User Guide

CPE (SC1050)

Version 1.1

December 8, 2005

1 Introduction

The SkyPilot CPE (SC1050) provides a subscriber interface to a SkyPilot wireless network. The SkyPilot CPE connects either to a SkyPilot Seed (SD1050) or directly to a SkyPilot Gateway (GW1050) device. The SkyPilot CPE operates in the public safety 4.9 GHz band and comes in Indoor and Outdoor variants.

The Indoor and Outdoor SkyPilot CPE differ only in the external mechanical packaging. The Indoor CPE is housed in an attractive plastic package that may be installed in a home or office environment. The Outdoor CPE utilizes a fully environmentally sealed housing that supports extended temperature range operation.

The combination of the SkyPilot wireless network elements provides a high capable and flexible system. The system and CPE offer:

- **High Capacity and Long Range**
  OFDM technology, a large link budget and modulation rates of 6-54Mbps, provide reliable Non-LOS operation and market leading capacity.
- **Meshing**
  The system offers the flexibility of subscriber CPE (SC1050) connection directly to a SkyPilot Gateway (GW1050) or via an intermediary Seed (SD1050), resulting in vastly increased coverage when compared to typical point-to-multipoint systems.
- **Standards Based**
  The SkyPilot system is based very closely on the 802.11 standard and utilizes commercial chipsets. SkyPilot has implemented significant enhancements that provide range and performance advantages.
- **Easy Installation**
  The SkyPilot Indoor CPE allows for very simple, end-user install. The compact, environmentally hardened Outdoor CPE is easily installed on a rooftop or under eave.
- **Networking**
  The SkyPilot system implements an intelligent, Ethernet switching network, with a 10500bT bridge interface provided by the Gateway and CPE. Subscriber rate control and traffic prioritization QoS mechanisms are supported, along with optional VLANs. In addition, there is support for configurable protocol filtering and Access Control Lists (ACL).
- **Security**
  AES link encryption and complete node authentication with optional support for full MD5 certificates.
- **Network Management**
  Both node types are fully manageable via SNMPv2c and a Command Line Interface (CLI). Static or DHCP IP address allocation is supported.

1.1   Outdoor CPE

The Outdoor CPE is a fully integrated, environmentally hardened device providing the interface between a wireless SkyPilot network and the local subscriber. The subscriber connection is via a single 10/100bT Ethernet port. The CPE connects to the SkyPilot network via a single, optimized wireless link.

The SkyPilot Outdoor CPE houses a single high gain panel antenna providing 30° horizontal coverage and a 9° vertical angle, along with all RF and digital circuitry. The Outdoor CPE utilizes Power over Ethernet (PoE), meaning that just a single cable is required to install the unit.

The Outdoor CPE is equipped with high-visibility LEDs that provide wireless connectivity feedback during installation. The Outdoor CPE may be monitored and managed remotely by the operator via SNMP and the embedded Command Line Interface (CLI).

1.2   Indoor CPE

The Indoor CPE contains the same antenna and circuitry as the Outdoor CPE. The external mechanicals are replaced with an attractive, consumer friendly plastic housing. The Indoor CPE may be used with either the desk or window mount provided.

The LEDs provide feedback allowing for the easy placement and pointing of the unit. As with the Outdoor CPE, the Indoor unit provides full operator monitoring and management.
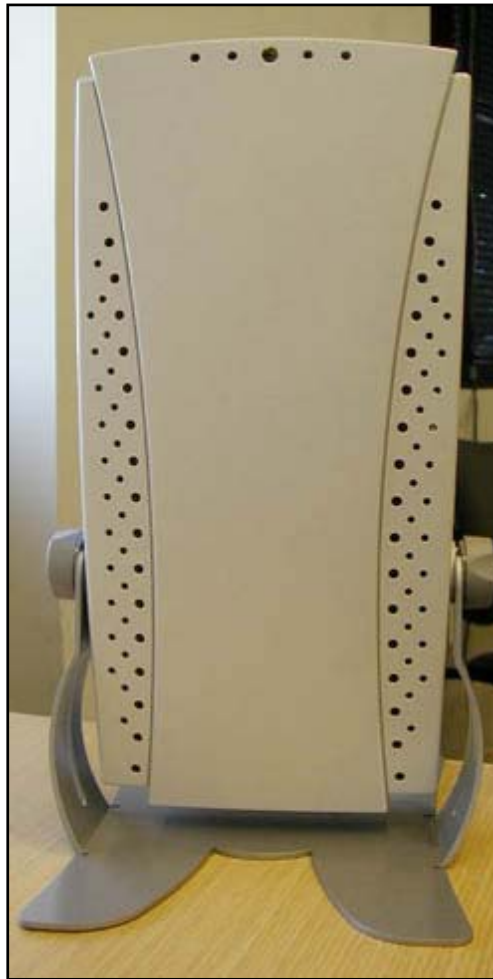
2 Network Architecture

The SkyPilot CPE (SC1050) combines with the Gateway (GW1050) and Seed (SD1050) to create a robust, high capacity wireless network. All wireless links within the network are established and optimized automatically. Seed units allow for expanded coverage and permit multiple paths through the network. A highly efficient routing algorithm selects the best path for user traffic and heals around any network failures.

2.1 Link Establishment

A Gateway is configured for a given channel within the 4.9 GHz band and signals its presence through the use of a periodic beacon message transmitted on that configured frequency. Seeds that have successfully connected to the network also transmit a periodic beacon message.

Upon power-up, the CPE listens for beacon messages generated by the Gateway and Seeds. The receive signal strength of these beacons is indicated by the LEDs. This LED indication allows the installer or end-user to position the CPE for optimum link performance. The CPE and Gateway or Seed automatically complete link optimization. This ensures the selection of optimal Gateway/Seed antenna and modulation rate. The SkyPilot units support modulation rates of 6-54Mbps and the highest, reliable rate shall be selected through the exchange of test packets. Note that established links are continually monitored and periodically optimized.

2.2 Bandwidth Allocation

The SkyPilot system implements a synchronization of the 802.11 protocol. This synchronization allows for the establishment of individual links between nodes utilizing a unique timing and antenna combination. In addition, highly accurate traffic rate and jitter control is enabled.

The SkyPilot system provides rate control for subscriber traffic both in the downstream (Gateway to CPE) and in the upstream (CPE to Gateway) direction. The maximum rate downstream and upstream rate can be specified for each subscriber. In conditions of over-subscription when the overall bandwidth demand is higher than the system capacity, the individual subscriber data rates will be reduced proportionately. i.e. a configured 2Mbps is reduced to 1.5Mbps while a configured 1Mbps rate is reduced to 750kbps.

2.3 Networking

The SkyPilot system operates as a Layer 2 network. The Gateway and CPE have an Ethernet bridge. All upstream subscriber traffic is direct out the Gateway Ethernet port and to external switch or router.

All SkyPilot network elements implement a SNMPv2c agent. In addition, there is also a CLI that may be access locally via a serial port or remotely via Telnet. In order to support these interfaces, an IP address must be allocated. This allocation can be done dynamically via DHCP or may be statically configured. See Section 4 for details.

3 Installation

The SkyPilot CPE is designed for a wide range of installations. The Indoor CPE can be user installed in a home or office. The Outdoor CPE can easily be installed on the roof or exterior wall of an office, apartment build or single family home. The Outdoor CPE can also be very easily installed on a light or utility pole.

3.1 Indoor CPE

3.1.1 Mounting

Before mounting the Indoor CPE the user must first find an appropriate location within the home or office building. In the case where there is limited Gateway/Seed coverage, the operator may aid this process by providing general pointing instructions. i.e. Point CPE in a West to Northerly direction. The user should avoid installations heavily effected by localized foliage or other obstructions, and should select upper floors if possible.

The user should power the CPE (See Section 3.1.2 for details) and place the unit in window. Once the CPE has successfully initialized, the beacon signal strength shall be indicated by the WAN Activity LED (LED 4). The faster the cadence, the higher the receive power. Ideally, the user shall test the CPE in multiple locations selecting the one with the highest reported power level. The Indoor CPE LEDs can be seen below.

Once the best location has been identified, then the user must mount the CPE. If there is a suitable desk, bookshelf or other flat surface, then the desk mount may be utilized. The user should set the CPE in the cradle, ensuring the front of the unit is pointing toward the window. The CPE can be fixed in position by tightening the mounting knobs.
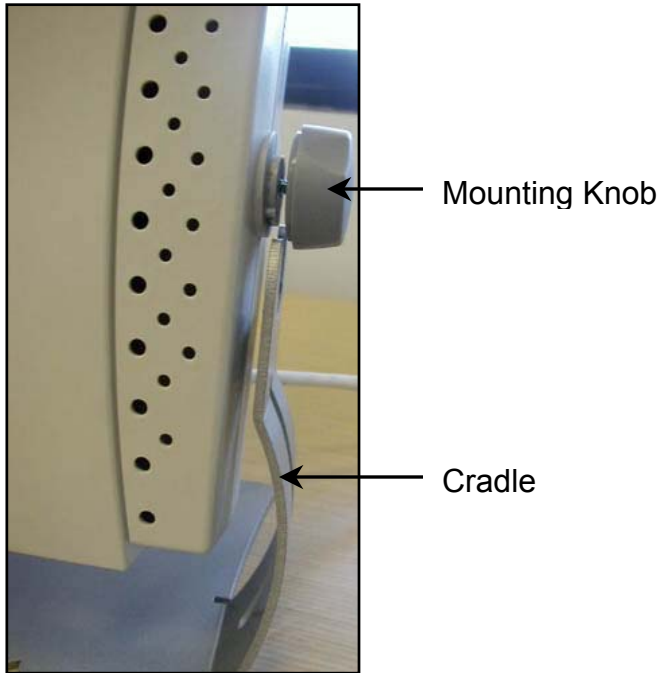
If there is no suitable flat surface, then the user should install the window mounting bracket. This can be installed on a window ledge or on the side or top of a window frame. The CPE is then attached to the bracket via one of the supplied mounting knobs. Note that the CPE must always be mounted vertically.
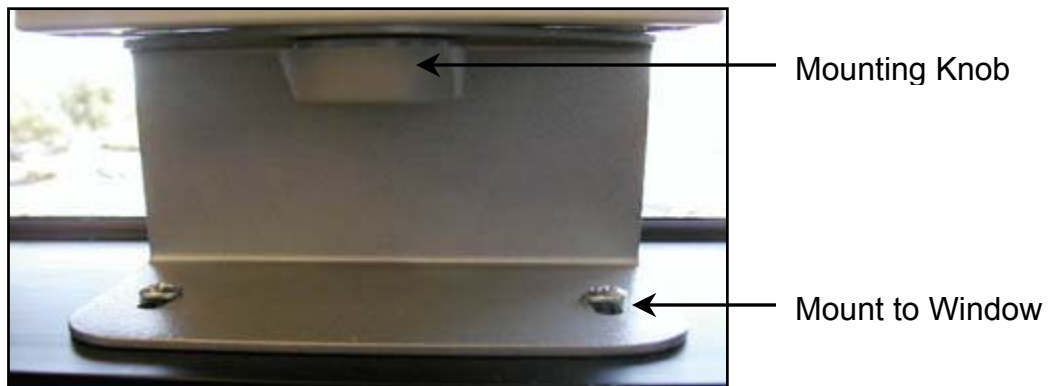
3.1.2   Cabling

The Indoor CPE utilizes Power over Ethernet (PoE) provided by the included Power Injector. ***Note that the CPE should be installed with the SkyPilot provided Power Injector only. The use of other PoE Power Injectors could result in damage to the unit.***

The Power Injector has three connections:

1. Power – receives power from the Power Supply.
2. CPE Connector – connects the Power Injector to the CPE via a supplied Cat5. This connection carries both 10/100bT Ethernet and power to the CPE.
3. LAN Connector – provides a 10/100bT Ethernet connection for the subscriber. This connects to a PC or local router/switch device.

When locating and mounting the CPE, the user should power the Power Injector via the Power Supply and power the CPE via PoE 10500bT interface.

3.2 Outdoor CPE

3.2.1 Mounting

As with the Indoor CPE, the appropriate location for the Outdoor CPE must be found before mounting. Link quality is generally improved with an installation as high and as free of obstruction as possible.

The installer should power the CPE and, using the LED indication (LED 4), find the location and direction with the best signal strength. As previously noted, knowledge of Gateway and/or Seed location(s) can speed this process.


Having found the best location for link quality, the Outdoor CPE can easily be mounted on a standard 1.25 inch diameter pole. Any mounting system that meets local wind-loading regulations will be satisfactory. The photograph below shows a typical rooftop unit installation.

3.2.2   Cabling

The Outdoor CPE is cabled in the same manner as the Indoor CPE. Note that it is recommended that the Power Injector is located indoors or a suitable weatherproof enclosure. The Outdoor CPE has a weatherproof 10500bt Ethernet interface that includes a rubber gasket and metal cover. First the Cat5 Ethernet cable is inserted.
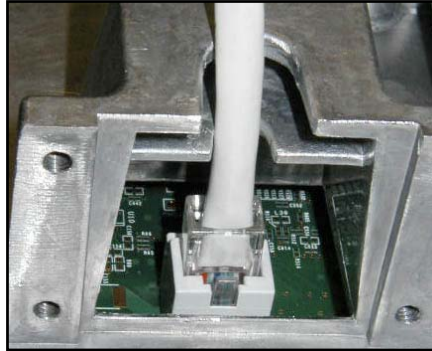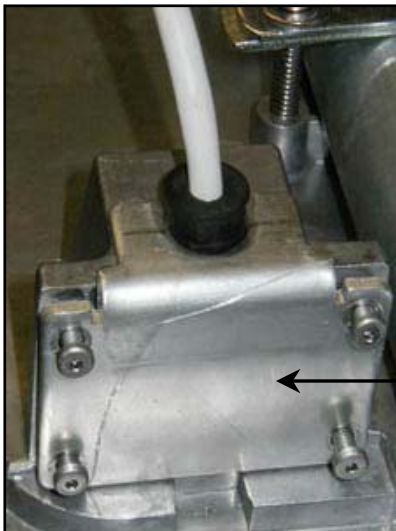

The gasket is then placed around the cable.
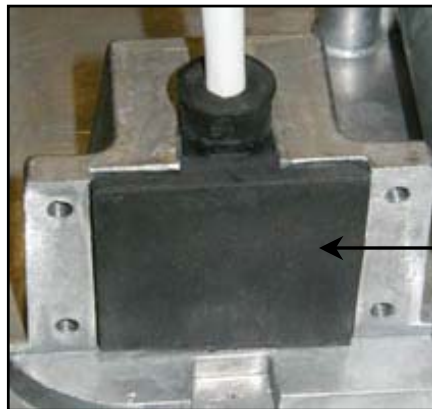
Weather Gasket

Finally the bottom cover is attached with the screws provided.

Cover

4 Configuration

The SkyPilot system requires minimal configuration before service can be offered. There is the option to utilize the SkyPilot Provisioning Server or to manual configure. The Provisioning Server, with its interface to an SQL database facilities the configuration of large scale networks. The Provisioning Server is the topic of a separate document. This document shall focus on the manual configuration of CPE (SC1050) units.

4.1 CPE Configuration

A CPE must be configured for the following:

1. IP Address Mode – DHCP or Manual
2. Management IP Address and Mask (if manually configure)
3. Ethernet Port Control
4. QoS Data Rates

4.1.1 IP Address Management

The CPE management interface (SNMP, Telnet) requires the allocation of an IP address. It can be configured to use either DHCP for dynamic IP address allocation or can be statically configured via the CLI.

DHCP is the default. For static allocation the IP Address, Netmask and IP Default Gateway must be input via the CLI. See Section 5 for details.

4.1.2 Ethernet Port Control

The CPE allows for the disabling (and enabling) of the 10500bT Ethernet port. Default is disabled. The enable/disable Ethernet port facility can also be used to control subscriber access.

4.1.3 Subscriber Data Rates

The CPE allows for configuration of maximum downstream and upstream data rates. The values relate to traffic sent and received over the Ethernet port.

5 CLI

The CPE (SC1050) provides a complete CLI interface. This interface may be used to configure and monitor the unit. A full definition of the CLI is available – email support@skypilot.com to request a copy.

As an example, the CPE configuration screen is shown below. All other CPE parameters are read-only.

```
Tera Term - COM1 VT
File  Edit  Setup  Control  Window  Help

> set ?
eth          - Activate or disable Ethernet port.
               Synopsis: set eth <up | down>

defaultgw    - Set the IP address of the default gateway.
               Synopsis: set defaultgw <IP address>

ip           - Set the Ethernet IP address.
               Synopsis: set ip <IP address>

mask         - Set the netmask.
               Synopsis: set mask <netmask>
> set ip 192.168.4.189

> set defaultgw 192.168.4.1

> set mask 24

> set eth up

> show flash
IP Address = 192.168.4.189
Net mask = 24
Default route = 192.168.4.1
Frequency = 5765
Node type = Seed
Ethernet state = up

> █
```

6 SNMP

The CPE (SC1050) has a SNMPv2c agent. The following MIBs are supported:

1. MIB-II (RFC 1213)
2. EtherLike (RFC 2665)
3. Bridge (RFC 1493)
4. SkyPilot Private MIB

Email support@skypilot.com to request a copy of the SkyPilot MIB.

FCC REGULATORY INFORMATION

Digital Device Section of Product

NOTE: 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:
-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

Information to user.
The user of this product is cautioned that changes or modifications not expressly approved by SkyPilot Inc. could void the user's authority to operate the equipment under FCC Rules.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Radiation Hazard Warning
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: