Deploying In-Building Wireless Solutions

How enterprise, wireless service providers and building owners can better serve their employees, customers and tenants by deploying a converged in-building wireless infrastructure for voice and data communications.

Careful consideration of the applications required by the end user can improve the operational and economical returns seen from deploying an in-building wireless system.

This white paper:

- Explains why broadband, converged services deployed in greenfield situations are superior to narrowband services for in-building wireless solutions
- Describes how WiFi and 3G can support in-building and on-the-street solutions such as wireless voice, server and Internet connectivity, RFID and VoIP
- Discusses some of the major factors to consider when contemplating deploying an in-building wireless solution

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Introduction

Many enterprises, service providers, building owners, and building tenants are investigating the deployment of in-building wireless voice and data communications.

Enterprises are looking for ways to make their employees more efficient and productive. Service providers want to better serve their customers and generate new revenues. By deploying in-building wireless communications capabilities, building owners can offer their tenants new services and attract new tenants.

In-building systems include wireless data systems, such as Wireless Fidelity (WiFi), and wireless voice enhancement systems, such as cellular. These solutions are not cheap – they usually involve significant up-front investigation and preparation costs, followed by capital investments in the equipment and its installation, and, of course, on-going operating expenses once the systems are functional.

Unfortunately, when the business case is analyzed many of these solutions fail to provide sufficient return on investment. Also, the system's capabilities may not be fully used after it becomes operational.

Capital funding for these systems usually comes from one or two sources – the enterprise itself; or a service provider trying to develop or improve a business relationship with its enterprise customers.

When the service provider finances an in-building system, the solution may only support that provider's proprietary services. If this is the case, the enterprise or building owner should consider implementing a solution that supports multiple access technologies, services, and applications. The customer can either fund the system internally, or share the costs with one or more service providers.

This paper describes how in-building wireless solution architectures using multiple access technologies can support a broad range of applications.

This approach potentially provides a greater return on investment as well as more value to the system's users. During the analysis and planning stages, determining the best mix of technologies and applications is crucial when considering whether or not the in-building system will meet current and future needs, will be sufficiently utilized, and can satisfy the enterprise or building owner's financial business case.

Technologies considered include WiFi, Cellular Voice and 3G data services, RFID and Mobile IP Data Roaming. These technologies provide a wide range of in-building wireless applications.

Narrow Band Solutions

Network service providers are struggling to keep up with user demands for ubiquitous, always available wireless voice and data communications services. Cellular and PCS networks are expanding their service footprints and capacity to indoor and outdoor areas. Wireless Fidelity (WiFi) providers that initially concentrated on providing services to public facilities are now broadening their offerings to cover select high-traffic outdoor regions.

As companies, building management agencies, and service providers respond to their customer desire for ubiquitous communications, they tend to choose a quick fix in the form of an infrastructure capable of supporting only one type of wireless service. Then, as end user needs continue to grow, they add a second infrastructure to meet the new requirements.

This causes a number of problems. The deployment of multiple infrastructures:

- Increases total capital expenditure
- Increases the cost of evaluating optional solutions
- Increases maintenance and operational costs, as well as equipment space requirements

Figure 1 shows a dual infrastructure supporting independent CDMA and WiFi services. This implementation increases the number of antennas and cables installed within the facility. Two cables are installed connecting the radiating points to the centralized Base Transceiver Station (BTS) and servers. In addition to the need for multiple cables, each radiating point now has two antennas – one for each service.

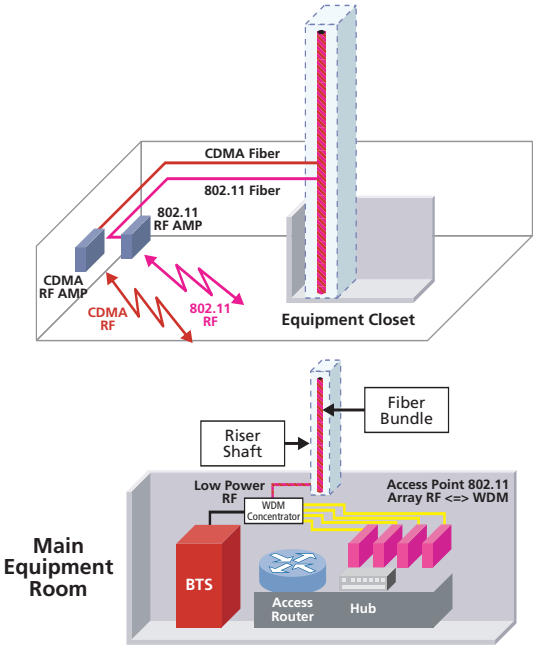

Figure 1: Dual Overlay to Support 2 Access Technologies

Broadband Distribution Solutions

Several vendors are now producing in-building infrastructures that can transport a broadband solution. These infrastructures use fiber optic, coaxial cables, and broadband antennas to transport multiple technologies over a broad range of frequencies.

Due to the mix of different wireless access technologies, frequencies, and power budgets required by the infrastructures, these solutions are more complex to engineer. When properly engineered, these solutions have a number of advantages compared to the narrowband approach. They provide a single infrastructure capable of supporting multiple access technologies. Also, they furnish a common network management interface for monitoring the performance of the distribution system used to transport the wireless services. A single infrastructure that can support a number of different technologies provides the user with a flexible range of options while, at the same time, reduces the system's capital and operational costs.

Frequency and Technology Support

These broadband infrastructures can support a wide range of frequencies and technologies. In North America, they support the 800, 850, 1900, 2400, and 5700 MHz bands.

Because the broadband systems only job is to transport the radio frequency (RF) signals applied to their inputs, they can support all access technologies within the frequency band. For example, in North America, iDEN, SMR, Analog Cellular, CDMA, TDMA, GSM, UMTS, EvDo, 802.11a, 802.11b, 802.11g, etc, can be supported simultaneously. These infrastructures can support wireless access from all the major cellular carriers, plus WiFi for high speed internet access.

Cost Reductions

Broadband in-building implementation supports a potential reduction in costs. A recent broadband deployment within a 52 story office building saved an estimated $300,000. This approach eliminated the need to reopen the ceiling for deployment of future access technologies.

Figure 2 shows how a common infrastructure can be deployed to support CDMA and WiFi services, simplifying the deployment and reducing the infrastructure costs. In addition, these solutions allow active devices to be located inside equipment rooms where they can be serviced without disrupting operations in occupied spaces. As indicated in the diagram, each radiating point can support both services simultaneously by using a common wiring backbone.

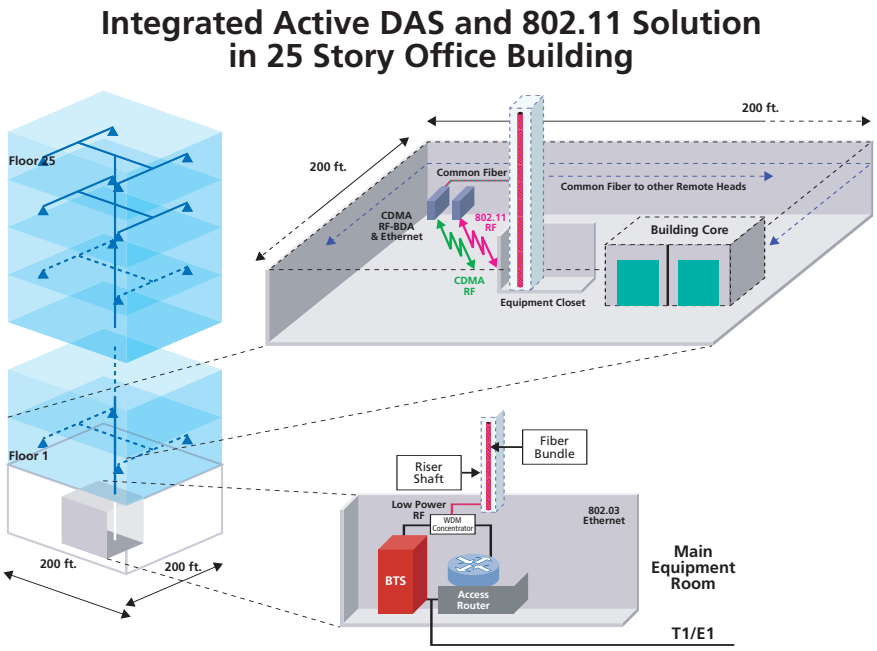

Figure 2: Single Overlay to Support 2 Access Technologies

Applications Support

Supporting In-Building and On-the-Street Applications

The broadband approach allows in-building facilities to provide a large number of voice and data applications that are supported by wireless Internet, voice, and 3G systems. Enterprises and building owners should take into account both present and potential future applications when choosing the wireless access technologies that will be used to deliver these applications over the selected distribution infrastructure.

The applications described below demonstrate how customers can experience increased usage and value, as well as an improved return on investment, by choosing an appropriate-building wireless system.

In addition to in-building communications, a large number of applications can be supported on-the-street or within public venues by wireless Internet, voice, and 3G systems.

A company should carefully consider the mix of applications to be deployed when selecting the wireless access technologies used to deliver the applications to the end user. Just how the on-the-street and in-building access technologies will interact and support the desired applications is a primary consideration when determining the solution to the company's mobile data needs.

Wireless Voice – In-Building

For many people, cell phones come to mind when they think of wireless services. And when it comes to cell phone performance within buildings, they tend to expect the worst. What customers want is wireless performance in the building that equals the quality of service available on the street.

To meet their customer's expectations, service providers, building owners, and building management agencies are deploying in-building systems to enhance coverage and performance within private and public facilities. However, in many situations, the infrastructure that is deployed can support only a subset of the frequencies available to the providers servicing the region. Only those services provided by the service provider that owns those frequencies can be enhanced. Customers using a different provider will not experience any improvement in their in-building wireless quality.

The solution is to deploy infrastructures that enable a broader band of frequencies that support more than one service provider. These broadband solutions require additional capital investment (on the order of 10 to 45 percent), but can provide enhanced service to a larger group of users within the building. These solutions are particularly effective within public venues, where users subscribe to multiple service providers. In addition to placing and receiving calls made to their mobile telephone numbers, customers can access cellular mobile data services.

A corporate wireless subscriber has two different telephone numbers – an office number and a mobile telephone number. Equipment and/or services are available that provide single number access whether the employee is in the office, somewhere else in the building, or on the road. Making employees always reachable reduces corporate operating expenses, speeds business transactions, and increased employee productivity by reducing the number of missed calls, the time required to deal with multiple voice mail messages, and playing "phone tag."

Wireless Voice – On-the-Street

In some locations, such as tunnels, subways, malls, and sky scrapers, service providers are still developing and deploying high quality services. Many of these locations are well suited for dedicated in-building solutions. One number access to an employee is particularly valuable in this environment.

Standard Data Connectivity - In-Building

Mobile data users can access corporate servers, email, and the Internet through public or subscriber WiFi and 3G data services. These same services can be reliably accessed when dedicated in-building systems are deployed. When reliable service is available within a facility, users are once again capable of constant data communication no matter where they are in the building.

Standard Data Connectivity – On-the-Street

The deployment of dedicated in-building systems using public or subscriber WiFi or 3G data allows remote customers to enjoy high quality connectivity to the Internet or corporate servers. By making reliable service available to its remote employees, companies can potentially increase their operational efficiency and effectiveness.

RFID – In-Building

The use of Radio Frequency Identification (RFID) technology is growing rapidly. RFID uses tags and special readers to identify and track items. RFID technology is used for such tasks as inventory control, asset tracking, and to pay tolls or bills.

RFID readers can be fixed or handheld wired devices, wireless handheld devices, and wireless vending equipment. The wireless devices transmit their readings to centralized servers using WiFi or 3G data networks, depending on the specific applications, readers used, and available wireless infrastructure. The implementation of an in-building WiFi or 3G data system can support these wireless RFID readers.

Employee mobility in warehouse or factory environments can provide extensive benefits. For example, inside a warehouse, mobile employees who perform operations such as shipping/receiving, order fulfillment, forklift operations and inventory, can substantially improve their operational efficiency through constant, direct access to the corporate servers.

Figure 3 shows a multifunction, portable RFID reader that can interface with a cellular network, WiFi, and Bluetooth.

Figure 3: Multifunction Portable RFID Reader

RFID – On-the-Street

RFID technology can be used to identify items that are remote to the central system. The tags are read by remotely located readers that download the captured data to a central server either using a hard wired reader, a reader connected to a network, or a reader in constant contact with the central servers via a wireless interface.

The wireless interface allows for real time downloads of the data that could be critical for some applications. For example, real time delivery tracking allows customers, or other interested parties, to determine a package's current disposition. This information is only available in real-time if the reader is capable of immediate communication with the centralized servers.

For real-time tracking, RFID-derived date and time information is entered into the corporate tracking database when the package is loaded on the truck and when it is delivered. While in transit, location data is also tracked when GPS coordinates are available.

The wireless readers can use WiFi or 3G data networks to communicate with the company servers depending on the availability of services. As public WiFi is not readily available on the street, the use of 3G data networks provides the best transport media for real time data.

Figure 4 illustrates an RFID network that moves beyond the facility boundary. There are seven areas where mobile devices could be used. Interconnection of these locations is performed by a Wide Area Network (WAN) which can use many different types of access technologies including:

- Dedicated T1/T3 lines
- Corporate Local Area Networks (LANs)
- In-Building wireless networks
- Public and private WiFi networks
- Cellular 3G data networks

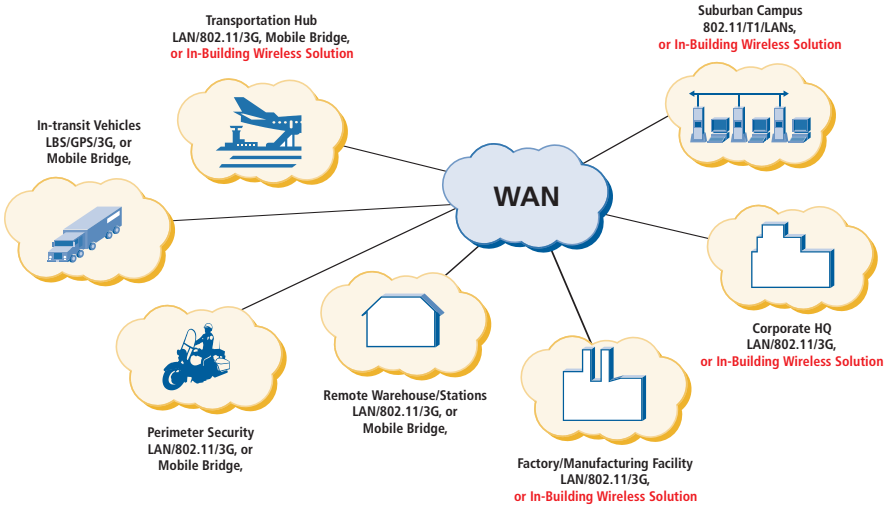

Figure 4: Conceptual RFID Network

VoIP – In Building

Voice over IP (VoIP) is usually associated with wired network services. With the introduction of WiFi networks, VoIP can now be supported wirelessly for mobile end users.

WiFi services must be deployed to support wireless VoIP within a facility. The WiFi solution must be engineered to ensure that data throughput, signal strength, and latency provide wire line quality VoIP service.

The data throughput available through WiFi services limits call capacity from an access point to a relatively small number of concurrent calls. The RF coverage of the WiFi network is directly related to the call quality achieved by the end user. Small coverage areas with strong signals and low interference are required to achieve wire line quality. Also, both wired and wireless VoIP systems need to be engineered carefully to minimize system latency and assure high call quality.

VoIP – On-the-Street

With the introduction of public WiFi services, VoIP can now be supported wirelessly on the street or within public venues. This application: expands one-number availability; provide end user call features tied to the corporate I-PBX; and minimize toll calling and cellular telephone costs.

Unfortunately, the number of locations offering public WiFi is relatively small when compared to cellular services. Also, the capacity, latency, and quality of these WiFi networks may be poor and unable to adequately support wireless VoIP. Over time, WiFi performance will improve, but, until then cellular will be the service of choice.

Applications That Bridge Facility Boundaries

New applications and hardware are being developed to help bridge facility boundaries. These applications, known as 3G/WiFi IP data roaming, help companies realize the full benefits of their wireless data applications.

These solutions allow data sessions established by mobile clients to be maintained as the user transitions between WiFi and 3G data networks. In order to provide optimum applications performance within the facility, a dedicated in-building infrastructure can be used to deliver private WiFi services. If 3G data is enhanced indoors, the added functionality of the WiFi/3G IP data roaming is not required.

In either case, implementing a data network solution that can bridge the facility boundary allows mobile user applications to be fully integrated with the centralized servers. This results in more efficient use of applications and boosts employee productivity.

Figure 5 shows several types of external networks that can be used to support corporate applications when the clients move outside the corporate LAN/WLAN environment.

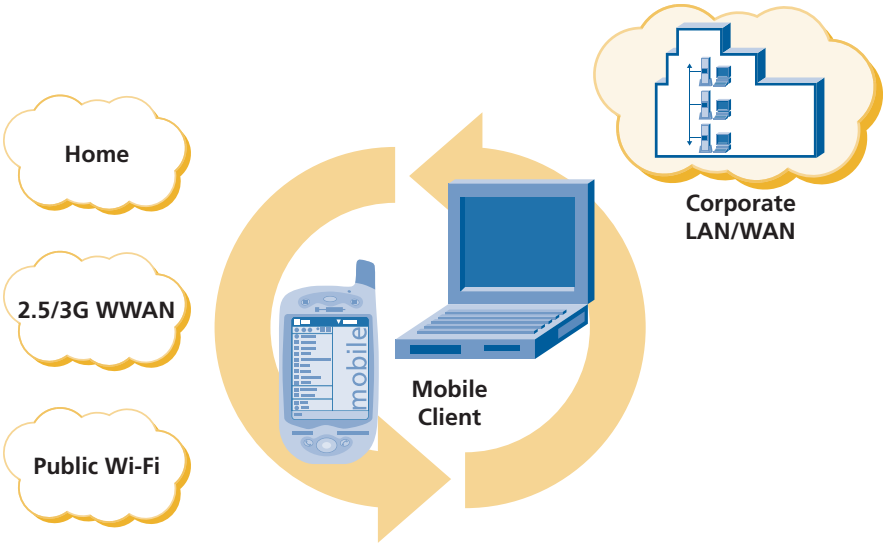

Figure 5: Roaming Between Internal Corporate and External Networks

Network managers need to ensure that their applications, applications servers, and transport mechanisms operate reliably, can be monitored, and report alarms. Any in-building infrastructure installed to deliver WiFi or cellular wireless services should exhibit the same capabilities.

These in-building systems offer network interfaces that allow system monitoring. Once connected to a network, these systems can be monitored by any computer within the corporate network or on the Internet – provided corporate security allows remote connections. Additionally, these systems can be monitored using commercially available network management systems (NMS) that use a Management Information Base (MIB) database provided by the in-building system manufacturers. The ability to integrate monitoring capabilities into existing systems streamlines operations and provides centralized operations management and monitoring. It also reduces the cost of performing these functions.

Evaluating In-Building Wireless Systems

Based on the access technologies and applications described above, there are many uses for an in-building wireless system. Each company, with its own unique mission, locations, operations and potential usage, must evaluate its own specific needs when considering this type of technological improvement.

The key to determining the correct solution is to identify the areas that will derive the most benefit from wireless connectivity, and their specific current and future requirements. This information is necessary to select the optimal mix of access technologies that will maximize the organization's return on investment. Internal operational processes will need to be rewritten to support these new technologies

Considerations include:

- Current and future business operations and their required bandwidth and latency levels
- Type and availability of mobile devices to be used
- Capital expenditures and recurring operating constraints

A carefully considered and well engineered solution will potentially deliver the best possible return on investment, while providing excellent wireless access services supporting single or multiple access technologies and a variety of applications.

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