Subscribers' Perception of the Quality of Service (QoS) of the Global System for Mobile Services in Ibadan, Nigeria

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ABSTRACT
Using a research instrument titled "A survey of subscribers' opinion on GSM services in Ibadan, Nigeria", subscribers perception of the quality of servoice of GSM operations was evaluated. The questionnaire solicits information on personal data of respondents as well as information from the GSM subscribers on their opinion of GSM network service provision as a means of communication. Findings from the research shows that the introduction of GSM has increased the workforce mobility for communication worldwide and its fueling demands for more powerful and flexible way of information access. However, the services are still plagued with problems such as call drops, higher cost and problems with short message services (SMS). Subscribers therefore clamour for services that are optimized to handle better quality communication and integrate evolving wireless applications. Recommendations were made based on these findings.

Keywords - GSM, QoS, Subscribers, Messages, Wireless, Cell Phones and Operators..

1. INTRODUCTION

Global System for Mobile Communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standard group established in 1982 to create a common European mobile telephone standard that would formulate specification for a Pan European mobile cellular radio system operating at 900MHZ frequency band. It is estimated that many countries outside Europe will join the GSM partnership. The GSM technology cellular phone is one of the fast growing and most demanding telecommunication application. Today, it represents a continuous increasing percentage of all new telephone subscription around the world. Currently, there are more than 45 million cellular subscribers' worldwide and nearly 50 percent of those subscribers are located in the United States. It is observed that the GSM 900MHZ and DCS (Digital cellular system) 1800 networks use a sophisticated array of digital equipment to provide a seamless, free connection of universal method of communication.

It became clear that solution to the development of mobile communication did not make long-term economic sense, giving the daunting costs facing operators and manufacturers, it was essential to exploit the economic scale inherent to global market penetration. This project work is targeted at acquiring subscribers' opinion on the GSM services and performance since they became operational in Nigeria particularly, in Ibadan, Nigeria. The subscribers are end-users of services rendered by GSM network operator, so they are in a better position to provide accurate assessment of the operations in Nigeria.

1.1 Historical Antecedents

In the mobile information age, the concept of cellular phone services (GSM) network is comprised of different cells that use low-power transmitter where the frequency can be re-used within a geographical area. The idea of cell-based mobile service was formulated in the United States at Bell labs in the early 1970s. However , the Nordic telephone (NMT) in 1981.

Cellular system began in the United States with the release of the Advance Mobile Service (AMPS) system in 1983. The AMPS standard was adopted by Asia, Latin America and Oceanic countries, creating the largest potential market in the world for cellular. Also, the idea of cell-based mobile network services was used to deliver more than voice calls, coupled with Short Messages Services (SMS), voice mail, fax mail, forward calls, incoming calls, barring calls, Dial-tone multi-frequency (DTMF) with personal computer (PC) for sending and receiving messages (Lee, 1999; Broadin, 2006)

The development of the GSM technology started in 1982 when the conference of European Post Telecommunication (CEPT 1982) formed a study group called Group Special Mobile (meaning GSM). The group was to study and develop a Pan European Public Cellular Systems that uses 900MHZ frequency bandwidth range using spectrum that had been previously allocated. At that, there were many incompatible analog telebased system in various part of Europe, some of the basic criteria for their proposed systems were; Good subjective sound or speech quality, low terminal and service cost, support handheld terminals, support for range of new service, ability to handle high volume of users and spectral facility efficiency.

In 1989, the responsibility of GSM was transferred to the European Telecommunication Standard Institute (ETSI, 1989) and phase one recommendation was published in 1990. at that time, the United Kingdom requested specification based on GSM but for high use densities with low-power mobile stations operating at 1.8GHZ. The specification for the system was called Digital cellular system (DCS, 1800). By 1991, GSM network technology started commercial operations within European countries with different bandwidth equipment. By 1995, there were over sixty (60) countries with operational facility on GSM networks in the Middle East, the far East, Australia, Africa and South America with a total of over 20.4 million subscribers. (Sampei, 2007).

The GSM technology feature a cell broadcast with D channel for call set up and B channel for transferring data with different base station subsystem network. It converts the voice into coded digital signals which is transmitted and then decoded in the receiving handset. This way, atmosphere noise has less effect on voice quality and the encoded messages provided security(Ekeh, 2001, Tayo, 2003).

Table 1: Summary Of The Development Of Mobile Telephone Systems

YEAR	MOBILE SYSTEM
1981	Nordic Mobile Telephone (NMT) 45
1983	American Mobile Phone System (APMS)
1985	Total Access Communication System (TACS)
1986	Nordic Mobile Telephony (NMT) 900
1991	American Digital Cellular (ADC)
1991	Global System for Mobile Communication (GSM)
1992	Digital Cellular System (DCS) 1800
1994	Personal Digital Cellular
1995	PCS 1900-Canada
1996	PCS- United States

TABLE 2: Mobile Technology Milestone

Year	Milestone
1982	The global system for mobile communication formed
1986	A field test was conducted
1987	Time division multiple access was chosen
1988	Memorandum of understanding was signed
1989	Validation of the GSM system
1990	Pre operation system
1991	Commercial system starts up
1992	Coverage of large cities
1993	Coverage of main roads
1995	Coverage of rural areas

2. RESEARCH FOCUS

The purpose of this study is to investigate the general service provided by the GSM network service operators and the difficulties subscribers encounter during the course of accessing the network service as they affect their social and economic life. We intend to evaluate the subscribers' views about the GSM service in terms of their billing system, Quality of Service (QoS), low network transmission, poor interconnectivity with other mobile network operators, low validity period experienced by subscribers, high cost of maintenance and their effect on subscribers. The intention is to educate the general public on the Quality of Service (QoS) provided by the GSM network operators and to highlight their short comings on the mobile services provided as generated from the opinion of the subscribers.

Our study is limited to GSM subscribers' opinion on the network services in Ibadan using ZAINE,, MTN, Globalcom and Odua tel.

2.1 Architecture of the GSM Network

A GSM network is composed of several functional entities whose functions and interface are specified. Figure 1 shows the layout of a generic GSM network. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber. The Base Station subsystem controls the radio link with the Mobile Station. The Network subsystem, the main part of which is the Mobile Services Switching Center (MSC) perform the switching of calls between the mobile users and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown, is the operations and maintenance center which oversees the proper operation and setup of the network. The Mobile Station and the Base Station subsystem communicate across the Um interface also known as the air interface or radio link. The Base Station subsystem communicate with the mobile services center across the A interface (The GSM Architecture)

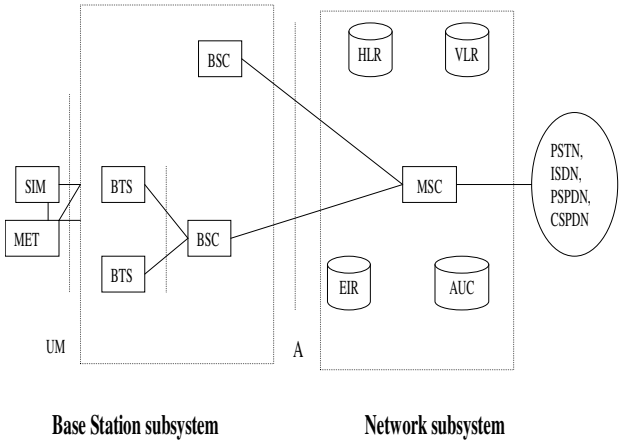

Figure 1: General Architecture of a GSM Subsystem

SIM: Subscriber Identity Module
HLR: Home Location Register
ME: Mobile Equipment
VLR: Visitor Location Register
BTS: Base Transceiver Station
MSC: Mobile Services Switching center
BSC: Base Station Controller
EIR: Equipment Identity Register
AUC: Authentication Center

2.2 GSM SYSTEM ARCHITECTURE

In GSM system, the mobile handset is called Mobile Station (**MS**). A cell is formed by the coverage area of a Base Transceiver Station (**BTS**) which serves the **MS** in its coverage area. Several **BTS** together are controlled by one Base Station Controller (**BSC**). The **BTS** and **BSC** together from Base Station Subsystem (**BSS**). The combined traffic of the Mobile Station in their respective cells is routed through a switch called Mobile Switching Center (**MSC**) connection originating or terminating from external telephone (**PSTN**) are handled by a dedicated Gateway Mobile Switching Center (**GMSC**). In addition to the above entities, several databases are used for the purpose of call control and network management. These databases are Home Location Register (**HLR**), Visitor Location Identity (**VLR**), the Authentication Center (**AUC**) and Equipment Identity Register (**EIR**).

Home Location Register (**HLR**) stores the permanent (such as user profile) as well as temporary (such as current location) information about all the users registered with the network. A **VLR** stores the data about the uses who are being serviced currently. It includes the data stored in **HLR** for faster access as well as the temporary data like the location of the user. The **AUC** stores the authentication information of the user such as the keys for encryption. The **EIR** stores data about the equipment and can be used to prevent calls from a stolen equipment (Abramson & Kuo, 1995)

All the mobile equipment in GSM system are assigned unique identity called **IMSI** (International Mobile Equipment Identity) and is allocated by equipment manufacturer and registered by the service provider. This number is stored in the **EIR**. The users are identified by the **IMSI** which is stored in the Subscriber Identity Module (**SIM**) of the user. A Mobile Station can be used only if a valid SIM is inserted into an equipment with valid IMSI. The "real" telephone number is different from the above identities and is stored in SIM.

2.3 Quality Of Service

Quality refers to the standard of something when compared to other things like it.Service can be defined as these separately identifiable, essentially intangible activities that provide ant-satisfaction and that are not necessarily tied to the sale of a product or another services. In GSM operation, the word Quality of Service (QoS) refers to the probability of the telecommunication network meeting a given traffic contract or in many cases is used informally to refer to the probability of a packet succeeding in passing between two points in the network. It essentially refers to the Quality of Service (QoS) which includes lack of noise and tones on the circuit, appropriate loudness level etc and includes Grade of Service (GoS) which comprises aspects of a connection relating to the capacity of a network. Quality of Service (QoS) is affected by Human and Technical factors. The Human factors include stability of service, availability of service, delays, user information. Technical factors include reliability, scalability, effectiveness, maintainability, Grade of Service (GoS).

2.4 Quality Of Service (QoS) and Product Marketing

Product is a set of tangible and intangible attributes including packaging, colour, price, manufacturers prestige, retailers prestige and manufacturers and retailer's services which the buyer may accept as offering want-satisfaction. Marketing is a system designed to plan, price, promote and distribute goods and services to market. The Quality of Service (QoS) of any product whether a tangible or an intangible service determines the rate at which the product will be accepted by the buyers both at wholesale and retailers level which will in turn determine to what extent the product will penetrate the market at any given time, manufacturers go to a large extent to put in place high The Quality of Service (QoS) to maintain standards which has earn them a name and a reputation in the competitive world market. The Quality of Service (QoS) are made available through promotions and advertisement. The Quality of Service (QoS) in some areas as associated with the price of the product and to ensure that standards are maintained at the lowest cost available (William, 1995).

Every GSM operator offers services ranging from Short Messages Services (SMS), Voice Mail, Telephoning, Fax Mail, Call Forwarding Service etc, the QoS has to be of an appreciable level to meet the need of each subscribers to the network.

2.5 Maintaining Quality Of Service (QoS)

There are currently four major GSM operator in Oyo state of Nigeria namely Globalcom, MTN, V-mobile and Odua tel. A critical examination of these operator show a similarity in handling subscribers opinion in improving the Quality of Service (QoS) rendered to subscribers. Subscribers usually make complains by;

(a) Visiting the customer care center office
(b) Calling the customer call center number (111).
(c) Visiting the website (www.Vmobile-nigeria.com)

The department that handles subscribers complain and suggestions is called the call center department, headed by the Head of Department (HOD) call center, and directly under the Head of Department are managers and under each managers are supervisors and under each supervisor is a group of call center agent that runs a twenty four hour shift duty to meet subscribers needs

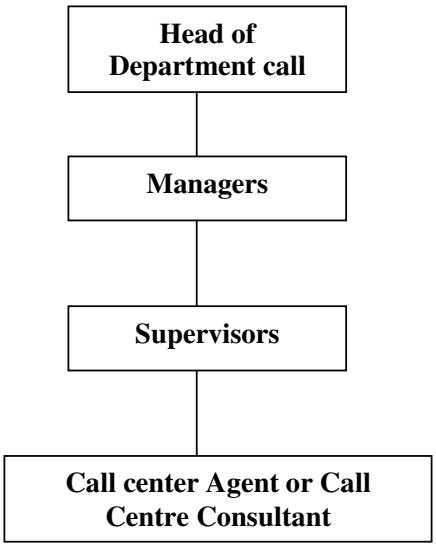

Figure 2: Structure Of The Call Center Department

Major problems encountered by subscribers before placing a call includes:
(i) Inability to place a call or send SMS
(ii) Inability to recharge and make balance enquiry
(iii) Phone problems

3. RESEARCH DESIGN

3.1 Population
The research population consist basically mobile phone users with a size of 200 respondents which consist of workers, traders and students subscribing the GSM network services in Ibadan.

3.2 Sampling Technique
The sampling technique used in this research work is the stratified sampling method in combination with simple random sampling. The simple random sampling technique is a method employed in selecting a sample of considerate size from a given population of data used in the survey, we find the estimate from the population in simple random sampling, sample size got from the given population is one in which every response has the same probability of being chosen(Ogbeide, 1997).

3.3 Research Instruments
The research questionnaire titled "A survey of subscribers' opinion on GSM services in Ibadan, Nigeria" was employed. The questionnaire was constructed by the researcher in collaboration with my project supervisor to suite the aims and objectives of the survey. The questionnaire contains two sections. Section A solicits information on personal data of respondents such as age, sex, marital status, occupation, religion and educational status. While section B contains 22 (twenty-two) questions requiring information from the mobile user on the opinion of GSM network service as a means of communication.

3.4 Administration of Instrument
The research instrument was personally administered by the researcher and distributed to respondents mobile users who subscribes to GSM network service in Ibadan, Nigeria.

3.5 Formulation Of Hypothesis
Test of independence apply to cross-classifications only. With cross-classification, there are two variables, a column variable and row variable. There may be any number of columns or rows. The two variables are to be tested to see if they are dependent on one another or if they independent of each other. The logic behind the test is that, if the columns row variables are independent of each other, there is no reason why the proportion of either columns to rows or rows to columns should differ. The hypothesis define the state of mind of the researcher regarding possible reason for a problem or a solution. There are usually two hypothesis referred to as Ho and H1. Ho is the null hypothesis and H1 is the alternate hypothesis. For this case, we formulate an hypothesis Ho which will be rejected and H1 which will be accepted based on the Chi-square analysis.

Hypothesis 1
Ho: There is no significant relationship between subscribers' opinion of the Quality of Service (QoS) of the GSM networks in Ibadan Nigeria.

Hypothesis *2*
H_0: There is no significant relationship between the respondents that subscribe GSM networks service and those that do not.

Hypothesis *3*
H_o: There is no significant relationship between the ages of subscribers on the GSM networks.

Hypothesis *4*
H_0: There is no significant relationship between the respondents sex of those that subscribe GSM networks service.

Hypothesis *5*
Ho: There is no significant relationship between marital status of respondents and their subscription to GSM networks service.

Hypothesis 6
Ho: There is no significant relationship between the respondents with different educational status.

Hypothesis *7*
Ho: There is no significant relationship between single and married respondents on the number of phone owned by them.

Hypothesis *8*
Ho: There is no significant relationship between the ages of subscribers and the number of mobile phone owned.

Hypothesis *9*
Ho: There is no significant relationship between the subscribers occupation and the number of mobile phone owned.

Hypothesis *10*
Ho: There is no significant relationship between monthly income of subscribers.

Hypothesis *11*
Ho: There is no significant relationship between subscribers and their subscription to the various networks.

Hypothesis *12*
Ho: There is no significant relationship among the rate at which the subscriber service their phone.

Hypothesis *13*
Ho: There is no significant relationship between the subscribers' opinion on the Quality of Service (QoS) provided by GSM operators.

Hypothesis *14*
Ho: There is no significant relationship between the respondents opinion on preferred billing system.

Hypothesis *15*
Ho: There is no significant relationship between the respondents opinion on whether GSM service is beneficial.

Hypothesis *17*
Ho: There is no significant relationship between the respondents opinion on interconnectivity.

Hypothesis *18*
Ho: There is no significant relationship between the respondents opinion on reduction of tariff.

4. DATA PRESENTATION AND ANALYSIS

The total number of responses from the survey instrument was 182 workers, 44 traders and 56 students all subscribers to GSM network services. The presentation of personal data of respondents was first analysed followed by main response to general question asked on the mobile phone users on the opinion of the service provided by the GSM operators located in .. Simple percentage and Chi-squared were employed for data analysis.

Table (1) Respondents That Subscribe To GSM Network Services

Respondents	Frequency	Percentage
YES	182	94
NO	11	6
TOTAL	193	100

Table 1 confirms the response of mobile phone subscribers to the GSM network service in the town. In the survey, 182 respondent (94%) access the networks by indicating "Yes" to the question asked in the questionnaire while 11 respondents representation (6%) says "No" as response, that is, they don't have mobile phone. This shows that a higher percentage of persons within the sample have GSM network connectivity.

Table (II) Age Distribution Of Respondents On The Gsm Networks

Age (Year)	Frequency	Percentage
12-18	11	6
19-26	54	30
27-ABOVE	117	64
TOTAL	182	100

The analysis shows that there are greater number of subscribers to the GSM networks and majority of these respondents has attained the age of 27 and above and it is confirmed that 117 respondents 64% use mobile phone handset.

Table (111) Sex Distribution Of Respondents

Sex	Frequency	Percentage
MALE	64	35
FEMALE	118	65
TOTAL	182	100

Table 3 shows that most of the respondents that are subscribers to GSM services are female. Analysis reveal that 118 respondents 65% are female while 64 respondents represent 35% are male.

Table (1V) Marital Status Of Respondents

MARITAL STATUS	FREQUENCY	PERCENTAGE
SINGLE	106	58
MARRIED	76	42
TOTAL	182	100

Table 4 confirmed that most of the single respondents representing 58% use GSM system and 42% are married.

Table (V) Educational Status Distribution Of Respondents

Educational Status	Frequency	Percentage
PRIMARY	22	12
SECONDARY	56	31
TERTIARY	104	57
TOTAL	182	100

It is evident that the majority of respondents who subscribe the GSM services obtained tertiary education as qualification. This can be extracted analytically from the table showing that 104 respondents 57% have tertiary education, while 56 respondents 31% obtained secondary education and 22 respondents 12% only obtained primary school qualification.

Table (V1) Marital Status On The Number Of Phone Owned By Respondents

Marital Status	One Phone	Two Phones	Three Phones	Total
Single	81(59%)	16(46%)	6(67%)	106
Married	57(41%)	19(54%)	3(33%)	76
TOTAL	138	35	9	182

It is evidently clear that 81 respondents 59% are single, 57 respondents 41% are married with only 1 mobile phone, 16 respondents 46% are single and 19 respondents 54% are married mobile phone user with 2 phones of choice network while 6 respondents 67% single and 3 respondents 33% married are mobile phone users with 3 phone of different network. This can be expressed as the type of calls made and information needed at every particular point in time and the nature of business such respondents are transacting.

Table (V11) Age Of Respondents On The Number Of Phone Used

Age (Year)	One Phone	Two Phones	Three Phones	Total
12-18	11(8%)	NIL	NIL	11
19-26	48(35%)	6(17%)	NIL	54
27-ABOVE	79(57%)	29(83%)	9	117
TOTAL	138	35	9	182

From the data represented above, it shows that 8% of respondents between the ages of (12-18) have 1 mobile phone and 35% of respondents attained the ages of (19-26) while majority of sample size attained the ages of 27 and above use 2 and 3 mobile phones of different network of choice.

Table (V111) Respondents By Occupation On The Number Of Mobile Phone Used

Occupation	One Phone	Two Phones	Three Phones	Total
WORKERS	57(41%)	21(60%)	4(44%)	82
TRADERS	28(20%)	11(31%)	5(56%)	44
STUDENTS	53(39%)	3(9%)	NIL	56
TOTAL	138	35	9	182

Analysis shows that 53 respondents 3% are students and 28 respondents 20% are traders, these group of respondents use 1 and 2 mobile phones while 57 respondents 41% whose occupation are the working class category use 2 and 3 mobile phones of different network.

Table (Ix) Occupation of Respondents on The Ownership Of Mobile Phones.

OCCUPATION	FREQUENCY	(%)
WORKERS	82	45
TRADERS	44	24
STUDENTS	56	31
TOTAL	182	100

Statistics show in table 8 and 9 above confirms that, out of the total sample size, 82 respondents 45% are workers while 56 respondents 31% are students while 44 respondents 24% are traders.

Table (X) Monthly Income On The Number Of Phones Of Respondents Subscribing Mobile Phone Services

Income Level	I Phone	2 Phones	3 Phones	Total
N7,500-N14,999	27 (20%)	NIL	NIL	27
N15,000 - N34,999	52(38%)	6(17%)	2(22%)	60
N35,000 -Above	57(42%)	29(83%)	7(78%)	95
TOTAL	138	35	9	182

Table (Xi) Income Earn By Ownership Of Mobile Phones

INCOME LEVEL	FREQ	TOTAL
N7,500-N14,999	27	15
N15,000-N34,999	60	33
N35,000-Above	95	52
TOTAL	182	100

From the above tables (10 and 11) confirm that there is a high demand of mobile phone by those respondents who earn a monthly income of N35,000 and above. Statistics reveal that 52% of the respondents are the working class category and this shows the type of people that subscribe the GSM network services in the town. It is evidently clear that subscribing GSM network is dependent on the level of monthly income.

Table (Xii) Respondent By Occupation Subscribing Gsm Network

Occupation	V-Mobile	Mtn	Globacom	Odua Tel	Total
WORKERS	25(35%)	28(47%)	21(48%)	2(29%)	76
TRADERS	17(24%)	15(25%)	10(23%)	NIL	42
STUDENTS	29(41%)	17(28%)	13(29%)	5(71%)	64
TOTAL	71	60	44	7	182

Table (Xiii) Respondents That Subscribe To Different Gsm Networks

NETWORK	FREQUENCY	PERCENTAGE(%)
V-MOBILE	71	39
MTN	60	33
GLOBACOM	44	24
ODUA TEL	7	4
TOTAL	182	100

Table 12 and 13 shows independent response of subscribers using different GSM network in the town, out of 71 respondents 39% subscribe to V-mobile network, 60 respondents 33% subscribe to MTN network and 44 respondents 24% subscribe to Globacom network while 7 respondents 4% to Odua tel network which is the least number of GSM mobile service.

The analysis shows that there is a great significant relationship between respondents that subscribe V-mobile and Odua tel services. This can be attributed to the early arrival of V-mobile (ZAIN) over Odua tel services in ..

Table (Xiv) Respondents By How Often Subscribers Service (Buy Recharge Cards) Their Phones

TIME	FREQUENCY	PERCENTAGE(%)
DAILY	24	13
WEEKLY	62	34
MONTHLY	96	53
TOTAL	182	100

From table 14 analysis, confirm that 96 respondents 53% buy recharge cards monthly in their mobile phones, this can be attributed to the fact that respondents seldom make calls with their phones. 62 respondents 34% buy recharge cards weekly and 24 respondents 13% service their phone daily.

Table (Xv) Respondents Opinion On The Quality Of Service (Qos) Provided By Gsm Operators

NETWORK QUALITY	FREQ	PERCENTAGE(%)
POOR	89	49
GOOD	82	45
EXCELLENT	11	6
TOTAL	182	100

From the table, it is observed that a very small percentage of the population appreciates the Quality of Service (QOS) provided by the GSM operators. This is confirmed in the analysis where 11 respondents 6% indicate excellent, 82 respondents 45% says the Quality of Service (QOS) is good while 89 respondents 49% indicate poor to the service rendered by the GSM operators.

Table (Xvi) Respondents Opinion On Preferred Billing System

BILLING SYSTEM	FREQ	PERCENTAGE(%)
PER-SECOND	138	76
PER-MINUTE	44	24
TOTAL	182	100

The analysis shows in table 16 confirm that most of the respondents prefer the per seconds billing system which has a total response of 138 respondents 76% while 44 respondents 24% still subscribe to the per minutes billing system with contrary opinion.

Table (Xvii) Respondents Opinion On Whether Gsm Service Is Beneficial

RESPONDENTS	FREQ	PERCENTAGE(%)
YES	168	92
NO	14	8
TOTAL	182	100

It is very clear from the table that the introduction of GSM has immense benefits to the populace. This can be buttressed by the fact that 168 respondents 92% affirm to its benefits while 14 respondents 8% claim not to derive any benefit from subscribing the network service.

Table (Xviii) Respondent Opinion On Interconnectivity Problems With Each Other Network Operators.

RESPONDENTS	FREQ	PERCENTAGE(%)
YES	173	95
NO	9	5
TOTAL	182	100

From the table, it shows that there is high magnitude of interconnectivity problems between the different GSM network operators subscribing mobile phone services in the town. Its proven with the fact that 173 respondents 95% responded "yes" to the question raised which only 9 respondents 5% claimed to have an hitch free interconnectivity with other networks.

Table (Xix) Respondents Opinion On Reduction Of Tarrif

RESPONDENTS	FREQ	PERCENTAGE(%)
YES	174	96
NO	8	4
TOTAL	182	100

It is evident from table 19 that subscribers prefer reduction of tariffs charged by network operators. Analysis confirm that 174 respondents representing 96% indicate "yes" to the question raised on reduction while 8 respondents 4% feel it should remain the same provided there is an upward improvement in the service provided.

4.1 Chi-Squared Tests (χ^2)

The essential nature of the chi-square analysis is to compare an observed distribution to a theoretical distribution of values, the theoretical distribution having been arrived at on the basis of some rational grounds. It is thus, a test of the significance of the difference between an observed, actual distribution consisting of data to be analysed and a theoretical usually computed, distribution to which the observed distribution is to be compared.

The formula for chi-squared is $\chi 2 = \Sigma\{f\text{-}f^{l})\ 2/\ f^{l}\}$

Where: f = observed frequencies of each class or cell

f^{l}= theoretical frequencies of each class or cell

Degree of Freedom

Since chi-square is additive in nature, the greater the number of classes or cells, the larger of chi square. The value of chi-square computed from the data must be interpreted in terms of the chi-square distribution. The number of cells or classes provides the degrees of freedom.

Mathematically, the degree of freedom is given by the formula df (Degree of freedom) df = (c-1) (r-1)

Where c = Total number of column and r = Total number of rows

4.2 Analysis Of Generated Table Using Chi-Square Test

Hypothesis

H_0 = There is no significant distribution between respondents that subscribe GSM network and those that do not.

H1 = There is significant distribution between respondents that subscribe GSM network and those that do not.

Chi-Squared Corrected

This method is used in the 2 by 2 distribution.
General formula for chi-square corrected is

$$Eij = \frac{\Sigma r \Sigma c}{N} \quad \text{or} \quad \frac{\Sigma (oij-eij)2}{eij} \quad \text{or} \quad \frac{\Sigma (/oij-eij/-0.5)^2}{eij}$$

Interpretation of the above is
Σ = Summation
oij = Observed value of the row and column
eij = Expected value of the row and column
Eij = Expected value of the row and column
Σc = Summation of all the column
Σr = Summation of all the row
N = Number of row and column

Table (1) Respondents That Subscribe Gsm To Network Services

Observed Value Table

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	182	94	276
NO	11	6	17
TOTAL	193	100	293

$$E11 = \frac{193 * 276}{293} = 181.8$$
$$E12 = \frac{100 * 276}{293} = 94.2$$
$$E21 = \frac{17 * 193}{293} = 11.2$$
$$E22 = \frac{17 * 100}{293} = 5.8$$

Expected Value

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	181.8	94.2	276
NO	11.2	5.8	17
TOTAL	193	100	293

Using the formula $\frac{\Sigma (oij-eij)^2}{eij}$

$$\chi 2cal = \frac{(182-181.8)^2}{181.8} + \frac{(94-94.2)^2}{94.2} + \frac{(11-11.2)^2}{11.2} + \frac{(6-5.8)^2}{5.8}$$

$$\chi 2cal = 0.00022 + 0.00042 + 0.00357 + 0.00690$$
$$\chi 2cal = 0.01111$$

Critical value (table value)
$\chi 2df = (r-1)\ (c-1); \quad = (2-1)\ (2-1) = 1$

Using χdf of 99% , $\chi 2df=1 = 6.635$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis), we see that there is no significant relationship between the respondents that subscribe GSM network service and those that do not.

Table (11) Age Distribution Of Respondent On The Gsm Networks

Observed Value

AGE (YEARS)	FREQ	EXPECTED FREQ (e)	o-e	$(0-e)^2/e$
12-18	11	60.7	-49.6	40.6
19-26	54	60.7	-6.7	0.74
29-ABOVE	117	60.7	56.3	52.2
TOTAL	182			93.54

Using the formula $\Sigma(0-e)^2/e$

The number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of $\chi 2$ for 2 degree of freedom 9.21. Since the calculated value of $\chi^2 = 93.54$, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant difference between the ages of subscribers on the GSM networks.

TABLE (111) SEX DISTRIBUTION OF RESPONDENTS

Observed Value Table

SEX	FREQ	PERCENTAGE	TOTAL
MALE	64	35	99
FEMALE	118	65	183
TOTAL	182	100	282

$$E11 = \frac{182 * 99}{282} = 63.9$$
$$E12 = \frac{100 * 99}{282} = 35.1$$
$$E21 = \frac{182 * 183}{282} = 118.1$$
$$E22 = \frac{100 * 183}{282} = 64.9$$

Expected Value

SEX	FREQ	PERCENTAGE	TOTAL
MALE	63.9	35.1	99
FEMALE	118.1	64.9	183
TOTAL	182	100	282

Using the formula $\frac{(oij-eij)2}{eij}$

$$\chi^2 cal = \frac{(64-63.9)2}{63.9} + \frac{(35-35.1)2}{35.1} + \frac{(118-118.1)2}{118.1} + \frac{(65-64.9)2}{64.9}$$

$\chi^2 cal = 0.00015 + 0.00028 + 0.00008 + 0.00015$
$\chi^2 cal = 0.00066$
Critical value (table value)
$\chi^2 df = (r-1)\ (c-1); \quad = (2-1)\ (2-1) = 1$
Using χdf of 99%; $\chi^2 df=1 = 6.635$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis), we see that there is no significant relationship between the respondents sex of those that subscribe the GSM network service.

Table (1v) Marital Status Of Respondents

Observed Table

Marital status	Freq	Percentage	Total
YES	106	58	164
NO	76	42	118
TOTAL	182	100	282

$$E11 = \frac{182 * 164}{282} = 58.2$$

$$E12 = \frac{100 * 164}{282} = 58.2$$

$$E21 = \frac{118 * 182}{293} = 76.2$$

$$E22 = \frac{100 * 118}{282} = 41.8$$

Expected Value

Marital Status	Freq	Percentage	Total
YES	105.8	58.2	164
NO	76.2	41.8	118
TOTAL	182	100	282

Using the formula $\frac{(oij-eij)2}{eij}$

$$\chi^2cal = \frac{(106-105.8)2}{105.8} + \frac{(58-58.2)2}{58.2} + \frac{(76-76.2)2}{76.2} + \frac{(42-41.8)2}{41.8}$$

$$\chi^2cal = 0.00038 + 0.00069 + 0.00052 + 0.00096$$

$$\chi^2cal = 0.0025$$

Critical value (table value)

$$\chi^2df = (r-1)\ (c-1)$$

$$= (2-1)\ (2-1) = 1$$

Using χdf of 99%

$$\chi^2df=1 = 6.635$$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis). There is no significant relationship between marital status of respondents and their subscription to GSM network service.

Table (V) Educational Status Of Respondents
Observed Value

Educational Status	Freq (O)	Expected Freq(E)	O-E	$(0-E)^2/E$
PRIMARY	22	60.7	-38.7	24.6
SECONDARY	56	60.7	-4.7	0.4
TETIARY	104	60.7	43.3	30.9
TOTAL	182			55.9

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of χ^2 for 2 degree of freedom 9.21. Since the calculated value of χ^2 = 55.9, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between respondents with different educational status.

Table (V1) Marital Status On The Number Of Phone Owned By Respondents
Observed Value

RESPONDENTS	FREQ (O)	EXPECTED FREQ (e)	o-e	$(0-e)^2/e$
1 PHONE	138	60.7	-77.3	97.7
2 PHONES	35	60.7	-25.7	10.9
3 PHONES	9	60.7	51.7	44
TOTAL	182			152.6

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of χ^2 for 2 degree of freedom 9.21. Since the calculated value of χ^2 = 152.6, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between single and married respondents on the number of phone owned by them.

Table (V11) Age Of Respondents On The Number Of Mobile Phone

Observed Value

AGE (YEARS)	FREQ(O)	EXPECTED FREQUENCY(e)	o-e	$(0-e)^2/e$
12-18	138	60.7	-77.3	95.4
19-26	35	60.7	-25.7	10.9
29-ABOVE	9	60.7	51.7	44
TOTAL	182			153.3

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of χ2 for 2 degree of freedom 9.21. Since the calculated value of χ2 = 153.3, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is significant relationship between the ages of subscribers and the number of mobile phone owned.

Table (V111) Respondent By Occupation On The Number Of Mobile Phone Used

Observed Value

Occupation	Freq (O)	Expected Frequency (E)	O-E	$(0-E)^2/E$
WORKERS	82	60.7	-21.3	7.5
TRADERS	44	60.7	-16.7	4.6
STUDENTS	56	60.7	4.7	0.4
TOTAL	182			12.5

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of $\chi 2$ for 2 degree of freedom 9.21. Since the calculated value of $\chi 2$ = 12.5, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between subscribers occupation and the number of mobile phone owned.

Table (1x) Monthly Income Of Respondents Subscribing Mobile Phone Service

Observed Value

Income Level	Freq (O)	Expected Freq (E)	O-E	$(0-E)^2/E$
N7,500-N14,999	27	60.7	-33.7	18.7
N15,000-N34,999	60	60.7	-0.7	0.008
N35,000-ABOVE	95	60.7	34.3	19.4
TOTAL	182			38.11

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of $\chi 2$ for 2 degree of freedom 9.21. Since the calculated value of $\chi 2$ = 38.11, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between monthly income of subscribers.

Table (X) Respondents That Subscribe To Different Gsm Network

Observed Value

NETWORK	FREQ (O)	EXPECTED FREQ(e)	o-e	$(0-e)^2/e$
VMOBILE	71	45.5	-25.5	14.29
MTN	60	45.5	-14.5	4.62
GLOBACOM	44	45.5	1.5	0.05
ODUA TEL	7	45.5	-38.5	32.58
TOTAL	182			51.54

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (4-1) = 3. Using a 0.01 level of significance we find the value of $\chi 2$ for 3 degree of freedom 11.34. Since the calculated value of $\chi 2$ = 51.54, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between subscribers and their subscription to the various networks.

Table (X1) Respondents By How Often Subscriber Service (Buy Recharge Card) Their Phone

TIME	FREQ (O)	EXPECTED FREQ(e)	o-e	$(0-e)^2/e$
DAILY	24	60.7	-36.7	22.19
WEEKLY	62	60.7	-6.3	0.65
MONTHLY	96	60.7	35.3	20.53
TOTAL	182			43.37

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of $\chi 2$ for 2 degree of freedom 9.21. Since the calculated value of $\chi 2$ = 43.37, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship among the rate at which the subscriber service their phone.

Table (X11) Respondents Opinion On The Quality Of Service (QoS) Provided By Gsm Operators

OBSERVED VALUE

NETWORK QUALITY	FREQ (O)	EXPECTED FREQ (e)	o-e	$(0-e)^2/e$
POOR	89	60.7	-28.3	13.0
GOOD	82	60.7	-21.3	7.5
EXCELLENT	11	60.7	-49.7	40.7
TOTAL	182			61.2

Using the formula Σ(0-e)2/e, the number of degree of freedom is r = k-1 (3-1) = 2. Using a 0.01 level of significance we find the value of $\chi 2$ for 2 degree of freedom 9.21. Since the calculated value of $\chi 2$ = 61.2, is greater than the table value of 9.21, we reject null hypothesis and accept alternative hypothesis.

Conclusion: There is a significant relationship between the subscribers opinion on the Quality of Service (QoS) provided by GSM operators.

Table (X111) Respondents Opinion On Preferred Billing System

Observed Table

Billing System	Frequency	Percentage	Total
PER MINUTE	138	76	214
PER SECOND	44	24	68
TOTAL	182	100	282

$$E11 = \frac{182 * 214}{282} = 138.1$$

$$E12 = \frac{100 * 214}{282} = 75.9$$

$$E21 = \frac{68 * 182}{282} = 43.9$$

$$E22 = \frac{68 * 100}{282} = 24.1$$

EXPECTED VALUE

Billing System	Frequency	Percentage	Total
PER MINUTE	138.1	75.9	214
PER SECOND	43.9	24.1	68
TOTAL	182	100	282

Using the formula $\Sigma \frac{(oij-eij)^2}{eij}$

$$\chi 2cal = \frac{(138-138.1)^2}{138.1} + \frac{(76-75.9)^2}{75.9} + \frac{(44-43.9)^2}{43.9} + \frac{(24-24.1)^2}{24.1}$$

$$\chi 2cal = 0.00007 + 0.0001 + 0.0002 + 0.0004$$

$$\chi 2cal = 0.0007$$

Critical value (table value)

$\chi 2df = (r-1)(c-1); = (2-1)(2-1) = 1$

Using χdf of 99%; $\chi 2df_{=1} = 6.635$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis), we see that there is no significant relationship between respondents opinion on preferred billing system.

Table (X1v) Respondents Opinion On Whether Gsm Service Is Beneficial

Observed Table

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	168	92	260
NO	14	8	22
TOTAL	182	100	282

$$E11 = \frac{182 * 260}{282} = 167.8$$

$$E12 = \frac{100 * 260}{282} = 92.2$$

$$E21 = \frac{22 * 182}{282} = 14.2$$

$$E22 = \frac{22 * 100}{282} = 7.8$$

Expected Value

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	167.8	92.2	260
NO	14.2	7.8	22
TOTAL	182	100	282

Using the formula $\Sigma \frac{(oij-eij)2}{eij}$

$$\chi 2cal = \frac{(168-167.8)^2}{167.8} + \frac{(92-92.2)^2}{92.2} + \frac{(14-14.2)^2}{14.2} + \frac{(8-7.8)^2}{7.8}$$

$$\chi 2cal = 0.0002 + 0.0004 + 0.0003 + 0.0005$$

$$\chi 2cal = 0.001$$

Critical value (table value)

$\chi 2df = (r-1)(c-1)$

$= (2-1)(2-1) = 1$

Using χdf of 99%

$\chi 2df=1 = 6.635$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis). There is no significant relationship between respondents opinion on whether GSM services are beneficial.

Table (Xv) Respondents Opinion On Interconnectivity Problem With Other Network Operators

Observed Table

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	173	95	268
NO	9	5	14
TOTAL	182	100	282

$$E11 = \frac{182 * 268}{282} = 172.9$$

$$E12 = \frac{100 * 268}{282} = 95.1$$

$$E21 = \frac{14 * 182}{282} = 9.1$$

$$E22 = \frac{14 * 100}{282} = 4.9$$

Expected Value

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	172.9	95.1	268
NO	9.1	4.9	14
TOTAL	182	100	282

Using the formula $\Sigma \frac{(oij-eij)^2}{eij}$

$\chi 2cal =$

$$\frac{(9-9.1)^2}{9.1} + \frac{(95-95.1)^2}{95.1} + \frac{(9-9.1)^2}{9.1} + \frac{(5-4.9)^2}{4.9}$$

$\chi 2cal = 0.001 + 0.0001 + 0.001 + 0.002$

$\chi 2cal = 0.004$

Critical value (table value)

$\chi 2df = (r-1)\ (c-1)$

$= (2-1)\ (2-1) = 1$

Using χdf of 99%

$\chi 2df=1 = 6.635$

Since the table value is higher than the calculated value, we accept the Ho (null hypothesis), we see that there is no significant relationship between the respondents opinion on interconnectivity.

TABLE (XV1) RESPONDENTS OPINION ON REDUCTION OF TARRIF

OBSERVED TABLE

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	174	96	270
NO	8	4	12
TOTAL	182	100	282

$$E11 = \frac{182 * 270}{282} = 174.3$$

$$E12 = \frac{100 * 270}{282} = 95.7$$

$$E21 = \frac{12 * 182}{282} = 7.7$$

$$E22 = \frac{12 * 100}{282} = 4.3$$

Expected Value

RESPONDENT	FREQ	PERCENTAGE	TOTAL
YES	172.9	95.1	268
NO	9.1	4.9	14
TOTAL	182	100	282

Using the formula $\Sigma \frac{(oij-eij)^2}{eij}$

$$\chi 2_{cal} = \frac{(174-174.3)^2}{174.3} + \frac{(97-95.7)^2}{95.7} + \frac{(8-7.7)^2}{7.7} + \frac{(4-4.3)^2}{4.3}$$

$\chi 2cal = 0.0005 + 0.0009 + 0.001 + 0.02$

$\chi 2cal = 0.0314$

Critical value (table value)

$\chi 2df = (r-1)\ (c-1)$

$= (2-1)\ (2-1) = 1$

Using χdf of 99%

$\chi 2df=1 = 6.635$

Since the table value is higher than the calculated value, we accept the Ho
(null hypothesis), we see that there is no significant relationship between the respondents opinion on reduction of tariff.

5. SUMMARY OF FINDINGS

After a critical analysis of subscribers' opinion, the GSM network service in town, a significant percentage of the respondents are not satisfied with the Quality of Service (QoS) provided by the network operators. Many mobile phone users do not have access to the telephone services. Subscribers complained of call drop during telephony, low voice quality, poor interconnectivity, high billing system on services provided and poor reception to network to network service problems. The greatest worries and drawbacks of the GSM network service is the cost of maintenance, access day to calls, validity are short, problems of teledensity i.e (network congestion) in the areas covered by service operators.

6. CONCLUSION

The introduction of GSM has increased the workforce mobility for communication worldwide and its fueling demands for more powerful and flexible way of information access. As mobile service is expanding, subscribers expect more than just speed. Subscribers demand a total solution that will meet their diverse needs and looking for networks that are optimized to handle corporate wireless applications. To ensure a higher quality of service the following should be done:

1) There should be expansion of network service coverage to rural areas, this will promote the habits of communication link between those in geographical locations which also boost the economic production in the society.
2) There should be a downward review of tariff (Taxes) charged by the network operators providing communication service in the country.
3) The GSM operators (V-mobile, MTN, Globacom, Odua tel) should reduce their airtime charge of every call made on services subscribed.
4) GSM operators should embark on building more transmission and base station in strategic places in order to boost network reception in every part of the town. This will reduce teledensity within network.
5) GSM operators must improve on their operating facility by upgrading the systems so as to accommodate more service, automate their system on interconnectivity with other communication service provider for automatic roaming and information linkage.

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