Comparative Analysis of The Received Signal Strength Measurement of GSM Network in Owo, Ondo State Nigeria

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Abstract—This work presents a comparative analysis of the received signal strength measurement of GSM network Owo, Ondo state Nigeria. Software was developed to create an interface for the computer to aid in the measurement of the RSSI from different networks in Owo at random sampling points. The three networks considered were; MTN, GLO and AIRTEL in the three different locations (Old Ikare Road, Idasen and Rufus Giwa Polytechnic) within Owo. The data collected were analysed using SPSS (Statistical Package for Social Scientists) as the statistical tool. The mean value of the signal strength received using the developed software for MTN, GLO and AIRTEL are -73.11, -78.74 and -80.75 respectively. The results of the analysis reveal that F-computed (F_{computed}) from the F-Test for MTN, GLO and AIRTEL are 2,627.99, 5,910.395 and 27,592.209 respectively, shows that MTN with the least F {F}_{computed} valued is the most preferred network when compared to the other networks. The significant level value for the three providers being 0.001, 0.002 and 0.003 respectively. This inferred that there is variation in the received signal strength of the three GSM networks. The result also show that MTN having the highest mean value of received signal strength and the lowest signal variation has the best received signal strength followed by GLO and AIRTEL respectively in Owo.

Keywords—GSM, Signal Strength, ICT, SMS, QoS, SIM, NCC,

I. INTRODUCTION

The inception of GSM in Nigeria has brought about a number of positive and remarkable influences on Nigerians, in the areas of economy, information, banking, entertainment, employment, etc. in spite of these positive influences, GSM encounter some problems like; inadequate network coverage, poor connectivity, fluctuation in the signal and low signal levels. Other are network congestion, instability in power supply, call drop, high cost and poor reception. The information and communication technology (ICT) are in a continuous developments. Besides, the number of areas which are using ICT is also spreading. The digital data produced in areas using these technologies continue to grow exponentially over time. Mobile communication area is one for the areas producing the most digital data. The number of mobile communication technology users is increasing day by day, (Savas, Topaloglu and Ciylan, 2012).

The deployment of GSM is most aptly characterized by the commitment of twenty-six European national phone companies to standardize a system, and the working process responsible for this accomplishment has been deemed a great success worthy of replication. Essentially, those countries and firms involved realized the advantages of a cross-border standard and the amount of money and energy that can be wasted when competing for mobile technology ‘world domination’. (Anderson, 2001). Generally speaking, the story of the establishment of GSM is of interest to anybody studying the growth and trajectory of digital technology aid its commercial applications. After all, as some have argued, the nature of digital economies implies that control over network evolution translates into control over the architecture of the digital market place. Cellular system design has become more challenging in recent years as the wireless industry experience a phenomenal growth, both in terms of mobile technology and subscribers. This enormous growth raises the need for a reliable network planning tools to speed the process from network design to implementation (Oseni, popoola, Abolade and Adegbola, 2014). GSM network in Nigeria is currently faced with the challenge of customers’ dissatisfaction in the quality of service offered by the existing network operators due to frequent dropped calls, poor network interconnectivity, echoes and network congestion encountered (Ogbutezie, Onuu, Ushie and Ushibe, 2013). Cellular phones have become an indispensible part of our everyday life. We continuously make use of them in voice calls, sending of short message services (SMS), sending of e-mails, in e-commerce, e-banking, e-learning and watching movies. These cellular phones operate through cellular networks, which are responsible for generating and distributing of radio signals that are used by cellular phones over wide geographic areas (Emeruwa, 2015). The service rendered by these cellular networks in the recent times has been epileptic and this has been attributed to the weakness in the strengths of their research their signals. This research compares the signal strengths of these cellular networks, in which case the quality of their signals is analysed with a view to determining the network with better signal quality.
GSM (Global System for Mobile Communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time-division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies. GSM digitalizes and compresses data then sends it down a channel with two other streams of users’ data, each in its own time-slot. Mobile phone based on cellular network with multiple base stations located relatively close to each other and protocols for the automated “handover” between two cells when a phone moved from one cell to the other. It operates at either the 900MHZ or 18MHZ frequency band.

The GSM revolution in Nigeria started in August 2001 and this brought a great change in the face of information and communication Technology (ICT) in Nigeria. Since it was launched, 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. Indeed these developments have been truly explosive according to statistics from Nigeria Communication Commission (NCC). This explosive growth has brought huge revenue to both the operators and government through tax and license fees. As revolutionary as GSM may seem to be many problems have bedevilled the sector in the recent past.

The performance of the network has a direct impact on the revenues. The NCC is bringing pressure to the operators to step up the quality of service offered Nigerians and had gone a step further to award contract to private companies to conduct comparative analysis of the quality of service offered by each of the operators. The NCC is further threatening to sanction any operator that fails to pay attention to quality.

Therefore, it behoves all operators to ensure that all the subscribers enjoy the best of service.

It is therefore necessary to do a comparative study or analysis to address some of these problems and suggest adequate solution to establish suitable sustainable quality of service (QoS) and thereby reducing the complaint and hardship experienced by subscribers when making and receiving calls.

II. MATERIALS AND METHODS

A program was developed for getting the signal strength information from the Cellular phones. The program got the mobile communication signals from the Cellular phones and saved them in a file. This program allows interaction between the mobile phone and the computer (laptop) connected to it through the Universal Serial Bus (USB) ports of the computer. The software/program was designed to monitor the signal strength for the three leading mobile operators of GSM at the same time. Although, each of the three networks can be monitored individually or separately but for comparison purpose, the network signal strength has to be monitored at the same time using the same type of phone. The signal strength generated for each of the mobile operators can easily be displayed. It is also important to note that the signal strength for each of the mobile network is being recorded at every second.

Figure 1. Computer connection with the mobile phone
Comparative analysis of signal strength for GSM network in Owo, Ondo State was carried out using software/program written in Visual Basic to display the signal strength of phones. The software was designed to detect and monitor the signal strength of the leading three mobile operators i.e. MTN, GLO, and AIRTÉL at the same time and also display them.

Three locations were chosen within Owo metropolis. They are Rufus Giwa Polytechnic, Idasen and Old Ikare Road respectively.

In each of the location, the signal strength for each of the three leading GSM network were monitored at the same time using the same mobile phone.

Three mobile phones (Samsung SGH-J700L) were used to monitor the signal strength with each SIM card for the GSM networks in consideration.

The data were obtained by recording the received signal strength of the three major mobile operators at a specified location (Old Ikare Road, Idasen and Rufus Giwa Polytechnic) using the developed software program. Twenty two thousand four hundred and twenty (22,420) data were collected in all the three locations for each of the mobile operators.

Below is the flow chart of relationship between the phone and the software.
Are the phones made by the same manufacturer? 

Yes 

Are the phones of the same model? 

Yes 

Install the device, is the device driver available? 

Yes 

Install the device driver 

Is the device driver installed successfully? 

No 

Computer cannot communicate successfully with the phones 

Quit Operation 

First requirement fail 

Quit Operation 

Second requirement fail 

Quit Operation 

These phones cannot by used 

Quit Operation
A

Use the phones and modem software to assign port numbers to the phones e.g. port 1 for MTN, port 2 for GLO and port 3 for AIRTEL

Switch on the phones and connect them to the computer using the USB ports

Is the GSM signal Detector available on the system?

Yes

Launch the GSM signal Detector software

Follow every other necessary instruction in order to get the GSM signal readings

Stop

No

Install the software
III. RESULT AND DISCUSSION

The table 1.0 and 2.0 shows that the mean received signal strength for three network in the three locations chosen are -78.73, -73.10 and -80.75 for GLO, MTN and AIRTEL respectively.

<table>
<thead>
<tr>
<th>Location</th>
<th>N (GLO)</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-Ikare Rd</td>
<td>6027</td>
<td>-84.1936</td>
<td>5.67023</td>
<td>.07304</td>
<td>-101.00</td>
<td>-73.00</td>
</tr>
<tr>
<td>Idasen</td>
<td>9268</td>
<td>-74.6982</td>
<td>5.85871</td>
<td>.06087</td>
<td>-89.00</td>
<td>-71.00</td>
</tr>
<tr>
<td>RUGIPO</td>
<td>7125</td>
<td>-79.3681</td>
<td>4.11173</td>
<td>.04872</td>
<td>-91.00</td>
<td>-75.00</td>
</tr>
<tr>
<td>Total</td>
<td>22420</td>
<td>-78.7355</td>
<td>6.56337</td>
<td>.04384</td>
<td>-101.00</td>
<td>-71.00</td>
</tr>
</tbody>
</table>

This reveal in the overall that the received signal strength for MTN is the highest followed by GLO and AIRTEL. In all the three locations, MTN has the best signal reception followed by GLO and AIRTEL has the least signal reception.

<table>
<thead>
<tr>
<th>Location</th>
<th>N (MTN)</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-Ikare Rd</td>
<td>6024</td>
<td>-78.2208</td>
<td>14.47673</td>
<td>.18652</td>
<td>-113.00</td>
<td>-59.00</td>
</tr>
<tr>
<td>Idasen</td>
<td>9269</td>
<td>-59.0000</td>
<td>.00000</td>
<td>.00000</td>
<td>-59.00</td>
<td>-59.00</td>
</tr>
<tr>
<td>RUGIPO</td>
<td>7127</td>
<td>-87.1215</td>
<td>5.13586</td>
<td>.06084</td>
<td>-105.00</td>
<td>-77.00</td>
</tr>
<tr>
<td>Total</td>
<td>22420</td>
<td>-73.1070</td>
<td>14.71171</td>
<td>.09826</td>
<td>-113.00</td>
<td>-59.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>N (AIRTEL)</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-Ikare Rd</td>
<td>6028</td>
<td>-93.7432</td>
<td>9.42416</td>
<td>.12138</td>
<td>-113.00</td>
<td>-75.00</td>
</tr>
<tr>
<td>Idasen</td>
<td>9264</td>
<td>-75.0041</td>
<td>.39481</td>
<td>.00410</td>
<td>-113.00</td>
<td>-75.00</td>
</tr>
<tr>
<td>RUGIPO</td>
<td>7128</td>
<td>-77.2281</td>
<td>2.27310</td>
<td>.02690</td>
<td>-113.00</td>
<td>-75.00</td>
</tr>
<tr>
<td>Total</td>
<td>22420</td>
<td>-80.7495</td>
<td>9.41078</td>
<td>.06285</td>
<td>-113.00</td>
<td>-75.00</td>
</tr>
</tbody>
</table>
Table 3.0: ANALYSIS OF VARIANCE (ANOVA) TABLE FOR MULTIPLE COMPARISONS

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLO</td>
<td>333404.179</td>
<td>2</td>
<td>166702.090</td>
<td>5910.395</td>
<td>.002</td>
</tr>
<tr>
<td>MTN</td>
<td>3400926.327</td>
<td>2</td>
<td>1700463.163</td>
<td>2627.99</td>
<td>.001</td>
</tr>
<tr>
<td>AIRTEL</td>
<td>1411933.843</td>
<td>2</td>
<td>705966.922</td>
<td>27592.209</td>
<td>.003</td>
</tr>
<tr>
<td>Error</td>
<td>2655892.501</td>
<td>67253</td>
<td>39.49106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7802156.359</td>
<td>67259</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Rule: Reject the null hypothesis. Imply that there is Significant at 0.05 level of significant. The F-Computed from the ANOVA table (GLO = 5910.395, MTN = 2627.99 and AIRTEL = 27592.209 with Significant value of 0.002, 0.001 and 0.003 respectively). MTN has the least significant value of 0.002 followed by GLO with 0.001 while AIRTEL has the highest significant value of 0.003. This implies that in all the three locations under study, MTN is the most efficient followed by GLO while AIRTEL is the least efficient.

IV. CONCLUSION

The comparative analysis of the data collected from the three locations within Owo revealed that Idasen has the best signal reception compared to the other two locations; that is, Old Ikare road and Rufus Giwa Polytechnic. The poorest signal reception at Rufus Giwa Polytechnic compared to the other two locations may be due to the base stations of these networks being farther from Rufus Giwa Polytechnic than they are from Idasen and Old Ikare road.

In overall, for the three networks under consideration, MTN has the highest received signal strength in Owo and hence the best network so far in Owo. Little wonder that it continued to enjoy the highest subscriber patronage.

In choosing a network, the signal strength should be considered seriously since the quality of signal provided by a network is a function of the signal strength of that network.

REFERENCES