ORiNOCO® AP-9200R

(Outdoor Access Point)

Hardware Installation Guide

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ORiNOCO® AP-9200R - Hardware Installation Guide

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Package Contents 1

Each shipment includes the items listed in the following table. Please verify that you have received all the parts in this shipment, prior to installation.

What's in the kit	Image
AP9200R	
Power Injector with Country specific Power Cord *WD - US and EU power cords* *US - US power cord*	
2.4 GHz, 7 dBi Omni Antennas (x 3)	
5 GHz, 7 dBi Omni Antennas (x 4)	
Connector Weather Proofing Kit (1 set)	
Grounding Kit	

What's in the kit	Image
Mounting Kit and Hardware	The mounting kit includes the following:  Full axis mounting kit
Quick Installation Guide	

Getting Started 2

2.1 Power-Up

To Power on the device, perform the following steps:

1. Connect the **OUT / POE** port on the PoE and the **Ethernet Port** of the device using a standard Cat5e cable terminated with RJ45 connectors.
2. Connect the **IN / LAN** port on the PoE and the **NIC** port of a computer.
3. Connect the AC power cord to PoE and switch ON the AC power.
4. The LEDs on the RJ45 port of the device glows.
5. Ping the device's IP Address to check the network connectivity. (Please refer QIG for IP Address of the device)
6. If the ping is successful, continue with the installation process.

The device receives (36 - 57) V DC via a a standard Cat5e cable connected between the PoE and the device.

: Due to DC power requirements, the maximum cable length between the PoE Injector and the device should be less than 100 meters.

Prior to the Pole Mounting or Wall Mounting procedure, it is always recommended to check the functionality by powering on the device with the temporary connections.

2.2 Pre-Installation Check List

It is mandatory to check the Safety & Regulatory Information before you perform the Installation procedure.

You will need the following tools to perform the Installation:

10mm Spanner

#2 Philips Screw Driver

#3 Philips Screw Driver

Crimping Tool

Device Overview 3

This section provides the hardware overview and installation procedure for the following product(s):

- AP-9200R

3.1 ORiNOCO® AP-9200R Hardware Overview

Device Model	Description
AP-9200R	ORiNOCO® AP-9200R, MU-MIMO 4x4 w2, dual radio, connectorized outdoor Access Point

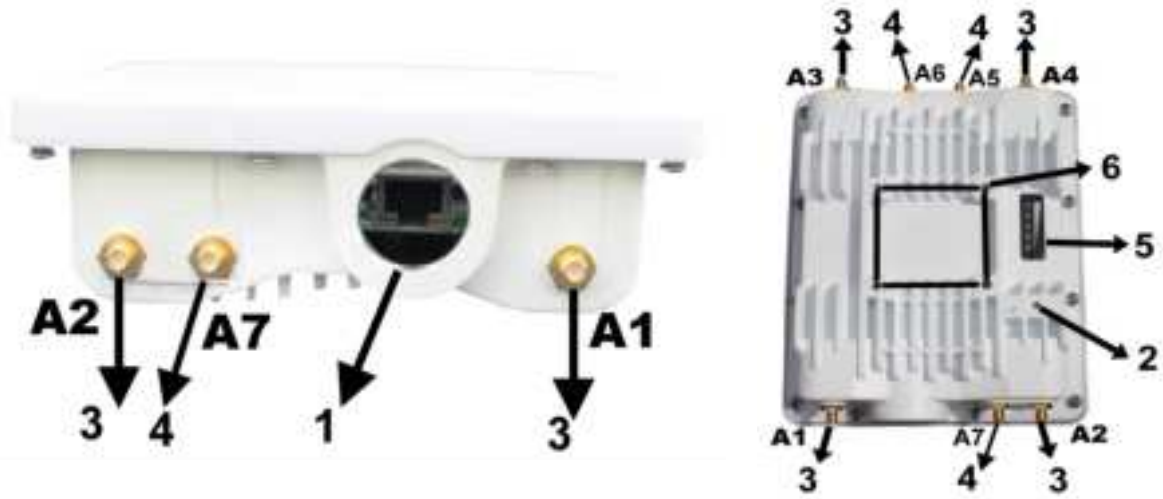


Figure 3-1 AP9200R

The features of the above devices are tabulated as below:

A detailed description about the various components of the device are explained in the following sections.

Item	Features	Description
1	Ethernet Port	• PoE IN and Data • Debugging and Management
2	Grounding Point	• A provision to ground the device.
3	5 GHz Antenna Ports (A1, A2, A3 and A4)	• A provision to connect external antenna in MIMO 4x4 mode (supplied).
4	2.4 GHz Antenna Ports (A5, A6 and A7)	• A provision to connect external antenna in MIMO 3x3 mode (supplied).
5	RSSI Display	• Displays status information (see Status LED Behavior section).
6	Mounting Holes	• A provision to connect 1000-UMK mounting kit (provided) or 10000-UMK mounting kit (optional).

3.1.1 Gigabit Ethernet Ports

The device comes with one 1000 BASE-T ethernet port with configurable Tx modes and speeds.

- **Ethernet Port/ PoE IN and Data**

  The Gigabit Ethernet Port (PoE IN and Data) of the device allows the user to connect to the LAN by using Cat5e Ethernet cable, and also power ON the device by using the Power over Ethernet (PoE) Injector supplied with the product package.

  - The device receives (36 - 57) V DC via a STP Cat5e cable connected between the PoE and the device.
  - Ethernet Port supports the following features:
    1. Auto MDI-X, auto configuration and fixed speed/duplex configurations.
    2. Jumbo frames of size up to 9 k bytes.

Recommended Ethernet Cable Specifications	
Type	Cat5e, Cat6, STP, 24 AWG, UL rated, Shielded, UV Resistant and outdoor-rated
Impedance	100 ohms
Cable Length	330 feet / 100 meters  *: The total length of cabling between the Personal Computer and the device cannot exceed 100 meters (includes cable from the Personal Computer to the PoE, and the cable from the PoE to the device). Due to DC power requirements, the maximum cable length between the PoE Injector and the device should be less than 100 meters.*

3.1.2 Grounding Points

To protect the device against lighting or ESD events, you must ground the device properly. To ensure proper grounding, use the ground point that is situated at the bottom corner of the device and the grounding screw (M4 thread size) provided to attach a ground wire of at least 12 AWG stranded to the device.

Device Installation 4

4.1 Installation Procedure

This section describes the steps to install and mount the device(s).

: The device must be installed by a trained professional who is familiar with radio frequency planning and regulatory limits. Please refer** Safety & Regulatory Information **for details.

Perform the following steps to install and mount the device

Step 1: Plan for Installation

There are several planning factors to be considered before installing the device. In addition to selecting the installation site, you should do the following:

Determine:

- System frequency plan
- Required antenna mounting height to obtain proper path clearance
- Required transmission line types (like RF cable, waveguides) and lengths

Plan for:

- Device's continuous power consumption needs
- Lightning protection and system grounding
- Hardware mounting
- Cable installation including ingress
- Pre-testing equipment (back-to-back test)

Step 2: Choose a Location

To make optimal use of the device, you must find a suitable location to install the hardware. The range of the radio device largely depends upon the position of the antenna. Proxim recommends you do a site survey, observing the following requirements, before mounting the hardware.

- The location must allow easy disconnection of power to the radio, if necessary.
- Ensure free flow of air around the hardware.
- The radio device must be kept away from vibration and excessive heat.
- The installation must conform to local regulations at all times. For details, please refer to Safety & Regulatory Information.

The devices are designed to directly mount to a pole. By using the supplied brackets and hardware, you can mount them to a 1.5 to 3.25 inch pole (outside diameter).

Step 3: Gather Required Materials

You should have the following materials available before installing the device:

- Weatherproofing material (such as butyl mastic tape and vinyl tape) for sealing external connectors.
- Straight-through UV-protected STP-rated Cat5e Ethernet cable for connecting to PC, or cable for connecting to a hub or a switch.
- Another straight-through UV-protected STP-rated Cat5e Ethernet cable for connecting the OUT / POE port of PoE and device.

Step 4: Unpack the Product Package

1. Unpack the device and its accessories from the product package box.
2. Please make a note of the Ethernet addresses, the MAC addresses and the serial number. These addresses may be used when configuring the device. Note that the serial number helps you to seek support from the Proxim's Customer support team.

Step 5: Weatherproofing RJ45 Connection and RP-SMA Connection

1. Use an outdoor rated CAT5e cable with a straight-through terminated on both ends.
2. Insert the CAT5e cable through the Sealing Nut (D) and install the Compression Washer (C) to the cable. Compression Washer (C) has a slit in the middle for quick installation onto the cable.
3. Install the parts (D) and (C) in the direction as shown in Figure 2.
4. Insert the Flat Washer (A) onto the Connector Body (B) and then insert the CAT5e cable through the Connector Body (B).
5. Connect the cable end of RJ45 connector into Ethernet port of the device.
6. Make sure that the locking latch of RJ45 Connector is properly inserted into the ethernet port.
7. Fasten the Connector Body Assembly to the Device Ethernet port hole and fully tighten it.
8. Slide and Insert the Compression Washer (C) into the Connector Body Assembly.
9. Fasten the Sealing Nut (D) to the Connector Body Assembly and fully tighten it to weatherproof the cable.
10. Warp Butyl Mastic Tape and Vinyl Tape around the connectors to weatherproof the RP-SMA and antenna connections.

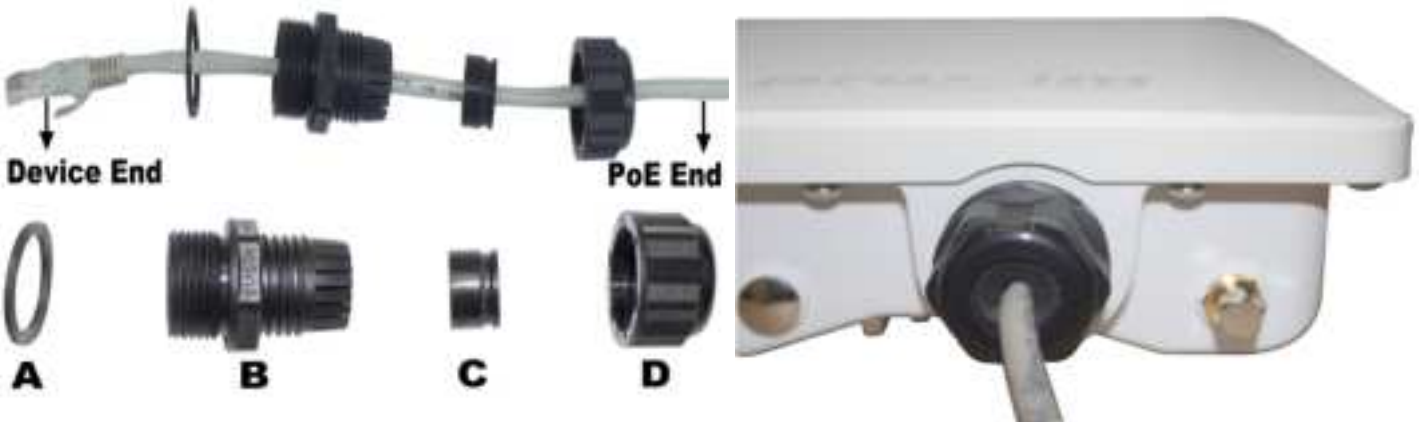


Figure 4-1 Weatherproofing RJ45 Connection

Additional Weatherproofing Steps

To add an additional layer of protection to the connectors against the environment, see Additional Weatherproofing Steps.

Step 6: Assemble Mounting Hardware

1. Place the L-Shaped Mounting Bracket onto the bottom of the device and align with the four mounting holes.
2. Insert the screws and washers into the four mounting holes as shown in Figure 4-2 view (B).
3. Tighten the screws to the required torque. The last image in Figure 4-2 view (C) shows the fully assembled mounting hardware attached to the device.

Figure 4-2 Assemble the Mounting Hardware

Step 7: Mount the Device

1. To pole-mount the device to a 1.5 to 3.25 inch diameter pole, place the fully assembled mounting hardware along with the device against the pole and insert the U-bolt through the holes provided on full axis plate on the Mounting Bracket.
2. Insert the Toothed Washer, Spring Washer, Flat Washer and Nut on both ends of the U-bolt as shown in Figure 4.
3. Tighten the nut slightly so that the U-bolt is adjustable for pole mounting. After adjusting the angle of the device, fully tighten the nut.

Figure 4-3 Pole Mounting

Step 8: Plug in the Cables

1. Plug one end of the straight-through Cat5e cable into the Ethernet Port of the device by following the procedure explained under Step 5: Weatherproofing RJ45 Connection and RP-SMA Connection. Connect the other end of the cable into the **OUT / POE** port on the PoE Injector.

Figure 4-4 Cable Plugged In

2. To connect the device through a hub or a switch to a Personal Computer, connect an Ethernet cable between the network interface card in the Personal Computer and the hub, and between the hub and the RJ45 **IN / LAN** port on the PoE Injector.
3. To connect the device directly to a Personal Computer, connect an Ethernet cable between the network interface card in the Personal Computer and the RJ45 **IN / LAN** port on the PoE Injector.

: AP-9200R device is supplied with a 30W passive PoE injector. It can also be powered up via 802.3af/at power injector or switch.

Step 10: Install Surge Protector

ORiNOCO® AP-9200R Series products comes with a built-in Ethernet surge protection; however, it is mandatory to install an approved lightning surge protector at the building ingress point. Moreover, if you are installing the device in a region subjected to violent thunderstorms or severe weather conditions, then installation of an additional approved lightning surge protector near the device is recommended.

*: The Surge Arrestor (Part Number **235-00001**) is not provided with the Proxim's Package Contents, it needs to be procured by the customer. To buy an additional Surge Protector, place an order separately with your distributor.*

Perform the following steps to ensure proper surge protection:

1. Mount a surge protector near the building ingress and use 12 AWG or larger wire to connect the surge protector's ground lug to earth ground.
2. The outdoor device and co-located surge protector (optional) should have a common grounding point using the shortest possible grounding cable.

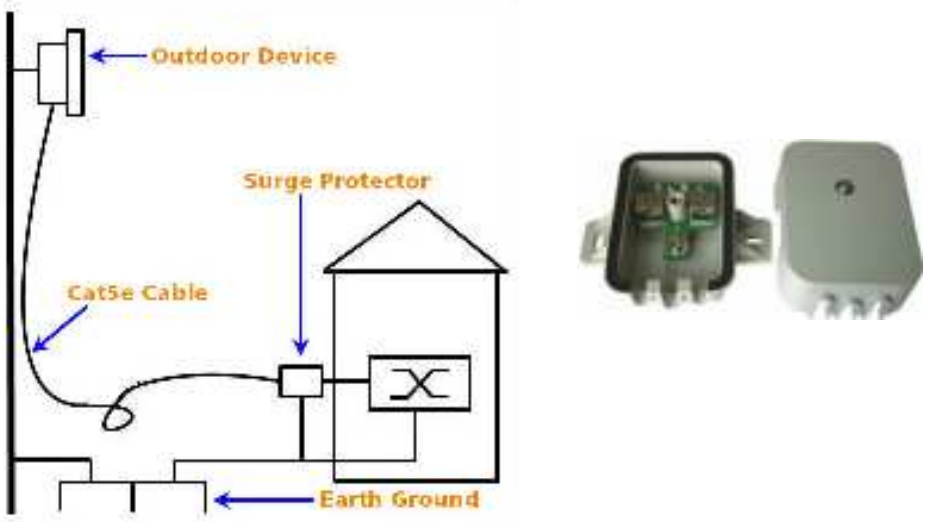


Figure 4-5 Surge Protector

: Use Outdoor-rated, UV protected, shielded Cat5e cable for the following:

3. Connect an RJ45 terminated cable between the indoor device and to the port on the surge protector at the building ingress.
4. Connect an RJ45 terminated cable between the surge protector and the outdoor device on the Ethernet Port.

:Ensure to loop the cable before entering the premise to prevent water ingress.

Step 11: Ground the Unit

To ensure proper grounding, attach a ground wire of at least 12 AWG stranded to the device at the ground point which is located at the bottom corner of the device and use the grounding screw provided. It is important to follow the grounding guidelines below to protect the device against lighting or ESD events:

1. Connect one end of the grounding cable to the device and the other end to the closest earth ground point at the installation site.
2. Remove any extra ground wire length when finished connecting it to the single point earth ground.
3. Avoid sharp bends, loops or coiling the ground wire, always connect it straight to ground.
4. A proper earth ground impedance is less than 1.0 ohm.
5. Measure ground impedance at the point where the surge protector ground wire is connected and not at the grounding rod.
6. Connect the surge protector ground wire and equipment ground (both power ground and telecomm ground) to a single common ground.
7. Make sure all connections are fastened securely and tight.
8. Never install a link during a storm and always follow your local safety codes.

Connect the grounding wire, which is supplied with the product package, to the device as shown below:

Figure 4-6 Ground the Device

Step 12: Power ON the Device

After connecting the PoE Injector and the device using straight-through CAT5e cable plug the power cord into a power outlet. There is no ON/OFF switch on the device. To power down the unit, unplug the RJ45 connector from the **OUT / POE** port on the PoE injector.

Step 13: Port LED Indicators

When the device is powered on, it performs startup diagnostics. When startup is complete, the LEDs show the device's operational state. The LEDs are located on the Ethernet port inside the device enclosure.

: The LEDs will not be visible when the weather-sealing cap is installed.

The LEDs can be seen at the bottom of the Ethernet port. The following table describes the status of LEDs:

Figure 4-7 Port LED Indicators

LED State	Off	On
Status LED	Ethernet link is down	Ethernet link is active
Gigabit LED	Ethernet link is established at 100 Mbps	Ethernet link is established at 1 Gbps

Technical Specifications 5

Device Models

Model	Part Number	Description
AP-9200R-US	903-00035	ORiNOCO® AP-9200R, MU-MIMO 4x4 w2, dual radio, connectorized outdoor Access Point – US Power
AP-9200R-WD	903-00036	ORiNOCO® AP-9200R, MU-MIMO 4x4 w2, dual radio, connectorized outdoor Access Point – WD Power
AP-9200R-JP	903-00040	ORiNOCO® AP-9200R, MU-MIMO 4x4 w2, dual radio, connectorized outdoor Access Point – JP Power
AP-9200R-CN	903-00041	ORiNOCO® AP-9200R, MU-MIMO 4x4 w2, dual radio, connectorized outdoor Access Point – CN Power

Accessories

Part Numbers	CAMCODE	Accessories
76955	PA5-0823-DP	4.9 - 5.875 GHz, Dual Polarity, Slanted (±45º) or V/H, 23 dBi Panel Antenna
949-00019	PA5-0530-DP	4.9 - 6.1 GHz, Dual Polarity, Vertical and Horizontal, 30 dBi Panel Antenna
949-00011	SA5-6015-DP	4.9-6GHz, Dual Polarity,Vertical /Horizontal,16.5 dBi Sector Antenna - 60 degrees.Mounting kit Incd.
949-00012	SA5-9014-DP	4.9-5.95GHz, Dual Polarity,Vertical and Horizontal, 14dBi Sector Antenna- 90 degrees. Mounting kit Incd.
949-00027	PA2-1720-DP	2.3-2.7 GHz, Dual Polarity, Vertical & Horizantal, 20 dBi Panel Antenna
949-00152	CBL-240-6-RA	6 ft Low Loss Coaxial Antenna Cable, 0.240", Reverse Polarity SMA Male to Right Angle N-Male
949-00153	SMA-CAP-50	SMA metal weatherproofing cap with O-ring (fit SMA and RP-SMA connectors) - 50 pack
400-00036	GIG-POE-INJ-48VDC	PoE Gigabit 48V DC Injector with terminal Jack
400-00002	GIG-POE-INJ-48VDC-T	PoE Gigabit 48V DC Injector with terminal Jack - 25 pack
949-00140	ETH-POEINJ60-1G-VI	Gigabit, 60W, PoE injector with RJ45, level VI Compliance
949-00144	ETH-POEINJ30-1G-VI-v2	Gigabit, 30W, passive PoE injector with RJ45, level VI Compliance
235-00001	ETH-SURGE-1G	SURGE, GIGABIT SURGE PROTECTOR WITH SHIELDED RJ45
949-00125	ETH-STP-25-CAP	25m outdoor, RJ45 terminated, UV Rated, STP Shielded CAT5e cable with M20 and M25 cable gland

949-00150	ETH-STP-50-CAP	50m outdoor, RJ45 terminated, UV Rated, STP Shielded CAT5e cable with M20 and M25 cable gland
949-00175	ETH-STP-75-CAP	75m outdoor, RJ45 terminated, UV Rated, STP Shielded CAT5e cable with M20 and M25 cable gland
949-00154	ETH-CAP-M25-25	Cable Feed Thru, M25 Cable Gland Connector for Edge and ORiNOCO® 9200R - 25 pack
949-00155	1000-UMK	Outdoor Universal Mounting Kit for Edge and ORiNOCO® 9200R
949-00076	10000-UMK	Outdoor Universal Mounting Kit for Tsunami® 800/10100 and outdoor ORiNOCO® 9100

OFDM Modulation Rates

Given below are the OFDM modulation rates for the **ORiNOCO®** products:

Radio #1: 5 GHz									
Products	**MCS Index**	**Modulation**	**Coding Rate**	**Data Rates (Mbps) Per Stream**					
				20 MHz Channels		**40 MHz Channels**		**80 MHz Channels**	
				800ns GI	**400ns GI**	**800nsGI**	**400ns GI**	**800ns GI**	**400ns GI**
AP-9200R	0	BPSK	1/2	6.5	7.2	13.5	15	29.3	32.5
	1	QPSK	1/2	13	14.4	27	30	58.5	65
	2	QPSK	3/4	19.5	21.7	40.5	45	87.8	97.5
	3	16QAM	1/2	26	28.9	54	60	117	130
	4	16QAM	3/4	39	43.3	81	90	175.5	195
	5	64QAM	2/3	52	57.8	108	120	234	260
	6	64QAM	3/4	58.5	65	121.5	135	263.3	292.5
	7	64QAM	5/6	65	72.2	135	150	292.5	325
	8	256-QAM	3/4	78	86.7	162	180	351	390
	9	256-QAM	5/6	N/A	N/A	180	200	390	433.3
Note: Maximum Packet Size = 9000 Bytes (excluding one VLAN header, Ethernet header and FCS).									

Radio #2: 2.4 GHz							
Products	MCS Index	Modulation	Coding Rate	Data Rates (Mbps) Per Stream			
				20 MHz Channels		40 MHz Channels	
				800ns GI	400ns GI	800ns GI	400ns GI
AP-9200R	0	BPSK	1/2	6.5	7.2	13.5	15
	1	QPSK	1/2	13	14.4	27	30
	2	QPSK	3/4	19.5	21.7	40.5	45
	3	16QAM	1/2	26	28.9	54	60
	4	16QAM	3/4	39	43.3	81	90
	5	64QAM	2/3	52	57.8	108	120
	6	64QAM	3/4	58.5	65	121.5	135
	7	64QAM	5/6	65	72.2	135	150
Note: Maximum Packet Size = 9000 Bytes (excluding one VLAN header, Ethernet header and FCS).							

Wireless Protocol

Category	Specification
Wireless Protocol	Radio #1: 802.11a/n/ac Radio #2: 802.11b/g/n

Interfaces

Products	Category	Specification
AP-9200R	Wired Ethernet	Auto MDI-X, auto configuration and fixed speed/duplex configurations. One auto MDI-X RJ45 Gigabit Ethernet Port with PoE IN and Data.

Transmit Power Specifications (5.150 to 5.850) GHz

Products	Stream	MCS Index	Modulation Type	Coding Rate	Tx Power* (dBm)		
					VHT20 (5.15-5.80 GHz)	VHT40 (5.15- 5.80 GHz)	VHT80 (5.15- 5.80 GHz)
AP-9200R	Single stream (or) Dual Stream (or) Quad Stream	MCS 0	BPSK	1/2	21	20	18
		MCS 1	QPSK	1/2	21	20	18
		MCS 2	QPSK	3/4	20	19	18
		MCS 3	16QAM	1/2	20	19	18
		MCS 4	16QAM	3/4	19	18	18
		MCS 5	64QAM	2/3	19	18	17
		MCS 6	64QAM	3/4	17	17	17
		MCS 7	64QAM	5/6	17	16	16
		MCS 8	256-QAM	3/4	16	15	15
		MCS 9	256-QAM	5/6	NA	15	14

Note:

- Output Power Attenuation: 0 – 17 dB, in 1 dB steps
- For MCS 0, the maximum attenuation limit is 17 dB
- For MCS 9, the maximum attenuation limit is 10 dB
- Total EIRP must be calculated based on the antenna gain
- Tolerance = +/- 2 dB

  ** Tx Power indicates the power at the radio ports.*

  ** In case of integrated devices, the Tx Power at the antenna ports is 1 dB higher than the above tabulated values.*
- In the FCC United States 5.8 GHz band edge frequencies, the Maximum Tx Power of the radio will be restricted based on the FCC Certification and Antenna Type used. For details refer the Antenna Intallation and Recommendation Guide.

Transmit Power Specifications (2.400 to 2.484) GHz

2.400 ~ 2.484 GHz						
Products	**Stream**	**MCS Index**	**Modulation Type**	**Coding Rate**	**Tx Power* (dBm)**	
					11n HT20	**11n HT40**
AP-9200R	Single stream (or) Dual Stream	MCS 0 (or) MCS 8	BPSK	1/2	21	20
		MCS 1 (or) MCS 9	QPSK	1/2	21	20
		MCS 2 (or) MCS 10	QPSK	3/4	20	19
		MCS 3 (or) MCS 11	16 QAM	1/2	20	19
		MCS 4 (or) MCS 12	16 QAM	3/4	19	18
		MCS 5 (or) MCS 13	64 QAM	2/3	19	18
		MCS 6 (or) MCS 14	64 QAM	3/4	18	17
		MCS 7 (or) MCS 15	64 QAM	5/6	18	17

Note:
Output Power Attenuation: 0 – 17 dB, in 1 dB steps
Total EIRP must be calculated based on the antenna gain

** Tx Power indicates the power at the radio ports.*

Receive Sensitivity (5.150 - 5.850) GHz

Products	**Stream**	**Modulation Type**	**Coding Rate**	**Receive Sensitivity* (dBm) (5.150 ~ 5.850) GHz**		
				VHT20	**VHT40**	**VHT80**
AP-9200R	Dual Stream	BPSK	1/2	-91	-87	-85
		QPSK	1/2	-87	-84	-82
		QPSK	3/4	-85	-82	-80
		16 QAM	1/2	-83	-79	-77
		16 QAM	3/4	-78	-75	-73
		64 QAM	2/3	-74	-72	-69
		64 QAM	3/4	-72	-70	-68
		64 QAM	5/6	-70	-67	-67
		256QAM	3/4	-68	-64	-62
		256QAM	5/6	-66	-62	-59

Note:
- Receive Sensitivity values should be considered with a tolerance +/- 2 dB.

Receive Sensitivity (2.400 to 2.484) GHz

2.400 - 2.484 GHz						
Products	**Stream**	**MCS Index**	**Modulation Type**	**Coding Rate**	**Receive Sensitivity***	
					11n HT20	**11n HT40**
AP-9200R	Single Stream	MCS 0	BPSK	1/2	-91	-86
		MCS 1	QPSK	1/2	-89	-85
		MCS 2	QPSK	3/4	-86	-82
		MCS 3	16 QAM	1/2	-83	-80
		MCS 4	16 QAM	3/4	-80	-76
		MCS 5	64 QAM	2/3	-75	-73
		MCS 6	64 QAM	3/4	-73	-71
		MCS 7	64 QAM	5/6	-72	-69
	Dual Stream	MCS 8	BPSK	1/2	-89	-85
		MCS 9	QPSK	1/2	-86	-83
		MCS 10	QPSK	3/4	-83	-79
		MCS 11	16 QAM	1/2	-79	-77
		MCS 12	16 QAM	3/4	-76	-73
		MCS 13	64 QAM	2/3	-72	-69
		MCS 14	64 QAM	3/4	-70	-67
		MCS 15	64 QAM	5/6	-68	-64
Note: Receive Sensitivity values should be considered with a tolerance +/- 2 dB.						

2.400 - 2.484 GHz			
Products	**Stream**	**Data Rate (Mbps)**	**Receive Sensitivity (dBm) 11g**
AP-9200R	Single Stream	6	-91
		9	-90
		12	-90
		18	-87
		24	-84
		36	-81
		48	-76
		54	-74

2.400 - 2.484 GHz			
Products	**Stream**	**Data Rate (Mbps)**	**Receive Sensitivity (dBm) 11b**
AP-9200R	Single Stream	1	-93
		2	-93
		5.5	-92
		11	-89

Power Supply

Products	Category	Specification
AP-9200R	Input Voltage	Via RJ45 Ethernet interface supplying 36 - 57 V DC on Ethernet Port. Power consumption: **27 W** typical, **30 W** max.
	PoE Injector	Input: 100 – 240 V AC (50/60 Hz) Output: 56 V DC (30 Watts) *Pin-out: V+ on pins 3/4/5/6, V- on pins 1/2/7/8 Operating Temp: 0° C to +40° C ** Refer supplied PoE model for actual power Pin-out specification.*

Hardware Specifications

Products	Radio	Processor Speed	Memory	Input Power	Power Consumption
AP-9200R	5.150 - 5.850 GHz and 2.400 - 2.484 GHz MIMO radios	720 MHz	Flash: 32 MB RAM: 256 MB	Power-over-Ethernet 36 - 57 V DC	**27 W** typical, **30 W** max

Physical Specifications

Products	Category	Specification
AP-9200R	Dimensions (L x W x H)	170 x 217 x 56 mm / 6.7 x 8.55 x 2.2 in
	Weight	1.20 kg / 2.65 lbs

Environmental Specifications

Products	Operating Temperature	Storage Temperature	Humidity	Wind Loading
AP-9200R	-30° to 55° Celsius -22° to 131° Fahrenheit	-50° to 70° Celsius -58° to 158° Fahrenheit	100% relative humidity IP67	180 km/h 112.5 mph

MTBF

Products	MTBF
AP-9200R	>250,000 hours

Recommended Antennas 6

7.1 Introduction to Antennas

Antenna is an electrical device which distributes signals transmitted by the wireless radios, through the medium of air in a particular pattern. Antennas focus the signals on a given frequency, by reducing the signal flow in other directions. Directional antennas (sector, parabolic, flat), therefore provide maximum range. But due to their narrow beamwidth, these antennas require precise antenna alignment to achieve optimal performance. The higher the antenna gain, the more precise is their alignment. Directional antennas are typically used to connect:

- A Base Station and a Subscriber Station in a point-to-multipoint network.
- An End Point A and an End Point B in a point-to-point network.

7.2 Antennas Supported

Proxim supports two types of directional antennas:

- Flat Panel Antennas
- Sector Antennas

7.2.1 Flat Panel Antennas

Flat panel antennas are patch type antennas in the shape of a square or rectangle. Flat panel antennas are directional, as they have most of their power radiated in both vertical and horizontal planes. A flat panel antenna is frequently used for sectorized base station installations, where it is desirable to provide coverage in a limited azimuthal direction. This reduces the interference from the out of coverage areas and provides high throughput with increased signal strength, within the coverage area. Since a reduced azimuth area is covered, the radio covers only limited subscribers, hence providing increased bandwidth.

Flat panel antennas have varying amounts of gain based on the construction. Hence, they produce hemispherical coverage of narrow beamwidth, spreading away from the mount point to a width of 5 to 30 degrees typically. Concentrating the signal on such smaller area increases the system range. These antennas are used for the point-to-point or multi-point links used on the subscriber side. The figure below depicts the radiation pattern for the flat panel.

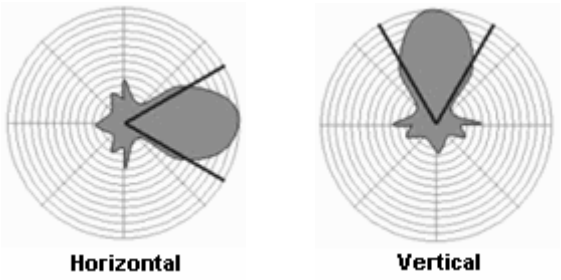


Figure 7-1 Flat Panel Antenna Coverage

7.2.2 Sector Antennas

The wide-angle sector antenna is a good Base Station antenna for hilly terrain. It combines a wide opening angle “sector” with relatively high gain, while the mounting brackets allow tilting of the antenna. This antenna is also used when the amount of traffic in a cell is too high for a single Base Station with an omni-directional antenna. The wide-angle antenna allows dividing the cell into three sectors, where each can be serviced by a Base Station. Sector antennas are better for corridors, hallways, tunnels, long narrow buildings, and point-to-point medium range connections between outdoor bridges (for example, connecting two buildings in an office park or campus).

Sector antennas produce hemispherical coverage, spreading away from the mount point to a width of 30 to 180 degrees typically. The figure below depicts the radiation pattern for the sector antenna.

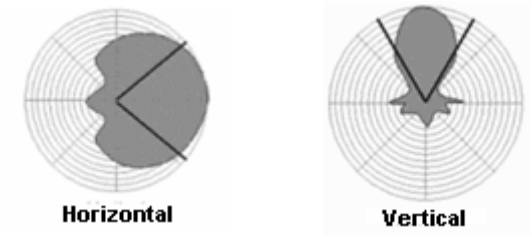


Figure 7-2 Sector Antenna Coverage

7.3 Supplied Antenna Specifications

This section illustrates the technical specifications of the following:

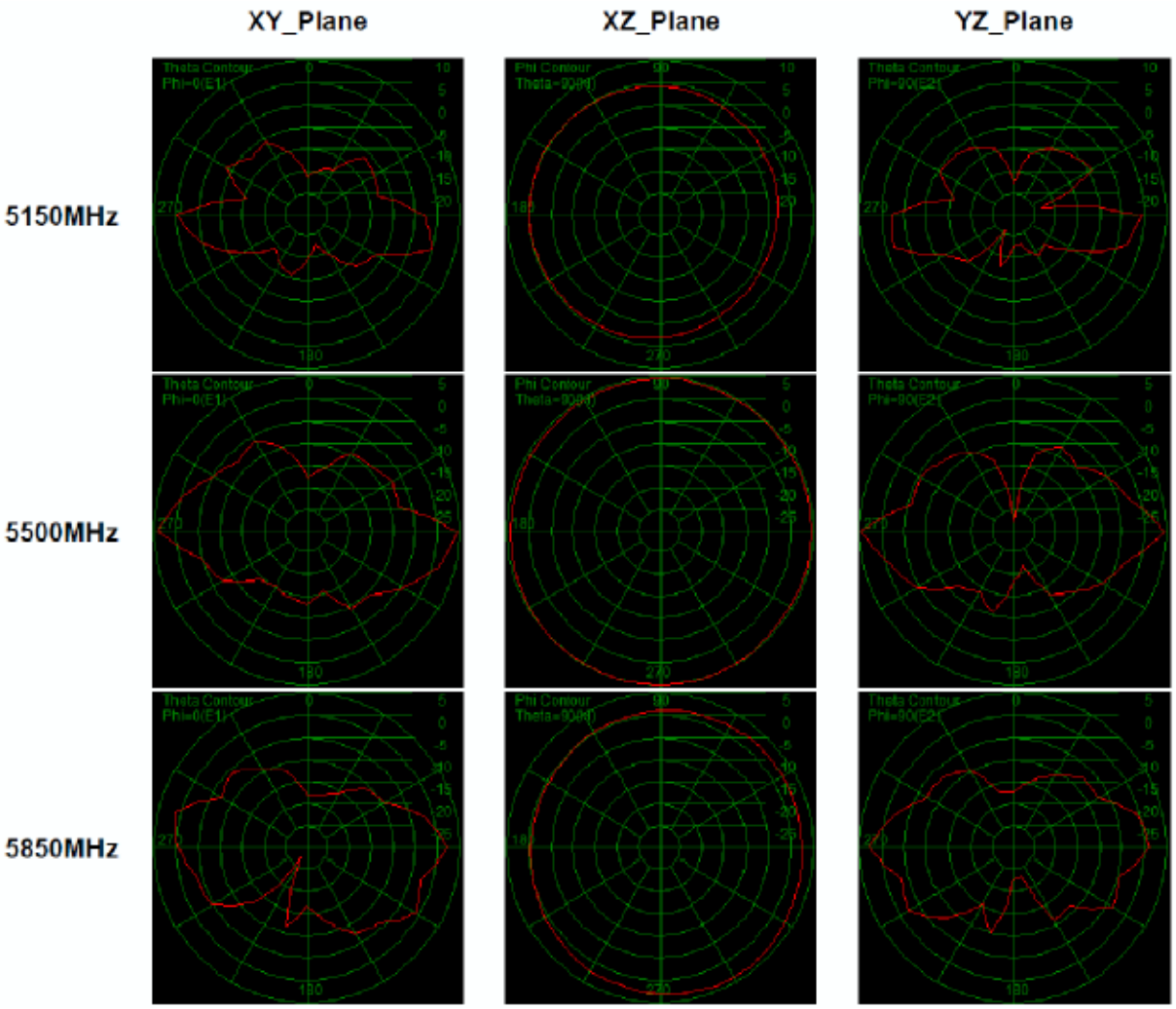
- AP-9200R

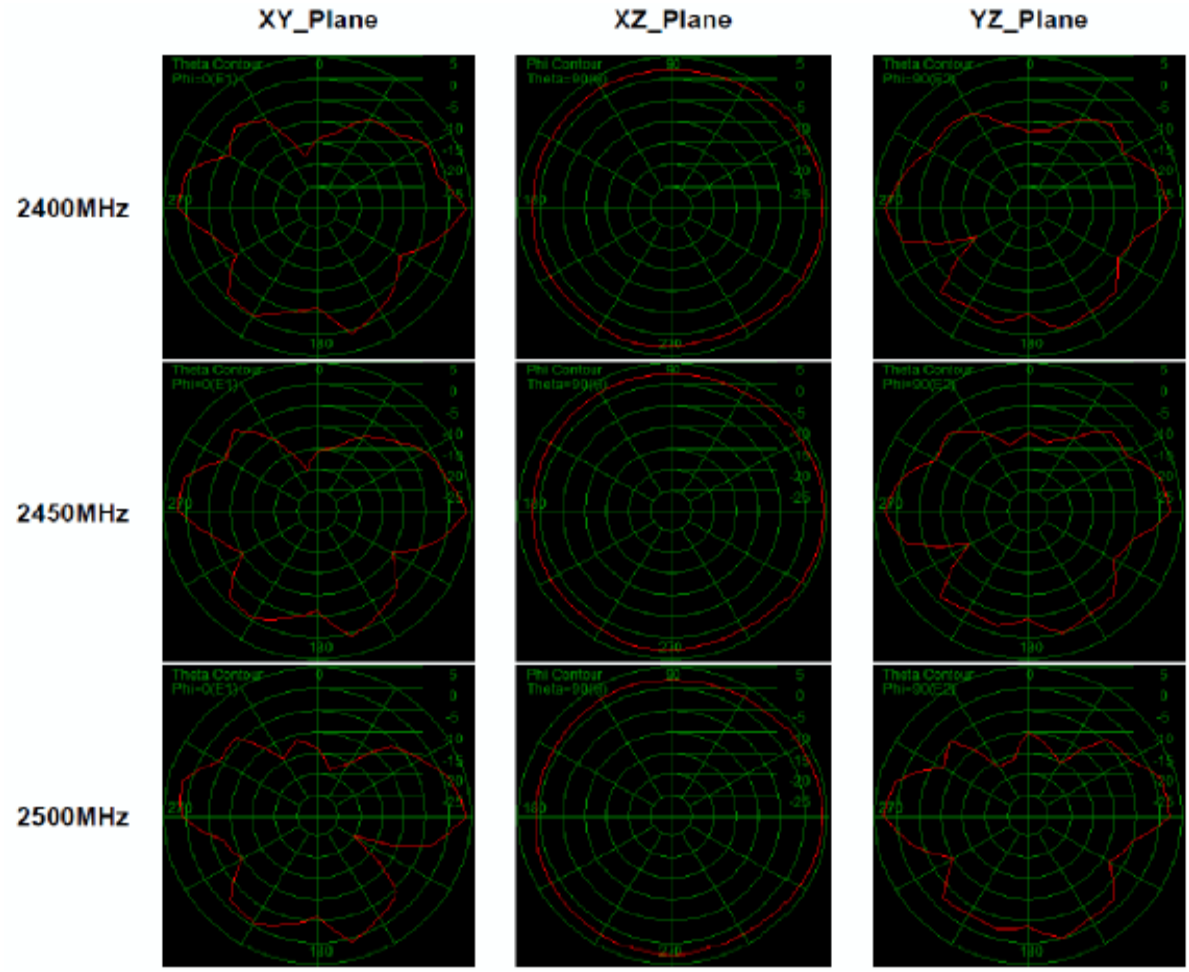
Electrical Specification

Products: AP-9200R		
Feature	**Specification**	
	5 GHz Omni Antenna	**2.4 GHz Omni Antenna**
Frequency Band	5150 - 5850 MHz	2400 - 2500 MHz
Gain	7 dBi	7 dBi
Azimuth Half Power Beam Width	360^{o}	360^{o}
Elevation Half Power Beam Width	10^{o}	15^{o}
Polarization	Linear	Linear
VSWR	<= 2.0	<= 2.0
Impedance	50 Ohm	50 Ohm

Mechanical Specification

Products: AP-9200R		
Feature	**Specification**	
	5 GHz Omni Antenna	**2.4 GHz Omni Antenna**
Connector	RP-SMA plug	RP-SMA plug
Size	250xØ16 mm	250xØ16 mm
Operating Temperature	-40°C ~ +80°C	-40°C ~ +80°C
Storage Temperature	-40°C ~ +80°C	-40°C ~ +80°C

5 GHz Omni Antenna	

2.4 GHz Omni Antenna	

7.4 Recommended Antennas

: Tabulated below are the antennas that Proxim recommends you to use with the ORiNOCO® AP-9200R Series devices. To buy these antennas, place an order separately with your distributor.

Dual - Polarized Antennas			
Product(s)	**Part Number**	**Antenna Type**	**Description**
AP-9200R	SA5-9014-DP	Sector Antenna	4.9 - 5.95 GHz, Dual Polarity, Vertical and Horizontal, 14 dBi Sector Antenna- 90 degrees. Mounting kit included.
	SA5-6015-DP	Sector Antenna	4.9 - 6 GHz, Dual Polarity, Vertical /Horizontal, 15.5 dBi Sector Antenna - 60 degrees. Mounting kit included.
AP-9200R	PA5-0823-DP	Panel Antenna	4.9 - 5.875 GHz, Dual Polarity, Slanted (±45º) or V/H, 23 dBi Panel Antenna.
	PA5-0530-DP	Panel Antenna	4.9 - 6.1 GHz, Dual Polarity, Vertical and Horizontal, 29 dBi Panel Antenna.
Quad - Polarized Antennas			
Product(s)	**Part Number**	**Antenna Type**	**Description**
AP-9200R	PA5-1919-QP	Panel Antenna	4.9-6.4GHz, Quad Polarity, Vertical/Horizontal/Dual Slant, 19 dBi Pannel Antenna - 19 degrees. Mounting kit Incd.

:

- *To ensure proper installation of antenna(s), refer to* Antenna Installation.
- *Ensure, you meet all the pre-requisites described in the Antenna Installation, while selecting the antennas and antenna cables.*
- *Antennas should be aligned and installed on both the sides of a wireless link, maintaining the same polarization.*
- *We recommend you to use higher gain antennas for better coverage.*
- *ORiNOCO® AP-9200R Series products requires professional installation.*

7.5 Recommended Antenna Specifications

This section illustrates the technical specifications of the following:

- Sector Antenna Specifications
- Panel Antenna Specifications

: Ensure to use the same antenna specifications listed below, while using any of the non-proxim antennas.

7.5.1 Sector Antenna Specifications

- 14 dBi Dual Polarized Sector Antenna
- 15.5 dBi Dual Polarized Sector Antenna

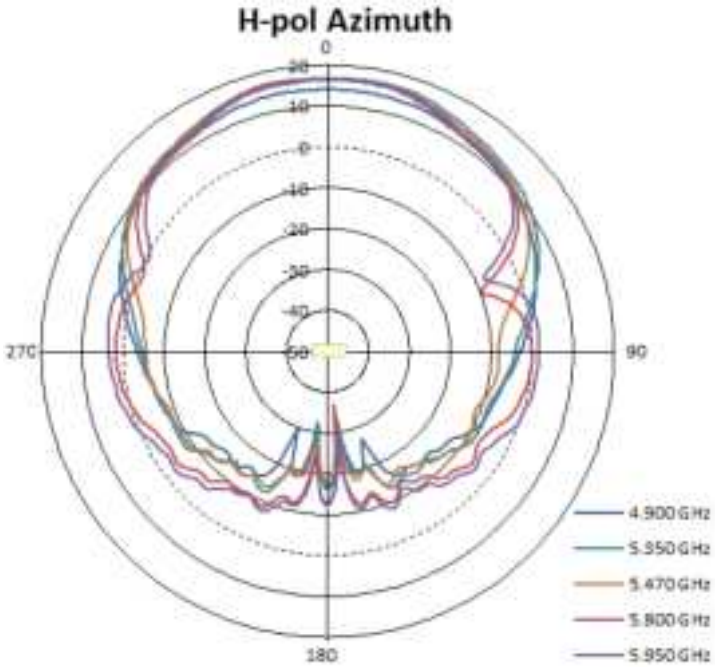
7.5.1.1 14 dBi Dual Polarized Sector Antenna

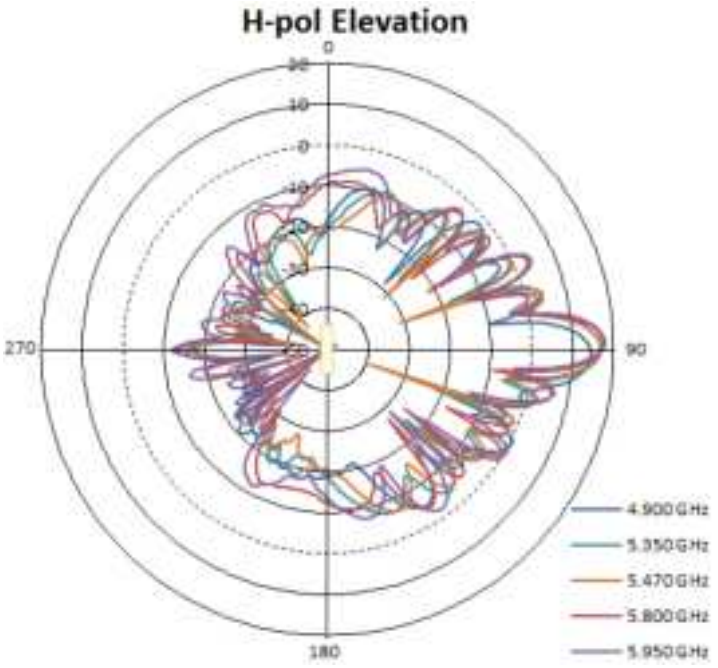
Electrical Specifications

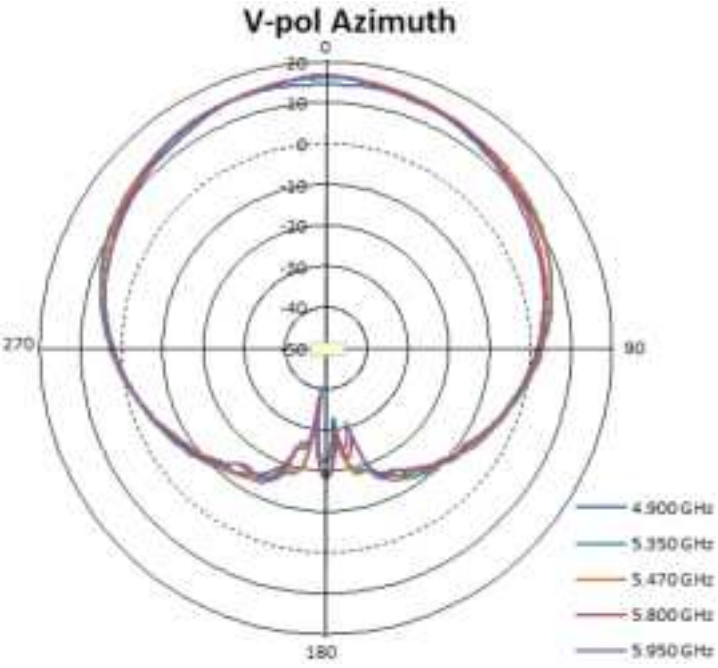
Frequency Range	4.9 GHz - 5.95 GHz
Gain	14 dBi (min)
VSWR	2:1 (max) 1.7: 1 (typ)
Azimuth Beam Width • Port V • Port H	 90° (typ) @11dBi Gain 90° (typ) @10dBi Gain
3dB Elevation Beam width	8° (typ)
Polarization	Linear, Vertical and Horizontal
Cross Polarization	-25 dB (type), -15 dB (max)
F/B Ratio	25 dB (min)
El Side lobes Level	-10 dB (typ)
Port To Port Isolation	30 dB (min)
Input Impedance	50 Ohms
Input Power	20 W (max)
Lightning Protection	DC Grounded

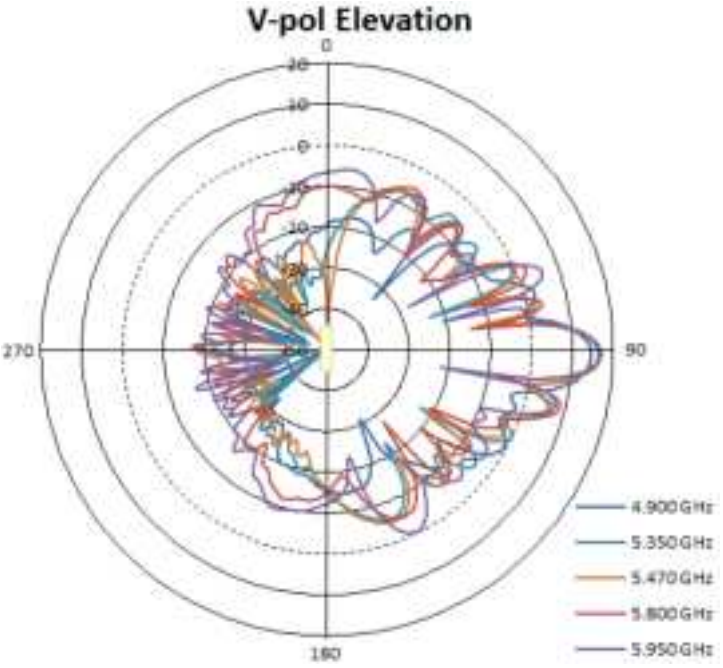
Environmental and Mechanical Specifications

Wind Survival	220 km/hr
Temperature Range	-45 to +70 °C
Humidity	95%
Water Tightness	IP67
Dimension (L x W x H)	500 x 200 x 30 mm
Weight	1.5 kg (max)
Connectors	2 x N-type female
Radome Material	Plastic
Radome Thickness	2.0 ± 0.2 mm


H-pol Azimuth
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
5.950 GHz


H-pol Elevation
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
5.950 GHz


V-pol Azimuth
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
5.950 GHz


V-pol Elevation
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
5.950 GHz

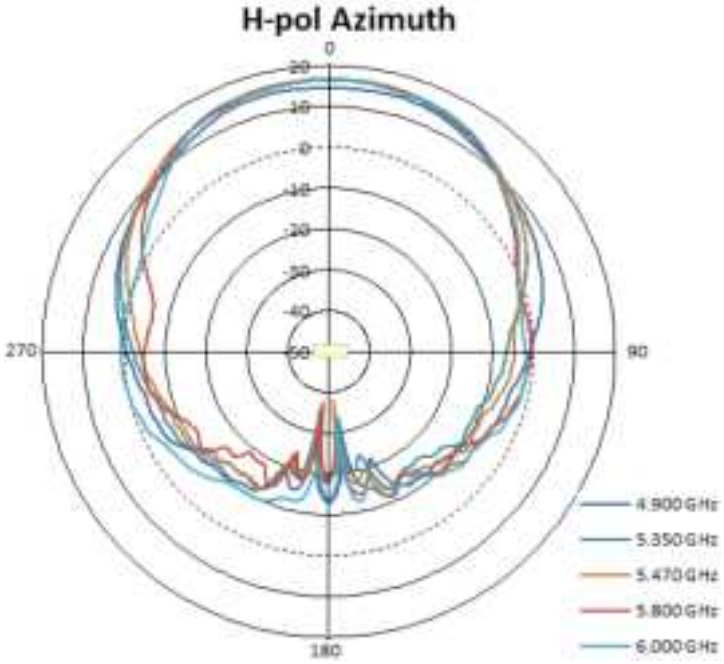
7.5.1.2 15.5 dBi Dual Polarized Sector Antenna

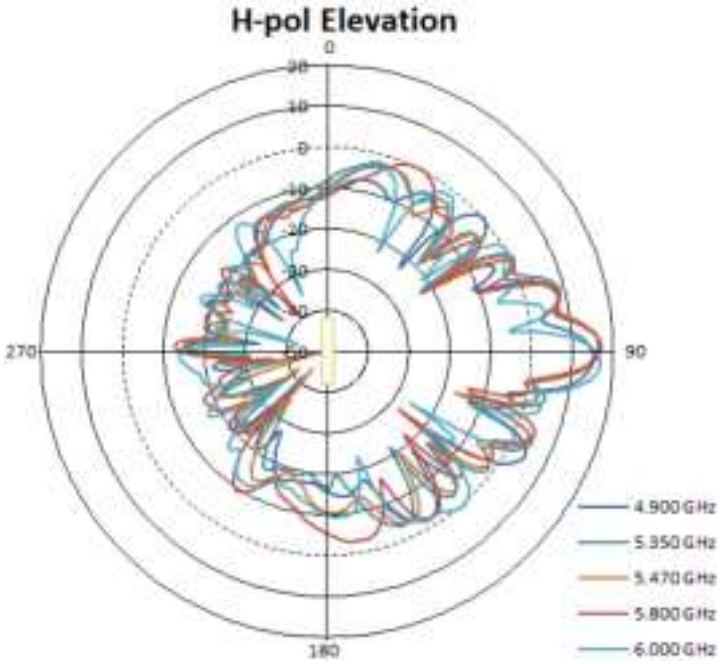
Electrical Specifications

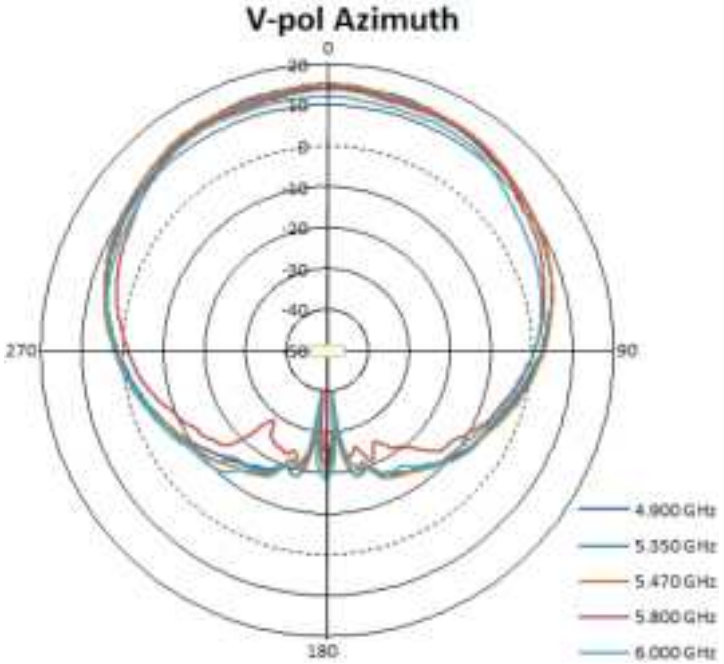
Frequency Range	4.9 GHz - 6.0 GHz
Gain	15.5 dBi (typ)
VSWR	2:1 (max) 1.7: 1 (typ)
3 dB Azimuth Beam Width	60° (typ)
3dB Elevation Beam width	8° (typ)
Polarization	Linear, Vertical and Horizontal
Cross Polarization	-15 dB (typ)
F/B Ratio	20 dB (max)
El Side lobes Level	-10 dB (typ)
Port To Port Isolation	22 dB (min) 25 dB (typ)
Input Impedance	50 Ohms
Input Power	20 W (max)
Lightning Protection	DC Grounded

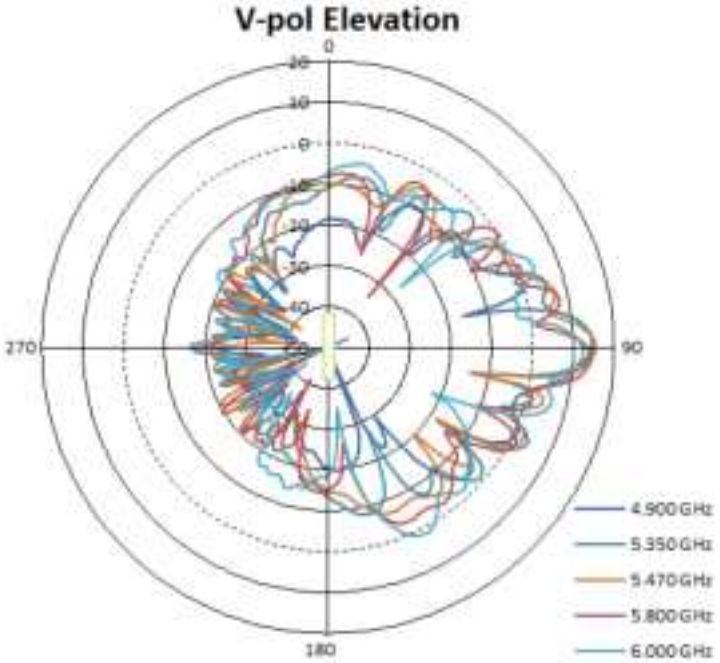
Environmental and Mechanical Specifications

Wind Survival	220 km/hr
Temperature Range	-45 to +70 °C
Humidity	95%
Water Tightness	IP67
Dimension (L x W x H)	500 x 200 x 30 mm
Weight	1.5 kg (max)
Connectors	2 x N-type female
Radome Material	Plastic
Radome Thickness	2.0 ± 0.2 mm


H-pol Azimuth
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
6.000 GHz


H-pol Elevation
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
6.000 GHz


V-pol Azimuth
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
6.000 GHz


V-pol Elevation
0
90
180
270
4.900 GHz
5.350 GHz
5.470 GHz
5.800 GHz
6.000 GHz

7.5.2 Panel Antenna Specifications

- 23 dBi Dual Polarized Panel Antenna
- 29 dBi Dual Polarized Panel Antenna
- 19 dBi Quad Polarized Panel Antenna

7.5.2.1 23 dBi Dual Polarized Panel Antenna

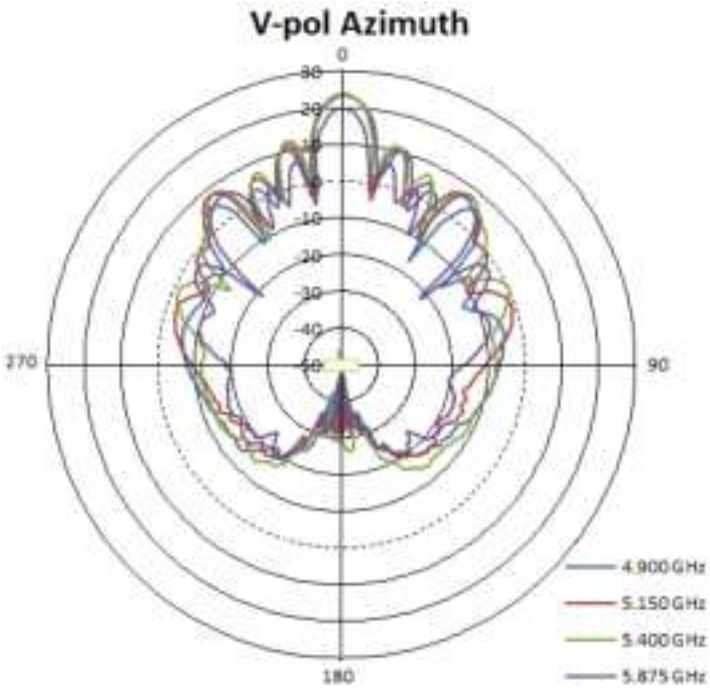
Electrical Specifications

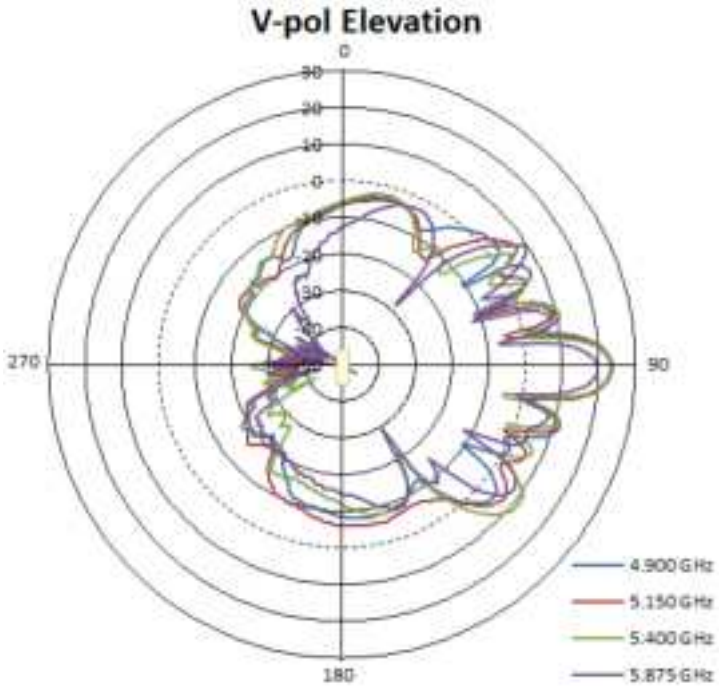
Frequency Range	4.9 GHz - 5.875 GHz
Gain	23.5 dBi V-Pol:24.5 Â± 1 dBi H-Pol:23.5 Â± 1 dBi
VSWR	1.7: 1
3 dB Beam-Width, H-Plane, typ.	7° to 9°
3 dB Beam-Width, E-Plane, typ.	7° to 9°
Side Lobes, min.	ETSI TS3, TS4, TS5
Polarization	Linear, Vertical and Horizontal
Cross Polarization, typ.	-25 dB
F/B Ratio, min	ETSI TS3, TS4, TS5
Port To Port Isolation	-30 dB
Input Impedance	50 Ohms
Input Power	5 W (max)
Lightning Protection	DC Grounded

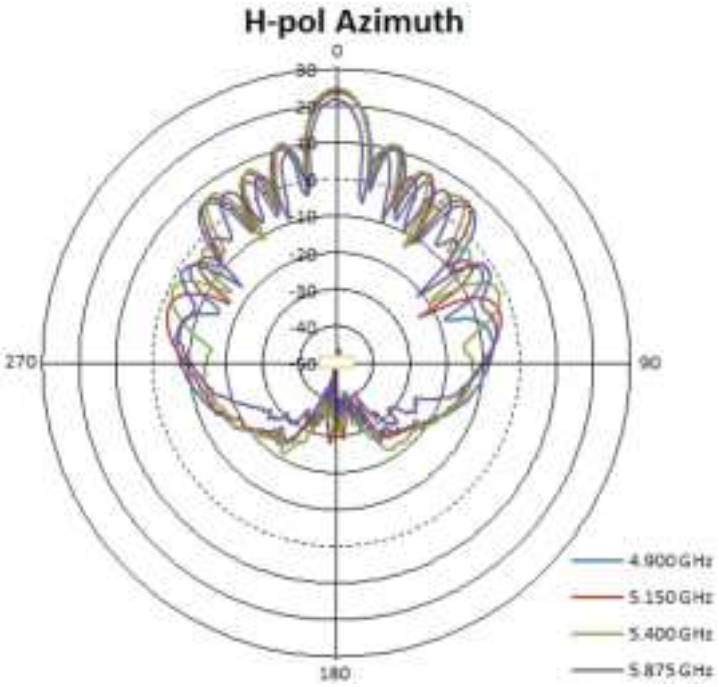
Environmental and Mechanical Specifications

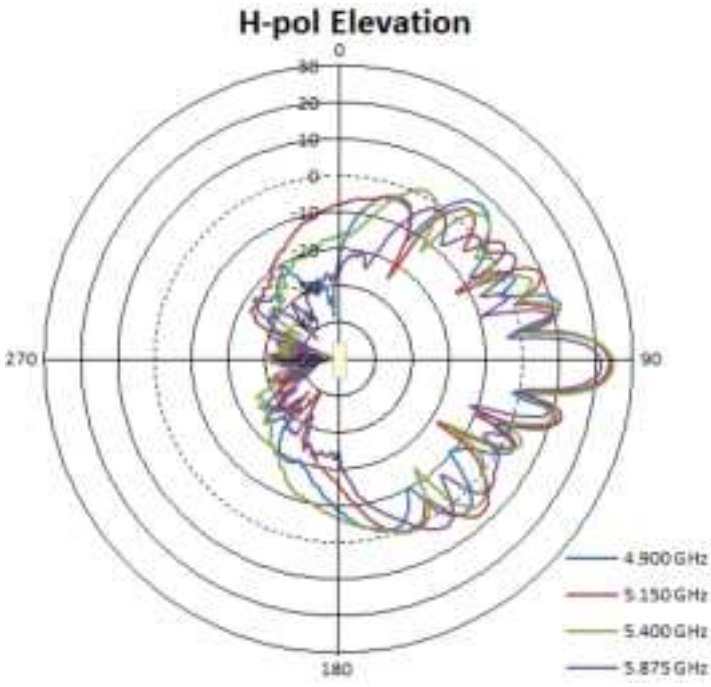
Wind Survival	200 km/hr.
Temperature Range	-40 to +65 °C
Humidity	ETS 300 019-1-4, EN 302 085
Water Proofing	IP67
Dimension (L x W x H)	370 x 370 x 40 mm
Weight	2.1 kg
Connectors	2 x N-type female
Radome Material	UV Protected Poly carbonate
Back Plane	Aluminum protected through chemical passivation

Antenna Patterns









7.5.2.2 29 dBi Dual Polarized Panel Antenna

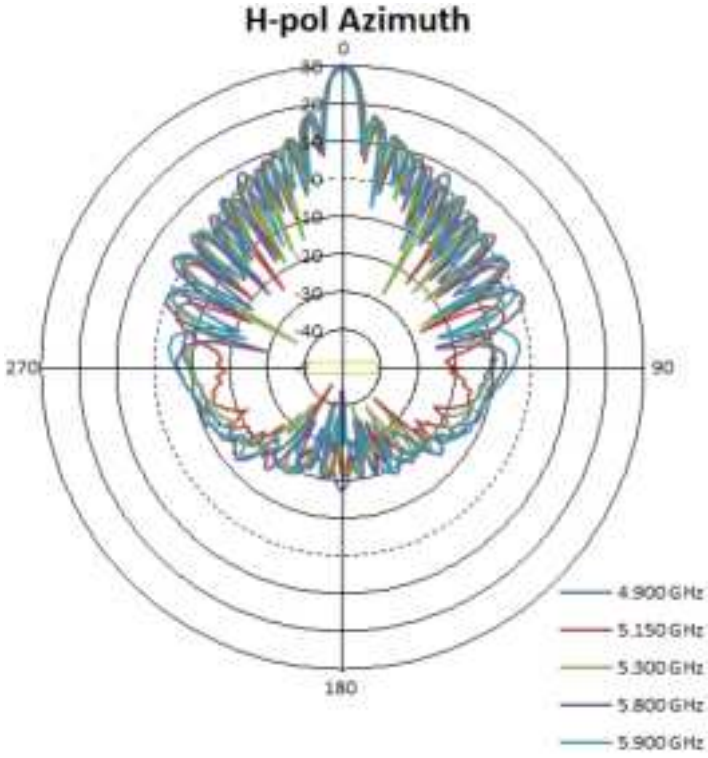
Electrical Specifications

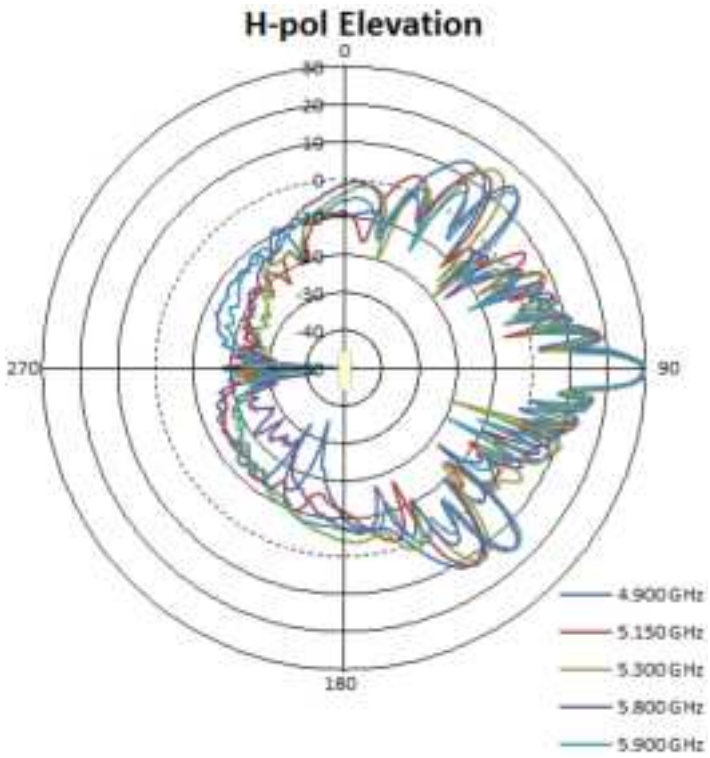
Frequency Range	4.9 - 5.15 GHz	5.15 - 5.875 GHz	5.875 - 6.1 GHz
Gain • Vertical Pol. • Dual Pol.	 28.5±0.5 dBi 28±0.5 dBi	 29±0.5 dBi 28.5±0.5 dBi	 28.5±0.5 dBi 28±1 dBi
VSWR, max	2:1	1.7:1	2:1
3 dB Beam-Width, H-Plane, typ.	5.2°	4.7°	4.4°
3 dB Beam-Width, E-Plane, typ.	5.2°	4.7°	4.4°
Side Lobes, min.	ETSI TS3		
Polarization Dual Pole	Dual Polarization Vertical and Horizontal ± 45°		
Cross Polarization, min • V-Pol • H-Pol	 -26 dB -25 dB	 -23 dB -23 dB	 -23 dB -23 dB
F/B Ratio, min	ETSI TS3		
Port To Port Isolation	-30 dB		
Input Impedance	50 Ohms		
Input Power	10 W (max)		
Lightning Protection	DC Grounded		

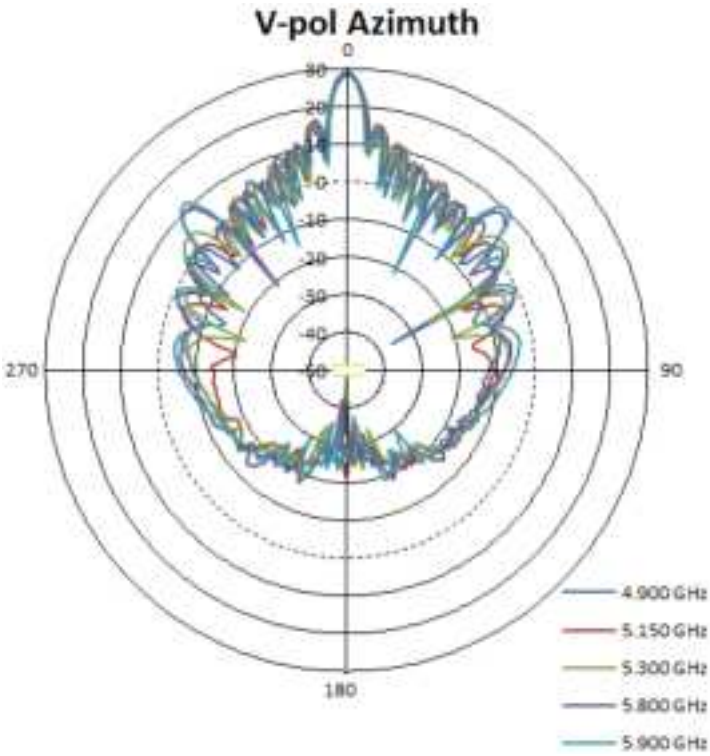
Environmental and Mechanical Specifications

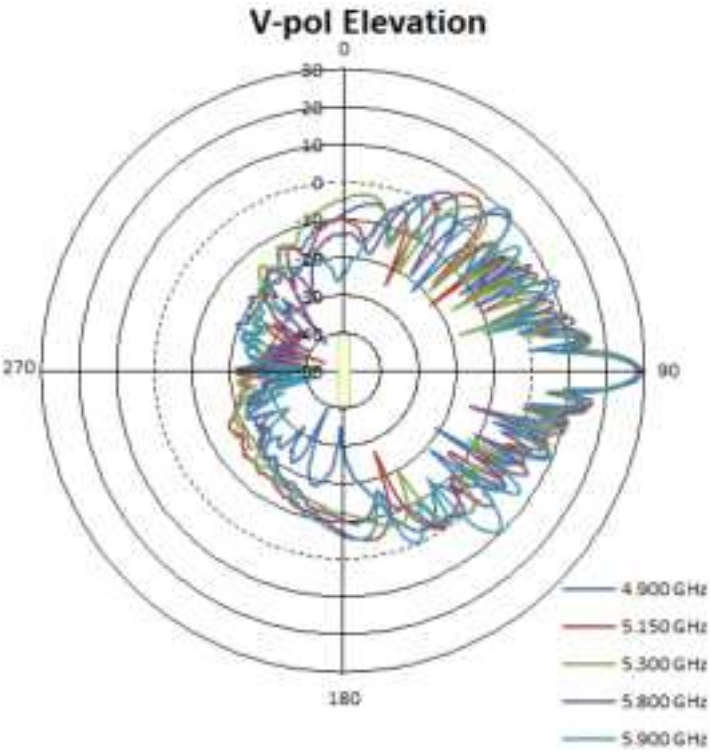
Wind Survival	200 km/hr
Temperature Range	-40 to +65 °C
Humidity	ETS 300 019-1-4, EN 302 085
Water Proofing	IP67
Dimension (L x W x H)	600 x 600 x 22 mm
Weight	4.7 kg
Connectors	2 x N-type female
Radome Material	UV Protected Poly carbonate
Back Plane	Aluminum protected through chemical passivation

Antenna Patterns









7.5.2.3 19 dBi Quad Polarized Panel Antenna

Electrical Specifications

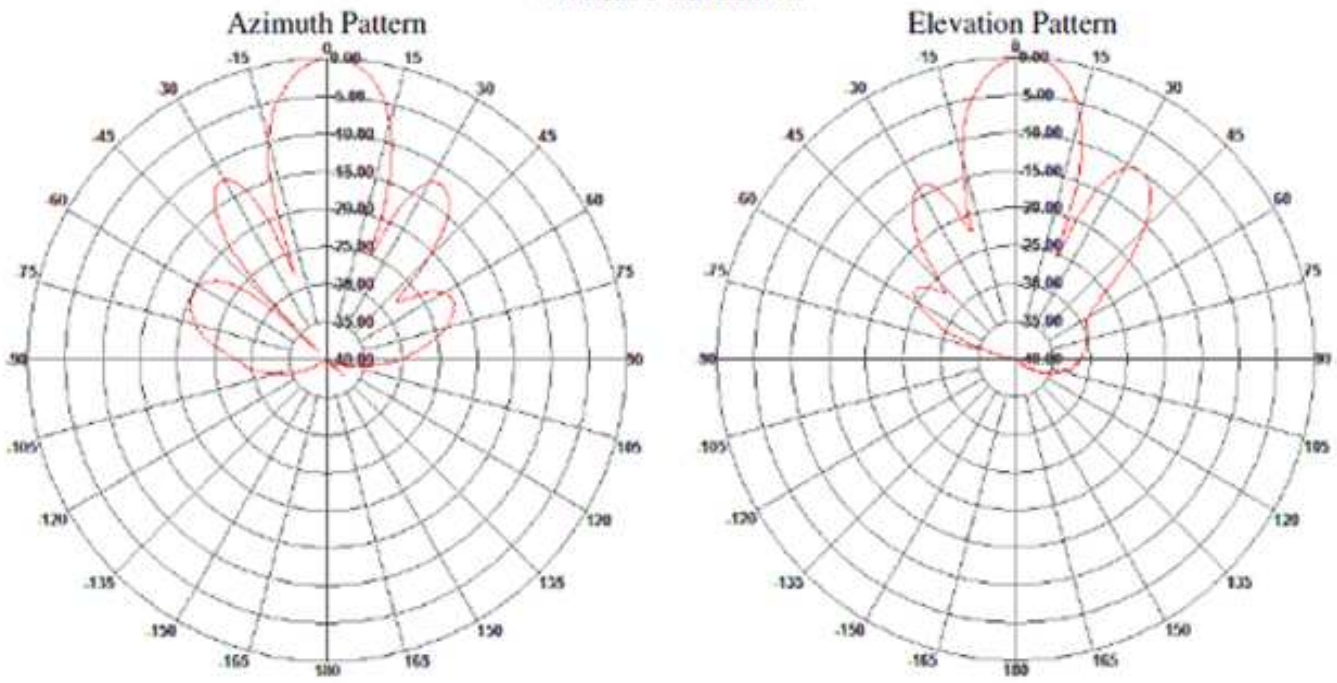
Frequency Range	4.9 - 6.425 GHz
Gain	4.9 - 5.15 @ 4x18 dBi 5.15 - 6.425 @ 4x19 dBi
VSWR, max.	1.7 :1
Polarization Quad Pole	Vertical, Horizontal & Dual Slant (±45°)
3 dB Beam-Width-Azimuth, typ.	19°
3 dB Beam-Width-Elevation, typ.	19°
Side Lobes, min.	-12 dB
Front to Back Ratio, min.	-35 dB
Port to Port Isolation, min.	-34 dB
Input Impedance	50 Ohms
Input Power	10 W (max)
Lightning Protection	DC Grounded

Environmental and Mechanical Specifications

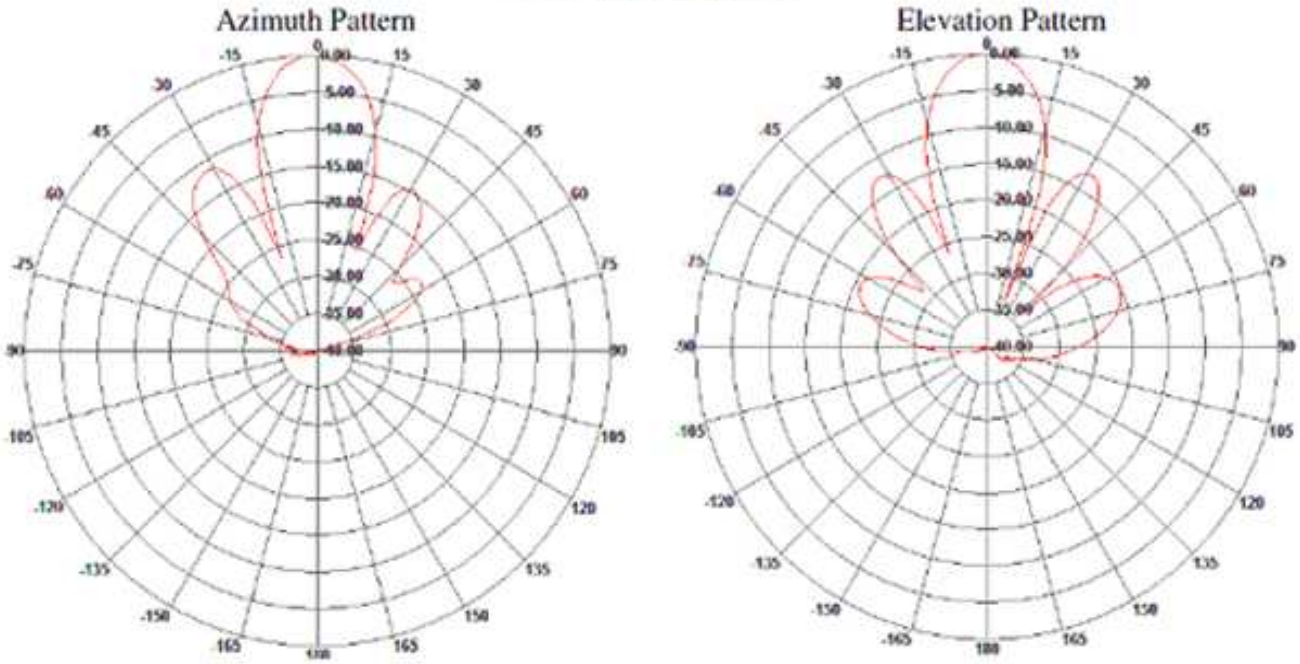
Dimensions (HxWxD)	370 x 370 x 40 mm (14.6" x 14.6" x 1.5")
Connector	4 X N-type Female
Weight	2 kg.
Radome	UV Protected Polycarbonate
Back Plane	Aluminum protected through chemical passivation
Operating Temperature Range	-55°C to +65°C
Vibration	According to IEC 60721-3-4
Wind Load	200 Km/h (Survival)
Flammability	UL94
Water Proofing	IP-67
Humidity	ETS 300 019-1-4,EN 302 085 (Annex A.1.1)
Salt Fog	According to IEC 68-2-11

Antenna Patterns

Vertical Polarization

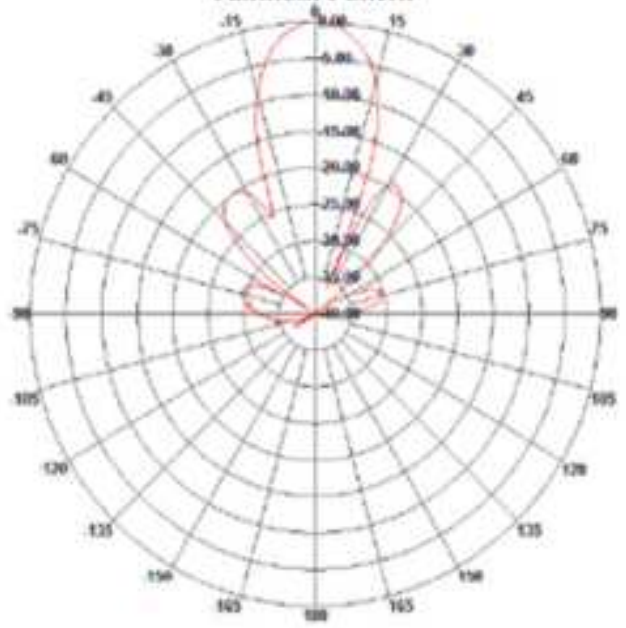


Horizontal Polarization

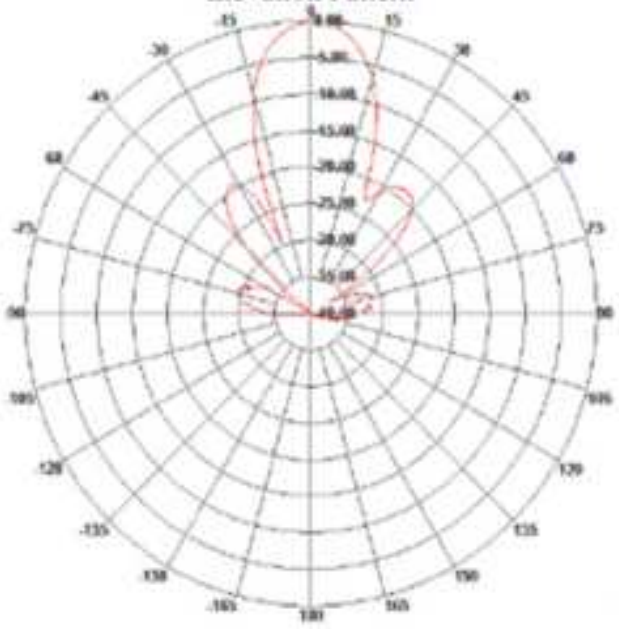


Slant +45° Polarization

Azimuth Pattern

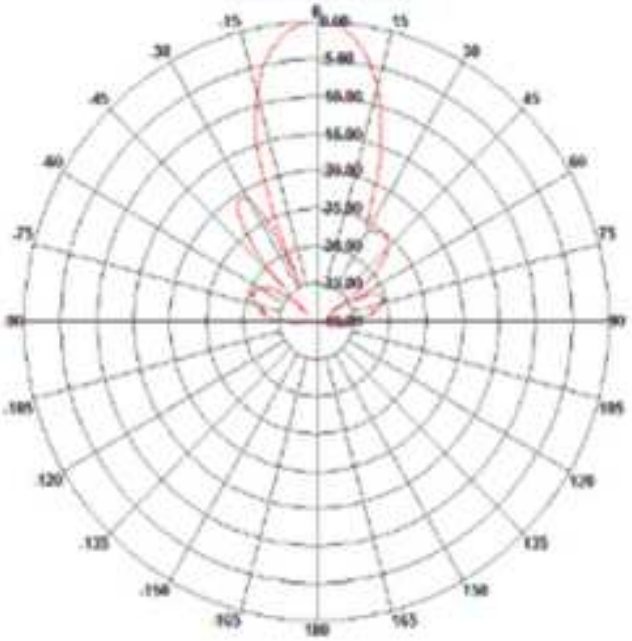


Elevation Pattern

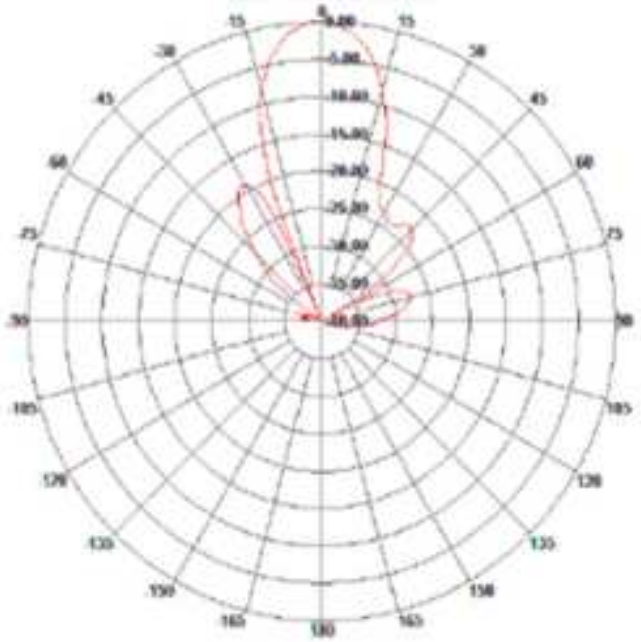


Slant -45° Polarization

Azimuth Pattern



Elevation Pattern



Antenna Installation 8

8.1 Safety Precautions

Listed below are the safety precautions to be satisfied, prior to the outdoor antennas installation:

- Outdoor antennas and antenna cables (good conductors of electricity) should be installed properly to avoid the transients or electrostatic discharges (that occur due to lightning during thunderstorm) from damaging your equipment and causing personal injury or death to the persons touching the exposed metal connectors of the equipment.
- When installing, disconnecting, or replacing one of the cable components, ensure that each of the exposed metal connectors of the antenna cabling system are grounded locally.
- Do not install the antenna, where there is a possibility of contact with the high-voltage arc-over from the power cables or service drops to the buildings. Ensure that the antenna-mast or antenna-tower are not close by any power line, during the installation or removal of antennas.
- Apply a *Danger* label on a plainly visible area of the antenna support structure.
- Do not climb the rooftops during a thunderstorm, in wet or windy conditions, or on the equipment installation area which is covered with ice or snow.
- Do not touch the antennas, surge arrestors, or antenna cables during a thunderstorm.
- Install the antennas at a safe distance (at least twice the height of the antenna-mast plus the antenna) from power lines or telephone lines.
- Mount the antennas at a safe distance, avoiding any human contact during the normal equipment operation.
- Humans should ensure 50 cm separation from the antenna (8 inches), avoid the possibility of exceeding the FCC radio frequency exposure limits, during the normal operation of the equipment.
- Verify that the low-loss antenna cable used to connect the antenna with the surge arrestor, or the ethernet cable used to connect the surge arrestor, are at least 1 m (3 ft.) away from any high voltage current cable.
- Check whether the antenna mast and its guy wires or wall bracket are positioned correctly and secured properly to the roof or walls. Also, ensure that the base area, where the antenna-mast is mounted is weatherproofed.
- Ensure, that the grounding system for the antenna mast and the surge arrestor have been installed. The grounding system must comply with the local electrical code and other requirements. See Grounding the Antennas.
- Always consult an experienced electrician to assure that the antenna mast, surge arrestor, and the equipment hardware are grounded properly.
- The antenna cable between the antenna and the surge arrestor should be grounded. Ensure that the exposed metal connector of the cable is grounded locally, if the cable is disconnected at one end (disconnected to replace the surge arrestor).

8.2 Installation Process

Follow the following step-by-step procedure to install outdoor antennas:

1. Ensure that all the materials, essential to install the outdoor antennas are acquired. See Required Materials.
2. Once you have acquired all the required materials, refer *Quick Installation Guide* (that comes along with your product) to mount the outdoor equipment and begin the outdoor antenna installation.
3. Verify the optimal antenna placement, maintaining a clear line-of-sight. See Determining the Optimal Antenna Placement.
4. Mount the antenna to the support structure, following the guidelines as described in Mounting the Antenna.
5. Verify that the device, support structure for antenna (antenna-mast) and entire cable set-up for the antenna are connected properly. See Connecting the Cables.
6. Connect the antenna cable to the antenna. See Connecting the Antenna Cable.

7. Ensure that the cabling of ethernet / power cables and the surge arrestor is proper. See Connecting the Surge Arrestor and Ethernet / Power cables.
8. Ensure that the antennas are grounded properly to the grounding system, satisfying the local electrical code requirements. See Grounding the Antennas.
9. Once the antenna is properly positioned, grounded and the outdoor cable setup is verified, secure all the cables and use weatherproofing tape to seal all the outdoor connectors. See Sealing the Cable Connectors.
10. Make sure that the outdoor antennas at both the ends maintain the same antenna polarizations.

: *For easy outdoor antenna installation, note the following:*

- *Go through the Safety Precautions.*
- *Read all the requirements outlined in this chapter. See Required Materials.*
- *Familiarize yourself with the antenna and the radio-specific mounting instructions, prior to climbing any roof or ladder.*
- *Verify that you have arranged all safety measures for outdoor installation or rooftop installation. See Safety Precautions.*
- *Test all the equipment before beginning the actual rooftop installation, to determine if all the required equipment is functioning properly.*
- *Install the grounding system for the antenna mast, device, and surge arrestor before connecting the cables. This protects your system against lightning strikes during installation.*
- *When you remove or relocate the antenna, verify the Required Materials and Safety Precautions, before you restart the installation process, and follow the above steps in exactly the reverse order.*

8.2.1 Required Materials

The outdoor installation of the equipment and the antennas, require the following:

- An outdoor radio unit.
- An outdoor antenna, supporting the local electrical code.
- A low-loss antenna cable.

: *We recommend you to use a coaxial antenna cable (P/N CBL-240-6-RA), that is available with your distributor.*

- Antenna mast or wall bracket for the antenna/device**.**
- A grounding system that meets the local electrical code. See Grounding the System.
- Weatherproofing kit for sealing all the cable connections. See Sealing the Cable Connectors.
- Tools and material to mount the antenna. See Mounting the Antenna.
- Tape or wraps to attach the antenna cable to the mast.
- Ethernet cable (RJ 45 cable / Cat5e ethernet cable) with waterproof cap.
- Proper tools for system installation.
- Ethernet Surge Arrestor and Surge Protector (RF-cable). See Connecting the Surge Arrestor and Ethernet / Power cables.

Ensure that you have acquired all the materials listed above, to begin with the outdoor antenna installation. Refer to the *Quick Installation Guide,* that comes along with your product, for details on mounting the outdoor equipment.

8.2.2 Determining the Optimal Antenna Placement

To achieve the maximum throughput, the outdoor antenna must have clear line-of-sight with the antenna at the other end. The outdoor antennas are said to have a clear line-of-sight, when there are:

- No obstacles in the direct path between the antennas (antenna beam)
- No obstacles within a defined zone around the antenna beam

Although, the radio signal can work well without the clear line-of-sight in urban environments, where the signal is transported by reflection rather than transporting it directly along the obstacles. The following figure shows some typical examples of obstacles you must avoid in urban environments, for the directional antenna to operate effectively.

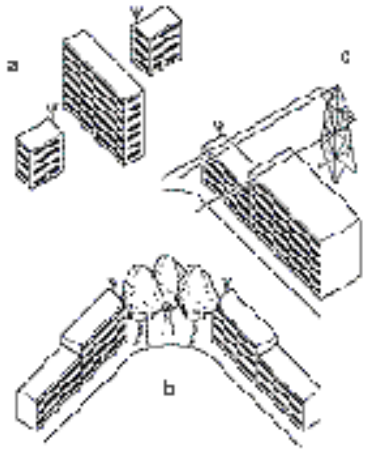


Figure 8-1 Obstacles to be avoided: (a) Neighbouring Buildings (b) Tall Trees (c) Power Lines

To minimize the signal interference or reflections due to obstacles, note the following guidelines:

- Mount the antenna as high as possible above the ground to allow maximum clearance.
  - — In open areas, 'ground' is the actual surface of the earth.
  - — In dense urban areas, 'ground' is to be interpreted as the height of the highest obstacle in the signal path between the two antenna sites.
- Avoid trees in the signal path to avoid signal absorption due to seasonal changes (leaves or ice).
- Install the antenna at least 2 m (6 ft.) away from all other antennas.

Other situations in which reflections of the radio signal may cause interference are environments with large reflecting surfaces, parallel or partly perpendicular to the antenna beam, such as:

- Mirror-glass buildings.
- Crowded parking lots.
- Water surface, moist earth and moist vegetation.
- Electric power lines and telephone lines above the ground level.

: *Reflective surfaces can be used to improve the performance of a link, if the direct line-of-sight is impaired or absent.*

In the absence of a direct path or clear line-of-sight, transporting a signal through reflection depends on two factors:

- **Fresnel Zone**: It is required to calculate the distance of the obstacle from the antenna. See Fresnel Zone.
- **Clearance Factor**: It is required for optimal performance (See Clearance Factor). Ensure that the type and placement of the antennas leave sufficient clearance of the Fresnel Zone at the maximum width of the bulge, which is typically at the mid-point between the antennas.

8.2.3 Mounting the Antenna

Mounting an antenna directly to the wall does not let you align the antenna properly with the corresponding antenna at the opposite end of your wireless link. Poor antenna alignment typically results in poor performance and therefore, we recommend mounting the antennas to a mast.

The two methods followed frequently to erect an antenna mast are:

- **Tripod Mount**: The tripod mount is used primarily on peak and flat roofs. The antenna mast must be secured to the roof using three or four guy wires equally spaced around the mast. When the height of the antenna mast is more than 3 meters (10 ft.), you should use at least three guy wires for every 3-meter (10-foot) section of the mast.
- **Wall (Side) Mount:** A wall (side) mount allows you to mount the antenna (mast) on the side of a building or on the side of an elevator penthouse. This provides you with a convenient mounting location, when the roof overhang is not excessive or when the location is high enough to provide a clear line-of-sight.

When mounting multiple antennas on a single mast, use the following methods to minimize the influence of cross-talk interference between the antennas:

  – Place your antennas as far as possible.
  – Mount the directional antennas, such that the identical side of both the antennas face the same direction.

: *As the mounting procedures for the various antennas differ from one another, refer to the guide that comes along with the antenna.*

: The antennas installed at both the ends of a wireless link should maintain same antenna polarizations.

8.2.3.1 Antenna Mast Requirements

To accommodate the antennas, the antenna mast must satisfy the following requirements:

- The construction of the antenna mast must contain sturdy, weatherproof, and non-corrosive material (for example, galvanized or stainless steel construction pipe).
- Diameter of the mast should be between 35 mm (1.4 inches) and 41 mm (1.6 inches). The diameter of the antenna mast vary depending on the type of antenna you intend to install.
- The height of the antenna mast must be high enough to allow the antenna to be installed at least 1.5 m (5 ft.) above the roof. The height of the antenna should be at least 3 m (10 ft.) above, if it is a metal roof.
- The antenna mast or wall bracket must be free from any material (like paint) that prevents a good electrical conduction with the antenna.

8.2.3.2 Antenna Tilt Angles and corresponding EIRP values

: *The below mentioned particulars are applicable only to the devices operating in U-NII-1US frequency band 5.15 GHz - 5.25 GHz.*

The Federal Communications Commission (FCC) established new rules for the 5.15 GHz - 5.25 GHz U-NII-1 band in the Report and Order FCC-14-30A1 are effective from June 2nd, 2014. With the help of professional installation, all the Proxim devices can be configured to comply with the power requirements set in the rules. For an angle of elevation which is above 30 degrees, the maximum EIRP limit should be set to 125 mW (21 dBm). The compliance can be achieved through proper selection of antenna, angle of elevation, and Tx power control to provide reasonable protection from harmful interference to users, authorized devices, and co-channel NGSO/MSS operations.

The antenna/devices located at different altitudes should be tilted at the correct angle to efficiently transmit/receive the signals between the devices in the wireless network. The following figure shows the antenna tilt and its importance when the successive devices are located at different elevations above the ground.

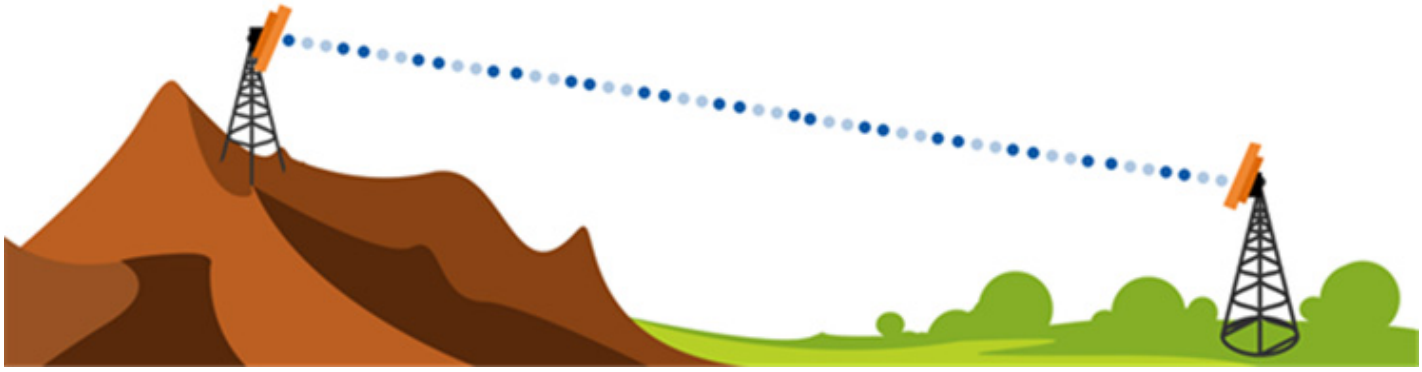


Figure 8-2 Typical installation showing device/antenna tilt angle

The radiation patterns for a device with Dual polarized antenna in **Elevation** planes are shown below in **Figure 1-3**. As per the regulatory domain, there are no limitations to the Azimuthal plane with respect to EIRP, but the Elevation plane has a limit specific to EIRP above 30 degrees as 21 dBm. To comply with this specification, Proxim products have an option to control the transmit power based on the installation tilt angle and the radiation pattern of the antenna.

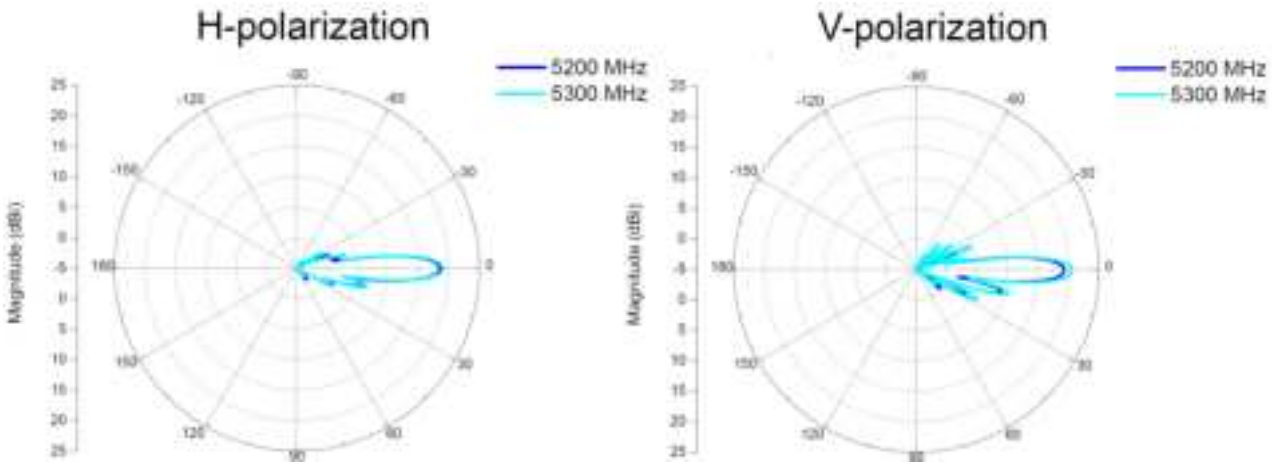


Figure 8-3 Antenna radiation patterns for Elevation Planes

The formula used for the calculation of **Transmit Power** is given below:

Transmit Power = EIRP - G $_{(30-\theta)}$ - MIMO Gain

Where,

EIRP - Equivalent Isotropically Radiated Power

G $_{(30-\theta)}$ - Antenna gain at (30- θ) in the elevation plane

MIMO Gain - Gain for Multi Input Multiple Output products *(2x2 MIMO Gain is 3 dB, 3X3 MIMO Gain is 4.8 dB and 4X4 MIMO Gain is 6 dB).*

- The calculation of Transmit Power to comply with the EIRP limits for an antenna with a gain of 22 dB is explained below for three different tilt angles:
  - **Case 1**: θ = 0^0 (No antenna tilt)

– The antenna gain for **θ = 0^0** is shown in the following figure:

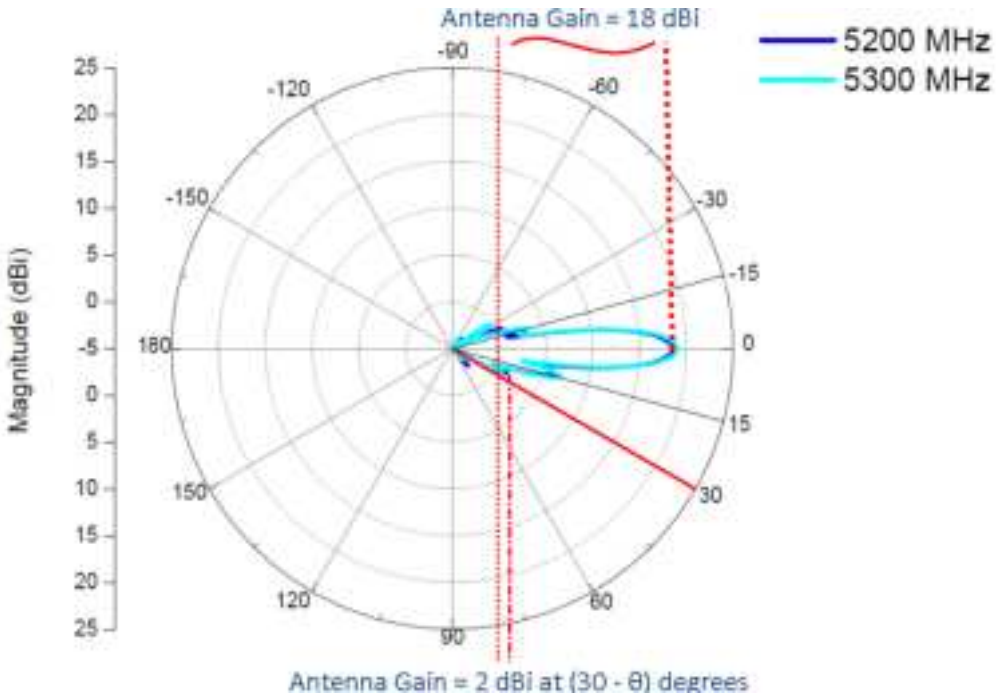


Figure 8-4 Antenna gain at (30- 0) = 30^0

– Transmit Power = EIRP - G $_{(30-\theta)}$ - MIMO Gain

= 21 - 5 = 16 dBm

- **Case 2**: θ = 15^0 (antenna tilted upward)
  – The antenna gain for **θ = 15^0** is shown in the following figure:

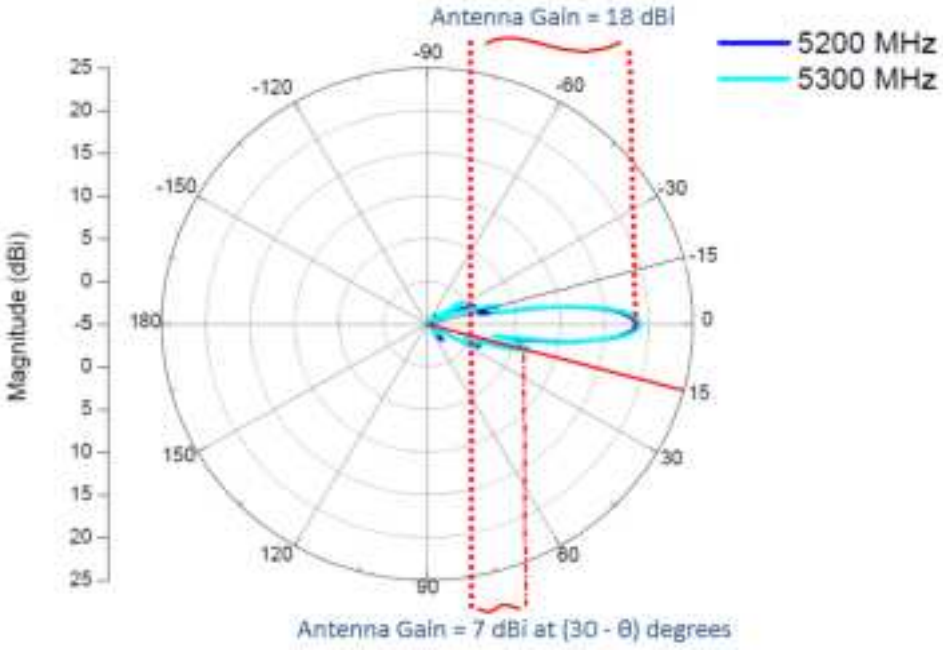


Figure 8-5 Antenna gain at (30- θ) = 15^0

– Transmit Power = EIRP - $G_{(30-\theta)}$ - MIMO Gain

= 21 - 10 = 11 dBm

- **Case 3**: $\theta = -15^0$ (antenna tilted downward)
  - The antenna gain for $\boldsymbol{\theta = -15^0}$ is shown in the following figure:

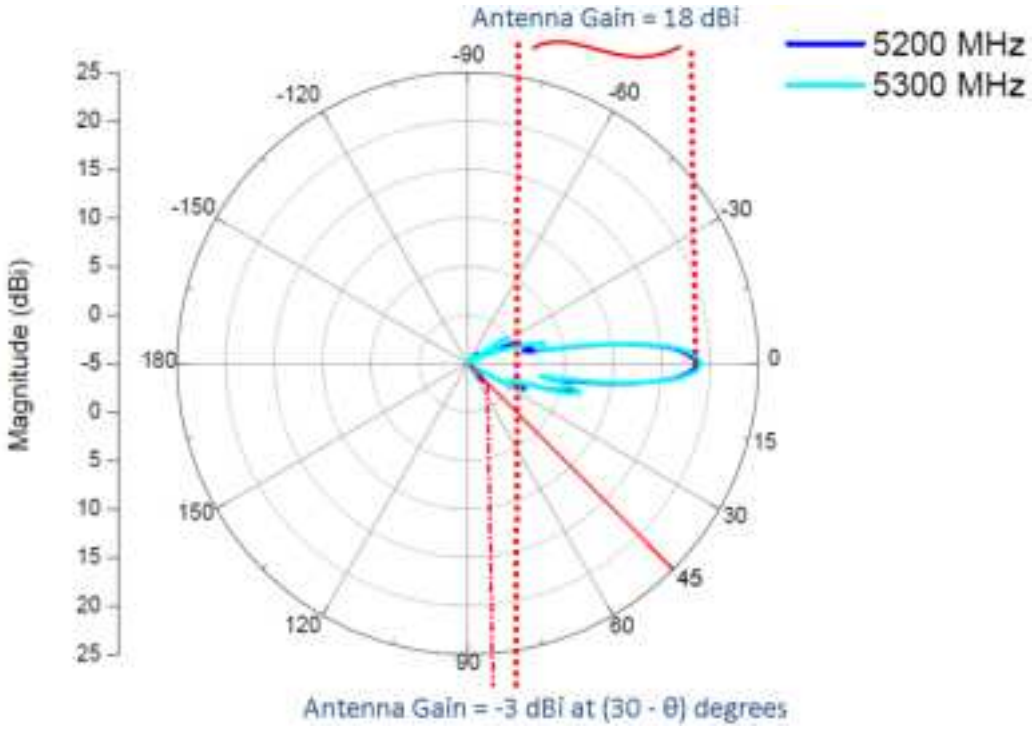


Figure 8-6 Antenna gain at (30- θ) $= 45^0$

– Transmit Power = EIRP - $G_{(30-\theta)}$ - MIMO Gain

= 21 - 0 = 21 dBm

:

- *-10 degree indicates that the antenna is tilted downwards.*
- *10 degrees indicates that the antenna is titled upwards.*

Tilt Angle (degrees)	Allowed Transmit Power per Single chain (dBm)	EIRP of Product (dBm)	Remarks
0	12	37	
-10	13	42	
-20	13	38	
-30	17	42	
10	10	35	
20	10	35	
30	-5	21	Not Recommended

8.2.4 Connecting the Cables

Once the outdoor antennas are properly mounted, the cable setup essential to complete the outdoor antenna installation is depicted in the following figure:

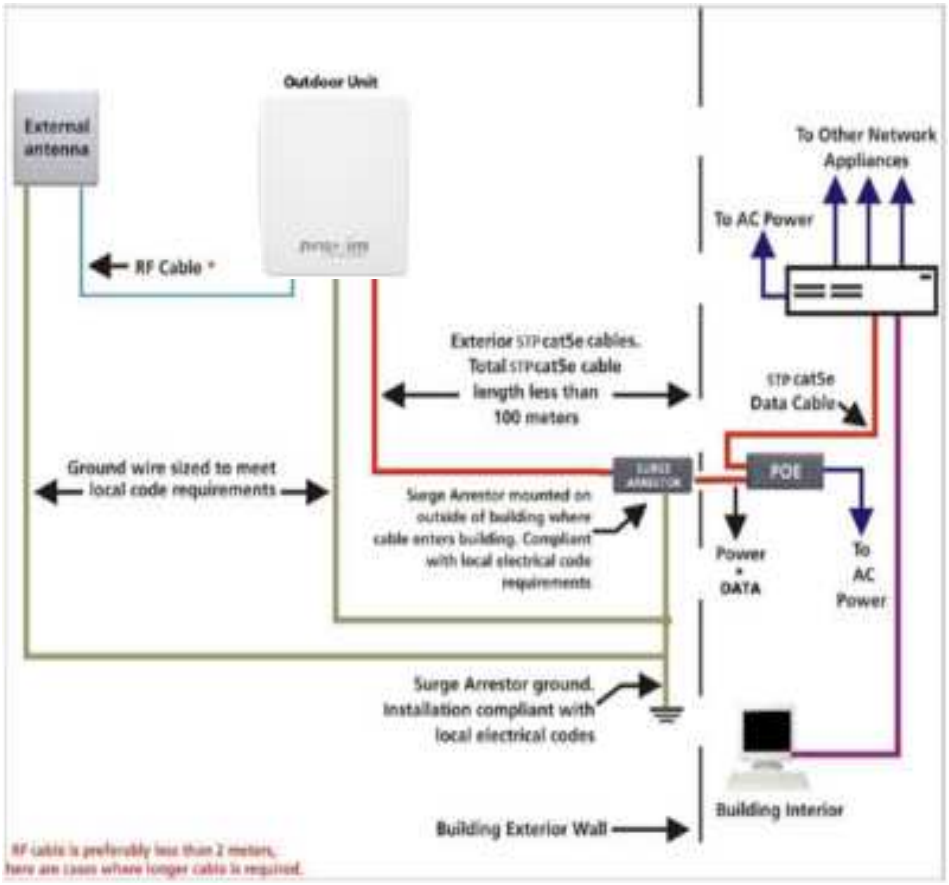


Figure 8-7 Cable Setup

The entire outdoor cabling setup requires the following cabling to be done:

1. Connecting the Antenna Cable
2. Connecting the Surge Arrestor and Ethernet / Power cables
3. Grounding the System

8.2.4.1 Connecting the Antenna Cable

Follow the following steps to connect an antenna to the device, by using an antenna cable.

1. Use an RF cable (antenna cable) to connect the outdoor device to an external antenna.
2. Connect the right-angled N-male connector of RF cable on the antenna. The antenna cables run from the external antenna to the RP-SMA connectors on the device. The N-Type connectors on the antenna have built-in surge protection.
3. Secure the antenna cable to the antenna mast, as the cable connectors do not support the full weight of the cable.
4. Connect the other end of the antenna cable to the device.

: Do not use tools to tighten the cable connectors, as they damage the antenna cable and connectors.

5. If required, adjust the direction of the antenna.
6. Tighten the nuts of the antenna to lock the antenna into its position.

: Avoid over-tightening of the connector, nuts and screws that are used to mount the antenna, to protect the antenna and device from getting damaged.

7. Secure the cable along its complete length with a cable or electrical tape to relieve strain on the antenna connector. No part of the cable should be allowed to hang free, especially the parts that are routed outside the building.
8. Weatherproof all the outdoor connectors. See Sealing the Cable Connectors.

Ensure you follow the below guidelines while using the antenna cable:

- The entire cable used must be secured and no part of the antenna cable should be allowed to hang free, precisely the outdoor cable parts.
- The antenna cable and cable connectors are not designed to withstand excessive force.
- Do not use the connectors like 'cable grips', to pull the cable through raceways or conduits.
  - Do not use the cable connector to support the weight of the cable during or after installation.
  - Do not use any tool to tighten the connectors.
- Always seal the connectors using the weatherproofing tape.
- Avoid any water or moisture entering the cable, as it impacts the performance of the wireless link.
- Prior to sealing the outdoor connectors and permanently securing the cable to the wall with cable ties and wall hooks, assure that the components that are installed are functioning properly.

Antenna Cable Routing

The antenna cable must be routed and fixed in such a way, that the installation technicians have a clear passage area. All the connectors that are located outdoor must have a weatherproof seal. We recommend you to seal the connectors only after completing the final radio test. See Sealing the Cable Connectors.

8.2.4.2 Connecting the Surge Arrestor and Ethernet / Power cables

Perform the following steps to ensure proper surge protection, and ethernet or power cabling:

- Connect the surge arrestor near the outdoor device with a CAT5e ethernet cable (properly ground it near to the cable ingress point of the building, complying with the local electrical code requirements).
- Connect the RJ 45 **IN / LAN** port on the POE (power injector) and the network interface card of the personal computer with a Cat5e ethernet cable.
- Plug one end of the Cat5e ethernet cable into the ethernet port of the surge arrestor (near building ingress point) and connect the other end of the cable to the **OUT / POE** port on the POE. Ensure that the cable connector is latched securely.
- Connect the remaining ports on both the surge arrestors (one near the outdoor device and other at the building ingress point) with an RJ 45 terminated cable.

IMPORTANT! Ensure to loop the cable before entering the premise to prevent water ingress.

: *It is mandatory to install an approved lightening surge protector at the building ingress point. If the device is installed in a region subjected to violent thunderstorms or severe weather conditions, then installation of an additional*

approved lightening surge protector near the device is recommended. To buy an additional Surge Protector (Part Number: 235-00001), place an order separately with your distributor.

: The surge arrestor and the antenna mast must be connected to the same grounding system, by using the shortest cable possible, as prescribed by local electrical codes.

8.2.4.3 Grounding the System

Direct grounding of the antenna mast, device, and surge arrestor is extremely important. Refer to the *Quick Installation Guide*, that comes along with your product, for detailed illustration on grounding the outdoor device and surge arrestors.

***:** A safety grounding system is necessary to protect your radio from lightning strikes and the static electricity generated from it.*

Grounding the Antennas

Following precautions should be satisfied, while grounding the antenna:

- The antenna mast and the grounding system should be installed only by qualified installation professionals and electrician, who are familiar with local building, safety, and electrical codes in the country of use.
- The antenna mast, the device, and the surge arrestor must be connected to the same ground, by using an equi-potential bonding conductor.
- A good electrical connection should be made to one or more ground rods, by using at least a 12 AWG ground wire and non-corrosive hardware.

8.2.5 Sealing the Cable Connectors

Corrosion of the antenna cable, cable connectors and other wireless outdoor installations degrade the performance of the wireless link. To avoid, you must always seal the outdoor cable connectors using weatherproofing tape. To weatherproof the antenna connectors at both the ends of a wireless link, follow the following step-by-step procedure:

1. **Collect the required material:**

   The material required for weatherproofing connectors are,

   - Any standard Butyl Mastic Tape
   - Any standard Vinyl Tape

   We have used the following Butyl Mastic Tape and Vinyl Tape as an example to demonstrate the weatherproofing steps:

2. **Follow the following weatherproofing steps:**

: We have taken MP-1xxx-BSU and external antenna as an example to explain the weatherproofing steps. Follow the same method to weatherproof the antenna connectors of the ORiNOCO® products.

Step 1: Wrap vinyl tape in a half-lapped fashion, from the weatherproof connector end and continue wrapping down 3 inches onto the CAT5e cable.

a. Weatherproofing at the device end:

(a)

(b)

b. Weatherproofing at the antenna end:

(a)

(b)

(c)

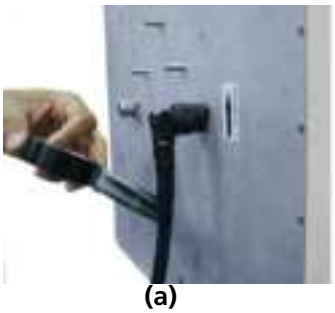
Step 2: Wrap a second layer of vinyl tape in the reverse direction over the first layer of tape.

a. Weatherproofing at the device end:

(a)

(b)

b. Weatherproofing at the antenna end:



(a)

(b)

Step 3: Now, wrap a third layer of vinyl tape over the other two layers but with the adhesive side up as this provides a sticky surface for the next layer.

a. Weatherproofing antenna connectors on the device:

(a)

(b)

b. Weatherproofing antenna cable:

(a)

(b)

Step 4: Next, wrap a layer of the butyl mastic tape over the adhesive side of the tape, covering all of the tape and connector.

a. Weatherproofing antenna connectors on the device:

(a)

(b)

b. Weatherproofing antenna cable:

(a)

(b)

Step 5: Wrap vinyl tape over the butyl layer and cover the entire tape assembly.

a. Weatherproofing antenna connectors on the device:

(a)

(b)

b. Weatherproofing antenna cable:

(a)

(b)

Step 6: Place a small zip tie over the last wrap of tape to prevent it from unwrapping over time.

The figure below depicts the complete weatherproofing of the RF connection.

Measuring Signal Performance 9

9.1 Introduction

The performance of a microwave link (wireless link established between two outdoor antennas) is closely related to the following factors:

- Range
- Fresnel Zone
- Clearance Factor

Calculating the above factors help you align the antennas properly and achieve a better throughput.

9.2 Determining the Range

Range is the maximum distance a microwave link travels and is based on the:

- Type of the outdoor antenna equipment (Outdoor antennas differ in technical specifications).
- Data speed of the wireless link.
- Clearance of the signal path (see Clearance Factor).

Use the following formula to determine the range of the microwave link:

Range = Maximum Range x Clearance Factor

1. **Maximum Range**: It is the theoretically calculated value achieved under optimal circumstances, by using the available products and their technical specifications that comply with the local radio regulations. The calculations made assuming the optimal radio conditions do not guarantee of achieving the same maximum distance at your location.
2. **Clearance Factor**: See Clearance Factor.

Variations in calculations of the above two factors occur due to any of the following reasons:

- Incorrect alignment of antennas.
- Polarization mismatch of the antennas.
- Sources of interference or unexpected reflections in the signal path that affect the quality of communication (Refer Determining the Optimal Antenna Placement).
- Severe weather conditions such as heavy rainfall, snow or strong winds.
- Unexpected obstacles in the link path.
- Seasonal influences such as leaves on trees or icing of the antennas.

9.3 Fresnel Zone

The narrow antenna beam emerged from the antennas contain a bulged area called as Fresnel Zone. The first Fresnel Zone is known to be an imaginary boundary line offset along the direct path of the signal, where a signal reflected will travel an additional one-half distance of wavelength. Each succeeding Fresnel Zone boundary adds an additional half-wavelength to the reflected path distance than the direct signal path between the antennas.

When any significant part of the Fresnel Zone is obstructed, a portion of the radio energy is lost that results in reduced performance. Reduced performance can also occur when obstacles close to the antenna beam cause signal reflections or noise that interfere with the radio signal.

Weather conditions (rain or snow) usually do not have much impact on the performance of your device, provided you have sealed all the cable connectors with weatherproofing tape. Seasonal influence on signal propagation can occur in the following situations:

- Marginal communications quality in late fall (with no leaves on the trees along the signal path) might fail in the summer (with leaves on the trees along the signal path).
- In winter, a wireless link can fail when the antenna is exposed to ice buildup or when the antenna elements are covered with snow.

Radio paths over water or extremely flat ground require optimization of antenna height at one end. This is due to in-phase or out-of-phase reflections. Adjustment of antenna height by 1 to 3 meters may move the signal from null to peak.

Long distance links may be obstructed by earth curvature, so the antenna height requirements must not only take the height of obstructions and Fresnel Zone into account but also the earth bulge. The earth bulge is approximately 5 meters (16.4 ft.) at a link distance of 16 Kilometers (10 millimeters). Consult your supplier to take appropriate steps to maintain or optimize wireless link performance.

9.3.1 Fresnel Zone Calculation

The exact shape and width of the Fresnel Zone is determined by calculating the Fresnel Radius. The distance between the Fresnel Zone boundary and a straight line running along the signal path (shortest path) between the antennas is called the Fresnel Radius. Fresnel Radius can be determined by using the path difference (difference between the shortest path and alternative path) and frequency of the radio signal. If there are no obstacles in the space forming 60% of the path difference, then the propagation characteristics are said to be the same as that in free space.

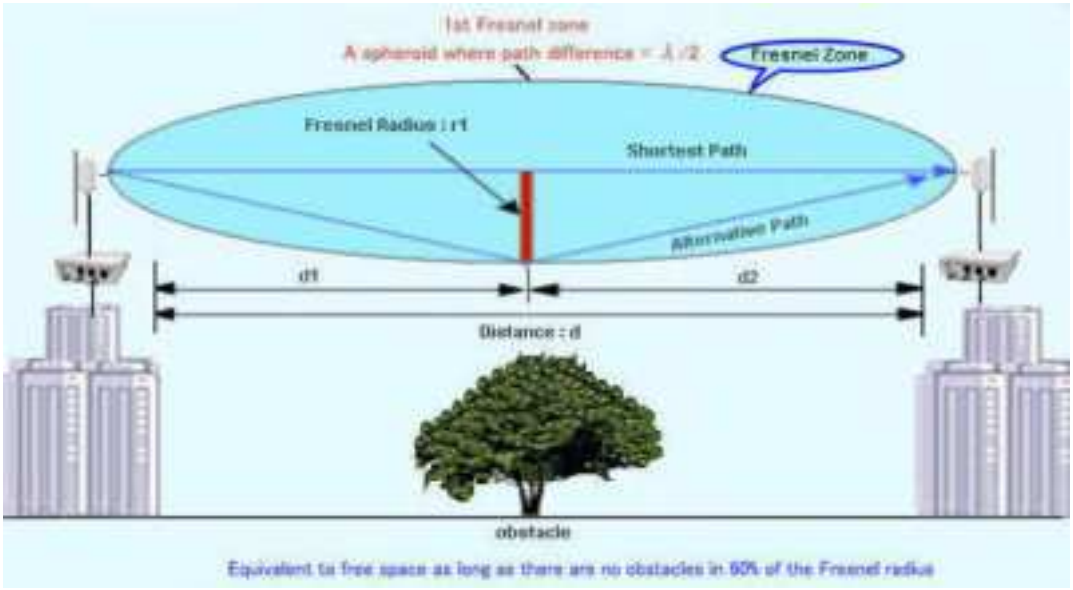


Figure 9-1 Fresnel Zone Calculation

Let's say, in the above figure:

- **d1** is the distance between the obstacle and the antenna at one end.
- **d2** is the distance between the obstacle and the antenna at the other end.
- λ is the wavelength of the operating frequency.

Then, Path Difference (**d3**) and Fresnel Radius ($\mathbf{r_n}$, radius of the $\mathbf{n^{th}}$ Fresnel Zone) can be calculated from the formula below:

Path difference: $d3 = \sqrt{d1^2 + r_n^2} + \sqrt{d2^2 + r_n^2} - d = \frac{\lambda}{2}$

Fresnel radius: $r_n = \sqrt{n\lambda \frac{d1 \times d2}{d1 + d2}}$ (where **n** = 1, for the first Fresnel Zone and $\mathbf{r_n} = \mathbf{r_1}$)

The path difference is the required clearance of the antenna beam from obstacles in its path to avoid loss of radio signal. Signals reflected from any even-numbered Fresnel Zone result in signal cancellation while the odd-numbered Fresnel Zones add to the direct path signal.

9.4 Clearance Factor

Clearance Factor is a correction value (in percentage) that should be used in case, where the signal path of your wireless link does not provide the minimum clearance as listed in the Maximum Range Table. In general, clearance factor is taken as 60% of the Fresnel Zone and is calculated as:

Clearance Factor = Fresnel Zone x 60%

For optimal performance of your outdoor wireless link, the signal path between the BSU and SU must provide sufficient clearance. Clearance is interpreted as:

- The total height above the surface of the earth, in the open areas without obstacles in the signal path. Let's say antenna is mounted on the roof, then clearance is the total height including the height of the building and the height of the mast above the rooftop.
- The height above the highest possible obstacle, in the areas with obstacles along the signal path (path between two antennas).
- The height above the rooftop or highest obstacle in the signal path, in dense urban areas.

: *An outdoor wireless link that lacks sufficient clearance will exhibit poor performance, which is typically perceived as slow network response time. However, your radio equipment automatically retransmits every lost data frame due to an out-of-range situation or frame collision. The larger the number of retransmissions, the lower is the throughput efficiency of your wireless link.*

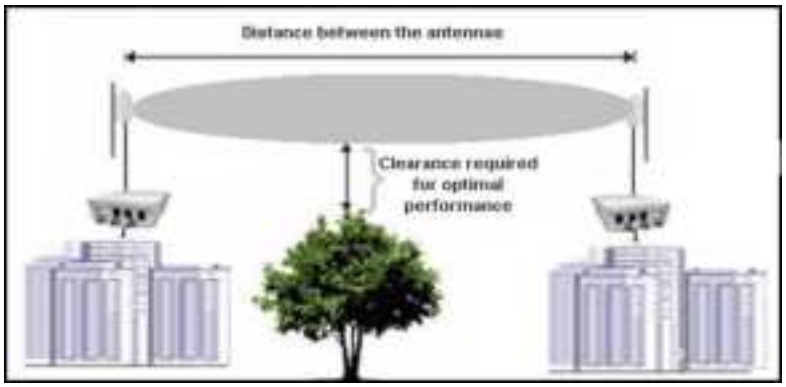


Figure 9-2 Clearance required for the Optimal Performance

As shown in the above figure, the clearance required for optimal performance is interpreted as:

- Vertical clearance above the ground and the highest buildings or objects along the signal path
- Horizontal clearance from neighboring buildings and objects along the signal path

For optimal range and throughput performance, you must ensure that your antenna installation provides maximum clearance in both horizontal and vertical directions.

If the local authorities, proprietor of the premises or other miscellaneous factors do not allow you to set up an antenna mast for the clearance requirements, then you may not achieve a full line-of-sight clearance. However, if the distance that your wireless outdoor installation covers is less than the listed maximum range, you don't need full clearance.

To determine the effect of insufficient signal path clearance, you must determine the Clearance Factor and also calculate its effect on the range for your antenna installation, by using the formula described in Determining the Range.

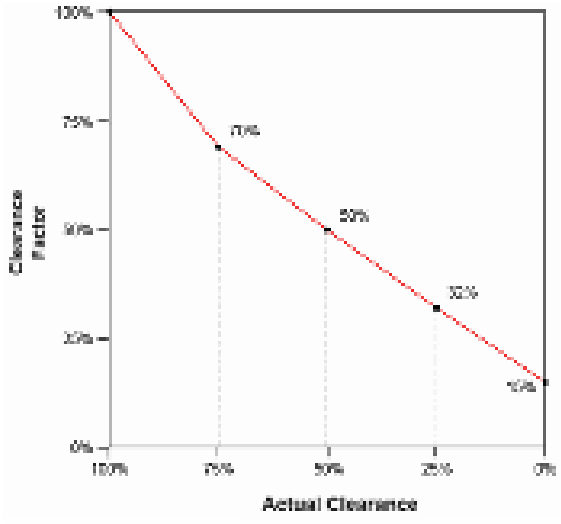


Figure 9-3 Clearance Factor

If the clearance for your antenna installation is equal to or better than the minimum clearance required, then the Clearance Factor for your installation is 100%. If your actual clearance is less than the minimum clearance, then refer the above figure to determine the actual range that applies to the current requirement.

: *Practically, it is impossible to achieve the maximum range due to the interference from the other radio products.*

Proxim recommends you to maintain at least 60-70% of the first Fresnel Zone free. If the clearance is lower than this percentage, then the *link budget* and acquired *fade margin* are affected. Clearances more than 100% of the Fresnel Zone can cause reflections that are 180 degrees out of phase and can cancel the signal. The Fresnel Zone works in both the horizontal and vertical paths.

9.5 Calculations

A microwave link is established along the path between antennas. Availability of the microwave path is therefore a prediction of the percent of time that the wireless link operates. In the absence of direct interference, availability of microwave path is affected by the following factors:

- Path length
- Fade margin
- Frequency
- Terrain (smooth, average, mountainous)
- Climate (dry, temperate, humid)

Availability of the microwave path can be improved by increasing the fade margin, either by making the path shorter or by using the higher gain antennas in conjunction with lower loss antenna cable (using a higher quality antenna cable, shortening the length, or both).

Establish a wireless link for a specific availability rate of microwave path, depending upon the type of information carried over the link and the overall network design redundancy. Let's say, the data or voice traffic carried by the radio is critical, then the link can be established at a very high availability rate of microwave path (say, 99.999% or 5.3 minutes of predicted outage per year).

9.5.1 Calculating Link Budget

Use the following formula to estimate the received signal level (RSL):

RSL (dBm) = P_{out} - L_1+ G_1 + G_2 - L_2 - L_p

where:

- **P_{out}** is the output power (in dBm) of the transmitter.
- **L_1** is the total loss of all transmission elements between the antenna and the RF device on one side of the link (in dB).
- **G_1** is the gain of the antenna on one side of the link (in dB).
- **G_2** is the gain of the antenna on the opposite side of the link (in dB).
- **L_2** is the total loss of all transmission elements between the antenna and the RF device on the opposite side of the link (in dB).
- **L_p** is the Path loss, defined by:

  $Lp\ (dB) = 96.6 + 20\ log_{10}F + 20\ log_{10}D$; where:
  - **F** is the frequency of the radio system in GHz.
  - **D** is the distance of the path in miles.

:

- *This formula is available on a calculation sheet provided by Proxim to generate an estimate of link distance and reliability.*
- *The path loss must be smaller than the link budget minus the minimum required fade margin. The maximum ranges cause the path loss plus the fade margin to be the same as the link budget.*

The following figure is a pictorial representation of the elements in the Link Budget equation.

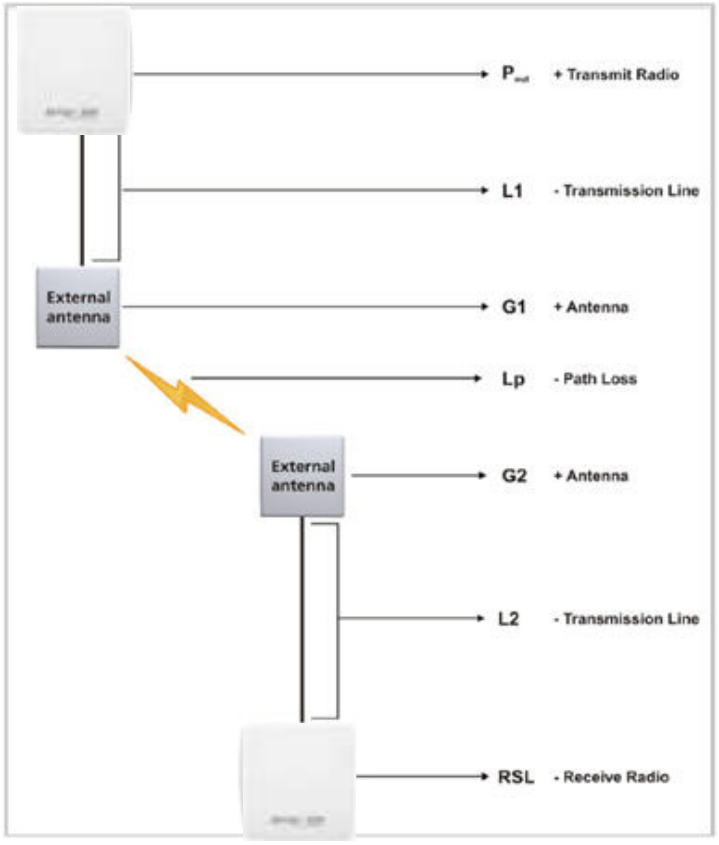


Figure 9-4 Link Budget Equation-Pictorial Representation

Procedure

1. Start with the transmit power and the number of the channel to be used in dBm. Subtract the total loss of all transmission elements between the antenna and the radio on one side of the link (dB).
2. Add the gain of the antenna you will be using. The total is the **EIRP** (Equivalent Isotropically Radiated Power).
3. Determine the path loss of the microwave link by using the mathematical formula of $\mathbf{L_p}$, illustrated in Calculating Link Budget.
4. Add the gain of the antenna on the second side of the link.
5. Subtract the total loss of all transmission elements between the antenna and the radio on the second side of the link. The result is the **Received Signal Level** (RSL).
6. For details on the receive sensitivity and data rate values used for the wireless link, for details refer to *ORiNOCO® AP-9200R Hardware Installation Guide*.
7. Subtract this value from the Received Signal Level; this is the **Fade Margin**.

- *The RSL must be higher than the Receiver Sensitivity plus the Fade Margin for a good link. The amount of Fade Margin indicates the reliability of the link. The more the Fade Margin, the more reliable is the link.*

The results of this link budget calculation are very important for determining any potential problems during installation. If you have calculated the expected RSL, you can verify that it has been achieved during installation and troubleshooting.

Tabulated below is the relation between the *Distance* and *Link Budget,* for a selected frequency:

Reference Frequency: 5600 MHz Center Frequency for Europe								
Link Budget (dB)	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**
61	4.8	0.3	91	151	1.4	121	4.8	8.0
62	5.4	0.3	92	170	1.5	122	5.4	8.5
63	6.0	0.3	93	190	1.6	123	6.0	9.0
64	6.8	0.3	94	214	1.7	124	6.8	9.5
65	7.6	0.3	95	240	1.8	125	7.6	10.1
66	8.5	0.3	96	269	1.9	126	8.5	10.7
67	9.5	0.4	97	302	2.0	127	9.5	11.3
68	11	0.4	98	339	2.1	128	10.7	12.0
69	12	0.4	99	380	2.3	129	12.0	12.7
Link Budget (dB)	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**
70	13	0.4	100	426	2.4	130	13.5	13.4
71	15	0.5	101	478	2.5	131	15.1	14.2
72	17	0.5	102	537	2.7	132	17.0	15.1
73	19	0.5	103	602	2.8	133	19.0	16.0
74	21	0.5	104	676	3.0	134	21.4	16.9
75	24	0.6	105	758	3.2	135	24.0	17.9
76	27	0.6	106	850	3.4	136	26.9	19.0
77	30	0.6	107	954	3.6	137	30.2	20.1
78	34	0.7	108	1071	3.8	138	33.9	21.3
79	38	0.7	109	1201	4.0	139	38.0	22.6
80	43	0.8	110	1348	4.2	140	42.6	23.9
81	48	0.8	111	1512	4.5	141	47.8	25.3

82	54	0.8	112	1697	4.8	142	53.7	26.8
83	60	0.9	113	1904	5.0	143	60.2	28.4
84	68	1.0	114	2136	5.3	144	67.6	30.1
85	76	1.0	115	2397	5.7	145	75.8	31.9
86	85	1.1	116	2689	6.0	146	85.0	33.7
87	95	1.1	117	3018	6.4	147	95.4	35.7
88	107	1.2	118	3386	6.7	148	107.1	37.9
89	120	1.3	119	3799	7.1	149	120.1	40.1
90	135	1.3	120	4263	7.6	150	134.8	42.5

*: The **Distance (m)** is calculated by assuming the 60% of the 1st Fresnal to be clear.*

Effective Isotropic Radiated Power (EIRP)

In countries like USA and Canada, radio can be installed with any directional antennas gain, as there is no Effective Isotropic Radiated Power (EIRP) limit for the application of these systems for fixed point-to-point applications in the 5.8 GHz frequency band. In other bands and in other countries, EIRP limits may apply. In the case of EIRP limits, use the lower values of either (P_{out} - L_1+ G_1) or the EIRP limit, within the Link Budget equation. You should check this calculation in both the directions to assure legal application. An EIRP limit is the maximum RF energy that can be transmitted as measured at the transmitting antenna and is usually deterwmined by government regulations.

FCC United States 5.8GHz band power limit for band edge frequencies

- 20MHz Channel

Antenna	Channel 165	Channel 150 to 164	Channel 165
Gain < 10 dBi	22 dBm	22 dBm	22 dBm
11 < Gain ≤ 20 dBi	16 dBm	25 dBm	16 dBm
21 < Gain ≤ 30 dBi	16 dBm	25 dBm	16 dBm
Gain ≥ 31 dBi	16 dBm	16 dBm	16 dBm

- 40MHz Channel

Antenna	Channel 147 to 151	Channel 152 to 158	Channel 159 to 164
Gain ≤ 10 dBi	22 dBm	22 dBm	22 dBm
11 < Gain < 20 dBi	12 dBm	16 dBm	12 dBm
21 < Gain < 30 dBi	14 dBm	16 dBm	16 dBm
Gain > 31 dBi	16 dBm	16 dBm	16 dBm

- 80MHz Channel

Antenna	All Channels
Gain ≤ 10 dBi	22 dBm
Gain ≥ 11 dBi	16 dBm

Lightning Protection

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Lightning protection is used to maximize the reliability of the communications equipment by safely re-directing current from a lightning strike or a power surge traveling along the STP Cat5e Ethernet cabling to the ground using the shortest path possible. Designing a proper grounding system prior to installing any communications equipment is critical to minimize the possibility of equipment damage, void warranties, and cause serious injury.

The surge arrestor (sometimes referred to as a lightning protector) can protect your sensitive electronic equipment from high-voltage surges caused by discharges and transients at the PoE.

Proxim Wireless offers superior lightning and surge protection for *ORiNOCO® AP-9200R Series* products. Contact your reseller or distributor for more information.

Abbreviations

B

Abbreviations	
AWG	American Wire Gauge
BSU	Base Station Unit
CLI	Command Line Interface
CPE	Customer Premises Equipment
DC	Direct Current
ESD	Electrostatic Discharge
FCS	Frame Check Sequence
LED	Light Emitting Diode
MIMO	Multiple-input and Multiple-output
MTBF	Mean Time Between Failures
OFDM	Orthogonal frequency-division multiplexing
PC	Personal Computer
PoE	Power Over Ethernet
PTMP	Point-to-multipoint
PTP	Point-to-point
QIG	Quick Installation Guide
RSSI	Received Signal Strength Indicator
Rx	Receiver
STP	Shielded Twisted Pair
SU	Subscriber Unit
TCP	Transmission Control Protocol
Tx	Transmission
UDP	User Diagram Protocol
UTP	Unshielded Twisted Pair
WORP	Wireless Outdoor Router Protocol

Warranty and Technical Support C

For Warranty and Technical Support Policy, please visit http://proxim.com/support.

Obtaining Technical Service and Support

If you are having trouble using the Proxim product, please read this manual and the additional documentation provided with your product. If you require additional support to resolve your issue, please be ready to provide the following information before you contact Proxim's Technical Services team:

- Product information
  - Part number and number of the suspected faulty device
- Trouble/error information
  - Trouble/symptom being experienced
  - Activities completed to confirm fault
  - Network information (What kind of network are you using?)
  - Circumstances that preceded or led up to the error
  - Message or alarms viewed
  - Steps taken to reproduce the problem
- ServPak information (if a Servpak customer):
  - ServPak account number
- Registration information
  - If the product is not registered, date and location where you purchased the product


: Technical Support is free for the warranty period from the date of purchase.

Support Options

Proxim Customer Support Website

The Proxim Customer Support Website is available 7x24x365 at http://support.proxim.com.

On the Proxim Customer Support Website, you can access the following services:

- **Product Download Page**: Provides quick links to product firmware, software, and documentation downloads.
- **Proxim TV Links**: A link to helpful video tutorials.
- **Knowledgebase**: A solution database of all the resolved problems. You can search by product, category, keywords, or phrases.
- **Live Chat**: Chat with a support technician on-line or request to call back at a later time.
- **Create a Support Request**: Create a support request with our technical support staff who will reply to you by email.
- **Case Management**: Login to check the status of your support cases, update your personal profile, or access restricted information and features.
- **Provide Feedback**: Submit a suggestion, complaint, or other feedback about the support site and our products.

Telephone Support

Contact technical support via telephone as follows:

USA and Canada Customers

- **Phone**: +1-408-383-7700; +1-866-674-6626
- **Business Hours**: Tier 1 support: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PST (UTC/GMT -7 hrs)

International Customers

- **Phone**: +1-408-383-7700
- **Business Hours**: Tier 1 support: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PST (UTC/GMT -7 hrs)

ServPak Support

To provide even greater investment protection, Proxim Wireless offers a cost-effective support program called ServPak. ServPak is a program of enhanced service support options that can be purchased as a bundle or individually, tailored to meet your specific needs. Whether your requirement is round the clock technical support or advance replacement service, we are confident that the level of support provided in every service in our portfolio will exceed your expectations.

All ServPak service bundles are sold as service contracts that provide coverage for specific products from 1 to 3 years. Servpak bundles are considered an upgrade to the standard product warranty and not an extension.

All Plans Include	ServPak Plus	ServPak Prime
24x7 Basic Technical Support	Basic Advanced Replacement (Two business days/ International economy shipment service)	Priority Advanced Replacement (Next business day/ International priority shipment service)
8x7 Advanced Technical Support		24x7 Advanced Technical Support
Software Maintenance		Proxim Vision Support
Access to Knowledge Base		

Additional Information on ServPak Options

Advanced Replacement of Hardware

In the event of a hardware failure, our guaranteed turnaround time for return to factory repair is 30 days or less. Customers who purchase this service are guaranteed replacement of refurbished or new hardware to be shipped out within one or two business days, as applicable. Options are available for shipment services depending on the customer's support needs. Hardware is shipped on business days, Monday – Friday excluding Holidays, 8:00 AM – 3:30 PM Eastern Time.

7x24x365 Availability

Unlimited, direct access to technical support engineers 24 hours a day, 7 days a week, 365 days a year including Holidays.

8x5 Availability

Unlimited, direct access to world-class technical support engineers 8 hours a day, 5 days a week, Monday through Friday from 8:00AM - 5:00PM Pacific Standard Time.

Basic Technical Support

Customers who purchase this service can be rest assured that their call will be answered by Proxim's Tier 1 technical support and a case opened immediately to document the problem and provide initial troubleshooting to identify the solution and resolve the incident in a timely manner.

Advanced Technical Support

In addition to Proxim's world-class Tier 1 technical support, customers will be able to have their more complex issues escalated to our world-class Tier 3 technical support engineers. Our Tier 3 engineers will review specific configurations to troubleshoot intricate issues and will also provide helpful insights regarding Proxim's products and various tips from decades of collective experience in the wireless industry.

Software Maintenance

It's important to maintain and enhance security and performance of wireless equipment and Proxim makes this easy by providing a Software Maintenance program that enables customers to access new feature and functionality rich software upgrades and updates. Customers will also have full access to Proxim's vast Knowledgebase of technical bulletins, white papers and troubleshooting documents.

To purchase ServPak support services, please contact your authorized Proxim distributor. To receive more information or for questions on any of the available ServPak support options, please visit our website at http://www.proxim.com/support/servpak, call Proxim Support (For telephone numbers, see Telephone Support) or send an email to servpak@proxim.com.

Safety & Regulatory Information

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For Safety & Regulatory Information, please refer Safety and Regulatory guide for ORiNOCO® AP-9200R Series. To download the Safety and Regulatory Guide, visit http://support.proxim.com.