



Antenna Installation and Guidance for IoT M2M Cellular Devices

Whatever Your Thing,
We Keep It Connected.™

Shown below, are the basic antennas & options for use with OptConnect devices:



Gemini Antenna:

Our current standard antenna for newly purchased 4G models, is a magnetic mount device for use with all dual antenna port OptConnect devices.



4" Taoglas Antenna:

Magnetic mount for use with the OptConnect mylo (single antenna) or used in pairs with older 3G and 4G OptConnect devices.



Brute Antenna:

Offered as an optional antenna for all dual antenna port OptConnect devices – Available in both a super-strong magnetic mount or through-bolt version.



Paddle Antenna:

Offered as an optional antenna. This is a direct connect antenna used in pairs, but only where the OptConnect device itself can be placed outside of any cabinet/enclosure.



4G-LTE SIGNAL BOOSTER:

This is optional equipment sold by OptConnect. Check cellular carrier and network type compatibility (ex. Verizon 4G/LTE) before purchasing. Maximum signal gain (amplification) is typically in the 7 to 15 dBm range.

Understanding Cellular



All cellular devices utilize a radio transceiver to communicate with a broadcast tower or repeater station. High quality signal reception is the key to reliable performance of your M2M (data only) cellular device. It is important for consumers to understand that cellular network providers do not guarantee service or signal strength, and you may not be able to receive all types of cellular services or signals in all areas. With that in mind, given the variability of signal strength in a given location, the proper placement and installation of your antenna(s) is key to a successful integration with your equipment where cell service is available.

Signal Strength



Cellular radio signal strength is measured in several ways, but the most common metric used is RSSI (Received Signal Strength Indicator) and this is measured in negative decibels (dBm). The lower the RSSI, the stronger the signal. EX: RSSI of -50 dBm is excellent, while -120 dBm is effectively no signal. Correlations with the number of signal bars displayed on your device is generally helpful but not a reliable indicator of quality. Seeing 2 bars vs. 4 bars on your device does not mean that your device will not function, as cellular providers do not use the same algorithms for displaying signal bars. EX: An AT&T device may display only 1 bar when signal RSSI is -80 dBm, but the same device on Verizon may display 2 bars at the same -80 dBm RSSI. In general, the lower the RSSI, the better the data throughput will be as the speed of data transmission is directly related to the strength and quality of the signal.

Signal Interference



Environmental factors must be considered when evaluating signal reception in any cellular installation. Radio signal reception, whether AM/FM, Digital Television, WiFi or Cellular, require good line-of-sight to the transmitter. Geographic terrain features, buildings, trees and other environmental features represent significant challenges to clear signal reception. Anything which obstructs your clear line of sight to the transmitter will impact the quality of the signal received by

your device. Likewise, different building materials and building layout can reduce signal reception. This interference is clearly evident in our daily lives, such as when we use our cell phones outside as opposed to inside our homes and offices. Materials like brick or concrete are going to interfere with signal more than a sheet of plywood or drywall, but the interference can be anywhere from 8 to 20 dBm. A single pane of clear glass may only reduce the signal by 3 to 4 dBm, but a double-pane window with Low-E glass may reduce the signal by as much as 40 dBm. Materials such as aluminum or steel siding or roofs can reduce signal reception to the point where it is impossible to receive signal at all. Even weather conditions can impact signal reception, such as heavy rain, fog or snow. Finally, signal interference from other cellular radios in the close proximity, high frequency electrical noise, as from neon lights and refrigeration compressors and high electromagnetic interference from equipment like MRI and CAT scan systems found in Hospitals, can all cause your device to see poor signal quality or to fail to maintain a reliable connection.

Optimizing Signal Reception – Proper Installation



All of the antennas offered by OptConnect, with the exception of the Paddle type, are Omnidirectional and cover all signal bands/frequencies for the major service providers in the US, Canada and many other countries. Omnidirectional antennas are designed to receive signals in a 360° radius. In order to maximize signal reception with an Omnidirectional antenna, that antenna must be installed vertically. Horizontal or side mounting of the antenna is therefore not recommended. Paddle antennas can be aimed (tuned) to help focus signal, but regardless of whether you use Omnidirectional or Paddle type antenna(s), it is imperative that the antenna(s) be installed outside of any type of metal enclosure. We recommend that you place the antenna(s) on a flat metal surface to maximize the “reflective” signal from that surface onto the antenna(s). Finally, the location of the cellular device inside of a building can make a difference in signal strength and interference. Typically, the deeper you move into the core of a building, the weaker your signal reception becomes. An enclosed space, such as a utility closet or walled-in room, will generally see weaker signal than an open unobstructed space.

Review Best Practices

1. Conduct a site survey prior to installation. Check with staff who work in the location or walk the location with your cell phone to identify any issues with cellular service in the building and try to ascertain which cellular carrier(s) work best or if there are dead zones where signal is poor or where you have no signal.

The OptConnect Customer Care Team can assist you with identifying carrier coverage in an area by the location address but cannot evaluate how well those signals may penetrate or be received inside the building.

2. When testing service with your cell phone, utilize data services, such as accessing a website with your internet browser to see how well you are able to access data. Remember that your cell phone utilizes both voice and data services, while your OptConnect device only utilizes data services, so always test data services. If the location reports general difficulty using cell phones inside the building or if you have to go outside the building to use your cell phone reliably, it is likely that your OptConnect device will experience signal reception issues at that location.
3. Antennas should always be placed as near to the center / top of the mounting surface as possible – away from the edges and away from known signal interference sources like refrigeration equipment, neon signs, etc.
4. Antennas should be mounted as high as possible but Do Not use antenna cable extensions, as doing so will decrease signal strength. Antenna cabling provided with your antenna is pre-tuned for that antenna.
5. Antenna wiring (excess) should not be tightly bound or wrapped up with power or other equipment cabling.
6. Antennas should always be mounted in a vertical orientation.
7. Antennas should never be placed inside of a metal enclosure.
8. Avoid placement of the OptConnect device in basements, walled-in enclosures or below-ground structures such as parking garages.
9. When installing your OptConnect device in a mobile service trailer, mobile food service vehicle or in steel/aluminum buildings, you will want to have the antenna(s) mounted on the outside of the trailer/vehicle/building.

10. Dual antennas need to be separated by twice the length of the antenna. So, for a 4" antenna pair, they should be spaced at least 8" apart.
11. Do not use mismatched antennas – Dual antennas need to be of the same size, type and specification.
12. *If using a non-OptConnect cellular antenna, make sure it is of the proper type for the device. E.g., do not use an antenna designed for 2G/3G on a 4G/LTE device and insure it is designed for use with the correct cell carrier.

Third Party Products

There are many independent companies that provide cellular antenna products for both office and industrial use. Many of these products can be used with your OptConnect device.

Signal Boosters

A cellular signal booster (aka. signal amplifier) will be installed inside the building (along with the OptConnect device) and will typically replace one of the antennas or the primary lead on the OptConnect device. Signal gain (amplification) will generally be in the 7 to 15 dBm range but may vary with the type or model purchased. The signal increase (gain) will be over whatever the non-amplified RSSI would be, so if your unamplified RSSI is -119, you would expect to see improvement in the -112 to -104 dBm range but there are many factors involved, so you may or may not see sufficient improvement to overcome other environmental interference. It is important to note that the amount of signal gain that any booster can apply is limited by FCC regulations, so if your RSSI is already poor (near -120 dBm), you may not see a significant improvement. Best results with most boosters are generally achieved when your RSSI is between -100 to -109 dBm and depending upon the booster purchased, may improve by as much as 20 to 30 dBm, but again, most consumers will see an average of 7 to 15 dBm in real world applications. OptConnect cannot guarantee that the use of a signal booster will improve overall signal quality or allow a device to function where there is poor or no cellular service available.

High Gain Antennas

Directional (aka. Yagi) antennas and signal repeater systems. These devices typically require professional installation and will require both internal and external hardware and building wiring. Hardware and labor costs may make these solutions cost prohibitive and it is recommended that you get a professional site evaluation prior to purchase. These types of antenna systems are typically mounted on a mast, which is mounted above or on top of the building. Most high-gain antennas are directional and must be aimed at the strongest signal source.

NOTE: Some external antenna systems may employ an Omnidirectional antenna, which does not require special alignment or aiming, other than a vertical orientation. However, with a Yagi type antenna, precise alignment and aiming of the antenna is critical, and this generally requires special signal analysis equipment and the expertise of a professional cellular equipment installer. Cabling from the outside antenna brings the signal inside the building to a signal repeater that should be located near your equipment. The signal repeater (transceiver) re-broadcasts the signal to and from your cellular device. Your OptConnect device will still need to employ its own antenna(s). It is also important to note that most signal repeaters will only handle a limited number of connections and additional steps and configuration may be needed to prevent other nearby cellular devices from utilizing your equipment and possibly preventing your device from connecting. While an external antenna/repeater system will generally provide a better result than a signal booster, OptConnect cannot guarantee that the use of such equipment will improve overall signal quality or allow a device to function where there is poor or no cellular service available.

****Before purchasing any third-party equipment for use with your OptConnect device,*** it is highly recommended that you contact the OptConnect Customer Care Team with the make, model and specifications of the equipment you are considering, so that any potential compatibility issues can be addressed before attaching or using such equipment with your OptConnect device.