CASE STUDIES

VoWiFi Vanguards: Blazing The Trail

Lisa Phifer

Is voice over WLAN ready for prime time? At these enterprises, it's getting there.

Recent surveys show that voice over IP (VOIP) has gone mainstream, deployed by two out of three enterprises. A similar percentage are rolling out business-grade wireless LANs based on the 802.11 Wi-Fi technology. VoWiFi, the synergistic marriage of these technologies, seems sure to follow. Indeed, one in five companies cites VOIP as a primary driver for Wi-Fi deployment. But elsewhere, VoWiFi remains an unrealized vision.

Why? Some companies lack budget or staff; others are stymied by quality or security. For most, VoWiFi is simply uncharted territory with unknown challenges. To better understand what it takes to tap VoWiFi's potential, we consulted six firms that have already ventured down this path. From health care to hospitality, walled office to warehouse, these vanguards have given VoWiFi a try, with varied goals and results. These are their stories...

McKee Foods: VoWiFi As Legacy Replacement

Most major network upgrades start with a small trial. This is the state of VoWiFi at McKee Foods Corp., the Tennessee maker of Little Debbie snack cakes with annual sales of more than $1 billion.

Before turning up VoWiFi, McKee replaced its headquarters' aging Cisco Aironet WLAN with Meru Networks gear. "Our [wireless data] network had grown to a point where centralized control was required," said Bo Smith, IS group manager of the Network Services Group. "So we took a fresh look at the next-generation players."

"We have wireless on lift trucks that carry our product around. Their coverage area spans multiple Access Points (APs), so the problem is handoff, being able to maintain security and coverage," Smith continued. McKee tested several AP/switch alternatives before settling on Meru to support its warehouse management system with improved coverage and smoother handoff.

"Our experience in replacing wireless infrastructure made us more open to doing voice over WLAN," said Smith. To date, two dozen Nortel 2210 VoWiFi handsets have been placed in service, to be accompanied by Hitachi WIP-5000 handsets later this fall. These 802.11b phones share the same WLAN with warehouse applications and office laptops, but APs are still being added to reach indoor locations that did not require Wi-Fi for data.

McKee is evaluating VoWiFi as replacement for its Nortel Companion Unlicensed PCS phone system. About 350 Companion phones are now used by "everyone from tech support who are on the go all the time, to production supervisors who carry those phones to keep in touch with operations staff," said Smith. "That system is at end-of-life, but we still need to keep those folks mobile, so we must provide them with replacements.

"We're reviewing whether we want to roll [VoWiFi] out in a bigger way or whether some of those users would be better served with cell phones," explained Smith. But going cellular would require repeaters to provide indoor coverage. "We'd be looking at spending money to put in cellular infrastructure, plus monthly service plans, versus using the WLAN infrastructure we already have, without recurring service fees.

"The investment that we've already made in Meru infrastructure will not only serve WLAN phones, but we're also looking at putting smart devices in the hands of our front-line supervisors to keep up with real-time data off production lines," said Smith. "This gives us the opportunity to integrate what were previously independent systems."

Smith's initial VoWiFi challenge was integrating VoWiFi handsets with his Nortel IP-PBX system. "Anytime you're taking new technology and integrating it into an existing system, you have hoops you have to jump through," said Smith. "Upgrading firmware, rebooting servers and getting everything synched up took awhile."

Today, "wherever we have wireless coverage, we have quality as good or better than a typical desktop IP phone," said Smith. But that clearly could change when VoWiFi usage and resource

Lisa Phifer is vice president of Core Competence, Inc., a network security technology consulting firm based in Chester Springs, PA. When she's not chatting on her VOIP phone, Lisa can be reached at lisa@corecom.com.

competition grow. In early tests McKee was able to squeeze just 4 calls out of each of its legacy APs. Based on experience to date, Smith hopes to get more than 30 calls out of each Meru AP, although the trial has not yet reached this scale or exercised QOS controls.

VoWiFi security options are still being explored. McKee's data WLAN already uses several layers of security, depending on the application. Smith would like to go with certificate authentication on handheld units for convenience. "Security is required to make our voice over WLAN implementation official," said Smith. "If you can't add security once you scale it up, voice over WLAN won't happen at this site."

Smith recommends that anyone considering VoWiFi conduct a formal evaluation to weigh competing solutions and their ability to meet requirements. "We did a thorough analysis, putting several vendors through a rigorous decision-making process," explained Smith. "Many of our wants, needs and must-haves were very company- and environment-focused. But what we require may be different than other facilities, so take a hard look at your own environment."

UNC Hospitals: Integrating VoWiFi Handsets

At UNC Hospitals, an academic medical center located in Chapel Hill, NC, VoWiFi handsets are being used to increase nursing staff productivity and reduce background paging noise (Figure 1).

According to Tom McCotter, director of telecommunications services, the hospital's WLAN was initially deployed to support order entry. Voice handsets were added about two years ago to enable integration with the hospital's nurse call system. "Now, when a patient hits their call button, instead of the call going to the nurse's station, it goes directly to their caregiver," said McCotter. "This saves footsteps and improves patient care."

VoWiFi phones are now carried by staff who roam throughout the hospital. "We cover a number of buildings—we have a Women's Hospital, a Children's Hospital, a Memorial Hospital, and a Neurosciences Hospital," said Greg Fitts, telecommunications analyst. "Our buildings are so old and dense that cellular doesn't penetrate the building at its core. We also have policies that prevent use of cellular in patient care areas."

About 300 SpectraLink i640 handsets are used by hospital staff 24 hours a day. Voice calls are supported by two dozen SpectraLink NetLink Telephony Gateways, interfaced with a Nortel Meridian 1 Option 81 PBX. Nurse call system integration is accomplished by pairing SpectraLink's NetLink OAI Gateway with Emergin's Nurse Call Gateway.

Wireless voice and data are carried by 250 Cisco 1200 APs, covering nearly 2 million square feet of space. "One of the cost justifications for installing VoWiFi was that we could take advantage of the WLAN infrastructure we were already building," said Fitts. But obtaining satisfactory voice coverage and quality required re-surveying and tuning.

"Our APs were configured for data," explained Fitts. "We had to make modifications to those APs to work with SpectraLink. You might be standing right below an AP, but pulling service from an AP on the floor above or below you. Initially, we didn't know if QOS issues were the result of the phones or the network. But once we discovered the right software combination, we found that we did have good [radio] coverage."

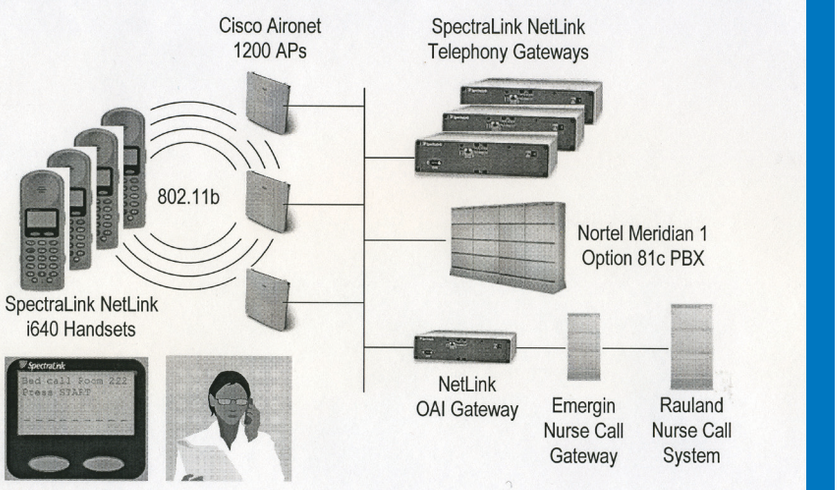
Fitts estimates that each AP supports 7 concurrent voice calls. SpectraLink's Voice Priority (SVP) mechanism is used for priority queuing and reduced back-off delay when handsets have voice to send. Because traffic is secured with 128-bit WEP, inter-AP handoff is fairly seamless. However, users must stay within a single IP subnet's coverage area to avoid call disruption when roaming.

If fact, user education played a major role in this rollout. "We trained approximately 800 nurses, assistants and clerks to use the system," said McCotter. "Getting everyone to understand how to use the phones and the nurse call application was a major undertaking. In most hospitals, there's high [staff] turnover, so training is an ongoing task."

When alerted, the nurse call system identifies the patient's room, caregiver and handset they're carrying. Text messages direct the appropriate caregiver to the right location. "If a patient calls the nurse station, the unit clerk triages the call and

"If you can't add security...voice over WLAN won't happen at this site"

FIGURE 1 UNC Hospitals



During our interview, one user roamed among eight access points

does a one-button push-to-send [one of 15 programmed] messages to the caregiver's phone," said McCotter. "By determining what help is needed, you're not sending RNs to bring patients water."

VoWiFi handsets also permit direct communication between doctors and nurses. "The doctor can get an immediate response rather than paging the nurse, and vice versa," explained McCotter. "Some areas where nurses work are large, so being able to ask and answer questions from their current location significantly reduces footsteps." The hospital hopes to integrate further applications, like using handsets to view lab results.

McCotter's advice for companies deploying VoWiFi? Coordination is critical.

"Our project involved three internal departments and four separate vendors," said McCotter. "This may be the first time you have data and telecoms staff working together, and everyone has a piece of the pie. Make sure that everyone is on the same page—know who is responsible for doing what and when."

Metro Toronto Convention Center: Visitor VoWiFi

Like many conference facilities, the Metro Toronto Convention Center (MTCC) provides Wi-Fi Internet access to visitors. But MTCC takes Wi-Fi one step further, using it to deliver mobile voice to customers and staff within the center's underground complex.

According to Chris Taylor, telecommunications manager, most VoWiFi handsets are carried by employees. "Our staff can't be tied to desks, they must be out with the clients. From the banquets department to event services, we're all mobile," said Taylor. "But we also have handsets reserved to rent to clients." For example, event managers routinely use VoWiFi push-to-talk to coordinate with their own on-site staff and exhibitors.

A former Companion customer, MTCC gained functionality by upgrading to VoWiFi a year ago. "Our old 900-MHz technology had a better penetrating effect, but our [802.11b handsets] have digital line features—call forward, caller display, conference calling," said Taylor. With VoWiFi "your portable phone and desk phone are the same. You have one voice mailbox, one number, one direct line of communication."

MTCC considered cellular but rejected this option due to recurring costs. "Initial costs are probably about the same, but we have warranty coverage for our [VoWiFi] units, and cell phones don't generally have that," explained Taylor. "With [VoWiFi], internal communications don't tie up trunk lines like cell phones. And of course there's no airtime cost."

The center's telephony platform resembles that employed by UNC Hospitals: 90 SpectraLink i640 handsets, 7 NetLink Telephony Gateways and a NetLink SVP server. MTCC's Nortel Meridian 1 Option 61c PBX interfaces to the PSTN to deliver wired and wireless dial tone. However, VOIP is only used by mobile handsets; MTCC has no business need to replace wireline phones with IP phones.

IP data and voice ride over a Siemens (formerly Chantry) HiPath WLAN that covers 1.5 million square feet, spanning two multi-story buildings, connected by escalators and a skywalk. One central HiPath C100 Controller communicates with 45 HiPath 802.11b/g APs, mounted in public and private areas.

During our interview, Taylor moved between buildings, roaming across 8 APs, with just one noticeable pause: when he entered an elevator. Voice dropouts are also encountered near structures like escalators. "We still need to fine-tune reception," said Taylor. "When we improve one area, we seem to degrade another. We're working with Chantry to get a better overall [radio] footprint by adjusting power levels and upgrading software."

To investigate issues, MTCC uses AirMagnet and NetLink handset diagnostic tools. For QOS, MTCC employs SVP, but Taylor does not think calls are facing significant channel contention anyway. "We're supposed to get 12 calls per AP, but I don't know if we hit that because we have so many APs," explained Taylor. "When it's busy, about 70–80 handsets are turned on, but not all in the same area."

MTCC uses HiPath's virtual network feature to meet diverse voice/data security needs. The HiPath Controller places each user/group into a defined IP subnet so that access privileges and routes can be enforced. Visitors using wireless data log into a captive portal page for Internet access. MAC exclusion lists authorize VoWiFi handset access, while ensuring they send only VOIP packets, and only to MTCC's telephony gateways. Neither visitor Internet access nor voice traffic is encrypted.

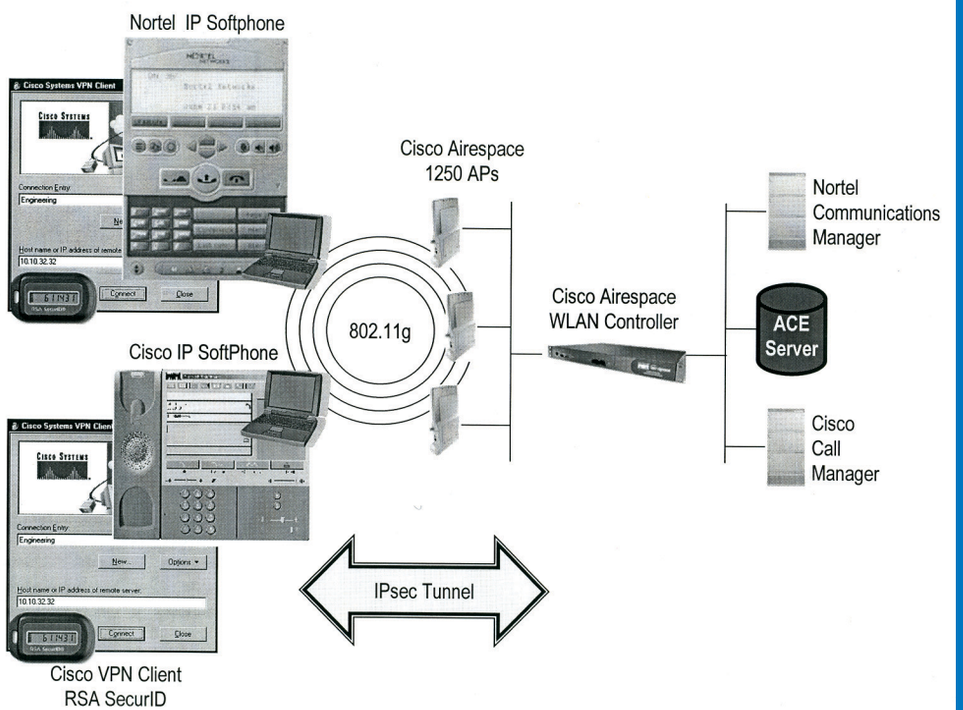
Although MTCC's VoWiFi users can place calls to on-site and off-site destinations, handsets themselves must be within reach of the center's WLAN. "We've taken APs and handsets off-campus and tunneled back [across the Internet to our controller], but latency has been too great. We've had calls, but they've been pretty choppy."

Overall, Taylor believes that MTCC has learned quite a bit by deploying VoWiFi. One big lesson: An exhaustive site survey is money well-spent. "Even if you're not doing voice now, take voice into consideration at the start if there is even a remote possibility that you'll use it in the future."

EMC: Visions of Global, Secure VoWiFi

Verticals like health care have jumped on VoWiFi faster than other enterprises. To appreciate why, consider the pilot conducted by EMC Corp., the Massachusetts supplier of information storage

FIGURE 2 EMC Wi-Fi Implementation



products that employs 23,000 people in 300 locations worldwide.

According to Terry Dymek, senior director of global technology, EMC found issues with functionality and security. "For now, we are concentrating on deploying secure Wi-Fi to every EMC location," explained Dymek. "Our vision is that when the technology is ready, we will have Wi-Fi phones that use VOIP in our buildings and cellular service outside."

To get ready, EMC has been testing VoWiFi in niche applications and remote offices. "I see VOIP as part of our new standard configuration for field offices," said Dymek. "We'll use Wi-Fi to cut down on wired networking dramatically, using VOIP over VPN instead of MPLS. As part of that rollout, I don't want to buy more TDM systems."

Why limit VoWiFi to new offices? "We've been using trunk-side VOIP for a long time, where it makes sense from traffic and financial perspectives. But there's no need to retrofit where what we have is working fine. I'm not going to displace functioning, paid-for TDM telephone assets," explained Dymek.

As at many large enterprises, Wi-Fi grew organically at EMC. "We had Wi-Fi in a few buildings, but the WEP key was three years old, etc., and we realized we had to do something about it," said Dymek. "It took us awhile to come up with a design and security model, then find the right vendor to meet requirements." Today, wireless workers at EMC headquarters use Airespace 1250 (Cisco 1000) APs (Figure 2).

To secure this WLAN, users tunnel IPSec to Airespace 3500 (Cisco 2000) Controllers, authenticating with RSA SecurID. "We wanted to move away from WEP, and WPA wasn't quite there yet. We already use Cisco's IPsec Client for remote access—we have thousands of those—so we decided to just extend them to wireless," explained Dymek.

Not that IPSec over Wi-Fi has been easy. First, a new drop-down had to be added to EMC's standard IPSec Client profile and pushed to all laptops. Then EMC ran into IPSec scale issues, resolved after Cisco acquired Airespace. "We reached a level of stability, then retrofitted our [main] campus to replace older APs with Airespace and update [more than 3,000] IPSec Clients," said Dymek. But a global WLAN rollout takes time; more than 200 sites and thousands of laptops are left to be upgraded.

EMC leverages this WLAN by running Nortel and Cisco softphones over IPSec. "On the Nortel side, we use Succession programming so that, when I travel, my office phone rings on my laptop," said Dymek. "On the Cisco side, we have softphones using Cisco's Call Manager, but that is more of a technology pilot."

Dymek found that, as with cellular, users expect voice drop-outs on VoWiFi phones. "People are willing to accept some inconvenience for the financial tradeoff," he said. "Folks have been surprised at call quality, but I take that with a grain of salt because, unless you have a lot of people banging at same time, you aren't going to get

"So far, there's no killer app. I'm not going to do a technology push"

"There was a whole pile of little issues, but the way to overcome them is to monitor carefully as you deploy"

Dunkin Donuts: Debugging Is Hard To Do

Isochronous application packets must flow at a steady rate that reflects the receiver's ability to process them. VOIP systems use "jitter buffers" to accommodate small variations in packet arrival. Even so, loss and latency can easily disrupt voice applications. And, as Boris Shubin, IT director at Dunkin Donuts mid-Atlantic distribution center learned, debugging latency issues in a production WLAN can be very challenging.

Dunkin Donuts does not send real-time voice over Wi-Fi. Instead, synthesized voice work orders are sent to Voxware VLS-410 wireless headsets worn by warehouse workers. A recently-installed enterprise resource planning (ERP) system generates units of work, sent over an Airespace WLAN to Cisco Aironet NICs embedded in headsets. As units are completed, confirmation must flow back to the ERP system before the next unit can be sent.

This ERP system gives Dunkin Donuts a real-time view of warehouse inventory, but has proven extremely vulnerable to latency. "It can causing crippling delays in our operations, as we have found over the last month," said Shubin. "If there is any latency, you get a cascade delay that affects all clients. If one client experiences delay, the rest experience delay in sequence. Our warehouse staff work towards a quota. If they're experiencing delays from Voice Pick [our voice work order system,] it affects their productivity."

The situation was so critical that Shubin didn't have time to isolate the problem. "Our priority was to solve it, so we tried everything at once," he said. "We eliminated a router from the flow. We rearranged coverage in a freezer where we were experiencing most problems. We changed the affinity of APs to controllers, enabled load balancing, changed client firmware and created code to restart timed-out sockets."

Although he can't be sure, Shubin believes the culprit was too many clients and too few APs, and obsolete Aironet firmware in headsets. "That firmware was more than two years old, so we bumped it up and immediately saw improvement," he said. After three independent site surveys found no coverage holes, Shubin dedicated two more 802.11b APs to the freezer to reduce contention there, and that seemed to do the trick.

"We have certainly learned a few lessons about how vulnerable wireless networks and voice applications are to latency, how to resolve such issues, and how few people really understand wireless technology," concluded Shubin□

QOS problems. We tried to scale Wi-Fi as best we could. We added some new QOS on our LAN. We're mostly out of the woods now, but there are still issues with stability/reliability."

EMC continues to struggle with fast handoff. "We've run into buggy code as people move around," explained Dymek. "Mobility is a big issue moving forward. Remember: [our users] carry SecurID fobs. It would be one thing if they could just sign in once a day, but repeatedly signing in [when roaming] would be a pain."

EMC expects to deploy VoWiFi on a global scale—when it makes business sense. "For the most part, I don't have to do anything with our existing telco deployment, so the business case for VoWiFi would have to be pretty compelling. So far, there's no killer app. I'm not going to do a technology push that disrupts our business and doesn't solve a business problem," said Dymek.

Credit Valley Hospital: Growing With VoWiFi

Some facilities do find that VoWiFi can help them grow more cost-effectively. For example, Credit Valley, a community hospital in Mississauga, Ontario, plans to leverage VoWiFi to deal with new construction that will nearly double its current floor space.

"We just commissioned a new 330,000 square foot state-of-the-art cancer center, but we haven't been given any additional IT staff to support that center," said Leigh Popov, manager, IS technical infrastructure and capital projects. "Being able to use a single network for voice and data is an important part of being able to do that."

Credit Valley turned up VoWiFi four months ago. "The beauty is that [these handsets] work anywhere on campus," said Popov. "We have an administration building, a medical arts building, a building that houses physicians' offices. In fact, you can be in our remote facility, 15 kilometers away, and still use the same mobile phone."

Like McKee, Credit Valley recently retired aging wireless networks. To strengthen security and management, Credit Valley replaced its 3,000-user Cisco Aironet WLAN with 250 Airespace APs. To support a growing mobile voice constituency, PCS phones were replaced by 440 Nortel 2211 VoWiFi handsets. "We chose 2211 handsets because they are more durable, and our users can be pretty hard on equipment," said Popov.

VoWiFi users at Credit Valley are mostly nurses and physicians. "We have 3,000 staff and 2,000 desk phones, but the clinical workforce in community acute care hospitals is mobile," said Popov. "Many don't even have a permanent desk, so there's nowhere to give them a desk phone. Instead, we give them mobile phones. That translates into better patient care because they can access information on-the-spot."

Most calls are handled by the hospital's Nortel Meridian 1 Option 81. According to Popov, this traditional TDM PBX has evolved into a TDM/IP

hybrid that runs analog, digital and IP voice natively. Credit Valley uses a Communications Server 1000 to handle calls at its remote facility, and an Option 11 PBX for contingency planning.

Popov was concerned that quality and reliability would suffer when moving to VoWiFi. "When you start running voice over an IP network, you immediately notice that it's not as great as you thought," he said. "You end up having these little dead zones where the wireless signal isn't strong. Data is not a consistent stream but, with voice, there's always something going on. Continuity of coverage becomes incredibly important."

That is why Credit Valley revamped its WLAN when deploying VoWiFi. "You can't do first-come-first-serve with voice; you have to be able to give priority to voice," explained Popov. "We addressed that by implementing QOS across our whole network, starting at core routing switches, going right out to the edge, covering everything in between. Calls traverse wireless and wired networks, and voice must get from here to there in a consistent manner."

One challenge that Credit Valley has yet to solve is the great outdoors. "I'd like to be able to say that I don't care where you are," said Popov. "Even if you're walking to the parking lot or garage, that you'd still get your calls. But that must be seamless—you can't have to push a button if you want to receive your calls outside."

For Popov, slow and steady is the key to success. "There was a whole pile of little issues, but the way to overcome them is to monitor carefully as you deploy," explained Popov. "If you have 10 handsets, and then move to 100 handsets, there's a big difference and you have to adjust. So grow very carefully and watch what you're doing." To Popov, that includes talking to VoWiFi users. "Ask them: How is your phone working? What's happening; what's not happening? You have to ask them, because they're not going to come to you until it's really bad."

Conclusion

Each of the organizations profiled in this article had unique requirements for Wi-Fi and VOIP, influenced by business needs, environmental conditions, legacy data network and telephony systems, existing applications and mobile user population. Deployments that are this complex are tough to summarize in a few paragraphs, much less directly compare. However, some common threads can be found in these stories:

A WLAN designed to carry data probably will not meet your voice needs without some redesign and expansion. Network convergence and asset reuse may reduce cost, but companies should include WLAN refinement in their VoWiFi project budgets.

Expect to spend plenty of time on system integration—for example, pairing VOIP headsets or softphones with your WLAN platform, engineering voice QOS support into your wireless and wired networks, pairing VOIP gateways with existing PBXs and business applications. Choosing the right platforms can facilitate integration, but VoWiFi is not going to be plug-and-play (see "Dunkin Donuts: Debugging Is Hard To Do").

Quality and security warrant careful consideration, but in many cases, these issues have not been show-stoppers. However, keep in mind that many of today's VoWiFi deployments are relatively small and modestly secure. Scaling from hundreds to thousands of handsets may require improvements in AP/client density, contention management mechanisms and voice-aware monitoring/diagnostic tools.

Wireless and VOIP products are evolving, so look for innovative technologies. The companies we interviewed used WLAN products that centralize and automate radio network control; VOIP systems with open application interfaces; and phones that speak QOS protocols. But watch for other VoWiFi advances, like dual-mode handsets that support 3G plus 802.11a/n and fast/secure handoff, to name just two.

Technology matters, but it isn't the endgame. Business impact and cost played a primary role in each of the deployments described here. For your enterprise, understand whether and how VoWiFi will add to your bottom line. Piloting VoWiFi can help you get a handle on this.

Finally, we would like to thank these organizations for sharing their insights and experiences. Hindsight is 20/20, and there is much we can learn from those who have gone before us□

VoWiFi is not going to be plug-and-play

Companies Mentioned In This Article

AirMagnet (www.airmagnet.com)
Cisco (www.cisco.com)
Credit Valley Hospital (www.cvh.on.ca)
Dunkin Donuts (www.dunkindonuts.com)
EMC Corp. (www.emc.com)
Emergin (www.emergin.com)
Hitachi (www.hitachi.com)
McKee Foods Corp. (www.mckeefoods.com)
Meru Networks (www.merunetworks.com)
Metro Toronto Convention Center (www.mtccc.com)
Nortel (www.nortel.com)
RSA Security (www.rsasecurity.com)
Siemens (www.communications.usa.siemens.com)
SpectraLink (www.spectralink.com)
UNC Hospitals (www.unchealthcare.org)
Voxware (www.voxware.com)