DESIGN OF A 10,000 SUBSCRIBER CDMA TELEPHONE NETWORK

BY

ABUBAKAR AMINU

(99/9391EE)

DEPARTMENT OF ELECTRICAL

COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA, NIGER STATE. NIGERIA.

NOVEMBER 2005

DESIGN OF A 10,000 SUBSCRIBER CDMA TELEPHONE NETWORK

BY

ABUBAKAR AMINU

(99/9391EE)

DEPARTMENT OF ELECTRICAL COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE, NIGERIA.

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE BACHELOR OF ENGINEERING (B.ENG) ELECTRICAL / COMPUTER

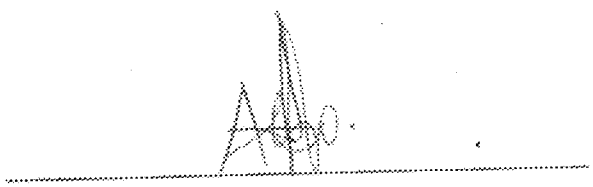
CERTIFICATION

This is to certify that ABUBAKAR AMINU (99/9391EE) carried out this project titled "DESGIN OF A 10,000 SUBSCRIBER CDMA TELEPHONE NETWORK" for the award of a Bachelor of Engineering (B. Eng) in the department of Electrical and Computer Engineering of Federal University of Technology, Minna, Niger State.

DR. ENG E.N. ONWUKA	DATE
(PROJECT SUPERVISOR)	
ENGR M.D. ABDULLAHI	DATE
(HEAD OF DEPARTMENT)	
EXTERNAL EXAMINER	DATE

DECLARATION

I hereby declare that project was written by me "ABUBAKAR AMINU" (99/939IEE) of the Department of Electrical and Computer Engineering, Federal University of Technology Minna, under the supervision of Dr. Engr E.N Onwuka.



Signature of Student

06th Dec, 2005

Date

DEDICATION

This project work is humbly dedicated to my dear supporting parents. Mama Da Baba Nagode.You are the best parents in the world.

Also to the souls of my grand father Mal Muhtar Bello(Walin Katsina) and my uncle B.Hadi Imam.Who all died some few months to my graduation.

May their souls rest in Jannatul Firdaus. Amen.

ABSTRACT

An investigation of major element that makes up a CDMA wireless telephone network has been carried out using the classical approach of comparism between various forms of telephone system (IDMA, FDMA). The main focus was on operational functionalilty of CDMA (a digital system) and what makes it unique.

Also, network paramenters required in setting up a network that will support and cover 10,00 users, using most practical approximations and assumptions.

It was also found that a design like this one will cost a minimum of =N=200m. The outcome that it will generate will massively depend on management and marketing strategies. Hence, a real structure like this one can bring out up to =N=4.5m per month.

ACKNOWLEDGEMENT

Firstly, I must thank Almighty Allah (SWT) the beneficent the merciful who gave me the life and health to undertake this project. For his servant and prophet may peace be upon him.

Secondly, I will like to express my appreciation to my able and understanding supervisor Dr. E. N. Onwuka, for her advices concerning both the project and life in general. Dr, your encouragement and support which include monetary are best appreciated.

I am also grateful to my dear parents for everything you have done to satisfaction. Also to my sisters (Ummusalma, Asiya, Fatima, Ramat) and my brothers (Umar, Usman, Aliyu, Hamza & Moh'd), thank you all. For my friends that I lived together with in Minna; Yusuf, Dahiru, Sale, Moh'd & Farouq. May Allah grant all of you the best life can offer.

My thanks also goes to my class colleagues; Nurudeen Moh'd, Ibrahim Mukhtar & Usman Galadima. Also to Salisu Garba & Co we will forever remain friends.

My acknowledgement will absolutely remain without counting my sincere appreciation to the family of Mal. Bello Sule, for inducting me generously into there family. Anty Zilly thank you may Allah reward you abundantly, and may He also strengthen this realationship.

Lastly, my appreciation goes to my Aunties, A. Uwani, A. Sa'adatu, A. Bilki, Gwaggo, A. Halima, my brother and friend Umar Usman Muhalli. Dear Safiya, Habiba, my friends at home, other people too numerous to mention.

All I could say is may Allah join us all in JANNATUL FIRDAUS. Amin.

TABLE OF CONTENTS

CHAPTER ONE

1.1 INTRODUCTION

Cellular telephone has enjoyed extra growth in Nigeria. In just less than a decade Nigeria and Nigerians has pass through three generations of telephone systems. Different companies and government agencies have deployed different variations of this generations at different periods.

The earliest national wireless telephone system was introduced by the ministry of science and technology, which created Nigeria mobile telecommunication in 1996. Full commercial operations started later in 1997, with two switches in Lagos and Abuja. Subsequently, two other switches were deployed at Jos and Enugu, as expansion. [1]

The system used was the Total Area Coverage System (TACS) popularly referred to as "analogue" or "cellular" using Motorola Emx-2500 an earlier model than the one to be considered in this project. Other institutions mainly multinational oil companies and the NNPC, for example, deployed personal communications system (PCS) which is referred to as "Trunking"

The deregulation of telecommunication in Nigeria effectively took off in December 1997 when multilink limited, a Private Telephone Operator (PTO), announced the commencement of commercial operations. This was the first time Code Division Multiple Access (CDMA) technology was

deployed in Nigeria; Mutilinks was followed very closely the following month by Intercellular Nigeria Limited in Lagos. This opened the way for the rest of the (PTOS); Starcomms, Mobitel, VGC, EMIS, Cellcom, Bourdex, XPT, Reltel and others.

As at December 2003 there are over 2 million mobile phones subscribes in Nigeria, representing a penetration a rate of over 1.7% of the population. Almost all the PTO'S in Nigeria are using the CDMA technology. The GSM that was deployed later had open wider subscription to mobile telephone. Currently over 100 towns had signals from one of the GSM and PTO operators.

1.2 CDMA

The code Division multiple access (CDMA) technology is considered a recent generation technology. The technology offers a lot of advantages over the previous ones, these include; Security, Voice quality, High capacity and Power management.

Service that could be rendered with the technology are:

a. **Fixed Wireless Communication or Wireless local loop**

This service is similar to the old Mtel landline phone but detached from the problem of wiring and wires. It can be an option for a user at a fixed location. Example office or residence, it is together with a fixed wireless

terminal (FWT) attached with antenna that receives and transmits message to the exchange.

b. **Limited Mobility System.**

This is an option for the mobile user within a city. Different handsets are available that do not require the use of sim cards. Normally, the service provides programmers the handsets with the subscriber number.

c. **Internet/Data and Fax Capability**

The two service mentioned above are data capable. The data function is through the normal dial up method to other computers for transfer/transmission of information or to other internet world. [2]

1.3 PROJECT METHODOLOGY

This design operates on a recent technology, code instead of time or frequency are manipulated using calculation to link communications of data (voice or text).the choice of 10,000 come up because it is the population of a standard community. Hence, a community can develop such project for there communicating needs.

1.4 AIMS AND OBJECTIVES

The objective of this project is to develop a 10,000 subscriber wireless telephone network. Network and signal parameters will be determined in relation to existing systems so as to make it real.

Costing will also be considered, so that interested organisations and institutions can see the reality of this kind of venture.

1.5 SCOPE OF RESEARCH

(a) This project shall provide general overview of cellular system in general; comparisons of different communication technologies and protocols. Emphasis will be laid on CDMA.

(b) Give basic concept elements and operational functionality of wireless telecommunication as they compare with the CDMA systems.

(c) Give system parameters for setting up of a 10,000 subscribers CDMA network. And also give room for expansions.

(d) Simple and compatible way of billing the subscribers will also be looked upon. Furthermore cost for the project design as in above will also be manifested.

1.6 JUSTIFICATION

Most analysts in telecommunication industry today have strong belief that CDMA or one its forms (W-CDMA N-CDMA) is the most probable platform for third generation (3G) mobile telephony and in light of the enormous opportunities in the wireless telecommunications industry, which from all indications has come to stay in Nigeria.

CHAPTER TWO

2.1 CDMA TECHNIQUE

2.2 EVOLUTION OF CDMA

The history of wireless communications can be traced back to the first wireless telegram radioed in 1898, and the first practical project is the police car wireless communications system put into use in Detroit, USA in 1920s. At that time, the system had poor voice quality, low level of automation and it could not be connected to any other different communication system.

U.S. bell lab led the development of really use wireless communication systems in early years and the one named improved mobile telephone service launched in the 1960s. Since the mid 1970s, the conflict between the frequency resources and available channel has become increasingly fierce with the increase of civiler mobile communication subscribers and the expansion of services. [9]

Theoretically, the principle of a cellular system is the repeated usage of wireless channels in geographically different locations. The service area is divided into many abstract cells, two non-adjacent cells can use the same frequency, and the size of the cell is up to the density of subscribers. Therefore, the theory greatly improves the utilization of frequency speculum and effectively enlarges the system capacity.

2.3 DEVELOPMENT OF THE TECHNOLOGIES

The development of micro-electronics communication network, signal encoding, and digital signal proceeding technologies leads to rapid development of mobile communication in such aspects as switching, signalling system and wireless modulation encoding technologies. As a result, the cellular mobile communication system has experienced the changes from analogue to digital, from FDMA to TDMA and CDMA as well as evolution from the first generation mobile communication system to the third generation cellular mobile communication system.

By means of digital transmission and adopting the key technologies such as spread spectrum, power control, soft handover, voice activation, voice coding, multiple access, and diversity reception. It highlighted the features of CDMA and pushed the mobile communication technology to a new level.

2.4 VARIATION IN CELLULAR USAGE

Various cellular protocols are in use throughout the world. They differ in the use of radio frequencies and bandwidths. Depending on local regulations, a country's cellular telephones are assigned specific radio frequencies. The portions of the RF spectrum assigned to TACS/E-TACS, each are summarized below fig A. This project is going to utilise Motorola

electronic mobile exchange EMX – 5000 that is compatible with all the listed system. [2]

2.5 BASIC CONCEPTS OF CDMA WIRELESS TRANSMISSION SYSTEM

2.5.1 Wireless Multiple Access Communication

As it is in electric wave coverage area of wireless communication environment, it is basic for any transmission system to establish channel connection between subscribers. Actually, it is about multiple access mobile communication, at present, the wireless multiple access mode include FDMA in analogue system, and TDMA and CDMA in digital system.

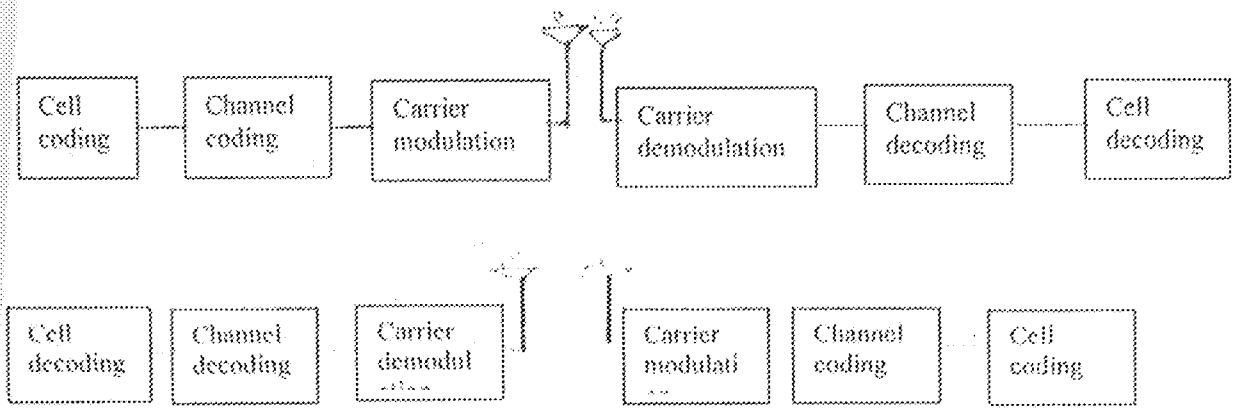
The theoretical basis for multiple access connection is the signal division technology, which is differentiating signal from various stations by proper signal design at the receiving end, and separating signals from their combination by signal recognition set at the receiving end. [3]

2.6 PRINCIPLE OF CDMA TRANSMISSION SYSTEM

The Structure

CDMA means to modulate the transmitted signal by using different and orthogonal pseudo random address codes at the transmitting end and demodulate the mixed signals by using the same pseudo random address codes at the receiving end to get the original signal. The pseudo random address codes are periodic code sequence with strong self – relativity but none or little inter – relativity. [2]

Below is the system transmission in both formal and backward directions.



2.7 MAJOR COMPONENT OF A CELLULAR SYSTEM

The major system components are the Msc-mobile switching centre (Emx 5000 is used in this project), base transmission station (BTS) – (RF_Base station) and base station controller (Bsc) – (C-Bsc).

(a) Mobile Switching Centre (MSC)

The Msc route the appropriate mobile call to the other called party land vice-versa, it also co-ordinates the hands-off process and records all of the system traffic.

(b) Base Controller (Bc)

The Bsc provides the interface between the base station RF equipment and the channel Banks (Emx 5000). The Bsc also monitors itself as in performance. Alarm indications are visible through the Bsc.

(c) Rf Base Station

Rf base stations are located at the cell site. A base station receives and transmits the voice and data message to and from the subscriber with the Bsc providing the interface.

It also monitors the performance of itself and the associated base station Rf equipment, supplying visible indications whenever alarm conditions occur.

(d) Mobile Station (Subscriber Equipment or Handset)

This is the mobile or portable telephone u fixed wireless terminal. At each base site, one pair of frequency is reserved for signalling (control channel). Most of the data traffic between the subscriber unit and the cell site occurs on this channel. Each voice channel is connected to the Emx switch via a dedicated 4-wire circuit. [6]

Network of navigation satellites that along with supplying geographical coordinates continuously transmit an incredibly accurate time signal. In summary, CDMA is a digital system whereby many RF users can share the same spectrum simultaneously, discriminating the signals by the code division used for each subscriber.

2.8 TECHNICAL FEATURES OF CDMA

a. Strong resistance to interface and multipath

b. Multiple access, increased capacity and improved frequency multiplexing.

c. Concealment and security.

2.9 ADVANTAGE OF CDMA OVER GSM

a. Improved coverage characteristic, allowing the possibility of fewer cell sites.

b. Improved call quality, with better and more consistent sound, compared with any system.

c. Simplified system planning through the use of the some frequency in every sector of every cell.

d. Enhanced privacy

e. Roaming.

The above advantages are mostly utilized by the various CDMA operators in Nigeria. But still the subscribers are crying foul on some provide services. This project research considers it deeming to provide services. That wills satisfy the intended subscriber. Hence, the CDMA 2000 is implored, he CDMA 2000 dominates the 3G market today and analysis forecast that it will continue to lead at least in the near future [7]

CHAPTER THREE

3.1 THE NETWORK DESIGN

This chapter is aimed at encompassing the design of the network, taking the cell, proximity and the various user, the antenna, the base stations and some other few things into consideration. Furthermore, some order to clearly picture the network, assumptions have to be made. As some assumption were made already existing network.

It was assumed that the network is having two cell site, each cell site is having a tower in which an antenna, GPS were mounted. The cell site is also having a BTS processing and modulating of signals. The network is provided with a switching centre which housed the MSC. The MSC provides connections to the internet service provider (ISP) gadget is collocated in the switch.

The frequency on which this network will operate is assumed to be 100MHZ. The Nigerian communication commission (NCC) is the regulatory body that is allocating frequency bands to telephone network operates. They have reserved from 80MH2 – 120MH2 for all private telephone operators (PTO).[1]

The gateway for international calls and accessing is chosen to be NITEL because of there cheap mode of operation.

This network provides a wireless connection to the PSTN and GSM for user location within the radio range of the system. The network also accommodates large number of users within the stated frequency. High capacity is achieved because the coverage of each of the two base stations is limited to a small geographical area called a cell, so hat the same radio channels may be reused. A sophisticated switching technique called a handoff or handover enables a call to proceed uninterrupted, when the user moves from due call to another.

Each of the two base stations consists of transmitter and receiving antennas. The base station serves as a bridge between all mobile users in the cell. Calls are connected though microware links, to the MSC. The Msc coordinates the activities of the two base stations and connects the entire network to the PSTN.

The Msc handles 10,000 subscribers and 500 simultaneous conversations at a time. It also accommodates the billing system.

3.2 CHANNEL ASSIGNMENT STRATEGIES

For efficient utilization of the radio spectrum, that is consistent with the objectives of increasing capacity and minimizing interference.

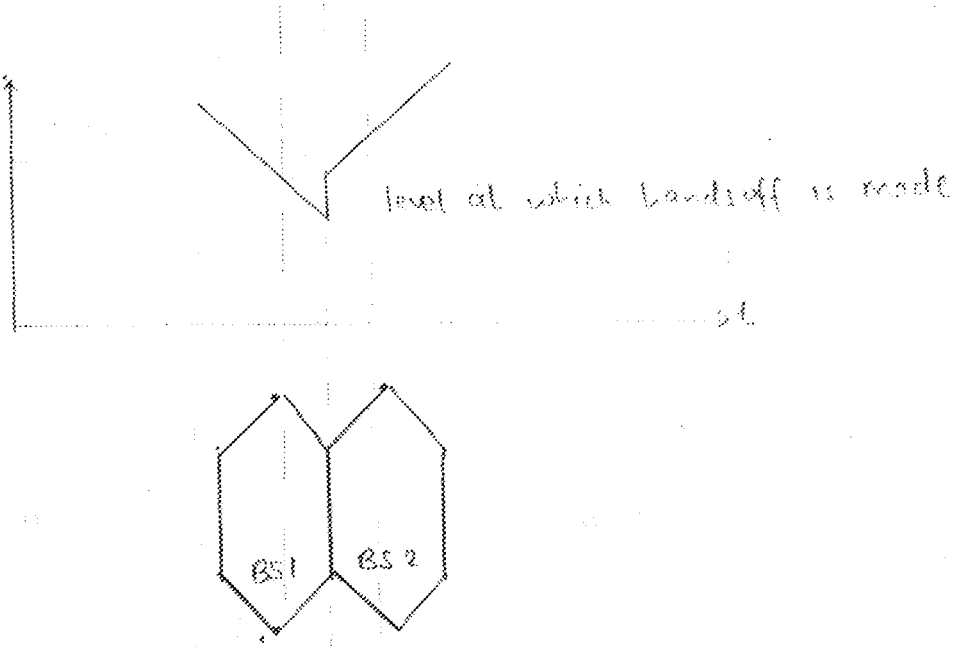
In this network design, voice channels are not allocated permanently. Instead, each time a call request is made, the nearest base station requests a

channel from he Msc. The switch then allocates a channel to the requested cell.

Accordingly, the msc only allocates a given frequency if that frequency is not in use in any other cell to avoid co-channel interference.

3.3 HAND OFF

When a subscriber move into a different cell while conversations is in progress the Msc automatically transfer the call to a new channel belonging to the other base station. This hand off operation involves identification of a new base station, but also the voice and control signals associated with the new base station.



In this project design soft hand off is utilized, in this type of hand off, new cell has to be briefly in use before cutting the old one.

The assumed city in which the network is to be developed is 20squaremiles. The radio of each of the two cells is two miles. Therefore each cell covers an area of;

$2.5981 \times R^2$

$2.5981 \times (2)^2 = 10.3924$ square miles

Hence, the total number of cells are Nc = 20 / 10.3924 = 2 cells

The total number of channels per cell C

=allocated spectrum/channel width*frequency.

=40000/20000*2

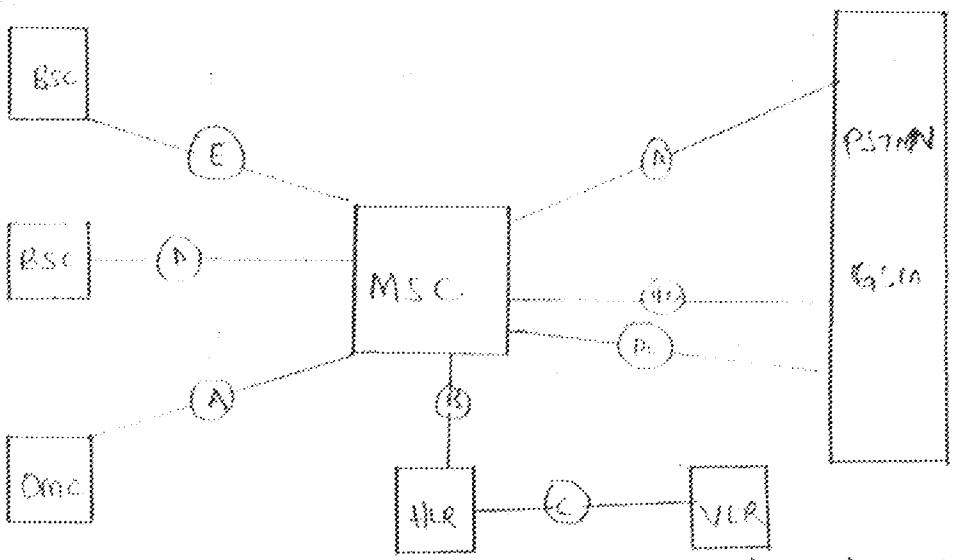
=1 channel/cell

[4]

As the demand for more service increase, the number of channels arranged to a cell eventually becomes insufficient to support the required number of users. Therefore, cell splitting is implored, which will provide more channels per unit area.

Cell spitting in essence is the process of subdividing congested cell in to smaller cells, each with its own base station and a corresponding reduction transmitter power.

3.4 ARCHITECTURE OF THE NETWORK



MSC (mobile switching centre) – This is a piece of automatic equipment between CDMA network and other public switching networks or between subscribers of different Msc's.

VLR (visitor location register) – It saves and updates data of mobile subscribers who roam.

HLR (home location register) – Here information such as (ESN), current location, valid term are stored here.

OMC (operation and maintenance centre) – This enhance the overall working efficiency and service quality of the system.

BSC (base centre) – This consist of both wireless equipment and wireless channel control equipment, serving one or several cells.

The letters A,B,Vm,C,D,E e.t.c represents the interface between the functional entities. The interface marked Ai, Di, and Pi connect CDMA

digital mobile network with other communication networks PSTN / GSM – other network.[6]

3.5 CAPACITY OF THE CDMA NETWORK

Whereas the capacity of CDMA is interference limited, in both FDMA and TDMA it is the bandwidth that is limited. Reduction in the interference will cause an increase in the capacity of the network. Furthermore, the link performance for an individual user increases as the number of users decrease. To further increase the performance of this network multi sectorial antennas were used, which results in spatial isolation of users (subscribes).

In evaluating the capacity of the CDMA network. The signal-to-noise ratio is found. Which is from:

$$SNR = \frac{S}{(N-1)S} = \frac{1}{N-1}$$

Where,

SNR – signal – to – noise ratio

N – Number of users

(N-1) – interfering users

S – Power of the users

In order to achieve an increase in capacity, the interference due to other should be reduced. This is done by decreasing the denominator, in the above equation.

For this network the SNR is calculated this

$$SNR = \frac{10}{(500-1)\ 10} = 0.002$$

Where,

S = 10w, N = 500 [4]

3.6 GRADE OF SERVICE AND BLOCKING

The grade of service ((GOS) is the measure of the ability of a user to access a trucked system during the busiest hour. By maintaining standards, the ncc, which is the telecommunication regulatory body in Nigeria provided a minimum service delivery point. Below which no telecom company should not go which is 0.016

The system load in the very busy hour VBH given by

$$YVBH = \frac{KVBH\ QAT}{3600} \quad \text{(Erlarg) [2]}$$

Where,

YVBH – system load

KVBH – co-efficient concentration on system load

T- average time taken by a subscriber in a call.

Qa – calls in 24hrs.

The following data was generated from a specific data in a similar 10,000 subscriber network. This is also used to determine average time taken by a subscriber and the VBH load [ ]

Total number of calls in 24hrs

Incoming calls 28.28%

Outgoing calls 66.88%

In usage (incoming minutes) 123457.1

Out usage (out going minute) 131810.5

Average time taken by a subscriber ta

$$Ta = \frac{\text{in usage + out usage}}{\text{Total no of calls}} = \frac{255357.6}{124951} = 2.0437 \text{ minutes}$$

$= 2.0437 \times 60 = 122.62$ seconds

3.7 CALL BLOCKING

During the user initiated call stage, if all the traffic channels assigned to the nearest BS are busy, then the user makes a number of repeated attempts.

After a certain number of failed tries, a busy tone is returned to the user consequently, for every user who requests connection is given immediate access to a channel if one is available. If non the . If on channels are immediately available the call is also delayed.

The average delay D for calls in a queed system is given by:

$$D = P_r(\text{delay} > 0) \quad H$$

$$\overline{C - A}$$

Where,

P_r (delay >0) = probability of delay and is greater than 0.

H = average duration

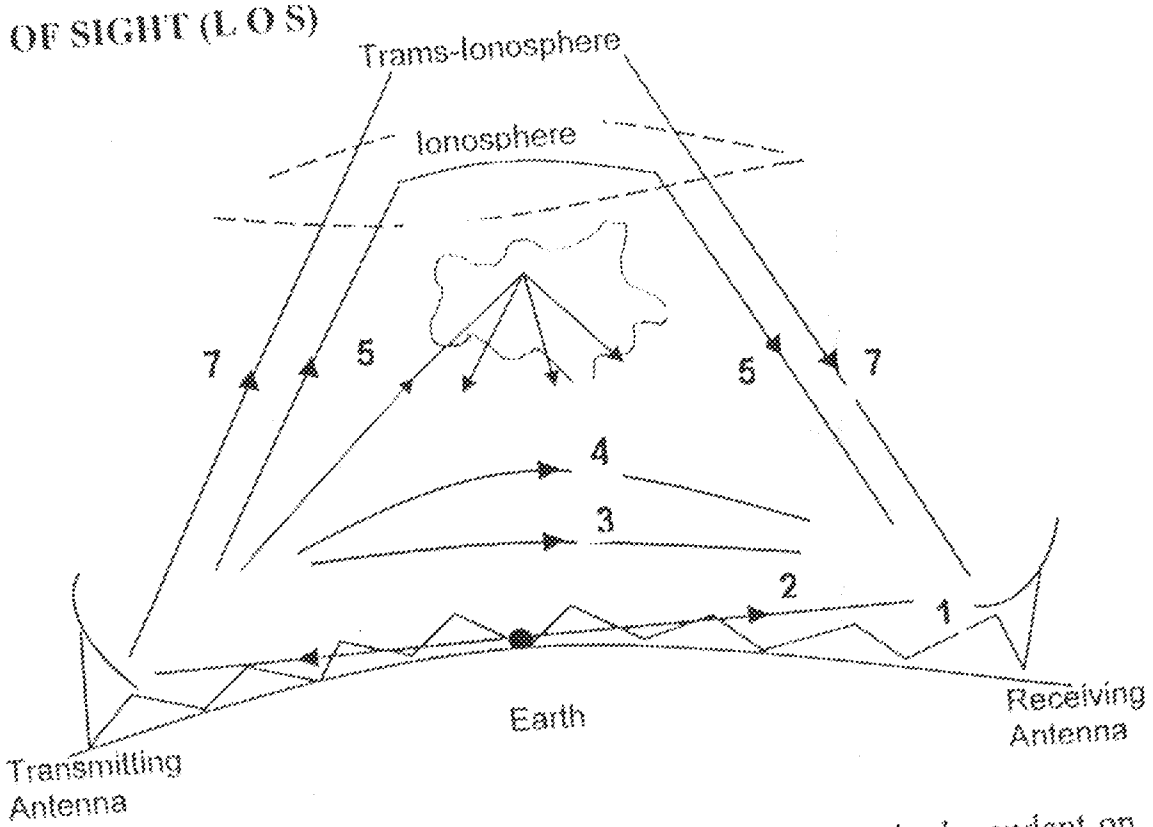
C = channels number

A = traffic intensity

[4]

The delay varies also with all the parameters above.

LINE OF SIGHT (L O S)



The power of the signal in respect to the cell from the user is dependent on the distance. The signal fades as the user moves away from either of the cells. The antenna gain is also defined as the power output in a known direction. The antenna used in this design is 3-sectirial to ensure wider and stable coverage.

The gain of the antenna is found from:

$$G = \frac{4\pi Ae}{\lambda^2} = \frac{4\pi f^2 Ae}{C^2} \quad [1]$$

where,

G – Antenna gain

Ae – Effective area

F – Frequency

C – speed of light (3×10m/s)

λ - Wavelength

$$A = \frac{4\pi Ro}{2\lambda}$$

this project design made use of the following parameters to achieve the 10,000 users.

Wavelength λ = 5cm

Transmit power Ptx – 10w

Amplification co-efficient $r^2 = 0.1$

Distance between Ro = 13km

Antenna gain can be found thus:

$$G = \frac{4\pi A}{\lambda} \quad [1]$$

$$A = \frac{4\pi Ro}{2\lambda} = \frac{4\pi \times 13}{10} = 16.33$$

$$G = \frac{4\pi \times 16.33}{5}$$

$$= 41.0 = 40dB$$

note that;

GdB = 10 Log G

Therefore G = 10 GdB/10

G = 10 40/10 = 10^4

3.8 ANALYSIS OF PN CODE

Let consider the PN offsets Lc (t – Ta) and Lc (t – TB) assigned to user A and user B respectively. the signal from user A to cell A is of the form di(t). Lc(t-Ta).

Like wise the signal from user B to cell B is of the from dj(t) Lc(t-TB)

The received signal at cell A is the composite signal from user A and user B (both are on the same frequency).

The composite signal by each cell is represented as;

Rx = di(t). Lc(t-TA) + dj(t) . Lc(t-TB)

The signal code ae fully econgised by both user and the base station.

During reception at the base station, the input signal to cell A is given by;

Input = di(t). Lc(t-TA) + dj(t) . Lc(t-TB)

Cell A is assumed to have synchronised with user A so, it is tuned to user A with the PN code set to LC(t-TA).

The resulting output signal is this

Output = di(t) . Lc(t-TA) . Lc(t-TA) + dj(t) . Lc (T-TA) . Lc(t-TB)

This too is also recognised by all the network component at default.

3.9 VOICE CONVERSION

In CDMA, code excited linear predictive (CELP) is the format of compressed digital voice data between the BSC and mobile station. For this project, Quantization CELP was used which is an advancement over the CELP.

CELP samples the frequency component of the speech in the frequency domain. CELP uses less data to approximate the original signal. It also uses a complex algorithm which always attempts to describe the speech pattern. The algorithm produces parameters, which becomes a model or liner prediction of the speech pattern.

At the receiving end, the parameters are used to control a speech synthesizer, which uses the inverse algorithm to convert the data back into speech.

CELP conversion takes place at the Bsc.

3.10 VOCODING

Vocoding is the application of QCELP conversion which occurs as in above. The inverse vocoding process is used by the mobile station when receiving voice.

3.11 CALL FLOW

Fixed subscriber calls mobile subscriber.

Firstly the mobile station will locate the strongest pilot channel and monitor the associated paging channel. The BTS uses the paging channel to send a "page" to the mobile station. This notifies the mobile station that it has an incoming call. The mobile station responds by sending a "page response" message to the BTS. The Bts then send a "channel Assignment" message to then mobile station over the paging channel.

Ss7 message can convey information such as:

- So-so number just dialled 080…. Where do I route the call.
- The called subscriber for the call on trunk 11 is busy. Release the call and play a busy tone.
- The route or channel xxxx is congested point send any message too xxxx unless they are of priority.
- I'm forwarding to you a call placed from 22xxxx to 22xxxx look for it in trunk 062.
- I'm taking trunk 143 out of service for maintenance.

3.12 BILLING

Billing is the manual or automated process involved in the pricing and subsequent collection of the income due for the service provided to a customer (subscriber) by an operator.

After a call is made collector gather data from the switch and built a call-detail record (CDR). Which contains originating and terminating numbers. And the start and end times CDR are stored until it is rated. Call data is also shared between companies to handle cals that originate, terminate or are transported on another company's network (I>E interconnectivity).

3.13 COMPONENTS OF THE BILLING SYSTEM

CDR – This contains the detail of the calls and data, CDR can be used for network monitoring, accounting and billing.

GUIDING – This matches calls to customer rate plans.

BILLING – This is to be performed once a month, the program is to add any discounts that are associated with the customer account. [1]

Client specification

Two clients of billing are often used in telecommunication in post paid clients and pre-paid client.

Among the purpose of this project work, is to provide an affordable and easy communication system. Therefore advantage the pre-paid client is used.

Pre-paid client:- This operation is the pay as you go mode-subscriber will buy a card and load it through either the digital VR system or manual crediting.

The cards to be used will be produced by another company on a contract bases.

CHAPTER FOUR

4.1 CONCLUSION

This research has found that there is very little difference in the design of different wireless telecommunication systems. The difference arises in the working functionality. Therefore, after specifying preferred network entities and determining the effective load expected to be processed by the equipment, then the basic network parameters established are ready for implementation.

The various parameter are adjusted in such a way that the network can handle 10,000 subscribers.

4.2 RECOMMENDATION

Though this research has considered the utilization of latest CDMA technologies, still some problems are not overcomed. Some of this problems include the high level of power when very close to the base station.

It is also recommended that, since we are living in a tropical (abundant sunny) region, solar energy can be the source of power instead of PHCN, GENERATOR and BATTERIES. This will surely reduce the cost of running, which will in essence make subscription and usage cheaper.

For the part of both the schools and student, it is recommended that student should work be encouraged to work on topics related to where they have

done there industrial attachment (IT), generally, students should first seek topic in fields related to their experience.

The student will also have the opportunity to mix classroom knowledge with practical know-how of which the benefits are immeasurable.

I also recommend that group or even departmental project should be innovated. The source of funds should be companies with related objectives.

As we all know that engineering is always to make life easier. We have to utilise both our knowledge and local available resource in making our life much easier.

REFERENCES

[1] www.ncc.org

[2] Intercellular Students Training Manual (2000)

[3] Motorola GNL060 Manual (1998) P76 – P93

[4] Wireless Communication Principles and Practice; Theodore S. Rapport P30 – 31, P50 – 55, P422 – 425.

[5] Wireless Communication Network Stalling P102 – 104, 181, 293, 357.

[6] 2TE Operation Manual 2000

[7] WWW. CDG. COM

[8] Encarta 2004 Premium.