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Performance Evaluation of GSM Traffic

Ihekweaba Ogechi, Nweke Chisom B.

***Abstract*— Mobile communications have had a strong increase in our society in the recent years and it keeps increasing. The Global System for Mobile communication (GSM) deployment into Nigerian market was unanimously embraced and found to be quite proficient at the commencement. But with time, operators started experiencing degradation in network performance due to traffic impairment. Mobile networks are traffic sensitive due to the swift increase of subscribers all over the world. Consequently it is very critical to save on operating cost and to consume bandwidth effectively with respect to traffic load as spectrum is limited. This paper investigates the performance of GSM traffic observed in a leading telecom company in Nigeria.**

***Index Terms*— GSM, Performance, Traffic, Nigeria.**

I. INTRODUCTION

Global System for Mobile communication (GSM) is the name of a standardization group that was established in 1982 in an effort to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900MHz [1]. GSM technology uses Time Division Multiple Access (TDMA) to chop up the channel into sequential slices, where each user of the channel takes turns to transmit and receive signals.

Besides the growth of the subscriber numbers, the technological growth of GSM is going on. New services and applications have been developed and standardized and are presently incorporated into GSM networks [2]. Though its chief use is for mobile telephony, mobile data services are becoming more and more popular.

The traffic performance evaluation of mobile packet data services is a complex problem, because non-Poissonian traffic characteristics, dynamic behavior of lower layer protocols and the effects of the radio channel have to be considered. Presently in Nigeria, users do complain of service unavailability, sudden termination of calls, failure to institute calls, interconnectivity problems, etc. Network operators therefore needs complete information about the network performance in order to manage the network resourcefully and monitor their Quality of Service (QoS).

II. HISTORY

Global System for Mobile communication (GSM) is the name of a standardization group that was established in 1982 in an effort to create a common European mobile telephone standard that would formulate specifications for a

pan-European mobile cellular radio system operating at 900MHz. The idea was first conceived at Bell Laboratories in (USA) in the earlier 1970s; however, mobile cellular systems were not introduced for commercial use until the 1980s. In 1989, the task of GSM was transferred to the European Telecommunication Standard Institute (ETSI) and stage one suggestion was published in 1990[3]. Sequel to that, the United Kingdom requested requirement based on GSM but for high use densities with low-power mobile stations working 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 [4]. The development of GSM technology came to Nigeria in 2001, when the Federal Government issues license to some private telecommunication operator, like the Mobile Telecommunication of Nigeria (MTN), ZAINwireless (now ZAIN), Globalcom and M-Tel which is the second network operator to participate in the communication industry by providing network services in order to reduce the stress subscribers encounter whenever they wish to utilize the services rendered by these GSM operators [5]. The GSM network services in Nigeria was introduced with a view of meeting the urge and high demand for communication with increased ability to meet services capacity and subscription demand in order to satisfy the common subscriber of GSM network communication services and the opportunity of integrating herself to a public cellular phone system within and outside its locality [6][7]

III. ARCHITECTURE OF THE GSM NETWORK

A GSM network is composed of several functional entities whose functions and interface are specified. Figure 1 shows the design of a 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 [8]. The Network subsystem, the main part of which is the Mobile Services Switching Center (MSC) performs 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)

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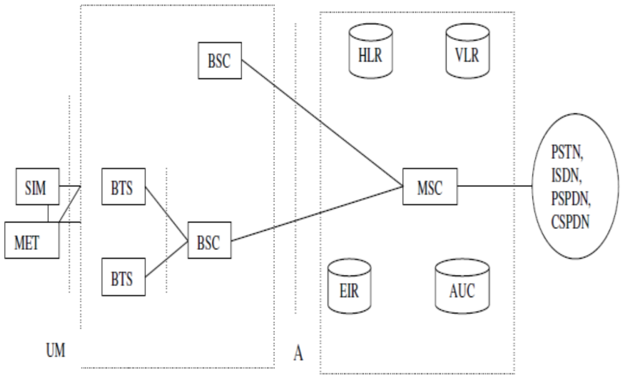
Ihekweaba Ogechi, Department of Computer Engineering Michael Okpara University of Agriculture, Umudike, Abia state, Nigeria.

Nweke Chisom B., Department of Computer Engineering Michael Okpara University of Agriculture, Umudike, Abia state, Nigeria.



Base Station subsystem Network subsystem

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

IV. METHODOLOGY

The method used in this research is called passive method. Passive method involves the gathering of real traffic data at one or more points on the network. We measured call procedures on definite Base Transceiver Station (BTS) for a period of two (2) days. The total number of accepted calls, successful calls and dropped calls by the network under study were recorded. The observed and recorded data from measurement forms part of the primary data for the research. To obtain the required data for analysis, simulation and measurement were limited to one Base Transceiver Station (BTS) in Umudike area of Umuahia switching center, and the result recorded forms part of the secondary data which are presented in tables1-2

Table 1: Traffic performance measurement at a BTS in Umudike, Umuahia.

DAY ONE (1)

Time(Per Minutes)	**Total Call Accepted**	**Average Holding Time (Minutes)**	**No of Successful Calls**	**No of Dropped Calls**
8.00-8.15am	660	1.28	180	550
8.15-8.30am	667	1.31	210	530
8.30-8.45am	663	1.20	180	541
8.45-9.00am	596	1.31	250	410
9.00-9.15am	560	1.32	178	470
9.15-9.30am	651	1.28	200	481
9.30-9.45am	800	1.31	250	560
9.45-10.00am	731	1.29	250	510
10.00-10.15am	781	1.24	178	590
10.15-10.30am	729	1.25	300	400
10.30-10.45am	773	1.26	270	490
10.45-11.00am	762	1.31	290	439
Total	8,373	15.36	2,736	6,025
Average	698	1.28	228	502

Table2**: DAY ONE (2)**

Time(Per Minutes)	**Total Call Accepted**	**Average Holding Time (Minutes)**	**No of Successful Calls**	**No of Dropped Calls**
8.00-8.15am	640	1.36	220	460
8.15-8.30am	650	1.30	229	463
8.30-8.45am	638	1.33	249	410
8.45-9.00am	652	1.17	240	450
9.00-9.15am	651	1.20	209	472
9.15-9.30am	670	1.34	230	510
9.30-9.45am	700	1.32	270	504
9.45-10.00am	690	1.34	290	480
10.00-10.15am	691	1.36	255	502
10.15-10.30am	661	1.19	210	462
10.30-10.45am	665	1.31	214	520
10.45-11.00am	680	1.29	228	525
Total	7,988	15.51	2,844	5,758
Average	666	1.29	237	480

V. ANALYSIS OF THE RESULTS AND DISCUSSION

A. ANALYSIS

There were about 24 radio channels between the base transceiver station and the base controller station. From the tables, each observation period lasted for 15 minutes; total observation time for the 12 period is 3 hours.

Let consider DAY ONE (1)

- Observed period=90 seconds
- Total observation period=180 minutes
- Average holding time=1.28 minutes=76.8 seconds
- Successful calls per minute= Successful Calls Average /Observation Period = 228/15=15calls
- Channel capacity in 15 minutes=Observation Period×(One Minute/ Average holding time) =15×(60/76.8)=12calls
- No of channel required for observed period= Average of Total Call Accepted/ observed period= 698/12=58channels
- Estimated Grade of Service= Average of No of Dropped Calls/ Average of Total Call Accepted= 480/666=0.72

DAY TWO (2)

- Observed period=90 seconds
- Total observation period=180 minutes
- Average holding time=1.29 minutes=77.7 seconds
- Successful calls per minute= Successful Calls Average /Observation Period = 237/15=16 calls
- Channel capacity in 15 minutes=Observation Period×(One Minute/ Average holding time) =15×(60/77.7)=12calls
- No of channel required for observed period= Average of Total Call Accepted/ observed period= 666/12=56channels
- Estimated Grade of Service= Average of No of Dropped Calls/ Average of Total Call Accepted= 502/698=0.72

B. DISCUSSION

The results from the analysis has shown that the grade of service anticipated at two different times and days match to a value of roughly 0.72.This shows that there is still need for operators to advance on their services. Also, the simulated average number of accepted, dropped, successful calls and Grade of Service (GOS) are higher than the average measured values. This is due to the fact that the simulated data exposes the authentic performance of the network under study, on the assumption that all enabling conditions and infrastructures are in place.

VI. CONCLUSION

The GSM deployment into Nigerian market was generally embraced and found to be pretty competent at the beginning. But with time, operators started experiencing degradation in network performance due to traffic impairment.

One of the results established in this research is the examining of traffic performance on definite area of the network in order to offer an insight into the competence exploitation of the network system. This is crucial in the areas of prevention of call dropping during conversation, stability, as well as putting additional capacity to enable availability of lines to users.

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AUTHORS

Engr. (Mrs) Ogechi Ihekweaba is a lecturer in the department of Computer Engineering, Michael Okpara University Of Agriculture Umudike, Abia State, Nigeria. She holds a Bachelor degree (B.Eng) in Computer Science & Engineering, a Master's degree (M.Eng) in Computer Engineering and also at the verge of completing a Doctorate degree (PhD) in Computer Engineering. Her area of specialization is network security and computational intelligence. She is a COREN registered Engineer and has several publications.

Nweke Chisom B. received his B.Sc. degree in Computer Science from Michael Okpara University of Agriculture, (MOUAU) Umudike, Abia State Nigeria in 2012. His research interests are in the fields of Electronics Design and Embedded Systems, Computer Programming, Microcontroller based System, and Computer Maintenance etc.