

Interfacing with interWAVE



White Paper

Wireless Local Loop Based On GSM Technology: Applications, Payphones, And Fixed Cellular Terminals

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Overview

Since the advent of the telephone system, copper wire has traditionally been relied upon as the link in the local loop - between the telephone subscriber and the local exchange. However, more recently, economic imperatives and emerging technologies have opened the door for Wireless Local Loop (WLL), bringing copper's heyday to an end.

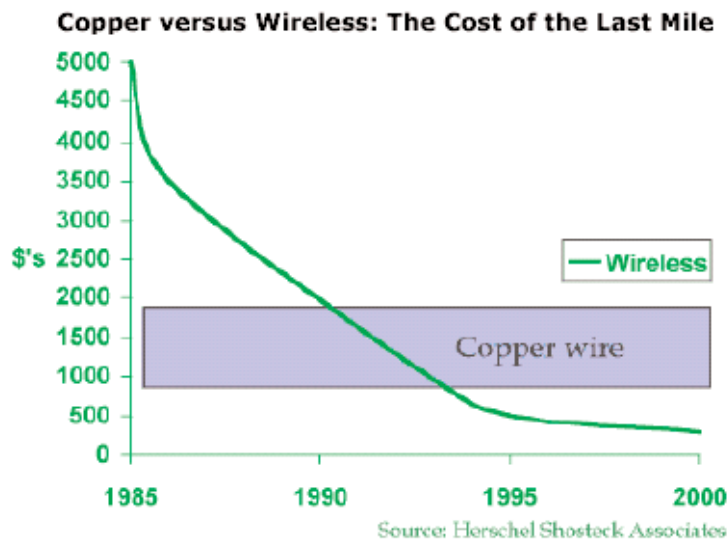
WLL is a telephone system that connects subscribers to the Public Switched Telephone Network (PSTN) using radio signals rather than copper wire for part, or all, of the connection between the subscriber and the PSTN switch. WLL uses wireless technology coupled with line interfaces and other circuitry to complete the last mile between the customer premise and the exchange equipment.

WLL is a market that continues to be on the verge of explosion. The exorbitant wireline access rates, coupled with regulatory changes, have created a competitive environment where WLL offers an attractive business plan. It makes eminent sense for rural areas and those countries with a huge, pent up demand for basic telephone services. In addition, WLL systems are able to address the growing demand for high-bandwidth transmission.

WLL Based on GSM Technology

Global System for Mobile communication (GSM) is expected to play an important role in providing WLL. It is the most appropriate technology both for high-capacity urban areas and for regions requiring widespread coverage. It offers a wide range of services that are well suited to emulate capabilities of advanced wireline networks. The robustness of the GSM platform and the advantages resulting from the economies of scale of more than 645 million users worldwide (representing 70% of the cellular subscribers), make the system attractive from both an economic and technical point of view.

GSM WLL has several economical and practical advantages over fixed telephony. First, the cost of connecting a customer through wireless is independent of the distance to the exchange. In areas where the cost of cable layout to each house is high, such as remote regions or rugged terrain, it is much easier and more cost effective to deploy GSM technology. WLL has also a much lower incremental investment cost than copper, and the cost of deploying the last mile of connectivity will continue to decrease for wireless while remaining constant for copper-wired networks, as highlighted in the graphic below.



Secondly, laying cables is much more time consuming than rolling out a GSM network. Although this economic benefit is difficult to measure in purely economic terms, it is a key advantage in a market where multiple service providers are competing for the same subscriber base. GSM WLL also enables operators to set up a network that can easily and rapidly grow as the number of subscribers increases, rather than having to rely on wireline availability or provisioning.

In addition, copper wires are prone to breaks and theft, especially in lower income countries, whereas a significant portion of the infrastructure costs for WLL are in towers, which are more easily guarded. The result is not only reduced maintenance costs, but also increased customer satisfaction because of the reduced likelihood of a lapse in service.

The network infrastructure for GSM WLL is exactly the same as for mobile GSM. As GSM radio infrastructure has continued to flourish over the past 10 years, GSM WLL offers an appealing opportunity for operators to capitalize on this already deployed infrastructure. Operators can implement a GSM wireless access solution to the PSTN and provide a fixed type of telephony service to its customers; in this case, the configuration of the network prevents physical or network hand-over. Operators are also able to offer subscribers a limited amount of mobility within the range of a base station - if users have mobile handsets - extending the service to provide a useful, local mobile solution for smaller communities.

Interest in WLL based on GSM technology is spreading worldwide. For instance, in South Africa two operators have been awarded licenses specifically for GSM WLL networks, which allow limited mobility and no hand-over. This means that no communication is possible outside the home cell. South Africa is the first country in the world to award licenses for GSM WLL only, with operations starting in 2002.

Other technologies such as Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA) and Digital European Cordless Telecommunications (DECT) also allow WLL but one of GSM's greatest advantages in emerging markets is the maturity of the technology. The GSM competence is available and the technology is constantly being improved, thanks to the strong Third Generation (3G) migration path.

GSM WLL Applications

Residential Applications

GSM WLL is primarily a rural application that extends telephone service to rural areas by replacing a wireline local loop with radio communications. The handset can be an ordinary GSM handset or can be fixed to the wall of a house. Even in populated areas, where telephone services are beyond the reach of the majority, network operators can leverage the existing GSM infrastructure to bring new public services quickly to market.

The concept of GSM WLL, consisting of restricted mobility to the home cell with no hand-over between coverage areas, can be extended to the Home Zone concept that combines fixed GSM with mobility. When using the phone at home the user is charged a special tariff. When leaving the house, the tariff is adjusted according to the ordinary mobile tariff.

Based on the operator's requirements and the mobility needed by the subscriber, interWAVE's Home Zone solution can provide several classes of service. All classes of service are based on the same GSM infrastructure and are available through a distributed switching architecture that allows for multiple tariff support based on the location of the user. The Home Zone market requires local telephony solutions that mirror fixed line networks as a significant portion of the traffic is expected to be local. The key value proposition of interWAVE's GSM solution resides in its local switching capability, which eliminates the need to backhaul local calls and therefore allows for reduced cost tariff offerings. interWAVE's innovative GSM network solution combines a Mobile Switching Center (MSC), a Base Station Controller (BSC) and a Base Transceiver Station (BTS) within a cabinet about the size of a PC tower. This compact solution can serve as an initial package to cover a home cell and, as the demand in the geographical area expands, can evolve to higher capacities by adding external BTSs. By placing a switch close to the community, backhaul costs for intra-community calls are greatly reduced. To find out more about interWAVE's GSM WLL solution, please refer to interWAVE's web site:
http://www.iwv.com/home_zone.html.

Public Payphones

After residential telephony, the most common GSM WLL applications are public payphones with built-in GSM receivers and emergency phones. In rural areas, GSM payphones are far and away the most cost-effective way of bringing coverage to remote locations, or to extend fixed network service areas. In the most developed parts of the world, such as Europe and the United States, there are two other application areas common for payphones. The first is on-board public transportation such as trains, ships and long-distance bus services. The second is temporary installations at special events such as concerts and sports events.



A Ugandan fisherman uses a solar powered payphone in Lake Victoria

Some companies have been involved in GSM payphone projects as diverse as the remote areas of Senegal, the ski slopes of Andorra, bus services operated in Indonesia and installations in cities with low conventional payphone penetration - such as Beirut.

Telemetry

Telemetry, which is the remote reading of various types of measurement devices and instrumentation, is a future WLL application. Measured values are transferred via the telecommunications network - or a data network - typically to a computer or directly to people. Using telemetry enables a variety of applications such as surveillance of parking meters, vending machines, the remote monitoring of alarms and the remote-controlled distribution of electric power.

Payphones

Operator Benefits

As explained above, public payphones are a common application for GSM WLL, and present several benefits to the operator. The installation and maintenance costs associated with GSM payphones is less than half of those associated with a wired payphone. For operators, this means that the investment in the payphone is typically recovered within two years of initial deployment. Experience in Europe and the United States indicated that revenues generated on one payphone could reach US\$3,000 per month.¹

GSM payphones can be located anywhere within a 35-kilometer radius of their base station -subject to local geographical considerations.

As cellular users and GSM payphones share the same network infrastructure, GSM operators can take advantage of the under-exploited capacity of their network to maximize the efficiency of their network usage. Not only does a GSM payphone usually generate higher levels of traffic than private cellular users, but also peak traffic times tend to be different so that congestion is avoided and efficient use of the network enhanced.

The security offered by sophisticated payment mechanisms such as smart cards, also known as prepaid cards, also plays a role in reducing maintenance costs and increasing user satisfaction. Coins have played an important role in the development of public telephony, but they present a range of problems. Cash needs to be collected periodically which has a cost penalty. Coin telephones are exposed to vandalism and theft, which not only results in direct loss of revenue but also further losses during the subsequent downtime. The high level of security necessary also results in higher terminal costs.

Consequently, prepaid cards have become the fastest growing payment method over the past 20 years. They offer a reduction in losses from vandalism and thefts, improved cash flow through pre-payment (an estimated 20 per cent increase), no need to collect cash, and reduced out-of-service time. For example, the average availability of smart card based payphones is more than 95 per cent, while the comparable figure for coin phones is less than 70 per cent.

Smart card technology in public payphones provides a high level of security based on their inherent processing power that enables the implementation of sophisticated security routines. The GSM technology also strengthens the security aspect: encryption ensures that stored information is transmitted without compromising confidentiality and authentication prevents unauthorized access.

¹ International May 1998: Smart Cards in Payphones - The Wireless Dimension, Bostjan Veronik

Payphones Suppliers

Payphone suppliers include but are not limited to :

NOKIA

Nokia offers a small sized, integrated wireless payphone for GSM networks (900, 1800 and 1900 MHz). It provides a standard, easy-to-use payphone interface, large graphical display, hands-free functionality and modern design. Additionally, the payphone comes in an array of colors. Payment methods include ISO7816 standard smart card technologies (I, II and III generations) and electronic purse.

It can be operated either stand-alone or by utilizing a payphone management system, a software system that supports the maintenance and operation of Nokia's wireless payphones. In addition to providing statistical information on usage and the contribution of each payphone, the terminals can also be controlled or monitored to prevent fraudulent use.

PREMIUM TELECOM

The Pulsar 50 payphone from Premium Telecom is a small, outdoor GSM payphone (GSM Phase2 - 900, 1800 and 1900 MHz). It can be easily installed in narrow or small locations such as trains, boat corridors, etc.

Requiring only 12V of energy, it can be powered by many different sources, such as battery, solar cell, or main power. It integrates chip card payphone and GSM receiver in "one box", facilitating quick and easy installation.

It accepts the latest in payment technology, such as third generation prepaid chip cards.

It reports its status and statistics daily to the management center. The Remote Management System is an integrated system that provides technical operations and maintenance tools to manage payphones, as well as the related financial transaction management.

A mechanism for real-time signaling of faults offers several choices for notification of faults, including on-line, on-screen display, on-line printing, and direct fax, pager or email transmission.

Key options include: patented anti-wiring device, software download, graphic display, back light display, electronic purse - credit card.

The system connection can be done via SMS (daily report), or via data transfer (download).

SCHLUMBERGERSEMA

The Access GSM payphone from SchlumbergerSema is a dual-band GSM 900 and GSM 1800 payphone.

Access GSM payphone features include:

- Voice only functionality/high-end terminals with value-added services
- Flexible payment options including prepaid cards/credit cards/e-purse/ coins/tokens
- Rugged construction and proven reliability, highly compact design
- Subscriber Identity Module (SIM) handling with secure pin protection
- Optional solar panel
- Integrates with powerful management system Paynet.

TELLUMAT

The Tellumat prepaid public payphone is dual-band GSM 900/1800 MHz.

Features include:

- Multiple payment (IC card, GSM SIM card, optional credit card and/or coin operation)
- Supports voice/Short Message Service (SMS)/fax/data calls
- Friendly user features (phonebook, SMS and voicemail with SIM card)
- Operator-dependent services (e.g. directory enquiries, emergency calls)
- Internal battery gives up to 4 hour talk time after power failure
- Fault reporting to management system using SMS/GSM data call.

GSM Fixed Cellular Terminals

User Benefits

By simply installing a fixed cellular terminal, a user gains instant access to the GSM network from a fixed telephone network. This eliminates waiting time and the cost of installing a fixed telephone line.

Having an instant GSM connection provides enormous advantages in areas where the fixed network is underdeveloped or simply does not exist. It also gives the user all the benefits of high quality digital communications.

In addition, fixed cellular terminals can be easily installed by the subscriber in their home without the use of complicated tools.

In case of the use of a Private Branch eXchange (PBX), the PBX can be programmed to direct specific calls to the fixed wireless terminal, taking advantage of low cost mobile-to-mobile rates and avoiding high interconnect charges. Landline-to-wireless calls actually become wireless-to-wireless calls, which eliminates the cost of routing calls to wireless phones through the PSTN.

A fixed cellular terminal can accommodate a fixed line telephone(s), a fax and can also provide a data connection to a computer, as depicted in the diagram below.



Fixed Cellular Terminal Connections

High gain antennas are commonly used in conjunction with fixed cellular terminals in order to increase the range of the cell coverage, or overcome the loss associated with the in-building penetration. This is achieved by installing a cost-effective Yagi antenna outside the building, as shown on the picture, or by mounting an antenna on a window.



interWAVE's Deployment of a Yagi Antenna

GSM Fixed Cellular Terminals Suppliers

Fixed GSM terminals suppliers include but are not limited to :

ERICSSON

Ericsson F221m is a fixed GSM triple band terminal for residential applications - 900, 1800 and 1900 MHz.

For voice transmission, the Enhanced Full Rate (EFR) speech codec emulates the fixed line voice quality. For data transmission, the F221m terminal features the latest GSM Internet services access technology, including General Packet Radio Services (GPRS). This provides a high data rate transmission guarantee and the option to always be connected to the net. V.90 data transmission over the line interface qualifies the terminal to support analog modems for the Internet environment.

The F221m terminal allows automatic network search between GSM 900, GSM 1800 and GSM 1900 frequencies. It offers a broad range of GSM services such as Prepaid Subscription, Call Waiting, Call Barring, Call Forwarding and SMS capability. It is equipped with an embedded modem that is available over the RS232 port for PC Fax/Data services and SMS. It provides built-in SMS supervision that allows remote control and supervision of the unit.

NOKIA

Nokia PremiCell terminal operates in GSM 900 and 1800 networks.

In addition to drawing the current from the main network, the subscriber can also use battery with the solar power pack.

Nokia has implemented powerful antenna diversity on its PremiCell terminal, which makes the connection less liable to interference than many normal connections. This is a property that is important, particularly in areas where the field is weak.

SAGEM

The RT Wireless Local Loop terminals from Sagem are available in dual-band configurations - GSM 900 and GSM 1800 - as well as in mono-band configurations for the GSM 1900 frequency band.

It provides access to the PSTN through the GSM radio network for different types of terminals:

- Analog telephones for wireline networks
- Analog fax machines
- Digital terminals, such as PCs and digital fax machines.

The product line includes a ruggedized version that allows the terminal to operate in harsh environments (range of temperature, lack of main power, etc).

It supports Full Rate (FR) as well as EFR speech codecs, and offers a wide range of features, such as Call Waiting, Call Forwarding, Voice Mail access.

TELULAR

The Phonenumber® SX5e from Telular is a dual-band fixed cellular terminal - GSM 900 and GSM 1800 MHz. It provides voice, high-speed data, circuit switched computer fax, and optional group 3 analog fax capability.

Main features/benefits include:

- Incorporates GPRS for high-speed Internet and e-mail capability
- Automatic end-of-dialing (no SEND key)
- Caller ID, call waiting/call hold, call forwarding
- 7 LEDs for signal strength, message alert and terminal status
- Flexible power supply and battery backup options to maximize performance

Conclusion

Wireless Local Loop (WLL) based on GSM technology allows operators to capitalize on economies of scale offered by a worldwide-adopted wireless standard and an already-deployed infrastructure.

GSM WLL offers a wide range of applications that are perfect for the rural environment. Some licenses have already been issued for WLL usage over GSM frequencies, and we will see more of them in the future.

interWAVE's Home Zone solution goes beyond the traditional concept of WLL that does not enable any mobility, and can extend the service to provide a useful, local mobile solution for small communities. Payphones and fixed wireless terminals' suppliers complete the picture to provide operators with a full turnkey WLL solution.

List of Acronyms

3G	Third Generation
BSC	Base Station Controller
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
DECT	Digital European Cordless Telecommunications
EFR	Enhanced Full Rate
FR	Full Rate
GPRS	General Packet Radio Services
GSM	Global System for Mobile communication
IC	Integrated Circuit
LED	Light Emitting Diode
MSC	Mobile Switching Center
PBX	Private Branch eXchange
PSTN	Public Switched Telephone Network
SIM	Subscriber Identity Module
SMS	Short Message System
TDMA	Time Division Multiple Access
WLL	Wireless Local Loop