SkyZhone 1624, 1424, 1224 Hardware Installation Guide

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Z H O N E ™

WARNING!

The SkyZhone product is a line power device conforming to UL 60950-1 and UL 60950-21 standards. The DC voltages (RFT-V signals) are provided to SkyZhone through the SHDSL connector. These voltages must be provided by a UL 60950-1 and UL 60950-21 certified power source, typically located at the Central Office. One such certified power source is the Argus Technologies CSM35 Modular Converter System (#012-550-B2). Uncertified power sources can result in injury or death.

Proper Safety Grounding is required to insure proper operation and protection from lightning strikes and surges. A copper ground lug is provided on the unit for this purpose. Connect a length of #10 AWG solid, bare, copper wire to the grounding lug and firmly tighten the grounding screw (see Figure 20). Connect the other end of the grounding wire to a grounded surface or another earth ground such as a metal rod. This ground must be install before applying power to the unit.

SkyZhone provides both Primary and Secondary lightning and surge protection to the SHDSL and PoE cable signals. The Console cable signals are not protected and this cable, which is not intended for outdoor use, should not be connected when the unit is installed.

This unit is powered by high voltage over the SHDSL lines. Electrical shock and personal injury can occur by touching the leads with the power on. Verify that the SHDSL lines are deenergized before installing or removing the equipment. Always turn the power off at the DSLAM before installing or removing this equipment.

The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require the use of an agency listed (UL/CSA) Building Entrance Protector for all power and data communications cables entering a building. This is to protect the building and occupants from damage caused by transient voltage and current surges.

A UL 497 (CSA C22.2 No. 226-92) approved primary protection device must be used at the building entrance if the Ethernet port is used to provide in-building access to the SkyZhone network. Also check with local wiring codes.

Caution:

- This product requires professional installation.

- The unit is sealed at the factory and must not be opened in the field. The unit shall be returned to the factory for repairs.

- Serious injury can occur if the antennas come in contact with electric power lines. Carefully follow the instructions in this manual. During and after installation, the antennas must be a minimum of 24 inches from any power lines. Use caution when installing this outdoor equipment.

- FCC RF Exposure Requirements (per OET-65) requires the SkyZhone platform to be mounted such that the general public does not come within 10 inches of the antennae.

- The PoE (Power over Ethernet) connector sources power to other devices. Some devices may not be compatible with this feature. In that case, do not connect the wires that supply the power. The power is 48 volts DC, at a maximum of 5 watts.

Note:

- This equipment has been tested and found to comply with the limits for a Class C digital device, pursuant to part 15, subpart C, of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, may increase the potential for harmful interference to radio communications.

WARNING!

The authority to operate this equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the manufacturer.

- This warning applies to the Skyzhone-1424 only. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense..

- Changes or modifications not expressly approved by Zhone Technologies, Inc. could void the user's authority to operate the equipment.

- The supplied cables and antennae must be used to ensure compliance with Part 15, FCC Rules.

- This device may only be used with approved antennae that are shipped with the unit and installed per installation instructions. The use of any other antennas will invalidate the unit's FCC Part 15 certification.

- The 2.4 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5 dBi. Antennae not included in this list (Comet Part Number CFA-245W-SR) or having a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- The 4.9 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5.3 dBi. Antennae not included in this list (Comet Part Number SF-D49NW-SR) or having a gain greater than 5.3 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms

- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication. Operating the device with the supplied antennas will ensure that this requirement is met..

- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

CONTENTS

ABOUT THIS GUIDE

This guide is intended for use by installation technicians, system administrators, network administrators. It explains how to install the SkyZhone station and how to provision the physical interfaces.

Style and notation conventions

The following conventions are used in this document to alert users to information that is instructional, warns of potential damage to system equipment or data, and warns of potential injury or death. Carefully read and follow the instructions included in this document.

Caution: A caution alerts users to conditions or actions that could damage equipment or data.

Note: A note provides important supplemental or amplified information.

Tip: A tip provides additional information that enables users to more readily complete their tasks.

WARNING! A warning alerts users to conditions or actions that could lead to injury or death.

Typographical conventions

The following typographical styles are used in this guide to represent specific types of information.

Bold	Used for names of buttons, dialog boxes, icons, menus, profiles when placed in body text, and property pages (or sheets). Also used for commands, options, parameters in body text, and user input in body text.
Fixed	Used in code examples for computer output, file names, path names, and the contents of online files or directories.
Fixed Bold	Used in code examples for text typed by users.
Fixed Bold Italic	Used in code examples for variable text typed by users.
Italic	Used for book titles, chapter titles, file path names, notes in body text requiring special attention, section titles, emphasized terms, and variables.
PLAIN UPPER CASE	Used for environment variables.
Command Syntax	Brackets [ ] indicate optional syntax. Vertical bar | indicates the OR symbol.

Related documentation

Refer to the following publication for additional information:

 SkyZhone CLI Reference Guide explains how to use the Zhone command line interface (CLI) and describes the system commands and parameters.

SkyZhone WEB Configuration Tool User Guide explains how to configure and manage SkyZhone using the Web interface.

Refer to the release notes for software installation information and for changes in features and functionality of the product, if any.

Acronyms

The following acronyms are related to Zhone products and may appear throughout this manual:

Table 1: Acronyms and their descriptions

Acronym	Description
ADSL	Asymmetrical Digital Subscriber Line
AP	Access Point
ACS	Auto Configuration Server
DHCP	Dynamic Host Configuration Protocol

Table 1: Acronyms and their descriptions

Acronym	Description
DSL	Digital Subscriber Line
EFM	Ethernet in the First Mile
MALC	Multi-Access Line Concentrator
MIB	Management Information Bases
NAT	Network Address Translation
NMS	Network Management System
RADIUS	Remote Authentication Dial In User Service
SHDSL	Symmetric High-bit-rate Digital Subscriber Line
SLMS	Single Line Multi-Service
SNMP	Simple Network Management Protocol
TFTP	Trivial File Transfer Protocol
VoIP	Voice over IP
VoWi-Fi	Voice-over-Wifi
VPN	Virtual Private Network
WEP	Wired Equivalent Privacy
Wi-Fi	Wireless Fidelity (IEEE 802.11 wireless networking)
WMM	Wi-Fi Multimedia
WPA	Wi-Fi Protected Access
ZMS	Zhone Management System

Contacting Global Service and Support

Contact Global Service and Support (GSS) if you have any questions about this or other Zhone products. Before contacting GSS, make sure you have the following information:

- Zhone product you are using

- System configuration

- Software version running on the system

- Description of the issue

Technical support

If you require assistance with the installation or operation of your product, or if you want to return a product for repair under warranty, contact GSS. The contact information is as follows:

E-mail	support@zhone.com
Telephone (North America)	877-ZHONE20 (877-946-6320)
Telephone (International)	510-777-7133
Internet	www.zhone.com/support

If you purchased the product from an authorized dealer, distributor, Value Added Reseller (VAR), or third party, contact that supplier for technical assistance and warranty support.

Service requirements

If the product malfunctions, all repairs must be performed by the manufacturer or a Zhone-authorized agent. It is the responsibility of users requiring service to report the need for service to GSS.

1

THE SKYZHONE ACCESS POINT

This chapter provides an overview of the SkyZhone Wi-Fi outdoor access point. It includes these sections:

- Overview, page 11
- SkyZhone features, page 13
- SkyZhone ordering information, page 20

Overview

The SkyZhone access point is a line-powered carrier class outdoor Wi-Fi access point with 22 Mbps symmetric DSL backhaul to every unit. The SkyZhone supports a variety of applications including VoIP, internet access, mobile video, and enterprise VPNs optimized for citywide Wi-Fi deployments by telephone companies.

SkyZhone enables telephone companies to deploy a more reliable, lower latency, higher speed and lower cost network than traditional mesh Wi-Fi solutions.

Figure 1: SkyZhone with 2.4GHz 802.11b/g/n and 4.9 GHz 802.11a antennas
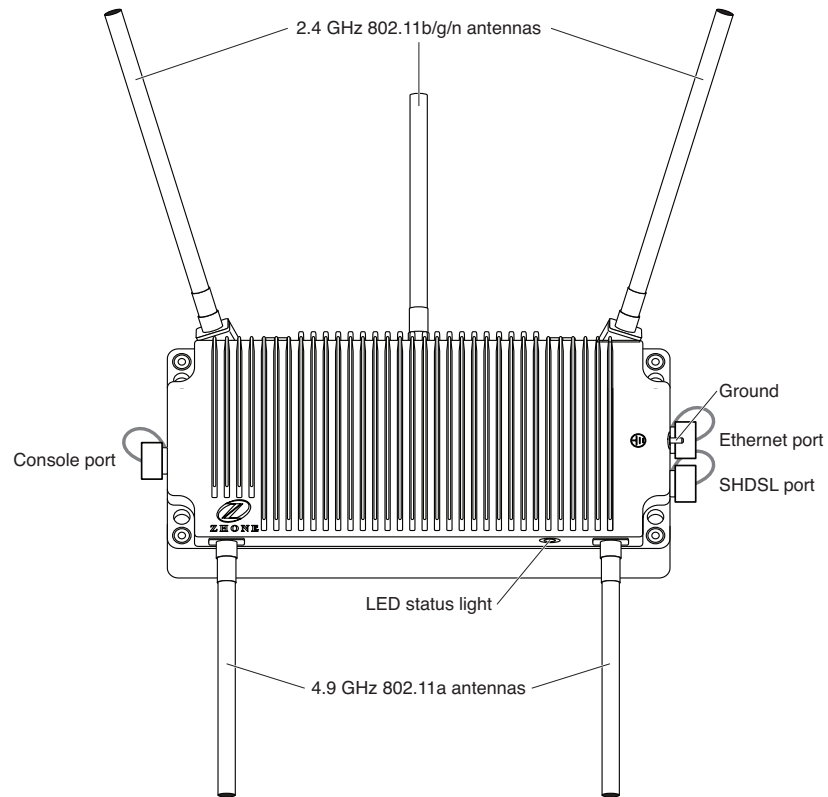
SkyZhone models

The SkyZhone access point is available in the following models:

* SkyZhone-1624 Wi-Fi Access Point

  Supports wireless radio transmission of 2.4 GHz 802.11b/g, and 4.9 GHz 802.11a, using two separate radios. Four SHDSL lines with EFM Bonding are used for backhaul and line powering.

* SkyZhone-1424 Wi-Fi Access Point

  Supports wireless radio transmission of 4.9 GHz 802.11a. Four SHDSL lines with EFM Bonding are used for backhaul and line powering.

* SkyZhone-1224 Wi-Fi Access Point

  Supports wireless radio transmission of 2.4 GHz 802.11b/g. Four SHDSL lines with EFM Bonding are used for backhaul and line powering.

Coverage area

With the SkyZhone access point, there is no need to use Wi-Fi links for communication between stations. This eliminates issues associated with buildings, trees, or hilly terrain that can impact node-to-node communications for mesh access points.

The SkyZhone access point uses 5dBi antennas that provide a 26 degree beam-width per antenna. Additionally, the three 2.4 GHz antennas are oriented to provide complete coverage both horizontally and vertically. SkyZhone access point's signals extend up and down, and all around to minimize dead spots.

MIMO (Multiple-In, Multiple-Out) technology maximizes the receive signal strength from typical low-power 802.11b/g client devices and enables SkyZhone to maintain a reliable link at distances more than 50% greater than non-MIMO solutions.

In Figure 1 on page 12, note that the 4.9 GHz 802.11a radio uses the bottom two antennas and the 2.4 GHz 802.11b/g radio uses the top three antennas.

The 2.4 GHz radio operates in the unlicensed ISM band and can be used for a variety of applications such as Internet Access, Voice over IP, Mobile Video, or Enterprise VPN.

The 4.9 GHz radio operates in the licensed spectrum reserved for Public Safety users including city government, police, fire and EMT.

SkyZhone features

The SkyZhone access points communicate with SkyZhone aggregators using standards-based SHDSL-EFM uplinks to transport data traffic between access points and the Central Office or remote cabinet.

After initial power up, the SkyZhone access point contacts the ACS Server, downloads the latest software, downloads the configuration file, and registers itself with the Network Management System (NMS) system.

The SkyZhone access points' dual-radio architecture provides 2.4GHz access for residential and commercial applications while simultaneously providing 4.9GHz access for public safety applications, using industry standard IEEE 802.11 client devices.

Remote configuration and troubleshooting is supported via SSH and HTTPS to SkyZhone access points through a separate management VLAN. In addition, a console port is provided for local access to the CLI.

SkyZhone also includes a Power-over-Ethernet (PoE) port which provides for connectivity from the SkyZhone access point to a video camera or other accessory.

Bonding

The SkyZhone access point supports Ethernet in the First Mile (EFM) bonding on SHDSL lines. This bonding complies with the IEEE 802.3ah standard. Additional SHDSL lines can be added as your bandwidth needs increase. The SkyZhone access point automatically performs load balancing over the SHDSL lines.

Figure 2 shows an example of a SkyZhone network configuration.

Figure 2: SkyZhone network configuration
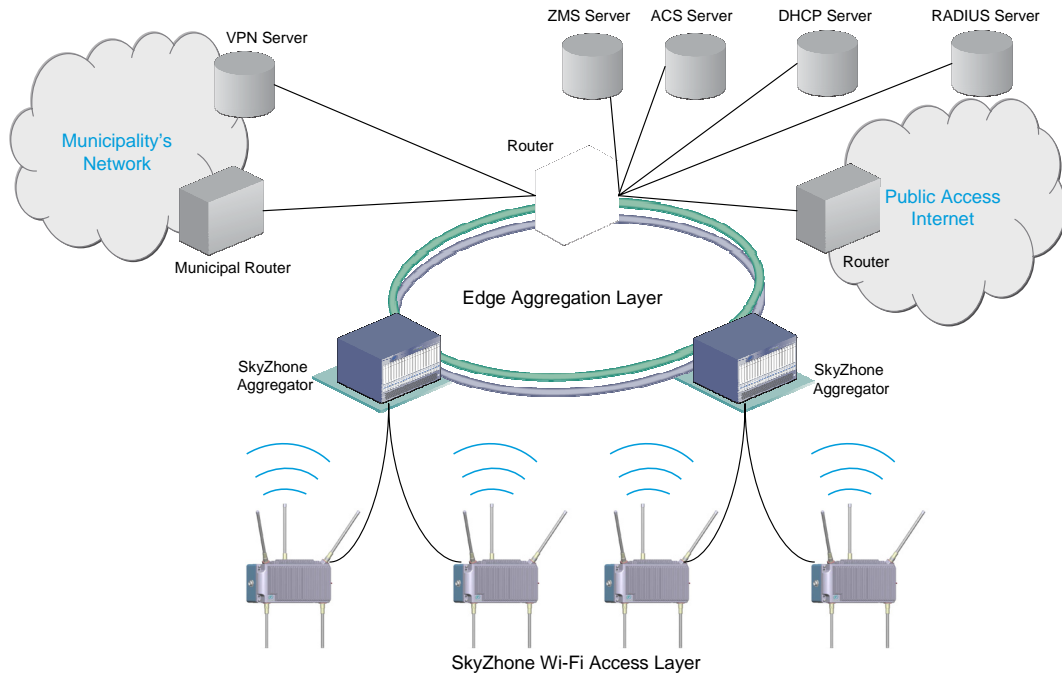
The SkyZhone supports 4 SHDSL lines bonded as a single EFM interface and connected to a SHDSL card installed in a SkyZhone Aggregator. Each SHDSL line card in the SkyZhone Aggregator provides 24 ports and each SkyZhone access point uses up to 4 ports. The data rates for the SHDSL card are shown in Table 2:

SHDSL Data Rates

The SkyZhone Access Points support the following SHDSL data rates.

SHDSL Data Rates

Table 2: SHDSL Data Rates

Distance (Feet)	Line 1 (Kbps)	Line 2 (Kbps)	Line 4 (Kbps)
4000	5696	11392	22784
5000	5120	10240	20480
6000	3776	7552	15104
7000	2944	5888	11776
8000	2432	4864	9728
9000	2048	4096	8192
10000	1664	3328	6656
11000	1359	2718	5436

Table 2: SHDSL Data Rates

Distance (Feet)	Line 1 (Kbps)	Line 2 (Kbps)	Line 4 (Kbps)
12000	1024	2048	4096
13000	768	1536	3072
14000	640	1280	2560
15000	512	1024	2048
16000	512	1024	2048
17000	384	768	1536
18000	320	640	1280

Mounting options

The SkyZhone access point can be mounted on a pole, at any angle (between vertical and horizontal), on a streetlight, loop span, or wall.

Wall-Mounting Enclosure

When wall-mounted the SkyZhone access point may be contained in an enclosed and "hidden" plastic casing that is supported on an aluminum mounting shelf. The following figure shows the SkyZhone access point with the enclosure lid removed.

Figure 3: Wall-Mount Enclosure with cover removed
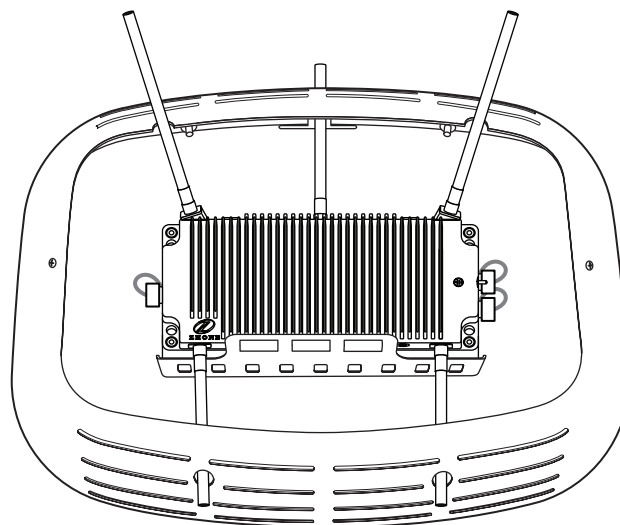
See for using the wall-mounted enclosure kit.

Line power

The SkyZhone access point is powered by a SkyZhone aggregator over the SHDSL link. There are four pairs of twisted wires on the uplink interface that are capable of delivering power to the unit in addition to carrying the SHDSL signals. Two powered pairs are required with the other two for longer loops. The wiring diagram below illustrates the wiring connections for power and data being transmitted over the same pair of wires..

Figure 4: SHDSL backhaul with span powering
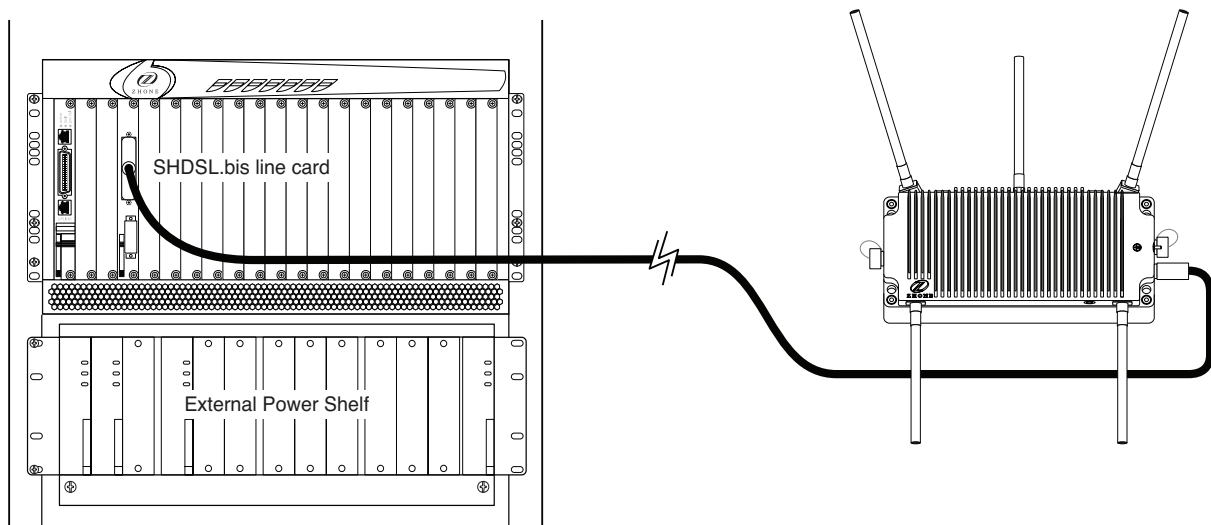
The SkyZhone access point supports power and data on the same wires.

Delivering power and data over the same wires

Note: For more information about the hardware required to deliver power and data over the same wires, contact your Zhone sales representative.

Cables

The SkyZhone Port Connectors

The port connectors are located on either side of the SkyZhone unit. Figure 5 shows the SkyZhone access point port locations.

Figure 5: SkyZhone port connectors

Console port

Ethernet port

SHDSL port
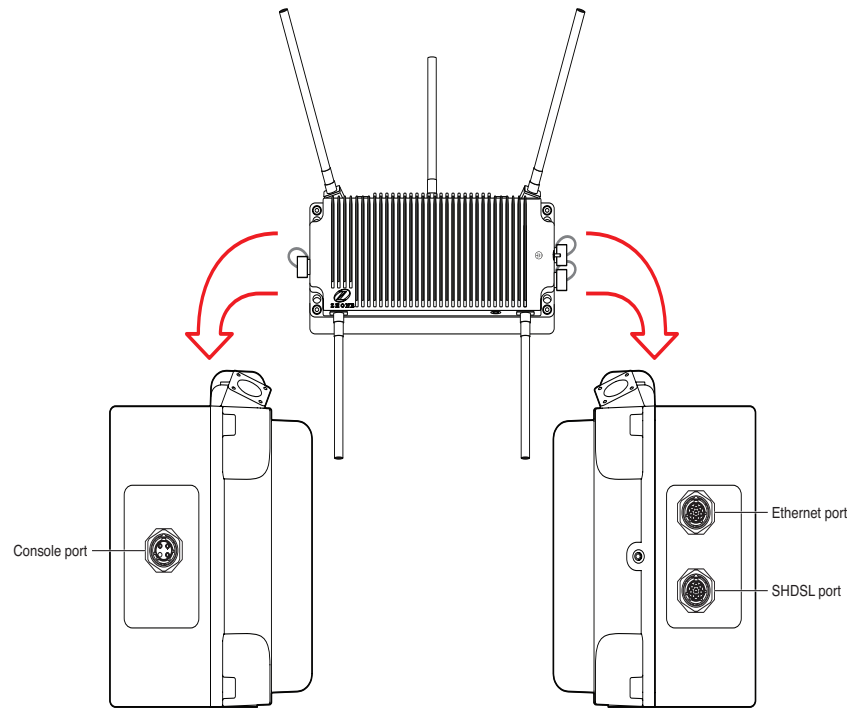
SHDSL, Ethernet (PoE) and Console connectors

Figure 6 displays the pinouts for the SHDL PLUG connector.

Figure 6: SHDSL PLUG connector
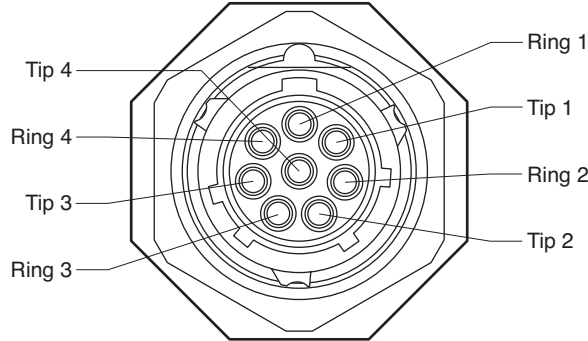
Table 3 on page 18 lists the pinouts for the SHDSL cable. Each DSL line is composed of a twisted-pair of wires. Two pairs are for power (RFT-V voltages) and data and two pairs are for data only. To operate on longer loops power is required on Tip/Ring 3 and 4. These wires can be used in any combination, although positive voltage is typically carried on T/R1 and T/R3, while negative voltage is on T/R2 and T/R4.

> **Note:** The mechanical configuration (SOCKET vs. PLUG) of the SHDSL and the Power-over-Ethernet connectors are unique to prevent attaching a cable to the wrong connector.

Table 3: SHDSL connector pinouts for line power and data over the same wire pairs

Line	Signal	Color
1	Ring 1 (data and power)	Blue
	Tip 1 (data and power)	White/Blue
2	Ring 2 (data and power)	Orange
	Tip 2 (data and power)	White/Orange
3	Ring 3 (data and additional power)	Green
	Tip 3 (data and additional power)	White/Green
4	Ring 4 (data and additional power)	Brown
	Tip 4 (data and additional power)	White/Brown

Ethernet (PoE)

Figure 7 displays the pinouts for a PoE SOCKET connector.

Figure 7: PoE SOCKET connector
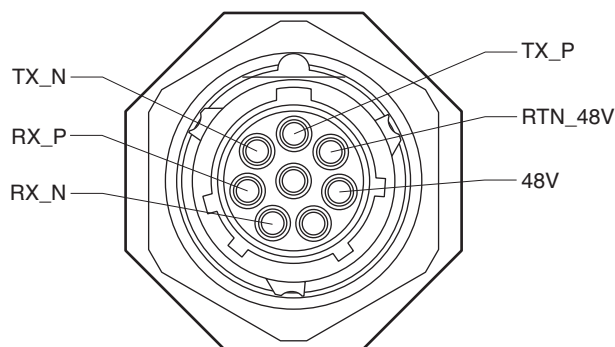
Table 4 lists the pinouts for the Ethernet (PoE) cable. Unused PoE connectors must have a dust cap installed to maintain an IP66 rating.

Table 4: Power-over-Ethernet (PoE) connector pinouts for line power

Pin	Signal	Color
A	TX_P	Blue
B	TX_N	White/Blue
C	RX_P	Orange
D	RX_N	White/Orange
E	No connection	
F	48V	Green
G	Return_48V	White/Green
H	No connection	
I	No connection	
J	No connection	

Console

Figure 8 displays the pinouts for a Console SOCKET connector. This connector is for temporary use to configure the SkyZhone before mounting. Any cabling to the console connector must be removed from the permanent installation to avoid shock hazards. Dust caps must be installed to maintain an IP66 rating.

Figure 8: Console SOCKET connector
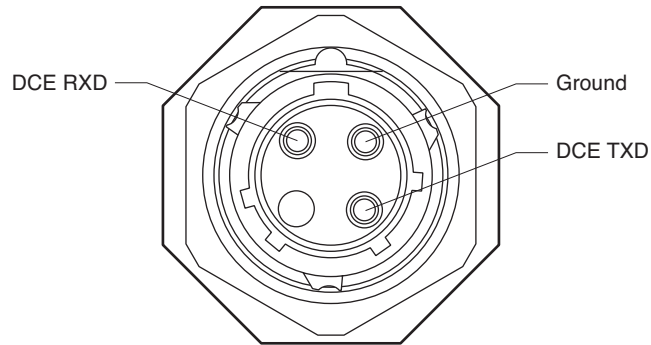
Table 5 lists the pinouts for the Console SOCKET cable.

Table 5: Console **SOCKET connector pinouts for line power**

Pin	Signal	Color
1	DCE_RXD	Brown
2	No connection	
3	DCE_TXD	White
GND	GND	Black

> ☑ **Note:** For more information about the hardware required to deliver power and data over the same wires, contact your Zhone sales representative.

Grounding

Proper grounding must be complete before you connect power to the unit. See *Grounding* on page 37.

SkyZhone ordering information

To order SkyZhone Wi-Fi outdoor access points by model number contact GSS, see *Contacting Global Service and Support* on page 9.

2 PREPARING FOR INSTALLATION

This chapter describes how to prepare your site for the installation of the SkyZhone. It includes the following sections:

Installation precautions

It is advisable to be aware of the following precautions:

WARNING! This unit is powered by high voltage over the SHDSL lines. Electrical shock can occur by touching the leads with the power on. Span power supply has current limiters to prevent personal injury due to shock. Verify that the SHDSL lines are deenergized before installing the equipment. Always turn the power off by opening the relays of the Aggregator before installing this equipment.

WARNING! Serious injury can occur if the antennas come in contact with electric power lines. Carefully follow the instructions in this manual. During and after installation, the antennas must be a minimum of 24 inches from any power lines. Use caution when installing this outdoor equipment.

WARNING! The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require the use of an agency listed (UL/CSA) Building Entrance Protector for all power and data communications cables entering a building. This is to protect the building and occupants from damage caused by transient voltage and current surges.

WARNING! A UL 497 (CSA C22.2 No. 226-92) approved primary protection device must be used at the building entrance. Also check with local wiring codes.

> ⚡ **WARNING! The unit is sealed at the factory and must not be opened in the field. The unit shall be returned to the factory for repairs.**

- SkyZhone product requires professional installation.

- This equipment has been tested and found to comply with the limits for a Class C digital device, pursuant to part 15, subpart C, of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, may increase the potential for harmful interference to radio communications.

- The SkyZhone-1424 equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.

> ⚡ **WARNING! The authority to operate SkyZhone-1424 equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the manufacturer.**

- The PoE (Power over Ethernet) connector sources power to other devices. Some devices may not be compatible with this feature. In that case, do not connect the wires that supply the power. The power is 48 volts DC, at a maximum of 5 watts.

- This unit can only be used with approved antennas that are shipped with the unit. Antennae should be kept at least 10 inches away from contact with the general public passing by the area.

- Proper grounding of the SkyZhone platform must be completed before you connect power to the unit.

  – The internal subassemblies signal/Logic ground is internally bonded to the Safety Ground (chassis).

  – SkyZhone provides both Primary and Secondary lightning and surge protection to the SHDSL and PoE cable signals. The Console cable signals are not protected and this cable, which is not intended for outdoor use, should not be connected when the unit is installed.

– The SHDSL cable that carries RFT-V power to the unit has no connection to the Chassis Ground. This cable shield is only intended to add durability and mechanical protection of the internal wires.

– Proper Safety Grounding is required to insure proper operation and protection from lightning strikes and surges. A copper ground lug is provided on the unit for this purpose. Connect a length of #10 AWG solid, bare, copper wire to the grounding lug and firmly tighten the grounding screw (see *Grounding* on page 37). Connect the other end of the grounding wire to a grounded surface or another earth ground such as a metal rod.

• No modifications or changes to this equipment are allowed, unless the changes or modifications are expressly approved by the manufacturer. It is recommended that shielded cables be used to reduce interference whenever interference is suspected.

Selecting the locations

Each installation is unique due to the physical environment. Before installing each SkyZhone access point, perform a site survey to determine the optimum placement of units for maximum range, coverage, and network performance.

The SkyZhone radio is susceptible to interference that can reduce data rate and range. For best performance, follow these guidelines:

• Install the unit in an area where trees, buildings, and large steel structures do not obstruct radio signals to and from the antenna. Be sure to consider the future tree growth and construction when considering a site. Direct line-of-sight operation is always best. Antennae should be kept at least 8 inches away from contact with the general public passing by the area.

• Install the units away from other possible sources of 2.4 GHz WLAN interference. These sources include cordless phones and microwave ovens, as well as other WiFi access points.

• Install the units, when wall-mounted, onto an area that can accommodate the plastic casing and lid of 24 inches high and at least 36 inches wide.

Specifications

The following table lists SkyZhone's technical specifications:

Table 6: SkyZhone technical specifications

Description	Specifications
PHYSICAL	
Dimensions	14" W x 6"H x 6"D

Table 6: SkyZhone technical specifications (Continued)

Description	Specifications
Weight	18 lbs
Operating Temperature	-31F to 122F (-35C to 50C)
Power	+/- (70-140) VDC input (RFT-V Signals), 45W Maximum Span powered on two or four Tip/Ring pairs.
Line Power input Capacitance	Tip - Ring < 2 uF Tip - Gnd < 1000 pF Ring - Gnd < 1000 pF (Note: When combined with telco cable the Tip-Gnd and Ring to Gnd cannot exceed 10 uF. This should be verified with the Telco before installation)
Backhaul	22.8 Mbps symmetric backhaul using ITU G.991.2 (SHDSL) on four Tip/Ring pairs.
Regulatory Certifications	FCC Part 15, Subpart-C (15.247) FCC Part 15, Class A FCC Part 90 UL60950-1, UL60950-21 Industry Canada RSS210 CAN/CSA-22.2 No. 60950-1-03
Enclosure/ Humidity and Dust	IP66, NEMA4X, IEC 60529
MANAGEMENT	
Management Interfaces	WEB I/F, Command Line I/F, SNMPv2, TR-069
Management Access	HTTPS, SSH, TR-069
Mgmt Access Security	RADIUS password authentication
Wi-Fi Access Security	IEEE 802.1X, WPA/WPA2, WEP

Table 6: SkyZhone technical specifications (Continued)

Description	Specifications
Standards Compliance	EN60950
	IEEE 802.11b, g, n (draft) (2.4 GHz Wireless)
	IEEE 802.11a (4.9 GHz Wireless)
	IEEE 802.1D Bridging
	K.20 Surge Immunity
	IEEE 802.3ah (2Base-TL) Ethernet in the first mile
	IEEE 802.1Q VLANS
	IEEE 802.1p Priority
	IEEE 802.3u 10/100 Base-TX (Power over Ethernet I/F)
	ITU 991.2 Annex A and F
Frequency Band	2.412 - 2.462 GHz (2.4 GHz Wireless)
	4.900 - 4.990 GHz (4.9 GHz Wireless)
Channel Width	20 MHz (2.4 GHz Wireless)
	20 MHz (4.9 GHz Wireless)
Output Power (EIRP)	1.15 W (2.4 GHz Wireless)
	4.74 W (4.9 GHz Wireless)
Antenna Type	3 x 5 dBi Omni (2.4 GHz Wireless)
	2 x 5.3 dBi Omni (4.9 GHz Wireless)
Modulation Technique	PSK, DQPSK, DBPSK, OFDM (2.4 GHz Wireless)
	OFDM (4.9 GHz Wireless)
Data Rates (Mbps)	2.4 GHz Wireless (Channels 1-11)
	b: 11, 5.5, 2, 1
	g: 54, 48, 36, 24, 18, 12, 9, 6
	4.9 GHz Wireless (4.96 GHz and 4.98 GHz center freq.)
	a: 54, 48, 36, 24, 18, 12, 9, 6
Operating Distance	Up to 1300 DC Ohm loop loss (SHDSL I/F)) - Model and PoE power use dependent.
	Up to 300 feet (Power over Ethernet I/F)
	Up to 1800 feet 2.4 GHz 802.11 b/g and 4.9 GHz 802.11a
Connector Type	8 pin circular I/O PLUG (SHDSL I/F)
	8 pin circular I/O SOCKET (Power over Ethernet I/F)
WAN I/F	
Data Rate (per pair)	Up to 5.7 Mbps Full Duplex
Number of pairs	4 (up to 22.8 Mbps total)

Table 6: SkyZhone technical specifications (Continued)

Description	Specifications
Loop Bonding	IEEE 802.3ah (EFM)
Power over Ethernet I/F	
Data Rate	10Mbps/100Mbps
Number of Ports	1
Output Power	48V DC, maximum 5W
Data Path	
VLAN support	IEEE 802.1Q
Traffic Prioritization	IEEE 802.1p, 802.11e, IP TOS
Number of Priority Queues	4
Traffic Classification	Based on priority bits, protocol type, IP address
Rate Limiting	Upstream and downstream rate limiting per classified flow

3

INSTALLING THE SKYZHONE ACCESS POINT

This chapter describes how to mount the SkyZhone access point on a pole or on the side of a building. It includes the following topics:

Note that:

- The SkyZhone access point must always be mounted with the top of the unit horizontal and level.

- It is best to mount the SkyZhone access point to a metal structure. The metal mounting brackets are designed to make good contact with the pole, thereby assuring good quality connection to the grounded structure.

- The SkyZhone access point ships in a container with the antennas. The antennas are inside the protective foam, beneath the flap at the top. Do not throw away the foam.

Equipment needed for installation

Pole-mounting kit

The SkyZhone access point's pole-mounting kit (920-07821-01) contains the following items:

- One universal pole bracket that can be oriented for use on small or large diameter poles

- One SkyZhone support shelf with sun shield

- One nut to attach shelf to the center stud on the pole bracket

- Banding

- 4 screws to securely fasten shelf to the pole bracket

- 1 driver bit for the tamper-resistant screws

Wall-mounting enclosure kit

The SkyZhone access point wall-mounting enclosure kit (920-07811-01) contains the following items:

- One wall bracket

- One paintable decorative cover

- 4 (four) tamper-resistant mounting screws to mount the unit to the bracket

- 6 (six) mounting screws for the decorative cover

- 1 driver bit for the tamper-resistant screws

- *Not included:* 4 screws that will go through the metal bracket, plastic cover and into your wall's surface.

Wall-mount kit (without plastic cover)

The SkyZhone access point wall-mount kit (without plastic cover) (SkyZhone-1224 Wi-Fi Access Point) contains the following items:

- One wall bracket

- 4 (four) tamper-resistant screws

- 1 driver bit for the tamper-resistant screws

Customer supplied equipment

For installation, you need the following items:

- Band tensioner (BAND-IT Tool C001) with cutter

  Examples of tensioners are:

  Pok-It II Tool (CJ020)

  Ratchet Tool (C400

  Bantam Tool (C075)

  Bantam Strapping Tool (C085)

  Heavy Duty BAND-IT Tool (C003)

  Thriftool (J075)

 Giant Tool (G402)

- 7/16-inch nut driver

- cordless screwdriver with a 2 1/2 " extension to be able to secure the tamper-resistant screws, or a screwdriver that can receive a tamper-resistant screw that is at least three inches long.

Mounting the SkyZhone to a pole

This section describes the steps to mount a pole for the SkyZhone access point. First select a mounting location. You can attach the SkyZhone access point to any pipe or pole.
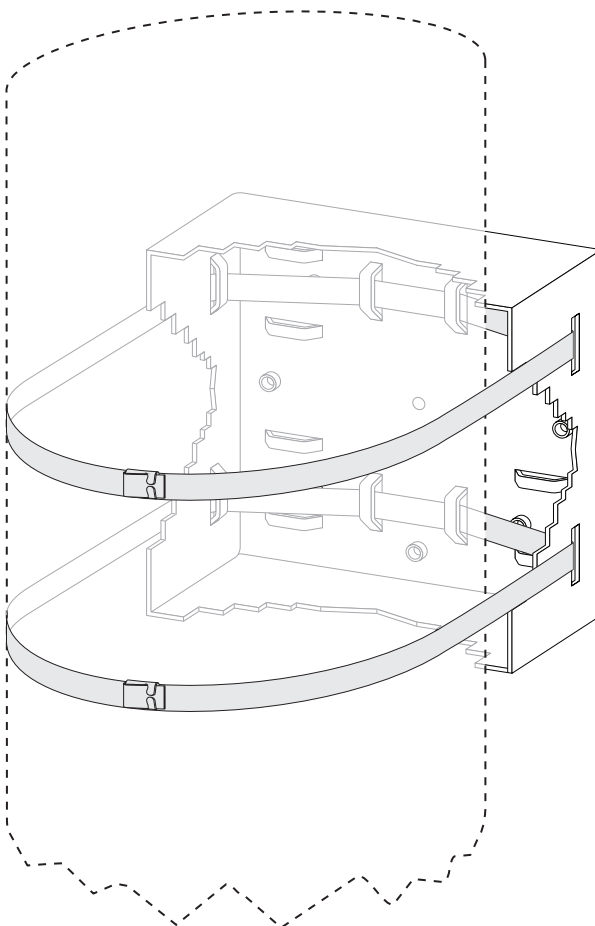
1   Attach tension bands to the pole mounting plate by threading them through the slots on the mounting plate. The slots are for either horizontal or vertical mounting on large or small diameter poles. Choose the one most appropriate for this installation.

Figure 9: Threading tension bands through mounting plate slots

Small diameter poles use this side of the mounting surface

Large diameter poles use this side of the mounting surface
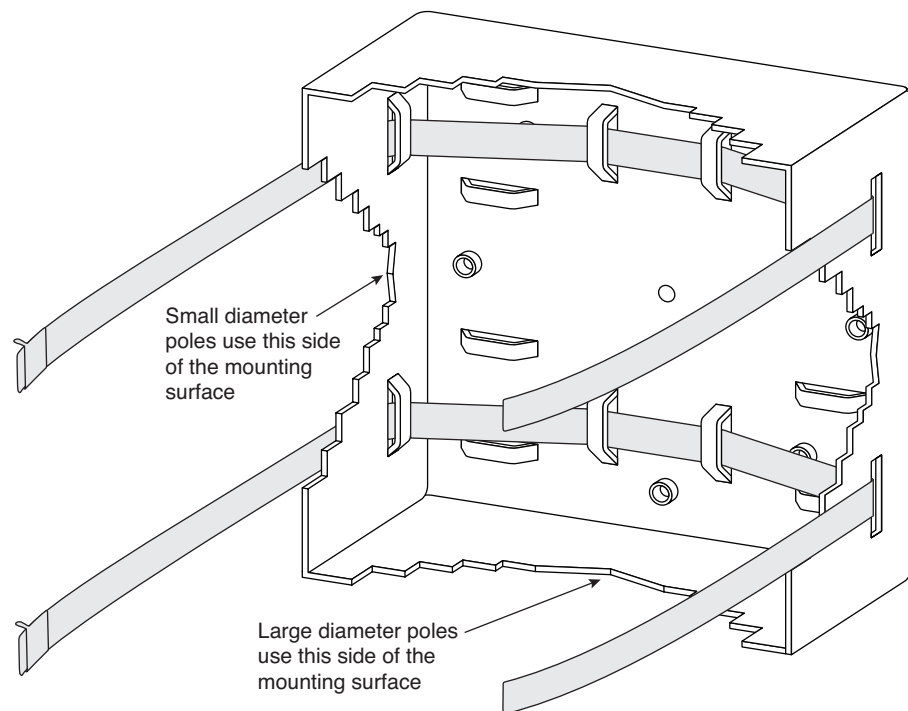
2   Secure the tension bands around the pole, following the illustrations provided with the BAND-IT Tool.
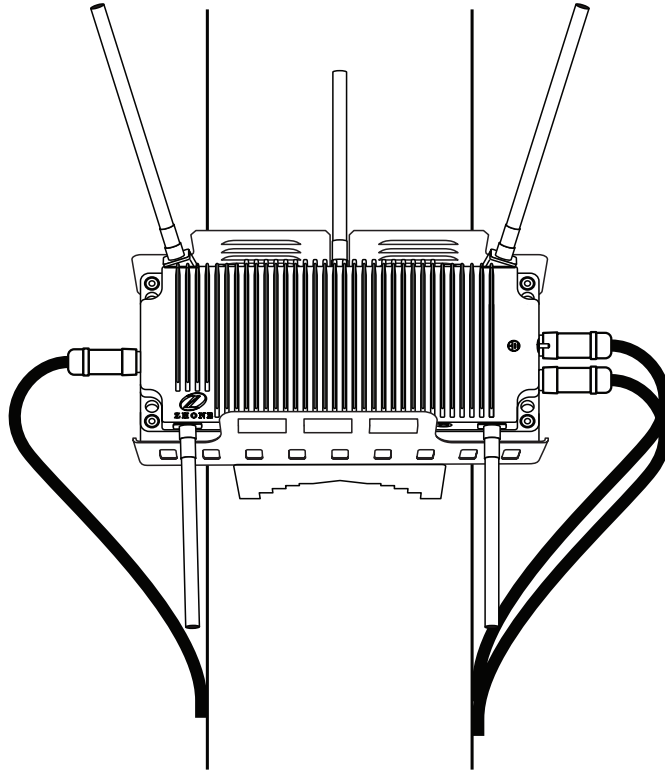
Figure 10: Mounting plate "strapped" around a pole

3   Tighten and if necessary, trim off any excess tension band.

4   Secure the mounting bracket to the pole, see Figure 11 on page 31.

The SkyZhone shelf is attached to the poll-mounting bracket. The shelf may need to be adjusted so that it is level.

**Figure 11: Bracket attached to the mounting plate attached to the pole**

5 Adjust the shelf until it is level by rotating the unit along the curved slot tracks.

6 Once the unit is level, securely tighten the center nut and four bolts that hold the shelf to the pole mount bracket as shown in Figure 11.

7 Attach the antennas to the unit.

Note the antennas are different sizes. The three longer antennas are connected to the top of the unit. The two shorter antennas are mounted to the bottom of the unit. The antennas are not interchangeable. It is critical that the longer antennas are on the top, and the shorter ones on the bottom of the unit.

8 Slide the unit into the sun shield housing.

9 Secure with 4 (four) tamper-resistant screws, provided in the mounting kit, through the holes on the front of the unit.

10 Attach the SHDSL cable to the SHDSL connector.

11 Attach the Ethernet cable if it is being used.

12 Secure the cable(s) to the pole with cable ties to provide strain relief, if needed.

> ☑ **Note:** This previous procedure showed the SkyZhone station being mounted to a vertical pole. The same instructions apply to the installation on a horizontal pole or any other orientation as shown in the figure below.

Figure 12: The bracket and sunshield mounted on a horizontal pole
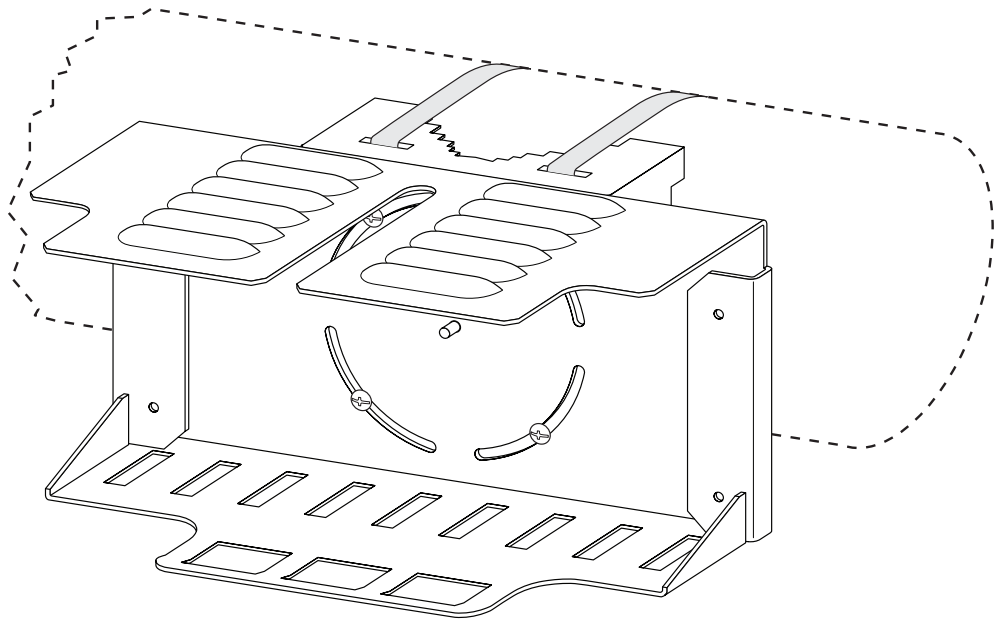
Mounting the SkyZhone to the side of a building

The wall mount enclosure kit is used when the SkyZhone is mounted to a building. The cover is used to hide the unit for aesthetic purposes. This cover can be painted, which allows the unit to blend in with the building. Figure 13 displays a fully-assembled SkyZhone with its cover.

Figure 13: SkyZhone with a cover
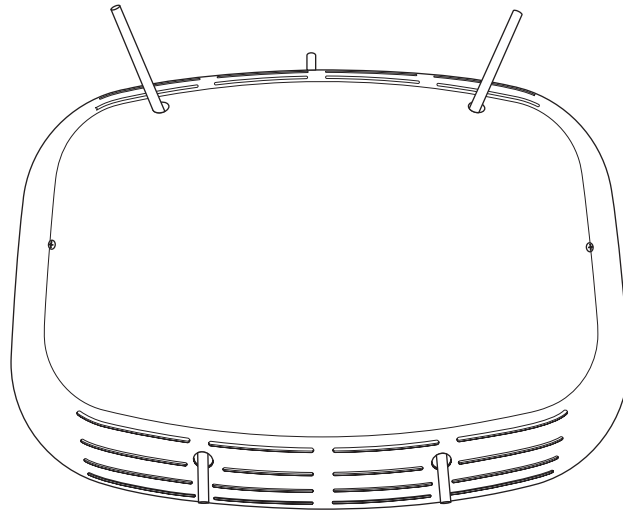
The SkyZhone wall mount enclosure kit (920-07811-01) includes the
following items:

• lid

• front cover

• bracket and base

These items are also displayed in Figure 14:

Figure 14: Contents of wall mount enclosure kit (from left: the lid, the front cover, the bracket and the base)
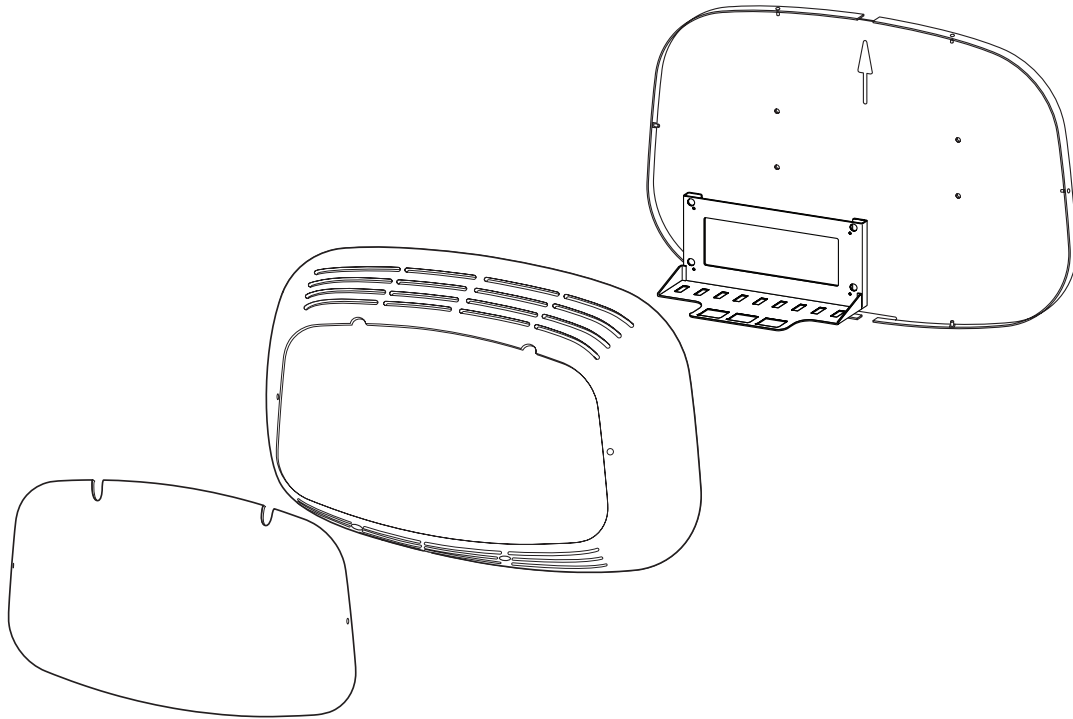

To mount the optional cover

> **Note:** The mounting of the SkyZhone unit should be as high as possible to ensure maximum coverage. A flat surface measuring 24 inches high and 36 inches wide will be needed to mount the unit securely.

1   Find a flat surface that is at least 24 inches tall and 36 inches wide.

2   Drill the holes in the wall to align with the corresponding holes in the mounting bracket. See Figure 15.

3   Obtain the proper screws (not included) to anchor the wall mount assembly to the type of surface it is being mounted to.

4   Place the mounting bracket on the rear panel of the cover, lining up the mounting holes.

5   Fasten the mounting bracket in the desired location with the appropriate type of screw. Use the outside holes displayed in Figure 16. These should line up with the holes in the cover.

Figure 15: Mounting Bracket with screw locations
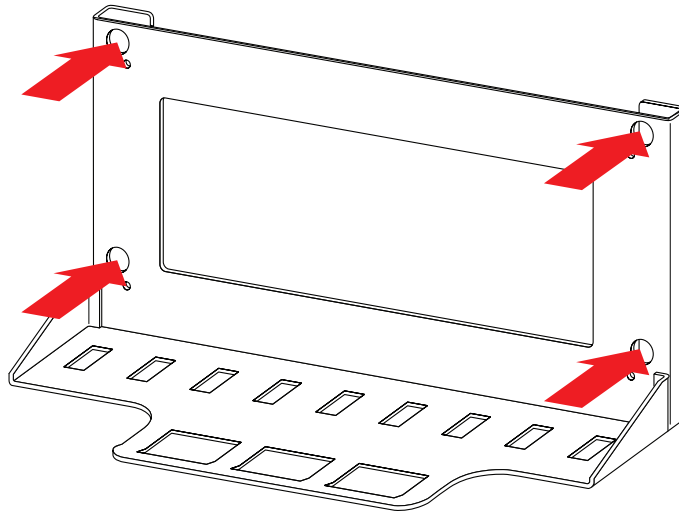
6 Attach the mounting bracket and the base to the wall (Figure 16). (The base has an UP arrow cut into the plastic casing to ensure in proper orientation.) Use a 1/4 inch drill masonry bit to install a 1 inch plastic insert to secure the cover and the aluminum frame to the concrete wall with the appropriate screws.

Figure 16: Bracket and Base
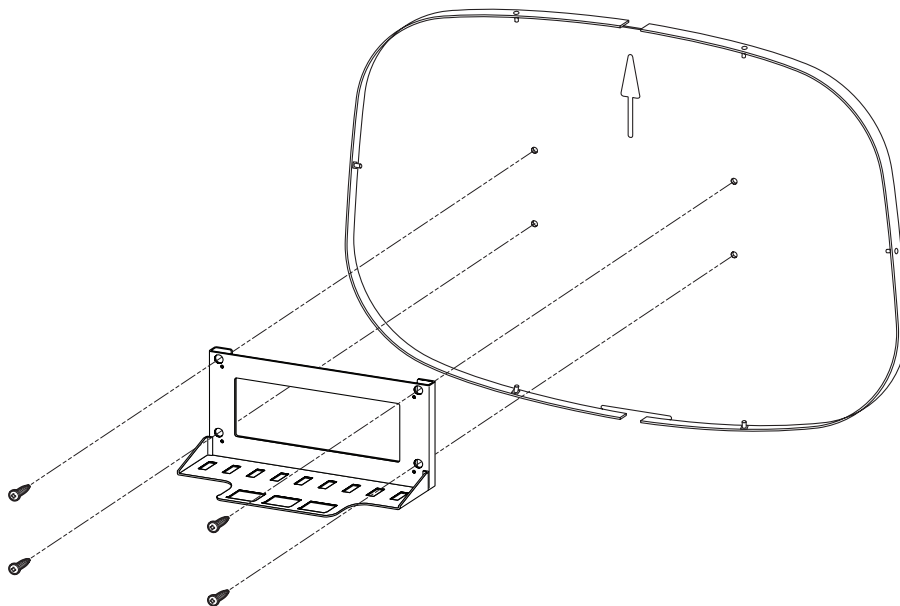
7 Attach the protective cover to the base and then attach the base to the (concrete) wall. Note that the cover should be attached so that the top contains the two cutouts for the angled antennas.

Figure 17: Base, Bracket, and Front Cover displaying two holes for antennas
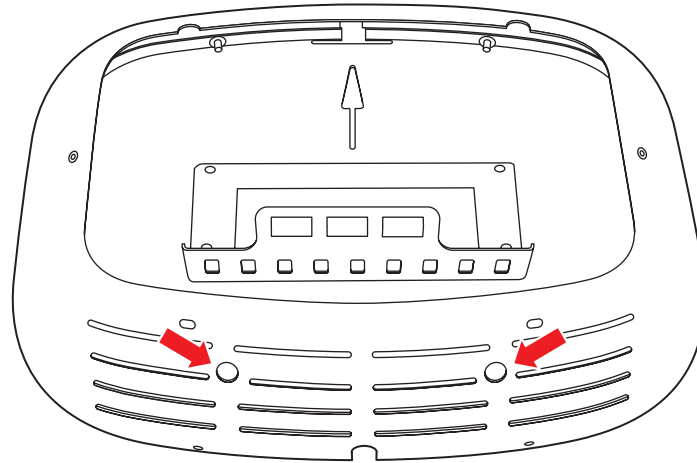
8   Attach the antennas to the SkyZhone access point.

Note that the antennas are different sizes. The three longer antennas are connected to the top of the unit. The two shorter antennas are mounted to the bottom of the unit. The antennas are not interchangeable. It is critical that the longer antennas are on the top, and the shorter ones on the bottom of the unit.

9   Slide the SkyZhone station onto the wall mounting bracket.

**10**   Secure the SkyZhone to the wall mounting bracket with the 4 (four) tamper-resistant screws, provided in the installation kit, through the holes on the front of the unit.

11   Attach the SHDSL cable. Also connect the optional console cable and Ethernet cables, if they are being used. In some installations, it might be easier to install the cables before mounting the unit to the bracket.

12   Attach the lid of the protective cover and secure it with the screws provided in the installation kit. The final assembly appears in Figure 18, and the final installation appears in Figure 19.

Figure 18: Wall Mount Kit - Final Assembly
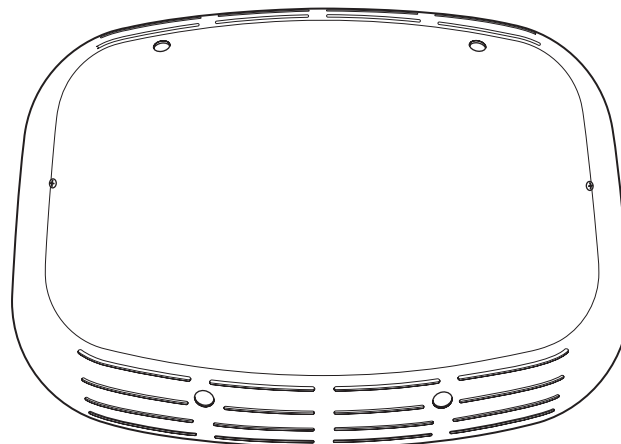
Figure 19: Example of a wall-mounted SkyZhone
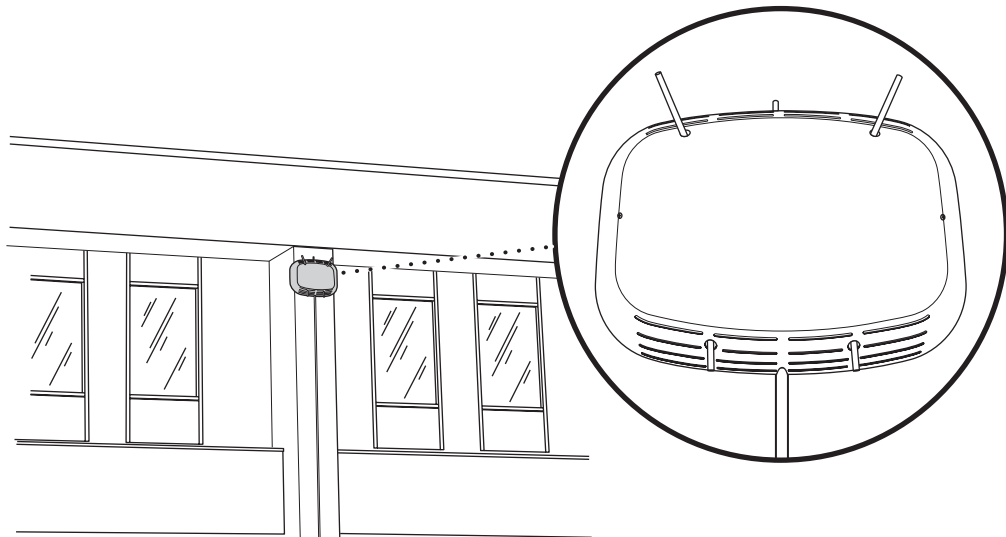
Grounding

To ensure proper grounding:

*   Connect a length of *#10 AWG solid bare copper wire* to the wire
    grounding lug of the unit and tighten the grounding nut. See Figure 20.

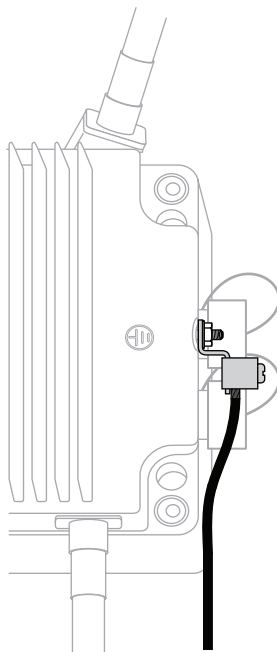*   Connect the other end of the grounding wire strap that is attached to a
    grounded surface or another earth ground such as a metal rod.

Figure 20: Grounding lug

Initial Configuration

Using the factory defaults

The factory defaults for the SkyZhone Access Point includes two VLANS.

- **VLAN 1** is the default data VLAN.

  Ports **eth0** (SHDSL), **eth1** (PoE), and **wlan1** are all members of this VLAN.

- **VLAN 7** is the default management VLAN.

  Ports **eth0** (SHDSL) and **eth1** (PoE) are members of this VLAN.

Before using the SkyZhone Access point, use the CLI commands on the console interface to assign an IP address to the SkyZhone. For your network, determine the appropriate IP addresses as well as subnet mask, default gateway and broadcast address settings. The SkyZhone Access Point can now be configured for management.

In the following example, the values for the settings for the network are:

- IP address: 10.108.14.218

- Subnet mask: 255.255.255.0

- Broadcast Address: 10.108.14.255

- Default gateway: 10.108.14.254

Use the following three commands to configure VLAN management.

- **config if interface brvlan7 ip 10.108.14.218 mask 255.255.255.0 broadcast 10.108.14.255**

- **config if route-add destination default gateway 10.108.14.254**

- **config admin-tools save running-config**

After entering these commands, the system can be managed using SSH or HTTPS over the SHDSL interface or the PoE interface.

Refer to the *SkyZhone CLI Reference Guide* for a list of supported commands to configure advanced SkyZhone features.

Changing the factory defaults

If you are not using the factory default VLANs, you need to delete the default VLANs and configure the VLANs that are appropriate for your network. In the example below, VLAN 2 is used for management instead of the default VLAN 7. Also, VLAN 122 is the data VLAN instead of VLAN 1.

1   Delete the default VLANS. The following commands remove the default
    VLANs:

```
config vlan vlanconfig removeport interface eth1
vlanid 1
config vlan vlanconfig removeport interface eth0
vlanid 1
config vlan vlanconfig removeport interface wlan1
vlanid 1
config vlan vlanconfig removevlan vlanid 1

config vlan vlanconfig removeport interface eth1
vlanid 7
config vlan vlanconfig removeport interface eth0
vlanid 7
config vlan vlanconfig removevlan vlanid 7
```

2   Define the new management VLAN. In this example, VLAN 2 is the
    management VLAN.

```
config vlan vlanconfig addvlan vlan_name management
vlanid 2
config vlan vlanconfig addport interface eth0 vlanid 2
tagged
config vlan vlanconfig addport interface eth1 vlanid 2
untagged
config vlan portdefaults default-pvid vlanport eth1
pvid 2
```

3   Configure the management address. In this example, the device address is
    10.108.14.218.

```
config if interface brvlan2 ip 10.108.14.218 mask
255.255.255.0 broadcast 10.108.14.255
config if route-add destination default gw-addr
10.108.14.254
```

4   Define the data VLAN. In this example, the data VLAN is VLAN 122.

```
config vlan vlanconfig addvlan vlan_name data vlanid 122
config vlan vlanconfig addport interface wlan0 vlanid
122 tagged
config vlan vlanconfig addport interface eth2 vlanid
122 tagged
config vlan vlanconfig addport interface eth3 vlanid
122 tagged

config admin-tools save running-config
```

Using the Ethernet interface

The Ethernet port can be used to configure the SkyZhone using the factory default. The Ethernet port on the SkyZhone has a default address of 192.168.1.1. If a static IP address is set on your PC that is on the same subnet (for example, 192.168.1.100), then use HTTPS to configure the remaining parameters. Note that the SkyZhone uses HTTPS and not HTTP. The default login is **admin** and the default password is **zhone**.

Note that if the IP address of the management VLAN is changed, you lose your connection to the SkyZhone unit. A new static IP address must be configured on your PC that is compatible with the new IP address that you configured in the SkyZhone unit.

Also, if any changes have been made to the VLAN definitions, the corresponding changes will have to be made in the DSLAM that the SkyZhone is connected to.

4 DIAGNOSTICS

This chapter describes the SkyZhone access point's LED light.

Status and LED

The SkyZhone contains one red LED located on the bottom right of the unit. (Figure 21). The LED provides a quick verification as to whether it is operating correctly or if it needs to be replaced.

Figure 21: LED Location

LED
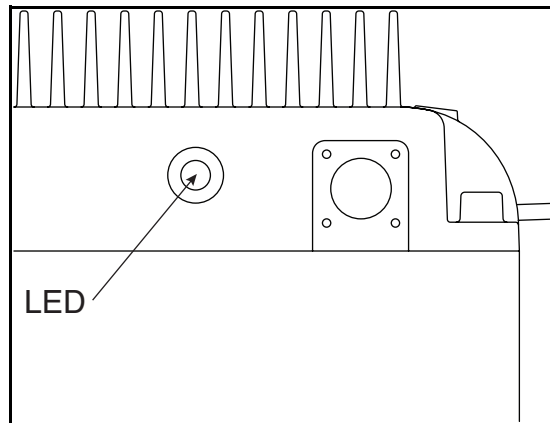
The following table describes the possible states of the LED light.

Color	Operation	Description
Red	On solid	Power is on and the software is not in an operational state. If the LED stays in this state for more than one minute, the unit should be replaced.
Red	One blink every 3 seconds	Power is on and the unit is operational.
Off	Off	There is no power.

SAFETY, REGULATIONS, AND CERTIFICATIONS

This chapter describes how to prepare your site for the installation of the SkyZhone platform. It includes the following topics:

Safety

⚠ **WARNING!**

The SkyZhone product is a line power device conforming to UL 60950-1 and UL 60950-21 standards. The DC voltages (RFT-V signals) are provided to SkyZhone through the SHDSL connector. These voltages must be provided by a UL 60950-1 and UL 60950-21 certified power source, typically located at the Central Office. One such certified power source is the Argus Technologies CSM35 Modular Converter System (#012-550-B2). Uncertified power sources can result in injury or death.

Proper Safety Grounding is required to insure proper operation and protection from lightning strikes and surges. A copper ground lug is provided on the unit for this purpose. Connect a length of #10 AWG solid, bare, copper wire to the grounding lug and firmly tighten the grounding screw (see Figure 20). Connect the other end of the grounding wire to a grounded surface or another earth ground such as a metal rod. This ground must be install before applying power to the unit.

SkyZhone provides both Primary and Secondary lightning and surge protection to the SHDSL and PoE cable signals. The Console cable signals are not protected and this cable, which is not intended for outdoor use, should not be connected when the unit is installed.

This unit is powered by high voltage over the SHDSL lines. Electrical shock and personal injury can occur by touching the leads with the power on. Verify that the SHDSL lines are deenergized before installing or removing the equipment. Always turn the power off at the DSLAM before installing or removing this equipment.

The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require the use of an agency listed (UL/CSA) Building Entrance Protector for all power and data communications cables entering a building. This is to protect the building and occupants from damage caused by transient voltage and current surges.

A UL 497 (CSA C22.2 No. 226-92) approved primary protection device must be used at the building entrance if the Ethernet port is used to provide in-building access to the SkyZhone network. Also check with local wiring codes.

Caution:

- The unit is sealed at the factory and must not be opened in the field. The unit shall be returned to the factory for repairs.

- Serious injury can occur if the antennas come in contact with electric power lines. Carefully follow the instructions in this manual. During and after installation, the antennas must be a minimum of 24 inches from any power lines. Use caution when installing this outdoor equipment.

- FCC RF Exposure Requirements (per OET-65) requires the SkyZhone platform to be mounted such that the general public does not come within 10 inches of the antennae.

- The PoE (Power over Ethernet) connector sources power to other devices. Some devices may not be compatible with this feature. In that case, do not connect the wires that supply the power. The power is 48 volts DC, at a maximum of 5 watts.

Note:

- This equipment has been tested and found to comply with the limits for a Class C digital device, pursuant to part 15, subpart C, of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, may increase the potential for harmful interference to radio communications.

- The SkyZhone-1424 equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense

WARNING!

The authority to operate the SkyZhone-1424 equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the manufacturer.

- Changes or modifications not expressly approved by Zhone Technologies, Inc. could void the user's authority to operate the equipment.

- The supplied cables and antennae must be used to ensure compliance with Part 15, FCC Rules.

- This device may only be used with approved antennae that are shipped with the unit and installed per installation instructions. The use of any other antennas will invalidate the unit's FCC Part 15 certification.

- The 2.4 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5 dBi. Antennae not included in this list (Comet Part Number CFA-245W-SR) or having a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- The 4.9 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5.3 dBi. Antennae not included in this list (Comet Part Number SF-D49NW-SR) or having a gain greater than 5.3 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication. Operating the device with the supplied antennas will ensure that this requirement is met.

- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Grounding and isolation

Proper grounding of the SkyZhone platform must be completed before you connect power to the unit.

- The internal subassemblies signal/Logic ground is internally bonded to the Safety Ground (chassis).

- SkyZhone provides both Primary and Secondary lightning and surge protection to the SHDSL and PoE cable signals. The Console cable signals are not protected and this cable, which is not intended for outdoor use, should not be connected when the unit is installed.

- The SHDSL cable that carries RFT-V power to the unit has no connection to the Chassis Ground. This cable shield is only intended to add durability and mechanical protection of the internal wires.

- Proper Safety Grounding is required to insure proper operation and protection from lightning strikes and surges. A copper ground lug is provided on the unit for this purpose. Connect a length of #10 AWG solid, bare, copper wire to the grounding lug and firmly tighten the grounding screw (see Figure 20). Connect the other end of the grounding wire to a grounded surface or another earth ground such as a metal rod.

Installation safety precautions

Maximum ambient operating temperature should not exceed 50^0C (122^0F).

Minimum ambient operating temperature should not exceed -35^0C (-31^0F). Observe the maximum recommended operating temperature as indicated here.

Do not block system air vents; this will deprive the system of the airflow required for proper cooling. Sufficient clearance must exist on all sides of the rack to permit equipment access. Connect the system to the power supply circuit as described in this document. Do not overload the system or power supply circuit. Ensure that proper system grounding is performed and maintained.

Important Safety Instructions

Read and follow all warning notices and instructions marked on the product or included in the manual.

1 The SkyZhone product is a line power device conforming to UL 60950-1 and UL 60950-21. The DC voltages (RFT-V signals) provided to SkyZhone through the SHDSL connector must be provide by a UL 60950-1 and UL 60950-21 certified power source, typically located at the Central Office. One such certified power source is the Argus Technologies CSM35 Modular Converter System (#012-550-B2). Uncertified power source should not be used. The installer must verify this

2 The Telco must be contacted to assure the cables providing the SHDSL data and power to the unit are capable of carrying the RFT-V voltages required.

3 Do not attempt to service this product yourself, as opening or removing covers may expose you to hazardous voltage or to other risks. Refer all servicing to qualified service personnel.

5 When installed, the product must comply with the applicable Safety Standards and regulatory requirements of the country in which it is installed. If necessary, consult with the appropriate regulatory agencies and inspection authorities to ensure compliance.

4 A rare phenomenon can create a voltage potential between the earth grounds of two or more buildings. If products installed in separate buildings are interconnected, the voltage potential may cause a hazardous condition. Consult a qualified electrical consultant to determine whether or not this phenomenon exists and, if necessary, implement corrective action prior to interconnecting the products.

5 In addition, since the equipment is to be used with telecommunications circuits, take the following precautions:
— Never install telephone wiring during a lightning storm.
— Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
— Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
— Use caution when installing or modifying telephone lines.
— Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.
— Do not use the telephone to report a gas leak in the vicinity of the leak.

EMI Notices

The following are EMI notices.

United States - EMI Notice

- Changes or modifications not expressly approved by Zhone Technologies, Inc. could void the user's authority to operate the equipment.

- The supplied cables and antennae must be used to ensure compliance with Part 15 and Part 90, FCC Rules.

- This device may only be used with approved antennae that are shipped with the unit and installed per installation instructions. The use of any other antennas will invalidate the unit's FCC Part 15 certification.

- The 2.4 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5 dBi. Antennae not included in this list (Comet Part Number CFA-245W-SR) or having a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- The 4.9 GHz band has been designed to operate with the antennae listed below, and having a maximum gain of 5.3 dBi. Antennae not included in this list (Comet Part Number SF-D49NW-SR) or having a gain greater than 5.3 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication. Operating the device with the supplied antennas will ensure that this requirement is met.

- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Canada - EMI Notice

This Class A and C digital apparatus complies with Industry Canada RSS-210.

Supplier's Declaration of Conformity

Place of Issue: Zhone Technologies

  8545 126th Avenue North

  Largo, FL 33773-1502

  USA

Date of Issue: October 30, 2007

Zhone Technologies, located at the above address, hereby certifies that the SKYZHONE-1224/1424/1624 bearing the FCC identification numbers PJZSZ1224, PJZSZ1424, PJZSZ1624 complies with the Federal Communications Commission's ("FCC") Rules and Regulations pursuant to part 15, subpart C (14.247), part 15 Class A and part 90, as appropriate. Additionally, the Industry Canada identification numbers 3619ASZ1224, 3619ASZ1424, 3619ASZ1624 insures that the SKYZHONE-1224/1424/1624 also meet the requirements of RSS-210. The unit has network certification associated with ITU-T G.991.2.

Keith Nauman
Vice President

Notice to Users of the Canadian Telephone Network

NOTICE: This equipment has been certified to ITU-T G991.2

CE Marking

When the product is marked with the CE mark on the equipment label, a supporting Declaration of Conformity may be downloaded from the Zhone World Wide Web site at www.zhone.com.

Contacting Global Service and Support

Contact Global Service and Support (GSS) if you have any questions about this or other Zhone products. Before contacting GSS, make sure you have the following information:

- Software version running on the system

- System configuration

- Zhone product you are using

- Description of the issue

Technical Support

If you require assistance with the installation or operation of your product, or if you want to return a product for repair under warranty, contact GSS. The contact information is as follows

Table 7:

E-mail	support@zhone.com
Telephone (North America)	877-ZHONE20
Telephone (International)	510-777-7133
Internet	www.zhone.com/support

If you purchased the product from an authorized dealer, distributor, Value Added Reseller (VAR), or third party, contact that supplier for technical assistance and warranty support.

Service Requirements

If the product malfunctions, all repairs must be performed by the manufacturer or a Zhone-authorized agent. It is the responsibility of users requiring service to report the need for service to GSS.

INDEX

Numerics

2.4 GHz radio 13
4.9 GHz radio 13

A

acronyms, described 8
antenna 13
    2.4 GHz 13
    4.9 GHz 13

B

bonding 13
    SHDSL lines 14

C

connector 18
    Console SOCKET connector 19
    Power-over-Ethernet (PoE) 18, 22
    SHDSL 18
Console 19
Console SOCKET connector
    connector 19

G

grounding requirements 37

I

installation
    safety precautions 21

L

LED 41
line power requirements 16

M

mounting
    pole 15
    pole-mounting kit, contents 27
    wall 15
    wall-mounting enclosure kit, contents 28

N

network configuration 13

P

pinouts
    Console SOCKETconnector 19
    Power-over-Ethernet (PoE) connector 18
    SHDSL connector 18
PoE 18
pole-mounting 15
    kit, contents 27
Power-over-Ethernet (PoE)
    connector 18, 19, 22
    connector, pinouts 19

R

requirements
    grounding 37
    line power 16

S

safety precautions 21
SHDSL
    backhaul 16
    connector 18
    connector, pinouts 18
    lines 14
SkyZhone
    access point, illustrated 11
    antenna 13
    bonding 13
    LED 41