wirewerks
NETWORK INNOVATIONS

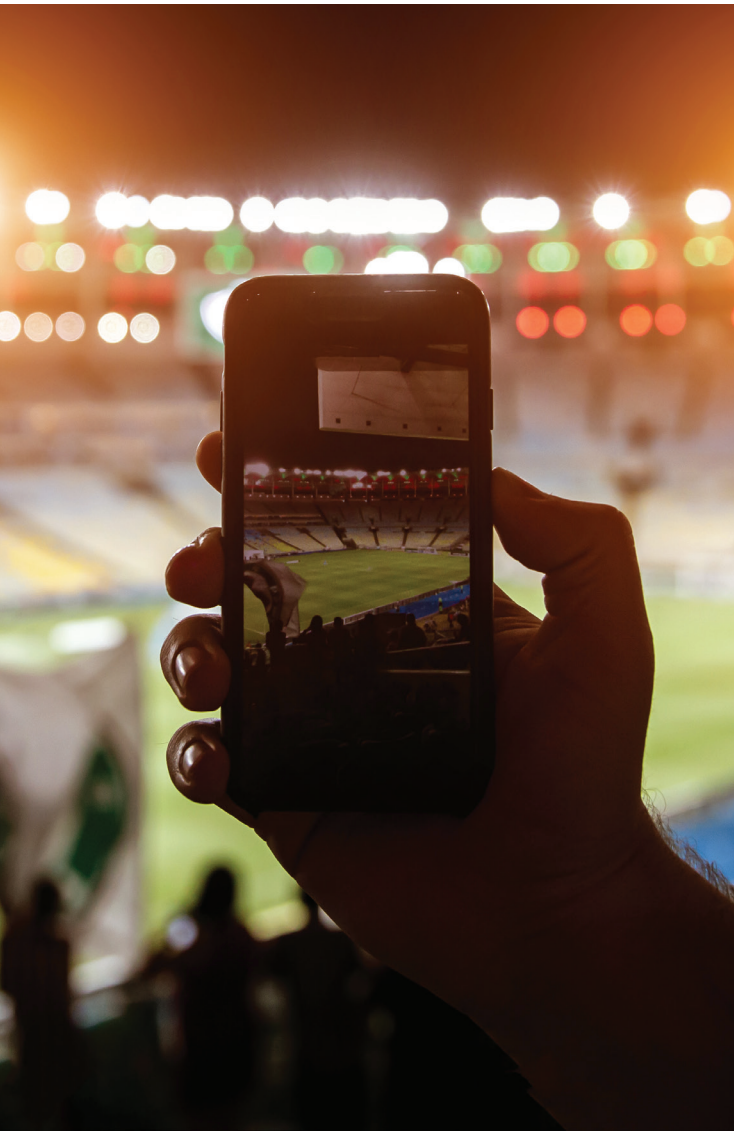
Case Study: Cellular 5G DAS Solution

Leading Cellular Operator solves 5G DAS challenges in iconic stadium complex with Wirewerks' hybrid fiber/power cabling solution.

T 1 888 993-4237 | **F** 1 888 893-4237

Inside

Leading Cellular provider installs 5G DAS in heritage open-air stadium with innovative hybrid fiber/power cabling solution from Wirewerks.



PROJECT OVERVIEW

The fan experience is *everything.*

We've come a long way from leather football helmets, horsehide baseballs, two-handed set shots in hoops, and no helmets at all in hockey. Today's elite athletes are faster, stronger, exceptionally skilled, multi-millionaire, multi-media celebrities directly connected to their global fan base.

The business of sports has changed, too. While the 'content' is sports, the 'product' is entertainment. Teams and leagues regularly generate more revenue off-field than they do on-field, with broadcast revenues and merchandising sales producing billions in revenues and millions in profits.

For sports venue owners, the landscape has changed as well. Seventy-inch HD TVs and surround sound systems are now common in the home, and broadcasters strive to put viewers 'in the seats' without the bother of paying for parking or getting out of their pyjamas.

In order to fill the stands, venue operators are constantly searching for new ways to improve the fan experience and generate ancillary revenues within the venue. Gigantic digital HD video scoreboards, digital signage and advertising, on-line concessions, VIP services and hi-tech corporate boxes are typical in today's venues. The common thread in these enhanced fan services is the use of technology to create and deliver personalized amenities to individual attendees -- with wireless networking providing reliable, responsive, high-quality connectivity *everywhere* throughout the facility, even with tens of thousands of simultaneous users.

The in-venue fan experience is so important today that we often see completely new multi-billion dollar stadiums and arenas built to replace still serviceable older venues that may not be friendly to the deployment of modern technologies and their associated infrastructures.

But what of iconic, historic venues like Fenway Park, the Rose Bowl, Churchill Downs, Indianapolis Motor Speedway, and Madison Square Garden? These are just a few examples where the venue itself is an essential part of the experience, and it's unlikely that these landmarks would be replaced simply because of challenges in deploying new technologies.

Similarly, there are many regional and local venues, albeit less famous, that are historically, culturally, economically and emotionally significant to their communities and ardent fan base. Here again, venue operators are looking to enhance the fan experience with new technologies that are easy to deploy in these often older structures.

This Case Study documents the challenges encountered in deploying a new 5G DAS solution in a 45-year old, 56,000-seat multi-purpose open-air stadium hosting football, soccer, rugby union, athletics, and concerts in a major North American city. Marquee events have included the World University Games, the IAAF World Championships and the Commonwealth Games; concerts from the Rolling Stones to Beyoncé; the NHL's first outdoor regular season hockey game; the IRB Rugby World Cup; Triple-A baseball; and numerous FIFA soccer events including the Women's World Cup and the CONCACAF Men's Olympic Qualifying Tournament. The venue is currently scheduled to host matches in the upcoming 2026 FIFA Men's World Cup -- the most widely viewed sports event in the world.

CUSTOMER'S CHALLENGES

In this Case Study, Wirewerks' customer is the mobility division of a major ICT corporation offering wireline and wireless telecom services to residential, business and government customers, along with IT services to the Healthcare industry and other vertical markets.

For the network provider and the venue owner, the ultimate goal was to provide uncompromised wireless connectivity and next-generation 5G network performance to fans anywhere in the facility -- by efficiently and economically retro-fitting the existing stadium structure with a state-of-the-art 4G/LTE/5G cellular DAS/IBW solution.

As an experienced wireless provider, the network operator had developed their own preferred set of standardized DAS, DSC and IBW solutions for 4G/LTE/5G cellular deployments in virtually any kind of service area or in-building environment. However, in this Case Study, the heritage open-air stadium presented a unique set of site conditions requiring an innovative, **custom hybrid fiber/power cabling solution** for the outdoor DAS, along with a proven CAT6A/PoE++ network solution for the indoor IBW system.

KEY PROJECT CHALLENGES

No Power Distribution at Antenna Locations
- RF engineered optimal locations for antennas were in areas not reached by the existing power distribution infrastructure
- Cabling solution must deliver signal and provide power

No Conduits to Antenna Locations
- No existing conduits and no practical possibility of installing new conduits to antennas

Limited Space to Mount Antennas and RRUs
- Optimal antenna locations were often limited in mounting space and/or unreceptive to the physical requirements for antenna installation

Site includes the Outdoor Bowl and Indoor Concourse
- Requires signal/power cabling solutions for outdoor wireless and in-building wireless environments

Single PoP at East Side of Stadium
- Single PoP to serve/connect/power 300+ remote antennas
- Relatively long reach (>90m) from PoP to most distributed antenna locations

Limited Space in PoP
- Existing storage closet re-purposed as provider's PoP
- Limited space for active equipment, network systems and ancillary equipment

Severe Outdoor Environment
- Year-round use, multi-purpose open-air stadium in northern prairie location
- -40° to 40°C (-40° to 104°F) temperature range (typical)
- Heavy rain, snow, icing and high wind conditions
- Frequent severe electrical storms

Carrier-class Performance, Reliability, Maintenance and Operations Objectives
- All elements of solution must meet industry standards for materials, manufacturing quality, and component/system performance and reliability
- Solutions must meet network provider's OAMPT requirements and Best Practices

Manufacturer's Technical Support, Training and Documentation
- Manufacturer must meet network operator's exact requirements for technical support, training and documentation

Reliable Project Logistics and On-going Product/Component Supply
- Manufacturer's distributor network must demonstrate logistics capabilities necessary to support the project, and provide delivery lead-times for all products following project completion

WIREWERKS' SOLUTION

Wirewerks engineers worked in close collaboration with the customer's RF Engineering and Field Installation teams to develop a custom hybrid fiber/power cabling solution for the outdoor 5G DAS optical network. Wirewerks engineering also designed a complete end-to-end Wirewerks CAT6A/PoE++ structured cabling system for the IBW areas of the stadium complex.

In the PoP

Our customer installed their preferred wireless system active electronics in their PoP, including Baseband Units (BBUs) and Remote Hubs (RHUs). The RHUs manage CPRI data transmission between the Remote Radio Units (RRUs) and BBUs; support optical fiber connections to the RRUs, and provide a clean DC power source for the RRUs .

Co-located in the PoP with the BBUs and RHUs are Wirewerks' NextSTEP™ 1U Rack Mount Patch Panels (Figure 1). Each NextSTEP PP houses up to 12 NextSTEP LC Patch Modules, with each module managing 12 fibers. This NextSTEP system configuration supports up to 144F in 1U, providing manageable high-density and space savings in the relatively small PoP.

NextSTEP Patch Modules (Figure 2) provide 12 LC ports at the front of each module, spliced to a 12-fiber ribbon cable exiting the rear of the module. The 12F ribbon cable may be pre-terminated or field-terminated in the Patch Module's integrated fusion splice tray. The Patch Module includes integrated fiber routing, bend-radius protection and strain-relief features, and the integrated fusion splice tray features Wirewerks' exclusive magnetic splice sleeve holder that eliminates performance-robbing micro-bends in splices.

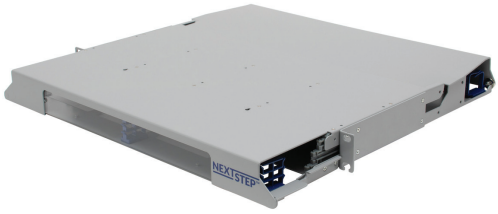


Figure 1
NextSTEP 1U Patch Panel

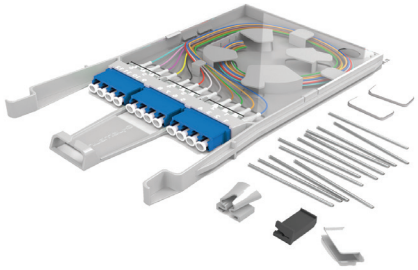


Figure 2
NextSTEP Patch Module

Wirewerks' NextSTEP Fiber Management System is an award-winning set of products that provide complete solutions for advanced fiber management in Broadband, Data Center, and Premise Network applications. For more information on the NextSTEP system, please see Page 14 of this Case Study.

Optical ports on the RHU are patched to the LC ports of the NextSTEP Patch Modules spliced to a 12F Ribbon Cable in the module's integrated fusion splice tray. Corresponding copper power conductors are routed from the RHU's DC-Out power connectors to a terminal block in the PoP, and the 12F Ribbon Cable and eight copper power conductors merge into a custom hybrid fiber/copper (12F/8C) OSP cable (Figure 3), running from the PoP to the Wirewerks custom engineered outdoor Hybrid Distribution Enclosures (HDEs) located near groups of RRU/antenna pairs (Figure 4).

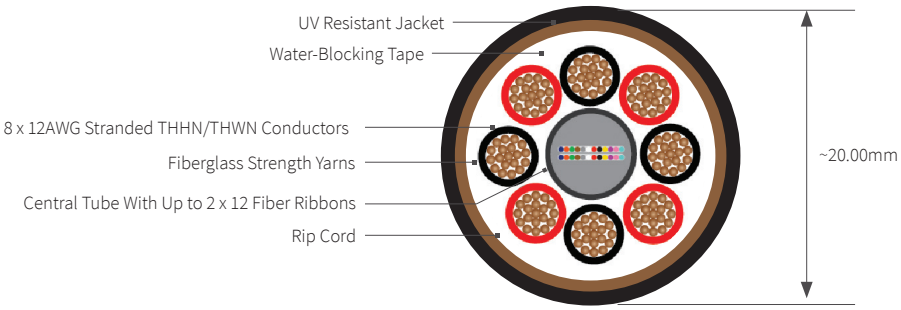


Figure 3
Hybrid Fiber/Copper Outdoor Cable

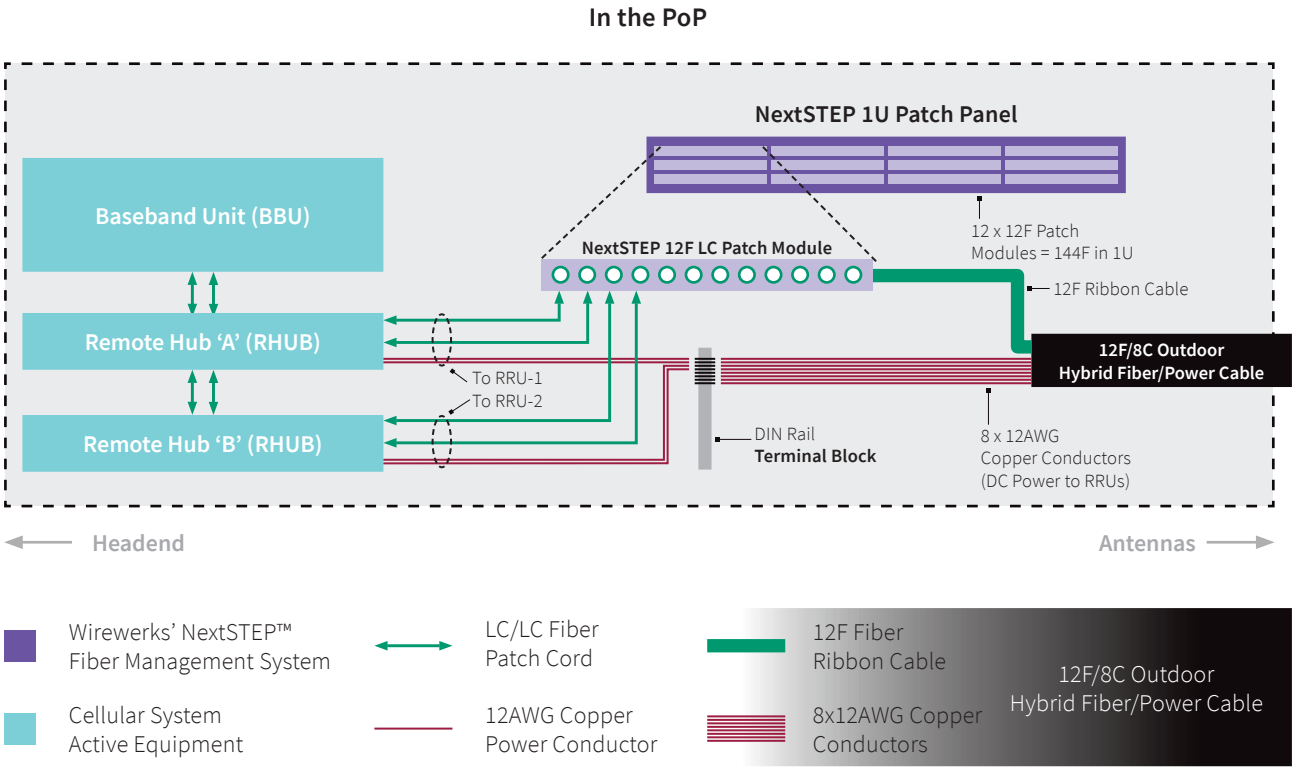


Figure 4
In the PoP

At the Outdoor DAS Antennas

The OSP hybrid fiber/power cables (12F/8C) originating in the PoP are routed to custom engineered Wirewerks Hybrid Distribution Enclosures (HDEs) strategically located relative to the RRU/antenna pairs throughout the stadium's open-air bowl.

Each HDE (Figures 5 & 6) is a compact, high-strength, surface-mount, outdoor-rated metal enclosure that receives an outdoor hybrid fiber/power cable originating in the PoP through a weather-resistant cable-gland entry. The outdoor hybrid cable's outer jacket is stripped within the HDE and the eight copper power conductors are routed to a double-level 8-circuit terminal block (plus ground). The 12F ribbon cable within the outdoor hybrid cable is routed to the HDE's integrated Mini-Splice Tray connecting to a 12-port LC Adapter Strip. The Mini-Splice Tray and the LC Adapter Strip may be removed from the enclosure for easy access during installation and maintenance procedures. Note that the HDE is available in two models, with the standard model supporting one incoming outdoor hybrid cable (HDE CP009341-12F/8C), while the high-capacity model supports two incoming outdoor hybrid cables (HDE CP009342-24F/16C). The high capacity version (HDE CP009342-24F/16C) includes two 12F Mini-Splice Trays, a 24-port LC Adapter Strip and a 16-circuit double-level terminal block (plus ground). Both models use the same enclosure and have the same exterior dimensions, compact footprint, surface mounting tabs, and cable entry/exit points.

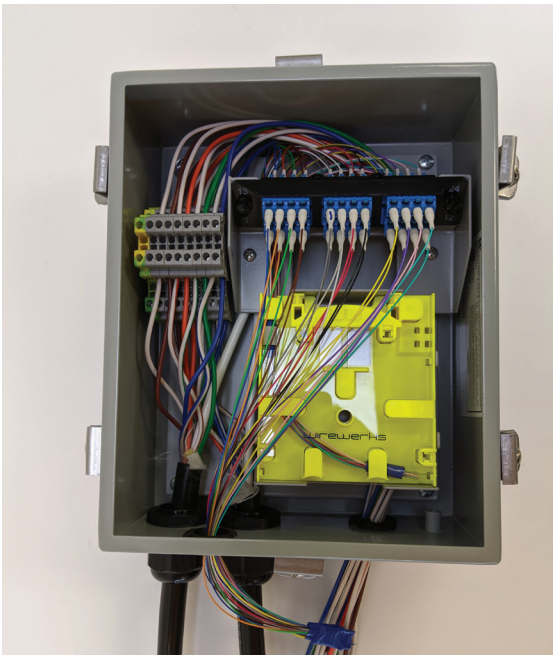


Figure 5
HDE

Exiting from the HDE are outdoor ruggedized fiber patch cords connecting to the optical network ports of an RRU. Copper power conductors exit the HDE and supply power to the RRUs. Finally, the RRUs connect to the antennas with coax cables carrying signal and power.

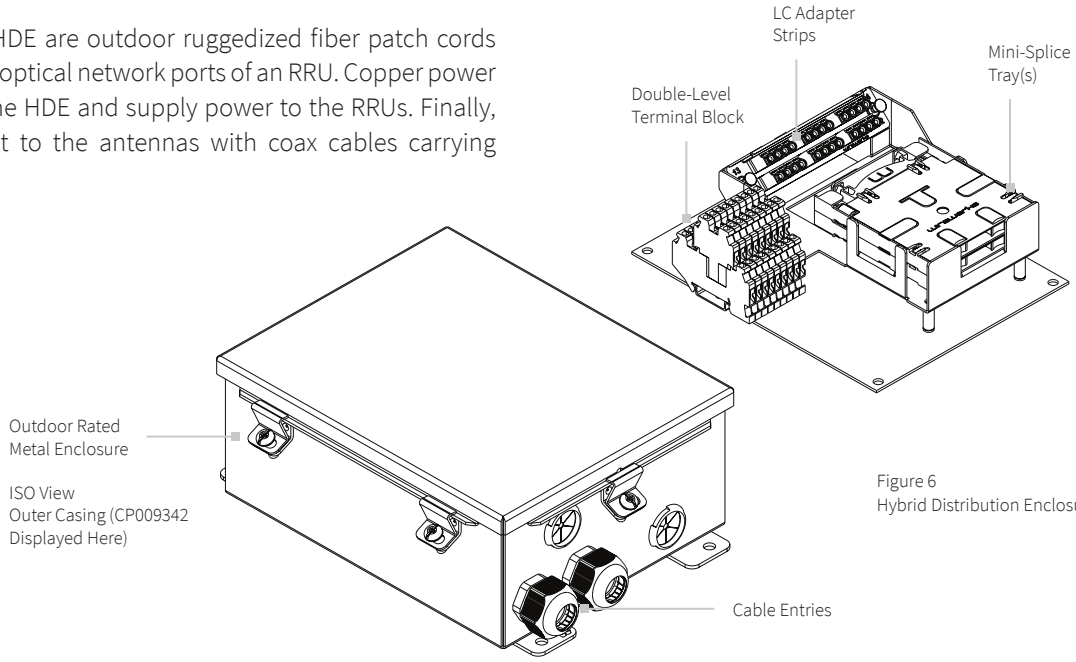
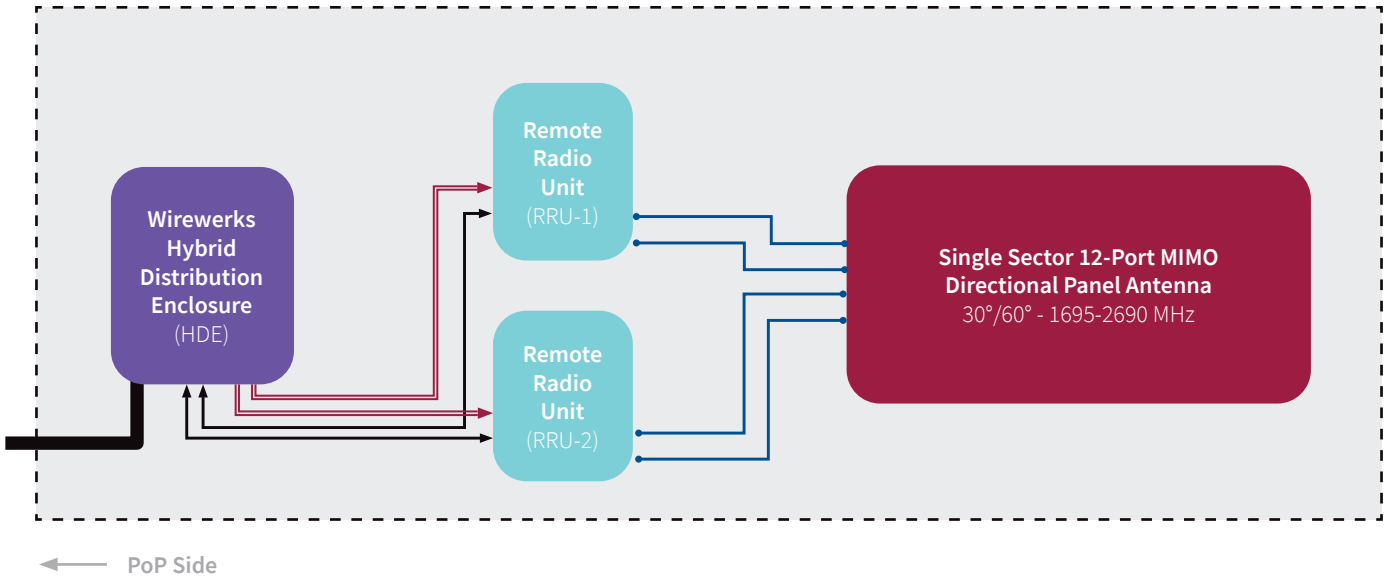


Figure 6
Hybrid Distribution Enclosure (HDE)

At the Antennas



Wirewerks HDE	Standard	Hi-Capacity
Incoming 12F/8C Hybrid Cables	1	2
Double-Level Terminal Block	8-circuit	16-circuit
Integrated Fusion Splice Tray	1x12F	2x12F
LC Ports/Fiber Count	12	24

Figure 7
Antenna Side Network Diagram

At the Retail Concourse IBW Antennas

Wirewerks' KEYWERKS™ standard CAT6A/PoE++ U/UTP copper structured cabling system is used to network and power the IBW antennas located throughout the indoor Retail Concourse of the stadium. Wirewerks' CAT6A/PoE++ is a complete, end-to-end copper structured cabling system including modular jacks and connectivity components; patch panels, patch cords, U/UTP 4-pr horizontal distribution cables and surface mount boxes (Figure 7). The system is fully compliant with all key industry standards, including:

- ANSI/TIA-568.2-D Category 6A 10Gb/s channels
- IEEE 802.3-2018 10GbE 10GBASE-T
- IEEE 802.3bt Power-over-Ethernet (PoE): Type 3 & 4 devices up to 90 watts (PSEs)

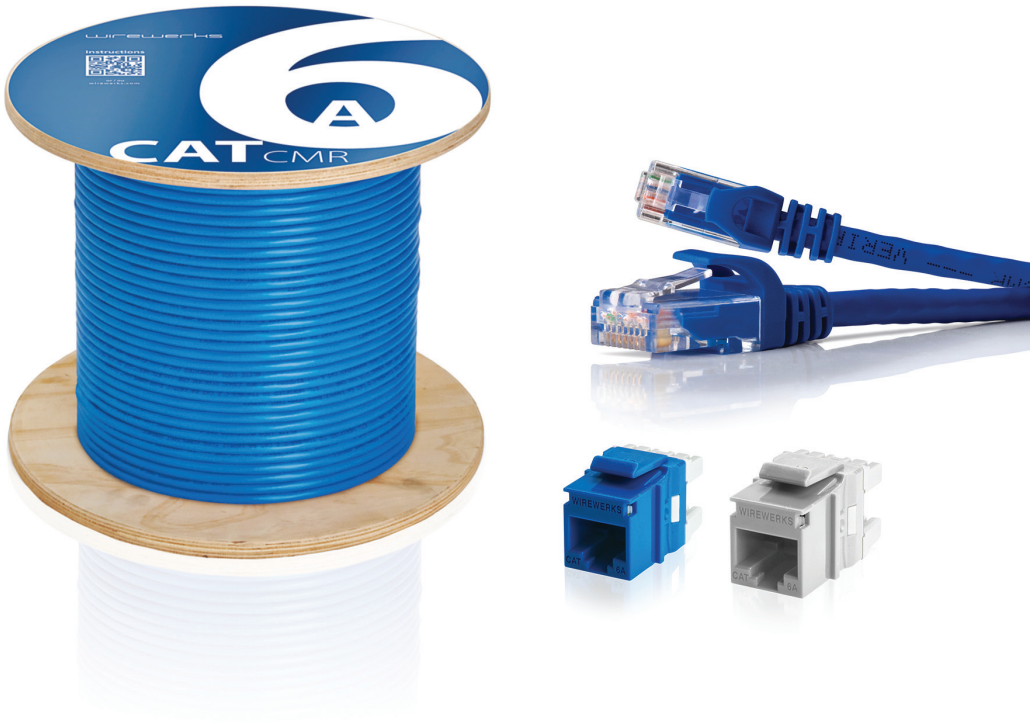


Figure 8
Wirewerks' KEYWERKS CAT6A PoE++
Structured Cabling System

KEY FEATURES AND BENEFITS OF THE WIREWERKS SOLUTION

Wirewerks' custom hybrid fiber/copper power solution for 5G DAS in the open-air bowl, and Wirewerks' KEYWERKS CAT6A/PoE++ U/UTP structured cabling system for IBW in the indoor Concourse addressed and solved each of the customer's key project challenges.

	Key Project Challenges		Wirewerks' Solutions
1	No Power Distribution at Antenna Locations	✓	• Custom developed outdoor hybrid fiber/copper power cables and outdoor Hybrid Distribution Enclosures (HDE) deliver fiber communications and DC power from the PoP to outdoor DAS • CAT6A/PoE++ U/UTP structured cabling system supports 10GbE and PoE to IBW equipment
2	No Conduits to Antenna Locations	✓	• Outdoor-rated hybrid fiber/copper power cables do not require conduit
3	Limited Space to Mount Antennas and RRUs	✓	• Compact, small footprint, outdoor-rated HDEs surface mount easily in available space and conditions
4	Site Includes the Primary Outdoor Bowl Environment and an Indoor Concourse and Connected Buildings	✓	• Wirewerks' cabling infrastructure solutions solve outdoor and indoor requirements throughout the complete stadium complex
5	Single PoP at East Side of Stadium	✓	• SM fiber cabling provides extended 'reach' to all points in the open-air bowl with massive bandwidth, high-performance and superior reliability • CAT6A/PoE++ U/UTP structured cabling system supports IBW anywhere in the stadium complex using traditional TR to Work Area/Station topology per ANSI/TIA-568.D Category 6A standards
6	Limited Space In PoP	✓	• Wirewerks' NextSTEP™ high-density 1U rack-mount Patch Panels and NextSTEP Patch Modules manage, splice and route up to 144F in 1U in the PoP
7	Severe Outdoor Environment	✓	• Outdoor-rated hybrid fiber/copper cables, outdoor ruggedized fiber patch cords, and outdoor-rated Hybrid Distribution Enclosure exceed all typical environmental requirements
8	Carrier-class Performance, Reliability, Maintenance and Operations Objectives	✓	• All Wirewerks' standard and custom products meet specified industry standards -- and customer's additional specifications for component/system performance, materials and manufacturing quality • Solution meets network provider's OAMPT requirements • The custom HDEs are assembled from commercially available components. This reduces the need for extensive, expensive maintenance spares inventories and ultimately reduces MTTR
9	Manufacturer's Technical Support, Training and Documentation	✓	• The Wirewerks cabling solution is fully documented, including product drawings, system/network schematics and installation/maintenance guides • Wirewerks Engineering supported the project roll-out and continues to provide escalation support to the Wirewerks Technical Support team for the project • Multi-media installation and maintenance training resources are provided by the Wirewerks Training Center (WTC)
10	Reliable Project Logistics and On-going Product/Component Supply	✓	• Wirewerks and authorized distributor GAP Wireless collaborated to provide project supply logistics and on-going post installation product/component supply

KEY WIREWERKS PRODUCTS IN THIS SOLUTION

Summary of Key Wirewerks Products in this Solution

Product	Part Number*	Data Sheet*
12F Hybrid Distribution Enclosure (HDE) Outdoor/1x12F Mini-Splice Tray/12F LC Adapter Strip Module/8-conductor Terminal Block	CP009341	Contact Customer Service for specs
24F Hybrid Distribution Enclosure (HDE) Outdoor/2x12F Mini-Splice Tray/24F LC Adapter Strip Module/16-conductor Terminal Block	CP009342	Contact Customer Service for specs
Hybrid Fiber/Copper Power Cable Assembly 20mmØ/OSP/SM/12F-24F Ribbon/8x12AWG Copper Power Conductors	CP00xxxx	Contact Customer Service for specs
Fiber Patch Cord - Outdoor Ruggedized SM 2F/3mmØ OFNR/6ft/LC-LC/OCC/Black/Ruggedized	CP009326	Contact Customer Service for specs
Wirewerks NextSTEP™ 1U Rack Mount Fiber Patch Panel 1U/19"/144F	NS-PPW1U1	PDS-0189
Wirewerks NextSTEP™ Patch Module 12F/SM/LC-UPC/12F Ribbon with Integrated Splice Kit	LPMWL12SR	PDS-0230
Wirewerks Fiber Patch Cord SM OS2/1.6mmØ/LC-LC/Bend Insensitive/Yellow Jacket 2 Fiber Zip/Various Lengths	PC-FNLPBLPB	PDS-0022

*Please contact your Wirewerks Salesperson or Wirewerks Customer Service (1.888.993.4237 or customerservice@wirewerks.com) for assistance with Part Numbers, Data Sheets and other documentation.

BONUS: NEW IBW HYBRID DISTRIBUTION ENCLOSURE FOR INDOOR APPLICATIONS

The custom engineered and manufactured outdoor Hybrid Distribution Enclosure featured in this Case Study was developed by Wirewerks in collaboration with our customer to meet their specifications for outdoor DAS applications.

Distinct from outdoor applications, there are many IBW applications that might benefit from a hybrid fiber/copper power cabling solution -- for example, when IBW antenna locations or wireless access points (WAPs) exceed the reach of CAT6A/PoE UTP structured cabling channels.

For IBW applications, Wirewerks now offers the **IBW Hybrid Distribution Enclosure (IBW HDE) (P/N: WW001900).** The IBW HDE is a compact, small-footprint, surface-mount enclosure intended for indoor installations requiring up to 12 fibers and 12 copper power conductors. The IBW HDE includes a robust ABS thermoplastic polymer box housing a 12F Mini-Splice Tray, a 12-port LC Adapter Strip and a 12-circuit 20A 300V-AC/DC terminal block. Cable attachment, strain-relief, bend-radius protection and routing features are standard, and rubber grommets protect cables entering and exiting the enclosure.

For more information and detailed specifications, please contact Wirewerks Customer Service.

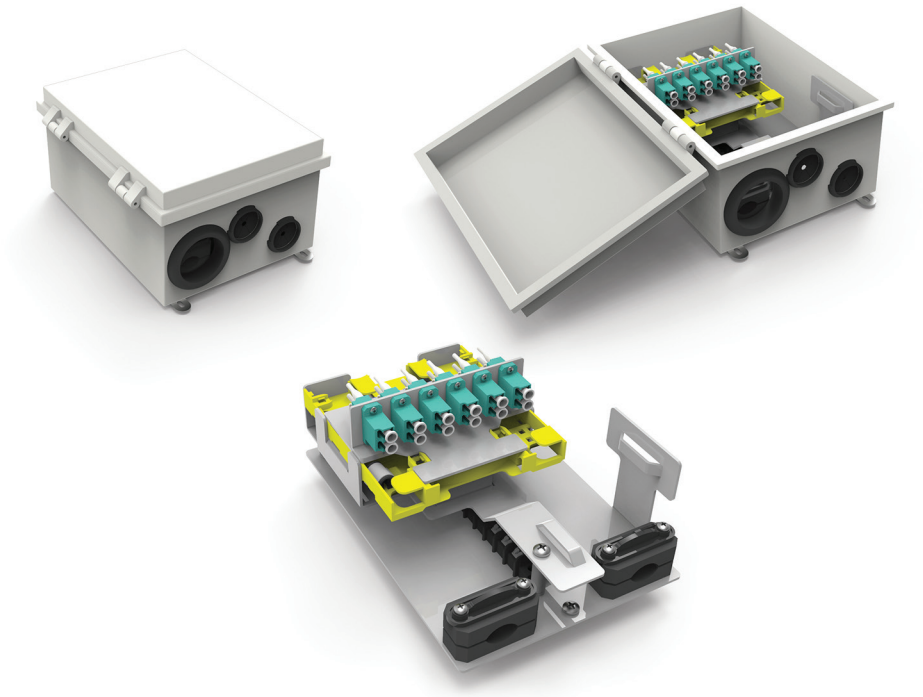


Figure 9
Wirewerks IBW Hybrid Distribution Enclosure (IBW HDE)

WIREWERKS' NextSTEP SYSTEM OVERVIEW

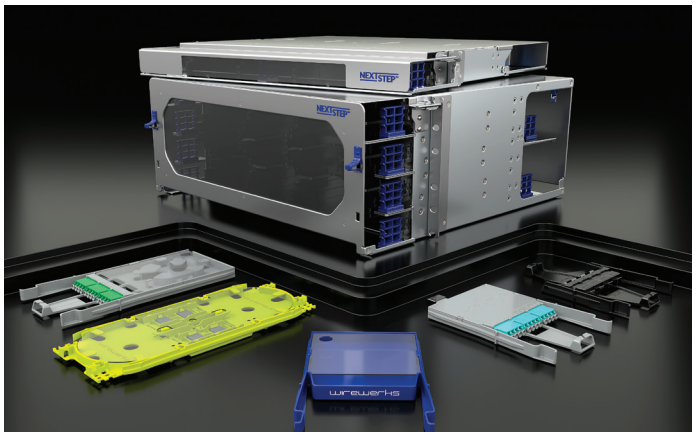


Figure 10
Wirewerks' NextSTEP System

The section titled **'In the PoP'** on page 6 of this Case Study explains how Wirewerks' NextSTEP 1U Patch Panels and NextSTEP LC Patch Modules play a key role in this network solution. NextSTEP 1U Patch Panels and LC Patch Modules are standard products within Wirewerks' NextSTEP Fiber Management System -- an award-winning, comprehensive solution for high performance, high-density fiber management in Broadband Networks, Data Centers, and Enterprise LANs.

The NextSTEP System includes a range of feature-rich 1U and 4U rack-mount patch panels, wall-mount enclosures, and an industry-leading Optical Distribution Frame (ODF). These NextSTEP enclosures house any combination of function-specific NextSTEP Fiber Modules for fiber patching, distribution, fusion splicing, splitter, plug-and-play pre-term solutions, and S/C/D-WDM applications (Figure 10).

Scalable, cost-effective NextSTEP Fiber Management Systems offer faster installations, easier maintenance and reliable operations in any fiber networking application from small LAN applications to the high fiber count, high-density fiber management applications found in Data Centers and Broadband Networks.

For more information, product specifications, and your copy of Wirewerks' NextSTEP Solutions Guide, please contact Wirewerks Customer Service or visit us at **www.wirewerks.com/products-and-systems/wirewerks-systems/**

Award Winning Innovation

At Wirewerks, we believe that innovation is a repeatable process -- not an isolated event.
Since its launch in 2017, Wirewerks' NextSTEP Fiber Management System has been recognized with more than twenty major industry awards for innovation and engineering excellence.

Cabling Installation & Maintenance 2018 Innovators Awards

2018 Diamond Technology Reviews BTR Broadband Technology Report

2020 Lightwave Innovation Reviews

wirewerks
NETWORK INNOVATIONS

ABOUT WIREWERKS

Founded in 1991, Wirewerks is an industry-leading manufacturer of advanced optical fiber and copper structured cabling systems and network infrastructure solutions. Built on core values of quality, innovation, and integrity, Wirewerks is relentlessly customer-focused and dedicated to total customer satisfaction. From project planning, to custom product development, through network implementation and ongoing technical support, Wirewerks operates in partnership with an extensive network of distributors, consultants and authorized installers to provide customers with superior networking solutions and the best value in the industry today.

sales@wirewerks.com
www.wirewerks.com

19144 Avenue Cruickshank, Baie-d'Urfé, QC H9X 3P1
T 1 888 993-4237 | **F** 1 888 893-4237