CEL-FI QUATRA | Smart Cellular Coverage

Enhancing Warehouse and Distribution Center Efficiency Through Reliable Cellular Coverage

As warehouse infrastructure grows across the world, building materials, remote locations, and other factors are hampering the opportunities to leverage new cellular-based communication solutions inside facilities. This is especially problematic for organizations looking to bolster their presence and productivity to keep up with rising demand. According to commercial real estate and investment firm, CBRE, an estimated 400-500 million sq. ft. of additional warehouse space will be needed over the next five years to accommodate for purchasing trends in the U.S. alone.

With this expansion, online retailers and supply chain companies have been undergoing a digital transformation to attain elevated levels of efficiency in their warehouses. Ranging from inventory and network optimization tools to sensors, smartphones, and tablets, new technologies have allowed employees to transition from fixed desktop workstations to mobile devices and access operational systems from anywhere in the facility. In addition to using programs to track and monitor inventory and shelf-to-shipping movement in real time, warehouse personnel can use video conferencing software to communicate and conduct meetings instantly. As these digital tools become business standards, organizations will require strong cellular connectivity that enables effective communication and enhances productivity across the property.

- **Highest Coverage Gain:** Up to 100 dB Max Gain for 3G/4G/5G Voice and Data
- **All Digital:** Cat5e PoE/RFoE Solution
- **Scalable:** Up to 125,000 sq. ft. Coverage per Network Unit
- **Multi Mode:** Off-Air or SuperCell Mode with Fiber Expansion
- **Network Safe:** Carrier-Approved with No Noise Guaranty
- **Cel-Fi WAVE Platform:** Setup, Remote Monitoring, and Management

Bringing reliable cellular reception into any facility, Cel-Fi systems are available in 100 countries and authorized by 200 carriers around the world. In addition to being the most powerful solutions on the market, Cel-Fi products are cost effective and designed to be installed in days (compared to months typical of other solutions). They also deliver uniform, high quality cellular signal throughout a building and are scalable to fit the required size. Plus, Cel-Fi's carrier-grade solutions are network safe and provide a no noise guaranty.

Unlike older analog boosters and passive DAS technology, Cel-Fi QUATRA delivers a cellular signal that is up to 1000x stronger. The system utilizes Cat5e cabling for RF and Power over Ethernet, with no signal attenuation right to the perimeter of the building. With coverage like this, teams can stay connected and get the job done.

Cel-Fi QUATRA Delivers Cellular Coverage for Grocery Chain Distribution Center

SUMMARY

CHALLENGE

- Regional grocery chain specializing in Latin American cuisine was experiencing poor cellular coverage at its primary distribution center and headquarters
- Cellular connectivity needed for the safety of employees and for real time inventory tracking on cellular-enabled devices
- Significant macro capacity congestion due to the nearby major freeway interchange, airport, and conference center

SOLUTION

- Cel-Fi QUATRA

RESULTS

- Strong and reliable cellular connectivity throughout the facility
- Cost-effective solution significantly less expensive than the picocells initially recommended by carrier
- Improved distribution center operations
- Increased subscribers for the carrier

THE CHALLENGE

A supermarket chain that specializes in Latin American cuisine handles the entire food ecosystem for its operations, from purchasing fresh produce and authentic ingredients in Mexico and warehousing it to distributing it to its 60 retail grocery stores in Southern California, Arizona, and Nevada. Its headquarters and central distribution center are located in Rancho Cucamonga, California in a 353,000 sq. ft. building. The warehouse is 297,000 sq. ft., while the offices are on two levels and span 60,000 sq. ft.

The facility is adjacent to a major freeway interchange in Los Angeles with extremely heavy traffic during the morning and evening rush hours. The cellular tower serving this area has capacity constraints due to the volume of the freeway traffic, resulting in poor signal and capacity issues inside the building as the bulk of the bandwidth is used by commuters on the freeway. An airport and major conference center are also close to the building, which further reduces available capacity and creates service problems for other subscribers in the area.

While Wi-Fi Calling was being used to address the cellular signal and capacity issues, the coverage was spotty and the calls were of a poor quality with too much latency. The company's main concern was employee safety. The warehouse runs 24/7 and has 40 bays for trucks. At any given time, there are two dozen forklifts and the same number of power jacks whipping around the warehouse at high speed.

The company was concerned that they could not depend on Wi-Fi Calling if a safety issue occurred and an employee somewhere in the facility had to call 911. Handheld wireless devices were also being used to track inventory in real time when loaded on pallets and then into the trucks.

These devices experienced problems due to the poor Wi-Fi connection, so the chain wanted to transition the handheld devices over to LTE for better reliability.

A carrier suggested taking the necessary steps to improve cellular coverage in the building so the distribution center could move off Wi-Fi Calling. The carrier initially recommended picocells, but too many units were required, which made that solution too expensive. There were also interoperability challenges for handoffs between the picocells when placed inside the facilities.

THE SOLUTION

The carrier contacted Nextivity for a solution, and Cel-Fi QUATRA was installed by RSRF, a reseller and engineering firm specializing in enterprise cellular DAS solutions based in Irvine, California.

Cel-Fi QUATRA is an active DAS hybrid that delivers a cellular signal that is up to 1000x stronger than analog boosters and Bi-Directional (BDA) Passive DAS systems, offering a much larger coverage footprint for multi-carrier voice and data on 3G/4G/5G networks. QUATRA uses cabling with Power over Ethernet, so there is no need to install additional power outlets for the internal remote antennas.

In the offices, RSRF installed three Network Units (NUs), the headend of the system, and 10 Coverage Units (CUs), the remote internal antennas that distribute the cellular signal to end users. On the warehouse floor, two NUs and 6 CUs were installed. CAT5e cabling from the NUs to the CUs made the installation easier to accomplish by four technicians.

RSRF

- Established in 2007
- Based in Irvine, CA
- Services include custom design of cell signal boosters for a wide variety of applications, including enterprise, small business/home office, and mobile
- Customers include commercial, industrial, and government facilities across the U.S

CEL-FI CERTIFIED **RESELLER**

The major challenge in the deployment was aiming the antennas to avoid the interference from the heavy rush hour traffic on the freeway, the airport, and convention center. However, this was resolved by RSRF using the Cel-Fi COMPASS smart radio frequency handheld scanner, which is designed to measure signal strength and the quality of multiple bands.

THE RESULTS

After the installation was completed, Wi-Fi Calling was disabled in the warehouse. LTE coverage, which is far superior in quality and reliability to Wi-Fi Calling, meant that the real time inventory tracking devices performed with a stable connection to smooth out operations. Employees were also able to connect using their cell phones throughout the building, addressing any of the previously raised safety concerns.

The chain was so pleased with the installation and reliability of the cellular coverage achieved in the distribution center that they installed 100 cellular-enabled M2M devices that track the utilization of all their lift equipment, including usage trends and driver behavior, so the company can now better manage their resources and investments.

Cel-Fi QUATRA provided the cellular coverage the supermarket chain needed for employee safety and to ensure the smooth running of its operations. Before and after performance data, reports from the carrier, and customer feedback were all positive.

CEL-FI™ QUATRA | BEYOND BETTER COVERAGE

- **High-quality middleprise solution for 3G/4G/5G voice and data coverage**
- **Supports multi-carrier voice and data**
- **Carrier-approved, unconditionally network safe, and no interference guarantee**
- **Can be monitored and managed using Cel-Fi WAVE**

Cel-Fi QUATRA Provides 430,000 Square Foot of Indoor Cellular Coverage for e-Commerce Giant's Distribution Center

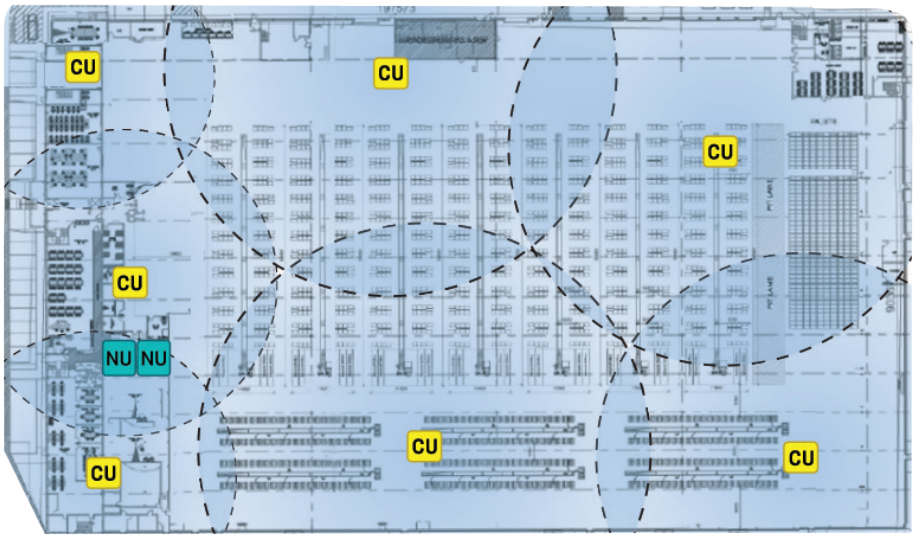
ABOUT THE PROBLEM

E-COMMERCE DISTRIBUTION CENTER

- Global e-commerce company renovating a two-story warehouse and distribution facility with a combined square footage of more than 430,000
- Impenetrable building materials blocked cellular signals from reaching warehouse space and ground-floor offices
- Needed to secure indoor 3G/4G/5G coverage prior to becoming fully operational to support general communication of management team and staff

THE CHALLENGE

A brand-name, e-commerce giant was renovating its more-than 430,000 square foot warehouse located in England. Like many other distribution centers, the building was constructed primarily with metal, steel I-beams, and impenetrable cladding on the outside. Combined with a metal roof, a minimal number of windows located in the few existing offices, and a property largely obstructed by trees, bringing a cellular signal indoors had been next to impossible.



The company initially contacted its mobile network operator for an X cellular solution. The operator contacted their partner integrator NET Coverage Solutions to evaluate the situation. After careful consideration, NET Coverage Solutions decided to select Cel-Fi QUATRA, an active DAS hybrid that can be automatically configured and managed using the Cel-Fi WAVE cloud-based management platform.

THE SOLUTION

NET Coverage Solutions went to the facility to perform a site walk, assess the building's cellular environment, and determine how much equipment was needed.The two NUs that are the head ends of a QUATRA system receive cellular signals via coaxial cable that runs to a MIMO antenna affixed to the outside of the warehouse. This donor antenna is located at the southeast side of the building—one of the few areas not obstructed by large trees. The donor antenna is attached to a pole that is just under three meters high, clearing the roof line and increasing the line of sight to the nearest cellular tower.

NUs are connected with Cat 5e cable to remote internal antennas (called Coverage Units or CUs). Four CUs were conveniently placed in the mostly open, ground-floor space which also houses a few offices and meeting rooms; while the large, open warehouse with low-level equipment and storage was outfitted with three CUs. Because Cel-Fi QUATRA leverages Power-over-Ethernet, no additional power outlets were required, enabling optimum CU placement wherever signal was required.

The Cel-Fi QUATRA system was installed and commissioned using the Cel-Fi WAVE portal authentication and activation system. The installation was further optimized with antenna pointing tools available in the Cel-Fi WAVE App, and the ready reading and optimization of SINR, RSRP, and RSRQ. After successful install, remote access was available to manage and provide updates.

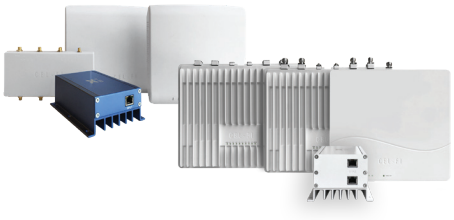
NETCS
NETWORK COVERAGE SOLUTIONS

NET Coverage Solutions UK

- Founded in 2004
- Headquartered in Camberley, England, UK
- One of the UK's largest systems integrators in the cellular industry
- Cellular solutions in-house: from closed access domestic femtocells to multi-sector, multi-operator, multi-technology macro/pico cells.
- Provides services to operators, landlords, property developers, and private clients.

THE RESULTS

Immediately following installation, the e-commerce giant experienced clear and reliable cellular connections inside its offices, operations area, and warehouse. NET Coverage Solutions Director Dave Stephens stated, "Cel-Fi QUATRA is exactly the type of solution the market has needed. It's safe for the operator, economical, and very simple way to deploy, bringing IT-level ease-of-use interfaces to the RF industry.The expectation is that cellular shouldn't be any more complicated than Wi-Fi, and Nextivity has accomplished that illusion by its innovative design and simplified user interfaces."



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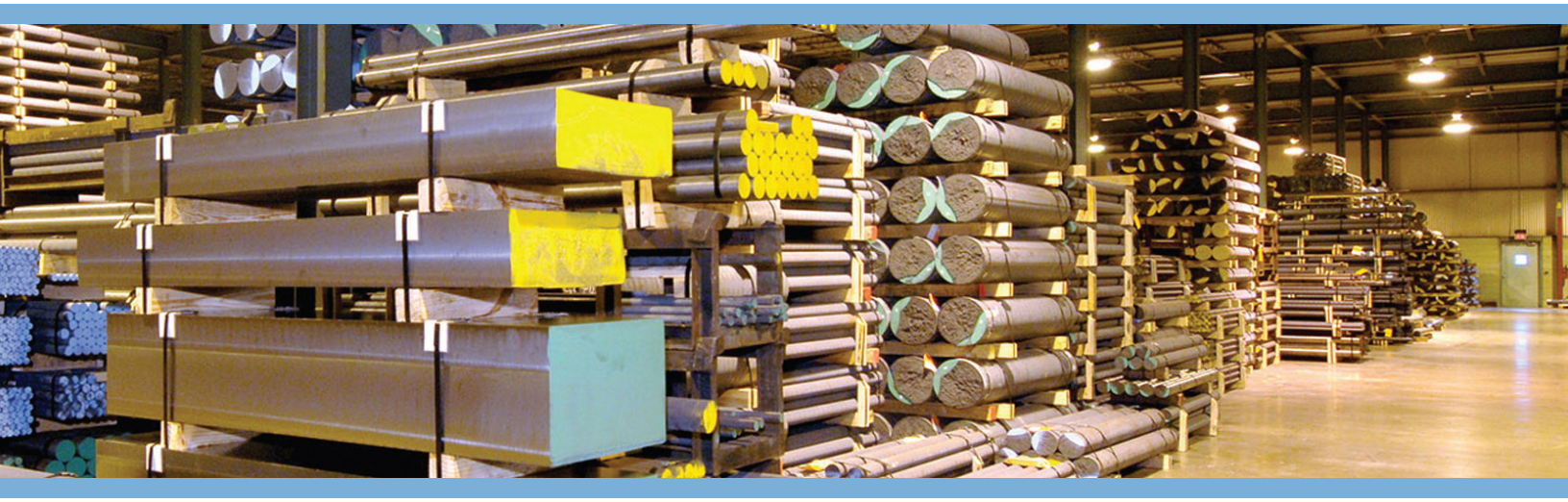
Cel-Fi QUATRA Powers Cellular Connection for Underground Electric Vehicle Charging Stations



Headquartered in Woodstock, Illinois, Charter Dura-Bar focuses on continuous cast iron bar products that are used as alternatives to carbon and alloy steel for industrial applications such as drilling and hydraulic fracturing in oil and gas. The company is comprised of two divisions. Dura-Bar is the world's largest producer of engineered cast iron bar products—and the only continuous cast iron bar foundry in the United States. Dura-Bar Metal Services is Dura-Bar's largest distributor, serving more than 3,000 global customers from locations in Illinois, Pennsylvania, Texas, and North Carolina.

Charter Dura-Bar boasts a picturesque campus. A lake and plenty of green space surround its three main buildings, which house administrative functions, metal services, and an iron foundry. Its somewhat rural location, coupled with the large amount of steel and cinder block walls in the foundry, made it difficult for cellular signals to penetrate indoors. As the company's 10 small cells began to reach the end of their lifecycle and the carrier no longer supported the offering, Charter Dura-Bar was on the hunt for a new solution.

Ease of management was a key criterion. "Each small cell could only hold 15 numbers, so we were constantly having to make updates as employees moved around or phone numbers changed," says Wendy Zeitler, a senior telecommunications technician at Charter Dura-Bar. "We also had to prioritize based on seniority, so it was very disheartening to tell employees we weren't able to give them cellular coverage at work."

THE CHALLENGES: Manufacturing

- Within a rural area: 35,000 square foot, brick-exterior administrative building, 57,000 square foot shop area used to cut metal
- A large amount of steel and cinder block walls in the foundry
- 10 small cells began to reach the end of their lifecycle
- Constantly having to assign available phone numbers to a set number of employees due to limitations of how many each small cell could support
- Need secure machine-to-machine communications moving from the network to a cellular network.

USING CELLULAR TO POWER IOT

In addition to wanting to provide typical voice and data services over the cellular network—for example, enabling employees to communicate with one another between buildings, or for personal reasons—the metal services building, and the iron foundry feature industrial-sized vending machines that contain various tools and supplies. Employees working on the factory floor must enter a personalized code to access, for instance, protective gloves or specific parts they need to operate a piece of machinery. The company's credit card is then processed in real-time for these purchases.

Payment processing was running over Charter Dura-Bar's network. But because

the vending machines were operated by a third-party company, the security team wanted to separate this function from the company's IT network to mitigate security risks in the event of a breach.

"By moving to a cellular network," explains Trent Bruha, a service desk technician at Charter Dura-Bar, "we would gain peace of mind while enabling secure, machine-to-machine communication."

Charter Dura-Bar also wanted to improve the cellular experience for employees taking part in the company's BYOD program, and more generally to eliminate the inconvenience of having to run out to the parking lot whenever they wanted to use their phones.

CONNECTING WITH KONECTAUSA AND CEL-FI QUATRA

On the recommendation of their carrier, Charter Dura-Bar turned to KonectaUSA, a leading provider and installer of indoor cellular solutions. KonectaUSA decided to use the Cel-Fi QUATRA active DAS hybrid from Nextivity to build out Charter Dura-Bar's cellular network.

"When we tell customers that we can support applications such as credit card vending machine transactions over cellular, they love it because we don't have to touch their IT network," explains Mike Shortridge, a partner at KonectaUSA. "Cel-Fi QUATRA is a cost-effective solution that can provide reliable, multi-carrier coverage in places that have traditionally proved to be a challenge."

Shortridge began his work in the iron foundry, a 596,000 square-foot building that runs 24 hours a day in three shifts totalling 300 employees. A cafeteria, as well as administrative and engineering offices are located in the foundry. The vending machines are situated in an office next to the cafeteria because it is too hot in the foundry itself to make calls.

KonectaUSA

- Founded in 2015, with headquarters in Minneapolis, Minnesota
- Leading cellular live-inside provider installations and service provider
- Services include design, installation, and maintenance
- Customers include education, hospitality, healthcare, and FORTUNE 500 companies

A Cel-Fi QUATRA Network Unit (NU – the head-end of the active DAS hybrid) was installed to deliver Verizon and AT&T signals to four Coverage Units (CUs – the internal antennas that rebroadcast the signal inside the building). Three CUs provide coverage to the offices, including one CU that is cabled to two passive dome antennas for a cost-effective solution to feed signal to the cafeteria where the vending machines were located. The fourth CU was used to cover the large engineering area (50 x 100 square feet) with cinder block walls.

"With other products, we would definitely have needed two, maybe even three, coverage units for the engineering area," says Shortridge. "But Cel-Fi QUATRA performed really well with just the one coverage unit. It was impressive."

THREE BUILDINGS IN EIGHT DAYS

Next up was the 35,000 square foot, brick-exterior administrative building predominantly made up of offices, meeting rooms, and a cafeteria. There, KonnectaUSA installed one NU and four CUs that were placed in a typical square configuration to ensure coverage in each corner of the building. A wideband directional antenna on the roof provided the donor signal.

Once this was complete, Shortridge turned his attention to the metal services building. The 57,000 square foot shop area is used to cut metal, with 30 employees split over two shifts to do this work. It also housed a vending machine. Here, one NU and four CUs also did the trick. Now, employees working in shipping and receiving can communicate more easily with truck drivers trying to pick up or deliver materials.

In total, it took Shortridge's cabling crew only eight days to complete the installation in all three buildings.

"It was a seamless and non-disruptive installation process," says Bruha. "We were able to continue production without interruption."

REALIZING BUSINESS BENEFITS ACROSS THE BOARD

Charter Dura-Bar now has a separate, secure network to handle vending machine orders. Operationally, the company has seen a number of operational benefits. Pre installation readings went from -120 and -110 to post installation readings of -85 and -75 throughout the different buildings, and capacity is no longer an issue—every employee now enjoys coverage. This has come with some unexpected, but welcome, benefits.

"One of our employees received a text from her child's school while she was at work, and she was able to see it and deal with it immediately," says Bruha. "That simply wasn't possible before. Our employees are very much enjoying this soft benefit, and morale has definitely improved."

It has also eased the burden of IT management on the Charter Dura-Bar team, who estimate they've saved several hours a month from not having to manage the previous solution, or employees' expectations around coverage.

"Our president was behind this 120% and is beyond thrilled with Cel-Fi QUATRA," says Zeitler. "He understands the impact it has on the business and is so very appreciative."

What is Smart Cellular Coverage?

Award-winning Cel-Fi Products

Nextivity Inc., develops the award-winning Cel-Fi products that optimize cellular coverage in enterprise, business, residential, and transportation applications. Cel-Fi products are self-configuring, carrier-approved, and unconditionally network safe; leveraging the IntelliBoost chipset to deliver the industry's highest gain at the lowest cost per square foot. Cel-Fi is authorized by 200 carriers.

Best in Performance

Cel-Fi solutions are carrier-grade, and can perform at a level that is 1,000 times stronger.

Cel-Fi WAVE Portal

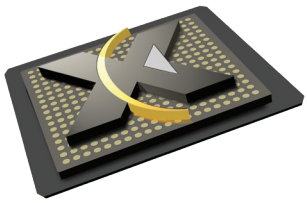
- Data modeling and reporting
- Cel-Fi device and asset management
- Mobile applications
- Globally trusted carrier-grade security
- Users can access the Cel-Fi WAVE portal through the dashboard interface.

Network Safe with No Noise Guaranty

Self-organizing edge intelligence ensures that Cel-Fi does not interfere with other indoor wireless products such as Wi-Fi routers, Small Cells, and Distributed Antenna Systems (DAS). High speed Automatic Gain Control ensures that Cel-Fi is unconditionally network safe, and enables more simultaneous calls and higher data speeds.

IntelliBoost® Chipset

The Nextivity IntelliBoost® baseband processor is the first six-core processor designed specifically to optimize the indoor transmission and reception of 3G, 4G, and 5G wireless signals. With advanced equalization and echo-cancellation techniques, Nextivity has developed an architecture which delivers unprecedented in-building data rates and pervasive voice and data connectivity. The IntelliBoost processor ensures that Cel-Fi products never negatively impact the macro network while providing maximum coverage.



Ease of Setup

Cel-Fi solutions are designed to be the easiest solutions in their class to set up. Leverage Cel-Fi tools to set up and install, and the core technology that does the math for you.

Solving coverage issues for voice, data, and public safety communications.

San Diego, CA based company, Nextivity builds and designs cellular coverage and public safetycommunication solutions. Cel-Fi products have been approved in 100 countries. In many countries, Cel-Fi products are the only legal solution approved by the communications regulatory commissions. Not interfering with the network, and only improving upon it is the key.

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