Enabling The Wireless Utility

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Wireless technologies can help make building operations more efficient, workplaces safer and more secure, and people more productive. The enabler of these benefits is a wireless utility, soon to become as ubiquitous in buildings – and as expected – as heating, cooling, telephone, plumbing and electricity.

We live in an increasingly wireless world. Wireless devices are becoming pervasive at home and at work, allowing levels of connectivity, convenience and efficiency never imagined before. Wireless telephones and high-speed wireless Internet alone are having profound effects on the way we work, live, and play.

The fundamental benefit of wireless access to tools and information is that it makes people more productive. They can work where they need to work, yet still be accessible to customers and colleagues and have on hand the information they need to perform their duties. If a facilities technician can receive work orders on a PDA while making rounds, if a doctor can check a patient's vital signs without reporting to the bedside, if employees can read e-mail without having to stop at their desks, then steps are saved, less time is wasted, more work gets done.

Because productivity is critical, the question for company and building owners is not whether to embrace wireless technology. The question is how to accommodate it cost-effectively, to maximum business advantage, and with the same service quality users expect from other utilities in the workplace.

The answer lies in a fast-emerging concept known as a wireless utility. Simply stated, a wireless utility is a building infrastructure that helps bring order, structure, and robust performance to what otherwise could become a clutter of wireless devices.

A wireless utility is a facility-based, engineered, broadband, shared infrastructure. It carries all approved wireless applications, ensures reliable service to all users, and accommodates newly emerging applications at minimal inconvenience and cost. It delivers on the promise of wireless technology as an enabler of efficiency, flexibility, and employee convenience and comfort, at no sacrifice of service quality.

Wireless utilities are not likely to replace wired infrastructure – at least not in the foreseeable future. However, when added to the wired infrastructure, they can help building occupants tap the full power of today's and tomorrow's wireless services and applications. That makes the buildings more valuable and the companies in them more safe and secure, more productive and more competitive.

For this reason, experts project that the wireless utility will become a requirement in buildings alongside all other commonly accepted utility infrastructures – as essential as electricity and plumbing.

The Wireless World

Growth in wireless communication is undeniable and unstoppable, among consumers and in the workplace. Consider:

- The Cellular Telecommunications & Internet Association's Annualized Wireless Industry Survey places the number of cellular, ESMR and PCS subscribers in the United States at 148 million in 2003 – versus 13 million ten years ago and 60 million five years ago.
- The Radicati Group marketing consulting firm projected the number of solely wireless e-mail users to grow from 1.99 million worldwide in 2003 to 8.76 million in 2007.
- In the latest wireless survey by CIO Magazine, 68 percent of respondents said wireless technology was either important or somewhat important, and 16 percent cited wireless as extremely important to their current business goals.

Statistics like these merely support what is easy to observe in daily work and personal life. As striking as the sheer numbers of wireless users is the growth in the range of applications and devices already available and emerging. Today two-way radio, cellular and PCS telephone, high-speed data (wireless LAN), and paging are almost universally accepted. Fully practical applications just coming into widespread use include Voice over IP telephone, building automation, security and access control, fire and life safety control, asset management with radio-frequency tagging and tracking, and inventory management. Some industry observers also predict a rise in wireless device-to-device communication in buildings, such as between a thermostat and an HVAC controller, or between various other kinds of sensors and controllers. A logical extension of that concept is a wireless sensor network, in which thousands of sensors and devices work in concert to improve all aspects of life indoors.

The State of Wireless in Buildings

Wireless technologies in buildings today are typically far from optimized. "The classic problem with wireless tools inside a building is that the signals are hindered by the building itself," says Jim McCoy, chief technical officer with InnerWireless, a wireless infrastructure provider based in Richardson, Texas. "The signals are attenuated and reflected by the structure, so that signal quality typically is not good."

That inherent problem can be aggravated when wireless technologies are installed outside a comprehensive strategy. "Today, most wireless technologies in buildings are single-application deployments," says James Heinz, president of Heinz Corporation, a radio frequency (RF) engineering and consulting company in St. Louis, Missouri.

"Everybody is excited about wireless, so different departments and functions bring technologies in, perhaps a wireless LAN, a cellular or PCS system, a two-way radio system for the facility operations staff. You end up with multiple-layered, piecemeal, redundant infrastructures that create a chaotic RF environment. No one steps back and does the engineering needed to make the systems function at their best."

In fact, according to McCoy, the individual systems themselves are often sub-optimized. "They are being put in place for only one purpose," he says, "so the typical approach is to spend as little as possible on the infrastructure to get just enough performance.

When systems are suboptimized, coverage for the various services may not be uniform within the building. The different applications may interfere with each other within a workspace or between workspaces in adjoining areas of the building. A common response to such concerns is to add amplifiers to increase the signal strength or add more antennas. That is rarely effective – more often it only creates more noise and interference.

Furthermore, in the absence of proper engineering, poorly controlled signals may "leak" outside the walls, creating potential security breaches. Perhaps most important, the building cannot accommodate new and appealing wireless technologies without the construction of more separate and costly infrastructure.

It is no wonder under such circumstances that the quality of wireless services comes into question. In reality, a strong argument can be made that perceptions of in-building wireless technologies as "unreliable" have less to do with the technologies themselves than with the lack of discipline in their deployment.

Furthermore, as wireless technologies become more popular, people inevitably will bring all conceivable wireless gadgets into the workplace. That practice will not stop until facility owners and managers decide to offer wireless conveniences to their people in an organized manner. A wireless infrastructure provides the opportunity not only to provide the service but to manage and optimize its usage."

The Wireless Utility

A wireless utility imposes discipline and so enables quality. It is similar in meaningful ways to other building utilities. "An electrical system in a building provides a general-use platform for electrical devices – it doesn't care what you plug into the wall," says Heinz. "A wireless infrastructure accomplishes same thing. It provides a platform for multiple wireless applications under a common infrastructure, instead of multiple, redundant systems that may be in conflict and competition with each other."

At the heart of a wireless utility lies – somewhat paradoxically – wire, typically coaxial cable. The basic infrastructure is a system of cable, antennas, and other components engineered to capture and convey signals throughout the building, and confine them to the interior.

"It is in essence an engineered utility," says McCoy. "The cabling and antenna infrastructure takes the signals and helps them bypass the walls and floors and other impediments in the building. The signals are released into free space only through antennas close to the end user, be that a person or a machine. If you keep the signal inside a cable, in

a controlled and conditioned environment, for most of the distance it must travel, you substantially increase reliability and quality."

A wireless utility handles the complete range of frequencies that exist or are likely to come into play in the workplace. It is an extremely broadband infrastructure that is frequency and technology agnostic. It delivers a variety of wireless services in a robust manner, so that the enterprise and individual workers can depend on them.

Service quality is assured at the design level. Proper engineering, with attention to variables like cable location, signal strength and signal direction, ensures that the signals reach where they are needed but do not escape outside the building. The latter point is important to security. In an environment with poor signal containment, it is conceivable that someone sitting in a car outside with a laptop computer could hack into the data network.

"A skilled system designer is very conscious of how far outside a structure the signals will permeate," says Heinz. "By using the appropriate design tools, and by knowing the composition of materials in the shell of the building, it is possible to be highly effective in keeping the signals contained."

In a world where new wireless technologies emerge every year, the greatest advantage of a wireless infrastructure may be its flexibility. Once the backbone infrastructure is engineered and in place, new services can be added easily. "By definition, a wireless utility must accommodate growth and must accommodate future technologies without change in the backbone," says McCoy.

"A well designed infrastructure provides extreme flexibility. For example, it would be possible to upgrade an entire building from today's CDMA technology to tomorrow's 3G technology by going to only one place in the building, rather than going to dozens or even hundreds of locations. Multiple services, multiple frequencies, guaranteed coverage, engineered containment, capacity for change and growth – all these must be present in a true wireless utility."

The Benefits of a Wireless Utility

A well-designed wireless infrastructure adds value to a building at every level. For building owners and developers, it provides an additional, high-value infrastructure that helps attract tenants and command premium rent. It can enhance an owner's reputation for quality and technology leadership, add to the market value of a property, and enhance the company's return on investment for each premise.

For building occupants, a wireless infrastructure delivers the best of two worlds: Freedom of movement with high-quality, dependable service. Land-line telephones, for all their sound clarity and reliability, cannot follow users around a building. Wired sensors and controllers, similarly reliable, often must be moved at considerable expense as building usage and interior configurations change. Wireless devices in the context of a wireless utility are both mobile and reliable. The productivity advantages are undeniable.

While owners and tenants seldom justify a wireless utility solely on hard-dollar return on investment, it does reduce cost in meaningful ways. It eliminates the cost of building multiple, redundant infrastructures. It requires fewer antennas, access points and other components than individual systems. As a passive system – one that carries signals without need for powered electronic devices to boost their level – it is essentially maintenance-free and has no inherent failure or wear-out mechanism.

A wireless infrastructure in theory can reduce the redundant wiring and cabling of individual workspaces. "In newer buildings, in a typical office space, it's common to see electrical outlets on all four walls," says McCoy. "And it is not unusual also to see telephone and computer jacks on all four walls – even though only one person will work in the office and only one set of connections will be used at a given time. All of this is designed to give the occupant flexibility in setting up the workspace. But a wireless utility provides even more flexibility for that person to use the telephone and computer in any location desired, without the need to deploy four times the infrastructure actually needed to connect to the necessary services."

In practice, at least for the immediate future, wireless utilities will seldom displace wired infrastructure – rather, they will augment it. Still, the presence of wireless services has potential to reduce significantly the time and cost involved in space reconfiguration – moves, adds and changes. It allows the option of moving desks, walls and partitions without also having to reroute all telephone and network cabling.

Another benefit of the wireless utility is extreme flexibility in the work environment. Employees can literally go anywhere with neither loss of efficiency nor loss of connectivity to co-workers and customers. This enables redefinition of workspaces, allowing open floor plans and comfortable, lounge-like areas where people can work on laptop computers.

Where device-to-device communication is concerned, wireless technology allows enterprises to place sensors or

controllers in remote locations that are too costly to wire, and to deliver high-quality signals to otherwise hard-to-reach areas, such as basements and boiler rooms.

The Wireless Utility at Work

A wireless utility can support far more than two-way radios, wireless LANs, cellular and PCS phones, pagers, and other technologies in common use today. In fact, its possibilities are limited only by inventors' and users' ingenuity.

The potential of wireless permeates every level of the enterprise and spans a wide range of vertical markets. Multiple technologies can coexist – and perform reliably and efficiently – only within the context of a wireless infrastructure. Here is just a sampling of promising applications that wireless utilities will help to enable:

Facility operations. Facilities managers prefer to operate on-the-go, not from a desk. Most facilities staffs communicate on two-way radios. Many also use computerized maintenance management systems (CMMS). Such systems have wireless capability, but its value is limited if the signals cannot reach technicians in certain areas of the facility. A wireless utility provides the needed signal reliability, enabling building occupants to send maintenance and repair requests from a web portal to technicians by pager or PDA, instead of filling out paper forms. Technicians, in turn, save time and accomplish more because they do not have to walk to an office to pick up and close out work orders.

Security and emergency service. Wireless technology allows security cameras to be placed anywhere and moved at will. It can track people and high-value equipment using radio frequency identification (RFID) tagging. It can create close linkages with first responders, so that arriving police, fire and rescue personnel have immediate access to construction and floor plans and can immediately locate the people in the building.

Healthcare. Hospitals already use wireless extensively. Most physicians and nurses carry a pager, wireless phone, or both. They may also carry wireless devices that allow them to check patients' status remotely. Patients' vital signs are monitored from a central station (telemetry). Many hospitals are implementing computerized prescription entry in place of handwritten orders – many such systems have wireless components. Also growing is RFID tracking of mobile medical devices and of patients. It is technically feasible for a patient to wear an RFID tag coded to direct the building automation system to adjust room temperature to his or her needs – comfort settings follow the patient from room to room. A wireless infrastructure can help deliver these and other services with the reliability healthcare demands.

Retailing. Shopping malls can use wireless technology to provide connectivity for kiosk shops in the corridors, to download data from the front office to electronic plasma screen advertising display boards on the floor, to transmit inventory data, to set up temporary security cameras for sales or special events, or to simplify security incident reporting.

Airports. Travelers prefer to use cell phones and want anytime-anywhere Internet access from laptop computers. Airlines benefit from wireless communication between data terminals at the counters. Wireless systems help them reconfigure easily as airport and gate layouts change. Airports own operations staffs rely on two-way radios. Wireless sensing technologies offer wide potential to increase airport safety and security.

Hospitality. Guests at hotels and convention centers want flexibility to use telephones and computers anywhere. The industry is interested in wireless Voice over IP telephone service, enabling guests to take their in-room telephones anywhere on the property. In their own operations, hotels can use wireless to automate management of functions like facility operations and housekeeping.

Education. Distance learning is a major trend in schools and colleges. Wireless systems can support remote classes and educational video conferences. In classrooms, wireless technology greatly simplifies the process of providing data access to all students.

Entertainment. Wireless technology has applications for ticketing in sports venues and performance arenas, for delivering real-time replays of football games to cellular phones by 3G data technology, and for helping parents find lost children at amusement parks (through RFID tracking).

The Wireless Utility in Practice

Infrastructure is not the only component of a wireless utility. A truly robust and reliable system must be deployed under a clear, written and thoroughly enforced wireless spectrum management policy.

Here, the issue is RF interference. Front-end engineering can do a great deal to prevent interference from rogue signals, such as those that may penetrate from outside sources. But effective policies are needed to make the internal system work. The use of the wireless system must be restricted to devices approved by the enterprise.

"Right now, this not being done as a matter of practice, and the results can be disastrous," says Heinz. "It is com-

mon to hear people complain that their company has a wireless LAN, but they can't get on their computer, or they can't talk on their cell phones next to their computer. Owners need to get control of the RF environment.

"Information technology (IT) departments have very distinct policies that cover computing and data," adds Heinz. "Those policies say employees may not load personal software onto network computers and may not download software at will off the Internet. Companies need to adopt similar policies to protect the integrity of wireless systems.

"Without proper management of the RF spectrum and without a written and enforced wireless policy, interference will continue to be an issue. Suppose for example that a company installs a wireless infrastructure, and then an operations manager leaves company. A successor is hired, and no one tells him or her about the system. Now a vendor comes in and offers a new wireless technology. The manager deploys it, not knowing about the wireless infrastructure, and immediately there is interference."

On a more basic level, McCoy observes, "If an enterprise relies on a wireless LAN, that enterprise needs a policy stating that employees will not bring cordless radio headsets into the building. The LAN and the headsets will interfere with each other because they operate on the same frequencies."

In general, building occupants must be told that they may not bring wireless devices into the workplace without the wireless system administrator's knowledge and consent. A wireless policy also can help prevent conflicts among different enterprises occupying the same building.

"If multiple parties plan to use same frequency bands, it is necessary to determine the rules of engagement – how those parties will share the common resource," McCoy says. "A good example is a wireless LAN. It operates in an unlicensed RF spectrum, and if everyone involved does not coordinate, the result will be chaos that renders everyone's system inoperable.

"The way to avoid that is for the building owner and the tenants to proactively adopt policies. The owner who installed the utility puts the policy in place. The tenants are advised of it and, in turn, let their employees know what services and what types of wireless devices may and may not be introduced to that space.

"In the frequency range assigned to wireless LANs, there are three non-interfering channel assignments. In a practical scenario, the owner could take the first channel and use it throughout the building for operations and maintenance purposes. The second channel could be made available to tenants on a floor-by-floor basis. The third channel could be dedicated to and Internet service provider wishing to offer service within the building."

Embracing the Wireless World

Taken together, the advantages of the wireless utility make a compelling case for its routine inclusion in new buildings and its retrofit to existing buildings. "It makes sense to think of a wireless infrastructure in the same context as systems like water, electricity, and HVAC," says McCoy.

"That is to say, it is expected in the building. No one goes into a building and expects it not to have electricity, lighting, fire control, and security. Wireless will come to be the next expected piece of infrastructure in buildings. It is not unrealistic to predict that in the next three to five years, wireless infrastructures will be as ubiquitous as electrical service is today."

Adds Heinz, "When the concept is presented effectively to owners and developers, they readily understand it. Our experience indicates that the wireless utility concept will permeate the industry. In next several years, it will become the predominant strategy for deploying wireless technology, and it will be a standard design consideration in buildings.

"In fact, in the future, designers of buildings may focus more on how to make the structure conducive to better RF coverage. For example, they may choose construction materials that more readily pass RF – perhaps in certain cases replacing metal building components with plastics that pose less challenge to RF system design."

No one doubts that wireless technology will play a growing role in business. A wireless utility creates an opportunity to put it to work for maximum value and maximum business advantage.

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