



# **ASWipLL and AS3010 Systems**

Wireless IP-Based Local Loop System

Release 4.8

## **Hardware Installation Guide**

Leading the World in Wireless DSL

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## About this Guide

This section discusses the purpose, targeted audience, references, organization, and technical support of the ASWipLL Hardware Installation Guide.

### Purpose

This guide describes the procedures for installing Airspan's **ASWipLL** devices. These devices include the Base Station Radio (BSR), Base Station Distribution Unit (BSDU), Base Station Power Supply (BSPS), Global Positioning System antenna (GPS), Subscriber Premises Radio (SPR), Subscriber Data Adapter (SDA), and Indoor Data Radio (IDR).

### Referenced Documentation

Although this guide provides software configuration information for certain ASWipLL devices, it is not comprehensive. For detailed software configuration, see the , , and The following documentation is referenced in this guide:

- *ASWipLL System Description*: provides an overview of the entire ASWipLL system.
- *WipConfig User's Guide*: Airspan recommends that you refer to this manual for performing serial initial configuration.
- *WipManage User's Guide*: Airspan recommends that you refer to this guide for descriptions on managing the ASWipLL devices.
- *ASWipLL Commissioning Manual*: Airspan recommends that you refer to this guide for descriptions on managing the ASWipLL devices.

## Targeted Audience

This guide is intended for the person who is responsible for installing the ASWipLL system. This person should be familiar with electronic circuitry and wiring.

## Organization of this Guide

This guide is organized into the following chapters and parts:

- Chapter 1, "**Overview**": provides a brief overview of the ASWipLL devices.
- Chapter 2, "**Safety Guidelines**": lists the safety guidelines for handling cables and electricity during the installation.
- Chapter 3, "**Package Contents**": lists items provided in standard ASWipLL kits.
- Chapter 4, "**Required Tools**": lists the tools required for installing the system.
- Chapter 5, "**Radio Site Planning**": describes radio issues for planning the site before installation.
- Part 1, "**Base Station Installation**": includes the following chapters concerned with installing ASWipLL equipment at the Base Station:
  - Chapter 6, "**Basic Design of Devices**"
  - Chapter 7, "**Mounting the Devices**"
  - Chapter 8, "**Network Cabling**"
  - Chapter 9, "**Serial Cabling**"
  - Chapter 10, "**Connecting Third-Party External Antennas**"
  - Chapter 11, "**Power Cabling**"
- Part 2, "**CPE Installation - SPR**": includes the following chapters concerned with installing an SPR (interfacing with subscriber's network through an SDA) at the subscriber's premises:
  - Chapter 12, "**Basic Design of Devices**"

- Chapter 13, "**Mounting the Devices**"
- Chapter 14, "**Network Cabling**"
- Chapter 15, "**Serial Cabling**"
- Chapter 16, "**Connecting Third-Party External Antennas**"
- Chapter 17, "**Antenna Alignment using RSS LED Adapter**"
- Chapter 18, "**Power Cabling**"
- Part 3, "**CPE Installation - IDR**": includes the following chapters concerned with installing an IDR at the subscriber's premises:
  - Chapter 19, "**Basic Design**"
  - Chapter 20, "**Mounting**"
  - Chapter 21, "**Network Cabling**"
  - Chapter 22, "**Serial Cabling**"
  - Chapter 23, "**Connecting Third-Party External Antenna**"
  - Chapter 24, "**Antenna Alignment using RSS LEDs**"
  - Chapter 25, "**Power Cabling**"
- Appendix A, "**Glossary**": glossary of terms used in this guide
- Appendix B, "**Installing the BSPS**": describes the procedures for installing an optional third-party Base Station Power System.
- Appendix C, "**Cable Crimping**": describes the crimping procedure for 15-Pin D-type, N-type, and GPS connectors.
- Appendix D, "**RSS Led Plug Cabling for SPR with DB9 Port**": describes connector pinouts for SPR-to-RSS LED Adapter cabling when the old SPR model that provides a 9-pin D-type port is used.
- Appendix E, "**RJ-45 to DB15 Adapter for IDU/ODU Connectivity**": describes the use of an optional RJ-45 to DB15 adapter for connecting the outdoor radio to the indoor hub/switch.

- Appendix F, "**Evaluating Link Quality**": describes the procedures for evaluating quality of the BSR-SPR link.
- Appendix G, "**ASWipLL Product Technical Specifications**": lists the technical specifications of the ASWipLL devices.
- Appendix H, "**Antenna Specifications**": lists the technical specifications of built-in and third-party external antennas.
- Appendix I, "ASWipLL Product List": provides a list of all the ASWipLL products.
- Appendix J, "**FCC Declaration of Conformity** ": provides a declaration of FCC conformity for the ASWipLL radios.

## Conventions

This guide uses the following bulletin conventions:



**Warning:** Provides information that can prevent and avoid bodily or mechanical harm.



**Note:** Provides useful information.

## Customer Service

For service and support for your ASWipLL system, contact your regional Airspan representative, or Airspan's Technical Assistance Center (TAC) at:

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# Overview

This chapter provides a brief overview of the ASWipLL system.

## 1.1. Introduction

Airspan's **ASWipLL** system provides a low-cost, high-performance point-to-multipoint IP-based Broadband Fixed Wireless (BFW) Access solution. ASWipLL provides wireless local-loop (last-mile) connectivity designed to deliver high-speed data, Voice over IP (VoIP), and multimedia services to residential, SOHO (small office/home office), and SME (small medium enterprise). **ASWipLL** offers service providers an integrated access solution, providing quick-to-market deployment and low-market entry cost for broadband services.

ASWipLL operates in the licensed band (700 MHz, 925 MHz, 1.5 GHz, 2.3 GHz, 2.5 GHz Multichannel Multipoint Distribution Services - MMDS, 2.8 GHz, and 3.x GHz - ranging from 3.3 to 3.8 GHz), and unlicensed band (900 MHz, 2.4 GHz ISM, and 5.8 GHz).

Each **ASWipLL** Base Station, at maximum configuration, supports up to 3,024 subscribers, providing connectivity speeds of up to 4 Mbps.

**ASWipLL** enables interconnection with the Public Switched Telephone Network (PSTN) by the use of an IP-to-PSTN gateway. **ASWipLL** provides VoIP by its interoperability with a wide range of third-party products such as residential gateways (RGW), access gateways, gatekeepers, and softswitches.

**ASWipLL** utilizes air protocol technology for wireless packet switching using Frequency Hopping technology. **ASWipLL**'s in-house Preemptive Polling Multiple Access (PPMA) Air MAC protocol technology, which recognizes transmission type and allocates bandwidth, is highly efficient—80% throughput (e.g. 80% of 4 Mbps = 3.2 Mbps net capacity)—allowing multiple concurrent subscribers to utilize bandwidth.

**ASWipLL** provides bandwidth management by supporting both asymmetric and aggregated Committed Information Rate (CIR) and Maximum Information Rate (MIR), guaranteeing bandwidth levels to subscribers. In asymmetric CIR/MIR, different values are defined for uplink and downlink traffic: in aggregated CIR/MIR, values are defined as the sum of the uplink and downlink traffic.

**ASWipLL** supports VLANs and VPNs based on IEEE 802.1Q/p. **ASWipLL** supports IP routing and PPPoE bridging, as well as transparent bridging.

**ASWipLL** provides embedded security features such as IP (packet) filtering based on addresses, protocols, and applications.

The **ASWipLL** system provides SNMP-based management, allowing remote and local management, configuration, and monitoring of **ASWipLL** equipment.

## 1.2. System Architecture

The **ASWipLL** system architecture is composed of the following three basic areas:

- **Base Station site:** consists of **ASWipLL** access units that interface between the provider's backbone and the **ASWipLL** subscriber sites.
- **Subscriber site:** consists of **ASWipLL** customer premises equipment (CPE) that interfaces between the Base Station and the subscriber's network.
- **Network management tools:** consists mainly of Windows- and SNMP-based programs, providing fault, configuration, performance, and security management for the **ASWipLL** system.

Figure 1-1 displays a block diagram of the ASWipLL system architecture.

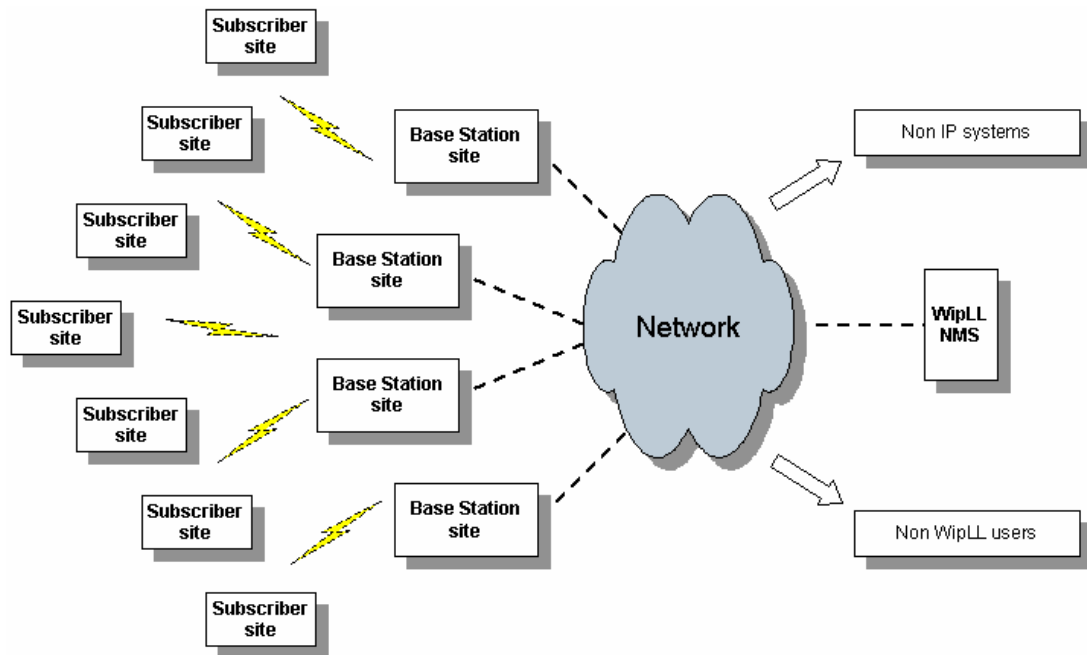


Figure 1-1: ASWipLL system architecture

## 1.3. Base Station Units

The ASWipLL Base Station interfaces between the subscriber sites and the service provider's backbone, providing subscribers with high-speed data, Internet, and VoIP services.

The ASWipLL system provides various devices (some optional) for the Base Station site. The implementation of these devices depends on the desired network (e.g. point-to-point radio link), number of outdoor radios and power source at the Base Station, and required synchronization type (i.e. by GPS).

Figure 1-2 shows a fully populated ASWipLL Base Station at maximum configuration (24 BSRs, 4 BSDUs, 1 BSPS, and a GPS).

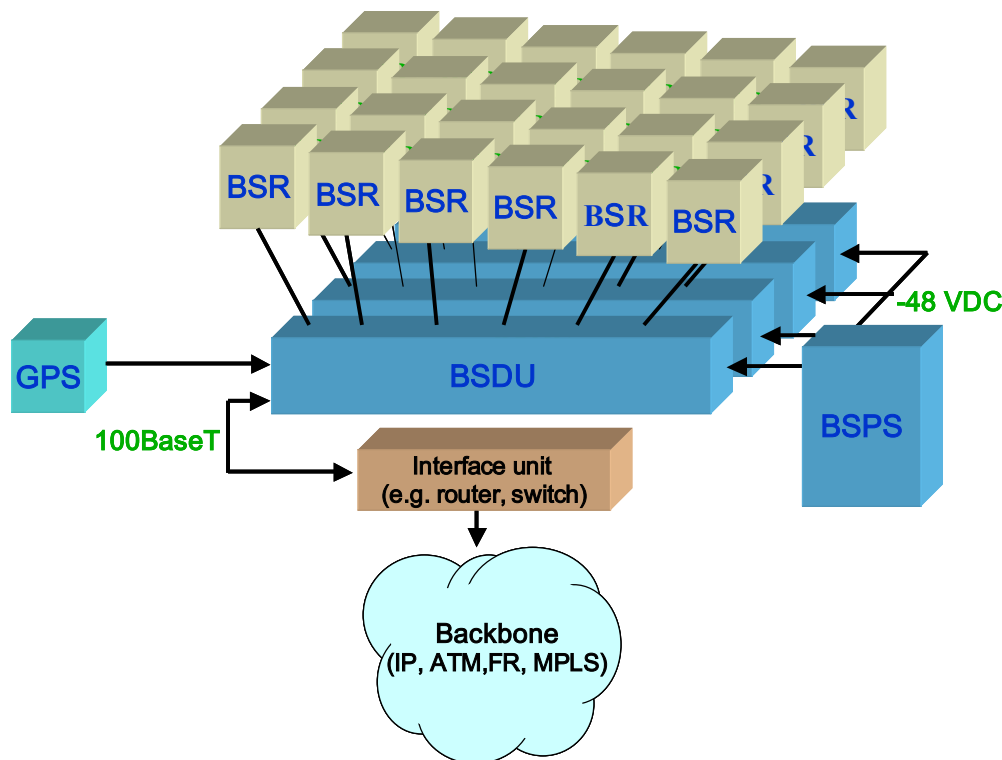


Figure 1-2: ASWipLL Base Station units (maximum configuration)

### **1.3.1. Base Station Radio (BSR)**

The BSR is an outdoor radio unit, typically mounted on a pole or wall, involved in providing a wireless link between the Base Station and subscribers. The standard BSR provides 60-degree radio coverage, serving up to 126 subscribers in a sector.

For Base Stations consisting of multiple BSRs, the BSRs are powered, and interface with the provider's backbone by the ASWipLL Base Station Distribution Unit (BSDU). For a Base Station consisting of a single BSR, the BSR is typically powered and connected to the provider's backbone by the ASWipLL Subscriber Data Adapter (SDA).

### **1.3.2. Point-to-Point Radio (PPR)**

The PPR device is similar to the BSR, but implemented in a point-to-point radio configuration, providing wireless communication with a single remote subscriber ASWipLL radio unit (i.e. SPR or IDR).

### 1.3.3. Base Station Distribution Unit (BSDU)

The BSDU is an Ethernet switch implemented at Base Stations consisting of multiple BSRs. The BSDU provides 100Base-T interface between the BSRs and the provider's backbone. The BSDU is also responsible for providing BSRs with –48 VDC power supply and frequency hop synchronization between BSDUs, BSRs, and Base Stations (when a GPS is implemented).

The BSDU is installed indoors in a standard 19-inch cabinet, and connects to the BSRs by standard CAT-5 cables. Each BSDU can connect to a maximum of six BSRs. In addition, up to four BSDUs can be daisy-chained to support a maximum of 24 BSRs. Therefore, a Base Station at maximum configuration can serve up to 3,024 subscribers.



**Note:** At a Base Station consisting of a single BSR, the BSR typically interfaces with the provider's backhaul through the SDA instead of the BSDU. (See Section 1.4.1, "Outdoor Radio (SPR) with Indoor Switch/Hub").

### 1.3.4. SDA-1/48V

The SDA-1/48V is a compact indoor adapter, especially designed for use when available power source is 48VDC (i.e. no AC power supply), and when no synchronization is required (i.e. in licensed bands). The SDA-1/48V provides the BSR with Ethernet connectivity to the backhaul.

### 1.3.5. Global Positioning System (GPS) - Optional

The GPS antenna is a rugged, self-contained GPS receiver and antenna that receives a universal GPS satellite clock signal. The GPS is an optional unit that connects to the BSDU. The GPS synchronizes frequency hopping of multiple Base Stations, ensuring that the entire ASWiPLL network operates with the same clock based on a universal satellite clock signal, and, thereby, eliminating radio frequency ghosting effects.

### 1.3.6. Base Station Power Supply (BSPS) - Optional

The BSPS is an optional third-party unit that is implemented at Base Stations to provide –48 VDC power supply and power redundancy. The BSPS is installed in a standard 19-inch cabinet and connected to the BSDU.

The BSPS provides the BSDUs and BSRs with the following:

- Power supply of –48 VDC.
- Power redundancy in case of power failure. The BSPS charges a battery bank that provides this power redundancy during mains failure. Thus, the BSPS acts as a DC-uninterruptible power supply (UPS) with a battery connected to it. The size of the battery determines the backup and charging time. Since the system is current limited, the maximum battery size is based on that limit.
- Remote power management and monitoring (by ASWipLL's WipManage program).

The BSPS consists of the following basic components:

- **Main unit:**
  - **DC Rectifier modules:** converts AC current to DC. The BSPS can house up to four rectifiers. The rectifiers are "hot plugged" and operate in parallel. This enables the user to define an N+1 or N+2 redundant system. Each rectifier has its own current sharing system, satisfying a complete sharing among rectifiers.
  - **System controller:** provides BSPS management control and BSPS operating information.
  - **Electronic Low Voltage Detector (ELVD):** disconnects the battery from the load, avoiding damage to the battery when over-discharged.
  - **Load and battery circuit breakers:** provide DC protection and distribution.
- **DC Distribution unit:** provides circuit breakers for distributing the output current to multiple BSDUs. It also contains a bypass switch to bypass the LVD.
- **Battery:** provides the BSPS system with back-up power.

## 1.4. Subscriber Site Units

The ASWipLL subscriber units are located at the subscriber's premises. The ASWipLL subscriber site consists of a radio transceiver that receives and transmits signals from and to the Base Station. The radio transceiver provides the subscriber with high-speed data access, Internet access, and VoIP at up to 4 Mbps. The ASWipLL radios interface with the subscriber's Ethernet network either through a hub or switch, or directly, depending on ASWipLL radio model.



**Note:** For VoIP support, Airspan can provide a third-party residential gateway (RGW). The RGW typically provides two POTS ports for telephony, a 10BaseT LAN port for subscriber PC/network, and a 10BaseT port for connecting to the SDA or IDR (depending on subscriber site configuration).

The ASWipLL system provides two different subscriber site configurations:

- Outdoor radio (i.e. SPR) with indoor Ethernet switch/hub (i.e. SDA)
- Indoor radio only (i.e. IDR device)

### 1.4.1. Outdoor Radio (SPR) with Indoor Switch/Hub (SDA)

The outdoor radio with indoor Ethernet switch/hub configuration consists of the ASWipLL Subscriber Premises Radio (SPR) and the ASWipLL Subscriber Data Adapter (SDA), respectively.

#### 1.4.1.1. Subscriber Premises Radio (SPR)

The SPR is an outdoor radio transceiver that provides a wireless link between the subscriber's network and the Base Station.

The SPR connects to the subscriber's network through the SDA Ethernet hub/switch. The SDA provides the SPR with DC power, lightening protection, and Ethernet (10Base-T and/or 100Base-T) interface with the subscriber's PCs/network (up to four PCs depending on SDA model).



The SPR is mounted outside on an external wall or on a pole. The SPR connects to the SDA by a standard CAT-5 cable.

#### 1.4.1.2. Subscriber Data Adapter (SDA)

The SDA is a switch or hub (depending on model), providing the SPR with -48 VDC power supply, lightening protection, and 10/100BaseT interface to the subscriber's PCs/network.

The SDA is installed indoors and can be mounted on a wall or simply placed on a desktop. The SDA connects to the SPR by a standard CAT-5 cable.

The SDA is available in the following models:

- **SDA-1:** hub providing one 10BaseT interface with the subscriber's computer (or LAN network if connected to another hub or a switch).
- **SDA-1/DC:** adapter that provides Ethernet (one 10BaseT) and regulated -48 VDC power to the SPR. This model can be powered from a voltage of 10 – 52 VDC (e.g. from a **solar panel** that typically provides 12 VDC). This model is typically implemented in mobile wireless applications, e.g. in a car or truck. (This model can also be implemented at a Base Station with a BSR.)
- **SDA-4H:** hub providing four 10BaseT interfaces with the subscriber's computers and/or networks. One of the 10BaseT ports provides crossover cabling for interfacing with another hub or LAN switch. Alternatively, it may be connected to another PC via a crossed Ethernet cable.

- **SDA-4S:** integrated LAN switch, providing four 10/100BaseT interfaces with the subscriber's PCs/network. The ports of the SDA-4S models support **Auto Negotiation**, allowing automatic configuration for the highest possible speed link: 10BaseT or 100BaseT, and Full Duplex or Half Duplex mode. In other words, the speed of the connected device (e.g. a PC) determines the speed at which packets are transmitted through the SDA-4S port. For example, if the device to which the port is connected is running at 100 Mbps, the port connection will transmit packets at 100 Mbps. If the device to which the port is connected is running at 10 Mbps, the port connection will transmit packets at 10 Mbps.

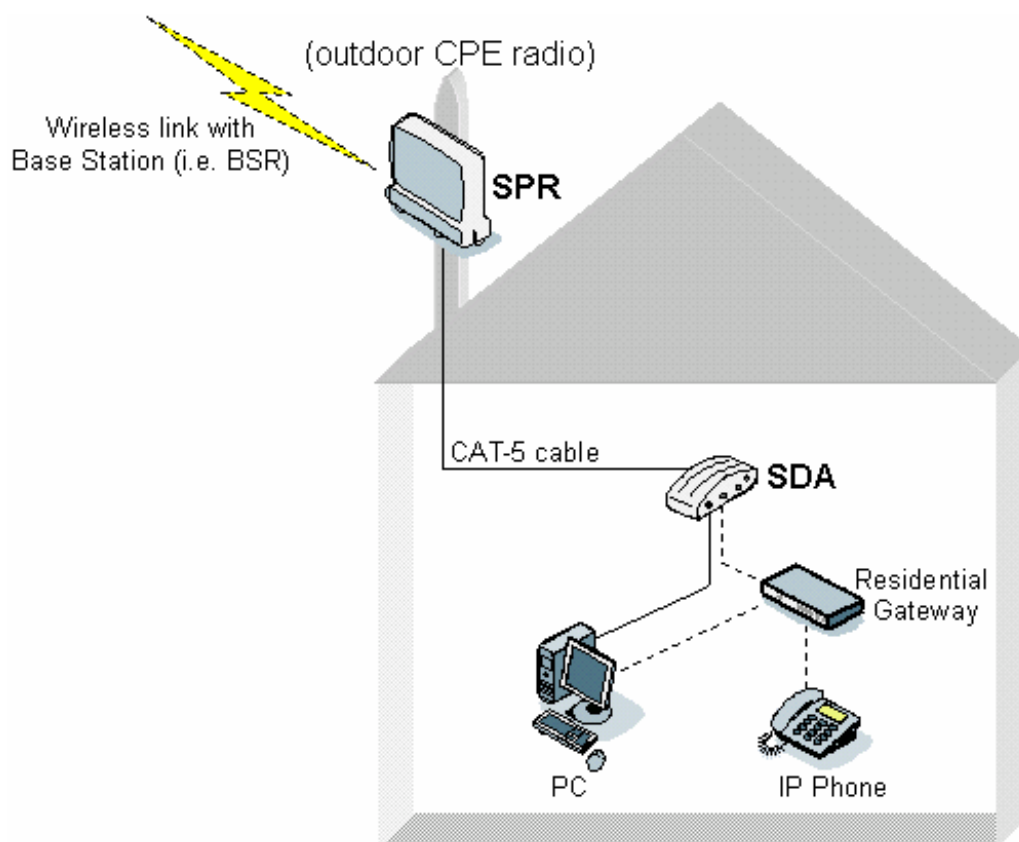
The SDA-4S ports also support automatic **MDI/MDI-X** crossover detection, allowing connection of straight-through or crossover CAT-5 cables to any port.

The SDA-4S is available in the following models:

- **SDA-4S (standard):** standard integrated LAN switch, providing four 10/100BaseT interfaces with the subscriber's computers. This model is ideal for SOHO implementation.
- **SDA-4S/VL:** provides VLANs between ports and the SPR, ensuring privacy between LAN users of the different ports. For example, all users connected to Port 1 do not "see" users connected to Port 2. This model is ideal for multi-tenant (VLAN security) implementation.
- **SDA-4S/VLtag:** ideal for multi-tenant applications where traffic engineering and privacy is required. SDA-4S/VLtag assigns a specific VLAN ID to traffic, based on the SDA-4S/VLtag port at which the traffic arrives. The VLAN IDs are fixed (since SDA-4S/VLtag is not user configurable). SPR converts the four VLAN IDs tagged by SDA-4S/VLtag to four VLAN IDs configured through ASWipLL's network management system (WipManage). The tag conversion is performed by SPR before sending the traffic to the air (i.e. to the BSR) and vice versa when coming from the air.

- **SDA-4S/1H3L:** provides a high priority port (left-most port) for VoIP traffic.
- **SDA-4S/VL/1H3L:** combines the functionality of the SDA-4S/VL and SDA-4S/1H3L models (i.e. VLAN for each port and a high priority port for VoIP).

Figure 1-3 displays a typical subscriber site setup implementing an SPR and SDA.



**Figure 1-3: Subscriber site with SPR and SDA units (optional RGW)**

## 1.4.2. Indoor Radio Unit (IDR) Only

The indoor radio unit configuration consists of the ASWipLL Indoor Data Radio (IDR). The IDR combines the functionality of the SPR and SDA, functioning as a transceiver and a hub. The IDR provides one 10BaseT Ethernet interface to the subscriber's network. The IDR receives its power from a separate power supply unit (AC-DC power adapter).

The IDR with a built-in antenna is typically mounted on an interior wall or on a desktop with line-of-site with the Base Station. The antenna of the IDR model with an external antenna is typically mounted outdoors to provide line-of-site with the Base Station.

The IDR can be used for data and voice transmissions. In the case of voice, the IDR uses a third-party RGW to interface with the subscriber's IP phone. Figure 1-4 displays a typical setup for data and voice at a subscriber site implementing the IDR.

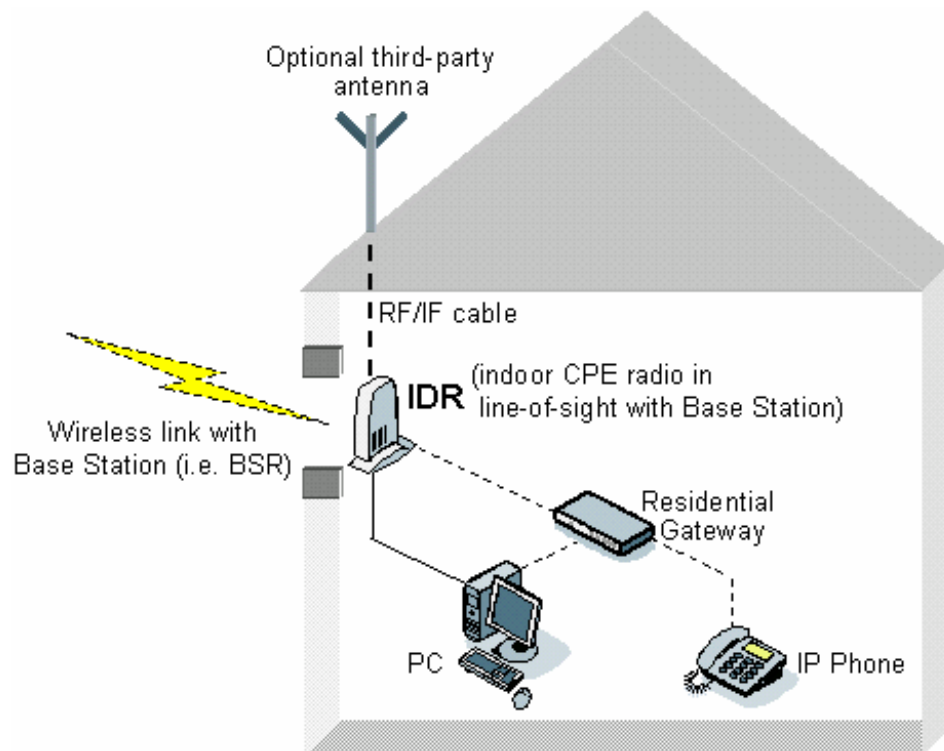


Figure 1-4: Subscriber site with IDR (optional third-party external antenna and RGW)





## Safety Guidelines

This chapter outlines safety guidelines when installing the ASWipLL system.



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**Warning:** The user and the installer should be aware that changes and modifications not expressly approved by Airspan Networks could void the user's authority to operate the equipment.

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**Warning:** Never install equipment that is damaged.

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**Warning:** Only qualified personnel should be allowed to install, replace, and service the ASWipLL equipment.

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## 2.1. ASWipLL Radios and Third-Party External Antennas



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**Warning:** Do not connect and disconnect antennas while the power is on. This can cause irreversible damage to the device.

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**Warning:** The digital portion of the transceiver 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 on and off, the user is encouraged to try correct the interference by performing one or more of the following measures:

- Reorientate or relocate the receiving antenna
  - Increase separation between the equipment and receiver
  - Connect the equipment to 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
- 



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**Warnings:**

- 1) The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers.
  - 2) Installation must be controlled.
  - 3) Installation must be performed by licensed professionals.
  - 4) Installation requires special training.
- 



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**Warning:** The ASWipLL radio devices and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void Airspan's ASWipLL product warranty and may expose the end user or the service provider to legal and financial liabilities. Airspan and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

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**Warning:** For **unlicensed** bands, it is the responsibility of the person installing the ASWipLL system to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), that only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance with FCC rules CFR47 part 15.204. The installer should configure the output power level of antennas according to country regulations and per antenna type.



**Warning:** For **unlicensed** bands, in accordance with FCC regulations, ensure that the external antennas provide an EIRP of less than or equal to **36 dBm** to prevent interference with other radios operating in the unlicensed band. The EIRP is defined by the following formula:

$$\text{Max. Power Output} + \text{Antenna Gain} - \text{Cable Loss} \leq 36 \text{ dBm (EIRP)}$$

Airspan does not supply cables for connecting external antennas. It is the responsibility of the installer to provide the cable and ensure the cable characteristics (e.g. length and cable loss) enables adherence to FCC's regulations concerning maximum EIRP.

The table below lists **examples** of cable loss per cable (not supplied by Airspan) for maximum antenna gains, based on the formula above. Note that the EIRP is either equal to or less than 36 dBm.

Cable type	Cable length (ft)	Tx power (dBm)	Cable loss (dB)	Max. Antenna gain (dBi)	Max. EIRP (dBm)
BELDEN - 9913	10	21.1	0.6	15.5	36
	30	22	1.5	15.5	36
	100	23	4.4	15.5	34.1
BELDEN - 89907	10	22.4	1.9	15.5	36
	30	23	5.2	15.5	33.3
	100	23	16.3	15.5	22.2



**Warning:** The ASWipLL radios emit microwave radiation. Therefore, a minimum distance must be maintained from the front of the ASWipLL radios:

- **Unlicensed bands (e.g. 5.8 GHz):** 200 mm
- **Licensed bands:**
  - 700 MHz (i.e. ASWipLL 700) = 800 mm
  - 2.5 GHz (i.e. ASWipLL 2.5) = 500 mm



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**Warning:** To avoid RF interference between BSRs, ensure a minimum 1-meter horizontal separation between co-located BSRs.

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**Warning:** To avoid RF interference between BSRs operating in the **700 MHz** where four BSRs are installed at a Base Station, in addition to 1-meter horizontal separation, a minimum 1-meter **vertical** separation must be provided between the two pairs of BSR antennas: one pair operating in the lower frequencies (i.e. 711.5 and 714.5 for 1 Msps mode; 712 and 714 for 1.33 Msps mode) and the other pair operating in the upper frequencies (i.e. 741.5 and 744.5 for 1 Msps mode; 742 and 744 for 1.33 Msps mode).

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**Warning:** When using external antennas, the external antennas must not be co-located or operating in conjunction with any other antenna or transmitter.

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**Warning:** ASWipLL radios using an external antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

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**Warning:** Inherent risks exist in operating equipment in license-exempt bands (i.e. 900 MHz). Airspan recommends that you do not purchase or deploy any equipment that operates in license-exempt bands without first analyzing the interference environment at each of your proposed deployment locations. Please contact your Authorized Airspan System Integrator or Distributor if you have any questions or require assistance regarding interference analysis. Airspan Networks will not be held responsible for product performance issues related to interference.

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**Warning:** In environments that produce disturbances such as paging systems, Airspan recommends using a narrow-band cavity filter and implementing the appropriate frequency bands (within the filter's capabilities), i.e. building an NVRAM frequency table using only these frequencies.

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**Warning:** Mount outdoor radios so that their front panel ports face down to prevent water from settling on the ports. This avoids damage to the units such as corrosion and electrical short-circuiting.

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**Warning:** Do not mount outdoor radios and external antennas in weather such as rain or lightening that may increase risk of electrocution.

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## 2.2. Electrical Safety Guidelines



**Warning:** Connect the power only after all network and antenna cable connections are performed. Powering the device before connecting, for example, the external antenna, can lead to irreversible device damage.



**Warning:** To prevent short-circuiting and electrical shocks, cables with exposed ends (i.e. not yet crimped) should be covered with protective polythene bags during external cable installation processes.

### 2.2.1. Handling Electrostatic Devices



**Warning:** To prevent ESD damage to ASWipLL devices, always wear an ESD wrist strap when handling these devices or coming into contact with internal components.

Electrostatic devices are those devices that may be damaged by the inadvertent discharge of static electricity from a charged body. The risk of damage, due to electrostatic discharge (ESD) to a device, may cause the device to fail suddenly, or it may induce a partial defect within the device, which will cause subsequent premature failure. Static electricity can result from operators walking on floors, moving around on chairs, from the movement of operator's clothing or even casual brushing against racks, benches or walls.

Airspan recommends the following guidelines to be adopted to minimize the risk of component failure due to electrostatic discharge to the device:

- ASWipLL devices are provided typically in see-through anti-static bags. Wherever possible, checking and inspection of a unit should occur without removing it from the bag.
- All operators shall wear the approved conductive overall.
- Where operators come into direct contact with any piece of electronic hardware, operators must wear an **ESD-preventive wrist strap**. All straps and cords should be tested using a Wrist Strap Tester prior to use. The wrist strap cords

shall have a 2 Meg Ohm resistor fitted at either end. Wrist straps should be worn in direct contact with bare skin and not over clothing.

## 2.2.2. Grounding

Only certain ASWipLL devices require additional grounding. ASWipLL devices that do not require additional grounding provide grounding at the main supply outlet. The following table lists the ASWipLL devices' grounding requirements.

**Table 2-1: ASWipLL grounding requirements**

Site	ASWipLL device	Grounding
Base Station	BSR	Through the mains (via BSDU), i.e. no additional grounding required
	BSDU	Additional grounding required (grounding lug at rear end of chassis)
	BSPS (third-party)	Additional grounding required (grounding lug at rear end of chassis)
CPE	SPR	Through the mains (via SDA), i.e. no additional grounding required
	IDR	Through the mains, i.e. no additional grounding required

## 2.2.3. Lightning Protection



**Warning:** Never install the equipment during stormy weather and lightning.

ASWipLL devices comply with the **Surge Immunity standard: EN 61000-4-5**. ASWipLL devices are protected from lightning surges as the outdoor devices (BSRs and SPRs) are encased in a plastic covering. Therefore, if lightning strikes the device, an electrical circuit cannot be completed, and hence, no electrical surge can occur.

In addition, ASWipLL outdoor and indoor (i.e. SDA) devices provide high-speed data line protection against direct and induced transient over-voltage surges on the cables. This capability is provided by the fact that all ASWipLL devices are

designed with transient voltage suppressor (TVS) components that maintain potential differences.

However, in geographical areas that have above normal lightning activity, Airspan can supply an optional DC surge protector adapter (see Part II, Chapter 18, "Power Cabling").

## 2.3. Cabling



**Warning:** The maximum cable length between the radio transmitters (i.e. BSR and SPR) and terminating equipment is 100 meters.



**Warning:** Cables with exposed ends (i.e. not yet crimped) should be covered with protective polythene bags during external cable installation processes.



**Warning:** Disturbance of cables on an In-Service exchange can cause loss of service. Extreme care must be taken when installing cables at any customer or subscriber premises.

### 2.3.1. Considerations

The following issues should be considered during cabling at the ASWipLL Base Station and customer premises:

- Cable routes are to be defined in a site-specific documentation.



**Note:** A minimum separation of 200 mm should exist between power and data cables. However, it is permissible to allow these cables to cross each other at right angles.

- Observe recommended minimum bend radii when installing copper cables. Wherever a cable changes direction, ensure that it does so in a smooth curve with a radius of at least 50 mm to prevent damage.
- Plastic ties and wraps are to be used to secure cables at regular intervals to trays, guides, and mounting pole/bracket. Ensure all trimmed ends are disposed of safely and at regular intervals.

- Data cables of less than 20 pairs shall be mixed in bundles not exceeding 50 mm in diameter.
- Ensure cables are not trapped in cabinet doors, by slide-in equipment or support metalwork.
- Excessive stress on cable terminations caused by taught cables should be avoided. Connector strain relief, if not built into the connector used, shall be provided by means of a strategically located cable tie. A maintenance loop or a generous amount of cable slack shall be provided just before the cable reaches the ASWiP LL device to allow for equipment removal without disturbance to adjacent cables.
- When installing network cables, ensure they are not damaged by friction or sharp edges.
- Data cables providing connection to the customers network shall be run in protective conduits. Cable conduits should be secured to the wall in accordance with manufacturers instructions.
- External data cables are to be protected in metal conduits, which are to be secured to the building structure in accordance with manufacturers recommendations.
- Wiring conduits must be placed in areas to prevent a trip hazard (e.g. don't install on roof walkways)
- Cables should be carefully fed through conduits and not pulled by means of any attached connector.
- Sufficient space should be provided in cable conduits, trunking or trays (where possible) to allow for future cabling growth.
- Data cables threaded into holes drilled in walls are to be covered by a waterproof sheath to prevent water penetration.
- Silicone sealant should be used to plug any holes on both internal and external wall surfaces once cables are in place.
- Cables not housed in conduits must be placed in a manner to avoid a trip hazard. (Avoid trailing wires across passageways.)

## 2.3.2. Labeling

The following labels are required to be fitted to ASWipLL equipment:

- Voltage Warning
- High Earth Leakage Current
- Signal Cable Designation

### 2.3.2.1. Voltage Warning

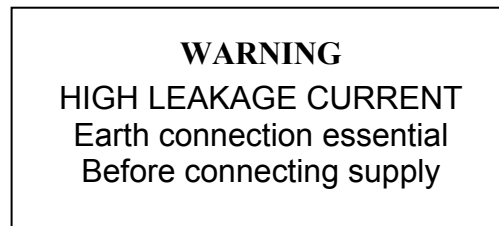


**Warning:** Voltages over 30 Volts AC and 50 Volts DC are categorized as hazardous. Hazard warning labels should be fitted where required. Certain countries require equipment warning and instruction labels to appear in the local language. When installing ASWipLL equipment ensure that local requirements regarding labels are given consideration.

- Where mains power is fed from separate phases, appropriate warning labels must be fitted to warn of the increased danger.
- The AC equipment used in the BSPS cabinet must carry a relevant voltage warning label specific to the country in which it is being installed. The label will be fitted to the cabinet doors displaying an electrical hazard symbol, the local operating voltage and the letters 'AC'.
- A power feed identification label (e.g. PWR 'A') shall be applied in the following locations:
  - On the rear of the main power rack adjacent to the terminal block
  - Attached to BSPS AC mains power plug or lead
  - Attached to the customer mains power socket or distribution rail
  - On the BSPS power circuit connection at the fuse board

### 2.3.2.2. High Earth Leakage Current

If equipment earth leakage current exceeds 3.5 mA, a warning label as shown in Figure 2-1 must be fitted to the rear of the main power rack alongside the AC inlet terminal block.



**Figure 2-1: Warning label if earth leakage current exceeds 3.5 mA**

### 2.3.2.3. Signal Cable Designation

All data cables should be labeled with both the source and destination at each end. A wrap around identification label is to be fitted to both ends of ASWipLL data cables. Care should be taken to ensure that the cable identification information is clearly visible. Fit the label 100 mm from the cable end. Wrap the label ensuring good adhesion to cable and itself.





## Radio Site Planning

Proper site selection and planning before installing your ASWipLL devices will ensure a successful deployment of your ASWipLL system. Site planning includes the following considerations:

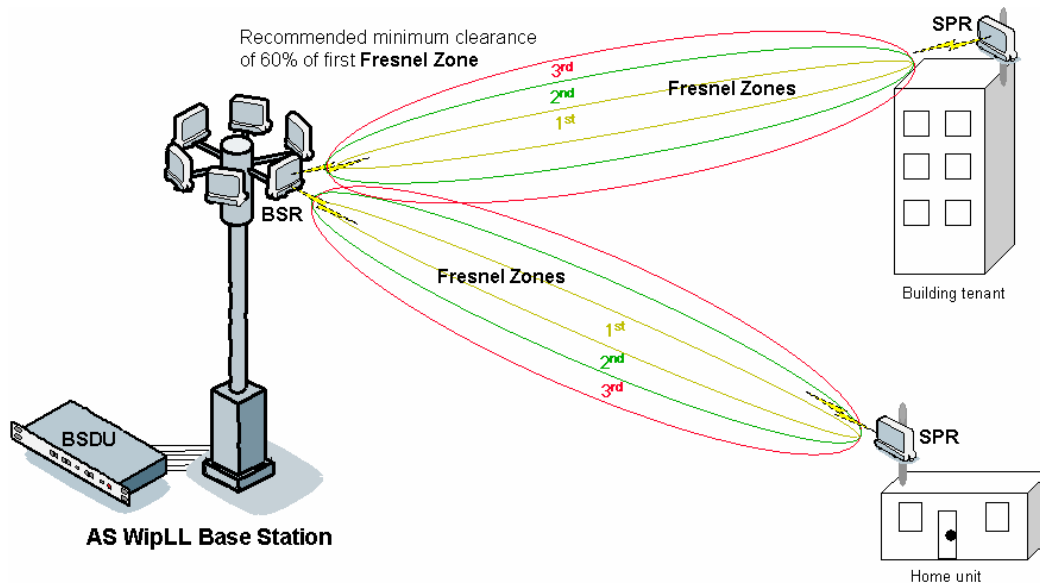
- **Minimum obstructions** (e.g. buildings) in the radio path between Base Station radio (i.e. BSR) and subscriber radios (i.e. SPR/IDR).
- Minimum incursions on Fresnel Zone (recommended minimum of 60% clearance of first Fresnel Zone).
- Mount radios as high as possible to avoid obstructions in the wireless path.
- Check possibility of future obstructions such as plans to erect buildings and trees that may grow tall enough to obstruct the wireless path.
- Align antennas for maximizing received signal strength (RSS)
- Consider nearby sources of interference that could degrade performance of radio. Mount radios as far from sources of interference as possible
- Ensure Base Station radio and subscriber premise's radio are within maximum coverage **range of reception**
- Maximum CAT-5 cable length connecting the outdoor radio to the indoor terminating equipment (i.e. switch/hub) is **100 meters**
- Ensure that you have sufficient **wiring conduit** and cable ties to channel and protect the CAT 5 cable connecting the outdoor radio to the indoor hub/switch.
- Ensure required **power mains outlet** is available at the site.

## 5.1. Minimal Radio Path Obstructions

ASWipLL radios communicate by propagation of waves. Thus, ensure minimum obstructions (from, e.g. buildings and trees) in the radio path between Base Station radio (i.e. BSR) and subscriber radios (i.e. SPR/IDR). It is essential that the ASWipLL radios or antennas be installed in such a way that their radio paths have a clear path with each other.

## 5.2. Fresnel Zone Clearance

There must be sufficient open space around the radio path to minimize interference with the radio beam. A minimum of **60% of the first Fresnel Zone** of the path should be clear of obstructions. Despite a clear line-of-site, objects close enough to the transmission path may cause attenuation in signal strength and an increase in signal interference. Objects with reflective surfaces that seem relatively far away, but yet still encroaching on Fresnel Zone, may cause these interferences.



**Figure 5-1: At least 60% of first Fresnel Zone should be clear**

Fresnel Zones define the amount of clearance required from obstacles. These zones are composed of concentric ellipsoid areas surrounding the straight-line path

between two antennas. Thus, the zone affects objects to the side of the path and those directly in the path. The first Fresnel Zone is the surface containing every point for which the distance from the transmitter to any reflection point on the surface point and then onto the receiver is one-half wavelength longer than the direct signal path.

One method for clearing the Fresnel Zone (to use the free space model to calculate link budget – see Section 5.6, "Calculating Link Budget") is by increasing the antenna height.

The first Fresnel Zone radius is calculated by the following equation:

$$r = \sqrt{\frac{75 \cdot d}{f}}$$

Where  $f$  is the frequency (in MHz) and  $d$  is the distance (in meters).

For example, using the formula above, a link of 4 km at 700 MHz produces a first Fresnel Zone radius clearance of about 20 meters. This implies that to ensure the ground does not enter into the first Fresnel Zone, both antennas (i.e. at Base Station and subscriber) must be mounted at least 20 meters above ground level (or clutter level). Typically, at least 60% clearance of the first Fresnel Zone is considered as LOS. Therefore, in the above example, a height of at least 12 meters (i.e. 60% of 20 meters) above ground level is sufficient for LOS.

## 5.3. Multipath Fading

Some of the transmitted signals may be reflected from a nearby building, by water under the signal path, or from any other reflectors. This reflected ("bounced") signal can then be received by the radio receiving the signal and superimposed on the main received signal, thereby degrading the signal strength.

To avoid multipath fading from nearby buildings etc., Airspan recommends installing the outdoor radios at the rear end of the buildings instead of at the front. When you install at the rear end of the building, the front-end of the building blocks incoming signals from multipath reflections.

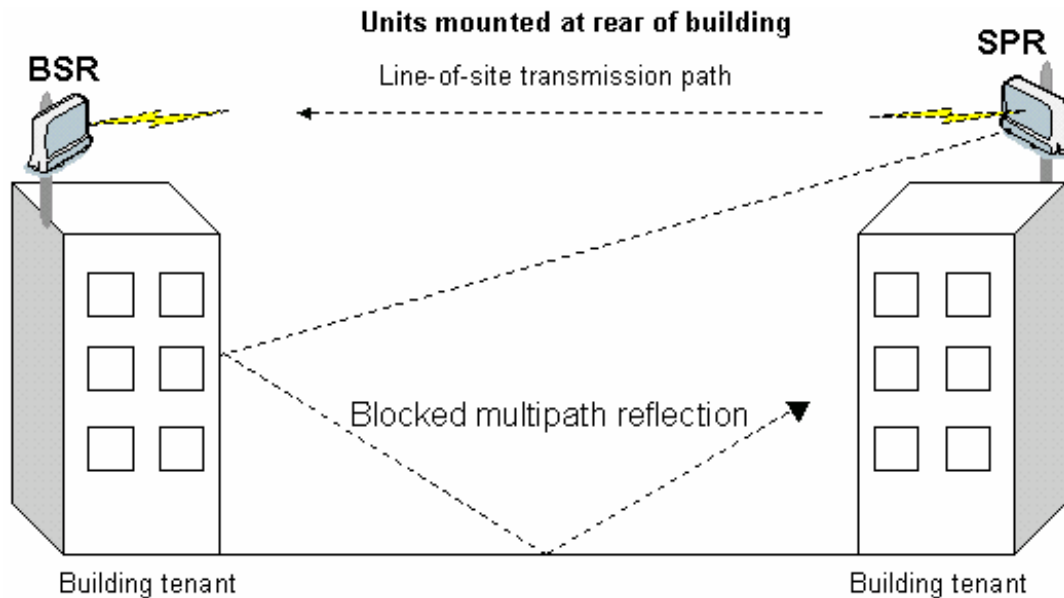


Figure 5-2: Radios mounted at rear, blocking multipath reflection

## 5.4. Spectrum Analysis for Locating Clear Frequencies

Before setting up your wireless link between Base Station and subscribers, Airspan recommends (especially in unlicensed bands), analyzing the RF spectrum at the Base Station to select only clear frequency channels (i.e. without interferences) for building a frequency table for wireless communication between Base Station and subscriber.

Prior to performing this test, you need to mount the radio/antenna in the desired installation spot. In general, you will be looking for frequencies with signal strengths of  $-85$  dBm or greater.

For using Airspan's spectrum analyzer tool, refer to the *WipConfig User's Guide*. For evaluating link quality using the Spectrum Analyzer, see Appendix F, "Evaluating Link Quality".

## 5.5. Adjacent Base Station Radios

For installations involving co-location of BSRs, it is important to assign frequencies of maximum spacing. This is to reduce possible radio interference between adjacently installed BSRs. In addition, a 1-meter separation must exist between adjacent BSRs.

## 5.6. Calculating Link Budget

Link budget is the computation of the maximal achievable reception level for the communication link between the Base Station and the subscriber site. This level is the minimum required received signal level (RSS) at the antenna port for the radio to close the communication link at a given data rate and under the worst-case fading channel. This level must be greater or equal to the radio's receiver sensitivity, which is the minimum RF signal power level required at the input of a receiver for certain performance (e.g. > BER).

This takes into account the following parameters:

### ■ Transmit (dBm) EIRP:

Tx transmitter power (dBm) - cable loss (dB) + Tx antenna gain (dBi)

### ■ Propagation (dB):

Free space loss (dB) =  $32.44 + 20\log d(\text{km}) + 20\log f(\text{MHz})$ , where  $f$  is the frequency in MHz, and  $d$  is the distance between transmitting and receiving radios in km.

Note: Free space propagation loss is valid when the first Fresnel Zone is clear.

### ■ Receive (dBm):

Rx antenna gain (dBi) - cable loss (dB)

The formula to calculate receive signal power:

$$\text{Rx} = \text{Tx EIRP} - (\text{path loss}) + \text{receive (i.e. Tx gain} - \text{Tx cable loss)}$$

The Rx value must be higher than the receiver sensitivity for communication link to succeed.

Example: Frequency = 2.4 GHz; Tx power output = 27 dBm; Tx and Rx cable loss = 0 dB; Tx antenna gain = 11 dBi; Rx antenna gain = 15 dBi; distance between sites = 6 km; Receiver sensitivity = -75 dBm.

<b>Transmit</b>	Transmit output power	27	dBm
	Cable loss (negative value)	0	dB
	Antenna gain	11	dBi
<b>Propagation</b>	Free space loss (negative value) $32.44 + 20\log(6 \text{ km}) + 20\log(2400 \text{ MHz})$	-116	dB
<b>Receive</b>	Antenna gain	15	dBi
	Cable loss (negative value)	0	dB
<b>Minimal received signal Rx =</b>		<b>-63</b>	<b>dBi</b>

Therefore, received signal power is EIRP – path loss + receive = 38 dBm – 116 dB + 15 dBi = -63 dBm. In conclusion, the received signal power is above the device's sensitivity threshold (-75); thus a communication link should succeed.



#### Notes:

- 1) ASWiPLL can operate in 2-, 4-, and 8-level FSK with signal strengths (i.e. receiver sensitivity) of greater than -90, -83, and -75 dBm, respectively.
- 2) These link budget rules are theoretical. It represents the maximum achievable for a system. In reality we have interferences (other WLAN networks, bluetooth), industrial noise (microwave ovens), atmospheric losses (air moisture, scattering, refraction), badly pointed antenna, reflexions,... that will affect performances. Thus, It is necessary to take a sufficient security margin on large distances.
- 3) Normally, a higher margin is desirable due to fluctuation in received power as a result of signal fading.

## 5.7. Radio Antenna Alignment

Once the subscriber unit (i.e. SPR/IDR) is installed and aimed in the general direction of the BSR, it is recommended to measure the received signal strength

(RSS) to determine the signal strength received from the BSR, and to precisely align the SPR/IDR for maximum signal strength.

You need to orientate (up/down, left/right) the SPR/IDR until the maximum RSSI levels are achieved, and then secure the SPR/IDR. For short links you can expect an RSSI of  $-60$  dBm or better. For longer links, an RSSI of  $-75$  dBm is acceptable. Any RSSI of less than  $-80$  dBm may be too weak for the radios to reliably communicate.

Airspan offers various tools for measuring RSS (check with your Airspan representative regarding cost and supply):

- SPR:
  - RSS LED adapter (see Part II, Chapter 17, "Antenna Alignment using RSS LED Adapter")
  - WipConfig program (see Appendix F, "Evaluating Link Quality")
- IDR: built-in RSSI LEDs (see Part III, Chapter 24, "Antenna Alignment Using RSS LEDs")

## 5.8. Considerations when Using External Antennas



---

**Notes:**

- 1) To avoid unnecessary RF cable loss, use short-length cables and with low attenuation.
  - 2) Antennas should have a VSWR of less than 1:1.5.
  - 3) Ensure BSR and SPR/IDR use the same antenna polarity.
  - 4) When using an omni-directional antenna, choose a type providing a wide vertical beam width (of at least  $8^\circ$ ) to allow connection of closer CPEs.
  - 5) Antenna must be DC grounded.
- 

### 5.8.1. Cable Loss

Airspan's ASWipLL radios provide transmit power compensation for power attenuation caused by cable loss (in cable connecting to external antenna). Cable loss

is the loss of radio transmit (Tx) power as heat, and directly proportional to cable length and quality, and operating frequency.



To adhere to Effective Isotropic Radiated Power (EIRP) limitations in the regulatory domain (country) in which you are operating your ASWipLL system, when purchasing antenna cables, take into consideration cable loss per cable length. EIRP is calculated using cable loss (i.e.  $\text{EIRP} = \text{max. transmitter power output} + \text{antenna gain} - \text{cable loss}$ ). For example, FCC regulations state that when operating in unlicensed bands, the external antennas must provide an EIRP of less than or equal to 36 dBm to prevent interference with other radios. Thus, knowing this EIRP parameter, you can choose the cable that ensures adherence to this parameter value.

The table below lists examples of cable loss per cable length.

**Table 5-1: Examples of cable loss per cable length**

Cable type	Cable length (ft)	Tx power (dBm)	Cable loss (dB)	Max. Antenna gain (dBi)	Max. EIRP (dBm)
BELDEN - 9913	10	21.1	0.6	15.5	36
	30	22	1.5	15.5	36
	100	23	4.4	15.5	34.1
BELDEN - 89907	10	22.4	1.9	15.5	36
	30	23	5.2	15.5	33.3
	100	23	16.3	15.5	22.2



**Note:** Airspan does not supply external antenna cables. It is the responsibility of the installer to provide the cable and ensure the cable characteristics (e.g. length and cable loss) enables adherence to EIRP regulations of the country or area in which the ASWipLL system is operating.

## 5.8.2. Omni-Directional Antennas

In some scenarios, where capacity demand is relatively low, external omni-directional antenna use at the Base Station may seem attractive. However, it is recommended to avoid using omni-directional antennas (if possible), due to the following disadvantages that these antennas pose compared to directional antennas:

- **Higher sensitivity to external interferences.**
- **Higher sensitivity to multipath**, resulting in the following:
  - The root mean square (RMS) delay spread at the Base Station is substantially higher.
  - Multipath interference at the CPE side (when using omni-directional antenna at the Base Station) is substantially higher. In fact, when using an omni-directional antenna, the existence of clear Fresnel zone between BSR and SPR/IDR is insufficient to eliminate multipath interference, since multipath, in this case, can be caused by reflections originating from obstacles outside the Fresnel zone.
- **Higher sensitivity to alignment.** Since the omni-directional antenna gain is achieved by narrowing the vertical beam width, a relatively low deviation in the antenna alignment will result in severe signal attenuation.

## 5.8.3. Operating in 900 MHz

The performance of ASWipLL 900 operating in the 900 MHz band, may vary dramatically depending on the polarization of antennas, i.e. vertical or horizontal. Therefore, it is recommended that the operator, during installation, compare the performance between horizontal and vertical polarization of external antennas, and use the polarization providing the best performance.



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**Note:** Some antennas support both horizontal and vertical polarization:

- Yagi
  - 9 dBi antenna (Cat. No. 35000008)
  - 6.5 dBi antenna (Cat. No. 35000009)
- 
-

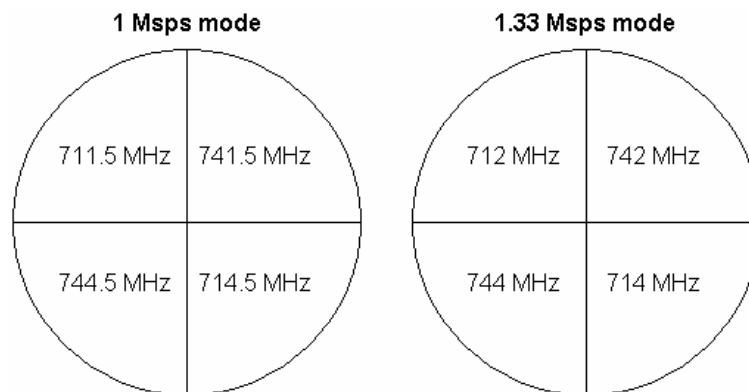
### 5.8.4. Operating in Band-C for FCC Markets

Some operators (e.g. in the USA) have licenses for Band-C (710 – 716 MHz and 740 – 746 MHz). ASWipLL 700 provides an external antenna, allowing coverage in the entire 700 MHz band (698 to 746 MHz), including the licensed A and B bands used in USA.

A maximum of four BSRs operating in Band-C are allowed at a Base Station (in accordance with FCC regulations). This regulation ensures minimum RF interference with other radio devices that may be operating in nearby frequencies.

In the 1 Megasymbols per second (Mps) mode, the center frequencies are 711.5, 712.5, 713.5, 714.5, 741.5, 742.5, 743.5, and 744.5. Thus, the frequency allocation for four BSRs is **711.5, 741.5, 714.5, and 744.5**.

In the **1.33 Mps** mode, the center frequencies are 712, 713, 714, 742, 743, and 744. Thus, the frequency allocation for four BSRs is **712, 742, 714, and 744**.



**Figure 5-3: Frequency allocation in a four-sector Base Station**

Radio interference may occur between the BSRs operating in the upper frequency range (i.e. 742 MHz and 744 MHz) and the lower frequency range (i.e. 712 MHz and 714 MHz). To overcome this interference, a **1-meter vertical separation** (in addition to the general 1-meter horizontal separation) is recommended between the BSRs operating in the upper frequency and the BSRs operating in the lower frequency.

### 5.8.5. Dual Antenna Receive Diversity

For BSRs operating in the 700 MHz or 900 MHz bands, two antennas are provided for antenna receive diversity at the ASWipLL Base Station. This allows the BSR to select the antenna providing the best RF reception to receive the signal.

In this operating band, for BSR models with integral antennas, two internal, built-in antennas are provided. For BSR models without built-in, internal antennas, dual diversity is provided by the existence of two N-type connectors for attaching two external antennas.



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**Notes:**

- 1) The BSR with two antennas transmits using only one of the antennas (factory selected).
  - 2) Antennas must be orientated to cover the same area/cell (i.e. subscriber sites), from only a slightly different location.
-



## Basic Design of Devices

This chapter describes the basic design of the ASWipLL devices that can be installed at the Base Station:

- BSR
- BSDU
- SDA-1/48V
- GPS
- BSPS

### 6.1. BSR

The BSR is an encased outdoor radio providing access to the BSR's communication ports on its front panel. The BSR's bottom panel provides holes for mounting the BSR to, for example, a pole or wall.

#### 6.1.1. Models

The BSR is available in the following basic physical designs:

- BSR with a built-in, internal antenna
- BSR with an N-type port for connecting an optional third-party external antenna
- BSR with two N-type ports for connecting two optional third-party external antennas for dual antenna diversity (when operating in the 700 or 900 MHz bands)

The table below provides a brief description of the BSR models and the frequencies in which they can operate. For a detailed description of the BSR products, see Appendix I, "ASWipLL Product List".

**Table 6-1: Operating frequency ranges per BSR model**

BSR model	Operating frequency (MHz)	Antenna configuration
BSR 700	698 to 746	Internal or external (up to two external antennas)
BSR 900	902 to 928	Internal or external (up to two external antennas)
BSR 925	910 to 940	External
BSR 1.5	1,427 to 1,525	Internal or external
BSR 2.3	2,300 to 2,400	Internal or external
BSR 2.4	2,400 to 2,500	Internal or external
BSR MMDS	2,500 to 2,686	Internal or external
BSR 2.8	2,700 to 2,900	Internal or external
BSR 3.x	3,300 to 3,810	Internal or external
BSR 5.8	5,725 to 5,875	Internal or external



**Notes:**

- 1) BSR device with an N-type port(s) for attaching a third-party external antenna(s) do not provide a built-in antenna.
- 2) The BSR installation procedures described in this guide apply to all BSR models, except the procedures for attaching third-party external antennas (which apply only to BSR models providing an N-type port).

## 6.1.2. Physical Dimensions

The BSR's physical dimensions are described in the table below.

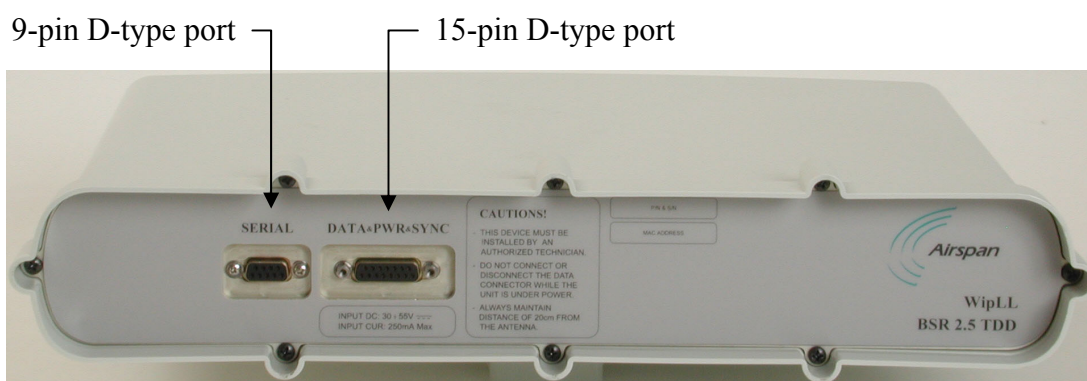
**Table 6-2: BSR physical dimensions**

Parameter	Value	Comment
Height	400 mm (15.74 inches)	The BSR's physical dimensions

Width	317 mm (12.48 inches)	exclude the mounting kit
Depth	65.5 mm (2.58 inches)	
Weight	4.7 kg	

### 6.1.3. Ports

The BSR provides various ports on its front panel, as displayed below:



**Figure 6-1: BSR front panel (built-in antenna model)**



**Note:** BSR models that use third-party external antennas provide an N-type female receptacle for attaching an external antenna. In addition, BSR models operating in the 700 and 900 MHz bands provide two N-type receptacles for dual antenna receive diversity.

The table below describes the BSR ports.

**Table 6-3: BSR ports**

Port	Interface
15-pin D-type	<ul style="list-style-type: none"> <li>Ethernet (10BaseT): with the BSDU (or SDA)</li> <li>Synchronization: of BSRs controlled by BSDU</li> <li>Power: supplied by BSDU (or SDA)</li> </ul>
9-pin D-type	Serial (RS-232) local initial configuration (using WipConfig tool) during installation
N-type	(Depends on model). For attaching third-party external antennas. BSR models for the 700 and 900 MHz bands provide two N-type ports. BSR models with

	built-in antennas do not provide N-type ports.
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## 6.2. BSDU

The BSDU is an Ethernet switch encased in a chassis providing access to the BSDU's communication ports on the front and rear panels. The BSDU is installed in a standard 19-inch rack.

### 6.2.1. Physical Dimensions

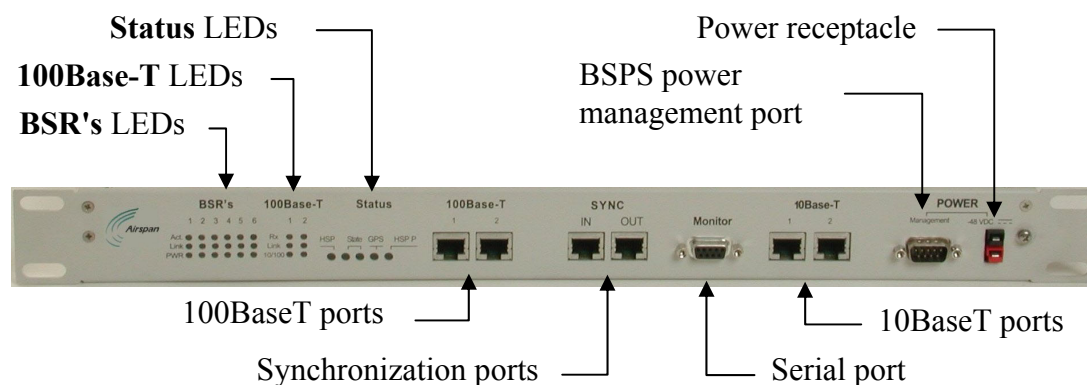
The BSDU's physical dimensions are described in the table below.

**Table 6-4: BSDU physical dimensions**

Parameter	Value
Height	43.2 mm (1.7 inches)
Width	482.6 mm (19 inches)
Depth	228.6 mm (9 inches)
Weight	2.9 kg

### 6.2.2. Ports

The BSDU (displayed below) provides ports on the front and rear panels.



**Figure 6-2: BSDU front panel**

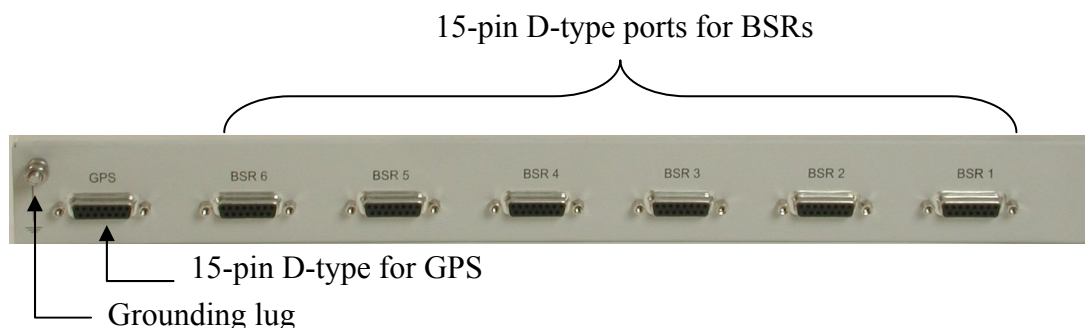


Figure 6-3: BSDU rear panel

The table below describes the BSDU's ports on the front and rear panels.

Table 6-5: List of BSDU ports

Panel	Label	Port	Interface
Front	<b>100Base-T</b>	RJ-45 (two)	100BaseT interface with provider's backbone (WAN), and for BSDU and BSRs management interface (if 10Base-T ports are looped)
	<b>SYNC</b>	RJ-45 (two)	Synchronization between BSDUs
	<b>Monitor</b>	9-pin D-type female	BSDU serial interface
	<b>10Base-T</b>	RJ-45 (two)	BSDU management (port #2) and management to BSRs connected to BSDU (port #1)
	<b>Management</b>	9-pin D-type male	Base Station Power System (BSPS) remote management interface using WipManage
	<b>48 VDC</b>	Power receptacle	Connecting DC power supply from, e.g. BSPS
Rear	<b>GPS</b>	15-pin D-type	Connecting a Global Positioning System (GPS) antenna for synchronization
	<b>BSR</b>	15-pin D-type (six)	Interfacing with BSRs, providing BSRs with DC power, Ethernet connection, and synchronization

A 5-mm diameter-grounding lug is present on the rear panel for grounding the BSDU.

### 6.2.3. LED Indicators

The BSDU provides various LED indicators located on the BSDU's front panel (see Figure 6-2). These LEDs are grouped under the following labels:

- BSR's
- 100Base-T
- Status

### 6.2.3.1. BSR's LEDs

The **BSR's** LED indicators provide three LEDs for each of the six BSR ports. These LEDs are described in Table 6-6.

**Table 6-6: BSR's LED description**

LED	Color	Status	Meaning
Act	Yellow	On	Ethernet activity is detected on the BSR port
		Off	No Ethernet activity detected on the BSR port
Link	Yellow	On	Physical link exists between the BSDU and BSR
		Off	No physical link exists between the BSDU and BSR
PWR	Yellow	On	Power is supplied to the BSDU's <b>BSR</b> port
		Off	No power is available, or the BSDU's <b>BSR</b> port is disabled by software, or port failure has occurred

### 6.2.3.2. 100Base-T LEDs

The **100Base-T** LED indicators provide three LEDs for each of the two 100Base-T ports. These LEDs are described in Table 6-7.

**Table 6-7: 100Base-T LED Description**

LED	Color	Status	Meaning
Rx	Yellow	On	Data is received through the 100Base-T port
		Off	No data is received through the 100Base-T port
Link	Yellow	On	Viable physical link between the 100Base-T port and the external device to which this port connects
		Off	No physical link between the 100Base-T port and the external device to which this port connects
10/100	Yellow	On	Power is supplied to the 100Base-T port
		Off	No power at the 100Base-T port

### 6.2.3.3. Status LEDs

The **Status** LEDs indicate various synchronization and GPS functioning, as described in the table below.

**Table 6-8: Status LED Description**

LED	Color	Status	Meaning
<b>HSP</b> (Hop Synchronization Process)	Green	On	BSDU synchronization process is active
<b>State</b> (two LEDs)	Green	Only right LED is on	Synchronization process is starting
		Both LEDs are on	BSDU is the master unit
		Only left LED is on	BSDU is a slave unit
		Both LEDs are off	BSDU synchronization pulse lost (i.e. no synchronization)
<b>GPS</b>	Green	On	GPS antenna is connected to the BSDU
		Blinking	Receiving a satellite signal via GPS
<b>HSP P</b> (Hop Synchronization Process Pulse)	Green	On	Change state for the HSP pulse

## 6.3. SDA-1/48V

The SDA-1/48V is a compact indoor adapter especially designed for use when available power source is 48VDC (i.e. no AC power supply), and when no synchronization is required (i.e. in licensed bands). The SDA-1/48V connects to the BSR by a standard CAT 5 cable, providing Ethernet and power interfaces.

### 6.3.1. Physical Dimensions

The SDA-1/48V physical dimensions are described in the table below.

Table 6-9: SDA-1/48V physical dimensions

Parameter	Dimensions
Height	123 mm (4.84 inches)
Width	68 mm (2.68 inches)
Depth	30 mm (1.18 inches)
Weight	85g

### 6.3.2. Ports

The SDA-1/48V provides various port interfaces as displayed in Figure 6-4.

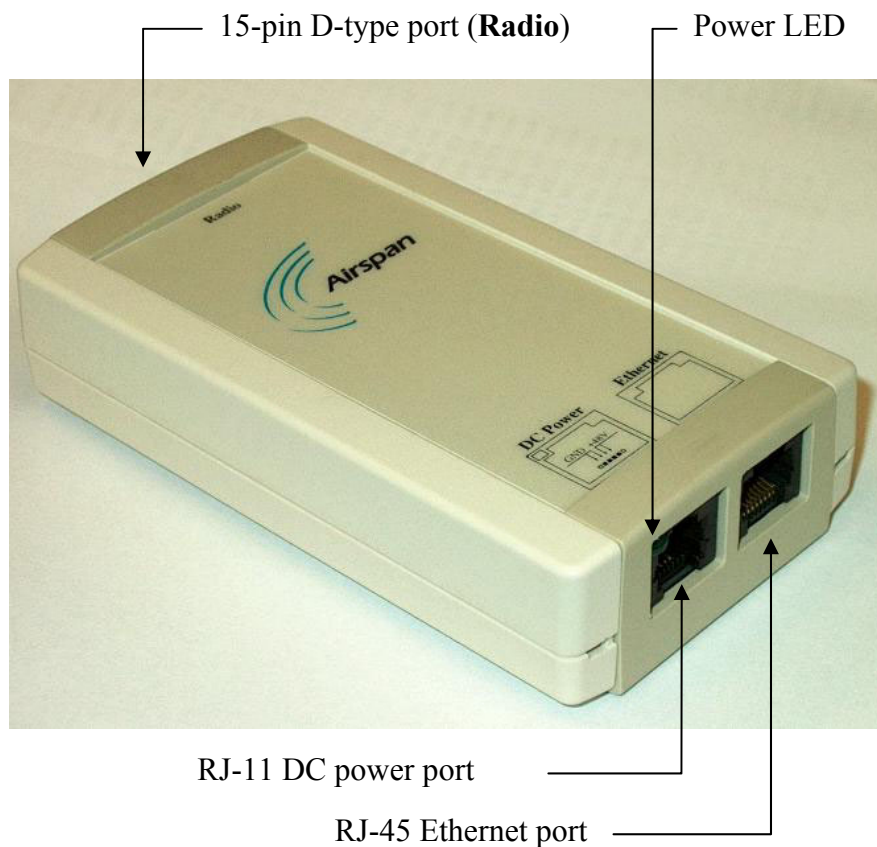


Figure 6-4: SDA-1/48V ports

The table below describes the SDA-1/48V port interfaces.

**Table 6-10: Description of SDA-1/48V ports**

Port	Interface
15-pin D-type	Interfaces with ASWipLL outdoor radio (i.e. BSR, PPR, or SPR) by a CAT 5 cable
8-pin RJ-45	10BaseT interface with, for example, a router, backhaul solutions, a LAN switch, a PC
6-pin RJ-11	Power (including power LED)

### 6.3.3. LED Indicators

The SDA-1/48V provides a power LED that indicates whether or not the SDA-1/48V is receiving power. This LED is located in the top-left corner of the RJ-11 port (labeled **DC Power**).

When power is received by the SDA-1/48V, the power LED is lit (**green** color). When no power is received, the power LED is off.

## 6.4. GPS

The third-party GPS antenna is a rugged, self-contained GPS receiver and antenna. The GPS connects to the BSDU, providing satellite clock signals for synchronizing the BSDUs and multiple Base Stations.

### 6.4.1. Ports

The GPS provides a 12-pin male contacts for connecting a cable between it and the BSDU.



Figure 6-5: GPS antenna – side view

### 6.4.2. Physical Dimensions

The GPS physical dimensions are described in the following table.

Table 6-11: GPS physical dimensions

Parameter	Description
Diameter	4.5" (115 mm)
Height	3.6" (90 mm)
Weight	0.454 kg (2 lb)

## **6.5. BSPS**

For a detailed description of the BSPS, see Appendix B, "Installing the BSPS".





## Mounting the Devices

This chapter describes the mounting procedures for the following devices:

- BSR
- BSDU
- SDA-1/48V
- BSPS

### 7.1. Pole-Mounting the BSR

The BSR is typically mounted on a pole, however, it can be wall mounted as well. Pole mounting allows the BSR to be easily adjusted in the horizontal (azimuth) and vertical (elevation) planes for antenna alignment.



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**Note:** In the standard BSR kit, Airspan does not supply wall-mounting brackets. To order wall-mounting brackets, contact your Airspan representative. BSR wall mounting is identical to SPR wall mounting. Therefore, for a detailed description of wall mounting, see SPR wall mounting in Part II, Chapter 13, "Mounting the Devices".

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The BSR is mounted using the mounting holes located on the BSR's bottom panel (see Figure 7-1) and the supplied pole-mounting brackets. The pole-mounting bracket is designed to support the BSR on a round pole of 45 mm in diameter.