WIPLL

FREQUENTLY ASKED QUESTIONS (FAQ)

Date: 25-March-00

1. Scope of this document

The Scope of this document is to provide information to users based on frequently asked questions.

2. Overview of WipLL – Wireless, IP based Wireless Local Loop system.

2.1 Introduction

Access Technology is often seen as the real differentiator by which every network operator is measured against their competitors, trying to deliver the best services, at the lowest cost.

In fact, the choice of the proper access technology could be the key function that will allow profitable growth, and a reduction of the capital and current account costs. It can improve the return on the capital employed but more than that can help the operator in differentiating himself from competitors, increasing it's competitiveness and the possibility to win more business.

Wireless Systems provide a mean to reach the customer in an easy and cost-effective way, especially where rapid deployment is requested, and where basic infrastructures are missing. The radio technology involved in the customer access has traditionally been limited in general to low quality and with limited transmission bit-rates available. This is the reason for the development of new technologies, allowing point to multi-point microwave wireless communication in the local loop.

To address this need, Marconi provides a Wireless Local Loop system that is based on Frequency Hoping CDMA technology and Internet Protocol (IP). This WLL system, named WipLL, is capable of providing integration of voice telephony and high-speed data services. The system is especially suitable to new public operators delivering voice telephony, data and multimedia services in a deregulated business environment.

As the demands on telephony networks migrate from traditional voice telephony to being predominantly data driven, the capability to provide integrated voice telephony and high-speed data services becomes crucial. By offering a WLL access solution built on IP protocol, WipLL provides telecom operators with a genuine opportunity to provide their targeted customer base with the type of service that they will increasingly demand in an efficient, cost effective manner.

2.2 Key advantages of WipLL:

2.2.1 Range of End User Services that can be offered using WipLL

Web Browsing, E-mail, File Transfer, Video Conferencing and other IP based applications can all be supported over a standard 10baseT Ethernet connection

The same core of WipLL equipment is ready for delivery of toll quality voice service (future release)

"Bandwidth on demand" or "Service on Demand" - users connected by WipLL can access up to 3.2 Mb/s peak data rate.

2.2.2 A High Capacity, High Efficiency and Reliable Service from WipLL's advanced air interface

WipLL allows up to 24 Radio units (according to the available frequency band allocation) installed within a single Base Station Site, which generate effective traffic of up to 76.8 Mbps.

WipLL uses a highly effective PPMA protocol on its air interface. PPMA is designed for Wireless Point to Multi-point applications and is much more efficient than alternative CSMA or traditional TDMA systems.

WipLL's use of Spread Spectrum Frequency Hopping CDMA radio technology minimises interference to provide a reliable service

2.2.3 Quality of Service

WipLL can provide the different Quality of Service levels required by different applications by recognising data packet and session types and allocating system resources accordingly.

Please refer to Annex 2 for more information about the advantages of WipLL.

2.3 Description of WipLL system

WipLL is a wireless communications system capable of supporting voice, data and video services to SME, SOHO and residential customers. Data applications such as high speed Internet access, video conferencing, tele-working and others are all supported.

The heart of the WipLL system contains Frequency Hopping CDMA (FH-CDMA) Spread Spectrum digital radios, and an air-protocol supporting Bandwidth-on-Demand (BoD) and Time Bounded Services (TBS).

The WipLL system supports a variety of network topologies: point-to-point (e.g. for back-hauling traffic), point-to-multipoint (e.g. traditional WLL applications), and multipoint-to-multipoint (e.g. base station interconnection). It supports various user environments such as LAN, IP-PBX, or single user.

Each outdoor radio contains an internal high gain antenna. The radio's software controlled transmitted power is up to 40 dBm EIRP, enabling it to exceed distances of 10Km without costly external power amplifiers.

The air traffic is managed by a proprietary protocol named PPMA (Preemptive Poling Multiple Access), which enables transmissions of packetized information, in uncommitted directions, while maintaining high data throughput under changing channel conditions and for various packet sizes. The protocol transmits packets in accordance with priorities based on the applications with which they are associated, thus providing Quality of Service (QoS) functionality by ensuring arrival of packets within the time boundaries required by the corresponding application.

The WipLL and its components are described in Figure 1. Please refer to annex 1 for more information about WipLL.

The Base Station is the focal point where all data is routed from the backbone to the end users. The Base Station Radio (BSR) performs the multiple wireless connections to the subscribers premises located within its sector. The Base Station Distribution Unit (BSDU) concentrates the data traffic of all BSRs in the site into the IP/WAN backbone connections. It also remotely feeds the power required to the operation of the BSRs.

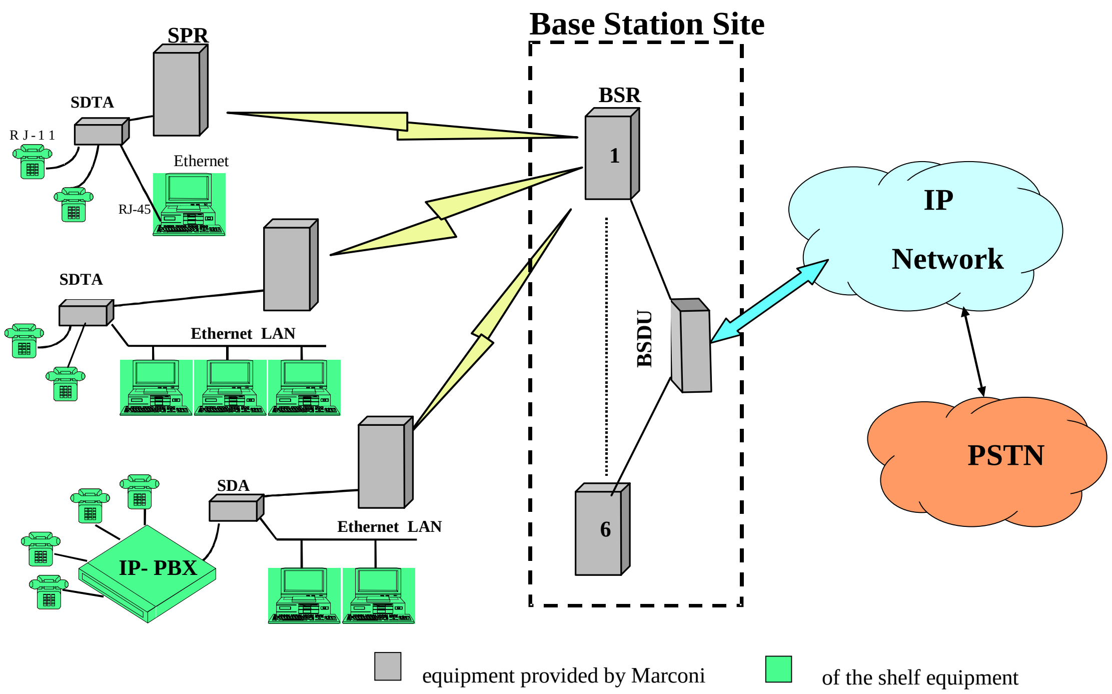


Figure 1: WipLL System Architecture

Each Radio Base Station Site can have up to 24 BSRs (This number might be limited in the 3.5Ghz Frequency band operation due to limitation of allocated frequency band) connected via Ethernet 10BaseT cable to the Base Station Distribution Unit (BSDU). The BSDU performs the main indoor functions of the WipLL base-station. This mainly refers to the interfacing function between the Base-Station Radio's (BSRs), the Wide Area Network (WAN) and the DC Power System. The BSDU can feed up to six BSRs and provides an Ethernet 100BaseT interface to the network. Up to 4 BSDU can be chained to provide a total of 96 Mbps radio bit rate out of 24 BSRs.

The equipment at the Subscriber premises serve as an access point of the user to the network. The user is connected to the Subscriber Data Adapter (SDA) for data applications and to STDA (Subscriber Telephony Data Adapter – future release) for mixed data and voice applications. These adapters route the data to the network via the Subscriber Premises Radio (SPR) installed at Subscriber Premises Site.

A Head End Gateway, which is not part of the WipLL system, plays an important role in the operation of the system with the PSTN environment. The Head End Gateway is a network element that is installed at the boundary of the access network and the backbone telephony network. The Head End Gateway provides the signalling adaptation and structure telephony channels as required by the backbone network. Normally the gateways will be at the access points to the WAN being connected to the WAN interface's of the base stations in the region. The Head End Gateway provides a transparent telephony interface between the PSTN and a local exchange supporting interfaces such as V5.2, PRI, CAS via (Wireless) IP network.

The number of radios that can be install within a single Radio Base Station Site depends mainly on the Frequency band allocated for the system. In the 2.4Ghz band the maximum number of 24 radios can coexist within a single Radio Base Station.

Each BSR radio provides up to 3.2 Mbps effective bandwidth. By utilising between 6 and 24 BSRs per base station, one WipLL base-station may provide as much as 76.8 Mbps effective capacity to be shared among the users of that base station.

At the customer site, the SPR is connected to an indoor unit either to the SDA unit, which provides two Ethernet 10BaseT interfaces, or to the STDA unit which provides two standard analogue telephone interfaces and an Ethernet 10BaseT interface. The bandwidth allocated to a single user may be varied between 64 Kbps and 3.2 Mbps, according to predefined service levels set by the operator.

2.4 WipManage™ - Network Management

The WipLL as a whole system and each network element within the WipLL system can be managed via Marconi Network Management System (WipManage) and management umbrella such as HP OpenView, using Simple Network Management Protocol (SNMP).

WipManage can perform the following tasks:

Installation

Configuration

Trap Management

Fault Management (Problem determination)

Performance Monitoring

Software Update

Security policy

WipManage can access each and every WipLL unit in the system and manage it remotely. The top hierarchy of WipManage is base-stations and it can zoom into every SPR.

WipManage is designed to ensure easy integration into any existing Network Management platform that supports SNMP. WipManage supports standard Management Information Base (MIB) -II for routing and Ethernet, as well as the private Marconi MIBs.

WipManage can be integrated with any standard network management umbrella that supports SNMP, such as HP OpenView for NT, Solaris and HPUX, CA Unicenter TNG, Tivoli NetView for AIX and NT and others. These umbrellas can integrate other element managers such as the routers, gateways and any other device on the network.

WipManage can also run in a stand-alone environment on any OS that support Tcl/TK (Windows 95, Windows NT, Unix, IBM, etc) without the NMS umbrella, and then it will manage only the WipLL units.

WipManage supports:

Device configuration: Ability to control all MIBs from the NMS (control power levels, routing tables, QoS policies, Device drivers, frequency usage, BW and more of each Sector and each SPR)

Device monitoring: Ability to monitor the traffic transmitted and received by each device, as well as the ability to monitor the RF performance at each location. A monitoring session can be saved to a file for further analysis.

Event Management: Utilises traps to indicate any malfunction, or any notable event from the devices to the NMS. The traps are time stamped and stored.

2.5 WipPlan™ - Network Planning

WipPlan is a network-planing tool, developed and provided by Marconi, which allows the evaluation, optimisation, complete deployment planning and upgrade of the wireless network. WipPlan is an interactive tool that works on two levels: Network and RF planning.

Various inputs such as topography of the service area, number of subscribers within the area, their type and traffic requirements and potential locations for base stations are loaded into Site Builder. This information is processed and verified so that the capacity and service requirements are met with the proposed network.

3. WipLL - Features

3.1 Spectrum Efficiency

3.1.1 Access method

WipLL is based on Frequency Hopping Code Division Multiple Access technology (FH-CDMA) in accordance with ETSI standard EN301 253. The system supports a variety of network topologies:

- point-to-multipoint, traditional WLL applications to access end users
- multipoint-to-multipoint for base station interconnection.
- point-to-point (e.g. for backhauling traffic)

WipLL uses a medium-access (MAC) air protocol that combines Time Division Multiple Access (TDMA) and Preemptive Polling Multiple Access (PPMA) to enable optimal, high QoS transmission of multiple transmission types. TDMA is a wireless transmission method that allows multiple simultaneous transmission over a single radio frequency channel, without interference, by allocating unique time slots to each user. PPMA is a proprietary MAC protocol that allows WipLL to allocate system resources dynamically, according to network user needs.

3.1.2 Bandwidth allocation and channelisation

The WipLL can operate in the 2.4Ghz ISM frequency band as well as in 3.5Ghz band. The 2.4Ghz can utilize the whole range between 2,400 to 2,483.5 MHz. However, utilization of the 3.5Ghz band depends on the available frequency band to CLEAR.

The system will operate in the TDD mode and 16 MHz is sufficient to install six BSR units covering 360° in the multi-site radio environment.

3.1.3 Modulation types and associated spectral efficiency

The product supports multilevel FSK (2, 4, 8) using CPM [Continuous Phase Modulation] also called 8 level CPFSK.

By combining TDMA and PPMA, and with the help of WipLL's QoS mechanism, WipLL uses the most appropriate of these protocols for each type of application while implementing an intelligent polling policy. In all, WipLL's protocol ensures approximately 80% of actual application throughput. While the efficiency of other protocols, used for the implementation of WipLL, depends on the number of users, WipLL's protocol provides maximum efficiency with very little impact from user volume.

WipLL's protocol provides an efficiency of up to 80%. Table 1 shows the data rate per each modulation scheme.

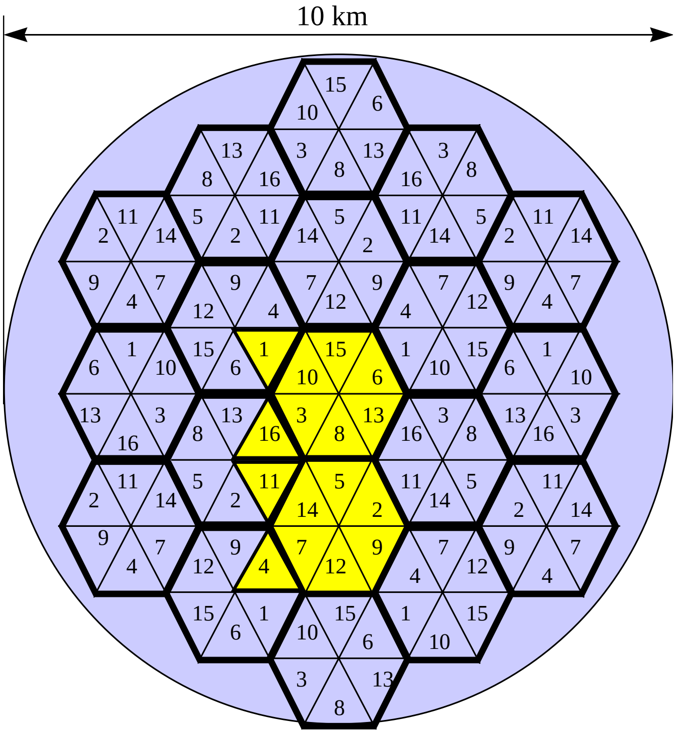
Table 1. WipLL efficiency

Mode of Operation	Row bit rate	effective Data Rate per Channel
8 level FSK **(Note 1)**	4 Mbit/s	3.2Mbps
8 level FSK	3Mbps	2.4Mbps
4 level FSK	2Mbps	1.6Mbps
2 level FSK	1Mbps	0.8Mbps

Note 1 : In development

3.1.4 Dynamic modulation and bit rate adaptation

As mentioned above, the modulation method of WipLL is multilevel FSK (2, 4, 8) using CPM [Continuous Phase Modulation] also called 8 level CPFSK. On top of that, it is important to note that the offered product is a packet-based system.



The spectrum utilisation of WipLL can be measured in the following way : bit/second/Hz/cell. Under this measure WipLL introduces the following performance:

$$\frac{(\mathrm{bit}/\mathrm{sec})}{(\mathrm{cell}\cdot\mathrm{Hz})} = \frac{\mathrm{Num\_of\_radios\_in\_tile}}{\mathrm{Channel\_required}} \times \frac{\mathrm{channel\_rate}}{\mathrm{num\_of\_hexagonals}}$$

$$\frac{(\mathrm{bit}/\mathrm{sec})}{(\mathrm{cell}\cdot\mathrm{Hz})} = \frac{16}{16} \times \frac{3.2}{2.66} = 1.203$$

The above tile, can be set one on top of the other, presenting an ever-growing capacity coverage, each layer requiring additional 16 MHz of spectrum. For example, in case of an available 2 X 25 MHz = 50 MHz spectrum, three (3) tiles can be layered (16MHz X 3 = 48 MHz). Thus, up to 18 BSRs can be install within one Base Station Site.

3.2 Spectrum Efficiency

3.2.1 Frequency Range and RF bandwidth

The WipLL system operates in the 2.4 GHz ISM frequency band. Another version of the System can operate in the 3.4 to 3.6 GHz band. The system can be configured to operate in the specific to CLEAR available frequency band that will be allocated.

3.2.2 Sectorization

The WipLL system is, in its basic configuration, a point to multi-point system. The BSR is the center of each WipLL sector, where a full site may contain up to 24 BSRs.

Figure 2 shows a WipLL cell with 6 sectors.

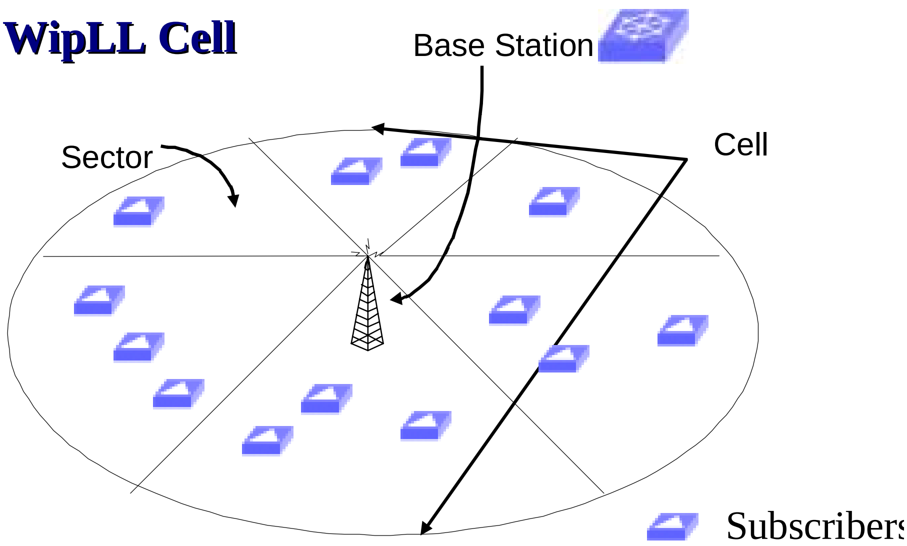


Figure 2 : A WipLL cell

Antenna types for the BSR (at the Base-station) :

- Regular antenna : 60 ^{0} Coverage
- Space diversity antenna

3.2.3 Sector/Cell Capacity (Mbps)

Current version of WipLL: Each BSR operates at 3 Mbps with effective throughput of 80%, thus it provides up to 2.4 MBps . Up to 24 BSRs can be installed in a single site providing as much as 57.6 Mbps per Site.

Future version of WipLL : Each BSR operates at 4 Mbps with effective throughput of 80%, thus it provides up to 3.2 Mbps . Up to 24 BSRs can be installed in a single Site providing as much as 76.8 Mbps per Site.

3.2.4 Kbps) for voice and Data /

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3.3.3 Modular structure of WipLL's equipment installed at the Base Station Site

Within the base station site, BSRs are connected to one another and to the network backbone via the BSDU – Base Station Distribution Unit. Among other roles, the BSDU is practically an Ethernet switch that connects 6 BSRs to a single 100baseT connection. Such configuration provides about 24Mbps of total capacity.

Figure 3 shows the minimum configuration required for a base station site.

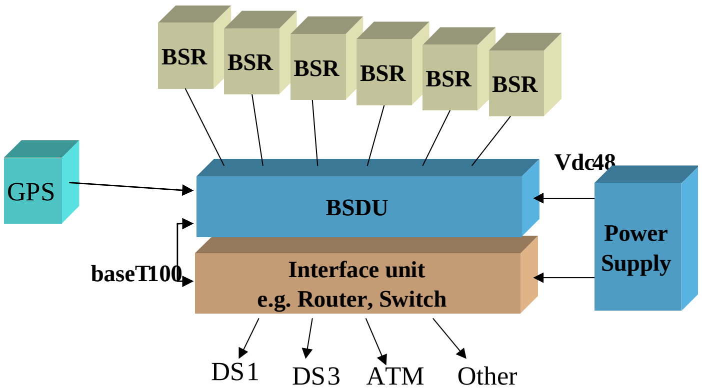


Figure 3 : Base Station site – minimum configuration

Up to 4 BSDUs can be daisy chained to provide a 24 BSRs base station. In its maximum capacity a base station site can provide up to 96Mbps of bit rate.

Figure 4 illustrates the maximum configuration of a base station site.

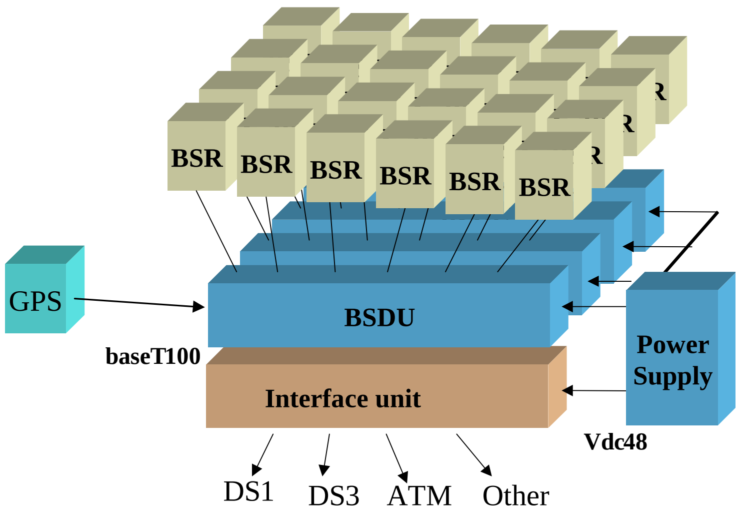


Figure 4 - Base Station maximum configuration

The backhaul of the network is transparent to the WipLL system. It is really a matter of network capacity and architecture. For example – a full capacity base station requires at least 96Mbps of dedicated bandwidth. Such bandwidth is available using 155Mbps ATM connection.

Typical network architecture for maximum capacity is demonstrated in Figure 5.

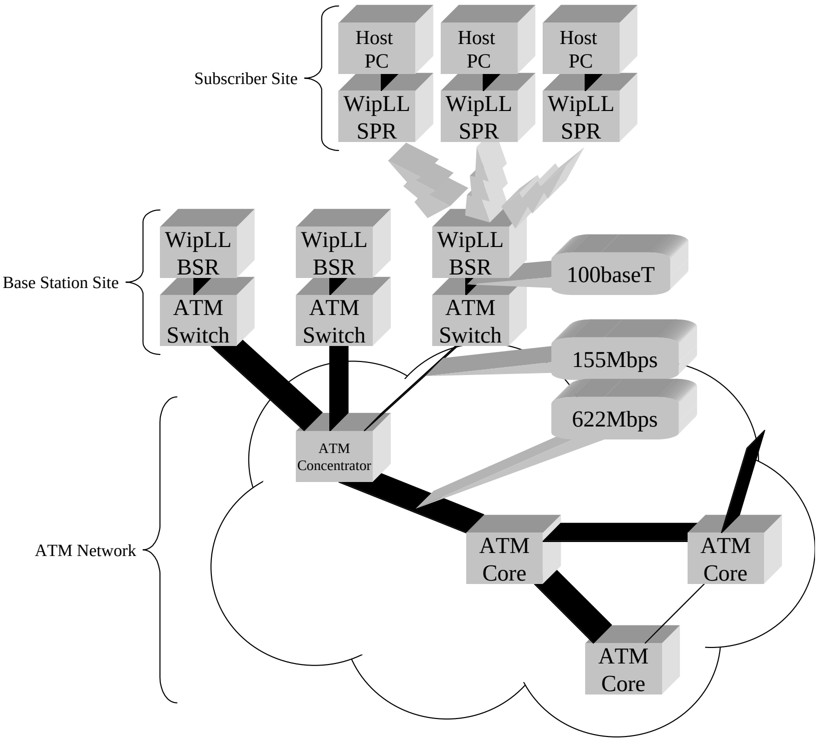


Figure 5 - Maximum Capacity ATM network

3.3.4 Network interfaces

The Network Interfaces that the base station offers :

a. Physical Interface : 100 BaseT

b. IP Applications : Internet protocol stack

c. Voice applications : MGCP

d. Network management applications : SNMP

In cases that other interfaces will be required, an appropriate network interface adapter may be selected from the wide range of "off the shelf" products.

3.3.5 Type of network synchronization

The base station radios (BSRs), installed within a base station site, are phase synchronised.

Inter Base Station sites may be synchronised by using GPS (future release)

3.3.6 Base Station physical dimensions and temperature

WipLL's equipment installed within Base Station is generally divided into two major parts :

a. The outdoor – BSRs and the installation accessories

b. The indoor - BSDUs and the DC power system (option).

Each part complies with different specifications due to the different nature of their environment.

Outdoor :

Operating temperature : -30^{0}C to +60^{0}C

Optional operating temperature : -40^{0}C to +70^{0}C

Dimensions of the BSR : 400x317x65.5 mm – not including mounting kit.

Indoor :

- Operating temperature : 0^{0}C to +50^{0}C
- All the indoor equipment is installed in 19 inch rack
- The BSDU height is 1 U

3.3.7 Base Station Power Supply specifications

The Power Supply is optional.

The DC power system supplies the DC power to the WipLL Base Station.

The principle components of the DC power system are:

The power unit – provides up to 300W of DC power. Several units may be installed in one site to provide the power capacity and the redundancy required.

The PS Control Unit – Single unit, that concentrate all indications, monitor and manage the local power units, the batteries and the DC power system. It also provides the communications link for the network management and is responsible for executing its commands.

Power Sub Rack – can accommodate three power units and a control unit.

Extended Power Sub Rack – can accommodate six power units.

Batteries – Back-up to store energy to be used when the mains fails.

DC distribution panel – accommodates the circuit breakers required for power distribution, control and protection functions.

The minimum configuration of the DC power system is one power Sub Rack accommodating a single control module and three power units. This will operate a base station in a minimal configuration. At full capacity, the DC power system is able to support 24 BSRs and the associated indoor equipment.

The DC power system specifications:

a. Input Voltage : nominal 230 VAC

b. Output Voltage : - 48 VDC

c. Output power : 300 to 2400 Watts

d. Output per power unit : 300 Watts, Hot swappable

e. Redundancy: N+1, N+2.

f. Installation: 19 inch rack mountable. DC power distribution available.

g. Batteries: arranged in two separate loops. Each monitored for overheat and low voltage cut-off.

h. Alarms: alarms and indications per power unit

i. Remote management – via a remote WipManage workstation.

3.3.8 Base Station battery back up option and characteristics

The DC Power system includes in standard configuration eight batteries. The back up time depends on the BS configuration and number of batteries.

The DC power system can be configured to the actual needs of the specific site.

3.3.9 Base Station cables used between BSDU and BSR

The cable connecting the Indoor and the outdoor units is:

Category 5, Twisted pair, 8 wires, 24 AWG for outdoor use.

Maximum distance – 100 meters.

3.3.10 Key factors that make equipment easy to install and maintain

The WipLL equipment is small, compact, lightweight and easy to cable out. The data, DC power and synchronisation connection between the indoor and outdoor equipment are all contained in the same CAT 5 cable.

The indoor part of the installation is provided with a pre-wired cabinet

The antenna can be either wall mounted or erected on a radio mast.

3.3.11 Installation and deployment time for the Base station

A base station installation would vary greatly depending upon how many BSRs are to be used on the installation, the route for the cables and location of the antenna, i.e. building or tower. In a “standard” base station with 12 radios and non complicated installation environment it will take about 2-3 days for 2 team members.

3.4 Air Interface Specifications

3.4.1 Access scheme and Air Interface protocol

WipLL is based on Frequency Hopping Code Division Multiple Access technology (FH-CDMA) in accordance with ETSI standard EN301 253. The system supports a variety of network topologies:

- point-to-multipoint, traditional WLL applications to access end users
- multipoint-to-multipoint for base station interconnection.
- point-to-point (e.g. for backhauling traffic)

WipLL uses a medium-access (MAC) air protocol that combines Time Division Multiple Access (TDMA) and Preemptive Polling Multiple Access (PPMA) to enable optimal, high QoS transmission of multiple transmission types. TDMA is a wireless transmission method that allows multiple simultaneous transmission over a single radio frequency channel, without interference, by allocating unique time slots to each user. PPMA is a proprietary MAC protocol that allows WipLL to allocate system resources dynamically, according to network user needs.

3.4.2 Channel bandwidth (MHz)

The channel bandwidth of WipLL is 1 MHz

3.4.3 Link budget

The link budget of WipLL is presented bellow:

Bit rate [Mbps]	1	2	3
Output power [dBm]	25	25	25
Antenna Gain, BSR [dBi]	11	11	11
Antenna Gain, SPR [dBi]	15	15	15
Sensitivity @ BER 10^{-5} [dBm]	-90	-83	-75
Fade Margin [dB]	10	10	10
Path loss [dB]	133	126	118
Distance LOS [Km] in 2.4GHz	35	15	6

Remark: The above distances assume perfect conditions and Line Of Sight (LOS).

3.4.4 Typical cell radius

The operational range of the WipLL system, operating in the 2.4 GHz frequency band, at maximum radio data rate of 3Mbps (current version) and under Line of Site (LOS) conditions exceeds 6 km. The range is increased (see Link Budget above) when WipLL operates at 1 Mbps. This distance is relevant only in case of rural, range-limited applications.

In case of urban environment, WipLL faces capacity limited conditions, due to relatively high density of potential subscribers per square kilometre. The following parameters need to be considered in order to define Base Station Radio Site (cell) radius of the Multi-Site installation:

a) subscriber density per square kilometre

b) type of subscribers (low/high end residential, SOHO, SME)

c) type of applications (telephony, data, multimedia)

d) traffic load per application/per subscriber type

e) topography - decision to allow Non-LOS or Near-LOS conditions (shorter distances) or to adopt LOS conditions (larger distances) policy

The above information can be loaded into WipPlan™, which can provide a specific planning for the required case. However, the common practice is to restrict the average radius of the Site to a distance ranging from 400 meters to 3 kilometres. It is advisable, as well to leave extra capacity for future expansion, therefore the upper limit might be further reduced down to 2 kilometres.

3.4.5 Procedures to configure/update frequencies and operational parameters relatives to Cell Site Station and user terminal.

The current equipment is pre-programmed with four sets of frequencies that the operator can remotely choose from.

The update of other relevant parameters of the system can be done locally by using WipConfig tool or remotely by using WipManage, WipLL's network element manager.

3.4.6 Procedure to perform tests from remote facility

All WipLL's units can be tested remotely by using WipManage software during the installation, operation and maintenance phases.

3.5 User terminal specifications

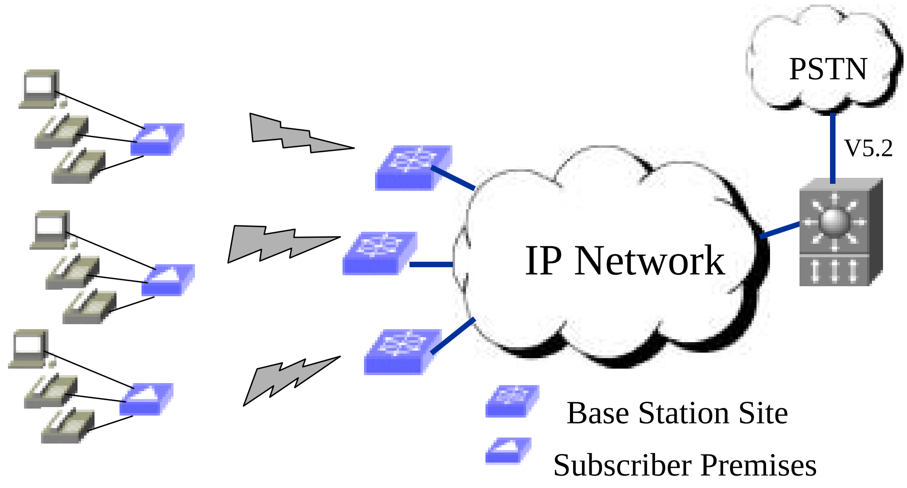
3.5.1 Voice and Data over WipLL - services architecture

The WipLL is designed to support mixed, voice and data services. Three terminal units may be used to provide required services:

a. SDA – a subscriber unit that provides two data interfaces.

b. STDA - a residential gateway (future release) – network element that installed at the subscriber premises and provides telephony and data services.

c. Head End gateway - This element is a standard (off the shelf) equipment in the market that is not part of the WipLL system but consists and important role to operation of the system with the PSTN environment. The Head end gateway is a network element that installed at the boundary of the access network and the backbone telephony network. The Head End Gateway provides the signalling adaptation and structure telephony channels as required by the backbone network. Normally the gateways will be at the access points to the WAN being connected to the WAN interface/s of the base stations in the region. The Head End Gateway provides a transparent telephony interface between the PSTN and a local exchange supporting interfaces such as V5.2, PRI, CAS via (Wireless) IP network. The following figure illustrates architecture of the IP Data/Telephony Wireless system:



The information exchange between the WipLL network elements is based on standard MGCP protocol that allows interoperability with third parties equipment and reduces as much as possible the number of signalling conversion.

3.5.2 Combined solutions for voice and data

The physical interfaces of the equipment installed within subscriber premises include voice, standard RJ-11 connector and Data by using 10BaseT connection. See wider description in the following paragraphs.

3.5.3 Available Terminal types and interfaces

Outdoor: SPR, includes antenna, radio and digital electronics. The SPR is remotely fed from the internal unit

Indoor:

SDA with two 10BaseT ports, connection to BSR and mains (110/220 Volts).

SDTA (future release) with two POTS and one 10BaseT interfaces, connection to BSR, mains (110/220 Volts) and back-up battery.

3.5.4 Voice codec standards applicable

The SDTA will support :

- G.711 A-law
- G.723.1
- G.729 A/B

3.5.5 Antenna types

Antenna types for the SPR :

- Regular antenna : low gain, 23^0 angle
- Optional Antenna : high gain, 18^0 angle

3.5.6 Possibility of using a single antenna for multiple users

The quantity of the available user interfaces per terminal is defined in the previous clauses. It is possible, however, to use a single radio to provide data to multiple users by connecting SDA/SDTA units to the SPR via a standard, of the shelf LAN Switch which concentrate the traffic of all users, each equipped with SDA or STDA.

3.5.7 Transmit power control mechanisms

SPR supports automatic power control feature in the range of –10 to +27 dBm with incrementing steps of 1 dB. The system will emit minimum power that ensures successful transmission of each packet to BSR.

3.5.8 Type and number of cables used between indoor and outdoor units

Cable connecting the indoor and the outdoor units is:

a) Single cable per SPR
b) Twisted pairs – category 5
c) 4 pairs
d) Coating for outdoor installation.
e) Length: up to 100 meters.

3.5.9 Installation and deployment time for each offered user terminal type

The typical time for the installation of SPR and SDA/SSTA with a 10 meters cable run would be 4 hours for a two-man team.

3.5.10 Required tool kit for terminal installation at the subscriber's premises point.

Each installation team should be equipped with the relevant harnessing and safety protection equipment. In addition to standard installation tools, the team will require laptops with

WipConfig software for the commissioning period and a GPS for the positioning of the antenna (or at least a magnetic compas). The laptops will also be used for the acceptance testing of the basestation.

3.6 Physical and environmental conditions

3.6.1 Radio Base Station equipment

The WipLL equipment installed within the Base Station Site is devided into two major parts :

c. The outdoor – BSRs and the installation accessories

d. The indoor - BSDUs and the DC power system (option).

Each part complies with different specifications due to the different nature of their environment.

Outdoor :

Operating temperature : -30^{0}C to $+60^{0}$C

Dimensions of the BSR, including antenna diversity : 400x317x65.5 mm – not including mounting kit.

Indoor :

- Operating temperature : 0^{0}C to $+50^{0}$C
- All the indoor equipment is installed in 19 inch rack
- The BSDU hieght is 1 U
- The DC power supply (optional) is installed in 19 inch rack. Its high depends on the number of BSRs installed with a Radio Base Station Site.

The DC power system specifications :

a. Input Voltage : nominal 230 VAC
b. Output Voltage : - 48 VDC
c. Output power : 300 to 2400 Watts (depends on the number of units)
d. Output per power unit : 300 Watts, Hot swappable
e. Redundancy : N+1, N+2.
f. Baterries : arranged in two separate loops. Each monitored for overheat and low voltage cutoff.

3.6.2 Subscriber Premises Site equipment

a. SPR – the outdoor unit :
- Basic SPR : 311x224x66 mm
- SPR with high gain antenna : 400x317x65.5 mm

The power supply for the subscriber equipment :
- Input voltage : 100 to 240 VAC (50 to 60 Hz)
- Power consumption : up to 40W
- Voltage output to SPR : -48VDC

3.7 Dimensioning Assumptions