White Paper

Driving Revenue for Mobile Operators with In-Building Solutions

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Despite the trend toward convergence in the greater communications industry, what we see in today's in-building marketplace is a highly fragmented architecture, with only nascent convergence between voice and data solutions. As licensed wireless operators become more data-centric, and unlicensed wireless data products evolve into voice platforms, there may finally be the critical mass of competition required for driving new innovation. By combining the right set of products and services, mobile operators will be able to deploy solutions that increase network usage, provide for greater uptake of new services, and discover new revenue streams from application and content providers who want to access operators' customers.

A Bit of History

Early efforts by the cellular carriers for in-building wireless revolved around the development of adjunct systems that had various levels of integration with a customer's voice platform. Although these systems, such as Panasonic's BusinessLink® and AG Communications' Roameo®, had limited success, they failed to capture enough business to sustain their survival. While they offered a fair level of integration into PBXs, the cost per user and limited handset choice eventually spelled their demise. Mobile operators then began to focus on installing systems to bring the external network into buildings. Although there was talk of enabling a new set of services for in-building through the use of the Wireless Intelligent Networking (WIN) embedded into the operator's network, very few materialized.

Current in-building technology involves multiple methods for providing voice and data coverage inside buildings. The most popular is using repeaters to bring voice and data channels into a facility from the outside macro network, and using various forms of a Distributed Antenna System (DAS) for coverage. These types of deployments meet two important goals: increasing revenue for the operator and providing connectivity for the users. However, one drawback to these systems is that they do not typically interconnect locally to the customers' voice and data networks, thus limiting IT deployments of productive services such as follow-me voice routing and constant throughput-thin client data applications.

Another popular method for providing wireless voice and data is through unlicensed products such as WLAN access points, which has seen explosive growth in the last few years. These hotspots have become an integral part of the LAN environment, and attempts are being made to add voice services into the mix. Although voice is much trickier than data in the current Wi-Fi world, progress is being made. Traditional networking companies such as Cisco are pushing hard, and are seeing some limited success.

These two approaches for solving in-building wireless connectivity for voice and data come at the problem from opposite poles. Cellular networks started with voice and added data, while the unlicensed networks provided data connectivity first. Both are faced with having to mix disparate traffic over the same network. In today's marketplace, it is unclear if one method will clearly win out over the other or whether a converged approach will take hold. Ultimately, end users will decide, and applications and end user devices will be major deciding factors. Mobile operators can seize this opportunity by utilizing recent technology advancements that can lead to high value in-building networks

In-building Applications and Segments

IT organizations continuously look for products and services that will help them meet their business objectives and out perform their competitors. The wireless industry, in all its various forms has become a large part of the corporate IT infrastructure due to its ability to provide connectivity to a rapidly increasing mobile workforce. As wireless technology becomes more ubiquitous, more is asked of it. New applications become dependent on new services from communications providers; indeed these services often times drive application growth. The efficacy of any technology is judged by how well it adapts to this changing environment.

The current topology of cellular coverage for in-building relies on the core network for the transfer of voice and data, and is somewhat application agnostic. For many market segments such as transportation, providing access to public networks and the Internet is sufficient because the vast majority of users need to connect to the outside world. One only needs to sit in an airport for a short time to see how indispensable laptops, cell phones, and PDAs are for the business traveler. However, in segments such as healthcare or corporate facilities, much of the traffic is not destined for the outside world. It is in these situations where tighter integration to existing communication networks is needed. Further, the better the fit of the underlying transport to the application, the greater value wireless services have to an organization.

An example of this is the healthcare industry, and hospital facilities represent an application-rich mobile environment. It is no coincidence that this market segment has embraced in-building wireless. Wireless telemetry services have been around for decades, leading to hospital IT departments becoming comfortable with the use of wireless communications. The pressing need for increased worker mobility has spawned the innovative use of wireless in other areas of patient care. A part of this innovation is the recent trend of more hospitals allowing the use of once banned cell phones in most hospital areas, as administrators have come to realize this service is an important part of patient care and well being. The use of a well designed and installed system obviates the interference concerns of the past. Once in place, this wireless backbone can carry mobile traffic as well as a host of other wireless technologies. Realizing this, some mobile operators have begun to forge partnerships that drive healthcare specific applications which are optimized for their networks. Future growth in this area will depend on how well carriers can continue to integrate their services to the business needs of these facilities.

Alternately, market segments such as multi-tenant commercial real estate have been slower to adapt in-building wireless. One reason often stated is that property managers and owners do not clearly see the value of providing a wireless backbone, which, for the most part, carries cellular traffic destined to the mobile operators' networks. This has made ROI difficult to calculate and often yields long payback periods. However, once the application set can be broadened to include public safety, building automation, and maintenance efficiency, the net benefit increases.

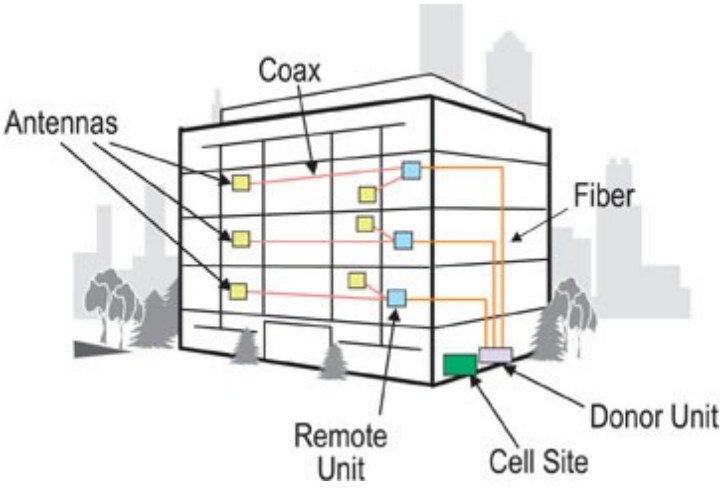
The typical experience with wireless for commercial real estate in the last few years has been the deployment of wireless LAN hotspots that are under control of each individual tenant. The familiarity with this topology and the benefits of individual system control indicates that mobile operators must avail themselves to a wider solution set then they do today. The following is a discussion of such technologies.

Backbone DAS vs. Distributed Coverage and Capacity Systems

The most common method by mobile carriers for providing in-building coverage is through a wireless DAS backbone, which can either be a passive or active system. Both approaches have their adherents, as they have different strengths and weaknesses. The typical decision factors for deciding which solution to deploy include cost, flexibility, and scalability.

Passive systems rely on coaxial cables, splitters/combiners, antennas and possibly radiating cable such as Andrew Corporation's RADIAX® to distribute signals. Until recently, these types of systems have been dominant due to their price advantage over active systems. They also represent a familiar topology to many of the system integrators in the market place that grew up using coax. These systems, once installed, are very stable; however, adding additional coverage can be problematic as the system may need a complete reconfiguration to maintain proper power levels.

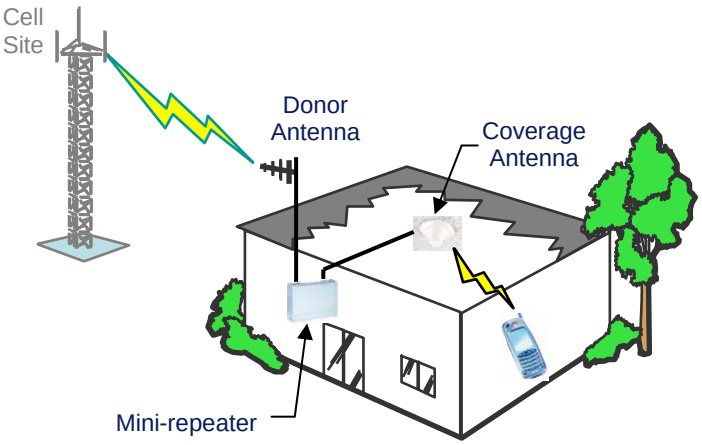
Although passive systems still make up the majority of globally deployed systems, greater growth in recent years has been in active systems. Product such as Andrew Corporation's ION™-B and ION-M rely on fiber optics for their transport backbone, and present many advantages over passive systems, particularly in larger systems. The real or perceived cost advantage for passive systems begins to evaporate in larger projects, typically over 250,000 square feet. The signal losses in passive systems begin to add significant cost for increased power amplifiers, larger cables and their associated installation costs. Active DAS systems have a distinct advantage in many technical areas including: lower noise, greater coverage and power uniformity, advanced network management and control, and scalability.



(Figure 1: An Example of a Fiber DAS)

While the backbone topology is prevalent in today's in-building marketplace, new products are coming to market that will allow for a distributed model. A distributed model is used for bringing coverage and capacity to targeted areas and customers. For instance, in a multi-tenant office building, tenants can still avail themselves to operators' networks if a building does not provide a distributed antenna network by utilizing mini-repeaters and "pico" or "femto" base stations.

Mini-repeaters are gaining momentum as a valuable coverage tool for operators. These devices are characterized by their low power, high flexibility, and inexpensiveness. Andrew recently released two lines of repeaters that address the needs of small and medium footprint deployments. The MR mini-repeater series allows for a more surgical approach to spatial coverage. Features such as auto-setup, auto-adaptation to the RF environment, and high quality filtering translate into rapid and cost effective deployments. This permits carriers to cover specific high traffic areas with pinpoint accuracy.



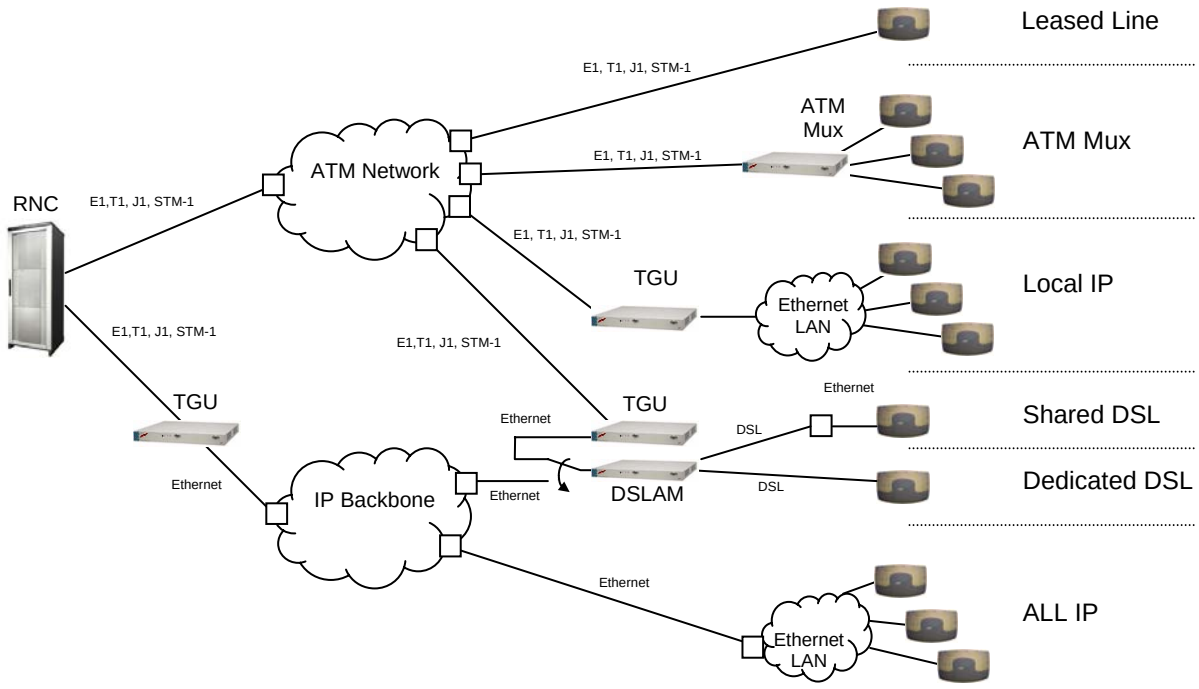
(Figure 2: A typical mini-repeater deployment)

Another distributed solution involves the use of pico base stations. Pico cells are defined as a low power (less than 1 Watt), low channel count device that provides capacity to either a DAS for wide coverage, or in the case of some products, is a fully self-contained node on a network that has transceivers, amplification, filtering and an antenna.

An example of such a product is Andrew's One Base™ Pico Node B for UMTS coverage in GSM networks. This product can provide up to 80 voice channels and a peak data rate of 14.4 Mbps in one UMTS channel. Andrew has developed a full line of these base stations, including a Femto Node B for homes and small offices. Each device has a built-in antenna and can easily and quickly be installed in a variety of locations.

The use of UMTS technology for both voice and data in in-building networks face some near term challenges. The greatest challenge is providing a wide selection of handsets that are based on successful current GSM models. This is offset, at least from an operator's viewpoint, by the greater capacity per MHz that UMTS can deliver. Further, using UMTS for in-building applications lessens the burden on the core GSM network to provide in-building channels through repeaters, and can help accelerate the migration from GSM/Edge services to UMTS. Utilizing this technology can also allow operators to provide services such as enhanced push-to-talk, which helps the ROI for in-building deployments.

These devices have overcome two barriers that have limited the deployment of small footprint base stations: price and backhaul connectivity. As the major operating expense of a cell site is the connection back to the Radio Network Controller (RNC) at the central core, traditional connections such as T-1s or STM fiber connections are often too expensive to justify deployment of a device that carries fewer calls than a typical macro- cell site. This problem has been resolved by providing Ethernet connections carrying native IP as an alternative connection type. Operators can use less expensive services such as DSL to bring the signal back to a central point for aggregation. Andrew has developed a Transmission Gateway Unit that can connect a variety of last mile technologies including DSL, ATM, leased lines, and Metro Ethernet, and concentrate them on a backbone connection to the RNC. The result is a great reduction in cost of the most expensive part, on a per bit basis, of cell site connectivity, the last mile.



(Figure 3: Pico Node B Network Connectivity Options)

Gaining More Revenue through Technology

The technology exists today to develop higher level solution sets for in-building wireless. The key is focusing these products and services towards the goal of driving more revenue for mobile operators and greater productivity and satisfaction for end users. This involves creating cost-effective models that will have favorable ROI results for both operators and their end user organizations. In some instances, the burden of ownership will fall completely on the operators; in others, enterprises will share in the investment. Thus, the hallmark of future in-building systems must be flexibility and cost-effectiveness, with a clearly defined ROI and enhanced value proposition. Industry groups such as the In Building Wireless Alliance (IBWA) and PCIA are working at defining new ROI models that can capture more benefits of in-building systems. For instance, the IBWA has constructed an ROI model that expands upon current thinking about in-building, and shows a conservative return of over eight dollars for every dollar invested for in-building systems.

The deployment of in-building systems can be categorized as public, private, and public/private. For public venues such as airports, the ROI can be understood as an increase in Minutes of Use that can translate into higher ARPU. It also has the concomitant value of increasing broadband data subscriptions and usage.

For public/private networks, the linkage between revenue and deployment becomes more difficult as softer cost justifications are used. However, the more robust the system is in

providing access to valuable applications and their underlying services, the stronger the business case. This is particularly important for mobile operators that are deploying broadband data services. With effective in-building solutions, mobile operators represent a strong and appealing alternative to other wireless technologies such as Wi-Fi, and can be used as an alternative or supplement to existing corporate wide area networks.

As operators, vendors, and enterprises work together to jointly develop unique solutions, it is more likely that the cost of some of the needed components for advanced services can be borne by the enterprise, since this permits these organizations to have greater control over areas such as security and application development. Enterprise ownership of coverage infrastructure also has the added benefit of spurring internal innovation that is focused on a company's particular needs, as they are not constrained like an operator, who must develop services and application for a wide-spread marketplace.

Integrating mobile voice and data services with enterprise legacy voice and data networks is a vital ingredient for developing targeted services and applications. For large- and medium-sized enterprises, the ideal starting point for service creation is the use of a Pico BTS, which provides voice and data capacity as well as connectivity to downstream networks. A second device consisting of a transmission gateway, voice switch, and data router is used to vector traffic to the desired endpoint, be it the mobile operator's network, a company's PBX, or the local area network. The advantage of this architecture is that it allows a user's cell phone to be mated to their desk phone, allowing features such as simultaneous ring, no answer call forward, four digit dialing, and unified voice mail. For data, this device would allow traffic destined for the LAN to stay local and not have to rely on VPN services to reach its final endpoint. This architecture also allows enterprises to utilize their Quality of Service (QOS) and security rules for each in-building wireless session.

For small businesses, the mobile operator can develop a suite of services that are network based, providing what is essentially a mobile voice and data network hosted service. Today, some mobile operators and third parties offer enhanced voice call vectoring services that extends PBX functionality to mobile devices. Broadband data services can be similarly enhanced, either through VPNs or dedicated terrestrial circuits that terminate in a mobile operator's network.

Another source of possible incremental revenue for network operators is providing content and application providers a "captive" audience as defined by users of in-building or campus- wide systems. One example of such an audience is at sporting arenas and stadiums. An operator's business partner could push content such as instant replay and statistics out to only that operator's customers in this particular stadium, creating a highly differentiated service. These types of valued-added services can be a source of revenue for the carrier from both subscribers and content providers.

Conclusions

Currently, the vast majority of in-building systems have been deployed to satisfy two distinct needs: retaining valuable corporate customers or driving more minutes of use in venues with a large concentration of network users. However, with the advent of broadband data services, mobile operators can accelerate new services offerings such as 3G voice and data by investigating, developing, and deploying in-building networks that address their end users applications. Vendors such as Andrew are rapidly developing products that can be combined to drive solutions that lead to the deployments of services that support these initiatives. By moving together, in-building systems can finally be unleashed as a way to enhance revenue and create greater customer loyalty.

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