



Making Wireless an Indoor State of Mind

Tapping the Wireless Healthcare Opportunity: Key Challenges and Strategies for Network Deployment

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There has never been a better time than now to deploy wireless access in the healthcare industry. Technologies have matured, carriers are motivated to entice a mobile-dependent hospital workforce with better deals, and demand to cut the cord is high. Hospitals have traditionally have been slow to invest in a wired network infrastructure, making wireless a more compelling proposition as they try to catch up and deploy new applications.

Part of the reason that wireless now makes sense is that there are real productivity benefits to be gained from using wireless networks in hospitals. By deploying more wireless monitoring gear bedside, patients can be more ambulatory and nurses can cover more ground as well, improving care. Mobility gives hospitals more flexibility and more usage out of the same number of beds.

But this doesn't mean that supporting wireless networks will be a 'slam-dunk' and not without its problems. There are multiple radio frequencies and standards in place, and hospitals need to support many of them to deliver wireless coverage for cellular voice and data, Wi-Fi, and medical devices. And even though hospitals are building new wireless networks, they still need to support them with a wired infrastructure that eradicates dead spots and provides universal access to applications and services across a hospital's campus. Any wireless application needs to take into account the loose collection of hospitals, medical practice groups and offsite clinics that can derail any standardization effort and confound any central IT department's choices for particular applications, frequencies, and devices. As a result, establishing end-to-end control over the entire network proves challenging and makes the case for adopting a flexible wireless design.

Let's talk about these challenges and opportunities for wireless deployment and ways that modern technology solutions can play an important role in deciding the shape that wireless networks take in the healthcare industry.

Multiple end customers

Hospitals are not like a typical white-collar office. While they are considered large corporations, they have become a collection of different corporate groups: doctors are employed by their practice groups, laboratories are their own entities, and clinics operate off-campus but continue sending their results to the main hospital campus for further analysis. Each of these entities can have their own IT budget and other funding sources for computing equipment and infrastructure investments.

All of this means that a centralized IT department has limited to no control over their entire collection of end-users and can't dictate the eventual endpoint

devices for all applications. Any new network infrastructure has to handle a wide variety of situations, applications, devices, frequencies, and users, and has to be able to quickly adapt as new applications are added to support new treatment methods.

Today's healthcare institutions also run on multiple complementary and often disconnected systems: patient records are on one system, medication inventory management and monitoring are on separate systems, doctor and nurse paging systems are yet another application, and many hospitals still use mainframe-based administration programs. Some medical data is stored digitally and some still as analog copies that need to be shared among the doctor's practice, the insurance carrier, and other entities, all while protecting patient privacy. It is a tall order, indeed, for any integrator that wants to deliver a new kind of network that will be able to tie all of this together.

Adding to this challenge, many hospitals still have a mixture of manual and electronic record keeping, using paper-based handwritten notes for patient diagnoses and progress reports when using computerized billing and scheduling, for example. "There are so many steps in the typical workflow and so many of them aren't automated or require human interaction or interpretation," says Cathy Zatloukal, the CEO of MobileAccess. "Sometimes we find everything on a separate system— patient records, dispensed drugs, equipment and asset tags, billing. It is hard for many hospitals to get a handle on workflow and processes with so many disparate systems, and without an overall campus infrastructure in place."

Part of serving a campus with multiple mobile users means that plenty of departments are interested in budgeting funds for wireless applications, making for a chaotic purchasing situation in many hospitals. This means that often, there is no single funding source for IT equipment since requests can come from a practice group, a particular clinical specialty department, or even originate from the telephony support organization. Often, these are fragmented efforts and departments are working at cross-purposes towards an overall campus-wide wireless installation.

These departmental efforts should be consolidated before a campus-wide wireless deployment makes any sense. "The moment that clients realize they can combine their various departmental budgets, our typical wireless project quickly grows, and customers want to expand wireless coverage even further and control their wireless network end-to-end," says Zatloukal. "We have to bring all of the various stakeholders together to reduce a hospital's overall infrastructure costs."

Location, location, location

The old saying about the three things you need to know about real estate is true when it comes to deploying the latest healthcare applications: it is all about the

location of your staff and their tools of the trade. Locating someone on campus and positioning the doctor, the support staff, and the patient together with the treatment room location can save time and improve the quality of care through increased coordination. The right kinds of wireless applications can be the underlying glue that brings all of this basic location information together and helps to quickly collect the team needed for a particular care situation.

"This isn't to play Big Brother, but more to track and tie in movements of staff with which rooms are available, which need to be cleaned or restocked with supplies, and to provide information such as how long a patient occupied a very expensive intensive care bed before they were moved," says Scott Sbihli, the global product manager of networking systems for GE Healthcare. This is a great productivity and efficiency enhancer and a way for hospitals to capture some solid cost savings with these technologies.

Wireless can also improve treatment. "When a patient isn't in intensive care or the emergency room, hospitals can still capture vital signs with patient telemetry, through their recovery process or even record this information in their homes, using wireless technologies," says Zatloukal. "This gives clinicians more insight into the recovery process and the patient's medical condition and helps with tailor treatment."

One of the leading vendors in location detection is Vocera, which provides a Wi-Fi based "badge" that is worn by hospital staff and can be used to quickly page or locate someone. There are other applications based on radio frequency ID tags, too. "Vocera has become our standard for two-way communications," says Todd Larson, an IT manager with Intermountain Systems Health Care in Utah. This helps reduce response time, making Vocera a standard application. Of course, supporting Vocera throughout the hospital requires a broad, facility-wide wireless coverage footprint for Wi-Fi services.

A single wireless network? Not!

One of the reasons why wireless is so compelling for hospitals is that in many cases, their wired network infrastructure has not kept pace with the technology needs of its end-users. Many hospitals don't have the kinds of wired networks that can be found in typical general offices, where category 5 cabling runs to every cubicle and across each office floor. In many situations, only small areas of the hospital were ever wired for data networks, and even telephone wiring can be scarce in some hospitals since, again, they were built in an era when staff shared phones in common areas. This means that many healthcare providers are looking to improve the reach of their data networks with wireless coverage, while catching up to support the latest applications.

However, hospitals still have a long way to go, and in many cases they are just getting started with wireless deployments. "Wireless is still not pervasive in most

hospitals," says Sbihli. "Wi-Fi is not universally deployed from top to bottom, and few hospitals have brought cellular coverage indoors today." Yet there are compelling reasons to go wireless: "No one wants to walk back to a workstation on another floor just to view patient status – that doesn't fly anymore," he says.

The days where a single wireless network could do everything for a hospital are clearly over. Not only are there different frequency bands for medical devices, cellular, and Wi-Fi, but now there are different subspecies, applications and protocols within these frequency bands that make for a very chaotic collection of radios inside a hospital. "Many hospitals are looking at running 10 or more different wireless applications and services as a typical scenario," says Zatloukal.

Because a hospital bring together a wide array of mobile caregivers, on and off site, creating a single wireless standard is nearly impossible. Take the situation of providing better indoor voice cellular coverage as an example. You can't choose a single cellular operator because workers are bringing in their cell phones with a variety of providers and plans, so hospitals usually need to support three or more of the major wireless carriers if they are going to roll out indoor cellular coverage. And this support has become more complex as cellular networks are used for more than just voice calls, such as using wireless Web browsers and text messaging that is standard on most modern cell phones. "Medical technology providers have recognized that there is a growing demand for applications that are run from PDAs and cell phones," says Zatloukal.

And there is no such thing as supporting a single Wi-Fi frequency – now that there are devices operating using 802.11a, b, and g standards, hospitals need gear that supports all of these wireless standards. And again, this support is getting more complex as the Wi-Fi frequency bands are used for more than just sending computer data, and are being considered for voice over IP and sending video streams too. "Some hospitals are finding that their Wi-Fi bands are filling up with these applications, and they're looking to other frequencies such as cellular and WiMax to carry more of their data traffic," says Sbihli. "Wireless is no longer a single domain, a single technology or frequency or even a single protocol," says Zatloukal. "Hospitals need a universal platform and wireless pipe that can carry all kinds of applications currently available while handling new ones in the future, too."

Some hospitals that have discovered the benefits of wireless networks have found that these networks are becoming their primary network, in terms of traffic. "The number of wireless devices that we put on our network is growing rapidly, which means that we need a solid and well-functioning architecture," says David Baird, Central Region Director of Information Systems with Intermountain Systems Health Care, a regional hospital group based in Utah. "Wireless now carries almost the same amount of data as our wired networks."

Managing antenna and radio interference

Early on, hospitals were slow to support wireless access because of fears that Wi-Fi and cellular connections would interfere with the operations of medical equipment, and indeed many still ban visitors' cell phones and laptops for this reason. "Five years ago, hospitals were afraid that wireless devices were going to interfere with their medical telemetry and they put these bans into effect. But few problems have materialized and for the most part interference isn't an issue," says Sbihli. As technologies have matured, many have realized that interference is more of an urban legend than reality, and with proper arrangement of antennas and configuration, everyone's radios can co-exist and not threaten patient monitoring or other critical applications.

Perhaps the biggest cause of interference for radio signals is the actual building structure itself that can block many outdoor cellular transmissions. The heavy construction materials used in many buildings readily absorb high frequency radio signals, significantly degrading the quality of wireless communications within the building. As a result, wireless coverage can be unpredictable, location dependent, and sensitive to floor plan changes.

In some cases, hospitals that are designed with reflective glass exteriors for energy conservation can also block these radio signals, and make using cell phones indoors useless without any additional interior antennas to propagate signals. Because of these external and internal construction obstacles, many hospitals are going with indoor cellular solutions so that their staff will still be able to make and receive cell calls while walking around their campuses.

As the number of different radio frequencies increase within a hospital, it is important that any deployment make use of filters to mitigate interference, as well as proper construction of antenna arrays that can operate at low power levels and focus coverage on particular areas inside the buildings. The goal is to keep coverage broad without sacrificing signal quality and service. This is the approach adopted by MobileAccess, with its Universal Wireless Network solution that combines multiple radio signals over a single antenna array. While this integrated approach makes a lot of sense, it has to be done with care. This is because when two or more signals are transmitted together or near each other they can generate noise or interference. While MobileAccess combines multiple signals together, it does so by using lower power emitters and highly specialized filters to condition the signals and, thus, mitigate interference.

"Overall, our approach requires less power and provides more antenna gain," says Zatloukal. "This means we cut overall requirements for deploying each service while easily accommodating and adding new wireless services, without sacrificing signal quality or creating interference."

You still need wires for wireless networks

Unfortunately, any wireless solution is still going to require some wired portions. The differences are what kinds of antennas will be placed on the horizontal floors and how signals will be transmitted from the central wiring closets to these antennas. There are two distinct approaches, each with their advantages and disadvantages.

One approach is to use a separate antenna system for each wireless service that it supports, connecting each via separate and parallel cabling to bring the radio signals from the floor's wiring closet to the ceiling-mounted antennas. With this solution, Wi-Fi is deployed as a separate network from the cellular services or any other wireless applications.

MobileAccess uses a second method, where a single antenna is used to support multiple wireless services, making use of very broadband coaxial cabling to connect antennas to the wiring closet on each floor. With the MobileAccess solution, Wi-Fi signals are supported over the same cables and antennas used to deliver other wireless services. The Wi-Fi access points are kept in secure, easily accessible wiring closets and Wi-Fi signals are combined with the other wireless services so that all signals run over a single cable to a single broadband antenna. This has the advantage of keeping IT infrastructure out of the ceilings and in more centralized areas that can be protected and more easily maintained. This approach also removes these devices from locations in patient areas -- they can now be accessed without invoking time-consuming and expensive infection control procedures.

MobileAccess supports a broad array of wireless services, including cellular, Wi-Fi, and the medical telemetry band on a single omni-directional antenna. Less integrated parallel solutions require multiple separate antennas, and typically don't offer combined support for challenging service combinations such as Sprint-Nextel on a single antenna.

One of the biggest cost components of any antenna installation is the final few yards of cabling that go closest to the ultimate end-users. "There is big labor cost to go up in the ceiling, and the less you need to do there and the more you can do in the wiring closet when you want to add your second and third frequency band, the less costly your job will be," says Sbihli. "You might also design a system for future expansion so you don't have to pull more cabling two or three years from now."

Conclusion

As you can see, deploying wireless healthcare solutions will require understanding several different aspects of technology, applications, and usage patterns before it can become a success. While none of these issues are

showstoppers, taken together they can be vexing for even the smallest wireless rollout in a hospital.

About MobileAccess

MobileAccess Networks is an enterprise wireless innovator that provides a universal platform for connecting the people and applications that drive business. The MobileAccess Universal Wireless Network is the key to widespread wireless connectivity in hospitals, office buildings, public venues and other large-scale facilities. The company's intelligent, in-building infrastructure delivers business-quality performance, scalability, security and signal reliability to more than 1000 customers, including Fortune 1000 companies such as Lehman Brothers and Hearst Corporation, leading healthcare facilities such as Northwestern Memorial and Clarian Health, as well as many public sector customers such as Aladdin Resort and Casino, ALLTEL Stadium, American University, and the Oakland International Airport. For more information, visit www.mobileaccess.com.

About the Author

Jeff Kunst is Vice President of Marketing for MobileAccess. Mr. Kunst brings over 15 years of telecommunications experience to MobileAccess Networks. Mr. Kunst was Vice President of Marketing and Product Management for Lucent's metroMSX product family. The metroMSX platform was developed by Chromatis Networks where Mr. Kunst, as Director of Product Management, was instrumental in the acquisition of Chromatis for \$4.75B. He has also held senior technical and marketing positions at Newbridge Networks, Hughes Networks Systems and the U.S. Coast Guard. Jeff has a B.S. in Electrical Engineering from the U.S. Coast Guard Academy in New London, CT and an M.S. in Electrical Engineering from the George Washington University in Washington, D.C.