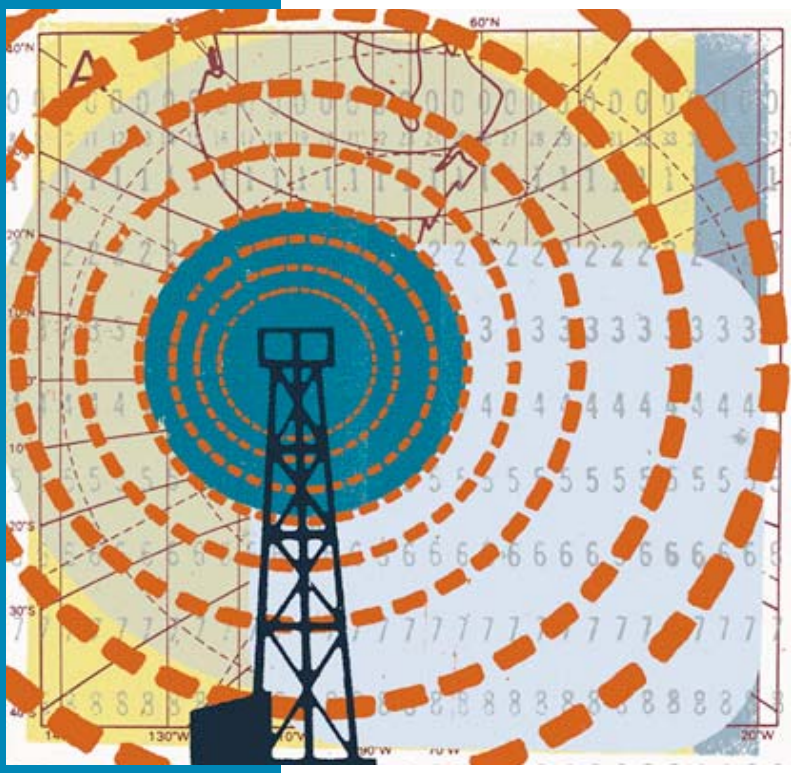
Getting Started with the SkyPilot Network



SkyPilot™ NETWORKS

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SkyPilot EMS 1.4
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Contents

About This Guide

This guide introduces the SkyPilot Networks™ broadband wireless solution.

Chapter Highlights

- Audience and purpose
- How this guide is organized
- Conventions used in this guide

Audience and Purpose

This guide introduces the SkyPilot Networks™ broadband wireless solution and provides a "cookbook" for the initial setup of a SkyPilot™ wireless network. It also includes an overview of the network topologies supported by SkyPilot and provides references to installation, provisioning, and troubleshooting procedures found in other SkyPilot documents. (For a description of the SkyPilot documentation suite, see "Documentation" on page 6.)

How This Guide Is Organized

This guide is organized as follows:

- Chapter 1, "Introduction," introduces the SkyPilot Networks broadband wireless solution and provides an overview of its hardware and software components.
- Chapter 2, "Topologies," describes the full range of network topologies, which are all supported by the SkyPilot Networks™ architecture.
- Chapter 3, "Initial Setup and Configuration," describes the steps required to set up a SkyPilot wireless network and successfully bring it online.
- The Glossary provides a list of terms and definitions relating to broadband wireless in general, and the SkyPilot network in particular.

Conventions Used in This Guide

This section describes the text and syntax conventions used throughout this guide.

Text Conventions

This guide uses the following text conventions:

- *Italic* is used to introduce new terms.
- **Bold** is used to indicate what you click or type in a graphical user interface (for example, commands names or text being entered). In examples showing user interaction with the command-line interface, bold is used to indicate user input as opposed to command output.
- A `monospace` font is used for code elements (variable names, data values, function names, and so forth), command lines, scripts, and source code listings.
- *`Italic-monospace`* is used for replaceable elements and placeholders within code listings.

Syntax Conventions

This guide uses the following conventions when showing syntax:

- Angle brackets, "<" and ">", enclose mandatory elements. You must enter these elements. For example:
  `ping <IP-address>`
- Square brackets, "[" and "]", enclose optional elements. You can omit these elements. For example:
  `show filter [filter-table-number]`
  Square brackets are also used to show the current value of parameters in the output of some commands.
- A vertical bar, "|", separates choices. For example:
  `show bridge [cache | port]`

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Introduction

This chapter introduces the SkyPilot Networks™ broadband wireless solution and provides an overview of its hardware and software components.

Chapter Highlights

- The SkyPilot Networks solution
- Hardware components
- Software components
- Documentation

The SkyPilot Networks Solution

SkyPilot Networks delivers a wireless, end-to-end broadband solution that seamlessly supports high-capacity, high-coverage 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.

SkyPilot gives carriers an opportunity to expand rapidly into new markets and extend their offerings to include VoIP and high-bandwidth applications such as video and location-based services.

The SkyPilot solution offers a "tipping point" for converting dial-up customers to broadband and will help drive the growth of neighborhood "hotspots," offering ubiquitous wireless connectivity to local communities.

Based on a high-performance architecture that deploys intelligent antenna arrays, the SkyPilot network delivers dynamic bandwidth allocation, VoIP, and Quality of Service.

The auto-discovery and rapid provisioning features of a SkyPilot wireless mesh network can greatly reduce deployment and maintenance costs. Multiple topology options and network scalability create intriguing options for rapidly expanding a metro Wi-Fi customer base.

SkyPilot's plug-and-play wireless devices are simple to install and will easily fit into any type of business or home environment.

Hardware Components

A SkyPilot network includes the following physical components:

- **SkyGateway™**—Operates as a base station for your wireless network. It provides an interface between wired infrastructure and a wireless network of subscribers who enjoy secure, high-speed access to the Internet or wide area networks.

  A SkyPilot wireless network requires at least one SkyGateway for operation. If desired, you can add additional SkyGateways to increase network capacity or provide redundancy. The SkyGateway typically resides at a location that offers easy access to wired infrastructure—usually a POP or data center. For optimal performance, the SkyGateway should be installed on an elevated site, such as a cell tower or the top of a tall building.

  NOTE There must be at least one functioning SkyGateway in your SkyPilot network before any other devices (SkyExtenders or SkyConnectors) can form communication links.

- **SkyExtender™**—Functions as a repeater and extends the wireless range of a SkyGateway. SkyExtenders are optional equipment; by adding them to your network, you can expand your coverage area and provide redundancy through SkyPilot's mesh networking features. SkyExtenders offer a cost-effective way to add capacity and balance network loads.

  A SkyExtender's Ethernet interface can supply local subscriber service (creating a direct connection to the wireless network via the SkyExtender's Ethernet port) in addition to wirelessly forwarding data on behalf of other end users.

  For optimal performance, SkyExtenders should be installed on an elevated, fixed location, such as a roof, tower, or utility pole.

- **SkyExtender DualBand**—Combines the features of a SkyExtender with a high-powered 802.11b/g access point that allows service providers and municipalities to offer standard Wi-Fi services over great distances, for targeted hot zones or dense, ubiquitous coverage patterns.

- **SkyExtender TriBand**—Combines the features of a SkyExtender DualBand with an additional radio, which is accessible through a second access point operating in parallel with the 2.4 GHz access point. The second access point leverages the 4.9 GHz Public Safety band, using 802.11a communication protocol. Each access point uses a single antenna with similar coverage patterns, providing a cost effective solution for municipal networks.

IMPORTANT From here on in this guide, all references to "SkyExtender" refer to the SkyExtender, the SkyExtender DualBand, *and* the SkyExtender TriBand, unless otherwise noted.

- **SkyConnector™**—Links your subscribers to the SkyPilot wireless network. An Ethernet interface on the SkyConnector enables connecting to the subscribers' computers or a local area network (via a switch or router).

  For flexibility of installation, SkyPilot offers two versions of the SkyConnector:

  - **Outdoor**—Designed for installation by the service provider, the outdoor version of the SkyConnector attaches to an external structure such as eaves, a roof, or a pole. In general, the outdoor SkyConnector provides greater range than the indoor unit.
  - **Indoor**—Plug-and-play network device that a subscriber can easily install without technical assistance. Advise subscribers to place the SkyConnector in a location with an optimal sight line to the SkyGateway or a SkyExtender—for example, on a windowsill or in a window frame.

For information about how the SkyPilot components work together in the various network topologies, see Chapter 2, "Topologies."

Software Components

The software components of a SkyPilot system are:

- **SkyProvision™**—A server-based application that automates device provisioning by enabling devices to get their configuration information from the SkyPilot EMS server. SkyProvision is also used for updating network node firmware and for setting device and system configuration options.

  SkyProvision functions are accessed using the EMS Java client or the EMS Web client. For installation information, refer to *SkyPilot EMS Installation*. For usage instructions, refer to *SkyPilot Network Administration*.

- **SkyControl™**—An SNMP management system for real-time device monitoring and management. This software provides a graphical view of your network topology with at-a-glance updates on topology, routing, and performance. SkyControl supports both standard and private MIBs.

  SkyControl functions are accessed using the EMS Java client. For installation information, refer to *SkyPilot EMS Installation*. For usage instructions, refer to *SkyPilot Network Administration*.

- **Third-party applications**—Provided as part of the SkyPilot EMS server installation. The server package includes open-source versions of FTP, HTTP, and DHCP servers plus an open-source database for storing device configuration information. For more information about these third-party applications, refer to *SkyPilot EMS Installation*.

- **SkyPilot command-line interface**—A text-based interactive application built into all SkyPilot devices. This interface enables you to manually provision a device, retrieve information about the device's status, and perform real-time logging.

  NOTE This interface is typically referred to as the "command-line interface" (without the preceding "SkyPilot").

- **SkyPilot Web interface**—A Web–based application built into all SkyPilot devices. This tool provides much the same functionality as the SkyPilot command-line interface in an easy to use graphical interface.

  NOTE This interface is typically referred to as the "Web interface" (without the preceding "SkyPilot").

- **Access point command-line interface**—The Linux command shell interface of DualBand and TriBand access points. This interface enables you to execute standard Linux commands in order to configure and retrieve access point settings directly (versus through the SkyPilot Web interface). This interface is intended for SkyPilot use only.

For more information about how to use the software components, refer to *SkyPilot Network Administration* and the appropriate SkyPilot reference guides.

Documentation

The SkyPilot documentation suite, available on the SkyPilot website at www.skypilot.com/support/, includes the following:

- *Getting Started with the SkyPilot Network* (this guide)
- SkyPilot devices' installation guides:
  - *SkyGateway/SkyExtender Installation and Setup*
  - *SkyConnector Indoor Installation*
  - *SkyConnector Outdoor Installation*
- Operating system installation guides:
  - *SkyPilot OS Installation: Red Hat Linux 9.0*
  - *SkyPilot OS Installation: Fedora Core 2 and 4*
  - *SkyPilot OS Installation: Red Hat Enterprise Linux ES 3 and 4*
- *SkyPilot EMS Installation*
- *SkyPilot Network Administration*
- SkyPilot reference guides:
  - *SkyPilot Command-Line Interface Reference*
  - *SkyPilot Web Interface Reference*

2

Topologies

This chapter describes the full range of network topologies that are supported by the SkyPilot Networks architecture.

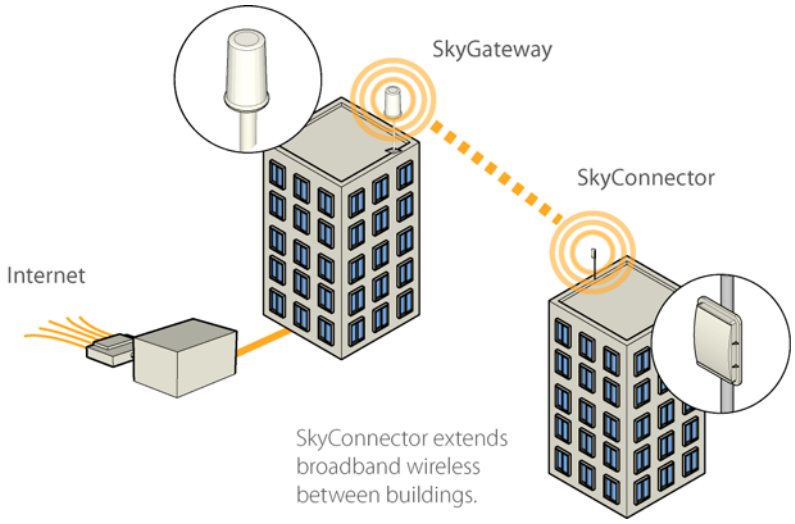
Chapter Highlights

- Point-to-point
- Point-to-multipoint
- Mesh
- Topology and network architecture

Point-to-Point

The most basic wireless topology, point-to-point connects a SkyGateway directly to a SkyConnector at a subscriber site. A point-to-point network is ideal for extending high-performance networks between buildings.

Figure 2-1. Point-to-point configuration



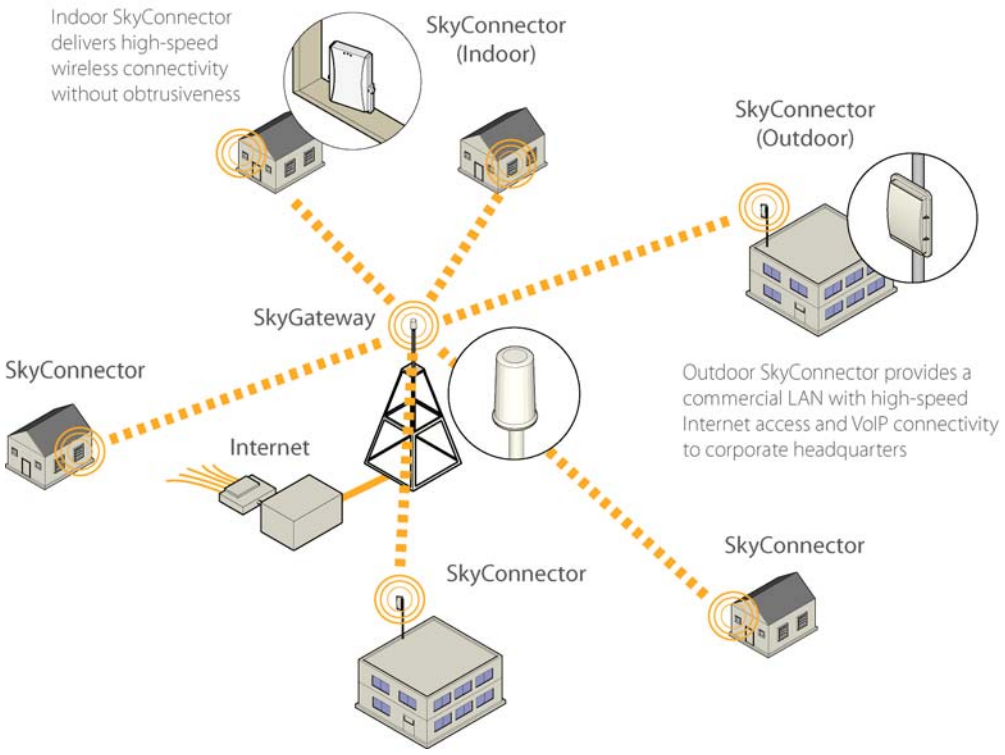
Point-to-Multipoint

A point-to-multipoint topology employs a SkyGateway as the hub of a star configuration of multiple SkyConnectors.

This topology scales easily. You can add subscribers simply by installing a SkyConnector at the customer site, or by delivering a SkyConnector to the subscriber for plug-and-play installation.

A point-to-multipoint SkyPilot network is ideal for delivering broadband wireless service to both residential customers and small businesses.

Figure 2-2. Point-to-multipoint configuration

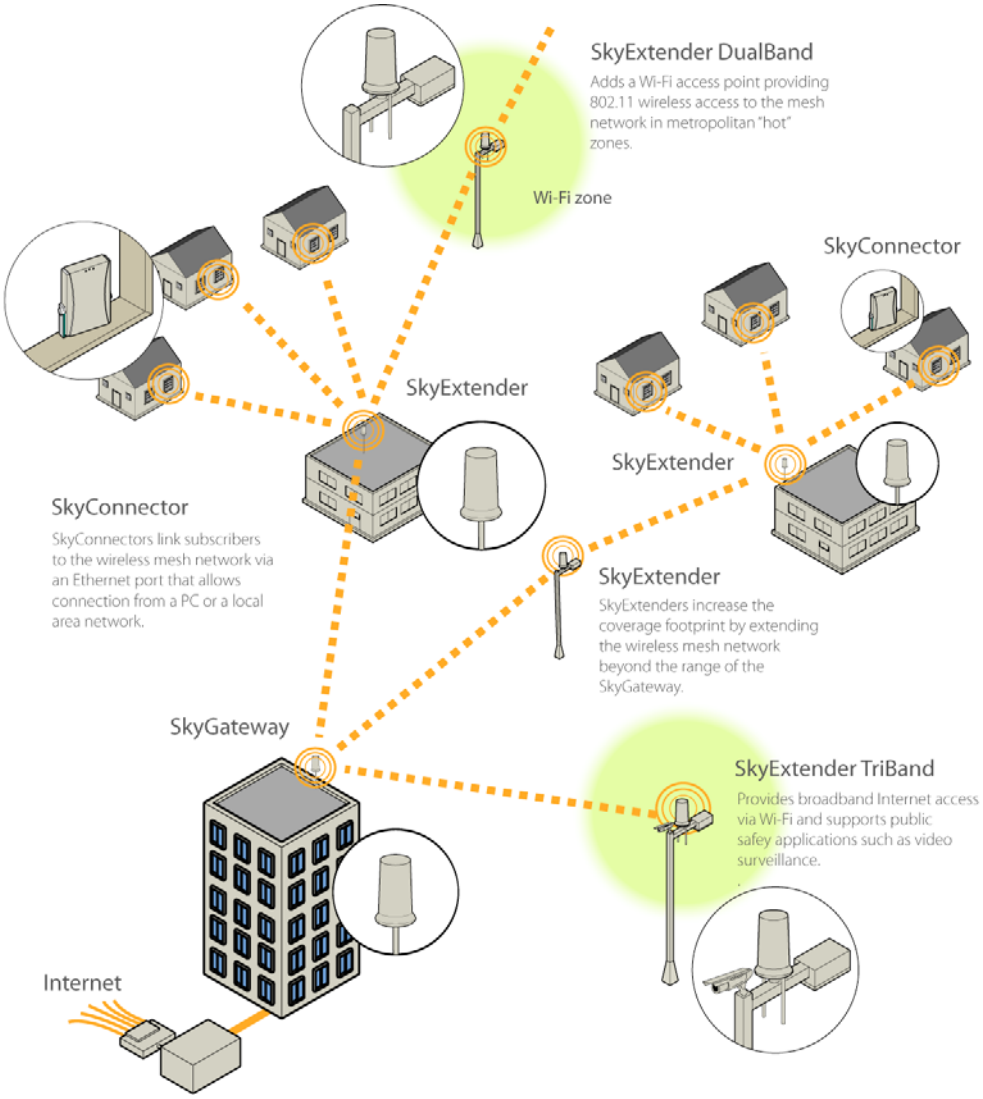


Mesh

A mesh topology uses SkyExtenders to extend range and add network flexibility. In a mesh configuration, subscribers can either connect to the SkyGateway directly or connect to it indirectly via SkyExtenders (see Figure 2-3). In addition to adding range, a mesh network allows connections from locations where obstructions prevent line-of-sight access to a SkyGateway.

Mesh networks are ideal for dense subscriber environments, for filling in coverage "holes," and for reaching subscribers where there are obstructions to RF communications due to hills, trees, buildings, or other obstacles.

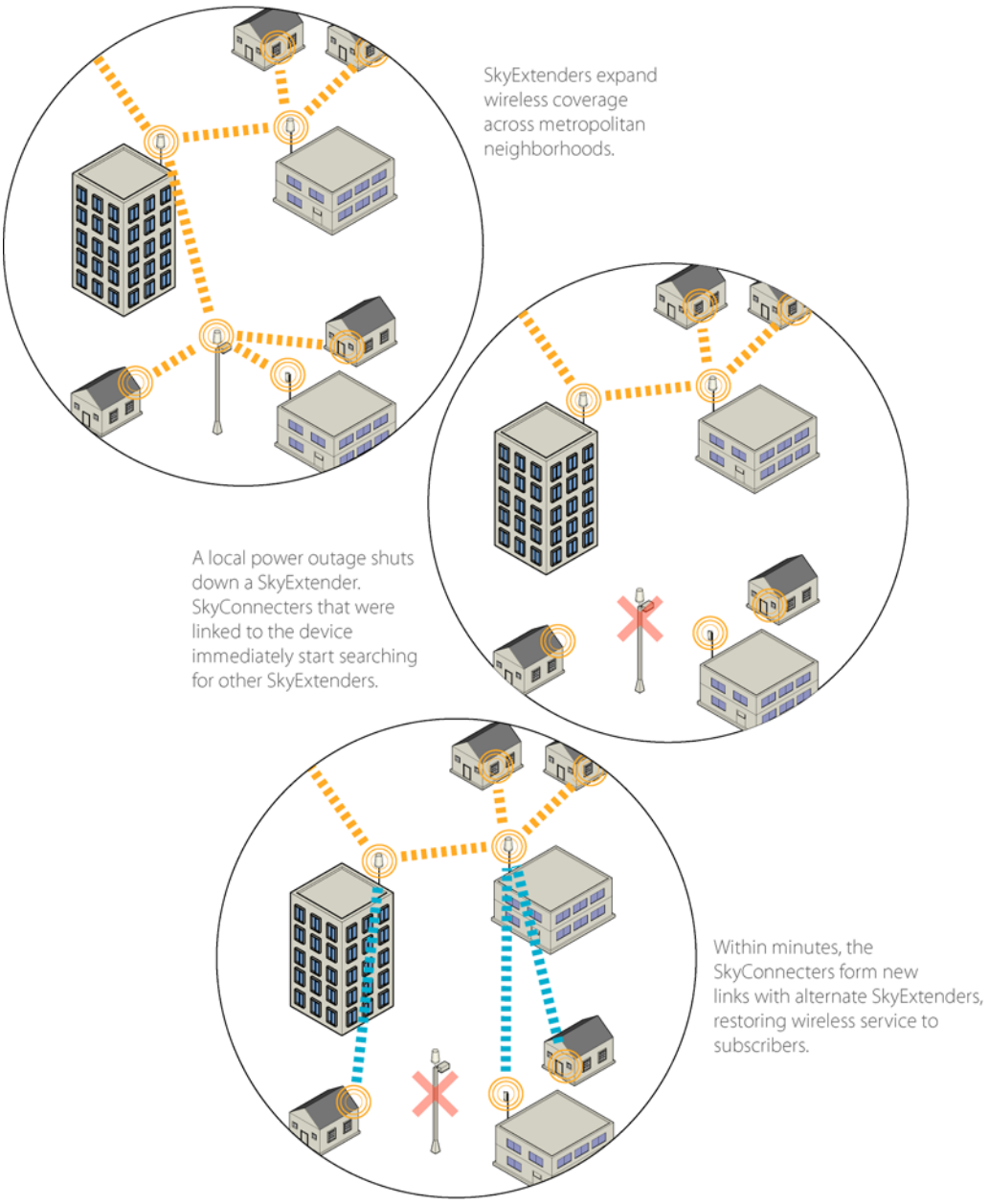
Figure 2-3. Mesh configuration



In addition to extending the service range and overcoming obstructions, SkyPilot's mesh technology makes your network "self-healing." If a connection fails, affected devices automatically seek out alternate network paths and bring themselves back online.

Figure 2-4 shows how a SkyPilot network can respond to a loss of connection by using alternate network paths—a capability that's unavailable in conventional wired broadband installations.

Figure 2-4. A self-healing mesh network



Topology and Network Architecture

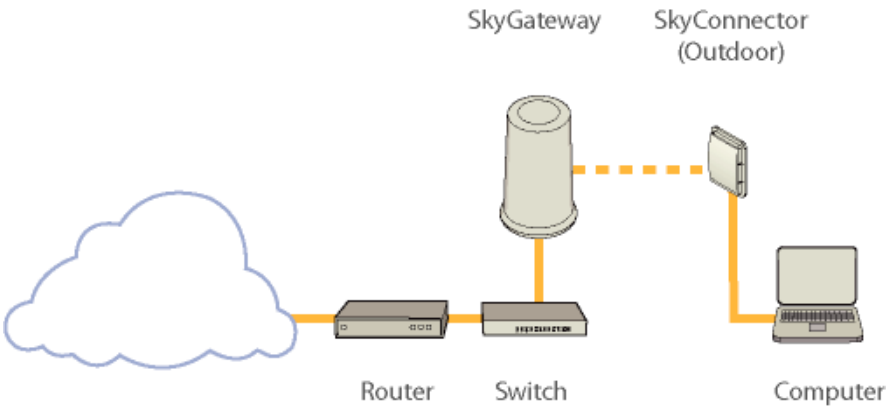
A SkyPilot wireless network is an intelligent, switched-Ethernet system. A sophisticated transport layer (Layer 2) lets subscribers move between SkyGateways without requiring updates to their IP addresses.

Advanced techniques for rate control and packet prioritization permit multiple service offerings and provide support for high-quality VoIP. Packet filtering and wireless-link encryption ensure high levels of data security.

SkyPilot fully supports VLANs and filters for managing subscriber traffic across a wireless network.

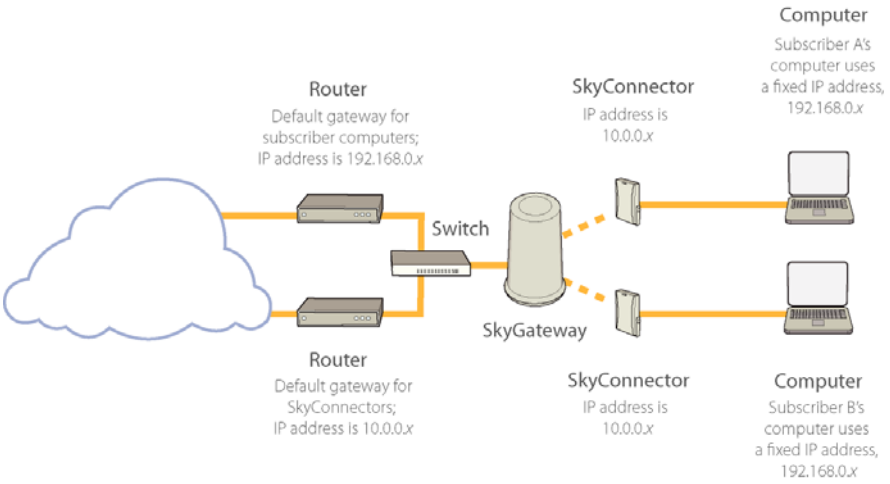
Figure 2-5 illustrates how a SkyPilot network fits into a basic LAN environment.

Figure 2-5. LAN configuration



The SkyPilot solution supports a variety of techniques for IP addressing and Layer 3 end points across a broad range of devices. Figure 2-6 shows how you can easily segment SkyPilot traffic at the IP layer, without installing additional equipment.

Figure 2-6. IP segmentation across a SkyPilot network



3

Initial Setup and Configuration

This chapter describes the steps required to set up a SkyPilot wireless network and successfully bring it online. Where applicable, the procedures refer to SkyPilot documentation that contains more detailed information.

Chapter Highlights

- Overview
- Stage 1: Identifying equipment locations
- Stage 2: Choosing an operating frequency
- Stage 3: Provisioning and installing devices
- Stage 4: Verifying connectivity

Overview

Table 3-1 summarizes the stages of SkyPilot network deployment.

Table 3-1. Stages of deployment

	Stage	Description
1	Identifying equipment locations	Identify and prepare locations for installation.
2	Choosing an operating frequency	Choose a "clean" center frequency that permits interference-free operation of devices.
3	Provisioning and installing SkyPilot devices	Choose a provisioning mode for the devices: manual or automatic. Provision the devices. (For automatic provisioning, install operating system and SkyPilot EMS software.) Install the devices.
4	Verifying connectivity	Confirm that the SkyGateway is online. Confirm that installed SkyConnectors and SkyExtenders have established a link with the SkyGateway. Review link characteristics and network performance.

Stage 1: Identifying Equipment Locations

Deployment of a SkyPilot network starts with a site survey to help you identify the devices you need and choose optimal locations for installation.

Identifying locations for the SkyGateway and SkyConnectors is straightforward. For the SkyGateway, location depends on proximity to existing network infrastructure and site elevation. SkyConnectors are placed at subscriber sites—homes or offices.

SkyExtenders are far more flexible in terms of location. If you determine that you need SkyExtenders in order to reach all your customers or add redundancy, you must also identify optimal locations for their installation.

Guidelines for Adding SkyExtenders

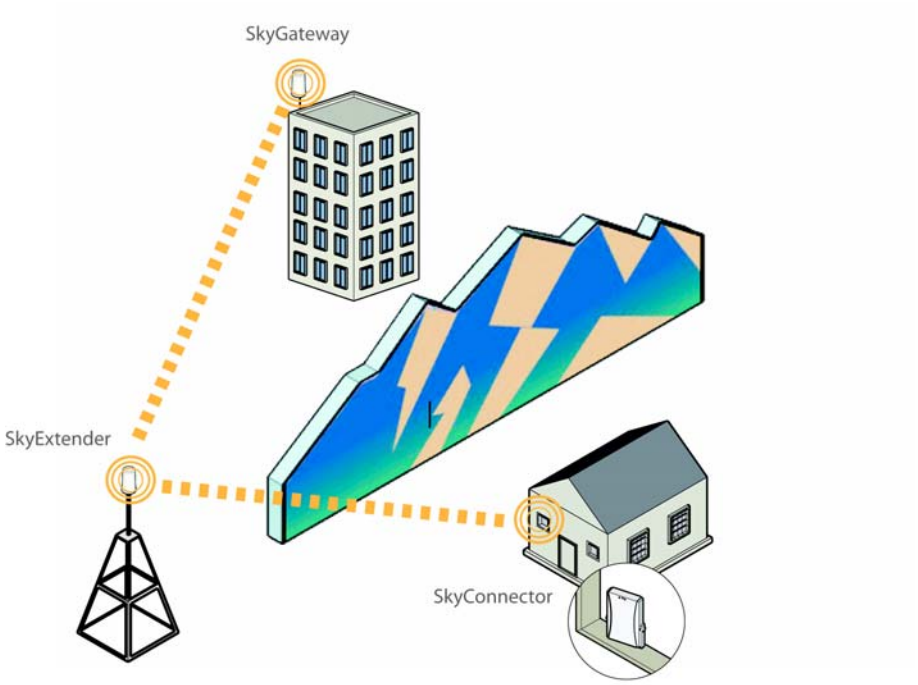
Multiple factors can affect wireless network performance—and dictate the need for SkyExtenders.

- **Physical distance**—Are all your subscriber sites close enough to the SkyGateway for radio communications? If a SkyGateway is installed in a high location with a clear sight line to subscriber sites, it can maintain radio communications with SkyConnectors or SkyExtenders at greater distances.
- **Elevation**—There is a correlation between range and device elevation. By installing SkyPilot devices on raised locations, such as towers or tops of buildings, you can avoid traffic "collisions" that occur at ground level, thereby extending the range at which the devices can operate normally.

  Optimally, you should install SkyPilot devices at similar elevation because large elevation differences may have an adverse impact on signal strength.
- **Obstructions**—An optimal link between a SkyGateway and a SkyConnector requires a clear line of sight. Obstructions, both artificial and natural, can reduce effective network range or block radio communications entirely.
- **Type of SkyConnector**—Because it's typically placed outside and at higher elevation than the indoor connector, the outdoor version of the SkyConnector provides greater wireless range than the indoor version.

If there are obstructions blocking subscriber access (as in Figure 3-1) or if there are subscriber sites beyond the distance that a wireless link can maintain, you need to add one or more SkyExtenders to the network.

Figure 3-1. Using a SkyExtender for network extension behind an obstruction



Preparing SkyExtender Sites

If SkyExtenders are required, perform a survey of possible sites before beginning installation. For a detailed discussion of site requirements, refer to *SkyGateway/SkyExtender Installation and Setup*.

For optimal service, attach SkyExtenders to elevated, fixed locations with easy and continuous access to power.

Stage 2: Choosing an Operating Frequency

All the devices on a SkyPilot network operate on a single frequency. Before beginning the installation, visit the deployment area and identify an optimal operating frequency. Use a spectrum analyzer or other frequency-planning tool to identify the best available frequency for the SkyPilot wireless network—a "clean" center frequency that permits interference-free operation of devices.

For detailed information about frequency planning, refer to *SkyGateway/SkyExtender Installation and Setup*.

Stage 3: Provisioning and Installing Devices

Stage 3 involves these tasks:

- Choosing a provisioning mode: automatic or manual. For details about the provisioning modes, including selection guidelines, provisioning tools, and manual and automatic provisioning procedures, refer to the following sections in *SkyPilot Network Administration*:
  - "Choosing a Device Provisioning Mode"
  - "Provisioning Mode and Device Operations"
  - "Hybrid Network Provisioning"
  - "General Provisioning Guidelines"
- Preparing the network infrastructure (for automatic provisioning, installing a supported operating system and SkyPilot software)
- Installing the devices

Order of Installation

You can ensure optimal operations—and reduce administrative overhead—by installing your network devices in this order: first SkyGateway, then SkyExtenders (optional), and finally SkyConnectors.

You install the SkyGateway first because, as the base station of the SkyPilot wireless network, it must be present in order for other devices to establish network links. When provisioned and powered on, the SkyGateway immediately starts transmitting hello beacons that SkyExtenders and Sky Connectors use to form links.

After installing the SkyGateway, you add SkyExtenders (if required) and then SkyConnectors. Upon powering on, each device responds to the base station's hello beacon and starts forming links with the SkyGateway. Each device attempts to establish as many links as possible before choosing an optimal path.

After establishing network links, SkyExtenders on your network also begin transmitting hello beacons, extending the range of beacons available to other devices. (SkyConnectors do not transmit hello beacons.)

Manually Provisioning Devices

Manual provisioning stores settings in the device's flash memory, where they remain available for recall when the device starts up.

NOTE If you're installing a device in a location that poses difficulties, consider delaying the final mounting until you can confirm that provisioning was successful.

Table 3-2 summarizes the steps required to manually provision a device.

Table 3-2. Manually Provisioning a Device (Page 1 of 2)

	Step	Refer to
1	Decide whether to provision the device using the command-line interface or the Web interface. (For DualBand/TriBand access points, you must use the Web interface.)	"Choosing a Manual Provisioning Method" in *SkyPilot Network Administration*
2	Prepare the device for installation by installing the necessary cabling, attaching antennas (for DualBands and TriBands), and readying the device for service. Do *not* install the device yet.	The appropriate installation manual: • *SkyGateway/SkyExtender Installation and Setup* • *SkyConnector Indoor Installation* • *SkyConnector Outdoor Installation*
3	Power on the device.	
4	Connect a computer to the device and access the command-line interface or the Web interface. (For DualBands/TriBands, this step refers to the SkyExtender portion of the device.)	The appropriate interface reference manual: • *SkyPilot Command-Line Interface Reference* • *SkyPilot Web Interface Reference*

Table 3-2. Manually Provisioning a Device (Page 2 of 2)

	Step	Refer to
5	Provision the device. (For DualBands/TriBands, this step refers to the SkyExtender portion of the device.)	Either of the following provisioning tool references, making sure to set at least the minimum provisioning parameters (refer to "Required Provisioning Parameters" and in *SkyPilot Network Administration*): • *SkyPilot Command-Line Interface Reference* • *SkyPilot Web Interface Reference*
6	For DualBands/TriBands, reboot the device, connect a computer to the device's 2.4 GHz access point, and provision the access point.	*SkyPilot Web Interface Reference*
7	For TriBands, connect a computer to the 4.9 GHz access point and provision it.	*SkyPilot Web Interface Reference*
8	Power off the device.	
9	Complete the installation.	The appropriate installation manual: • *SkyGateway/SkyExtender Installation and Setup* • *SkyConnector Indoor Installation* • *SkyConnector Outdoor Installation*
10	Power on the device.	

Automatically Provisioning All Network Devices

Table 3-3 summarizes the steps required to automatically provision all devices on a network. Although it's possible to provision SkyPilot devices in any order, by following this sequence (as described in "Order of Installation" on page 19) you can ensure that devices are able to form links as soon as they come online.

Table 3-3. Automatically Provisioning All Network Devices (Page 1 of 2)

	Step	Refer to
1	For new SkyPilot network deployments, custom-install the operating system software on the SkyPilot EMS server.	The appropriate installation manual: • *SkyPilot OS Installation: Red Hat Linux 9.0* • *SkyPilot OS Installation: Fedora Core 2 and 4* • *SkyPilot OS Installation: Red Hat Enterprise Linux ES 3 and 4*
2	For new SkyPilot network deployments, install the server component of SkyPilot EMS, and then install the client component of SkyPilot EMS on any appropriate computer.	*SkyPilot EMS Installation*
3	For new SkyGateways, set up the DHCP server and, if the provisioning server is behind a firewall, specify ports for data traffic between the server and SkyPilot devices.	"Adding Devices to the DHCP Configuration File" in *SkyPilot Network Administration*
4	Provision the SkyGateway(s).	The following automatic provisioning topics in *SkyPilot Network Administration*: • "Provisioning a Device" • "Starting SkyProvision" • "SkyProvision Display Pane" • "Searching for Configured Devices"

Table 3-3. Automatically Provisioning All Network Devices (Page 2 of 2)

	Step	Refer to
5	For new SkyGateways, complete the installation and power it on.	*SkyGateway/SkyExtender Installation and Setup*
6	(Optional) Log in to the SkyGateway and configure the management VLAN.	"The SkyPilot EMS Interface" in *SkyPilot Network Administration*
7	Provision the SkyExtender(s).	The following automatic provisioning topics in *SkyPilot Network Administration*: • "Provisioning a Device" • "Starting SkyProvision" • "SkyProvision Display Pane" • "Searching for Configured Devices"
8	For DualBands and TriBands, provision the access point(s).	For information about access point settings, refer to *SkyPilot Network Administration*. For configuration procedures, refer to the *SkyPilot Web Interface Reference*
9	For new SkyExtenders, install the device and power it on.	*SkyGateway/SkyExtender Installation and Setup*
10	Provision the SkyConnector(s).	• Same as for step **7**.
11	For new SkyConnectors, install the device and power it on.	The appropriate installation manual: • *SkyConnector Indoor Installation* • *SkyConnector Outdoor Installation*

Stage 4: Verifying Connectivity

After provisioning and installing your SkyPilot devices, you should perform the procedures in the following sections to confirm that the devices are properly connected to the network.

Confirming SkyGateway Connectivity

There are two ways to confirm SkyGateway connectivity:

- Check the LED status lights on the SkyGateway to verify that the device is fully online.

  See Table 3-4 for a summary of what the LED status lights mean. For a detailed description of the status lights, refer to *SkyGateway/SkyExtender Installation and Setup*.

  Table 3-4. SkyGateway LED status lights

Device state	Link LED	Activity LED
Startup in progress	Slow staggered blinking of both LEDs	
Startup failure	Off	On
Initializing image (and acquiring GPS signal)	Blinks 4 times; repeats cycle	Blinks 4 times; repeats cycle
Initialization failure	Fast, synchronized blinking of both LEDs	
Successful initialization, but authorization failure	On	Off
Connected	On	On

- From the command line, use the `ping` command to verify that you can reach the device's default gateway

  For example:

  ```
  > ping 192.168.5.1

  PING 192.168.5.1: 56 data bytes
  64 bytes from 192.168.5.1: icmp_seq=0. time=11. ms
  64 bytes from 192.168.5.1: icmp_seq=1. time=12. ms
  64 bytes from 192.168.5.1: icmp_seq=2. time=12. ms
  ----192.168.5.1 PING Statistics----
  3 packets transmitted, 3 packets received, 0% packet loss
  round-trip (ms) min/avg/max = 0/16/32
  ```

Confirming SkyExtender and SkyConnector Connectivity

There are four ways to confirm SkyExtender and SkyConnector connectivity. You can use any method at any time.

- Check the LED status lights on the device to verify that the device is fully online.

  For a summary of what the LED status lights mean, see Table 3-5 (for SkyExtenders) or Table 3-6 (for SkyConnectors). For a detailed description of the status lights, refer to the installation guide for the device.

Table 3-5. SkyExtender/DualBand/TriBand LED status lights (Page 1 of 2)

Device state	Link LED	Activity LED
Startup in progress	Slow staggered blinking of both LEDs	
Startup failure	Off	On
Initializing image (and acquiring GPS signal)	Blinks 4 times; repeats cycle	Blinks 4 times; repeats cycle
Initialization failure	Fast, synchronized blinking of both LEDs	
Successful initialization, but can't locate hello	On	Off
Successful initialization; heard hello on antennas with power levels in the proper RSSI range	Off	Blink (modulation rate-based)

Table 3-5. SkyExtender/DualBand/TriBand LED status lights (Page 2 of 2)

Device state	Link LED	Activity LED
Successful initialization; link is not optimized, or is in pre-authorization	Slow blink	Blink (modulation rate-based)
Successful initialization; link is in standby state on antenna and modulation rate	Fast blink	Blink (modulation rate-based)
Connected	On	On

Table 3-6. SkyConnector LED status lights

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
WAN Link	Blinking (fast blink when device is in standby mode)	Device is attempting to establish an authorized connection on the wireless network
	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 indicates signal strength: • Fast (8x per second): excellent • Medium (4x per second): good • Slow (<1x per second): poor

- From the command line, use the `show link` command to confirm that an active link exists.

  The device is online if the output displays an `act path` (active path) link state.

  For example:

```
Node Id           LType NType State     RSSI LTxMod RTxMod LAnt RAnt
----------------- ----- ----- --------- ---- ------ ------ ---- ---
00:0a:db:00:00:43 data  ext   act path  39   48      36     2    4
```

- Use the `traceroute` command to confirm that you can send and receive data across the wireless network.

  The `traceroute` command performs a SkyPilot protocol trace that shows the path to the SkyGateway. Entering the `traceroute` command without arguments returns a path that the device identifies as its exit from the network.

  For example:

```
> traceroute

traceroute to 00:0a:db:00:00:a6
>>    1  (48) --> 00:00:43 --> (36)
2  (36) --> 00:00:a6 --> (36)
```

- Use the `ping` command to verify that you can reach the device's default gateway.

  For example:

```
> ping 192.168.5.1

PING 192.168.5.1: 56 data bytes
64 bytes from 192.168.5.1: icmp_seq=0. time=11. ms
64 bytes from 192.168.5.1: icmp_seq=1. time=12. ms
64 bytes from 192.168.5.1: icmp_seq=2. time=12. ms ----
192.168.5.1 PING
Statistics---- 3 packets transmitted, 3 packets received, 0%
packet loss round-trip (ms)  min/avg/max = 0/16/32
```

Confirming SkyExtender DualBand/TriBand Access Point Connectivity

There are four ways to confirm SkyExtender DualBand/TriBand access point connectivity:

- Use the `ping` command to verify that the access point is up and running—for example, `ping 192.168.0.3`.
- For SkyPilot firmware versions 1.2p3 and later, use the `show version ap` command to verify the firmware version and, indirectly, that proper heartbeats are being sent from the PePLink Linux access point.
- From the command line, enable debugging (using the `debug on` command) and use the `set log apwatchdog 3` command to display successful or failed heartbeat updates, reboot notices, factory resets, and so on.
- Using an 802.11b/g wireless card, connect to the default SSID, a string representation of the SkyExtender's MAC address with the WPA passphrase `publicpublic`.

  Once connected, use the `ping` command to verify that you can reach both the SkyExtender and the access point. For example:

```
> ping 192.168.0.3

PING 192.168.5.1: 56 data bytes
64 bytes from 192.168.0.3: icmp_seq=0. time=11. ms
64 bytes from 192.168.0.3: icmp_seq=1. time=12. ms
64 bytes from 192.168.0.3: icmp_seq=2. time=12. ms ----
192.168.5.1 PING
Statistics---- 3 packets transmitted, 3 packets received, 0%
packet loss round-trip (ms)  min/avg/max = 0/16/32

> ping 192.168.0.2

PING 192.168.5.1: 56 data bytes
64 bytes from 192.168.0.2: icmp_seq=0. time=11. ms
64 bytes from 192.168.0.2: icmp_seq=1. time=12. ms
64 bytes from 192.168.0.2: icmp_seq=2. time=12. ms ----
192.168.5.1 PING
Statistics---- 3 packets transmitted, 3 packets received, 0%
packet loss round-trip (ms)  min/avg/max = 0/16/32
```

Troubleshooting

For troubleshooting procedures for startup or connectivity problems, refer to the "Troubleshooting" section in *SkyPilot Network Administration*. There you'll find troubleshooting procedures for:

- Power-on problems
- Ethernet connectivity problems
- IP connectivity problems
- SkyGateway Transmission problems
- Link failure problems

Glossary

This glossary provides a list of terms and definitions related to SkyPilot. In addition, definitions of some general network and communications terms are included.

AP Access point.

ARP Address Resolution Protocol; a TCP/IP protocol used to convert an IP address into a physical address, such as an Ethernet address. A host wishing to obtain a physical address broadcasts an ARP request onto the TCP/IP network. The host on the network that has the address in the request then replies with its physical hardware address.

CPE Customer premise equipment.

DHCP Dynamic Host Configuration Protocol; you can use an open-source DHCP server to provide IP addresses to SkyPilot devices.

EMS client See SkyPilot EMS client.

EMS server See SkyPilot EMS server.

ISP Internet service provider.

MAC address Media Access Control address; a globally unique identifier specific to the network card inside a computer.

MIB Management information base; a database of objects that can be monitored by an SNMP-based network management system.

netkey Shared network key.

NOC Network operations center.

OTA Over-the-Air.

PoE Power over Ethernet.

POP Point of Presence; a place where communications services are available to subscribers.

provisioning The process of giving a network configuration to a SkyPilot device and optimizing that device for wireless operation. You can use SkyProvision to enable devices to get their configuration information from the server automatically, or you can manually perform provisioning using the device's command-line interface.

`Relay_Server` A custom SkyPilot agent that processes requests between a MySQL database and an Apache HTTPD server.

RSSI Receive Signal Strength Indication; a measurement of the strength of the signal received in a wireless environment.

SkyControl A Java-based software application for monitoring devices on a SkyPilot network.

SkyPilot EMS SkyPilot Element Management System, comprising server and client components; allows automatic provisioning and monitoring of SkyPilot devices from a central server at your NOC.

SkyPilot EMS client Computer containing SkyPilot EMS software allowing you to connect to the SkyPilot EMS server and to use SkyProvision and SkyControl to set up automatic provisioning and to monitor network operations.

SkyPilot EMS server Computer containing component services that allow automatic provisioning and management of devices on a SkyPilot network.

SkyProvision A Java-based software application for setting up automatic provisioninging of devices on a SkyPilot network.

SNMP Simple Network Management Protocol, which provides a means to monitor and control network devices and to manage configurations, statistics collection, performance, and security.

ToS field Type of Service field; as defined by RFC 1349, a single-byte field in an IP packet header that specifies the service level required for the packet.

VSFTPD Open-source FTP server used to download software images to SkyPilot devices or get files from the server. For more information, refer to the following website: http://vsftpd.beasts.org/.