msr/mobile sports report

Q3 2014

STADIUM TECH REPORT

THE FOOTBALL ISSUE:

Levi's Stadium leads the way for NFL technology deployments

Update on tech deployments for all 32 NFL teams, with a focus on Wi-Fi and DAS

Stadium DAS and Wi-Fi tech profiles

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Welcome to our third STADIUM TECH REPORT, aka THE FOOTBALL ISSUE, for Q3 2014. These quarterly long-form reports are designed to give stadium and large public venue owners and operators a way to dig deep into the topic of stadium technology, via exclusive research and some profiles of successful stadium technology deployments.

In this issue we take a thorough look at the most exciting technology deployment in the stadium world today, the opening of the San Francisco 49ers' new home, Levi's Stadium. With its pervasive Wi-Fi and DAS deployments, massive backbone bandwidth, and a well-designed app, Levi's Stadium may well become the standard other stadiums shoot for when it comes to using technology to improve the fan experience.

In addition to our Levi's coverage we have team-by-team capsules of technology deployment updates for every NFL stadium, as well as an exclusive interview with NFL CIO Michelle McKenna-Doyle, and a profile of the St. Louis Rams' Edward Jones Dome. Insight and analysis from industry thought leaders rounds out our largest-ever issue, which makes sense given the outsized impact the NFL has in sports.

We'd like to take a quick moment to thank our sponsors, which for this issue include Crown Castle, SOLiD, TE Connectivity, Extreme Networks, Aruba Networks, Mobilitie, and DAS Group Professionals. Their generous sponsorship makes it possible for us to offer this content free of charge to our readers. We'd also like to thank you for your interest and continued support.

As always, we are here to hear what you have to say: Send me an email to kaps@mobile-sportsreport.com and let us know what you think of our STADIUM TECH REPORT series.

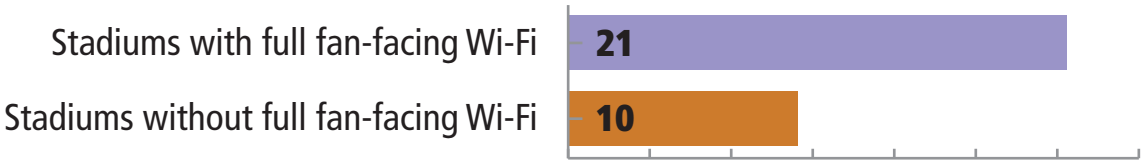
Paul Kapustka, Founder & Editor
Mobile Sports Report

IN THIS ISSUE:

NFL TEAMS PLAYING FOLLOW THE LEADER IN TECH DEPLOYMENTS

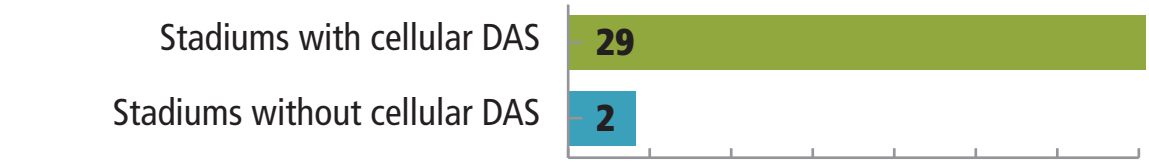
BY PAUL KAPUSTKA

NFL Stadium Wi-Fi Networks



Franchises that don't offer fan-facing Wi-Fi:
Green Bay, Baltimore, Cleveland, Buffalo, Houston, Oakland, San Diego, Minnesota, Washington and St. Louis.

NFL Stadium DAS Networks



When you mention the National Football League and stadium technology, images like the one of Levi's Stadium on our cover come to mind: Billion-dollar facilities with the latest and greatest offerings to enhance the fan experience.

But when it comes to looking at the league as a whole, the technology situation is a lot like the actual competition on the field: There are a few select championship contenders, another handful of playoff contestants, and then a larger balance of organizations just starting to build their technology operations. Though the league itself is already putting in place methods and programs to help advance the overall level of technology adoption, an uneven playing field will likely exist for the near future, since much of the actual deployment decisions – and spending – will be done by the individual teams themselves.

What does that situation mean for fans? If you follow one of the teams that is leading the way in fan-facing technology deployments, your at-the-game experience these days is likely far different than it was just a few years ago. Stadium apps that offer concession ordering and in-seat food delivery are no longer just cool ideas but actual features being deployed, as are instant replays and access to popular content like live streaming broadcasts and the league's own RedZone channel. Seat upgrades, electronic ticket transfers and easier access to things like parking-lot and bathroom line information are also among the new ways technology is making

going to the game a better experience, topped off by humungous in-stadium video boards that threaten to swallow facilities all by themselves. In some stadiums, being a fan has never been better.

Still some laggards in tech deployment

But unlike Major League Baseball, where the in-stadium app experience is the same for all teams, in the NFL you could also still find yourself at a stadium that has an app from the iPhone 3 era, and little or no cellular connectivity, and none of the other amenities mentioned above. Though fan-facing Wi-Fi seems like a constitutional right these days, there are still 10 NFL stadiums (out of 31 total) that don't offer full stadium Wi-Fi for fans, and two that don't even have a distributed antenna system (DAS) to assist with basic cellular connectivity. While having roughly two-thirds of the stadiums with Wi-Fi might not seem so bad, it's not so great when you recall that 2 years ago, commissioner Roger Goodell called for all stadiums to offer Wi-Fi as soon as possible. In a league that is minting money through its TV contracts and expensive seat licenses, why the delay?

"...THE TECHNOLOGY SITUATION IS A LOT LIKE THE ACTUAL COMPETITION ON THE FIELD: THERE ARE A FEW SELECT CHAMPIONSHIP CONTENDERS, ANOTHER HANDFUL OF PLAYOFF CONTESTANTS, AND THEN A LARGER BALANCE OF ORGANIZATIONS JUST STARTING TO BUILD THEIR TECHNOLOGY OPERATIONS."

In some cases, pending ends of stadium leases, possible franchise moves or construction of new stadiums is keeping teams from spending millions on Wi-Fi right now, a smart move if the team is going to change addresses. In other cases, teams whose facilities don't see a lot of other outside uses other than the small number of NFL games a year are still moving cautiously, wondering about how and when a Wi-Fi investment will show any return.

"...THERE ARE STILL 10 NFL STADIUMS (OUT OF 31 TOTAL) THAT DON'T OFFER Wi-Fi FOR FANS, AND TWO THAT DON'T EVEN HAVE A DISTRIBUTED ANTENNA SYSTEM (DAS) TO ASSIST WITH BASIC CELLULAR CONNECTIVITY."

Will all of the teams get to a base level of connectivity sooner rather than later? The guess here is yes, especially if the league continues to help franchises by making more deals like the one it signed last season with Extreme Networks, under which teams can get discounted pricing on Wi-Fi gear in exchange for the sponsorship rights granted to Extreme. Though teams don't have to use Extreme gear, according to league CIO Michelle McKenna-Doyle such deals can help out overall by compelling other providers to compete by lowering prices.

And stadium app developer YinzCam, already part of many teams' stadium apps, will have competition from newcomer VenueNext, the firm that developed the Levi's Stadium app.

Then there is also the natural competitiveness between NFL organizations, which happens off the field as well as on it. Just look at AT&T Stadium and its aggressive connectivity upgrades this past offseason – if you don't think that is in part an answer to the high-profile debut of Levi's Stadium and its technology offerings, you aren't paying attention. And just like when teams compete for better players by bidding up their contracts, fans can and should be the ultimate winners in a game of technology one-upmanship. -MSR-

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IS LEVI'S STADIUM THE BEST TECHNOLOGY-ENABLED STADIUM EVER BUILT?

(That's what everyone wants to know.)

BY PAUL KAPUSTKA

The easy answer is: if it's not No. 1, Levi's Stadium certainly deserves to be in any discussion about the ranking.. Its advanced wireless network, its innovative and powerfully simple app, its solid design and well thought-out human engineering all combine to produce a fan experience few places can match. Plus, in its first regular season game, Wi-Fi traffic at Levi's Stadium surpassed that from the most recent Super Bowl. If you're contending for the title of top technology stadium, that's a good place to start.

One thing is for sure: the technology part of Levi's Stadium generates interest in the facility that goes far beyond the stadium technology marketplace, and even past the realm of just sports fans. The combination of an "iPhone of a stadium" located in the middle of one of the most interesting places on earth – Silicon Valley – led an interesting parade of interview requests to MSR's front door, a list that included local newspapers, local radio stations, several tech websites and even NPR.

What they all wanted to know: Is this the No. 1 stadium when it comes to fan-facing technology? And if so, what makes it special? The lengthier answer, of course, is spelled out in this story below, and includes not just the well-designed and deployed technology itself, but also the strategy of using technology to enhance the game-day fan experience, instead of focusing on technology for technology's sake.

By combining massive, pervasive wireless connectivity with an app strategy that solves simple pain points of a live visit like reducing or eliminating the time spent in lines, the Niners have pulled off a non-trivial revolution in what fans can and should expect when they come to a game. As such, they have put themselves and Levi's Stadium into the spot that other teams not just in the NFL, but in the sports world in general, will be looking up to and following. Is it the best-connected venue out there? I'd give Levi's Stadium the pole position right now. But I also expect challengers to ramp up their games quickly – a competition that is only good news for sports fans everywhere, as teams and owner/operators seek to use technology to make their venues places where fans want to keep coming back to.

Breaking down Levi's Stadium: Wi-Fi is 'Best in Show'

Many people in the stadium-tech industry thought the Niners were overshooting the mark when they talked about building a stadium with high-fidelity Wi-Fi available to every fan in the 68,500-seat house. Now, after doing just that, the crew behind the Levi's Stadium Wi-Fi network has definitely set the new bar that others will be measured against. At the Niners' first regular season home game in Levi's, the team reported a Wi-Fi traffic figure of 3.3 terabytes, which eclipsed the most recent Super Bowl and its reported 3.2 TB mark. Whether or not those stats match up exactly is somewhat beside the point. For a regular-season game attended by a crowd of some 20,000 fewer fans, to equal or pass the traffic mark generated by the biggest of big games means that fans had no issues with wireless connectivity – and may likely consume more as they become more familiar with the environment.

In several visits to Levi's Stadium the MSR crew conducted numerous unofficial speed tests of the Wi-Fi network, and generally found solid signals (often 20 Mbps or higher for both download and upload) everywhere we walked in the building. And we walked and tested everywhere, from inside the concourses to the highest cheap-seat decks. From our technology tour visit we learned that the 1,200 Aruba Networks Wi-Fi access points were split in half, with 600 deployed in the seating "bowl" and the other 600 spread throughout the other parts of the venue. Though a couple stadiums we know of either are at or past the 1,200 AP mark (AT&T Park in San Francisco and AT&T Stadium in North Texas), almost every other stadium Wi-Fi project we know of uses far fewer Wi-Fi APs – and almost none of them had the Levi's Stadium advantage of being able to design Wi-Fi placements (like the many under-the-seat APs) into the actual stadium construction.

If there is a drawback to the Wi-Fi deployment at Levi's Stadium, it is the acknowledged lack of better support for older devices that only use the 2.4 GHz unlicensed bands. Team tech officials

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1) The gigantic high-resolution screens can be viewed by every seat in the house. 2) "NiNerds" provide on-site technical assistance. 3) Light rail brings fans right to the front gates of Levi's Stadium. 4) Interactive fan kiosks in the concourse are part of the Levi's experience. 5) Niners VP of technology, Dan Williams, makes a "seat call" to fix a Wi-Fi issue. 6) Two of the 1,200 Wi-Fi access points located throughout the stadium.

were "surprised" by the number of iPhone 4 devices still being used by their tech-savvy Silicon Valley crowd, and have admitted some of those fans may not have a great Wi-Fi experience. The good news? Apple just released the iPhone 6, so more upgrades are no doubt on the way.

With plenty of backbone capacity thanks to the twin 10 GB pipes provided by sponsor Comcast (and another pair of 10 GB pipes provided by an unnamed provider for redundant backup) and fiber connections throughout the facility, the Levi's Stadium Wi-Fi network is also well-positioned for the inevitable upgrades coming soon, as more devices and APs move to the more-desirable 802.11ac standard. The network crew is smart enough to know that when it comes to Wi-Fi, you're never really done building your network. But right now, it's tough to imagine that any other stadium network has a better Wi-Fi system than Levi's Stadium.

Double DAS keeps the peace between carriers

We know somewhat less about the DAS (distributed antenna system) deployment at Levi's Stadium, mainly because the wireless carriers aren't as forthcoming with performance statistics as the team is with Wi-Fi. But all you need to do is walk around the stadium a bit to see how thorough the DAS deployment is; there's pretty much an antenna everywhere you look, if you know what to look for.

According to neutral host provider DAS Group Professionals (DGP), there are more than 700 DAS antennas inside Levi's Stadium, and they often appear in pairs, highlighting a smart decision by DGP to build parallel DAS systems. Though the official strategy behind that move is to provide more capacity for all, a stadium worker we talked to at the opening ceremony put it better: "Why are there two antennas? One for Verizon, and one for AT&T." The double-DAS may be something that is more common over time, since we know of several other big stadium deployments – including the DAS at MetLife Stadium, site of last season's Super Bowl – where AT&T and Verizon each built their own DAS deployment.

Though usage statistics haven't yet been shared from the DAS, our informal speed tests showed the cellular signal for both AT&T and Verizon to be strong throughout the building, even during heavy use times. When rapper Snoop Dogg performed at halftime during the home opener, we tested the Verizon 4G LTE connection to see if the crowd was clogging the network with texts, calls and data. Our test showed speeds of 29 Mbps down, 9 Mbps up. No Snoop slowdown is one sign that the DAS is probably as solid as the Wi-Fi.

Two big screens and lots of little ones get the job done

The most obvious technology after the wireless network are the digital displays, especially the two enormous video boards that sit atop the stadium above each end zone. The clarity of the Sony screens is incredible, even if you are jaded by the new era of displays. Even in bright sunlight the screens are crisp and readable, and are positioned so that every seat in the house has a good look at at least one, if not both.

Complementing the big screens is the incredible number of smaller video displays installed throughout the facility – we haven't done an exact count, but the team's claim of 2,200 flat screens is believable, simply because there's one just about anywhere you look. What that means is that if you do leave your seat for some reason, or need to be on a concourse during live play, you're never far from seeing the action, one of the big pain points of being in stadiums that don't have a lot of screens. The only drawback we've discovered so far is the 5- to 7-second delay between action on the concourse screens and live play on the field; though we understand the technological reasons behind the delay, because of the open-air construction of the stadium if you are watching on an inside display you hear the roar of the crowd reaction before you see the play unfold. Maybe it's a good thing, since it makes you want to get back to your seat.

Levi's Stadium app good, but still a work in progress

The one piece of technology that we like so far but aren't quite sure about is the Levi's Stadium

app, which still feels a little like a "beta" project that changes every week. The app is also one place where the Niners fell short on their technology promises, since their claim to have "better replays than the coaches" hasn't yet materialized. In fact, the instant replay function in the app only showed up for the first time at the home opener, and even then it didn't show any replays until late in the first half.

When it did go live, the replay feature was fast – replays were posted just seconds after the live play had been whistled dead. But in keeping with the "beta" feel of the app, the replay function was not called out by its own button – you had to know to click on a down arrow to make replays appear. Also, there were only replays available for the two most recent plays, and only a handful of highlights. And while the app developer, VenueNext, said that multiple replay angles were available for the first game, they weren't easily identified (you needed to tap on the player to get multiple choices), making it hard for fans to find them. According to the team fans watched 7,800 replays during the game.

The parts of the app that are more fully baked include the food and beverage ordering feature, which continues to grow in use as more fans discover it. At the regular season opener the Niners positioned their on-site technical assistance crew – the "NiNerds," who wear bowties and geek glasses – at various concession stands to help show fans how to use the app to order items for express pickup or for seat delivery (which carries an additional $5 delivery charge). According to the team it had more than 2,100 food deliveries during the Bears game, up from 1,000 at the last preseason game.

The team also claims that the app has had 80,000+ downloads, and that more than half the season ticket holder base has registered their seating information through the app, which then allows them to do things like electronically transfer seats. Where the app still needs some help is in allowing secondary ticket purchasers to have in-app ticketing functionality. Though I understand the desire to prioritize season ticket holders, the reality of any sports team these days is that many season ticket holders are at least part-time ticket arbiters, selling off seats to games they don't want to attend. With the league's partnership with Ticketmaster to provide sanctioned secondary sales, there's no reason for the Niners' app not to support those fans as well.

Passing the Super Bowl, establishing a new leader

So can the Niners' tech team hoist the "mission accomplished" banner? I would say they set out to redefine the fan experience via technology... and largely achieved the goals. Levi's Stadium has reset the bar for wireless connectivity, and there are great features in an app that is stripped down enough (no feature overload) to make it usable in a stadium situation. The huge TV screens and multiple other screens are a win for fans; and the team clearly did its homework on the human engineering side, making sure there were enough trained food runners to make the in-seat delivery option viable.

Is it the best stadium, technology-wise? Maybe. Does it host the most demanding fan base, technology-wise? Probably. More importantly, the stadium also appears to be built to get better; one thing we noticed in walking around was the available space on wiring runs, and the empty racks in data centers. It was built, at the very least, by people who know that no network is every truly finished, with ways for the inevitable upgrades to take place quickly.

Is it perfect? No. The wireless is good, but not friendly to older devices; the app is better than most we've seen, but still hasn't been at full force. And many concession kiosks were still taking cash only at the home opener, because they said they couldn't get their wireless POS systems working. Other problems include the parking situation – the Niners have online maps that show you how to get to the place, but the departing process is still a huge snafu; after the regular season opener some fans had to resort to driving over curbs after being stuck in one place for more than an hour. And while we're at it, can we request a huge awning for those 1 p.m. starts? Put that in, and Levi's Stadium will remain No. 1 for a long time. -MSR-

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BUILDING THE ULTIMATE STADIUM Wi-Fi NETWORK:

Aruba Networks chief engineer Chuck Lukaszewski on the Levi's Stadium deployment

BY PAUL KAPUSTKA

For Chuck Lukaszewski, getting the job to design the Wi-Fi network at Levi's Stadium was a bit of a personal perfect storm: Having long desired to build the ultimate stadium Wi-Fi network, he'd finally been matched with a customer with plans and a budget to fulfill that dream.

Chuck Lukaszewski, Aruba Networks

Lukaszewski, the senior director for outdoor solutions engineering at Levi's Wi-Fi gear supplier Aruba Networks, said the aggressive vision for connected fan engagement put forth by the San Francisco 49ers and their vice president of technology Dan Williams was a plan Lukaszewski had long wanted to pursue.

"I had a vision of how to build an 'ultimate stadium,' and Dan said he wanted an ultimate stadium," said Lukaszewski. "He gave me the freedom to design something that had never really been done before. It was a real meeting of the minds."

By early results, the joint effort is by all standards a success, with network traffic statistics from the first football game at Levi's showing a robust Wi-Fi network with Super Bowl levels of user traffic. According to Lukaszewski, by the time kickoff rolled around for the Niners' preseason game against the Denver Broncos on Aug. 17, the Wi-Fi network at Levi's Stadium had already surpassed the three most recent Super Bowls when it came to concurrent network usage, and had also exceeded the peak network usage statistics from the recent World Cup finale in Brazil.

While the network team did have some factors in their favor – including the ability to blend the wireless infrastructure into the overall stadium buildout and the budget for 1,200 Wi-Fi APs – there was still significant work that had to be done to produce a wireless experience with the magnitude of Levi's offering.

Avoiding the 'circular firing squad of RF' in antenna deployment

According to Lukaszewski, he's had experience deploying Wi-Fi networks in many unusual or difficult places, including on oil tankers and on financial-market trading floors. But stadiums, he said, especially open-air arenas like football stadiums, require a much higher level of deployment expertise, especially when you are trying to provide an extremely high level of connectivity to every seat in the stadium, as the Niners wanted to do at their new 68,500-seat home in Santa Clara, Calif.

"The 49ers have a completely unique view of the connectivity experience in a stadium – it's the whole relationship of a fan with home," said Lukaszewski. "Technology is just one piece of that. And [wireless] connectivity, is the last yard."

But just like those last three feet into the end zone, the last yard to the fan's handset is often the toughest distance to cover when it comes to providing Wi-Fi connectivity. Unlike cellular operators, who own and control their licensed swath of spectrum, Wi-Fi networks operate in the unlicensed band of airwaves, and have an unknown number and type of end-user customers to support. According to Lukaszewski, designing and deploying a large-scale stadium Wi-Fi network is extremely more difficult than building a similar cellular network, mainly because of the interference situation.

"The classic design for a cellular DAS [distributed antenna system] in a stadium is to just put antennas

high up, all the way around the bowl, pointing down," said Lukaszewski. "That's completely inefficient for Wi-Fi – we call it the 'RF circular firing squad.' Cellular owners can do that because they are exclusive owners of their spectrum and can bathe the bowl in signals. With Wi-Fi we have to 'share the air' in a 'listen before talk' environment."

APs under seats, close to the fans

Without getting too deep into the specifics of Wi-Fi networking, what Lukaszewski, Williams and their teams needed to do was to figure out how many Wi-Fi access points (APs) they would need to provide high-quality connectivity to every seat in the house, and where to put them not just to provide the connection, but to also avoid interfering with signals from other close-by APs. While some of the planning can be done beforehand, Lukaszewski said that like in a restaurant kitchen, the final product often involves some hands-on refinement.

"You have a recipe, but you taste it and change it as you go," Lukaszewski said, comparing the Levi's deployment to a dinner dish. "We start out by going with the plan, then take a lot of data and make changes in real time."

In the Niners' favor was the fact that Levi's Stadium was built from the ground up with the connectivity in mind, which made it much easier to deploy the network than in older stadiums where wiring and antennas need to be retrofitted into existing structures. Things like the many under-the-seat APs at Levi's, with their wiring holes and mounting infrastructure designed into blueprints, might require concrete drilling and unsightly cable runs at stadiums built before networking was a pressing need.

"It's always better when you can design it in," said Lukaszewski of the wireless infrastructure. "The key is to have lots of low power cells, right among the people. That's how we extract capacity. To get that you have to mount APs, and get the wiring to them. That can be very expensive in a retrofit. And it's not always going to look very nice when you do it."

More recipes for different events

Even with the impressive stats from the initial game, Lukaszewski was fast to note that the Levi's Stadium wireless network is far from a finished product. "We still have a lot of work to do – we're definitely not done trying yet." Lukaszewski said. "Every game, we want to get a little better."

Typically in a stadium situation, Lukaszewski said, it may take 5 to 6 big events for the network team to really lock in on the tuning and tweaking necessary to make the network run at optimal performance. But even then, there's still work to be done since the network requirements often differ greatly for different event types and crowds.

"There can be, more than one [network] recipe," Luckszewski said. "The use case for a concert, for example, is way different than a football game. In an indoor stadium where you have both basketball and hockey, you may have 3 or 4 recipes, depending on the event." Levi's Stadium, he noted, is already scheduled to host several different types of events, including soccer games, high school football games, and an NHL game early next year.

But even as Lukaszewski, Williams and their teams continue to improve on their work, the early returns seem to suggest that the Niners have accomplished what they set out to build at their new home: A connected stadium that provides a fan experience unlike that found in most other large public venues.

"I think the 49ers have set an example for any team, in any sport," Lukaszewski said. -MSR-

DAS GROUP PROFESSIONALS MAKES A NAME FOR ITSELF WITH LEVI'S STADIUM DAS

BY PAUL KAPUSTKA

If you look around at the walls, ceilings and overhangs at Levi's Stadium, it's hard to miss the small square boxes with the off-white color and a "DGP" logo in one corner. While the wires hanging out the back of each box make it an easy guess that the equipment has something to do with wireless networks, even many industry insiders may not know the company behind the boxes and the three-letter acronym.

Steve Dutto, DAS Group Professionals

Meet DAS Group Professionals, the Bay Area firm in charge of deploying a distributed antenna system (DAS) to make sure your cell phone gets a good signal at San Francisco 49ers games and any other event inside the 68,500-seat Levi's Stadium. And while you might not be familiar with DGP, rest assured the company is extremely familiar with cellular deployments for large public venues, having installed similar DAS networks for airports, casinos and hotels, and even for San Francisco's BART train system. Of course, most of that work was done when the company was called Forza Telecom, before changing its name to DGP earlier this year, another reason why "DGP" may not have rung any bells.

"It may appear like we just fell out of the sky, but we've actually built quite a few [DAS] systems," said Steve Dutto, president of DGP. "We've got years of experience."

DAS: The Rodney Dangerfield of stadium connectivity

One thing that keeps firms like DGP in the shadows is the relative obscurity of DAS itself. While most people generally understand how cell phones work – you turn on your phone, and it connects to an antenna somewhere on a tower or rooftop – in crowded public facilities like stadiums, traditional cellular networks with towers several miles apart can't handle the concentrated capacity. To provide connectivity for areas with large crowds, the latest tactic is to deploy a DAS, a network of lots of smaller antennas. Originally deployed in places like office buildings, hotels and convention centers, DAS is rapidly gaining favor in stadiums and arenas, helping to alleviate the "no signal" problem that has cropped up in many venues the past few years.

And while stadium Wi-Fi gets lots of headlines whenever it gets deployed – probably thanks again to the widespread understanding of how Wi-Fi works – there are already far more DAS deployments in stadiums than Wi-Fi, mainly because cellular carriers will pay almost all the associated costs of a DAS buildout to make sure their customers get a signal. According to our most recent 2014 State of the Stadium survey, 71.4 percent of our respondents said they had a full DAS at their facility, while only 35.7 percent had fan-facing Wi-Fi.

How does a DAS work? Usually, either a major cellular carrier or a third-party "neutral" host like DGP will build out the antenna infrastructure, which includes many small antennas and then cables to bring the connections back to a wiring room or data center. There, cellular carriers install their own cell-tower back-end gear to authenticate customers and to provide a connection to the company networks and the Internet. Since it's in the cellular carriers' interest to keep their customers connected (and using billable minutes and data), carriers will often pay the full cost of a DAS infrastructure by building

and running it themselves. In the case like Levi's, where DGP is the "neutral host," DGP builds the infrastructure and then charges cellular carriers to use it.

Such deals are rarely publicized, and Dutto would not comment on how much each carrier was being charged to use the Levi's DAS. And just like fight club, for many deployments the first rule of DAS is that you don't talk about DAS, because no cellular carrier ever wants to admit that its network might need help. So just like Rodney Dangerfield, DAS often doesn't get a lot of public respect. But at Levi's Stadium and many other sports and entertainment venues, DAS is a booming business that would be sorely missed if it wasn't there.

The 'dream and the nightmare' of building the Levi's DAS

Now that DGP's 700-plus antenna DAS deployment is up and running at Levi's, Dutto can breathe a small bit easier. While the network is good business for the company and an obvious prominent calling card for the future, the aggressive deployment timeframe probably isn't something Dutto is eager to repeat.

"Levi's Stadium was both a dream and a nightmare [for DGP]," Dutto said, due in part both to the Niners' aggressive performance expectations and the rapid buildout schedule. Of course, DGP was somewhat used to working quickly with the Niners – when the company put a DAS in Candlestick Park back in 2012 to solve that stadium's legendary lack of connectivity, Dutto said it was deployed "in about 90 days."

The success of the Candlestick deployment, Dutto said, led to the Niners offering the Levi's DAS gig to DGP. With it, however, came the need to match the team's out-front statements about how the stadium was going to be the best ever in terms of wireless connectivity.

"We knew that it [the DAS] needed to be significantly better than anywhere else, right at the launch," Dutto said. While the late addition of an early August soccer game at Levi's pushed deployment schedules ahead even faster, Dutto said in the end it helped DGP overall.

"I wasn't a big fan of getting ready for that date [the Aug. 2 soccer game was Levi's first event] but it was a blessing in disguise," Dutto said. "The trouble with a network is that you can't really test it until everyone shows up. We got some good data from that event."

After the "daily and nightly" discussions with the Niners' tech team about antenna placements and other matters, the DAS network performed well when it mattered, during the Niners' two preseason games on Aug. 17 and 24. According to a traffic report from the stadium tech team, the DAS network carried a combined 1.02 terabytes of wireless traffic for the two preseason games, which is on par with activity seen at big events in the past, like Super Bowls. According to Dutto DGP's internal tests showed that few, if any, calls were dropped or didn't connect.

"We're at 98 percent [network performance] already, without [the network] being fully optimized," Dutto said.

RF challenges and too many iPhone 4 customers

While many of the stadium's Wi-Fi antennas are well hidden – including the ones in boxes under seats – the DAS antennas are a bit more prominent, especially if you are near where the first overhang comes close to the seats.

"Unfortunately, with Levi's exposed steel-beam construction, if you want the DAS to work, you're going to see it," Dutto said. "It's hard to be stealthy in there."

And in many cases there isn't just one but instead two DGP antennas side by side, which reflects the company's decision to actually build two parallel DAS systems to better accomodate the major wireless carriers. According to Dutto, AT&T and T-Mobile are based on one system, while Verizon Wireless, Sprint and public safety communications are handled by the other one.

Currently, all the carriers are live on the DAS except for Sprint, which is still in the process of installing its back-end equipment.

> ...WHILE LEVI'S Wi-Fi NETWORK HAS SHOWN ITSELF TO BE INCREDIBLY ROBUST... CELLULAR CONNECTIVITY OVER THE DAS MIGHT BE EVEN FASTER THAN Wi-Fi IN MANY INSTANCES, ESPECIALLY IF FANS HAVE LATER-MODEL PHONES WITH 4G LTE.

One of the biggest challenges for DGP, Dutto said, comes from outside the stadium, and not inside. Like other open-air stadiums located in city cores, Levi's Stadium faces significant interference from cellular antennas on nearby office building rooftops, as well as from the Santa Clara Convention Center right across the street.

"Less than a half mile from Levi's you can see seven different rooftop cell sites," said Dutto, who said the flat, open terrain around the stadium increases the ability for those signals to interfere with the stadium DAS deployment. Target Field in Minneapolis had some similar problems with cell antennas on nearby office buildings.

"We've done a lot of work with the carriers to adjust their macro networks around the stadium," Dutto said. "We'll do more of that as we go, and expect it to get better."

And while Levi's Wi-Fi network has shown itself to be incredibly robust, Dutto said that cellular connectivity over the DAS might be even faster than Wi-Fi in many instances, especially if fans have later-model phones with 4G LTE.

Even though Dutto said DGP's testing recorded download speeds of up to 200 Mbps – and 65 Mbps sustained – he acknowledged that many Levi's patrons might never see those kinds of numbers unless they snap up some of the new iPhone 6 models introduced by Apple. According to network stats collected by DGP during the preseason games, a lot of fans may be ready for an upgrade.

"There's a lot more iPhone 4 users out there than we thought," Dutto said. -MSR-

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If there is one constant that keeps stadium owners and wireless operators up at night when it comes to deploying wireless networks, it's the where-to-start dilemma. Because these rapidly-evolving technologies are new even to many communications professionals, those tasked with setting wireless strategies may not even know what they are looking for when they set out on a path to find partners, suppliers and integrators to help them on their journey to deliver a remarkable wireless game day experience.

SOLiD, a wireless infrastructure company that manufactures Distributed Antenna Systems (DAS) which have been deployed in international, professional and college sports arenas around the world, believes it is paramount to know the right questions to ask to jump-start a successful stadium network planning and deployment initiative.

Begin with the End in Mind

Before any fiber gets pulled or an antenna mounted, stadium owners and operators need to ask some very basic questions about their network plans according to Hitesh Kshatriya, Director of Sales Engineering at SOLiD. What does the venue seek to accomplish with its wireless infrastructure? Is it just looking for simple reliable connectivity? Or will there be advanced applications for connecting with fans, to enhance their experience while also possibly opening new revenue streams?

The owner/operator also needs to decide if it wants to or is required to ensure public-safety in its venue, as well as support staff communications and other related tasks like ticketing and concessions.

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Will there be a need or a desire for detailed network-use analytics, and can the network itself be a source of revenue if the owner/operator owns it and acts as a "neutral host" for wireless service providers? What roles will Wi-Fi and DAS play, and how will the owner and operator either pay for the network or find a financial partner to provide the necessary resources?

Answering these questions defines the goal for the wireless network. The next step is developing the strategy to achieve that goal.

Working the Plan

Because stadium networks are inherently complex in nature, with the need to work well with many different partners, Kshatriya says the first step toward developing the plan is to decide who will "own" the network, from both a fiscal and an operational standpoint. Questions that need to be answered include determining who is best-suited to negotiate with wireless service providers who will join the network, and who is best qualified to evaluate technology solutions. Sometimes this expertise is available in-house, but for many turning to a trusted, knowledgeable and experienced partner may be the best path forward.

Beyond technology and service-contract choices there are the questions related to design and deployment. It is critical that the integrator possesses design, RF engineering and project management expertise. Further, Kshatriya advocates that field technicians and installers be certified through a third party or the DAS manufacturer: "DAS networks are highly complex and based on scientific principles".

Working the plan also means assessing current capabilities, and figuring out what is or isn't needed. An often-overlooked success key is finding or creating the space needed to house the necessary on-site networking equipment. Is there enough climate-controlled, secure real estate ready to go? Do you or your integration partners have the design capabilities to ensure that construction and deployment will be completed on schedule? Have you determined who will be responsible for testing and optimizing the network so it performs as needed? Is the network optimized to for high-capacity use to keep up with spikes and increases in demand?

Beyond the First Day On-Air

Kshatriya cautions that even when stadium wireless networks get built, they are never really truly ever "finished."

Given the rapid pace of technology advancement and the never-ending growth in wireless services demand, a successful deployment includes an important commitment to keep looking forward, to ensure the network can scale for capacity and additional services, while keeping pace through network optimization and a maintenance and monitoring plan.

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AFC NORTH

REPORTING BY CHRIS GALLO

Baltimore Ravens
M&T Bank Stadium
Seating Capacity: 71,008
Wi-Fi - No
DAS – Yes, 856 antennas
Beaconing - No

The Ravens are in the midst of a $35 million renovation to update their 15-year-old stadium. The focus of the enhancements is on aesthetics, with new video boards and more LED displays being installed.

No Wi-Fi at the stadium yet, but fans should have no problem getting a cell signal via the now 2-year old Corning MobileAccess DAS system.


Photo: Tysto Public Domain

Cincinnati Bengals
Paul Brown Stadium
Seating Capacity: 65,515
Wi-Fi - Yes
DAS - Yes
Beaconing - No

The upgrades on the field over the last two seasons have been significant for the Cincinnati Bengals. And soon you'll be able to say the same about Paul Brown Stadium. A DAS in already in place, and Wi-Fi from Extreme Networks is on the way, expected to be in place for all home games this NFL season.

Cleveland Browns
FirstEnergy Stadium
Seating Capacity: 73,200
Wi-Fi - No, planned for 2015
DAS - Yes
Beaconing - No

Less than a year ago, the Cleveland Browns were awarded $62.5 million from the NFL to improve FirstEnergy Stadium. Upgrades for the 15-year-old stadium include Wi-Fi, video boards, and a new sound system. With two first-round draft picks, a Heisman trophy winner potentially under center, and another new coach - the stadium is not the only thing experiencing a makeover. But Browns fans will have to wait a year to have Wi-Fi and Johnny Football at the same time.

Pittsburgh Steelers
Heinz Field
Seating Capacity: 65,500
Wi-Fi - Yes, 193 access points
DAS - Yes, 339 antennas
Beaconing - No

With plans to increase its capacity over the coming years, it's important for Heinz Field to continue to be one of the best home field advantages in all of football. The easiest way to do that is to keep fans happy.

And as a Steelers fan, what sounds better than waving your Terrible Towel whilst taking a selfie? Steelers faithful can do just that thanks to 193 Wi-Fi access points and 339 DAS antennas outfitted from AT&T and Verizon. Now can Pittsburgh return to the playoffs after a 2-year break?

AFC EAST

Buffalo Bills
Ralph Wilson Stadium
Seating Capacity: 71,757
Wi-Fi - No
DAS - Yes, 200 antennas
Beaconing - No

The Buffalo Bills have had a busy offseason. After the passing of longtime owner Ralph Wilson, the oranization [add] is close to being bought by Buffalo husaband-and-wife team of Terry and Kim Pegula for $1.4 billion, with approval by owners expected to come in October.

Even while the future of the team was uncertain, the stadium named after its longtime owner became fan-friendlier. New gates to enter the stadium, HD video boards, and increased cell service are just a few of the improvements. No Wi-Fi, but Ralph Wilson Stadium does have over 200 DAS antennas.

New England Patriots
Gillette Stadium
Seating Capacity: 68,756
Wi-Fi - Yes
DAS - Yes
Beaconing - No

The New England Patriots are doing everything to get fans off the couch and in Gillette Stadium, with Wi-Fi outfitted by Extreme Networks, a team-centric Game Day Live mobile app, and a squad that's won the AFC East 5 years in a row. Is it time for another Patriots Super Bowl run?

Miami Dolphins
Sun Life Stadium
Seating Capacity: 75,540
Wi-Fi - Yes, 1,100 access points
DAS - Yes
Beaconing - Yes

Near the end of the 2013 season, Sun Life Stadium became one of the NFL's first venues to feature beacon technology. The Qualcomm Gimbal contextual awareness platform delivers coupons for concessions as fans walk by and alerts them of shorter wait times on the concourse. Plus, AT&T upgraded the stadium with more than 1,100 Wi-Fi access points and DAS antennas a year ago.

All of this has the Dolphins delivering one of the better wireless game day experiences. The search to find a new Dan Marino, however, is still a work in progress.

New York Jets
MetLife Stadium
Seating Capacity: 82,500
Wi-Fi - Yes, 850 access points
DAS - Yes, over 600 antennas
Beaconing - No

There are lots of benefits to hosting a Super Bowl - including the improved connectivity of your stadium. After AT&T and Verizon spent over a year outfitting MetLife Stadium with their own DAS deployments, the stadium saw a 60 percent increase in wireless data from the previous Super Bowl.

Safe to say the stadium is well-equipped to easily connect fans with 850 Wi-Fi access points and more than 600 DAS antennas. MetLife Stadium enters its fourth season and continues to make the fan experience unforgettable. Now can the Jets make 2014 an unforgettable season and find their way back to the playoffs?

AFC SOUTH

Houston Texans
NRG Stadium
Seating Capacity: 71,054
Wi-Fi - No
DAS - No
Beaconing - No

The Houston Texans have lots of holes to fill after a 2-14 season last year. Is a new coach, the number one draft pick to play alongside J.J. Watt, and one of best wideouts and running backs in the game a recipe for success in 2014? We'll see.

One area that won't improve in 2014 is stadium connectivity. With no Wi-Fi, Texans fans will struggle to check their fantasy stats at games.

Photo: eschipul CC

Indianapolis Colts
Lucas Oil Stadium
Seating Capacity: 63,000
Wi-Fi - Yes
DAS - Yes
Beaconing - No

After an exciting home playoff win last season, Colts fans are ready for another promising year. Lucas Oil Stadium enters its sixth season and another year with Wi-Fi upgrades. The facility is another beneficiary of hosting a recent Super Bowl, which brings lots of carrier spending to ensure a quality experience for the big game.

There are no specifics on access points or DAS antennas, but the organization is encouraging fans to test the upgrades by watching the last play, checking the latest stats, and sharing photos with friends. Indianapolis is doing everything to make Lucas Oil Stadium the best place to catch the Colts on Sunday.

Jacksonville Jaguars
EverBank Field
Seating Capacity: 67,297
Wi-Fi - Yes
DAS - No
Beaconing - No

Any guesses where the largest video boards are in the world? That's right. EverBank Field in Jacksonville. The Jaguars installed two video boards that showcase almost 22,000 (!) square feet of digital canvas.

The video boards are the highlight of a $63 million dollar renovation to the stadium that also includes not just one – but two swimming pools. Yes, a pool. And cabanas. The Jaguars are teaming up with Extreme Networks and SignalShare to deliver Wi-Fi access to fans for this season. No DAS yet, but expect more upgrades to follow soon at EverBank.

Tennessee Titans
LP Field
Seating Capacity: 69,149
Wi-Fi - Yes
DAS - Yes
Beaconing - No

Another outfit by Extreme Networks, Titans fans will be able to connect this fall to Wi-Fi at LP Field. It's a major upgrade from years past, as new owner Tommy Smith continues to deliver on his promise of changes to the organization. The Wi-Fi was expected to be in full use for all home games this NFL season, starting in September.

AFC WEST

Denver Broncos
Sports Authority Field at Mile High
Seating Capacity: 76,125
Wi-Fi - Yes
DAS - Yes
Beaconing - No

When Sports Authority Field at Mile High is at full capacity (76,125) on game days, the stadium is the 14th largest city in Colorado. And it's a well-connected one too. Because the Denver Broncos deliver TE Connectivity DAS and a Verizon-built Wi-Fi network to the stadium.

On the Wi-Fi side, Sprint should be joining this season, allowing its customers to join Verizon's with free Wi-Fi access. Verizon, which has added Wi-Fi APs in strategic spots around the facility, has also added an additional 180 DAS antennas to its network. AT&T customers use a separate DAS at Sports Authority, and Sprint is also adding to its DAS deployment with more antennas.

Kansas City Chiefs
Arrowhead Stadium
Seating Capacity: 76,416
Wi-Fi - Yes, 600+ access points
DAS - Yes
Beaconing - No

On a quest to challenge the HD experience at home, Chiefs president Mark Donovan delivered Wi-Fi and a mobile app to Arrowhead Stadium last season. Chiefs fans will continue to be able to share status updates and check fantasy lineups on game days in 2014. Let's hope the support helps Kansas City make the playoffs for consecutive seasons for the first time since 1994-1995.

Oakland Raiders
O.Co Coliseum
Seating Capacity: 56,057
Wi-Fi - No
DAS - Yes
Beaconing - No

The Raiders enter 2014 seeking their first winning season in over a decade. The fans will have to cheer their team on without Wi-Fi for another year at O.Co Coliseum. Despite being available for A's fans, when the stadium capacity increases by almost 20,000 people for football, Raiders faithful are left without any access.

San Diego Chargers
Qualcomm Stadium
Seating Capacity: 70,561
Wi-Fi - No
DAS - Yes
Beaconing - No

The stadium that's named after the wireless giant remains a mystery. Because Wi-Fi in Qualcomm Stadium, a facility whose sponsor's fortunes come mainly from the sale of wireless-phone silicon, is still absent.

The stadium that hosted the Super Bowl over a decade ago does have DAS antennas courtesy of AT&T for improved cell coverage.

Photo: Minerva Vazquez CC

NFC NORTH

Chicago Bears
Soldier Field
Seating Capacity: 61,500
Wi-Fi - Yes, 175 access points
DAS - Yes, 220 access points
Beaconing - No

An unexpected experiment tested Soldier Field's connectivity in 2013. Severe weather delayed the Ravens and Bears Nov. 17 tilt for two hours, meaning fans were reaching for their phones all at once to stay connected. The wireless activity doubled in this time period, but Solider Field handled it as Brandon Marshall would a Jay Cutler pass – with ease.

Boingo and AT&T boosted the stadium's DAS with over 220 antennas. Combine that with 175 Wi-Fi access points, and one of the NFL's oldest stadiums is well-connected. However, it will cost fans to be connected – $1.99 per day or $7.95 for the monthly Boingo fee.

Detroit Lions
Ford Field
Seating Capacity: 65,000
Wi-Fi - Yes
DAS - Yes
Beaconing - No

The Detroit Lions have one of the more exciting offenses in the NFL. And now fans will be able to share that excitement as Verizon brings Wi-Fi to Ford Field in 2014. It's a major upgrade for a stadium that enters in 12th season. Will the improvement spill over onto the field, and have the Lions host their first playoff game since 1994?

Photo: JL1Row CC

Green Bay Packers
Lambeau Field
Seating Capacity: 80,735
Wi-Fi - No
DAS - Yes
Beaconing - No

The oldest home stadium in the NFL is still a memorable place to catch a game. But after the Packers needed corporate sponsors to sell out last year's home playoff game against the San Francisco 49ers, the organization is planning more upgrades.

The Packers are in the middle of another multi-million dollar renovation that improves score-boards, increases capacity, and has plans to add Wi-Fi to the stadium in the near future.

Minnesota Vikings
TCF Bank Stadium
Seating Capacity: 52,000
Wi-Fi - Limited / in select areas only
DAS - Yes
Beaconing - No

The Vikings are headed for the outdoors in 2014 and 2015. While the organization's new digs are being built, the team will play at TCF Bank Stadium - home of the Minnesota Golden Gophers. While not available throughout the stadium, there is some Wi-Fi present (in suites and club areas), as well as a new DAS upgrade from AT&T.

NFC SOUTH

Atlanta Falcons
Georgia Dome
Seating Capacity: 71,280
Wi-Fi - Yes, approximately 500 access points
DAS - Yes
Beaconing - No

Last year's 4-12 record came as a surprise to Falcons fans after three straight playoff seasons. With lots of talent on the field, the fans are looking forward to a rebound year. And they'll get to follow the team with ease as the multi-venue Georgia Dome features 500 Wi-Fi access points from Cisco.

Carolina Panthers
Bank of America Stadium
Seating Capacity: 74,455
Wi-Fi - Yes, 645 access points
DAS - Yes
Beaconing - No

Bank of America Stadium receives a Wi-Fi boost from AT&T in 2014. Now with 645-plus Wi-Fi access points, Panthers fans should find it a little easier to share that photo of Cam Newton's touchdown celebration. Will they be able to do so for another home playoff game?

New Orleans Saints
Mercedes-Benz Superdome
Seating Capacity: 76,468
Wi-Fi - Yes, 600+ access points
DAS - Yes
Beaconing - No

Remember the blackout from Super Bowl XLVII? How could you forget? The Superdome doesn't. Good thing the versatile venue was prepared to keep fans connected with a robust DAS and more than 600 Cisco Wi-Fi access points. Saints fans will have plenty to share on game days with a high-powered offense back in 2014.


Photo: David Reber CC

Tampa Bay Buccaneers
Raymond James Stadium
Seating Capacity: 65,890
Wi-Fi - Yes
DAS - Yes
Beaconing - No

After installing Wi-Fi in 2012 and releasing an updated team mobile app in 2013, Tampa Bay delayed plans to enhance the stadium's video boards in the offseason. The reason? The organization wants to supersize the upgrades with larger screen sizes and video replay capability.

Owned by the Tampa Bay Sports Authority, Raymond James Stadium has secured the 2017 College Football National Championship game. This means Bucs fans can expect the game day experience to continue to improve in the coming years. And with a new coach and new quarterback in town, Bucs faithful have plenty to look forward to in 2014.

NFC EAST

Dallas Cowboys
AT&T Stadium
Seating Capacity: 105,121
Wi-Fi - Yes, 1,525 access points
DAS - Yes, 1,374 antennas
Beaconing - No

Everything is bigger in Texas – including connectivity. AT&T Stadium features 1,525 Wi-Fi access points and 1,374 DAS antennas. That's enough cellular capacity to service the small suburb of McKinney, Texas.

While watching Tony Romo target Dez Bryant, Cowboys fans will notice a new 130-foot LED display along the east platform. The AT&T Fan Experience board features 40 robotic panels that work in combination with other stadium displays to entertain fans all game along. And don't forget the big TV hanging in the middle of the place!

New York Giants
MetLife Stadium
Seating Capacity: 82,500
Wi-Fi - Yes, 850 access points
DAS - Yes, over 600 antennas
Beaconing - No

The Super Bowl champions just three years ago, it appears their bunk mates' play is rubbing off on the Giants. Like the cross-town Jets, the G-Men missed the playoffs for the second straight season last year. If it's any consolation, the Giants still share one sports top venues in MetLife Stadium.

AT&T and Verizon gave enough love and attention the stadium last year as host of Super Bowl XLVII. Over 600 DAS antennas, 850 Wi-Fi access points, CISCO StadiumVision with over 2,100 HD TVs around the concourse – that's a recipe for a good time at a game. Let's hope the Giants give fans something to cheer about this year.

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Philadelphia Eagles
Lincoln Financial Field
Seating Capacity: 69,176
Wi-Fi - Yes, 600+ access points
DAS - Yes
Beaconing - No

Lincoln Financial Field is one of the "greenest" stadiums in all of professional sports. And that's not just because of the Eagles colors. All (100 percent) of the Eagles operations are powered by the sun and the wind.

The stadium's connectivity is something fans can get behind too. With over 600 Wi-Fi access points and a group of Extreme Networks' "Wi-Fi coaches", the Eagles are doing everything they can to make sure fans are connected at games. This year, the organization is partnering with CrowdOptics to test out wearable devices on Sunday. Imagine watching LeSean McCoy break a big run through Google Glass.

Washington Redskins
FedExField
Seating Capacity: 85,000
Wi-Fi - Limited / club level only
DAS - Yes
Beaconing - No

A new coach, name controversy, and a $27 million dollar renovation underway at FedEx Field. It's been an offseason full of distractions in the nation's capital.

Though the team promised Wi-Fi for fans for this season, so far it is only available for club level seating.

NFC WEST

Arizona Cardinals
University of Phoenix Stadium
Seating Capacity: 65,000
Wi-Fi - Yes, over 100 access points
DAS - Yes
Beaconing - No

As the site of the Super Bowl XLIX, University of Phoenix Stadium is in the midst of massive upgrades. This includes an $8 million dollar improvement for faster wireless and larger video boards. The stadium turned eight this summer and already has one Super Bowl under its belt. Look for more information about upgrades throughout the year before the big game on Feb. 1, 2015.

San Francisco 49ers
Levi's Stadium
Seating Capacity: 68,500
Wi-Fi - Yes, 1,200 access points
DAS - Yes, 700 antennas
Beaconing - Yes

There is a buzz around Levi's Stadium entering this season. And for good reason. The brand-new venue boasts more than 1,200 Wi-Fi access points and 700 DAS antennas. Aruba Networks (Wi-Fi) and DAS Group Professionals are hoping to fulfill the 49ers' desires to own the most-connected stadium in all of sports. An ambitious new team app, with replays and food ordering and delivery to all seats is also part of the technology offerings.

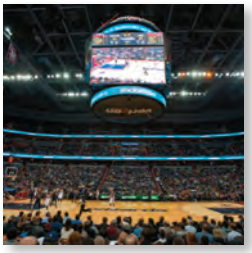
Early tests of the stadium network during the preseason were promising, with Wi-Fi speed tests into the tens and 20s of megabit per second performance. On the DAS side, strong cellular signals were reached, with a nearly full house of fans. The question for the network, like the team itself – can it keep performing at a high level during the regular season?

Seattle Seahawks
CenturyLink Field
Seating Capacity: 72,000
Wi-Fi - Yes
DAS - Yes
Beaconing - No

Fans of the reigning Super Bowl Champions will have more to cheer for in coming years at CenturyLink Field. The question is, will the loudest stadium in the NFL stay that way if Seahawks fans are using their phones more often, now that Verizon has installed stadium-wide Wi-Fi?

St. Louis Rams
Edward Jones Dome
Seating Capacity: 66,000
Wi-Fi - No
DAS - Yes
Beaconing - No

After a proposed $700 million dollar upgrade was rejected, the St. Louis Rams are still seeking to improve the Edward Jones Dome. The good news for fans is that for this season a Mobilitie neutral-host DAS should significantly improve cellular communications not just in the stadium itself, but also in the adjacent convention center.



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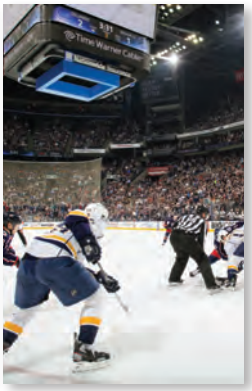


MOBILITIE'S ALL-STAR COVERAGE TEAM INCLUDES THE LARGEST VENUES ACROSS ALL PROFESSIONAL SPORTS LEAGUES

NFL NBA NHL MLB MLS


FOR
THE
FANS

In a league known for its intense rivalries,

is it possible to get teams to work together and share information for the betterment of all?

In the area of stadium technology, that task is on the to-do list for Michelle McKenna-Doyle, who is just starting her third season as chief information officer for the National Football League.

In an interview with Mobile Sports Report, McKenna-Doyle outlined some of the league's recent accomplishments in technology-related areas like instant replay and digital content, while also explaining how the league oversees stadium technology deployments. According to McKenna-Doyle, one of her office's jobs is to act as a best-practices and lessons-learned clearing-house, to better move the state of NFL stadium technology forward faster as a whole.

"One of our roles is helping teams help themselves" with technology deployment strategies, McKenna-Doyle said. "What we want is to provide a forum where clubs can share information with each other. If somebody's done something and learned it doesn't work, we can tell other clubs not to waste their time doing the same thing."

Focusing on the business uses of technology and not the 1s and 0s is somewhat of a natural fit for McKenna-Doyle, who spent 13 years at the Walt Disney Company in disciplines including finance and marketing before becoming a VP in IT for two years. During CIO stints at Centex Homes and Universal Orlando Resort, McKenna-Doyle said she focused on using technology to enhance the guest experience, a goal the NFL sought when it brought her aboard in September 2012.

"Part of my job is making sure our in-stadium experience for mobility meets the needs of our fans," McKenna-Doyle said. While it is true that commissioner Roger Goodell said he wanted all NFL stadiums to have fan-facing Wi-Fi, and that the league does expect teams to meet a minimum set of connectivity standards, McKenna-Doyle said the NFL's overall stadium-tech strategy is to be more of a guide than to dictate exactly which technologies or apps teams should deploy.

"People really are fans of their own team first, and we encourage clubs to have that engagement, and help them interact with fans," McKenna-Doyle said. "There are minimum standards and we do grade their [technology] experience, and report that back to the club. But they manage it. We are more of a guide."

Putting out a plan for stadium Wi-Fi

In the area of Wi-Fi, for example, McKenna-Doyle said that last year the league put together "a really deep-dive spec" that laid out all the basics necessary for stadium Wi-Fi deployments. "That was so teams didn't have to start at square one for design," McKenna-Doyle said.

The league also helped move Wi-Fi deployments forward faster by signing a preferred-supplier deal with Extreme Networks, under which teams get a discount on pricing in exchange for the league-wide sponsorship exposure. Though teams are not required to use Extreme's Wi-Fi gear, new Extreme-based Wi-Fi networks are in

use this season at Jacksonville, Tennessee, and Cincinnati, joining two previous Extreme installations in Philadelphia and New England.

"It's a great option if teams choose Extreme, and it [the league deal] also creates a competitive environment for other suppliers like Cisco to step up," McKenna-Doyle said.

If necessary, the league can also play Wi-Fi matchmaker, as McKenna-Doyle said it did in bringing partner Verizon into Seattle, where the carrier deployed a Wi-Fi network at CenturyLink Field that is live this season.

At the writing of this report, 10 of the NFL's 32 teams still had no fan-facing Wi-Fi services at their stadiums, a list that includes Green Bay, Baltimore, Cleveland, Buffalo, Houston, Oakland, San Diego, Washington, Minnesota and St. Louis. While McKenna-Doyle said that there are "a few more Wi-Fi announcements coming," she also noted that some teams with lease uncertanties still don't have firm plans to deploy Wi-Fi.

"WE STRESS THAT IT'S NOT ABOUT THE TECHNOLOGY, BUT ABOUT THE FAN EXPERIENCE."

Help on the app side with partner YinzCam

McKenna-Doyle said the league also provides assistance in stadium application development via YinzCam Inc., a Pittsburgh-based company that has developed mobile apps for a number of pro sports teams. The NFL, which was an investor in YinzCam, uses the company's technology in its league mobile apps, and McKenna-Doyle said YinzCam is also developing an app for the upcoming Super Bowl XLIX that will be "like nothing we've ever had before."

Though teams are not required to use YinzCam – the San Francisco 49ers, for example, turned to newcomer VenueNext to develop their Levi's Stadium app – McKenna-Doyle said that YinzCam may be a fit for other teams. "For quality and speed to market, [YinzCam's] product is very strong," McKenna-Doyle said.

It's about the fans, not the technology

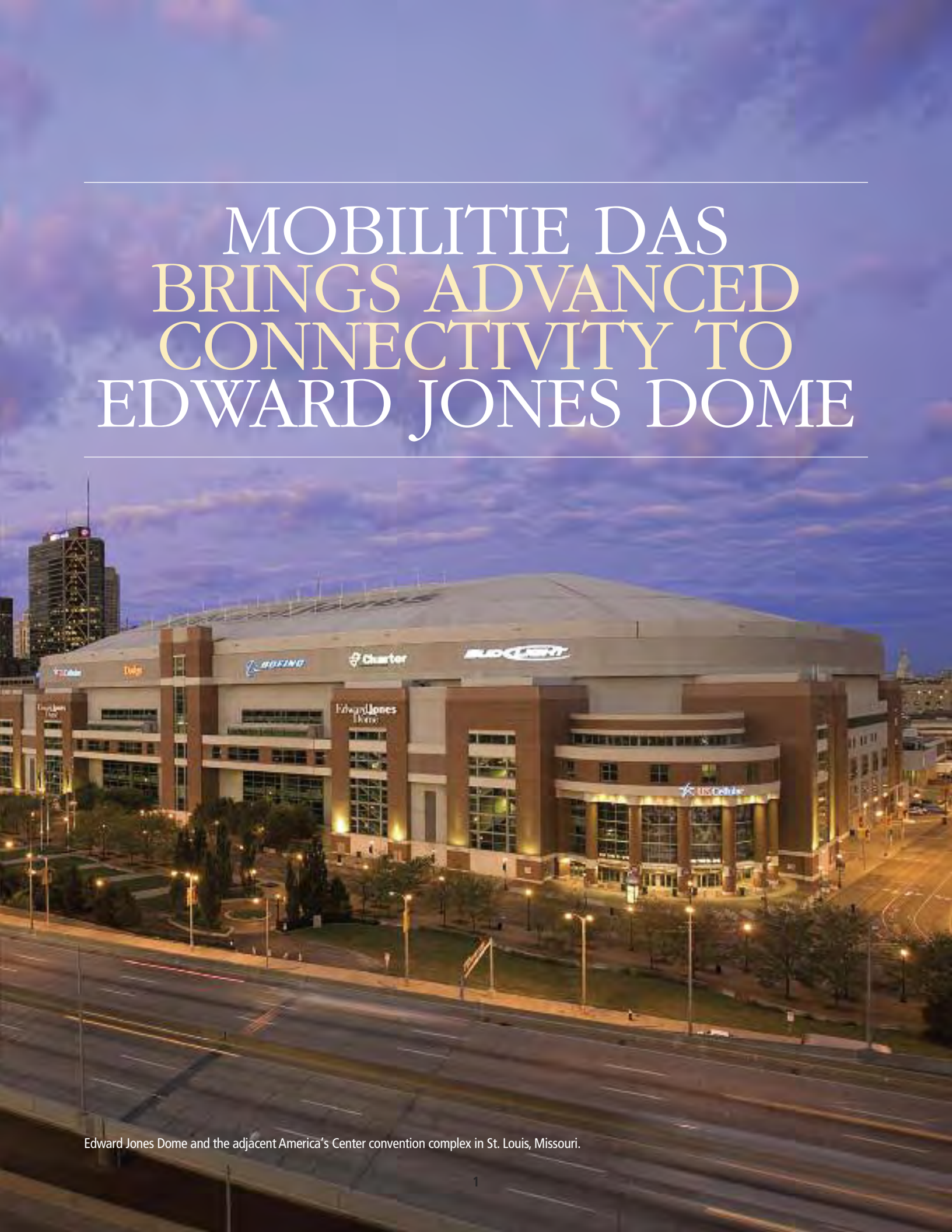
Michelle McKenna-Doyle, Chief Information Officer for the National Football League

Following a summer that saw her office overseeing the new method for on-field official review of replay calls – "which meant building a new system for 32 teams, 31 stadiums, and training all the officials" – as well as the launch of the NFL Now digital content site, McKenna-Doyle is back spending time with teams, counseling them on technology deployment resource management – "what to prioritize, and what to put on the back burner," she said.

That includes technology ideas that might not work operationally, like a food-ordering service that isn't staffed properly. For the in-seat food ordering feature at Levi's Stadium, for instance, the 49ers said they did extensive research, hiring and training to make sure they had enough feet on the ground – runners carrying orders – to make the tech-inspired feature work. If teams don't do the human engineering behind the scenes, McKenna-Doyle said, the technology may not be that cool.

"We stress that it's not about the technology, but about the fan experience," McKenna-Doyle said. "It has to be operationally sound, and it has to be integrated with being at the game. If it's not something that's operationally sound, you might be better off not doing it." -MSR

MOBILITIE DAS BRINGS ADVANCED CONNECTIVITY TO EDWARD JONES DOME



Edward Jones Dome and the adjacent America's Center convention complex in St. Louis, Missouri.

You can add the Edward Jones Dome in St. Louis to the list of large, public facilities that used to have a common No. 1 complaint from visitors: Why doesn't my cell phone work?

"People get really anxious when they can't get a signal," said Marty Brooks, senior vice president and general manager of the Edward Jones Dome and the adjacent America's Center convention complex. "It's been our number one complaint, that people can't connect."

To address its connectivity issues, the team in charge of IT at the 66,000-seat stadium that is home to the NFL's Rams and the adjacent 500,000-square-foot convention center enlisted wireless infrastructure supplier Mobilitie to install a neutral-host distributed antenna system (DAS) in time for the current NFL season. When it's live, cellular reception for customers of all the major carriers should improve drastically, even in the concrete hallways and closed meeting rooms of the connected facilities.

"Like many facilities that are 10 years old or older, we were not prepared for the [wireless] demands that the public and our clients have brought," Brooks said in a recent interview with MSR. "It was a no-brainer for us to upgrade. We knew we had to."

Aside from the connectivity issues, the deployment schedule Brooks and his team chose – DAS first – is also in line with many other facilities. Though Wi-Fi services often get more public attention, according to Mobile Sports Report's 2014 State of the Stadium Technology Survey, most large public facilities that are installing new wireless infrastructure put a priority on DAS, perhaps because it alleivates the most pressing problem, that of having no connection at all.

"Our first priority was to address [basic] cellular, because we felt we could mobilize that deployment faster," said Brooks. Though the facility, which opened in 1995, also hopes to bring Wi-Fi in, Brooks said the early negotiations confirms his beliefs that installing Wi-Fi is a longer process.

"We hope to get Wi-Fi installed in a couple years," Brooks said. "But DAS will bring an immediate marked improvement."

Marty Brooks, Senior Vice President and General Manager of Edward Jones Dome

Staying in Neutral

Though the largest wireless carriers in the U.S., especially AT&T and Verizon Wireless, often like to lead or build DAS installations they are a part of, Brooks said that the St. Louis arena and convention center – which is owned by the St. Louis Regional Sports Authority and operated by the St. Louis Convention/Visitors Bureau – knew it wanted a third-party DAS operator.

"We felt the [DAS] backbone should be built like Switzerland," said Brooks, who said that carrier groups were not even allowed to bid for the system's construction. In the end the complex went with Mobilitie, a firm whose long track record of putting DAS into large public venues helped Brooks and his team move confidently forward.

"Mobilitie has good relationships with all the carriers, and they had the experience we were looking for," Brooks said.

"Our focus has always been to be a good partner with [wireless] carriers," said Christos Karmis, president of Mobilitie, in a recent interview. One of the benefits a facility owner or operator gets when they work with a neutral provider like Mobilitie is the accumulated knowledge gained by doing many large-venue deployments, and the internal resources to have staff who knows the differences in needs between the major carriers.

"We have people who are 100 percent dedicated to each of the different carriers, and how their technology changes from year to year," Karmis said. "You have to stay up to speed or even

Inside the 66,000-seat Edward Jones Dome – home of the NFL's Rams.

ahead of it. If not, you end up in a situation where [the DAS] is not deployed right and the carriers don't move onto the system."

Antennas easy, cabling hard

According to Brooks, the easy part of the DAS installation is the deployment of the actual antennas. The hard part, he said, is stringing all the cable necessary to bring signals to the antennas, especially in the "dark" areas like long concrete-walled hallways and the convention center's many internal meeting rooms. Pulling all the wire is very difficult and time consuming," Brooks said. "We need to make sure that the media members who are working back at the end of dark corridors, or the suite holders in the backs of their suites, all have the ability to connect with their cell phones. Same with the all the attendees in our convention halls. We need to bring [wireless] access to all the inner spaces of a steel and concrete building."

For its DAS operations, the facility has a 1,700-square foot enclosure with all the necessary HVAC and electricity. Brooks said stadium owners and operators need to "be creative" in finding spaces for DAS gear, which has only grown larger the past few years with the 4G LTE network deployments from all the major carriers.

Planning for crowds beyond the game

Unlike other stadiums that exist by themselves, the combination of arena and convention center makes for some unusual crowd gatherings, Brooks said, including a half-dozen or so times a year when the 66,000-seat stadium is at capacity while another 25,000 to 30,000 people are at the convention center.

But just like they expect their team to win no matter who the opponent is, Brooks said Rams fans also expect their phones to work on game day – and they aren't shy about letting his team know if their performance isn't a winning one.

"There's such a level of expectation for the service we have to provide – and the fans are not shy about letting us know," Brooks said. "But we told them, we're committed to making this happen."

-MSR


Make the Call.
Send the Photo.
Tweet the Action.
This is the Silicon Valley. We expect the latest technology. We demand a communications network to support the data and call load we generate with calls, texts, posts, photos, apps... anything.
Levi's Stadium proudly delivers. Its high performance service is brought to fans via a state-of-the-art communications network designed, built and managed by DAS Group Professionals.
Proudly supporting all stadium communications using AT&T, Sprint, T-Mobile and Verizon.
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Wi-Fi + ADVANCED STADIUM APP HELPS EAGLES 'LINC' WITH FANS

BY PAUL KAPUSTKA

With victories in their first three games, the Philadelphia Eagles are off to a fast start this NFL season. And from a networking standpoint, Eagles fans are keeping pace, with Wi-Fi connections at Lincoln Financial Field already surpassing last year's totals.

Now in the second season of having full-stadium Wi-Fi available for fans, the Eagles' technology team is pushing the needle forward, much like the high-powered offense head coach Chip Kelly runs on the field. An already advanced stadium app will soon get even more video features, including instant replay, to further enhance the game experience for the 69,176 fans who fill the "Linc" on home-game Sundays.

According to Anne Gordon, the Eagles' senior vice president for media and communications, there were more than 21,000 fans using the in-stadium Wi-Fi network at the team's Sept. 7 opening game, a total that surpasssed the 19,671 users on the network at the Eagles' final game last season, a 26-24 loss to the New Orleans Saints in a wild card game on Jan. 4, 2014.

Along with the growth in user numbers is an even greater jump in the amount of data being used; according to Gordon, the Eagles' Extreme Networks-powered Wi-Fi network carried 946 Gigabytes of data in the Sept. 7 game against the Jacksonville Jaguars, up from around 400 GB used during the playoff game in January. Unlike some other stadiums with Wi-Fi networks, Gordon said that the Linc network regularly sees fans download more data than they upload – a reflection of the team's strategy to provide a wide range of custom content for fans to help improve the game-day experience.

"We want to help them become better fans, and improve their enjoyment of the game," said Gordon in a recent phone interview. "That was our vision from the beginning."

But to get to that vision, the Eagles first had to give fans a way to get the content. That meant using some of the $125 million in recent renovation fees to build out the stadium-wide Wi-Fi network, which Gordon said eliminated past connectivity headaches for Philadelphia fans.

Build it, and show them how to use it

"Prior to the 2013 season, there were real issues trying to connect mobile devices in the stadium," Gordon said. "You might get a signal, but then walk 20 steps and lose it. When we talked to fans, improving the wireless network [in the stadium] was high on their list."

Anne Gordon, Philadelphia Eagles Senior Vice President for Media and Communications

Working with partner Extreme Networks, which now runs Wi-Fi networks in four other NFL stadiums, the Eagles had stadium-wide coverage ready to go before the 2013 season kicked off. But unlike some venues, which do little to promote their in-stadium networks, the Eagles and Extreme brought some more NFL flavor to their wireless experience in the form of "Wi-Fi coaches," network-savvy people who roamed the stands in readily identifiable clothing, offering personal assistance to fans trying to connect.

"We put notes in the cup holders the first few games of last season, and then had the coaches with jackets that said 'ask me' on them," Gordon said. That little bit of assistance, she said, spreads quickly.

"If you connect one person, that fan shows six more people in the row [how to connect]," Gordon said. "Our fans took to the network immediately."

And just in case fans need a refresher, the team's website has perhaps the league's best help pages, with simple screen shots showing how to install, open and use the most popular features on the team app.

Out front with app features

As we found out in our recent report on NFL stadium technology deployments, there are many teams with stadium Wi-Fi networks, but the level of application and content delivery varies from team to team. With a feature lineup

A powerful, stadium-wide Wi-Fi network supports the Philadelphia Eagles' popular YinzCam-developed stadium app.

that includes in-stadium access to the NFL's popular RedZone channel alongside a live feed from the stadium's large video boards, the Eagles' app was clearly among the league leaders when it launched last year. And soon, Gordon said the Eagles will add more live camera views and replay choices to the menu, developments made possible in part by the team's close relationship with app designer YinzCam Inc.

"We have a unique relationship with YinzCam, and work hand in hand with them [on new developments]," Gordon said. "We're blessed in that we get a lot of things in our app first." The Pittsburgh-based YinzCam, which has designed team and stadium apps for a long list of sports-team customers, is a preferred team-app partner of the NFL, which was an early investor in the company.

With a long history of full houses, Gordon said the team doesn't need to use its network or app strategy to try to put people in seats.

"We are continuously sold out, so thankfully we don't have to sell tickets [with the app]," said Gordon, noting that some fans have had season tickets in their families for several generations. That fact allows the Eagles' tech team to make their digital strategy "100 percent about improving the game experience," Gordon said. "We're giving them a reason to download and consume."

Not possible without the network

With more than 700,000 downloads of the stadium app so far, it appears as if the Eagles have a winning digital strategy to match the team's recent on-field successes. Now the biggest challenge may be finding enough internet bandwidth to keep the fans supplied with the in-game content.

"We are definitely bumping up against our [bandwidth] pipe threshold," Gordon said. So far, it looks like the campaign to use content to improve the experience at the Linc is working – along with the network that links it all.

"If the [Wi-Fi] network doesn't work, people get frustrated and don't use the app," Gordon said. "The network is what had to happen to make this vision possible." -MSR-

SETH'S CORNER

ADVICE BEFORE YOU JUMP INTO A DAS PROJECT

BY SETH BUECHLEY

What would I need to know and do if I had no experience with Distributed Antenna Systems (DAS), but was given the problem of fixing cellular coverage in my own sports venue? My answer, in short, would be; (1) Get Educated, (2) Be Realistic, and (3) Decide Who You Will Trust.

Get Educated.

DAS is now a mainstream solution for solving indoor and high-capacity public venue wireless performance issues. There are several specialized industry conferences where you can get familiar with high-level trends and meet the vendor ecosystem that forms the DAS industry. Reading Mobile Sport Report indicates you're on the right path.

The DAS industry association, known as the HetNet Forum, is also good place to start. Most importantly, talk to those that have gone before you. I like to say that "the first person to uncharted waters should make the charts." Many of the highest profile sports venues have had years of experience with DAS systems that have evolved and in some cases been ripped-and-replaced over the years.

Use your sports industry network and attend events like SEAT 2015 to ask the tough questions about lessons learned. Never rely on the positive press releases from participating carriers as the whole story. Dig deep for the pain points and the "if you had it to do over again…" truths that come from painful mistakes.

Be Realistic.

What financial and timeline promises will you make to your stakeholders? Even though you control the venue, there are a lot of moving parts that are completely unknown on the front end of a DAS project. Most NCAA Division I schools can expect to have a DAS constructed in their football stadium at no cost to them. If we're talking about a NCAA basketball arena for no cost, the numbers probably drop by 50 percent. And, only the rare world-class venue should expect to generate meaningful rent or

profit from their DAS. A DAS without a firm commitment from the wireless operators to fund or join the DAS won't help your cause, so make sure to use your organization's influence to arrange high-level meetings with the wireless operators to get plugged into their budget cycles and align your stated schedule with what they can truly deliver on.

DAS deployments for sports venues are major projects that involve new construction, permits, license agreements with participating carriers, system integrators and consensus across multiple stakeholders in your own organization including facilities, athletics, venue ownership and team ownership. It is almost unheard of for a venue owner to complete a project within a single year.

Do yourself a career-enhancing favor and double your initial timeline estimates before going public with a target date on enhancing coverage in your existing stadium. If your sports venue is new construction you're in good shape – deadlines have a miraculous way of making people make it happen.

Assessing your own internal assets and obstacles will also help set a realistic schedule. For instance, do you have available environmentally controlled (think Data Center) carrier head-end equipment space? If not, how long will it take you to find space or build it out?

Another key area where realism is required is in the area of Wi-Fi. Carriers are currently cold on paying for adding Wi-Fi to your venue for the simple reason that Wi-Fi moves subscribers off a network they control (licensed spectrum) and moves them onto a free network (unlicensed spectrum) they have much less control over. Additionally, owning the Wi-Fi network usually comes with an obligation to replace 802.11X Access Points at a pace rivaling the fashion industry. Keep in mind that a carrier who invests properly in a DAS should have sufficient capacity to handle the traffic in that venue for a few years.

One of the biggest sticking points we have seen lately occurs when a venue demands a wireless carrier fund a Wi-Fi network in order to win the DAS deployment. If Wi-Fi is a must have for your venue, you're best off working with a Third Party Owner (3PO) who can build your DAS and Wi-Fi network for you and manage the interaction with carriers on your behalf. Several 3PO firms have gained tremendous experience deploying, and more importantly, monetizing Wi-Fi in major public venues.

Decide Who You Will Trust.

The DAS industry is growing exponentially and has many new entrants claiming that they have "built" a DAS. Do your homework on the scale, credibility, and relationships of the members of your DAS team.

Whether you self-perform using a DAS Integrator as your expert, select a 3PO to handle the whole project, or rely on a carrier to "drive the bus," make sure you're putting your project and reputation in the hands of a partner with motivation and the wherewithal to execute. Working with leading DAS industry players brings a built-in sense of obligation to meet deadlines and work through challenges since there are national ramifications when commitments aren't kept. Stated simply, major DAS OEMs, System Integrators, and 3POs can't afford to drop the ball on your project because bad news travels fast and reputation is everything.

In your research, you'll discover that technology is evolving quickly and keeping an eye on what's coming around the corner will be a key factor in avoiding having to replace or rebuild your DAS earlier than planned. By taking the time to get educated, keeping the project expectations realistic, and finding yourself a proven industry partner to trust you'll be well on your way to completing a successful DAS deployment and keeping your sports fans safe and happy.-MSR-

Seth Buechley serves as President of SOLiD, a leading DAS manufacturer providing cellular and public safety coverage in some of the worlds largest public venues including the NY Subway, Daytona International Speedway, Ohio Stadium, and Nationals Park.

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Crown Castle (NYSE: CCI, S&P 500) is one of the country's largest independent owners and operators of shared wireless infrastructure, including towers, rooftops and Distributed Antenna Systems (DAS), a type of small cell solution (SCS). Our custom designed indoor and outdoor DAS solutions help improve and enhance the fan experience for visitors who demand anywhere, anytime wireless access. From accessing real-time stats and scores to social networking, our DAS solutions help keep sports fans connected. With a DAS solution, you can offer quality cellular service from multiple carriers and provide capacity improvements to anticipate large fluctuations in crowd sizes. www.crowncastle.com

TE Connectivity (NYSE: TEL) is a $13 billion world leader in connectivity. The company designs and manufactures products at the heart of electronic connections for the world's leading industries including automotive, energy and industrial, broadband communications, consumer devices, healthcare, and aerospace and defense. TE Connectivity's long-standing commitment to innovation and engineering excellence helps its customers solve the need for more energy efficiency, always-on communications and ever-increasing productivity. With nearly 90,000 employees in over 50 countries, TE Connectivity makes connections the world relies on to work flawlessly every day. To connect with the company, visit: www.TE.com.

Mobilitie is the premier wireless infrastructure provider to sporting venues across the country. Our high density wireless infrastructure is designed to enable the latest and richest fan based experiences, including real time video streaming, location based services, social media, and other fan facing applications. We design, install, and operate neutral host DAS, Small Cell, and Wi-Fi networks at stadiums, arenas, and other public venues and marquee events. Mobilitie currently operates neutral host DAS networks across all the major professional sports leagues. To learn more about our unique and customized wireless solutions, please visit www.mobilitie.com.

DAS Group Professionals designs, builds and monitors sports venue Wi-Fi and DAS networks, including Levi's Stadium's DAS. DGP's success rests in its combined expertise in future friendly system architecture and an owner-oriented approach to the business of wireless communications. Besides the successful design and implementation of the Levi's network, DGP signed on all four major carriers, delivering a superior fan experience. DGP also provides DAS solutions for transportation providers (BART) and a range of major metropolitan buildings. Learn more at dasgroupprofessionals.com.

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Burlingame, CA 94010
Telephone: +1 650-685-6340
www.mobilesportsreport.com