Rethinking In-building Wireless

The ‘Consumerization’ of IT and the Emergence of the Mobile Enterprise Enabled by Mobile Operator Managed Services

The Emergence of Enterprise Small Cells

October 2012
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Executive Summary</td>
<td>3</td>
</tr>
<tr>
<td>II. Enterprise Perspective</td>
<td>4</td>
</tr>
<tr>
<td>A. Bring Your Own Device (“BYOD”): Balancing Security and Costs</td>
<td>4</td>
</tr>
<tr>
<td>B. Better Coverage and New Applications to Spur Productivity</td>
<td>5</td>
</tr>
<tr>
<td>III. Service Provider Perspective</td>
<td>6</td>
</tr>
<tr>
<td>A. Increasing Customer Satisfaction and Minimizing Churn</td>
<td>6</td>
</tr>
<tr>
<td>B. Controlling Customer Support and Capex Costs</td>
<td>6</td>
</tr>
<tr>
<td>C. Increasing Revenue Opportunity</td>
<td>7</td>
</tr>
<tr>
<td>IV. Enterprise Small Cells: A Disruptive Economic Force</td>
<td>9</td>
</tr>
<tr>
<td>V. SpiderCloud Wireless Enterprise Radio Access Network (E-RAN)</td>
<td>11</td>
</tr>
<tr>
<td>VI. Conclusions</td>
<td>13</td>
</tr>
</tbody>
</table>
I. Executive Summary

- Given the huge influx of smartphones and tablets into the enterprise, the attitude of many IT managers is changing from wireless coverage – whether over unlicensed or licensed spectrum - is someone else’s problem to where having solid, reliable, and secure wireless coverage is a core IT infrastructure issue. Wireless coverage has become a core issue to IT due to wireless devices moving to mission critical role in business operations. Devices are expected to simply work, without limitations, in all indoor locations by IT’s business users.

- Wireless data traffic continues to more than double each year, and since approximately 80% of wireless devices are used indoors, much of the increase in traffic will be generated in places where cellular coverage is poor. Therefore, both capacity and coverage continually need to be added to enterprise and other indoor environments.

- Enterprise Small Cells are emerging as an ideal solution for addressing the problem of indoor coverage for many service providers that find the economics of distributed antenna systems (DAS) for medium and large enterprises prohibitive. Small cell systems are relatively inexpensive, are easy to install, configure, and maintain, and they furthermore add new capacity to operator networks.

- Enterprise Small Cells networks are a necessary and disruptive development in the in-building wireless market.

- The cost advantage of Enterprise Small Cells over Distributed Antenna Systems (DAS) is staggering and will likely create a significant disruption to the DAS market in the coming years. While the cost of DAS can vary significantly depending on the size, type, and condition of the building or structure being covered, cost modeling conclude and interviews with service providers confirm that Enterprise Small Cell networks can be an order of magnitude—or 10 times—less expensive than a DAS with comparable coverage and capacity.

- The firm ABI Research expects that small cell adoption, as a coverage option for small-to medium-size enterprises will catch up with DAS by 2016. ABI also predicts that DAS and Enterprise Small Cell equipment revenue will each reach the $2 billion mark by 2016.

- Enterprise customers and mobile operators will benefit from the emergence of mobile enterprise services beyond basic coverage and capacity in the years to come as more opex-based cloud and applications services are offered by mobile operators and service providers in an effort to offset enterprise capital expenditures and to manage the pressure to keep up with the ‘consumerization’ of IT.
II. Enterprise Perspective

With the huge influx of smartphones and tablets into the enterprise, the attitude of many IT managers is changing from wireless coverage as being “someone else’s (i.e., the operator’s) problem” to where having solid, reliable, and secure wireless coverage is a core IT infrastructure issue. Even before the influx of smartphones and tablets, enterprises often had to simply struggle with poor wireless coverage from mobile operators let alone be concerned with capacity issues associated with the growth in usage of these new devices. The common solution to this problem, Distributed Antenna System (DAS), is often not economical for many enterprises or operators that serve small to large enterprise customers. Fortunately, a new class of Enterprise Small Cell systems is addressing the business problem of indoor coverage and capacity with improved spectrum use and managed services options.

A. Bring Your Own Device (“BYOD”): Balancing Security and Costs

The surge in the number and types of devices that must be supported and/or controlled for by IT departments is putting BYOD policies at the forefront of modern IT strategies. It is now common for business users to carry at least three mobile devices: a smartphone, tablet, and laptop. Moreover, e-readers, wireless music services, cameras, and game players can also be used to access corporate network resources and data.

Deciding which devices to support and what level of enterprise access to provide the ever expanding and varied set of devices is a key challenge for CIOs and IT departments. These groups must balance keeping support costs under control and keeping network resources secure while keeping the user base productive and satisfied.

iPad and tablet usage in the enterprise is a key emerging trend that IT managers increasingly need to address. iPads and tablets typically drive three times the capacity of a smartphone (500-600 Mb vs. 1.2-3.0 Gb) and are likely to be used for high-bandwidth and latency sensitive applications such as video.

Enterprise Small Cells, working in conjunction with corporate IT resources, can help provide the added capacity and security needed for the ever-expanding bandwidth requirements and variety of devices in today’s BYOD world. Moreover, Enterprise Small Cells can enable new applications which leverage the BYOD trend, making employees more efficient and productive.
B. Better Coverage and New Applications to Spur Productivity

With so many employees working away from their desks, ubiquitous wireless coverage is important in making workers accessible via telephony and email, as well as allowing them access to corporate information while not at their desks.

Improved throughput, coverage, and latency can enable the use of real-time data, voice, and video applications like video conferencing, as well as location-based services, thereby enabling greater communication between individuals and teams, spurring creativity, and fostering timelier decision-making.

Enterprise IT departments can save money by equipping facilities with Enterprise Small Cells. They can at long last consider phasing out desk phones and traditional PBX-based telephony systems as users are increasingly using mobile phones, softphone clients and/or over-the-top (OTT) services to access cloud-based or hosted telephony services.
III. Service Provider Perspective

Enterprise Small Cell networks offer operators an effective solution to provide high value enterprise and SMB customers with outstanding indoor voice and data coverage and capacity. This added coverage and capacity can help them maximize customer satisfaction, minimize churn, spur usage to drive users to higher tiers of service, and to provide a platform for offering new revenue-generating services.

A. Increasing Customer Satisfaction and Minimizing Churn

Coverage limitations mean that many subscribers cannot make or receive simple voice calls or access mobile data services while in the office. Providing cost-effective in-building wireless coverage has long been a challenge for mobile operators. Penetrating buildings with wireless signals from the outside using a macro cellular network is difficult because as signal strength decreases as the wireless signal travels through walls and windows, particularly at higher frequencies used by many network operators. (Of course use of lower frequencies also creates radio planning issues from interference when the radio signal propagates indoors too well). “Cell breathing”, the expansion and contraction of macro cell coverage to accommodate for spikes and changes in traffic, can exacerbate this problem by causing coverage within an Enterprise to shrink dramatically if the coverage of the macro cell covering the enterprise must shrink in order to accommodate high user demand from elsewhere in the cell.

Enterprise Small Cell systems can provide mobile operators an easy, cost effective way to offer their enterprise and SMB customers’ improved wireless coverage and capacity needed to support the ever growing base of connected devices and the thirst for wireless bandwidth.

B. Controlling Customer Support and Capex Costs

With seamless, reliable wireless coverage throughout the enterprise, service providers will likely have lower support costs due to a decrease in customer service complaints and technical service calls. Moreover, the added capacity within the enterprise premises will mean an easing of the traffic and coverage burden on the macro network thereby improving performance and increasing satisfaction for those users accessing their network outside of the Enterprise Small Cell network.

With voice and data traffic being backhauled through the enterprise, operators may be able to reduce the amount of backhaul capacity to certain macro cell sites or at least slow the growth of such capacity and delay capital-intensive network expansions.
C. Increasing Revenue Opportunity

a. Increased Revenue Opportunity from Existing Services

Better coverage within medium to large enterprise environments will drive usage and uptake of wireless services, helping to boost revenues as users move to higher tiers of voice and data services. As iPad and tablet usage continues to surge in enterprise, users will likely use these devices for video applications, further accelerating bandwidth demands.

b. Mobility, Application, and Cloud Services (MACS)

Beyond the benefits of enterprise small cell networks in customer satisfaction, reduced churn, and cost savings on the macro cellular network, they allow service providers to offer their enterprise customers cellular and WiFi as a service on top of the mobile services they already purchase. Via MACS, service providers can help enterprises minimize the amount of capital expenditure (capex) they dedicate to wireless, including wireless LAN (WLAN), and allow them to offer pay-as-you-grow services. Via MACS, service providers and their affiliated partners can offer mobile device management along with consulting, implementation, and management of wireless security and BYOD policies.

MACS could also include fixed-mobile convergence (FMC) services where employees would have the convenience of a single handset, address book, and messaging system. Previously, most of these services would be based on the enterprise premises. With MACS, enabled by an Enterprise Small Cell network, these functions can all reside in the service provider’s cloud network. Enterprises in turn can then look to remove desk phones for mobile workers and lower their fixed-line telecommunications expenses.

MACS will also help to control device and service proliferation. With an Enterprise Small Cell network, employees do not have to guess or choose their wireless service based on which operator provides the best coverage in their particular building or floor.

Via Enterprise Small Cell networks that include integrated WLAN functionality, a service provider can begin to offer its enterprise customers outsourced WLAN management and support. Seamless, consistent, and coordinated security, access and control policies—regardless of wireless access technology—vital for enterprises and mobile operators as more dual Wi-Fi/cellular devices are adopted inside the mobile enterprise.

An Enterprise Small Cell network can also enable service providers to offer services based on location and/or presence. Network access and applications can be customized based on a device’s location, and employees can manage their accessibility (for example, when in a laboratory or conference room, delivering all communication to voicemail) based on their location or presence.
c. Increased Revenue Opportunity from New Services

Enterprise Small Cell networks will also provide a platform for offering new business services. Rich Communication Suite (RCS) is starting to be introduced as a consumer service by operators as a way to compete against over-the-top (OTT) service offerings. Operators can begin to offer enterprise customers their own, internally branded RCS-like offerings, allowing the enterprise user base to take advantage of the latest messaging and communications applications while remaining secure as they leverage and access corporate network resources and databases.
IV. Enterprise Small Cell Systems: A Disruptive Economic Force

The cost advantage of enterprise small cell systems is significant compared to DAS and will likely cause a large disruption to the DAS market in the coming years particularly as Enterprise Small Cell solutions mature and become even more economical.

Operator feedback confirms that the cost of an indoor DAS can vary widely depending on the size, type, and condition on the building or structure being covered. Cabling can account for half to three-quarters of the total cost of the DAS system. In contrast, Enterprise Small Cells use standard Ethernet cabling and do not require the expensive and inefficient conversions from optical to electrical signaling of Active DAS.

Self Organizing Network (SON) systems that self-optimize the radio access network, make configuration and system operation easier than with DAS systems, which, by contrast, typically work with multiple carriers and multiple frequencies and therefore require significant amounts of RF planning, tuning, and optimization. Such specialized services are expensive and can typically take many months to complete. By contrast, Enterprise Small Cell systems can be “plug-and-play” and are comparable to enterprise WiFi installations with the SON to optimizing coverage, capacity and centralizing management.

The cost of coverage for a DAS can vary significantly based on a number of factors. Industry feedback indicates that the cost alone of an indoor DAS system can range between $1.00 and $5.00 per square foot with much of the capital cost (Capex) being comprised of cabling, planning and approval cycles. This does not include the cost of the signal generating equipment or radio frequency (RF) of the BTS or Node B nor the continued cost of operations (Opex)

Assuming a 431,000-square-foot coverage area (40,000 square meters), then the cost of a DAS system would be between $431,000 and $2.2 million. Assuming the cost per square foot is toward the low-end of the range, or $2.00 per square foot, and then the cost of a DAS system without the RF and baseband (i.e., BTS or Node B) would be nearly $862,000.

In contrast, for an enterprise small cell system, it would take approximately 65 SpiderCloud Radio Nodes (SCRNs) in order to provide the same coverage of the DAS mentioned above at a cost of approximately $0.25 per square foot or less than $100,000.
A WCDMA service provider with an indoor DAS would need to purchase 16 carrier sectors, with each carrier sector being able to accommodate 64 voice channels, in order to provide a comparable system capacity. The cost of a WCDMA carrier sector including RF and baseband to accommodate 64 voice channels is approximately $7,000. Thus the total cost of the Node B capacity would be $112,000. With an enterprise small cell network, RF and baseband capacity is included in the cost of the Radio Node so there is no incremental cost for providing the source capacity.

Cost Comparison: Indoor DAS versus Enterprise Small Cells

<table>
<thead>
<tr>
<th>Description</th>
<th>Indoor DAS</th>
<th>Enterprise Small Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base System Cost per Square Foot</td>
<td>$1.00-$5.00</td>
<td>$0.20-$0.50</td>
</tr>
<tr>
<td>Signal (RF+Baseband) Cost per Channel</td>
<td>&gt;$100</td>
<td>$0 (included in above)</td>
</tr>
<tr>
<td>Installation Time</td>
<td>Weeks</td>
<td>Days</td>
</tr>
<tr>
<td>Installation Expertise</td>
<td>Specialized/Trained</td>
<td>General</td>
</tr>
</tbody>
</table>

Note: In the table above, “base system cost” consists of all hardware, including antenna, cabling, cabinets, access points, and service nodes, plus related software and installation.

The total equipment cost of the DAS solution in this scenario would amount to $971,000, while the cost of the small cell systems would be $100,000 to $125,000 or 85% less expensive in equipment costs alone. When the costs and time involved in RF planning, installation, and optimization of a DAS system are factored in compared to the Wi-Fi-like planning and installation of an enterprise small cell network, the cost difference becomes even more staggering.
V. SpiderCloud Wireless Enterprise Scalable Small Cell RAN for Enterprise Deployments

SpiderCloud Wireless is a Silicon Valley pioneer in developing small cell or Enterprise RAN (E-RAN) solutions and a managed services platform for scalable indoor deployments for medium to large enterprise customers and large venues. The systems are now commercially deployed after several years of development with Vodafone. The Multi-Access Small Cell RAN system is powered over Ethernet and delivered and managed by mobile operators. The system offers a reliable and cost-effective indoor mobile access (3G/LTE and Wi-Fi) services solution for any enterprise or venue customer.

SpiderCloud Wireless products and architectures provide the following advantages that make it a strong fit for any size Enterprise Small Cell system deployments:

**Improves quality of experience for users on the macro cellular network**
As users and usage are offloaded from the macro network onto the dedicated Enterprise RAN, capacity and resources are relieved from the macro network to better serve users outside of the enterprise premises. The need to expand the macro cellular infrastructure is reduced because there is less of a need to deploy new cell sites and radio network controllers (RNCs) because the SpiderCloud Radio and Services Nodes provide this functionality and capacity.

**Managing interference between small cells using soft handover**
All SpiderCloud Radio Nodes operate on the same 5 MHz-wide 3G channel (unlike so-called “small cell grids” that use two 5 MHz channels). Rather than inventing a new method for managing interference between Radio Nodes, SpiderCloud Services Node (SCSN) enables the same, proven, technique that is used in the macro-cellular networks: soft handovers. Mobile devices connect to multiple Radio Nodes at the same time, assuring seamless handoffs as the user moves across the building or across the campus.

**Ensuring seamless mobility inside the building**
Soft handovers, along with SpiderCloud’s automatic RF management and neighbor list assignment algorithms, enables seamless mobility inside buildings. Commercial systems deployed by SpiderCloud, with thousands of subscribers on multiple floors, meet the demanding network KPI’s of mobile operators.

**Managing mobility between small cells and the macro cellular network**
When a mobile user walks inside a building, their mobile device detects the small-cell system automatically. The SpiderCloud system self configures to work as a part of the macro network and to allow seamless handovers to and from the macro network.

**Optimizing backhaul traffic across the E-RAN**
SpiderCloud’s Services Node (SCSN) locally handles signaling for inter Radio Node handovers and management of radio nodes. The SCSN then consolidates all the traffic, marks it for QoS, and sends it over dedicated or shared IP backhaul to the operator’s core network.
Single IPSec tunnel links enterprise to service provider’s core
SpiderCloud E-RAN system deployment establishes a single tunnel to the operator's core network via the Services Node. That is in contrast to clusters of Femto Cells, where multiple Femto Access Points (AP) are located inside an enterprise and APs have to establish IPSec tunnels to a core-network gateway, forcing the enterprise to open firewall ports across dozens of routers in the enterprise.

A scalable method to create “white” lists
Businesses that invest in an in-building system want it to give higher priority to their employees. Doing so requires creating a “white list.” Manually adding a white list of thousands of subscribers and dealing with adding and removing employees is time intensive and an operational burden. SpiderCloud offers a method to create this list using the enterprise’s existing global directory. Now, an employee from a large bank’s New York office (for US customers of a mobile operator) can arrive at their London office which has a SpiderCloud system deployed and serviced by a UK operator and receive priority access, provided appropriate international operator agreements are in place.

Switching packet data to the enterprise’ Intranet (or “local data switching”)
Though many small cell companies talk about offloading wireless data traffic to the Internet, doing so is not straightforward in an enterprise environment. Before traffic can flow through the enterprise’s network, a mobile device needs to authenticate with the enterprise’s AAA system. Mobile subscribers expect a 'no-touch' mobile experience as they move around a building. SpiderCloud’s E-RAN system provides local data switching and IP session continuity to assure seamless roaming between Radio Nodes and the macro network.

Enterprise-friendly installation
SpiderCloud Radio Nodes are powered-over-Ethernet and thus require only one cable pull. DAS and picocell solutions, by contrast, often require special RF planning, engineering, and optimization and installation by trained technicians; deployment and optimization can take weeks. Enterprise small cells, on the other hand, can be installed on ceilings, above the plenum and auto-discover the services node with no required manual configuration. Therefore, installation takes days instead of weeks as described above.

Because of this ease of installation, Enterprise Small Cells can be distributed via value-added resellers without expertise in planning, deploying and optimizing DAS systems. These resellers can offer service providers new channels that likely have existing enterprise relationships.
VI. Conclusions

Given the continual growth in mobile data traffic combined with the influx of mobile devices into enterprise environments, more coverage and capacity is needed to assure high quality wireless services.

Enterprise small cells represent a significant opportunity for service providers to not only improve customer satisfaction and reduce churn both inside and outside of the enterprise but also to have a platform to provide mobility, application, and cloud services that will enable them to grow revenue and to address the threat of over-the-top (OTT) services.

The key question is not whether or not Enterprise Small Cell systems are needed. Rather, the questions concern their economics: Can Enterprise Small Cell systems be inexpensive enough to purchase, install, and operate? Can they grow in size and density while providing seamless handoffs, at the same time conserving spectrum resources sufficiently to justify the investment? Increasingly, the answer is “Yes.”

Enterprise Small Cells represent a dramatic improvement in cost over DAS, both in terms of capital and operational costs. Given the prevalence of Ethernet connections in enterprise networks, backhaul is less of an issue for Enterprise Small Cell systems than for DAS. Recent innovations in radio technology and in self-organizing networks have enabled significant improvements in installation and operational time and expense.

SpiderCloud Wireless is at the forefront of defining the enterprise small cell market, making the systems possible from both a technical and economical perspective. The company is thus very well positioned to capitalize on this emerging, multi-billion dollar market.
ABOUT EXACT VENTURES
Exact Ventures is an independent market intelligence firm that creates unbiased, enduring benchmarks for measuring market shares and understanding and quantifying market transitions and market opportunities. Current research areas include: NGN Voice and IMS Core, Wireless Packet Core and Evolved Packet Core, Diameter Signaling Controllers, Small Cells and WiFi.

Exact Ventures offers market intelligence with greater depth and context than traditional, static silos of market data. Exact Ventures’ research combines both supply- and demand-side market intelligence and analytics and highlights the economics underlying emerging and transitioning markets and technologies.

GREG COLLINS,
Founder & Principal Analyst
Greg Collins is a technology analyst and strategist with extensive experience in creating innovative, highly analytical and enduring market segmentation and research practices in technical networking, telecommunications, and wireless markets. Greg founded Exact Ventures in 2011, in order to provide market intelligence and analytics for emerging and transitioning technology markets.

Greg was an industry analyst with Dell’Oro Group from 1998 to 2011, during which time he created and/or managed approximately half of the company’s research. He created the company’s coverage of the Layer 3, Layer 4/7, and 10-Gigabit Ethernet markets, and created market research practices covering the Wireless LAN, Mobile Infrastructure, IP Multimedia Subsystems (IMS), and Wireless Packet Core markets. All of these programs were at the forefront of market research and became standards for quantifying market shares and understanding technology shifts.

Greg is a frequent speaker at industry events worldwide, contributes articles to various industry publications, and is often quoted in leading trade and business publications. He holds a BS in Economics from Carnegie Mellon University and an MBA in Finance and Marketing from Washington University in St. Louis.