IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 14, Issue 5, Ser. I (Sep.-Oct. 2019), PP 26-38
www.iosrjournals.org

Signal Attenuation Effect on the Reception of VHF/UHF Terrestrial Broadcasting in Oron and Its Environment, Nigeria.

Aniefiok o. Akpan
Physics Department, Akwa Ibom State University, Nigeria
Corresponding Author: Aniefiok o. Akpan

Abstract: *High-tech innovations flitting around the scientific manipulation of the electron, have tremendously influenced the Information and Entertainment industry. One of these major beneficiaries is the Broadcast industry. Television viewing hubs play major role because of its audio visual content. Audio signal quality can deteriorate without much impact on the received signal. However, visual signals are highly sensitive to fluctuations, and therefore, easily noticed to the discomfort of the viewer. This research study carried out measurements and analyses of signal strength levels from two propagating television stations (UHF and VHF): Akwa Ibom Broadcasting Corporation (AKBC), and Nigerian Television Authority (NTA). This was with a view to finding out whether signal attenuation has effect on the reception of VHF/UHF in Oron from television broadcasting stations. It was also aimed at establishing the primary, secondary and fringe service areas of these signals at different strategic locations in Oron Local Government Area. Radio frequency analyzer, with 24 channels spectrum, ranging between 46-870MHz (model: RO.VE.R.-'DLM3-T') was deployed to capture signals from terrestrial television stations (TV). CATV measured signal of TV stations in dB, dBμV and dBmV. An outside television antenna of dimension 59(L) x 8.5(W) x 11(H) cm on a pole of about 10m, was used to receive the signal at different locations. Its frequency ranged from 40-860MHz; while varying from channel 1 to channel 69. Even in areas where the audio signal received was partially audible, the video signal was alright to the comfort of some subscribers. Interestingly, there was a very good reception from Channel 45 in Oron with over 50% of the accessible region receiving over 32dBμV and empirical path-loss levels were best predicted by Egli's model.. This was attributed mostly to flatness of some regions which were almost at the same level with the transmitting antenna .The calculated path loss was compared with other standard models, and the results indicated that only Egli's model closely agreed with the measured path-loss in this rural setting. However signals from channel 12 dropped to about 19dBμV in the creeks due to signal attenuations caused by the thick vegetation of this environment. This has greatly affected the signal reception in this arear.*

Keywords: *Attenuation, Oron Creeks, Broadcast station, Propagation models, Television, Video signal , Audio Signal*

Date of Submission: 01-11-2019 Date of Acceptance: 16-11-2019

I. Introduction

Information and Entertainment industry have made the entire world a one-stop shop due to innovations in science and technology. These innovations flit around the scientific manipulation of the electron. Through the exploitation of electrons, information and leisure activities are shared world-wide, at minimum cost. This disquieting transaction is made possible using electronic media. One of this major media outfit is the television. Television plays a major role because of its audio visual content. Undoubtedly, the media and entertainment industry is currently ranked 4th in term of CSR (Corporate Social Responsibility) in the world, only surpassed by computers, telecommunication and food industries; according to (Global digital divide,2011).

These admirable features that captivate the public are made possible by a broadcast station which transmits signals through space as an electromagnetic. The transmission is done over certain frequencies which are assigned to the stations and are mostly VHF (Very High Frequency) and UHF (Ultra High Frequency) for terrestrial broadcasting. As viewers tuned to broadcast stations within and outside their localities, they expect the television to faithfully reproduce the following features of the image transmitted by the broadcasting station's transmitter; the structural content or shape of object, the tonal content or relative brightness, the motion of the object or kinematic content, sound, color or chromatic content and lastly the stereoscopic content also known as perspective (Kenedy & David 2011).

These contents are direct function of how good the signal is at the point of reception. In other word, they reflect the signal strength at such point. The signals are electromagnetic in nature and as such are subject to natural or man-made phenomena. Factors like the presence of hills, buildings, vegetation and the atmosphere have been found to have great influence on the propagation of this signal in different regions (Bassey et all, 2016).

In telecommunication, the areas of reception have been classified into primary, secondary and fringe service area. The signal decreases from primary to fringe zone (Oyetunji, 2013). Wave could be seen as an oscillation or vibration or disturbance that is characterized by energy transfer that moves through space or object. Waves have two main types and they are mechanical and electromagnetic waves. Whereas mechanical waves require material medium for its propagation, electromagnetic waves requires no material medium for its propagation. When an electric current flows through a conductor, it produces a time-varying electric field which in turn acts as a source of magnetic field. These two fields created can sustain and interact with each other giving rise a special form of energy known as electromagnetic wave (Griffiths, 1999). Figure 1, below shows that both fields are perpendicular to each other and are

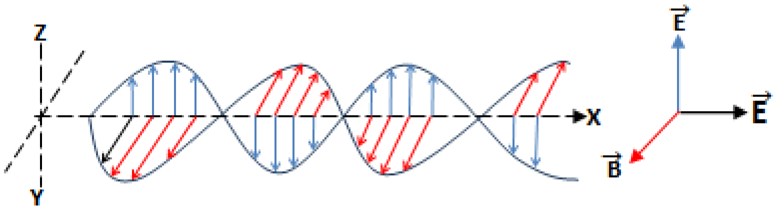

Fig. 1: Electromagnetic waves showing the electric field E, magnetic field B,

perpendicular to the direction of propagation. According to Maxwell's equations, both electric and magnetic fields which form the electromagnetic disturbance are sinusoidal functions of time and position, and characterized by frequency and wavelength. These equations and direction of propagation define the basic principle undergirding the operation of electromagnetic wave as a combination of Gauss's law of electric fields, Gauss's law of magnetic fields, Ampere's law and Faraday's law (Lev & Alexander, 2002) The equations are as follows: $\oint E.dA = Qencl/\epsilon_{\circ}(1)$ (1)

Equation (1) implies that the surface integral of E over any closed surface equals $1/\epsilon$ multiplied by the total charge Q_{encl} , where E is the electric field and A represents the area.

(ii) $\oint B.dA = 0.$ (2)

Equation (2) states that the surface integral of B over any closed surface is zero, where B is the magnetic field.

(iii) $\oint B.dl = \mu_{\circ}(i_{c} + \varepsilon_{\circ}\frac{d\Phi}{dt}E)$ (3)

This is also known as Ampere's law. It implies that both conduction and displacement current act as sources of magnetic field; where $\varepsilon_{\circ}$ is the permittivity of free space, $\mu_{\circ}$ the permeability of free space, and ΦE the electric flux.

(iv) $\oint E.dl = -\frac{d\Phi}{dt}E$ (4)

Equation (4) is Faraday's law and implies that a changing magnetic flux induces an electric field. The Heaviside version of this equation using Laplace transform is shown in Equations (5) to (8) below:

$\nabla.E = 0$ (5)

$\nabla \mathrm{xE} = -\frac{\partial B}{\partial t}$ (6)

$\nabla.B = 0$ (7)

$\nabla XE = \frac{\mu_{\circ}\epsilon_{\circ}\partial E}{\partial t}$ (8)

Deploying the curl of curl to these equations, we obtain Equations (9) and (10) as presented below:

$\nabla \mathrm{x}(\nabla \mathrm{xE}) = -\frac{\partial}{\partial t}\nabla \mathrm{xB} = -\frac{\mu_{\circ}\epsilon_{\circ}\partial^2 E}{\partial t^2}$ (9)

$\nabla \mathrm{x}(\nabla \mathrm{xB}) = -\frac{\partial}{\partial t}\nabla \mathrm{xE} = -\frac{\mu_{\circ}\epsilon_{\circ}\partial^2 E}{\partial t^2}$ (10)

Further to the above, applying the vector identity, Equation (11) is derived as:

$\nabla \mathrm{x}(\nabla \mathrm{xV}) = \nabla.(\nabla.\mathrm{V}) - \nabla^2 \mathrm{V}$ (11)

Where **V** is any vector function of space. And Equation (12),

$\nabla^2 \mathrm{V} = \nabla.(\nabla.\mathrm{V})$ (12)

Where ∇**V** is a dyadic which when operated on by the divergence operator ∇· yields a vector. Since

$\nabla.\mathrm{E} = 0$

$\nabla.\mathrm{B} = 0$

Then, the first term on the right in the identity vanishes and the wave equations is obtained as presented below:

$$\frac{\partial^2 E}{\partial t^2} - c_\circ^{\,2}.\nabla^2\mathrm{E} = 0 \qquad (13)$$

$$\frac{\partial^2 B}{\partial t^2} - c_\circ^{\,2}.\nabla^2\mathrm{B} = 0 \qquad (14)$$

Where C in Equation 15:

$$c_\circ = \frac{1}{\sqrt{\mu_\circ \epsilon_\circ}} = 2.99792458 \text{ x } 108 \text{ m/s} \qquad (15)$$

is the speed of light in free space.

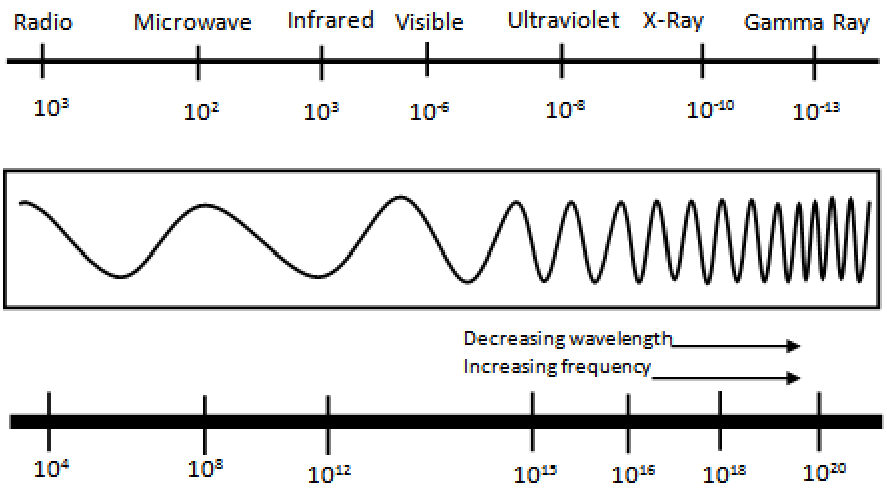

Fig. 1: The Electromagnetic spectrum

The radial electric field surrounding such electron is given by the Equation (16) below:

$$Er = \frac{1}{4\pi\varepsilon_0} * \frac{e}{r^2} \qquad (16)$$

The condition stated by Equation (16) holds only for a stationary electron; but changes when such an electron is moving. Example: a current-carrying wire. The moving electron which produces current is also responsible for the magnetic field around it.

According to [9], any new field (electromagnetic radiation) produced by an accelerating electron depends on the acceleration of the electron and the reciprocal of the distance of the electron from the nucleus. This theory is illustrated in Equation (17) below:

$$E_\theta = e * \frac{1}{4\pi\varepsilon_0} * \frac{\ddot{r}\sin\theta}{c^2 r} \qquad (17)$$

where E_θ is the pulse of electromagnetic radiation, e is the electronic charge, r is the acceleration, c is the speed of light, r the distance from the nucleus, and the angle between the changing fields. The amount of radiation leaving the system also depends of the length of the current-carrying conductor and the wavelength of the current flowing through it. Base on this, electromagnetic radiation can be described as an energy that is transmitted in form of electromagnetic wave either through space or a material medium.

Attenuation of Electromagnetic radiations

This is one of the major setbacks in the propagation of electromagnetic waves when it leaves its source. Researchers have shown that electromagnetic waves get attenuated as they travel outwardly. Attenuation can be referred to as a reduction in the intensity of propagated electromagnetic waves. Attenuation of electromagnetic radiation in space obeys the inverse-square law which indicates that power density reduces fairly rapidly with distance from the source. This means that signal attenuation, is proportional to the square of the distance travelled by the wave (Kenedy & Davis, 2011). The attenuation of field intensity is given by Equation (18):

$$\alpha_E = \frac{\sqrt{\frac{30P_t}{r_1}}}{\sqrt{\frac{30P_t}{r_2}}} = 20log\frac{r_1}{r_2} \qquad (18)$$

where α_E is the field intensity attenuation, P_t the transmitted power, r_1 and r_2 are distances from the source of electromagnetic waves with r_2 greater than r_2. This implies that at a distance of 2r from the source of the electromagnetic waves, the field intensity drops by 6dB of its value from a distance r from the source.

In electromagnetic waves, the electric and magnetic components are related to each other in the same way voltage, V and currents, I are related in an electrical circuit where. These can be illustrated in Equations (19) to (20), as follows:

$$V = IZ \qquad (19)$$

Z is the impedance of the circuit.

Similarly, electric field, E and magnetic field, H are related are related thus:

$E = \mathcal{L}H$ (20)

Where $\mathcal{L}$ is the characteristic impedance of the medium, and is given in Equation (21):

$\mathcal{L} = \sqrt{\mu/\varepsilon}$ (21)

where μ is the permeability and ε is the permittivity of the medium.. E is actually the root mean square value of the field strength or intensity in v/m, while H is also the root mean square of magnetic field strength or intensity in A/m.

But for free space,

$$\mu = 4\pi * 10^{-7} = 1.25 * 10^{-6} H/m$$

$$\varepsilon = {}^{1}\!/_{36\pi * 10^9} = 8.854 * 10^9 F/m$$

With this:

$\mathcal{L} = \sqrt{\frac{\mu}{\varepsilon}} = \sqrt{\frac{4\pi*10^{-7}}{{}^{1}\!/_{36\pi*10^9}}}$ (22)

$$\mathcal{L} = 120\pi = 377\Omega$$

This is the impedance of free space.

Power density, $P_d = {}^{E^2}\!/_{\mathcal{L}}$ (23)

$E^2 = P_d * \mathcal{L}$ (24)

${}^{P_t}\!/_{4\pi r^2} * 120\pi = \frac{30P_t}{r^2}$ (25)

Therefore:

$E = {}^{\sqrt{30P_t}}\!/_{r} V/m$ (26)

This represents the electric field strength in a free space at a point r from the radiating source with power P_t [2].

Television transmitter

In broadcasting industry, many devices function with respect to the required output; starting from the video camera or microphone in the studio, to the antenna which finally radiates the transformed input. One of the major intermediaries of this process is the transmitter. It's an electronic device which generates and amplifies a radio-frequency carrier, modulates it with the desired input signal; either video or audio and finally feeds it to an antenna for transmission (Mardeni & Kwan. 2014). Transmitters are classed based on the system standards, output power, backup facility, stereophonic facility, aural/visual power combining principle and active acts element in the final amplifier stage .

All transmitters are regulated by the Stockholm plan (1961) from the International Telecommunication Union (ITU), which set the broadcast standards for all transmitting station based on radio frequency, frequency separation between aural and visual carrier and band bandwidth. Below is a block diagrams of a TV transmitters commonly used in broadcast industry (Okey & Raji).

Statement of the Problem

Propagation loss has been established to be inevitable as the distance between the transmitting antenna and the receiving antenna increases. Researchers have also indicated the probable cause of the loss to be from natural or manmade phenomena such as forest, hills, mountains, equipment, etc. Audio signal quality can deteriorate without much impact on the received signal; as well as message. However, visual signals are highly sensitive to fluctuations, and therefore, easily noticed to the discomfort of the viewer. This research study is therefore focused on the UHF/VHF visual signal distortions. It carried out measurements and analyses of signal strength levels from two propagating television stations (UHF and VHF): Akwa Ibom Broadcasting Corporation (AKBC) channel 45 and Nigerian television Authority (NTA) Channel 12. This is with a view to establish the primary, secondary and fringe service areas of these signals at different strategic locations, and topographical influences on the delivered signal strength levels in Oron in Akwa Ibom State.

Electric field strength:

The intensity or power of transmitted signal from a transmitting station received by an antenna at a different location is referred to as the electric field strength. Electric field strength are measured in dB millivolt per metre (dBmV/m) or dB microvolt per metre (dBuV/m). In 1998, Werner and Emders researched on an alternative means of calibration of electric field sensor which will enable a smooth computation of coupling errors which was not dealt with by previous methods of calibration like the use of closed transverse electromagnetic (TEM) wave. The new method involves the superposition of radiated and guided wave, and this presented an easy assessment of the coupling factor, a key index for computation of electric field strength, calibrations of sensors and antennas.

Pathloss and models:

The intensity of radio wave leaving a transmitting station is found to differ in value at some locations away from the transmitter. This means that not all the intensity or signal strength that is transmitted by a station is being received at measured distances from the transmitter. Some percentages are lost in the propagation path. This drop in signal power as the radio wave propagates through space is known as path loss. A lot of factors are responsible for this phenomenon such as poor terrain and environment like the rural, sub-urban or urban areas, presence of hills, mountains, foliage etc and transmitter-antenna distance. Other factors include the height and location of antennas, diffractions and absorption of the electromagnetic waves. Path loss models on the other hand are experimented mathematical expressions used when illustrating radio wave propagation as a function of frequency, distance and some conditions. There are different models in existence for different conditions of the atmosphere, terrain, paths, obstructions, etc. The models for outdoor attenuations include:

(i) Weissberger's modified exponential model. It is a radio wave propagation model for predicting path loss by foliage. It has a frequency range of 230MHz to 95GHz with foliage depth of 400m. It is a reviewed ITU (International Telecommunication Union) model for Exponential Decay (MED) created in 1982. (Koutis &Tafazolie, 2002].

Weissberger's model is formally expected as :

$$L = \begin{cases} 1.33 f^{0.284} d^{0.586}, & \text{if } 14 < d \leq 400 \\ 0.45 f^{0.284}\, d \;, & \text{if } 0 < d \leq 14 \end{cases} \qquad (27)$$

Where L = the loss due to foliage in decibel (dB); F = the transmission frequency gigahertz (GHz); d = the depth of foliage along the path in meters

(ii) Early ITU model. It is also a radio propagation model for predicting loss due to foliage and was adopted in late 1986. It has no specified frequency range and no foliage depth and it is expressed as: L =

$$0.2 f^{0.3} d^{0.6} \qquad (28)$$

where f and d are defined as above; and L = path loss in dB, F = transmission frequency in megahertz (MHz), d = depth of the foliage

(iii) Egli Model: This is a model sourced from UHF and VHF television transmissions data in several large cities and suitable for cellular communication on irregular terrain. It predicts the path loss for outdoor line-of-sight transmissions and expressed as follows:

$$P_{R50} = 0.668 G_R\, G_m \left[\frac{h_B h_m}{d^2}\right]^2 \left[\frac{40}{f}\right]^2 P_T \qquad (29)$$

where P_{R50} = 50th percentile receive power (W); P_T = Transmit Power (W); G_B = Absolute gain of the mobile station antenna, h_B = Height of the base station antenna (m), h_m = Height of the mobile station antenna (m); d = Distance from base station antenna (m), f = frequency of transmission (MHz) [14].

(iv) ITU terrain model: This provides a method to predict the medium path loss for a telecommunication link and its prediction is based on the height of the path blockage [15]. It is applicable on any terrain and expressed as follows:

$$A = 10 - 20C_{N(37)}; \quad C_N = h/Fi; \quad h = h_L - h_o; \quad F_1 = 17.3\sqrt{\frac{d_1 d_2}{fd}} \qquad (30)$$

A = Additional loss (in excess of free – space loss) due to diffraction (dB); C_N = Normalized terrain clearance; h = The height difference (negative in the case that the LOS path in completely obscured) (m); h_L = Height of the line-of-sight link (m);
h_o = Height of the obstruction (m); F_1 = Radius of the First Fresnel zone (m); d_1 = Distance of obstruction from one terminal (m); d_2= Distance of obstruction from the other terminal (m); f = Frequency of transmission (GHz); d = Distance from transmitter to receiver (km).

(v) Young Model: It is an appropriate model for predicting path loss in cellular communications in large cities with tall structures. It has a frequency range of 150 MHz to 3700MHz and it is expressed as presented in Equation 31:

$$L = G_B\, G_m \left(\frac{h_B\, h_m}{d^2}\right)^2 \beta \qquad (31)$$

L = path loss in (dB); G_B = gain of base transmitter (dB); G_m = gain of mobile transmitter (dB; h_B = height of base station antenna (m); h_m = height of mobile station antenna (m); d = line distance (Km); β = clutter factor.

(vi) Okumura model: This is used mostly in the cities where there are many urban structures, but not many tall blocking structures. It has a frequency range of 150-1920MHz, a base station antenna height between 30m and 1000m and link distance between 1Km and 100km (Okamura, 1999).

It is expressed as presented in Equation 32:

$$L = L_{FSL} + A_{mu} - H_{MG} - H_{BG} - \sum k \ \text{correection} \quad (32)$$

Where L = The medium path loss (dB); L_{FSL} = The free space loss (dB);

A_{mu} = Medium Attenuation (dB); H_{GM} = Mobile station antenna height gain factor. H_{BG} = Base station antenna height gain factor; $K_{correction}$ = Correction factor gain (such as type of environment, water, surfaces, isolated obstacle etc.

(vii) Hata model for Urban areas: It is also referred as Okumura-Hata model and widely used radio frequency propagation model for predicting the behaviour of cellular transmissions in built up areas. It has a frequency range of 150-1500MHz with mobile antenna height of 1-10m, base station antenna height 30-200m and link distance 1-10km. *It incorporates both suburban and open areas (Seybold, 2005).* It is formulated as presented in Equation 33

$$Lu = 69.55 + 26.16 \log_{10} f - 1.82 \log_{10} h_B - C_h + [44.9 - 6.55 \log_{10} h_B] \log_{10} d \quad (33)$$

for small or medium sized city

$$C_H = 0.8 + (1.1 \log_{10} f - 0.7) h_m - 1.56 \log_{10} f \quad (34)$$

and large cities

$$C_H = \begin{cases} 8.29 \left[\log_{10}(1.54\ h_m)\right]^2 - 1.1, & \text{if } 150 \le f \le 200 \\ 3.2 \left[\log_{10}(11.75\ h_m)\right]^2 - 4.97, & \text{if } 200 < f \le 1500 \end{cases} \quad (35)$$

L_u = Path loss in urban areas (dB); h_B = Height of base station antenna (m);

h_m = Height of mobile station antenna (m); f = Frequency of transmission (MHz); C_H = Antenna height correction factor; d = Distance between the base and mobile stations (Km).

(viii) Hata model for open areas is presented in Equation 36:

$$L_o = L_u - 4.78 (\log_{10} f)^2 + 18.53 \log_{10} f - 40.94 \quad (36)$$

Where L_o = Path loss in open area (dB); L_u = Path loss in urban areas for small sized city (dB); f = Frequency of transmission (MHz).

(ix) COST231 Extension to Hata Model: A model that is widely used for predicting path loss in mobile wireless system is the COST-231 [18]. The COST-231 Hata model is designed to be used in the frequency band from 500 MHz to 2000 MHz. It also contains corrections for urban, suburban and rural (flat) environments. Although its frequency range is outside that of the measurements, its simplicity and the availability of correction factors has seen it widely used for path loss prediction at this frequency band (Mardeni & Kwan, 2010). The basic equation for path loss in dB is :

$$L = 46.3 + 33.9 \log f - 13.82 \log h_B - a(h_R) + [44.9 - 6.55 \log h_B] log d + c \quad (37)$$

For suburban or rural environments:

$$(h_R) = (1.1 \log f - 0.7)\, h_R - (1.56 \log f - 0.8) \quad (38)$$

$$c = \begin{cases} 0dB, & formediumcitiesandsuburbanareas \\ 3dB, & formetropolitanareas \end{cases}$$

Where, L = Median path loss. Unit: decibel (dB); f = Frequency of Transmission. Unit: megahertz (MHz); h_B = Base station antenna effective height. Unit: meter (m).

d = Link distance. Unit: Kilometer (km); h_R = Mobile station antenna effective height. Unit: meter (m); $a(h_R)$ = Mobile station antenna height correction factor as described in the Hata model for urban areas.

Nadir et al, present an investigation on the characteristics of radio propagation, by measurement, at the small town of rural area in Purwokerto Central Java Indonesia. Their results were used to evaluate the accuracy of Okumura Hata and Lee prediction models and to determine the necessary adjustments to these models in order to improve their accuracies. He radiated a 20dBm signal at 1467MHz by an omni directional antenna with 5.2dB gain. His propagation measurements showed that the received signal strength decreases with distance at the rate of 2.34dB, while its mean values fall between 10 and 15dB below free space prediction with standard deviation of 6.5dB. Comparing these propagation measurements with Okumura- Hata and Lee prediction models for open area classifications, they discovered that they were in agreement for area coverage of 3 to 10Km. Also, Okumura-Hata and Lee models gave less path loss prediction for smaller coverage area but propose higher values for larger distances.

Similarly, in Ondo State, the relationship between the line of sight and signal strength of an Ultra High Frequency (UHF) television signals was investigated. The Propagation curves for the signal along different routes were plotted and regression analysis was used to determine the exponential models which can be used to calculate signal strength for a given line of sight at the designated routes in the state (Nwalozie et al, 2014).

According to Faruk et al, (2013), path loss exponent is one of the important parameters in all distance path loss models (log-normal); once it is known for an environment, coverage planning and propagation analysis could be done easily. In their work, log-normal propagation path loss model was used to characterize the path loss parameters in the VHF and UHF frequencies for Ilorin City of Kwara State, Nigeria. Results indicated that the path loss exponent varies from 1.4 to 4.94 with an average value of 2.80. The work further investigated the behaviour of the TV signals in the same environment in terms of standard deviation and building penetration loss. It is concluded that the standard deviation for Ilorin city is 7.35 dB, the average penetration loss is 11.49 dB and the path loss intercept at 1 km at 203.25 MHz and 583.25 MHz is 107.56 dB.

A research in south-eastern Nigeria by Nwalozie et al (2014), showed that Hata and other empirical models didn't predict the path loss. Instead using the log-normal, the outdoor path loss model for Aba urban was obtained as

$$Lp\,(d) = 75 + 31 \log (D) \qquad (39)$$

where D is the ratio of the test distance (d_i) to the reference distance (d_0)
And 75dB is the path loss at the reference distance using the free-space model.

GSM signals operating on the frequencies of 900 MHz and 1800 MHz, which are the two frequencies used by mobile operators in Nigeria, were investigated in Enugu and Portharcourt. The mean square errors (μ_e) ranged from 0.8 dB to 5.04 dB for Okumura Hata at 900 MHz. For COST 231 Hata lied between $1 \leq \mu \leq 15$ dB which is universally accepted (Ogbulezie et al, 2013).

Measurement results of signal strength in UHF band obtained in Idanre Town of Ondo State Nigeria are presented and compared with the results predicted by using the propagation models. A modified COST231-Hata radiowave propagation model was developed and implemented with Matlab GUI (Graphical User Interface) for simulation. The model developed has 93.8% accuracy (Oluwole & Olajide, 2013).

II. Materials And Methods

Materials

Study Area

This work titled "Signal Attenuation Effect on the Reception of VHF/UHF Terrestrial Broadcasting in Oron and its environments, Nigeria". is an annex from a comprehensive research studies carried out in Akwa Ibom State, Nigeria; one of the few costal states in the South South, Nigeria. It is located in the Niger Delta region . **Oron** is found in the flood plain of South Eastern Nigeria, with the land mainly intersected by numerous streams and tributaries flowing into Cross River. The entire coastline stretches from Uya **Oron** to Udung Uko. The region is extremely fertile and is known for its topographical Oil Palm Belt, tropical rainforest, swamps, and beaches. The mangrove forests also provide timber and raw materials for medicinal purposes. There are also deposits of solid minerals such as iron, free silica or glass sand and gravel. Seafoods such as crayfish, snipers, oyster and periwinkle abound richly in all coastal areas.

Oron is in the tropical region and has a uniformly high temperature all the year round. The two main seasons are the dry which spans between October and April and wet season which starts around May and ends in September. There are also two prevailing winds – the South-West onshore winds which brings heavy rains and the North- East trade winds blowing across the Sahara Desert, which brings in the dry season.

These distinct environmental characteristics made Oron creeks a challenging location to monitor the reception of propagated signal through electromagnetic waves.

Digital Cable Television Analyzer (CATV)

It is radio frequency analyzer, with 24 channels spectrum, ranging between 46-870MHz (model: RO.VE.R.-'DLM3-T'). It has a video display screen and corresponding output sound to capture signals from terrestrial radio stations and television stations. CATV measures signal of both radio and TV in dB, dBμV and dBmV. The equipment works perfectly with 12V supply, either from an external battery, or from other available grid supply; and it's capable of powering the pre-amplifier of an antenna system for maximum reception. Figure 2 shows the field strength meter in its operational form displaying a monitored TV channel.

Fig. 2: Field strength meter(CATV)

Receiving antenna

An outside television antenna of dimension 59(L) x 8.5(W) x 11(H) cm on a pole of about 10m, was used to receive the signal at different locations across Oron. Its frequency range spans from 40-860MHz, from channel 1 to channel 69. The antenna has both VHF and UHF gain of 20 $\pm$ 3dB, with an impedance of 75Ω and a noise coefficient less than 3dB. The operational power of this antenna is 3W with an output level of 145dB.

Global positioning system

GPS 72H from Garmin was used to measure the distance from the transmitting antennas to different measuring locations in the state as well as their elevations above sea level.

Measurement procedure

Measurements were carried out in Oron along accessible routes. Field or signal strength at various locations were examined both at the UHF and VHF bands, with special attention given to some reliefs along the measuring route. The signal strength of various stations were measured. Measurements of the signal strength was first at premises of the stations also referred to as the near field signal, before subsequent measurements at other locations.

III. Results

Analysis of Empirical Results from Oron

Figure 3 is a plot of signal strength from channel 12 against distance, Figure 4 is plot of calculated path loss in Channel 12 against distance, Figure 5 plot calculated path loss in Channel 12 against distance, Figure 6 is Plot of path loss in Channel 45 against distance, Figure 7 is plot of signal strength from Channel 45 against distance, Figure 8 plot of calculated path loss and other models in Channel 45 against Distance , all in Oron. Table 1 presents the descriptive statistics of path loss models in channel 45 while Table 2 is the descriptive statistics of path loss models in channel 12 in Oron.

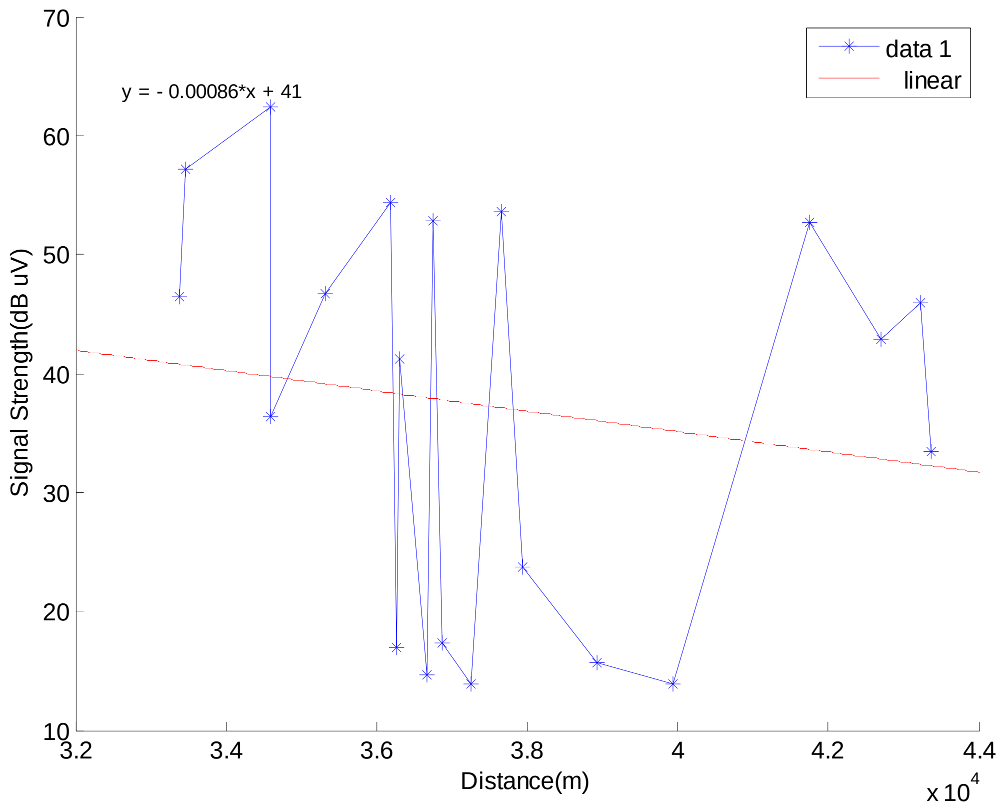

Fig. 3: Plot of signal strength from channel 12 against distance in Oron

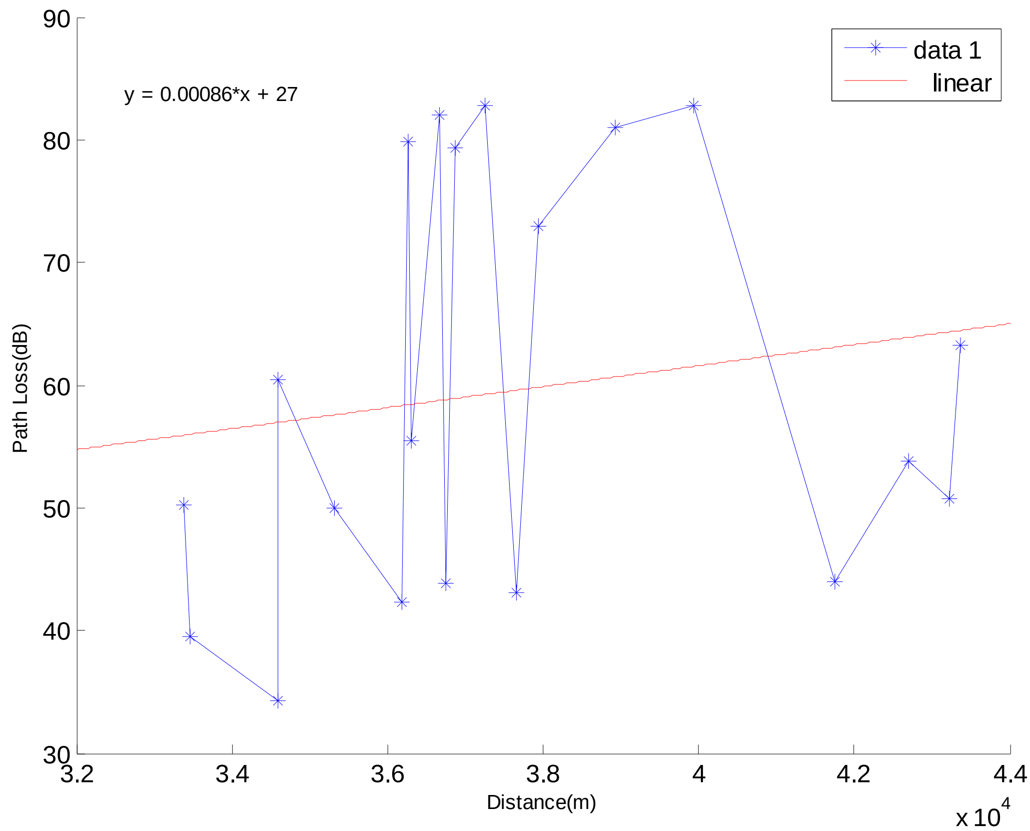

Fig. 4: Plot of calculated path loss in Channel 12 against distance in Oron

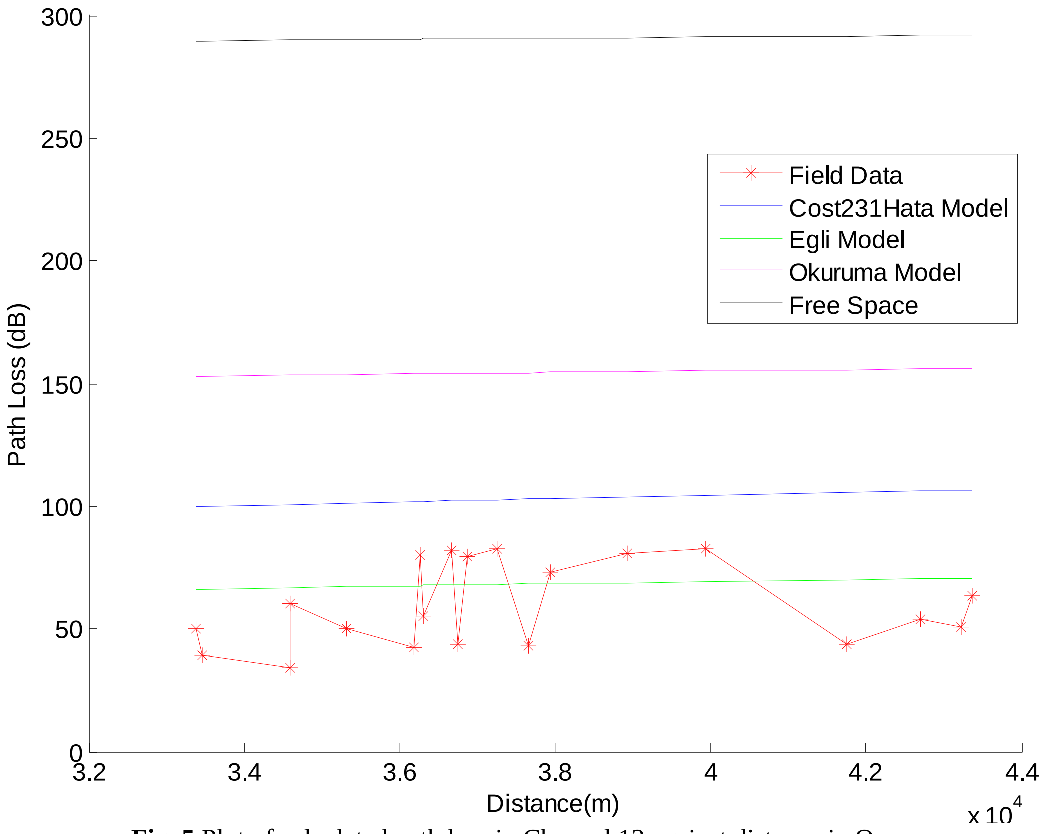

Fig. 5 Plot of calculated path loss in Channel 12 against distance in Oron

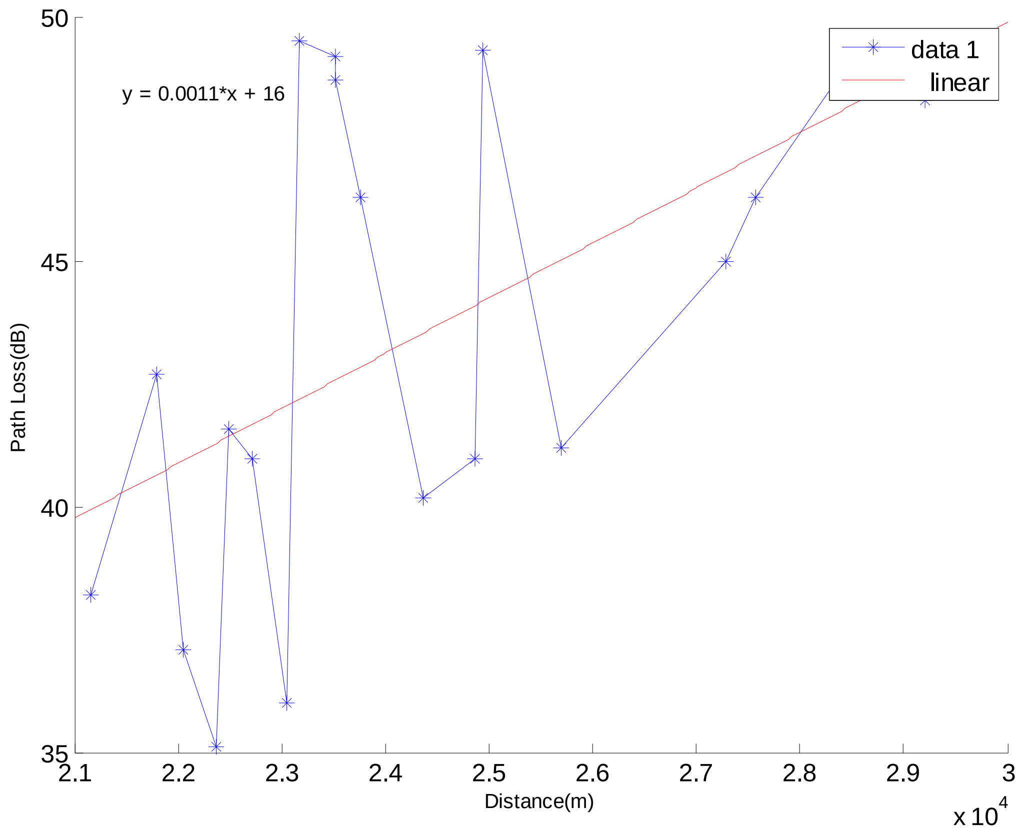

Fig. 6: Plot of path loss in Channel 45 against distance in Oron

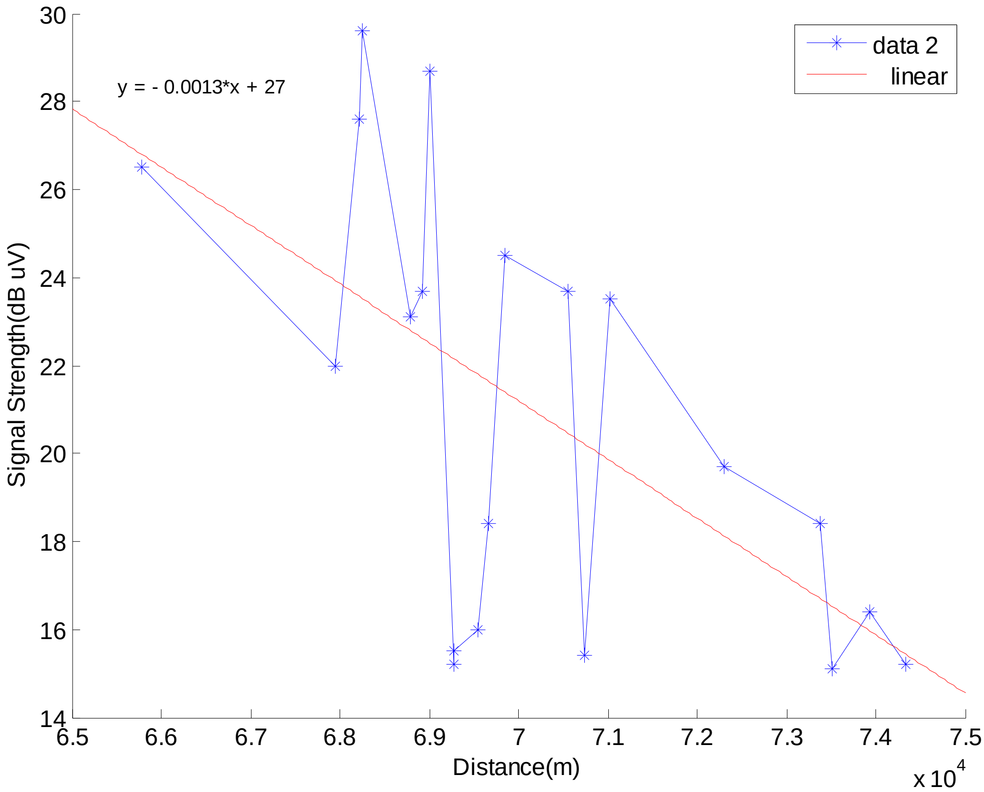

Fig. 7: Plot of signal strength from Channel 45 against distance in Oron

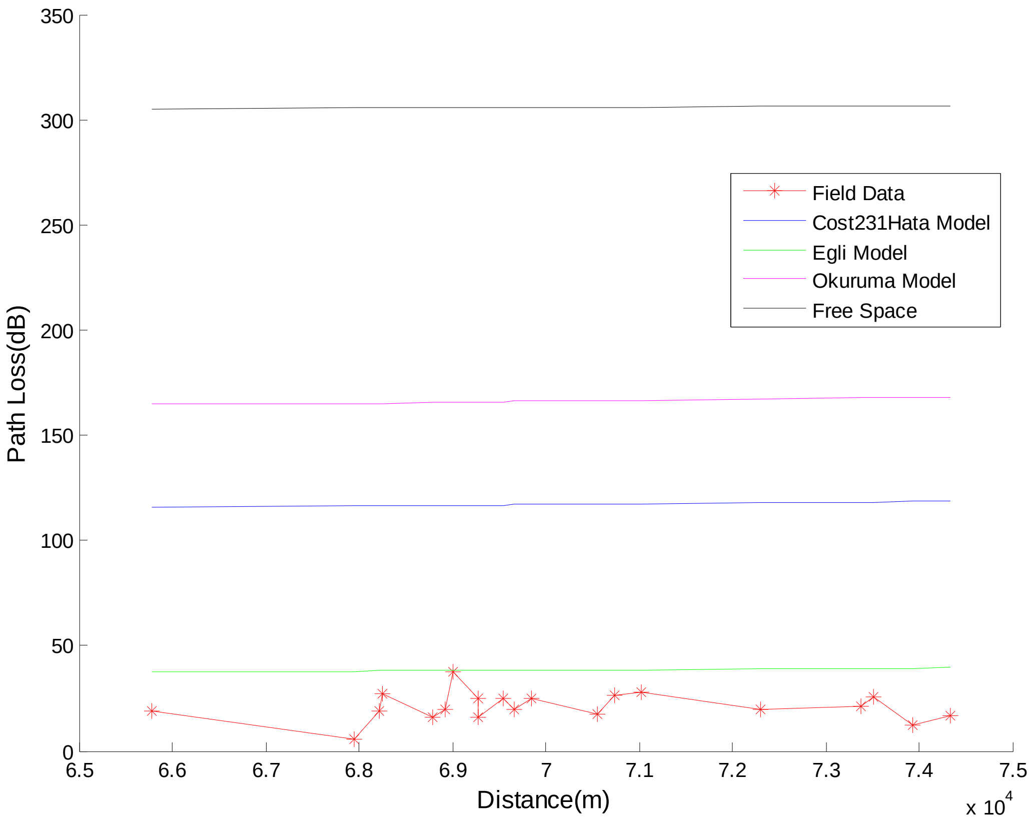

Fig. 8: Plot of calculated path loss and other models in Channel 45 against distance in Oron

Table 1: Descriptive statistics of path loss models in channel 12 at Oron

Statistics	Field Data	Cost231Hata	Egli	Okuruma	Free Space
Min	32.3	93.25	61.01	60.01	278.6
max	79.5	101.4	68.45	68.46	287
mean	53.27	99.4	62.15	62.14	285.4
median	49.43	98.1	63.51	63.71	284.3
mode	78.8	92.35	62.25	62.31	279.7
Std	13.620	1.034	1.048	1.098	0.588

Table 2: Descriptive statistics of path loss models in channel 45 at Oron

Statistics	Field Data	Cost231Hata	Egli	Okuruma	Free Space
Min	31.3	97.45	63.11	63.10	259.3
Max	79.7	101.4	68.85	68.75	284
Mean	53.51	99.7	64.12	63.15	278.7
Median	50.45	99.2	65.81	65.81	276.5
Mode	78.9	93.45	63.11	62.21	279.7
Std	13.72	1.174	1.188	1.148	0.599

IV. Summary And Conclusion

Summary

Signals in the creeks dropped to about 31dB$\mu V$from 59dBμV. This is attributed mostly to thick vegetation surrounding this environment which most have attenuated the signals. The electromagnetic wave encountered less obstruction except from tress along the path. The calculated path loss was compared with other standard models, and the results indicated that only Egli's model closely agreed with the measured path-loss in this rural setting. The field data path loss in this area agreed with Egli's model; while other models show wide variance.

Interestingly, there was a very good reception from Channel 45 in Oron with over 50% of the accessible region receiving over 32dBμV and empirical path-loss levels were best predicted by Egli's model.

The Nigerian Television Authority (NTA) television transmission at channel 12, has its near field signal strength levels coverage in some parts of of Odung Uko. Minority of the residents in this creek fall within the secondary coverage zone and others in the fringe zone. The calculated path loss, when compared with standard path loss models in areas where there was signal, closely agreed with Egli's model; in terms of path loss prediction. Channel 12 has very scanty signal in most part of this location. The study showed that Uya Oron and other surrounding fishing locations receives signal strength level up to 51dB from AKBC. AKBC transmits from a 30KW transmitter, with an average power of 10KW; and about 75% of residents of Uya Oron access this signal. Generally, Egli's model closely predicts the path loss at this frequency for rural settings. Egli's model also closely agreed with the calculated path loss in regions where this signal was received.

Conclusion

The study showed that Terrestrial broadcasting, using one spot transmission out-let is achievable in this location. This is predicated on the fact that the state's topography is naturally flat; thus, allowing smooth travelling of electromagnetic signals. The broadcasting stations, both at UHF and VHF channels do transmit successfully across many parts of Oron. Even in areas where the audio signal received was partially audible, the video signal was alright to the comfort of some subscribers. Oron, therefore, is better covered in terms of television signal. Building Repeater stations at different locations as signal booster will further enhance this performance.

References

[1]. United Nations, Global Development and Goal indicator, Global Digital divide, 2011.

[2]. Kenedy & Davis, Electronic Communication Systems, Fourth Edition page 236. 2011

[3]. D.E. Bassey, R.C. Okoro, B.E. Okon. Modelling of Radio Waves Transmission of Building located around Niger Delta Urban Microcell Environment using Ray Tracing technique. International Journal of Science and Research, 5(2), 10, 2016.

[4]. Oyetunji S.A "Determination of Propagation Path Loss and Contour Map for FUTA FM Radio Federal University of Technology, Akure Nigeria" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) Volume 6, Issue 3, PP 04-09. (2013)

[5]. Griffiths, D. J.. Introduction to Electrodynamics (3rd ed.). Prentice Hall. pp. 301–303. ISBN 0-13-805326-X. 1999.

[6]. Lev A. Ostrovsky & Alexander I. Potapov. Modulated waves: theory and application. Johns Hopkins University Press. ISBN 0-8018-7325-8. 2002.

[7]. D. E. Bassey., J.C Ogbulezie, R. Umunnah. Empirical Review of Basic Concepts of Teletraffic Postulates international Journal of Scientific and Engineering Research. 2016.

[8]. W.C. Lee. Mobile Communication Engineering,. New York. McGrawhul, 1982.

[9]. Nadir, Z., Elfadhil, N. and Touati, F..“Path loss Determination, using Okumura-Hata Model and Spline Interpolation for missing data for Oman’’– Proceedings of Journal of World Congress. 2009.

[10]. Mardeni, R., and Kwan, K. F. . Optimization of Hata propagation prediction model in suburban in Malaysia. Progress In Electromagnetics Research C,, Vol. 13, (2010)

[11]. Oke, M and Raji, R. "Exponential Models Of Signal Strength Of A Television Station In Nigeria",International Journal of Mathematics and Statistics Studies, Vol.2, No.1, pp.45-54. 2014.
[12]. D.E. Bassey, A.P. Orim, S. Ekwe, Investigation of the Effect of Mobile Number Portability on Network Switching capacity In Nigeria., International Journal of Engineering Research and General Science. Vol, 4,. Issue 5, September, 2016.
[13]. S. Koutis and R. Tafazolle, "modelling cell residence time of mobile terminals in cellular Radio systems" IEEE Elect letters, Vol. 38, Pp. 52-54 Jan. 2002.
[14]. Eun S. Cho, Go Whan Jin, "traffic modelling and performance Analysis in the CDMA system with soft Handoff". IEEE, Beijing, China, 2003.
[15]. Seybold, John S. . Introduction to RF propagation. John Wiley and Sons. pp. 144–146.
[16]. D. E. Bassey, J. C. Ogbulezie, R. Umunnah. Design. 2005. Names 1,2,3,4: threshold levels for Radio Waves in the Southern Region of Nigeria. International Journal of Innovative Research in Computer an communications 2016.
[17]. Okamura, Y. a kol.: Field Strength and its Variability in VHF and UHF Land-
[18]. M. Gudmundson, "correlation model for shadow fading in mobile Radio system", IEEE" Elect letters, Vol. 27, Nov. 1991.
[19]. Mardeni, R., and Kwan, K. F. Optimization of Hata propagation prediction model in suburban in Malaysia. Progress In Electromagnetics Research C,, Vol. 13. 2010.
[20]. Nadir, Z., Elfadhil, N. and Touati, F."Path loss Determination, using Okumura-Hata Model and Spline Interpolation for missing data for Oman''– Proceedings of Journal of World Congress. 2009.
[21]. Nwalozie, G. C., Ufoaroh, S.U., Ezeagwu, C.O., and Ejiofor, A.C. "Path Loss Prediction For Gsm Mobile Networks For Urban Region Of Aba, South-East Nigeria", International Journal Of Computer Science And Mobile Computing, vol. 3, issue. 2, pg.267 – 281. 2014.
[22]. Faruk, N., Ayeni, A., and Adediran, A.. "Characterization Of Propagation Path Loss At Vhf/Uhf Bands For Ilorin City, Nigeria." **Nigerian Journal of Technology,** Vol. 32. No. 2. pp. 253-265. 2013.
[23]. Ogbulezie, J., Onuu, M., Ushie, J and Usibe, B. "Propagation Models for GSM 900 and 1800 MHz for Port Harcourt and Enugu, Nigeria", Network and Communication Technologies; Vol. 2, No. 2. 2013.
[24]. (24). Oluwole, F. J. and Olajide, O. Y. "Radio Frequency Propagation Mechanisms and Empirical Models for Hilly Areas", International Journal of Electrical and Computer Engineering, Vol. 3, No. 3, June 2013, pp. 372-376. 2013.
[25]. Ajewole, M. O., Akinbolati, A., Adediji, A. T. and Ojo, J.S. "Precipitation Effect on the Coverage Areas of Terrestrial UHF Television Stations in Ondo State, Nigeria" International Journal of Engineering and Technology Volume 4 No. 9. 2014.

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Lavanya B K. " Protection of Underground Fiber to the Home Installations against Accidental Damage by Contractors – The case for Lusaka City." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 14.5 (2019): 26-38.