Antenna Selection and Installation

This chapter contains the following sections:

Antenna Selection and Installation

Note Before you install the Cisco IR1101 Integrated Services Router on a table, wall, or DIN rail, install the antennas on the Pluggable Module. It is difficult to install the antennas after the router is installed.

The following section contains information for installing antennas with the base IR1101 router with or without the Expansion Modules, using P-LTE-xx or P-LTEA-xx cellular modules. There are three RF SMA(f) connectors on the Pluggable Module. Two connectors, Main and Div (diversity) are used to connect to the 4G/LTE modem. The third connector is used for GPS. The Diversity port may also be referred to as an Aux connector.

Antenna Installation Best Practices

The optimal site location for antennas for 4G routers and cellular modules plays a significant role in determining overall cellular link performance. Routers located at the farthest coverage points might have 10 to 50 percent of the bandwidth available compared to routers located closer to the cellular base station tower, away from obstructions, and with an unobstructed view of the cellular tower.

Because antennas transmit and receive radio signals over the air, the signal propagation and antenna performance may be adversely affected by the surrounding environment, including physical obstructions. Radio frequency (RF) interference may also occur between wireless systems located close to each other, especially if the antennas of these systems are located close to each other. Interference may also occur when the antenna is in close proximity to cable clutter or other sources of radio interference.

Follow these guidelines to ensure the best possible performance:

- When you use any cellular antennas such as 3G UMTS, 4G/LTE, 4G/LTEA (LTE Advanced) with a modular router and a pluggable module, try to mount the antenna a certain distance away from the router. For example, in indoor deployments, an appropriate extension cable and antenna stand can be utilized. For outdoor installations, choose a suitable outdoor antenna, and mount it away from obstructions that ideally have a direct view of the cellular tower. The antenna performance, and therefore that of the router, will not be optimal if mounted directly on a pluggable module. Primary reasons for possible degradation of performance include:
  - Obstruction of the router antenna view of the cellular base station tower by Ethernet cables, power cables, USB cables, and walls.
  - Possible coupling of digital noise from inside the router to the antenna when unshielded Ethernet cables are used.
- Keep antennas away from electrical and signal cable clutter. Metal conductors inside cables may block antenna view of the base station. Additionally, unshielded (and even shielded cables in some cases) may radiate signals that interfere with RF signal reception.
- It is recommended that all cellular antennas for the IR1101 are oriented vertically to ensure polarization match. While polarization of the signal may change as it is reflected from obstructions, when the view is unobstructed - vertical polarization is optimal.
- When installing the IR1101 with or without the Expansion Modules, the following note is important:

Note When cellular FDD Band 5 is deployed with 3G WCDMA, 4G/LTE or 4G/LTEA C/A, such as with P-LTE-US or P-LTEA-EA pluggable modules on certain carriers, ensure that both Main and Aux cellular antennas are physically separated from the IR1101 chassis by a minimum of 5 feet (1.5 meters). This note only affects P-LTE-xx receiver operation in Band 5 in a narrow 875 MHz frequency range. No significant effect on the P-LTE-xx cellular Band 5 receiver has been measured when antennas are separated from the chassis by more than 5 feet (1.5 meters). This note does not apply when the receive signal does not overlap 875 MHz, such as when operating on other bands, or other frequencies within FDD Band 5.

- For optimal MIMO performance, space cellular Main and Aux antennas apart by at least 17 inches (43 cm). At the lowest LTE frequency of 700 MHz, 17 inches represents 1 wavelength. Spacing of half (or 0.5) wavelength or 8.5 inch (22.5cm) results in good MIMO performance.
- Spacing Main and Aux LTE antennas less than 8.5 inches may result in significantly reduced MIMO performance.
- Spacing antennas too close to each other (e.g. 3 inches) results in antennas significantly detuning from their original designed performance due to antenna coupling.
- Wherever possible, mount the IR1101 router with the pluggable LTE module and antenna where the cellular base station or tower are within sight and without physical obstructions. Barriers along the line of sight between the router and the local base station will degrade the wireless radio signals. Install the IR1101, pluggable modules and antennas above floor level in office environments or near the ceiling for better performance because most obstructions tend to be near the floor level.
- The density of the materials used in a building's construction determines the number of walls the signal must pass through while still maintaining adequate coverage. Consider the following before choosing the location for installing the antenna:

  - Paper and vinyl walls have very little effect on signal penetration.
  - Solid and precast concrete walls limit signal penetration to one or two walls without degradation of coverage.
  - Concrete and wood block walls limit signal penetration to three or four walls.
  - A signal can penetrate five or six walls constructed of drywall or wood.
  - A thick metal wall or wire-mesh stucco wall causes signals to reflect back and causes poor penetration.
- Avoid mounting the antenna next to a column or vertical support that could create a shadow zone and reduce the coverage area.
- Keep the antenna away from reflective metal objects such as heating and air-conditioning ducts, large ceiling trusses, building superstructures, and major power cabling runs. If necessary, use an extension cable to relocate the antenna away from these obstructions.

Supported Antennas for the IR1101

All of the currently supported antennas are broken down by functional groups in the Cisco Industrial Routers and Industrial Wireless Access Points Antenna Guide. Details are found in the Antenna Selection Table.

Supported Accessories for the IR1101

All of the currently supported accessories are broken down by functional groups in the Cisco Industrial Routers and Industrial Wireless Access Points Antenna Guide. Details are found in the Cisco RF Cables, Adapters, Lightning Arrestors, Extension Bases and other Accessories chapter.