AN APPRAISAL OF WIRELESS NETWORKS IN NIGERIA (GSM AND FIXED WIRELESS)

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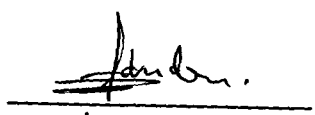
DECLARATION

I hereby declare that this project was wholly conducted by me, Badrudeen Abdullahi Abiodun, under the able supervision Dr. Adediran Yinusa A. of the department of Electrical and computer Engineering, federal University of technology, Minna, Niger state. The project report has not been presented else where for the award of any degree, distinction or certificate.



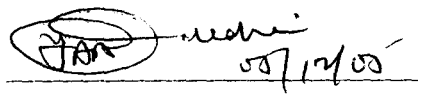
signature

05/12/05

Date

CERTIFICATION

This is to certify that this thesis "An Appraisal of Wireless Network in Nigeria (GSM and Fixed Wireless)" is the original work of Badrudeen Abdulahi Abiodun carried out under the supervision of Dr Y. A. Adediran for the award of Bachelor of Engineering (B. Eng) degree in Electrical and Computer Engineering of F U T., Minna.



Dr. Y. A. Adediran — Date

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(External Examiner)

DEDICATION

This project is dedicated to my role model, my father, Alhaji Badrudeen Sulaeman Mubaraq. May his gentle soul rest in perfect peace. Also, to my son Badrudeen Abdulsobur.

ACKNOWLEDGEMENT

The following people have contributed to see the success of this project.

- My industrious and highly capable supervisor, Dr. Adediran Yinusa A. for fine-tuning my work with so much understanding; thanks for helping me to extract the best in me.
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- Lastly, My mother, for her unflinching support and caring always

ABSTRACT

The growth of the telecoms market in Nigeria continued at geometric rates, thereby sustaining the market as one of the fastest growing telecoms markets globally. From about 2.3 million lines at the end of 2002, the number of connected telephone lines increased to about 4.04 million at the end of 2003 and 10.20 million in 2004. This represents an average annual growth rate of about 115% between 2002 and 2004.

This market growth has been sustained essentially by a number of factors, primary amongst which has been the continued cooperation of the Federal Government of Nigeria with the Board of the Commission in ensuring virile competition among the operators through t transparent, fair and firm policy and regulatory act ions. Through the regulatory decisions taken in 2002, the increase in the number of active players in the industry gave impetus to increased competition in service provision, resulting in higher value- for-money to the end users, without compromising the return on investment to the operators

This project gives concise description of the GSM and Fixed wireless from a technical point of view and culminate with the description of the various GSM and Fixed wireless network operators in Nigeria, including the assessment of their service performance. The level of penetration of service, the social and economic contributions of the service and the problems faced by the operators to roll out their networks are treated. Lastly, recommendations are made to improve the current teledensity and delivery of affordable and quality telecom services.

TABLE OF CONTENT

CHAPTER ONE

INTRODUCTION

1.1 BRIEF HISTORY

Before the advent of present democratic government in 1999, the state of communications development in Nigeria was slow, and teledensity was low. Though a few private operations had come into the Nigerian telecommunication field, their entry was unable to improve appreciably, the level of telephone penetration. The country had bemoaned its teledensity rate, which a century efforts by successive regimes did not succeed in improving significantly. Demand for phone service increased geometrically, but supply fell miserably short, and where there was access to telephone the cost was prohibitive.

Deregulation and liberalization of the telecommunication sector began as far back as 1992 when the Nigerian Communication Commission (NCC) was set up to speed up the development of the sector. Its initial efforts, between 1992 and 1999 in terms of improving the country's teledensity profile, were not quite successful.

NCC'S process of allowing new entrants into the field was widely challenged as undemocratic and lacking in transparency. At the advent of Chief Olusegun Obasanjo's democratic government on 29th May, 1999, government quickly realized the importance of telecommunication in the economic, social and political life of a nation and its people. Thus, it became compelling for the administration to immediately commence steps aimed at increasing access and reducing cost of phone service

To underscore this resolve, barely a week in office, Mr. President inaugurated a committee on telecommunication policy for Nigeria and personally presided over its

inaugural sittings. In further demonstration of the commitment, Vice president Atiku Abubakar, on 1st February, 2002, inaugurated a 22- member Telecommunication Sector Reform Implementation Committee (TSRIC). In line with its democratic principles, the body's membership included all stakeholders in the sector, including the organized labor, consumer protection and regulatory agencies [1].

In December 2000, many local and foreign telecommunication companies competed for the coveted Nigeria Communication Commission GSM license. By February 2000, three firms and NITEL (now M-Tel) emerged as GSM licensed operators in the country. These major players are ECONET WIRELESS NIGERIA(now V mobile), MTN and Communication Investment Limited (CIL). The only indigenous firm at the time, CIL, was eased out of the race by the NCC after allegedly failing to meet up with the deadline for the payment of the balance of the license fee by the midnight of 9th February, 2001. The race started in earnest between two digital mobile licensed operators, ECONET WIRELESS and MTN, having paid $285 million each to the NCC as a license fee. They commenced operations by the 6th and 8th of August 2002 respectively. NITEL took off the next day, August 9th, 2002. [2].

NCC also gave license to about 30 Fixed Wireless Access operators and two long distance operators in 2002. M-Tel had been enjoying it6s incumbent power as the only national carriers until August29th, 2003 when Glomobile was given licensed as a digital mobile operator and second National carrier having paid the sum of $200million as a license fee. [3]. Recently, the Glomobile and M-Tel announced to start CDMA technology, fixed wireless.

1.2 SCOPE OF COVERAGE

This project is sectioned into six chapters. Chapter Two will cover the overviews of Nigeria's telecommunication, under which the historical development in Nigeria will be treated to have a look and understanding of what happened in the past before the emergence of cellular telecommunication. It will also cover the evolution of the GSM and FM network in Nigeria.

Chapter Three will cover the brief study of GSM and Fixed wireless Network under which the structure and concept of the said network will be discussed. Chapter Four shall attempt the main appraisal of GSM operators in Nigeria. Chapter five treats the few among licensed fixed wireless network operators in Nigeria. Both chapter four and Five shall look into the difficulties and challenges facing to run the industry, the social and economic influence and lastly the future network of the telecommunication industry.

The last chapter is Chapter Six and covers the assessment of the performance of the wireless service, the difficulties facing the sector and recommendations to the wireless networks operators for the continuous success of their operations. The conclusion shall be drawn based on the facts in the entire project.

1.3 OBJECTIVES

The primary objective of this project is that it serves as a partial fulfillment to the award of Bachelor of engineering in the department of Electrical and Computer Engineering. The second objective is to critically appraise the growth or transition in the field of GSM and FW networks in Nigeria so as to compare the difference between the present day telecommunication which is wireless type and the past days.

Lastly, to have a better understanding of how the GSM and fixed wireless network operate by briefly studying the structure and the concept of their network.

1.4 LIMITATION OF THE PROJECT

The GSM and Fixed wireless network systems will be described in brief and comprehensive approach. This is going to be highly summarized version given that the GSM specification document alone is over 8000 pages long.

The appraisal will only be on the few fixed wireless network operators among others and the four GSM operators respectively.

CHAPTER TWO

OVERVIEW OF NIGERIA'S TELECOMMUNICATIONS

2.1 HISTORICAL DEVELOPMENT OF TELECOMMUNICATION IN NIGERIA.

The emergence of telecommunication in Nigeria dates back to the colonial era, precisely 1851, when the British established its postal branch in the country. In 1885, for the course of effective administration and contact with the home office in London, the internal telecommunication, arm was established. However, the first direct telegraph services between Lagos and London began in September 1886 using submarine cables by African District Telegraphy company Limited and the Cable and Wireless Company of London [4].

In 1895, the colonial government advanced the course of telecommunications when it introduced local telecommunications in form of telegraphy using the 'key and sound' system. By1907, the responsibility to provide telecommunication service, which was under the public work department (PWD), was transferred to the post and telegraph department (P&T) which was formed to operate national postal and telecommunications services. The P&T took a major step in developing the telecommunication industry in 1923 when it established the first trunk telephone service between ITU and Calabar. Demand for more circuits consequently followed the introduction of line carrier system between Ibadan and Lagos with extensions to other part of the country.

By 1946, the P&T had begun more purposeful development of the national network in a move that appeared to have had a slight shift of focus and purpose other than that of telecommunications provision for governance alone. In 1950, this resulted

into the installation 98 exchanges with 15,063 telephone instruments. The exchanges then were of the magnetic and central battery type installed mainly by direct labour provided by the expatriates. By 1950, General Electric Corporation (GEC) had installed a 600-line automatic exchange in port-harcourt. This was followed by 500 lines exchange in Lagos in 1953. At Nigeria's independence in 1960 there were only 18,724 telephone lines for an estimated population of 45million, giving a teledensity of 0.04 telephones per 100 peoples and 600 lines, Ikeja 400 lines and Ebute-meta 500 lines had been installed. [4].

Between 1962 and 1968, the First Plan, which marked the start of planned telecommunication development in Nigeria, was conceived to provide reliable an efficient telephone, telegraph and telex services. The high point of the programme included the provision of medium capacity microwave radio relay transmission systems linking Lagos with some major cities such as Ibadan, Enugu, Benin and port –harcourt. It also included provision of 24 additional telephone exchanges and end offices with associated local cable distribution network, expansion of some existing telephone exchanges by a total of 10,000 trunks and provision of Subscribers Trunk Dialing (STD) facility in major cities.

Though 90,000 telephone lines were projected to be realized at the end of the plan period, only 2,000 direct exchange lines were installed due to disruptions and damages caused by the civil war. The second development plan, which spanned through 1970 and 1974, saw the completion of the last phase of the first plan an provided telex and genntex networks. The plan was also aimed at providing 930- kilometers back-up coaxial cable transmission link between Lagos and Kaduna. At the end of the programme, the P&T had successfully provided a National Telex/ Gentex Network, 19

crossbars Telephone Exchange, and the introduction of subscribers Trunk Dialing (STD) facilities, between Lagos, Ibadan, Kaduna, Enugu and Benin. [4]

There was a contingency plan between 1973 and 1975 too, among others, provide a back-up to the uncompleted second development programme, provide exchanges in 45 locations with a total capacity of 162,000 lines and another 32 exchanges in local government headquarters with a total capacity of 22,000 line. Also in the contingency plan were the expansion of the existing radio transmission of network and the STD to additional major cities and provision of External Line Plants (ELP) in 44 occasions. The programme was abandoned mid-way due to inadequacy of ELP and only 52,000 lines were achieved out of projected total of 184,000. [4].

The third developmental plan of 1975 to 1980, like its predecessors, only achieved 188,000 lines out of the projected 750,000 and 5,000 telex lines. The fourth development plan of 1981-1985 achieved a cumulative 400,000 phone lines at the end of the plan period out of the projected increase to 612,000 lines [4].

A more purposeful reform focused at growing the Nigeria telecommunication sector came in 1984 when the Federal Government accepted a proposed for the merger of the telecommunication arm of the Post and Telecommunication (P&T) with Nigerian External Telecommunication (NET) enabled by the companies decree of 1968, the Nigerian Telecommunication Limited (NITEL) was formed with the mandate to prove efficient and reliable telecommunications services for the country.

Between 1985 and 1992 NITEL held a monopoly on the market, ending with the industry's partial deregulation (i.e. still allowing NITEL'S monopoly in major service areas such as public voice telephony and international traffic) and the setting up of the

Nigerian Communication Commission (NCC) enabled by the Decree 75 of 1992. The NCC'S role was to create an enabling regulatory environment for efficient supply of telecommunications services and facilities. Endowed with the power to issue licenses to private operators, the NCC was also intended to facilitate private entrepreneurs' entry into the market and to promote fair competition and efficient market conduct among all players in the industry.

Though the NCC was established in 1992, it was not until 1996 that any licenses were issued. Among the new issues were one for mobile phone card and system and one for community telecommunications. Several more licenses were awarded in 1997. In addition, awards were granted for installation of terminal equipment, repair and maintenance activities, private network links, payphone and cabling services as well as internet, e-mail and voice mail. In all, over one hundred licenses were granted to Private Telecommunication Operators (PTOs) to offer a wide range of telecomm services to national subscribers.

Beginning from 1992 when NITEL signed the performance bond with the government technical committee on privatization and commercialization (TCPC), the tempo of network expansion and modernization gained momentum. Priority was given to digitization of the network to equip it for the new challenges of meeting the ever-growing customers needs and services quality.

NITEL contended with many obstacles. Though it was desired to find solutions to them, an uninspired management, lack of fund and public sector bureaucracy, nevertheless frustrated it. The little progress that was witnessed between 1992 and 199 was not encouraging either to meet the minimum continental and global standards. The

advent of the PTOs did not reduce the woes of the telephone network in Nigeria appreciably. [1]

According to the International Telecommunication Union (ITU), by 1996, Nigeria's teledensity was a mere 0.36. It rose slightly to 0.4 by 1999, according to the NCC. Nigeria's teledensity was a far cry from the African average of 1.67 (ITU). NITEL had established a subsidiary, mobile telecommunication, or Mtel, which was responsible for the analogue cellular service. Today M-Tel is in charge of NITEL's GSM network. [2].

2.2 GSM AND FIXED WIRELESS EVOLUTUION

In the last five years, the Nigerian telecommunication industry had seen a notable development with the successful auctioning of 2G digital mobile licenses, the licensing of fixed wireless access and two long distance operators in 2002.[1]

Major telecommunications actors in our country of about 120 million people today include NCC as the national regulator, two national operators (NITEL Globacom was granted license in August 2003). Four mobile national wireless licenses (Global system for mobile (GSM) communications), and 22 fixed wireless licenses (regional licenses issued in July 2002), and over ten private telephone operators (PTOs) which provide wireless local loop (WILL) in various cities around the country. Prior to the entry of the new operators, NITEL land lines were of the order of 800,000 lines, of which 500,000 were operational, serving possibly no more than 250-350,000 households and business/commercial units. As at the year 2002, the total number of landlines and mobiles

had risen to about 3million in two years and the potential is estimated to 42million lines in just a few years time [1].

Nigeria's teledensity rose from 0.6 in 1999 to 3.3 per 100 inhabitants by December 2003 and this is a record above the ITU recommended ratio of 1.0 per 100 habitants for Africa [5]. One could walk to GSM shop and within a few minutes one is out with an activated pone. A major problem is the fact that the teledensity is not uniformly distributed across the nation. Though the subscribers are still contending with the airtime rates, the problems of contested bills have been eliminated due to the pre-paid billing system and a better bill capturing, recording and forwarding system [1].

CHAPTER THREE

GSM AND FIXED WIRELESS NETWORK TECHNOLOGY

3.1 CONCEPT OF GSM

GSM means Global System for Mobile Communication. The GSM system can be considered as the first digital cellular system. It uses an advanced form of Time Division Multiple Access (TDMA) with a capacity of close to fifteen times that of analogue systems. The reasons that explain the transition from analogue to digital cellular technology are:

The capacity of the system

Compatibility with other systems such as ISDN

Aspect of quality

Roaming. [6]

3.1.1 GENERATION OF GSM OR WIRELESS

This is the transitional mode in technology of wireless telecommunication. The first generation, called 1G, this is the analogue type of technology. The second generation of GSM is called 2G, and deploys the digital technology. 2G ranges from 2G to 2.7G. With 2G the services like calls, SMS are possible. The 2.5G enhances the multimedia services (MMS) with mobile station having its GPRS enabled. Also all other services in 2G are possible.

The 2.7G enhances the use of EDGE services (Enhance Data Rate for GSM Evolution), hence allows the subscribers to enjoy the internet service plus all other services in 2.5G. The next generation is third generation (3G). It makes use of optic fibers to transmit signals through a long distance between the network switching centers and Base stations. It enhances the videos conferencing services and all other services in the above generations. The future generation of GSM in the world level is 4G while Nigeria is preparing for the 3G.

3.1.2 CELL

A cell is the basic geographical unit of a cellular system. The density of population in a country is so varied that different types of cells are used, such as Macro cells, Micro cells, Selective cells and Umbrella cells.

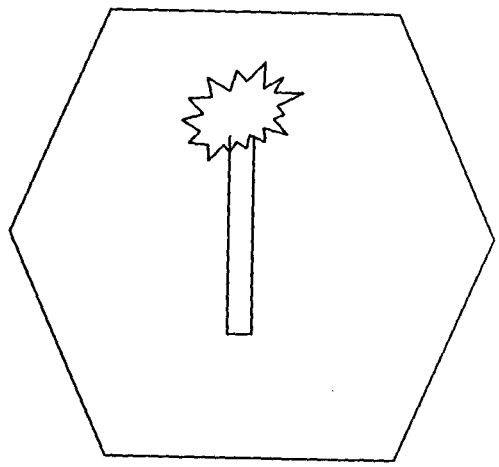


Fig 3.1: A hexagonal representation of a cell

3.1.2.1 MACRO CELLS

The macro cells are large cells for remote and sparsely populated areas. These are mostly used in rural areas.

3.1.2.2 MICRO CELLS

These cells are used for densely populated areas, mostly found in urban centers where the density of users is quite large. By splitting the existing areas into smaller cells, the number of channels available is increased as well as the capacity of the cells. The power level of transmitters used in these cells is then decreased, hence reducing the possibility of interference between neighboring cells.

3.1.2.3 SELECTIVE CELLS

It is not always useful to define a cell with a full coverage of 360 degree. In some cases, cells with a particular shape and coverage are needed. These cells are called selective cells. Typical examples are the cells that may be located at the entrances of tunnels where coverage of 360 degree is not needed. In this case, a selective cell with coverage of 120 degree is used.

3.1.2.4 UMBRELLA CELLS

A freeway crossing very small cells produces an important number of handovers among the different small neighboring cells. In order to solve this problem, the concept of umbrella cells is introduced. An umbrella cell covers several micro cells. The power level

inside an umbrella cell is increased compared to the power level used in micro cells that form the umbrella cell. When the spread of the mobile is too high, the mobile is handed off to the umbrella cell. The mobile will then stay longer in this umbrella cell. Hence reduce the number of handovers and work of the network.

3.1.3 CLUSTERS

Cells are grouped into clusters. No channel is reused within a cluster. The number of cells in a cluster must be determined so that the cluster can be repeated continuously within the coverage area of an operator. Typical clusters contain 4,7,12, or 21 cells. The smaller the number of cells per cluster is, the bigger the number of channel per cell will be. The capacity of each cell will therefore be increased. However, a balance must be found in order to avoid the interference that could occur between neighboring clusters. Figure 1.2 illustrate a seven-cell cluster.

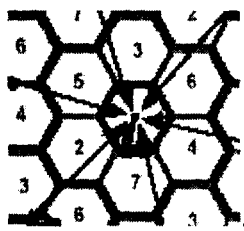


Figure 1.2 illustrate a seven-cell cluster.

3.1.4 FREQUENCY REUSE

The concept of frequency reuse is based on assigning to each cell a set of radio channels that are completely different from that of neighboring cells. The coverage area of cells is called footprint. This footprint is limited by a boundary so that the same set of

channels can be used in different cells that are far enough away from each other so that their frequencies do not interfere. The clusters facilitate the frequency reuse pattern when they are arranged such that they share the same boundaries. This is illustrated in the figure 3.3 .

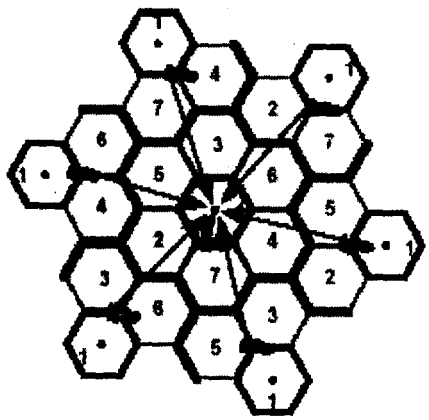


Fig. 3.3: Frequency Reuse

3.1.5 COMPONENT OF A CELLULAR SYSTEM

Components of a cellular system are:

Public Switched Telephone Network (PSTN)

Mobile Telephone Switching Office (MTSO)

Cell site with antenna system

Mobile subscriber unit

3.1.5.1 PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

The PSTN is made up of local networks, the exchange area networks and the long-haul networks that interconnect telephones and other communication devices on a worldwide basis.

3.1.5.2 MOBILE TELEPHONE SWITCHING OFFICE (MTSO)

The MTSO is the central office for mobile switching center (MTSC), field monitoring and relay stations for switching calls from cell sites to wire line central office (PSTN). In analogue cellular networks, the Mobile Switching Center (MSC) controls the system operation like calls, billing information, locations of cellular subscribers e.t.c.

3.1.5.3 THE CELL SITE

The cell site refers to the physical location of radio equipment that provides coverage within a cell. Hardware located at a cell site include power sources, interface equipment, radio frequency transceiver and an antenna system.

3.1.5.4 MOBILE SUBSCRIBER UNIT

The mobile subscriber unit consists of a control unit and a transceiver that transmits and receives radio transmission to and from a cell site.

3.1. 6 THE GEOGRAPHICAL AREAS OF THE GSM

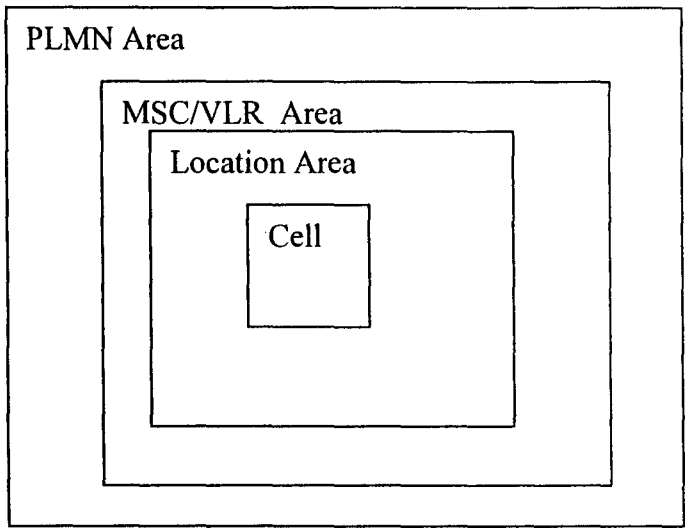


Fig 3.4 GSM NETWORK AREA

A cell is identified by its Cell Global Identity (CGI) number, which corresponds to the radio coverage of a base transceiver station.

A Location Area (LA), is identified by its Location Area Identity (LAI) number, it is a group of cells served by a single MSC/VLR.

A group of location area under the control of the same MSC/VLR defines the MSC/VLR area.

A Public Land Mobile Network (PLMN) is the area served by one network operator [6].

3.1.6 THE GSM RADIO INTERFACE

The radio interface is the interface between the MS ad the fixed infrastructure. One of the main objectives of GSM is roaming. Therefore, in order to obtain a complete

3.1.7.2.1 TIME DIVISION MULTIPLE ACCESS/FREQUENCY DIVISION MUILTIPLE ACCESS (TDMA/FDMA)

TDMA stands for Time Division Multiple Access which is a digital transmission technology that allows a number of users to access a single radio –frequency (RF) channels without interference by allocating unique time slots to each user within each channel [7]. The FDMA part involves the division by frequency of the (maximum) 25MHz bandwidth into 124 carrier frequencies spaced 200KHz apart. One or more carrier frequencies are assigned to each base station. Each of these carrier frequency is then divided in time, using a TDMA scheme. The fundamental units of time in this TDMA scheme is called a burst period and it lasts 0.577ms which forms the basic unit for a grouped into a TDMA frame of 4.615ms, which forms the basic unit for the definition of logical channels. One physical channel is one burst period per TDMA frame channels are defined by the number and position of their corresponding burst periods. All these definitions are cyclic, and the entire pattern repeats approximately every 3hours. Channel can be divided into dedicated channels which are allocated to a mobile station and common channels, which are used by mobile station in idle mode [6].

3.1.7.2.2 FREQUENCY HOPPING

The mobile station already has to be frequency agile, meaning it can move between a transmit, receive and monitor time slot within one TDMA frame, which normally are on different frequencies. GSM makes use of this inherent frequency agility

to implement slow frequency hopping, where the mobile BTS transmit each TDMA frame on a different carrier frequency.

The frequency hopping algorithm is broadcast on the Broadcast Control Channel. Since multipath fading is dependant on carrier frequency, slow frequency hopping helps alleviate the problem. In addition, co-channel interference is in effect randomized.[6]

3.1.8 MODULATION

The modulation chosen for the GSM system is the Gaussian Minimum Shift Keying (GMSK). The aim of this section is not to describe extensively the GMSK as it is too long and it implies the presentation of too many mathematical concepts. Consequently, only brief aspects of the GSMK modulation are presented in this section. The GMSK modulation has been chosen as a compromise between spectrum efficiency, complexity and low spurious radiations (that reduces possibility of adjacent channel interference). The GMSK modulation has a rate of 270.87Kb bands and a BT product equal to 0.3.

Fig 3.5 presents the principle of GMSK modulation

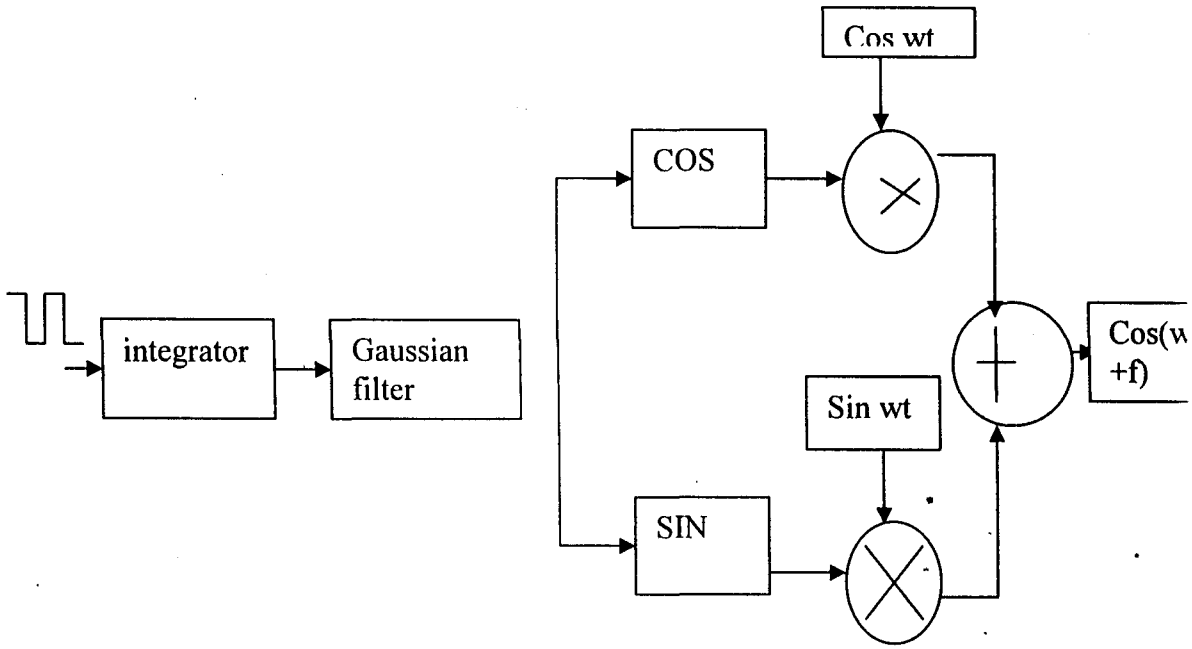


fig 3.5 GSM modulator[2]

3.2 THE STRUCTURE OF GSM

A GSM network is composed of several functional entities, whose functions and interfaces are specified. Figure 3.6 shows the layout of a generic GSM network. The GSM network can be divided into three broad parts:

The Mobile Station: The MS is carried by the subscriber

The Base Station subsystem controls the radio link with the mobile station

The network subsystem, the main part of which is the mobile services switching center (MSC) which performs the switching of cells between the mobile users and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown is the operation and maintenance center, which oversees the

proper operation and setup of the network. The mobile station and base station subsystem communicate across Um interface, also known as the air interface or radio link. The Base Station subsystem communicate with the mobile services switching center across the A interface [6].

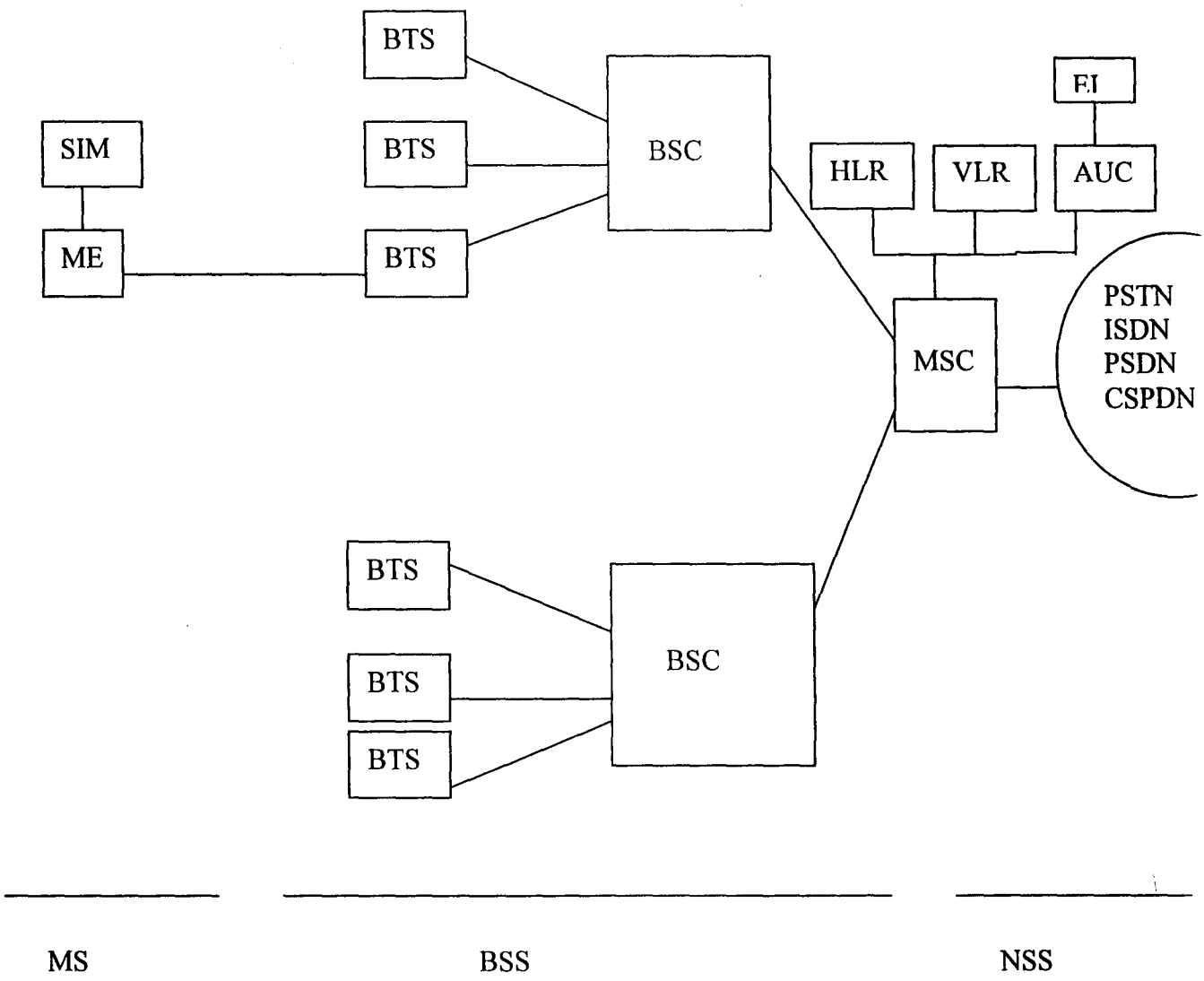


Fig 3.6 General structure of a GSM network.
Acronym:
SIM: subscriber identity module, ME: mobile equipment, MS: mobile station, BTS: base transceivers station, BSC: base station controller, MSC: message switching center, BSS: base station subsystem, HLR: home location register, VLR: visitor location register, AUC: authentication center, EIR: equipment identity register [7]

compatibility between mobile stations (MS) and network of different manufacturers and operators, the radio interface must be completely defined.

The spectrum efficiency depends on the radio interface and transmission, more particularly in aspects such as the capacity of the system and the techniques used in order to decrease the interference and to improve the frequency reuse scheme. The specification of the radio interface has then an important influence on the spectrum efficiency.

3.1.7.1 FREQUENCY ALLOCATION

The frequency allocated for GSM is 900/1800MHZ. This is why it is called a dual band system, two frequency bands of 25MHz each have been allocated from the 900MHz ranges, that is the band 890-915MHz has been allocated for the GSM system up link directions (transmitting from the MS to the BS). Also the band 935-960MHz has been allocated for the down link (transmitting from the BS to the MS), these are frequently referred to as reverse and forward links.

3.1.7.2 MULTIPLE ACCESS SHCEME

Since radio spectrum is a limited resource shared by all users, a method must be devised to divide up to the bandwidth among as many users as possible. The method deployed by GSM is a combination of TDMA and FDMA combined with frequency hopping.

3.2.1 MOBILE STATION

The Mobile Station (MS) consists of the mobile equipment (the terminal) and a smart card called the SIM. The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the international mobile subscribers identity (IMSI) used to identify the subscriber to the system, a secrete key for authentication, and other information.

The IMEI and the IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized used by a password or personal identity number (PIN).

3.2.2 BASE STATION SUBSYTEM (BSS)

The Base Station subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across standard Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio link protocols with the MS. In a large urban area, there will potentially be a large number of BTS deployed, thus the requirement for BTS are ruggedness, reliability, portability, and minimum cost.

The Base Station Controller manages the radio resources for one or more BTS. It handles radio channels setup, frequency hopping, and handovers as described below. The BSC is the connection between the mobile station and the mobile services switching center (MSC).

3.2.3 NETWORK SUBSYSTEM

The central component of the NSS is the MSC. It acts like a normal switching node of PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscribers such as registration, authentication, location, updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the network subsystem. The MSC provides the connection to the fixed networks (such as PSTN or ISDN). Signaling between functional entities in the NS uses signaling system number 7 (SSN7), used for trunk signaling in ISDN and widely used in current Public networks.

3.2.3.1 HOME LOCATION REGISTER AND VISTOR LOCATION REGISTER

HLR and VLR, together with the MSC, provide the call-routing and roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The location of the mobile is typically of the VLR associated with the

mobile station. There is logically one HLR per GSM network, although it may be implemented as a distributed database.

The VLR contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services for each mobile currently located in the geographical area are controlled by the VLR. Although each functional entity can be implemented as an independent unit, all manufacturers of switching equipment to date implement the VLR together with the MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR, thus simplifying the signaling required.

3.2.3.2 THE EQUIPMENT IDENTITY REGISTER AND AUTHENTICATION CENTER

The two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved.

The Authentication Center (AUC) is a protected database that stores a copy of the secret key stored in each subscribers SIM card, which is used for authentication and encryption over the radio channel.

3.3 CONCEPT OF FIXED WIRELESS NETWORK

Fixed wireless network can be categorized into two forms, the fixed terminal type and a limited mobile wireless. This is to say that the terminal type used by the subscriber

differentiates the two. Fixed wireless is a telecommunication services via wireless media just like the GSM. Their concept are similar because it is easily possible by the fixed wireless network operator to switch to GSM. The fixed wireless network is derived from the license name issued to the operator, that is, to offer services to a subscriber in a fixed area and also incorporate in their services, the limited mobility within the operator coverage area with the subscriber using a mobile handset.

3.3.1 FIXED TERMINAL

This is the service that replaced the old analogue wired telecom service, where by the operator supply the digital modem having the antenna and the subscribers number is configured in it, that is, it does not need SIM card, the SIM is configured in the modem. The modem has to be powered either by electricity (ac) or 12V dc battery. Therefore the system is too bulky to be carried about. So, it is used in the offices or homes or by the umbrella people for commercial purposes.

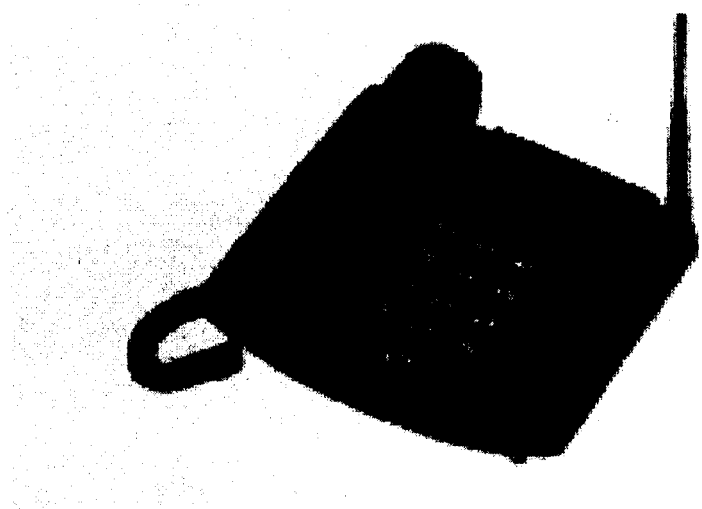


fig. 3.7: fixed terminal

3.3.2 MOBILE HANDSET TERMINAL

Recently the fixed wireless operators extend their services to offer limited mobility to their subscriber, consequently a mobile handset with the SIM already configured in it is supplied out to the people to subscribe on their network and enjoy roaming only within the same network region that their data is being configured to. Both the fixed terminal above and the mobile terminal should be compatible with the technology used for fixed wireless network. In Nigeria the CDMA technology is deployed by the leading operators and therefore the terminal should be CDMA compatible.

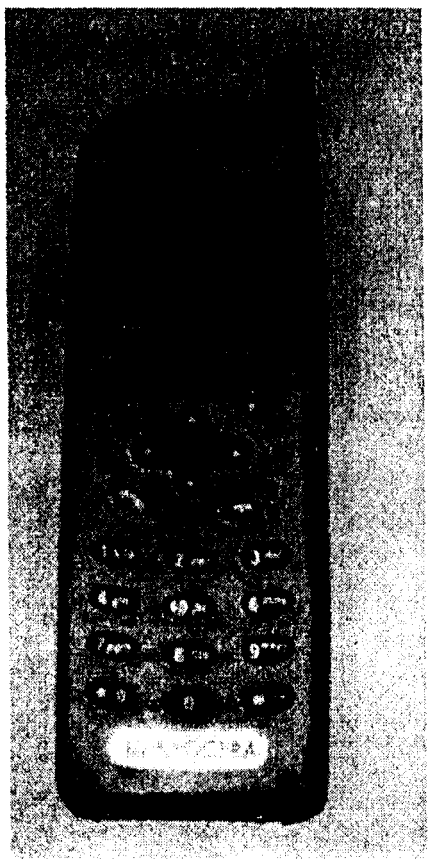


fig. 3.8: Mobile handset terminal

3.3.3 ROAMING

This is what differentiates the GSM from fixed wireless. The GSM enjoys national roaming while it is not allowed in the fixed wireless network. Although it is possible but not allowed by the regulatory body as it is contained in the license issued to them.

Each fixed wireless has a MSC that has the data base of the subscribers configured for the network. If the subscriber then visited another network even though it is owned by the same network operator. It cannot roam in the visited network because the MSC there does not have that subscribers data in its HLR/VLR.

3.3.4 FREQUENCY ALLOCATION

The frequency allocation for fixed wireless network is varied depending on the operator and it is not dual band like GSM. Most leading operators in Nigeria make use of 1900MHZ

3.3.5 TECHNOLOGY USED

Fixed wireless network as a cellular network have all the concept of cellular as described in GSM section. There are various technologies that can be used to operate fixed wireless network. Presently in Nigeria most leading fixed wireless operators deploy CDMA technology and its concept has to be treated.

3.3.5.1 CLAUDE SHANNON: THE EINSTEIN OF INFORMATION THEORY

The core idea that makes CDMA possible was first explained by Claude Shannon, a Bell Labs research mathematician. His work relates amount of information carried, channel bandwidth, signal-to-noise ratio and detection error probability. This theory is called a mathematical theory of communication. He observed that "the fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point". Shannon's capacity equation is given by.

$C = B_W \text{ Log } [1 + S/N]$

B_W = Bandwidth in Hertz

C = Channel capacity in bits per seconds

S = Signal power

N = Noise power

3.3.5.2 CDMA DEFINITION

CDMA stands for code division multiple access, a digital technology that uses digital encoding "spread spectrum radio frequency (RF) techniques, thus providing much better and more cost effective voice quality, privacy, system capacity, and flexibility than other wireless technology [7].

CDMA interference comes mainly from nearly users. Each user is a small voice in a roaming crowd but with a unique recoverable code. Two types of CDMA are Frequency-Hopping and Direct sequence.

3.3.5.3 FREQUENCY - HOPPING

Each users narrow band signal hope among discrete frequencies, and the receiver follows in sequence. Frequency-hopping spread spectrum (FHSS) CDMA is not currently used in wireless system, although used by the military.

3.3.5.4 DIRECT SEQUENCE.

Narrowband input from a user is coded ("spread") by a user unique broadband code, then transmitted. Also broadband signal is received, receiver knows, applier users code, recovers users code. The Direct sequence spread (DSS) CDMA is the method used in 15-95 commercial systems.

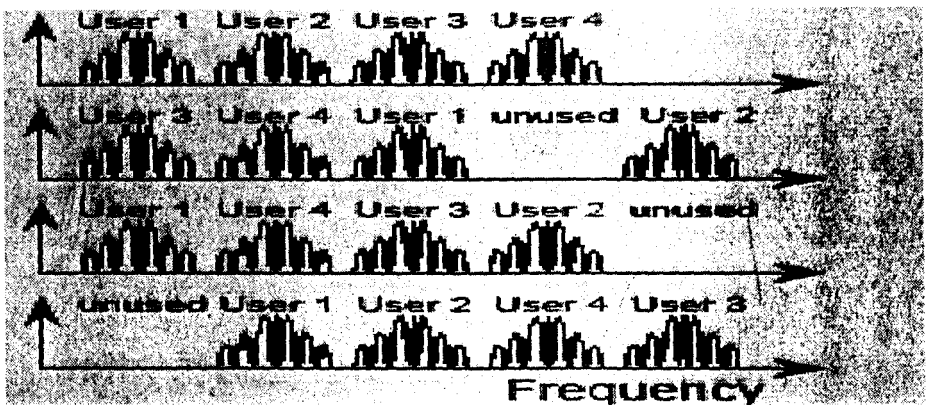


fig 3.9(a) Frequency Hopping CDMA

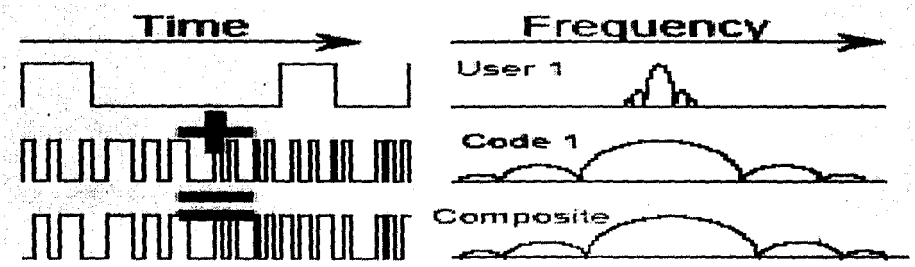


Fig 3.9(b) Direct sequence CDMA

3.4 STRUCTURE OF A CDMA NETWORK FOR AFIXED WIRELESS

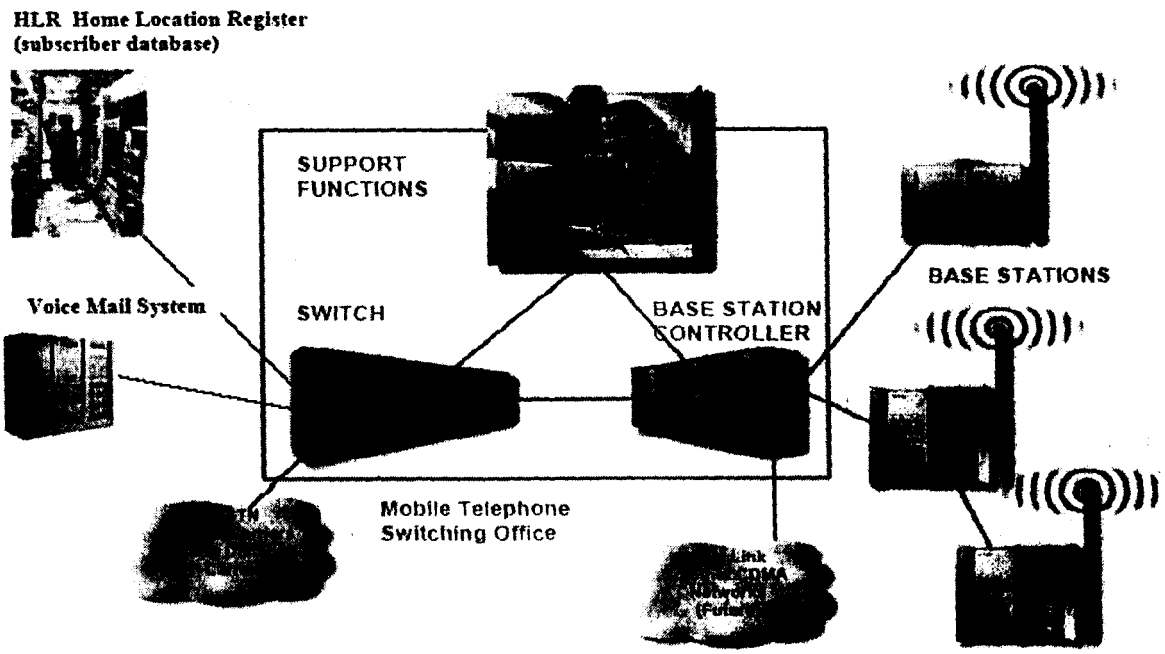


Figure 3.10: Structure of a typical CDMA network for a Fixed Wireless. [8]

The CDMA network is a little bit similar to that of GSM. The difference is that the set of Mobile Subscriber Integrated Service Digital Network Number (MSISDN) have been configured in the HLR of a particular switch which enables the terminal having this MSISDN have access to the service of that network. If the subscriber left the network for the other network area even though controlled by this same operator that controlled the network his ISDN was configured to, the visiting switch will not allow the terminal to have the access to the network because the MSISDN number was not configured in its switch HLR database. The functions of each functional entity connected in figure 3.6 above are treated thus.

3.4.1 BASE STATION

It provides radio connection between mobile users and the switch. One wireless system in a large metropolitan area may require hundreds of Base stations to deliver unbroken coverage and provide sufficient capacity to handle all potential users.

3.4.1 SWITCH

Each calls involves joining a circuit leading to one customer (usually on radio side of the system and a circuit leading to another person (usually out in the Public Switched Telephone Network (PSTN)).

Switch is a device that makes actual physical connection. It is also responsible for strong billing records, interpreting dialed phone numbers, routing calls and implementing calling futures.

3.4.2 BASE STATION CONTROLLER (BSC)

BSC interfaces the switch and Base Stations. It compresses speech signals for more efficient transmission over the scarce radio spectrum. It controls the Base Stations and implements the hand-off of calls from one Base station as user drive across the system.

3.4.4 MAIL SYSTEM (VMS)

When subscribers receives an incoming call but his phone is turned off or already on a call (without a "call waiting" feature), a Voice Mail System can store a message. The subscriber is alerted the next time he turn on his phone.

3.5 DELIVERING AN INCOMING WIRELESS CALL

- Someone dial a wireless subscriber's number.
- System checks database for current location of mobile or fixed terminal and pages this area. The database is kept up to date by process called registration.
- The terminal recognizes page and sends back acknowledgement to the strongest cell.
- System assigns voice channel to the terminal. The system sends voice channel assignment to terminal on control channel.
- Phone rings and limited mobile subscriber or fixed terminal (modem) user, answer call.

3.6 MANAGING HANDOFFS

Since fixed wireless operators have been given chance to operate or offer limited mobile service for their subscriber the principle of handoffs have to be treated and this is stated below :

As a mobile (limited) travels through its services area, that is, passes from one coverage zone of one base station into coverage of another, the signal strength

measurement by the mobile or the base station trigger the BSC and switch to "handoff" the call from and interference. Each wireless technology uses its own method to implement the handoffs. CDMA can even "simulcast" to the mobile from multiple base stations to reduce fading effects (this is called "soft handoff").

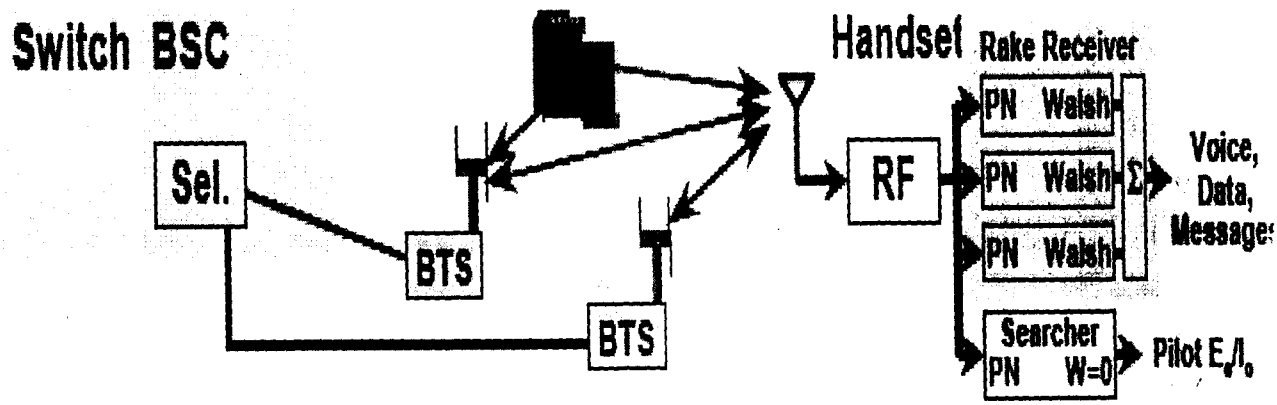


Fig. 3.11: CDMA soft handoff mechanics

3.8 REGISTRATION

Registration process by which an idle mobile lets the system know its awake and available for incoming calls; this allows the system to inform the mobile's home switch of the mobile's current location, so that incoming calls can be delivered.

Registration also allows the system to intelligently page the mobile only in the area where the mobile is currently located, thereby eliminating useless congestion on the paging channels in other areas of the system.

There are many different conditions that could trigger an obligation for the mobile to register, there are flags in the System Parameters Message which tell the mobile when it must register on the current system

3.6 THE CDMA TECHNOLOGY PATH TO 3G

Table 1: CDMA Technology Path to 3G [8]

		CDMAone		CDMA2000/IS-2000		
Generation	1G	2G	2G	2.5G or 3?	3G	3G
Technology	AMPS	IS-95A/J-Std008	IS-95B	IS-2000 1XRTT	IS-2000 3XRTT	1xEV: HDR or 1Xtreme
Signal Bandwidth, #Users	30 kHz. 1	1250 kHz. 20-35	1250 kHz. 50-80 voice and data	1250 kHz. Many packet users		
Data Capabilities	None, 2.4K by modem	14.4K	64K	153K 307K 230K		2.4 Mb/s (HDR) 5 Mb/s (1Xtreme)
Features: Incremental Progress	First System, Capacity & Handoffs	First CDMA, Capacity, Quality	Improved Capacity, Smaller Handoffs	•Enhanced Access •Channel Structure		Faster data rates on dedicated 1x RF data carrier

3.8 A 3G CDMA2000 1XRTT CDMA NETWORK FOR FIXED WIRELESS

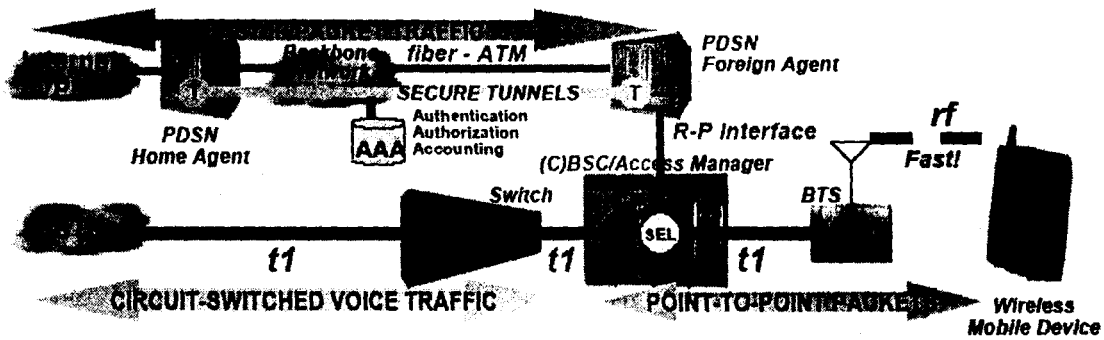


Fig. 3.12: A 3G CDMA2000 1XRTT CDMA NETWORK [8]

For full-featured data access over a 3G network, a true IP packet connection must be established tom outside packet data networks (including internet). This requires a packet data serving node. ISP and operator-provided services are provided by external home network and home agent routers. Authentication, Authorization and Accounting provided by external server. The old IWF (not shown above) is still maintained to allow old mobiles to use dial- up and WAP/wireless web keypad access.

CHAPTER FOUR

THE GSM NETWORK OPERATOR IN NIGERIA

The GSM operators in Nigeria are: MTN, V-mobile, M-tel, and Globacom. These operators have reached several stages in the execution of their duties as GSM service provider. MTN, V-mobile, M-tel have been operating since, despite periods of hitches and sometimes total shutdown. Globacom started their operation in 2003 and its network has been defined as the fastest growing so far.

All these operators' network will be described in brief by explaining their historical background and the services offered. Many aspects of their operation are quite similar since they are all following the same specifications. The differences lie in the modes of operations and publicity techniques.

4.1 V-MOBILE

4.1.1 HISTORICAL BACKGROUND

As Econet Wireless Nigeria, Vee Networks Limited, trading as V-mobile Nigeria, was one of the three winners of the highly competitive Nigeria's GSM license bid in 2001. Since its inception on August 6, 2001, V-mobile has continued to make good milestones, recording its 1million subscribers in December 2003. Econet wireless changed its name to V-mobile Nigeria and unveiled to the Nigeria public on the 15th of March, 2004. Presently the number of V-mobile active subscribers is 3.25million.

V-mobile has acquired fairly good coverage through an aggressive roll out strategy. Presently operating in cites and over 500 communities. V-mobile was first lunched in Lagos, Portharcourt, Uyo, Warri, Kano and Ibadan. The network is fully

geared towards social responsibility in Nigeria. In partnership with the Critical Rescue International (CRI) of South Africa, V-mobile runs pre-medical emergency, a service offered free of charge to subscribers on the network. It has created over 20,000 indirect jobs out of its growing network of distributors, dealers and vendors. It has also had direct impact on the advertising, engineering, construction, transportation and security industries [9].

4.1.2 SHAREHOLDERS

A truly Nigerian company, V-mobile is fully owned by indigenous investors including three state governments (Lagos, delta and Akwa Ibom), Banks and other institutional investors [9].

4.1.3 SERVICES

V-mobile offers the following services to its subscriber on the 2G digital GSM network: audio or voice service, short message services for local and international, the emergency medical and rescue initiative (V-mobile199) service. The company also renders internet service for the business organization or home users, that is they serve as Internet Service Provider (ISP) [9].

4.1.4 TARIFF

The V-mobile tariff to make call to any network is 70 kobo per second as at the time of this project.

4.1.5 OWN A LINE

V-mobile SIM pack is five hundred naira plus a free of five hundred naira air time as at the time of writing this project.

4.2 MTN NIGERIA

4.2.1 BRIEF HISTORY

MTN Nigeria is the most successful mobile telecomms operator so far in the Nigerian telecomm market. Following the acquisition of a GSM license for 285 million US dollars in August 2001, the company, by April 2002, reported having about 315,000 subscribers on its network. In February 2003, MTN Nigeria reported more than 1 million subscribers on its network. 1,650,000 subscribers were reported on their network with services available in 79 cities and towns, 364 local government areas and mobile signals coverings about 46.98% of the Nigeria population as at December 2003. The subscriber base of MTN is now about 6.4 million [11].

This huge success of MTN was basically because of the aggressive roll-out and marketing strategies adopted by the company. In rolling out its network, MTN did not use Turnkey operators like most of their competitors did. Rather, they decided to assemble a strong team made up of MTN expatriate, national staff and skilled Nigerian technocrats in the Diaspora. This enables them to roll out their base stations at record-breaking speed and thus was able to take majority of the market.

In a move to further improve the network infrastructure throughout Nigeria, MTN installed a microwave transmission backbone, Yhellobahn (1st phase), which spans 3,400Km and links some 120 towns and communities. According to Engineer Oyesiku

Dayemo, the GM Networking expansion for MTN, stated on NTA network program on August 2nd, 2005, that the second phase of Yhellobahn of transmission backup covering 3,500Km will soon be lunched in Nigeria. The Yhelobahn represents the spine from which the network derives its robustness and expansion ability. It had steadily increased in size from 3,400Km as at 2003 to 4700Km by January 2004; in capacity from STM-1 in January 2003 to 2X STM-1 (on most critical routes) in September 2003. Lately progress is being made in upgrading it to 4XSTM-5 capacity in a self healing ring architecture (2nd phase Yhellobahn). [5]

4.2.2 SERVICES

MTN Nigeria offers voice, SMS and other added value services like information such as help line, directory enquiry, news, commerce and entertainment services. All these are possible effectively as a result of 2G technology being deployed by MTN.

MTN offers internet services provider for some business organization, cyber café and home users. Presently, MTN is deploying 2.5G and hence offers multimedia message services to its subscribers, started in Abuja (FCT), Lagos and Portharcourt.

4.2.3 OWNERSHIP

MTN Nigeria is a South African cellular network operator and is listed on the Johannesburg Stock Exchange under the umbrella of the M-cell Group [12].

4.2.4 BE A SUBSCRIBER

MTN presently offers its starter pack at the price of N500.00 plus four hundred and eighty naira free air time inclusive. When the SIM is inserted in the set, it is the choice of the subscriber to choose the available service or billing method that is pay as you go; per second or per minute (pre-paid package).

It is possible to change from one service to the other free of charge by texting the customer care except for the booster package which needs to be charged depending on the duration of the service. There is also post paid package whereby the subscriber has to clear his bill every month or otherwise but he has to pay a deposit of some huge amount of money to the MTN as a collateral and he must have driving license and international passport.

4.2.5 TRANSMMISSION EQUIPMENT

Some of the equipment used are

- Harris equipment (Mega Star, True point)
- DMC (Digital Microwave Corporation) Equipments
- Ericson minilinks
- Fiber optics
- The switching centers: Nine switching centers with more than 16 switches per one center.
- The generating plant serves as a power source with Power Holding Company of Nigeria PLC as a backup.

4.3 GLOBACOM

4.3.1 ABOUT GLOBACOM

Globacom is the newest entrant into the mobile telecoms market and also the Second National Operator (SNO) after NITEL. The SNO license which costs US$200 million includes fixed and cellular elements. The former is valid for 20years and the latter 15years. Fixed/Mobile network roll out followed immediately with the award of a US$715 million turnkey contract in February 2003 to Alcatel supplied its Evolium solution as the wireless element of the package. With a predicted initial capacity to handle two million fixed and wireless subscribers, the combined network was expected to offer enhanced voice and data services, pre-paid VPN, SMS and unified messaging and comprise full radio access in fracture to support GSM/GPRS wireless services. The network adopts the 2.5G technology and hence able to offers the service of MMS (Multi media Service) and internet services browsing, both on the handset and personnel computers. Alcatel Local Multipoint Distribution Services (LMDS) with low/medium/high capacity microwave radios, provided 300Km of microwave routers serving as backhaul capacity for the network [5].

In August 2003 Globacom rolled out its GSM service in three major cities of Nigeria: Lagos, Abuja and Portharcourt. Its marketing strategies were aggressive and this promised a change in the trend of competition among GSM operators.

To distinguish itself from the existing operators, Globacom introduced per second billing and data services and proposed a new prepaid tariff scheme reducing connection charges, allowing more Nigerians to go mobile. Its "Talk Now" package allowed subscribers to get connected with a down payment of 2,999 Naira (US$23) while the

balance of N4,000 is deducted from subscribers airtime account in three monthly instalments. This innovative development forced MTN and Econet to lower their tariffs by about 20 percent and also to start offering per second billing. However, it experience set back as a result of interconnection disputes between it and MTN which had the lion share of mobile subscribers. But by November 2003 this was resolved and Globacom, since then, has become the only active competitor to MTN. [5]

Globacom, in its first year of operation, became the fastest growing GSM network in Africa, achieving a record of one million subscribers and covering 87 towns in just one month. The subscribers figure at the moment stands at 3.4 million with coverage extending to over 10,000 cities, towns, communities and major roads.

4.3.2 GLO M-BANKING

This is a glo service that gives customers opportunity to check their bank accounts from their mobile phones. The launching of Glo M-Banking makes it the first time in Nigeria that one single application will provide a uniform interface to a multitude of banks.

4.3.3 GLO FIXED

Glo fixed is a fixed wireless network service offered by the Glo mobile to his subscribers so that the subscriber can only have access to the network as described in chapter 3. The initial launch phase will provide fixed line services to 15 major cities in Nigeria with capacity of 500,000 lines. Towards achieving this and Glo express to enhance 3G GSM networking in Nigeria, state of the art equipment and 10,000Km long

private optic fiber backbone network is being deployed. The contract was awarded to Siemens.

4.4 M-TEL

4.4.1 BACKGROUND

M-TEL was the cellular arm of the incumbent fixed line operator and is one of the new licensed GSM operators. M-TEL had about 25,000 subscribers in 1999 and their cellular services were grossly inefficient. This was basically because they were operating analogue cellular lines (1G) with a network of a mixture of obsolete equipment and poorly maintained modern equipment [5].

Following the licensing of M-TEL as one of the GSM operators in 2001 their subscriber base rose to about 140,000. However, because of management problems and the failure of privatization process of Nigeria Telecommunications Limited (NITEL), M-TEL could not perform adequately compared to other GSM operators. M-TEL is using NEPA or PHCN today as a source of power to their base stations; it is known that PHCN (Power Holding Company of Nigeria) power is not reliable. Hence, MTEL service is also not reliable.

Pentascope, a Dutch telecoms network operators (until 2002 was wholly owned by the Dutch KPN organization but now a telecom consulting firm owned by Pentascope group) successfully won the management contract to manage M-TEL for three years (2003 to 2006). Pentascope remuneration was based on a base of four million US Dollar per annum of which two million Dollars are in respect of clearly variable expenses. Pentascope was expected to increase M-TEL's mobile subscriber base seven fold from

around 140,000 to 1 million and to increase the number of fixed lines from some 600,000 to 1.3 million in the three- year period [5]. However pentascope was sent packing early 2005 for alleged nonperformance and suspected irregularities in their appointment. As at March 2005, the active subscriber of M-TEL is 1.1 million. It is obvious, with the present reform in MTEL , that the technology used is 2G and the services have tremendously improved compared to the past 4 months.

4.4.2 SERVICES

MTEL services as national carriers to all fixed lines and GSM operators, excluding the Globacom who is second National carriers. Also, Mtel offers so many services to its subscribers such as: Voice, Data, Internet Service Provider, SMS e.t.c.

4.5 ADVANTAGES AND DISADVANTAGES OF GSM SERVICE IN NIGERIA

The GSM service in Nigeria has the good and the ugly aspect of it. There are treated thus:

4.5.1 THE ADVANTAGES OF GSM SERVICE

The good aspect of GSM service in Nigeria are:

- In other to improve the quality and increase the services of GSM telecommunication the operators had upgraded their technology from 2G to 2.5G and 2.7G. Presently, Glomobile, MTN and MTEL are almost done with their 3G optic fibre technology.

- As the GSM name implies, there has been a great access provision to GSM services as a result of its national roaming advantage. Therefore, this has made most GSM users abandon the old type landline (fixed line)
- The GSM services offers so many opportunities to the Banking system, Business men, transporters and private and public bodies, therefore, it has made life easier to live
- The presence of GSM has greater effect in the increment of Nigeria teledensity from 0.4% in 1999 to 8.4% as at the time of writing this project. Consequently, the demand for the GSM terminals increased and this brought down the cell phone price. Many cell phone manufacturers like o sell their product in Nigeria, hence they have to make the price cheaper as a market strategy.
- The information technology has been improved by the GSM service that provides the internet service. One can configure the cell phone with GPRS (Genet package radio service) and WAP (wireless access protocol) in built to browse the internet
- Although the GSM tariff is not affordable by the common men, the access day of any credit card is not least 3 months which is long enough to acquire N500.00 credit card.

4.5.2 THE UGLY SIDE OF GSM SERVICE IN NIGERIA

The GSM service in Nigeria for the past five years has been known with all these problems:

- Some of the lines do have permanent problems the problem such as unable to check the credit balance, unable to send a short message service e.t.c. that may not be rectified even when the complaint is lodged to the network operators.
- . Most of the times the GSM operators do cut off the network without a notice. Sometime the cut off may last one week or less. MTEL network relies on PHCN as a power source to the BTS, hence their network is not reliable always.
- Most of the times the GSM operators do cut off the network without a notice. Sometime the cut off may last one week or less. MTEL network relies on PHCN as a power source to the BTS, hence their network is not reliable always.
- The GSM users do experience the voice mail problem even though the destination line was not configured for voice mail. This is occurred by the hearing of arbitrary digits from the operator's voice mail system and lastly the caller will be charged.
- Interconnectivity problem is also one of the ugly sides of GSM. Either GSM-to-GSM or GSM-to-fixed lines the problem of interconnectivity is being experienced by the subscribers. Although this has been solved partially but it will be better if it is solved completely. The interconnectivity problems may not always mean one is not connected. If you are connected you may experience these errors of connectivity, the cross talk or completely loss of signals or hearing of hissing sounds

- The tariff levy the subscribers are not friendly. Consequently many subscribers mostly recharge their credit once in three months. They prefer calling at the business center to their own line because it is cheaper.
- The problem of unwanted or abnormal charges is being experienced by the subscribers sometimes, whereby the amount charged for a cell is not commensurate with the time spent. Sometimes, without making call the credit could be charged. Recently the problem of charging the credit without making call has been reduced.
- The GSM service has aided the crime of fraudulence, popularly called "419".
- The GSM operators are fond of increasing their number of lines without the proper technical capacity that can ensure the good working of these new lines. Even though the lines are more or less free but the service capacity are lacking. While the old line will be having access to the network, these new lines may be out of service for days.

CHAPTER 5

FIXED WIRELESS NETWORK OPERATORS IN NIGERIA

The Five main fixed wireless network providers in Nigeria are Multilinks, Starcomm, Mobitel, Reliance telecom, intercellular. Others include Top comm., Oodua telecomm, Bourdex, VGC e.t.c. The leading FWN operators have migrated to CDMA network, deploying CDMA 200 1X fixed wireless networks.

Between them they have more than 1million subscribers. The network can offer mobility within a certain range. The limited mobility possibility of FWNs has been a cause of disagreement for GSM operators who argue that they paid large amount for their licenses and that FWN operators effectively provide (Limited) mobile services without a license. Limited mobility is particularly attractive to users from a financial point of view.

Since it is an extension of the users home telephone services it is priced at fixed line rates, which are almost always significantly lower than mobile cellular prices. By the deployment of CDMA 2001X network, some of these FWN operators will provide wireless 3G technology in Nigeria in future.

5.1 MULTILINKS

Multilinks was granted a license by the Nigerian Communication Commission (NCC) to run telecommunication system specifically for the provision and operation of Fixed terrestrial network comprising radio, cable or a combination of any of these systems within Nigeria. Multilinks awarded the contract to NORTEL to install a Digital wireless local loop network for Fixed Wireless Telephones using TDMA technology.

The system is engineered to provide about 99% availability to users who have access to national and international direct dialing facilities. The company successfully launched the commercial operations on 8th December, 1997. After successfully establishing a market for the private sector wireless service, Multilinks license was amended to include limited mobility in 1998. In December 1998, multilinks started providing mobile phone services in Lagos.

Multilinks, as one of the leading FWN operators in Nigeria, migrated to CDMA 2001X technology using Nortel kit and launched in March 2003. Multilinks subscribers within Lagos and its environs enjoy reliable wireless telephone service integrated with high speed internet service. By the end of 2004, Multilinks expected its subscribers to be over 500,000 [7].

5.2 STARCOMMS

Starcomms was commercially launched in 1999. It has invested heavily over the years to improve the quality of its products. Its deployment of the world class CDMA technology in 2002 has exponentially taken the company to its current position of over 150,000 customers in Lagos, Kano and Maiduguri, a subscriber base that has increased 30 times since operations commenced. In 2002, Starcomms introduced a ground breaking

marketing strategy aimed at permanently changing the fixed/wireless industry for the better.

The strategy focused on the need to improve customer service quality and network performance and also introduced its award wining advertising campaign featuring "the talking drum" to the Nigeria public.

In December 2003, Starcomms expanded its network to cover the historic states of Kano and Borno. Asserting its position as one of the leading PTOs, the company was the first deploy intelligent network technology in Nigeria. History was made in December 2003 when Starcomms introduced its intelligent network, the next generation of wireless services, in Kano, Nigeria.

The platform has the capacity to accommodate a large number of subscribers and enables business to operate their own Virtual Private Network (VPN). The VPN is a private secure network that enables one to define one's communication preferences. The Stracomms CDMA 200 IX network costing US$60million in Lagos with the capacity of 500,000 lines but currently enabled for only 150,000 subscribers. Starcomms also offers internet access at the speed of 144Kbps. [13]

5.3 REL –TEL

Reliance Telecom was incorporated under the companies and Allied Matters Act 1990, of Federal Republic of Nigeria, on the 25th of August 1998. It is a Nigeria company with a capital structure composed of local and international financing. Reliance Telecommunications Ltd. Is licensed by NCC to provide digital telephone service in Nigeria, using the CDMA technology. The CDMA200 1X contract valued at US$145

million was awarded to Ericson so as to have effective performance network and allow Reltel to quickly and cost – effectively deploy 3G services to its customers and meet on – demand capacity growth [14].

5.4 ODUATEL

Odu'a Telecoms is a registered company in Nigeria, licenseed to provide telecommunications services using the fixed wireless access technology. The company is licensed to operate from Oyo, Ogun, Osun Ondo and Ekiti States of Nigeria and beam to the rest of the world. Its vision is to establish comprehensive telecommunications service in all nooks and crannies of Odu's telecom services area within four years.

The network, which, is being rolled out across the Five states utilizes Harri's clear Burst fixed wireless technology. The clear Bust-MB is a broadband wireless point- to-multipoint communication that provides digital two way voice, data, internet and video services. It uses line –of-sight principle where the remote station must 'see' the base station. Harris will also provide a radio backhaul and interconnection network including network management software as well as integration services. [15]

5.5 ADVANTAGE OF FIXED WIRELESS SERVICE (CDMA) IN NIGERIA.

- The handset can be at least twice as far away from a base station before dropouts occur, when compared to a GSM network. This means for rural

areas where there may be several tens of kilometer away from a town, with a base station some reception was possible.

- The other great advantage is built into handset. This is a form of noise reduction exclusive to CDMA where background noise is suppressed so that the result is a clearer voice for the receiver. For example, if one was standing in a large crowd at a shopping center talking on your mobile phone, or the fixed terminal of fixed wireless, the CDMA technology inbuilt in these terminals, hence the background crowd noise will be filtered out and a clearer voice is transmitted and received.
- The fixed wireless service offers cheaper tariff to the subscribers. Both local, National and GSM network call is cheaper when compared to the tariff of GSM service. Therefore, in most of the public parastatals the fixed wireless network is subscribed to

5.6 THE DISADVANTAGES OF THE FIXED WIRELESS NETWORK SERVICE IN NIGERIA

- The fixed wireless network lacks international roaming capacities. International roaming is when the handset can be used in a similar network to CDMA. With GSM phones it is a simple as having a phone which can operate on several different bands (dual or triple band) and switching to the appropriate band when in a different country. With CDMA at present, there are a few other compatible networks in other countries and the cost involved to provide the service to

relatively small number of roaming CDMA users is completely unfeasible, so international roaming is impossible.

- With CDMA, the ability to upgrade or change to another handset is not as easy as for GSM phone. The network service information for CDMA phone is actually stored in the actual phone and not in SIM card like GSM.
- There are limited varieties of handset available for CDMA network. This is because the GSM network operators outnumber the fixed wireless network operators everywhere in the world. Therefore most terminal manufacturers prefer to produce various types of GSM handset. Therefore, the CDMA handset is not cheap. Presently the cheapest fixed terminal with the line in it is N15, 000. The cheapest mobile terminal for CDMA network with line in it is N12, 000.
- From the year 2000 to the beginning of this year the fixed wireless subscribers suffered the problem of interconnectivity between them and GSM network users. This problem has been looked into. Even though the problem has still not been solved completely, this could be as a result of differences in the technology being used.

CHAPTER SIX

ASSESSMENT OF WIRELESS NETWORK SERVICE PERFORMANCE AND CONCLUSION

6.1 OVERALL SECTOR GROWTH

The telecommunications sector is currently undergoing very rapid change and explosive growth. Over the past three years, in particular, the Nigerian telecommunications sector has begun to deliver for the residential and business consumer. Waiting lists for telephone lines have disappeared, while telephone tariffs for local, national and international calls are gradually ranking amongst the lowest in Africa. The liberalisation of the sector and the resulting competition by private operators is bringing about very substantial benefits to subscribers in terms of much lower prices and enhanced choice. During the period under review, the Nigerian telecom sector received global acclaim as one of the fastest growing mobile markets in the world. The total subscriber base for connected fixed and mobile lines rose from 2,271,050 at the end of December 2002 to 10,201,728 at year-end 2004, an average growth rate of 125% annually. Overall, 7,930,678 new telephone lines have been taken up since December 2002, a phenomenal increase of 249%.

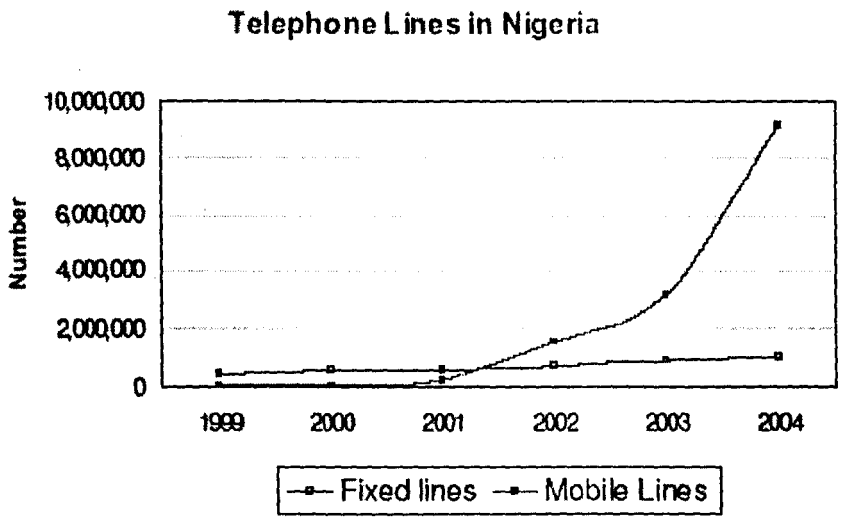


fig.6.1: telephone lines in Nigeria [16]

Yet the demand for more lines persists in Nigeria, Africa's most populous country. There is substantial evidence showing the deep quest by consumers not just for lines but also for good quality services from the operators, a quest that many operators are making at tempts to satisfy by continuous infrastructure investments. Strong growth is due mainly to fierce competition to sign up new users by the GSM operators and their fixed counterparts. Operators are currently engaged in rolling out , powering and securing their networks further into unserved or underserved parts of the country, with the trend being urban first , rural later.

The summaries of the Performance of the industry for the past five years is presented thus

Table 6.1: Growth of Nigeria telecom industry [16]

Growth of the Nigerian Telecoms Industry

	2000	2001	2002	2003	2004
Population	120,000,000	120,000,000	120,000,000	120,000,000	120,000,000
Households	12,800,524	13,173,020	13,545,516	13,893,868	14,254,520
Fixed	553,374	600,321	702,000	888,534	1,027,519
Mobile	35,000	266,461	1,569,050	3,149,472	9,174,209
Total	588,374	866,782	2,271,050	4,038,006	10,201,728
Internet Users	107,194	153,350	420,000	1,613,258	1,769,661
Internet Penetration	0.1%	0.1%	0.3%	1.3%	1.5%
Net New Additions (Fixed)	*80,058*	*46,947*	*101,679*	*186,534*	*138,985*
Net New Additions (Mobile)		*231,461*	*1,302,589*	*1,580,422*	*6,024,737*
Net New Additions (Total)	*80,058*	*278,408*	*1,404,268*	*1,766,956*	*6,163,722*
Teledensity	*0.49%*	*0.72%*	*1.89%*	*3.36%*	*8.5%*
Fixed Growth %	*16.9%*	*8.5%*	*16.9%*	*26.6%*	*15.6%*
Mobile Growth %	*0.0%*	*661.3%*	*488.8%*	*100.7%*	*191.3%*
Total Growth %	*15.7%*	*47.3%*	*162.0%*	*77.8%*	*152.6%*
Growth in Internet Users %		*43.06%*	*173.88%*	*284.11%*	*9.69%*
Teledensity Growth %	*16.7%*	*46.9%*	*162.5%*	*77.8%*	*153%*

6.1.1 SSESSMENT OF PERFORMANCE OF GSM SERVICE

In terms of competitive market structures, mobile has become the strongest telecoms sub-sector, as all the four competing operators engaged the market even more aggressively during 2003/ 4. In almost all aspects, the mobile sector displays the hallmarks of a vigorously competitive market with operators declaring good profits, consumers enjoying lowering prices under a stable and fairly consistent regulatory regime.

Increased network congestion due to strong demand for services by consumers, however resulted in a slow down of sales by many of the telecoms operators in 2003 as the regulator insisted on the increase of network capacity to accommodate the high demand. The sale of pre-paid packages was initially slowed down through increased connection fees by some of the operators, notably MTN and Vmobile, and subsequently

through infrequent temporary restrictions on the sale of pre-paid packages, often self-imposed, or ordered by the regulator. Four years into the mobile revolution, queues of vendors and other customers who have come to lodge complaints can still be observed at many operators outlets or "friendship centers".

At the end of 2004, MTN was the largest network in terms of subscribers, with a market share of 42 per cent , a 10% drop over 2003 figures. Vmobile and Globacom had 24 per cent subscriber market shares each, with the latter aggressively claiming market share from the older operators. The fourth operator, MTEL, had a market share of 10 percent. Figure 6.2 shows the market share trend over the past three years

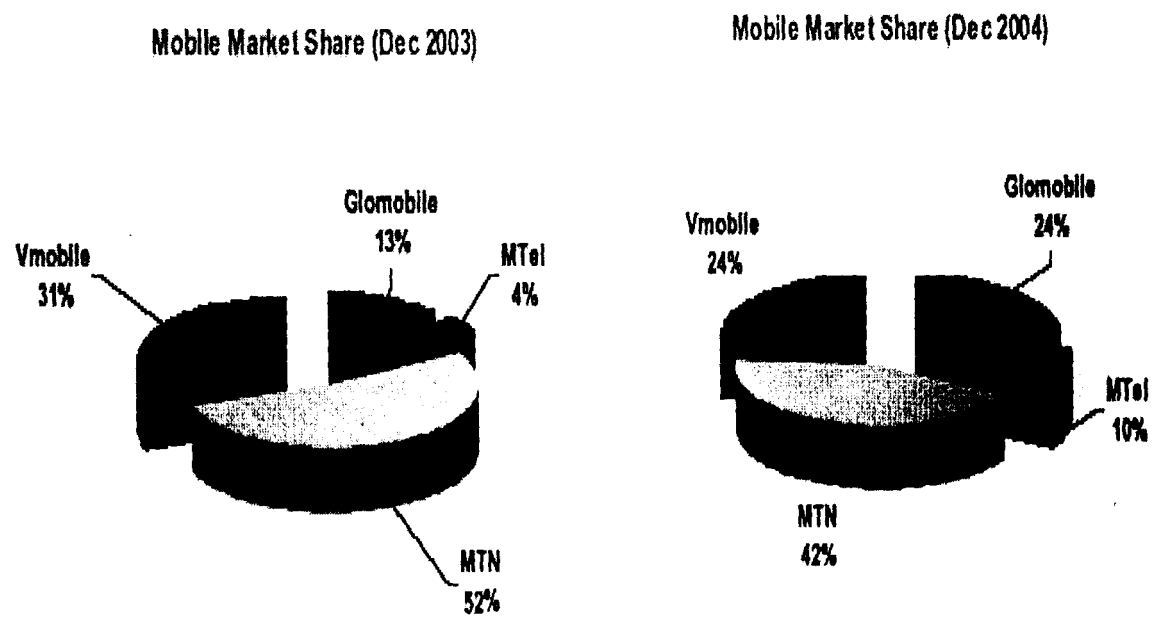


Fig. 6.2: Mobile market share in Nigeria [16]

Private telecoms operators have been taking full advantage of the relative inactivity of NITEL and the newly licensed Second National Operator, Globacom, whose

basket of licenses includes fixed services. Though about 24 private operators offer fixed line services, NITEL continues to be the dominant network in terms of revenues, market capitalisation and investment, and is larger than all of its competitors put together. However, the former telecoms monopoly is sub-optimised and currently carries the burden of an almost unending privatisation program.

6.1.2 ASSESSMENT OF THE PERFORMANCE OF FIXED WIRELESS SERVICES

Understandably, fixed telephony competition has come mainly from a few of the private operators, who are aggressively engaging the market with products running on CDMA-based Fixed Wireless networks. The technology shift has, however, brought about some new investment activity, as some of the private players attempt to extend their network coverage beyond urban areas. New fixed operators that launched in 2003/ 4 include:

. MTS First Wireless

. Rainbownet

. Startech Connect ions

. Swift Networks

Notwithstanding the foregoing, the rate of fixed telephone subscriptions has not matched the pace of mobile. While the total number of fixed lines increased to 1.027m only 138,985 new fixed lines were connected between 2003 and 2004.

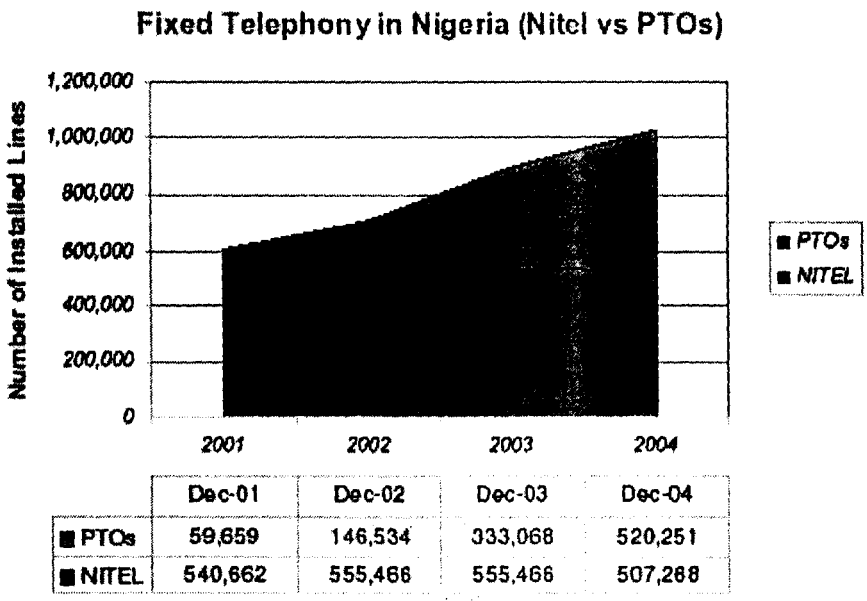
This represents an average annual growth of 26% or one- tenth of the speed of mobile acquisitions. Private operators provided nearly all the new lines. The slower growth of fixed relative to mobile can be attributed to:

1. Continuing delays in the privatisation of NITEL thus limiting the incumbent's ability to install new lines.

2. The attraction of mobile to majority of telephone users.

3. The relative weak financial strength of many of the fixed operators compared to their mobile counterparts.

Nevertheless, Nigeria is still the most active fixed telephony market in Africa, and rate of connecting new lines by Private Telephone operators (PTOs) has been above average. PTOs now contribute about a third of all fixed telephone subscriptions in the country. Figure 6.3 shows the comparative performance of NITEL and the private telecoms with respect to telephone connections.



	Dec-01	Dec-02	Dec-03	Dec-04
PTOs	59,659	146,534	333,068	520,251
NITEL	540,662	555,466	555,466	507,268

Fig. 6.3: Fixed Telephony in Nigeria [16]

6.1.3 INCREASING TELEPHONE PENETRATION

Teledensity is a measure of the penetration of telephone lines within a territory. Nigeria's teledensity has grown from near zero at the turn of the millennium to about 8% in just four years. The addressable market for telephone subscriptions is 25 – 30 million regions as at 2004. Presently the teledensity is 8.4%.

Fig. 6.4: Teledensity curve as at 2004 [16]

6.1.4 NETWORK ROLL-OUT

The majority of the active operators have awarded contracts for the expansion of their networks into the hinterland. Operators with aggressive network rollouts include MTN Nigeria, Vmobile, Globacom, Intercellular, and Starcomms. At the end of 2004, at least 100 Nigerian towns had primary coverage from the telephone operators.

Table 6.2: Telephone coverage information [16]

Telephone Coverage Information
Number of Towns Covered

	2002	2003	2004
MTN	41	69	93
MTEL	18	34	85
VMOBILE	14	36	52
GLOBACOM	0	5	64
NITEL	72	70	70
PTOs	6	11	14

Table 6.3: GSM Base Station information [16]

GSM Base Station Information
Number of Installations

	2003	2004
MTN	580	820
MTEL	136	280
VMOBILE	N/A	430
GLOBACOM	N/A	400
Total	716	1930

6.1.5 THE PRICING TREND

Table 6.4: GSM Pricing Trend

GSM Pricing Trend
Prepaid SIM Pack

	Dec-02	Jun-03	Dec-03	Jun-04	Dec-04
MTN	13000	13000	6500	5999	1000
VMOBILE	4000	12900	6000	5500	1000
MTEL	10000	9000	9000	6500	2500
GLOBACOM	-	-	10999	3300	1
Average	*9000*	*11633*	*8125*	*5325*	*1125*
% Change		*29%*	*-30%*	*-34%*	*-373%*

Presently the SIM pack is more or less free, excluding MTEL. The price of handsets is falling too. Fixed wireless terminals are now going for about N13, 000 (US$92.90) on average, as the shown in table 6.5.

6.1.6 TRENDS IN FIXED TELEPHONE ACQUISITION

Table 6.5: Trends in Fixed Telephone Acquisition [16]

Trends in Fixed Telephone Acquisition

	Dec-02	Jun-03	Sep-03	Dec-03	Jun-04	Sep-04	Dec-04
Starcomms	27,500	25,000	25,000	21,000	21,000	21,000	14,980
Multilinks	25,000	25,000	25,000	25,000	18,000	18,000	18,000
Intercellular	25,000	25,000	25,000	25,000	22,000	22,000	22,000
Reltel	33,333	27,000	19,000	19,000	17,000	17,000	6,995
Cellcom	46,000	35,000	35,000	35,000	9,500	9,500	6,500
21st Century	15,000	15,000	15,000	10,000	10,000	10,000	10,000
Average	*28,639*	*25,333*	*24,000*	*22,500*	*16,250*	*16,250*	*13,079*
% Change (Annual)				*-21%*			*-42%*

The crash in price of telephone lines is caused by the need of operators to get more subscribers, but some practitioners fear that this may lead to network congestion in the long run. They fear that the crash in price may not last, because of increased overhead cost, as it takes up to 5 to 8 years to make free cash flow in the industry.
Others however insist that the crash in prices is sustainable, because more subscribers mean more profit for operators.

6.1.7 FINANCIAL ASSESSMENT

Since nearly all of the operators are private entities, they are not obliged to disclose information about their financial performance, except for MTN, whose figures, being listed on the Johannesburg Stock Exchange, are more readily available for public

scrutiny. From diverse industry sources, EBITDA margins of 40% and above are quite typical of the majority of Nigerian telecoms operators.

In its figures for the half-year ended 31 December 2003, Vmobile declared a net profit of N22billion (US$160m) from about one million lines. Vmobile's full year net profit for 2003 was US$480m. Similarly, MTN is reported to have earned about N150 billion (US$1.09bn) in its second full year of operations in Nigeria. An example of the profitability of the industry comes by examining the Group accounts of MTN. For the first time in its ten-year history, the MTN Group became more profitable than Vodacom in 2003 and rose to become the most profitable telecoms company in Africa. Its net profit of R2.1 billion for the six months ended September 30, 2003 was R700 million higher than Vodacom's, though both firms had similar revenues.

The key to MTN's recent success has been its forays into the Nigerian market , where it has been adding nearly a million subscribers to its network every year. While profits have been generally positive for most operators, there appears to be a drop in Average Revenue per User (ARPU) within the industry over the past three years. High rates of USD$55 (2002) per user per month have progressively given way to new figures of USD$48 (2003) and USD$44 (2004). The decline is attributable to several factors including lowering tariffs, increasing penetration, and apparent growth in low- income subscribers. Nevertheless, Nigeria's ARPU rates are nearly double the African average of USD$25 per user per month.

However, it has not been all smooth sailing for the industry. News that Nigerian Telecommunications (NITEL) suffered a NGN19 billion (USD145 million) loss in 2003, compared to a profit of NGN8 billion in 2002, shocked the industry. According to the

Telco's former management contractors, Pentascope International, the heavy budgetary deficit comprised of NGN5billion operational loss, pension fund provision of NGN6 billion, and a debt write-off of NGN8 billion. In addition, NITEL owes a further NGN14.8 billion to other operators, although Pentascope claimed the operator is owed NGN27 billion in outstanding accounts. Reacting to criticism of the figures from the Nigerian Senate Commit tee, NITEL's management claimed the operator's accounts would return to the black in 2004, following an anticipated 15% increase in total revenues.

6.1.8 INNOVATIVE SERVICES AND APPLICATION

Many operators launched innovative products and applications during 2003/ 4. Some of these include:

. Wireless Internet (Multilinks/ Intercellular/Reltel/Cellcom/ Starcomms)

. Fleet Management & Vehicle Tracking Systems (Globacom/MTN)

. SMS- to-Email (Globacom/ Vmobile)

. GPRS/ Limited Internet Access (Globacom)

. Multimedia Messaging Services (Globacom)

. Fax Messaging (MTN/Globacom/ Vmobile)

. Mobile Banking (Globacom)

. Mobile Commerce (MTN/ Vmobile/Globacom/MTEL)

. MTN announced to offer MMS recently, but it does not work on their network.

6.2 THE DIFFICULTIES AND CHALENGES TO RUN THE INDUSTRY

The licensed operators, especially the GSM operator and fixed wireless network operators faced a lot of challenges I rolling out their network and providing adequate telecom services in Nigeria. Some of these challenges are highlighted below:

6.2.1 INADEQUATE OF POWER SUPPLY

The condition electric power supply in Nigeria was a major challenge to the operators. Because of the erratic power supply, the operators had to power the Base stations, mobile switching centers and other functional elements of their network by generating sets and using PHCN power as a back up. This led to high cost of maintenance of generators and fueling. Consequently, the telecom services is being provide at a higher cost.

6.2.2 UNSTEADY FUEL PRICE

The hiccups in the oil industry also affect the telecomm operators. The operators resort to buying diesel at a very high cost to run their generating sets for the base stations.

Recently, the fuel price which was acclaimed to be too high by Nigerian was further increased by 46%. These changes will definitely threaten the tariff.

6.2.3 LACK OF INDUSTRY INFORMATION

The paucity of industry information for policy and planning affected most of the operators initially in rolling out their networks. These however led to the operators

making mistakes in the decisions which consequently lead to delays in coming up with policies as regards the provision of telecom services.

6.2.4 VANDALISATION

Vandalisation of infrastructure and equipment in Nigeria has continued oppose a threat to the sustainability of economic development in Nigeria. This menace cuts across both public and private sectors of the economy in the length and breath of the country. In the public sector, institutions and parastatals such as NITEL, NEPA now PHCN, NNPC to mention but a few have several tales of woe resulting from vandalisation of their equipment by hoodlums. Operators constantly complain about the vandalisation of their base stations equipment and generating sets, leading to frequent disruption in the provision of telecomm services.

6.2.5 INTERCONNECTIVITY PROBLEMS

Interconnectivity was a major challenge for the operators initially. It frustrated their efforts in proper service provision because they could not resolve interconnect rates among themselves and this led to customer dissatisfaction. This however, has been resolved as most of the operators are interconnected with one another.

6.2.6 GOVERNMENT POLICIES

In rolling out their networks, the operators order equipment from infrastructure vendors and because most of the equipment are not manufactured in Nigeria, the vendors need a letter of credit to enforce manufacturing of needed equipment (i.e. payment for

materials/equipment). The control Bank policies on equipment procurement affected network roll-out as regards time constraints because it takes a lot of time to process. Also, the equipment takes a lot of time in clearing because of custom's policies and the port congestion in the country.

6.2.7 SPECTRUM PLANNING AND ALLOCATION PROBLEMS

Allocation of frequencies to the operators was initially a problem and this sometimes resulted in two or more operators sharing the same range of spectrum. This problem resulted in serious disagreements among the operators, until 2003 when NCC was able to bring out a detailed spectrum plan for Nigeria.

6.3 SOCIAL AND ECONOMIC IMPACT OF GSM AND FIXED WIRELESS NETWORK IN NIGERIA

In many identifiable ways the GSM and Fixed Wireless Network Services have affected the well being of Nigeria. These impacts are highlighted below:

6.3.1 GROWTH IN TELEDENSITY

Economists agree that for a developing country to attain 5 percent GDP growth, it needs a minimum teledensity of 1 percent; and that a country's economy will only expand at half the rate at which it increases its investment in the infrastructure. The wireless network have shot up the teledensity to 8.4 lines per 100 inhabitants in Nigeria and this has created tremendous growth in country's GDP. [11]

6.3.2 EMPLOYMENT CREATION

One area that GSM and Fixed wireless operators activities can be visibly seen is in job creation for Nigerians. It is estimated that over 4,000 as at 2005 people are directly employed by the GSM operators alone not to talk of the Fixed wireless operators. In addition, the GSM and Fixed Wireless centers have sprung in their millions nationwide providing employment and means of sustenance. It is estimated that 400,000 indirect employment opportunities were created through the operation of recharge cards hawkers, resellers, e.t.c.

6.3.3 BANKING

One of the biggest impacts of GSM technology in Nigeria is in the banking sectors. Since the advent of GSM revolution, many banks in the country have launched various e-banking or m-banking or online banking schemes with GSM as the probable tool. Today you can check your account balance through GSM mobile phones. One can also make various forms of banking transactions through GSM mobile phone without having to visit a bank physically. Today GSM phone uses in conducting banking transactions have drastically reduced the amount of time spent in banking halls especially by those who employ the strategy.

6.3.4 FOREIGN CAPITAL INFLOW

Since the full liberation of telecom sector, there has been a great difference in the capital flow into the country economy. The huge capital investment by foreign investors vis-à-vis the operators has consequently led to an increase in the capital inflow of the

country. It is recorded recently that private investment in the telecom sector ranks second only to the oil and gas industry in the country.

6.3.5 SMALL BUSINESS VENTURES

The impact of the GSM and Fixed Wireless revolution on artisans such as mechanics, technicians, traders, roadside artists, hairdressers, product distributors, clearing agents is enormous. Their businesses have been enhanced in terms of communication with, and management of their clientele. Orders are taken, cancelled, confirmed and amended online, anytime and anywhere. This has helped them considerably to reduce time and money spent on moving from one point to another.

6.3.6 INDIGENOUS SKILLS ACQUISITION AND TECHNOLOGY TRANSFER

Another impact of GSM and Fixed Wireless technology is that it has brought about the indigenous skill acquisition and technology transfer. For example, the GSM phone technician and modern terminal for fixed wireless, technician; are now economically empowered because of the skills they acquire out of repairing mobile phones. Also, Nigeria engineers working with the operators gradually learns the technology behind the GSM and wireless communications as whole.

6.3.7 INCREASED TAX REVENUE FOR THE GOVERNMENT

As a result of the licensing of several telecom operators and services offered by them, the investment in the telecom sector has led to increased tax revenue for the government.

6.3.8 ORGANISATION OF SOCIAL, EDUCATIVE AND EMPOWERMENT PROGRAMME

Some GSM operators and fixed wireless operators have been organizing and sponsoring some GSM programs over the radio and televisions, and in schools so as to educate, socialized and empower Nigerians in one way or the other. For example, "who wants to be a millionaire" show organized and sponsored by Vmobile Nigeria every Thursday at 8:00 pm to 9:00 pm is an educative, social and empowered programme by winning up to 5million naira. Also, Glomobile and MTN have contributed enormously in the area of sorts, school, school net, campus show. e.t.c.

Also Starcomms organized and sponsored some events in the area of education like University of Lagos, with event tagged Moremi Hall week on 29th February to 4th of march 2004, in the area of tourist like organization of French cultural center, the event is tagged happy hour on the march to December and many more. These events are still being sponsored till today, 2005.

6.4 RECOMMENDATIONS TO THE TELECOMM INDUSTRY

For faster growth in the telecom sector and to ensure a cheaper and affordable telecom service to Nigerians, the following recommendations are suggested.

6.4.1 LICENSING

- Licensing criteria must be well articulated and publicly available.
- Terms and conditions of individual license must be investor friendly and also ensure consumer rights.
- Licensing process must be transparent and timely.
- Exclusivity for optimum number of mobile operators.
- Prevention of anti-competitive conduct by dominant operators.

6.4.2 FREQUENCY ALLOCATION AND MANAGEMENT

- The plan for spectrum allocation should be done in such a way that adequate provision for various services based on their relative importance to Nigeria's socioeconomic goals are met and also make forecast for future requirement.
- The NCC should evolve fair, equitable and transparent procedures and conditions for the allocation and assignment of spectrum.
- Continually and systematically phase out ageing technologies in order to free up new spectrum space allocation to emerging technologies and new service.
- Interconnecting parties must have access to quick and independent dispute resolution process.

6.4.3 INTERCONNECTION.

- The regulatory environment should be such that new entrants should be guaranteed seamless interconnection with the incumbents.
- Interconnection must be on non-discriminatory basis with respect to technical standard and specialization rates and quality.
- Interconnection must be ensured in a timely, transparent and reasonable manners.
- Interconnecting parties must have access to quick and independent dispute resolution process.

6.4.4 BOOSTING RURAL ACCESS

- Operators should be obliged to install community service telephones as part of their license obligation either by installing telephone boot in remote area of the country where low income citizens can make calls at cheaper rates.
- Mobile operators should be obliged also to provide minimum of 70% population coverage within five years of launching service as part of their license conditions
- Incentives such as free frequency bands should be given to operators in exchange for free SIM cards for the low income earners.

6.4.5 IMPORT DUTY REBATE AND FISCAL INCENTIVES

- Telecomm infrastructures are highly capital intensive. Duty rate therefore must be such that will encourage massive importation of telecomm equipment and systems.

- The government should therefore reduce quite substantially or completely remove duty rate on import of telecomm goods.
- Government should depend on other sources of revenue such as company tax, value added tax and other taxes rather than import duty on telecomm infrastructure that could limit the expansion which Nigeria badly needs.
- Simplification of procedures for importation of telecommunications equipment and development of related software.
- Granting of pioneer status to qualified investors.
- Incentive to encourage local manufacture of telecomm infrastructure.
- Encouragements of infrastructure sheering to reduce network roll out cost among operators and also protect the environment.

6.4.6 HUMAN CAPCITY BUILDING

Nigeria should take human capacity development very seriously. There must be conscious effort for skill development intervention through training and re-training of technical and managerial personnel.

Finally, attaining an efficient and sustainable GSM and Fixed Wireless Network telecommunication in Nigeria is the collective responsibility of all; the government, operators, regulators and the consumers.

6.5 RECOMMENDATION TO RECTIFY THE UGLYSIDE OF GSM SERVICE IN NIGERIA

- Every line (MSDN numbers) should have access to the same services offered by the network. The software and the hardware should ensure this configuration for all the subscribers at all time.
- To prevent any loss due to the low network problems it is recommended that each of the base stations and switching centers should have back up. Although it is costly but the incessant network failure is great loss to the operators themselves not to talk of subscribers. Also there should be a 48 hours notice before the general overhauling of their system and it should be done within a bearable down time.
- The regulatory body should not relent on its effort in sanctioning any operators that sabotage activities of interconnectivity in Nigeria telecom sector.
- The GSM operators should deactivate the voice mail of all lines before it is introduced to the market to the market for sale, so it can be activated by any interested subscriber.
- The modulators and the multiplexers deployed by the operators should be of high standard to avoid the problem of cross talk, hissing sound, faint sound signals and completely loss of sound signals.
- The federal government should reduce tax and the license fees to run the industry, as these contributed to the unfriendly tariff paid by the subscriber.

- The National Orientation Agency should not relent on its effort in sensitizing the public on the fraud by the use of GSM. This does not exclude the EFCC and the ICPC.

6.6 RECOMMENDATIONS TO RECTIFY THE UGLYSIDE OF FIXED WIRELESS NETWORK SERVICE IN NIGERIA

- Fixed wireless network should embrace the unified license introduced by the NCC recently whereby the GSM and Fixed Wireless Network operators will have a right to operate the two type of wireless service in Nigeria.. This will solve the fixed wireless national roaming problem.
- CDMA technology should be improved to make use of SIM card so as to give room for easier upgrading of the hand set and used the phone with other SIM card. In a null shell, they should sell the SIM card only and allow the subscriber to purchase the hand set or fixed terminal at the market. This will encourage many terminal manufacturers to invest in CDMA terminals.

6.7 CONCLUSSION: FUTURE OUTLOOK

The Nigerian telecoms sector continues to demonstrate strong growth prospects, with aggressive private companies making solid at tempts at meeting the demand needs of large sections of the population with respect to the provision of high quality voice, data and video services. The future growth and competitiveness of this vital economic sector looks very bright. Specifically, on the horizon are:

1. The forth coming privatization of NITEL AND MTEL by the government's Bureau of Public Enterprises (BPE).

2. The licensing of VOIP services/operation by NCC

3. The creation of International Data Access (IDA); guidelines have already been published by the regulator. The IDA license is to include the right to provide voice and data services and full interconnection to Public Switch Telephone Network (PSTN).

4. The end of the exclusivity period granted to digital mobile operators licensees and the implications thereof.

5. The implementation of the new unified licensing regime by NCC, due to commence from February 2006. The unified licensing regime will allow existing fixed wireless and mobile licenses to provide both services subject to geographical/ regional limitations. I t will also mark the end of service-based license segmentation as all wireless licenses shall be free to offer voice, data or multimedia services as they deem fit .

6. The full implementation of the government Universal Access to enable equitable access to telecoms resources by the entire citizenry.

7. Initial public offerings by telecoms companies is likely to become commonplace. Two companies, namely Intercellular and Reltel, have already announced plans to approach the Nigeria Stock Exchange to have their shares traded on the floor of the market.

8. Continuing focus on aggressive customer acquisition and network roll-out. The Commission has already set an industry target of 10 million new subscriptions by the end of 2005.

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