CEL-FI QUATRA 4000

Installation and User Guide

Revision: 3 draft

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About This Guide

There are a variety of Cel-Fi QUATRA product variants available, supporting a variety of band configurations, for multiple regions. This manual is applicable to the Cel-Fi QUATRA 4000 ONLY, and does not apply to any other QUATRA variants.

Safety Precautions

- Use Cel-Fi QUATRA 4000 indoors. It should not be used outdoors.
- These products are designed to be used with the power supply unit that shipped with the Network Unit. When installing the equipment, all the requirements of the manufacturer and the referenced standards must be met.
- There are no user serviceable parts inside.

CAUTION: Changes or modifications to this product not expressly approved by Nextivity may void your right to operate the equipment.

Introduction to QUATRA 4000

Understanding Cellular Coverage

Spotty cellular coverage, poor voice quality, dropped calls, and dead zones continue to plague occupants in buildings of all shapes and sizes. Cel-Fi QUATRA solves that problem. It is an affordable, all-digital solution, providing uniform, high quality cellular signal throughout a building. Cel-Fi QUATRA is scalable to fit buildings of all sizes, and is carrier approved and guaranteed network safe.

Unlike traditional analog boosters and passive DAS technology, Cel-Fi QUATRA delivers a cellular signal that is up to 1000x stronger, utilizing CAT 5e (or better) cabling for the connection between the head end and each remote. The remotes are powered via Power over Ethernet (PoE), delivering an un-attenuated signal throughout the building. Cel-Fi QUATRA can be installed in just days (compared to months typical of other solutions), and at a price point that meets the middleprise budget.

The Cel-Fi QUATRA Solution

While cellular networks are outside, the majority of calls take place inside. A recent study showed 80% of business users inside complain of poor coverage or dropped calls. Modern building materials, while improving energy efficiency, will block or inhibit cellular service from the outside network. To exacerbate the issue, cellular coverage is increasingly critical. In fact, cellular coverage can be considered a safety or even regulatory requirement, depending on the region. Building owners need a flexible, high-quality solution. Installers and Value-Added Resellers need a product that can serve the majority of building types and not take months to deploy.

- Cel-Fi created a new solution category that combines its core technology with the architecture of an Active DAS – to deliver an Active DAS Hybrid – carrier-grade but built for Installers.

- Integrators and Carriers have partnered with Cel-Fi to deliver a smart solution designed for middleprise buildings – Cel-Fi QUATRA solutions.
- Cel-Fi provides the QUATRA BOM Estimator to help installers select the appropriate equipment in the right quantity, to eliminate the heavy cost / time of the (pre) planning effort.
- Cel-Fi's all-digital, scalable, PoE Category cable-based solution makes it ideal for Single or Multi-Carrier environments.

Speed of Installation, higher quality in-building cellular solutions, and cost savings – are some of the reasons building owners, facility managers, and IT professionals are making the smart investment in Cel-Fi QUATRA solutions.

A Solution Anyone Can Confidently Deploy

Cel-Fi QUATRA is designed to improve indoor signal coverage without any risk of interference on the mobile network. Cel-Fi QUATRA provides a sophisticated network-safe solution that has been rigorously tested globally, through multiple generations, engineered to deliver multiple levels of network protection:

- Uplink power control to prevent desensitizing the network
- Echo-cancellation and feedback control
- Uplink muting, when handsets (UE) are not detected
- Signal qualification (channels are individually qualified, so noise or very poor signals won't be amplified and degrade the network)
- The Cel-Fi WAVE Platform cloud-based portal enables an operator to monitor equipment and network KPI's, such as channel configurations, RSRP, RSCP, SINR, and system gains, providing control and optimization insight.

Regulatory // Model Number: Cel-Fi QUATRA 4000

The QUATRA 4000 is FCC Part 20 certified. It supports bands 4,5,12,13 and 25.

This is a CONSUMER device.

BEFORE USE, you **MUST REGISTER THIS DEVICE** with your wireless provider and have your provider's consent. Most wireless providers consent to use of signal boosters. Some providers may not consent to the use of this device on their network. If you are unsure, contact your provider.

You **MUST** operate this device with approved antennas and cables as specified by the manufacturer. Antennas **MUST** be installed at least 20 cm (8 inches) from any person.

You **MUST** cease operating this device immediately if requested by the FCC or a licensed wireless service provider.

WARNING. E911 location information may not be provided or may be inaccurate for calls served by using this device.

Bands Supported Under This FCC Certification

Verizon

Band 4, 13 and 25

Sprint Support

Band 2, 25

AT&T Support

Band 4, 5, 12, 25

T-Mobile Support

Band 4, 12, 25

System Overview

How Does It Work?

Cel-Fi QUATRA 4000 is a powerful cellular signal distribution solution. Cel-Fi QUATRA 4000 is fundamentally comprised of a Network Unit (NU) and up to six (6) Coverage Units (per NU). The Network Unit takes the donor input from up to four (4) carrier signal sources. The signal source can be off-air (over-the-air (OTA)) from the macro network, or delivered via a small cell.

The NU receives and individually processes channels from each carrier, allowing higher gain for weaker channels (up to 100 dB). The channels are digitized and sent over a pair of Ethernet cables to each CU for retransmission through one or more service antennas.

Architecture Overview

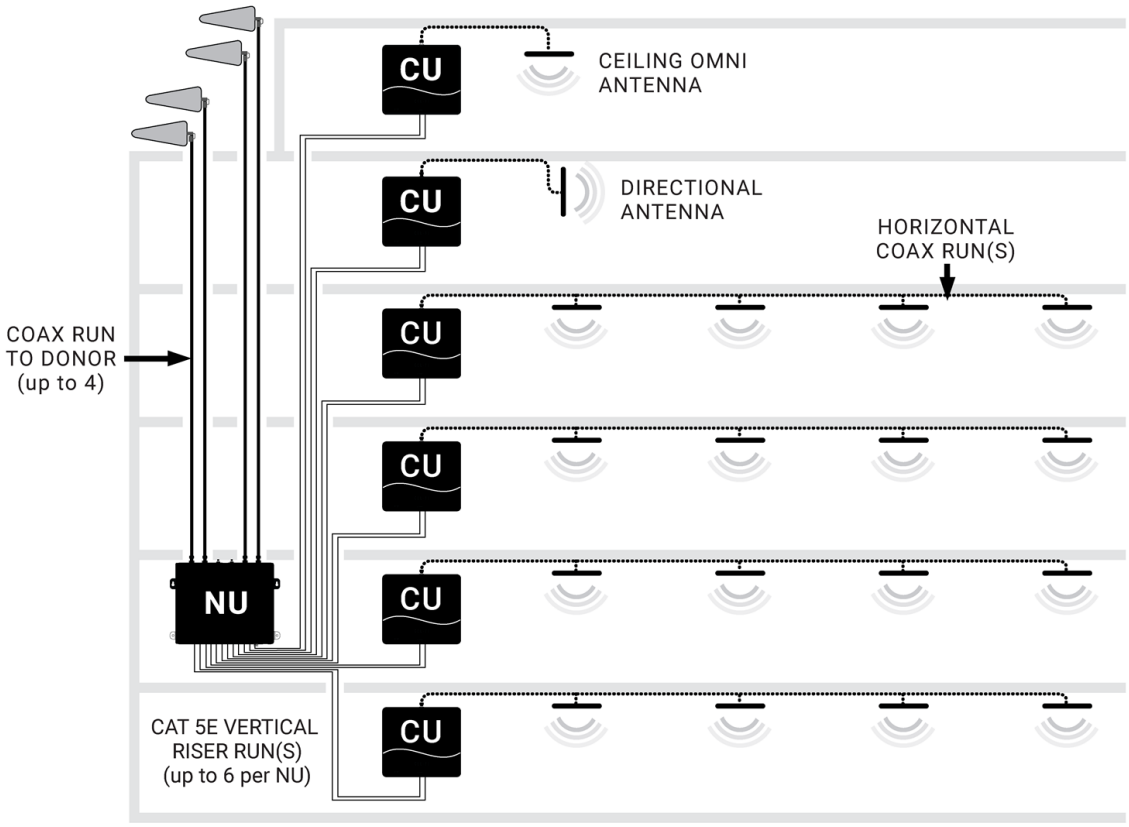


Figure 1. Architecture Overview

Cel-Fi QUATRA 4000 Key Features

- Carrier Grade, FCC-certified Smart Signal Booster
- Support for AT&T, Verizon, T-Mobile and Sprint
- Relays two (2) bands per operator, simultaneously
- Independent donor ports for each operator allows for independent antenna optimization
- Single combined (CU) server port enables driving either a serving antenna or passive DAS field
- 95-100 dB max system gain
- 140MHz total relay bandwidth
    - 6 channels x 20MHz
    - 2 channels x 10MHz
- Support for up to six (6) CU via Cat5e cable (or better)
- N-type RF connectors (donor and server)
- Internal modem for remote management (SIM slot access)
- Industrial aluminum powder-coated housing
- Up to 100m distance between NU and CU (using Cat5e)
- QUATRA Range Extender (QRE) extends the NU to CU distance by 100 meters
- 20-22dBm uplink power per operator per band
- 13-16dBm downlink power per operator per band

Hardware Components

Cel-Fi QUATRA 4000 is a modular solution with two (2) foundational components: the Network Unit (NU) and the Coverage Unit (CU). In traditional DAS terminology these could be known as the Head End (NU) and the Remote Unit (CU).

Power is provided to the entire system through AC power at the NU. The CUs are powered via Power over Ethernet (PoE), and therefore do not require a separate power source at their location.

Signal source is brought into the system at the NU, via a wired connection, like a small cell, or through a donor antenna and an RF connection.

Network Unit (NU)

The Network Unit, referred to as the NU, is the head end for the QUATRA 4000 system. The signal sources (one for

Figure 2. NU Image

each port/carrier) are connected to the NU. Then they are digitized and purified, and distributed over dual Category cables to the Coverage Units (CU).

Note: Only cellular signals may be connected to the donor ports. Other types of radio signals will not work, and may damage the system.

The NU has four (4) N-type RF ports on the top. Each RF port is assigned, and marked, to a specific carrier.

There are two (2) SMA-female ports on the top of the NU. One functions as the external antenna connection for the unit's internal cellular modem, and the other is for GPS. (The GPS port is for future functionality)

Power

- AC Power Supply (inside the NU)
- AC power cord

Physical Interface

- RJ45 ports (13)
    - Paired RJ45 ports, 2 per CU served
    - LAN port for Internet connection

- SFP+ module dock (future use)
- N-type Female RF Ports (4) for Donor Antenna
    - One for each carrier
- SMA port (2)
    - Provides an external antenna connection for the internal cellular modem (when used)

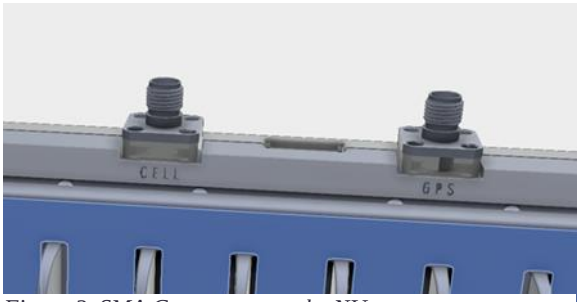


Figure 3. SMA Connectors on the NU

User Interface

- LED interface (front) to indicate system status. (For detail on the LED go to LEDs.)
    - Power
    - CU1
    - CU2
    - CU3
    - CU4
    - CU5
    - CU6
    - SFP+
    - LAN
    - MODEM

Power Supply Cable

Coverage Unit (CU)

The Coverage Unit (CU) receives the digitized cellular signal from the NU, converts back to RF, amplifies, and distributes the service from its RF port. Service can be deployed through a single connected antenna, or through a DAS field.

Figure 4. QUATRA 4000 CU

The Coverage Unit includes a multiband blade-style antenna that can be connected directly to the CU. See Figure 8. CU Antenna

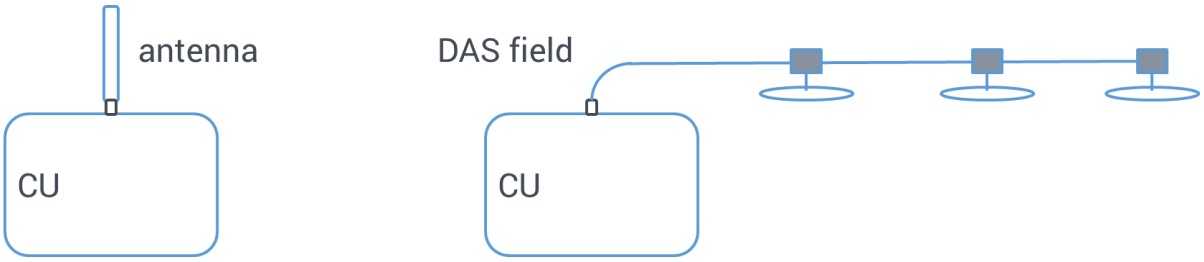


Figure 5. CU Antenna

Figure 6. CU Server Antenna

Accessories

QUATRA 4000 Range Extender (QRE4K)

Model Number: Q40-OE

Figure 7. QRE-4K

The QRE-4K unit is a device that extends the standard 100 meter cable length from NU to CU by an additional 100 meters. It is inserted in-line between the NU and CU, and requires no external power. The RJ45 connectors are on each side (two per side).

Figure 8. Using QRE-4K

Donor Antennas

The donor antennas are used to provide off-air signals to individual carrier donor input ports. The objective is to provide the best quality carrier signals to the NU. A variety of donor antennas are available from Nextivity. The right donor antenna choice can make the difference between a good outcome and a great outcome. Please refer to other antenna-specific documents for choosing the right donor antenna.

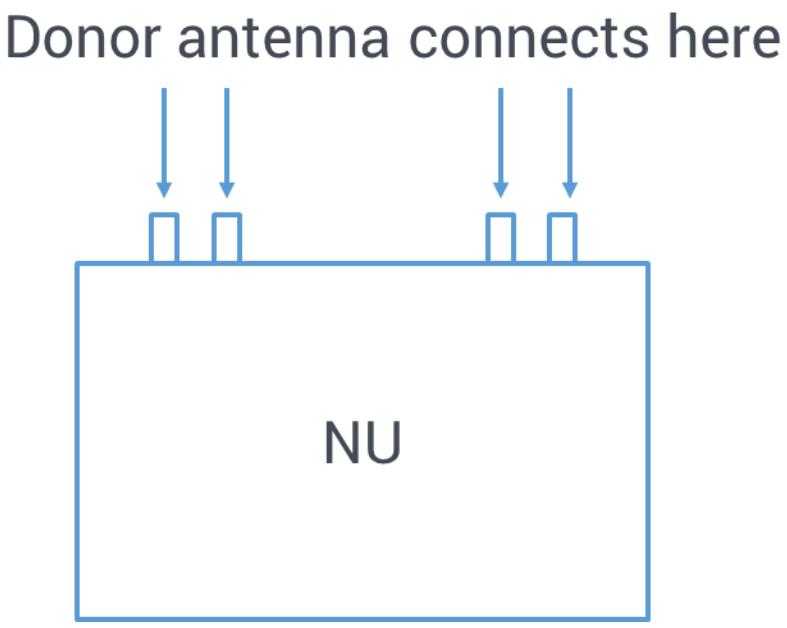


Figure 9. Donor Antenna Connection

Cel-Fi LPDA-R Antenna

Model Number: A62-V44-200

Nextivity recommends its LPDA-R antenna for use as a great donor antenna for most situations.

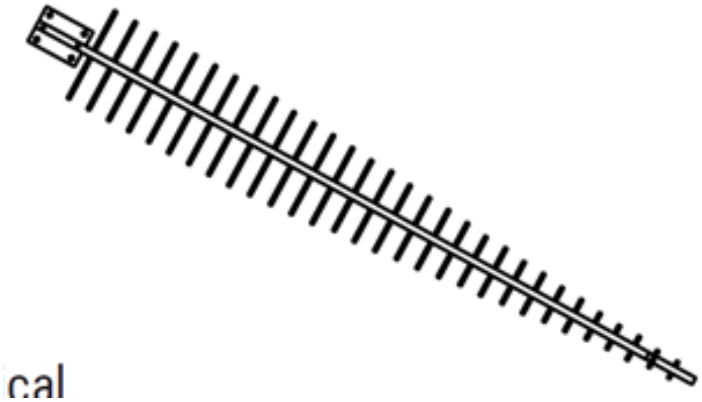


Figure 10. Cel-Fi LPDA-R antenna

Check www.cel-fi.com/antennas for details and updates.

Server Antenna

The server antenna connects to the RF port on the CU.

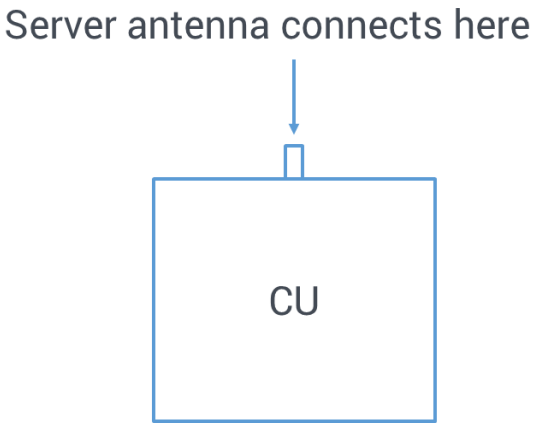


Figure 11. Server Antenna Connects

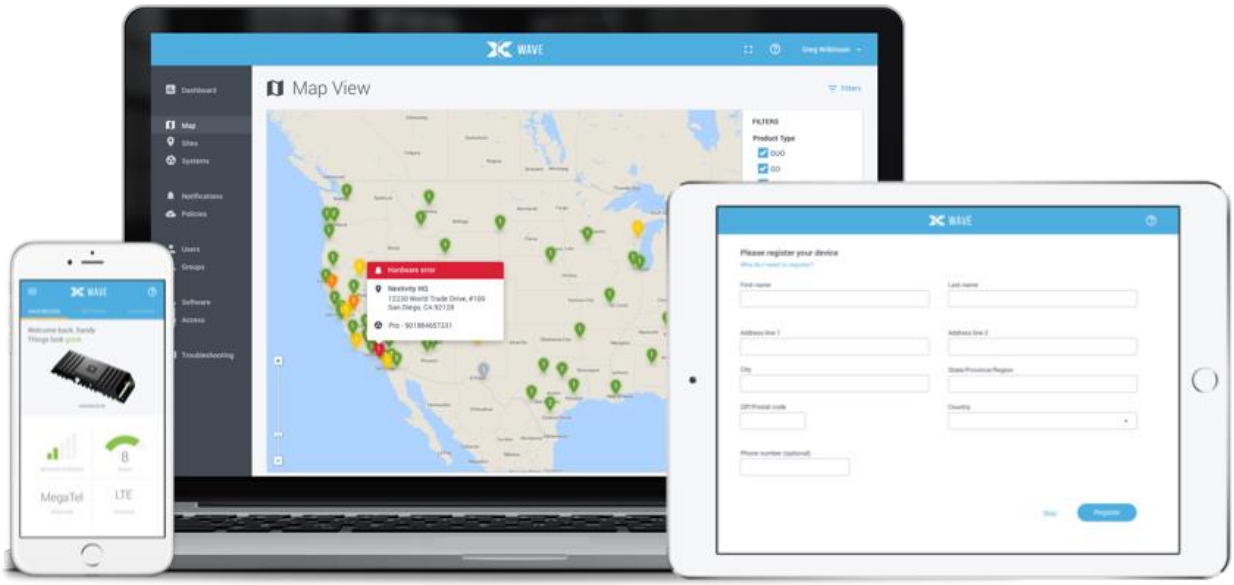
A variety of Server antennas are available from Nextivity.

Check www.cel-fi.com/antennas for updates.

Couplers

RF couplers or tappers can be used in conjunction with the Cel-Fi QUATRA 4000 and 4000i, when multiple antennas are required for the installation. Careful system design should be implemented to insure sufficient power levels into all antennas.

The WAVE Portal



Introduction

Cel-Fi WAVE is Nextivity's SOC2 Type 1 compliant cloud-based software platform from which Cel-Fi apps and connected capabilities are hosted and driven. Current-generation Cel-Fi products feature embedded connectivity that allows them to connect to the WAVE cloud. The WAVE portal and apps are used to facilitate software updates, registration, commissioning, installation, optimization, and troubleshooting. The Cel-Fi WAVE platform continues to expand in features and function.

In order to use the WAVE portal and related capabilities, you must be registered with the system. To request access to the WAVE portal go to:

https://cel-fi.com/account-request/

Once you are registered, the URL for the WAVE portal is:

https://wave.cel-fi.com/#/login

Alarms, Alerts, and Policies

Cel-Fi systems support a variety of standard alarm conditions.

Use the Notifications page in the WAVE portal to view a listing of notifications (alerts) sent to inform specified users of alarm conditions occurring in installed systems, or assets within systems. You can access and view Notification Detail by double-clicking a displayed notification.

A wide variety of standard alarm conditions are available.

The Main Alarms

Error Indication	Name	Meaning
ES1	NU HW	Network Unit hardware error
ES2	Not Receiving Signal	Insufficient donor Signal
ES3	CU HW	Coverage Unit hardware error
ES4	Input too strong	Donor signal (RSRP) too strong
ES5	NU Overheating	Network Unit is overheating
ES6	CU Overheating	Coverage Unit is overheating
ES7	Too Close	*Not applicable for QUATRA*
ES8	Too Far	*Not applicable for QUATRA*
ES9	Disabled by operator	*Not applicable for QUATRA*
ES10	Location Lock	*Not applicable for QUATRA*
ES11	New Registration Required	*Not applicable for QUATRA*
ES12	Self-Test Failed	System self-test has failed
	Ethernet Link Error	An error has been detected in the link between the NU and CU
	CU Shutdown from Portal	A CU has been shut down remotely from the WAVE portal

User Profiles

User profiles are created in the Wave Portal. User Profile is where individual account information is stored, as well as any Group assignments.

Installation

Important: Before any permanent installation, make sure all the components are planned and accounted for, as well as any wiring, cabling, power, mounting, antenna placements, and system access.

Overview

Several things need to be determined as part of installation planning and preparation. There isn't a specific order these items need to be resolved. Depending on the specific needs at the site, varying orders of activity may be employed.

- Perform any required indoor and outdoor signal surveys to understand current signal problems to solve and to assess candidate donor antenna locations.
- Determine where the **NU(s)** will be mounted.
    - Ensure adequate power source.
    - Determine donor signal sources and cabling/routing.
    - Ensure access to the Category cable runs, connecting to the CU(s).
- Determine where the **CU(s)** will be mounted and how coverage is to be distributed.
    - Determine if the (included) Mini Panel Antenna will be used or a DAS field, for each CU.
    - If coaxial cable and antennas are planned for use then that should be considered at this point.

Note: IBWAVE (or other RF planning tools) designs are not required but are a good way to ensure the best performance outcomes.

NU

Mounting

The Cel-Fi QUATRA NU is designed for simple wall mounting. Mounting accessories, including screws and anchors, for common material types (drywall, plywood, etc) are included with each NU.

An NU Mounting Template is included in the NU box. The QUATRA 4000 NU Mounting Template can also be downloaded from www.cel-fi.com/QUATRA4000.

Equipment Required for Mounting

- Drill
- Drill bit extender (3"+)
- Hammer
- Pencil, or other similar marker.
- Level

Caution: Make sure the area behind any surface is free of electrical wires or other dangerous elements prior to drilling.

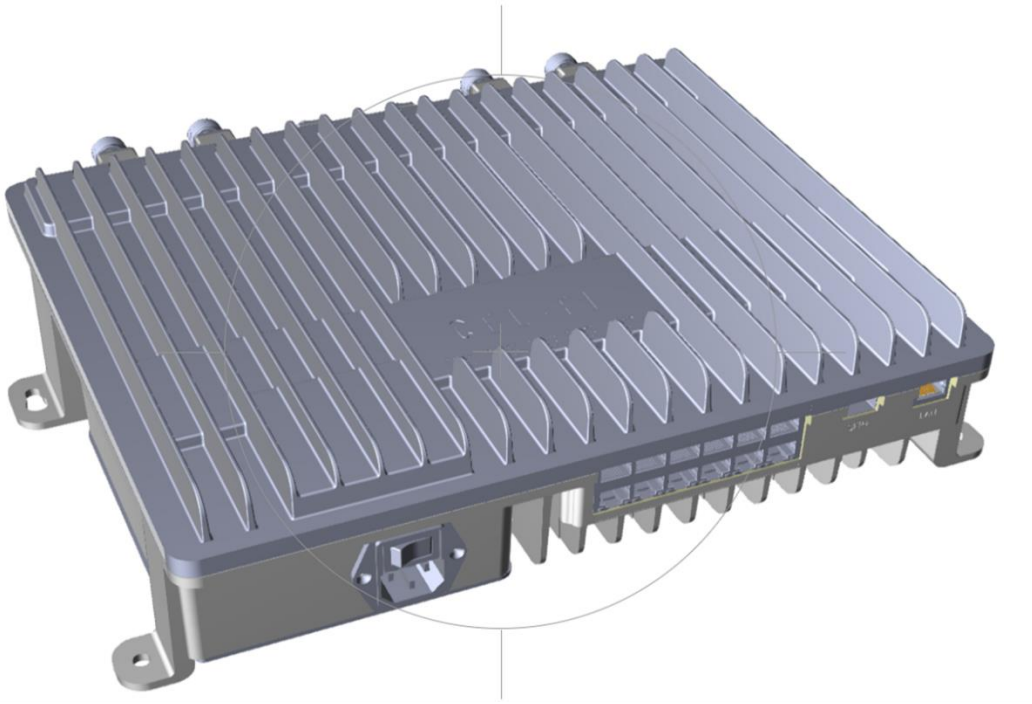


Figure 12. NU Mounting Illustration

The QUATRA 4000 NU has four (4) secure mounting tabs, two on each side. The two topmost tabs have been keyholed.

Note: The Mounting Instructions below use the standard drywall mounting anchors and screws included with the unit. If the NU is to be mounted onto other surfaces, make sure the appropriate anchors and screws are used (not included).

Option 1. Using the NU Mounting Template

Use the mounting template included in the QUATRA 4000 NU box.

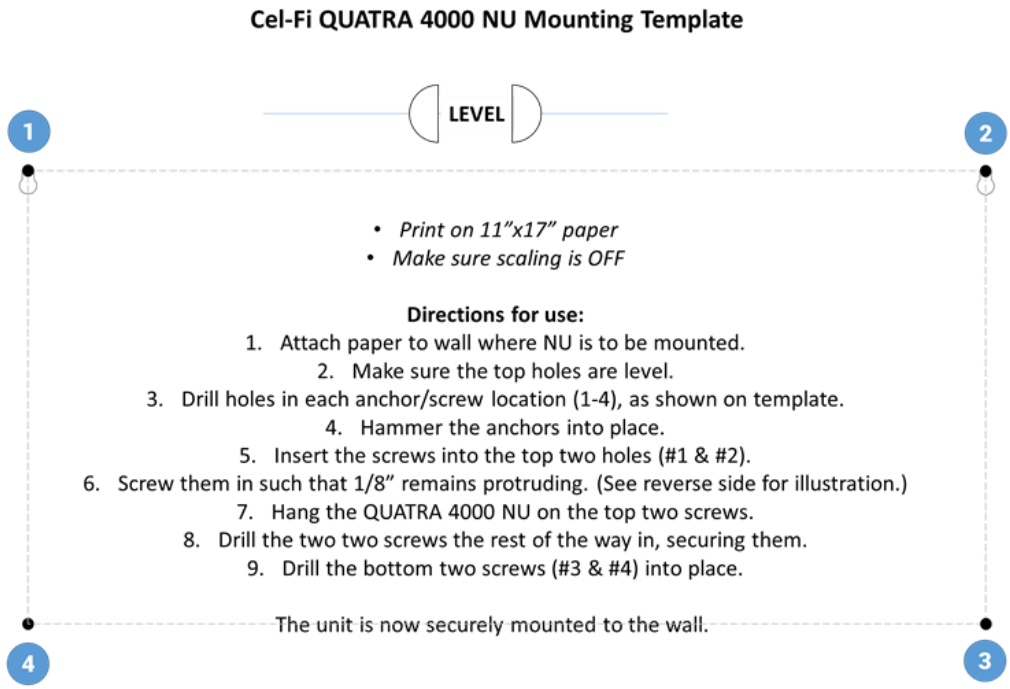


Figure 13, NU Mounting Template

Option 2. No Template

1. To mount the NU, first determine the approximate location on the wall for the unit.
2. Hold the unit up on the wall and, using a pencil or similar marker, mark one of the top (right or left) points.
3. Using a drill, drill the location for the wall anchor.
4. Hammer in the wall anchor.
5. Place the NU in the right location and screw on the mount.
6. Make the unit as level as possible, and mark the spot for the other top mounting hole on the wall.
7. Using the drill, drill the appropriate hole where marked.
8. Hammer in the anchor, appropriately.
9. Screw in the second NU tab.

Note: The keyhole style allows for fine-tuning of the horizontal level.

Figure 14. Leveling the NU

10. With the NU attached to wall, drill holes for each remaining anchor.
11. Unscrew the top two screws slightly, so the unit can be removed, but leave the screws in the wall.
12. Remove the NU from the wall and hammer the bottom two drywall anchors into place.
13. Hang the NU back on the top two screws and re-tighten those screws.
14. Screw the bottom two screws into place, through each bottom tab hole.

The unit should now be firmly attached to the wall.

Connecting Donor Source

The QUATRA 4000 has four independent RF ports for connecting the donor signal. Each port:

- Is an N-type Female connector
- Is specific to the supported operator
- Supports one and only one operator
- Is designed to support a variety of band configurations

Donor Antenna

Each RF port can be fed by a donor signal consisting of either a small cell or an antenna. Nextivity offers a number of donor signals perfect for use with Cel-Fi QUATRA 4000.

Note: Small cell inputs and off-air inputs can be used in the same system, but not for the same donor port.

The donor antenna is used to collect the donor signal from the external (over-the-air) carrier network. Better donor signals lead to better customer experiences, improved voice quality and faster data throughput. An RSRP signal-to-noise ratio (SiNR) of >0dBm is strongly recommended for each given carrier's source signal. Better SiNR leads to better throughput.

Each donor antenna should be mounted safely and securely where it can access the desired cellular network. A coaxial cable connects the donor antenna to the NU's RF port for each given carrier.

Small Cell Donor

If a small cell is used as the donor source then it should be connected at this time.

The input signal level for the donor port should be between -60 and -50 dBm.

Note: the small cell should be fully-operational in standalone mode prior to being connected to the QUATRA 4000.

Power

The QUATRA 4000 system is powered from the Network Unit (NU). The NU comes with a power cord that plugs in to the back of the unit. The Coverage Units (CU) are Powered-over-Ethernet (PoE) and therefore do not have independent power supplies that need to be plugged in.

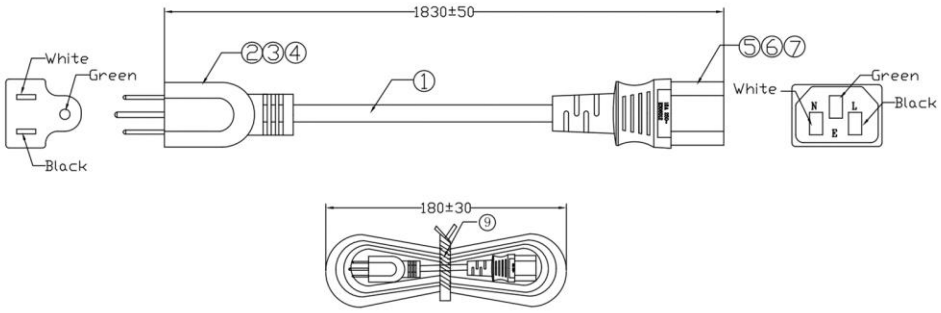


Figure 15. NU Power Cord

The entire system should be installed, CUs located in the desired coverage location, before the system is powered-on. The power cord can be installed, with the switch in the OFF position. When the system is ready to be powered, switch to ON.

Note: It is recommended to zip-tie or otherwise secure the power cord once the system is powered-up, to prevent accidental unplugging.

CU

Mounting

The Coverage Unit (CU) comes with a wall mounting bracket in the box. To mount the QUATRA 4000 CU simply follow these steps:

1. Position the QUATRA 4000 CU wall mount on the wall in the desired mounting location.

   Note: Whenever mounting any Cel-Fi gear on a wall or ceiling make sure the area is free of any dangerous electrical wires, other safety hazards, or any other objects that could be damaged or effect the quality or stability of the mounted unit.

2. Holding the mounting bracket in place, mark hole locations with a pencil.
3. Drill the holes.

4. Hammer in the anchors.
5. Attach the bracket to the wall with the included screws.
6. Once the bracket is firmly attached to the wall, the CU can be attached to the bracket.

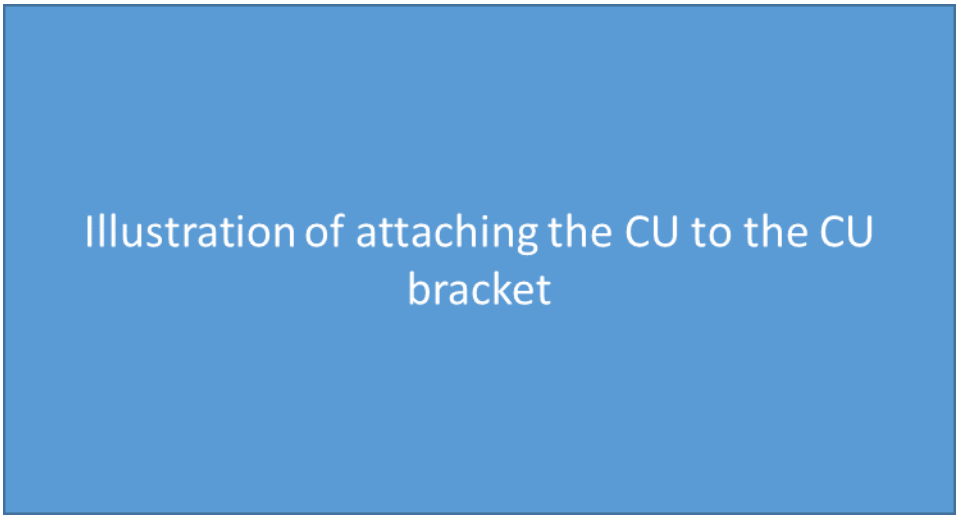


Figure 16. Attach CU to bracket

7. With the bracket in place, attach the CU.

8. Tighten (finger) each Locking Screw into place to ensure the CU is securely attached.

Connecting Server Antenna(s)

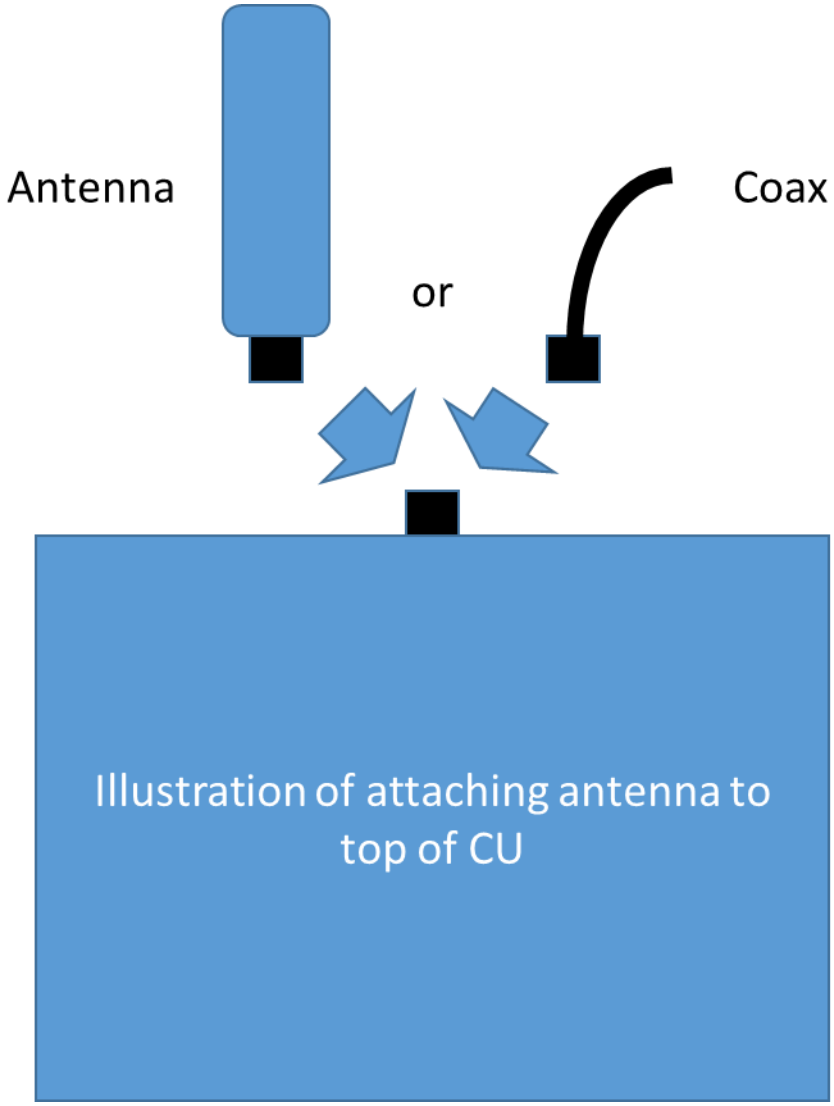


Figure 17. Attaching antenna to CU

The CU has an N-type connector on the top of the unit for attaching an antenna. An omni-directional antenna is included with each CU, or a coax cable can be connected with a series of passive antennas attached.

Connecting NU and CU

Each CU connects to the NU using two Ethernet cables (Cat5e or better).

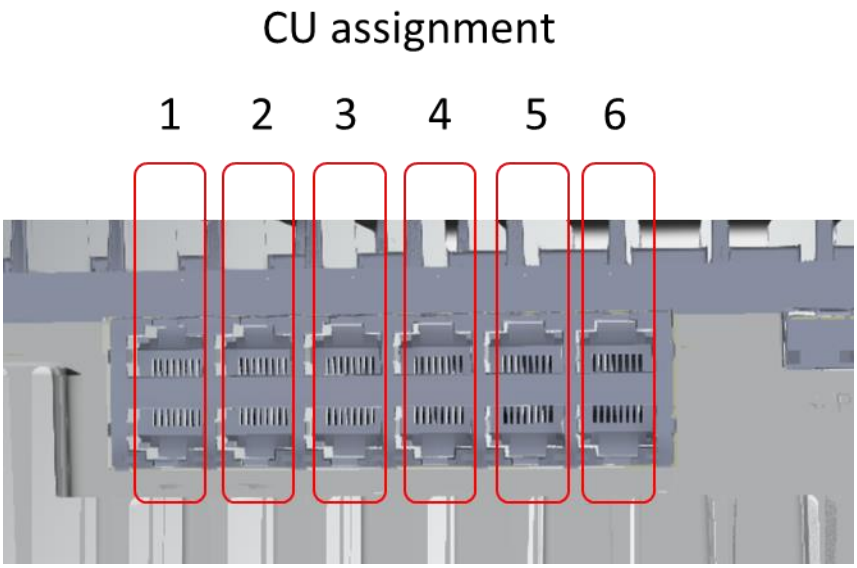


Figure 18. CU port assignment on the NU

Using a QRE

If distances greater than 100 meters from NU to CU are required, an extra 100 meters can be achieved by inserting the QUATRA RANGE EXTENDER (QRE) between the NU and the CU.

Note: Only the QUATRA 4000 RANGE EXTENDER may be used. The QUATRA 1000 and QUATRA 2000 QRE is not compatible with the QUATRA 4000.

LEDs

NU

The QUATRA 4000 NU has ten (10) LEDs on the front of the unit, used as status indicators, during setup and normal operation. The LEDs are labeled.

The LEDs on the front of the QUATRA 4000 function as follows:

NU LED Table		
LED Label	**LED State**	**Meaning**
POWER	NO LIGHT	No power
	SOLID GREEN	Powered and operating normally
	FLASHING GREEN	Scanning to acquire network signals
	SOLID RED	Hardware error
	FLASHING RED	Error
CU1, CU2, CU3, CU4, CU5, CU6	NO LIGHT	Not connected properly, no power
	SOLID GREEN	Connected, powered and operating normally
SFP+	SOLID GREEN	SFP+ module installed, and communicating properly
	FLASHING GREEN	SFP+ module installed, not communicating
LAN	SOLID GREEN	Link is up
	FLASHING GREEN	Link is up and active
MODEM	SOLID GREEN	Modem is installed, connected, and has an IP address
	FLASHING GREEN	Modem is attempting to connect
	FLASHING RED	Modem error

CU

Each QUATRA 4000 CU has three (3) LEDs on the front of the unit, used as status indicators, during setup and normal operation. The LEDs are labeled.

The meaning for each LED on the CU is shown in the table below.

CU LED TABLE		
LED Label	**LED State**	**Meaning**
PWR	SOLID GREEN	NORMAL OP (S1)
	SOLID RED	HARDWARE ERROR
	FLASHING GREEN	NETWORK SCANNING
	FLASHING RED	Error
NU LINK	SOLID GREEN	Logical Link: Up
	OFF	Logical Link: Down
CABLE LINK	SOLID GREEN	Physical Link: Up
	OFF	Physical Link: Down

Diagnostics and Testing

WAVE PRO and COMPASS

Introduction

COMPASS is a hand-held battery operated device specifically designed to simplify the installation of all QAUTRA variants, without the need for an Internet connection to the WAVE Portal in the cloud.

NOTE: The WAVE Portal is a very powerful and time saving system. Nextivity highly recommends that you still connect your QUATRA systems to the Internet for WAVE Portal remote management, alarms, and diagnostics.**Note**: COMPASS has its own User Manual. Included here are only those items that relate specifically to the QUATRA 4000.

Figure 19. QR Code for WAVE PRO

CEL-FI QUATRA INSTALLATION FEATURES

Overview

When it's not possible to open a LAN connection between a Cel-Fi QUATRA Network Unit (the NU) and the Cel-Fi WAVE Portal, these features will help installers setup Cel-Fi systems quickly and efficiently. While complete provisioning and optimization using the WAVE Portal is preferred, we understand that it's not always possible.

Note: Many features in the WAVE Portal are not available when using this tool. These include Commissioning, Operator Configuration, feature settings such as "disable software updates" and access to key performance data used in remote management.

Updating QUATRA Software

From time to time, the QUATRA 4000 firmware will be updated for feature improvements and bug fixes.

Updating QUATRA 4000 firmware can be accomplished in either of two ways:

1. Using WAVE PRO
    a. Launch the WAVE PRO app.
    b. Connect the LAN port on the QUATRA's NU to an active Ethernet LAN.
    c. Initiate the update from the Systems page Options menu.
        i. The unit will update its firmware automatically, communicating with Nextivity's cloud.

2. Using COMPASS
    a. Update the COMPASS' software by connecting it to an active Internet connection.
    b. Connect the COMPASS to the QUATRA NU and follow the instructions on the WAVE PRO app.

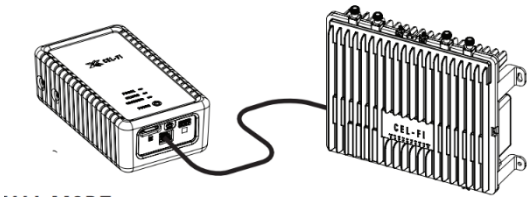
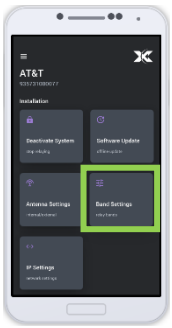


Figure XX Cel-Fi QUATRA 4000 connected to COMPASS

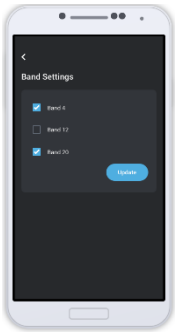
Band Settings

1. All Cel-Fi QUATRA variants will select bands and channels to relay automatically.

2. Optionally, bands may be enabled/disabled using the Bands Settings feature using COMPASS and the WAVE Pro app.
    a. Click on “Bands Settings”
    b. Select the band preference and then click “Update”



Step 1



Step 2

CEL-FI QUATRA OPTIMIZATION FEATURES

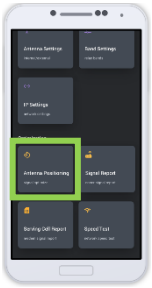
Antenna Positioning

The QUATRA 4000 system can accept up to four individual donor signals. One per carrier. Each donor can be established to the system either via small cell or off-air. When using an off-air signal, a directional antenna is recommended to provide the best signal quality. (Nextivity offers a number of directional antennas that can be used. See www.cel-fi.com/products for details.)

The Antenna Pointing feature allows you to easily optimize the direction your external antenna should be pointed. The algorithm takes into account the system gain and radio environment (including signal strength, signal quality, and pilot pollution).

This feature is designed to work with the Cel-Fi Mount, which is an indoor/outdoor mount with a proprietary 8-position dial base. This dial enables the antenna to be rotated in 45-degree increments.

1. Make sure the Cel-Fi COMPASS is connected to the donor antenna using the (included) SMA to N adaptor.
2. Click on “Antenna Positioning” in the WAVE PRO app.
3. Rotate your antenna to a position on the dial mount and tap the corresponding number button. You will need to test 2 or more positions to see the results.
4. The app will show the recommended band to use.



Step 2

Step 3

Step 4

Signal Report

A Full Signal Report scans all bands and channels for each carrier and returns a list of the channels it finds with RF metrics.

1. Go to the optimization section in the WAVE PRO app and click on “Full Signal Report”
2. Press the "Start Test" button to begin measuring
3. Can take up to 20 minutes before the app shows network information

Note: This scan will be quicker and more accurate when you have a SIM card installed.

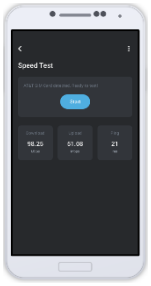
You can export the Signal Report by selecting the "More" icon and "Email Report". Type in your email address and results will be sent as a text attachment.

Speed Test

This feature tests the speed of the current Network Carrier of the SIM card inserted into the COMPASS.

1. In the WAVE PRO app, go to the “Optimization” section and press the "Speed Test" button.
2. Click on “Start,” and The Cel-Fi COMPASS will gather data for several minutes and display the results below.

Step 1



Step 2

Serving Cell Report

The Serving Cell Report is a live reading of the current Network Carrier of the SIM card inserted into the Cel-Fi COMPASS. The data will constantly refresh while on the page.

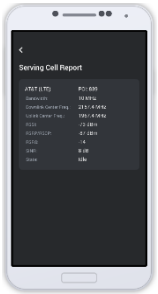


Fig. X Serving Cell Report

Advanced Information. Antennas and QUATRA 4000

Donor Antennas

Donor Signals

A good donor signal, arriving as cleanly as possible, to the NU, is perhaps the most important consideration in driving the best experiences and outcomes with QUATRA 4000.

With regard to 4G LTE, there are two metrics of particular importance to monitor and optimize:

1. RSRP. Reference Signal Receive Power. It is the power of the LTE Reference Signals spread over the full bandwidth and narrowband. A minimum of -20 dB SINR (of the S-Synch channel) is needed to detect RSRP/RSRQ

   In the context of Cel-Fi QUATRA 4000, the following stratification of quality is recognized:

RSRP	Signal Strength
> -90 dBm	Excellent
-90 dBm to -105 dBm	Good
-106 dBm to -120 dBm	Fair
< -120 dBm	Poor

2. SINR. Signal to Noise Ratio. The SINR is the ratio of the usable (desired) signal over the noise. The following metrics should be used when assessing SINR in the context of Cel-FI QUATRA 4000.

SINR Value	Throughput
> 10	Excellent
6 to 10	Good
0 to 5	Fair
< 0	Poor

Antenna Selection

There are a few considerations to make when determining the donor antenna.

1. How many serving sites? If there are multiple serving sites, and the design goal is to select a specific site, for loading, or any other reason, then a directional antenna would be required. If there is a single donor site, and not much RF contention, than an omni-directional antenna could be considered, which would save a little time and energy in the install process, as it would not need to be aimed.

2. How much noise? If the site location is very noisy, then a strong directional antenna would be a good choice, as it will filter out some of the unwanted signal.

3. How strong is the serving signal? Although Cel-Fi QUATRA 4000 has the highest gain of any antenna in its class, if the serving signal is extremely weak, then a high-gain antenna may be required to connect the uplink calls and to get the optimal DL power on the serving side.

Grounding and Lightning Protection

Installers of Cel-Fi QUATRA 4000 are encouraged to follow the lightning protection guidelines documented in the National Electrical Code (NEC) and NFPA 780, and/or local codes.

Server Antennas

The QUATRA 4000 Coverage Unit has a single RF output port in the form of an N-type female connector on the top of the unit. A single whip or blade-style antenna can be attached directly, or a distributed antenna system can be deployed.

Antenna Selection

There are two types of indoor antenna to choose from:

Omni-directional dome antennas broadcast and receive signals from all sides. They are designed for central locations with 360º coverage requirement. Like outdoor antennas, their power is measured by their "gain". They are typically mounted to a ceiling for best results.

Nextivity has standard dome antennas and also offers 'low-profile' server antennas that are thin and occupy less visual space.

Panel antennas are directional antennas. Panel antennas allow optimum reception to targeted areas. Like with outdoor antennas, a directional antenna is stronger than an omnidirectional antenna which means the signals it broadcasts are stronger. It can be mounted to either the wall or ceiling. We usually recommend placing it on the ceiling for maximum coverage but in some spaces (like a long narrow hallway) the panel antenna can be placed on the wall.

Nextivity has a few different panel antenna options, with different levels of gain and directivity.

MIMO vs SISO

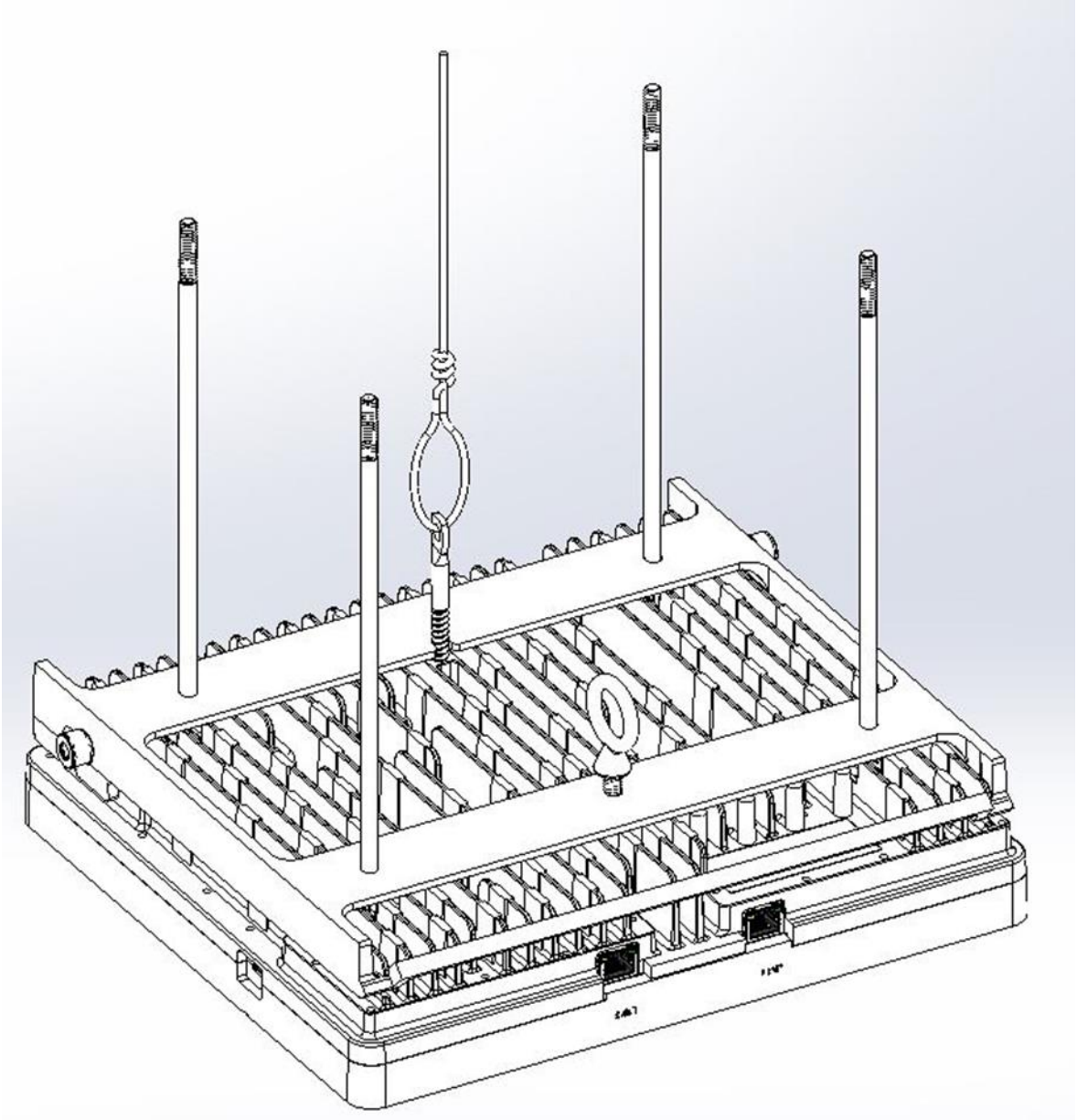
MIMO (multiple in, multiple out) antennas have multiple feeds and typically more than one coaxial (pigtail) cable or connector. Therefore, a MIMO antenna should only be used with a system that supports MIMO. (Cel-Fi QUATRA 1000 supports MIMO.)

A SISO (single in, single out) antenna has a single coaxial (pigtail) cable feed and/or connector, and works best with SISO systems. Cel-Fi QUATRA 4000 is a SISO system.

Mounting (Coverage Unit)

Drop Ceiling

The QUATRA 4000 Coverage Unit is fitted with two ¼"-20 inserts in the center of the bottom side of the unit. This is designed to mate perfectly with standard drop-ceiling infrastructure components. The mounting bracket also has four (4) ¼"-20 threaded inserts which can be similarly used. A variety of mounting methods can be employed through the integration of off-the-shelf accessories.



Note: The Cel-Fi QUATRA 4000 Coverage Unit is plenum rated.

Specifications

QUATRA 4000			
OPERATOR'S CONFIGURATIONS	**OPERATORS**	Operators Supported	AT&T, Sprint, Verizon, T-Mobile
		Bands: QUATRA 4000i (Part 20)	4,5,12,13,25
HARDWARE – READY **RELAY CONFIGURATIONS** (one configuration per operator)	**OPERATOR 1**	Verizon	B13 & B25
			B13 & B4
	OPERATOR 2	Sprint	B5 & B25
	OPERATOR 3	T-Mobile	B25 & B12
			B25 & B4
			B4 & B12
	OPERATOR 4	AT&T	B12 & B5
			B12 & B25
			B12 & B4
TRANSMIT EVM	UL	8.5%	16-QAM with full RB allocation
		8.5%	E-TM3.1
REGULATORY CERTIFICATIONS	FCC	Part 15	Yes
		Part 20	Yes
		Part 22	Yes
		Part 24	Yes
		Part 27	Yes

NETWORK UNIT				
RADIO SPECS	**VERIZON**	BAND 4	Downlink (DL) Frequency (MHz)	2110–2155
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
		BAND 13	Downlink (DL) Frequency (MHz)	746–756
			Uplink (UL) Frequency (MHz)	777–787
			Relay Bandwidth (Max)(MHz)	10
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	95
		BAND 25	Downlink (DL) Frequency (MHz)	1930–1995
			Uplink (UL) Frequency (MHz)	1850–1915
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100

	SPRINT	BAND 25	Downlink (DL) Frequency (MHz)	1930–1995
			Uplink (UL) Frequency (MHz)	1850–1915
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
		BAND 5	Downlink (DL) Frequency (MHz)	869–894
			Uplink (UL) Frequency (MHz)	824–849
			Relay Bandwidth (Max)(MHz)	15
			UL Output Power (at port)(dBm)	20
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	95
	T-MOBILE	BAND 4	Downlink (DL) Frequency (MHz)	2110–2155
			Uplink (UL) Frequency (MHz)	1710–1755
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
		BAND 12	Downlink (DL) Frequency (MHz)	728–746
			Uplink (UL) Frequency (MHz)	698–716
			Relay Bandwidth (Max)(MHz)	10
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	95
		BAND 25	Downlink (DL) Frequency (MHz)	1930–1995
			Uplink (UL) Frequency (MHz)	1850–1915
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
	AT&T	BAND 4	Downlink (DL) Frequency (MHz)	2110–2155
			Uplink (UL) Frequency (MHz)	1710–1755
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120

			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
		BAND 12	Downlink (DL) Frequency (MHz)	728–746
			Uplink (UL) Frequency (MHz)	698–716
			Relay Bandwidth (Max)(MHz)	10
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	95
		BAND 25	Downlink (DL) Frequency (MHz)	1930–1995
			Uplink (UL) Frequency (MHz)	1850–1915
			Relay Bandwidth (Max)(MHz)	20
			UL Output Power (at port)(dBm)	22
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	100
		BAND 5	Downlink (DL) Frequency (MHz)	869–894
			Uplink (UL) Frequency (MHz)	824–849
			Relay Bandwidth (Max)(MHz)	15
			UL Output Power (at port)(dBm)	20
			DL Min Input Level (dBm RSRP)	-120
			DL Max Input Level (dBm RSSI)	-20
			System Gain (Max)(dB)	95
RETURN LOSS (DB)			At all ports	-8
DONOR ANTENNAS			One RF Port per Operator	
			Operators Supported (Max)	4
			Impedance (Ohms)	50
COVERAGE UNIT CONFIGURATION TO NETWORK UNIT	Coverage Unit Support		Number Supported (Max)	6
			Category Cables per CU	2
			Interface Type	RJ45
	POE - PSE		Voltage (Vac)	110
			Power–Typical (W)	415
			Power–Max (W)	510
USER INTERFACE	Power / Status		LED	RED / GREEN
	CU Link		LED	GREEN
	Donor Antenna		LED	GREEN
	Cellular Modem		LED	RED / GREEN
	Ethernet		LED	Yes
	USB		n/a	Yes
MECHANICAL	Dimensions		L×W×H (mm)	330×272×85
			Weight (kg)	6.5
	RF Port Connector			N-type (Female)
	Mounting		Wall	Yes
	Cooling		Convection	Yes
	Power / Status		AC to NU	Yes
	Power		On/Off Switch	Yes

ENVIRONMENTAL	Maximum Surface Temperature (°C)	Measured at 30°C Ambient	44
STANDARDS			
ENVIRONMENTAL	FCC	Part 15, 22, 24,27,20	Yes
	ISED		Yes
	UL		Yes
	3GPP Repeater Specs		Yes
	Operating Temperature	Ambient	0–40°C
	Relative Humidity	Non-Condensing	0–95%
	Ingress Protection (IP)		40
COVERAGE UNIT			
RADIO SPECS	Frequency	Downlink (DL) Frequency (MHz)	617–2690
		Uplink (UL) Frequency (MHz)	663–2690
	DL Power (dBm)	Per Band	13-16
NETWORK UNIT INTERFACE		Interface type	RJ45 (×2)
USER INTERFACE	Power / Status	LED	RED / GREEN
	NU Link	LED	GREEN
MECHANICAL	Dimensions	L×W×H (mm)	287×255×57
		Weight (kg)	3.9
	Mounting	Ceiling, Wall	Yes

Trademarks

Cel-Fi, IntelliBoost, and Nextivity logo are trademarks of Nextivity, Inc.

Warranty & Limitation of Liability

Nextivity Inc., provides a limited warranty for its products.

For details, please refer to http://cel-fi. com/warranty.

In no event shall Nextivity, nor its directors, employees, agents, suppliers or End Users, be liable under contract, tort, strict liability, negligence or any other legal or equitable theory with respect to the Products or any other subject matter of this Agreement (i) for any lost profit, cost of procurement of substitute goods or services, or special, indirect, incidental, punitive, or consequential damages of any kind whatsoever or (ii) for any direct damages in excess of (in the aggregate) the fees actually received by Nextivity from End User with respect to the Products actually purchased and paid for.

Compliance

In the event of regulatory compliance issue, please contact Nextivity Inc. directly.

Contact information is available at www.nextivityinc.com/doc

Glossary

Term	Definition
MIMO	Multiple In, Multiple Out
SISO	Single In, Single Out
SiNR	Single to Noise ration
RSRP	Reference Signal Receive Power
RSSI	Received Signal Strength Indicator
Donor Antenna	Antenna used to capture the exterior macro cellular network signal, and provide such signal to the system.
Server Antenna	Antenna used internally to provide the coverage benefit from Cel-Fi QUATRA 4000.

Troubleshooting

Alarm Table

Network Unit Hardware Error	**Network Unit Hardware Error - Power cycle the Network Unit (NU) and check for software updates. If problem persists, return NU for service.**
Insufficient Donor Signal	Insufficient Donor Signal - Relocate Network Unit (NU) where a stronger signal exists, or use an external antenna for the NU. If using a small cell, verify the small cell can process calls and check the connections to the NU. Power cycle the NU.
Coverage Unit Hardware Error	Coverage Unit Hardware Error - Troubleshoot any Network Unit (NU) error first, and check for software updates. Make sure Coverage Unit (CU) cables do not exceed 100m (or 100m + QRE + 100m). Note that standard Ethernet Extenders or active LAN switches and routers will not work with CU cabling. Power cycle the CU by detaching and reattaching the LAN cable. Test CU by plugging it into back of NU with short test cable.
Donor Signal Too Strong	Donor Signal Too Strong - Move Network Unit (NU), or re-aim NU external antenna. Strong signal source may be from another Operator's device (cell tower, local small cell, or booster).
Network Unit is Overheating	Network Unit is Overheating - The Network Unit (NU) should be upright and the air vents not blocked. Move NU to a cooler area.
Coverage Unit is Overheating	Coverage Unit is Overheating - Make sure the Coverage Unit (CU) air vents are not blocked, or move the CU to a cooler location.
Too Close	Too Close - One of your Coverage Units (CU) is too close to your Network Unit (NU). Try moving the units farther apart (or move units so more signal blocking structures isolate them from each other).
Too Far	Too Far - One of your Coverage Units (CU) is too far from your Network Unit (NU). Try moving the units closer together.
Disabled by Operator/Vendor	Disabled by Operator/Vendor - Your system has been disabled by the mobile network operator or vendor. Contact your vendor for further assistance.
Location Lock	Location Lock - Your system has been moved from its original address. Please move the system back to its original location or register your new address with your wireless provider.
Registration Required	Registration Required - Systems are pre-enabled and carrier registration is obligatory.
Self-Test Failed	Self-Test Failed - Power cycle the unit and check for software updates. If problem persists, return the unit for service.
Small Cell Not Detected	Small Cell Not Detected - Network Unit (NU) Mode is set to small cell. Verify that small cell is connected and operational, or set NU Mode to Internal or External Antenna if no Small Cell used.

Small Cell Detected	Small Cell Detected - Small Cell Detected but Network Unit (NU) is not set to Small Cell. Use the WAVE Portal to set NU Mode to Small Cell.
Antenna Configuration Error	Antenna Configuration Error - Too Many Coverage Units (CU) connected. More than one CU in use for Off-Air configuration. Use the WAVE Portal to set Mode to External Antenna, and NU should be connected to an external antenna.
Antenna Positioning Required	Antenna Positioning Required - Antenna positioning incomplete. Use the WAVE Portal to aim the NU donor antenna.
Ethernet Link Error	Ethernet Link Error in Port 1-4 - The ethernet link between NU and CU is behaving unreliably or reporting an error. Ensure the ethernet cable is not damaged and its connectors are securely plugged in on both ends.
CU Shutdown from Portal	CU Shutdown from Portal - CU's 1 though 4 has been shut down from the Portal.

Support / Help