



# Distributed Antenna Systems (DAS) in Mid-Tier Markets

**A Primer for Establishing In-Building Mobile Networks**



# Content

**Introduction**

**The Changing DAS Landscape**

**DAS Growth and Forecast**

**DAS – Complementary to Macrocells, Not a Replacement**

**DAS' Role in the Customer Experience**

**The Internet of Things and Proliferation of Devices Across the Ecosystem**

**New Funding Models**

**Embracing Convergence**

**DAS Goals and Communications among Stakeholders**

**Who Pays for What?**

**Conclusion: Structuring the Deployment**

**About the Authors**

**Distributed Antenna Systems (DAS) in Mid-Tier Markets:  
A Primer for Establishing In-Building Mobile Networks**

This white paper is meant to be an educational tool and does not reflect Wireless Infrastructure Association policy.

# Introduction

The in-building wireless industry has seen a fundamental shift in the market for Distributed Antenna Systems (DAS) over the past 24 months. An ever-increasing ecosystem of integrators and solution manufacturers are meeting market demand.

Tier-one venue opportunities (including sports stadiums, entertainment facilities and other indoor venues averaging more than 500,000 square feet) have slowed. These venues, however, represent only about 30 percent of the in-building market for wireless infrastructure deployments. Mid-tier venues are now emerging as the biggest growth area for DAS deployments. These mid-tier venues range in size from 100,000 square feet to 500,000 square feet and represent every imaginable vertical, structure design and ownership model.

There are strong and sound arguments to deploy DAS solutions in these venues: DAS provide both a data and voice capacity for carriers and an enhanced experience for venue patrons. Nonetheless, there are significant barriers to overcome.

Deploying these systems is expensive, and carriers for the most part are unwilling to fund the vast majority of mid-tier market buildout. Affordability, ease-of-ownership, positive Return on Investment (ROI) and flexible/future-proof technologies are becoming mandatory. The in-building ecosystem is adapting new and creative approaches from an investment standpoint, as well as new technologies that embrace convergence.

All of this suggests a solid ROI for mid-tier DAS as the next chapter of in-building wireless communications. It also builds a case for why some mid-tier enterprises might be well suited to creating their own DAS networks, working cooperatively with other stakeholders and prospective partners.



# The Changing DAS Landscape

In the past, carriers often wanted to build and own their DAS deployments. Now, however, carriers are comfortable with sharing neutral-host systems owned by third-party operators. Third-party operators invest upfront capital needed to build the deployment and manage the deployment, taking some of that burden away from carriers, and the shared model is more economically efficient.

As with any new business opportunity, U.S. carriers and infrastructure providers initially viewed DAS deployments as a “land-grab.” They sought to buy a competitive advantage by investing in designing, building and launching these networks. These tier-one deployments required huge capital budgets. The sheer number of locations that needed DAS-based coverage and capacity extensions made the economic case of “going it alone” harder to justify.

Over the past five years, carriers have become more receptive to a funding model that shares the capital expenditure of these buildouts with neutral third-party host partners, ensuring access to prime locations. While these neutral-host systems are owned by third-party providers, the carriers still have a high degree of control over ongoing radio network optimization and operations, which is critical for the user experience and quality performance of their networks.

## DAS Growth and Forecast

Through 2020, the mid-tier market is likely to see the highest rate of in-building DAS growth, eclipsing tier-one office buildings, stadiums and concert halls. According to one industry report (Figure 1), retail spaces and mid-tier commercial spaces will see the highest percentage of DAS growth over the next five years.

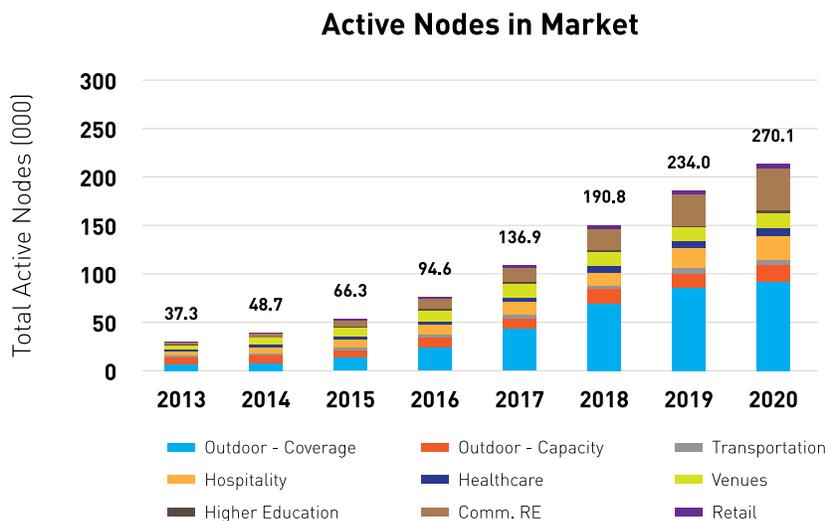


Figure 1

Source: Digital Bridge Holdings

## Why such growth?

As mentioned earlier, the first wave of DAS networks focused heavily on the tier-one market. The carriers targeted these locations to meet peak capacity needs during events, and to serve high-profile corporate accounts that demanded ubiquitous and uninterrupted high-quality coverage inside their office spaces. (During the last recession, property owners also learned that having a strong wireless signal was a competitive advantage to either attract new tenants or maintain existing ones.)

Then came Apple Inc.'s iPhone – and the subsequent explosion of data usage across all classes of wireless subscribers. Continuous, reliable coverage and capacity in all types of commercial, retail and public venues is now directly linked to user experience key performance indicators as competitive differentiation among carriers.

## DAS – Complementary to Macrocells, Not a Replacement

It's important to note that DAS networks (along with other wireless applications and access technologies) are a complementary solution to macrocellular sites, and not a replacement. Over the last 10 years, economic, regulatory and operational concerns have prompted wireless carriers to look for complementary wireless technologies and solutions that would reduce their need to deploy macro sites and installations on towers. With each technological advance in wireless radio networks, however, subscriber growth, changes in user behavior and user expectations have only increased the need for more macro sites deployed on towers and rooftops.

For example, wireless network performance is severely stressed by growing data usage and the dense penetration of always-connected smartphones and devices. As a result, providers have had to shift their focus from simply providing enough indoor coverage for voice calls to enabling wireless subscribers' growing demand for bandwidth-intensive data applications. DAS and small-cell deployments are clearly emerging as complementary solutions to the existing macro-cellular networks.

Nonetheless, Figure 2 shows how both more macrocellular sites and small cells will need to be deployed to keep up with demand.

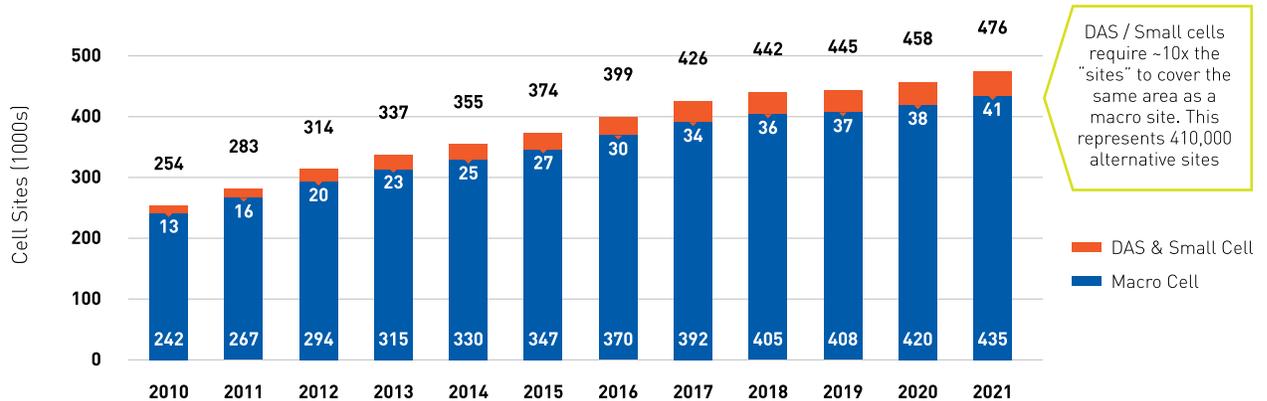


Figure 2

Source: Digital Bridge Holdings

The sheer number of small sites required to cover the same area as a macrocellular site means that these DAS solutions are unlikely to replace larger alternatives. DAS networks have simply become an integral and critical component of today's integrated heterogeneous network architecture.

That's not to say that DAS does not have a unique place alongside macro networks, however, as seen in the next section.

## DAS' Role in the Customer Experience

While customers expect ubiquitous high-quality voice coverage, increased use of data and video-driven applications have redefined the roles of roles of DAS systems. Wireless networks must now include capacity relief and higher bandwidth as an extension of the macro networks. Consequently, DAS has evolved to become more than a solution for indoor network coverage for voice calls. These systems provide capacity and increased bandwidth to support higher data speeds, low latency and improve the overall customer experience.

The wireless industry has been working to keep pace with the growing demand for more bandwidth and increased data usage for high-speed applications by deploying LTE standards and the upcoming LTE-Advanced (LTE-A) standards. Relying on macrocellular networks alone could not meet the demands of the last generation of applications, let alone the newly defined classes of services included in LTE-A.

This further emphasizes the need for the deployment of DAS networks to accommodate the user demands for such services in homes, offices, stadiums, airports and high-rises.

## The Internet of Things and Proliferation of Devices Across the Ecosystem

Today's wireless networks consist of not only licensed spectrum networks but also a massive deployment of private and public Wi-Fi networks. In a typical day, a device can be connected to the Internet via its land-based IP network in the office, the office Wi-Fi network in the conference room, to the external macrocellular wireless network in the parking lot.

The Internet of Things (IoT) aims to further expand the penetration of wireless chips and identifiers in many devices to enable machine-to-machine wireless communications. The proliferation of connected devices across the indoor and outdoor networks will require exceptional intersystem coordination in order to provide a satisfactory customer experience. These developments will further drive the integration of indoor DAS networks in the hierarchy of heterogeneous networks to provide seamless access to high-quality networks.

## New Funding Models

Today many buildings need DAS. The question is who will fund the networks and how specifically will they will finance them?

The most profitable deployments for carriers and neutral-host solutions are the large venues, office buildings, colleges and so on. They do not historically have an ROI model that accommodates a medium- to small-sized facility. In some cases, however, a joint funding model might help a carrier move a project forward. A business must be certain to balance the need for enhanced wireless communications with the needs of the business and the service to its customers.

There are three main funding models for providing enterprises with DAS. First, the enterprise can access internal funding from the company itself, if it exists; the enterprise could contract with a neutral-host company; or the enterprise could obtain funding from cellular carriers.

Each model has advantages and disadvantages.

## Self-Funded

Self-funding a DAS network requires both capital and operating expenses. In addition, a cellular carrier agreement is required for an RF signal source or carrier Base Transceiver Station (BTS). Fortunately, traditional base stations are steadily declining in price and are more scalable for medium-sized facilities.

As a rule, it is recommended to install twice as much fiber as the design requires. The incremental cost of pulling in additional fiber is relatively small and it enables “future-proofing,” assuring that the infrastructure can accommodate future technology advances.

## Neutral Host

Contracting with a third-party, neutral-host provider can be a viable and attractive option. These long-term engagements reduce the upfront capital expense of the self-funded model.

Depending on how the agreements are structured, however, they may add to the property’s operational expense. Additionally, this model will transfer the efforts of upfront and ongoing carrier coordination – as well as ongoing management efforts – to the neutral host.

A neutral host typically will provide coverage for multiple carriers and will benefit properties that require multiple carrier access. Creative agreements and contracts will need to be explored to ensure clear understanding of ROI. The neutral host should structure deployments that create revenue streams from property owners, carriers and possibly larger building tenants.

## Carrier Funded

Cellular carrier funding makes a wireless system affordable for an enterprise, as long as it offers an acceptable ROI for the carrier. Medium-sized facilities often do not provide enough of an ROI. It’s rare to have all four major carriers join a system, even for the largest venues. That can make it challenging to set up a reliable network in a carrier-funded model.

In some cases, an enterprise may find that mixed model funding is the best way to deploy a DAS network, using different models to fund the active and passive portions of the DAS, the RF signal sources and Wi-Fi requirements. As the market develops, however, this mixed funding approach may become more complex, with tenant funding, potential monetization options and even public safety emerging as requirements behind shared funding models.

# Embracing Convergence

The recommended method to scale investment in a DAS network and to realize an adequate ROI is to embrace convergence. Convergence refers to the provision of wireless, telephone, video and data communications services within a single network. In other words, one transmission facility is used to deliver all forms of communication services.

The primary objective of network convergence is to deliver better services at a lower cost of ownership to the enterprise. Users are able to access a wider range of services and choose among more service providers. In addition, convergence allows service providers to adopt new business models, offer innovative services and enter new markets.

Fiber is an excellent platform to enable all of these technologies. Services that can be “converged” onto IP and fiber include:

- Cellular
- Wi-Fi
- Building control systems
- Digital signage
- Location-based services
- Sensors and beaconing applications
- Public safety radio
- Point of Sale systems

In terms of ROI, DAS, Wi-Fi and the resulting applications may create new sources of revenue and a faster way to deploy new services for the property owners. Revenue will be derived from new services that can be offered to guests, patrons, renters and visitors, or used by on-site service personnel. In addition to the new services, contextually and location-aware applications (when combined with beacons, sensors and access points networked to the DAS) will open up a path to new revenues from suppliers, marketers, advertisers or customers.

Historically, these systems have been deployed separately, each one demanding significant financial and other resources. Converging these technologies onto a common infrastructure will result in a better ROI for the mid-tier facility.

A common infrastructure can provide the platform for a host of services and technologies, reducing the labor associated with deploying each one individually. An enterprise should consider spreading the infrastructure cost over multiple disparate technologies within the facilities on a common platform.

# DAS Goals and Communications among Stakeholders

The primary goal of a DAS system is to provide a cost-effective, seamless wireless coverage solution for an enterprise that meets or exceeds current and future demand for voice, messaging and data services, while maintaining adequate control of operational costs. Once deployed, the system must be maintained to ensure efficiencies moving forward and to maximize the potential ROI.

The second goal is to build an integrated system that is scalable and capable of supporting future technology requirements. This is accomplished by establishing secure and efficient communications protocols between hardware and software vendors, operators and service providers. Doing so makes it easier to implement cost-effective operations and maintenance plans tied to such functions as:

- Environmental compliance
- Safety compliance
- Preventive maintenance
- Work orders
- Trouble tickets

With the current demand and forecasted explosion of data usage, more companies are involved in the deployment. As such, everyone involved in the deployment must communicate with each other in a timely manner.

There is also a rapidly increasing need to streamline data sharing and workforce-collaboration communications between network operators and vendors. With the deployment of an electronic interoperability data exchange, the industry can significantly lower operational costs, record information and automate communication within heterogeneous networks.

In communication among stakeholders, the ultimate goal is to route specific network information to the relevant party (vendor, service provider or OEM) for appropriate action. For example there is a need to: standardize “Alert” and “Alarm” priority terminology and ranking between vendors (alarm, alert, ticket). There is also a need to implement an operations and support plan and maintain a four-hour resolution window.

<b>Alarm</b>	<b>Alert</b>	<b>Ticket</b>
Service Outage	= Critical	= High Priority
Service Risk	= Major	= Medium Priority
Action Needed	= Minor	= Low Priority

This enables easier identification of trends that become actionable.

An electronic interoperability data exchange also can improve communication, map fields and disseminate time-sensitive record information. This will significantly reduce operational expenses and improve operational efficiencies, while protecting investments for the future.

## Who Pays for What?

Traditionally, deploying the tools for in-building wireless coverage has fallen into two camps. Cellular coverage has been the wireless carriers' domain, and the wireless local area network (WLAN) belongs to the enterprise. This made perfect sense because enterprises were carrier customers and WLAN users were the enterprises' customers. Each group paid for their own networks to be deployed.

Today, those responsibilities are changing. The enterprises' customers are demanding connectivity to the cellular network in addition to the WLAN. While carrier-funded cellular deployments still make up the bulk of DAS installations, the enterprise is emerging rapidly as a deployment engine.

There are very good reasons why enterprises should consider building their own DAS networks. First, cellular coverage is now increasingly important to the enterprise both for its own use and for use by customers. Good cellular coverage can be a differentiating factor among similar properties whether the property is a hospital, hotel, school or office building. Second, the enterprise knows its coverage and capacity needs as it gets feedback from tenants and customers.

Using that knowledge, converged networks can be utilized to dramatically lower the cost basis and cable load in the building for multiple IT-supported systems including security, WLAN, structure cabling and building controls. This converged physical layer network can reduce money spent, space used and time spent on troubleshooting and repair.

With an enterprise-built DAS in place, the carrier only needs to fund the RF source and its operation expenses. This dramatically reduces the carrier's cost of coverage and makes it possible to fund many more sites with the available capital. The enterprise can have dedicated capacity and the carrier has more incentives to support deployment.

# Conclusion: Structuring the Deployment

Armed with the information included in this paper, building owners can begin to architect their DAS solution. From the building owners' perspective, the task initially can appear arduous and complicated.

However, today we are in the early stages of wide-spread enterprise DAS deployments. The key to success is found in the creativity of the market space. Building owners will need to look beyond their current business models and recognize the value wireless connectivity adds to their properties and their occupants' experiences.

Carriers and third-party providers also must look to scale and develop models that generate revenue and enhance the coverage and capacity of their networks. Finally, systems integrators and in-building wireless OEMs will need to continue to leverage the success of DAS technology deployed in the tier-one market and deliver scalable, lower-cost technology to meet both cellular and public-safety network requirements.

# About the Authors

## **Bernard A. Borghei, Vertical Bridge**



Bernard A. Borghei is Senior Vice President of Operations and one of the Co-Founders of Vertical Bridge, the largest private owner and operator of wireless communications infrastructure in the United States.

Prior to co-founding Vertical Bridge, Mr. Borghei served as Senior Vice President and partner at Global Tower Partners, the largest privately-held tower company in the United States, where he oversaw domestic and international market operations, including over 6,500 towers and 12,000 managed properties.

With over 22 years of experience in the telecommunications industry, Mr. Borghei has held executive and senior management positions of increasing responsibility in operations, engineering, sales, supply chain, site development, and customer care. He had held positions with wireless operators and service providers including SkyBitz, Wireless Facilities, Inc., Western Wireless International, and Triton PCS, successfully running operations across 24 different countries in Europe, the Middle East, Africa, North and South America.

Mr. Borghei earned a Bachelor's degree in Electrical Engineering from Villanova University and an MBA in Global Management from the University of Phoenix.

## **Scott Gregory, SOLiD**



Scott Gregory is Marketing Director at SOLiD. He has more than 20 years of telecom experience supporting Value Added Resellers (VAR) and carrier ecosystems and technologies from legacy infrastructures to today's wireless networks. He has held marketing and management roles within notable companies such as ADC Telecommunications, SPIRENT, and TESSCO Technologies. Today Scott is focused on advancing the "Middleprise" in-building wireless market for public cellular and public-safety applications.

## Ray Hild, Kavveri Telecom



Ray Preston Hild is an accomplished senior management and business development professional with over 23 years of experience working in the wireless industry. He has consulted on several initiatives including unified communications, interoperability, and wireless broadband solutions for large government, healthcare, hospitality, higher education and enterprise firms.

Ray has held management and leadership positions with several prominent corporations over the years. Those include Sprint-Nextel, Corning, Galtronics and Kavveri Telecom. He has won several awards for service and performance. Some are: President's Council 14 times, The CEO Award, Public Sector Distinguished Service Award, FBI Service Award post 9-11.

## Jeff Pokonoshy, Kaipac



Jeff Pokonoshy is CEO and Co-Founder of Kaipac, a leading provider of Network Operations Intelligence and Interoperability Data Exchange software solutions for the wireless industry, enabling workforce collaboration between network operators, tower companies, DAS providers, integrators, vendors, and service providers. Kaipac streamlines the sharing of time-sensitive, proprietary data related to network operations including, site location search, project builds, asset management, state and federal regulatory compliance and operations and maintenance. Jeff has 25+ years of experience in the wireless industry as an entrepreneur, inventor and business marketing executive with Qualcomm, Nokia Mobile Phones and SBC.

**Distributed Antenna Systems (DAS) in Mid-Tier Markets:  
A Primer for Establishing In-Building Mobile Networks**

This white paper is meant to be an educational tool and does not reflect Wireless Infrastructure Association policy.

# Wireless Infrastructure Association

WIA.ORG