SkyPilot
SkyConnector Outdoor and Indoor

Installation and Hardware Specification Guide

SkyPilot™
NETWORKS

Contents

About This Guide

This guide explains how to install and set up a SkyPilot™ SkyConnector™ to provide wireless network access to users of a SkyPilot wireless mesh network. It assumes administrator-level knowledge of IP networks and a familiarity with configuring wireless devices.

NOTE Where applicable, all information regarding physical characteristics and FCC Regulatory Information pertain to both the SkyConnector Outdoor and SkyConnector Indoor models.

SkyPilot Networks Solution Overview

SkyPilot Networks™ delivers a wireless, end-to-end broadband solution that seamlessly supports high-capacity, high-coverage mesh networks. Designed for managed-access networks and service providers, the SkyPilot network takes broadband wireless the "last mile" with a cost-effective, robust infrastructure solution.

Based on a high-performance architecture that deploys intelligent antenna arrays, the SkyPilot network delivers a dynamic broadband solution with significant advantages for business and home users.
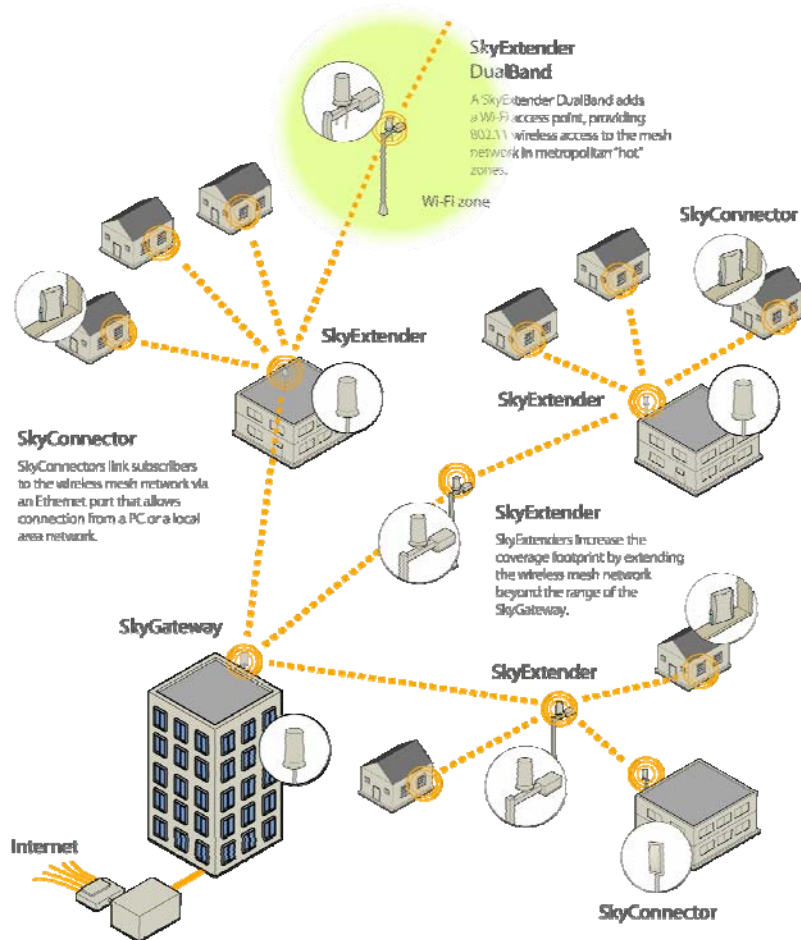
SkyPilot wireless devices are simple to install and easily fit into any type of wireless environment—metropolitan, business, or home.

The auto-discovery and rapid provisioning features of a SkyPilot wireless mesh network greatly reduce deployment and maintenance costs. Support for multiple topologies and high scalability allow attractive options for rapidly expanding a metro Wi-Fi customer base.

A SkyPilot network (as illustrated in Figure 1) may include the following physical components:

- SkyGateway™ (required)
- SkyExtender™
- SkyExtender™ DualBand
- SkyConnector™ Indoor
- SkyConnector™ Outdoor

Figure 1. SkyPilot wireless mesh network

SkyExtender DualBand

A SkyExtender DualBand adds a Wi-Fi access point, providing 802.11 wireless access to the mesh network in metropolitan "hot" zones.

Wi-Fi zone

SkyConnector

SkyExtender

SkyConnector

SkyConnectors link subscribers to the wireless mesh network via an Ethernet port that allows connection from a PC or a local area network.

SkyExtender

SkyExtenders increase the coverage footprint by extending the wireless mesh network beyond the range of the SkyGateway.

SkyGateway

SkyExtender

Internet

SkyConnector

SkyGateway

The SkyGateway operates as a base station for a wireless mesh network. It provides an interface between wired infrastructure and a wireless network of subscribers who enjoy secure, high-speed access to the Internet or to wide area networks (WANs).

A SkyPilot wireless network requires at least one SkyGateway for normal operation. If necessary, you can add additional SkyGateways to increase network capacity or provide redundancy.

The SkyGateway typically resides at a location with easy access to wired infrastructure—usually a POP (point of presence) or data center.

For optimal performance, install the SkyGateway on an elevated site such as a cell tower or the top of a tall building.

SkyExtender and SkyExtender DualBand

SkyExtenders and SkyExtender DualBands provide a cost-effective way to add capacity and balance network loads, by operating as "repeaters" to extend the wireless range of a SkyGateway (see Figure 1). You can add these devices to your network to expand your coverage footprint and provide redundancy through SkyPilot's mesh networking features. (A SkyExtender can also provide subscribers with a direct connection to the wireless network via its Ethernet port.)

In addition, the SkyExtender DualBand serves as a Wi-Fi access point, enabling service providers and municipalities to provide standard 802.11 wireless access across great distances, for targeted hot zones, or for dense coverage patterns.

For optimal performance, install the SkyExtender in an elevated location such as a roof, tower, or utility pole.

SkyConnector

SkyConnectors link your subscribers to the SkyPilot wireless network. An Ethernet port on the SkyConnector enables a connection to be established to the subscribers' computers, or to a local area network (LAN) via a data switch or router. For flexibility of installation, SkyPilot offers indoor and outdoor versions of the SkyConnector.

Designed for installation by the service provider, the outdoor version of the SkyConnector attaches to an external structure such as an eave, roof, or pole. Because it provides a better line of sight to the SkyGateway or a SkyExtender, the outdoor SkyConnector generally offers greater range than the indoor unit.

The indoor version of the SkyConnector is a plug-and-play network device that a subscriber can easily install without technical assistance. Service providers should advise subscribers to place the SkyConnector in a location with an optimal sight line to the SkyGateway or a SkyExtender.

2

The SkyConnector Outdoor Installation Kit

Your SkyPilot SkyConnector Outdoor installation kit provides the basic equipment you need to install the device and configure it for operations on a SkyPilot wireless mesh network. This chapter reviews that equipment and tells you what else you need to have on hand before starting installation.

What the kit provides
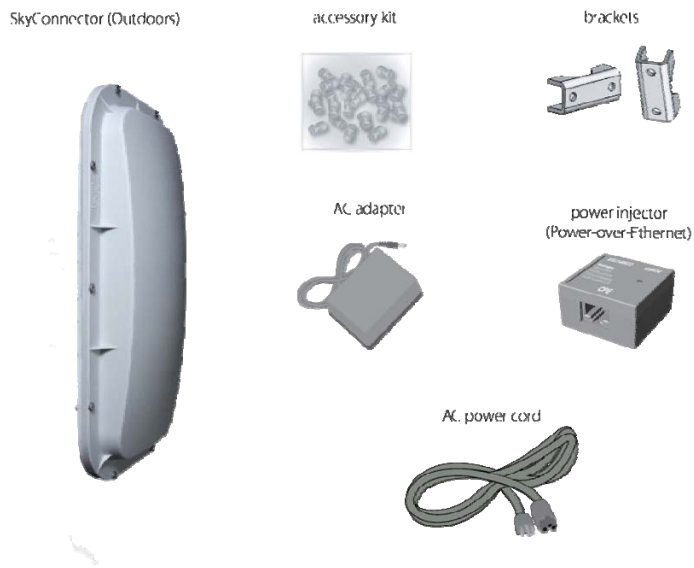
SkyPilot also offers accessories, including a tilt mount for optimizing your SkyConnector Outdoor installation. For more information, contact a SkyPilot sales representative.

What else you need

Before starting installation, you also need the following:

- For basic mounting: A Phillips screwdriver
- For pole mounting:

  A magnetic level (optional)

  A secured steel pole between 1.13" (2.87 cm) and 1.37" (3.48 cm) in diameter

- For network cabling:

  A spool of CAT5 network cable (shielded cable is recommended)

NOTE   Ethernet cabling must comply with the requirements of NEC/CEC codes for outdoor CAT5 cables. The outer jacket of the cabling must be clearly marked as CAT5e per ANSI/TIA/EIA-568-B.2.

> Ethernet crossover cable (for connecting to data switch or router)
>
> RJ-45 connectors (connectors without a protective "boot" are recommended)
>
> RJ-45 crimping tool

- For configuration: A laptop with a Telnet client application and a 10/100bT Ethernet network interface card

Installing a SkyConnector Outdoor

This chapter provides instructions for planning and performing the physical installation of a SkyConnector Outdoor.

Planning your installation

In a typical wide area wireless mesh network, you'll install a SkyConnector on a utility pole or the roof of a building. The effective range of the SkyConnector is usually proportional to the height of the installation.

When choosing a site for the SkyConnector, consider the radio frequency (RF) environment and physical characteristics of the site.

Trees, buildings, and hills can block a wireless signal. Also keep in mind that the RF environment is dynamic and can deteriorate over time as obstacles appear or are relocated.

Plan on testing potential sites to determine the suitability of the link topology for target applications. Once you've identified a potential site, use a topographic map or path profile software to ensure that terrain or obstacles will not interfere with the links.

Your site survey should include an RF scan to identify available frequencies. You should also check your preferred frequency at all locations; a frequency that's clear at one location may be crowded at another. Frequency planning is a critical factor in planning and implementing a wireless mesh network.

The site survey process should be ongoing. To verify that a site is relatively free of interference, make site audits every 6 to 12 months, scheduling regular maintenance visits to coincide with the site audits.

Cabling the SkyConnector

Ethernet cabling provides both power and data connectivity for the SkyConnector.

The section provides instructions for attaching CAT5 cable to the device.

1   Terminate the appropriate grade and length of CAT5 cable with an RJ-45 connector and plug it into the RJ-45 port on the back of the SkyConnector.

Figure 3. Connecting CAT5 cable to the SkyConnector
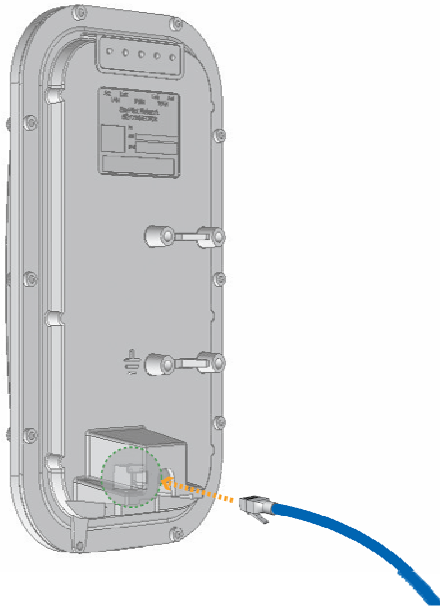
Make sure the fit is snug so that the cable does not interfere with the weather gasket.

2   Insert the weather gasket and secure the metal cover.

Press the CAT5 cable into the gasket and insert the gasket into the housing, taking care not to twist or place unnecessary force on the RJ-45 connector.
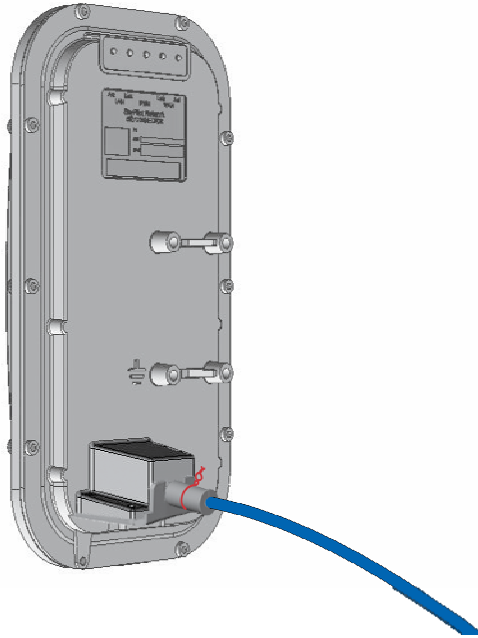
Fit the metal cover over the weather gasket and secure it with the four machine screws supplied in the accessory kit.

Figure 4. Attaching weather gasket and metal cover

weather gasket

cover

screws
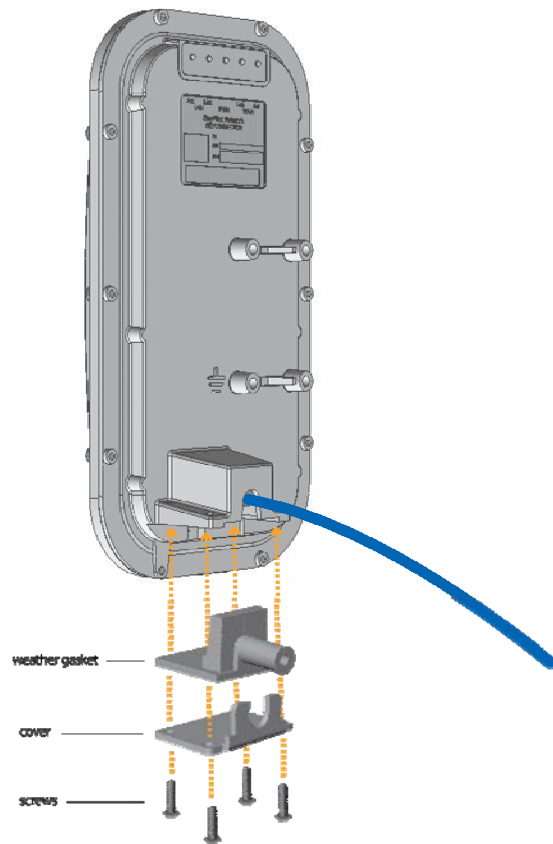
4 Attach tie wraps to the neck of the weather gasket and tighten them so that they slightly depress the neck.

Figure 5. Attaching tie wraps to the gasket neck

The tie wraps provide relief from cable strain and ensure a fully weatherproof seal.

Powering on the SkyConnector

Before mounting the SkyConnector, first power on the unit so that you can use the onboard LEDs to determine optimal placement.

1 Connect the SkyConnector to the power supply, as follows:

a. Plug the AC adapter into an AC outlet.

b. Connect the Ethernet cable to the port labeled "CPE" on the power injector.

c. Plug the AC adapter into the power injector.

Figure 6. Providing power to the SkyConnector
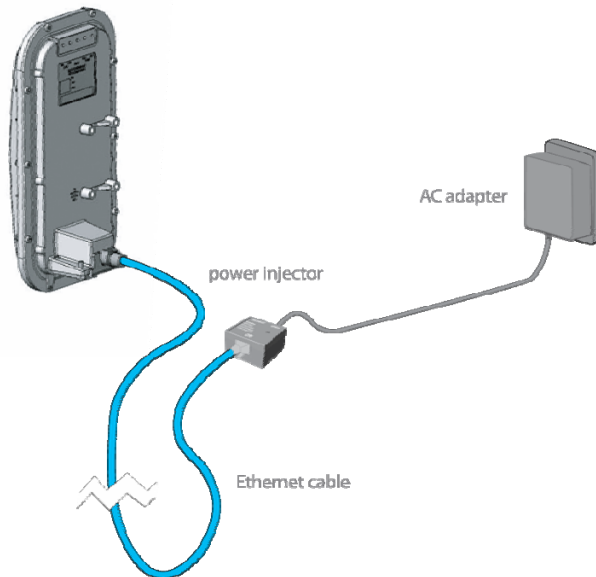
2 Check the LEDs on the SkyConnector.

If the connections are correct, the power LED (labeled "PWR") and the WAN activity LED (labeled "WAN Act") on the SkyConnector will illuminate. The WAN Act LED should blink and turn off, but the PWR LED should remain lit.

Figure 7. Checking the SkyConnector LEDs
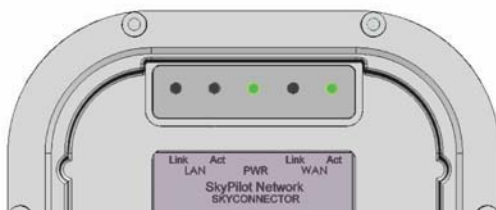
Optimizing location

After powering on the SkyConnector, use the device's LEDs to identify the optimal location for mounting.

Confirm signal acquisition

- Position the SkyConnector near the intended mounting location and watch the WAN Act LED for activity.

  The LED starts to blink when it has acquired a signal from the network and is attempting to set up a connection.

  If the WAN Act LED does not start blinking within 30 seconds, try changing the orientation of the SkyConnector or walk to a new location; then repeat the process until the LED begins blinking.

  When the LED starts blinking, make minor adjustments to find the location where the signal is strongest. (The faster the LED blinks, the stronger the signal.)

  When the WAN Act LED blinks steadily and at a high rate, you have an optimal signal. Go to the next section to verify the network connection.

Verify network connection

- Watch the WAN Link LED for activity.

  Within approximately 90 seconds of locating a signal, the WAN Link LED should start to blink—first slowly, then more quickly.

  When the WAN Link LED is solid and the WAN Act LED is blinking, the SkyConnector has established an authorized connection to the network, indicating that the current location is suitable for mounting

  If both the WAN Act LED and the WAN Link LED continuing blinking, a signal is available but is not strong enough for reliable service. Keep trying different locations until you can confirm a network connection.

  NOTE To optimize your SkyConnector installation, ask your network administrator (at the Network Operations Center) to measure signal strength on the node to which the SkyConnector has established a link.

For more information on LED states, see Table 1.

Table 1. SkyConnector LED states

| LED	LED state	Device state
LAN Link	Steady illumination	SkyConnector is connected to another device via its Ethernet port.
LAN Act	Blinking	Device is transmitting or receiving data via its Ethernet port.
PWR	Steady illumination	Device is powered on.
WAN Link	Blinking (fast blink when device is in standby mode)	Device is attempting to establish an authorized connection on the wireless network. If both WAN Link and WAN Act continue to blink, the signal is not strong enough to support reliable service or there is a provisioning problem that's preventing the device from coming online. Contact your network administrator.
	Steady illumination	Device is connected to the wireless network.
WAN Act	None	Device cannot detect a wireless network.
	Blinking	Device is within the coverage area of a wireless network. Blink rate communicates signal strength: • Fast (8x per second) = excellent • Medium (4x per second) = good • Slow (<1x per second) = poor • None = no reception

Mounting the SkyConnector

After determining an optimal location for your SkyConnector, you can mount the device and run the appropriate cables.

Before mounting the device, disconnect the CAT5 cable from the power injector to power down the device.

1   Use the supplied clamps to secure the SkyConnector to the pole; then loop the Ethernet cable around the mounting pole and secure it with tie wraps.

Figure 8. Securing the SkyConnector
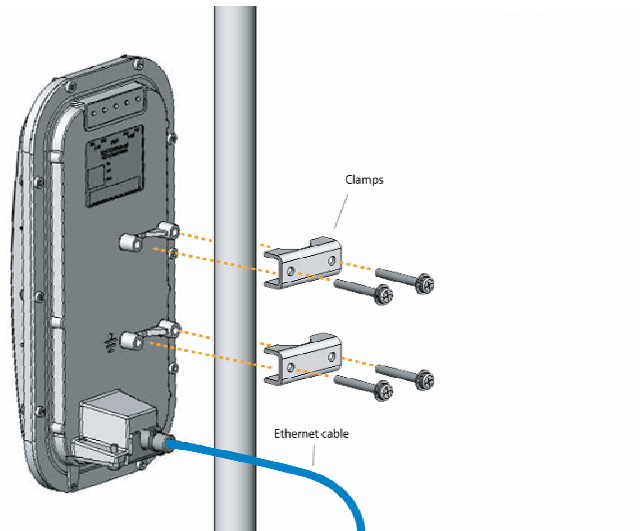
Tighten the bolts securely on the mounting hardware.

2   Reconnect the CAT5 cable to the port to the power injector to restore power to the SkyConnector.

# Connect to a computer or LAN

After mounting the SkyConnector, you can connect it to a local computer or LAN.

- **Connect the device to a computer or LAN (for a SkyConnector that's providing Internet/WAN access to the mesh network).**

  Connect a second Ethernet cable from the power injector port labeled "Computer" to a personal computer or router/data switch providing a connection to a LAN.

Figure 9. Connecting a SkyConnector to a computer

Figure 9. Connecting a SkyConnector to a computer
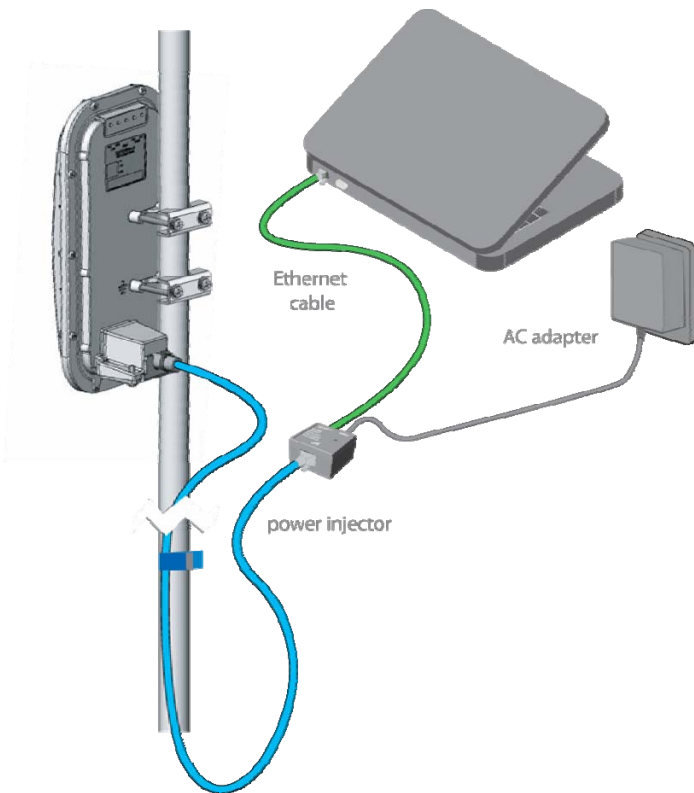
Configuring the SkyConnector

The SkyConnector requires a network configuration to operate on the wireless mesh network.

For information about configuring the device, see the document `SkyPilot Network Administration,` available in electronic format from the SkyPilot website at www.skypilot.com/support/.

A

Accessing the Command-Line Interface

This appendix describes how to access the command-line interface that SkyPilot devices provide for provisioning and troubleshooting.

You can connect to a SkyConnector and access the command-line interface through Telnet over an Ethernet connection. After logging in (by supplying a password), you can enter commands at the command prompt.

1 Mount and cable the SkyConnector according to the instructions in Chapter 3.

2 Prepare a PC or laptop.

Open the network settings panel and assign the computer the IP address 192.168.0.3 with a subnet mask of 255.255.255.0.

3 Connect the computer to the SkyConnector according to the instructions in Chapter 3 (see "Connect to a computer or LAN" on page 23).

4 Start a Telnet session.

Telnet to the default IP address of the SkyConnector (192.168.0.2).

5 Log in by entering the password at the command prompt. (The default is `public`.)

Figure 11. Example Telnet login


```
              Welcome to SkyPilot Networks, Inc.
Copyright (C) 2006 SkyPilot Networks, Inc. All Rights Reserved.


Password: ******
Login successful

>
```

After making an Ethernet connection to the SkyConnector, you can manage and troubleshoot the device using a wide range of commands available through the command-line interface. For detailed descriptions of the commands, as well as sample output for many of them, see `SkyPilot Network Administration`.

For comprehensive guidelines to troubleshooting devices on your SkyPilot wireless mesh network, see `Getting Started with the SkyPilot Network`.

FCC Regulatory Information

FCC Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

o   Reorient or relocate the receiving antenna.

o   Increase the separation between the equipment and receiver.

o   Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

o   Consult the dealer or an experienced radio/TV technician for help.

The user of this product is cautioned that changes or modifications made to the equipment without the approval of the manufacturer void the user's authority to operate the equipment.

FCC Radiation Exposure Limits

To comply with FCC RF exposure requirements in section 1.1307, a minimum separation distance of 40 cm (16 inches) is required between the antenna and all persons.

Specifications

This appendix provides technical specifications for the SkyPilot SkyConnector

Wireless Specifications

Frequency band	5.725–5.850 GHz
EIRP	42.5 dBm/17.8 W peak, 36 dBm/4 W average, 33 dBm/2 W average, 30 dBm/1 W average, or 36 dBm /4 W peak (EIRP selected for country-specific regulations)
Media access	Time Division Duplex (TDD)
Modulation technique	OFDM with adaptive modulation
Modulation rates	6–54 Mbps
Throughput	Up to 20 Mbps UDP, up to 10 Mbps TCP
Latency	8–10 ms roundtrip per hop
Antennas	28° horizontal x 9° vertical panel, **16.5dBi**
Channel width	20 MHz
Channel resolution	5 MHz frequency control
Receive sensitivity	-90 dBm at 6 Mbps modulation

Connectivity	SkyConnector connects with SkyGateways, SkyExtenders, and SkyExtender DualBands
Authentication	MD5-based certificates
Encryption	128-bit AES on all wireless links

Product Specifications

Connectors	RJ-45: Ethernet connection (10/100bT) and power (Power-over-Ethernet)
Mounting	Eave, roof, or chimney; outside pole diameter up to 2.0"
Range	7.5 miles (12 km)
LEDs	Wireless activity, wireless link, LAN activity, LAN link, and power
Dimensions	12.6" (32 cm) H x 6.6" (16.8 cm) W x 4.2" (10.7 cm) D
Weight	3.8 pounds (1.7 kg)
Operating temperature	-40° to 131° F (-40° to 55° C)
Wind loading	Up to 150 mph (240 km/h)
Enclosure/humidity	NEMA-4X
Power	110–230 VAC, 50–60 Hz input; 8 W
Certifications	FCC Part 15, FCC 47 CFR Part 15, Class B USA; compliance with UL safety standards, CE, C-Tick, IC RSS210 Issue 5
EMI and susceptibility	FCC Part 15.107 and 15.109
Warranty	One-year limited warranty on hardware and software

Security

Authentication	MD5-based certificates
Encryption	AES
Filtering	Based on protocol type, IP port ID, and configurable IP address list
VLAN	Supports 802.1q VLAN tagging; supports a management VLAN for managing traffic and a data VLAN for subscriber traffic

Network Management

Command-line interface	Console via Telnet
NMS integration	SNMP v2c
GUI configuration	SkyProvision™ software and Web interface
GUI EMS	SkyControl™ software
IP address	DHCP or static
Firmware	Multiple versions of firmware stored in nonvolatile memory; updated via FTP
Configuration file	XML over HTTP

Quality of Service

Prioritization	802.1p-based; based on protocol type, IP address, port ID, and **configurable IP address list**
Traffic shaping	Per-device rate limits upstream and downstream

Monitoring and MIB Support

Supported MIBs	MIB-II (RFC 1213); EtherLike (RFC 2665); Bridge (RFC 1493); SkyPilot private MIB
Local management	RS-232 Serial Console Port
Remote management	Command-line interface via Telnet, SNMP v2c, Web interface

Topology

Configurations	Mesh, point-to-multipoint, point-to-point