COMPARATIVE EVALUATION OF THE QUALITY OF SERVICE (QoS) FOR THE GSM NETWORKS IN OLEH, DELTA STATE, NIGERIA.

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ABSTRACT

Global System for mobile Communication (GSM) is a telecommunication network that is used globally for communication services such as voice communication, data connection for fax, short message service (SMS) and full dial-up connection to the internet for e-mail and web browsing. The effectiveness of the GSM network depends largely on the quality of its received signal strength; therefore, knowing the network with the best received signal strength (RSS) in an area helps the subscribers in their communication-voice and data. In this paper, a comparative evaluation of the Quality of Service (QoS) for the GSM networks (MTN, GLO, AIRTEL and ETISALAT) was carried out in Oleh, Delta State. Measurements were taken at different sample points randomly selected within Oleh town. Intra and inter network calls were initiated and maintained for 3 minutes (180sec), during which the received signal strength (in dBm) and Cell identification (CID) of the various network operators were recorded using an installed Netmonitor software in a Tecno phantom A3 Andriod phone for 30 days (ante meridiem and post meridiem).The results obtained from the evaluation show that in Oleh town, MTN has the best quality of signal strength hence best quality of service followed by AIRTEL, GLO and ETISALAT respectively for inter and intra network calls. It was also observed that the main town had a better network coverage and service accessibility than its outskirts and neighbouring settlements during the period of this investigation.

Key words: GSM, Netmonitor, RSS, QoS, Network operator.

1. INTRODUCTION

GSM, an acronym changed from Group Special Mobile to Global System for Mobile Communication evolved from the idea of the first cellular network which was brainstormed in 1947.It was intended for military purposes as a way of supplying troops with more advanced forms of communications. From 1947 till about 1979 several cell based broadcasting technologies emerged. The United States began to develop the AMPS (Advanced Mobile Phone Service) network, while European countries were developing their own form of communication, the TACS (Total Access communication System),which was essentially the AMPS system modified with a channel bandwidth of 25 KHz. However, mobile cellular system was not introduced for commercial use until the 1980's [1].

When Nigeria embraced the GSM revolution in 2001, it replaced the analog (NITEL) System, hence, it was expected that its introduction will bring about effective telecommunication services that would support good speech quality, international roaming, Spectral efficiency, minimized crosstalk, and service cost to mention but a few. The major operators of GSM in Nigeria till date are MTN, GLOBACOM, AIRTEL and ETISALAT

MTN Nigeria: This is a member of the MTN group, an acknowledged GSM Market leader [2] and Africa's leading cellular telecommunications company. On May 16, 2001, MTN became the first GSM network to make a call in Nigeria following the globally lauded Nigerian GSM auction conducted by the Nigerian Communication Commission earlier in the year. Thereafter, the company launched full commercial operations beginning with Lagos, Abuja and Port Harcourt [3].

Globacom: Launched in Nigeria in 2003, with a vision to be the market leading service provider in Nigeria and also aspire to build Africa's biggest and best telecommunications network [1]. Globacom stands out as the first single company to build an $800 million high capacity fibre optics cable known as GLO 1. It also built the first submarine cable from the UK to Nigeria for the purpose of providing sufficient bandwidth to all the cities connected to the cable. It is Nigeria's second national operator (SNO).

Airtel: Formerly known as Zain which was previously Celtel Nigeria. It was established in 2000, by a group of institutional and private investors as well as three state governments. Celtel was previously Vmobile which was first Econet. Bharti Airtel, Asia's leading telecommunications service provider, has acquired Airtel Africa's mobile operations. The One Network service is aimed at providing a borderless mobile phone network across the Airtel Group and pan African community.

Etisalat: The latest entrant into the GSM scene in Nigeria; a Nigerian company formed by the partnership of Mubadala Development Company and Etisalat of the United Arab Emirates. Etisalat acquired its operation License from the Federal Government in January 2007.

Since the launch of GSM, mobile telephony has rapidly become the most popular method of voice communication in Nigeria. Growth in this sector has been so rapid that Nigeria has been rightly described in various media as one of the fastest growing GSM market in the world [4]. Over the years, the improvement made by the different network Operators notwithstanding; the cellular network service in Oleh has not satisfactorily met the customers' communication need as there is a barrage of complaints of poor service in the different networks. Some of these complaints include frequent call drop, echo during conversation, crosstalk, poor inter and intra connectivity, network congestion, and no network coverage which may be attributed to poor quality of GSM signal strength. As a result; the need to evaluate the quality of GSM received signal strength of the different mobile networks (MTN, GLOBACOM, AIRTEL and ETISALAT) within Oleh is imperative.

2. LITERATURE REVIEW

Many researchers hitherto have worked on several aspects of the mobile networks especially the quality of service and received signal strength. Some of such works are here reviewed. The authors in [4], carried out a comparative study of the network performance of GLO and MTN. The researchers adopted an interview method to embark on the study thus interviewing mostly professionals and the public. Questionnaires were also deployed and visual observations made.

In [6], An Evaluation of Outgoing Calls using a netmonitor software installed on a Nokia 3310 mobile was carried out. The software consists of a scale which represents the percentage power for inter and intra network outgoing call level. Similarly, the authors in [6] using the GLO network and the net monitor software installed on a Nokia 3310 mobile carried out an investigation and modelling of power received at 1800MHZ in mountainous Terrain. The authors in [8] carried out their evaluation of the GSM signal strength in terms of the network service bars. They employed the use of Nokia L600 GSM dual band (signal strength detector) supported by General Packet Radio Service (GPRS). In [8], the authors used an analysis of Received Signal Strength in predicting the models for Radio network planning of GSM 900Hz.

3. DESIGN METHODOLOGY

A GSM signal Analyser, NETMONITOR application, installed in a Tecno phantom A3 android phone with functions which include on-air survey, signal strength evaluation, and interrogation of cells of a base transceiver station was used to find and identify the network operator type. The software was used to measure the received signal strength at different designated test points within Oleh for all the mobile networks. This software provided various parameters such as the operator code of the network, the operator type, location area code (LAC), cell identification (CID), signal strength in dBm,Global Positioning System (GPS) parameters and the location of the base transceiver station from which the phone was obtaining service at that instance.

At the various test points chosen within the test locations for the study, calls were initiated and maintained for three minutes (180secs) during which the received signal strength (in dBm) level was monitored and 10 readings recorded for

the various networks for both inter and intra network calls in the mornings and the evenings, (A.M and P.M), respectively for one month. A daily mean value was obtained for each test point for all the networks investigated; using the daily mean for 30 days, the mean for one month which is presented in this paper was determined.

4. RESULT AND ANALYSIS

A. The servicing cell identification for all the mobile networks within the period of this research.

Table 1: Servicing CID for the GSM Network in Oleh

S/N	NETWORK	SERVICING CID
1.	MTN	06913,06912,06911
2.	AIRTEL	40223,40226,40222,40225
3.	GLO	54892,54895,54183
4.	ETISALAT	45626,45622,45627

B. One month Received Signal strength (RSS) mean for both inter and intra network calls (AM&PM) for all the networks investigated:

Table 2: One Month Received Signal strength (RSS) Mean of AM intra-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-80.8333	-82.2333	-86.0333	-89.1
2.	-79.2333	-83.2667	-86.3	-91.7667
3.	-78.3667	-78.5333	-84.0333	-88.7
4	-73.9	-77.1667	-85.6333	-89.4333

Table 3: One month Received Signal strength (RSS) mean of PM Intra-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-83.8	-82.2333	-85.46667	-91.2667
2.	-80.8333	-83.2667	-87.9667	-88.8667
3.	-82.8333	-78.5333	-97.5333	-87.6
4	-81.7667	-77.1667	-88.6333	-88.0333

Table 4: One month Received Signal strength (RSS) mean of AM inter-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-82.0	-81.8333	-93.6333	-94.1667
2.	-81.8	-80.6	-91.7	-90.9333
3.	-79.5	-76.8333	-95.9333	-97.3333
4	-81.3667	-72.8667	-94.3667	-97.4

Table 5: One month Received Signal strength (RSS) mean of PM inter-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-79.7667	-73.8667	-87.4333	-89.6
2.	-80.2	-81.3	-83.4	-90.6333
3.	-81.2	-84.9333	-94.4	-94.1667
4	-84.1	-76.0667	-90.0333	-90.9333

C. Average RSS (AM&PM) for both intra and internetwork calls for all the mobile networks investigated.

Table 6: Average AM RSS for intra-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-80.8333	-82.2333	-86.0333	-89.1
2.	-79.2333	-83.2667	-86.3	-91.7667
3.	-78.3667	-78.5333	-84.0333	-88.7
4	-73.9	-77.1667	-85.6333	-89.4333
AVERAGE	-78.0833	-80.3	-85.49998	-89.75

Table 7: Average PM RSS for intra-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-83.8	-83.1	-85.4667	-91.2667
2.	-80.8333	-82.3667	-87.9667	-88.8667
3.	-85.4667	-87.9667	-97.5333	-87.6
4	-81.7667	-72.1	-88.6333	-88.0333
AVERAGE	-82.9667	-81.3834	-89.9	-88.9417

Table 8: Average AM RSS for inter-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-82	-81.8333	-93.6333	-94.1667
2.	-81.8	-80.6	-91.7	-90.9333
3.	-79.5	-76.8333	-95.9333	-97.3333
4	-81.3667	-72.8667	-94.3667	-97.4
AVERAGE	-81.1667	-78.0333	-93.9083	-94.9583

Table 9: Average PM RSS for inter-network calls.

TEST POINTS	RSS(dBm)			
	MTN	AIRTEL	GLO	ETISALAT
1.	-79.7667	-73.8667	-87.4333	-89.6
2.	-80.2	-81.3	-83.4	-90.6333
3.	-81.2	-84.9333	-94.4	-94.1667
4	-84.1	-76.0667	-90.0333	-90.9333
AVERAGE	-81.3167	-79.0417	-88.8167	-91.3333

D. Average RSS for intra-network (AM&PM) calls for all the mobile networks investigated.

Table10: Average RSS for intra-network (AM&PM) calls.

NETWORK	RSS(dBm)		
	AM	PM	AVERAGE
MTN	-78.0833	-82.9667	-80.525
AIRTEL	-80.3	-81.3434	-80.8217
GLO	-85.5	-89.9	-87.7
ETISALAT	-89.75	-88.9417	-89.3459

E. Average RSS for inter-network (AM&PM) calls for all the mobile networks investigated.

Table11: Average RSS for inter-network (AM&PM) calls.

NETWORK	RSS(dBm)		
	AM	PM	AVERAGE
MTN	-81.1667	-81.3167	-81.2417
AIRTEL	-82.0333	-81.917	-81.975

GLO	-93.9083	-88.8167	-91.363
ETISALAT	-94.9583	-91.3333	-93.1458

F. Average RSS for intra-network calls for all the mobile networks investigated.

Table12: Average RSS for intra-network calls

NETWORK	AVERAGE RSS(dBm)
MTN	-80.525
AIRTEL	-80.8217
GLO	-87.7
ETISALAT	-89.3459

G. Average RSS for intra-network calls for all the mobile networks investigated.

Table13: Average RSS for inter-network calls

NETWORK	AVERAGE RSS(dBm)
MTN	-81.2417
AIRTEL	-81.975
GLO	-91.363
ETISALAT	-93.1458

H. Comparison of received signal strength for intra-network calls for the GSM networks investigated.

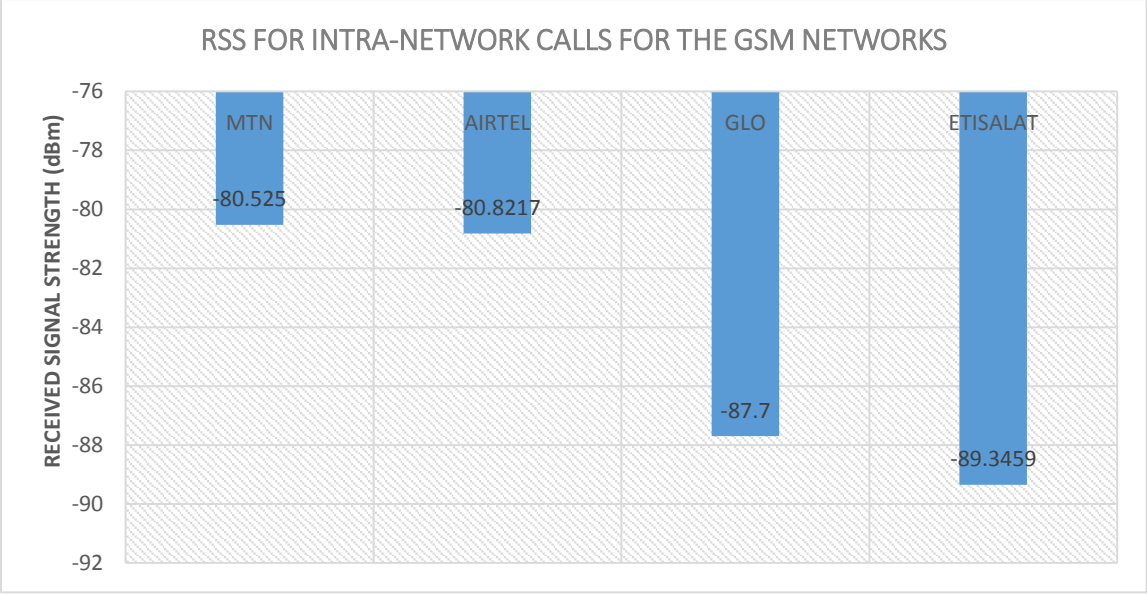

Figure 1: Bar charts of RSS for intra-network calls for the GSM networks.

I. Comparison of received signal strength for inter-network calls for the GSM networks investigated.

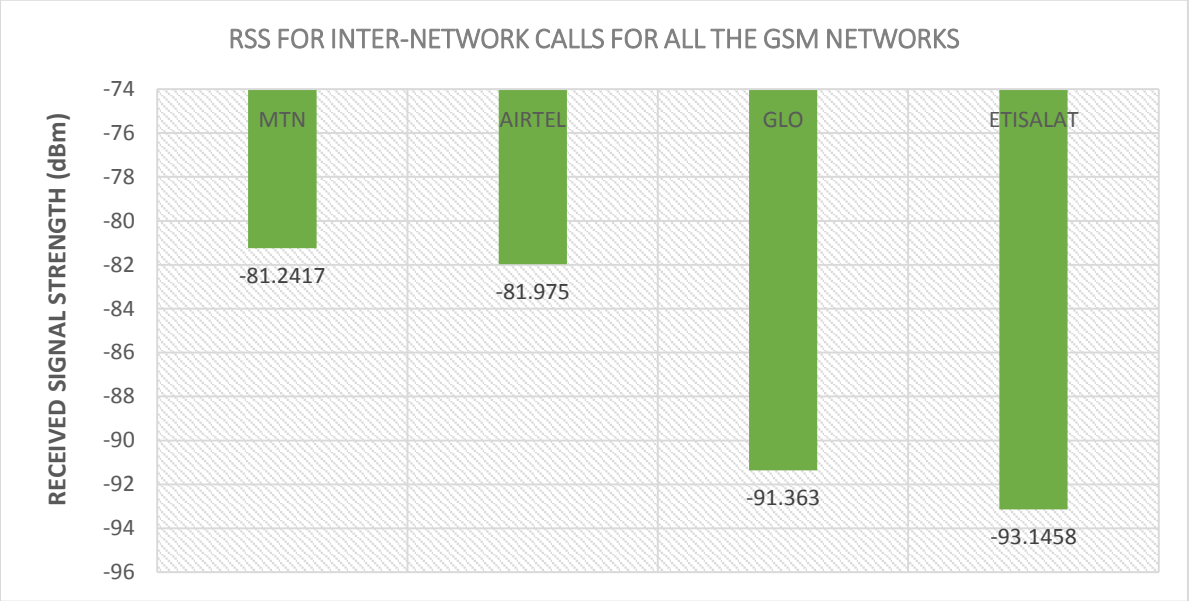

Figure 2: Bar charts of RSS for inter-network calls for the GSM networks.

From the analysis of the charts shown in Figures 1 and 2, the following deductions can be made:

- MTN has the best quality of received signal strength at -80.525 dBm for Intra-network calls in Oleh. This is closely followed by AIRTEL (- 80.8217dBm), GLO (-87.7dBm), and ETISALAT (-89.3459 dBm).
- MTN again has the best quality of received signal strength at -81.2417 dBm for inter-network calls in Oleh. This is closely followed by AIRTEL (-81.975 dBm), GLO (-91.363dBm), and ETISALAT (-93.1458 dBm).

5. DISCUSSION

The process of handover, a procedure that transfers an ongoing call from one cell to another as the user moves through the coverage area in a cellular network, requires that the quality of service (QoS) of a call be maintained. Each handover requires network resources to route the call to the next base station and if handover does not occur at the right time, the quality of service may drop below an adequate level and connection will be lost resulting in dropped call [9]

With a mobile station (MS) moving from one BS to another BS, the mean signal strength of the old BS decreases as the MS moves away from it. Similarly, the mean signal strength of the new BS increases as the MS approaches it. MS measures the signal strengths from surrounding BSs. A handoff can be initiated if the signal strength of the serving BS is lower than that of another BS by a certain threshold. The call is dropped if the received signal strength from the current BS falls below the receiver threshold level prior to the mobile being assigned a channel in the target cell [10]. Therefore, the received signal strength (RSS) determines whether the quality of service QoS prior to handover is

maintained for a quick and a successfully handover to occur. In other word, a high signal strength ensures that the quality of the service of an ongoing call does not drop below an adequate level. This accounts for a timely and successful handover and prevents call drops. From the analysis above, it is safe to say that for both intra and inter network calls in Oleh, the quality of

the Received Signal Strength (RSS) for MTN is the best followed by AIRTEL, GLO and ETISALAT respectively. This can be written in the order: MTN>AIRTEL>GLO>ETISALAT. This order also holds true for Quality Of Service (QoS):MTN>AIRTEL>GLO>ETISALAT. Since the frequency of dropped calls will be lower than all the other networks investigated.

6. CONCLUSION

A comparative evaluation of Quality of Service (QoS) for the GSM Networks in Oleh, Delta State, Nigeria is presented in this paper. The outdoor RSS measurements of the GSM networks investigated were taken at different test points in Oleh. At the end of the comparative analysis of the results obtained, MTN has the best Received signal Strength (RSS) followed by AIRTEL, GLO and ETISALAT respectively. This means that MTN has the best quality of service (QoS) as well since the frequency of dropped calls with the MTN network will be lower than all the other networks investigated bearing in mind that the Received Signal Strength (RSS) determines whether the Quality Of Service QoS prior to handover is maintained for a quick and a successfully handover to occur

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