idDAS

Bringing intelligence to coverage provision

Author: Ingo Flömer

White Paper – June 2015

The most important thing we build is trust

idDAS: Bringing intelligence to coverage provision

Executive Summary

Wireless telecoms services are now considered a mainstream utility around the world following years of investment by operators to ensure robust ubiquitous coverage. However, despite these large-scale infrastructure deployments coverage provision indoors and for high-density venues still proves extremely challenging, and the situation is becoming worse as reliance on data services continues to increase.

Distributed Antenna Systems (DAS) has long been seen as an excellent solution to the problem, but in some markets deployments have been held back by issues including cost and the changing needs of operators. The problem is particularly acute in large multi-purpose venues with extreme usage peaks and troughs.

By developing an intelligent DAS - idDAS -, Cobham Wireless has created a robust solution that allows operators and infrastructure providers to dynamically move capacity around a building or area to serve a number of needs, reducing both CAPEX and OPEX.

This White Paper outlines the problems the industry faces in the provision of high-density capacity in challenging environments and how, by using intelligent DAS, the economics and techniques of coverage provision change for the benefit of operators, venue owners – and ultimately service users.

Why read this White Paper?

Cobham Wireless has a 40 year history of providing market-leading DAS solutions to the cellular and critical communications industries and, following ongoing investment from parent company Cobham, has developed the world's first intelligent digital DAS solution.

Its products have been used in some of the most challenging and prestigious venues around the world including: The Pentagon, The new World Trade Center, Heathrow Airport, The Burj Khalifa, The Channel Tunnel and Nelson Mandela Square in South Africa. Cobham Wireless was also instrumental in the deployment of the world's largest DAS project at the London 2012 Olympics, where the network provided seamless cellular coverage for spectators, athletes, officials and media across the Games venues.

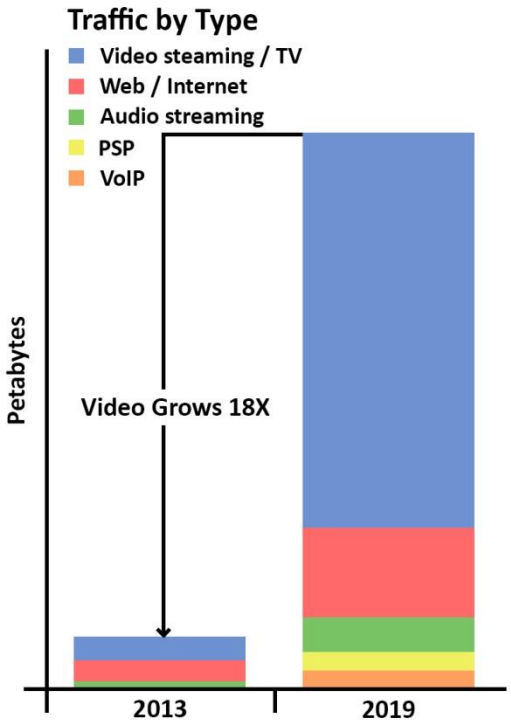
Its work with facilities owners, managers and the world's largest mobile operators puts Cobham Wireless in an unparalleled position to discuss indoor coverage needs across the world in 2015 and beyond, including how intelligent DAS solutions can revolutionise the provision of robust coverage in the most challenging environments.

Breaking down the coverage walls

Building materials old and new provide a range of issues that inhibit the propagation of indoor cellular coverage. From RF-blocking stone and marble to modern structures made of reflective materials, getting signals inside from masts outside has always been a challenge.

This was difficult enough for basic voice and SMS services, but now data usage has also become widespread, providing patchy coverage anywhere on the network is simply not accepted by end users and businesses. Poor signal quality has a direct effect on the network capacity and reduces data throughput dramatically. Seamless four-bar data coverage is therefore central to the user experience, and to high data rate throughput. However, this desired four-bar data coverage is still lacking in a large range of venues, including train stations, large office facilities, airports and stadia. Consumer demand has forced indoor coverage to the top of the priority list for telecommunications firms and facilities managers alike, and in order to enable services in these venues, increasingly sophisticated methods are required.

Rewind five years and the main challenge for carriers was how to extend coverage into venues to allow subscribers to use basic voice and messaging services. With the widespread proliferation and demand for mobile data services, this need has now evolved away from basic coverage towards the provision of adequate capacity to allow bandwidth-intensive services, ranging from email and social media, to secure enterprise apps, cloud server access and HD video calling.



Source: ABI Research

This has become a pressing issue. Whenever network connection is inadequate, subscribers become frustrated and blame either their mobile network operator or the managers of the facility they are in. From the venue owner's perspective this is likely to mean less time (and money) spent inside if this is a leisure facility or hotel, and office owners are faced with business tenants demanding solutions. The operators have to face complaints that they are not delivering the range of services that they have sold, potentially leading to unhappy customers, churn and regulatory fines.

Solutions must go further than simply enabling 3G and 4G mobile internet services. Installed infrastructure must continue to support legacy services but also be completely future-proofed in order to deal with the technological requirements and rapid increase in data usage expected as operators begin to introduce LTE-A. The spectre of 5G on the horizon further emphasises this need. By 2020, the introduction of 5G and an explosion in the Internet of Things is predicted to provide further expansion in the number of devices accessing networks, alongside the perceived higher bandwidth requirements of these connections.

The success of future 'always connected technologies' is completely reliant on strong and reliable coverage access both indoors and outdoors. By selecting an indoor solution fully able to support future technologies, operators can ensure they are ready to take full advantage of this revolution.

Investing for success

During 2014, operators internationally spent a combined figure of £145billion[i] upgrading networks to support new services to improve technological ability, capacity and coverage provision. This outlay is set to continue unabated and, as discussed, will not stop at the provision of 4G. Despite this ongoing investment, many operators have been accused of continuing to neglect the indoor market where around 80% of data usage currently takes place.

According to the GSMA's 2015 state of the industry report, The Mobile Economy 2015, the number of subscribers using mobile internet services reached 2.4 billion at the end of 2014. This is predicted to rise to 3.8 billion by 2020, driven by growth in developing markets and further uptake of online services in developed wireless markets. The impact of this rapid increase is that the volume of mobile data required is set to grow ten-fold by 2019.

Technological advances have allowed carriers to promise users reliable access to increasingly complex and bandwidth-heavy services such as HD video and high-quality music streaming services, wherever they are. The world, and industry, has moved away from low-bandwidth, high-latency packets of traffic towards reliance on high-bandwidth and low-latency services such as mobile video streaming and HD voice calls. As VoLTE services begin commercial launch and usage of high definition mobile multimedia services grows further, providing a seamless user experience both indoors and out will become even more critical.

Supplying critical capacity

It is not just within the consumer sector that there is a need for strong indoor LTE provision. Many commercial and business-critical applications now require access to mobile data services to operate effectively and efficiently.

ABI Research predicts that 26% of the workforce will be mobile by 2019, and as a result reliant on robust, widespread connectivity. This usage is not just focused on the use of smartphones and tablets for email, it also encompasses enterprise cloud and hybrid cloud and its associated rich range of applications. Business-critical information needs to be accessible at any given time, so there's a real need for low-latency, highly resilient coverage, both inside and outside of the office.

This need is at its most critical in the public safety communications sector, where the deployment of high-speed mobile data enables a range of rich applications that can enhance the abilities and reaction speed of emergency services. The use of LTE for public safety communications is already beginning, with FirstNet deployments under trial in the US and other markets also beginning to roll-out the technology. However, given the mission critical nature of its applications, the allocated LTE frequency needs a complete coverage footprint prior to deployment.

Distributed Antenna Systems (DAS) are already used very effectively by the mission critical sector, private organisations and managed venue complexes to supplement capacity provided by traditional base stations. Key deployments include many of the world's metro systems, rail networks and sporting venues such as the FIFA World Cup stadia in Brazil.

Many modern buildings are now constructed with DAS systems installed at the same time as the building's other utilities, including The Shard in London and The Burj Khalifa in Dubai. This increases the appeal of the facility for businesses and enhances emergency service support.

Evolving dynamic DAS

In locations where coverage demands are fairly constant and at a predictable level, legacy DAS is an excellent solution. However, in larger facilities where there are sporadic or seasonal demands for coverage, the ability to switch capacity around the venue using intelligent DAS provides a wide range of business benefits. Dynamic DAS solutions can have a significant OPEX impact and prevents a situation where one base-station has under-utilised capacity while a nearby facility is failing to keep up with demand.

Multi-use venues are an excellent illustration of these requirements. Imagine a business park, concert venue and office space within one area –for example London's O2 venue. In such a venue there are very clear spikes in demand for services at specific times. While network facilities serving the business area and office space are likely to be heavily congested during the daytime, the area will be almost empty at night. Simultaneously the concert area is likely to be extremely busy in the evening if there is an event taking place.

Using traditional DAS the capacity for each area would need to be hard-wired into each separate venue. In reality this often means operators invest in a solution which is 'redundant' a large proportion of the time: they choose to pay the running costs to provision the whole facility at maximum capacity to cater for the worst-case scenario. This results in infrastructure which is significantly underused.

The development of intelligent DAS solutions adds another layer to the abilities of DAS. Using idDAS, for the first time managers are able to divert capacity to other connected facilities in the area. This can be either done on an ad-hoc basis or by using pre-programmed capacity switching based on perceived requirements around known events or seasonality.

Facilities can be scaled-up as far as a whole inner-city area, where coverage can be dynamically moved to shopping facilities, leisure centres, hotels, offices and a range of other high-demand situations.

idDAS

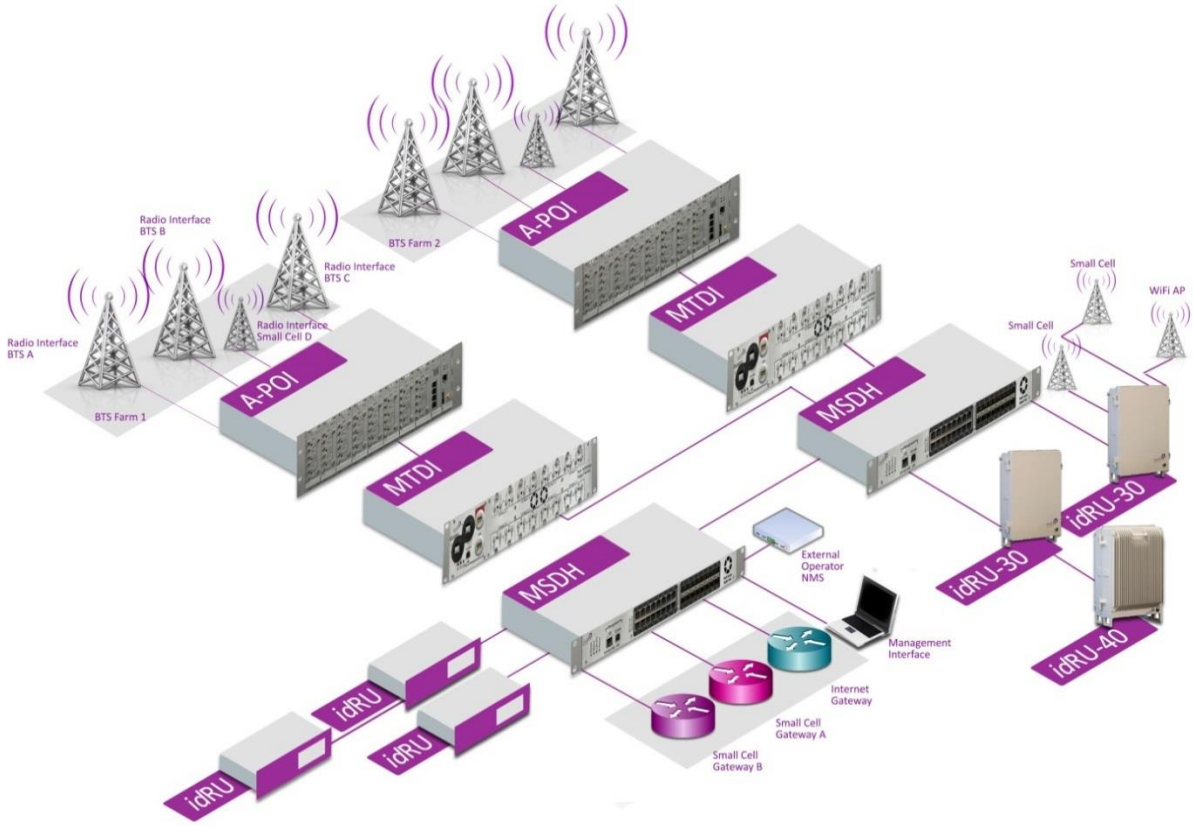
Cobham Wireless' idDAS solution is based on advanced digital communications and our innovative signal processing and filtering techniques.

As discussed above, the system can be configured to allow mobile network operators and facilities managers to dynamically reallocate capacity around a venue or series of buildings in a local area, dependent on the perceived need or according to pre-set boundaries.

idDAS effectively pools base station resources and reroutes capacity so it can be moved to wherever there is the greatest need. This vastly reduces OPEX for multi-use venues and areas which require maximum provision for specific parts of the day, including sports venues, offices, shopping facilities and universities.

The system is configured to deliver unrivalled uplink low noise performance resulting in increased base station throughput and, as a result, the best performing DAS solution available. idDAS operates with every major wireless technology, including GSM, UMTS, WCDMA and LTE, and supports all major frequency bands used by mobile operators across the world, including emerging technologies such as LTE-A.

To increase the ease and speed of deployment, the system is designed to be completely cable agnostic, supporting both single mode fibre and multimode fibre, as well as CAT 5/6 and copper and ideally should be installed at the point of construction, however it can also be retro-fitted. Embedded 1GB IP backhaul is supported for each remote, allowing the use of one common cabling infrastructure throughout the complex, which can then also be used for Wi-Fi and other IP traffic.



idDAS adopts a modular and flexible 'plug-and-play' approach to support a range of cable types and full MIMO compatibility. The ability to support MIMO using a single fibre provides the operators with maximum flexibility and enables them to deploy MIMO links on demand wherever and whenever they require without making any change to the idDAS cabling infrastructure.

idDAS fibre infrastructure can serve as the 'last mile' backbone for various IP devices such as Wi-Fi access points, small cells and IP surveillance cameras. This saves significant costs when compared to the deployment of specific 'last mile' IP backbones.

Complementary technologies

idDAS provides full radio coverage within every level of a building, and can be installed to encompass city-wide coverage issues.

However, to offer robust connectivity everywhere, operators need a complete toolkit including idDAS, Wi-Fi and small cells. Wi-Fi and small cell facilities can be easily incorporated into the idDAS system, with shared IP infrastructure within buildings supplying Wi-Fi and small cells located either in a central 'base station hotel', what is commonly known as a head-end room, or in a remote location serving a capacity hotspot.

Given the permission of base station providers, idDAS can also be connected directly to the base station as it uses CPRI protocols.

One of the key capabilities offered by DAS is the ability to include multi-operator interfaces. The system uses one central intelligent interface which can then be set-up to provide individual access portals for each operator. This allows each individual operator to control its own capacity allocation based on pre-set or ongoing needs.

DAS technology has continued to grow in sophistication and is now a vital part of network planning. It can be used alongside small cells and Wi-Fi to provide a complete coverage footprint both indoors and outdoors.

Unlike Wi-Fi, DAS can supply the whole spectrum of wireless communications services rather than just data. It also provides much greater flexibility than small cells, which are limited to a single operator. DAS supports every major wireless technology including GSM, WCDMA and LTE, and it is now also capable of providing IP backhaul infrastructure serving, for example, small cells and devices such as surveillance cameras.

Business models

As detailed in the 'use cases' outlined in the appendix of this White Paper, there are a large number of potential scenarios where intelligent DAS can provide a compelling and cost-effective solution for mobile operators and other stakeholders.

In some cases, such as the London Olympics, the DAS deployment was funded by a working group of all of the local operators. Increasingly, however, it is the facilities managers who are likely to commission communications infrastructure as part of the initial design of a building. Depending on target customers, owners can charge a rental fee to the local operators or actively promote their facilities as including enhanced cellular coverage.

In the case of office space, promoting enhanced coverage as an included utility within the building is attractive to businesses and can improve the overall income from rent. The same can be said for modern luxury hotels and apartments which can use the benefits of DAS as a marketing point for their venues. In this use case, DAS is normally installed at the point of construction to offer maximum business benefits.

The addition of intelligent digital DAS to the portfolio of solutions available to venue owners, managers and mobile operators further enhances the business case for coverage enhancement solutions. This is because capacity, and the associated costs, can be shared among various stakeholders ensuring money isn't wasted on provisioning for idle capacity and 'worst-case scenarios'.

idDAS: enabling cost-effective next-generation communications

As 4G usage and expectations of seamless access to high-bandwidth data services continues to increase, indoor provision is the new battle-ground for the communications infrastructure provider looking to differentiate from rivals with very similar outdoor offerings.

By adopting intelligent and flexible solutions, operators can improve their indoor provision while reducing the CAPEX and OPEX costs associated with hard-wiring DAS solutions into each individual section of a facility. The cost savings of these flexible coverage solutions are enhanced by the ability to offer these services to multiple venues in one area.

The ability to dynamically move capacity around a site or series of buildings is a complete game- changer, offering a unique selling point to managers and facility owners, and is a vital part in the battle to offer the truly ubiquitous cellular coverage demanded by mobile subscribers throughout the world.

Appendix: Use cases

DAS is a hugely flexible coverage solution with many varied use cases. Below are a number of the key markets for idDAS, serving to demonstrate how using an intelligent DAS solution can further improve provision by dynamically re-allocating capacity from elsewhere.

This will help operators and venue management firms alike improve customer satisfaction and provide a fully connected experience.

- Cloud RAN (C-RAN) Architecture and inner-city deployments

The unique qualities of idDAS are illustrated perfectly in city-wide deployments which utilise 'base station hotel' architecture or advanced C-RAN, here intelligent DAS can be used to improve performance by perfectly complementing existing infrastructure.

For C-RAN architecture, where all the BTS's baseband units are separated from the remote radio heads (RRH) and moved to the cloud for centralised processing and capacity management, idDAS serves as the perfect tool to route all multi-operator cellular resources located in the cloud to the correct multi-operator remote radio units.

For example, let us consider an area that incorporates a hotel, university, conference centre and stadium.

During the day, most of the capacity resources located in the idDAS head-end room or in the cloud are routed by the idDAS using the CPRI links to the university in order to provide high capacity data for the students while the exhibition hall utilises the capacity for its visitors. Later in the day, when the hotel complex is experiencing peak demand, huge sections of the capacity can be reallocated to serve its guests. Unused capacity can then be moved to the stadium in the evening so fans can upload photos while watching an event.

Therefore, for city-scale DAS deployments, idDAS offers operators the unique opportunity to increase their capacity footprint at key times without the need to hard-wire expensive base station facilities to every individual location to offer maximum output.

The amount of energy required to support this operation is reduced dramatically, making idDAS a very effective and environmentally friendly solution.

- Office blocks and hotels

Many modern high-rise buildings, such as the Shard in London, have multiple uses including underground parking, office spaces, a hotel, business and leisure facilities.

Today, coverage to these buildings is provided by dedicated base stations housed in a 'base station hotel' and propagated around the building by a DAS. The capacity resources are rigidly allocated to various locations in the building and can't be reallocated without costly cable rewiring and manual intervention. Using an idDAS system, all the BTS's baseband unit resources are installed in the head end room or in the cloud. These resources can be moved around the whole complex rather than tied to a specific area, serving the office facilities during the day and then dynamically moving the capacity to leisure facilities and the hotel at night. The amount of capacity resource saved, as well as the energy saving made, is significant.

This avoids wasting money by providing maximum coverage at all times, when the facilities are underused. Guaranteeing high-quality coverage to businesses, guests and conference facilities improves the attractiveness of the venue and can enhance business.

In the US market several multi-purpose venues with modern fibre DAS systems already installed actively promote their facilities as offering enhanced cellular coverage, idDAS will make this a cost-effective reality for even more building owners.

- Stadia

Stadia have unique requirements when it comes to cellular capacity.

Activity in the facility is far more concentrated around specific 'peak periods' compared to other venues, as it is almost exclusively centred on the times when events are taking place. This capacity strain is often at breaking point during stoppages in the entertainment and immediately following highlights, where fans upload videos and images of recent events.

The proliferation of social media usage at popular events has vastly increased in recent years as fans, and often the entertainers themselves, look to share the experience with followers. This has had a huge effect on network demand.

At the same time, there is also significant downlink traffic as fans stream video to provide a 'second screen' to watch the action, even while they are in the venue.

During the London Olympics, where Cobham Wireless provided extensive DAS coverage to the UK mobile network operators, 90,000 visitors generated the same peak data traffic as a city with a population of half a million people.

In this deployment, Cobham Wireless' Fibre DAS solution supplied a consortium of UK mobile operators with one network comprising a central base station hotel housing hundreds of individual base stations. Venues within the Olympic park were then connected through fibre DAS to cover the 900MHz band, 1800MHz band and 2100MHz band. Over 300 optical remotes were installed covering the entire Olympic Park, Athletes' Village, Greenwich Park, Horse Guards Parade, Earls Court and football stadia used during the event.

This provided extensive, seamless coverage that allowed the 10 million spectators who attended the Games to upload video, keep abreast of action in other venues and share their experience.

Smaller-scale venues can utilise this expertise and adopt intelligent DAS, allowing capacity to be shared by nearby complementary facilities, reducing OPEX and CAPEX for both venues.

- Shopping centres

Shopping centres are one of the key areas where effective mobile coverage is not just a necessity, but can increase the amount of time and money spent in the venue. During retail opening hours, customers increasingly want to stay connected while shopping and utilise data services to compare products.

Although many venues offer Wi-Fi, in reality, this is difficult to use and does not provide a seamless user experience. Wi-Fi invariably requires customer log-in, sometimes on a store-by-store basis. As high-definition voice and video use becomes widespread there is still a great need for cellular data provision and its ubiquity.
DAS deployments are already making a huge difference in this sector, increasing footfall and time spent within shopping facilities. However, many shopping centres are also multi-use facilities and include leisure venues such as restaurants and cinemas. This means there is still a need for coverage in certain parts of the vicinity even when shops are closed.

Traditional coverage provision solutions would mean having to hard-wire coverage facilities into both the shopping area and also the leisure facilities. Using idDAS this coverage can be shared between the shops in the daytime and other facilities as required later in the day. This increases both the quality of connection for subscribers and reduces the operational cost for the facilities managers.

- Transit hubs

With high waiting times and limited access to Wi-Fi, reliance on the cellular networks in transit hubs such as airports, railway stations and bus stops is greatly increased.

DAS already has a long history of enhancing capacity in these venues, including an extensive Cobham Wireless project to facilitate coverage in Heathrow Terminal 5, one of the largest common shared infrastructure projects in Europe.

As with many new structures DAS was installed during construction of T5, based around a shared facility installed to help propagate coverage for all of the major UK operators using cellular bands GSM900, GSM1800, WCDMA and all LTE bands in use. With the advent of intelligent digital DAS solutions, coverage in airports and other transport hubs can become more dynamic to better serve the changing needs of the whole airport facility including hotels, restaurants, concourses and gates - depending on the time of day.

Benefits include greater customer satisfaction, increased roaming revenues for the operators and a greater amount of time spent in retail facilities.

[i] The Mobile Economy 2015, GSMA Intelligence, March 2015