Wroclaw University Of Technology
Institute Of Telecommunications and Acoustics

Report Nr I-28/PRE-001/04

Doctoral Dissertation

Traffic Model of Telecommunications Network Subscriber

Sefaw Ahmed Gaed

Supervisor: Prof. Dr. eng. Hubert Trzaska

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Contains

1. Introduction

The stationary telephone passed several stages of development according to the 20th century development. The telecommunication service started to show various facilities ranging from video-service through multipurpose services such as transmission of both voice, picture and data.

Hence it follows that certain developments took place in Equipments and systems of communication to cope with the requirements of the era and its specialized purposes of utility. The switches services constituted the most important technology of the century in addition to the requirements of the stationary telephone service, and the mobile telephone. This included both local (inside the country) or international across the international systems between the countries. It was not possible for these telephone services to cope with the development of the switches had it not been for the consistent follow-up by the scientists to cope with the huge development in industry, science and economics.

It was crucial that the world should pay some attention to the sciences. Sciences which were at a time reserved for certain people are now open for all according to channels of world telecommunications.

All this digital international homogeneity in technology with all these identical and future systems of information had developed to overpass any boundaries.

It is known as the widespread or the unlimited knowledge-Science itself failed to contain or limit its sciences. This is the phenomenon of the era, which is known as the era of physics and mathematics

The digital era used in telecommunication service in the world in its paramount nature was not in only one industrial development. It has passed two important phases. The first one was the half digital telecommunication phase, and the second was in the Equipments which resulted in special digital usage which transferred the telephone service from the stage of homogeneous operation with the switches to the wider operation which covered all kinds of communication of which are (IDR) systems. This last one operates across the satellite media. These helped in the amalgamation of

voice transmission with the picture and re-receiving it in a unified context as used in the radio and video transmission. We can not show the role of the digital switches and the services they render unless we study the previous generation (the half – digital) stage, and its effective role in the rate of the telecommunications within its operation. These roles, we have not recognized their effects within its operation in the unified context with the similarity of the switches. Its effect was not prominent in the rate of communications in between these switches. This is because the identifications of the rate of these switches should be done through the study of the telephone communication from the actual measurements of its rates within the operation of the switch itself or that of a similar switch with the same specification within the same area of communication. That is why the role of this generation was not clear as far as its operational effect on the rate of communication whether in time or number of telephone calls. Its use remained confined in the telephone service. The introduction of the characteristics of the digital in telecommunication resulted in an indefinite revolution in the telecommunication service whether vocal, informative or transmission of picture or disclosure of cosmic phenomena.

The operation of communication in Libya passed through three stages (Analogue, half digital, digital). They were operated in a unified time across unified communication systems. We were not able to identify the operational rates for each generation and its effect and operational advantages, because the use of telephone in Libya, until recently was but a visual communication means. The switch operation was only recently introduced for the latest generation in Libya. The digital switches were introduced in Libya by the beginning of 1995. It is still spreading in the fields of operations whether through expansion or establishment. It consists now of the highest rate of operation in the national network. The digital switches can not be taken as having an effective role in this connection because the network on which it operates still depends mostly on the analogue network technology. The digital networks are still away from the multi-switch zones. These switches were connected successively with fiber optical cables technology successively. This part of technology is

considered defective in determining the optimum rate of operation. It is preferable in the consistent operation between these switches.

Accordingly the results brought about by the operational circumstances realized by the users of the telephone service and the authorizers who operate such service, each technology has its own advantages, which aim at replaying or reducing the disadvantages of the preceding system. **The present time is well known for the improvement in digital system, so the attractions of telephone subscribers were according to the services provided by the switches, this is reflected in the Switches Services, because of the great role they play in the daily life.** We can assure that the digital generation is more comprehensive and included two very important factors, They are reduction of the defects of the operations of the previous generation, and realization of speed and efficiency of operation. This in addition to the features of welfare and modernization in the method of contact, which contribute to the best of operation. **This thesis involves in proving the extent of the influence of Switches Services on the Telephone Traffic Volume of subscribers in GPTC during two period, one in which Switches Services were not introduced, and the other period where they are introduced. The influence is different for different groups of subscribers (Commercial, Public, Residential),** and the legal controls of the subscribers and their relationship to the operational methodology. These legal controls do change according the environment of operation and the legal regulation from one country to other, or from one organization another. Therefore we find that Libya has its own operational features, which are controlled by certain legislation and legal procedures which can protect the right of operator The General Posting and Telecommunication Company (GPTC), and those of the society which does not go beyond its rights to use the telephone service which guarantees safety of performance a way from exposing the secrets of telecommunications which may lead to any misuse or distortion in the general life or show any commercial speculations or illegal competition due to bad operation . This is contained in the bylaws of the service of the telecommunication No. (265) for 1999. This bylaw has resulted in an unusual status if compared to the use of switches services in the other telecommunication companies.

We find that the difference in between them centers around the fact that the operation in the industrial countries and commercial countries consider the switches services are complementary to the nature of operation. While in the General Posting and Telecommunication Company this was considered additional advantages. As such the company has the right to impose fees for it in the form of annual subscription to be paid in advance and should not be split. This means that the company is pursuing a policy of retaining fixed returns, which can not be discounted in any way and not liable for exemption neglecting any effect for these services on the increase in the rate of telecommunication whether by time or number of calls. The company has not done any study of the telephone traffic to understand the operational and marketing procedures and compare and measure the impact of such methods.

The company has adopted a Billing System, which depends on the basic data of the (ITU) whether in the local, national or transcontinental traffic, which is known as the international telecommunication. These data depended on two main sections: the first is that concerned with documentary data which show name of subscriber kind of activity, and the place providing the service. The second is concerned with (a) the identification of the local and national calls from the time of pulses according to the tariff applied and (b) the identification of calls crossing to the outside and this is identified according to its international traffic and time of starting and ending the communication and time of communication in minutes, these concluded data from the natural operation will be showed by the working GPTC billing system in measurement which shows the rate of telephone traffic which will be taken as measure for the technical operational reports originating from the switch and the extent of conformity between those measures on the local telecommunications. This will help to understand the present and future of the switches services, and its effect on the role of subscribers calls and whether this will be an alternative for the fees prescribed by the company for the switches services in case of applying annual subscription fees. This will also show the role of these Switches Services in reducing the loss from the telephone traffic from the number of calls and time taken during communication.

From the foregoing about the generations of switches, which we have shown that they worked in the same time and by the operation of unified telecommunication system, lately, the telecommunication traffic was harmonized yet, suffer from no uniformity. This work represents a group of facts that can not be concealed or any part of it. It will express itself from the previous and the present characteristics of the operation.

We can not either go away from the rates and measurements of any of these switches, which we can not find any clear differences between them of any common or joint feature of importance yesterday, which is still common today. The market economics of yesterday are the same for today even though they show certain positive changes, yet they are still within the first rates and they do not reflect any clear effect, which can be taken as an important indicator in the rate of traffic.

This thesis is divided into several chapters:

Chapter One presents the introduction to this work.

Chapter Two presents the categories and segmentation of subscribers in GPTC

Chapter Three describers the working billing system in GPTC, which has not involved in switches services.

Chapter Four presents the analysis of local and national traffic, based on data obtained from the billing system.

Chapter Five defines the switches services offered by GPTC, and present a sample of data for subscribers using switches services, and subscribers not using switches services.

Chapter Six is the main part of the thesis where operational data is used to prove the effect of switches services on the traffic volume during the chosen period.

The final part is the conclusion.

Chapter Two

Categories and Segmentations of Subscribers in GPTC

2. CATEGORIES AND SEGMENTATIONS OF SUBSCRIBERS IN GPTC

2.1 Abstract about the Company Involved by this Work

The General Company for Post and Telecommunications(GPTC) was established according to Law No. (16) for the year 1984 which was issued by the General People's Committe. It was designated for the duty ofexecution of the decisions of Basic People's Congresses in the field ofoperation and maintenance of post centers and telecommunications system atthe internal level and connecting it with the international society.

It started its work on 1.1.1985, and it is a Company, fully owned by the society, and is directed by a Popular Committee which is selected by the employees of the Company [1], and is considered as one of the leading services companies in Libya. The Company is seeking to achieve the objectives of comprehensive planning of communications, to achieve the rate of 37 telephones per 100 citizens in the year 2010, which is a high rate if compared with the advanced countries [2].

At the beginning of the year 2000, the Company started the stage of automatic computerized billing system, whereas the processes of indebting the subscribers in the telephone services were performed automatically through complete systems operated by Libyan cadres.

2.2 Company's structure

The Company is composed of (6) general departments, (7) communication districts, (18) specialized departments, and (6) specialized offices affiliating to the Secretariat of People's Committee [3].

2.3 Preamble

The Company is adopting the policy of rendering the telephone service by viewing it as a humanity social service for all the people of the Popular Congresses, away from the policy of competitions and achieving of quick profit. Hence the Popular Congresses, which are the owner of decision in Libya.

The communication services of a general company is fully owned by the society; which by its turn through Popular Committees supervise its local and international services in this concern, with stipulating the basis and rules for determining the fees identified by the Company against the service, within the limits of cost price, by the best available technologies in the field of communication services.

From the most important priorities of the Company is satisfaction of the Popular Congresses regarding the communication services and preserving its safety performance for achieving the welfare and safety of the citizen.Whereas satisfaction of the citizen needs from communication services is one of the important Company objectives, which is difficult to achieve because it depends on the extent of the desire of the citizen in subscripation in telephone services from one hand, and the available technical facilities from the other hand.

Hence the company exerted efforts to diversify this service through the public telephone offices which exceed (350) offices [4], distributed in all the cities and villages of Libya, whereas the cost of rendering the service through these offices, usually is expensive to the Company. The Company adopted diversification of this service by granting Licenses for practicing this activity on behalf of the Company through the Partnerships of communication services which are rendering all the local, national and international telephone services, and the services of telex and fax by the same prices submitted directly from the Company to the citizens through the public telephone offices.

The Company is responsible for the observation of these partnerships and follow-up for the extent of applying the prices and rendering the services. As the Company was serious for rendering its services for the citizens of the Popular Congresses, it was also serious for study of the requirements of theservices, industrial and commercial market from this service by an equivalent system between the objectives and achievement of social development andwelfare. The Company adopted the infra-structure through a comprehensive plan, in which had participated many specialized local and international scientific corporations, and the optimum studies had been made for up-grading the efficiency of communication network, and performance averages under supervision of the International Telecommunications Union (ITU) [5].

Whereas Libya is considered as a Petroleum Company, which part of its petroleum establishments are located in the deepest desert, hence the Company was compelled to develop these districts through highly efficient communication means, either from the point of vies of telephone aspects or the information correspondence aspect, due to the availability of many laboratories and research centers which are connected by their matching international centers.

These elements has been of the most important reasons which leads Libya to adopt the policy of involving the communication services by all their audio-visual types in a united system, under the supervision of the Popular Congresses citizens away from competition and creation of a competitive market, to avoid that the humanity services will be a competition target either from the local or international companies.

The Company did not neglect the humanity aspects regarding its activity,whereas it exempted all the communication aspects of humanity nature, such ascommunication services; aid, calling for help, fire extinguishing services, emergency communications particularly those emitted from the ships wherever they are, whether marine or sub-marine.

2.4 Telephone Service in Libya

Common carrier telecommunications provide the inhabitans of a country with services involving access to the network and the possibility of sending traffic with a certain grade of service. Access to the network is provided by switching exchanges with a certain access capacity, not all of which may be made available to users. The first characteristic of the size of a system from the traffic point of view is therefore the number of connection points to the network, i.e. main lines.

The second characteristic of the size of the system is the number of points of access to the network, i.e. telephone sets [6].

The telephone service in Libya involves some definitions which are defined to help understand the telephone service in Libya.

2.4.1 Company

The General Posting and Telecommunications Company (GPTC).

2.4.2 Subscriber

The Ordinary Judicial Character who benefits from the telephone service. Any entity external to the network which utilizes connections through the network for communication [7].

2.4.3 Service

Any of the communications services rendered by the Company, involving telephone service, information transfer service and other communication services. Service is defined in ITU Recommandations as a set of functions offered to a user by an organization [8].

2.4.4 Contract

Is an agreement concluded between the Company and the subscriber, which determines the type of service and conditions for its rendering.

2.4.5 Subscriber Site

Is the subscriber place which is legally owned and rented by him and under his disposal and supervision.

2.4.6 Fees

The money that the subscriber should pay against benefiting from the service.

2.4.7 Period

The time period required for the accountancy against the subscriber's benefiting from telephone service.

2.4.8 Subscription Fee

It is a financial fee to be paid in advance from the subscriber against his benefiting from the telephone service. These fees should be paid according to Four

Accountancy Periods Per Year, each three months of it represent a period, the fraction of a month is considered as a complete month in calculation of the subscripation fees.

2.4.9 Contract Period

The period of contract for subscription in telephone service is one year commencing from the first day of the second month of contract date which should be automatically renewed for the same period unless the subscriber wishes to terminate it.

2.4.10 Issuing of Claims

The Company issues their due statements to the subscriber at end of each accountancy period involved.

- Fees for local and international communications for the expired period.
- Subscripation fees for the next period of the expired period.

2.5 Segmentations of Subscribers According to Libyan Standards

2.5.1 Types of Subscribers

The subscribers categories in Libya are classified to three categories

1- Subscribers of Residential

Which is the telephone service rendered to the subscribing Residential without distinguishing between the subscriber whether he is a citizen or resident, and the percentage of this type is obtined by dividing the number of main lines serving households (i.e. lines which are not used for professional purposes or as public telephone stationes) by total unmber of main line [6].

2- Subscribers of Commercial Activity

Which is the telephone service rendered to businessmen for commercial or industrial aspects, experienced offices, national and international companies and similar activities.

3- Subscribers of Public Service

Which is a telephone service rendered to all secretariats of Popular Congresses, People's Committees, Philanthropic Social Corporations and all the Diplomatic Missions and similar authorities.

2.5.2 Recommended Fees for Rendering the Telephone Service According to Subscribers Classification

1 Subscribers of Residential

1- Installation Fees	=	50 L.D.
2- Annual Subscripation Fees	=	96 L.D

2 Subscribers of Commercial Activity

1- Installation Fees	=	180 L.D.
2- Annual Subscription Fees	=	180 L.D.

3- Subscribers of the Public Service Activities

This activity is divided into three sections:

1 People's Congresses and Secretariats and the like

1- Installation Fees	=	100 L.D.
2- Annual Subscription Fees	=	120 L.D.

2 The Social and Charity institutions and organizations:

1- Installation Fees	=	50 L.D.

2- Annual Subscription Fees = 96 L.D.

3 Embassies, Consulates and Diplomatic Missions

1- Installation Fees = 180 L.D.

2- Annual Subscription Fees = 180 L.D.

Note: The general service activity subscribers and their three classes are exempted from the stamp duty [9].

2.5.3 Switches Services Fees

GPTC offeres switches services only on digital switches for all type of subscribers with equal subscrption fee and installation fee [10], table 2.1 showes the switches services offered with subscription and installation fees for each switch service.

Table 2.1 Subscription and installation fees for swiches services.

Type of Service	Annual Subscription Fee	Installation Fee
Caller ID	36 L.D	15 L.D
Diverting	6 L.D	15 L.D
Call Waiting	6 L.D	15 L.D
Do Not Distrub	24 L.D	15 L.D
Call Barring	24 L.D	15 L.D
Conference	6 L.D	15 L.D
Receiving Only	60 L.D	15 L.D
Sending Only	24 L.D	15 L.D
Hot Line	48 L.D	15 L.D

2.6 Additional Services

The subscriber, and subject to certain control measures made by he Company, and accepted by it, may extend a telephone line on another network with the range of a multi-switchboard. This arrangement entails an additional fee amounting to:

- Double the installation fees
- Double the annual subscription

This is according to the category of the subscribers in he table of fees. The subscriber may request the installation of a branch telephone in another location inside the range of the same switchboard. This entails the payment of an additional fee amounting to:

- Installation fees in fall
- Half the subscription fees

According to the category of the subscribers in the table of fees.The telephone may be extended on a telephone channel in one of the transferring channels of the system. This entails adding the annual subscription fees estimated for the direct telephone lines service. The telephone may be extended over the local space communicationsystems and the international space communications by the provision of the necessary connecting equipments for this service and according to the required uses.

The Company also handles the provision of marine telecommunication service for all ships, sea boats, and the fixed and mobile locations on land through marine communications stations and with the conditions and prices internationally in force. The Company also provides the internet services for telephone service subscribers according to the control measures and local and international rates.

2.7 Rates of Telephone Calls

2.7.1 Traffic fees for Digital Switches

The Company fixed time and financial controls for local and national Traffic as follows:

Inside the range of the switch or within a multi-switch area, were divided into time units (by pulses) and each pulse for (3 minutes) and the minute for (16 Dirham) [9].

As for the national traffic it was limited per one minute and each minute is equal to a number of pulses.

2.7.2 Traffic Fees for Analogues Switches

The local conversation time is determined by one pulse and the price of a pulse is (16 Dirham). As far as the national conversations they are determined by one minute equals to a number of pulses. The fees differ from one cross center to another [11].

2.7.3 Failure to Pay

The Company put it as condition that payment must be effected in time. Those failing to pay within the permitted for payment should pay fees for returning service after the disconnection time as follows :-

- Those failing to pay in the prescribed period (15 days) have to pay reservice fees at the rate of (25%) of the installation fees according to the category of the subscriber in the table of fees [9].

- Those failing to in the second prescribed period (over 15 days) have to pay reservice fees at the rate of (50%) of the installation fees according to the category of the subscriber in the table of fees.

2.8 Switches Services of Digital Switches

The Company requested those subscribing in the telephone service and those who are interested in the digital switch, to pay additional fees for each period they think they can benefit from such service. The Company also determined an additional fee of (15 L.D.) for each advantage requested by the subscriber under the name of installation service fees.

2.9 Taxes Imposed on the Subscriber

2.9.1 The Excise Duties Stamp

Limited by a financial value of (2 per 1000) of the total value of the claim to be collected from the subscribers who are subject to payment of taxes to the treasury of the society [9].

2.9.2 Agent Stamp Duty

Amounting to a financial value of (5 per 1000) to be deducted from the value of invoice from those subscribing in the telephone service from the Secretariat of the People's Committees and public companies for the benefit of the treasury of the society [9].

2.10 Methods of Payments

The Company collects its dues according to financial claims to be issued to the subscribers at the end of each accounting period, and the Payment should be paid according to the following system [12]:

- **Direct payment (in cash)**
- **Direct payment (by confirmed checks)**

Payment through financial clearance between the Company and other entities. This should be done through the finance department. This arrangement is not recommended by the Company since it involves some difficulties in implementation according to the financial restrictions of repetition or dropping and financial negligence.

Payment through Treasury, this procedure is applied when paying the dues of the Company by the public authorities and People's Committees and the like.

2.11 Characteristics of subscribers in the Libyan network

The telephone service falls within the jurisdiction of the telecommunication service regulation No.(265) for 1999, issued by the general peoples committee. This

regulation specified the fees for this service according to the kind of subscribers and the nature of communication whether local, national or international. Special consideration is also given to the nature of the service whether it is a public company controlled by the government laws away from the commercial point of view. Since this company is controlling all the telecommunication service of all kinds, there should be a higher institute to control and supervise the work of this organization, such as fixing the erection and operational fees as fixed by this regulation. The subscribers in telecommunication vary according to variation in nature of service. Fees for commercial service fixed at a high rate than these for service in general. The house service fees are the lowest. We feel that there is need for a certain class to claim certain switches services over others. These are the national cooperatives, the charitable societies and social and humanitarian institutes.

The legislation's point of view is that there should be no differentiation between fees for telecommunication whether for commercial, service or household in local, national and international connections. The international communication fees are distributed between the company and the international department counterparts. Hence we find that the legislator has unified the fees over all the users of telecommunication in Libya. The only difference is in the night communication where the fees fall down to 50% of the daily communication for all subscribers [13].
The target of the company is to realize the highest income, since the policy of the company is based on the hypothesis that it is a public company and non-commercial company whose activity is based on supply and demand [14].

In applying the regulation of the telecommunications, the subscribers in the digital switches whom whish to have the switches services, they should pay subscription fees and installation for each service.

2.12 The Libyan Switches

The total number of local switches working in Libya is 229 ranging in Capacity between 500 – 25000 lines and a total capacity of 594447 between digitals and

analouges, all working within POTS. These switch are connected by (17) crossing centers some of which have modern digital technology and (6) supervisory and maintenance centers [15].

2.12.1 The Analogues Switches

With a capacity ranging between 500 – 2000 subscribers. These switches represent 44% of the total working switches in Libya. The total lines of these switches are 129.100 representing 21.7% of the total capacity of telephones working in Libya. The total number of subscribers in these switches is 87.761, representing 14.7% of the total capacity and 67.98% of the analogues switches.

2.12.2 The Digital Switches

The total number of digital switches is 129 representing 56% of the total working switches. Total number of these switches is 465698 representing 78.3% of total capacity of working telephones in Libya. Total number of Subscribers in these switches is 322831 which represent 54.3% of the total capacity, and represents 69.3% of the total capacity of the digital switches.

2.13 Principal of Customer Charge Moniotring

2.13.1 Pulse Metering

The older and simpler charging method (still used in many telephone networks among them Libyan telephone network) is to levy call charges on the basic of the number of pre-determined intervals of time used in the course of the call. This method is called *pulse metering.* In it a fixed price is charged for a small time period or unit of the conversation phase. Hence the call is first answered, the first unit (of time) commences. After a pre-detemined period of time (the length of which will depend on the location of origin and destination and the time of day), the first unit will expire and a second unit of time will commence. The charge payable is calculated by multiplying the number of units used by the fixed price per unit. The

customer is usually unaware when each unit ends and the next begins, or indeed how much of a partially used unit remains.

On different calls, e.g. to destinations at different distances away, or on calls to the same destination made at different times of day, the time duration of a unit may be varied. In this way, the average per-minute-charge made for different calls can be varied. One caution, however: it is not generally understood that the upper limit of metering pulse rate may not actually be determined by the capability of the pulsing unit, but on the ability of the transmission line to carry the pulse correctly and the meter to clock properly.

Over a given period of time (say three months) the number of units used by the customer is accumulated on a counting device (called a cyclic meter), located at the exchange. Location at the exchange eases the job of reading the meters, and reduces the scope for customer fraud.

During the course of individual calls, the cyclic meter is triggered to stop onward one count at the beginning of each new unit of time. This is done by sending a periodic electrical pulse to the meter. The customer's invoice shows the total number of units used, and a financial charge, which is calculated by multiplying this figure by the fixed price per unit.

While calls are being set up by the exchange, the exchange control and routing system (common equipment) obtains the destination of the call from the number dialed, to determine the appropriate outgoing route and charge rate. For routing, a fair number of digits may need to be examined to decide to which precise exchange the call should next be routed. However, although the same piece of common equipment may determine both the route and the call charge rate, it is likely that fewer digits will need to be analyzed for charging purposes. This is because most network operators choose to run charge band schemes, in which destinations within a fairly widegeographical zone (or charge band) are charged at the same rate. This eases the administration of the scheme and the customer's comprehension of it. As an example of a simple chargeband scheme, a public telephone company might opt to levy charge for international calls based only on the first digit of the country code. This would divide the world into eight distinct zones. A similar national charge band scheme

could equally well be developed corresponding to the area code digits of the national telephone number.

Each of the charge bands a charged program. The program divides the day into a number of time period, for each of which a different per-minute-charge will apply. At the busiest times, we expect higher rates, whereas cheap rates at off-peak times may help to stimulate traffic and revenue without needing more equipment. As an example, within the United Kingdom, British Telecom sub-divides its chargebands into times of day called rate (corresponding to the busiest times of day, when the highest per-minute-charge is levied), cheap rate (corresponding to periods of low activity, when the lowest per-minute-charge is made) and standard rate (for which a medium charge is made). Over the course of a weekday, peak rate applies from 9a.m. to 1p.m.; standard rate from 1 p.m.; to 6 p.m., and from 8 a.m. to 9 a.m.; and cheap rate applies each evening from 6 p.m. to 8 a.m. The per-minute-charge during peak rate period is made more expensive by reducing the time duration of the unit (remember that the units have a fixed price). Figure ***(meter pulse)*** illustrates the relationship between price-per-minute and unit duration on the British Telecom scheme, and shows the pulsing signal required to stop the customer's meter.

The advantage of such a charging philosophy is the simplicity of the equipment and the ease of administration. However, as the need to recover usage-dependent costs becomes more acute with the boom in demand (e.g. night-time dial-in calls to the Internet), so the method is falling into obsolescence. Another draw-back is the tendency to promote network congestion and phone box queues [16].

2.13.2 Electronic Ticketing

Electroinc Ticketing (also called automated message accounting or toll ticketing) is far more accurate and reliable than pulse metering, and it is becoming common in consequence of the spread of stored control exchange. In this method the exchange control computer monitors and records information about each call including the number dialled, the duration, the time of call set up, the time of call clear, etc. The information is stored in an electronic call record, usually on computer storage disk or

magnetic tape, until the time when the customer is due to be invoiced. The invoice is calculated by adding the amounts due from each individual call, derived from the details on the individual call records. Electronic Ticketing provides the scope for more complex chargeband structure, and the capability (much demanded by customer) for an itemized record of the details and cost of each call made [16].

2.14 Tariff Structure

The tariff for the service should normally consist of two components:

A network access component
A network utlization component

The network access component normally intended to cover the cost of making the service available represented the cost of the service which is not depended on network utilization. It corresponds to what is generlly known as the "network connection charge".
While the network utilization component normally covers the cost which are dependent on network utilization [17].

After the introduction ot the digital switches the authority in GPTC has adopted a series of decisions which have resulted in a notable changing in a local and national calls, and also international calls were effected by the decisions, if a comparison of tariff is considered between GPTC and other international telecommunication companies as a Polish Telecommunication (PT), it was noticed that the system of measuring the traffic is a pulse system in both companies, but the tariff is diferent in the sense that GPTC has only two kinds of tariff for local and national calls, during a day between 8:00 – 20:00 is a normal tariff based on a pulse system which is equal to 3 minutes, and the tariff is 0.016 Derham equivalent to 0.0072 dollar , the other kind of tariff is between 20:00 – 8:00 where the tariff is reduced to 50% for both local and national calls, while the system of tariff in PT is more comprehensive than in GPTC. The tariff of local and national calls in PT works as followes:

- weekdays 8:00 – 22:00 tariff for 180 seconds is 0.29zl equivalent to 0.078 dollar.
- Weekdays during night 22:00 – 8:00 tariff for 360 second is 0.29zl equivalent to 0.078 dollar.
- Working day national call 8:00 – 18:00 tariff for 43,50 seconds is 0.40zl equivalent to 0.108 dollar.
- Weekend national call 8:00 – 18:00 tariff for 58,00 seconds is 0.30zl equivalent to 0.081 dollar.
- Weekdays at night 18:00 – 8:00 tariff for 87 second is 0.20zl equivalent to 0.054 dollar [18].

It was noticed that the above data regarding the tariff is concerned only with local and national calls, and PT has many type of tariff as it's subscribers more than GPTC subscribers.

2.15 ISDN Technology and GPTC

Integrated Services Digital Network (ISDN) is a digital alternative to the standard (analogue) telephone, with no recabling required, it uses the same copper wires as POTs (or "plain old") , and it provides multiple channels per line , offering a high speed connection as well as the ability to use analogue service such as fax (group 2/3).

The idea of ISDN is to extend the digital part of the network out over the subscriber's line, and doing any analogue to digital conversion at the subscriber's premises, at the same time giving the subscriber an access also to the digital side, which, as will see, also gives a higher data throughput rate. Provided that the subscriber is not too far from the exchange, and the cables are in reasonable condition, the ordinary copper pair is quite capable of carrying the basic rate ISDN service, which consists of two 64kbps digital channel called "B" (bearer) channel, and a lower speed "D" channel used for signalling (i.e for setting up and tearing down calls, and similar purposes)[19].

Analogue technologies have serious capacity problem, which means that in high density areas, obtaining an outside line becomes a real problem. Digital technologies

by and large make more efficient use of the available capacity by juggling a number a simultaneous calls togather on one frequency, with analogue it's usually one call per frequency unlike analogue phones, digital network access codes can not intercepted in the air by hackers to make free calls on another subscriber's account. It is possible to combine many different digital data sources and have the information routed to the proper destination. The speed of transmission using a regular telephone line is generally 28.8kbps, ISDN line the line speed can go as high as 128kbps without compression almost four faster.

From above it can be said that ISDN technologies have a number of advantages over the convential analogue telephone network, whereas the analogue network only offers limited throughput rates, and since GPTC has not adopted ISDN technologies, and still using the existing technonogies of analogue, it should consider moving a step forward to ISDN technologies which could have a major impact on the influence of switches services which are supplementary services functions used in conjunction with an ISDN service as hotline, conference call, call transfer, etc, on increasing the traffic volume of subscribers which is the main goal of this work.

Chapter Three

Descriptions of GPTC Working Billing System

3. DESCRIPTIONS OF GPTC WORKING BILLING SYSTEM

3.1 Scope of the Billing System (BS)

The Billing System (BS) is able to handle in the initial stage up to 250 End Users and 270,000 subscriptions. The number of Call Data Records (CDRs) is estimated (international calls only) to 250,000 per day to be processed by the BS .

3.2 Previous Billing Process

The previouse method of billing is oriented around regional post offices. The customer goes to the post office and requests the bill. The bill is prepared manually and the customer is presented with the total charges. The customer pays the charges and the customer payment is recorded in the Account Ledger. There is an Account Ledger for every post office [20].

All international calls were previously billed in Tripoli by a PC system that reads the analogue gateway exchanged tapes.

3.2.1 Customer Management

The previouse steps to register a customer are:

1. Customer applies for telephone connection at their local office
2. Post office processes customer application
3. Post office notifies and issues a work order to connect the customer
4. Customer is connected and defined at the local exchange
5. The local post office records the name and number of the customer and charges a one off connection fee for this service

At the previouse method of billing, a customer can requset an additional services following the next steps:

1. Customer informs their local post office of the service request
2. Post office notifies issues a work order to supply the service

The local post offices charges a one fee for this service

For certain services rental fees will be charged monthly

3.2.2 Customer Billing

All International calls were processed in GPTC head office, Tripoli. Tapes produced by the analogue gateway exchanges were transported to GPTC head office in Tripoli where they processed by existing billing system. The call tariff was calculated at the gateway exchange, i.e. it is not calculated by the billing system.

There were two main call types, these being automatic (IDD) and manual (operator assisted). There dose not appear to be person to person message or collect call types in use presently.

The international telephone bills were produced on paper each month in Tripoli where they were sorted by hand for delivery to the post offices throghout Libya for integration with the local call charges.

Local call charges were calculated manually by post office personnel. The steps to calculating the local call charges are:

1. A photograph of the local exhange call meters is taken.
2. The photograph is developled and the call meter values for each subscrober are taken.
3. The meter values are written down in a customer accounts ledger.
4. The new meter value has the previous call meter value subtracted from it to give the number of metered pulses that have occurred since the last reading. This difference is used to calculate the local charge.

This process was normally done once every three.

Each customer was charged a yearly rental fee. This figure is divided into quarterly amount and added to the local and international call charges for the same time period.

Customers were sometimes required to pay a deposit to protect GPTC against the possibility of non-payment.

Tax is charged on the addition to the international call charges, local call charges and rental.

The customer bill is calculated on a quarterly basis as shown in table 3.1 [11].

Table 3.1 GPTC Customer Bill

Any previous charges +	(amount)
International call charges +	(amount)
Local and National call charges +	(amount)
Rental charges +	(amount)
Miscellaneous charges +	(amount)
Tax +	(amount)
Grand Total	**(amount)**

These figures are recorded in the customer account ledger.

The customer payment process steps are as follows:

1. The customer goes to their local post office and requests his/her customer bill.
2. Summarised bill details are written onto a customer invoice statement (the customer has the option of taking their copy of the international call bill).
3. The customer takes the customer invoice statement to the payment office where the payment is made and the customer is given a receipt.
4. The customer payment is then recorded in the customer account ledger.

The customer debt follow-up process steps are as follows:

1. The customer account ledgers at each post office are manually checked once a year on average. All customers that have not paid their bills for the year are recorded as customers to be disconnected.
2. The post office staff submits list to the local exchange where the customers are disconnected.
3. The customers are not reconnected until they pay their outstanding debts.

3.3 Customer Adminstration and Billing System Platform

Figure 4.1 illstrates the initial billing system configuration, [21] where the meter Reading Record (MRR) concerning local calls and national calls is captured at each switch and than transferred to the Billing system via file transfer.

Call Data Records (CDR) are instance of measurement by destination using incoming traffic,[22] and are created for all international calls Passing the international exchanges. There are two international switchs which are located at Triploi . One AXE in Tripoli, the other one ARE13 in Tripoli. The CDR files from AXE switch are transferred online to the Billing System through a mediation device (X25). The CDRs from the ARE13 switches are stored on tape and read by the Billing System, and than some actions are carried out regarding CDR management as state in the following:

1- Perform file Sequence checks.
2- Perform gap and overlap check between files.
3- Perform gap ckeck within a file.
4- Validate CDR on field level.
5- Store suspended or erroneous CDRs for later processing.
6- Recycle Suspended CDRs.
7- Produced control reports on suspended CDRs.
8- Create and maintain correction tables for erroneous CDRs.

The Correction tables are used when CDRs are recycled.

Having collected the meter reading for local and national traffic and CDR with the update of the data concerning subscribers which was enetred in a local GPTC post offices and transferred via a files to the Billing System, a billing cycle is generated to greate invoices, which takes few days due to the slowest of the system and growing up of the database [23].

Sample bills are created for the staff to review before the bills are acually generated.

The Billing System creates a bill print file to be transferred via a files for each concerned post office, and than and/or account statementa on the earlier descrbed levels; Customer Account and Subscription Account.

After the sample bills are accepted and the bill run is completed, and the printed-out files have been transferred to the local GPTC offices, the invoice should be posted to the subscribers according to their local addresses, but due to the lack of finding the addresses, subscriber comes to the local offices to collect invoice and to make the payment

All necessary hardware for the internal LAN and servers necessary for the operation of the system, and all the user terminal PCs are running Windows, as Operating System is Unix

Communication between the subsystem and the terminal/workstation is based on a non-proprietary protocol TCP/IP is preferred.

The Standard Software Platform is include a Relational Database Management System using a SQL retrieval function, and the database is scaleable to ensure that it can handel volumes caused by growing number of Customer and End User of System.

The Physical Database implementation is available in a machine-readable form.

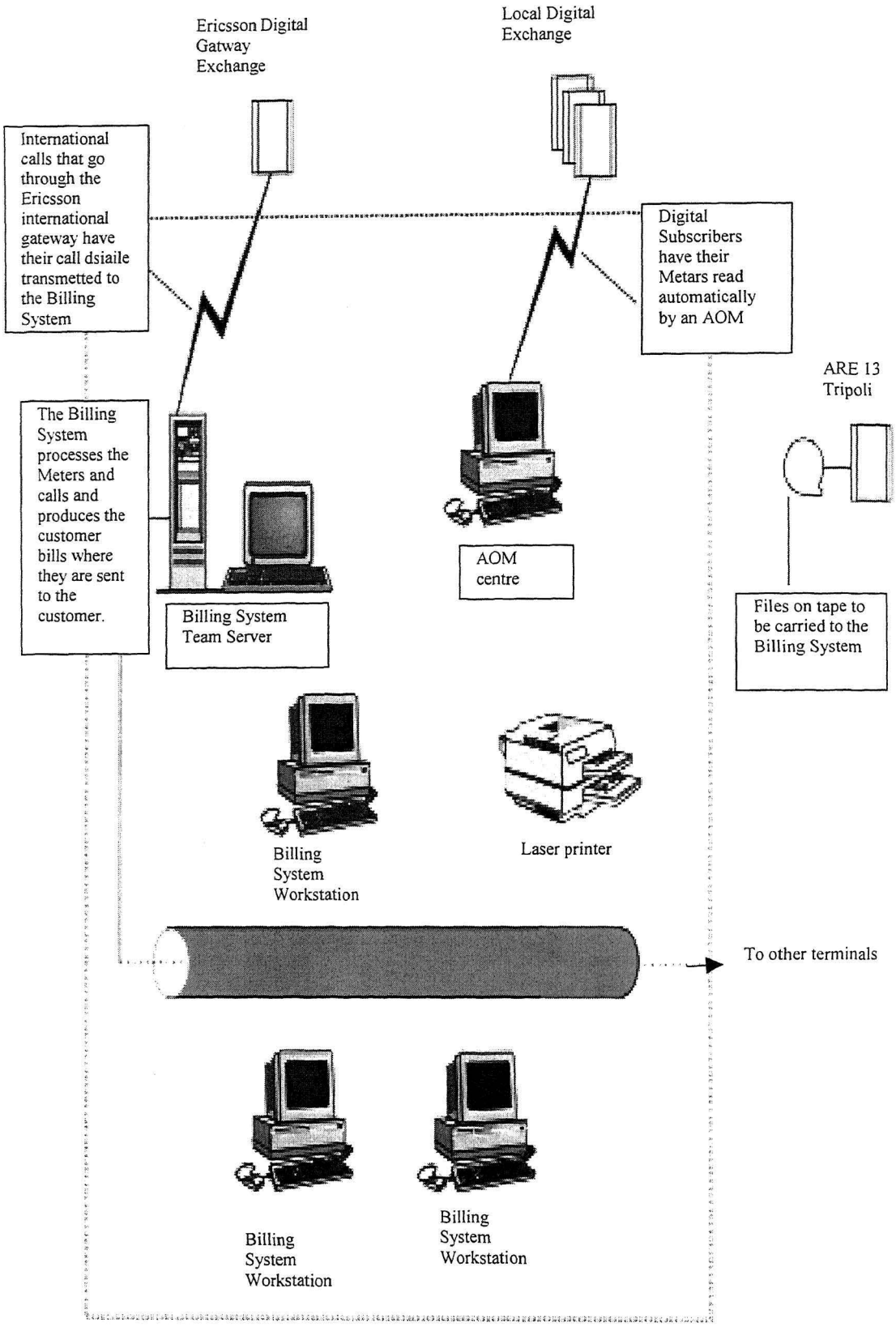

Figure 4.1 The initial billing system configuration

3.4 Account Numbering

Account Numbering is flexible and the numbering principle is available to comply with the following basic purposes:

- Customer Support
- Billing
- Customer Administration
- Statistic and Analysis

3.5 Functional Requirments

The BS designed to minimize multiple input of data i.e. data is entered only once.

3.5.1 Customer Administration

The following functionality is available:

- Credit rating
- Black list
- Continuous monitoring of consumption in relation to assigned credit limits.

Customers are divided into different categories like residential, commercial, Public, etc, and are also divided into different market segments in order to perform active marketing activities.

The System is flexible and support free codes for a number of different customer classes.

It is possible to enter and change:

1. Customer Name:

The name must be started using First Name, Fathers Name, Grand Father and Surname for people and the complete sector name if its for private or Public Sector e.g. Complete Company Name.

2. Customer title/ department
3. Customer Address:

   Detailed Address of the Customer will be supplied. (Correspondece Address)
4. PO. BOX, Post Box if available
5. Customer Category:

   Private Sector, Public Sector, Foreigner, etc.

Examples are:

5.1 People committees

5.2 People congress

5.3 People authorities

5.4 Partnership Establishment companies

5.5 Embassies

5.6 Joint companies and Establishment

5.7 Foreign companies and consultants offices

5.8 Hotels

5.9 Parnership of private post office

5.10 Administration related to GPTC

6. Customer Nationality:

   Libyan, Italian, Swedish etc. All nationalities must be stated in the system.
7. Market sector
8. District Category
9. Contact number (telephone/ fax/ e-mail)
10. Name and address of the Users
11. Billing addresses

12. Max credit limit allowed

13. GPTC responsible Branch Area

14. GPTC responsible Branch office

15. GPTC responsible Post office

16.Contract number

Each customer has one or several account or summary account. For each customer the following information be available:

1. Accounts' ids

2. Accounts' status

3. Deposit

    3.1 Description of deposit

    3.2 Amount

    3.3 Date of payment

    3.4 Receipt number

4. Deposit Returned

    4.1 Amount

    4.2 Date of payment

    4.3 Receipt number

    4.4 Document number

5.Advance payment

6.Credit rating

7.Credit limit

8.Price plan

9.Discount plan

10.Id, name and address of the Users

11.Billing address

3.5.2 Discount Management

Each customer is assigned a discount plan. The following discounts is possible to apply within the discount plans:

- Flat discount on selected services and/ or traffic cases. (I.e. applying Different discount rates to different services and/ or traffic cases. For Example, five percent discount on a national call and ten percent on International.)

- Volume discount of two types "Nrmal" and "Tiered".

Volume discounts is possible to apply on individual accounts on all levels or a free combination of accounts.

3.5.3 Pricing – Rating

The Pricing–Rating Process includes functionality to :

- Change one-off changes and recurrent changes,
- Capure Meter reading records and calculate the number of pluses since the last meter reading.
- Capture CDR's, to be priced, from the Switched by file transfer.
- Actually apply a price to the CDR according to the Customer's Price Plan.

3.5.4 Invoice Details

The Invoice includes the following details:

1- Subscription fee for the next period.

2- Local and National usage traffic charges
3- International usage traffic charges
4- Governmental and local taxes.
5- Amount to pay.

3.5.5 Account Receivable(A/R)

The Accounts Receivable is an integrated part of Billing System, it enables GPTC to adminstrate all.

3.5.5.1 Account Creation

An account is created automatically through the customer registration process.

3.5.5.2 Account Update

A Customer Billed Account is updated automatically through the billing process, the payment process or on-line routines for adjustments

3.5.6 Security Management

A method of log-in Password system is used.

The Security Management System gives the possibility to define groups or individuals that have access to specific screen, fields, and functions in accordance with the following scheme:

1. No access
2. Read only
3. Read and update
4. Approve

The following functions are available

3.5.6.1 User Group Management

1. Specific and Maintain User groups and User authority.
2. Specific and Maintain Windows and Screen accessible for a member of a User group.
3. Specific and Maintain the data a User group and add/modify/delete.
4. Specific and Maintain the data a specific member of a User group may add/modify/delete.

3.5.6.2 Data Security Management

1. Pack-up and restore facilities.
2. Purge and archive processes for all information in the BS.
3. Creation of files for tape or optical storag.
4. Revenue Assurance i.e. a process that makes consistency control between incoming CDRs and what was actually billed, ensures that all CDRs are processed correctly and properly billed.
5. If the system detect records in error files aqnd suspense filesm received from the switches, it reports instantly as a suspense record.

3.6 Reports

The system is capable of producing number of reported which are useful to related department in the company (GPTC), they were listed by Commercial Services Department at GPTC [24].

- A report on the distribution of the crossing and terminal international telephone traffic.
- A report of the international telephone traffic exchanged issued by switches of communication areas to the international switch.
- Report of the international telephone traffic across the switch to communication areas.
- Report of the international telephone traffic issued from Libya to another country.

- Report of direct international telephone traffic coming to Libya
- Report to the value of the international telephone traffic issued measured in settlement currency and evaluated in Libyan Dinars.
- Report of the international telephone traffic issued to another country and evaluated in Libyan Dinars.
- Report of the value of the international telephone traffic coming into Libya evaluated in Libyan Dinars.
- Detailed report of the international telephone traffic issued to the subscriber.
- An analytical report for the income of each switch.
- A comprehensive analytical report for all switches.
- An annual report of exchange traffic between fixed and mobil phone.

3.7 The Billing System and Study of Telephone Traffic

The company though a system for calculating the telephone traffic for the digital switches, yet for the same reasons mentioned before, it did not come to an ideal system. It depends on reading the registered pulses in the switch meters to calculate the traffic of the subscribers whether local or national, and those issued to the mobile. This system can be verified that it depends on the treatment with the subscribers, the telephone numbers, and the pulses. Therefore this analysis relied on the categorization of the subscribers and the number of pulses registered on their telephones.

3.8 Disadvantages of the Existing Billing System

The Billing System is considered non-standard because it does not contain analysis and treatment of the technical sides of the work of the local and international switches. It does not agree with the system used for supervision and the performance of local and national switches, which led to negative impact on the performance. The building of this system is based on the fundamental issues which are decided by the

(ITU) as far as the data to be shown for the subscriber when notified by the sum of money which he is claimed to pay are concerned. As a result of this a lot of important information is missed by the high administration of the company which may guide it in the telephone communication which act as an indicator for the traffic and the weak and strong points such as: -

1 – The inability of the system in identifying the international telephone channels with regard to the performance and switch off.

2 – The system is not mechanically connected with the switches for taking readings periodically and takes notice of the operational performance of the switch.

3 – The system did not show the role of the switches in the advantageous service and furnish it for the subscribers by increasing the rate of local, national and international traffic.

Chapter Four

Traffic Analysis Using GPTC Working Billing System

4. TRAFFC ANALYSIS USING GPTC WORKING BILLING SYSTEM

4.1 Reading in the Telephone Service in Libya

The means of communication is known to play the biggest role in the development of nation through transporting culture, sciences whether humanitarian or applied. It is an effective means for the speed of different sciences and knowledge. It becomes the most favored factor for change required by those countries, which look for growth. It is the only means to bring about such change quickly and with the least effort and time and without any limitations on the people and nations.

The audio-telecommunication traffic is considered the most important exchangeable commodity between countries. It crosses all the natural and artificial boundaries, and without waiting for entry visas or custom clearance. It is a cheaper commodity free from monopoly and trading.

The spread in this service made it a kind of individual worthiness away from any controls and with the least cost. It opens the doors of knowledge before all people, without any bars whether political, social or cultural. It is part of the individual freedom.

The local and national telephone traffic represents a good part of the company's income on which the company depends for its future policy. This traffic is estimated at about (63.000.000) sixty three millions Libyan dinars per year [25].

This figure encourages the company to increase the number of subscribers in the stationary telephone service according to a master plan for the years 2005 – 2010.

The capacity of the operating telephones in 2001 and its distribution consists of numbers and percentages as shown in the table 4.1.

Table 4.1 The capacity of the operating telephones in year 2001

Total capacity	Utilized capacity	Unused capacity	Commercial activity	%	Public activity	%	Residential activity	%
465698	330328	135379	82582	25	49549	15	198197	60

Since this work concerned with the study telephone traffic and its service, it's very important to know the role, which the telephone plays in the main towns in Libya.

We have to take a sample of the telecommunication district to show the capacity and the percentage of the subscribers as in table 4.2 which concerning Tripoli telecommunication district, and table 4.3 shows the capacity of operating telephones in the rest of telecommunications districts in Libya.

Table 4.2 The capacity of operating telephones in Tripoli Telecommunication District

Total capacity	Utilized capacity	Unused capacity	Commercial activity	%	Public activity	%	Residential activity	%
179616	157835	21781	23485	25	15231	15	119118	60

Table 4.3 The operating telephones in the rest of telecommunication district in Libya

Total capacity	Utilized capacity	Unused capacity	Commercial activity	%	Public activity	%	Residentia l activity	%
286082	142493	113598	25644	25	16671	15	130179	60

4.2 Billing System and Analysis of Local and National Traffic

It is not easy for any manual system to show all the data, which represent any service in a very comprehensive detailed and accurate way, specially if this service will meet with several telephones which take care of the subscriber, his activity, number of his telephone, address of the local, national and international calls registered against his telephone, and handle these data in standard time and with very accurate way as the case with the billing system.

The switches operating in Libya depend on the pulse system in calculating the traffic. Accordingly the billing system provided the special basis for each subscriber is as follows: -

- *Telephone of subscriber, the accounting period, It's category, Size of telephone traffic by pulses at the present rate of 16 Dirham per pulse.*

It was necessary to find a logical measurement, which can be used to get through it to identify the local traffic from the national traffic.

The telephone service in Libya is historical and has statistical features, which can be accepted in case of disputes between the subscriber and the company.

One of these features in the extension of time of local and national calls for subscribers.

4.3 Local and National Traffic

Local traffic consists of effective (completed) traffic exchange within the local charging area in which the calling station is situated. This is the area within which one subscriber can call another on payment of the local charge (if applicable). Each country should include a footnote explaining what it understands by the "local charging area" and indicating the number of such areas and their average size (in km2).

While national trunk (toll) traffic consists of effective (completed) national traffic exchanged with a station outside the local charging area of the calling station [6].

4.3.1 Basis of Pricing Local and National Telephone Traffic

The local and national telephone calls are calculated by means of pulses and not per minute. The pulse is equal to 3 minutes of local call [9]. The pulse is calculated as part of the minute for national calls between the switches of other towns according to distance between the centers of crossing.

This is also the same way for calls from stationary telephone to mobiles. Table 4.4 shows the distances and the cost of pulse for national calls [13].

Table 4.4 Distance and costs of pluses for national calls

Distances	Tariff	Number of pulse
Less than 100 km	64 Dirham	4
101 – 200 km	80 Dirham	5
201 – 300 km	96 Dirham	6
301 – 500 km	128 Dirham	8
More than 500 km	160 Dirham	10
Calls issued to the Mobile telephone system	160 Dirham	10

These pulses can be translated into money for all subscribers in the telephone service without any differentiation between local or national calls.

4.3.2 Limitation of Measuring Local and National Traffic

The company endorses the recommendations of the international telecommunication union (ITU) as basis for the ideal measurement of operation of the telephone line in the local and national traffic [26], which is as follows: -

The ideal time operating of telephone per day in minutes (T) = 200 minutes

The ideal time of operation for the telephone for local and national traffic yearly (N) =

$$= T * \text{Number of days per year}$$

$$= 200 * 360$$

$$= 72.000 \text{ minutes per year}$$

These international measurements will be taken as reference to get the measurements of the local and national telephone traffic for the subscribers in Libya.

Due to the difficulty in differentiating between local and national traffic because pulses measure them, it was necessary that the company should make a measure for

the proposed time for the call whether local or national. The company depended on the measure in several cases such as: -

1 – To have an idea about the size of traffic by the pulses related to the number of calls to resolve discrepancies between the subscribers and the company, about the pulses on their telephones due to mechanical defects on the meters of operating the traffic.

2 – Provide a logical measure for the rental fees of the telephone lines within the range of a multi-switch.

In connection with ITU, GPTC has laid down a table for measuring the rate of communication of subscribers according to their categories by changing the pulses to minutes.

By so doing it was possible to calculate the number of calls per 24 hours [27], as stated in table 4.5, which shows the measurement in pulses and minutes according to the category of subscribers with in 24 hours. It can be noticed that the length of the local and national calls of the Residential subscriber is longer than Commercial and Public subscribers, and Commercial and Public subscribers are almost the same length.

Table 4.5 Measurement in pulses and minutes according to the category of subscribers during 24 hours.

Category of subscriber	**Number of pulses**		**Number of minutes**	
	Local	**National**	**Local**	**National**
Commercial	2	3	6	9
Public	2	4	6	12
Residential	5	3	15	9

4.3.3 Analysis of Measuring of Traffic for 1st half of 2001

The users of telephone in Libya are asked to settle their accounts in four periods in the year. This includes subscriber's fees and the cost of telephone conversation local

and national as reflected by the pulses. This is also the same for the international calls. Therefore the pulses are the most important factors for calculation of the subscribers for his local and national calls which is the common factor for studying this traffic and its distribution between local and multi-switch area and national which ends in the crossings between the unification's area, table 4.6 shows the average of telephone traffic of Zawia Road switch during the six months of first half of year 2001 from actual data of billing system as a number of pluses used by each subscriber according to the category of subscribers present it in number of calls and minutes for local and national traffic, also a growth of traffic in number of calls per month is calculated where an annual growth can be defined as 3.3%. These pulses were subjected to table 4.5 from which we got a series of statistical data. These data reflect that the subscriber subjects his calls within a fixed rate. The telephone service in Libya is not affected by any abnormal operational circumstances. The volume of national traffic is equal to 1/3 of the volume local traffic. This is not known from the actual recorded traffic of the (systems). Since these (systems) convey the traffic from one crossing to another without any congestions and loss of traffic, hence its measurements are extracted from the actual time of operation. The analyses of the traffic was relayed on the pluses extracted from the billing system to be a standard for finding the rates which will relayed on during the analysis of the traffic of the second half of year 2001 based on reports operation from the switch, to prove the correctness of measurement for the first half of year 2001 from actual data of billing system

4.4 Switches Services and Telephone Traffic

From the analysis of local and national traffic using data from billing system, it can be seen that, the telephone traffic in the first half of 2001 is within normal level, and no sign for the switches services, because only 0.5% of the subscribers are using the services [28]. It was limited in the experimental level according to the importance of users. The company stopped supplying such services for social reasons. Accordingly the strategy service came into existence by the beginning of 2002.

Table 4.6 Average of local and national traffic for the subscribers in Zawia Road switch for first half of 2001 from the actual billing system data.

Commercial

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	301	2031	-	226	1356	-	75	672	-
Feb	324	2187	7.6%	243	1458	7.6%	81	729	8%
Mar	320	2160	-1.25%	240	1440	-1.25%	80	720	-1.25%
Apr	349	2355	9%	262	1572	9.1%	87	783	8.7%
May	373	2517	6.8%	280	1680	6.8%	93	837	6.8%
Jun	392	2646	5%	294	1764	5%	98	882	5.4%

Public

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	348	2508	-	278	1668	-	70	840	-
Feb	375	2700	7.7%	300	1800	7.9%	75	900	7.1%
Mar	394	2838	5%	315	1890	5%	79	948	5.3%
Apr	410	2952	4%	328	1968	3.8%	82	984	3.4%
May	435	3132	6%	348	2088	6%	87	1044	6%
Jun	465	3348	6.8%	372	2232	6.8%	93	1116	6.8%

Residential

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	88	1188	-	66	990	-	22	198	-
Feb	91	1227	3.4%	68	1020	3%	23	207	4.5%
Mar	93	1257	2.2%	70	1050	2.9%	23	207	0%
Apr	97	1311	4.3%	73	1095	4.2%	24	216	4.3%
May	100	1350	3%	75	1125	2.7%	25	225	4.1%
Jun	105	1419	5%	79	1185	5.3%	26	234	4%

4.5 International Telephone Traffic

The international telephone traffic covers all the effective (completed) traffic originating in a given country to destination outside that country [6], and is known to develop the financial resources, but in Libya, inspite of the huge money invested whether by the Construction Submarines cables and artificial satellites were only for humanitarian and educational purposes. The economic importance came after the humanitarian purpose. The importance of these communications is on the operational side according to the economic impact which realized in developing the resources of the company. Hence we notice that the company started to invest these systems.

The company started to give more attention to these media after the introduction of (DAMA) system in the African space, whereby this can be used to communicate with the European countries to convey sciences to Libya through Sea video-fibers across Italy.

4.5.1 Measuring International Telephone Traffic

The international telephone traffic, which is exchanged between Libya and the other countries, is subject to supply and demand forces according to the traffic exchanged with Libya in the fields of economics, trade and social. This is done through the opening of gauging or reducing it according to the size of traffic exchanged with Libya whether for the neighboring countries or those countries, which have trade economics, or social relations. The table 4.7 explains the incoming traffic and outgoing traffic from and to Libya in a number of calls and number of minutes during year 2001, and figure 4.1 shows the incoming and outgoing international traffic for Libya, noticing the following statistics:

Percentage of incoming calls to number of outgoing calls = *1 : 2.25*

Percentage of length of incoming calls to the length of outgoing calls = *1 : 3.31*

Percentage of average length of incoming calls to average length of outgoing calls = *3.62 : 5.33*

Table (4.7) The size of International traffic for Libya during year 2001

Outward traffic		**Inward traffic**	
Number of calls	Number of minutes	Number of calls	Number of minutes
31.244.628	166.652.806	13.881.767	50.190.868

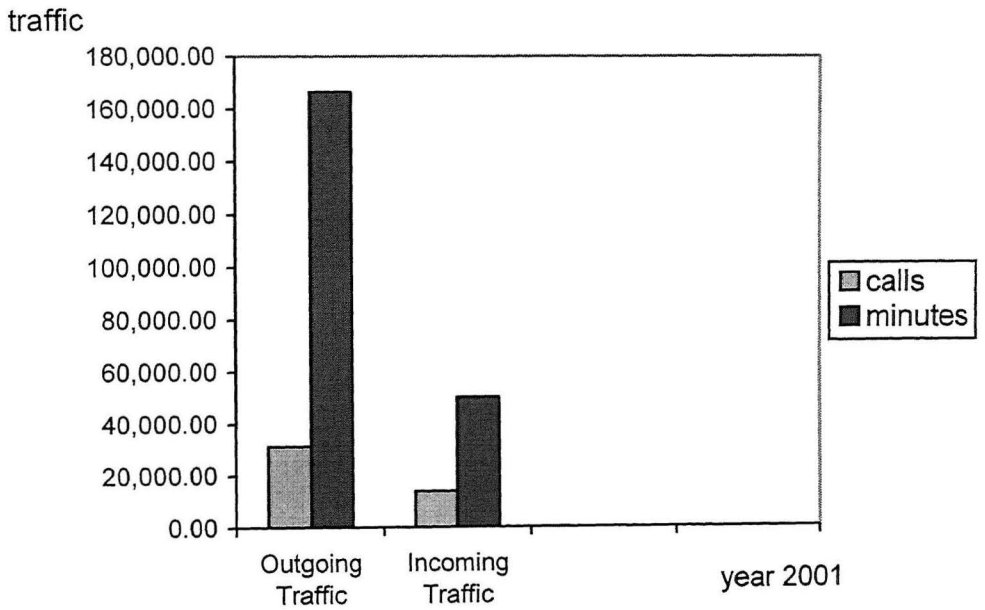

Figure 4.1 The size of International traffic in number of calls for Libya during 2001

This International traffic is divided as follows: according to the categories of the subscribers

* Commercial activity 52 %
* Public service activity 10 %
* Residential activity 38 %

It also falls within rates, which form the communication measurement according to its ratio between the incoming and, outgoing traffic. The telephone calls whether outgoing from Libya or incoming to Libya is affected by many factors social, humanitarian and commercial.

Libya is considered a very important commercial market. The ambition development in Libya covered many fields, which attracted many companies and labor. This has played a big role in increasing the telephone traffic.

The decrease in the incoming traffic as compared to the outgoing as noted is due to the following reasons: -

- The difference in the per capita income in Libya as compared to other neighboring countries was one factor in the increase in outgoing traffic in relation to incoming traffic.
- The need of the traders in Libya for the suitable commodity from neighboring countries and the world, which entails several trials of telephone, calls from the Libyan trader to look for the most suitable commodity.
- The emigrating labor contributed in the outgoing calls from Libya to other sources of these laborers.

4.5.2 Billing System and the International Traffic

The international telephone service is based on a very important factor, (the demand for the international service), hence entails of the market to understand the need of the market for such service whether audio, video, or informative.

The most important of these factors: -

- Suitability of the international telephone switches to those used in the corresponding countries.
- The international channels and the efficiency of the international switch
- The telephone traffic and the way it is applied in Libya and the corresponding department. The international telephone traffic is known to be subject to an

accounting system between the countries exporting the traffic and those where it terminates sometimes this traffic goes through intermediary channels.

Hence the shares of the traffic are distributed as follows:

- *Direct traffic* *from one country to another.*
- *Crossing traffic* *which crosses and intermediate switch and end with an international switch.*
- *Statistical traffic* *which is reported for statistically showing number of calls, minutes, and accounting is not done.*

It was included that the Billing System in existence helps to study and analyze the international traffic of the telephone deeper and comprehensively than the local switches or national switches. This is because the nature of the international calls require a number of data to identify the calls for each country including time and date of call. Therefore no estimates should be tried. The Billing System has been very successful in following the international telephone channels from the operational point of view and the measure of the performance of the international telephone channels and the congestions and the lost traffic due to it. Therefore the international switch competence was very clear. It has also contributed an important shift in the international costing and accounting in distribution of accounting shares between the international departments and Libya for both direct and transit traffic and the accompanying statistical reports.

4.5.3 Effect of Switches Services on International Traffic

The international telephone traffic posed a very high standard of communication by the outgoing and incoming telephone calls as shown in table 4.7, but it can not emphasize that the switches services have an effective rate in these rates. Because of the nature of operation and the high cost per minute these services are not introduced in the international calls very largely.

4.6 Traffic Between Stationary and Mobile phone

The growth of mobile telephony is spectacular. By the use of high frequency bands (800 and 900 MHz bands) and modern technology, mobile telephony is beginning to come within the reach of many people, although still almost exclusively for business traffic [29] in Libya.

The mobile was introduced in Libya in 1995 with a very limited capacity on trial basis. As it was accepted by the people, the company started to expand on this service with rates that follow the market needs without over estimation. Table 4.8 shows the size of the exchanged traffic between the mobile and the stationary telephone during 2001 as measured in minutes [30].

Tables 4.8 Traffic exchange between Stationary and Mobile telephone

Traffic from stationary telephone to mobile for 2001, in minutes	Traffic from mobile to stationary telephone for 2001, in minutes
111.236.361	36.664.404

The table shows the traffic between the two services, the outgoing and incoming traffic. The total communication by with the stationary was affected during 2001 in Zawia Road switch, and to calculate the telephone traffic per subscriber between these two systems we place these following measurements:

Total number of subscribers in mobile in Libya = 50.000

Total number of subscribers (zawia road) switch = 20.384

Total traffic exchanged for 2001 = 147.900.765

These data from average traffic for subscriber per month for both systems = 296 minutes

The exchanged traffic between the mobile telephone and Zawia Road switch = 6033 664 min / month.

4.7 Effect of Switches Services of Mobile on Stationary phone

The Billing System adopted now in Libya is based on calculating the traffic in minutes between the mobile and stationary telephone. From this we came to know the size of traffic exchanged between the two systems in minutes.

The stationary telephone traffic is divided into two divisions.

First division: The local and national traffic, which expected to be affected by the switches services of mobile system, such as the services of call waiting and Diverting calls. The billing system can not identify the switches services and just issue reports which show the exchanged traffic between the stationary telephone or the mobile in minutes.

Second division: The international traffic, which is clearly affected by the mobile traffic and which identified by the Billing System by analyzing the traffic of the international switch where the total minutes used by this service was (660.000) during 2001 i.e. 40 % of the total outgoing international traffic [31].

Chapter Five

Specifications of Switches services Used in Libyan Network

5. SPECIFICATIONS OF SWITCHES SERVICES USED IN LIBYAN NETWORK

5.1 The Digital Switches Services

The present century is known for the improvement in the digital system especially in the audio-visual aids, which attracted the subscribers according to the service provided by the switch. This is reflected in the switches services because of the great role it plays in the daily life for the development of the financial standpoint and the spread of humanitarian and social services and the technological advance in the manufacture of telecommunication industry.

At the beginning it was for welfare, but it become a necessity whether on local, national or international levels. This is ideally suitable for countries, which adopt high capacity telephone service and work on regional levels such as North America (Holland, Belgium, Luxembourg).

Nowadays some companies started to be unified into regional companies, which are capable of carpeting to realize high rates of growth in this domain.

These services are considered technical services, which complete the telecommunication service and allow certain flexibility for the subscriber to make full use of the telephone service. We can not assure nevertheless that it will lead to increasing the rate of traffic from the statistical data. It only affects the number of calls and the time taken.

5.2 Switches Services offered by Libyan Switches

The following are the switches services, which are offered by Libyan digital switches [32].

5.2.1 Caller Identification

The Highest percentage of subscribers use this service in Libya due to the price of the telephone which capable of showing the incoming call number, date of call, and time of calling. This service is useful in case of subscriber absence or do not want to answer the incoming call, and can be activated from the subscriber's own telephone. It is not possible to determinate the calling subscriber's number if the call originates from an incoming international trunk.

It is also considered as malicious call identification which is a supplementary service offered to the called party which enables the called party to request that the calling party be identified to the network and be registered in the network [33].

5.2.2 Outgoing Call Barring

The supplementary service Outgoing Call Barring enables a user to bar calls which are originating from this user's access. However, this services does not restrict the reception of incoming calls [34].

This service enables the subscriber to prevent certain types of outgoing calls to be dialed from his/her telephone, for example international calls. The services is controlled by the subscriber through special subscriber control procedures including the dialing of a personal code-a keyword to prevent any unauthorized control of barring.

During the activation procedure the subscriber can choose between a number of different barring categories. The subscriber is informed of an accepted or non-accepted activation/deactivation by means of a tons. An operator command-controlled variety of the service is also provided.

Incoming calls are not affected by this service. In Libya two types of call barring are provided. Type one is a permanent barring that is given by command in the AXE switches. Type two is a code controlled barring that can be activated by the subscriber when necessary. There are five levels of restriction that may be used in Libya.

Level 1 allows local, national and international calls to Arabic countries and Malta.

Level 2 allows local and national calls only.

Level 3 allows local calls within Tripoli area.

Level 4 allows local calls within own exchange.

Level 5 complete restriction of all calls.

5.2.3 Call Waiting

The Call Waiting Service is a supplementary service which permits a subscriber to be notified of an incoming call (as per basic call procedures) with an indication that no interface information channel is available [35].

. The subscriber can then choose one of the following alternative:

- Ignore the new call.
- Terminate the call in progress and initiate the new call.
- Hold the original call and accept the new call.
- Reject the new call and deactivate the service during the original call. After the service is automatically activate again.

The new call will be registered if no action is taken within 60 seconds.

The original call and the new entirely, with complete secrecy between them. In the two-call state the subscriber can switch between the calls as many times as needed, or terminate one and continue with the other. The call waiting service can be activate/deactivated by the subscriber.

5.2.4 Call Diversion

Call diversion gives the subscriber the facility to divert all incoming calls to another number, for instance when he/she is on a visit and is expecting an urgent call. The diversion of the incoming call is performed independently of the condition of the subscriber's line. The call diversion facility can only be activated from the subscriber's own telephone, by keying a code following by the directory number of the subscriber's to whom he/she wishes the calls to be diverted. Cancellation is effected from the subscriber's own telephone set if call diversion has been ordered to a number outside his/her own exchange. If the number is within his/her own exchange, cancellation is initiated either from the subscriber's own telephone set or

from the telephone set to which the diversion has been effected. Outgoing call are not effected by the diversion. A call diversion can be when no reply, busy , and immediate diversion.

5.2.5 Do Not Disturb

This service enables the subscriber to redirect all incoming calls to a special recorded announcement which informs the calling party that the B-subscriber dose not want to be disturbed at the moment. The service is subscriber-controlled, so the B-subscriber can activate and deactivate this function at wish. Outgoing calls are not affected by this service.

5.2.6 Hot Line

Hot Line is a facility where the connection to a predetermined B-number, stored in the exchange, is automatically set up as soon as the calling subscriber lifts the handset. A subscriber-controller variety of the service dialing of B-numbers other than the one the subscriber has stored with the control procedure – i.e. if dialing is started within a short time-out period. Incoming calls are not affected by this service.

Two types of hot line are available in Libya, Type one will only allow an immediate direct connection to the specified number. Type two will allow normal numbers to be dialed if a time period expires and no first digit is set up to the specified number. It is not normal that international calls are allowed for hot line but this facility has been added to the function for Libya at the request of GPTC.

5.2.7 Conference Call

The three party service enables a user to establish a three way conversation, i.e. a simultaneous communication between the served user and two other parties [36].

The first subscriber who has this service can dial to the second subscriber, after the connection is made, it can be possible to dial to the third subscriber to join the conference. If the three parties have the service of call waiting, conference call service dose not prevent any incoming calls during the conference.

5.2.8 Receiving Only

This service enables the subscriber only to receive incoming calls, and not allowed to make any calls.

5.2.9 Sending Only

This service enables the subscriber only to make calls, and not receiving any incoming calls.

5.3 Statistics of Switches Services Users in Libyan Digital Switches

The switches services was introduced in Libya by the end of 2001 with varying percentages according to the categories of the subscribers and their needs for such services. The advantageous service was considered an additional service which the subscribers can make use of after paying a certain annual fees and for any services which the subscriber needs. Therefore its use was limited in the switches operating in towns with high rate of operation, which we denoted by Zawia Road switch service in Tripoli Telecommunication District.

The use of such services in Zawia Road switch was 34 % of total subscribers in the switch, and the total number of subscribers are 20384 subscribers [37].

The ratio are distributed according to the categories of the subscribers and the switches services as shown in table 5.1 which shows the number of subscribers according to the switches services used by each subscriber. It is noted that the service of conference, call waiting and caller id reaches the rates in the commercial and Public classification, but the Residential classification reaches its climax in the call waiting and caller id services, and all these services help in raising the rate of traffic [37].

Table 5.1 Number of subscribers according to utilized switches services

Category	Number of subscribers	Switches services used by subscribers
Commercial	170	Conference – Call waiting – Diversion – caller ID
	339	Conference – Call waiting – Diversion -
	254	Call waiting – Diversion
	169	Call waiting
Public	61	Conference – Call waiting – Diversion – caller ID
	448	Conference – Call waiting – Diversion
	305	Conference – Call waiting
	203	Hot line- receiving only – sending only - Do Not Disturb
Residential	407	Call waiting – Caller ID – Diversion – Conference
	813	Diversion – Call waiting - Conference
	2684	Call waiting – Caller ID
	162	Hot line- receiving only – sending only - Do Not Disturb

5.3 Switches Services and Rates of Traffic

Inspite of the fact that the telephone traffic in Libya is measured from the reports of the Billing System of reading the recorded pulses for each telephone, yet the local and national pulses can not be separated. The digital switches services have been in use and effective only by the beginning of 2002.

It is therefore useful to study local and national telephone traffic by taking a sample in the range of 1000 subscribers from each category in (zawia road) switch who introduced these services in their telephone calls during 2002 and make the necessary

comparisons with the first half of 2001, which was operated without any switches services, from the reports of the Billing System to see the growth of the traffic in both cases.

1 – From the table (5.2) local and national telecommunication as measured in minutes and number of calls without using the switches services in the first half of 2001, it was noted that the telephone conversation for commercial activity grown by about 0.90% during the first period (six months). This growth is not due to the use of switches services, but natural growth of telecommunication in the registered traffic in their telephones.

2 – Table (5.3) shows the local and national traffic measured in minutes and number of calls during the first half of 2002 with switches services, there is a growth in the telephone traffic during this period through use of switches services by 154% for commercial activity and 156% for Residential activity and 137% for Public activity.

Table 5.2 Average of telephone traffic for a sample of subscribers (without switches services) in Zawia Road switch for 1st half year 2001

Commercial

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	297	1962	-	237	1422	-	60	540	-
Feb	300	1971	1%	243	1458	2.5%	57	513	-5%
Mar	295	1959	-1.6%	232	1392	-4.5%	63	567	10.5%
Apr	311	2045	5.4%	252	1514	8.6%	59	531	-6.3%
May	317	2106	2%	249	1494	-1.2%	68	612	15.2%
Jun	313	2100	1.2%	239	1434	-4%	74	666	8.8%

Public

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	347	2490	-	279	1674	-	68	816	-
Feb	367	2640	5.7%	294	1764	5.3%	73	876	7.3%
Mar	406	2982	10.6%	315	1890	7.1%	91	1092	24.6%
Apr	383	2820	5.6%	296	1776	-6%	87	1044	-4.3%
May	382	2766	-0.26%	303	1818	2.3%	79	948	-9.1%
Jun	410	2958	7.3%	327	1962	8%	83	996	5%

Residential

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	95	1350	-	70	1050	-	25	300	-
Feb	102	1449	7.3%	75	1125	7.1%	27	324	8%
Mar	92	1311	-10%	69	1035	-8%	23	276	14.8%
Apr	97	1377	5.4%	71	1065	2.9%	26	312	13%
May	106	1506	9.2%	78	1170	10%	28	336	7.7%
Jun	91	1284	14.1%	64	960	-18%	27	324	-3.5%

Table 5.3 Average of telephone traffic for a sample of subscribers using switches services in Zawia Road switch for 1st half year 2002

Commercial

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	776	4905	-	693	4158	-	83	747	-
Feb	761	4782	2%	689	4134	-0.57%	72	648	-13%
Mar	777	4932	2.1%	687	4122	0.29%	90	810	25%
Apr	783	4965	0.77%	694	4164	1%	89	801	-1.1%
May	783	4977	0%	690	4140	-0.57%	93	837	4.5%
Jun	787	4980	0.51%	701	4206	1.6%	86	774	-7.5%

Public

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	. No Mins	
Jan	890	6378	-	897	5382	-	83	996	-
Feb	997	6546	1.7%	903	5418	7.2%	94	1128	13.2%
Mar	1018	6732	2.1%	914	5484	1.2%	104	1248	10.6%
Apr	990	6522	-2.7%	893	5358	-2.3%	97	1164	-6.7%
May	989	6456	-0.1%	902	5412	1%	87	1044	-10.3%
Jun	997	6558	0.8%	901	5406	-0.11%	96	1152	10.3%

Resident

Period	Total Traffic		Growth	Local Traffic		Growth	National Traffic		Growth
	No.Calls	No.Mins		No.Calls	No.Mins		No.Calls	No.Mins	
Jan	231	2679	-	200	2400	-	31	279	-
Feb	224	3198	-3%	197	2955	-1.5%	27	243	-13%
Mar	220	3126	-1.7%	191	2869	-3%	29	261	7.4%
Apr	234	3324	6.3%	203	3045	6.2%	31	279	6.9%
May	239	3109	2.1%	205	3075	-0.99%	34	306	9.6%
Jun	231	3274	3.3%	199	2985	-3%	32	288	-5.8%

5.5 Effect of Switches Services on Telephone Traffic

By studying the chosen samples of subscribers, there is an effective relationship in the switches services to the subscribers in increasing the rate of traffic ranging between 154% and 156% and 137%in the commercial, public, and Residential activities respectively, since the growth rate shown in table 5.2 which was registered during the first standard period for 2001 was 0.90% and hence the rate of growth in the traffic by using the switches services for the commercial, public, and Residential activities for the year for the two first and second periods in 2002 was 153.1% , 155.1% , and 136.1 representatively.

We conclude from this that the switches services have an important role in increasing the size of the telephone traffic and reducing the loss.

Chapter Six

Actual Operational and Rates of Local Traffic

6. ACTUAL OPERATIONAL AND RATES OF LOCAL TRAFFIC

6.1 Methodology

The telephone conversation services are subject to technical measurements called (the rates of switch performance), and accounts measurements known as the pulse system. These measurements are in fact an interpretation for the telephone traffic, which is composed of a number of communications, which take place inside the country, locally and nationally. The technical measurements take into consideration the operational study where the successful call attempts across the operating channels in a record time is recorded.

The accounts measurements are those pulses, which are recorded in the telephones of the subscribers according to certain rates, which interpret the time and rate of each pulse. Therefore the accounts measurements which are used to determine the rate of the local and, national telephone conversations can not show the successful number of calls which take place in the switch or outside the switch in a record time.

From the pulses used in the communication in the standard period 2001, and the study of the registered pulses for the subscribers, from the Billing System and its interpretation into a number of calls and the time in minutes for both the local and national telecommunications, and according to standard rates in use by the specialized departments in the company to have an idea about the performance rates of the systems which conveys the traffic, It can not be seen that the increase in the rate of growth in the number of pulses is due to the increase in the number of calls, or the time of calls. The rates of the registered growth during the periods of measurement were a natural growth according to the use of the telephone conversation. This is due to the fact that the switches services in the switches do not have any effect on the rates and measurements of the traffic, which used to be given to the subscribers according to certain controls, which were the reason in the limitation of its dispersion among the subscribers.

By 2002, a thousand subscribers were selected from each category (commercial, public, Residential) for those who use switches services in Zawia Road switch, which is situated in the operational circuit of Tripoli Telecommunication District.

The traffic of their communications were realized from their telephone conversations during the first half of 2002 which was supposed to be affected by the switches services and their activities, and comparing them with the traffic of their communications with the first half of 2001 from the statistical reports extracted from Billing System without switches services.

The operation of the first half of 2002 shows clear increase in the rate of their conversations according to the number calls and minutes. This increase is the clear effect of the switches services in the switches in increasing the rate of traffic among the subscribers. But this sample can not be an indicator to rely on the authenticate the effect of the switch service on the rate of the telephone conversation, since it is a limited sample. It should have included a big number of subscribers. This needs to analyze the technical data of operation from Zawia Road Switch for the first half of 2002 according to the time of measurements and then compare these with measurements of traffic from the actual produced pulses from the Billing System. These technical measurements will show the reality of the growth in the traffic and its rate and switches service which effect the traffic away from any measurements controlled by rates developed by arbitrary deduction of the operational departments. To find out these measurements and how the telephone conversations are effected by the switches services, a sample of switch called Zawia Road Switch was chosen. It has a capacity of 20384 subscribers and is operated as a part of 9 digital switches within Tripoli town. The second half for measurement of the traffic in 2001 was deducted from the operational data (without Switches Services) and then compared with the traffic of communication from the conversation of the subscriber during the first half of 2002, bearing in mind that the operational capacity between the two periods of measurements are alike and do not exhibit any operational changes which may affect the rate of measurement of traffic. By analyzing these measurements

operationally and statistically to extract results which may explain the influence of switches services on the telephone conversation and the extent of reducing the loss in traffic and hence to have an economic gain which is compatible to the operational trend of the company.

6.2 Specifications of Traffic Data

The data used in the telephone communication is totally different from the group of traditional data since it is a series of digital signals used in transferring information. It is received in a non-limited size. These can be requested within a certain period of time to be predetermined. Since it is data, which represent actual telephone conversation for subscribers, it can only be read, and can not be changed or amend its contents. It is not stored in any kind of storage unless it is requested as such for certain demand, since it is a huge size of data and hence its storage is only needed for a very limited time. Example of traffic data can be seen in table 6.1 which shows the actual exchanged traffic between Zawia Road switch with nine switches in just one hour.

Table 6.1 Actual traffic data of Zawia Road switch during one hour

TRAFFIC MEASUREMENT ON ROUTES RESULTS,

R	TRAFF	NBIDS	CCONG	NDV	ANBLO	MHTIME	NBANSW
TRIPULO	242.1	14710	0.7	431	31.0	60.3	4327
TRIPULI	136.0	8649		431	31.0	56.6	2511
HAKHUDO	36.9	2201	0.0	124	0.0	60.4	715
HAKHUDI	34.4	2393		124	0.0	51.7	647
HANDULO	59.3	1981	0.0	124	0.0	107.7	810
HANDULI	30.2	1686		124	0.0	64.4	501
HYWUHDO	23.4	1042	0.0	124	0.0	80.7	421
HYWUHDI	21.3	1816		124	0.0	42.1	390
ANGIULO	13.6	514	0.0	93	0.0	95.6	236
ANGIULI	21.1	1694		93	0.0	44.8	323
SALJULO	10.2	520	0.0	62	0.0	70.8	224
SALJULI	18.7	1707		62	0.0	39.4	314
SUGOMUO	42.2	3444	0.0	124	1.0	44.1	647
SUGOMUI	41.4	2351		124	1.0	63.4	62[illegible]
FORNUGO	49.4	2784	0.4	93	0.0	67.3	7[illegible]
FORNUGI	35.1	2541		93	0.0	49.7	6
JUNZURO	18.7	1150	0.1	93	0.0	58.7	[illegible]
JUNZURI	11.6	853		93	0.0	49.0	

END

The data of the operational telephone conversation traffic is composed of a series of logical information which reflect a number of standard indicators which help in the study of the traffic from the statistical or technical side and which is composed of the following:

6.2.1 Calls Attempted

An attempt to achieve a connection to one or more devices attached to a telecommunication network [7]. The total number of calls attempted (also called the number of bids) is the best measure of unconstrained customer demand. At a time of network congestion, the busy hour call attempt (BHCA) count many continue to increase (as unsatisfied customer demand continues to grow). A very large number of unsatisfied call attempts is an almost certain sign of congestion, either through under provision of equipment or resulting from short term network failure, and is a good means of spotting suppressed traffic within a network Unfortunately the exact amount of suppressed traffic is difficult to estimate, because the persistence of customer in repeating call attempts many times over affects the overall bid count.
The number of call attempts can only measured accurately by monitoring each individual customer's line. A value measured at any point deeper in the network will not be an accurate measure, as it will have been reduced by the effect of any congestion at the network fringe [16].

6.2.2 Traffic Intensity

The traffic intensity of a circuit-switched network is defined to be the average number of calls simultaneously in progress during a particular period of time. It is measured in unit of *Erlangs* (Symbol E). 1 erlang is the traffic intensity in a pool of resources when just one of the resources is busy[7]. Thus an average of one call in progress during a particular period would represent a traffic intensity of one Erlang. The traffic intensity on any route between two exchanges can also be quoted in Erlang [16], the traffic intensity is given by the expression

$$\text{Traffic intensity} = \frac{\text{the sum of circuit holding times}}{\text{the duration of monitoring period}} \quad [6.1]$$

(carried traffic)

Now let

A = the traffic intensity in Erlang

T = the duration of the monitoring period

h_i = the holding time of the ith individual call

c = the total number of calls in the period of mathematical summation

Then, from above

$$A = \frac{\sum_{1}^{c} h_i}{T} \quad [6.2]$$

Now, because the sum of the holding times is equal to the number of calls multiplied by the average holding time, then

$$\sum_{1}^{c} h_i = ch \quad [6.3]$$

where h = average of call holding time, and therefore

$$A = \frac{ch}{T} \quad [6.4]$$

Traffic intensity varies irregularly during a year and it is not common for the highest loads to occur in the same weeks from one year to another. The lowest load season can be easier to predict. What is said about seasonal variations is valid also for individual days. Even if the weekdays can have repeated similarities from week to week, the predictability of the highest intensities per day is often poor. The low intensities are mostly found at weekends or other holidays but, due to many special reasons, some of these days can be the most loaded ones, too. Therefore, the highest

loads can be found only by measuring the traffic continuously, interrupting the work only for very good reasons. Such reasons can be network operations in order to clear a network overload, reprogramming of the processor, augmentation procedures, or similar actions. Except for the first one, it is preferable to carry out these operations during a predicted period with low load [38].

6.2.3 Congestion

Congestion in telecommunication network manifests itself to customers who are attempting to make calls as a "network busy" tone, or as a delay in computer or data network response. It annoys the customer; even worse, the congestion can rapidly increase as the result of customer or equipment repeat attempts. (Repeat attempts are further call attempts, made in vain by customers hoping to make a quick connection by immediate re - dialing.) These further call attempts only exacerbate the problem, because they greatly increase the loading on exchange equipment (e.g. switch processors, number stores, senders and receivers), and they add to the overall traffic volume. The congestion can then spiral out of control. The networks most at risk from congestion are those which have been kept to minimum circuit number in order to keep costs down. Also very much at risk are those networks that employ a high proportion of multi-link overflow routings, because congestion on one link in this type of network rapidly affects other routes, with a consequent "domino effect" [16].

6.2.4 Number of Devices (Routers)

The objective of routing is to establish a successful connection between any two exchanges in the network. The function of traffic routing is the selection of a particular circuit group, for a given call attempt or traffic stream, at an exchange in the network. The choice of a circuit group may be affected by information on the availability of downstream elements of the network on a quasi-real-time basis. [39]

6.2.5 Holding Time

The longer period of holding time represents the total time when network resources are in use, and the difference between holding time and paid time volumes is the time when the network common equipment (used for call set-up and clear down) in use. This quantity is called the common equipment holding time. The total holding time, the common equipment holding time, and the traffic intensity values all help to determine how many of each of the various equipments must be provided in the network.

The amount of a particular type of common equipment (e.g. signaling receivers) needed in an exchange is usually calculated by the normal Erlang method, with the common equipment traffic load calculated by multiplying the expected number of calls by the average common equipment holding time per call.[16]

6.2.6 Calls Completed

The number of calls completed also called (successful calls) in a network sense (i.e. reaching ringing tone or answer), when compared of busy with the number of calls attempted, gives another measure of the state of network congestion. The proportion of busy hour calls completed, when expressed as a percentage of the number of calls attempted, should equal the design grade of service. Hence

$$\textit{Grade of service} = \frac{\textit{(number of busy hour call attempts) – (number of busy hour call completion) * 100\%}}{\textit{(Number of busy hour call attempts)}} \quad [6.5]$$

The grade of service is a measure of the frustration that a customer will experience when trying to complete a call during the busiest hour of the day. The number of calls completed by the network is a difficult quantity to measure because not all signaling system indicate the 'network-completed' state. [16]

6.2.7 Unsuccessful Calls

Calls do not always succeed, and when a call fails, perhaps because of network congestion, or because the caller party is busy or fails to answer, the network has to tell the caller what has happened, and then it has to clear the connection to free the network for more fruitful use.

When it is a case of network congestion or called customer busy, the caller usually hears either a standard advisory tone, or recorded announcement.[16]

6.3 Telephone Traffic Measurement

Traffic measurement involves a number of parameters, including seizures (calls attempts), completed calls, traffic intensity (involving holding times), and congestion. The term "seizures" indicates the number of times a switching unit or groups are seized without taking into account holding time. Seizures may be equated to call attempts and give an expression of how much exchange control equipment is being worked. The number of completed calls is of interest in the operation and administration of an exchange. Of real interest are statistics on uncompleted calls are not attributed to busy lines or lack of answer or that can be attributed to the specified grade of service. However, at a particular exchange a completed call means only that the switch in question has carried out its function, which does not necessarily imply that a connection has been established between two subscribers. The intensity of traffic volume, a most important parameter, directly provides a measure of usage of a circuit. It is especially useful in those switching units involved directly in the speech network. On the other hand, it is not directly indicative of grade of service. Approximate grade of service should be taken from the traffic tables used to dimension the exchange by using measured traffic intensity as an input> The approximation is most accurate when traffic intensity approaches dimensioned intensity.

Congestion involves three characteristics: "all circuits busy," overflow, and dial-tone delay. "All circuits busy" is an indication of the number of times, and eventually the duration, where all units of a switching group are handling traffic simultaneously.

Thus it represents an index of the real grade of service. Its use is particularly effective for those switching groups that are operating near maximum capacity. For an over dimensioned exchange, the "all circuits busy" index is useless and tells us nothing. Overflow is an index of the number of call attempts that have not been able to proceed due to congestion. For network with alternative routing, overflow tells us the number of offered calls not handled by a specific switching equipment group. Dial-tone delay is directly indicative of overall grade of service that an exchange provides to its subscribers, particularly in the pre-selection switching stages. Dial-tone delay is normally expressed in the time required in getting dial tone compared to a fixed time, usually 3 second, as a percentage of total calls. [16]

Traffic measurements should be made through the busy hour (BH), It is recommended that administrations take traffic measurements continuously over the day throughout the measurement period.

Depending on the application, a busy hour value for dimensioning should be calculated as the peak value of the mean day profile of the average daily peak values. Normally, the measured days are working days, but Administrations may agree bilaterally to measure weekends too. In such cases the Average Daily Peak Hour (ADPH) concept is recommended [40].

Theoretically there are many formulas which are used to derive the telephone traffic, and it is always it depends on the data available. One of those formula which very well known for finding the traffic volume A during the busy hour which should be worked with the traffic intensity λ , which is the mean number of calls offered per time unit, and s, is the average of duration of the calls, which is sometimes is defined as h .

therefore

$$A = \lambda \cdot s \qquad [41,42] \qquad [6.6]$$

where $$\lambda = \frac{c}{t} \qquad [6.7]$$

c = the total number of calls and t = the duration of the monitoring period

6.4 Data Collection

The telephone conversation traffic data, which is described, constitutes a following traffic through the circuits used for its conveyance among the subscribers in the switches and it depends on the following:

6.4.1 The Administrative Data

It is concerned With the subscribers in Zawia Road Switch, the subject of this issue and its analysis according to the classification and the switches services used in their communications which is as follows: -

- Total number of subscribers	20384	
- Commercial subscribers	5096	25 %
- Public Service subscribers	3058	15 %
- Residential subscribers	12230	60 %

6.4.2 Distribution of Switches Services

- Commercial activity: Caller ID – Call waiting – Diverting – Call Conference
- Service activity: Caller ID – Call waiting – Diverting – Call Conference
- Residential activity: Caller ID – Call waiting – Call Barring.

6.4.3 The Operational Data

These are the measurements with the percentage of distributing the telephone conversation service according to the classification of the subscribers measured from the daily rate of communication on the switch and distributed according to the following: -

2.2% of break down of the network 2.2 % = 448 telephones [43]

6.5 Technical Operational Data of the Switch Across the Circuits

These were collected through the Operation and maintenance center (OMC) which supervises the traffic of these switches and the break downs of circuits and the redistribution them according to the inward and outward traffic by using special software for the supervision of the performance within the range of the (OMC). Using this system, it was possible to collect and store the data using (computers). It consists of traffic measurements to and from Zawia Road Switch through nine digital switches in Tripoli town with a total capacity of 108052 subscribers as shown in figure 6.1

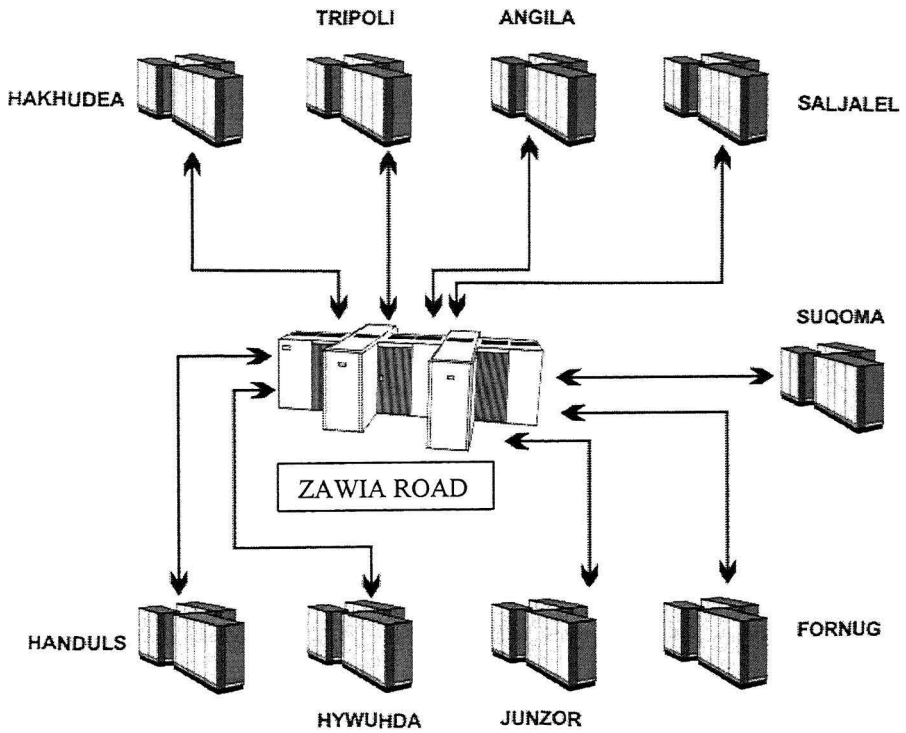

Figure 6.1 Exchange traffic between Zawia Road switch and other nine switches in Tripoli town.

6.6 Methodology of Statistical Analysis

This means understanding the features of operation and the accompanying performance measurements so as to identify the rate of traffic according to the total daily hours work full operation and the effect of the subscribers according to their categories on the results.

6.6.1 Daily Distribution of Traffic

In many cases the day's peak hour can be found among the common office hours, but seldom during a fixed hour from day to day. Peak hours in the evening are usually caused by domestic calls, but sometimes by data traffic, too. Low evening or night tariffs encourage calling during those hours. Traffic measurements have to be continuous during the whole day so that the peak intensities can be found [38].

The rate of the telephone conversation distribution in Libya follows the daily timeliness accompanying the activities of the community. There is some diversity in the distribution over the 16 hours of the ideal operational hours. The highest rate starts at 8.00am up to 10.00am due to the Public service activity, which amounts to 15 % from the total of subscribers. These accompany the operation up to 14.00pm the end of the activity. The commercial activity is effective between 10.00am up to 14.00pm, and it represents about 25 %.

Those measurements showed the recorded peak time is at 13.00pm, so it can be assume that the measurements of traffic between 10.00am and 13.00pm is due to the commercial activity. The activity of telephone conversation between 14.00pm and 19.00pm is concentrated in the commercial evening activity, and that between 20.00pm and 23.00pm hours is due mainly to residential activity. This shows the peak daily period for subscribers according to their categories as in table 6.2 and table 6.3 which they show the daily telephone conversations during 24 hours from Zawia Road switch to other switches and the opposite way, measured through the circuits in number of bids(NBIDS), number of devices or circuts used between switches to carry the traffic(NDIV), number of answered calls(NBANSW), and the number of lost calls or unsuccessful calls(NBLOST), figure 6.2 illustrates the daily traffic of conversation

in Libya noticing the peak time of the subscribers according to their categories, while table 6.4 presents the exchanged traffic in number of bids, a successful calls, and number of unsuccessful calls which are done by the subscribers during one working day in year 2001/2002, and the figure 6.3 compares the total traffic of one day of the second half of year 2001 with the traffic of first half of year 2002.

Table 6.2 Daily traffic from other switches to Zawia Road switch

time	NBIDS	NDIV	NBANSW	NBLOST
00	7420	1268	2356	5064
01	5162	1268	1723	3439
02	3264	1268	1432	1823
03	2009	1268	933	1075
04	1098	1268	530	569
05	2673	1268	1139	1534
06	3761	1268	1629	2214
07	4142	1268	1399	2743
08	6316	1268	2333	3983
09	14833	1268	5130	9703
10	21372	1268	7184	14189
11	27694	1268	8351	19343
12	29959	1268	8797	21164
13	24831	1268	7986	16846
14	13899	1268	4947	8951
15	9858	1268	3749	6109
16	7446	1268	3140	4306
17	9959	1268	4054	5905
18	11755	1268	4755	7000
19	11616	1268	4325	7290
20	19645	1268	6213	13433
21	12482	1268	3704	8778
22	9662	1268	2963	6699
23	8485	1268	2522	5963

Table 6.3 Daily traffic form Zawia Road switch to other switches

Time	NBIDS	NDIV	NBANSW	NBLOST
00	2402	1268	790	1612
01	1264	1268	430	835
02	978	1268	518	496
03	800	1268	180	620
04	766	1268	427	339
05	612	1268	202	409
06	439	1268	179	261
07	2184	1268	829	1355
08	4041	1268	1406	2634
09	11191	1268	3439	7753
10	19354	1268	4949	14404
11	24923	1268	6250	18673
12	25869	1268	6616	19253
13	19850	1268	5732	14117
14	9959	1268	3577	6380
15	6467	1268	2543	3925
16	6490	1268	2269	4221
17	7587	1268	2878	4709
18	10751	1268	3764	6987
19	10000	1268	3162	6838
20	13719	1268	4121	9598
21	6881	1286	1946	4936
22	3416	1268	2230	1186
23	2296	1268	619	1677

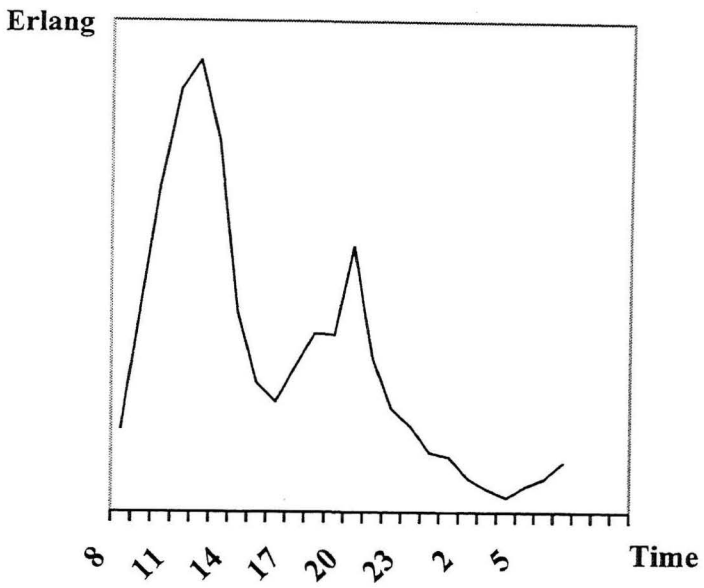

Figure 6.2 Peak time of the daily traffic of conversation in Libya

This shows that the daily traffic has a certain hours in each category according to the following percentages:

- The commercial classification 40 %
- The Public service classification 32 %
- The Residential classification 28 %

Table 6.4 Total Traffic of one working day in year 2001/2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	139.823	190.824	42.781	58.624	97.042	132.200
Incoming Calls	197.413	267.483	66.273	90.672	131.140	176.811
Total	337.236	458.307	109.054	149.296	228.182	309.011

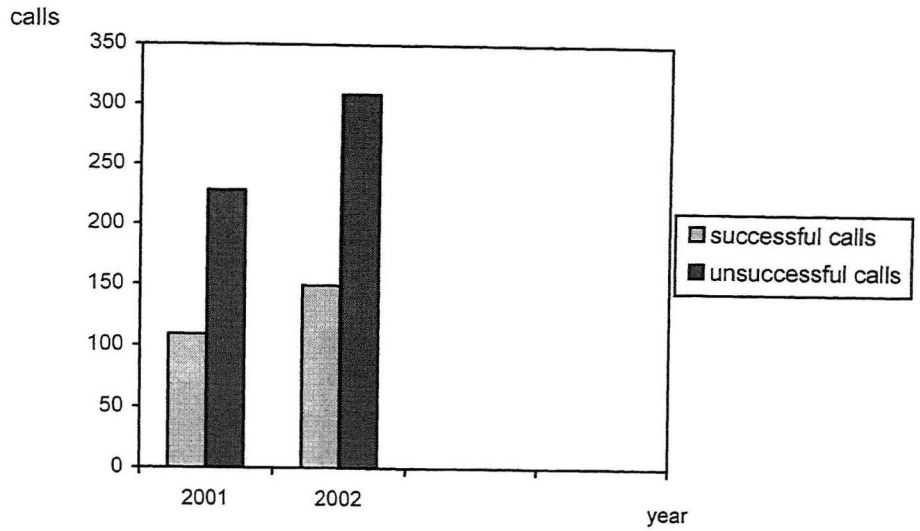

Figure 6.3 Comparison of successful calls and unsuccessful calls between year 2001 and year 2002 in one working day.

6.6.2 Telephone Traffic in a Standard Week

The standard week means the days between Saturday up to Thursday (6 days). They seem to reflect similar roles in traffic according to the category of activity during the whole day. The traffic starts at 8.00am hours up to 24.00pm night. Table 6.5 presents the exchanged traffic in number of bids, a successful calls, and number of unsuccessful which are done by the subscribers during the standard week in the second half year 2001 and the first half year 2002 , and the figure 6.4 compare the traffic of a standard week of the second half of year 2001 with the traffic of first half of year 2002.

Table 6.5 Total Traffic of one week (6 days) of 2nd half 2001 /1st half 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	849.289	1.152.457	259.988	354.039	589.301	798.418
Incoming Calls	1.201.613	1.615.874	403.027	547.646	798.586	106.328
Total	2.050.902	2.768.431	663.015	901.685	1.387.887	1.866.74

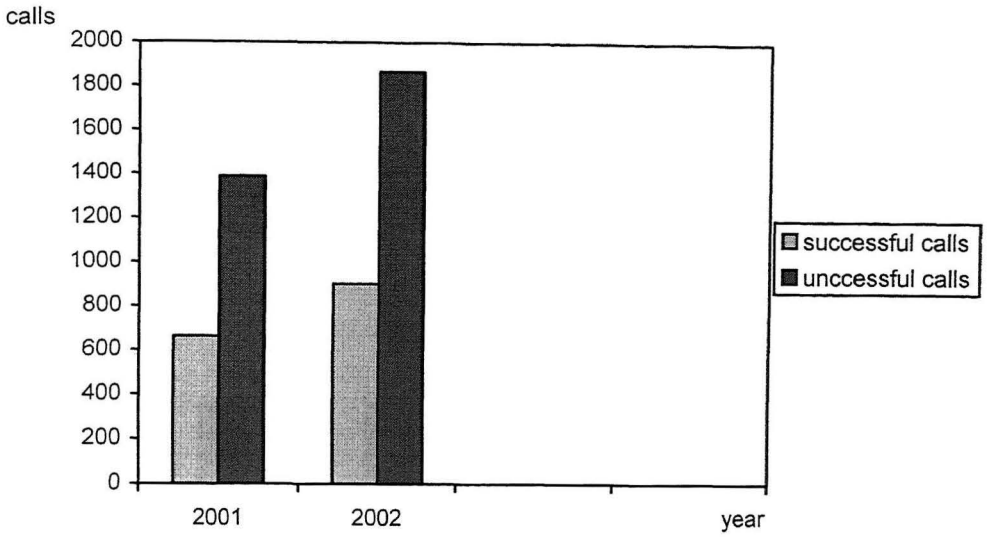

Figure 6.4 Comparison of successful calls and unsuccessful calls between year 2001 and year2002 in a standard week.

6.6.3 Telephone Traffic on the 7th day:

The 7th day which is Friday, the weekly holiday. In this day the general service activity seems to stop as well as the prominent commercial activity represented by the activities of the companies, banks and ports. It is limited in the market activities and the Residential conversations. Table 6.6 presents the exchanged traffic in number of bids, a successful calls, and number of unsuccessful which are done by the subscribers in the 7th day of second half year 2001 and first half year 2002, and figure 6.5 compares the total traffic of the 7th day (weekend) of the second half of year 2001 with the traffic of first half of year 2002.

Table 6.6 Total Traffic of weekend (Friday) 0f 2nd half 2001 /1st half 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	114.531	116.753	38.012	38.748	76.519	78.005
Incoming Calls	193.579	197.570	58.128	59.287	135.451	138.283
Total	308.110	314.323	96.140	98.035	211.970	216.288

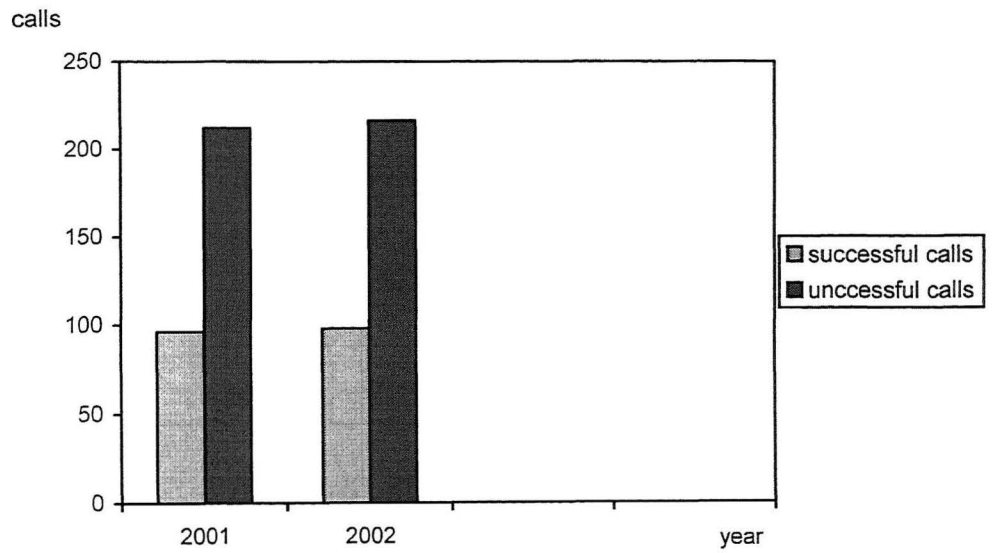

Figure 6.5 Comparison of successful calls and unsuccessful calls between 2nd half year and 1st half year 2002 of the 7th day of the week..

6.6.4 Telephone Traffic on the Record of Four Weeks 2001/2002

A selection of four weeks was made based on choosing the first week of July, second week of August, third week of September, and forth week of October to make a total of one standard month for the second half of the first period of measurement in year 2001. The second period of measurement which is the first half of year 2002, selection of four weeks was made also based on choosing the first week of January, second week of February, third week of March, and the forth week of April. Tables 6.7, 6.8, 6.9, 6.10 presents the exchanged traffic in number of bids, a successful

calls, and number of unsuccessful calls which are done by the subscribers during four weeks in year 2001 and 2002, and figure 6.6 compares the total traffic of four weeks of the second half of year 2001 with the traffic of first half of year 2002.

Table 6.7 Total Traffic of The First week of July 2001 / January 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	1.042.868	1.269.210	318.116	392.787	724.752	876.423
Incoming Calls	1.316.144	1.813.544	441.039	606.933	875.105	1.206.611
Total	2.359.012	3.082.754	759.155	999.720	1.599.857	2.083.034

Table 6.8Total Traffic of The Second week of August 2001 / February 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	1.061.276	1.280.297	323.739	396.122	737.537	884.175
Incoming Calls	1.339.570	1.828.254	448.890	612.111	890.680	1.216.143
Total	2.400.846	3.108.551	772.629	1.008.233	1.628.217	2.100.318

Table 6.9 Total Traffic of The Third week of September 2001 / March 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	1.053.073	1.280.681	321.216	396.255	731.857	884.426
Incoming Calls	1.337.420	1.828.960	448.167	612.311	889.253	1.216.649
Total	2.390.493	3.109.641	769.383	1.008.566	1.621.110	2.101.075

Table 6.10 Total Traffic of The Forth week of October 2001 / April 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	1.065.348	1.275.539	325.047	394.666	740.601	880.873
Incoming Calls	1.332.473	1.821.646	446.065	609.855	886.408	1.211791
Total	2.397.821	3.097.185	771.112	1.004.521	1.627.009	2.092.664

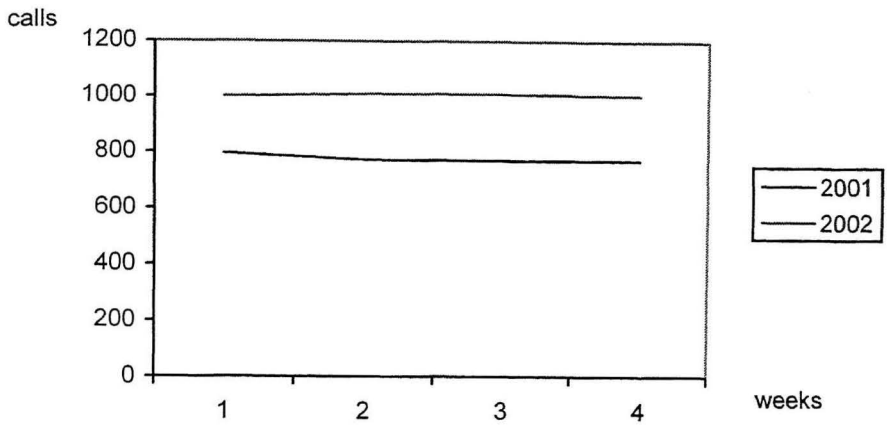

Figure 6.6 Comparison of weekly traffic

This comparison has showed the increase of weekly telephone traffic by average of 30% in number of successful calls in year 2002 , the reasons for this increase will be defined in this chapter.

6.6.5 Monthly Telephone Traffic

This measures the total monthly traffic of telephone conversations, which start from the first day of the month and end on the last day of the month on the 24 hours of the day. Tables 6.11, 6.12, 6.13, 6.14, 6.15, 4.16 present the exchanged traffic in number of bids, a successful calls, and number of unsuccessful which are done by the subscribers monthly in year 2001/2002, and figure 6.7 compares the total traffic of each month of the second half of year 2001 with the traffic of first half of year 2002.

Table 4.11 Total traffic of July 2001 / January 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.687.380	5.105.727	1.429.810	1.579.830	3.257.570	3.525.897
Incoming Calls	5.901.524	7.292.404	1.980.419	2.441.210	3.921.105	4.851.194
Total	10.588.904	12.398.131	3.410.229	4.021.040	7.178.675	8.377.097

Table 6.12 Total Traffic of August 2001 / February 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.815.686	5.155.381	1.468.950	1.595.196	3.346.736	3.560.185
Incoming Calls	6.126.822	7.363.340	2.052.571	2.464.955	4.074.251	4.898.385
Total	10.942.508	12.518.721	3.521.521	4.060.151	7.420.987	8.458.570

Table 6.13 Total Traffic of September 2001 / March 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.848.744	5.133.778	1.479.032	1.588.511	3.369.712	3.545.267
Incoming Calls	6.088.513	7.332.468	2.039.739	2.454.623	4.048.774	4.877.845
Total	10.937.257	12.466.246	3.518.771	4.043.134	7.418.486	8.423.112

Table 6.14 Total Traffic of October 2001 / April 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.876.739	5.113.251	1.487.573	1.582.161	3.389.166	3.531.090
Incoming Calls	6.163.186	7.303.171	2.064.747	2.444.811	4.098.439	4.858.360
Total	11.039.925	12.416.422	3.552.320	4.026.972	7.487.605	8.389.450

Table 6.15Total Traffic of November 2001 / May 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.990.963	5.140.582	1.522.415	1.590.613	3.468.548	3.549.969
Incoming Calls	6.281.547	7.342.161	2.104.397	2.457.873	4.177.150	4.884.288
Total	11.272.510	12.482.743	3.626.812	4.048.486	7.645.698	8.434.257

Table 6.16 Total Traffic of December 2001 / June 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	4.991.053	5.201.446	1.522.442	1.609.450	3.468.611	3.591.996
Incoming Calls	6.313.507	7.429.136	2.115.109	2.486.980	4.198.398	4.942.156
Total	11.304.560	12.630.582	3.637.551	4.096.430	7.667.009	8.534.152

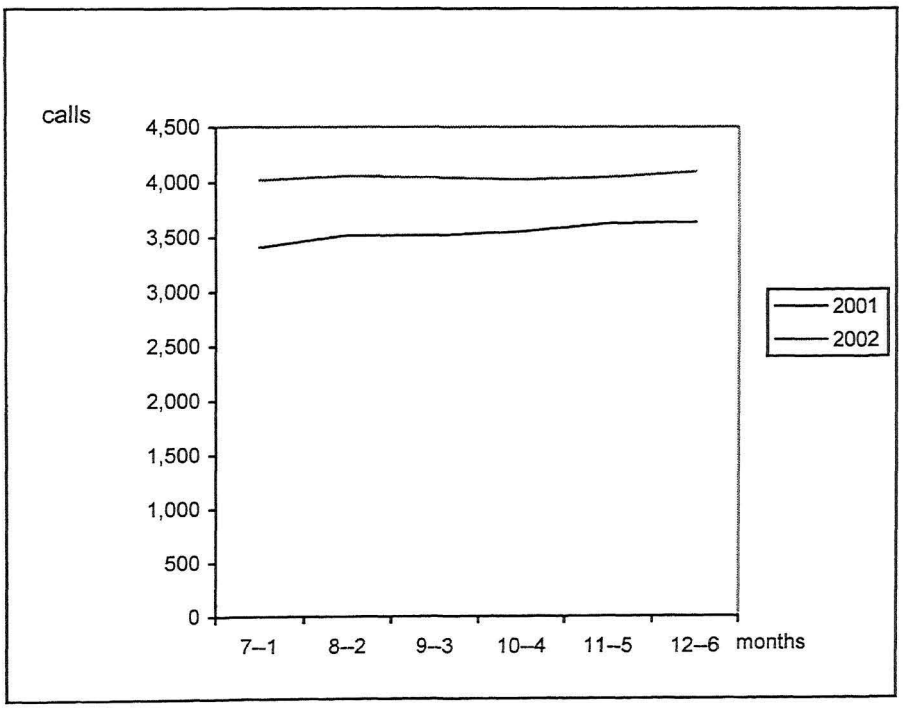

Figure 6.7 Comparison of monthly traffic between year 2001 and 2002

This comparison has showed the increase of monthly telephone traffic by the average of 14% in number of successful calls in year 2002 , the reasons for this increase will be defined in this chapter.

6.6.6 Telephone Traffic on the Record of Six Months

This is traffic measured for continuous 6 months period, (180 days). It is of various activities and distributed over 24 hours. It covers various days and activities including official and weekly holidays. Table 6.17 present the exchanged traffic in number of bids, successful calls, and number of unsuccessful calls which are done by the subscribers in six months of second half of year 2001 and first half of year 2002, and figure 6.8 compares the total traffic of six months of the second half of year 2001 with the traffic of first half of year 2002.

Table 6.17 Total Traffic of Six Months in 2001 / 2002

Index	Number of Bids		Successful Calls		Unsuccessful Calls	
	2001	2002	2001	2002	2001	2002
Outgoing Calls	29.210.565	30.850.165	8.910.222	9.545.761	20.300.343	21.304.404
Incoming Calls	36.875.099	44.062.680	12.356.983	14.750.452	24.518.117	29.312.228
Total	66.085.664	74.912.845	21.267.204	24.296.213	44.818.460	50.616.632

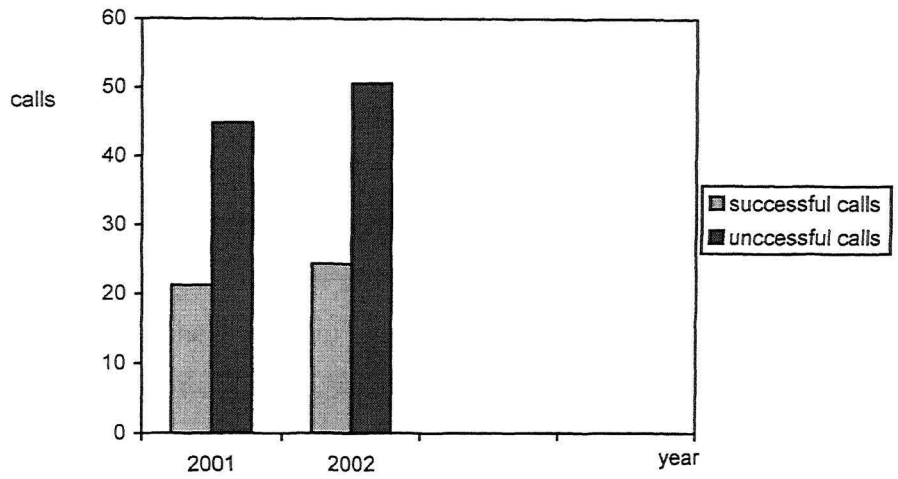

Figure 6.8 Comparison of successful calls and unsuccessful calls of the period of six months

This comparison has showed that the traffic in number of successful calls of the period of six months of year 2001 and year 2002 has increased by the average of 14.3% and increased in number of unsuccessful number of calls by the average of 13% in year 2002 , the reasons for this increase will be defined in this chapter.

6.7 The Statistical Analysis

Telephone traffic can be measured by the number of calls, by the number of charged pulses or, in certain cases, by the number of minutes, it is preferable to provide the number of calls, even if this has to be estimated [44].

This is meant to identify the successful telephone conversation traffic as shown in the tables of measuring the rate of telephone conversation according to the time series of distributing the telephone conversation traffic. It was noticed that it follows the same trend and sometime it fluctuates but it does not part from the natural rates. These measurements will lead us to understand the rate of traffic in the second half of 2001 without the switches services, and comparing it with the outcome of the results in the

monthly telephone conversation of the subscribers through the Billing System which was defined in chapter four.

These will lead us to know the standards of the first half of 2002 after the introduction of switches services. Accordingly we can arrive at the missing traffic (Unsuccessful calls), which will be analyzed by distributing this traffic according to the reasons for it's missing. We expect the reason to be the failure of most of the subscribers to use the service of switches in their telephone conversations. We so visualize that the telephone conversation is prototype in nature and rate, because the policy of operation is still under the control of the public interest and not the market situation in operation which is signified by the following economic features. Hence the operational policy is changing according to the commercial activity and the supply and demand forces.

6.7.1 Distribution of Subscribers According to their Categories

Zawia Road switch subscribers are divided according to the activity of the subscribers and nature of operation as shown in table 6.18, which illustrates the categories of the subscribers and the telephones used for each category and the percentage of this category to the total capacity and the monthly failures.

Table 6.18 Distribution of subscribers according to their categories

Categories	Number of Telephones	%	Monthly failure	%	Operating Telephones
Commercial	5096	25%	112	2.2%	4984
Public	3058	15%	67	2.2%	2991
Residential	12230	60%	269	2.2%	11961
Total	20384	100%	448	2.2%	19936

6.7.2 Measurements of Executed Telephone Calls in year 2001

These consists of the rate of the telephone traffic (successful telephone calls) according to its serial number and those extending according to the first hours of operation during the day, and then the measurements of a full day. These will form a series of the weekly measurement and monthly measurements with the second half of 2001.

From these is extracted the average monthly successful calls for the second half of 2001. From this average it was able to arrive at the number of successful calls for each telephone according to the categories of subscribers as following :

$$\text{Average monthly successful calls} = \frac{\text{Total successful calls for second half 2001}}{\text{Six months}} \quad [6.8]$$

$$= \frac{21.667.203}{6} = 3.544.534 calls$$

The average rates of successful calls for the telephones used by each category can be derived according to the following:

Average rate of successful calls =

Average monthly successful calls x percentage of daily traffic for the category [6.8]

- First: the commercial category 3.544.534 x 40% = 1.417.814 calls per month
- Second: the public category 3.544.534 x 32% = 1.134.151 calls per month
- Third: the residential category 3.544.534 x 28% = 992.469 calls per month

6.7.3 Average Rate of Monthly Traffic in 2001

The registered successful monthly traffic from the actual operation is the total telephone calls executed during the month of measurement. Since the subscribers in each switch are distributed according to the categories, it is feasible to distribute the telephone traffic estimated between the subscribers in the switch and determine the levels of using the telephone according to each subscriber as in the following expression:

Monthly Traffic per subscriber (calls) = Category Average Monthly Rate of successful calls [6.9]

Category Number of Subscribers

The commercial category = 1.417.814 = 284 calls per month

4984

The public category = 1.134.151 = 379 calls per month

2991

The residential category = 992.479 = 83 calls per month

11961

Using the limitation of measuring local and national traffic which was introduced in chapter three by converting number of pulses to minutes to define the average duration of calls s, the average rate of traffic volume A in Erlang can be found by using these rates of monthly calls λ.

therefore

$$A = \lambda \cdot s \qquad [6.6]$$

The commercial category = 284 = 28.4 Erlang monthly

60

The public category = 379 = 37.9 Erlang monthly

60

The residential category = 83 = 20.5 Erlang monthly

60

Figure 6.9 illustrates the amount of monthly traffic for each subscriber according to the categories, noticing that the public categories has the highest traffic rate, although it has the lowest number of subscribers, and the residential categories has the lowest traffic rate among the categories, although it has the highest number of subscribers.

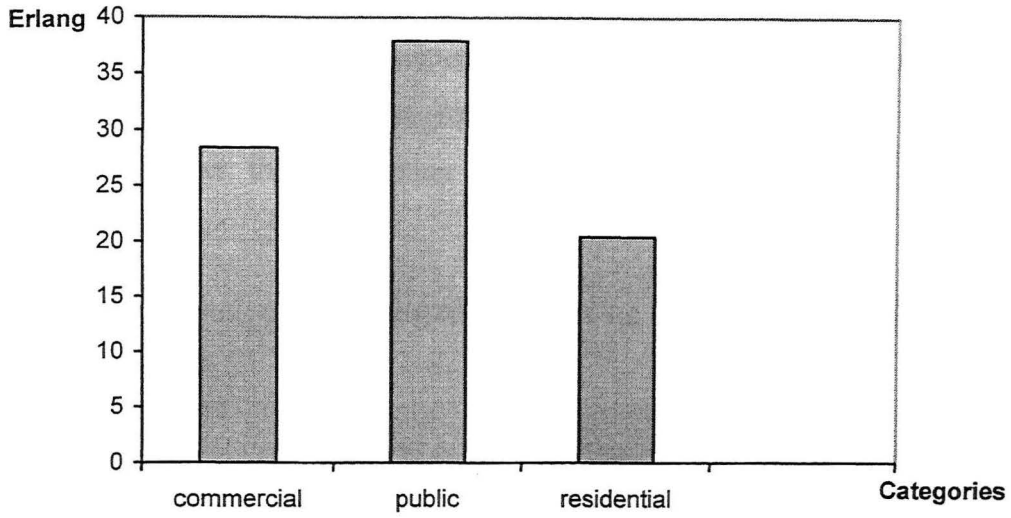

Figure 6.9 Subscriber's monthly traffic according to the categories

For more confirmation for the monthly deduced traffic during the first half of 2001, from the data of billing system and analysis of the telephone conversation analysis for the months of 4th period (Oct, Nov, Dec) year 2000 and with the same system, it was found that there was a slight difference which does affect the year 2001 measurements.

This is within the following percentage:

The commercial category + 1%

The service category + 1.3%

The house category + 0.3%

These fall within the reasonable measurements and do not pose any abnormal phenomenon. So we find that the number of monthly telephone calls for 2001 fall within the normal monthly operation for the subscribers.

6.7.4 Average Rate of Monthly Calls in 2002

From the actual operation, the switches services are confined within 34% of the total subscribers according to their categories in Zawia Road switch.

Table 6.19 shows the distribution of the subscribers according to their use of switches service.

Table 6.19 Distribution of the subscribers according to their use of switches services

Category	Number of subscribers	Switches Services users	Users without Switches Services
Commercial	4984	1694	3290
Public	2991	1017	1974
Residential	11961	4066	7859

There is an increase in number of successful calls of the first half of 2002, over that of the second half of 2001, by 14.2 % distributed between the natural growth and the switches services.

The Average rate of successful calls for the first half of 2002 = 24.296.213 calls

The Average rate of successful calls for the first half of 2001 = 21.267.203 calls

The difference between the two periods = 3.029.010 calls

From this, is deducted the natural growth of the traffic in Libyan network at 3.3% and the rest of the traffic should be the growth due to the switches services on the local calls.

therefore

Number of successful calls according to the natural growth =

(Difference of two periods) x (Percentage of natural growth) [6.10]

3.029010 x 3.3% = 99.957 calls

The natural growth is deducted from the difference of the two periods, and the outcome between the two rates of measurements, forms the balance from the successful calls and that is the growth of traffic by using switches services.

Traffic Growth = difference of the two periods – traffic according to natural growth [6.11]

$$3.029.010 - 99.957 = 2.929.253 \text{ calls}$$

therefore

$$\text{the monthly average successful calls} = \frac{\text{Traffic Growth}}{\text{Period of Measurement (six months)}} \quad [6.12]$$

$$\frac{2.929.253}{6} = 488.209 \text{ calls}$$

For getting the average successful monthly calls per month, which are effected by using the switches services of each category, the daily distribution of traffic for each category should be considered.

By so doing the successful local telephone calls for all the operating telephones operated by the subscribers who use the switches services in each category could be founded as in the following expression:

Effected monthly average successful calls for each category =

$$\frac{\text{(The successful monthly calls) x (percentage of distribution of traffic)}}{\text{(Number of subscribers using switches service for each category)}} \quad [6.13]$$

- The commercial category: $\frac{488.209 \times 40\%}{1694} = 115$ calls

- The public category: $\frac{488.209 \times 32\ \%}{1017} = 154$ calls

- The Residential category: $\frac{488.209 \times 28\ \%}{4066} = 34$ calls

an average of traffic volume A in Erlang for each category can be derived by using

$$A = \lambda \, . \, S \qquad [6.6]$$

Commercial Category = $\frac{115}{60} \times 6 = 11.6$ Erlang

Public Category = $\frac{154}{60} \times 6 = 15.4$ Erlang

Residential Category = $\frac{34}{60} \times 15 = 8.5$ Erlang

By apply the arithmetic outcome above on the operations of the subscribers according to their categories, it was found that the effect of these services are confined in the following rates. It does not show the total calls of the subscriber unless we add the natural rates of traffic (3.3%) according to the rates of operation for 2001 in addition to the natural effect of growth.

- Commercial rate 408 monthly calls 40.8 Erlang
- Public rate 546 monthly calls 54.6 Erlang
- Residential rate 120 monthly calls 30 Erlang

6.8 Results of the Analysis

The purpose of analysis is to realize confirmed results for the telephone traffic for the three measurement periods for the first half of 2001 from the Billing System (pulse system), the second period is the second half of 2001 from reports of operations, and compare them with the actual reports of operations for first half of 2002.

From These measurements it can be detect the correctness of these standard traffic of rates between the first half and the second half of 2001, compare the results with the results of the actual analysis of traffic of the first half of 2002.

These results are the real rates of traffic from the effect of the switches services whether effected by these positively or negatively from the rate of traffic for 2001.

6.8.1 Traffic Analysis from Actual Pulses and Operations Report for 2001

From the results of the rates of monthly local traffic deduced from the Billing System for first half of 2001 and comparing it with the monthly local traffic results from the reports of operations of data for second half of 2001. In table 6.20 there is some diversity between the monthly traffic measured by billing system and the corresponding report based on the switches. The difference in these rates may be normal, because it is difficult to distribute the traffic from the actual pulses with calls equal exactly to those made by the subscribers because the pulses reflect the total local and national traffic. The measurements of the operations are very difficult to reflect the total number of attempted calls for each telephone, because the measurements are taken as estimates through the use of circuits [16]. Figure 6.6 show the diversity between the monthly traffic measured by billing system and th corresponding report based on the switches.

Table 6.20 The diversity between the rates of monthly traffic measured by the billing system and the operational data.

Categories of subscribers	Billing System data first half 2001	Operation data second half 2001
Commercial	25.7E	28.4E
Public	32.3E	37.9E
Residential	18E	20.7E

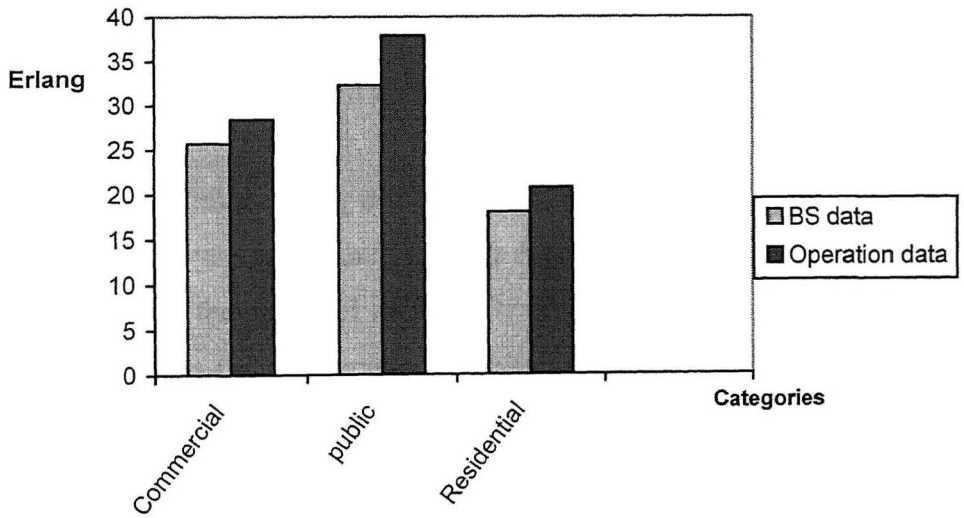

Figure (6.6) The diversity between the monthly calls measured by billing system and the corresponding report based on the switches.

The difference is very normal due to the difference in measurements between the two systems of measurements. But the average rate of traffic between the 6^{th} and 12^{th} month in year 2001 in the increase of number of calls represents the natural growth, which can be calculated using the follows expression:

$$\text{Average rate of traffic} = \frac{(\text{The traffic of the } 12^{th} \text{ month} - \text{The } 6^{th} \text{ month traffic}) \times 50\ \%}{\text{Average traffic of the } 6^{th} \text{ month.}} \quad [6.14]$$

6.8.2 Effect of Switches Services on the Rates of Local Traffic

The rates of the telephone traffic in 2001 falls within fixed rates free from any features, which can influence the traffic.

Since the annual rates of telephone conversations growth is within 3.3% as in chapter four, and the performance of Zawia Road switch is comparable with other switches in the area and the distribution of subscribers and measurement of traffic, all differences are waived and the rate of performance become the same.

Consequently the rates of 2001 are the same for 2002. But the introduction of the switches services resulted in a new situation, which led to an increase in the rates of the traffic.

Since 34 % of those using switches have their traffic different as shown in table 6.2 and figure 6.7, which are showing the monthly traffic for each subscriber according to category for the first half of 2001 from the actual data of billing system data, the table also shows the measurements of the second half of 2001 of the traffic from the actual data of operations, the table also shows the measurement for first half of 2002 for the monthly rate of traffic of subscribers who did not make use of the switches services, they were only effected by the natural rate of growth. It was then concluded from the data at the table, the effect of the switches services on the monthly local traffic, which increased their rate over the previous measurement by 39.2%.

Table 6.21 The effect of using the switches services on the rates of the monthly local traffic according to category of subscriber.

Category	Billing System data 1st half 2001	Operational data 2nd half 2001	Operational data with the annual growth 1st half 2002	Operational data and the affect of switches services	Percentage of effect
Commercial	25.7	28.4	29.3	40.8	39.2%
Public	32.3	37.9	39.2	54.6	39.2%
Residential	18	20.7	21.5	30	39.2%

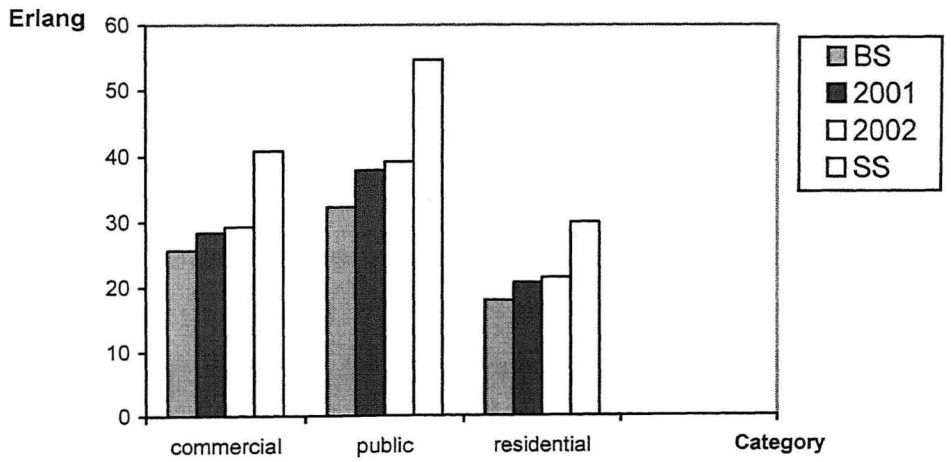

Figure 6.7 Effect of using switches services (SS) on a monthly traffic

6.8.3 The Actual Traffic Lost

There are three factors, which contribute to failure in calls. These are No reply, occupied and jams. There are two other factors which ,may cause the rate to increase in Libya. There are: technical failures, and lockout for debt reasons. These two reasons contribute the biggest headache whether for the company or the subscribers. The company claims that the failure is due to the construction works which take place on ground and which affect the underground cables, while the subscriber claims that the methodology of service rendered by the company is inadequate. They claim that

the diameter of the distribution switch is about 6km. one third of it is connected through the open air, more over this network is based on paper cables.

The closing for debt is only a supporting factor in increasing the unsuccessful calls due to the high cost of providing such services as visualized by the subscriber. About 60% of the operational capacity of the switch are allocated for the Residential service where the subscriber does not care much for paying his dues in the right time.

The nature of operation features is that it produces reasons which affect the rate of traffic it is effect is clear in increasing the rate of unsuccessful calls, and this is a natural outcome which does not cause bad operation or efficiency in performance like those calls which end with no reply or the other telephone being engaged, but then other factors for failure may be the congestions arising out of bad operation , so all the calls are stopped during the crossing from one subscriber to another which have no affect on the Number of attempted calls . This is often the result of inefficient operation on carrying the local calls through the circuits which carry the traffic between the switches. The data operational reports of the switch showed the percentage of the congestions is 0.0%. Table 6.22 shows that the hypotheses of analysis should be based on the unsuccessful calls and not the successful calls, because the focus of this work is based on reducing the lost traffic caused by unsuccessful calls using switches services, that is why the percentage of unsuccessful calls in the 2^{nd} period decreased by 2% from the measurement of the first period. This is due to the effect of the switches services on the local unsuccessful calls.

The logic of operation should result whenever the successful calls increase, the unsuccessful calls decrease in any operational area when switches services are introduced. But this is not necessary so, because at the time one call was successful due to the use of one of the switches services, there are a number of unsuccessful calls, because the subscriber was insisting to have successful call, so is the new technology used in the telephone, which helped in repeating the trials automatically and consecutively.

Table 6.22 Percentage of successful calls compared to unsuccessful calls

Period	Unsuccessful calls	Successful calls	Percentage
2nd half 2001	44.818.460	21.267.203	110%
1st half 2002	50.616.632	24.296.213	108%

6.8.4 Unsuccessful Calls According to Operation

The unsuccessful calls are distributed according to the reasons of failure as determined the Switches Department in the Company (GPTC) [45].

No reply 35.3%

Engaged 59%

Failures 2.2%

Closed telephones 3.5%

Table 6.23 shows the number of unsuccessful calls, with 0.0% of congestions and other percentage of no reply, engaged, faults and telephones closed or line has been cut off during the first half of 2002.

Table 6.23 Shows the number of unsuccessful calls according to reason of loss in the first half of 2002.

Unsuccessful calls	Congestion	No reply 35.3%	Engaged 2.2%	Faults 2.2%	Closed 3.5%
50.616.632	-	17.867.671	29.863.813	1.113.566	1.771.582

The no reply attempted calls, and engaged telephones constitutes the highest reasons for unsuccessful calls. This is the most effective cause for such unsuccessful calls. The unsuccessful attempted which a case of faults and closed telephones formed rates of unsuccessful calls which are a cases of repeating nature of operation.

From the data of the previous table 6.23, the average rate of monthly unsuccessful calls can be derived according to reason of loss in the first half of 2002 as shown in table 6.24.

Table 6.24 Monthly rate of unsuccessful calls according to reason of loss in 1st half of 2002

Unsuccessful calls	Congestions	No reply 35.3%	Engaged 59%	Failures 2.2%	Closed 3.5%
8.436.105	-	2.977.945	4.977.302	185.594	295.264

From the above it can be conclude the affect of unsuccessful calls on the operation and rate of efficiency of the switch.

6.8.5 Rates of Lost Traffic

The unsuccessful attempts in telephone calls have important economic impact in operation. It accounts for 2/3 the attempted calls, as it was shown in 6.24.

It was notice that 34% of the subscribers used during the 1st half of 2002 the switches services and that their calls were driven to the successful side. As compared to the first half of 2001, at the rate of 39.3% monthly for each subscriber of each category, that is amounting to 2.929.053 calls. The rest who did not use the switch services i.e. (66.%) encountered a loss of 5.858.106 calls during the period of measurement.

Therefore:

$$\text{Average rate of monthly unsuccessful calls} = \frac{\text{Total number of unsuccessful calls}}{\text{Period of measurement (six months)}} \quad [6.15]$$

Average rate of monthly unsuccessful calls = $\frac{5.858.106}{6}$ = 976.351 Calls

To calculate the monthly unsuccessful calls one has to consider the daily distribution of traffic in each category [35], according to this definition it can be determined the unsuccessful local calls for the operating telephones, which do not use switches services as follows:

Average rate of monthly unsuccessful calls per subscriber for each category =

$$\frac{\text{Number Of unsuccessful calls x percentage of operation for the category}}{\text{Number Of subscribers without switches services}} \quad [6.16]$$

The commercial category = $\frac{976.351 \times 40\%}{3290}$ = 119 Calls

Public category = $\frac{976.351 \times 32\%}{1974}$ = 158 Calls

Residential category = $\frac{976.351 \times 28\%}{7895}$ = 35 Calls

Figure 6.8 shows the average rate of monthly lost traffic volume A for subscribers according to the categories which was derived by using

$$A = \lambda \cdot S \quad [6.6]$$

The commercial category = $\frac{119}{60} \times 6 = 11.9$ Erlang

Public category = $\frac{158}{60} \times 6 = 15.8$ Erlang

Residential category = $\frac{35}{60} \times 15 = 8.75$ Erlang

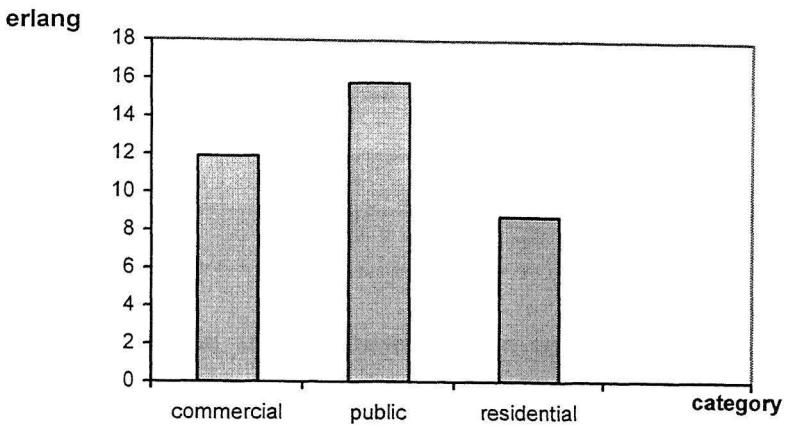

Figure 6.8 Average rate of lost traffic volume per category

6.8.6 Effect of Lost Traffic

From the foregoing annotation it is clear that the unsuccessful calls constitute a number of calls, which may have been successful, But has shown itself as a lost traffic and has high rates if compared with the natural operation without switches services for year 2001. It is very be useful to illustrate this in term of traffic in Erlang, to show the effect of monthly lost traffic for subscribers who do not use switches services on the position of the switch.

These have to be identified through the use of monthly number of unsuccessful calls per subscriber for each category and converting it to traffic in Erlang as in table 6.25 which shows the total monthly lost traffic for subscribers who do not use

switches services, or do not have them, in this case it is effecting the position of the company, because a large number of traffic has lost.

Table 6.25 Total monthly lost traffic for the company for not using switches services

Category	Number of Subscribers	Unsuccessful Calls	Traffic in Erlang	Monthly Lost Traffic in Erlang
Commercial	3290	119	11.9	39151.00
Public	1974	158	15.8	31189.20
Residential	7895	35	8.75	69081.25
Total	13159	321	36	139421.45

The unsuccessful traffic constitutes an indicator, which is worthy of study and shows its economic effects in the long run in the course of redistributing this amount of traffic among the subscribers. This is because the unsuccessful traffic has contributed very highly in the inability of subscribers using this value of switches services and determined by subscription fees. This has resulted in a loss in traffic for this category, which amount to about 66% of the number of subscribers according to the rate of calls of each subscriber.

6.8.7 The Impact of Switches Services

Through the study of local telephone traffic it is clear that the switches services has a very positive impact on the level of telephone traffic. The practical operation in Libya has very much limited the role of these switches services according to the request of subscriber. The use is limited in 34% at the best, this percentage accounts for 6777 subscribers distributed over all the categories, 66% of the subscribers were not interested in these services which amount to 13159 subscribers distributed over the categories. From the results, which we arrived at each subscriber who used the switches services has contributed about an average of 11.83 Erlang monthly, while the

subscriber who did not use the switches services has contributed a loss of an average of 12.15 Erlang monthly to the switch.

These facts were very clear from the very facts and statistics and the extent of their impact on the company. The company imposes additional fees for these services the nature of which will be reduction in the calls, or just maintain annual fees assumed to cover the switches services. The company may impose additional fees on services, which tend to decrease the calls by the subscribers

From table 6.25 which shows the impact of the digital switches services according to the monthly traffic by 34% of the subscribers due to their use of the switches services. Also showed the loss of traffic per month of the rate of communication is about 66% of those who do not use these services.

Table 6.26 The situation of the company for the chosen switch by using the switches services.

Monthly traffic by using switches services 34%	Monthly lost traffic by not using switches services 66%	Expected monthly traffic for all subscribers using switches services
11.83 Erlang	12.15 Erlang	23.98 Erlang

The table also shows what should be realized of traffic as a result of an increase in the rate of communication in case these services were introduced to all subscribers without imposing additional subscription fees. This can be realized by studding these indicators to show their impact as follows:

The switches services have a role to play in increasing the rate of local telephone traffic. It represents a hurdle on the traffic itself since it contributed in increasing the number of subscribers by 34%, and a loss of 66% of the subscribers. The common factor between what is realized and what is, is shown from the analysis which states that it falls within 23.98 Erlang monthly for each subscriber.

Therefore the subscription fees in the switches services are a reason for the abortion of the traffic estimated according to the monthly loss shown from the local traffic and the equivalent from the national communication traffic, which in itself is affected by the operational features.

6.9 Forecasting of Traffic

Although the choice of a forecasting model is usually guided by its forecasting performance, other considerations must receive attention. Thus, the length of the forecast period, the functional form, and the forecast accuracy of the explanatory variables of an econometric model must be considered.

The length of the forecast period affects the decision to use one type of a model versus another, along with historical data limitations and the purpose of the forecasting model. For normal extensions of switching equipment and additions of circuits, a forecast period of about six years is necessary [46].

In the case of GPTC it possible to forecast traffic for next six years, if the GPTC Master Plan is implemented, which will rise the number of subscribers in Libyan network to approximately one million by year 2010 which means an increase in number of subscribers by 12.5% every year starting from year 2003 until year 2010. To forecast the traffic of the chosen switch Zawia Road, if the switches service have given to all subscribers without imposing any restrictions, one has to think about the expected monthly traffic during year 2002 if all subscribers are given the switches services, which was derived by adding the monthly traffic by using switches services to the monthly traffic by not using switches services, than yearly traffic is calculated as in table 6.27 which also shows the forecasting of local traffic for the chosen switch for next six months by adding percentage of 12.5% yearly since the number of subscribers are approximately 500.000 in year 2002. Figure 6.8 illustrate forecasting of local traffic for the next six year.

Table 2.27 Forecasting of local traffic volume in Erlang for next six years

Expected monthly traffic 2002	Expected yearly traffic 2002	Expected yearly traffic 2003	Expected yearly traffic 2004	Expected yearly traffic 2005	Expected yearly traffic 2006	Expected yearly traffic 2007	Expected yearly traffic 2008
23.98	287.76	323.73	364.19	409.71	460.92	518.53	583.34

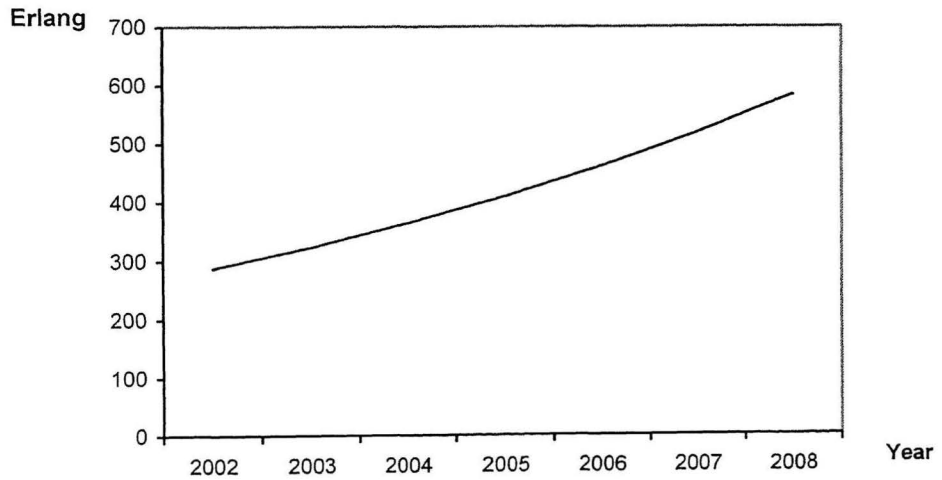

Figure 6.8 Forecasting of Local traffic for next six years

7.0 Conclusion

The General Company for Post and Telecommunication in Libya is responsible for the establishment of the telecommunication services. The General Company means the administrative structure, which is fully owned by the community (country).

Hence the policies of the company are drawn and determined according to the targets of the objectives of the country. Thus this definition led the company to provide its service according the priorities which serve the community and not satisfying the community. Accordingly this situation gave rise to short-comings in the methodology of the company whether the construction, the operational, or financial. This shortcoming depends on each factor of these factors. We feel that we should explain these sides, firstly The construction side, which deals with the policy of the company for extension in service is based on the funds available and the policy drawn by the country. Therefore the company can not develop by making civil construction and importing Equipments for the switches and networks apart from the plan of the development projects whose cost is covered by the country. Later appeared the mobile service as a new service in the Libyan telecommunication service. It becomes a very strong competitor to the stationary telephone service. Since both the mobile and stationary telephone service falls within the same operational and developmental service and one department, very high fees were paid for both subscription fees and tariff fees per minute. The company started to expand periodically accordingly the capacity of subscribers raised by 100%. The company is heading to develop this service to cover all the Libyan towns based on the working circumstances and financial capability. Secondly the operational side, the company relied on the high capacity switches and using networks with operating diameters than 6km. And has an analogue technology. The biggest percentage of the secondary network is distributed airily which made its maintenance very costly and needs quite a number of technical labors. The main network usually affected by cuts and damage in very important parts due to the operation and works done by the public companies such as the Gene

Electricity Company, the General Water Company, and contract works done by the people.

These technical problems are available in both main towns and rural areas, ending by house service. The commercial activity is the lowest. The distribution of these switches is such that 90 % airily network and the area of operation of the switch has a diameter of 10km, which tend to weaken the pulses and increase the breakdown. The network is also subjected to damage from natural hazards. The company also started to extend its services in the rural areas, which contributed to the increase in expenses in both aerial and rural networks.

The utilized cables are not suitable but for maintenance or to be sold as material for re-manufacturing. The third factor is the financial side, Since Libya is put in the category of the oil producing countries it has been committing high costs in its construction projects, services and maintenance because of the high per capita income of the individual. Therefore the cost of any project in Libya is considered relatively high.

All these factors affected the company in the construction, and resulted in certain circumstances which affected both the commercial and the residential users of the telephone service, but the Public service activity was not affected since it has priority over all other activities. The fees are paid from the community account and therefore this does not pose any burden on its budget, accordingly the consumption in return for the service falls within the high rates as reflected by the statistics of the local traffic.

The effective of operational circumstances on the users of the telephone service of the commercial and residential subscribers fall within the next following two factor:

- The incapacity of the network to provide the telephone service according to the commercial markets need which resulted in the lowering of traffic as compared to the developing countries, and caused some disturbances in the commercial market by not making use of the time factor which is included in the costing:

The bylaw of the telecommunication formed the contractual framework, which stipulates the legal relationship between the company and the subscriber. This bylaw was formulated in such a way so as to serve the operational objectives of the company, and parted away from the rights of the users of such service. These rights have their psychological impact on the users.

The main factors which may be taken against the bylaw from the point of view of the subscribers, is that it a joint advantage between the subscribers fees and the installation fees according to the categorization of the subscribers and unified the unit of the tariff for the unit of communication in the local call and the cost of a minute of national call, and also a minute of international call. This unification caused frustration among the Residential subscribers since the fees that these is unjust in unit cost specially for the calls which are located in one operational area which known as the multi-switches area. The users of the telephone service agreed that the fees applied on the switches services are unjustifiable since these were applied by the company as port of the basis of the annual subscribers fees for telephone service.

This is specially so if we know that the annual subscribers fees of the analogues switches was increased after introducing the digital switches. It is obvious that the cost of the digital service was calculated from the actual subscribers fees. The subscriber refuses the duality in collecting such fees.

Accordingly, it is quite clear that the policy of the company in the constructive, operational side has a direct impact on the continuity of the company as a living identity liable for growth, and the company is heading for a policy of contraction, since it is not capable of following the technical development and its incapability in furnishing the needs for telecommunication service in Libya for the following reasons: -

- The big geographical area of Libya as an essential factor in providing the telecommunication service at the highest level needed and with such methodology.
- The labor force poses a burden on the economy of the company. There are approximately 500.000 telephones being operated and served by 16.000 laborers.
- Libya is a non-industrial country and it is one of the countries, which import all the technology needed for modern switches and telecommunication network. These technologies are very developed and are continuously under development. Therefore training and operational factors are of great importance. The company can not meet these whether by importing or training the people. This also entails reviewing the present administrative skeleton, which embodies this activity to live and peruse such development according to supply and demand forces.

All these factors combine to make a compromise between the subscribers and the company through the valid legislation specially in collection of fees which is the main vein for the existence of the company. The company is looking forward to perform it's duties and responsibilities via the jurisdictions in force. It has improved the system of collecting fees through software and computer systems, which formed a good administrative base, which helped to know the addresses of the users of telephone system. And the administrative base is thus established through which command on the resources of the company is made.

To illustrate the role of invoicing we have to comprehend the suffering of the company before the introduction of this system. Before this there were several problems whether in invoicing or payment in both local and international calls.

Inspite of the many trials to collect payment by microfilm of data and bring an end to the following with telephone lines and convey them to other addresses. This resulted in the legal use of telephones and with illegal procedures by a technician authorized by the company.

The Billing System has contributed in solving many problems at the local level, it has ended all the previous problems with the international administration. The most important was the size of traffic in minutes and the crossing through the crossing administration. But it still poses some differences in the international measurements for the traffic.

These problems may be referred to the problems arising from programming operations by switches. This also a poses fears for the communication companies since they are not exact in calculation. These companies are still trying to renew their systems from time to time, which made most communication companies in the world turn to the system of prepayment to avoid the problems of accounts with the customers.

The Libyan Company is expected to change the system of prepayment gradually so that it becomes the first step toward the international communication.

From the foregoing discussion in which we explained the role of the telecommunication service on the society, and the positive and negative ties according to the conditions of contracting and the legal provisions in the regulation, we find that the company is not caring to study its operational circumstances and treating its negative role and find the solution. It has concentrated only on the policy of the routine operation. It is followed a policy of establishing non-justifiable fees such as the fees of switches services, which was a barrier for those who use the service of telephone. By analyzing the local telephone traffic whether through the number of calls or analyzing the pulses for the selected periods of this analysis which lie within the range of the first and second half of 2001, and comparing the results for the first and second half of 2001 with those of the first half of 2002, it was found that the average rate of monthly traffic affected by the switches services increased by 39.2% per month. The tendency to apply fees on such service will have a negative effect specially after we know that the statistics of year 2003 that who use the

switches services is continuously decreasing to 27%. So it was possible to prove that the switches services have an influence on increasing the rates of traffic by numbers of calls, since the introduction of the switches services in Libya started actually with the beginning of 2002, and also by forecasting of the traffic for the next six years, it was noticed that the traffic will increased rapidly, if all the subscribers are provided with the switches services.

In the introduction to thesis it was formulated the goal as possibility to prove the extent of the influence of switches services on the telephone traffic volume of subscribers in GPTC. The Goal was fully confirmed by the consideration presented in the work with an emphasis to different groups of subscribers. The analyses and consideration made it possible an evaluation of the influence of the servilities played in separate parts of the system and, as a result, make it possible to optimize necessary modifications of the system and its modernization. In the light the considerations may play key role in the reconstruction of the Libyan telecommunication network in its present stage as well as include suggestions to its further development.

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