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Original Research Article

Quality of Service Determination in Effurun, Warri Delta State, Nigeria Using Petroleum Training Institute as a Case Study.

Abstract: *Quality of service has become the major challenges being faced by telecommunication services users and the service providers (MTN, GLO and AIRTEL) have been trying as much as possible to fight this disease that is faced by this sector by minimizing the losses that occurs during transmission from the transmitter to the end users but this disease still remain the major challenges in this generation and the generation to come. This is so because losses cannot be eliminated in communication systems and as such noise cannot be eliminated which has direct impact on the quality of service. This papers focuses on the signal strength in the selected locations using an application called network monitor and thereby drawing a conclusion on the best service provider to use by the occupants of these locations.*

Keywords: *Network monitor, signal strength, path-loss, quality of service*

1. INTRODUCTION

As the world is increasing in population, developmental activities and technologies around this said area increases daily, also problem begins to arise in the communication services, like traffic in system and signals, Low capacity, less coverage area and poor quality of service. Telecommunication industries today have a major problem which is losses that occur during transmission of signals from the point of transmission (transmitter) to the receiving end (receiver). In wireless channels, the path loss exponent (PLE) has a strong impact on the quality of links, and hence, it needs to be accurately estimated for the efficient design and operation of wireless networks [6]. The wireless channel presents a formidable

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challenge as a medium for reliable high-rate communication. It is responsible not only for the attenuation of the propagated signal but also causes unpredictable spatial and temporal variations in this loss due to user movement and changes in the environment. In order to capture all these effects, the path loss for RF signals are commonly represented as the product of a deterministic distance component (large-scale path loss) and a randomly-varying component (small-scale fading). The large-scale path loss model assumes that the received signal strength falls off with distance according to a power law at a rate termed the path loss exponent (PLE) [7]. Fading describes the deviations of the received signal strength from the power-law decay due to shadowing and the constructive and destructive addition of its multipath components. While the small-scale fading behavior of the wireless channel can be well-represented using stochastic processes, it is critical to accurately estimate the PLE for the efficient design and operation of wireless networks [5].

2. LITERATURE REVIEW

[7] works on path loss exponent in a particular location where it was observed that path loss exponent has a great negative effect on signal strength of any location and it was also stated by these authors that the losses depend on the type of terrain, the environmental factors and the suitability of the mathematical model used. From their conclusion on the experiment conducted, it was shown that the log-distance model from literature have some limitation compare to the developed model by the authors which give better results.

2.1. PATH LOSS EXPERIMENT

In wireless communication studies, path loss is spoken to be the path

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loss exponent, whose esteem is regularly in the scope of 2 to 4, where 2 is for propagation in free space, 4 is for moderately lossy conditions and for the instance of full specular reflection from the earth surface alluded to as the level earth display. In a few conditions, the path loss exponent can achieve values in the scope of 4 to 6. Then again, a passage may go about as a waveguide, bringing about a path loss exponent under 2. Path loss is typically communicated in dB. In its most straightforward shape, the path loss can be computed utilizing the equation.

L = 10 n + C (1) Where L is the path loss in decibels, n is the path loss exponent, d is the separation between the transmitter and the receiver, normally estimated in meters, and C is a consistent which represent framework losses. The estimation of C typically fluctuates and is ordinarily reliant on the kind of demonstrating under thought. A rundown of run of the mill path loss exponents acquired in different versatile situations has appeared in Table 1.

Table 1: Path Loss Exponent for Different Environments [1, 2, 3, 4, 5]

Environment	Path loss exponent, n
Free space	2
Urban area cellular radio	2.7 to 3.5
Shadowed urban cellular radio	3 to 5
In building line-of-sight	1.6 to 1.8
Obstructed in building	4 to 6
Obstructed in factories	2 to 3

2.2. PATH LOSS PREDICTION TECHNIQUES

The process of calculating the path loss is usually called prediction. Exact prediction is plausible only for less complex cases, such as the previously mentioned free space propagation or the flat-earth model. In practical cases the path loss is calculated by using a number of approximations. Statistical methods (likewise called stochastic or empirical) depend on estimated and arrived at the midpoint of losses along typical classes of radio connections. Some of the most commonly utilized methods are Hata, Okumura-Hata, the COST Hata model, W.C.Y.Lee etc. which are otherwise known as radio wave propagation models and are typically utilized as a part of the plan of cellular networks and public land versatile networks (PLMN). The Okumura-Hata as refined by the COST-231 project is the method employed for wireless communications in the very high frequency (VHF) and ultra-high frequency (UHF) frequency band (the bands utilized by walkie-talkies, police, maneuvers and cellular telephones). For FM radio and the TV broadcasting, the path loss of 3 is most commonly predicted utilizing the ITU model as described in ITU-R P.1546 recommendation. Other well-known models are those of Walfisch- Ikegami, W.C.Y Lee, and Erceg. Ray tracing is one of the deterministic methods in view of the physical laws of wave propagation

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that are additionally utilized as they are expected to produce more accurate and solid predictions of the path loss than the empirical methods but are considerably costlier in computational exertion and rely upon the definite and accurate description of all objects in the propagation space, such as structures, rooftops, windows, entryways and walls. They are therefore employed predominantly for short propagation paths. Among the most commonly employed methods in the plan of radio gear such as antennas and bolsters is the limited difference time-space strategy. Comparable methods are employed in predicting the path loss in other frequency bands (medium wave (MW), short wave (SW or HF), micro wave (SHF) although the actual calculations and equations may slightly be dissimilar to those for VHF/UHF. Dependable prediction of the path loss in the SW/HF band is particularly difficult, and its accuracy is comparable to weather predictions [1-5]. Easy approximations for calculating the path loss over distances significantly shorter than the distance to the radio skyline: In free space the path loss increases with 20 dB every decade (one decade is when the distance between the transmitter and the receiver increases ten times) or 6dB for every octave (one octave is when the distance between the transmitter and the receiver pairs). This can be utilized as a very harsh first request guess for (microwave) communication joins. The path loss increases with roughly 35-40 dB for each decade (10-12 dB for each octave) for signals in the UHF/VHF band spreading over the surface of the Earth which can be utilized as a part of cellular networks as a first figure. The estimation of the path loss in developed regions can reach 110- 140 dB for the main kilometer of the connection between the base transmitter station (BTS) and the versatile in cellular networks, such as UMTS and GSM, which work in the UHF band. The path loss for the initial ten kilometers may be 150-190dB. These qualities are very inexact and are given here only as a delineation of the range in which the numbers used to express the path loss esteems can eventually be; these are not authoritative or restricting figures. Studies have shown that the path loss may be very extraordinary for a similar distance along two unique paths and it can be distinctive even along a similar path if estimated at various circumstances. In radio wave condition for versatile antennas is close to the ground. Viewable pathway propagation (LOS) models are highly altered.

The signal path from the BTS antenna normally raised over the rooftop tops is refracted down into the local physical condition (slopes, trees, houses) and the LOS signal only here and there reaches the antenna. Nature will produce a few deflections of the direct signal unto the antenna, where typically 2-5 deflected signal components will be vector included. These refractions and deflection processes cause loss

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of signal strength, which changes when the versatile antenna moves (Raleigh fading), causing quick varieties of up to 20 db. The network is therefore intended to give an excess of signal strength compared to LOS of 8-25 db relying upon the idea of the physical condition, and another 10 db to maintain a strategic distance from the fading because of development. [5-8]

3. METHODOLOGY

The method adopted in the realization of the experiment involves the following;

I. Measurement of the data needed using a software called network monitor; this software has the ability to give the received signal strength, the distance to site, the cell Id, the latitude and longitude of the chosen location.

II. The software was installed in an android mobile phone, see diagrams below showing the front view of the application and the mobile phone

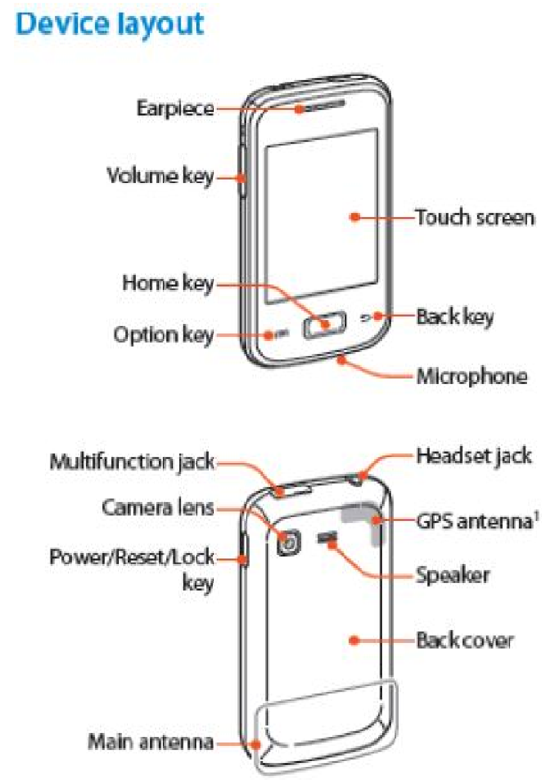

Figure 1: Front view of the mobile device

3.1. LOCATIONS USED:

The locations where the measurements were taken are outside some blocks of classrooms where students take lectures. The pictures of the class rooms and their GPS locations are as follows.

Figure 2: LT (AUDITORIUM)

LATITUDE: 5.57314100

LONGITUDE: 5.79500300

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Figure 3: N BLOCK

LATITUDE: 5.5673000

LONGITUDE: 5.79412600

Figure 4: NN BLOCK

LATITUDE: 5.5678500

LONGITUDE: 5.7965400

Figure 5: LH BLOCK

LATITUDE: 5.56573000

LONGITUDE: 5.79412600

Figure 6: NB BLOCK

LATITUDE: 5.57266100

LONGITUDE: 5.79599000

Figure 7: ELF BLOCK

LATITUDE: 5.56396800

LONGITUDE: 5.78865700

3.2. MEASUREMENT PROCEDURE

The general aim was to determine the best GSM network and internet service provider in the chosen locations. The signal strength of three different networks (MTN, GLOBACOM AND AIRTEL) was then measured and recorded. The geographical locations parameters and their descriptions were all recorded. The geographical locations parameters and their descriptions were taken from the beginning of the tested locations and the parameters include: mobile latitude, mobile longitude and mobile heading. The GPS function of the Samsung galaxy pocket must be switch ON before the network monitor can work otherwise, it will fail to function.

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4. DATA PRESENTATION

Table 2: LT (AUDITORIUM) (OUTSIDE)

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 319m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 414m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 454m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-83	-69	-69
February	-81	-67	-69
March	-81	-69	-67
April	-83	-69	-67
May	-79	-67	-71
June	-79	-65	-67

Table 3: N BLOCK (OUTSIDE)

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 389m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 432m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 458m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-81	-63	-83
February	-79	-61	-85
March	-79	-69	-83
April	-81	-69	-85
May	-77	-67	-81
June	-75	-69	-83

Table 4: NN BLOCK (OUTSIDE)

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 389m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 532m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 467m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-81	-83	-79
February	-81	-81	-75
March	-78	-81	-77
April	-83	-85	-71
May	-81	-79	-71
June	-81	-79	-79

Table 5: LH (AUDITORIUM) (OUTSIDE)

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 410m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 361m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 551m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-71	-75	-71
February	-73	-73	-73
March	-77	-75	-71
April	-71	-73	-75
May	-73	-81	-75
June	-75	-79	-81

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Table 6: NB BLOCK (OUTSIDE)

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 380m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 602m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 583m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-73	-75	-71
February	-77	-73	-73
March	-79	-75	-71
April	-77	-73	-75
May	-81	-80	-75
June	-77	-79	-77

Table 7**: ELF BLOCK (OUTSIDE)**

MONTH	SERVICE PROVIDER: AIRTEL; DISTANCE TO SITE: 330m	SERVICE PROVIDER: MTN; DISTANCE TO SITE: 647m	SERVICE PROVIDER: GLO; DISTANCE TO SITE: 908m
	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH	AVERAGE SIGNAL STRENGTH
January	-65	-79	-69
February	-61	-81	-71
March	-66	-81	-71
April	-63	-83	-69
May	-65	-79	-73
June	-61	-85	-77

5. GRAPHICAL REPRESENTATION OF DATA

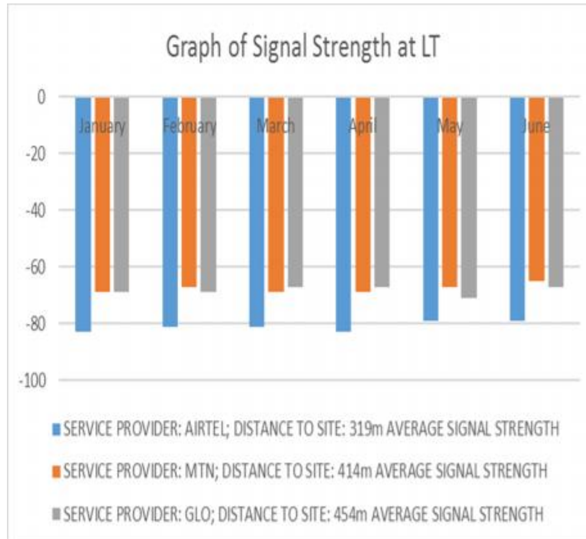

Figure 8 : Graph of Signal Strength at LT

Figure 9: Graph of Signal Strength at N Block

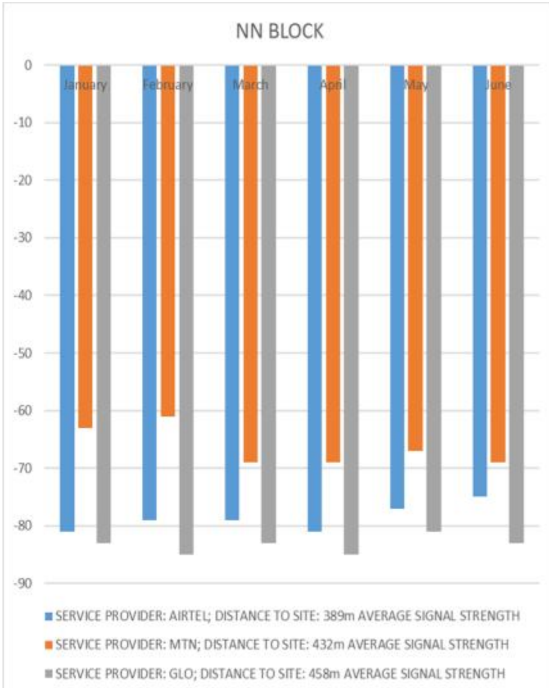

Figure 10: Graph of Signal Strength at NN Block

Figure 11: Graph of Signal Strength at LH Block

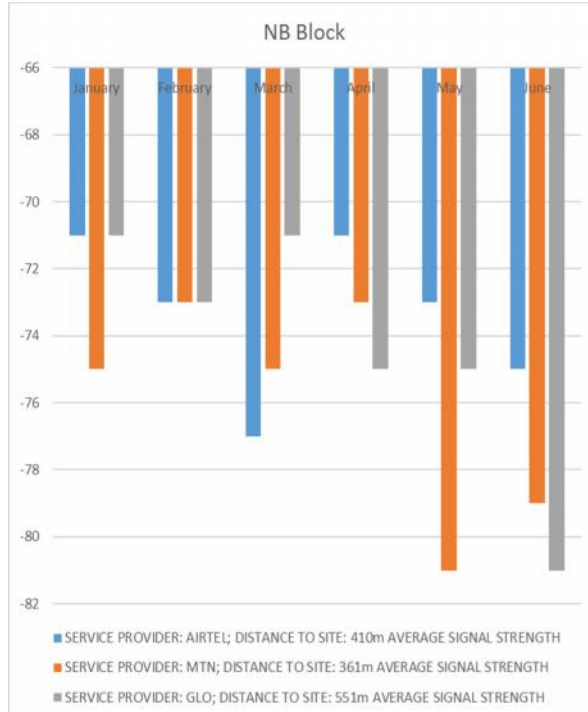

Figure 12: Graph of Signal Strength at NB Block

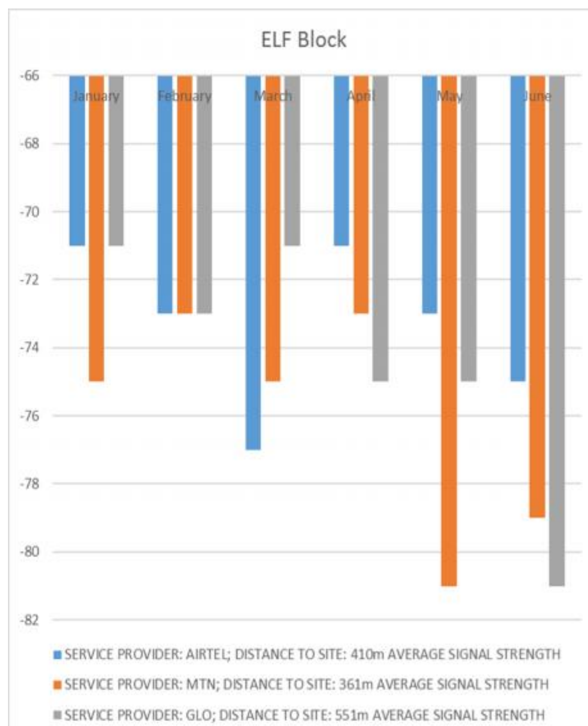

Figure13 : Graph of Signal Strength at ELF Block

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6. RESULT DISCUSSION AND CONCLUSION

From figure 8, it was observed that AIRTEL has the best quality of service around this location while MTN and GLO have almost the same quality of service. Taking a look at figure 9 and 10, it shows that AIRTEL and Glo have the same QoS while MTN has the lowest quality of service over the six months in analysis. Figure 11, 12, and 13 show that aside the month of feburary, 2018 where the QoS was the same in all the service providers, AIRTEL and MTN have the best QoS in other months in analysis. This variation could be as a result of the following factors;

a. Weather conditions
b. Time of the day the data was collected
c. The terrains
d. The surrounding environment
e. Equipment failure on the side of the service providers (MTN, GLO and AIRTEL).

These results have validated the literatures in references 2, 6, 7 and 8 where the authors stated that the factors mentioned above in (a, b, c, d, e) have a great effect on the signal strength of a GSM providers.

7. REFERENCES:

[1]. Andrea G. Wireless communications. Cambridge University Press. 2005.
[2]. Anyasi FI, Yesufu AK. Indoor propagation modeling in brick, zinc and wood buildings in Ekpoma. Journal of Engineering and Applied Sciences. Medwell Journals. ANSINET building, Pakistan. 2007;2(9): 1408-1413.
[3]. Anyasi FI, Yesufu AK, Akpaida VOA, Evbogbai MJE, Erua JB. Indoor modeling for determination of G. S. M. signal penetration level. A case study of mud, block, and steel building materials in Ekpoma. Journal of engineering and Applied Sciences. Medwell Journals, ANSINET Building, Pakistan. 2007;2(9): 1443-1449.
[4]. Armogum V, Soyjaudah KMS, Fogarty T, Mohamudally N. Comparative Study of Path loss using existing models for digital television broadcasting for summer, Mauritius. Season in the north of Mauritius, Proceeding of Third Advanced IEEE International Conference on Telecommunication. 2007; 4:34-38.
[5]. Baccelli F, Blaszczyszyn B, Mühlethaler P. An aloha protocol for multihop mobile wireless networks. IEEE Transactions on Information Theory. 2006;52(2):421-436.
[6]. Uzairue Stanley et al (2018) "Experimental Analysis of Cable Distance Effect on Signal Attenuation in Single and

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Multimode Fiber Optics" International Journal of Electrical and Computer Engineering (IJECE) Vol. 8, No. 3, June 2018, pp. 1577~1582

[7]. Anyasi F.I and Uzairue S.I (2014) "Determination of GSM Signal Strength Level in Some Selected Location in EKPOMA" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. II (Mar - Apr. 2014), PP 08-15

[8]. V.O.A Akpaida et al (2018) "Determination of an Outdoor Path Loss Model and Signal Penetration Level in Some Selected Modern Residential and Office Apartments in Ogbomosho, Oyo State, Nigeria" Journal of Engineering Research and Reports 1(2): 1-25,