JALFHCC DAS Solutions

A White Paper

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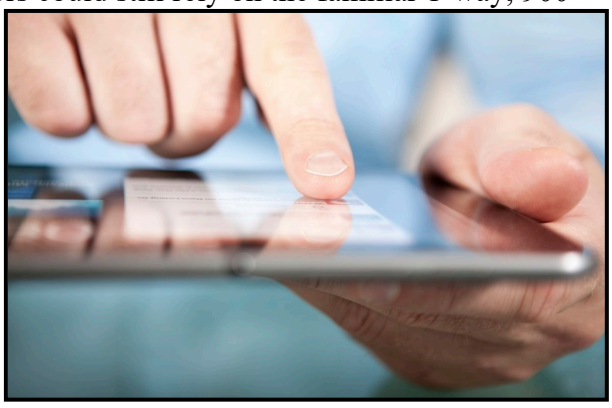
Introduction

This paper presents the current business case facing hospitals and their communication demands. It proposes an overview of the Distributed Antenna Solution (DAS) with a focus on the most up to date architectures, currently deployed to supply in-building coverage and capacity in supporting small group, public, and other forms of mass communication.

In the communication age, a connection is everything. The way technology and communication come together and affect our daily lives are defined as Convergence. Human beings now perceptively have an additional existence beyond the physical. We currently maintain a presence both physically and digitally—our "digital existence." Communication, the collaborative process of using messages to create and participate in social reality, is always changing. When considering healthcare and technology, it is imperative to understand the overarching needs of the end-user before attempting to address their ever-changing communication needs. Terry Pratchett once wrote, "It is important that we know where we come from, because if you do not know where you come from, then you don't know where you are, and if you don't know where you are, you don't know where you're going. And if you don't know where you're going, you're probably going wrong." In that vein, we will take a look at a brief history of our technological communication to understand Convergence. □

Wireless communications began taking significant hold with mainstream consumers in the 1980s. Initially, in-building wireless coverage was not a concern as most mobile communication existed in the form of "car phones," semi-portable devices permanently installed in cars. By the mid-1990s, phones had become smaller and were considered more "portable." These phones were also becoming more affordable, and as the middle-class consumer market came to the forefront, it became clear that the 2G services being deployed at 1800 MHz and 1900 MHz, and their required infrastructure, would not be able to support or sustain the increasing influx of demand. Hospital doctors, nurses, and administrators could still rely on the familiar 1-way, 900 MHz pager, but there was an undeniable need that the current technological limitation could not support. As the adoption of the mobile phone increased, the need for wireless coverage inside metro systems, airports, hospitals, shopping centers, and population consumer locations started becoming a priority for many mobile operators. By the mid-2000s, mobile phones were small enough to fit in your pocket, and features such as text messages eliminated the need for the pager market.



At the time, Blackberry devices were leading the market, buoyed by the ability to send and receive emails in real-time. Additionally, 3G speeds were now allowing limited viewing of web pages. As an unintended consequence of these advances was the elimination of companies who had come to prominence (and, in many cases, become part of the Fortune 500) by developing and producing technologies such as the fax machine, document scanners, microfiche scanners, cameras, physical music distribution (vinyl records and CDs), and even desktop computers. As

mobile communication technology continued to improve, businesses such as hotels began losing dependable long-term income from landline phone calls and even in-house movie purchases. Considering 3G systems were often deployed using even higher frequencies (2100 MHz), the lack of 3G coverage inside buildings became crucial Which led to 2007 when Steve Jobs and Apple introduced the iPhone.

The combination of 3G wireless data connectivity (a full mobile internet experience) with the intuitive nature of touch-screen technology injected technological steroids into an already demanding consumer market. Overnight, investors and opportunists turned their attention to consumer user stories in the interest of building out “Apps," downloadable tools, and everything in-between, creating a persistent dependency upon mobile phones. Today, nearly everyone with a heartbeat has some form of communication technology that follows everywhere they go. Our mobile devices are our camera, video recorder, email device, social media access device, text messaging device, book, newspaper, gaming device, and of course, mobile telephone. In other words, our entire human existence is now entirely dependent upon these little square technological boxes’ that accompany us everywhere. Hence, digital existence.

Problem Statement

With the public’s newfound technological dependency and digital existence comes the expectation that public service locations, including health care servicing, will support that aspect of our daily life. In addition to so many others, approximately 80% of mobile data traffic is generated indoors. This ever-growing demand presents a technical and economic problem for mobile operators worldwide. As the wireless industry evolves toward 5G, indoor mobile communication has rapidly become the number one priority for hospital administrators or IT managers, who need it to facilitate smooth delivery of patient services, facilitating emergency and specialist care, and coordinating between caregivers. Unfortunately, networks are easily overwhelmed by staff, patients, and visitors, or negatively impacted by building materials like brick, concrete, steel, and glass. These difficulties result in four problems common to hospitals and healthcare wireless networking.

Problem I: It is common for hospitals to encounter cellular connectivity issues with signals because an overload of medical devices can impact the system. Plus, hospital staff must have the support available for a variety of carriers on different frequency bands due to the diversity in competition for cellular carriers.

Problem II: Hospitals tasked with tending to hundreds of thousands of patients each year must obtain lab results and other patient information in real-time while the patient is in front of the provider. Any delays in receiving this information could result in an unproductive appointment, an unhappy patient, or worse.

Problem III: Patients (and their visitors) want the ability to stay in contact with work, their family, and friends while in the facility. Many hospitals offer virtually no cell service. Cellular connection latency can stem from many different things, such as the thickness of the building walls (which can prevent signals from penetrating) or an overload of signals moving through the building at once.

Problem IV: With overseeing entities such as the Department of Health and Human Services (HHS), and Center for Medicare and Medicaid Services (CMS) emphasizing measurable outcomes, many hospitals are struggling with budget limitations.

A DAS can help improve cell connectivity, as well as radio and other forms of communication signals. DAS in-building wireless systems provide enhanced network coverage and capacity when the existing macro network is not able to adequately service the demand.

Our Solution: DAS

DAS Defined

Much of the following detail for DAS has been taken directly from an article written by EMKS's DAS Hardware partner (Accu-tech) and posted via Health IT Outcomes. Please see the citation for reference.

A Distributed Antenna System is a system used to distribute wireless signals throughout a defined area, such as a mall (indoor or out) or entertainment venue. DAS can be simply understood by examining how wireless carriers (Verizon, AT&T, etc.) provide coverage for their customers. Since the introduction of cellular technology, carriers have relied on outdoor antennas commonly known as cellular towers or macrocells, to distribute their signals. Instead of creating their cellular signal, DAS solutions capture existing signals from surrounding cell towers using rooftop donor antennas, amplify the weak signal, and then distribute the boosted signal inside the building or complex. The advantages of DAS include:

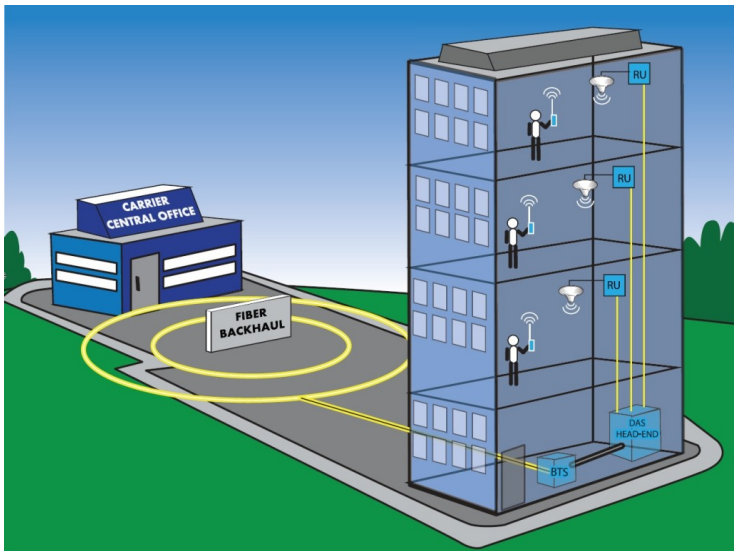


Figure 1: DAS Solution

- Significant financial savings.
- Reduced installation time.
- Carrier agnostic cellular services

Additional Benefits of DAS in Hospitals

A DAS Solution offers many significant benefits to hospitals beyond resolving the problems enumerated above.

One Network Simplified. Patients and their visitors are increasingly data-hungry, meaning that their activity on the Wi-Fi network could potentially compete with critical care applications. Keeping them on a cellular network mitigates this.

Emergency Communication for First Responders. On top of cellular data, a DAS facilitates radio communication signals as well. Radio communication greatly benefits first responders who rely on two-way radios to communicate. In any crisis, from a fire to a patient in distress, communication lines must remain open and available. DAS helps first responders communicate in real-time—which is imperative in a hospital setting.

Improved Healthcare Outcomes. More reliable communication results in higher quality healthcare. The ability to access patient information in real-time and increase communication speeds can reduce costs and improve the patient experience.

Hospitals are recognizing the benefits provided by DAS and are taking advantage of this innovation to achieve their overall goals. An effective DAS solution provides hospitals with a value far beyond their necessary expense, especially given the variety of funding options.

New Funding Models

There are multiple options when it comes to funding DAS innovation. Below we look at some of the more common funding models, as well as some of the ways that funding models can be combined to create additional appealing options.

1. **Funding by wireless operators**. As one of the more optimistic models for small to mid-sized enterprise spaces, an operator-funded solution may cost nothing to the enterprise itself. However, these are typically only offered to the most profitable/large venues such as stadiums, because a space of this nature will be able to provide fast, significant return on the operator's investment.
2. **Engaging with a neutral host**. Neutral host companies can provide a low- or no-cost connection, as long as they can be confident that they will recover sufficient ROI. Neutral-host companies are the third-party providers of DAS and small cell solutions that support multiple operators and then bill those operators for access. The volume of this access determines whether a solution investment will be of value to a neutral host as they need to ensure that the chargeable amount of traffic will be enough to secure ROI.
3. **Funding by the enterprise**. Essentially, with this model, enterprises are offered a 'you buy it, you install it' scenario, though maintenance and monitoring may be outsourced. Here, the operator will maintain responsibility for the RF signal source (unless deploying a small cell, in which case the radio is part of the infrastructure and may be funded by either the enterprise organization or the operator). Enterprise-owned DAS can be built to support as many carriers, technologies, and bands as required. These bands present an advantage when the solution must support a variety of device types across multiple

operator networks – for example, in spaces where tenants and visitors will bring their own devices, such as workplaces or retail spaces.

4. **Mixed-Funding Model**s. Sometimes the most practical solution will not fit one of the three options outlined above. And when we consider the many ways in which a DAS solution can be split up into its operational connections, components, and functions, it can make sense to spread ownership and responsibilities with a mixed-funding model.

How DAS Is Evolving

Today, new DAS solutions address hospital challenges. Rather than relying on analog technology and heavy coaxial cabling, new DAS solutions use an enterprise-friendly approach based on all-digital technology, Category 6A Ethernet cabling, and a local area network (LAN)-like architecture. In many ways, these products change the game for upgrading hospital DAS.

In the first place, Category 6A Ethernet cabling and a LAN-like, hub-and-spoke architecture are much easier to deploy and configure. Instead of heavy coaxial cabling, which requires special hangers, takes up a lot of space in hospital ceilings, and requires specialized installation, digital DAS is thin and easy to install. Digital DAS transport is between 70 and 90 percent smaller than analog DAS infrastructure so that it can be installed quickly and economically. The configuration is also more straightforward, because digital DAS eliminates the need for RF engineers to tune signals across the infrastructure, and many functions that were traditionally restricted to specialized hardware have been replaced with multi-function software-defined hardware.

Digital DAS also gives hospitals more control overcapacity across the network. For example, to deliver more bandwidth to a remote surgery suite, network managers can use software to reassign bandwidth from other, less-demanding parts of the network. Also, digital DAS carries more bandwidth than analog systems. Using common network wave division multiplexing, digital DAS networks can carry up to 90 percent additional bandwidth when compared with analog solutions.

Digital DAS also facilitates the use of multiple-input multiple-output (MIMO) technology. MIMO involves the use of additional antennas to double the bandwidth of a network, and it will be a crucial technology for 5G wireless. With analog DAS, supporting MIMO requires adding a second layer of cabling. With digital DAS, MIMO can be deployed by attaching additional antennas to the existing SISO infrastructure. A digital DAS allows users to deploy interleaved MIMO with a simple software reconfiguration to obtain up to 70 percent of the performance of MIMO without having to deploy additional antennas. This novel software-based approach offers significant performance improvement for a minimal incremental cost.

Finally, digital DAS can be deployed today to support 4G LTE wireless and then upgraded via software to support 5G when it becomes available. Most 5G wireless systems will rely on LTE technology for the first few years anyway, so deploying LTE now makes it easy to transition to 5G.

EMKS Program & Project Management for DAS Infrastructure

EM Key Solutions (EMKS) is a Service-Disabled Veteran-Owned Small Business (SDVOSB) offering a broad range of services to support Federal Government enterprises in meeting their

mission requirements and business demands. EMKS is an IT solutions and management consulting services provider supporting the Federal Government. EMKS leadership has over 30 years of proven performance and award-winning experience with core capabilities in Requirements Management; Software Development & Maintenance; Systems Integration; Software Testing Services; Web & SharePoint Development; E-Learning - Instructional Design & Delivery; Medical Modeling & Simulation; Theater Systems Support, Systems Training, and Management Consulting Services. In supporting a DAS project, four pieces make up the total cost of installation and continued lifecycle. Program & Project Management, OEM Manufacturing Equipment, Installation, and finally, Monitoring & Maintenance of the system. EMKS has conducted OEM Vendor audits for all DAS equipment and has direct strategic relationships through OEM Manufacturers that ensure our customers are receiving direct pricing to provide the best value. EMKS has assembled the best team locally for all four areas of DAS procurement, installation, monitoring & sustainment.

Results / Conclusion

Since cell phones were first introduced, we've gone from each having a single analog-identity to bifurcating into a physical and digital self. More than just a simple technological innovation, this represents an entirely new evolution in human communication. Digital technologies are replacing older analog technologies in many areas of life. Now DAS is making it easier for hospitals to meet their wireless infrastructure needs with systems that are cost-effective, easy to deploy, and easily capable of migrating to 5G technology when it becomes available.

Hospitals are seeing definitive and realistic solutions to age-old communication problems such as bandwidth limitations, cellular interference, and now telehealth latency. With improved technology comes a stronger basis for healthcare outcomes. The Department of Veterans Affairs continues its pursuit of continuous care by modernizing technology and creating a longitudinal electronic health record (EHR) for veterans using Cerner. Additionally, CMS continues to push the envelope in the interest of encouraging interoperability. Considering the tenuous relationship and merger of policy and technology, DAS presents an immediate solution. As more health care administrators hyper-focus on patient-centered meaningful use and measurable outcomes, DAS technology is becoming an infrastructural must-have. The dependency upon healthcare technology is ever-increasing, and as Cerner transitions, military health, utilizing more APIs and integrating with a broader spectrum of health care applications, a functioning, well-managed DAS Solution grows more essential every day.

Works Cited

CISCO Visual Networking Index; (2019, February 18). Retrieved from https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-738429.html

Grand View Research; (2018, December). Retrieved from

https://www.grandviewresearch.com/press-release/global-mHealth-market

Product Overview; Defining DAS

In-Building Wireless Solutions For Hospitals; (2019, August 08). Retrieved from

https://www.healthitoutcomes.com/doc/in-building-wireless-solutions-for-hospitals-0001