WipLL

Wireless IP-Based Local Loop System
Release 2.0

WipLL System Description

MCIL-WIPLL-SDN_R2_00

This product is marked with a CE Mark (see below). This mark has been affixed to demonstrate full product compliance with the following European directives:

a) Directive 73/23/EEC - Council Directive of 19/02/1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

b) Directive 89/336/EEC - Council Directive of 3/05/1989 on the approximation of laws of the Member States relating to Electro-Magnetic Compatibility (EMC).

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Thank you.

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Glossary

ACK .... Acknowledge

API .... Application Program Interface

BER .... Bit Error Rate

BSDU .... Base Station Distribution Unit

BSPS .... Base Station Power System

BSR .... Base Station Radio

CLI .... Call Level Interface

CRC .... Cyclic Redundancy Check

CROL .... Call Rollout

CTS .... Clear to Send

DHCP .... Dynamic Host Configuration Protcol

DNS .... Domain Name System

ELCB .... Earth Leakage Circuit Breaker

FTP .... File Transfer Protocol

ICMP .... Internet Control Message Protocol

IDC .... Insulation Displacement Connector

IP .... Internet Protocol

LVD .... Low Voltage Disconnect

MAC .... Media Access Control

MCB .... Main Circuit Breaker

MIB .... Management Information Base

NMS .... Network Management System

NOC	Network Operations Centre
ODBC	Open Database Connectivity
PING	Package Internet Groper
PMPT	Point-to-Multi-Point
PPMA	Pre-emptive Polling Multiple Access
PPP	Point to Point Protocol
QoS	Quality of Service
RCCB	Residual Current Circuit Breaker
RCD	Residual Current Device
RSSI	Received Signal Strength Indicator
RTS	Request to Send
SDA	Subscriber Data Adapter
SDTA	Subscriber Data and Telephony Adapter
SNMP	Simple Network Management Protocol
SPE	Subscriber Premises Equipment
SPR	Subscriber Premises Radio
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TFTP	Trivial File Transfer Protocol
TTL	Time to Live
UDP	User Datagram Protocol
URL	Uniform Resource Locator
VoIP	Voice over Internet Protocol

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Chapter

1

GENERAL OVERVIEW

WipLL is a broadband fixed cellular Wireless Access system. It provides an "all-in-one" broadband access solution for operators and network service providers supporting data applications including "toll quality" telephony service[1] over a single integrated platform. WipLL utilizes air protocol that enables one of WipLL's unique features - the ability to recognize the type of the transmission and assign bandwidth and other resources accordingly.

As an integrated broadband cellular wireless system WipLL is a complete system solution for carriers and providers of multiple fixed access services to the SME (small to medium enterprises), SOHO (small office / home office) and residential marketplace demanding video, voice and data access.

The WipLL system can be considered as functionally divided between three sites as described in Figure 1-1:

- Subscriber Premises Sites
- Base Station Sites
- A Network Operations Center (NOC) and planning site

The Base Station Site and the Subscriber Premises site each contain WipLL hardware whilst the NOC uses software and associated hardware platforms to plan, configure and manage the WipLL system.

[1] From WipLL Release 1.4.

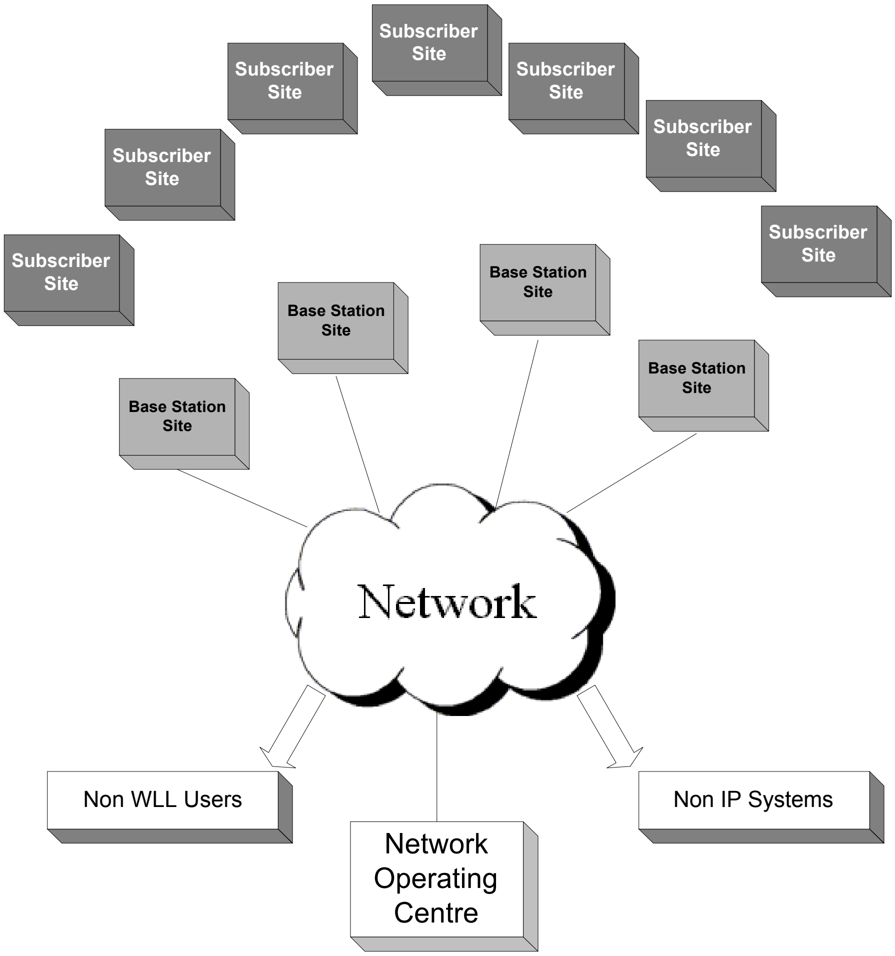

Figure 1-1: Typical Wipll System Partitioning

WipLL provides a radio link between the end-user of the telecom network (the subscriber) and the network itself to give high-speed data access. WipLL uses Internet Protocol (IP) to communicate between subscribers.

WipLL comprises radio transceivers installed at subscriber premises and further transceivers at local base stations. A transceiver at a subscriber premises links through radio to its local

base station. The base station then links through an Ethernet connection to datacom or IP network.
Each local base station serves numerous subscribers in its vicinity. The WipLL components at the subscribers' premises and at the base stations can be remotely controlled and configured by a management system using Simple Network Management Protocol (SNMP).

Figure 1-2 shows a diagram of a Typical WipLL installation.

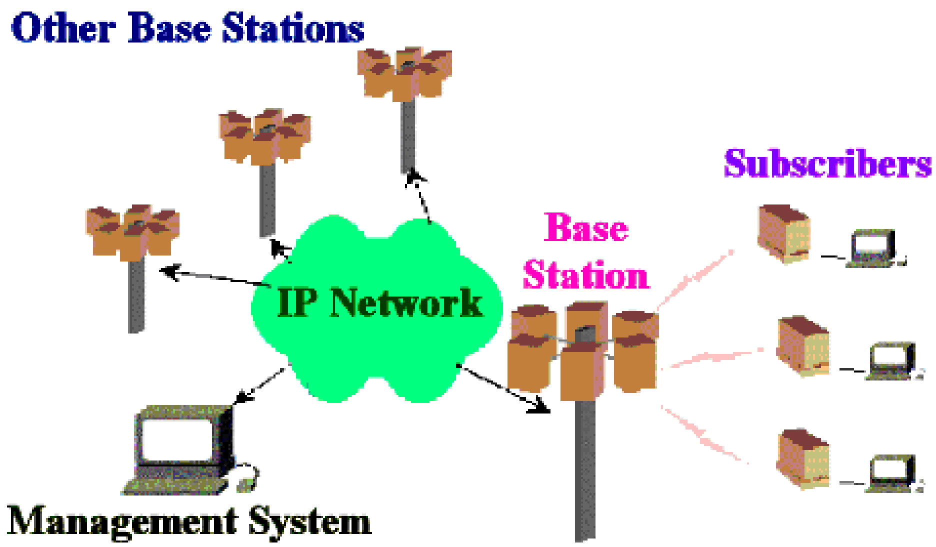

Figure 1-2: Typical WipLL System

WipLL supports multiple applications integrated on a single platform, such as:

- High-rate data transfer
- Video conferencing
- Internet access
- Voice over IP

1.1. Components of the System

The WipLL system comprises three main components as indicated in Figure 1-1:

1) Subscriber site

2) Base station

3) Coverage

1.1.1. The Subscriber Site

Each subscriber site contains Subscriber Premises Equipment (SPE) that links the subscriber to the WipLL system.
The SPE consists of:

- A Subscriber Premises Radio (SPR)
- A subscriber adapter or one of a set selected per application

The SPE performs routing functions between the customer site and the base station. The SPE also performs local Quality of Service (QoS) functions, such as re-ordering packets and assigning Time-to-Live (TTL).
The following drawing shows a current typical subscriber site installation:

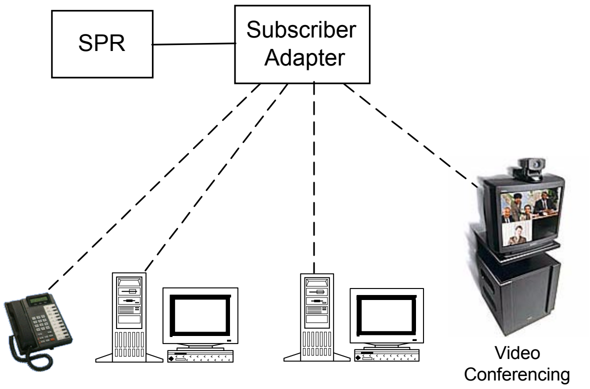

Figure 1-3: Typical Subscriber Configuration

1.1.2. Base Station Components

Each base station site contains several components that enable:

- Connection to telecom system
- Internal switching of traffic
- Power supply
- Radio communications.

Some of these components are mandatory and others optional depending on the configuration of the site and the particular type of network backbone interconnection.

Each Base Station Radio (BSR) is optionally physically connected to a Base Station Distribution Unit (BSDU), which provides data connectivity, power, and local switching functionality, as well synchronization between the BSRs. A BSDU can serve up to six BSRs, and up to four BSDUs can be chained in a single base station to support up to 24 BSRs.

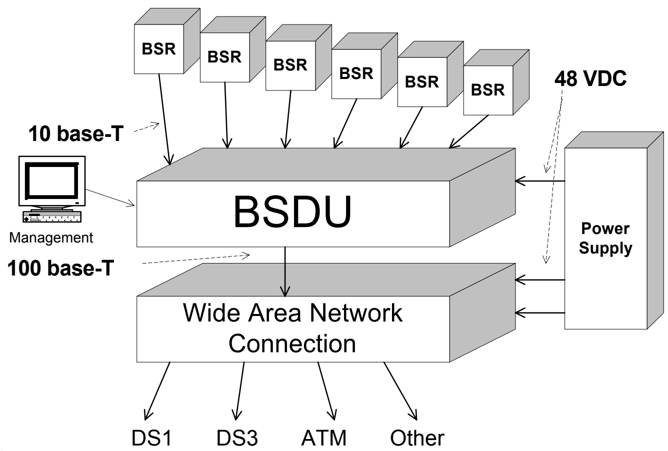

Figure 1-4: Base Station Units

A BSR can maintain a 3 Mbit air link with customers in its sector (net throughput of 2.4 Mb/s). A single base station has a capacity of up to 72 Mb/s and can support up to 3024 customer sites. The area covered by a single base station is called a cell and can extend to a radius of up to 25 km in ideal locations, about 6 km in suburban locations and about 2 km in urban locations dependent on locally permitted RF transmission power.

1.1.3. Coverage

Each base station provides a wireless link to all subscribers in the base station's area or domain. For full coverage several base stations can be set up over an extended area.

WipLL works in accordance with the operator's backbone and uses the backbone to connect between base stations, the central management station, and other resources on the network. WipLL assumes a network backbone that uses IP. The area covered by a base station is divided into sectors. Each sector is built around a Base Station Radio (BSR) unit which is the central coordinator of the sector.

The BSR can transmit and receive through a 60 degree sector. To cover a full 360 degree sweep, requires six BSRs at the base station which will comprise six sectors each covered by a BSR.

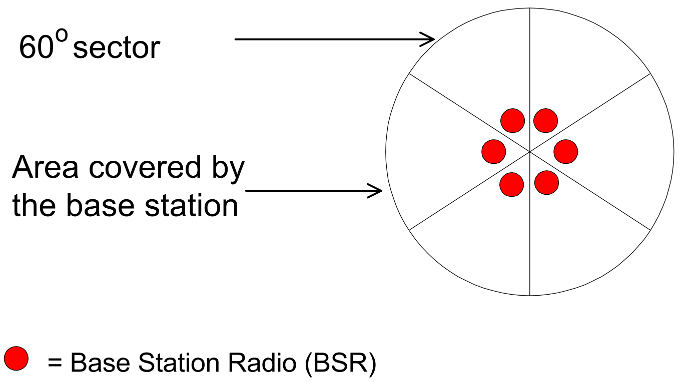

Figure 1-5: Base Station Covering 360°

Not all six sectors need be equipped. For example at a housing development that faces open farmland, one could site a base station that only covers 180 degrees to provide facilities only to the housing development.

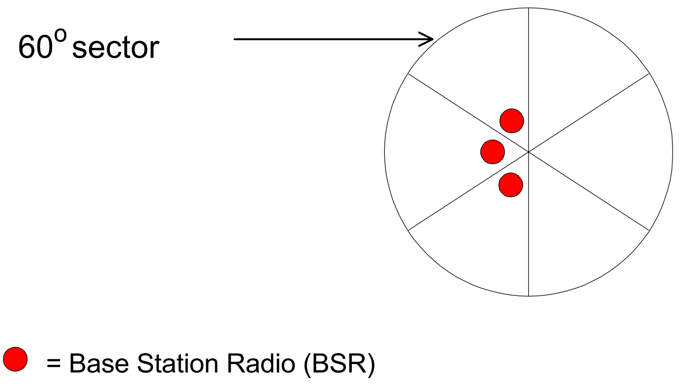

Figure 1-6: Base Station Giving Partial Cover

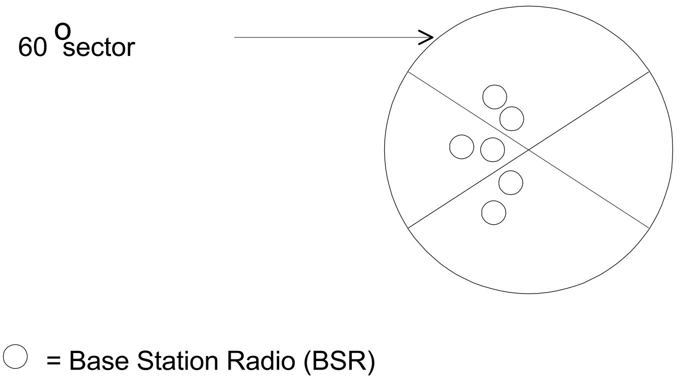

Figure 1-7: Base Station with Complete BSR Redundancy

Alternatively, the base station can have up to twenty-four BSRs, each covering 60 degrees. This allows either:

- Complete BSR redundancy with two or more BSRs covering each sector - see Figure 1-7 or

- Partial sector overlap with each layer of BSRs offset to the one above it - see Figure 1-8. This gives more capacity in areas where high demand requires more bandwidth.

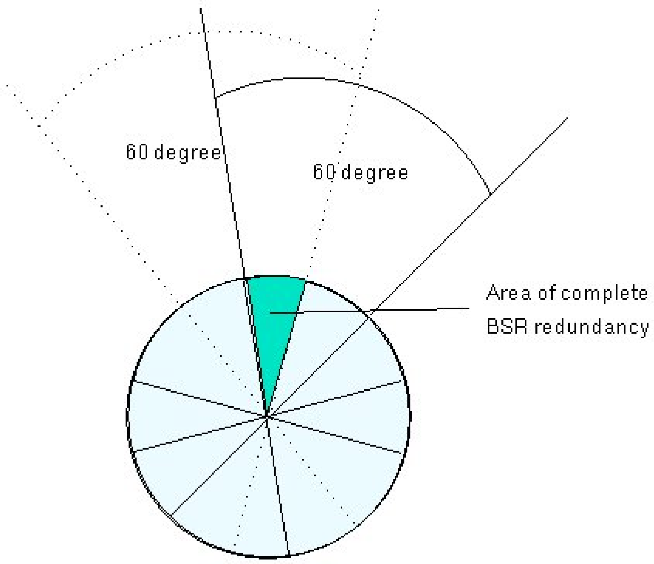

Figure 1-8: Base Station Sector

1.2. Management, and Commissioning

WipLL uses two tools for management and commissioning both implemented as software programs:

- The WipLL network management tool - WipManage
- WipConfig

Further information on the use of these tools can be found in the Operations and Maintenance Manual.

1.2.1. WipManage

WipManage™ is the primary WipLL network management tool for every WipLL unit. It enables:

- Configuration
- Fault isolation
- Performance monitoring
- Software upgrade

WipManage can access each unit in the system and manage it remotely using standard SNMP protocols for communicating with the WipLL unit, private and standard MIBs for setting and retrieving parameters from the units.
The top hierarchy of WipManage™ is a base-station site view from which one can zoom into every Subscriber Premises Radio (SPR).
WipManage™ can also be run as a stand-alone program running on Microsoft Windows NT.
Inputs to WipManage™ include the manual entry of parameters and retrieval of parameters directly from the WipLL units. WipManage™ outputs are sent either to the WipLL units or saved to the database as required.

1.2.2. WipConfig

WipConfig is a configuration tool for the WipLL units. It provides the flexibility to configure the units before leaving the shop or after the actual installation at the customer site.
WipConfig enables:

- Technicians to configure and monitor parameters at the WipLL units.
- Use of inputs from either a .CFG file that is produced by a database application or manually by typing the parameters into the appropriate fields of the program.

- Configuration and monitoring of the WipLL units via a serial or Ethernet port. It supports Microsoft Windows 9x and Windows 2000 platforms.

Chapter

2

MAIN FEATURES, PROTOCOL AND QoS

The WipLL system is designed to provide internet access and telephony service using spread spectrum frequency hopping technology to minimize interference in the 2.4 GHz ISM band.

Data is transmitted as Internet Protocol (IP) packets. Each packet is divided into fragments, and fragments can be repeated several times to ensure Quality of Service (QoS). Other techniques such as CRC and space diversity further enhance the system performance.

WipLL is an IP based platform that enables multiple applications over a single platform utilizing a quality of service mechanism that ensures the transmission of packets according to a pre-defined policy.

This chapter lists the most significant features and advantages of the WipLL system, including its protocol and Quality of Service (QoS) mechanism.

2.1. Features

WipLL was designed with the future in mind. Users, operators, service providers and installers can benefit from WipLL's unique features.

2.1.1. User Perspective

- Always connected.
- Standard 10Base-T connection.
- High throughput.

- Leverages new technologies and applications.
- Built-in security features.

2.1.2. Operator Perspective

Very efficient network due to:

- Single access platform for multiple applications.
- Bandwidth used only when there is real data to transmit.
- Shared bandwidth between users.
- No dedicated bandwidth to customer but capabilities to ensure throughput to the users.
- Uncommitted direction of transmission, no need to commit to full duplex.
- Control of bandwidth and delay according to pre-defined policy.

2.1.3. Capacity

- High bit rate up to 4Mbps per channel (using 1MHz of bandwidth).
- Up to 24 BSRs per base station providing a total capacity of up to 96Mbps and connection for up to 3024 subscribers.
- Synchronization between BSRs to enable wide area coverage .

2.1.4. QoS

- Recognition of packet and session type and assignment of resources accordingly.
- Multiple applications over the same connection.
- Bandwidth on demand.

- Service on demand.

2.1.5. Configuration

- Integrated IP router.
- Single outdoor box solution, i.e. no external SPR antennas or RF cables.
- Up to 100 meters of standard category 5 cable from the radio unit to the indoor adapter.
- Standard 10Base-T interface to the subscriber site and 100Base-T interface to the network backbone.

2.1.6. Installation and Commissioning

- Easy installation and commissioning using the WipConfig tool.
- Real time signal strength indication.
- No RF cables involved.
- All parameters can be configured lo cally or remotely.

Important!! 

- BSR-2.4 and SPR-2.4 outdoor units with internal antennas should be installedONLY by experienced installation professionals who are familiar with localbuilding and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void theMARCONI product warranty and may expose the end user or the service providerto legal and financial liabilities. MARCONI and its resellers ordistributors are not liable for violation of regulations associated with theinstallation of outddor units.

- All installed units **must** be installed with a seperation distance of at least 2 meters from all person during normal operation.

2.1.7. Security

- Login process with authentication mechanism.
- Data scrambling using public and private keys.

2.1.8. MAC Protocol

- Supports up to 126 subscriber sites per BSR, up to 3024 subscriber sites per base station.
- High efficiency 80% of the bit rate.
- Automatic rate control to maximize throughput under high Bit Error Rate (BER).
- Re-transmission of lost packets reliable operation in a high BER environment
- Centrally coordinated air protocol designed for point to multipoint environment.
- No transmission collisions.
- Real-time assessments on required and available bandwidth resources to control data flow.
- Intelligent polling of SPRs.

2.1.9. Radio Communications

- Frequency hopping spread spectrum system (FH-CDMA).
- Integrated antenna diversity in a single box.
- Variety of antenna types, internal and external.
- Configurable maximum output power up to 34dBm.
- Automatic power control to minimize interference between cells and to reduce transmission power where possible.
- Configurable frequency tables for efficient re-use of available bandwidth.

2.1.10. Management

2.1.10.1. Network Management Systems (NMS)

- SNMP agent at each WipLL unit.
- Comprehensive network management system based on SNMP for local and remote management.
- Standard and proprietary Management Information Bases (MIB).
- Configuration management.
- Fault isolation.
- Performance monitoring.
- Software upgrade of every WipLL unit using TFTP.
- Support for standard IP protocols ARP, DHCP relay, TFTP, ICMP, SNMP.

2.1.11. System Parameters

- Temperature range of
- Compliance with ETSI and FCC Regulations.

2.1.12. RF

This environment consists of point to multi-point directional antennas pointing towards the base station. Distances between stations and the base station may differ. Some may be near while others may be far away.

Additional features include:

- Multi-site mutual interference.
- Frequency hopping.
- Multi-rate: Sensitivity of the receiver changes and is dependent on the bit rate.

2.1.13. Network

- Ethernet packets between 64 and 1518 bytes.
- Burst of packets or constant flow to/from users depending on the application.

2.1.14. Application

Data different types of applications generate requirements for:

- Assignment of delays.
- Allowed packet loss rate that applications can sustain.
- Bandwidth for the application - video requires constant signal flow:

- Packets are generated usually every 30ms. (depending on the Residential Access Gateway (RAG) and sampling rate)
- Requires minimal delay.
- Silence suppression no packets

2.2. PPMA Protocol

This section describes the Preemptive Polling Multiple Access (PPMA) protocol. It discusses the environment in which this protocol operates, its task and description of the PPMA protocol as used by WipLL.
To support the above environment the main task of the PPMA protocol is to combine all these requirements in the most efficient manner.

2.2.1. What is PPMA?

2.2.1.1. Concept

PPMA is a centrally coordinated protocol. The BSR performs the task of coordination over the air. It constantly gathers information from the Subscriber Premises Radio (SPR) regarding their requirements for resources. These are rated according to the combination of parameters such as the number of packets in the SPR queues and the maximum allowed delay for the first packet in the queue.
Once the BSR has determined the requirements of resources for the next few milliseconds it starts to poll the SPRs accordingly. SPRs that receive the highest score are polled first and the others follow in order.

2.2.1.2. Slotted Aloha Process

The constant gathering of information regarding the required resources from the SPRs is performed by using a mechanism called "Slotted Aloha".
From time to time (and not exceeding every 100mS) the BSR sends a "Channel Clear" message which is an invitation for SPRs to send the score of their requirements. It then waits for a while and receives these requirements from the

SPRs. The waiting time is called **Slotted Aloha** due to the fact that the BSR waits for a time that is equivalent to 16 messages of "Request to Send" (RTS). The messages are synchronized so that an SPR does not transmit a message before the previous message is ended. The timing of each RTS message is represented as a "Slot".

SPRs are independent to choose which slots to use for sending their requirements. Occasionally a collision between SPRs can occur on a slot and then the probability is that the request is lost. Each SPR can use more than one slot to send its request. An SPR that was not allowed to transmit might try again during the next Slotted Aloha process.

This system ensures that all SPRs eventually get a fair chance to transmit their requests.

2.2.1.3. Packet Transmission

After the BSR has gathered the requests from the SPRs and decided on the priorities, it sends a "Clear to Send" (CTS) message to the first SPR. The packet is then transmitted from the SPR.

In the header of each packet more information about the status of the queues is included thus avoiding the need for the SPR to participate in the next Slotted Aloha process.

The data packet is divided into fragments and each fragment is added with CRC (Cyclic Redundancy Check). After the packet is complete, an "Acknowledge" (ACK) message is sent by the BSR that includes information about all fragments that were reported as errors. These fragments can be repeated several times until the entire message is successfully transmitted.

2.2.1.4. Polling Sequence

Each time the BSR sends a CTS (Clear to Send) message to one of the SPRs it is considered as if the SPR is being polled.

Polling of SPRs can happen according to the information gathered during the Slotted Aloha process or in a periodic manner every few milliseconds regardless of the Slotted Aloha process depending on the application transmitting data at the time.

The polling sequence of data applications is managed by the BSR based on the information gathered during the Slotted Aloha process. Data applications can sustain relatively long delays before expecting a response and therefore their packets can be delayed within the SPRs before being sent to the BSR and on to the network. Other applications which require a smaller delay for their packets are polled first.
Some applications are configured to transmit a burst of several packets in a row before expecting any response from the other party. In such a case the polling mechanism is able to support several polls of an SPR one after the other.
This mode is called "PPMA" (Preemptive Polling Multiple Access).
Real-time applications such as video often sends a constant flow of packets. In this case the BSR polls the SPR that is related to such an application in accordance with the flow of the packets. IP Telephony systems send packets about every 30ms and require a very small delay. Therefore, an SPR that was recognized as sending packets is polled usually every 30ms (see 2.1.14) without having to go through the Slotted Aloha process to inform the BSR about each packet.
This mode is called "Adaptive TDMA" (Time Division Multiple Access).

2.3. Security

Being a centrally coordinated protocol gives PPMA several options of security that are independent of other layers.

2.3.1. Login Mechanism

In order to be served by a BSR an SPR must be registered to it. This registration process is based on the SPR's MAC address and the BSR address that is configured by the network management.
When a new SPR tries to register to the BSR it sends an "Request to Send" message during the "Slotted Aloha" time. The BSR then checks if the SPR MAC address is listed as an "Allowed SPR" list. This list is maintained by the network management system. If it is listed as such then an "Association" message is sent to the SPR that includes information about the cell such as the public key for the encoding, number of users, etc.. The SPR then sends its own information to the BSR. It is then considered as being "associated" with the BSR and can start sending and receiving messages from it.

In case the SPR is not included in the "Allowed SPR" list or the address it provides for the BSR is incorrect no message will be sent to it and the association process will be terminated.

2.4. QoS

Quality of Service (QoS) is the ability to recognize the type of the transmission and assign bandwidth and other resources accordingly.
Resources are not necessarily only in terms of bandwidth but also in terms of delays, packet loss rate and whether or not data needs to be retransmitted in case it is lost.
Figure 2-1 represents the idea behind the QoS. Some applications require more network resources than others.

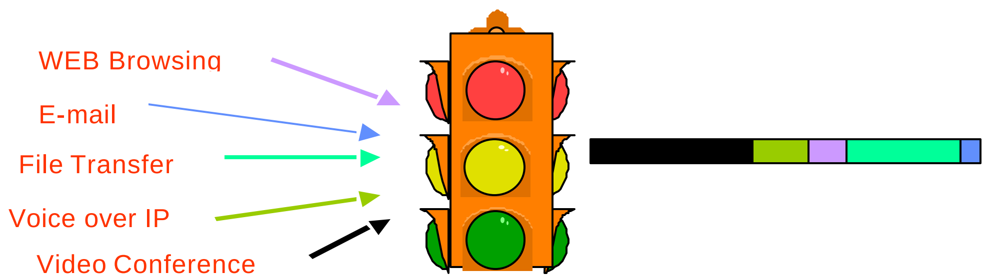

Figure 2-1: WipLL QoS Mechanism

Qos measurements are based on 2 factors, assigned traffic priority (0 through 7) and Time-To-Live (TTL) factor (1 through 5):

1) **Network protocol** - IP
2) **Transport protocol** TCP, UDP, ICMP
3) **Transport protocol and port number** (based on application type)
4) **IP address**
5) **Session type** - VoIP

2.5. Echo Management

Packet based systems are likely to introduce more delay (and variable) than circuit switched systems. Increased delay could present quality problems with time bounded services such as voice communication.

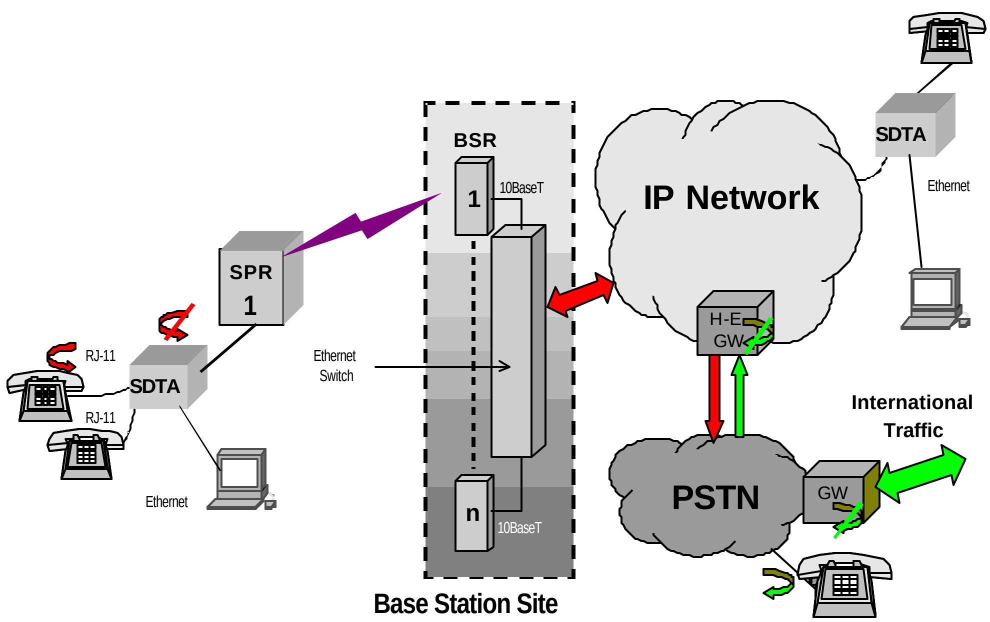

Figure 2-2: Echo Control

As can be seen from Figure 2-2, echo becomes an issue when a voice call is established between a customer connected to an SDTA and a PSTN customer. Echo is generated at the 2 wire-4 wire hybri
be cancelled. Note that a voice call between two customers, both connected to an SDTA, will not suffer from echo because the SDTA customers effectively become 4-wire customers.

PSTN has traditionally been a low delay network and has not bothered with echo cancellation, at least in smaller countries, if the round trip delay is below 50ms. Echo cancellors are used in international calls between different PSTNs.

The key principle is that the network that causes the echo should cancel it. Applying this principle to the introduction of IP based WLL systems means that echo should

system echo cancellation has been implemented in both the SDTA (upto 8ms) and the head-end gateways (upto 64ms).

Chapter

3

APPLICATIONS AND SERVICES

WipLL can be installed in several configurations to support different required applications. The following paragraphs discuss some of the applications and services that can be provided with WipLL.

3.1. Applications

3.1.1. Fixed Cellular Access System

Typically WipLL is used as a broadband fixed wireless access system. It is installed in a cellular structure where many base station sites are installed in a way that provides full coverage of an area for enabling access for all potential customers in the area.

Each cell consists of sectors that are determined by base station radios (BSRs).

The following figure shows the structure of a typical WipLL cell.

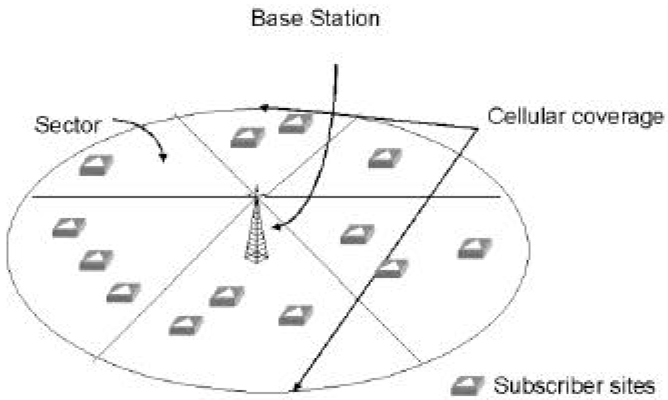

Figure 3-1: WipLL Cell

Subscriber Premises Radios (SPRs) are normally installed on a rooftop or a wall which has a direct line of sight to the base station radio (BSR) and are pointed towards the nearest base station or the base station that was assigned according to the pre-planning of the site.

well as enough capacity to accommodate the requirements of subscribers.

When a full area is covered, WipLL can provide services to tens of thousands of users. The backbone must be able to carry the required capacity, delays and connectivity in order to support the services and requirements of all users.

Prior to installation, a full site planning is required. Such planning normally includes forecasts of the required capacity based on the number of users, typical subscription contract, types of srevice, required bit rate per subscriber, etc.

It also includes radio planning for determining the best locations for BSRs to ensure full coverage, frequency allocation to minimize mutual interference and tilting options to determine the covered area for each sector of a base station.

Important!!

- BSR-2.4 and SPR-2.4 outdoor units with internal antennas should be installedONLY by experienced installation professionals who are familiar with localbuilding and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void theMARCONI product warranty and may expose the end user or the service providerto legal and financial liabilities. MARCONI and its resellers ordistributors are not liable for violation of regulations associated with theinstallation of outddor units.
- All installed units **must** be installed with a seperation distance of at least 2 meters from all person during normal operation.

3.1.2. Connecting the Base Station to the Network Backbone

-T

connections.

Figure 3-2 shows planning of a few base stations that cover an area.

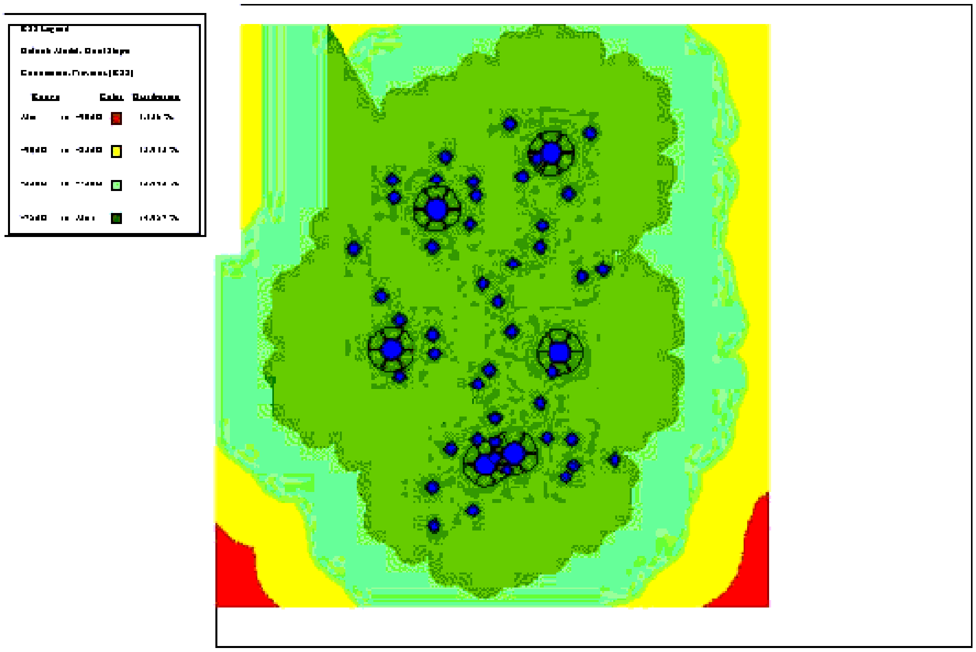

Figure 3-2: WipLL Coverage Planning

3.1.3. Remote Base Station Backhaul

Occasionally, when base stations are providing services to a small number of subscribers or when large capacity is not required, WipLL SPRs and BSRs can be used for backhauling.

Such configurations can be considered in most cases as a point-to-point (PTP) connection.

Each PTP connection can provide up to 4Mbps of bandwidth and is equivalent or better than a typical point-to-multi-point (PMP) connection that is used in a typical base station installation.

Figure 3-3 shows a typical backhauling of a base station using WipLL.

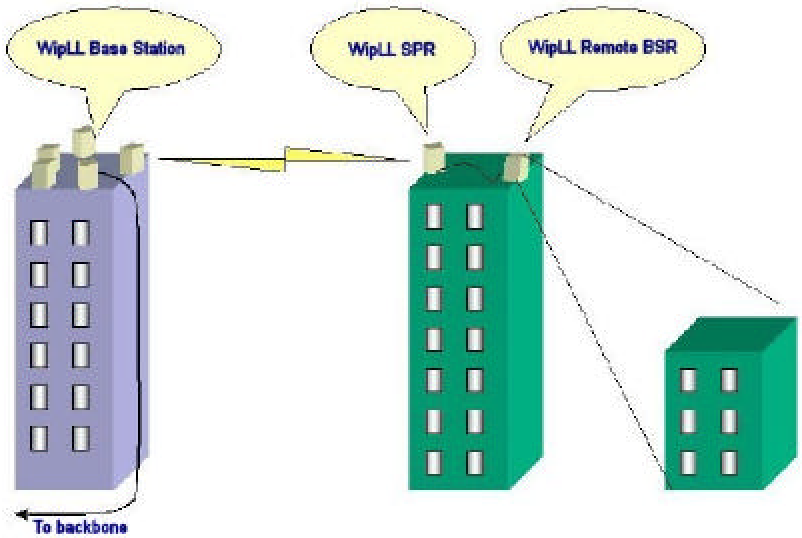

Figure 3-3: WipLL Backhauling

Remote base stations are typically required when the main base station sites cannot cover an area due to lack of line-of-sight or when the distance exceeds the capability of the radios to provide services.

It is recommended that a maximum of two hops be used between a main base station and a subscriber site.

Note: Each such connection adds about 15 to 25ms delay to each packet.

3.1.3.1. Indoor Coverage (Not for use in North America)

In many applications there is a need to provide access to users located in the lower floors of a building. These users usually do not have a direct line-of-sight with a base station. WipLL can be used for indoor coverage for apartment buildings and office areas.

There are ways to achieve such a configuration either by placing the BSR in a an adjacent building and covering one or two sides of the building or placing a BSR on the roof pointed towards the adjacent building to receive the reflections of the RF signals, or by placing the BSR inside the building and transmitting sufficient power to penetrate walls.

The following figures show some ways of providing indoor coverage.

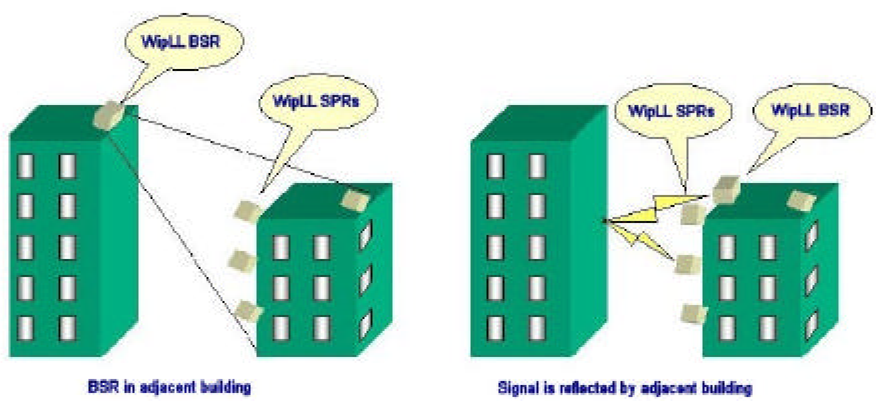

Figure 3-4: WipLL Indoor Coverage

3.2. Services

3.2.1. Broadband Data Access

Using a standard PSTN modem in circuit-switched networks customers are limited to 56Kbps of throughput and in most cases to 28.8Kbps.

From the operator's perspective once a customer has dialed with a PSTN modem a full 128Kbps channel is occupied for as long as the session lasts.

With WipLL customers are limited only by configuration, with a maximum of 4Mbps, 50 times faster than the fastest PSTN modem.

However, they do not necessarily consume more bandwidth from the operator since bandwidth is used only when there is an actual data packet to transmit. This happens about 10% of the time.

As a result, assuming the same bandwidth utilization of 128Kbps per customer an operator may actually commit 128Kbps to each customer, thus over-selling bandwidth without having any effect on the performance of the connection.

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

The following paragraphs discuss some of the services available with the broadband access that WipLL can offer.

3.2.2. High Speed Internet Access

One of the advantages of WipLL is the fact that users are "always on". This means that there is no dialing process and no need for the hassle involved with dialup access. You need only open your web browser or email program to be instantly connected.

WipLL can also distinguish between applications and users, thus enabling the operator to provide different class of service to users. For example, it can provide different services to web browsing and email, prioritizing web browsing for ensuring best "Internet experience".

3.2.3. Private Networks

WipLL allows the configuration for providing connectivity to branch offices. In this configuration the branch office can be connected to a central office or any other destination without allowing access from any other source.

Figure 3-5 illustrates two customers, A and B, with private networks to branch offices.

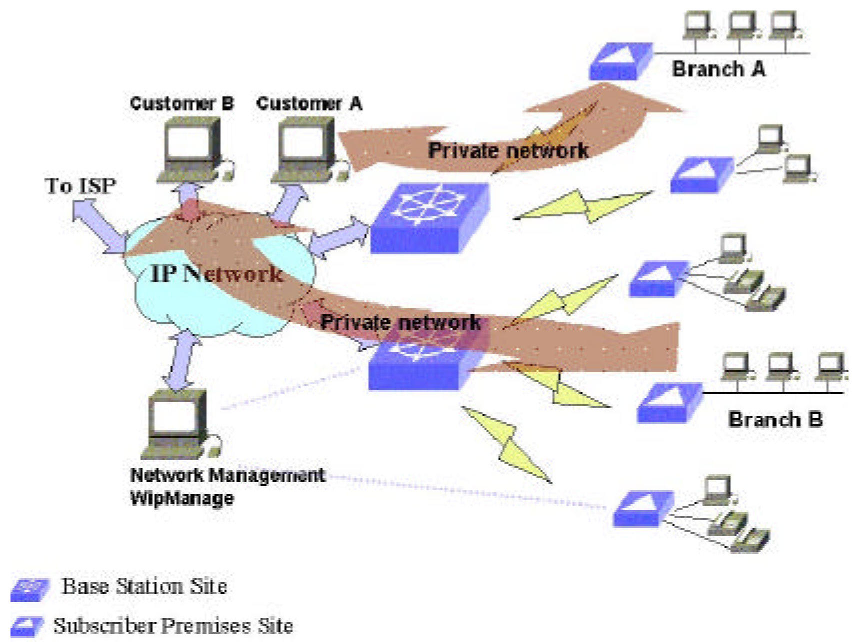

Figure 3-5: WipLL Private Networking

3.2.4. Remote Access

WipLL is very suitable for tele -workers who require high speed access combined with private network and flexible configuration.

The interface to the system is 10Base-T and enables seamless configuration between office and remote location.

3.2.5. Video Over IP

The fact that WipLL can provide Mbps of throughput to the user, together with its ability to set different delays and priorities to different applications and provide QoS, makes it a good solution for enabling applications like video over IP.

This means that customers can do high quality video conferencing.

The system can prioritize video packets in such a way that delays and jitter are minimized and the video packets pass smoothly through the system.

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Chapter

4

BSR

4.1. Base Station Radio

A BSR is the centre of a WipLL sector. It has several roles in both the MAC layer as well as in the networking and transport layers. In the MAC layer the BSR is responsible for synchronizing the SPRs in terms of timing, frequency hopping sequence, authentication, and control - allowing (or not) the transmission of data within the sector.

At the network layer the BSR performs routing functions between the base station's Ethernet network and the wireless stations, containing a routing table that can support up to 126 stations addresses. The transport layer at a BSR makes decisions on how to support an application in terms of bandwidth, delays and mode of operation.

There are two modes of operation - Pre-emptive Polling (PPMA) and Time Division Multiple Access (TDMA). Although the WipLL BSR employs PPMA, it also recognizes the traffic type and emulates TDMA where necessary.

The BSRs are connected to the wired backbone through a BSDU with a 10Base-T Ethernet connection which allows a cable length of up to 100 meters.

Each of the BSRs contains two internal high gain, flat plate antennas, to support functionality of antenna diversity which helps to overcome multi-path effects.

There are typically several BSRs at each base station site. Each BSR can cover an azimuth angle (yaw) of 60 degrees and therefore 6 BSRs can provide a full 360 degrees coverage of the entire cell if needed. The antenna may also be tilted vertically (pitch) to reduce interference between adjacent BSRs. The maximum number of radios that can be connected depends mainly on the radio bandwidth allocated to the system. 6 radios can coexist at the base-station providing as much as 18 Mbit/s per base station to be shared among the remote users. Each individual BSR delivers up to 4Mbps using only a minimal 1MHz of radio bandwidth. As capacity demand grows, more BSR's can be added to a total of 24 per cell, providing approximately 96Mbps throughput and connection to up to 3,024 discrete subscriber sites, however such a configuration would require a bandwidth allocation of at least 75 MHz.

Figure 4-1: Typical BSR Installation

4.1.1. BSR Default Accessories

- Mechanical mounting kit. Each BSR comes with a kit for mounting the unit on a pole with means for tilting.
- Data connector. A DB15 connector with waterproof cover included with the BSR.

- From WipLL Release 1.4, the BSR will also have an optional N-Type connector for attaching an optional 3rd-party external antenna[1] (Not for North America only for ETSI countries).

4.2. Network Management

The BSR is managed using SNMP and standard proprietary MIBs for the specific configurations of the BSR

4.2.1. Capabilities

- Configuration - network parameters (IP address, ports, routing tables, etc.), RF parameters (frequency tables, allowed CS, etc.)
- Traps - sends traps as per configuration.
- Fault management - debugging options.
- Counters - for statistics on packet loss.

[1] For 2.4GHz application only, an external antenna may have a gain of 5-15dbi. Responsibily of compliance is left to the customer.

4.2.2. Physical Interfaces

- DB15 connector - power, Ethernet, sync and serial.
- DB9 connector - for serial interface.

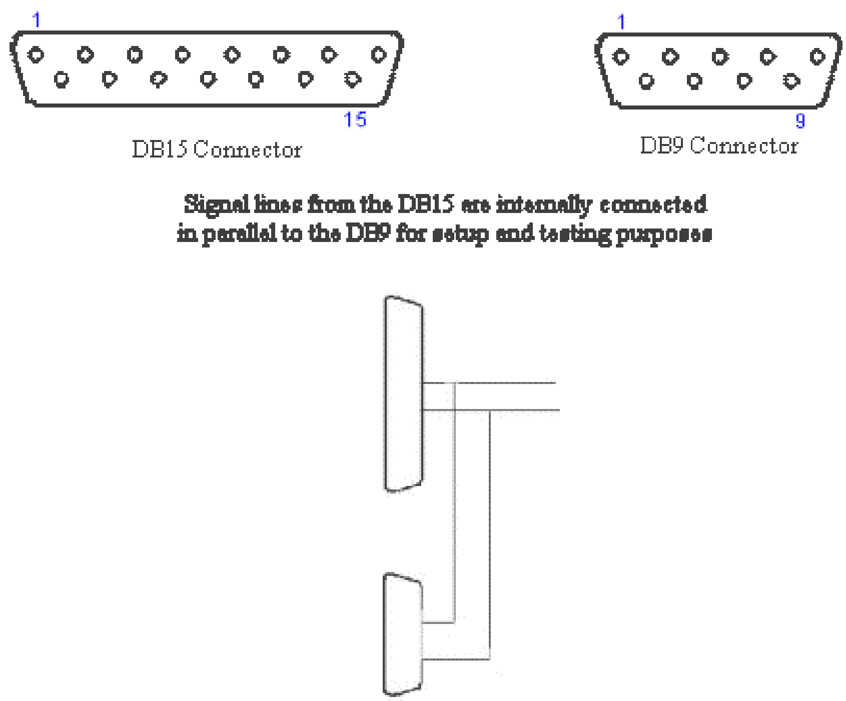

Figure 4-2: BSR Assembly

Table 4-1: Antenna Unit Connectors

	9 Pin Communications Connector		15 Pin Data/Power Connector
1	nc	1	+ VIN F
2	Rx	2	- VIN F
3	Tx	3	Ethernet Tx +
4	nc	4	Ethernet Tx -
5	Ground	5	Ethernet Rx +
6	nc	6	Ethernet Rx -
7	Ground	7	nc
8	nc	8	nc
9	+5vDC	9	+VIN F
		10	- VIN F
		11	VCC
		12	GND
		13	nc
		14	232 Rx
		15	232 Tx

4.2.3. Communication Interfaces

- Ethernet, 10Mbps.
- Serial, RS-232.

4.2.4. Features and Protocols

4.2.4.1. Features

- Synchronization of hops between BSRs.
- Software upgrade - with TFTP.
- Static routing tables - 16 entries per each SPR plus 32 entries for the Ethernet side, total 256 x 16 entries - 4096 routing entries.
- QoS - proprietary.
- Network management - SNMPv2
- Multiple concurrent open sessions - up to 50

4.2.4.2. Protocols

- ARP
- DHCP / BOOTP relay
- TFTP
- ICMP
- SNMP

Table 4-2: BSR and MAC Specifications

Parameter	Value	Comment
Operating frequency range Rel 1.2 Rel 1.4	 2.4GHz 2.4GHz	
Spectrum spreading method	Frequency hopping CDMA	Per ETSI EN300 328
Duplex method	Time division (TDD) - 2.4GHz	
Transmit bit rates	Up to 4Mbps	BER and distance dependent.
Channel spacing	1MHz	
Output power from the radio	Up to 23dBm, configurable	Depending on local regulations maximum output power can be set at factory
Effective Isotropic Radiated Power (EIRP)	Up to 34dBm, configurable	Depending on local regulations maximum output power can be set at factory
Modulation method	8 level CPFSK	
Channel access method Protocol efficiency	PPMA / Adaptive TDMA Up to 80%	 At BER = 10^{-5}, depending on the application
Number of SPR per BSR	Up to 126	62 concurrently

Table 4-3: BSR Agency Certification

Parameter	Value	Comment
Emissions / Immunity	EN 300 339 EN 300 386-2 ETS300 328	
Safety	EN / IEC 60950	
Environmental	ETS 300 019-2-x	

Table 4-4: BSR Network Specifications

Parameter	Value	Comment
Filtering Rate	10500 Frames / sec	

Forwarding Rate	1400 Frames / sec	
Routing table length	64 x 16	
Data open -sessions per BSR	50	

Table 4-5: BSR Power Requirements

Parameter	Value	Comment
Voltage Minimum: Maximum:	48Vdc nominal 30Vdc 55Vdc	Fed from the BSDU
Amperes Maximum:	 500mA	

Table 4-6: BSR Environmental Conditions

Parameter	Value	Comment
Operating Temperature Outdoor units (BSR,SPR)	-	Optional range of -
Storage Temperature	-	

Table 4-7: BSR Network Interface

Parameter	Value	Comment
Ethernet Network	UTP EIA/TIA	Category 5
Standards Compliance	ANSI/IEEE 802.3 and ISO /IEC 8802-3 10 Base-T compliant	
Serial Port	RS-232	

Table 4-8: BSR Physical Dimensions

Parameter	Value	Comment
Height	400mm	Excluding mounting kit
Width	317mm	
Depth	65.5mm	
Weight	4.7kg	

4.2.5. Unsynchronized vs Synchronized Operation (Not for North America only for ETSI countries).

In unsynchronized mode, BSRs use random frequency tables. As such signal collision is quite possible leading to frequent retransmission. Using orthogonal tables helps to reduce this to a limited extent.

In synchronized mode, all BSRs use the same frequency table. A signal received from the BSDU restarts the table phase. Up to 4 BSDUs may be daisy chained together, in which case each BSDU will be assigned as Sync Ring Id and the master BSDU will be the one to send the restart signal.

The GPS is designed to synchronize across base stations. 1 GPS can support upto 4 co-located BSDUs. If only one of the BSDUs has a GPS, that BSDU will automatically be assigned as the master. If each BSDU has its own GPS or if there are no GPSs installed on any of the BSRs, WipLL will assign a master BSDU Id to a Sync Ring Id.

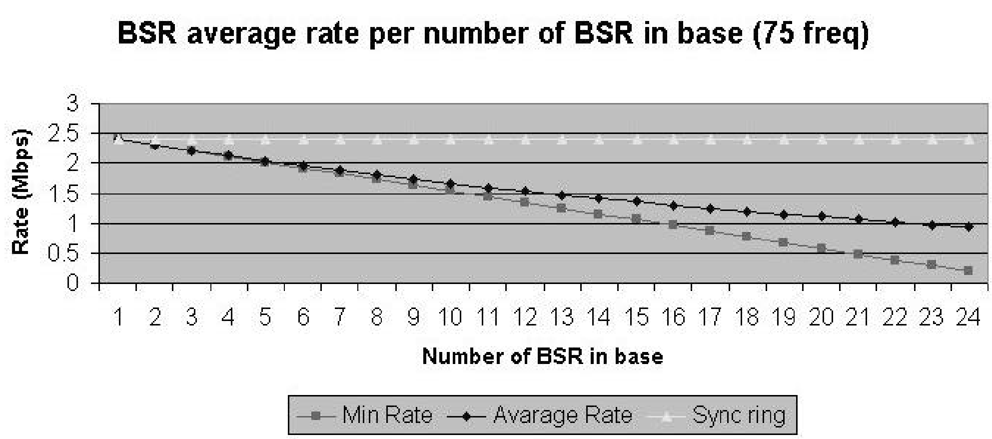

Figure 4-3: Sync/Unsync BS Capacity Comparison

Chapter

5

BSDU

5.1. Base Station Distribution Unit

The Base Station Distribution Unit (BSDU) is a major building block of the base station. It performs the main indoor functions of the WipLL base-station. This mainly refers to the interfacing function between the Base Station Radios (BSRs), the Wide Area Network (WAN) and the DC power system.

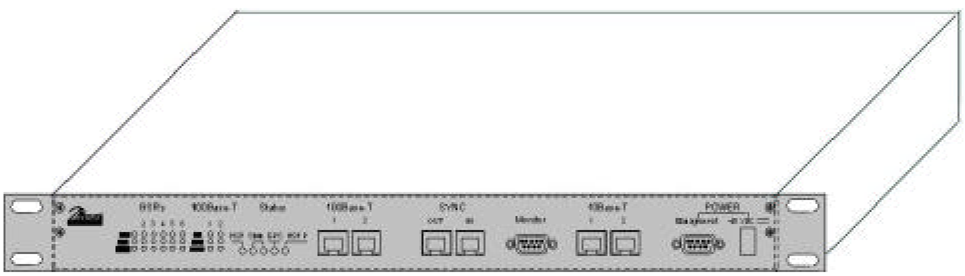

Figure 5-1: The WipLL BSDU

The functions implemented by the BSDU in the WipLL system's base station are:

- Data switching. - between 6 BSRs to a fast Ethernet 100Base-T port.
- Power distribution - DC power from a single -48Vdc connection to six BSRs.
- Domestic functions - focusing on local functions of the base station such as Hop-synchronization, power alarms, etc.

-T RJ45

-T RJ45 sockets, Sync in and Sync out RJ45 sockets, a DB9 socket for a monitor and a DB9 socket for management. The rear of the device has 6 DB15 connectors for connecting to each of the BSRs, cables and connectors for connecting to other BSDUs, a DB15 connector for the GPS plus mechanical brackets for mounting the BSDU unit in a 19" rack

5.2. Network Management

5.2.1. Management Information Base

- Standard Management Information Base (MIB) - Ethernet, switch.From WipLL Release 1.4, WipManage also controls the BSDU using SNMP.
- Marconi proprietary MIBS for managing the hop synchronization plus other specific parameters

5.2.2. Capabilities

- Configuration - network parameters
- Traps - sends traps as per configuration.
- Fault management - debugging options.
- Statistical counters - packet loss, etc.

5.3. Physical Interfaces

5.3.1. Connectors

- DB15 connectors for power, Ethernet, sync and connection to the BSRs.
- DB15 connector for power and signal connection to the GPS
- DB9 connectors for monitor and management.

- -T.
- -T.
-

5.3.2. Communication Interfaces

- Fast Ethernet, 100Base-T
- Ethernet, 10Mbps.
- Serial, RS-232.

5.4. Features and Protocols

5.4.1. Features

- Synchronization of hops between BSRs - the BSDU is the master (Not for North America it is only for ETSI countries).
- Software upgrade - with TFTP.
- Network management - SNMPv2

5.4.2. Protocols

- ARP
- TFTP
- ICMP
- SNMP

5.5. Table of Specifications - BSDU

5.5.1. Network Specifications

- Filtering rate - 105 000 frames / sec.
- Forwarding rate - 62 500 frames / sec.

5.5.2. Power Requirements

- Voltage- 48v DC nominal
- Power consumption -

5.5.3. Environmental Conditions

- Operating temperature 0C to +50C
- Storage temperature -40C to +80C

5.5.4. Network Interface

- Ethernet Network - RJ45: UTP EIA/TIA - Category 5

5.5.5. Standards Compliance

- ANSI/IEEE 802.3, ISO/IEC 8802-3 10/100 Base-T compliant
- Serial port - RS-232

5.5.6. Physical Dimensions

Table 5-1: BSDU Physical Dimensions

Parameter	Value
Height	4.32 cm
Width	48.26 cm
Depth	22.86 cm
Weight	2.9 kg

5.6. GPS (not for use in North America, only in ETSI countries).

Figure 5-2: Global Positioning System (GPS) Antenna

In order to synchronize a multiple BSDU environment and avoid RF ghosting effects it is critical that the entire network operates with the same clock. To achieve this, base stations are equipped with a GPS antenna, which receives a universal satellite clock signal.

The GPS antenna is a rugged, self-contained GPS receiver and antenna. This completely sealed unit is designed to meet or exceed MIL-STD 810E.

The GPS is available in a variety of configurations to suit the integration requirements: RS-422 for up to a 100-meter cable, DGPS input, 1 pulse-per-second output, 7- or 12-pin connectors, direct or cable mount, 1-14 UNS thread or 3 screws 10-32 UNF mounting.

Optional hardware available includes:

- Magnet mount
- 5/8" adaptor
- 5, 15 or 50-meter mating cable

Optional features include:

- WAAS DGPS accuracy
- RTCM-104 DGPS corrections output derived from WAAS DGPS system
- T-RAIM for timing applications
- Carrier phase measurements at 1 Hz

Measurements:

- Diameter: 4.5" (115mm)
- Height: 3.6" (90mm)

Power requirements:

- 36vDC from a BSDU (Note: DC/DC adapter is available for older BSDU units)
- 1.8 Watts

Operating temperature:

-

All connections are made through a single 12-conductor cable. Pin numbers and signals are shown in Figure 5-3 and Table 5-1.

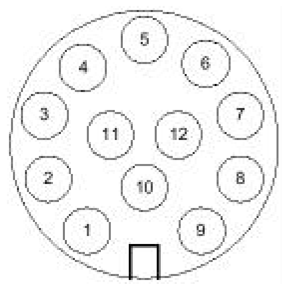

Figure 5-3: GPS Connector View from the Underside

Table 5-1: GPS Connections

GPS pin	GPS pin name	Cable colour	BSDU pin	BSDU lead
1	POWER	Red	9	
2	RX_DATA_1-	Blue		TD+ (After R5)
3	RX_DATA_1+	Black		TD-
4	TX_DATA_1-	Yellow	4	RD-
5	TX_DATA_1+	Black		RD+ (After R3)
6	RX_DATA_2-	Brown	x	
7 9	RX_DATA_2+ GND	Black Black	x 10	
11	1PPS+	Green	8	1PPS-
12	1PPS-	Black	7	1PPS+ (After R7)

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Chapter

6

SPR

6.1. Subscriber Premises Radio

The subscriber site typically includes a Subscriber Premises Radio (SPR) and a Subscriber Data Adapter (SDA).

Figure 6-1 shows a typical SPR installation.

Figure 6-1: Typical SPR Installation

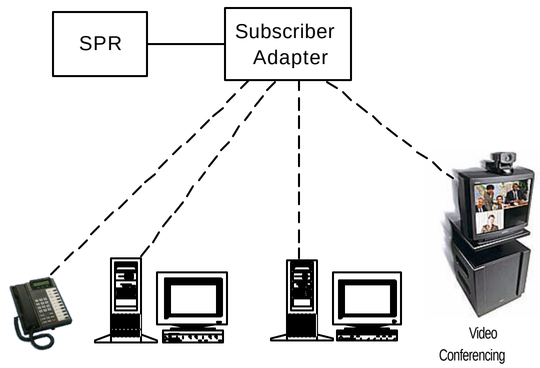

Figure 6-2: Typical Subscriber Site

6.2. SPR/BSR Communications

The SPR transmits and receives data to and from the base station. It is typically located on the roof or external wall of the subscriber premises. The SPR has the reference number of the Base Station Radio (BSR) coded into it. This prevents the SPR from being removed and placed at a different location without authorisation.

The SPR contains a high-gain directional antenna. The standard 2.4Ghz model covers an area of 23 degrees with a gain of 15dBi

At the network layer, the SPR performs routing functions between the subscriber's Ethernet network and the wireless network and contains a routing table that can support up to 16 entries.

The transport layer of the SPR makes decisions on how to support an application in terms of bandwidth, delays and mode of operation. There are two modes of operation - pre-emptive polling and Time Division Multiple Access (TDMA). The BSR's admission control makes the decision on which mode each unit of the cell will operate at a given moment.

The SPR is connected to the wired network through an SDA or SDTA supplied with WipLL Release 1.4, with a 10Base-T Ethernet connection which allows a cable length of up to 100 meters. The capacity of each SPR is up to 4Mbps.

6.2.1. SPR Configurations

Different versions of the SPR are available. Options include different mechanical, memory and antenna beam span configurations.

6.2.2. SPR Options

- Standard SPR - an SPR with basic functionality.
- SPR with high gain antenna includes an 18dBi antenna with a sharper beam. (Not for use in North America, only for ETSI countries).

This option requires a larger box.

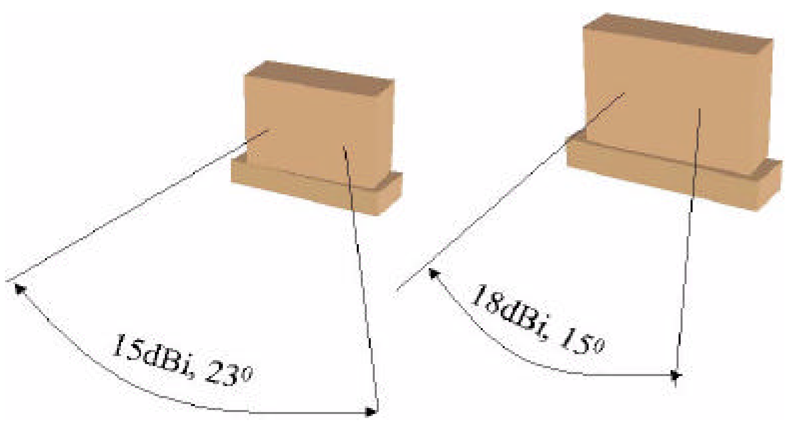

Figure 6-3: SPR Options

6.2.3. SPR Standard Accessories

- Mechanical mounting brackets - for mounting the units on a wall.
- DB15 connector for the data port with waterproof cover.

6.2.4. Network Management

- MIB - standard MIBs - Ethernet, router
- Marconi proprietary

6.2.5. Capabilities

- **Configuration** - network parameters (IP address, ports, routing tables, etc.), RF parameters (frequency tables, allowed BSRs, etc.).
- **Traps** - send traps as per configuration.
- **Fault management** - debugging options.
- **Statistical counters** - for packet loss, etc.

6.2.6. Physical Interfaces

6.2.6.1. Connectors:

- DB15 - power, Ethernet and serial.
- DB9 - serial interface.

6.2.6.2. Communication Interfaces:

- Ethernet - 10 Mbps.
- Serial - RS-232.

6.2.7. Features and Protocols

6.2.7.1. Features

- Software upgrade - with TFTP.
- Static routing tables - 16 entries per Ethernet port.

- QoS - Proprietary.
- Network management - SNMPv2
- Concurrent open sessions - 50

6.2.7.2. Protocols

- - ARP
- -
- - TFTP
- - ICMP
- - SNMP

Table 6-1: Radio and MAC Specifications

Parameter	Value	Comment
Operating frequency Release 1.2 Release 1.4	 2.4 GHz 2.4 GHz	
Spectrum spreading method	Frequency hopping CDMA	Per ETSI EN300 328
Duplexing Method	Time Div. Duplex (TDD) 2.4GHz	
Transmit Bit Rates	Up to 4Mbps	BER and distance dependent
Channel spacing	1MHz	
Output power from the radio	Up to 19dBm, configurable	
Effective Isotropic Radiated Power (EIRP)	34dBm, configurable up to 46dBm	Depending on local regulations maximum output power can be set at factory
Modulation method	8 level CPFSK	
Channel access method	PPMA / Adaptive TDMA	
Protocol efficiency	Up to 80%	At BER = 10^{-5}, depending on the application

Table 6-2: Agency Certification

Parameter	Value	Comment
Emissions / Immunity	EN 300 339 EN 300 386-2 ETS 300 328	
Safety	EN/IEC 60950	
Environmental	ETS 300 019-2-x	

Table 6-3: Network Specifications

Parameter	Value	Comment
Filtering rate	10500 frames / sec	
Forwarding rate	1300 frames / sec	
Routing table length	16	

Table 6-4: Power Requirements

Parameter	Value	Comment
Voltage Minimum Maximum	48Vdc nominal 30Vdc 55Vdc	Fed from either the SDA
Consumption	Maximum	500mA

Table 6-5: Environmental Considerations

Parameter	Value	Comment
Operating temperature Outdoor units (BSR,SPR)	-	Optional range of -
Storage temperature	-	

Table 6-6: Network Interface

Parameter	Value	Comment
Ethernet Network	UTP EIA / TIA	Category 5
Standards Compliance	ANSI/IEEE 802.3 and ISO/IEC 8802-3 10 Base-T compliant	
Serial Port	RS-232	

Table 6-7: SPR Physical Dimensions (w/o High Gain Antenna)

Parameter	Value	Comment
Height	311mm	Excluding mounting kit
Width	244mm	
Depth	65.5mm	
Weight	2.5kg	

Table 6-8: SPR Physical Dimensions (with High Gain Antenna)

Parameter	Value	Comment
Height	400mm	Excluding mounting kit
Width	317mm	
Depth	65.5mm	
Weight	4.7kg	

Note: The cable and connector are the same as for the base station.

6.3. Interface Connectors

Figure 6-4 and Table 6-9 detail the pin configuration for the SPR interfaces.

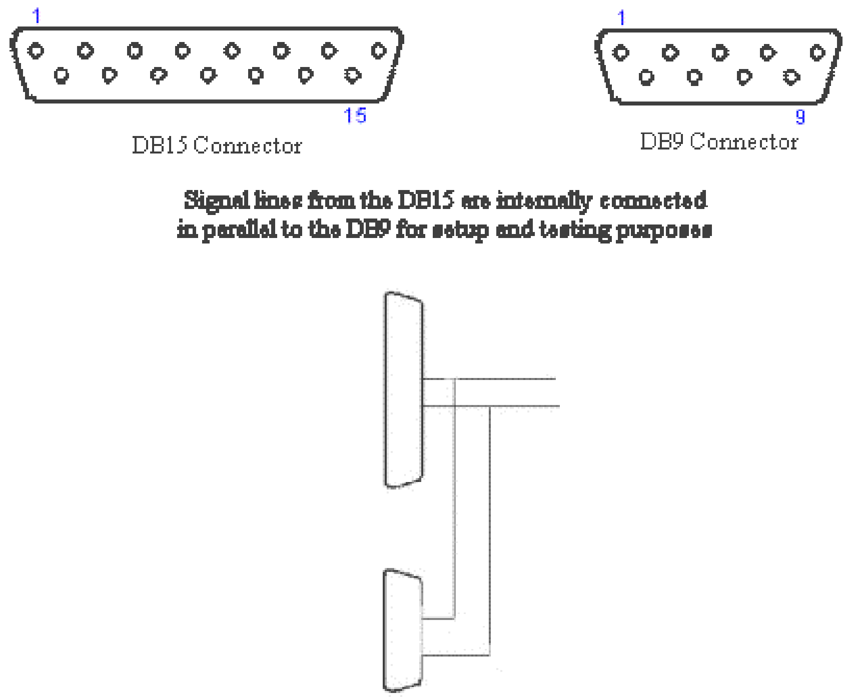

Figure 6-4: SPR Assembly

Table 6-9: SPR Connectors

	9 Pin Communications Connector		15 Pin Data/Power Connector
1	nc	**1**	+ VIN F
2	Rx	**2**	- VIN F
3	Tx	**3**	Ethernet Tx +
4	nc	**4**	Ethernet Tx -
5	Ground	**5**	Ethernet Rx +
6	nc	**6**	Ethernet Rx -
7	Ground	**7**	nc
8	nc	**8**	nc
9	+5vDC	**9**	+VIN F
		10	- VIN F
		11	VCC
		12	GND
		13	nc
		14	232 Rx
		15	232 Tx

The cable run must be mechanically protected and supported at maximum 1 meter intervals in a 20mm galvanised steel flexible conduit for external runs and in 20mm PVC conduit for internal runs. Communications output must be in 50mm x 20mm PVC trunking.

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Chapter

7

Customer Interface Adaptors

7.1. General

WipLL uses Internet Protocol (IP) to communicate between subscribers. Analog tele
to PSTN signaling by IP Telephony Gateways. WipLL subscriber units contain the client-side IP Telephony gateway. The PSTN gateway can be located anywhere within the network.

7.1.1. Configurations

WipLL's subscriber data and telephony adapter is located at the subscriber premises. The subscriber adapters' job is to interface the WipLL system with the subscriber premises equipment. It also provides power to the subscriber premises radio (SPR), which is located outdoors and performs IP routing and transmits and receive data from the base station, using radio frequencies (RF). Lightning protection is also done at the subscriber adapter.

There are several configurations for the subscriber adapters that are related mainly to the interface required by the subscriber and to the configuration of the system.

7.2. SDA

The Subscriber Data Adapter (SDA) is an Ethernet HUB that provides 2 10-BaseT connections to host computers or a network. It also provides power, lightning protection and data connection to the SPR. It connects to the main power and includes LEDs for display of network connection and data traffic.

The SDA box can be wall mounted, in a communications closet or sited on a desk.

7.2.1. SDA Specifications

- Dimensions: 150mm Height x 150mm width x 58.5mm depth
- Weight: .65kg
- Power Consimption: 6 watts (AC)
- Input Voltage: 117-230 Vac 50/60Hz
- Output Voltage: 48Vdc
- Power Capacity: 50 watts (DC)
- Environmental Conditions
  - Temperature: -
  -
- Connections
  - 8-pin connector to SPR or BSR (See Table 7-1, page 7-4)
  - RJ45 socket for Ethernet LAN
  - RJ45 socket for a PC interface
- Optional accessories
  - Wall mounting kit.

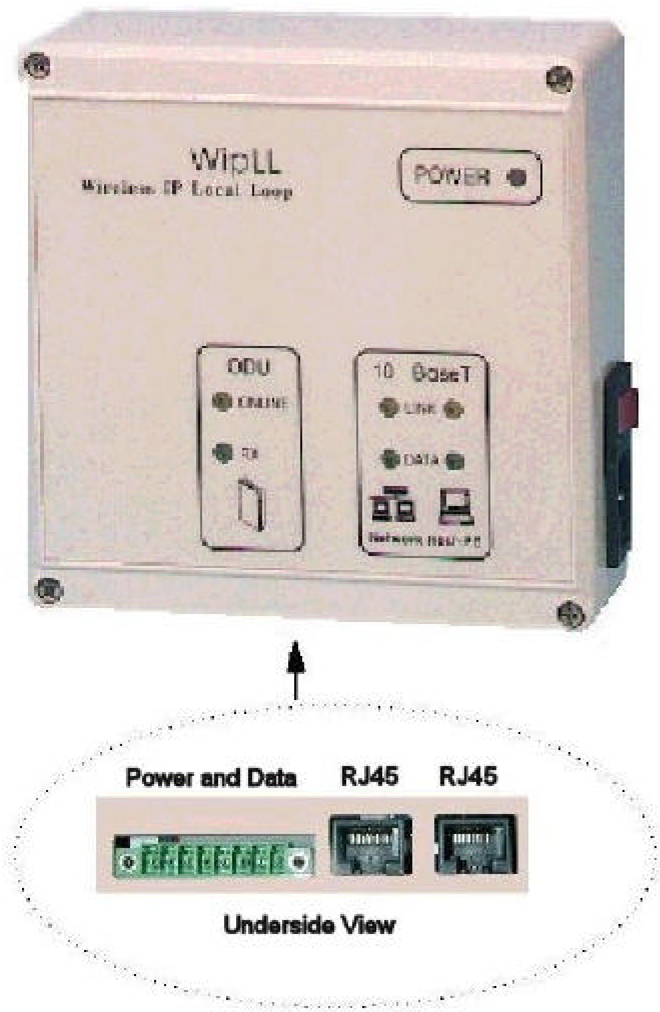

Figure 7-1: Subscriber Data Adapter (SDA)

The SDA includes lightning arrestors to protect the customer's local network from lightning. The SDA is connected to a standard power outlet (110-240vAC). The units are generally installed indoors in a communications cabinet or mounted on a wall. An SDA can also be placed on a table or shelf next to the customer's communications equipment.

Table 7-1 illustrates the data connector pinouts.

Table 7-1: Data Connections

8-way Connector		J3		J2	
1	nc	1	+Tx2	1	+Rx3
2	nc	2	-Tx2	2	-Rx3
3	-48v	3	+Rx2	3	+Tx3
4	+48v	4	nc	4	nc
5	-Tx	5	nc	5	nc
6	+Tx	6	-Rx2	6	-Tx3
7	-Rx	7	nc	7	nc
8	+RX	8	nc	8	nc

7.3. SDTA

The Subscriber Data and Telephony Adapter (SDTA) is a residential gateway that

telephone lines. It also provides power, lightning protection and data connection to the SPR. It connects to the main power and includes LEDs for display of network connection and data traffic.

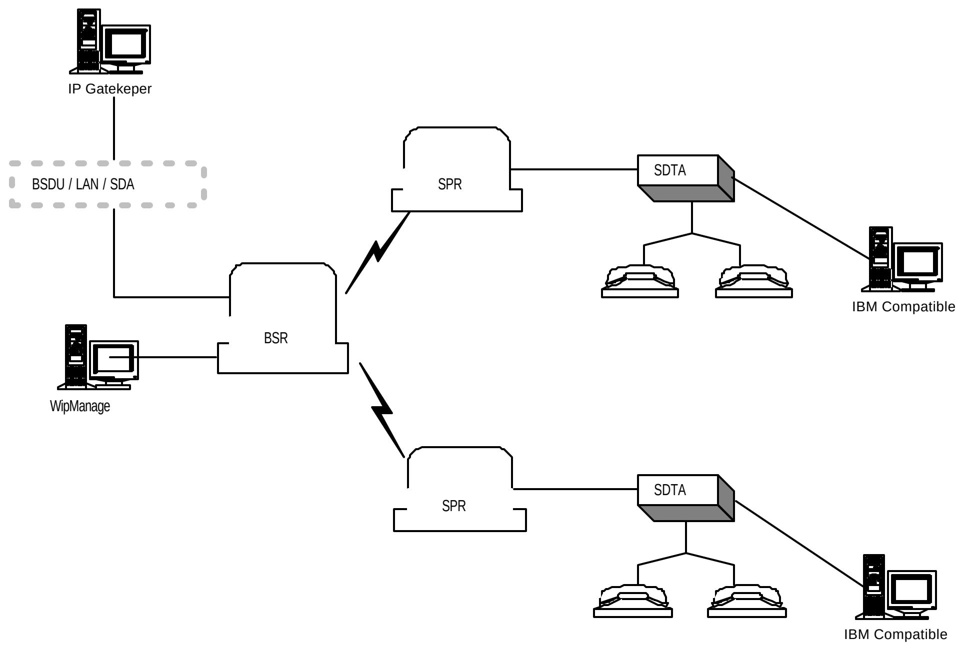

Figure 7-2: VoIP Networking Example

The SDTA box can be wall mounted, in a communications closet or sited on a desk.

7.3.1. SDTA Specifications

- Dimensions: 150mm Height x 150mm width x 70mm depth
- Weight: 1.9 Kg
- Power: 40 watts
- Voltage: 48Vdc
- Environmental Conditions
  -
  -
- Connections
  - 2 RJ11 telephone sockets
  - Power socket
  - DB15 WAN socket
  - DB9 serial socket (concealed)
  - RJ45 LAN socket
- Accessories
  - 48Vdc 750mA power supply
  - Wall mounting kit.(optional)

7.3.2. SDTA Interfaces

To SPR:

DB15 connector that includes:

- 10baseT, ANSI/IEEE 802.3
- 48Vdc, 50W
- RJ-11 telephone sockets

To the Ethernet:

- RJ-45 connector
- 10-BaseT, ANSI/IEEE 802.3

Figure 7-3: Subscriber Data and Telephony Adapter (SDTA)

The SDTA includes lightning arrestors to protect the customer's local network from lightning. The SDTA is connected to a standard power outlet (110-240vAC). Units are generally installed indoors in a communications cabinet or mounted on a wall. An SDTA can also be placed on a table or shelf next to the customer's communications equipment.

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Chapter

8

BSPS

The Marconi Base Station Power System (BSPS) supplies the following:

- Provides off-line power to sensitive equipment
- Charges the battery bank that provides backup power during a mains failure. Thus, this system is essentially a DC-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.
- Monitors the operation and communicates with a PC or a host to provide full (remote) control and indication.

8.1. General

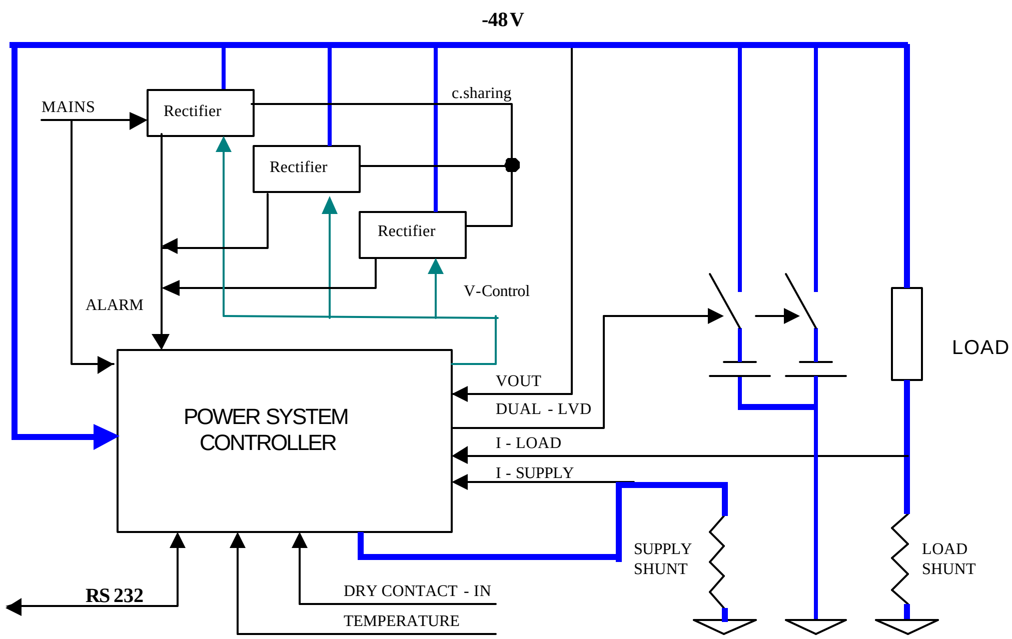

Figure 8-1: BSPS Block Diagram

As shown in Figure 8-1, 3 rectifiers (or more) are chained in parallel to provide the current capacity needed. The output voltage of the rectifiers feeds the load and charges the batteries through the dual LVD.

A dedicated bus that connects all rectifier modules does current sharing.

This is done autonomously and not related to the system controller.

All rectifiers are sharing a voltage control bus (V-CONTROL) by which it is possible to change the output DC voltage of the system, around the default value of the modules.

This bus is controlled by the system controller in order to change the output.

Another bus (ALARM) sends the information of a faulty rectifier module to the system controller.

Two accurate shunt-resistors are contained in the system to monitor the load and the total current.

The battery current is then calculated by the controller to be the difference between the two.

Two temperature sensors are connected to measure the battery temperature. The average temperature is calculated and demonstrated.

The status of the various circuit breakers (CB's) is monitored constantly by using their auxiliary switches. The opening of a CB will result in an audio/visual alarm. When the reason for alarm is removed, the alarm clears and stops.

8.2. Main Rack

8.2.1. Main Rack

The main rack is the core of the Full-Redundancy 48VDC-power system. It can contain between one to three rectifiers and a system controller. Listed below are the components that are housed in the main rack (see Figure 8-2).

- Rectifier modules
- System controller
- LVLD contactors (commanded by the system controller)
- Load and battery circuit breakers for DC protection and distribution

8.2.2. Front Panel

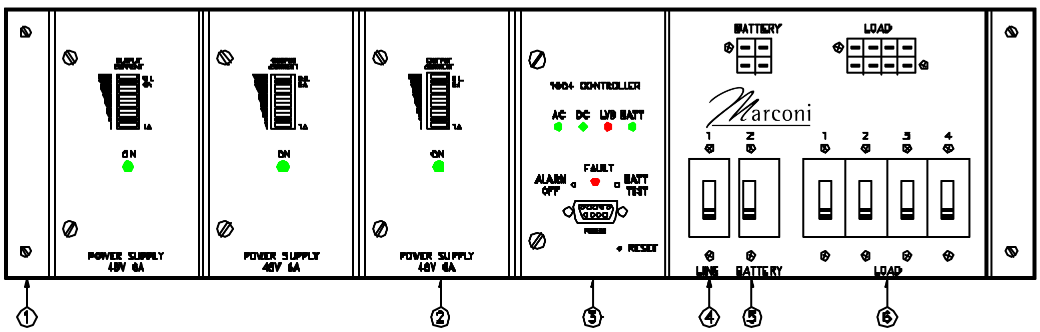

Figure 8-2: BSPS Main Rack - Front Panel

The following components are illustrated in Figure 8-3:

1)

2) Rectifier module

3) System controller module

4) Line breaker

5) Battery breaker

6) Load breakers

8.2.3. Rear Panel

The following components are shown in Figure 8-4:

1) ***LINE IN*** **-** AC line input terminations

2) ***LINE OUT*** **-** connection for the extension rack (when exists)

3) ***COMM*** - data and communication connection for extension rack

4) ***P.S. EXT*** - DC connection to the extension rack

5) ***LVD BYPASS*** - connection for the DC distribution rack

6) ***TEMP SENSOR*** - temperature sensor terminals (four wires)

7) ***GND*** - Ground terminal

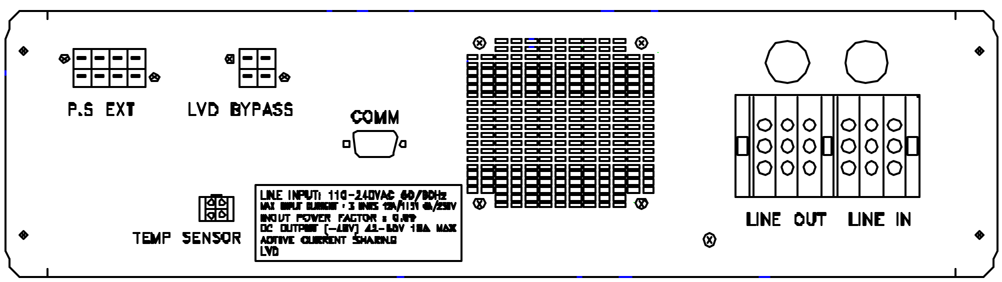

Figure 8-3: BSPS Main Rack - Rear Panel

8.3. Extension Rack (optional)

8.3.1. Overview

The extension rack is optional and is used only for getting more power from the system. It can house up to 6 rectifiers. A fully equipped system with the extension contains 9 rectifiers with a total capability of 54A output current.

8.3.2. Front Panel

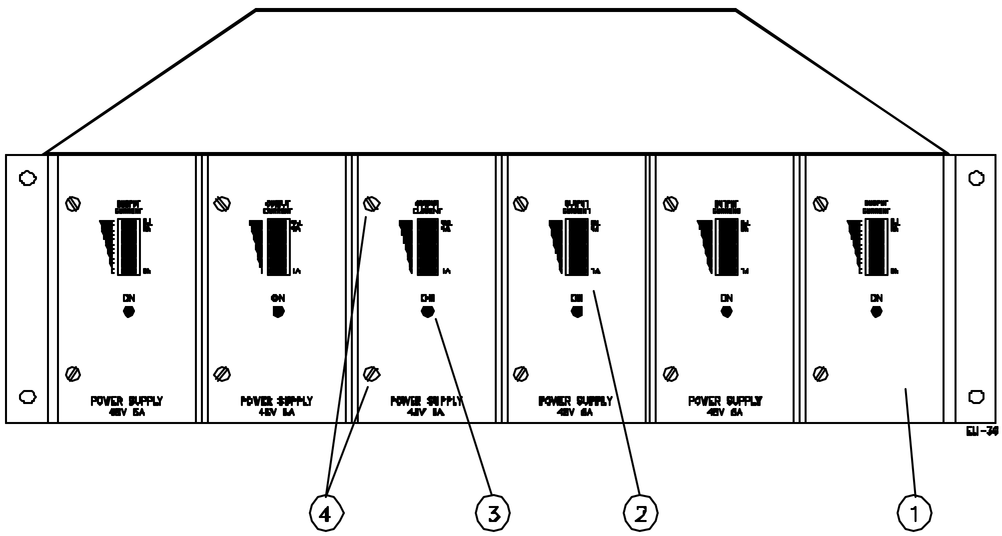

Figure 8-4: BSPS Extension Rack - Front Panel

The following are the components illustrated in Figure 8-4:

1) Rectifier module

2) Rectifier load bar graph

3) Rectifier status green LED

4) Rectifier module fasteners

8.3.3. Rear Panel

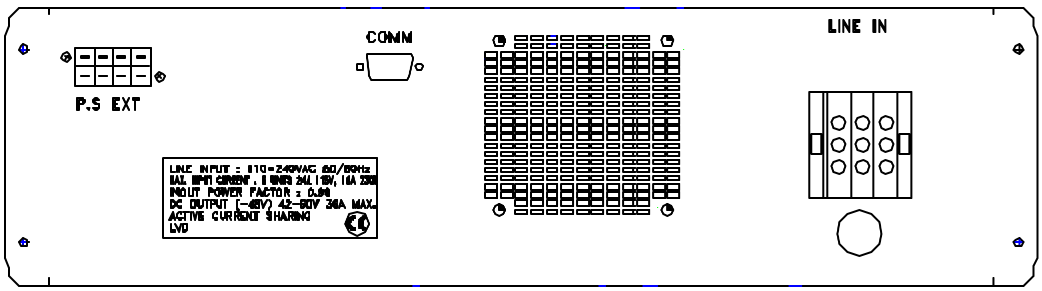

Figure 8-5: BSPS Extension Rack - Rear Panel

The following are the components specified in Figure 8-5:

1) ***LINE IN*** **-** AC line input terminations
2) ***COMM*** **-** data and communication connection to the main rack
3) ***P.S. EXT*** **-** DC connection to the main rack
4) ***GND*** **-** Ground terminal

8.4. DC Distribution Rack (optional)

8.4.1. Overview

This section is optional and provides more circuit-breakers (CB's) for the sake of distributing the output current to more separate consumers.

This rack contains as well a bypass switch to bypass the LVD.

When this switch is activated the battery is no longer protected against deep discharge and the system controller alarm will be thus activated.

The distribution rack also contains the terminations for connecting to other parts of the system (main and extension racks).

8.4.2. Front Panel

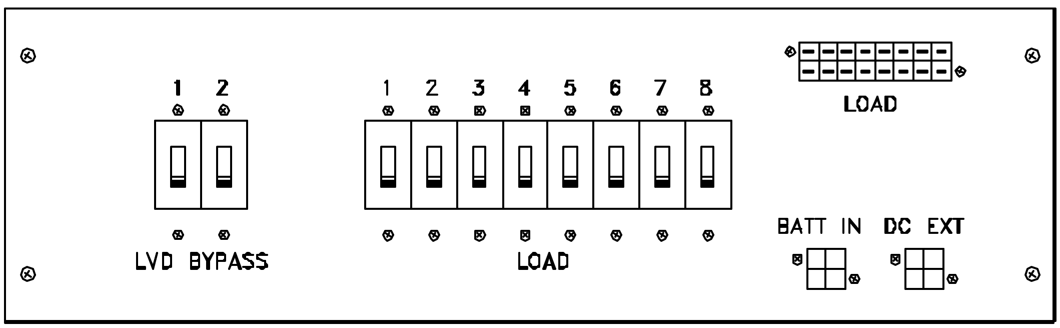

Figure 8-6: BSPS DC Distribution Rack - Front Panel

8.4.3. Rear Panel

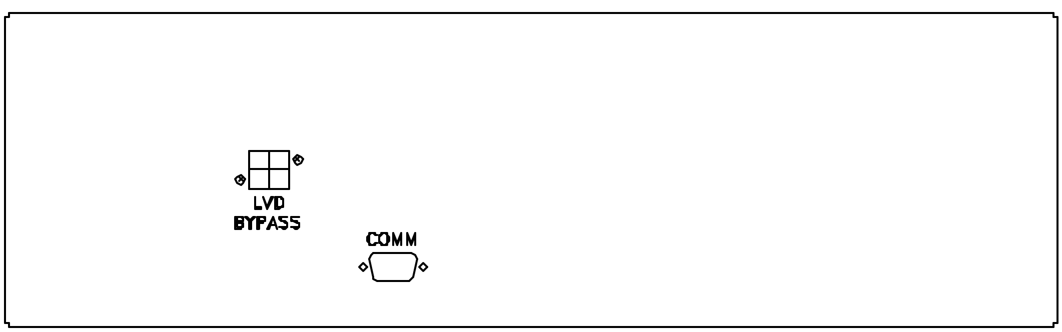

Figure 8-7: BSPS DC Distribution Rack - Rear Panel

8.5. Basic Rectifier Module

The PFC50-6 rectifier module is the heart of the Full-Redundancy 48VDC power system. It is a plugged-in module designed specifically for modular systems. The power factor correction (PFC) device at the input enables clean, stable, sinusoidal current consumption from the mains. This converter produces a 382VDC output, which is then converted to the 50V output.

A current sharing circuit is responsible for current sharing among the rectifiers. This enables each one of the rectifiers to slightly increase its output voltage.

The rectifiers follow the highest output voltage of the rectifiers that are used.

For example:

There are 2 rectifiers in the system, one of the rectifiers has an output voltage that is greater than that of the other rectifier. The rectifier with the higher output voltage will become the master and dictate the output voltage of the total system. The second rectifier raises its voltage slightly until its output current equals the output current of the master rectifier. Hence, one rectifier in the system is the master and the other rectifiers are slaves.

When the master rectifier fails to operate, the rectifier with the next highest initial output automatically becomes the new master of the system.

Note: The sharing mechanism tends to raise th
approximately one-volt of correction is applied to the system.

The output current indication is indicated by the LED bar graph shown on the front panel (see Figure 8-8). This bar graph is used to verify current sharing operation, and to indicate the percentage of the full load.

An RFI input filter built into the input stage suppresses the generated noise travelling to the line.

8.5.1. Block Diagram

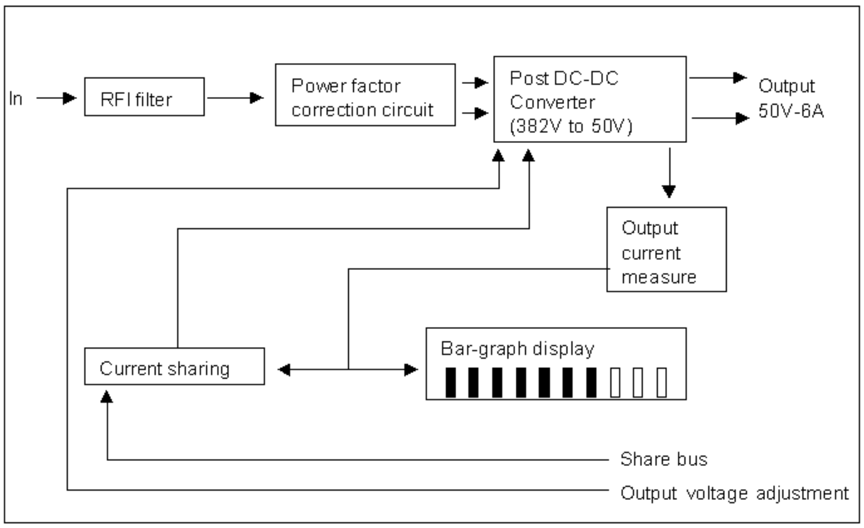

Figure 8-8: BSPS Rectifier - Simplified Block Diagram

8.5.2. Front Panel

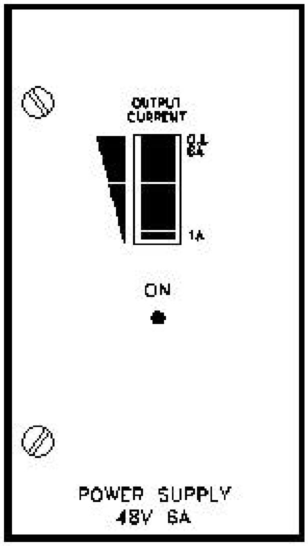

Figure 8-9: BSPS Rectifier Module - Front Panel

Table 8-1: Rectifier Specifications

INPUT	Voltage	90VAC to 270VAC
	Current (nominal)	1.6A @ 230V / 3.2A @ 115V
	Frequency	47Hz to 63Hz
	Power factor (nominal line/load)	≥ 0.993
	Inrush current (at 25°C ambient)	< 65A@230V / 33A@115V
OUTPUT	Voltage (default)	53.5VDC
	Regulation (line & load) (1)	± 0.4%
	Adjustable range	47 to 58 VDC
	Current	6A @ 54V

	Ripple & noise	50mVp -p

8.6. System Controller Module

8.6.1. Front Panel

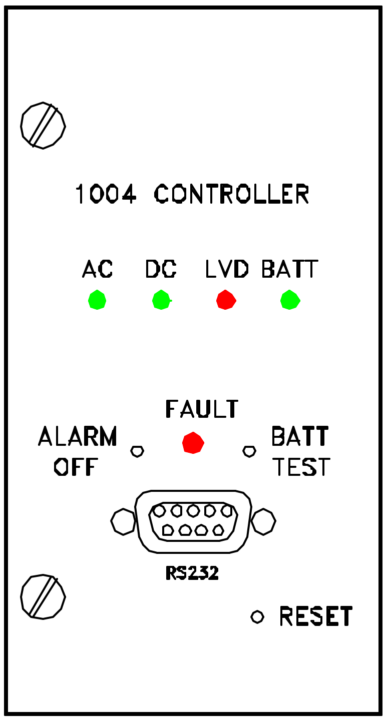

Figure 8-10: BSPS System Controller - Front Panel

Description:

AC - Input AC voltage is normal (green)

DC - Output DC voltage is normal (green)

LVD - Low Voltage Disconnect circuit is open (battery is disconnected, red)

BATT - Battery test passed (green)

FAULT - General alarm fault (red-continuous), Faulty rectifier (red-blinks)

BATT TEST - Manual battery test, use a pencil tip to initiate

ALARM OFF - Silences the internal buzzer, use a pencil tip

RESET - Resetting the controller, use a pencil tip

RS232 - Connector for the host

8.6.2. Main Functions

The 1004 system controller supports these functions:

1) RS232 communication with a host

2) Controlling dual-LVD for managing two branches of batteries. LVD voltages are settable and nonvolatile

3) Boost/Float charging, voltages are settable and nonvolatile

4) Battery test for two branches

5) Three dry-contacts for alarm, user-defined

6) Audio-visual alarm

7) LED's indicators for AC, DC, LVD, battery and general fault

8) Optional: 2x3 digits display for system voltage/current metering

9) Faulty rectifier detection

10) Open breakers detection (any of them)

11) LVD bypass activation alarm

12) Abnormal condition detection (AC, DC, battery, over-temperature etc.)

8.6.3. Host Communication

The detailed protocol of communication is described in section **8.7 Communication Protocol &** Data, page 8-14.

The RS232 plug, located at the front panel is used for the connection with the host. pin assignment for the DB9 connector is as follows:

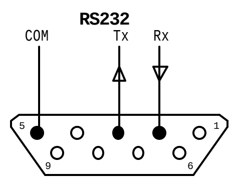

Figure 8-11: DB9 Connector

8.7. Communication Protocol & Data

1) The host and the controller communicate in Half-Duplex RS232 9600.N.1 RX, TX, COM lines, no flow control (neither h/w nor s/w).

2) The **HOST** is always the **MASTER**, and the **controller** is always a **slave**.

3) Data is binary with no dedicated control chars.

4) Data transmitted by each end has a constant length.

5) There are 3 elements for data reliability:**3 bytes - header.**

6) 1 byte - checksum.

7) 3 bytes - termination.

8) Upon reception of a valid packet, the controller will respond in 50mSec as of the end of the received packet.

9) Upon a reception of a **header start (0xAC)** there will be a start of a reception window 500mSec long. In case that a valid packet has been received it will be processed. Otherwise, the controller will initialize the reception counter.

This protocol provides the user with the ability of controlling the power system parameters as well as retrieving data and status from the system.

8.7.1. Master

The master sends its packet including **header**, **opcode**, **data**, **checksum** and **termination**. The 4-byte **opcode** bit-combination gives the user the ability to perform one or more functions at the same time.

The 32-byte **data** to be sent should include relevant data according to the operation, set as an **opcode** by the user.

8.7.2. Slave

The slave responds as soon as a valid packet is received including **header**, **received opcode**, **received_checksum**, **id**, **data**, **checksum** and **termination**.

The **received_opcode** is the last received opcode from the master.

The **received_checksum** is the last received checksum from the master.

The 4-byte **id** consists of 3 pre-programmed bytes and an additional byte that can be programmed by the master.

The 32-byte **data** always include all the data/status that the user may request, meaning that every transaction from the master to the slave will always result with retrieving all possible data that the slave is able to provide.

NOTE: The data retrieved in a transaction does not include the changes made by the host in its command (if any). Another retrieval should take place in order to get the values that were affected in the previous command.

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Chapter 9

Appendix

9.1. New Features Release 1.4

S/N	Feature	Remarks
1	3.5 GHz **(Not for North America)**	FDD mode in addition to 2.4 GHz (TDD)
2	External antenna for **BSR (Not for North America)**	N-type connector (only for 2.4GHz)
3	GPS for synchronization among Base Stations **(Not for North America)**	Adapter connects BSDU for Rev C only
4	BSPS	Provides power to the Base Station
5	VoIP (for test & demo):	H.323 based Only for tests and demos Works in conjunction with Commatch GW
6	Improved QoS	Eight (8) priorities
7	Bandwidth limitations	Each SPR may have a max. bit rate
8	SNMP support for BSDU	MIB -II and private MIB Via WipManage
9	IntraCom	Traffic among SPRs can be centrally monitored or not
10	Configuring IP on the air	More IP addressing related flexibility of the network
11	Default configurations via WipConfig & WipManage	
12	RSSI analysis in WipConfig	

9.2. 3.5 GHz ((Not for North America).

- WipLL now provides a Wireless Local Loop (WLL) solution in the licensed 3.5GHz band, as well as 2.4GHz unlicensed ISM frequency band. Previous releases supported 2.4GHz only.
- In a point-to-multipoint system, a base station radio communicates with multiple SPRs, using either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD). WipLL release 1.4 now uses FDD mode when working at 3.5GHz, dividing the available spectrum into two separate channels, one for upstream the other for downstream.
- 3.5GHz implementation requires new ETSI approved hardware for both the BSR and SPR.

9.3. External antenna (Not for North America).

- For 2.4GHz, BSRs are now also available with an N-type connector for attaching an external antenna instead of the internal antenna as in previous releases.

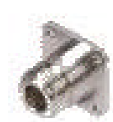

Figure 9-1: N-Type Connector

- External antenna support makes WipLL more flexible and allows WipLL to fit different scenarios following special customer requests.
- In order to support an external antenna, new hardware is required for the BSR. This hardware is ETSI approved.
- The external antenna may have a gain of 5-15dbi. The customer is responsible to ensure compliance.

9.4. GPS for synchronization among Base Stations (Not for North America)

- In order to synchronize an environment of multiple Base Station Distribution Units (BSDUs), it is critical that the entire network operates with the same clock. Base stations are now equipped with a GPS antenna, which receives a universal satellite clock signal.
- WipLL Release 1.4 includes software modification to the BSDU to support a GPS.
- A BSDU revision C provides the GPS with 48VDC. However as the GPS requires a 32VDC supply, a DC/DC convertor is available, whichconnects to the 15 pin connector on the BSDU.
- Release 1.4 now also includes a release for BSDU revisions D and E where there is no need for the adapter.

9.5. BSPS

- Base Station Power System (BSPS) is released as part of a cabinet, to provide power to the BSDUs at the base station.

9.6. VoIP

- WipLL now provides a solution for voice and data. However at this stage voice support is for demos and tests only and is not officially released for generaluse.
- WipLL 1.4 voice support includes a Subscriber Data and Telephony Adapter (SDTA), one of the elements of the latest WipLL solution. The SDTA provides both voice and data services whereas the SDA provides only data services. The SDTA also provides a LAN port to connect the local PVC and 2 POTS ports to connect analog telephones.
- The SDTA at release 1.4 supports H.323, G.711, G.723 and G.729 standards.

9.7. Improved Quality of Service (QoS)

- QoS is the ability to recognize the type of transmission and assign optimal resources accordingly. This is especially important for VoIP applications, that are sensitive to delay and jitter and should therefore be prioritized over other applications.
- QoS is used for packets leaving the SPRs towards the BSR as well as among SPRs making sure that the BSR assigns the correct priority to the correct SPR.
- WipLL 1.4 now provides eight (8) levels of priority: 0 through 7. Priorities are based on source IP address or ranges of addresses, destination IP address or ranges of addresses, protocol type (UDP, TCP, ICMP) and TCP/UDP ports which actually define the applications, such as a WEB application on port 80).
- When WipLL identifies a VoIP packet from an analog phone connected to the SDTA, it automatically provides it with the highest priority value (7).
- When a packet arrives from the Ethernet network to an SPR, the system recognizes the type of the packet and assigns it with a Time-To-Live (TTL) value.
- TTL determines which packets go first, where packets share the same priority.
- Each packet is marked whether critical or not, to determine if it should be sent when TTL expires or it should be dropped.
- Higher priority packets always go first regardless of the TTL of lower priority packets.

9.8. Bandwidth limitations

The BSR receives and transmits data to multiple SPRs. Using WipManage the user can set the maximum bandwidth values for different SPRs.

With good planning and minimal system congestion, each SPR can use the maximum defined bandwidth, so long as does not exceed the maximum overall bandwidth.

In a congested network, the real maximum bandwidth for an SPR cannot reach the defined value, but is still in proportion to the value configured. For example, an SPR that is set to a maximum of 256Kbps can reach a maximum bandwidth significantly larger than the maximum standard bandwidth of an SPR set to a 64Kbps.

9.9. SNMP support for BSDU

The BSDU is a major building block in a base station site. As such it is required to be remotely managed by WipManage. As part of release 1.4, WipManage now supports the BSDU that has an SNMP agent and supports Management Information Base II (MIB-II) and private MIB.

9.10. IntraCom

The enabling/disabling IntraCom feature provides an option of controlling the packets transferred among SPRs with the help of a router or a firewall connected to the BSR in the base station:

- If IntraCom is allowed, traffic can be routed among the SPRs (via the BSR) without the involvement of any external router or firewall.
- If IntraCom is not allowed, then traffic among SPRs is routed via the BSR to a central router or firewall. The central router or firewall controls the traffic. This capability is often requested by users interested in central control of the traffic among sites, for reasons such as security.

9.11. Configuring IP on the air

The IP addresses of the air ports of BSRs and SPRs can be configured by the user

Previous releases do not allow this configuration. The IP addresses of the air ports were fixed IP addr esses from the range of 192.168.0.0 .

This feature now increases the flexibility of WipLL, permits more efficient use of IP

pre-existing networks. For example a user that uses private IP addresses from the range of 192.168.0.0 does not have to change IP addresses in the network when installing WipLL.

9.12. Default configurations via WipConfig & WipManage

nd installation, release 1.4 provides 2 layers of default configurations for SPRs:

1. Customer defaults located in ROM and loaded during manufacturing. These parameters are customer specific.
2. Protected parameters basic parameters that enable connectivity of the SPR such as its IP address, subnet mask and community strings.

Undo operation enables restoring to the previous parameter settings.

9.13. RSSI analysis in WipConfig

WipConfig shows the RSSI value of each SPR. The RSSI value provides important RF-related information when installing WipLL.

9.14. What is RFC 1918?

Address allocation permits full network layer connectivity among all hosts inside an enterprise as well as among all public hosts of different enterprises. The cost of using private internet address space is the potentially costly effort to renumber hosts and networks between public a nd private.

The industry standard is that whenever possible, users of unregistered (or "dirty") networks use the reserved addresses in RFC 1918 on any networks inside the firewall.

The RFC 1918 addresses that can be used are:

- Class A: **10.x.x.x**
- Class B range: **172.16.0.0 -172.31.0.0**
- Class C range: **192.168.1.x-192.168.254.x**

The advantages of using these numbers on the inside of the firewall are twofold:

- hout fear of running out of addresses
- addresses.

For example, if arbitrarily using the Class C range of 192.31.7.0 for network addresses on the inside of your firewall, you will find that your computers will never be able to connect to another machine having a legitimate IP address such as 192.31.7.31, because the hosts will forever be trying to reach a machine on the inside of your firewall that does not exist.

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