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TECH REPORT

SPRING 2022

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STADIUM TECH REPORT

Welcome to the first issue of our NINTH year of STADIUM TECH REPORTS, the Spring 2022 issue!

These long-form reports are designed to give stadium and large public venue owners and operators, and digital sports business executives a way to dig deep into the topic of stadium technology, via exclusive research and profiles of successful stadium technology deployments, as well as news and analysis of topics important to this growing market.

Our stories for this issue include an in-depth look at the mind-blowing 53 petabytes of network data used at Super Bowl 56 on SoFi Stadium's converged IP network, as well as a feature profile of the new walk-through weapons detection systems being deployed at sports venues. We also have an in-depth look at the Denver Broncos' innovative concessions technology use at Empower Field at Mile High.

We'd like to take a quick moment to thank our sponsors, which for this issue include Verizon, ExteNet Systems, MatSing, Cox Business/Hospitality Network, Boingo, American Tower, and AmpThink. Their generous sponsorship makes it possible for us to offer this content free of charge to our readers.

A new hello goes out to members of the The Association of Luxury Suite Directors (ALSD) and the International Association of Venue Managers (IAVM), who now have access to Stadium Tech Report content. We'd also like to welcome readers from the Inside Towers community, who may have found their way here via our ongoing partnership with the excellent publication Inside Towers.

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

Paul Kapustka, Founder & Editor
Stadium Tech Report



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Paul Kapustka

WALK IN, WALK OUT: GET READY FOR MORE CHECKOUT- FREE CONCESSIONS

Coming soon, to a venue near you:
Checkout-free concession stands, where
you walk in, take what you want and walk
out, leaving the billing to the network.

If your stadium doesn't have these types of stands yet, just wait. If investors have anything to say about it, companies providing the technology behind the most innovative thing to possibly ever happen to the crusty old world of stadium concession stands will explode in orders for their services soon. That's the kind of momentum you can expect when multiple millions of dollars get poured into businesses that are just barely getting off the ground.

Case in point: In mid-March, the investment arms of Verizon and Qualcomm were part of a \$65

million funding round for a Silicon Valley startup called AiFi, which provides technology that powers the checkout-free or "just walk out" types of stores. These new systems basically work like this: People sign up for a prepayment system or swipe a credit card, walk into the store, pick out items they want and leave, with billing handled later. In AiFi's case the technology centers around cameras and artificial intelligence, with the cameras able to see what you are grabbing (and what you might take and put back on the shelf) and then sends you the receipt after you exit.

Why is this technology so powerful? In the short life of networked stadium technology developments, few innovations have benefited both fans and venue businesses so quickly and so directly. For fans it's as low impact as you can get — you enter billing information in an app, or even easier, just show up with a valid credit card. You walk in, grab something, and leave. No waiting behind the father wanting five different sandwich orders and six different drinks and nachos and popcorn and wait, what is a Sheboygan bratwurst? You walk in, get your Bud Light, and leave.

For teams, venues and other concessions operators, the technology is heaven on many levels. For starters, having everything automated means fewer employees in lower-value positions — and with hiring at a premium, most venues with such systems are saying they can find other, more valuable work for employees instead. While the format means that there are additional steps necessary to make the systems work (think more coolers full of cans, fewer made-to-order items, many things pre-packed for grab and go), once that flow is set in place all you have to worry about is restocking. And if the successes of the systems we've seen in place is any indicator, your next biggest worry as a venue operator is finding more space to put in more of the checkout-free stands.

CAN STARTUPS FIGHT THE 800-POUND GORILLA?

If you were at the Indy 500 last year, or at football games at Detroit's Ford Field or Miami's Hard Rock Stadium, you might have purchased items at an AiFi-powered store. In partnership with Verizon, AiFi helped deploy box-like "pop-up" stores at those venues and others, a self-enclosed concessions stand where fans could just do the walk-in, walk-out thing. According to both Verizon and AiFi, AiFi's technology was a good fit for such a Verizon-sponsored promotion because its camera-only technology only needed a solid connection (like Verizon 5G) on the back end.

While AiFi has other outlets for its technology than sports venues — it recently brought its technology to a convenience-size store in Denver and has similar customers in Poland and the U.K., among others — you can probably expect to see it in more stadiums soon. But it already has competition on the ground there, as Zippin — another Silicon Valley startup — has an existing and expanding footprint at big stadiums, including Golden 1 Center in Sacramento, NRG Stadium in Houston, AT&T Center in San Antonio, and at Empower Field at Mile High in Denver — where, with catering partner Aramark, it has its technology at no fewer than nine separate stands. And that may not be enough to satisfy demand.

With a new round of \$30 million of its own last summer Zippin (which also has its technology in other retail

areas, like airport shops and regular stores) has a funding total so far of \$45 million, more than enough of a war chest to compete with AiFi. Zippin also recently added some more stadium stores, and now has 25 Zippin stands at nine different stadiums. The big question is the big third competitor, a little Seattle firm called Amazon that recently installed its "Just Walk Out" technology in a full-sized Whole Foods store in Washington, D.C. Leaving no market unchallenged, Amazon is also moving into sports arenas, with four Just Walk Out stands at the newly renovated Climate Pledge Arena in Seattle, two more at TD Garden in Boston, one at United Center in Chicago, two at UBS Arena, and two new ones just added at Houston's Minute Maid Park.

Amazon's twist to the business is its Amazon One technology, which lets customers sign up for billing and be able to just use the palm of their hand as identification to get into and get stuff from a Just Walk Out store. Whether or not people want to give bodily information to a company run by Jeff Bezos is a question worth pondering. But letting sports fans get a beer even when they can't find their wallet may be a powerful enough incentive. So Alexa, who will be the winner?

HOW MANY STORES IS ENOUGH?

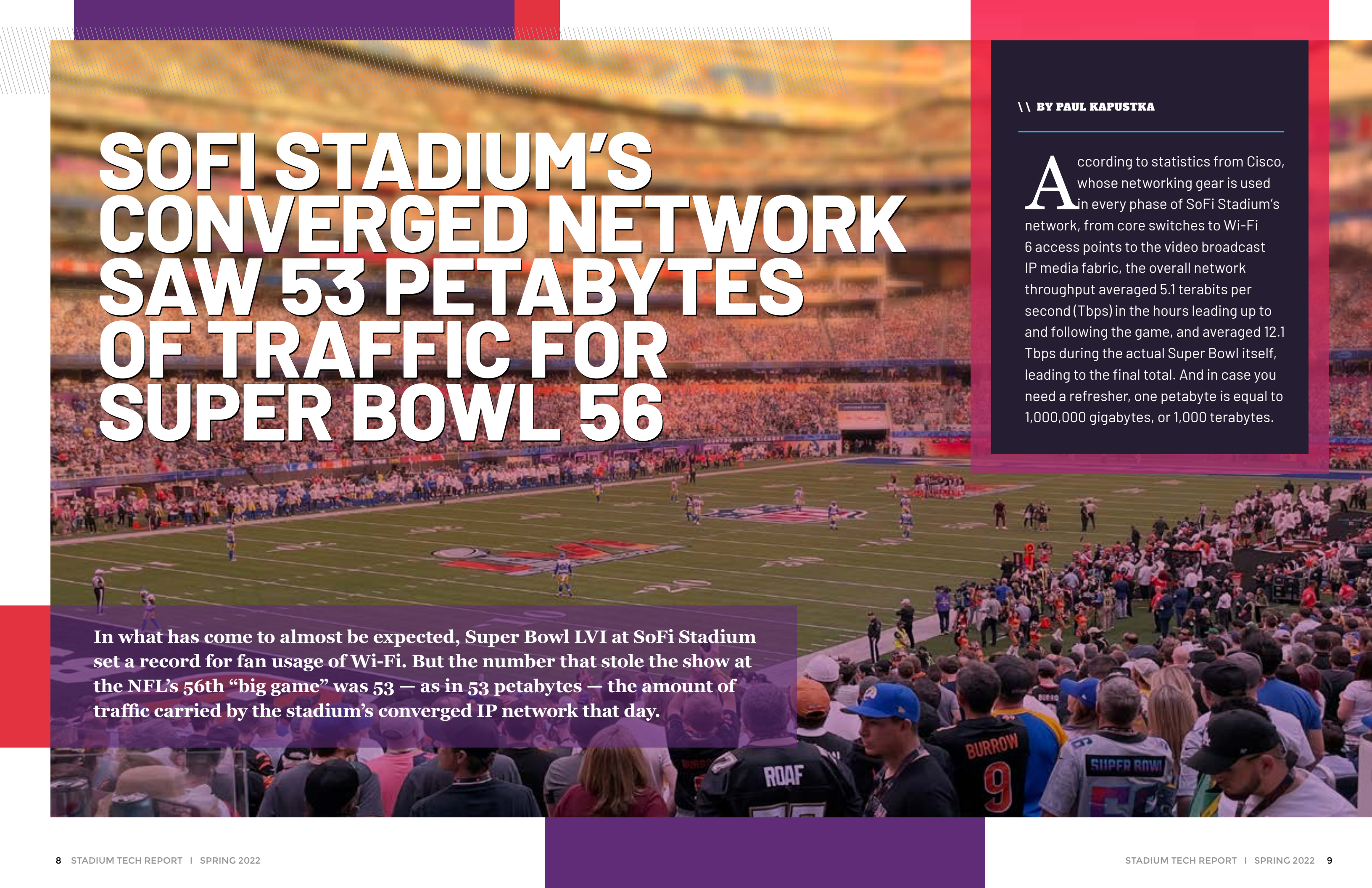
While all three entrants into the field tout their technology as one that eliminates concessions lines, our real-world observations have found that such claims aren't

exactly true. While customers don't spend much time inside the stores once they get through the gates, in Denver the Zippin-powered stands were so popular that by December Broncos fans did have to wait in line just to get into the stores — albeit probably a shorter wait than being at a traditional stand, but a line nonetheless.

And while traditional stands may never completely go away, it's a safe bet that any place that tests checkout-free stands will need more soon, as fans flock to the places that have the technology. While there is a higher up-front cost of putting such technology into existing concession spaces — sometimes the ceilings need to be elevated to support the cameras' sight lines — early returns from Denver and other places suggest that the huge increase in sales is well worth the investment.

We realize that despite the technology's sameness the unique aspects of every different venue means that like anything else, deployment stories for checkout-free concessions will widely vary. So when it arrives in your arena, tell us what happens. One thing we think for sure is there's going to be lots more tales to tell about this technology, very soon.





SOFI STADIUM'S CONVERGED NETWORK SAW 53 PETABYTES OF TRAFFIC FOR SUPER BOWL 56

\\ BY PAUL KAPUSTKA

According to statistics from Cisco, whose networking gear is used in every phase of SoFi Stadium's network, from core switches to Wi-Fi 6 access points to the video broadcast IP media fabric, the overall network throughput averaged 5.1 terabits per second (Tbps) in the hours leading up to and following the game, and averaged 12.1 Tbps during the actual Super Bowl itself, leading to the final total. And in case you need a refresher, one petabyte is equal to 1,000,000 gigabytes, or 1,000 terabytes.

In what has come to almost be expected, Super Bowl LVI at SoFi Stadium set a record for fan usage of Wi-Fi. But the number that stole the show at the NFL's 56th "big game" was 53 — as in 53 petabytes — the amount of traffic carried by the stadium's converged IP network that day.

As perhaps the stadium with the single largest such converged network – and the only one with the content-devouring Infinity Screen by Samsung video board – SoFi Stadium may have set a high-water mark for total network usage that may be hard for any other single building to approach. But more important perhaps than the raw numbers from the game is the proof that converged IP-based networks can indeed support the highest demands of all network systems in a large venue, and can do so at a much cheaper cost and with easier management than the traditional deployment of separate networks for each service.

THE HUGE DEMANDS OF VIDEO, ALL ON AN IP NETWORK

According to a blog post by Matt Swartz, a distinguished engineer within Cisco’s customer experience organization, the truly mind-boggling numbers came in large part from the video demands of SoFi Stadium’s big board as well as its 2,500 IPTV screens, which include 300 outdoor signs in and around the stadium and the surrounding Hollywood Park development.

Top: It takes a lot of cabling to carry 53 petabytes. Bottom: The Infinity Screen by Samsung gets ready for the big show. Credit, top: Paul Kapustka, STR. Credit, bottom: Dan Grimsley, STR.



According to Swartz, during the Super Bowl the broadcast network by itself was processing 24 Tbps, throughput made possible by the Cisco IP Media Fabric in the venue. For IPTV needs specifically, the network was running 2.5 gigabits per second of multicast traffic, bringing full uncompressed 4K feeds to every connected screen.



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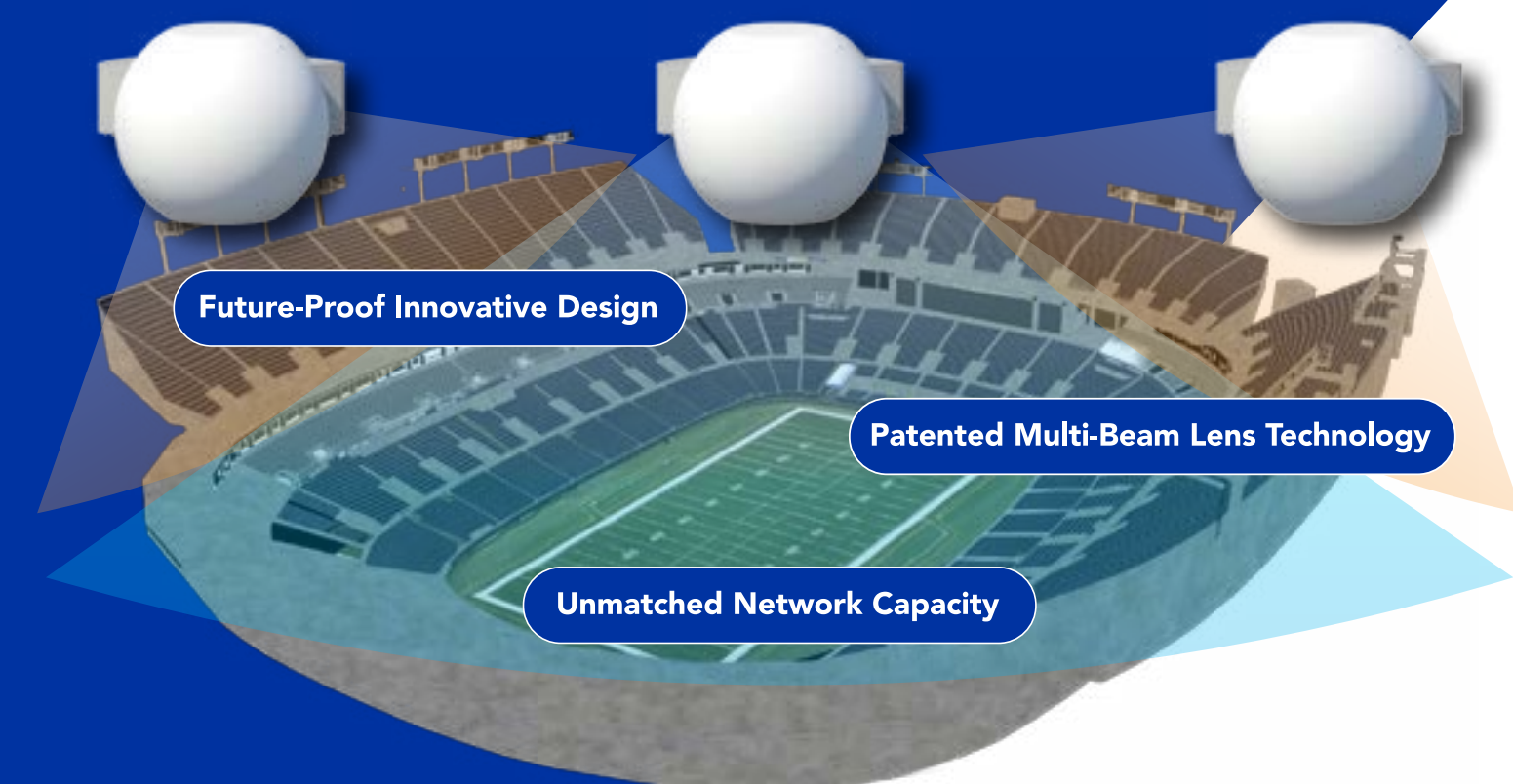


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Top and bottom left: Data-generating fans were everywhere on Super Sunday, from outside the NFL media headquarters to the various plazas surrounding SoFi Stadium. Bottom right: The main data room at SoFi Stadium. Credit all photos: Dan Grimsley, STR

The all-Cisco Wi-Fi 6 network, the largest in any stadium, set new records for single-day Wi-Fi usage, with 31.2 TB recorded, according to statistics provided by Extreme Networks. Super Bowl LVI also set a record for the highest percentage of unique Wi-Fi device connections with 57,618, which out of the 70,048 in attendance made for a “take rate” of 82 percent. Previous high Wi-Fi “take rates” seen include 71.5 percent at Ohio State’s Ohio Stadium on Oct. 5, 2019 (where overall Wi-Fi data used was 25.6 TB) and 71 percent at Super Bowl 54. This year’s game also set a new high mark for peak Wi-Fi network throughput, at

20.7 Gbps, almost double the peak throughput of 10.4 Gbps seen at Super Bowl LIV.

CONVERGED NETWORKS REPRESENT THE FUTURE AS STADIUM TECHNOLOGY NEEDS GROW

Led by Skarpi Hedinsson, chief technology officer, SoFi Stadium and Hollywood Park, and master technology integrator AmpThink, the networking and compute environment deployed inside the building (as well as in Hollywood Park’s neighboring retail, commercial and residential area) is unlike most large venues, where different systems typically exist in their own silos, often with their own separate and different network.

Instead, the SoFi Stadium network brings all building functionality – including the wireless networks (among the largest built anywhere), the server compute platform, the telephone system, the IPTV network, the indoor and outdoor digital signage (including the massive oval dual-sided 4K main videoboard), the television broadcast systems, and the building management systems – into one converged platform, with a single vendor/single format structure, using Cisco gear in all places.

If you poke your head inside older sports venues, you are most likely to see separate networks and operation centers for many of the different systems – wireless, wired networks, broadcast, and building operations. Historically the case has been made that those who know those systems best are responsible for building their operations – but the silo approach often brings headaches to those in charge of overall operations for the venue as a whole, as they deal with the proliferation of different systems to operate and manage.

In a Cisco blog post from last year, Hedinson said the unique single-network deployment inside SoFi Stadium was not built simply to run up big numbers like the Super Bowl statistics, but instead as simply a better, easier way to run a venue.

“We hyperconverged storage and the compute block, which had never been done in a building like this,” Hedinson said. “It allowed us to take 80 or 90 physical servers out of the design – things that were slated to run everything from access control systems to lighting control systems. We virtualized all of that.”



Fan-facing Wi-Fi also set a new single-day record, with 31.2 terabytes of data used on the SoFi Stadium network. Credit: Dan Grimsley, STR

Using 120 virtual machines, SoFi’s operations team can now run every single operational technology application in the building as well as some enterprise technology applications, Hedinson said. “At the same time, we dramatically upgraded the manageability and the security envelope of our network. What this

all translates to is we have time to pay attention to the things that we should be paying attention to: customer experiences.”



SAFER, FASTER: NEW WEAPONS-DETECTION TECHNOLOGY IS CHANGING THE SPEED OF STADIUM ENTRY

\\ BY PAUL KAPUSTKA

Put your keys back in your pocket. Keep your cell phone there, too. Keep your hands to your side and walk forward at a normal pace. Congratulations, you've perfected the new way to enter stadiums.

There's a new game in town, coming soon to a stadium near you: Walk-through weapons detectors, which use new technology to speed up the security screening process. And don't call them "metal detectors," because according to their creators, these systems do so much more than the old-school technology that requires fans to take out metal objects like keys and phones from inside pockets and purses.



Traditional metal detectors, which force fans to take objects out of pockets, can cause big entry backups, like this one at the recent Women's Final Four semifinals at Target Center in Minneapolis. Credit: Paul Kapustka, STR

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Top: An Evolv gateway at the Space Needle in Seattle. Bottom: CEIA Opengate systems in use at Empower Field at Mile High in Denver. Credit all photos: Paul Kapustka, STR

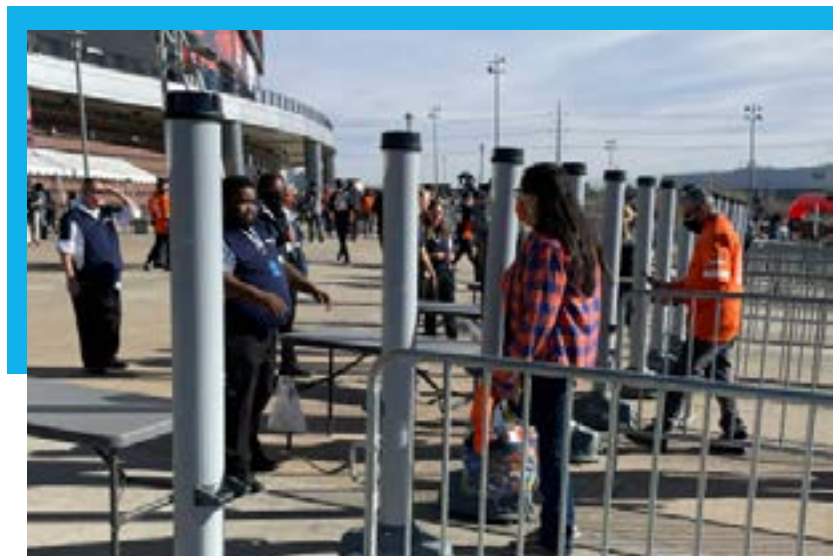
Using newer forms of radio-wave image detection or magnetic scanning, the claim for most of these new systems is that they can “see” weapons of all shapes and sizes, and then use artificial-intelligence (AI) software to compare images to known threats that are catalogued in digital databases. With claims of fewer “false positive” alarms and no need to “divest” metallic or any other items, these systems are designed in part to significantly speed up or even eliminate one of the bigger causes of stadium lines, namely the pre-game security check.

While security in many forms has always been present at large public events, the current era of having fans pass through airport-like detection systems before entering stadiums can be mainly tracked back to industry reactions to the Boston Marathon terrorist attacks in 2013, when bombs planted near the race finish line killed three people and injured hundreds more. Though there is no national standard

or requirement for stadium security protocols, local safety laws, and procedures and guidelines from leagues and conferences have pretty much led all large venues to deploy airport-like metal-detector systems to keep fans, athletes and building workers safe from carry-in threats.

And though detection system operations differ widely from venue to venue, almost any fan can tell you a story about waiting in a long line while other fans go through the security screening process, with almost inevitable stoppages to find things in pockets or jackets that caused the sensors to emit the well-known “beep.” While in the past fans might have been expected to wait out the delays with some degree of patience, in the Covid era of shortened tempers and increased willingness to flout protocols it has become even more important for venue operators to find ways to eliminate such pain points whenever possible.

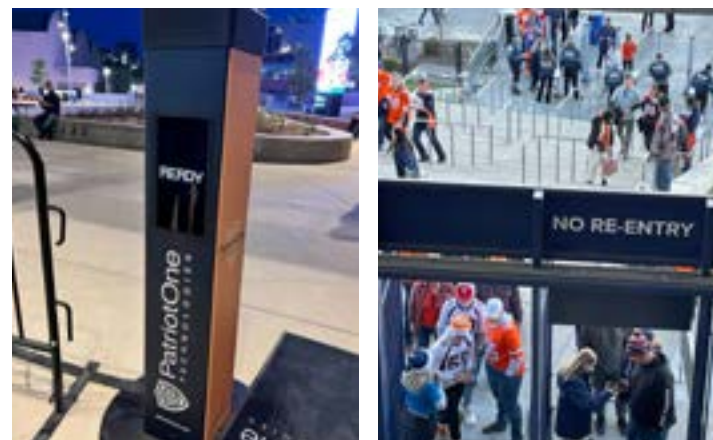
Add into the equation a need by venues to detect new kinds of threats that are hard for metal detectors to find, like “ghost guns” that may have some parts manufactured out of plastic with 3D printers, or very small things like ceramic knives, and you have a market in need of new technology that can both speed up lines and detect more threats. According to suppliers of the new systems, that is just what they are offering — though given the early stages of development and the challenges of disrupting years of accepted behavior,



implementing the new walk-through detection devices is far from an easy rip and replace.

VERSION 1.0 ISSUES AND THE NEED FOR EDUCATION

On a visit to Lower.com Field last summer for a Columbus Crew MLS game, Stadium Tech Report saw the promise of walk-through weapons detectors in live action, as groups of fans simply streamed by the Evolv Express detection systems. If old metal detectors can



Clockwise from top: Evolv systems at Lower.com Field in Columbus; An expanded security perimeter in Denver; and a Patriot One gate at the Moody Center in Austin. Credit top and bottom right: Paul Kapustka, STR. Credit bottom left: Patriot One

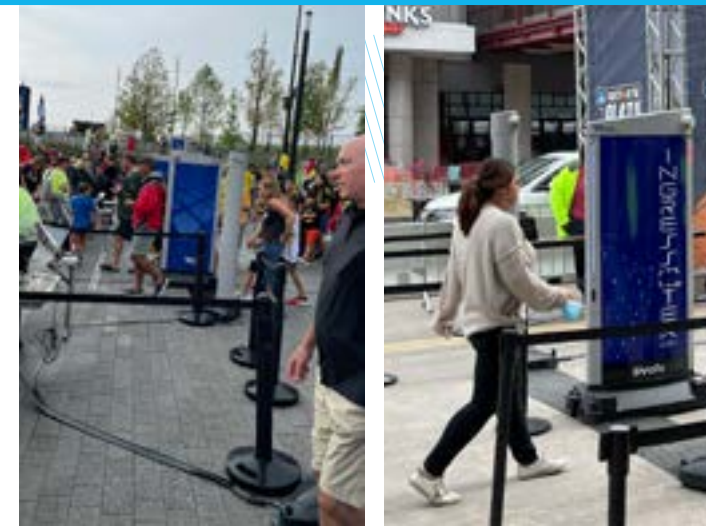
only scan around 300 fans per hour – or five per minute – the new systems like Evolv’s clearly eclipse that figure by a wide margin. The very few “positive” tests we saw mainly seemed to be umbrellas that were being carried under coats, with an unusually high number of those present due to the monsoon-like storms that swept through Columbus just before game time.

In December last year at the Denver Broncos’ Empower Field at Mile High we saw a new security perimeter strategy unveiled, as the Broncos put the walk-through Opengate systems from CEIA a bit farther away from the stadium than their previous deployments of stadium-door metal detectors. The new setup allowed the Broncos to have fans quickly inside their security perimeter, in a wide-open space where they could utilize stadium Wi-Fi to download tickets in preparation for the digital ticketing entry gates.

While both deployments seemed effective, the apparent simplicity of the new walk-through security systems belies the depth of the challenge for venues. Due to their radical difference in operation from past systems, the new ones will require venues to rethink their entire entry strategy, especially the relation between ticketing and security, to avoid causing more or worse problems than before. At some venues this past fall such problems did occur, as the speeded-up security process overloaded the ticketing gates, causing logjams.

Putting aside for a minute whether or not the systems work as advertised, the biggest issue most venues are likely to face is the education needed, mostly for operations staff but also for fans. It’s actually kind of amusing to watch fans on their first trips through the systems, as years of being taught to stop, raise hands, and maybe take things out of pockets is a hard lesson to unlearn. At all venues we’ve seen so far, part of the new security-systems staff job is to tell people to just keep walking and keep things in their pockets.

And while almost every vendor touts that their systems will reduce the number of security staff needed – another plus in this era of hard-to-hire reality – the flip side of that equation is that the staff need to be more thoroughly trained and sometimes more stern to react since people who trigger a positive test at a walk-through system may not know it and may need



Top: Evolv systems at Lower.com Field and outside the Target Center in Minneapolis. Bottom: Patriot One gates at Climate Pledge Arena in Seattle. Credit all photos: Paul Kapustka, STR

to be stopped from walking away, for a secondary scan. While our live experience is limited, it seems like every vendor deployment so far is a work in progress, with physical entry structures and available entry space sometimes a contributing factor. Several of the vendors we spoke with are also making changes to their systems to better help fans and staff comply with positive warnings, like adding louder beeps.

“The industry is still trying to understand best practices with staffing” for the new systems, said Daniel Ward, director of training and exercise for the National Center for Spectator Sports Safety and Security at the University of Southern Mississippi. Known as NCS4, the group, which conducts “research, training, and outreach programs” for the industry on products, services and best practices, is actively testing the new walk-through systems as they are deployed, according to Ward.

“It’s not as simple as plug and play,” said Ward, referring to the deployment issues presented by the

new security systems. “There’s going to be a learning curve.”

And then, there is the question about whether the systems really work, and if they are indeed safer than metal detectors. Since most people have at some point experienced a “positive” alarm while going through a metal detector – for whatever reason, either a device in a pocket or perhaps a belt buckle or medallion – there is generally a high level of confidence and belief that while sometimes onerous, the systems do work as advertised and thereby do provide fans some assurance of safety.

Contrast that experience to what fans encounter with the walk-through systems, where nothing seems to be happening, and it’s understandable that some may doubt that such detection is possible (especially when even some of the newer airport-screening systems still require people to stand still with hands raised). In this sense, the new providers of weapons detection systems do themselves no favors by being somewhat coy about how their products actually work.

While there is kind of a “Fight Club” type of silence around stadium security technology and strategies in general – for instance, Stadium Tech Report did not get any response to requests for interviews with security executives from any of the top U.S. professional sports leagues – it may be understandable since to fully describe such systems may be providing too much information to potential bad actors. In a similar vein, most of the companies we contacted were somewhat vague about the exact technologies their systems use, preferring instead to talk about capabilities than about the inner device workings. The reluctance to provide such information, however, puts more of a burden on team and venue security staff to dig deeper during purchasing negotiations.


INVESTMENT MONEY SEES A FUTURE FOR WALK-THROUGH SYSTEMS


If deployments of such systems are at the earliest stages, so too is the technology itself. Peter Evans, chief executive officer of systems provider Patriot One, compares his company’s current offering to the iPhone 3,


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The Evolv Express gates allow many fans to walk through security at one time. Credit: Paul Kapustka, STR

while predicting that improvements to the technology will come as quickly as new smartphones do.

“There will be a path” to improved technology, Evans said, with security systems perhaps even incorporating ticketing and other venue-specific needs like vaccination checks, going forward.

While fans seem to like the new systems – we have heard rave reviews from attendees at venues using the new devices – what may be more important from a business point of view is that investors also think there is great promise in the systems. While industry giant CEIA (which manufactures many of the current metal detectors in use at stadiums today) most likely has enough resources to compete on its own, the startups in the field are also attracting attention in the most important way, with investor cash.

Evolv actually went public last year on the NASDAQ exchange through a SPAC (special-purpose acquisition company) deal that netted the company approximately \$385 million in working capital. Patriot One, which is based in Toronto, Canada, was as of this writing going through a public share offering designed to raise approximately \$7 million (in Canadian dollars). And Liberty Defense, which produces the Hexwave detection systems, in March raised approximately \$8 million (in Canadian dollars) in funding bringing its total funding to approximately \$35 million CAD.

Mike Downing, chief security officer for Prevent Advisors, the security arm of venue operations giant the Oak View Group, said that OVG CEO Tim Leiweke called the walk-through systems the biggest venue technology innovation in the last 50 years. OVG has deployed Patriot One systems at Climate Pledge Arena in Seattle, where the systems are currently being tested as they await approval from the NHL for use at Seattle Kraken games. The Patriot One systems were also in use at the recent opening of the Moody Center, the new arena-sized venue at the University of Texas, managed in part by OVG.

According to Downing, OVG is “working very closely with Patriot One on a number of deployments,” with those deployments in different stages of planning and deployment. But overall, Downing said that the move toward walk-through systems in general is a positive.

“In our opinion, [the new technology] is far superior,” Downing said. “The upside is huge.”

So keep your keys in your pocket, and walk forward – to the future of stadium security screening.



RACE IS ON FOR WALK-THROUGH DETECTOR MARKET SHARE

\\ BY PAUL KAPUSTKA

Here are some quick snapshots of the leading providers in the new market for walk-through weapons detection systems for stadiums and large public venues. Data in the snapshots is mainly from company interviews and published website information.



Company: [CEIA USA](#) (U.S. subsidiary of Italian parent CEIA, whose initials stand for Costruzioni Elettroniche Industriali Automatism; but everyone calls the company by its acronym, which is pronounced “CHEY-ah”)

Product: [Opengate weapons detection system](#)

What it looks like: Two thin towers per gate



Other technology notes: Opengate systems are wireless and do not require wired connections between the two gates. They are light and portable, weighing 25 pounds per gate. According to CEIA the towers are hardened for outdoor use as well as in RF interference zones.

How it works: People walk between the two gates one at a time. Positive alerts generate audio and visual (lights) signals from the towers.

Venues using it now: Empower Field at Mile High (Denver Broncos), Ohio Stadium (The Ohio State University)

Finances: Privately held

Expertise: CEIA is a 50-year-old worldwide weapons detection behemoth, with systems of all shapes and sizes, including machines that can scan entire shipping containers. Its standard metal detectors are in wide use at many U.S. venues.

Why their product is the best: While CEIA did not make any executives available for an interview, the company did answer some email questions — although they didn’t answer questions directly but instead replied with boilerplate marketing messages. While CEIA did not provide any type of statistics for walk-through scanning rates or exactly what kinds of weapons its systems can detect, the company claims its systems

are better because of their combined abilities to detect threats, to ignore non-threats, and to perform in adverse conditions (rain, snow, etc.).

Possible issues: According to one observer, early versions of the Opengate product were so light that they were susceptible to being tipped over by strong winds (apparently the company now provides an add-on heavier base as an option).

STR take: With so many venues already using CEIA metal detectors, moving to a CEIA walk-through system may be an easy first choice, especially because it sounds like they may be the least expensive such system on the market. The light weight seems to make CEIA Opengate a good choice for venues who need greater flexibility for security perimeters. But the systems don’t do some of the things that others claim to do, like using an integrated alert viewing system (like a tablet) to show threat locations on scans.

Company quote: “In our opinion, and given what we have seen about the competition, the OPENGATE™ works better than the other detectors.”



Company: [Evolv Technology](#)

Product: [Evolv Express weapons detection system](#)

What it looks like: A two-lane system with one big panel gate in the middle and a smaller pole-type gate on each side



Other technology notes: According to Evolv, its scanners use magnetic field scanning to identify not just objects but also the composition of objects, like different types of metals. Evolv also offers a smaller, one-at-a-time system, the Evolv Edge.

How it works: For the Express system, people can walk by in groups on either side of the main panel, with no need to have single-file flow. Objects can be kept in pockets or bags. Alerts cause a sound and light change on the panel; staffers also watch a tablet that shows video of where the alert object is on the person’s body.

Venues using it now: Mercedes-Benz Stadium (Atlanta Falcons); Wrigley Field (Chicago Cubs); Nissan Stadium (Tennessee Titans); Lower.com Field (Columbus Crew)

Finances: Evolv went public in 2021 via a SPAC (special-

purpose acquisition company) deal that netted the company approximately \$385 million in working capital; celebrity investors include Bill Gates and Peyton Manning.

Expertise: Evolv has several executives with decades of experience in the security technology fields. Founder Mike Ellenbogen was previously the founder of Reveal Imaging Technologies and been issued sixteen patents in the field of X-ray inspection and automated detection technology.

Why their product is the best: In an interview with Ellenbogen, he told us he assembled the Evolv team out of experts he had worked with before, “people who solve really hard detection problems,” and they have been working for several years to “get the technology right.” Now Evolv’s Express systems claim an ability to scan 3,600 people an hour, with “really reliable detection.” Ellenbogen says one Express system can replace up to 10 traditional metal detectors, with significantly less staffing requirements. Ellenbogen calls some of his competitors “science experiment companies,” claiming that their products, unlike Evolv’s, have not been built to withstand real-world conditions. “There’s a huge chasm between the lab and the real world,” Ellenbogen said. “Your systems need to work in the heat in Atlanta and in the cold at Green Bay. It’s a challenge to make that leap.”

Possible issues: Competitors say that the size and weight of the main Express gate makes it far less portable and flexible than other options. Most observers also note that Evolv’s subscription pricing model is among the more expensive of the walk-through products on the market today.

STR take: Evolv’s Express systems seem to support the highest amount of “walk-through” traffic, though its effectiveness means that venues may need to rethink their overall entry procedures since its speed of performance can cause bottlenecks at other junctions, like ticketing. In Columbus, for instance, the team put the security checkpoints after ticketing, different than most stadiums.

Company quote: “You have to do screening at the pace of life. If you have to stop, it just doesn’t work.” — Mike Ellenbogen



Company: [Patriot One](#)

Product: [Patriot One Multi-Sensor Gateway](#); latest version for stadiums is called SmartGateway

What it looks like: Two thinner square poles, about four feet in height.



Other technology notes: Newest version of product for stadiums includes LED panels that can be used for traffic flow (stop/go) on customer-facing side, and threat location indicator on operator side. Company says systems can be used indoors or outdoors.

How it works: Fans walk between gates in single file. Devices can be kept in bags or pockets. Alerts are provided by LED lights on the towers as well as via a tablet or laptop used by staff.

Venues using it now: Climate Pledge Arena, Seattle (Seattle Kraken), Moody Center (University of Texas)
Finances: Recently raised \$7 million (Canadian dollars).

Expertise: Patriot One was founded in 2016 with research partner McMaster University, a Canadian center for radar technology research led by Dr. Natalia Nikolova. The company says it has combined microwave radar technology with multiple sensor technologies and artificial-intelligence software to produce its latest products.

Why their product is the best: Like all the other companies we spoke with, Patriot One is somewhat guarded about the exact makeup of their detector technology. But CEO Peter Evans said that the company’s systems can not just detect threat shapes and sizes, but can also get reflective information about things as granular as the types of metals in devices being carried in; “We can identify an iPhone 12 by the [different] metals inside it,” Evans said. Evans also touts the lighter-weight portability of the Patriot One product, which make it more flexible for deployments. While the company doesn’t have a single throughput number as its claim, CEO Evans did say it could be as much as four or seven times faster than traditional metal detectors.

Possible issues: In earlier versions of the Patriot One system, live reviews by the NCS4 (the National Center for Spectator Sports Safety and Security at the University of Southern Mississippi, a research clearinghouse) this past fall found that the systems had a high rate of “false alerts” for Apple Watches and Apple Air Pods, which both contain powerful magnets. According to the NCS4, the issue was corrected in a later version of the Patriot One system software. Some of the testers of the systems also noted that it had some difficulty detecting threats strapped low to the ankle, and that several positive tests in a row could sometimes “freeze” the detectors.

STR take: Patriot One is in somewhat of a pivot mode, as a few years ago the company was touting a system that would not use single static gates but instead would use multiple systems that would interact. Under new CEO Peter Evans the company has changed its product and message to the more recognizable walk-through systems. The relationship with Oak View Group — where the company has installed Patriot One systems at two of its newest venues — is net positive as OVG is responsible for a growing number of venue builds, upgrades and building management. While OVG says it is working with Patriot One on multiple possible deployments, there is as of yet no publicly signed agreement between Patriot One and OVG.

Company quote: “This technology can completely change the fan experience.” — Peter Evans



Company: [Liberty Defense](#)

Product: [Hexwave](#)

What it looks like: Two larger flat towers



Other technology notes: The Hexwave system uses “Active 3D imaging technology” to produce images of threats which are then matched against known items through artificial-intelligence software. The company claims the systems can be used indoors or outdoors. The company also claims it can scan 1,000 people per hour.

How it works: Fans walk through the two towers in single file; Devices can be kept in bags or pockets. Alerts cause a sound and light change on the panel; staffers also watch a tablet that shows video of where the alert object is on the person’s body.

Venues using it now: University of Wisconsin, Maryland Stadium Authority (Camden Yards), both beta testers

Finances: Recently raised \$8.62 million (Canadian), bringing funding total to \$35 million Canadian.

Expertise: Hexwave has several executives with extensive experience in the security technology industry, including CEO Bill Frain, former senior vice president for L-3 Security & Detection Systems. The Hexwave technology is based on technology licensed from the Massachusetts Institute of Technology.

Why their product is the best: According to CEO Bill

Frain, the principals behind Liberty Defense “saw a need for urban security screening” that would be similar to the advanced technologies being deployed at airports. Like other systems, the Hexwave platform makes use of artificial intelligence software that can “learn” as it is fed more information about possible threats. Frain cites the company’s ability to generate “real-time 3D images” of people passing through the gates as the best way to detect all possible threats, metallic and non-metallic.

Possible issues: Not much is known yet about the performance of Hexwave systems in stadium environments, since there are only two publicly announced beta trials currently taking place. Frain says the company expects to have a commercial product available later this year.

STR take: Solid executive credentials and MIT-developed technology seems like positive starting points for any startup. But in a quick-moving market with well-funded competitors Liberty Defense and Hexwave will be playing catch-up.

Company quote: “If you can improve entry throughput capacity the benefit is a better fan experience.” – Bill Frain

OTHER COMPANIES IN THE WEAPONS DETECTION AND STADIUM SECURITY SPACE:



Company: [Xonar](#)

Product: XonarSafe

What it looks like: Pathway with two elongated rails



How it works: Fans walk through rails in single file.

Venues using it now: None; one publicized test took place at a convention hall in Clearwater, Fla. The company last issued a press release in August, 2021, announcing a new COO “as it prepares for commercial launch.”



Company: [Syght](#)

Product: No product name yet

What it looks like: No photos

How it works: Company website claims “Syght sensors leverage passive millimeter wave imaging and automatic threat recognition technologies to pinpoint concealed weapons and explosives on moving objects at a distance.” Website also says that the sensors are “compact and lightweight” and can be used in covert or overt deployments. Company executives contacted via email said the company is still currently “under the radar.”



Company: [ZeroEyes](#)

Product: ZeroEyes detection system

What it looks like: No photos available, system is mostly software

How it works: ZeroEyes is not an entry weapons detection system but an active shooter identification system, designed to work with existing security cameras “to detect weapons in real time.” According to an interview with ZeroEyes, the company’s system includes the availability of real-time monitoring to help first responders locate and engage active shooters as quickly as possible.



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FASTER FOOD:

DENVER BRONCOS, ARAMARK TEAM UP ON AGGRESSIVE NEW-TECHNOLOGY CONCESSIONS

Fans line up outside a Zippin store at Empower Field at Mile High. Credit all photos: Paul Kapustka, STR

\\ BY PAUL KAPUSTKA

Even before they traded for star quarterback Russell Wilson this offseason, the Denver Broncos have been taking care of their fans at Empower Field at Mile High, especially when it comes to concessions operations.

By addressing years-old concessions problems with new technologies and new ideas of how to get food and drink into fans' hands (and stomachs) much faster, the Broncos are cutting down standing-in-line time while also adding to their business bottom line. Starting with the highest number of checkout-free stands in any stadium anywhere and by also adding in self-serve kiosks and optical-scanning checkout terminals, the Broncos and catering partner Aramark are leading the way in big-stadium concessions revolutions, with more to come.

While the Broncos and Aramark had tested some of the new concessions technology ideas before the Covid pandemic reduced crowd sizes, for the 2021 NFL season the caterer and the team went large with innovation. According to Aramark, that technology infusion helped Empower Field at Mile High record the

highest transaction rate per attendee of the 11 NFL stadiums where Aramark handles food and beverage service.

For 2021, Empower Field at Mile High had nine checkout-free stands, which use pre-visit payment information (collected either via an app or a credit-card swipe before entry) and a combination of in-store recognition technology – a mix of cameras, weight sensors and artificial intelligence software – to “see” what customers are taking off the shelves, and to digitally charge the customers for those items as they leave the store. The stores, powered by technology from a Silicon Valley startup named Zippin, proved to be very popular with Broncos fans, as Stadium Tech Report can attest from a December visit to the venue, where all the Zippin stores we saw had lines of fans waiting to get in.

The Broncos and Aramark have also implemented several other line-speeding technologies, including a combination of self-ordering kiosks and pickup windows, much like what is used at fast-food outlets



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The 'Downtown' stand lets fans place orders for three different types of food, either via kiosk or by a mobile app.

in shopping malls and airports. According to Aramark there are 10 such stands at Empower Field at Mile High, including ones that only serve chicken-tender products and another that serves tacos.

A technology concept that offers a wider range of popular "grab and go" items, including pizza, popcorn, nachos and hot dogs, uses an optical-scanner checkout terminal from Mashgin. The autonomous scanner "sees" a customer's order when placed on the terminal platform and instantly totals up the bill, which is paid via a credit-card reader. According to Aramark there are six stands at the stadium using the Mashgin checkout systems.

In all, more than a third of all the built-in concessions stands at the venue use some kind of new technology, including the ability to order concessions via a mobile app for express pickup at certain stand windows. According to Aramark, the concessions upgrades deployed at Empower Field at Mile High during the 2021 NFL season resulted in a 42 percent increase in transactions during peak concessions sales periods, as well as an increase in overall sales per game. And while Aramark didn't provide any statistics on staffing, the new technologies and procedures can clearly result in a reduced number of concessions workers needed for mundane tasks like cash register operations, since many of those tasks are basically eliminated.

NO TIME FOR CHECKOUTS

If you haven't heard of or seen a checkout-free stand, you probably will soon. There may be no recent concessions tech advancement more perfectly suited for stadiums than the systems that allow fans to use a credit card, app or other pre-registration system, then to just walk into a stand or store, select items, and leave. with billing taking place in the electronic background. There's almost zero human interaction

needed, other than (at stadiums) for a staffer to check IDs and one to make sure your alcohol can or bottle is opened before you go back to your seat.

When you visit such a stand for the first time, it may be hard to believe it works, but the systems clearly work well enough that caterers, teams and fans are buying in as fast as they can. There are already several different tech providers competing in the space, including big gorilla Amazon, which recently unveiled a full-size Whole Foods store using the system in Washington, D.C. Amazon Just Walk Out stores are also at Climate Pledge Arena in Seattle, TD Garden in Boston, the United Center in Chicago, UBS Arena and Houston's Minute Maid Park.

Another Silicon Valley startup, AiFi, has partnered with Verizon to place pop-up stores using similar walk-through technology, with deployments last year at Ford Field in Detroit, Hard Rock Stadium in Miami, at the Indy 500 and at outdoor concerts like BottleRock in Napa Valley.

In Denver, Aramark uses Zippin technology to power its nine "Drink Mkt" stands, which mostly sell beverages that fans just pick out of glass-door coolers. The technology is a perfect fit for fans who simply want to get a drink and don't want to wait in line at a traditional stand behind a dad ordering nachos, burgers and fries and different sodas for the whole family. By combining the walk-through technology with the simple desire to get a can or two, the

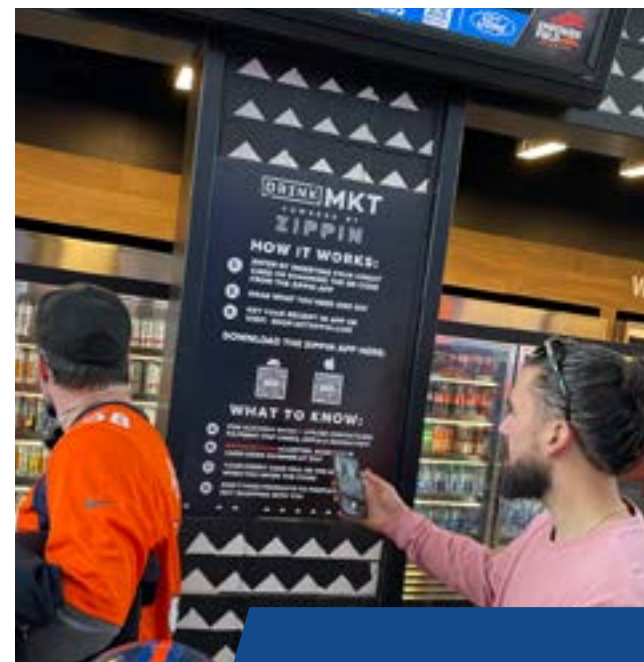
Drink Mkt stands can service fans in seconds, at least once they get inside the stores.

"There really is no better vertical (for the technology)," than stadiums, said Gary Jacobus, Zippin's senior vice president for business development, in a phone interview. "There's a lot of people who need to be served in a short amount of time."

In fact, as we went around the stadium at the December game it seems like the biggest problem with the Zippin stores is that they are so popular that big lines form outside the entry gates (the gates keep the number of people inside to a maximum that the cameras can handle). Those lines, however, do move quickly, and once fans are inside the stands their average stay there is often a minute or less.

"If you put in one [store], it becomes the place people want to go," Jacobus said.

If first-timers may wander around a bit and then take a selfie as they leave, from our observations it doesn't take long for the wonder to wear off and the simple attractiveness of getting something quickly takes over. As we watched fans use the stands, it was clear that there were already "veterans" at the game, whose no-



Left to right: A fan signs up for a Zippin store; a grab and go stand; the Mashgin optical-scanner payment system at the grab and go stand.

nonsense trips were concluded in a matter of seconds from entry to exit.

According to Jacobus the Drink Mkt stands were configured mainly to “take the drink pressure off other stands,” though he said that some of the stands at Empower Field at Mile High did offer hot food items as well. Stadium Tech Report also saw a “pop-up” style Drink Mkt stand inside a club area, a different configuration than the stands on concourses, which are built into the stadium infrastructure.

One of the biggest costs of putting in a Zippin stand (Aramark declined to reveal the price of a reconfiguration) is installing the overhead cameras and the sensors, which require some network and server infrastructure as well. So the pop-up stands, which have their own overhead infrastructure, could be a faster and cheaper way to install more Zippin stands.

KIOSKS AND GRAB-AND-GO WITH OPTICAL CHECKOUTS

If the Zippin-type stores are a bigger cost investment, in Denver Aramark and the Broncos have found other ways to add simpler technology that also speeds up the ordering procedure. An early test of self-ordering kiosks, which are fairly common at fast-food restaurants in malls and airport, expanded to 10 stands for this past season, according to Aramark. At these stands fans simply order and pay at a bank of touchscreen kiosks and then wait until their order number appears on a screen at an adjacent window. From a Covid standpoint, such stands have been very helpful since you don’t have to be in a line as you wait. But even as virus concerns wind down, the kiosk setup seems to be a better use of space and people’s personal space; and like the Zippin stores, by taking away the need for staffers to take orders it allows the operators to have more flexibility in how staff are deployed.

Technology also plays a role in the stadium’s six “grab and go” stands, where a selection of popular items, like pizza, popcorn, peanuts and hot dogs are offered in prepackaged boxes on shelves that face an open line flow. At these stands fans “grab” what they want and

then go to the innovative Mashgin terminals, where they simply place their items on the terminal’s pad where they are scanned by cameras. The terminal then totals the order, which fans pay via credit card scanner. Like the Zippin stands, the only staff needed is to check IDs and ensure alcohol cans and bottles are opened. Seattle’s Climate Pledge Arena also went large with self-scanning terminals, though the ones they use from Toshiba use standard bar codes.

NEIGHBORHOOD CONCEPT BRINGS THE CLUB EXPERIENCE TO THE CONCOURSE

In another experiment the Broncos and Aramark have built something that is both technology and process: An innovative area that combines outposts of three local restaurants built around a common ordering and eating area that has stand-up drink rails and sit-down tables. A renovated former storage space adds in two stand-up bars and more seating areas, bringing club-like amenities to the main concourse, a trial that was extremely popular on the day of our visit.

Known by the forgettable corporate official name of “Downtown Mile High at Empower Field at Mile High,” the trick of making the plan work revolves around a



The ‘Downtown’ concept brings club-like concessions to a general admission area.



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bank of 16 touchscreen kiosks and a mobile app that lets fans order from any of the three stands at the same time. Then when orders are ready the order numbers are displayed on digital screens, and fans go to the individual store windows to pick up their food.

With the wide number of ordering options and by not allowing fans to stand at each of the windows to order, lines are basically eliminated. Self-serve soda fountains in the middle common area also help with streamlined service and more choices. Fans can then enjoy the comfort of eating in a more normal way than in a stadium seat, and can socialize with other fans who may not be seated near them inside the seating bowl.

The popular local restaurants – the burger-and-beer menu from Cherry Cricket, casual Italian from Osteria Marco and “Modern Mexican street food” from Tacos Tequila Whiskey – also give all attendees an upscale dining option, the kind you might only typically find in stadium club areas.

According to Alicia Woznicki, vice president of design and development for Aramark Sports and Entertainment, the “Downtown” area repurposed the infrastructure of three previous standard concession stands, including the kitchens used to supply those stands. But what really makes the system interesting is how it is configured for ordering and pickup, taking the self-order single stand idea another step ahead.

“The unique ability to order from three distinct, local concepts all in one transaction is a main highlight of the space,” Woznicki said in an email exchange, saying the experiment was the first of its kind for the caterer.

Around the back of the food ordering area, the bar space consists of two large bars, which have multiple TV screens for watching game action, and seating and stand-up rails. The bar areas, which back up against a walkway ramp, were previously used for storage, Woznicki said.

FASTER IS BETTER

Empower Field at Mile High also saw new concessions technology of a different sort being trialed last season



– this one a “self-pouring” beer tap that let fans put an empty cup on a machine that tilts the cup as the beer flows in, resulting in just the right amount of foam.

Called the “Bud Light Speed Pass,” the stand featured several different taps of beer that fans could choose from. Fans could return for multiple fill-ups, without having to pay after the first time. While some might question the quantity and pricing of the offer – \$30 for three 24-ounce beers, the equivalent of a standard six-pack – fans we watched using the service seemed to have fun with the pouring machines and clearly were happy with the speed of the service, with no bartenders to get in the way.

“Based on the overwhelmingly positive reaction from guests, the plan is to roll out more [Speed Pass stands] in the future,” Woznicki said.

Providing food and drink for fans while they are attending events has always been a challenge for large

venues, and the larger the venues are, the harder the task is. Anyone alive today who’s been to games or concerts in their lifetime most likely has at least one bad remembrance of an instance when it took an overly long time to get concessions – an entire baseball inning, or half a football quarter – and would gladly try something new if it meant less time spent in lines. That means that ideas like self-order kiosks, grab-and-go stands, and checkout-free systems will probably become more prevalent as more teams follow the path blazed by the Broncos and Aramark.

“For every [fan] survey we ever did with Aramark, speed of [concessions] service was always at the top,” said Zippin’s Jacobus. “This technology is here to stay.”



Clockwise from top left: Once inside the gates at a Zippin store, fans simply take what they want and leave; the Bud Light Speed Pass lets fans pour their own drinks; the ‘Downtown’ area lets fans order on their phones by scanning QR-code menus.

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