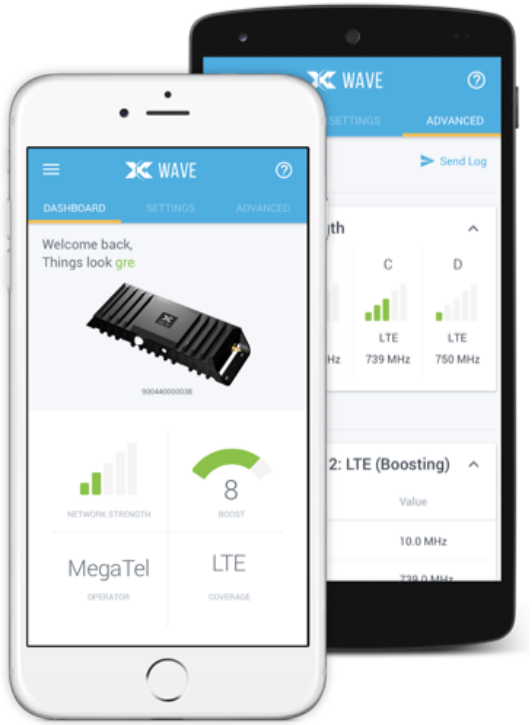
Cel-Fi GO

WAVE App User Guide

CEL-FI

CEL-FI WAVE FOR MOBILE

The Cel-Fi WAVE App is designed for end users, installers and channel partners to activate and manage the Cel-Fi product line. The app connects to the device via Bluetooth and is available on smartphones and tablets.



Features

Dashboard:
Glance-able view to the state of your Cel-Fi environment, including the Boost Strength indicator.

Settings:
Change the default Network Operator, select the booster technology (3G, 4G), setup an external antenna, configure the antenna position, and more.

Advanced Mode:
Get real-time data and performance metrics for troubleshooting devices.

Booster Updates:
Keep your Cel-Fi Booster up-to-date as new software versions become available.

Register (when required):
Easily activate and register your Cel-Fi Booster.

TABLE OF CONTENTS

Topic	Page
Install the WAVE Application	4
GO Registration using WAVE *(not enabled for most carriers)*	6
Navigating WAVE	8
Navigating WAVE‘s Advanced screen	1
Antenna Position Test	21
Operator switching	22
Selecting bands	23
Switching modes between X & M	24
Error Codes	30
Offline Mode	35

WAVE is our Mobile App that allows you to connect your Cel-Fi GO to a handset should you be interested in Advanced Cel-Fi information.

INSTALL THE WAVE APPLICATION

Prior to using WAVE for advanced information or troubleshooting, you must first install the application:

To use with mobile device download the WAVE app from either

- App store
- Google Play

Launching WAVE

Make sure that both Bluetooth and location services are enabled on your mobile device, the Cel-Fi WAVE app will then search for the GO device and sync automatically. Don't forget to accept privacy to continue to register the GO system (if required).

GO M and GO X

Registration:

In some cases, regulatory bodies and/or mobile network operators may require users to register the signal booster, this is due to regulations/restrictions in certain regions.

If you see a flashing red indicator after installing your Cel-Fi GO device, please launch WAVE to determine the reason for the error indication

The registration feature of WAVE can either be:

- Disabled – registration is not requested
- Optional – registration is requested but not required
- Required – registration must be completed prior to using the device

Registration Required

If registration is either optional or required, the user will be presented with this screen in the WAVE application

If registration is optional, a check box will appear that allows you to skip registration

Complete the steps to register your GO product

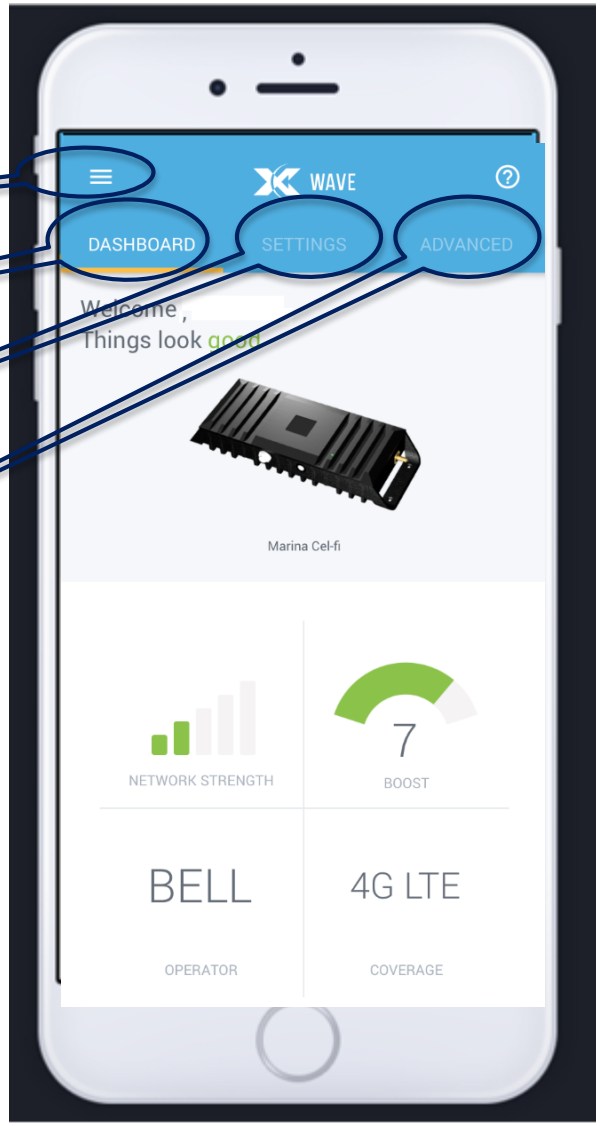
NAVIGATING THE MAIN HEADERS

Information Section

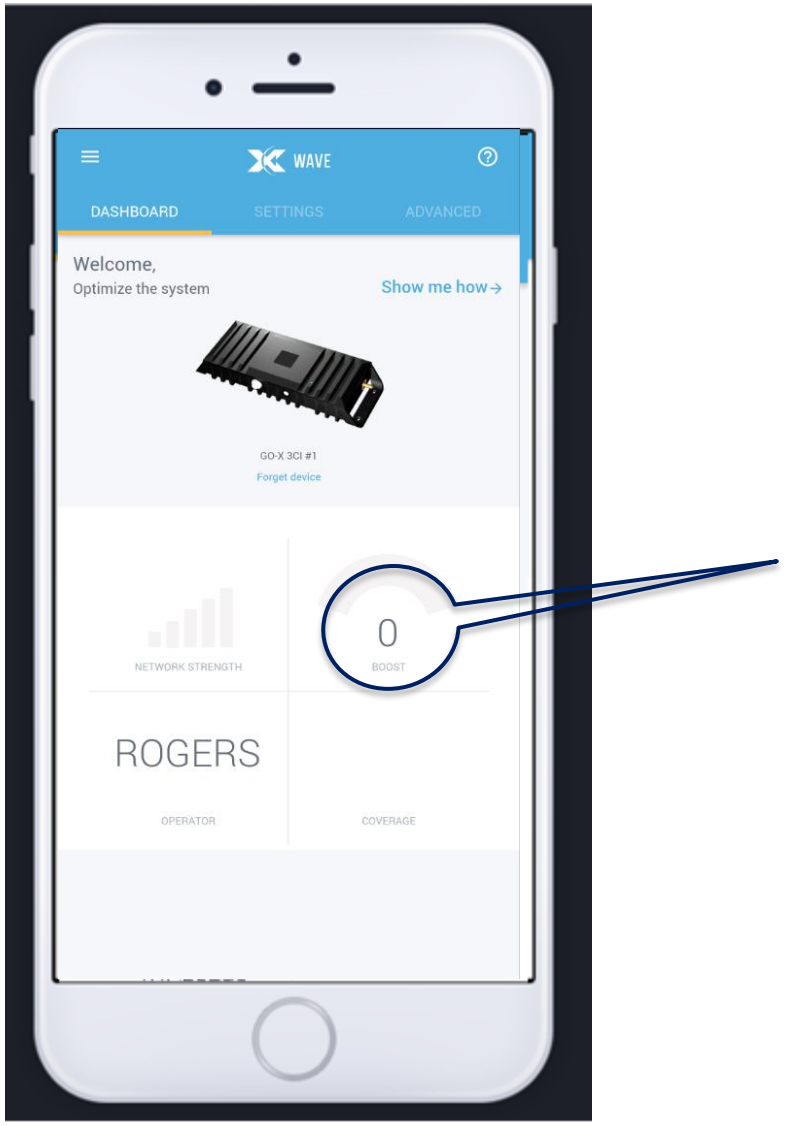
Main Dashboard

Settings Menu

Advanced Menu



NAVIGATING THE DASHBOARD



The main dashboard will provide you with basic information on the status of the Cel-Fi GO including:

- Network Strength of the macro network
- Cel-Fi boost # from 0 to 9).

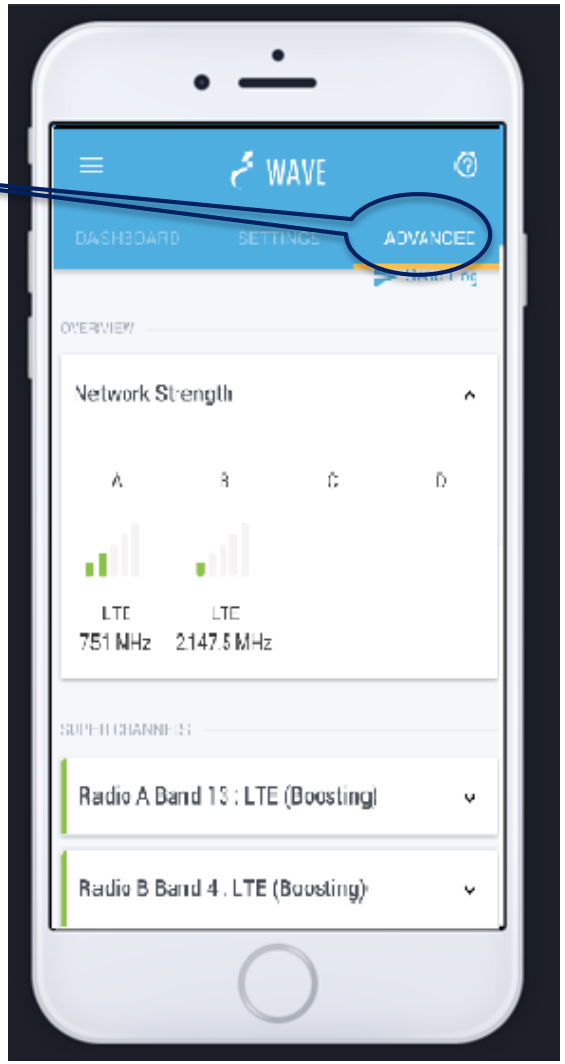
(The more you separate the donor and server the higher the boost number, hence more boost.)

- Support tips (when necessary)

NAVIGATING THE ADVANCED SCREEN

The advanced screen will allow you to see technical details about the frequency band(s) that is being repeated.

Use the drop down menus for more detail.



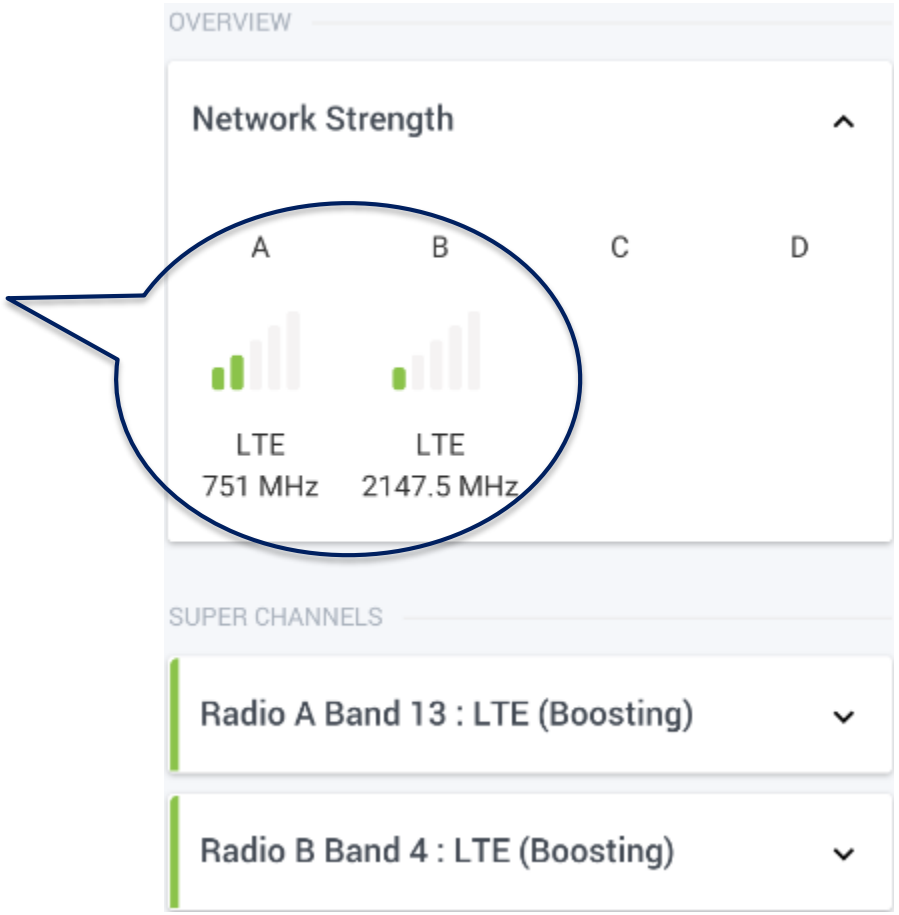
NAVIGATING THE ADVANCED SCREEN

The designators A and B are active. They designate the physical radio hardware that is responsible for the RF boosting. Each radio can tune to and boost either Band 2, 4, 5, 12 or 13. (1900/2100/850/700/700,MHz).

In this example A is tuned to Band 13, 751 MHz and B is tuned to Band 4, 2147.5 MHz

If you prefer using EARFCN, you can convert these frequencies to an EARFCN using this website:

http://niviuk.free.fr/lte_band.php



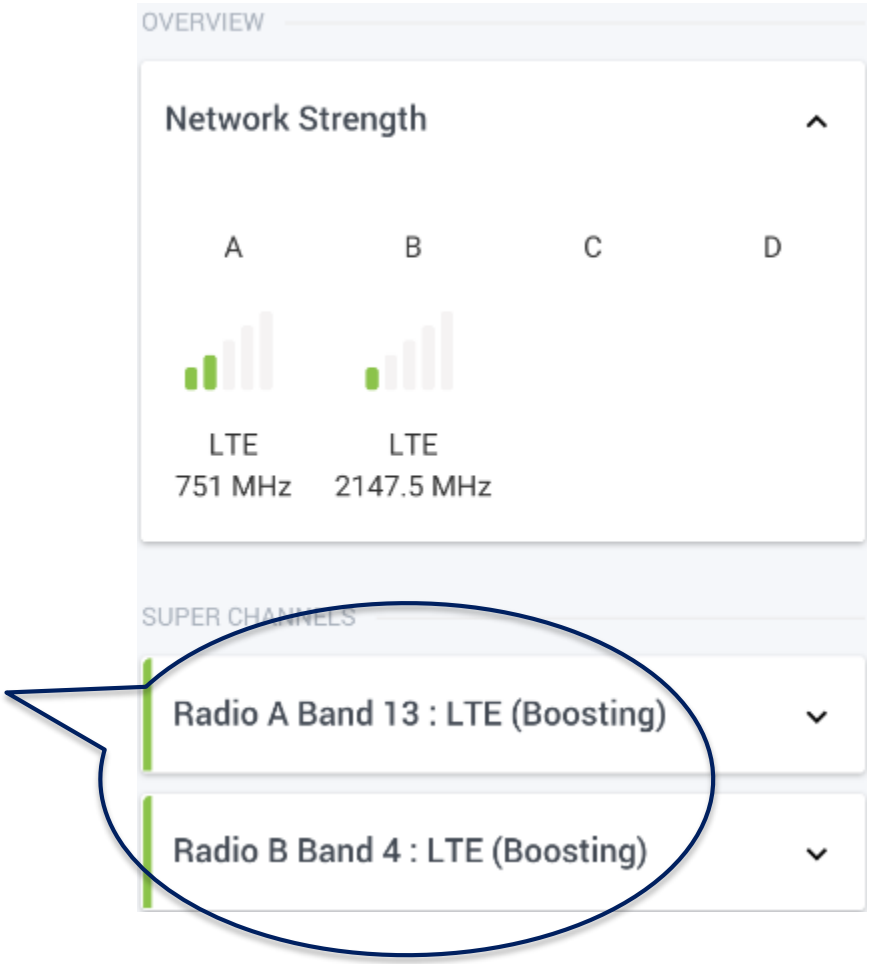
NAVIGATING THE ADVANCED SCREEN

This will further translate the frequency to a band and describe whether it is *Boosting* or *Not Boosting*.

In this example, 751 MHz on Radio A is Band 13. It is *boosting*.

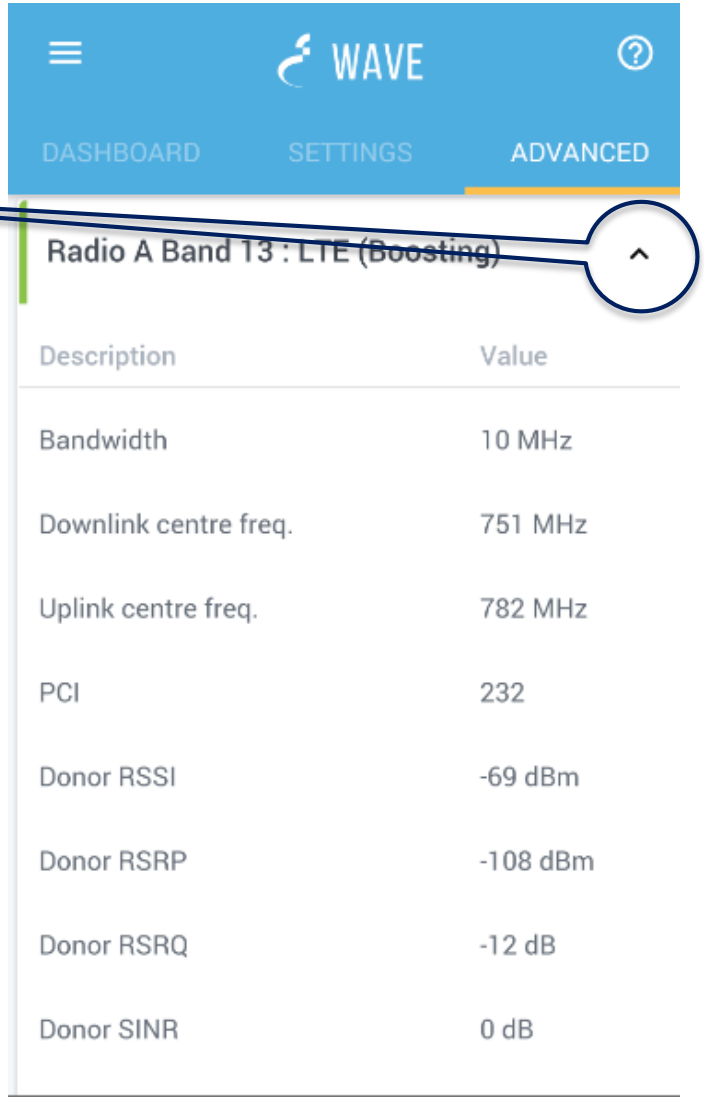
2147.5 MHz on Radio B is Band 4 and it is also *boosting*.

If 'Not Boosting' is observed, it means that the radio did not find a valid channel to boost. One possibility is because the channel at that frequency is not present or just too weak.



NAVIGATING THE ADVANCED SCREEN

Expand the Radio to reveal information about the particular Radio. WAVE will display additional information about the channel being boosted.



Bandwidth: The actual bandwidth of the LTE channel. The bandwidth is determined by decoding the signaled MIB that is broadcasted by the network.

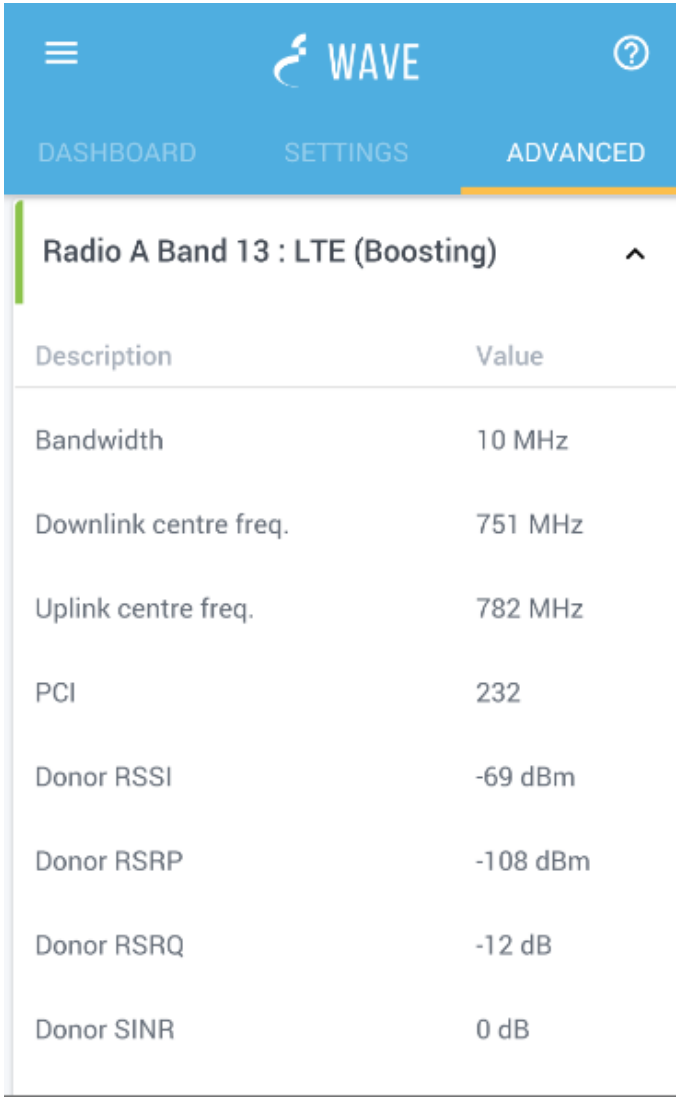
Downlink and Uplink Freq: The center frequency of the channel that is boosted. In this example, the channel that is boosted has a downlink center frequency of 751 MHz and a bandwidth of 10 MHz.

NAVIGATING THE ADVANCED SCREEN

PCI: Physical Cell ID is an identification of a cell at the physical layer. Every cell has a unique PCI.

Donor RSSI: The measured in-band signal power for the channel bandwidth. RSSI stands for Receive Signal Strength Indicator.

Donor RSRP: **Reference Signal Received Power**: RSRP is a RSSI type of measurement. It is the power of the LTE Reference Signals spread over the full bandwidth and narrowband. RSRP is used an a indicator that describes the path loss between the NU and tower.

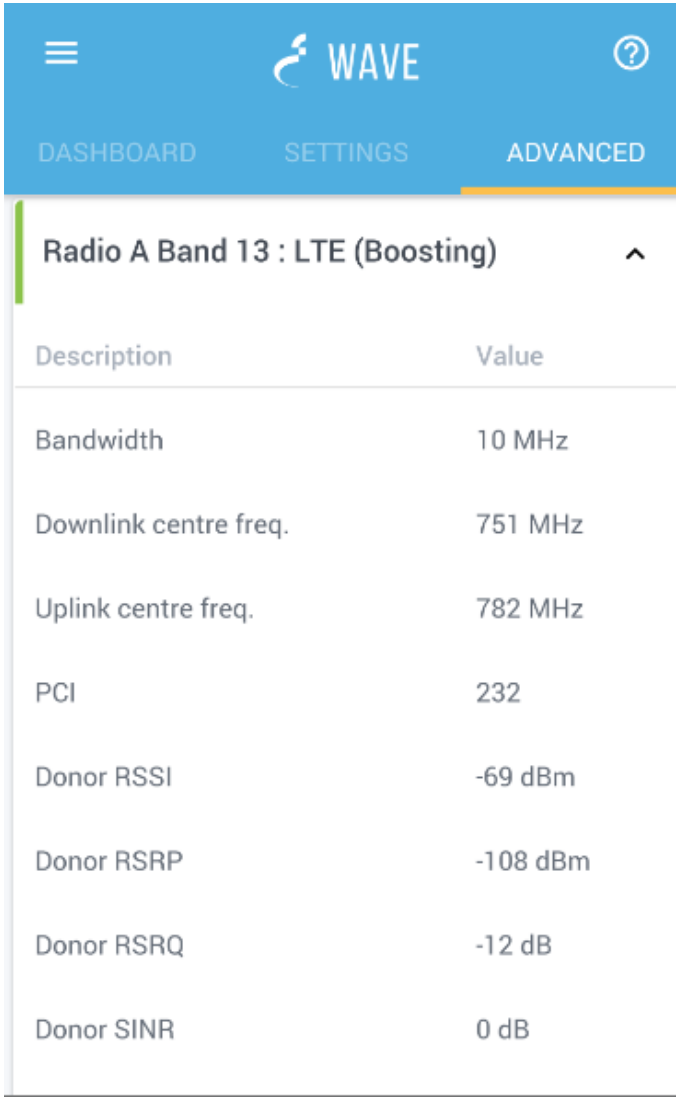


NAVIGATING THE ADVANCED SCREEN

Donor RSRQ: RSRQ = RSRP/ (RSSI/N)

Where N is number of resource blocks over which RSSI is measured. RSSI is calculated as a linear average of the total power measured across OFDMA symbols which contain reference symbols transmitted from first antenna port, e.g. symbols 0 and 4 when MIMO is not used.

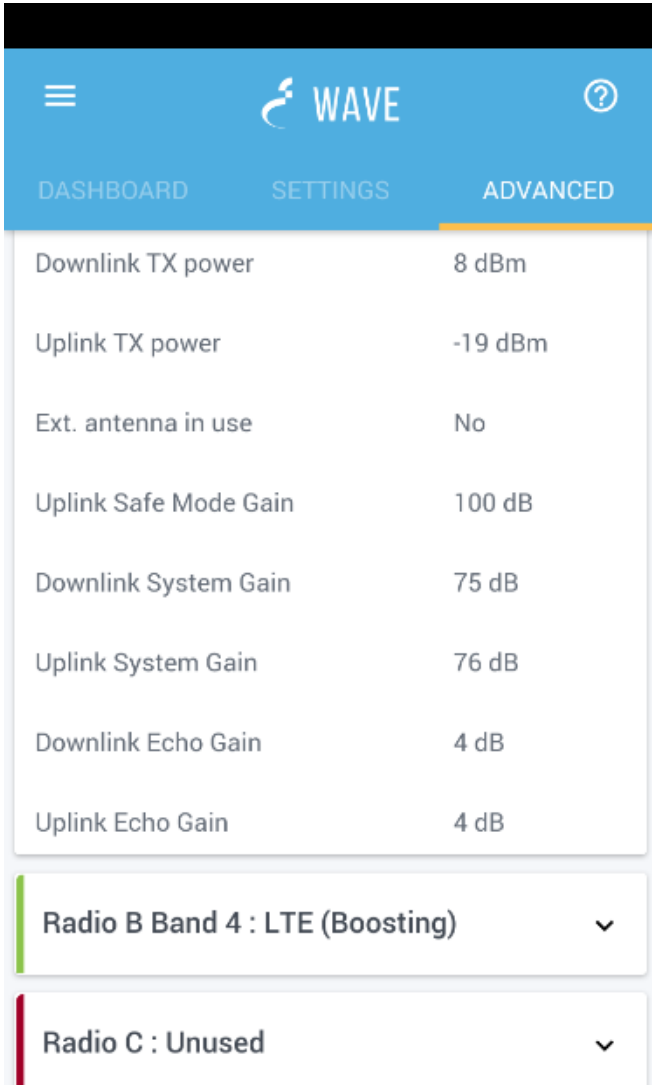
Donor SINR: The signal-to-noise-plus-interference ratio of the channel as measured in real-time. A positive value is desirable. Cel-Fi can still operate below 0 dB. Increasing this number is accomplished with a directional donor antenna and proper aiming.



NAVIGATING THE ADVANCED SCREEN

Downlink Tx power: The real-time transmit power of the server output (downlink broadcast). The maximum transmit power is 10 dBm per 5MHz. Note, the Wave App will not update this field as fast as the Cel-Fi can potentially change it. The AGC updates at up to 2000/times per second.

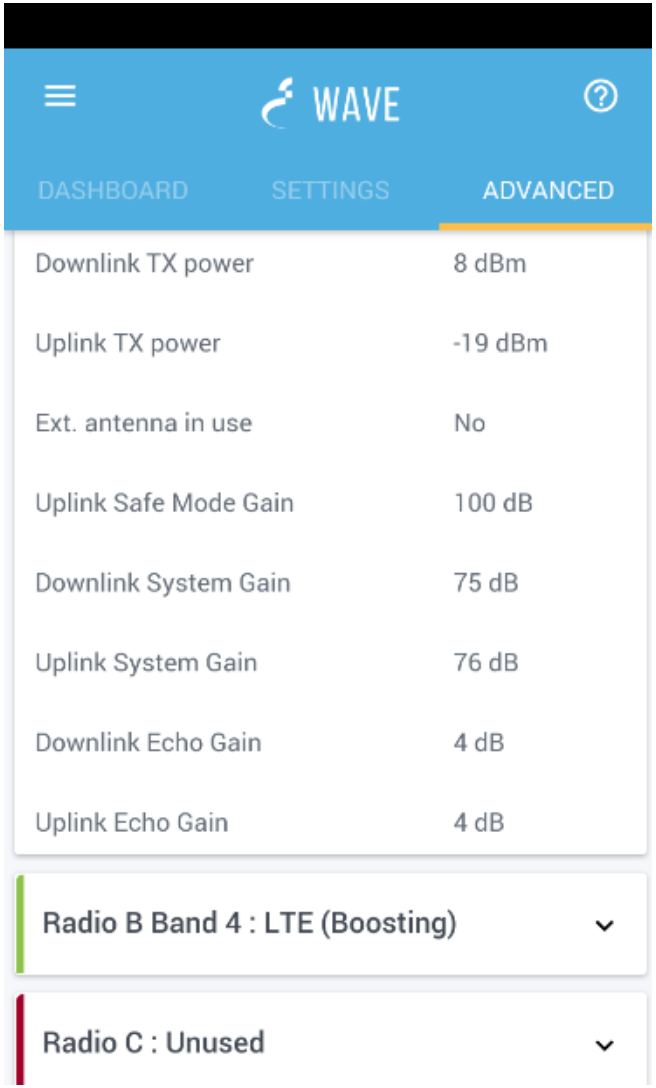
Uplink Tx power: The real-time transmit power of the uplink towards the tower. The maximum transmit power is 22dBm. Note, the Wave App will not update this field as fast as the Cel-Fi can potentially change it. The AGC updates at up to 2000/times per second.



NAVIGATING THE ADVANCED SCREEN

Ext. antenna in use. For the Cel-Fi GO this will always equal yes because the antennas are external.

Uplink Safe Mode Gain: Cel-Fi is self aware and can accurately estimate its proximity to the nearest tower. In the event the Cel-F GO donor antenna is installed nearby a tower, or it is close to another service provider's cell tower, Cel-Fi will set a cap to its maximum gain and display it here. This is done to maximize the gain in an effort to prevent the Donor antenna from interfering with the towers. Carriers love this because it protects their network.

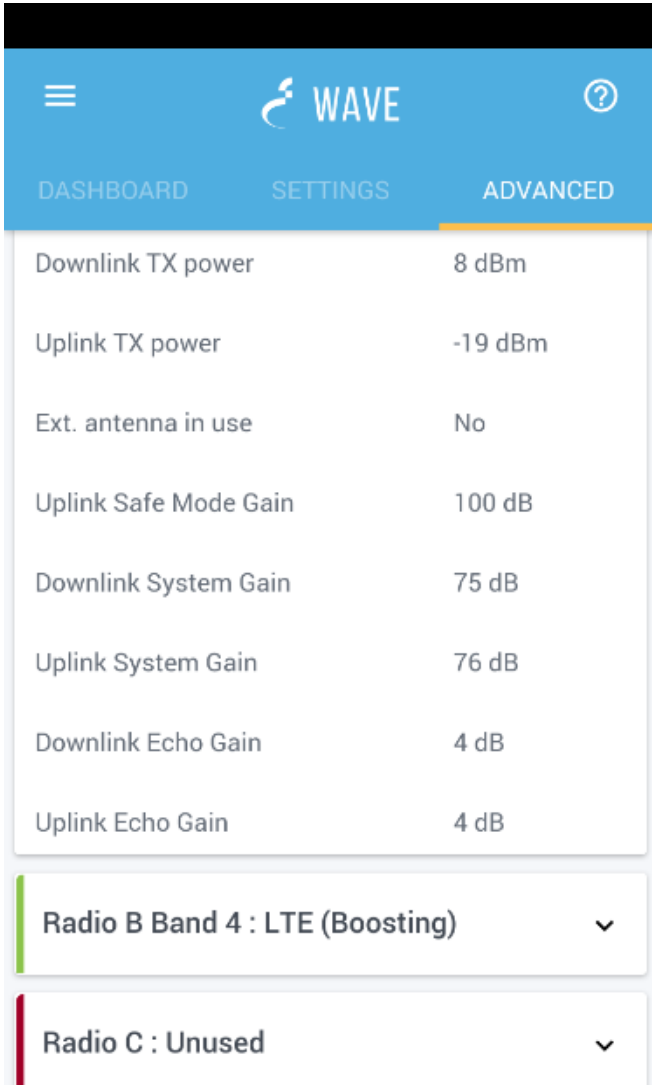


NAVIGATING THE ADVANCED SCREEN

Downlink System Gain: The boost (gain in decibels) that is applied. This 'System Gain' is derived by the amount of separation between the donor and server and capped by Uplink Safe Mode (also in dB).
Example: If the Donor RSSI was -90 dB and the 'Downlink System Gain' was 90 dB, then -90 + 90 = 0dBm. Therefore the CU Downlink Tx Power would output 0dBm out of the CU.

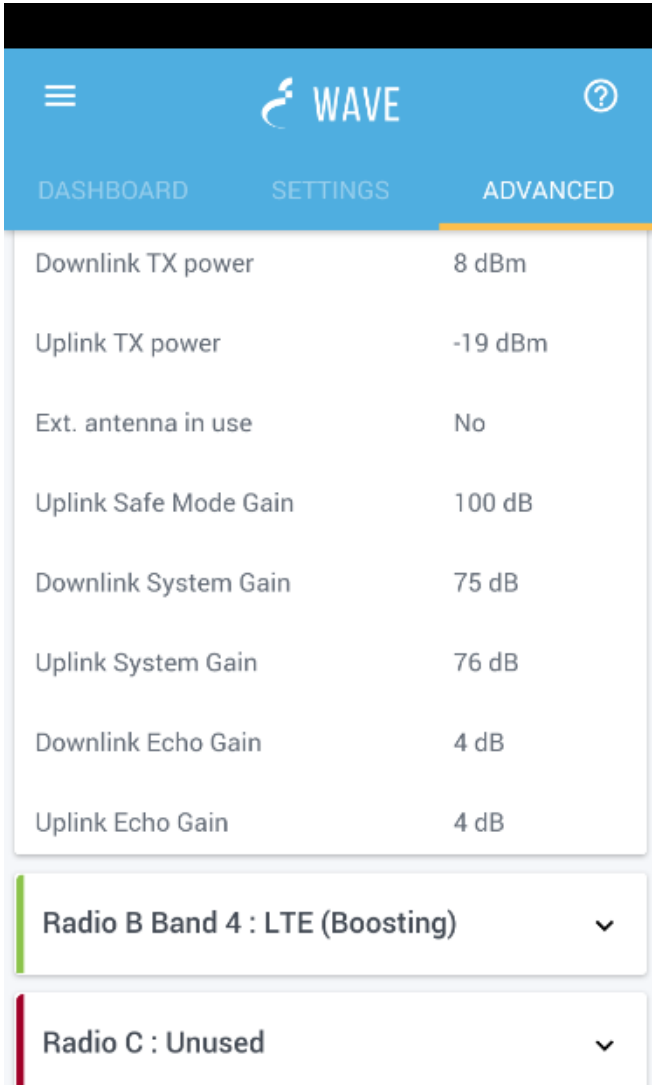
Gain (dB) = min(Isolation, UplinkSafeMode)

Uplink System Gain: : Same as above however the gain is applied to the uplink signal. Signal received by the server antenna in the uplink gets applied this gain before being transmitted by the Cel-Fi GO.



NAVIGATING THE ADVANCED SCREEN

Uplink (and Downlink) Echo Gain:
Cel-Fi has advanced echo cancellers to cancel its own signal, otherwise referred to as feedback or echo. A typical value here is 10 dB which means the GO is adding 10 dB of cancellation, so 10 dB is added on top of the physical donor and server isolation, which determines the gain in this frequency band.



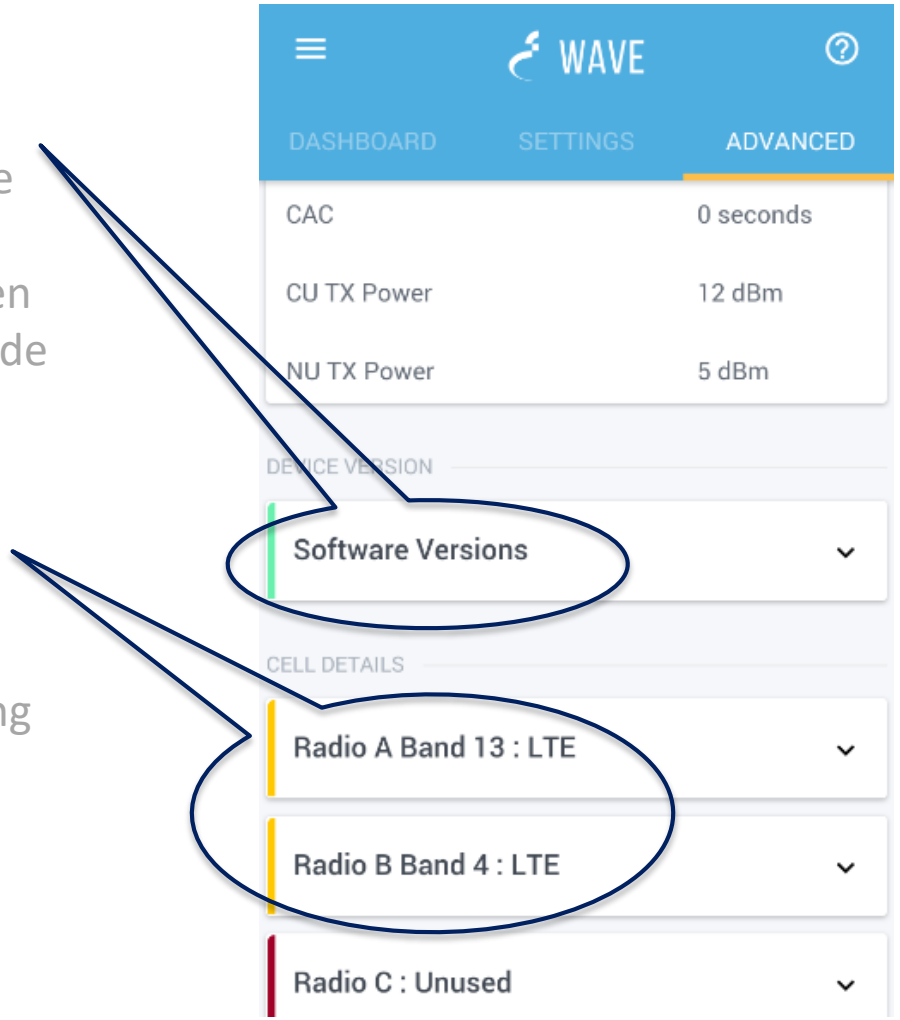
NAVIGATING THE ADVANCED SCREEN

Software Version

The software versions listed that are on the Cel-Fi system and a list of versions available in the cloud. When they differ, the WAVE App will provide the option to update.

Cell Details

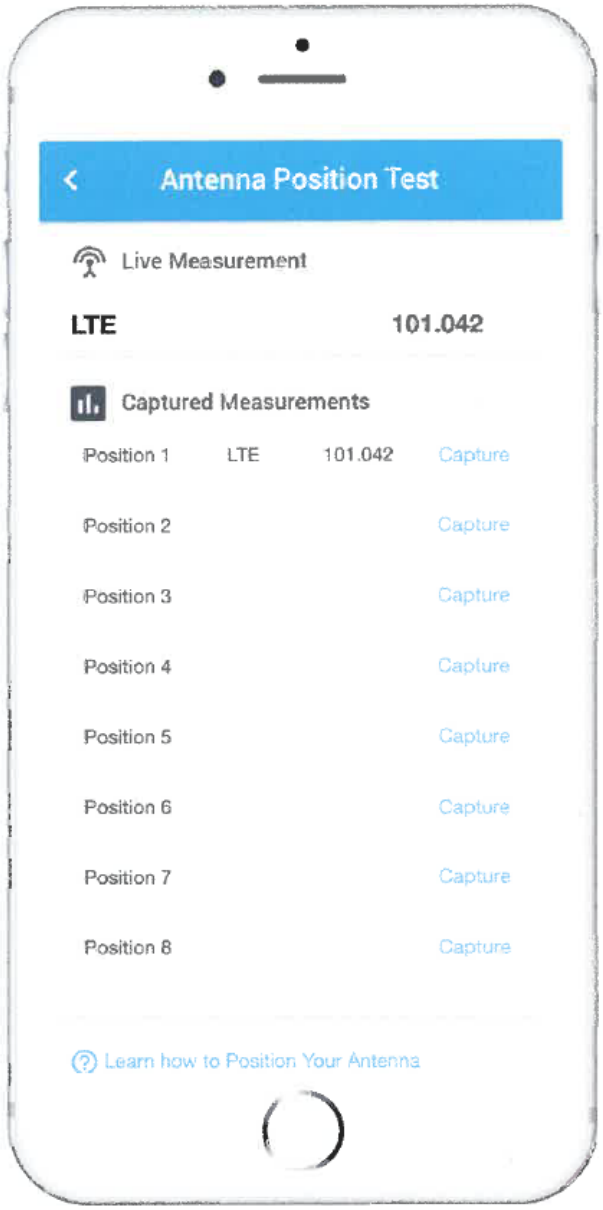
Additional real-time measurements provided on the donor channel being boosted



ANTENNA POSITION TEST

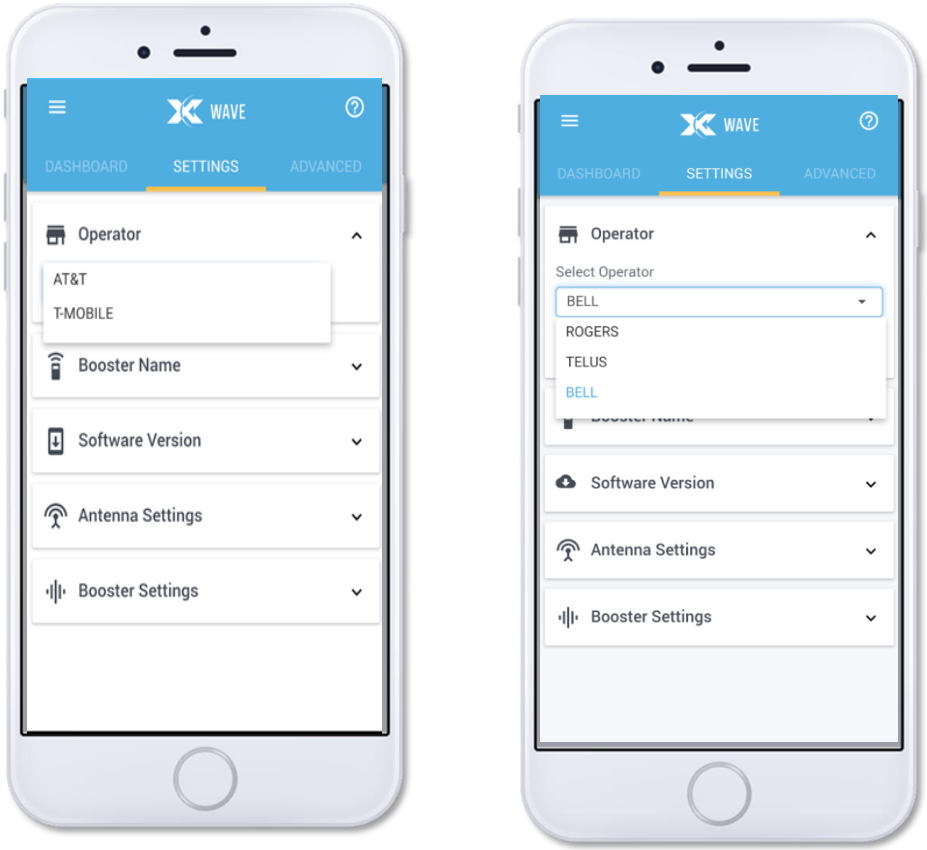
The WAVE App offers the Antenna Position Test that assists the installer in best pointing the donor antenna to achieve the best combination of coverage, signal quality and donor to server isolation.

1. Following the completion of the installation, the **Antenna Position Test** can be found under the **Settings** tab, and under the **Antenna Settings** tab select the **Antenna Position Test**
2. The App will guide you through taking multiple measurements. The higher the number the better the signal.



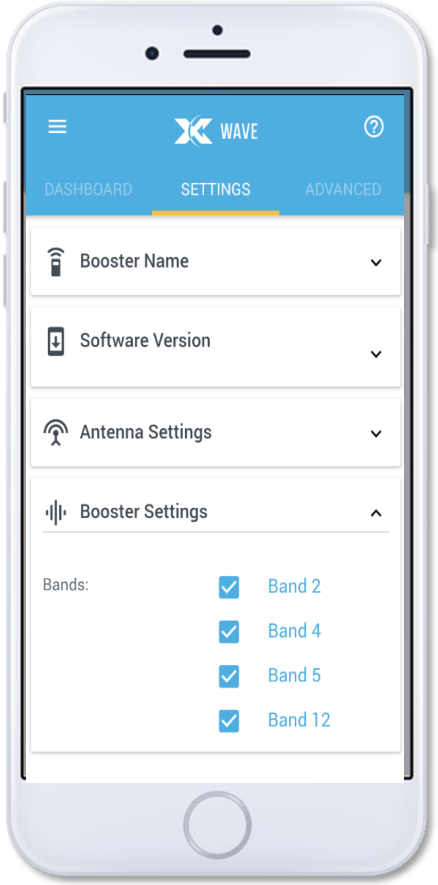
OPERATOR CHANGE

If your model of Cel-Fi GO supports it, you can change the operator under *Settings → Operator.*



SELECTING THE FREQUENCY BANDS TO BE BOOSTED

The most advanced carrier-grade cellular booster allows the user to disable certain frequency bands from being boosted and ensuring other are boosted.



SWITCHING MODES BETWEEN X AND M

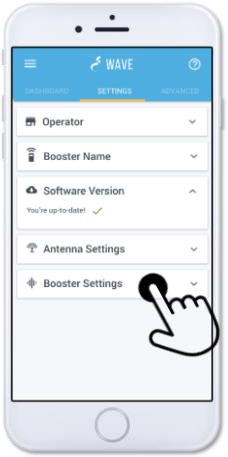
X = STATIONARY
M = MOBILE

SWITCHING MODES BETWEEN X AND M

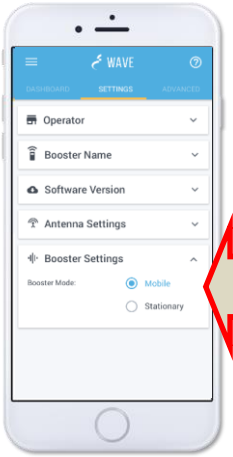
Start

Dashboard

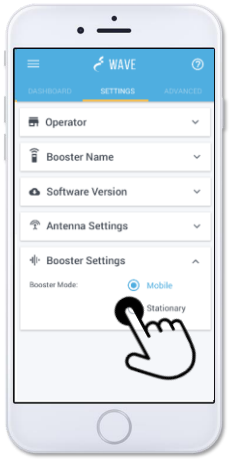
Select Settings



Select Booster Settings



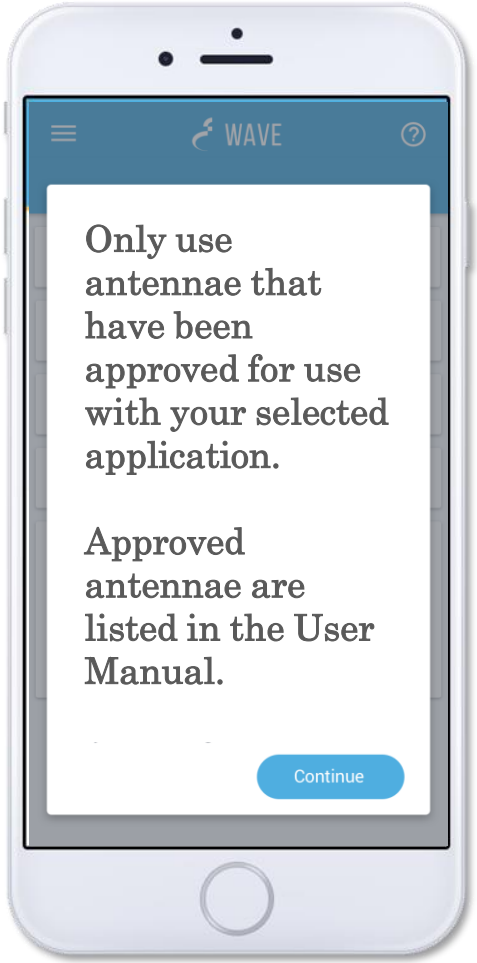
Menu Opens



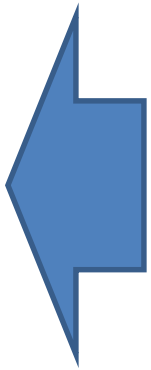
Change Setting

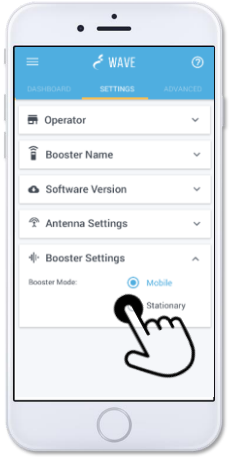
NEXT PAGE

SWITCHING MODES BETWEEN X AND M



Consumer Notice

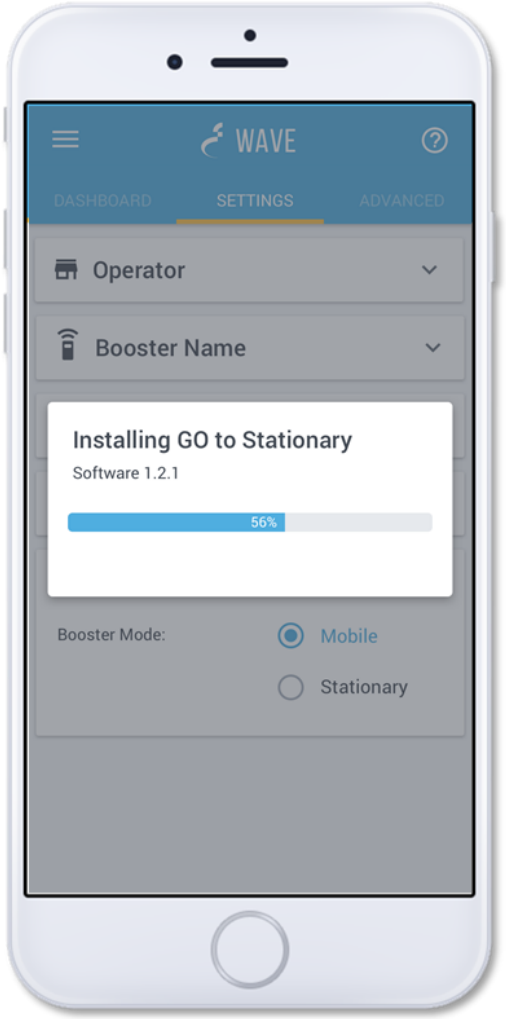




Change Setting

Acknowledgement

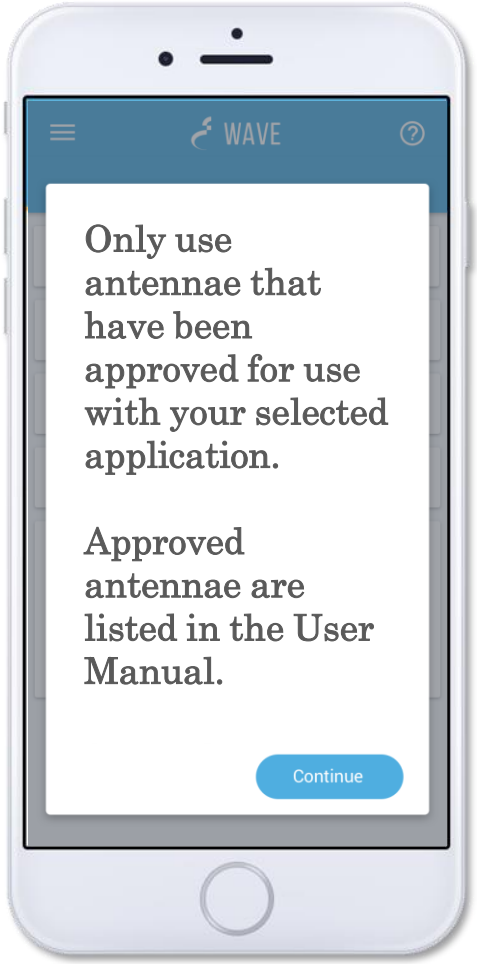
SWITCHING MODES BETWEEN X AND M



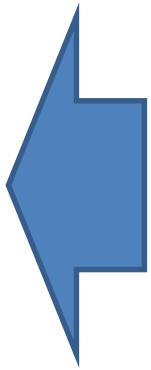
Software Change

SWITCHING MODES BETWEEN X AND M

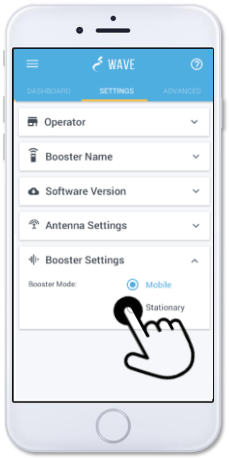
MOBILE



Consumer Notice

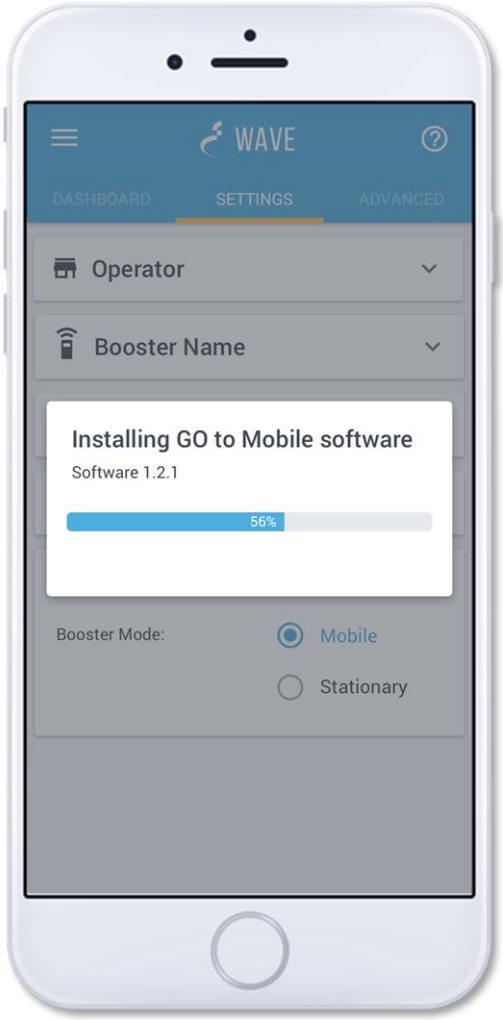


Acknowledgement



Change Setting

SWITCHING MODES BETWEEN X AND M



MOBILE

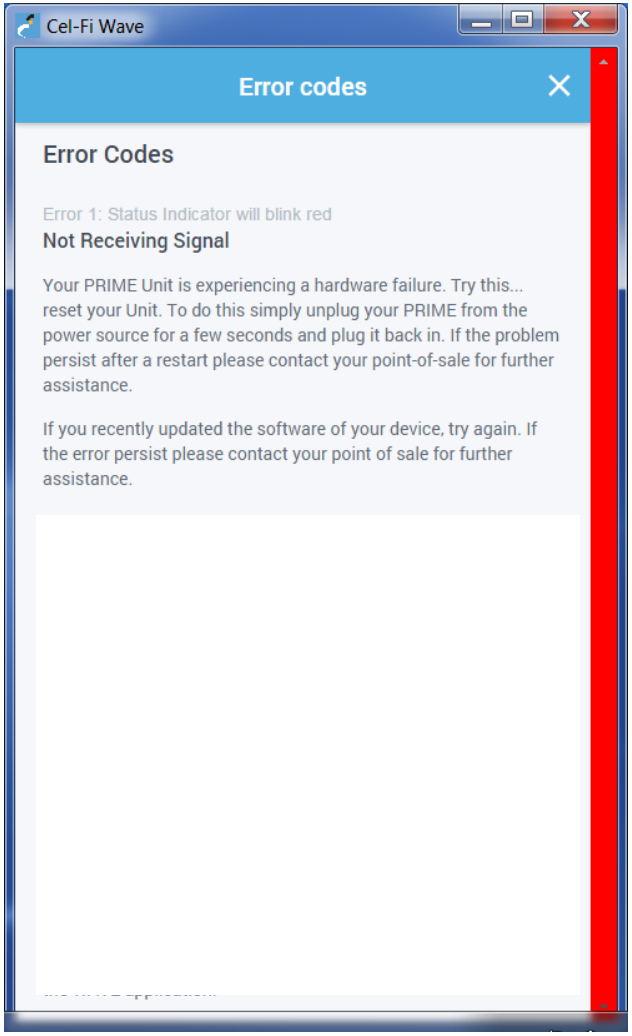
Software Change

ERROR CODES

DISPLAYING ERROR MESSAGES USING WAVE

If the system is not functioning properly, an error message will be displayed.

Clicking on "More" will provide help.



Troubleshooting

Cel-Fi GO X and **GO M** features an LED on the top face to indicate the unit's state:

LED	MEANING
Solid GREEN	The unit is working properly and boosting properly.
Blinking GREEN	Unit is scanning for networks to boost.
Blinking RED	The unit is in an error condition. Use the **Cel-Fi WAVE** app to check the error code meaning and remedy.
Solid RED	The unit has a hardware error and is not booting up normally.

Note: In mobile usage, it is normal for the **Cel-Fi GO M** to fluctuate between scanning and boosting. The Cel-Fi GO M automatically adjusts its boost behavior based on available signal.

ISSUE	MEANING	ACTION
Continual Blinking GREEN	Unit is operational, but not attaching to a network to boost.	• Make sure both antennas are connected properly and are appropriate for the desired frequencies to boost. • Make sure the selected operator to relay is available at your location. This can be checked with the **Cel-Fi WAVE** application. If the service is not available, it cannot be boosted.
Solid RED LED	Unit is not operational.	• Unplug and reinsert power. • If restart has no effect, contact vendor for remedy.

Error Codes

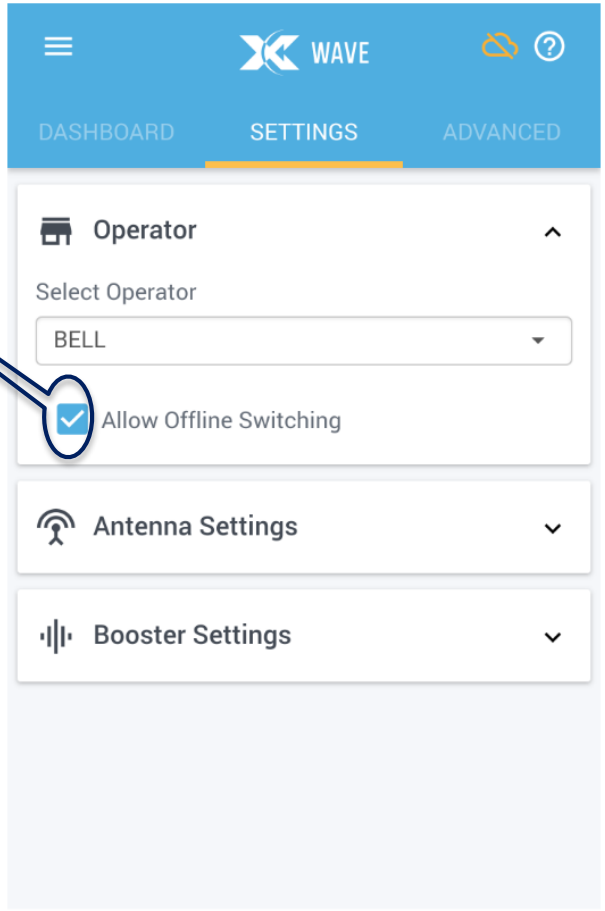
GO Status Indicator	Description & Suggestion
Status Indicator will **blink red**	**(Error 1) Not Receiving Signal from the cellular network** Your GO Unit is experiencing a hardware failure. Try this...Reset your Unit. To do this simply unplug your GO from the power source for a few seconds and plug it back in. If the problem, persist after a restart please contact your point-of-sale for further assistance. If you recently updated the software of your device, try again. If the error persists, please contact your point of sale for further assistance.
Status Indicator will be **solid red**	**(Error 4) GO is overheating** Your GO Unit is overheating. Please ensure that your GO Unit is clear of any blockage. If you have your GO in an exceptionally warm area you may need to relocate the device to ensure that this unit does not continue to overheat. Once GO has cooled it will operate as normal. *Normal operating temperature of the Cel-Fi unit is 0-40 Celsius.
Status Indicator will **blink red**	**(Error 5) Registration Required** Before use, you must register this device and have your provider's consent. You must operate this device with approved cables as specified by the manufacturer. Systems can be registered with the WAVE application.
Status Indicator will be **solid red**	**(Error 6) Hardware Error** Your GO Unit is experiencing a hardware failure. Try this...Reset your Unit. To do this simply unplug your GO from the power source for a few seconds and plug it back in. If the problem, persist after a restart please contact your point-of-sale for further assistance. If you recently updated your device using Wave, try again. If the error persists, please contact your point of sale for further assistance.

Status Indicator will **blink red**	**(Error 7) Disabled by operator** Your system has been disabled by the mobile network operator. Contact your point-of-sale for further assistance.
Status Indicator will **blink red**	**(Error 8) Input signal too strong** Your Donor Antenna is too close to a cellular tower. This may result in a reduced output power (smaller coverage bubble) to limit network interference. Try this…move your Donor Antenna to another physical location.
Status Indicator will **blink red**	**(Error 9) Location Lock – Registration Required** 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. Systems can be registered with the WAVE application.
Status Indicator will be **solid red**	**(Error 12) Self-Test Failed** During a system check a part of your unit's configuration has reported less than optimal performance. The system could be displaying a non-critical error message. If you have a boost in cellular service at your service antenna you can ignore the E12 message. If you do not have boosted signal, check to confirm that both your service antenna and donor antenna are properly connected and functional. If the antennas checkout, the boost number on the unit is high and you still don't have a boosted signal try restarting the unit. If the problem, persist after a restart please contact your point-of-sale for further assistance. If you recently updated the software of your device, try again. If the error persists, please contact your point of sale for further assistance.
Status Indicator will **blink red**	**Too Close** Your Service Antenna and your Donor Antennas are too close together. Try moving the antennas further apart.

USING WAVE IN OFFLINE MODE

Sometimes an internet connection is not available. To anticipate this scenario there is an offline mode. To enable offline mode, the user must beforehand download the necessary files.

Connect to the GO and tick the box ‘Allow Offline Switching’.



USING WAVE IN OFFLINE MODE

Later, when there is no internet connectivity, the WAVE App will support an Offline mode. Hit Continue to use offline mode.

Offline mode supports:

- Operator switching
- Booster Mode selection
- Band selection
- Advanced options like radio information