

**Computerized Billing System of the Global System for
Mobile Communications. (GSM).**

A Case Study of M-Tel's Post-Paid GSM M-Tel Abuja

By

**Ochu, Oyiwe Thomas
PGD/MCS/2003/1117**

**A Project submitted to the Department of
Mathematics/Computer Science, School of Science and
Science Education, Federal University of Technology Minna,
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November, 2004

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**A Project submitted to the Department of
Mathematics/Computer Science in Partial Fulfillment of the
Requirements for the Award of a Post Graduate Diploma in
Computer Science. Federal University of Technology Minna,
Niger State.**

November, 2004

CERTIFICATION

This Research project has been read and approved as meeting the requirements for the award of a Post Graduate Diploma in Computer Science of Department of Mathematics/Computer, Federal University of Technology Minna, Niger State.

Dr Y.M Aiyesimi
Project Supervisor

Date

L.N. Ezeako
Head of Department

Date

External Examiner

Date

DEDICATION

This project is dedicated to GOD Almighty who is forever faithful.

ACKNOWLEDGEMENT

I am glad and thankful to GOD Almighty that I went through this program successfully.

I am also indebted to my supervisor, Dr Y.M Aiyesimi, whose guidance has succeeded in bringing out the best in me.

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ABSTRACT

An efficient and effective billing system is no doubt of paramount importance to the operation of GSM services worldwide, but of more importance to M-Tel, whose present billing system is still below standard. It has been discovered that although M-Tel's present billing system is computerized, it has a number of problems which include the fact that it is 'archaic', it does not accommodate the relational database management system, it is not user friendly and it is cumbersome and expensive to maintain. This new billing system is designed to take care of these problems.

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CHAPTER ONE

BACKGROUND TO THE STUDY

1.0 INTRODUCTION

Computers are increasingly becoming an integral part of the operations of an increasing number of sectors of the Nigerian economy. Today there is hardly any sector of the Nigerian economy that does not employ the new information and communications technologies. The computer has become a prominent feature of most offices. So also is the telephone, which is the catalyst for the new information and communications technologies in a technology driven economy. The world is fast becoming a global village and a necessary tool for this process is communication of which telecommunication is a key player. A major breakthrough is the wireless telephone system, which comes in fixed wireless telephone lines, or the Global System of Mobile Communications (GSM). The catalytic function of the telephone has increased in recent times with the introduction of the Global System for mobile Communications (GSM). Communications without doubt is a major driver of any economy, with the arrival on the scene of the GSM, things have not been and will never be the same again. It has changed the way business is done; it has changed the way services are paid for. This research project is an attempt to analyze the billing system of

the Global System for Mobile Communications (GSM) using M-Tel's post paid GSM as a case study.

Nigeria joined the GSM League of Nations in 2001 when Econet rolled out its GSM services. MTN followed in the same year. The Nigerian Telecommunications Limited (NITEL) rolled out in 2002. A fourth network, Globacom rolled out in August 2003 in the Federal Capital Territory (FCT).

This research project focuses on the billing System of NITEL's Global System of Mobile Communications (GSM). The NITEL GSM operates the pre-paid ('Rose' pre-paid package) and the post-paid ('Royal' post-paid package) services. This project is interested in the post-paid service, which is the service provided by M-Tel, a subsidiary of NITEL. The objective of this research project is to analyze the way customers of this service are billed. It will also design a computerized billing system aimed at improving the existing system and the services it renders. It is hoped that the result of this research project will be a more efficient Customer Care and Billing System (CCBS) than the current billing system.

1.1 HISTORY OF THE COMPUTER SYSTEM

The abacus, which emerged about 650 BC in Asia Minor and is still in use today, maybe considered the first computer. In 1642, *Blaise Pascal*

(1623-1662), the 19-year old son of a French tax collector invented what he called a numerical wheel calculator to help his father with his duties. This brass rectangular box was called the *PASCALINE*. The drawback to the Pascaline of course was its limitation to function of addition. In 1694 *Goltfried Wilhelm Leibniz* (1646-1716) improved on the Pascaline by creating a machine that could multiply. Later inventors improved on and refined the calculator so that it could perform the four basic arithmetic functions of addition, subtraction, division and multiplication. These early inventors helped define the age of mechanical computation.

The real beginnings of the computer as we know it today, however, lay with an English mathematics professor, *Charles Babbage* (1791-1871). Frustrated at the many errors he found while examining calculations for the royal astronomical society, Babbage's first attempt at solving this problem was in 1822 when he proposed a machine to perform differential equations, called a *difference engine*. One of the few people who understood the engine design as well as Babbage was *Ausgusta Ada King*. She created the instruction routines to be fed into the computer making her the first female computer programmer. In the 1980's the U.S Defence Department named a programming language ADA in her honor.

The First-generations (1946-1959) of computers were developed with the onset of the World War II. Government's efforts to develop computers to exploit their potential strategic importance. First-generation computers were characterized by a major electronic component, which was the vacuum tube. It was programmed by connecting a lot of wires an example of this is the ENIAC (Electronic Numeric Integrator and Calculator), it was made of 18,000 vacuum tubes; the first computer to use the stored program concept.

The Second-generation of computers (1959-1965) were characterized by the solid state devices (Transistors which replaced the vacuum tube) and the magnetic core storage. It was the stored program and programming language that gave computers the flexibility to finally be cost-effective and productive for business use. The stored program concept meant that instructions to run a computer for a specific function (known as a program) were held inside the computer's memory and could quickly be replaced by a different set of instructions for a different function. Examples of these were the IBM 1400 series and UNIVAC III.

The Third-generation computers (1965-1970) had the Integrated Circuit system (IC) as their major components. The integrated circuit increased the speed of the computer by a factor of 10,000 over the previous computers. The Arithmetic operations were performed in microseconds; the

memory (Primary Storage Device) of the computer was greatly augmented. All these together with the fast I/O devices made a good and portable system. A good example was the IBM 360 series.

The Fourth-generation computers (1971-date) comprised of Microprocessors, which is a single miniature chip containing the circuitry and components for arithmetic, logical and control operations. These minicomputers as they came to be called came complete with user-friendly software packages that offered even non-technical users array of applications, most popularly word processing and spreadsheet programs. In the early 1980s, arcade video games such as PAC-man and home video game systems such as the *abari* 2600 ignited consumer interest for more sophisticated programmable home computers. In 1981, IBM introduced its personal computer for use in the home, office and schools. Asian computers continued their trend toward a smaller size, working their way down from desktop to laptop computers (which could fit inside a brief case), to palmtops (able to fit inside a breast pocket). As smaller computers became more powerful, they could be linked together, or networked to share memory space, software information and communicate with each other, using either direct wiring, called a *local area network* (LAN), or telephone lines. These networks could reach enormous proportions.

A global web of computer circuitry, the internet, for example, links computers worldwide into a single network of information. The most popular use today for computer networks such as the internet is *Electronic mail*, or E-mail, which allows users to type in a computer address and send messages through networked terminals across the office or across the world. Many advances in the science of computer design and technology (especially the Japanese technology) are coming together to enable the creation of Fifth-generation computers.

Fifth-generation computers (present and beyond); are mainly characterized by:

- Artificial intelligence
- High level decision making
- Voice recognition
- Robotics
- Natural language processing

Though still under development but gradually emerging with great advancement two such engineering advances are parallel processing, which replaces *Von Neumann's* single central processing unit design with a system harnessing the power of many CPU's to work as one. The second super conductor technology, which allows the flow of electricity with little or no

resistance, thus greatly increasing the speed of information flow. Computers today have some attributes of fifth-generation computers. For example, expert systems assist doctors in making diagnosis by applying the problem-solving steps a doctor might use in assessing a patient's needs.

It will take several more years of development before expert systems are in widespread use. (Jones, 2001).

1.2 OVERVIEW OF THE GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS (GSM).

During the early 1980s, analog cellular telephone systems were experiencing rapid growth in Europe, particularly in Scandinavia and the United Kingdom, also in France and Germany. Each country developed its own system, which was incompatible with every one else's equipment and operation. This was an undesirable situation. Because not only was the mobile equipment limited to operations within national boundaries which in a unified Europe were increasingly unimportant, but there was a very limited market for each type of equipment, and so economies of scale, and the subsequent savings could not be realized. The Europeans realized this early and in 1982 the Conference of European and Telegraphs (CERT), formed a study group called the "Group special" mobile (GSM), to study and develop

a pan-European public land mobile system. The proposed system had to meet certain criteria:

- good subjective speed quality;
- low terminal and service cost;
- support for international roaming;
- ability to support hand held terminals
- support for range of new services and facilities; and
- ISDN (Integrated Services Digital Network) compatibility.

In 1989, GSM responsibility was transferred to the European Telecommunications Standard Institute (ETSI). Phase 1 of the GSM specifications, were published in 1990. Commercial service was started in mid-1991, and by 1993 there were 36 GSM networks in 22 countries, with 25 additional countries having already selected or considered GSM [DS93]. This is not only an European standard; South Africa, Australia and many middle and far East countries have chosen GSM. By the beginning of 1994, there were 1.3 million subscribers worldwide. The acronym, GSM, now aptly stands for “Global System for Mobile” telecommunications. The developers of GSM chose an unproven (at that time) digital system, as opposed to the then standard analog cellular systems like the advanced mobile phone service (AMPS) in the United States and total access

communications system (TACS) in the United Kingdom. They had faith that advancements in compression algorithms and digital signal processors would allow the fulfillment of the system in terms of quality and cost. (Scorias, 1994).

1.3 HISTORICAL BACKGROUND OF M-TEL AND GSM SERVICES

In 1992, NITEL was commercialized following a tripartite agreement between it, the Government and the then Technical Committee on Privatization and Commercialization (TCPC). In January 1996, NITEL Mobile Telecommunications Limited (M-Tel) was established. It was established as a public enterprise under the supervision of the Ministry of Communications. On May 21, 1996, M-Tel was incorporated as limited liability company under the companies and Allied Matters Act, and expounded its cellular network capacity from 10,000 lines in 1996 to 20,000 lines in 1998. (NITEL's Management Information System, 2002).

1.3.1 Milestones

1. Increase in customer service centers from one in Lagos in 1993 to six in various parts of the country by 1998.
2. The cellular network in Areas 1 and 2 were upgraded to ASA software for increased connectivity and enhanced features.

3. Administrative offices and staff quarters were established in Abuja, Lagos, Enugu, Kaduna, Kano and Minna.
4. Implementation of national cellular network rehabilitation and expansion to provide additional 10,000 lines in Lagos and also extend services to the omitted parts of the South West, South East, South South, North Central, North West and provide services to the North East.
5. Implementation of the Area 3 (Abuja) network project by rehabilitating the infrastructure and replacing the 5,000 lines MSC (Mobile Switching Centre) with a 75,000 line MSC.
6. Implementation of the billing system in 1998.
7. Sustained revenue generation growth of about 100% per annum from 1996 to 1999.
8. M-Tel was licensed to provide GSM services.
9. M-Tel was admitted to the GSM Association as a full member in 1999
10. M-Tel was re-merged with NITEL and re-designated as the NITEL *Mobile communications directorate* in January 2001.
11. NITEL re-licensed to operate GSM in February 2001.
12. NITEL signed contracts for 118,000 GSM lines infrastructure in 2001.
13. NITEL submitted application for GSM Association Membership in 2001.
(NITEL's management information system,2002).

1.4 OBJECTIVES OF THE STUDY

The purpose of this research project was to automate by *alternative design* a full computerization of the existing billing system that is expected to be cheaper.

In line with M-Tel's corporate objectives of providing cellular services (GSM) to the citizenry as well as generating revenue for the Federal Government of Nigeria, M-Tel needs an efficient customer care and billing system (CCBS). This research project will help to achieve these objectives because the bedrock of M-Tel services is the provision of well documented statistics, beginning with the subscribers' bills which have to be very accurate at all times.

M-Tel operates a policy, which ensures that no matter the customer base size, only 5% of them will be provided with the postpaid service. This is largely because of the high cost of running the postpaid service and the lack of trustworthiness of some customers; this has led to the provision of the postpaid service to trusted customers and companies like the NNPC and CBN offices.

It is expected that the creation of an alternative computerized billing system instead of the contracted one will be cheaper. Also, it is hoped that

problems involving fraudsters, misappropriation of funds by subscriber companies and security will be tackled.

1.5 SCOPE / LIMITATION.

Due to the technical nature of the project, it was limited to the basic features of any typical billing system.

A typical GSM service provides two types of services, a *Pre-paid* service, which is the type of service provided by all the GSM service providers. With the pre-paid service, users are expected to buy a voucher card or a credit card. There is also the *Post-paid* service, which is the type of service provided by MTN and which was provided by M-Tel (still to be continued), whereby the users obtain their bills at the end of the month. The charging Data Record (CDR) monitors the user's call. The scope of this project is limited to the latter. The program design will compute this billing system with a view to improving on its performance.

1.6 RESEARCH METHODOLOGY.

The information used to carry out this project study will be obtained from three major sources.

- i. **Face-to-face interviews:** Those interviewed were staff from the Public Relations Office and the Computer Office of M-Tel. The issues discussed were the history of M-Tel, the mode of operation of the existing billing system and the benefits that would be derived from improving on this current system.
- ii. **Direct observation of the technology in question:** The GSM phone using the post-paid service was observed; its operation and how customers are billed.
- iii. **Record review:** Information was also gathered from books, related research materials obtained from the Internet, individual researchers and M-Tel on GSM.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 BILLING SYSTEMS

According to Ellis (2002) billing is so vital and so vexing. It is vital because most billing systems do so very much more than billing. It is vexing because billing systems are always among the top three reasons why such and such a new service can't be launched more quickly.

In telephony, billing involves gathering data for customer use and the provision of features, calculating costs and invoicing for payment. In order to be competitive, companies will need to improve the operational processes they use to provide these new services. The demand for new and more sophisticated products and services and the provider's time-to-market will drive the marketplace. More than ever, service providers will also need to focus their attention on understanding customer's needs and providing higher-quality services. A company's ability to represent and bill accurately for these newer and more complex services will become a bigger challenge over the next few years.

call to decide what the change should be, based on the calling plans on the customer's record.

- Rating application – This program applies the rate for the individual guided calls. Rating gives the call a value to be charged at the time of billing (not including any promotions, discounts, or taxes).
- Billing – This is usually performed once a month. This job collects all of the rated calls that have been stored over the past 30 days. The program adds any promotions and discounts that are associated with the customer account. For example, if customers have called over a certain number of minutes, they might get a volume discount. In addition, taxes and credits are applied.
- Invoicing - When the billing job is complete, a file is created that includes all of the customer's information. This file is sent to a print house to be converted to paper invoices. These invoices are then stuffed into envelopes, along with specific inserts targeted to the customer. Many companies will also create electronic statements and send customers their invoices through diskette, tape, or even e-mail; alternative, billing practice is especially common for business customers. (IEC: Telephony billing, 2004).

2.2 SERVICES PROVIDED BY THE GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS (GSM).

The International Telecommunications Union (ITU), divided telecommunications services into three categories:

- Bearer Services
- Tele-services
- Supplementary Services

2.2.1 Bearer Services

The digital nature of GSM allows data, both synchronous and asynchronous, to be transported as bearer service to or from an integrated services digital network (ISDN) terminal. Data can use either the transparent service, which has a fixed delay but no guarantee of data integrity, or a non-transparent service, which guarantees data integrity through an automatic repeat request (ARQ) mechanism, but with a variable delay. The data rates supported by GSM are 300bps, 600bps, 2400bps and 9600bps.

2.2.2 Tele-services.

The most basic tele-service supported by GSM is *telephony*. There is an emergency service, where the nearest emergency service provided is

notified by dialing three digits (similar to 911). Recommendation T.30 is also supported by the use of an appropriate fax adaptor. A unique feature of GSM compared to older analog systems is the Short Messaging Service (SMS). SMS is a bi-directional service for sending alphanumeric message (up to 160 bytes) in a store and forward fashion. For point-to-point SMS, messages can be sent to another subscriber to the service, and an acknowledgement of receipt is provided to the sender. SMS can also be used in a cell-broadcast mode, for sending messages such as traffic updates or news updates. Messages can be stored in the SMS card for later retrieval.

2.2.3 Supplementary Services.

Supplementary services are provide on top of tele-services or bearer services, and include features such as caller identification, call forwarding, call waiting, multi-party conversation, and barring of outgoing (international) calls among others. (Scourias, 1994)

2.3 GSM TERMINOLOGIES

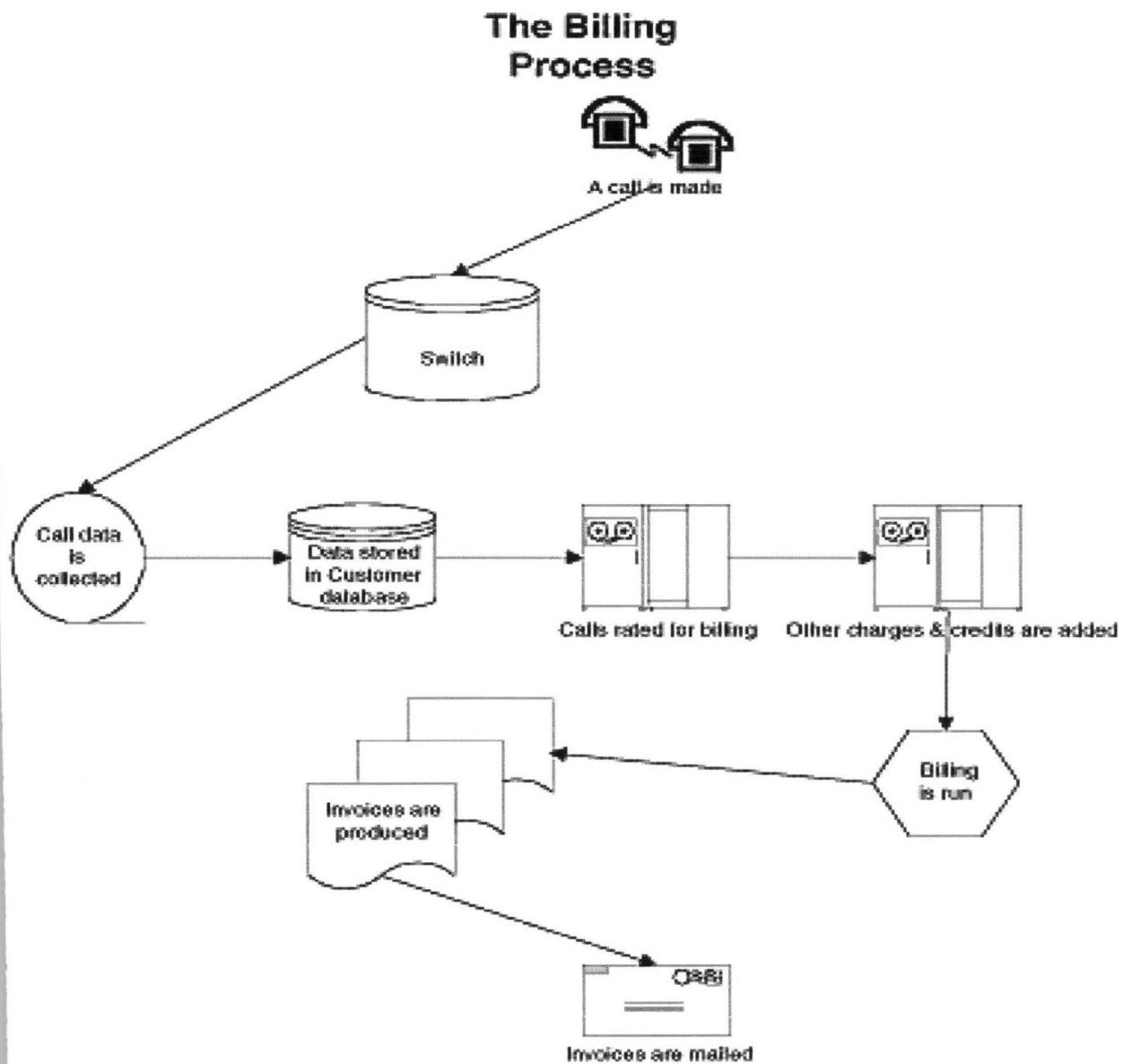
- **AUC** – This stands for *authentication center*. A unit that provides authentication and encryption parameters that verify the user identity and ensure that confidentiality of each cell. In other words the main function of the AUC is to authenticate subscribers attempting to use a network. It protects network operators from different types of fraud found in today's cellular world. It is a database connected to the home local register (HLR).
- **VLR** – This stands for *visitors location register*. This database contains temporary information about all mobile subscribers that is needed by the mobile switching center (MSC) to service all visiting subscribers. The VLR is always integrated with the MSC.
- **HLR** – The *home location register* is a centralized network database that stores and manages all mobile subscriptions belonging to a specific operator. Such information includes subscriber's: identity, supplementary services, location information, authentication information.
- **EIR** – This stands for *equipment identity register*. This is a database containing mobile equipment identity information, which can be used to detect and block stolen unauthorized or defective MSC's.

2.0.1 BASIC FUNCTIONALITY OF BILLING SYSTEMS

Billing systems collect, rate, and calculate charges and then invoice for the products(s) or service(s).

Figure 1 depicts a simple billing system and is an overview fo how a basic billing system works.

The Billing Process.



According to IEC (2004), Figure 1 shows that after a call is made, a collector gathers data from the switch and builds a call-detail record (CDR). This CDR must contain the *Caller id, the Receiver id, and the Start and Stop-times*. The CDR is then stored until it can be rated. To rate the call, the CDR is examined to see if the call is, for example, an '800' number, a local call that is covered by a local-area calling plan, or a toll call. Information such as the time call was placed and the distance between callers is also used to calculate the bill for the call. Once each call is billed, this information is stored until the invoice is run, usually once a month. When the invoice is run, other non-usage charges can be applied to the bill, such as volume discounts or monthly fees. This information is then prepared so that it can be printed in readable form. Finally the envelope is printed, stuffed with enclosures, and mailed. Call data is also shared between companies to handle calls that originate, terminate, or are transported on another company's network.

Several options are available that change the nature and capability of the billing system. For example, if calls are rated and stored, then accurate current bill total can be quoted to a customer.

Issues that must be addressed when managing the billing system are many. These are reliability, accuracy, and readability, are basic needs. Data

- **MSC** – This stands for *mobile switching center*. This performs the telephony switching functions for the mobile network. It controls calls to and from other telephone and data systems. It also performs such functions as toll ticketing, network interfacing, common channel signaling and others.
- **BSC** – The *base station controller* manages all the radio-related functions of GSM networks. It provides functions such as MS-hand-over, radio channel assignment and collection of cell configuration data.
- **BTS** – This stands for *base transceiver station*. This controls the radio interference to the MS. The BTS comprised of the radio equipment such as transceivers and antennas.
- **OMS** – *Operations and maintenance subsystem*. This is a computerized monitoring center, which is connected to other network components such as MSC's and BSC's through data network lines.
- **NMC** – *Networks management center*. This offers centralized control of networks. NMC staff can concentrate on long-term system wide issues, whereas local staff can concentrate on short-term regional issues.
- **MS** – *Mobile station*. This consists of a mobile terminal and a SIM.

- **Credit limit control** – Ability to control credit limits.

Other functions include:

- **SIM management**
- **Dealers management**
- **Front office administration** – such as activation, de-activation, account swap, PIN and super enquiries.
- **External interfaces** – Such as banks and dealers. (Ericsson radio systems AB, 1999).

changes and therefore, it is not robust. In other words, it cannot handle a large amount of billing.

2. It does not accommodate the relational database management system, which is the most appropriate database that can be used in the process of computerizing this type of billing system.
3. It is not user friendly. Because of this, when customers run into problems, they have trouble solving them.
4. It is cumbersome and expensive to maintain, because it is bulky and burdensome.

3.1 SYSTEM ANALYSIS

This section gives an overview of how the present billing system is operated and how calls are charged. Obtaining information at this stage was a little problematic because of the sensitivity of the issue at hand; i.e. billing. Also the expatriates invited to come and solve the company's (NITEL) problems also proved very secretive.

When a call is made from a *mobile station* (MS) i.e. (the handset), the request is sent to the *Base Transceiver System*, (BTS), which then sends the request to the *Base Transceiver Station Controller* (BSC). The BSC contains

the *Gateway Mobile Switching Center* (GMSC). The *Mobile Switching Center* (MSC), and the *Home Location Register* (HLR).

The GMSC collects processes and distributes billing data automatically online and also provides other features such as hot billing. It produces charging information. The MSC performs the telephony switching functions, while the HLR stores and manages all mobile subscriptions belonging to a specific operator. Such information include:

- The subscriber's identity
- The subscriber's supplementary services.
- The subscriber's location information.
- The subscriber's authentication information.

At the receiver's end the same transition takes place until the end connection is made. When the call gets through, an Intelligent Network (IN) component starts the charging at the intelligent network. The charging is performed and received in a hexadecimal format. It is then sent to the billing gateway, where it is translated into a readable, billable format on the Charging Data Record (CDR). From there it is sent to the billing system which charges the call and gives out reports.

This analysis describes an already computerized billing system which, was written as a network program, and describes what happens at the billing

- **INTERNATIONAL ROAMING** – This is one of the main advantages of the GSM standard and is applied when a mobile station moves from one public land mobile network to another.
- **CELL** – This is the basic unit of a cellular system and is defined as the area of radio coverage given by one base station antenna system.
- **LOCATION AREA** – This is a group of cells. The identity of the LA in which a mobile station is currently located is stored in the *Visitors location register* VLR. When a mobile station crosses the boundary between two cells belonging to different location areas it does *Location updating*, but occurs only in the idle state.
- **MSC SERVICE AREA** – This represents a number of *location areas* and represents the geographical part of the network controlled by one MSC.
- **PLMN** – *Public land mobile network* the area in which an operator offers radio coverage and network access.
- **GSM SERVICE AREA** – An area in which a subscriber can gain access to a GSM network.

gateway. Although computerized, this billing system has a few problems. System design involves the design of a new system to replace the existing system.

3.2 SYSTEM DESIGN

System design is concerned with the development of specifications for the proposed new system, which seeks to achieve the requirements detailed during the analysis phase. It should be noted that the system designed in this project would need a few modifications to meet the standard expected of industrial program design.

The new design monitors what happens as soon as a customer picks his/her handset to make a call, up to when the customer hangs up. The customer is then billed accordingly.

3.2.1 Preliminary Studies

The researcher took various steps towards the actualization of the project. Information of GSM operations and billing system was gathered from journal articles and other relevant publications. The Visual Basic 6.0, a dialect of the standard BASIC, was used because it is an object-oriented programming language, suitable for the design in question. Visual Basic 6.0

makes use of objects called textboxes, command buttons, combo boxes, etc. to each of these objects, codes are assigned to make them functional.

Some tutorial in the Visual Basic 6.0 programming language was required by the system designer to be able to carry out this research work.

3.2.2 Aims Behind Designing the System

In designing the system, the following were considered to be very important. The system must be:

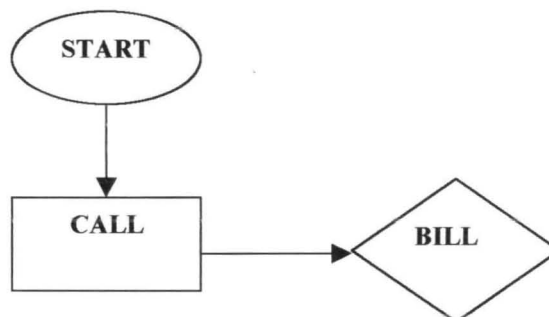
1. User Friendly: this involves making sure that any user can make use of the system without encountering any difficulties.
2. Error Capability: this involves making sure the system provided the facility for handling errors that could occur in the course of using the system, e.g. typing alphabets in the box for caller id.
3. Aid Solving Problems: the system should have the capability to solve all the problems of the existing billing system.
4. Interactive: there should be a level of interaction between a user and the system, e.g. when a user hangs up his/her handset, a message box appears asking the user if he/she wishes to make another call. The user is then expected to click 'Yes' or 'No'.

3.3 SOFTWARE DESIGN

A set of programs and subprograms put together with which the hardware (CPU) is made to perform a specific task or even produce a specific result is called software design. In designing software, the main objective or goal is to plan and design it in such a way that the result or final payment is the proposed one. An algorithm of the software being developed is usually the first step in software design. It is the step-by-step plan of action that if followed will solve the problem. In this chapter the algorithm for simplicity will be presented graphically in the form of a Flowchart.

3.3.1 Flowchart

The graphical representation of an algorithm is called a flowchart. It usually consists of boxes (squares or otherwise), which represent an operation, an operation, and directed lines (arrow headed lines), which show the direction in which a particular instruction is carried out. The system flowchart is shown in figure 3.1. This flowchart is a general outline of the system. A more detailed flowchart will be shown later on in this project.



3.4 OUTLINE OF DESIGN

3.4.1 Input Design

The program written for the system was majorly mathematical and therefore most of the characters required for input were numeric.

3.4.2 Output Design

The output displayed by the system is a Visual Basic screen, showing the Visual Basic objects or the billing grid depending on the stage you are in.

3.4.3 Process Design

This is usually controlled by the system design. The various inputs accepted from the user are processed to produce the bill.

3.5 THE MAIN PROGRAM

The system is mathematical in nature and the program is object-oriented programming.

3.5.1 Procedures for Billing

A customer's call has to be monitored from when he/she picks up the handset to make a call and gets through, up to when that customer hangs up the handset. Accordingly, the customer is billed according to the number of minutes spent.

2.4 FUNCTIONAL OVERVIEW OF A GSM BILLING SYSTEM: A CASE STUDY OF EPIX (ERICSSON) CCBS

To understand the functionality of a billing system, the concept of *mediation* must be understood.

The integration of various network nodes that produce charging outputs in one form or the other is an issue that is resolved with the aid of *mediation* devices. A mediation device from telecommunications point of view can be defined as a device that serves as an intermediary between two or more network elements. A popular mediation device (with particular regards to GSM billing) is the *Ericsson's bgw*. This allows customer administration systems to exchange information with network elements to produce charging data.

GSM networks are usually complex especially with the introduction of newer services and functions such as messaging centers or mobile data-com.

The billing gateway is a single point, uniform interface connection between the networks that produce charging information and the administrative of billing system. The billing gateway not, only collects, processes and distributes billing data automatically and online but also

provides other features such as billing and alarm handling. The key functions of the billing gateway include:

- Collection and distribution of charging data records (CDR)
- Hot billing
- Flexible processing of billing data
- Flexible filtering
- Flexible formatting
- Consolidation of partial CDR's
- Rating
- Charging data record (CDR) archiving
- Alarm handling
- Graphical user interface supervision and configuration. (Ericsson radio system AB, 1998)

2.5 BASIC FEATURES OF A TYPICAL GSM BILLING SYSTEM: i.e. EPPIX

- **Call rating** – This can be based on time of day, day of the week, region of call, and day of the year, type of call.
- **Minimum duration** – possibility of setting a duration below, which calls are free.
- **Call length** – possibility of charging for calls based on total length of a call.
- **Tap processing** – possibility of producing reports showing monies owed mutually between roaming partners.
- **Bundling** - Capability of attaching free talk time to a tariff.
- **Fraud management** – possibility of exercising controls especially between roaming networks. Each network typically possesses upper threshold limit for their subscribers while roaming.
- **Invoicing** – i.e., invoice production for services rendered.
- **Convergent/divergent invoicing** – possibility of separation or combination of subscriber invoices.
- **Friends and families** – This is usually subscriber-specific. It allows subscribers to define dialing numbers that are frequently called and on which special discount can be applied as agreed.

3.5.1.3BILLING GRID SCREEN FORM: This program was written to generate information on the call just made. This billing grid is a relational database. It was created using Microsoft Access and the programming language used to connect to the Visual Basic program is the SQL programming language. The customer's billing information is obtained by typing in the phone number in the *caller id* box and clicking on *bill*. Figure IV shows the billing report. This program was written, to make it possible to see all the calls that have ever been made by a customer. With this billing system, when a customer's bill has been seen, the program enables this bill to be printed out for the customer. To obtain specific information like *caller id* or the number of calls that have been made so far, all the user needs to do is click on "General Bill".

CHAPTER FOUR

IMPLEMENTATION

4.0 SYSTEM IMPLEMENTATION

This chapter deals with the implementation of the system taking into consideration the hardware, software, and other things necessary for the implementation of the system. Further explanation on the modules of the system and the way they are related will be given.

4.1 HARDWARE CONSIDERATION

To develop a suitable package, adequate attention must be given to the hardware components of the computer used in the implementation. The hardware is made up of the CPU – microprocessor. The hardware configuration should be as follows:

- Hardware configuration should be nothing less than Pentium 400Maz,
- Atleast 10 mega bytes of memory space
- 32 mega bytes of random access memory (RAM)
- operating system should be either windows 98, windows 2000, and windows XP

4.2 SOFTWARE CONSIDERATION

Many languages exist for the development of a system. In practice the choice of a suitable language is often inhibited by programmatic constraints. The architecture of the application, the languages available and the skill of the programmer may influence the decision. With due consideration of these facts, Visual Basic was used because it is an object-oriented program and most suitable for the topic in question, *billing*. Also Microsoft access was used to construct the *billing grid*, which is the database in this design SQL was used to link the database to the rest of the design.

4.3 MODULES OF THE SYSTEM

This section looks at the various modules that make up this system and the way they relate together to produce the general effect of the whole system.

4.3.1 Users' manual: To enter the system, first put on the computer and load the operating system. When you have loaded the operating system, follow these steps:

- Insert the source disk (or diskette) in either drive A or B depending on the number of floppy drives the CPU has
- Click on start, choose programs from the pop-up menu, and then choose windows explorer from the adjoining pop-up menu. When

windows explorer is opened, click on the drive with the disk (e.g. 3^{1/2} floppy A). The icon chosen depends on the name given to the design.

4.3.2 Modules

When a user accesses the system, he first sees a back screen after which the opening screen comes up by clicking the mouse bearing the title of the project and the programmer's name. About 1 minute later the next screen, which is the *login* screen for the main screen. This is where the main programming is. It contains a tool bar which is where the user can choose from the options '*Call*', '*Bill*' And '*Administrative*'.

- Call: When the user clicks on the *call* command he gets a drop down list that gives the options *Make call* or *Exit*. The *make call dropdown* shows a new screen that contains two (2) option buttons, which have identity of the type of calls made (i.e. if the call is local or international). It also contains six (6) text boxes, which have the *caller id*, *destination id*, *call date*, *timespent*, *start time*, *stoptime*, *duration* and *call cost*. There are four (4) command boxes which have the identity of *send/ok*, to make a call, *end call/stop*, *new call*, *done* (to exit). A frame (*Call Activity*) holds the *start time*, *stop time*, *duration* and *call cost* text boxes.

- Bill: Which brings out the General and Individual reports of all calls made, especially when any call(s) need to be monitored. It contains data buttons, and a command button that has the printer icon on it for printing out such reports
- Administrative: this drop down option accesses the *call cost update* screen; you have a login screen which contains two (2) text boxes for accepting user name and the password, and two (2) command buttons *ok* and *cancel*. Once the administrator's password is accepted a next screen is opened, which is the *call cost update* which contains three (3) text boxes *Current Call Cost / Second, International Call cost / Minute, Date*. It also contains two command buttons *update* and *cancel*, a horizontal and data scroll bar.

When a caller picks up a mobile phone and dials a number and a connection is made, it is equivalent to clicking on the '*send/ok*' button. This is after the caller has typed in the number of the person he wishes to call, i.e. *Destination Id*. It is assumed that if this system design is made a *network* program, once a subscriber picks his/her handset to make a call the billing system is automatically activated. So the subscriber's number i.e., *caller id* is immediately shown. But for the purpose of this project, the billing system is such that, in the *caller id* will have to be typed in.

Precautions were taken in the course of writing this program to prevent it from crashing in the process of using it. For example if a user types in a different *caller id* from that of the operating network (M-Tel – 0804-xxxxxxx) a message box comes up saying “*Wrong Number*”. If a wrong number (less than 11 or greater than 11 characters, or a text) is entered into the *caller id* text box an error message “*enter valid phone number*” is displayed.

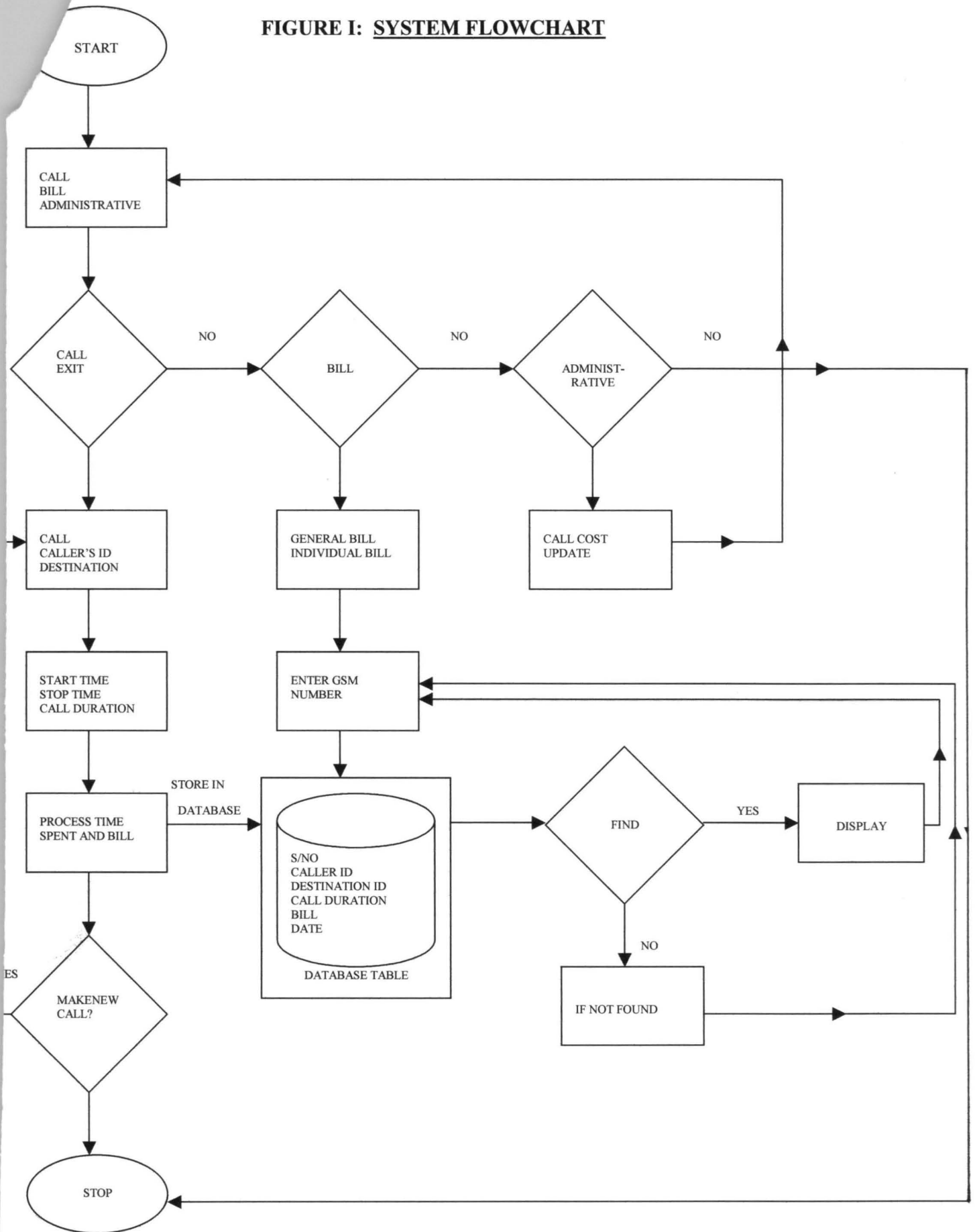
To view the documented bill or the report the user clicks on the *Bill* drop down option and then clicks on the ‘General Bill’ or the ‘individual’ to view the report, the user also has an option to print out the report for further documentation, the bill contains information like *caller Id, Destination Id, call duration, time spent, call cost* etc. This particular option allows better customer care, for instance, if a customer comes to complain about an irregular billing the administrator then prints out a report about the activities of that particular number to verify the complaints; this is a feature that is not readily available in the M-Tel service.

To terminate the program click ‘*done*’ on the make a call form which takes you to the beginning of the screen where you then click the ‘*call*’ drop down option then ‘*exit*’ to exit the program.

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FIGURE I: SYSTEM FLOWCHART

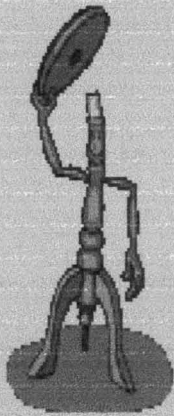


GSM BILLING SYSTEM



GSM BILLING

(A CASE STUDY OF M - TEL)



DEVELOPED BY:
THOMAS OCHU

DEPARTMENT OF MATHEMATICS / COMPUTER SCIENCE
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

Enter **HERE** >>

NOVEMBER, 2004

FIGURE II: Opening Screen Form

Billing Grid

Caller ID:

Month:

This is your Bill:

CallerID	ReceiverID	Date	StartTime	EndTime	TimeSpent	Bill	Type

Total Bill

FIGURE IV: BILLING GRID

SOURCE CODE FOR MAIN FORM

```
Private Sub callcost_Click()  
frmadmin.Show  
End Sub
```

```
Private Sub exit_Click()  
End
```

```
End Sub
```

```
Private Sub Form_Load()  
End Sub
```

```
Private Sub general_Click()  
FRMGENERAL.Show  
'CrystalReport1.Dsr  
'mainreport.show  
End Sub
```

```
Private Sub individual_Click()  
'section to open the open the database
```

```
Dim dbo As Database  
Dim rsk As Recordset  
Dim rsg As Recordset
```

```
Set dbo = OpenDatabase(App.Path & "\calldatabase.mdb")  
Set rsg = dbo.OpenRecordset("indtable")
```

```
    If rsg.RecordCount <> 0 Then  
        rsg.Delete
```

```
    Else  
        End If
```

```
    rsg.Close  
    dbo.Close
```

```
Menow = 0
```

```
Set dbo = OpenDatabase(App.Path & "\calldatabase.mdb")
```

```
Set rsk = dbo.OpenRecordset("calltable")
```

```
Set rsg = dbo.OpenRecordset("indtable")
```

```
    itest = InputBox("Enter GSM Number to View Report")
```

```
    With rsk
```

```
        .MoveFirst
```

```
10    If .EOF Then GoTo 100
```

```
        If UCase(Trim(itest)) = UCase(Trim(!callerid)) Then
```

```
            rsg.AddNew
```

```
            rsg!calleridt = rsk!callerid
```

```
            rsg!Callcostt = rsk!callcost
```

```
            rsg!Calltypet = rsk!calltype
```

```
            rsg!Calldatet = rsk!calldate
```

```
            rsg!durationt = rsk!Duration
```

```
            rsg!destinationt = rsk!destinationid
```

```
            rsg.Update
```

```
        Menow = 1
        'section to display the result
Else
End If
        .MoveNext
        GoTo 10
```

```
100 If Menow = 0 Then
        MsgBox ("Record Doesn't Exist"), vbCritical
    Else
        FRMINDIVIDUAL.Show
    End If
```

```
    rsk.Close
    rsg.Close
    dbo.Close
End with
End sub
```

```
Private sub make_Click()
    frmcall.Show
```

```
End sub
```

```
Private sub QUICKVIEW_Click()
    frmquickview.Show
End sub
```


SOURCE CODE FOR CALL FORM

```
Private Sub Command1_Click()
    fnum = UCase(Trim(Text1.Text))
    If fnum = "" Then
        MsgBox "PHONE NUMBER CANNOT BE BLANK", vbInformation
        Text6.Locked = False
        Text7.Locked = False
        Text6.Text = ""
        Command1.Enabled = True

        Text1.SetFocus
    Else
        Command1.Enabled = False
        Command2.Enabled = True

        Text4.Text = Time

        End If
    End Sub

Private Sub Command2_Click()
    'section to open the open the database
    Dim newcost As Single, calloption As String
    Dim totalcost As Single
    Dim dbo As Database
    Dim rsme As Recordset
    Set dbo = OpenDatabase(App.Path & "\calldatabase.mdb")
    Set rsme = dbo.OpenRecordset("cost")
    With rsme
        .MoveFirst
        If .EOF Then
            rsme.Close
            dbo.Close

        Else
            newcost = Val(!localcost)
            intcost = Val(!intecost)
            rsme.Close
            dbo.Close
        End If
    End With
    Text5.Text = Time
    'section to trap the text from the text box

    a = Trim(Mid$(Text4.Text, 4, 2))
    If Trim(Mid$(Text4.Text, 5, 1)) = ":" Then
        a = Trim(Mid$(Text4.Text, 4, 1))
    Else
        End If

    b = Trim(Mid$(Text5.Text, 4, 2))
    If Trim(Mid$(Text5.Text, 5, 1)) = ":" Then
        b = Trim(Mid$(Text5.Text, 4, 1))
    End If
End Sub
```

```

Else
End If
c = Trim(Mid$(Text4.Text, 7))
If (Trim(Mid$(Text4.Text, 8, 1)) = "p" Or Trim(Mid$(Text4.Text,
8, 1)) = "P" Or Trim(Mid$(Text4.Text, 8, 1)) = "A" Or
Trim(Mid$(Text4.Text, 8, 1)) = "a") Then
c = Trim(Mid$(Text4.Text, 7, 1))
Else
End If
d = Trim(Mid$(Text5.Text, 7))
If (Trim(Mid$(Text5.Text, 8, 1)) = "p" Or Trim(Mid$(Text5.Text,
8, 1)) = "P" Or Trim(Mid$(Text5.Text, 8, 1)) = "A" Or
Trim(Mid$(Text5.Text, 8, 1)) = "a") Then
c = Trim(Mid$(Text5.Text, 7, 1))
Else
End If
j = Trim(Mid$(Text4.Text, 1, 2))
If Trim(Mid$(Text4.Text, 2, 1)) = ":" Then
j = Trim(Mid$(Text4.Text, 1, 1))
Else
End If
k = Trim(Mid$(Text5.Text, 1, 2))
If Trim(Mid$(Text5.Text, 2, 1)) = ":" Then
k = Trim(Mid$(Text5.Text, 1, 1))
Else
End If
l = Val(j) * 60 * 60
m = Val(k) * 60 * 60
e = Val(b) * 60
f = Val(a) * 60
g = Val(c)
h = Val(d)
startseconds = l + f + g
stopseconds = m + e + h
Duration = stopseconds - startseconds

Text6.Text = Duration

If Option1.Value = True Then
totalcost = newcost * Duration
calloption = "Local"
Else
totalcost = intcost * Duration
calloption = "International"
End If

Text7.Text = totalcost

Text6.Locked = True
Text7.Locked = True

'section to open database and writw into it

Set dbo = OpenDatabase(App.Path & "\calldatabase.mdb")
Set rsk = dbo.OpenRecordset("calltable")
with rsk

```

```
.AddNew
!callerid = UCase(Trim(Text1.Text))
!destinationid = UCase(Trim(Text2.Text))
!calldate = UCase(Trim(Text3.Text))
!calltype = calloption
!starttime = UCase(Trim(Text4.Text))
!stoptime = UCase(Trim(Text5.Text))
!Duration = UCase(Trim(Text6.Text))
!callcost = UCase(Trim(Text7.Text))
.Update
rsk.Close
dbo.Close
```

End With

End Sub

```
Private Sub Command3_Click()
Command1.Enabled = True
Command2.Enabled = False
Text7.Text = ""
Text1.Text = ""
Text2.Text = ""
Text6.Text = ""
Text4.Text = ""
Text5.Text = ""
Text1.SetFocus
End Sub
```

```
Private Sub Command4_Click()
Me.Hide
```

End Sub

```
Private Sub Form_Load()
Dim dbo As Database
Dim rsme As Recordset
Set dbo = OpenDatabase(App.Path & "\calldatabase.mdb", ,
dbOpenDynaset)
Set rsme = dbo.OpenRecordset("cost", dbOpenDynaset)
Command1.Enabled = True
Command2.Enabled = False
Option1.Value = True
Text3.Text = Date
rsme.Close
dbo.Close
End Sub
```

```
Private Sub Text1_LostFocus()
If Mid$(Text1.Text, 1, 4) <> "0804" Then
MsgBox ("wrong number"), vbCritical
Text1.Text = ""
Text1.SetFocus
Else
End If
End Sub
```

```
Private Sub Text2_LostFocus()  
If IsNumeric(Text2.Text) = False Then  
MsgBox ("enter valid phone number"), vbCritical  
Text2.Text = ""  
Else  
End If  
End Sub
```