireless network by around 40 percent to accommodate the ATS, because connectivity is required in elevators, supply rooms, and large parts of the ground floor infrastructure where normally we would never need wireless connectivity. Since the robots never travel to patient areas, their routes were never included in our initial network," Telles explains.

"They only run on the 1200 Series access points, and we use the 802.11b standard. Robots don't require lots of throughput, but they do need time-sensitive data and commands, so their needs are definitely different than our applications-oriented users, many of whom can't wait for us to migrate to 802.11a and 802.11g."

The ATS was tested in 2003 and went live in the three major buildings at the start of 2004. OSU Medical Center projects 3,000 or more journeys by the robot fleet per day.

"The robots relieve the staff of an enormous amount of menial work, which provides more time for interacting with and caring for patients. It is an excellent application of cutting-edge technology, all animated by wireless," Telles says.

Outside the realm of the robots, the most frequent use is bedside order entry, according to Telles. "At this point, we are using wireless laptops atop carts that can be rolled right up to the patient's bedside, where the physician or nurse can record data while remaining in close contact with the patient. It also facilitates registration of patients at bedside without the inconvenience of separating the patient from prompt care. This is especially important in the Emergency Room." OSU uses Siemens SMS software for order entry.

"Using wireless technology is second nature now for our caregivers," he says. ."During their rounds, you will often see physicians accompanied by residents who are being taught right at the point of patient care. This teaching includes listening to normal physician-patient interchanges followed by instant order entry. This then sparks discussions with the residents. The point is, they can see when and how the wireless system is actually used, and they become accustomed to it. That's important because it's very likely what they will encounter when they are on their own."

The Medical Center is beginning to migrate to a smaller, more mobile cart and a downsized PC. In some cases, the Cisco Aironet 350 Series Workgroup Bridge will be used to facilitate the wireless signal. The Cisco Aironet 350 Series Workgroup Bridge quickly connects up to eight Ethernet-enabled laptops or other portable computers to a wireless LAN (WLAN), providing the link from

these devices to any Cisco Aironet Access Point or Wireless Bridge. Based on direct sequence spread spectrum (DSSS) technology, the Cisco Aironet 350 Series Workgroup Bridge operates in the 2.4 GHz band and supports data rates up to 11 Mbps.

"We are starting in gastroenterology, where six of these mobile units are deployed. It's a small Dell PC, and we have installed some Cisco Aironet workgroup bridges nearby because the PC only has Ethernet capability," Telles explains.

In operating rooms, perfusionists use wireless laptops to enter operative and perfusion case data into a patient's file while the patient is undergoing open-heart surgery. This allows the operative information to be available immediately following the procedure. The perfusionists can also access patient data as needed during the case through eResults, a software application by Siemens Medical Solutions, without leaving their task of monitoring the heart/lung bypass pumps.

The hospital pharmacy uses the wireless network in outpatient clinics on the first and second floors of the James Comprehensive Cancer Center in order to:

- Input medication orders, primarily chemotherapy, into Pharmakon, the inpatient pharmacy system
- Monitor patient laboratory values as it relates to drug therapy via eResults
- Answer drug information questions from physicians and nurses using Micromedex, the pharmacy intranet and other Internet-based resources
- Collect data for medications with specific use criteria
- Assist with drug cost reimbursement from third-party payers
- Submit adverse drug reaction reports to the appropriate OSU Medical Center committees and government agencies

While improving patient care remains the underlying motivation for wireless, the OSU Medical Center also welcomes the cost savings that its Cisco Aironet wireless network has delivered. Savings are especially evident through the use of in-line power. Like the Cisco Aironet 350 Series, the Cisco Aironet 1200 Series Access Point features a high-performance, 100-milliwatt (mW) radio design that includes a variety of power management capabilities. It also is designed to draw operating power from a powered Ethernet port. This in-line power configuration works with all Cisco in-line power-enabled devices, such as Catalyst switches, in-line power patch panels, and in-line power injectors, which are included with the product.

"In-line power has really saved us money," says Telles. "As we upgrade and expand our network, the fact that you don't need electrical outlets near access points makes an enormous difference. With the older models, the costs in manpower and time required in locating outlets or installing new ones was a big concern. In many parts of the hospital, we had to have maintenance people study the charts to determine electrical wiring and then pull electricity to each access point. Once again, this increases the labor and time required, and it delayed access point installation. But now we don't have to worry about any of that—it is a quick process to pull Ethernet cable, locate the access point, and install it. In-line power is a tremendous time- and money-saver."

NEXT STEPS

The Cisco Aironet 1200 Series access points that were installed for use by the ATS robots will serve a dual purpose: the OSU Medical Center plans eventually to run wireless traffic over them in support of administration, research and educational programs. "We will use VLANs to separate this traffic from Medical Center clinical traffic. Thus, by expanding the existing wireless network for the ATS project, we will also be accommodating the wireless needs of the teaching, research and administration communities," Telles explains.

The OSU Medical Center is one of only a few hospitals that use an entirely film-less, fully automated radiology imaging system. The Medical Center uses the Picture Archive and Communications System Radiology Information System (PACS/RIS). Plans are now being developed to make this film-less system completely wireless.

"The advantage of wireless transmission within our institution is, in our opinion, very obvious," says Kathy Tunstall, director, PACS/RIS, OSU Medical Center. "Hardwired transmissions would require either large expenditures of capital for networking or the expenditure of productive man-hours spent traveling to a common transmission point It is our intention to remain on the cutting edge of this technological advance."

Finally, wireless technology, using the Cisco Aironet 1200 Series access point, is being deployed at a new heart hospital at Ohio State University, scheduled to open in August, 2004. Medical Center plans are to standardize on both the IEEE 802.11a and IEEE802.11 g. "This will give us maximum flexibility and assured growth capability from the outset," says Telles.

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