WipLL and AS3010 Systems

Wireless IP-Based Local Loop System
Release 4.2B

System Description

Connecting the World with Wireless Access Solutions

The WipLL product bears the CE marking. This CE marking demonstrates WipLL's full compliance with applicable European Union (EU) directives:

The WipLL product bears the Underwriters Laboratories (UL) marking, demonstrating full compliance with UL's safety requirements:

WipLL products also bear the Federal Communications Commission (FCC) marking, demonstrating compliance with FCC Part 15 regulations.

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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.

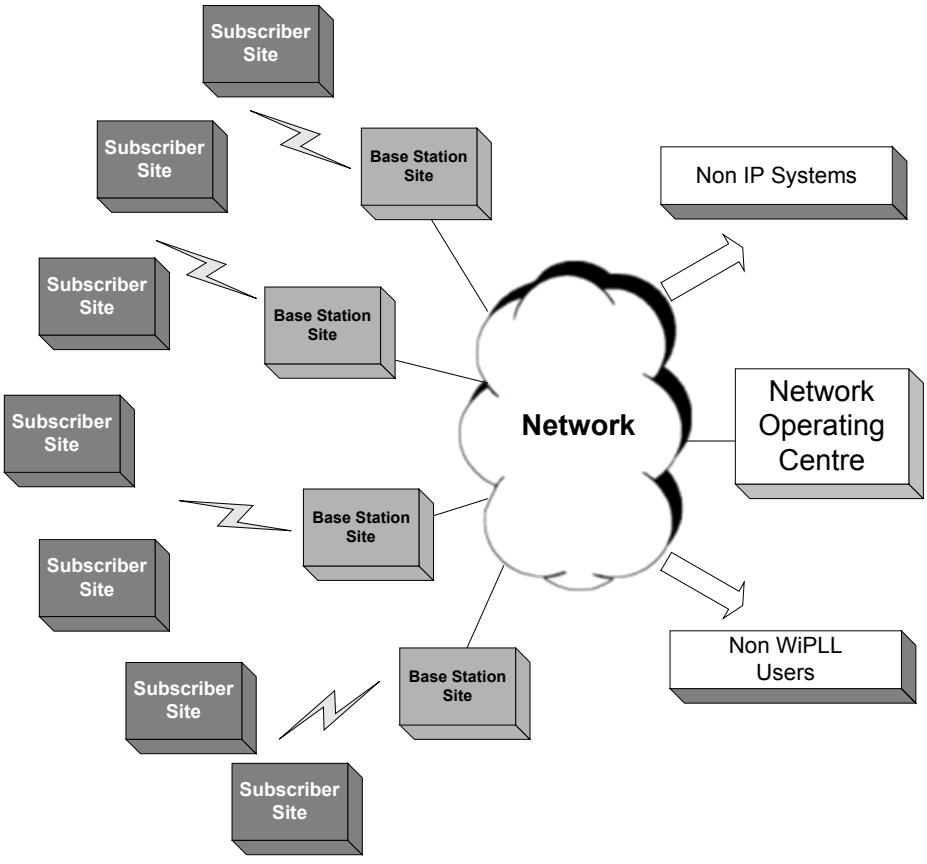

Figure 1-1: WipLL System Architecture

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).

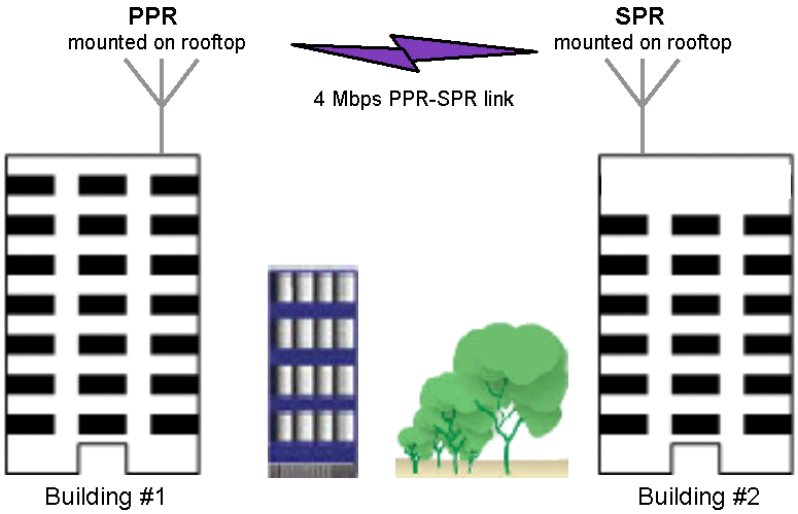

Figure 1-2: PPR in a building-to-building application

- **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.

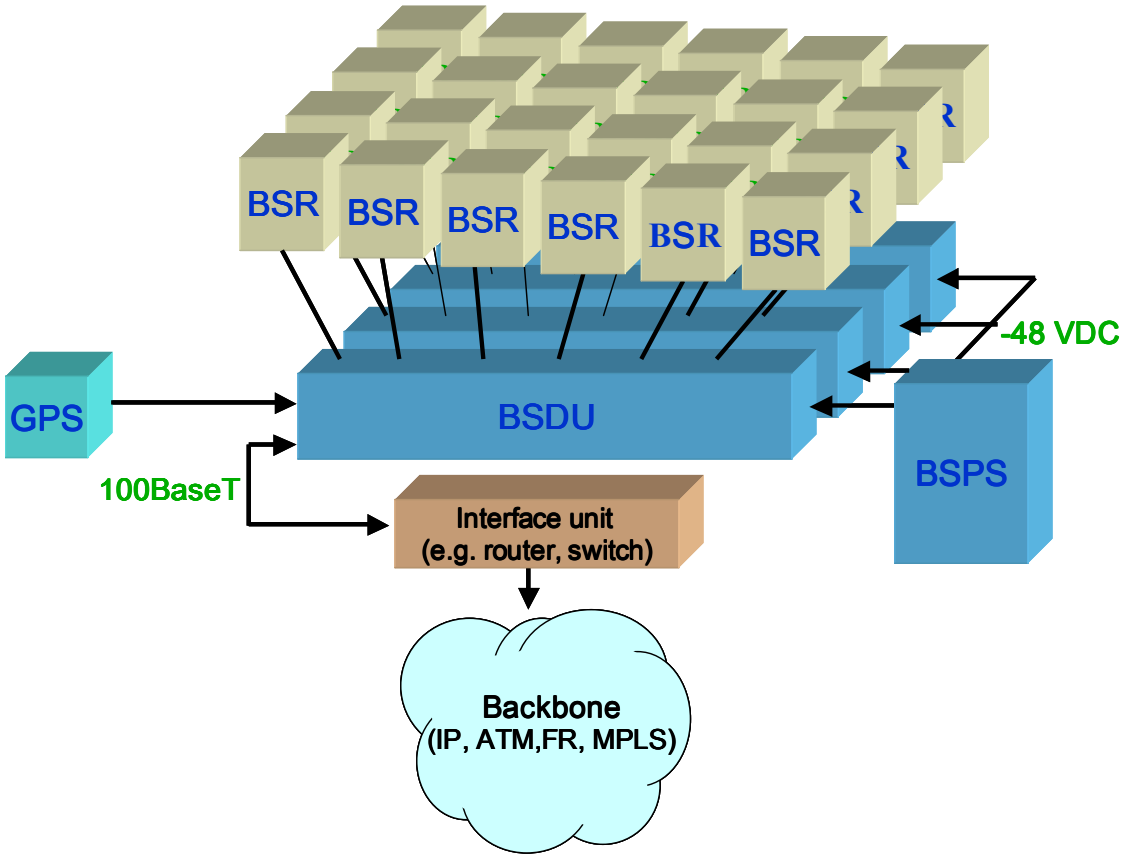

Figure 1-3: WipLL base station units (maximum configuration)

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.

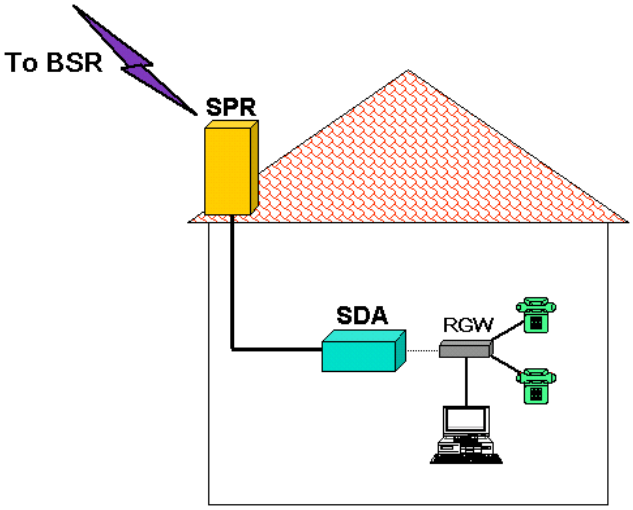

Figure 1-4: Subscriber site with SPR and SDA units (optional RGW unit)

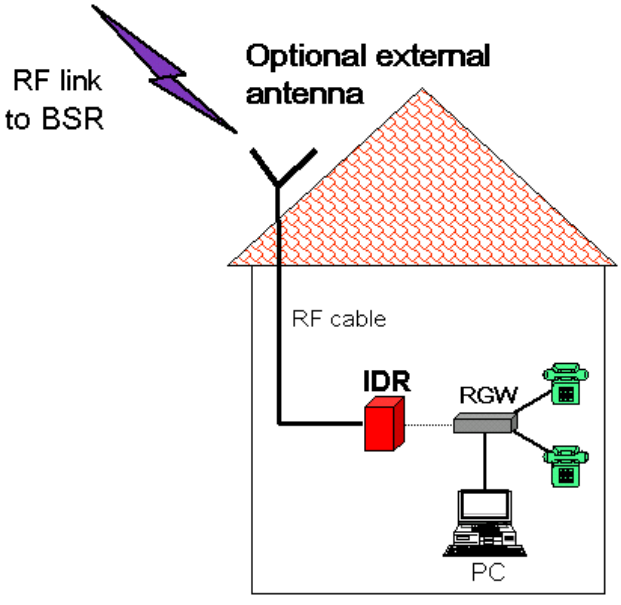

Figure 1-5: Subscriber site with IDR and third-party external antenna (optional RGW)

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.

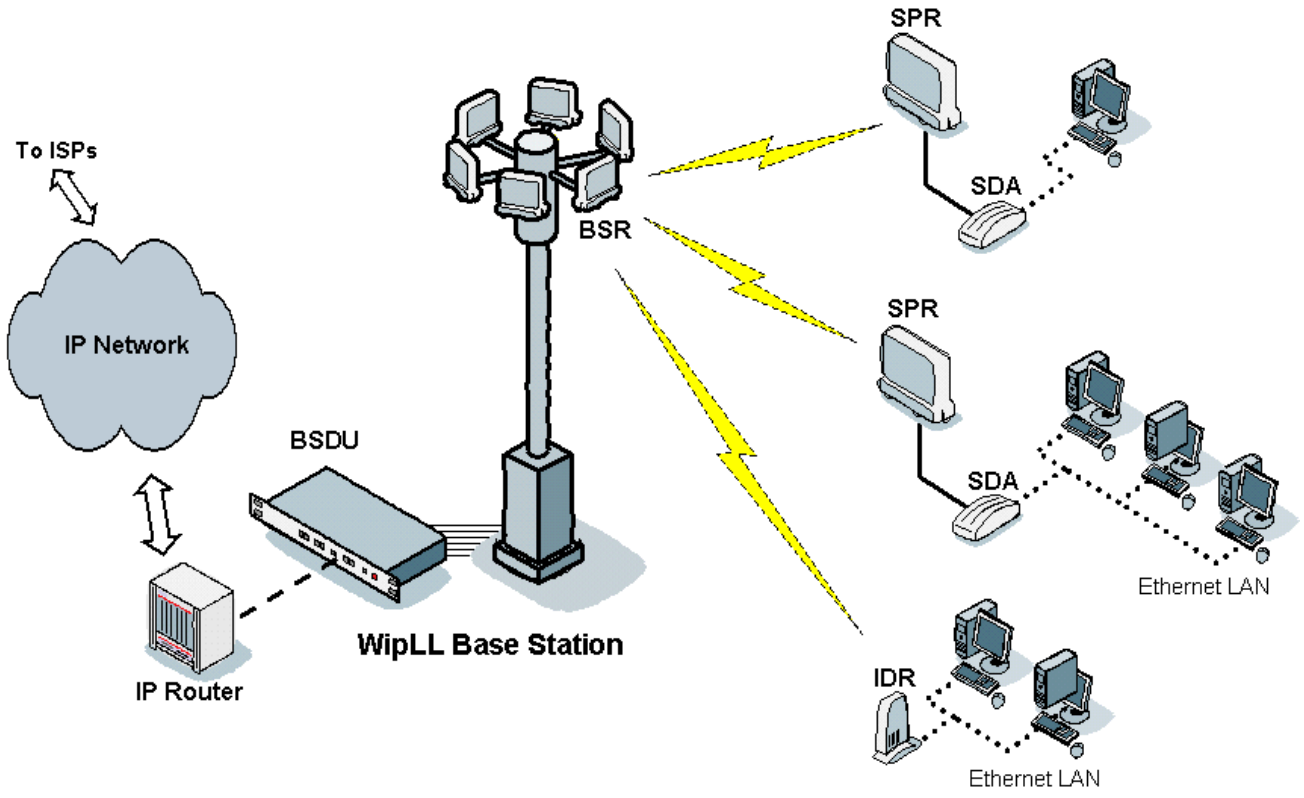

Figure 1-6: Typical WipLL Application for High-Speed Internet Access

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.

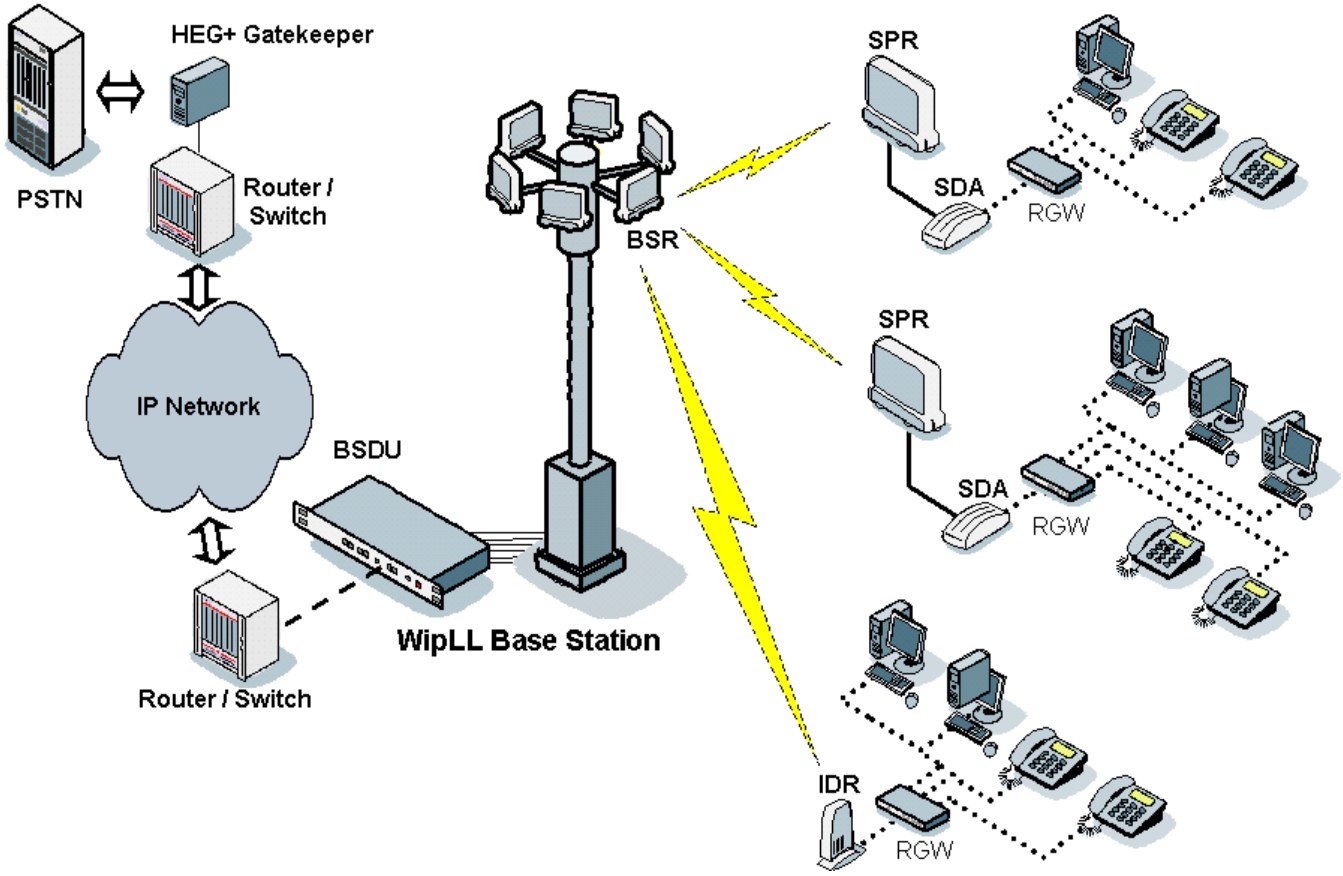

Figure 1-7: Typical WipLL Application for VoIP

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.

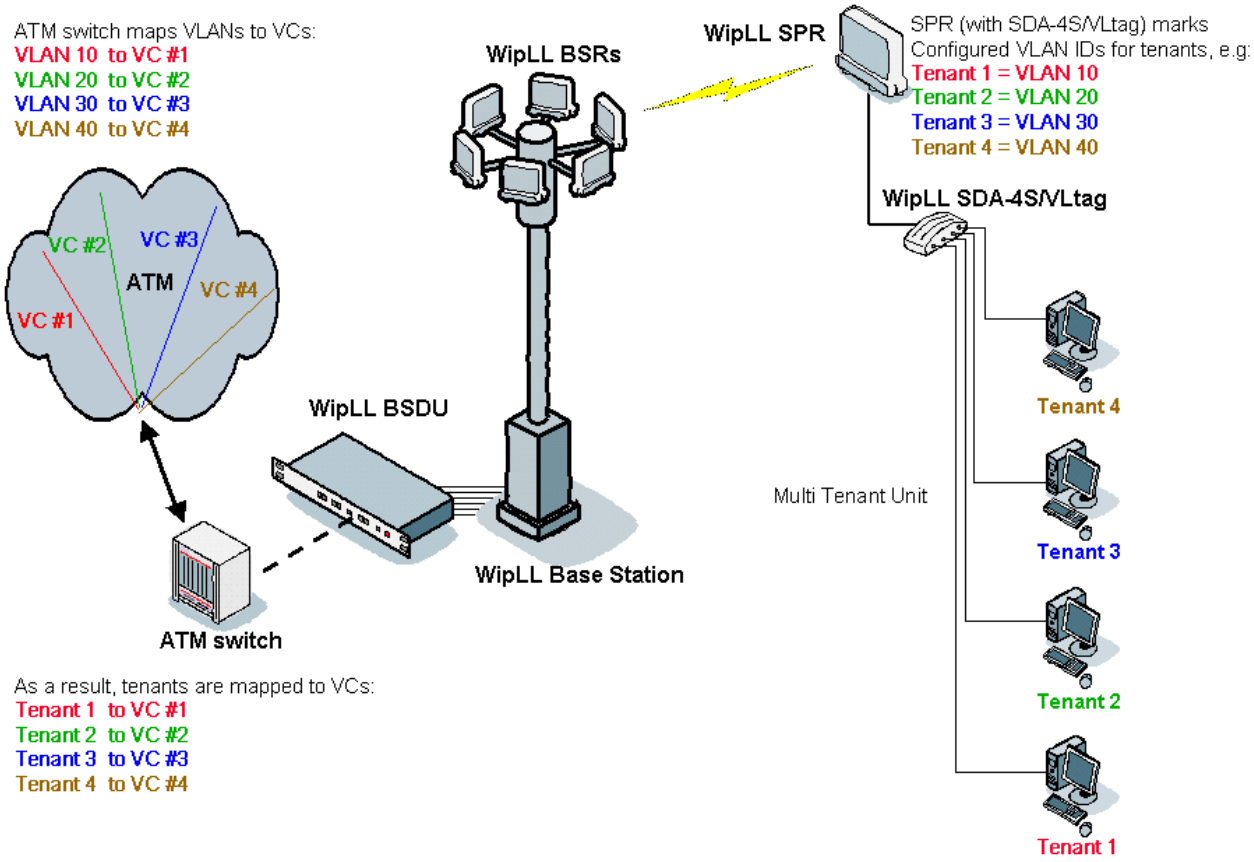

Figure 1-8: Multi-tenant solution (i.e., multiple VLANs) in an ATM environment

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.

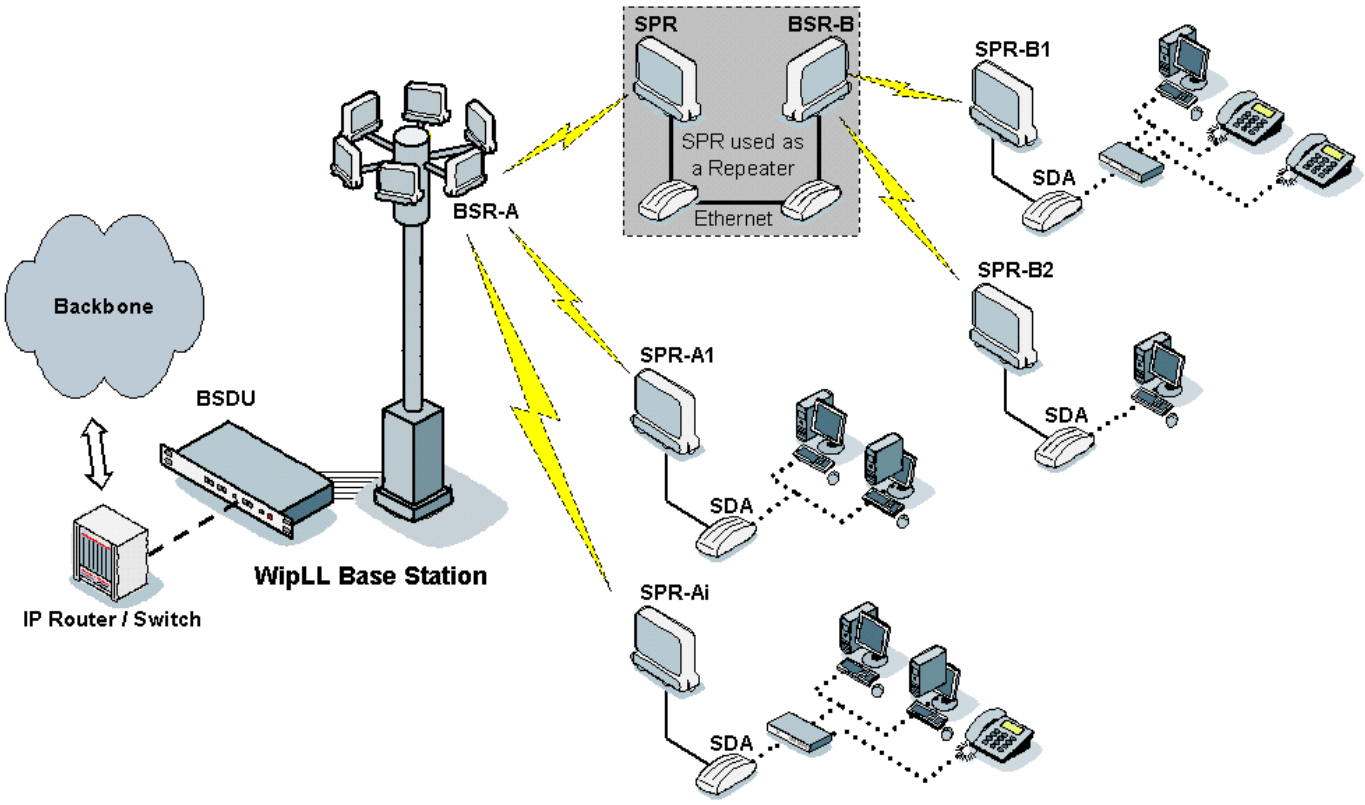

Figure 1-9: WipLL Repeater Solution

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.