WipLL and AS3010 Systems

Wireless IP-Based Local Loop System
Release 4.2B

Hardware Installation Guide

Connecting the World with Wireless Access Solutions

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About this Guide

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

Purpose

This guide describes the procedures for installing Airspan's **WipLL** 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).

Although this guide provides software configuration information for certain WipLL devices, it is not comprehensive. For detailed software configuration information, see the *WipLL Commissioning Manual*, *WipConfig User's Guide*, and *WipManage User's Guide*.

Targeted Audience

This guide is intended for the person who is responsible for installing the WipLL system, and who should be familiar with electronic circuitary and wiring.

Organization of this Guide

This guide is organized into the following chapters and parts:

- Chapter 1, "**Introduction**": provides a brief overview of the WipLL hardware devices.
- Chapter 2, "**Safety Guidelines**": lists the safety guidelines for handling cables and electricity during the installation.
- Chapter 3, "**Part List and Required Tools**": lists the equipment provided by Airspan, as well as the tools needed for installation.
- Part 1, "**Installing WipLL Base Station Equipment**": includes the following chapters concerned with installing WipLL equipment at the base station:
  - Chapter 4, "**Installing the BSR**"
  - Chapter 5, "**Installing the BSDU**"
  - Chapter 6, "**Installing the GPS"**
  - Chapter 7, "**Installing the BSPS**"
- Part 2, "**Installing WipLL Customer Premises Equipment**": includes the following chapters concerned with installing WipLL equipment at the subscriber's premises:
  - Chapter 8, "**Installing the SPR**"
  - Chapter 8, "**Installing the SDA**"
  - Chapter 9, "**Installing the IDR**"
- Appendix A, "**Glossary**": glossary of terms used in this guide
- Appendix B, "**Cable Crimping**": describes the crimping procedure for 15-Pin D-type, N-type, and GPS connectors.

- Appendix C, "**Technical Specifications**": lists the technical specifications of the WipLL units.
- Appendix D, "**Summary of Connector Pinouts**": provides a sumary of the connector pinouts and color-wiring for CAT 5 cable connectors.

Conventions

This guide uses the following bulletin conventions:

Note: Provides useful information.

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

Technical Support

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

- **Telephone hotline:** (+972)-8-929 2266
- **E-mail:** Wipll.tech_support@Airspan.com

Introduction

Airspan's **AS WipLL** system (hereafter referred to as WipLL) is a low-cost, high-performance point-to-multipoint IP-based Broadband Fixed Wireless (BFW) Access solution. WipLL 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). **WipLL** offers service providers an integrated access solution, providing quick-to-market deployment and low-market entry cost for broadband services.

WipLL provides connectivity speeds of up to 4 Mbps in the licensed 2.8 GHz, 3.*x* GHz, and Multichannel Multipoint Distribution Services (MMDS), and unlicensed 900 MHz, 2.4 GHz (ISM), and 5.8 GHz radio frequency bands. Each **WipLL** base station, at maximum configuration, supports up to 3,024 subscribers.

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

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

WipLL provides bandwidth management by supporting Committed Information Rate (CIR) and Maximum Information Rate (MIR), guaranteeing bandwidth levels to subscribers. In addition, **WipLL** supports VLANs/VPNs based on IEEE 802.1Q/p. **WipLL** supports IP routing and PPPoE bridging, as well as transparent bridging.

WipLL provides embedded security features such as IP (packet) filters based on addresses, protocols, and applications.

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

1.1. Main Features

The WipLL system includes the following main features:

- Low initial investment, maximum return on investment (ROI)
- Packet-based air interface supporting high speed data, VoIP, and multimedia services
- Modular architecture with flexible deployment architectures
- 4 Mbps (3.2 Mbps net) per sector—up to 24 sectors per base station
- Compact, integrated design allowing easy and quick deployment
- Advanced Quality of Service (QoS)
- Simultaneous support of IP routing and PPPoE bridging
- Supports transparent bridging, allowing easy IP addressing schemes
- Bandwidth management: CIR and MIR
- Supports 802.1Q/p for VLANs/VPNs and end-to-end QoS
- Provides automatic connection to base stations of first-time powered-on and unconfigured subscriber devices
- Allows redirection of subscriber devices to different base station radios
- Supports configuration files, allowing the same configuration settings to be applied to multiple WipLL devices
- Supports local and remote SNMP-based management, providing an intuitive GUI for easy management

1.2. Customer Benefits

The WipLL system provides the following customer benefits and advantages over competitors:

- No IF or RF cables required for indoor unit-to-outdoor unit (IDU-to-ODU) connectivity, providing a more cost-effective and easier installation. Instead of IF/RF cables, WipLL implements standard CAT-5 Ethernet cables.
- Scalability and modular base station architecture allows customers to add equipment when needed, thereby allowing low initial cost entry and pay-as-you-grow strategy. Unlike competitors, the WipLL base station is not a chassis-based design, providing flexibility and saving space at the base station.
- WipLL's open architecture allows interoperability with multi-vendor products such as residential gateways (RGW), access gateways, gatekeepers, and softswitches, thereby, operating seamlessly in multi-vendor environments.
- WipLL's proprietary PPMA air MAC protocol is highly efficient—80% throughput—allowing multiple concurrent subscribers to utilize bandwidth without network degradation (from collisions and high BER).
- Long-distance radio coverage.
- WipLL is both an IP router and a PPPoE bridge.
- Supports transparent bridging for easy implementation of IP addressing schemes
- WipLL's IP routing provides efficiency and eliminates the need for additional hardware.
- Enhanced QoS—based on IP addresses, protocols, and applications.
- End-to-end QoS—based on DiffServ/TOS or 802.1p.
- Fast-and-easy installation and configuration using WipLL Auto Connect.
- Embedded security features such as IP (packet) filters based on addresses, protocols, and applications.
- Rich networking packages such as 802.1Q/p VLANs/VPNs.

1.3. System Architecture

The WipLL system architecture is composed of the following three basic areas (see Figure 1-1):

- **Base station site:** consists of WipLL access units that interface between the provider's backbone and the WipLL system.
- **Subscriber site:** consists of WipLL customer premises equipment (CPE) that interfaces between the base station and the subscriber's network.
- **Network operations center (NOC):** consists of the WipLL SNMP-based management system that manages the entire WipLL system.

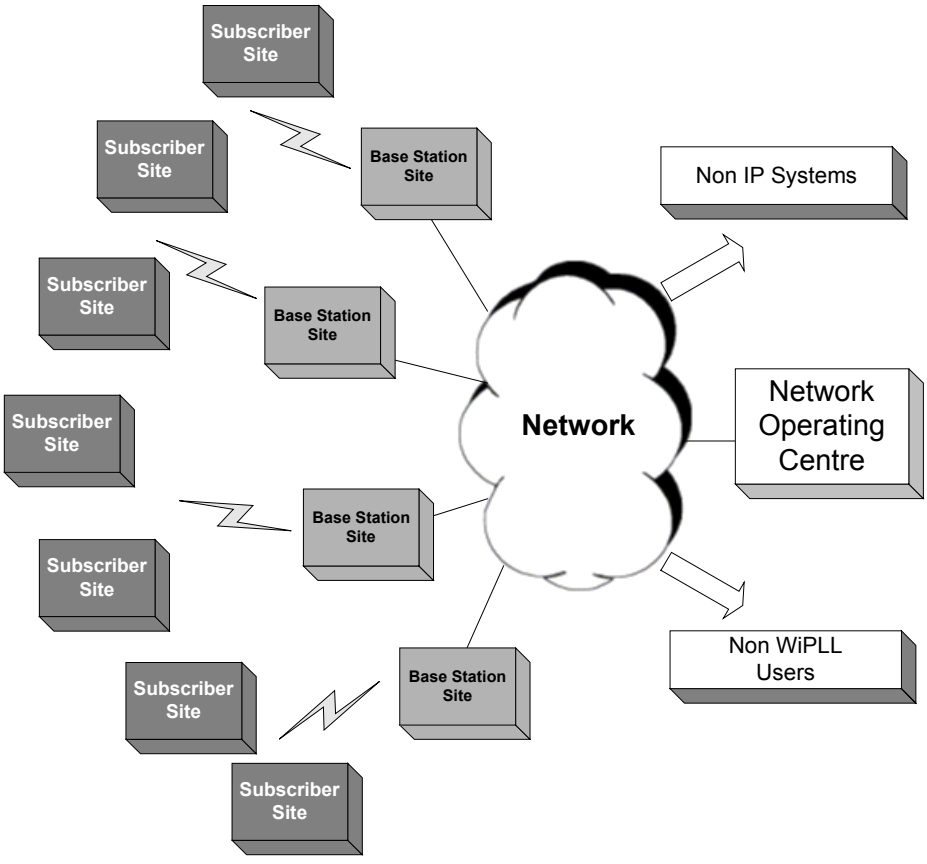

Figure 1-1: WipLL System Architecture

1.3.1. Base Station

The WipLL base station provides a radio link between the subscriber and the service provider's backbone to provide high-speed data access, Internet access, and VoIP. The WipLL base station equipment consists of a radio transceiver that transmits and receives signals to and from the subscriber, and of various optional routers and switches that connect the WipLL transceiver to the service provider's backbone, through a 100BaseT Ethernet connection.

The WipLL base station is comprised of the following units (see Figure 1-3):

- **Base Station Radio** (BSR)**:**

  The BSR is a radio transceiver that provides the wireless link between the subscriber and the provider's backbone. The standard BSR has 60-degree radio coverage, serving up to 126 subscribers in that sector.

  The BSR is installed outside the base station site, typically mounted on a pole.

- **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 WipLL radio unit (i.e., Subscriber Premises Radio).

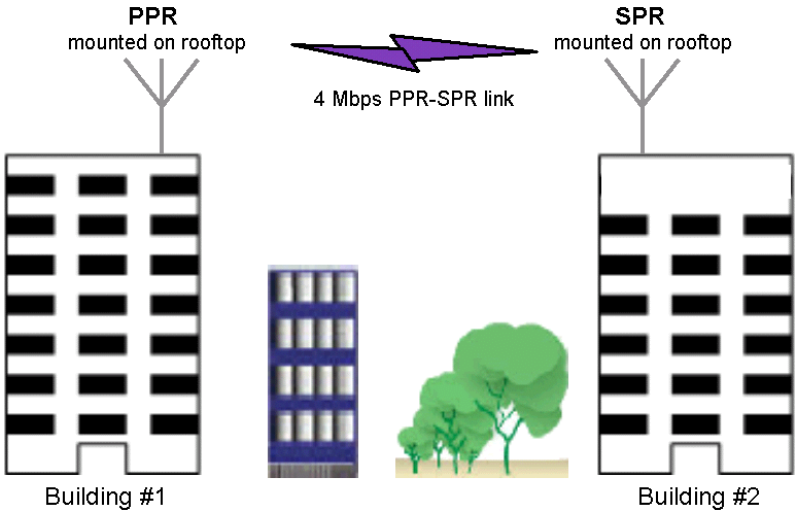

Figure 1-2: PPR in a building-to-building application

- **Subscriber Data Adapter** (SDA)**:**

  The SDA is implemented at base stations comprised of a single BSR. The SDA provides the BSR with -48 VDC power supply and Ethernet connectivity to the provider's backbone. The SDA is installed inside, connected to the BSR with a CAT-5 cable. For a description of the various SDA models, see Section 1.3.2, “Subscriber Site”.

- **Base Station Distribution Unit** (BSDU)**:**

  The BSDU is implemented at base stations comprising multiple BSRs. The BSDU provides BSRs with –48 VDC power supply, connectivity to the provider's backbone, and frequency hop synchronization. The BSDU is installed inside, connected to BSRs with CAT-5 cables.

  Each BSDU can support up to six BSRs, and 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.

- **Base Station Power Supply** (BSPS)**:**

  The BSPS is an optional WipLL unit that provides AC-to-DC power conversion and power redundancy to BSDUs.

- **Global Positioning System (GPS) antenna:**

  The GPS antenna is a rugged, self-contained GPS receiver and antenna that receives a universal GPS satellite clock signal. The GPS connects to the BSDU and synchronizes frequency hopping of multiple base stations to allow the WipLL network to operate with the same clock, and eliminating radio frequency ghosting effects.

Figure 1-3 shows the WipLL base station devices and their interconnections.

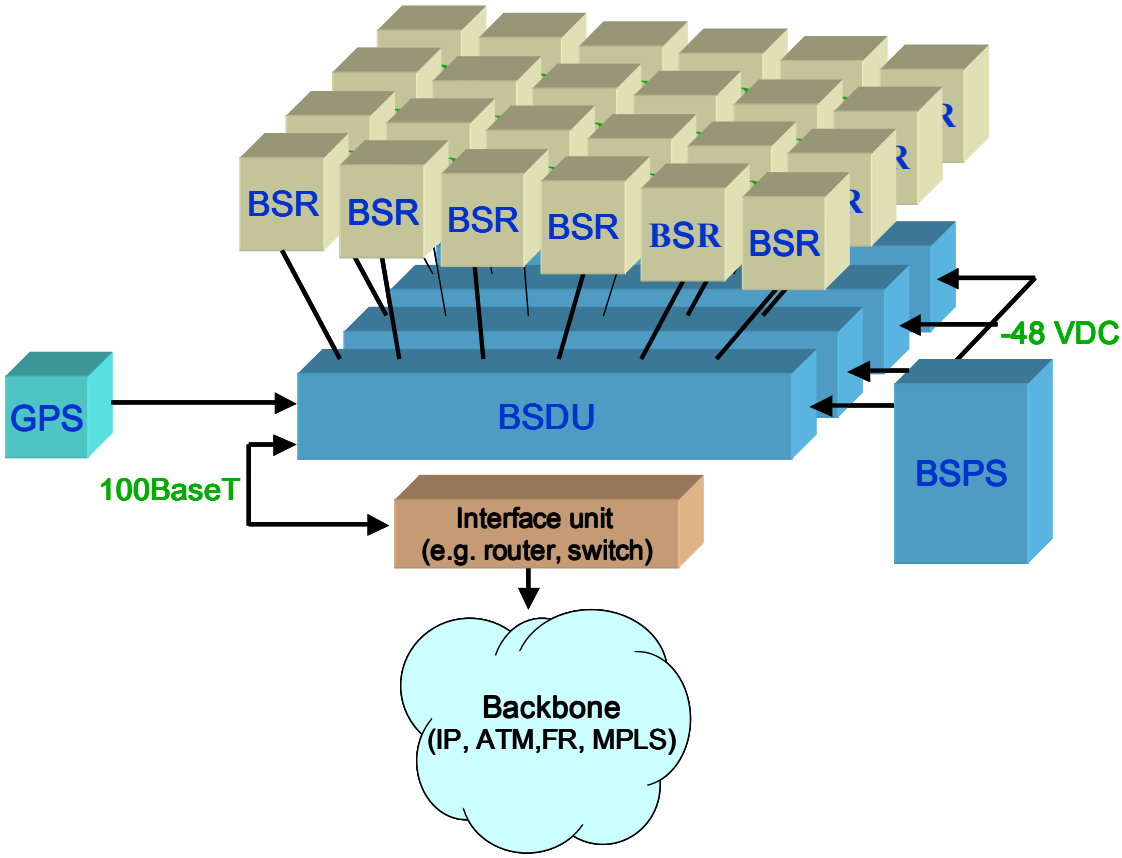

Figure 1-3: WipLL base station units (maximum configuration)

1.3.2. Subscriber Site

The WipLL subscriber site is located at the service provider's subscribers' premises. The WipLL subscriber site equipment consists of a radio transceiver that receives and transmits signals from and to the base station. The WipLL radio transceiver provides the subscriber with high-speed data access, Internet access, and VoIP at up to 4 Mbps. The WipLL transceiver connects to the subscriber's network or PC via WipLL's Ethernet hub (i.e., Subscriber Data Adapter).

The WipLL system can group subscribers into VLANs, as well as assign MIR and CIR levels to each subscriber, guaranteeing bandwidth to subscribers.

The WipLL system provides two different CPE installation configurations:

- **Indoor unit (IDU) and outdoor unit (ODU):** this setup is composed of WipLL's SDA and SPR devices, representing the IDU and ODU, respectively.
- **Indoor unit (IDU) only:** this setup is composed of the Indoor Data Radio (IDR)

WipLL's subscriber site equipment is comprised of the following:

- **Subscriber Premises Radio (SPR):**

  The SPR is a radio transceiver that provides a wireless link between the base station and the subscriber's network. The SPR is installed outside the subscriber's premises, typically on a roof.

- **Subscriber Data Adapter (SDA):**

  The SDA is a hub/switch that provides the SPR with -48 VDC power supply and Ethernet connectivity to the subscriber's network/PC. The SDA is installed inside the subscriber's premises and is connected to the SPR by a CAT-5 cable.

  The SDA models include the following:

  - **SDA-1:** provides one 10BaseT connection to the subscriber's computer and/or network.
  - **SDA-4H:** provides a hub and four 10BaseT interfaces to the subscriber's computers and/or networks. The hub interface is a crossed Ethernet cable that can connect to another hub or LAN switch. Alternatively, it may be connected to another PC via a crossed Ethernet cable.
  - **SDA-4S models:** integrated LAN switches, providing four Auto Negotiation 10/100BaseT (Full or Half Duplex mode) ports for interfacing with the subscriber's PCs/network) These models include the following:
    - **SDA-4S (standard):** Standard integrated LAN switch, providing four 10/100BaseT interfaces to the subscriber's computers. This model is ideal for SOHO implementation.
    - **SDA-4S/VL:** Provides VLANs between its ports and the SPR, ensuring privacy between users of 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 implementation.

- **SDA-4S/VLtag:** This model is ideal for multi-tenant applications where traffic engineering and privacy is required. SDA-4S/VLtag assigns the traffic from each of its four ports with a different VLAN ID. 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 via WipLL's NMS. The tag conversion is performed by SPR before sending the traffic to the air and the other way around 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 (VLAN for each port and a high priority port for VoIP).

- **Indoor Radio Adapter (IDR):**

  The IDR functions as a transceiver and a hub, eliminating the need for an SPR and SDA. The IDR is installed inside the subscriber's premises, typically mounted on a wall, desktop, or pole. The IDR is connected to a third-party antenna, which is typically mounted outside to provide line-of-site with the base station.

- **Residential Gateway (RGW)—**optional unit**:**

  The RGW is a third-party unit that provides gateway support for VoIP. The RGW is typically connected to the SDA through a 10BaseT port. Typically, the RGW provides two POTS ports for telephony; a LAN port for the local PC/network; and a LAN port for connectivity to the SDA.

Figure 1-4 and Figure 1-5 display the WipLL customer premises equipment and their interconnections.

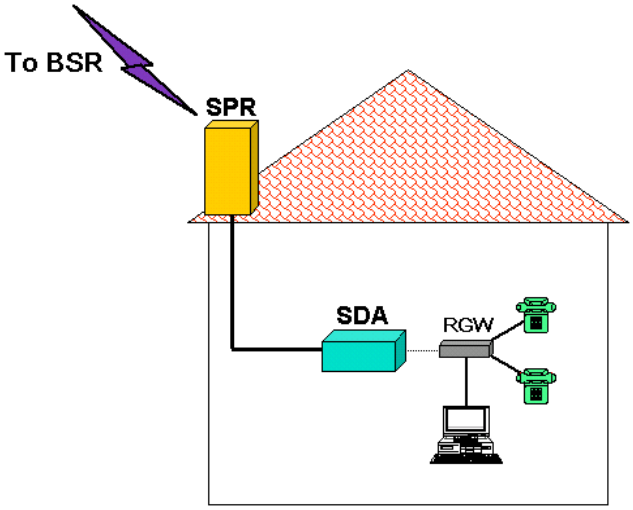

Figure 1-4: Subscriber site with SPR and SDA units (optional RGW unit)

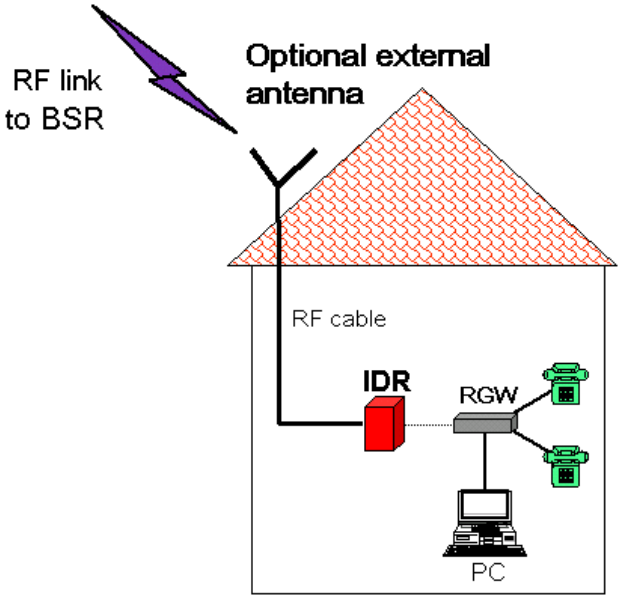

Figure 1-5: Subscriber site with IDR and third-party external antenna (optional RGW)

1.3.3. Network Operations Center

Airspan's WipLL system provides state-of-the-art, use-friendly management tools for managing the WipLL system. These management tools provide fault, configuration, performance, and security management of the WipLL system.

The WipLL system provides the following management tools:

- **WipManage™:**

  WipManage is the WipLL network (element) management system (NMS) providing fault, configuration, performance, and security management. WipManage is a Windows-based, stand-alone WipLL application that provides a user-friendly and intuitive Graphic User Interface (GUI).

  WipManage provides local and remote network management that is based on Simple Network Management Protocol (SNMP). WipManage provides configuration, fault and alarms, security, and bandwidth management to all the WipLL units—WipLL base station equipment and WipLL CPE.

- **WipConfig™:**

  WipConfig is an easy-to-use, Windows-based application that provides local initial configuration for WipLL devices during installation. This initial configuration includes, for example, assigning the units IP addresses and positioning the antenna (or transceiver) for optimal reception.

- **WipConfig PDA™:**

  WipConfigPDA is designed to run on personal digital assistants (PDA), and provides an alternative tool to WipConfig (described above) for providing initial configuration.

- **WipAD™:**

  WipAD is a Windows-based application that provides quick-and-easy automatic downloading of software versions to multiple WipLL devices.

1.4. Applications

The following subsections provide examples of typical WipLL applications.

1.4.1. Broadband Data Access

Using a standard PSTN modem in circuit-switched networks, subscribers are limited to 56 Kbps of throughput, and in most cases, to 28.8 Kbps. From the operator's perspective, once a subscriber has dialed up with a PSTN modem, a full channel is occupied for as long as the session lasts.

WipLL subscribers are limited only by their own configuration, with a maximum of 4 Mbps—70 times faster than the fastest PSTN modem. However, subscribers do not necessarily consume more bandwidth from the operator, since bandwidth is used only when a data packet is transmitted.

These characteristics of WipLL make it suitable for providing data access to subscribers while maintaining best usage of bandwidth and capacity.

1.4.2. High Speed Internet Access

One of the advantages of WipLL is the fact that subscribers are "always on" Internet. This means that there is no dialing process and no need for the hassle involved with dialup access. Subscribers need only to open their Web browser or e-mail to be instantly connected.

WipLL can also distinguish between applications and subscribers, thus, enabling the operator to provide different class of service to subscribers. For example, it can provide different services to Web browsing and e-mail by prioritizing Web browsing for ensuring best "Internet experience".

Figure 1-6 shows a typical WipLL application for high-speed Internet access.

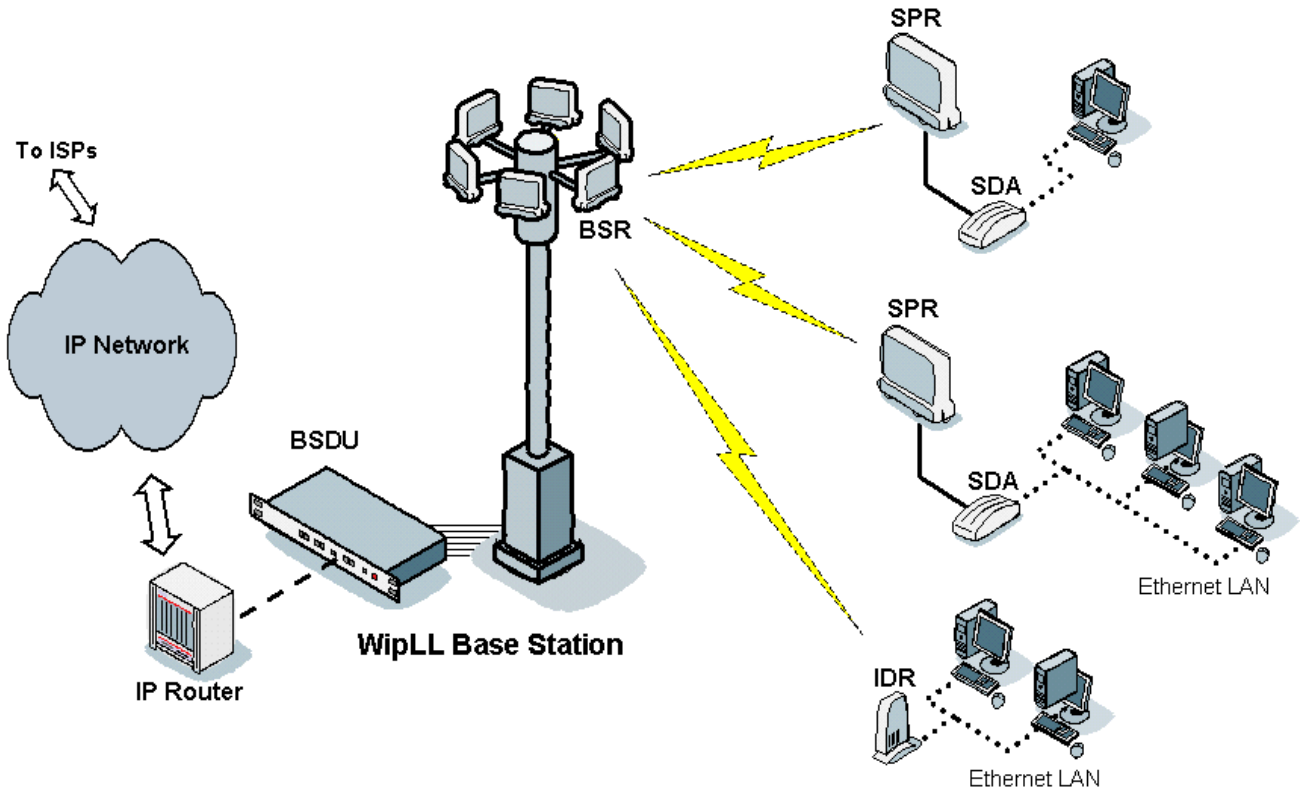

Figure 1-6: Typical WipLL Application for High-Speed Internet Access

1.4.3. Voice over IP

The WipLL system enables customers the flexibility of migration from a data-only network to an integrated Voice-over-IP and data network. The WipLL voice solution provides interoperability with any IP-to-PSTN network gateway. The use of the IP-to-PSTN gateway allows operators seamless PSTN connectivity such as SS7 (signaling network), G3-303, and V5.2 over E1, allowing deployment in multi-national markets.

Figure 1-7 shows a typical WipLL application for VoIP.

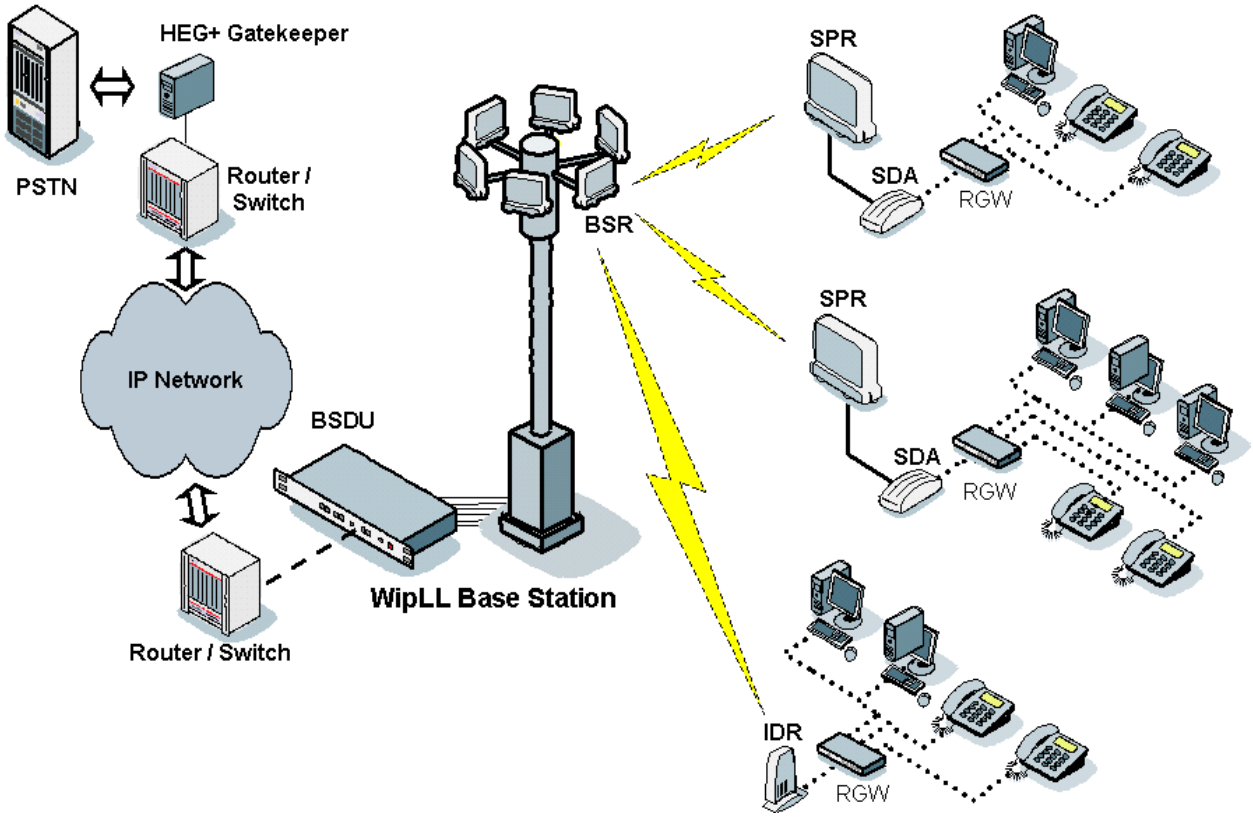

Figure 1-7: Typical WipLL Application for VoIP

1.4.4. Traffic Engineering in Multi-Tenant Application

Airspan's WipLL system provides high-speed wireless broadband (e.g., Internet) access for multiple-tenant units (MTU). WipLL provides a dedicated high-speed connection to the building, and then distributes that bandwidth among the tenants, providing them with a private, secure connection.

The WipLL system provides traffic engineering in MTU applications in networks that connect to MPLS, ATM, or Frame Relay backbones. The WipLL hardware responsible for providing MTU solutions is the SDA-4S/VLtag Ethernet switch. SDA-4S/VLtag assigns a different VLAN ID (fixed) to traffic from each of its four ports. WipLL's SPR converts these four VLAN IDs, tagged by SDA-4S/VLtag, to four VLAN IDs configured by WipLL's NMS (WipManage). SPR performs this tag conversion before sending traffic to the air, and when receiving traffic from the air. This VLAN conversion is applicable only when SPR is used as a transparent bridge.

Figure 1-8 shows an example of how MTU works in an ATM environment.

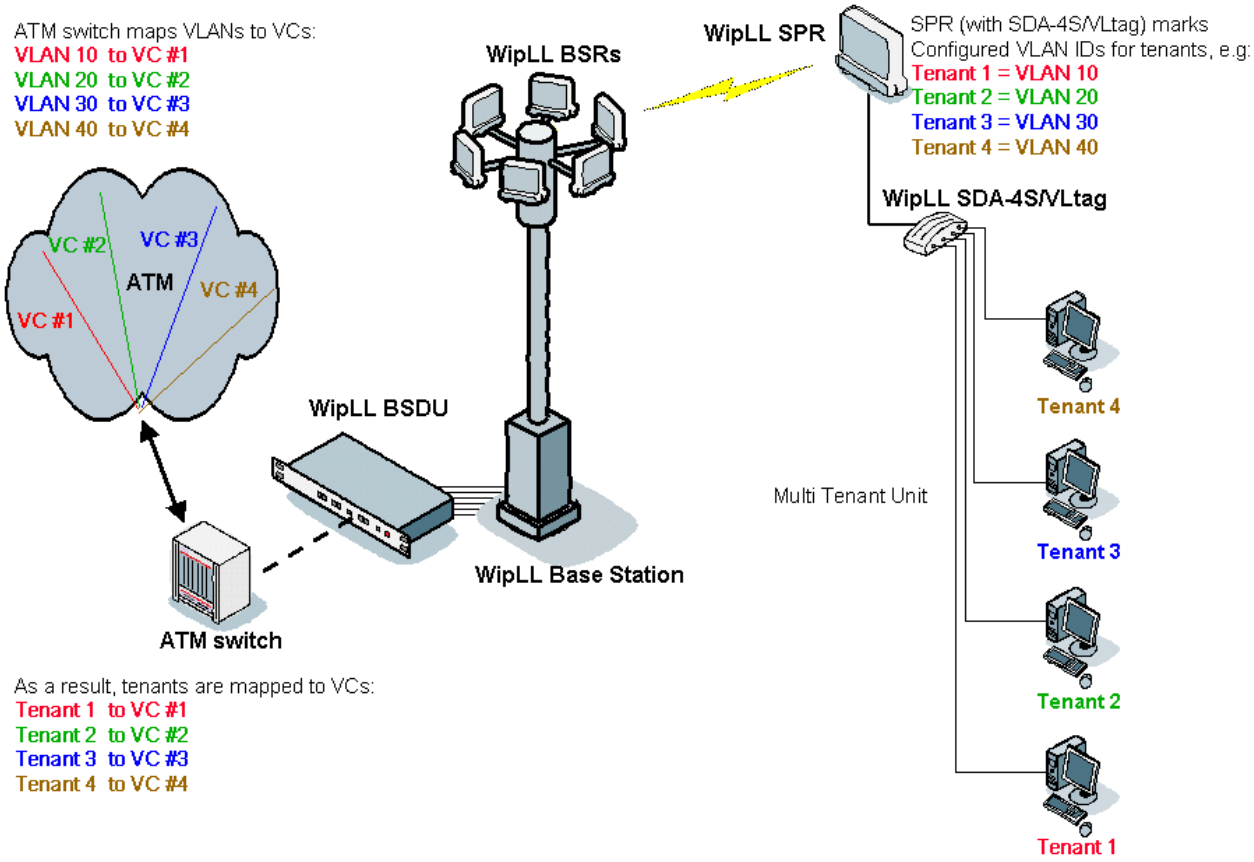

Figure 1-8: Multi-tenant solution (i.e., multiple VLANs) in an ATM environment

1.4.5. Repeater Solution

WipLL units can be used to provide repeater functionality. This is implemented in where the BSR needs to be "extended" to remote subscriber sites that are blocked by obstacles (such as trees, hills, and other typical line-of-sight obstructions) or that the BSR-SPR (or BSR-IDR) transmission is out-of-range. Back-to-back Ethernet connectivity of a BSR with an SPR/IDR provides the repeater capability, as demonstrated in Figure 1-9.

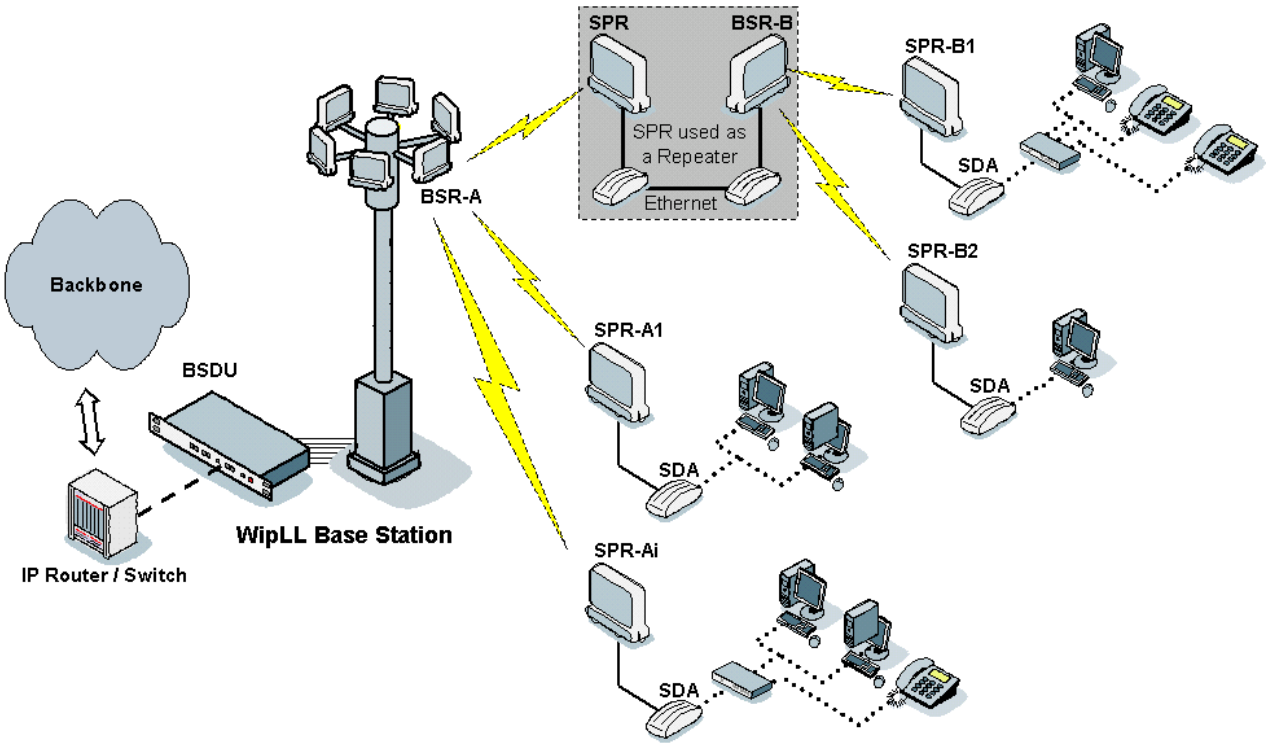

Figure 1-9: WipLL Repeater Solution

In Figure 1-9, BSR ***A*** is part of a WipLL base station that is connected to the service provider's backbone. BSR ***A*** serves multiple SPRs, marked as SPR **Ai**. Two SPRs—SPR ***B1*** and SPR ***B2***—cannot communicate directly with the base station. Therefore, an SPR acts as a repeater by connecting back-to-back with BSR ***B*** (SPR ***B1*** and ***B2*** are served by BSR ***B***).

Notes:
- Careful planning is required to cope with issues such as interferences and delay that are introduced by the repeater solution. For example, if the system is used as a frequency hopping system, GPS may be required at each base station.
- Space and frequency isolation between the "repeater SPR" and BSR *B* is required.
- Bandwidth management should be calculated to support the "repeater bandwidth".
- IP addressing and routing tables should be configured to support the repeater solution.

2

Safety Guidelines

This chapter outlines general safety guidelines when installing the WipLL system.

This chapter includes the following sections:

- General Safety Guidelines
- Electrical Safety Guidelines
  - Handling Electrostatic Devices
  - Grounding
- Lightening Protection
- Installing Outdoor Units and Third-Party External Antennas
- Radio Interference Prevention
- Cabling
  - General
  - Labeling

2.1. General Safety Guidelines

The following lists general safety guidelines when working with the WipLL equipment:

- 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.
- Never install equipment that is damaged.
- Only qualified personnel should be allowed to install, replace, and service the WipLL equipment.

2.2. Electrical Safety Guidelines

The following lists electrical safety guidelines when working with the WipLL equipment:

- Disconnect all power when installing
- Never install the equipment during stormy weather and lightening

2.2.1. Handling Electrostatic Devices

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:

- WipLL 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.

Warning: Under no circumstances is it permissible for units to be handled by unprotected operators.

2.2.2. Grounding

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

Site	WipLL device	Grounding
Base Station	BSR	Through the mains (via BSDU)
	BSDU	Additional grounding required (grounding lug at rear end of chassis)
	BSPS	Additional grounding required (grounding lug at rear end of chassis)
CPE	SPR	Through the mains (via SDA)
	IDR	Through the mains

2.3. Lightening Protection

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

In addition, WipLL outdoor and indoor (SDA) devices provide high speed data line protection against direct and induced transient over-voltages surges on the cables. This capability is provided by the fact that all WipLL device are designed with TVS (transient voltage suppressor) components that maintain potential differences.

However, for geographical areas that have above normal lightening activity, Airspan can supply a surge protector composed of a 15-pin D-type adapter with a grounding wire.

2.4. Installing Outdoor Units and Third-Party External Antennas

Warning: It is the responsibility of the person installing the WipLL 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: Outdoor WipLL units 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 WipLL 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.

2.5. Radio Interference Prevention

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

Warning: The WipLL transceivers emit microwave radiation; a minimum distance of 200 mm must be maintained from the front of the device, and a minimum separation of 1 meter must exists between adjacently installed WipLL transceivers.

2.6. Cabling

This section defines the cabling procedures to be adopted during WipLL equipment installations at both base station and subscriber premises.

2.6.1. General

A summary of issues to be considered during cabling of WipLL base station and customer premises equipment is as follows:

- Cable routes are to be defined in the site-specific documentation.
- Data and DC power cables running parallel to AC power cables shall be separated by a minimum distance of 200 mm. 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 to trays and guides. Ensure all trimmed ends are disposed of safely and at regular intervals.
- Data cables of less than 20 pair 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 to allow for equipment removal without disturbance to adjacent cables.
- Cables run in guides or on trays shall be kept as flat as possible and secured at regular intervals using cable ties.

Note: Prior to the commencement of any installation, commissioning work at 'live' sites it is the responsibility of the Airspan engineer to advise the customers representative before any activity commences. If in doubt assume equipment is 'live'.

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.

2.6.2. Labeling

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

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

2.6.2.1. Voltage Warning

- Where mains power is fed from separate phases, then 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

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 WipLL equipment ensure that local requirements regarding labels are given consideration.

2.6.2.2. High Earth Leakage Current

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

WARNING
HIGH LEAKAGE CURRENT
Earth connection essential
Before connecting supply

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

2.6.2.3. Signal Cable Designation

A wrap around identification label, similar to that shown in Figure 2-2, is to be fitted to both ends of WipLL data cables. Care should be taken to ensure that the cable identification information is clearly visible. The labels are to be supplied with the installer's folder. Identify the cable as detailed in the CROL supplied by Contract Engineering. Fit the label 100 mm from the cable end. Wrap the label ensuring good adhesion to cable and itself.

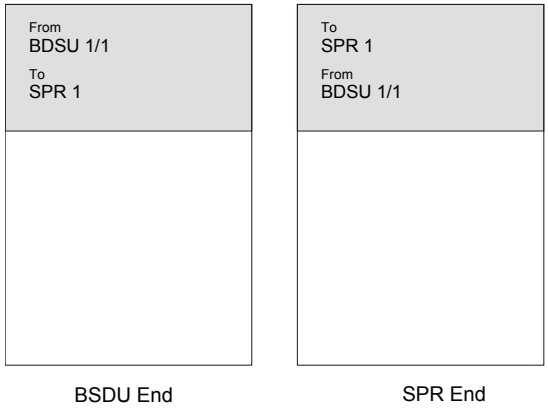

Figure 2-2: Typical signal cable identification label