Antenna Selection and Installation

This chapter contains information about installing antennas with the IR8340 router using cellular modules.

Antenna Selection and Installation

Note Before you install the Cisco IR8340 router in a rack, install the antennas on the Pluggable Modules first. It is difficult to install the antennas after the router is mounted.

The P-LTE-xx or P-LTEA-xx cellular modules have three 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 is also referred to as an Aux connector.

The P-LTEAP18-GL module has four SMA(f) connectors. Two connectors are Primary (Main) supporting Uplink and Downlink, and two connectors are secondary supporting downlink MIMO.

The P-5GS6-GL module has five SMA(f) connectors, of which four support 4G LTE / 5G FR1 and one supports GPS.

Antenna Installation Best Practices

The optimal site location for antennas for 4G enabled 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 cellular antennas such as 4G/LTE, 4G/LTEA (LTE Advanced), and 5G NR FR1 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 IR8340 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.

Note When cellular FDD Band 5 is deployed with 4G/LTE or 4G/LTEA C/A, such as with P-LTEA-EA pluggable modules on certain carriers, ensure that both Main and Aux cellular antennas are physically separated from the IR8340 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, set the cellular Main and Aux antennas apart by at least 20 inches (50 cm). At the lowest LTE frequency of 617 MHz, 20 inches represents 1 wavelength. Spacing of half (or 0.5) wavelength or 10 inch (25 cm) results in good MIMO performance.
- Spacing Main and Aux LTE antennas less than 10 inches may result in significantly reduced MIMO performance.
- Spacing antennas too close to each other, for example, 3 inches, results in antennas significantly detuning from their original designed performance due to antenna coupling.
- Wherever possible, mount the IR8340 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 IR8340, 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 IR8340

All the supported antennas are listed by functional groups.

Cellular Antennas

Part Number/ Description	RF Connectors	Antenna Frequency Band Support and Gain
Cisco 4G (LTE) / 5G (FR1) Omnidirectional Outdoor Antenna (ANT-5G-OMNI-OUT-N) Outdoor Omnidirectional Antenna.	N(f)	2.5 dBi, 617-960 MHz 4.0 dBi, 1450-4200 MHz 4.3 dBi, 4400-7125 MHz
Cisco Multiband Panel Outdoor 4G MIMO Antenna (ANT-4G-PNL-OUT-N) Multiband Panel Outdoor 4G MIMO dual-port antenna designed to cover cellular 4G bands.	Dual type N female direct connector	698-960 MHz 8.0-10.0 dBi 1710-2170 MHz 6.0-8.5 dBi 2200-2400 MHz 6.5-9.5 dBi 2500-2700 MHz 8.5-9.5 dBi Antenna is not designed to operate in 1448-1511 MHz Japan band. Does not have high gain.

Part Number/ Description	RF Connectors	Antenna Frequency Band Support and Gain
Cisco 4G (LTE) / 5G (FR1) / GNSS Integrated Indoor and Outdoor Antenna (ANT-5-5G4G1-O) Integrated indoor and outdoor Antenna with five ports; four ports for 4G (LTE) / 5G (FR1) and one port for GNSS.	4 x 4G/5G FR1, SMA(m) 1 x GNSS, SMA(m)	2.0 dBi, 617-960 MHz 5.0 dBi, 1710-2170 MHz 5.6 dBi, 2300-2700 MHz 6.6 dBi, 3400 - 3800 MHz 6.0 dBi, 4900 - 5925 MHz One port with GNSS element.
Cisco Cellular and GPS 3-in-1 Vehicle Mount and Fixed Infrastructure Antenna (ANT-3-4G2G1-O) Fixed Infrastructure Antenna with three ports; two port 2G/3G/4G and one port GPS Vehicle Mount.	2 x 4G/LTE, TNC(m) 1 x GPS SMA(m)	4G/LTE 698-960, 1448-1511, 1710-2400, 2500-2700 MHz 2.6 dBi typical, 3.8 dBi max 698-960 MHz 3.8 dBi typical, 4.3 dBi max 1448-1551 MHz 4.6 dBi typical, 5.5 dBi max 1710-2700 MHz
Cisco Dual LTE-Single GPS Multi-band Antenna (4G-LTE-ANTM-O-3-B) Integrated indoor and outdoor Antenna with three ports; two ports for 2G, 3G, 4G/LTE and one port for GPS.	2 x 4G/LTE, SMA(m) 1 x GPS SMA(m)	4G/LTE 698-960, 1710-2700 MHz 2.5 dBi typical 698-960 MHz 2.5 dBi typical 1710-2700 MHz
Cisco Cellular 2-in-1 Vehicle Mount and Fixed Infrastructure Antenna (ANT-2-4G2-O) Two port 2G/3G/4G antenna with two elements. This dual port LTE antenna does not have an active GPS antenna (compared to ANT-3-4G2G1-O which does), and is useful for cases when there is no GPS required, or when GPS is connected to a completely separate GPS antenna.	2 x 4G/LTE, TNC(m)	4G/LTE: 698-960,1448-1511,1710-2400,2500-2700 MHz 2.6 dBi typical, 3.8 dBi max 698-960 MHz 3.8 dBi typical, 4.3 dBi max 1448-1511 MHz 4.6 dBi typical, 5.5 dBi max 1710-2700 MHz No GPS element and no WiFi.
Cisco Outdoor Omnidirectional Antenna for 2G/3G/4G Cellular (ANT-4G-OMNI-OUT-N) Outdoor Omnidirectional Antenna for 2G/3G/4G Cellular antenna is designed to cover domestic LTE700/Cellular/PCS/AWS/MDS, WiMAX 2300/2500, and GSM900/GSM1800/UMTS/LTE2600 bands.	N(f)	1.5 dBi 698-960 MHz 2 dBi 1448-1511 MHz 3.5 dBi 1710-2700 MHz

GPS Antennas

Part Number / Description	RF Connectors	Antenna Frequency Band Support and Gain
Cisco GPS Antenna (ANT-GPS-OUT-TNC) Active GPS antenna, integrated 15' LMR-100 cable with RA-TNC(m). The ANT-GPS-OUT-TNC integrated GPS RF front end is designed to reject collocated RF interference.	Right-angle TNC(m)	Active GPS antenna, 4.0 dBi min at Zenith, 1575.42 MHz, plus 25 dB amplifier gain
Cisco Indoor/Outdoor Active GPS Antenna (GPS-ACT-ANTM-SMA) Active GPS antenna that can be physically connected to the Cisco Integrated Services Routers (ISRs) and Cisco Enhanced High-Speed WAN Interface Cards (EHWICs) to receive GPS broadcasts from satellites. GPS-ACT-ANTM-SMA has GPS filters, but all the filters are after the LNA. Therefore, antenna may not be suitable for co-location with strong RF transmitters.	SMA(m)	Active GPS antenna, 4 dBi @Zenith, 1575.42 MHz, plus 27 dB amplifier gain
Cisco Dual LTE-Single GPS Multi-band Antenna (4G-LTE-ANTM-O-3-B) Integrated indoor and outdoor Antenna with three ports; two ports for 2G, 3G, 4G/LTE and one port for GPS. The 4G-LTE-ANTM-O-3-B integrated GPS RF front end is designed to reject collocated RF interference.	2 x 4G/LTE, SMA(m) 1 x GPS SMA(m)	2.5 dBi typical 698-960 MHz 2.5 dBi typical 1710-2700 MHz One port with GPS element.

Supported RF Cables for the IR8340

The following tables provide information for the cables supported by the IR8340:

Table 1: SMA(m) to SMA(f) and SMA(m) to N(m) RF cables

Antenna Cable Type	Description	RF Loss
CAB-L195-10-SM-SF	LMR195, 10ft SMA(m) to SMA(f)	1.2 dB @ 1.0 GHz 2.2 dB @ 3.0 GHz 3.0 dB @ 5.0 GHz 3.6 dB @ 7.0 GHz

Antenna Cable Type	Description	RF Loss
CAB-L240-20-SM-SF	LMR240, 20ft SMA(m) to SMA(f)	1.6 dB @ 1.0 GHz 2.9 dB @ 3.0 GHz 3.8 dB @ 5.0 GHz 4.6 dB @ 7.0 GHz
CAB-L240-10-SM-NM	LMR240, 10ft SMA(m) to N(m)	0.9 dB @ 1.0 GHz 1.5 dB @ 3.0 GHz 2.0 dB @ 5.0 GHz 2.4 dB @ 7.0 GHz

Table 2: TNC(m) to SMA(m) RF cables

Antenna Cable Type	Description	RF Loss
CAB-L240-10-SM-TM	SMA(m)-STR to TNC(m)-STRLMR-240, 10ft RF cableType: outdoor DB (direct burial)	0.8 dB @ 0.7 GHz 0.9 dB @ 1.0 GHz 1.2 dB @ 1.7 GHz 1.5 dB @ 2.4 GHz 1.6 dB @ 2.7 GHz
CAB-L240-15-SM-TM	SMA(m)-STR to TNC(m)-STRLMR-240, 15ft RF cableType: outdoor DB (direct burial)	1.1 dB @ 0.7 GHz 1.4 dB @ 1.0 GHz 1.8 dB @ 1.7 GHz 2.2 dB @ 2.4 GHz 2.3 dB @ 2.7 GHz
CAB-L240-20-SM-TM	SMA(m)-STR to TNC(m)-STRLMR-240, 20ft RF cableType: outdoor DB (direct burial)	1.5 dB @ 0.7 GHz 1.8 dB @ 1.0 GHz 2.4 dB @ 1.7 GHz 2.9 dB @ 2.4 GHz 3.1 dB @ 2.7 GHz

Table 3: N(m) to TNC(m) RF cable

Antenna Cable Type	Description	RF Loss
CAB-L400-20-TNC-N	TNC(m)-RA to N(m)-STRLMR-400, 20 foot RF cable Type: outdoor DB (direct burial)	0.8 dB @ 0.7 GHz 1.0 dB @ 1.0 GHz 1.3 dB @ 1.7 GHz 1.6 dB @ 2.4 GHz
CAB-L400-50-TNC-N	TNC(m)-RA to N(m)-STRLMR-400, 50 foot RF cable Type: outdoor DB (direct burial)	1.9 dB @ 0.7 GHz 2.3 dB @ 1.0 GHz 3.1 dB @ 1.7 GHz 3.8 dB @ 2.4 GHz

Table 4: TNC(m) to TNC(f) RF cable

Antenna Cable Type	Description	RF Loss
4G-CAB-LMR400-10	TNC(m)-RA to TNC(f)-STRLMR-400, 10 foot RF cable Type: outdoor DB (direct burial)	0.4 dB @ 0.7 GHz 0.5 dB @ 1.0 GHz 0.7 dB @ 1.7 GHz 0.8 dB @ 2.4 GHz
4G-CAB-ULL-20	TNC(m)-RA to TNC(f)-STRLMR-400, 20 foot RF cable Type: Plenum	0.8 dB @ 0.7 GHz 1.0 dB @ 1.0 GHz 1.3 dB @ 1.7 GHz 1.6 dB @ 2.4 GHz
4G-CAB-LMR240-25	TNC(m)-RA to TNC(f)-STRLMR-240, 25 foot RF cable Type: Plenum	1.9 dB @ 0.7 GHz 2.3 dB @ 1.0 GHz 3.0 dB @ 1.7 GHz 3.6 dB @ 2.4 GHz

Table 5: N(m) to N(m) RF cables

Antenna Cable Type	Description	RF Loss
AIR-CAB002L240-N	N(m)-STR to N(m)-RALMR-240, 2 foot RF cableType: Indoor Interconnect.Not DB, CMR or CMP (not direct burial or flame rated)	0.2 dB @ 0.7 GHz 0.3 dB @ 1.0 GHz 0.4 dB @ 1.7 GHz 0.5 dB @ 2.4 GHz 0.8 dB @ 5.8 GHz

Antenna Cable Type	Description	RF Loss
AIR-CAB005LL-N	N(m)-STR to N(m)-RALMR-400, 5 foot RF cableType: outdoor DB (direct burial)	0.2 dB @ 0.7 GHz 0.3 dB @ 1.0 GHz 0.4 dB @ 1.7 GHz 0.5 dB @ 2.4 GHz 0.8 dB @ 5.8 GHz
CAB-L400-5-N-N	N(m)-STR to N(m)-RALMR-400, 5 foot RF cableType: outdoor DB (direct burial)	0.2 dB @ 0.7 GHz 0.3 dB @ 1.0 GHz 0.4 dB @ 1.7 GHz 0.5 dB @ 2.4 GHz 0.8 dB @ 5.8 GHz
CAB-L400-5-N-NS	N(m)-STR to N(m)-STR LMR-400, 5 foot RF cable Type: outdoor DB (direct burial)	0.2 dB @ 0.7 GHz 0.3 dB @ 1.0 GHz 0.4 dB @ 1.7 GHz 0.5 dB @ 2.4 GHz 0.8 dB @ 5.8 GHz
AIR-CAB010LL-N	N(m)-STR to N(m)-RALMR-400, 10 foot RF cable Type: outdoor DB (direct burial)	0.4 dB @ 0.7 GHz 0.5 dB @ 1.0 GHz 0.7 dB @ 1.7 GHz 0.9 dB @ 2.4 GHz 1.5 dB @ 5.8 GHz
AIR-CAB025HZ-N	N(m)-STR to N(m)-STRLMR-400, 25 foot RF cable Type: outdoor DB (direct burial) with additional resistance to petrochemicals and oils	1.0 dB @ 0.7 GHz 1.2 dB @ 1.0 GHz 1.6 dB @ 1.7 GHz 2.0 dB @ 2.4 GHz 3.1 dB @ 5.8 GHz
CAB-L600-30-N-N	N(m)-STR to N(m)-RALMR-600, 30 foot RF cable Type: outdoor DB (direct burial)	0.8 dB @ 0.7 GHz 0.9 dB @ 1.0 GHz 1.3 dB @ 1.7 GHz 1.6 dB @ 2.4 GHz 2.6 dB @ 5.8 GHz

Accessories

The following tables provide information for other accessories supported by the IR8340:

Table 6: Cisco Lightning Arrestors

Cisco PID	Connectors Type	Arrestor Type and Frequency Range (MHz)
ACC-LA-G-SM-SF	SMA(m) to SMA(f)	DC to 7000 MHz Supports active GNSS antennas, passes DC
CGR-LA-NM-NF	N(m)-STR to N(f)-STR	DC to 6000 MHz GDT type Supports active GNSS antennas, passes DC
CGR-LA-NF-NF	N(f)-STR to N(f)-STR	DC to 6000 MHz GDT type Supports active GNSS antennas, passes DC
ACC-LA-G-TM-TF	TNC(f)-STR to TNC(m)-STR	DC to 6000 MHz GDT type Supports active GNSS antennas, passes DC
ACC-LA-G-TF-TF	TNC(f)-STR to TNC(f)-STR	DC to 6000 MHz GDT type Supports active GNSS antennas, passes DC

Table 7: Cisco Coaxial Adapters

Cisco PID	Connectors Type
AIR-ACC370-NF-NF	N(f)-STR to N(f)-STR
LTE-ADPT-SM-TF	SMA(m)-STR to TNC(f)-STR