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Path Loss Mitigation for Digital Terrestrial Transmission in Onne, Rivers State, Nigeria

Ukatu Ifeanyi Emmanuel✉, **Numbara Barineka Meneyah**, **Biebuma JJ**

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Author Affiliation:
Department of Electrical Electronic Engineering, University of Port Harcourt Nigeria

✉**Corresponding author:**
Department of Electrical Electronic Engineering, University of Port Harcourt Nigeria
Email: ieukatu@gmail.com

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ABSTRACT

This work presents the possibilities of path loss mitigation for Digital Terrestrial Transmission / Television (DTT) / (DTTV) in Onne, Rivers State, Nigeria. A Multichoice DTT web-based signal Tracker, Google earth Global Positioning System (GSP) alongside a drive test was used to carry out the research work at Onne, Rivers state. The path loss changes with the varying distance between the receiver and the transmitter. The further the location of the receiver gets away from the transmitter, the higher the path loss attained, this shows the effect of interference of buildings, and other forms of obstruction. The simulation graph shows a decrease in signal received along the increasing distance axis, elaborating the inverse relationship between signal received and distance. Signal loss was observed to be mitigated by increasing the transmitter or receiver antenna height while increasing the distance between the transmitter and receiver. The results obtained were analyzed using the Egli model to obtain the path loss values and were simulated on MATLAB. This paper is of the opinion that this could be harnessed to mitigate signal losses in the present telecommunication Industries.

Keywords: Digital Terrestrial Transmission / Television (DTT) / (DTTV), digital terrestrial television base stations (DTTBS), customer premises equipment (CPE), a decoder / set-top box (STB), Effective Isotropic Radiated Power (EIRP)

1. INTRODUCTION

Path loss can simply be defined as the attenuation of signal (electromagnetic wave) travelling through space over a given distance between a transmitter and receiver. It is equally a comparison between the transmitted signal strength and the received signal strength in a telecommunication system.

In wireless communication, a transmitted signal from a base station (transmitter) to a mobile station (receiver) over a Path distance as shown in figure 1, will experience propagation loss (path loss) along the transmission path. This loss maybe due to path distance, free-space loss, refraction, reflection, diffraction, terrain features (urban, suburban or rural) [12, 16].

Taking cognizance of Multichoice Nigeria limited who started its digital terrestrial television (DTT or DTTV) broadcasting in 2011, having several digital terrestrial television base stations (DTTBS) in strategic positions for transmission of digital signals and also provides customer premises equipment (CPE) for its customers for reception of these digital signals. The CPE comprises mostly of a decoder / set-top box (STB), remote, coaxial cable and antenna.

Like every other DTT system, signal loss is experienced in GOTV DTT operations in Rivers State which may be due to terrain features, geographical location of the CPE, antenna height of the DTTBS and CPE etc. Generally, DTT involves broadcasting of audiovisual content from a transmitter (DTTBS) to a receiver (CPE).

Path loss is determined by different propagation models or Path Loss models. Thus, for prediction of path loss in various terrain, the radio engineer applies suitable path loss model. Path loss models are set of mathematical equations and algorithms used for signal propagation prediction such as link budget (received signal strength), interference analysis, cell size estimation and in general wireless network planning. Path Loss models are classified basically as deterministic and empirical models, although some models combine the attributes of both deterministic and empirical models which are therefore called the Semi-deterministic models or Semi-empirical models [2].

When signals are generated at the earth base station (transmitter), they are propagated to the receiver. These signals experience degradation mostly when the receiver is located outside the network coverage area of earth base station. Going forward, an analysis will be carried on path loss sensitivity to foster solution in mitigating this signal losses.

The aim of this research is to reduce propagation loss experienced by the receiver located outside the DTT coverage area in Onne, Rivers State and the objectives are;

a) Examine DTT base stations responsible for signal delivery to Onne, Rivers State by taking field measurements.
b) Network coverage mapping using a Multichoice DTT web-based signal Tracker, Google earth Global Positioning System (GSP) alongside a drive test.

Review of Related Path Loss Models

When it comes to telecommunication systems, path loss becomes a crucial issue due to its impact on degradation of propagated signal. Path loss is determined by different propagation models or Path Loss models. Authors in [15] described path loss models as a planning tool that is employed to achieve optimal level for the base station and also meeting the expected service level requirements. It is acceptable to say that path loss models are fundaments of wireless communication research [6]. In this section we will be looking at various path loss models adopted by various researchers in the quest for signal propagation prediction.

Free Space Path Loss Model

Free space loss is considered the attenuation of signal strength during a line-of-sight path with none obstacle inflicting reflection or diffraction. [11] found that free-space path loss is proportional to the square of the gap between the transmitter and receiver and additionally proportional to the square of the frequency of the radio radiation. Propagated signal in free area does not experience reflection or absorbtion [10].This model is considered the foremost model in all wireless communication system [14]. Free space path loss model is expressed mathematical as [9]:

*Equation **Error! No text of specified style in document.**.1* *Free Space PL*

$$PL_{fs} = 20Log_{10}(d) + 20Log_{10}(f) + 32.45 \quad (1)$$

Where:
f is the signal frequency in MHz
d is the distance from the transmitter in Km
PL_{fs} is path loss in dB

Electronic Communication Committee 33 (ECC 33) Path Loss Model

This model was formed in Tokyo based Okumura's model. It is applied to calculate propagation loss for crowded and clustered area with very tall buildings, i.e. urban environments especially large and medium cities. It is often referred to as the Hata Okumura Extended model [7]. It was developed by the electronic communication committee and designed for frequency range greater than 3GHz [1].

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ECC-33 path loss formula is given as [7];

*Equation **Error! No text of specified style in document.**.2* *ECC-33 PL*

$PL_{ECC-33} = A(fs) + BM(PL) + G_{tx} - G_{rx}$ ... (2)

$A(fs) = 92.4 + 20 \, Log_{10}(d) + 20 \, Log_{10}(f)$

$BM(PL) = 20.41 + 9.83 \, Log_{10}(d) + 7.894 \, Log_{10}(f) + 9.56[Log_{10}(f)]^2$

$G_{tx} = Log_{10}(h_{b/200})\{13.958 + 5.8[Log_{10}(d)]^2\}$

For Medium Cities

$G_{rx} = [42.57 + 13.7 \, Log_{10}(f)][log_{10}(hrx) - 0.585]$

For Large Cities

$G_{rx} = 0.759 * h_{rx} - 1.862$

PL_{ECC-33} is path loss in dB

A(fs)= free space attenuation (dB)

BM(PL)= Basic median Path Loss (dB)

G_{tx}= Transmitter antenna height gain factor

G_{rx}= Receiver antenna gain factor

COST 231 Hata Model

This is an extension of Hata Okumura model which is also referred to as Personal Communication System (PCS) Extension [4]. A remarkable effort was made by the European Co-operative for Scientific and Technical research (EURO-COST) to form the COST-231 model [5]. It is used for propagation loss modelling in the frequency range of 1500MHz to 2000MHz. But due to the presence of correction factor and its simplicity, it may be used to predict path loss for frequency range greater than 2000MHz [11]. This model is equally a good fit for base station (transmitter) antenna height from 1m to 10m, Path distance from 1km to 20km and mobile station (receiver) antenna height from 30m to 200m [3]. This model is designed for three different terrains namely; urban, suburban and rural.

The formula for this model is expressed as [11];

*Equation **Error! No text of specified style in document.**.3* *COST231 Hata PL*

$PL_{CH} = 46.3 + 33.9 \, Log_{10}(f) - 13.82 \, Log_{10}(h_{tx}) - C(hrx) + [44.9 - 6.55 \, Log_{10}(h_{tx})] \, Log_{10}(d) + Cm$.. (3)

For Urban

$C(h_{rx}) = 3.20[Log10(11.75 * hrx)]^2 - 4.79$ for $f > 400MHz$

For Suburban and Rural

$C(h_{rx}) = [1.11 \, Log10(f) - 0.7] * hrx - [1.5Log10(f) - 0.8]$

f is the frequency in MHz (1500MHz to 2000MHz)

d is the separation distance in Km (1km to 20km)

h_{tx} is hieght of the base station antenna in meters (30m to 200m)

h_{rx} is height of the receiver antenna in meters (1m to 10m)

$C(h_{rx})$ is the receiver antenna height correction factor

Cm is the correction factor (0dB for rural or suburban and 3dB for urban area)

Egli Path Loss Model

Egli path loss model was developed by Egli J.J and it is very suitable for irregular topography [8]. As an empirical model, it is designed to work on the frequency range of 40MHz to 900MHz, and path distance from 0.1km to 60km. This model was founded on the basis of UHF/VHF TV transmission measured data in large cities [13].

Egli Path loss model is given as [8];

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Equation ***Error! No text of specified style in document.****.4Egli PL*

$PL_{EGLI} = 20 \log10 (f) + 40 \text{ Log } (d) - 20 \text{ Log } (htx) + Ch_{rx}$ ……………………………………………(4)

Where;

$$Zhm = \begin{cases} 76.3 - 10 \text{ Log}(hrx) & \text{for } hm \leq 10m \\ 85.9 - 20 \text{ Log}(hrx) & \text{for } hm \geq 10m \end{cases}$$

PL_{EGLI} is path loss in dB

f is the frequency in MHz (40MHz to 900MHz)

d is the separation distance in Km (0.1km to 60km)

h_{tx} is hieght of the base station antenna in meters

h_{rx} is height of the mobile station antenna in meters

Chrx is receiving antenna correction factor

In this study Egli model is used for the evaluation of path loss in Onne, Rivers state Nigeria. This model has proven to be reliable and efficient in the analysis of mitigating signal losses encountered between a transmitter and receiver as shown in the results produced.

2. METHODS AND MATERIALS

To analyze the mitigation of path loss in the Onne area of Rivers State, Egli model equation was employed for modeling the path loss using data from Multichoice Nigeria. This model was derived by Egli J.J and it depends on the following factors; frequency, base station antenna height, distance and receiver station antenna height. Also, the Effective Isotropic Radiated Power (EIRP) and receiver sensitivity was calculated to determine the power radiated from the base station antenna and the received signal strength respectively. The data collected from multichoice for this analysis is stated below as;

I. Antenna type
II. Antenna Gain
III. Coverage distance
IV. Operating frequency
V. Antenna height
VI. Cable loss
VII. Effective Isotropic Radiated Power
VIII. Latitude
IX. longitude

3. RESULTS AND DISCUSSION

Path Loss Analysis Simulation Results

A comparison between simulation results, by varying the distance, frequency, Base station height, Mobile station height one at a time from ±10% to ± 50% to determine the most sensitive parameter to influence the reduction of path loss.

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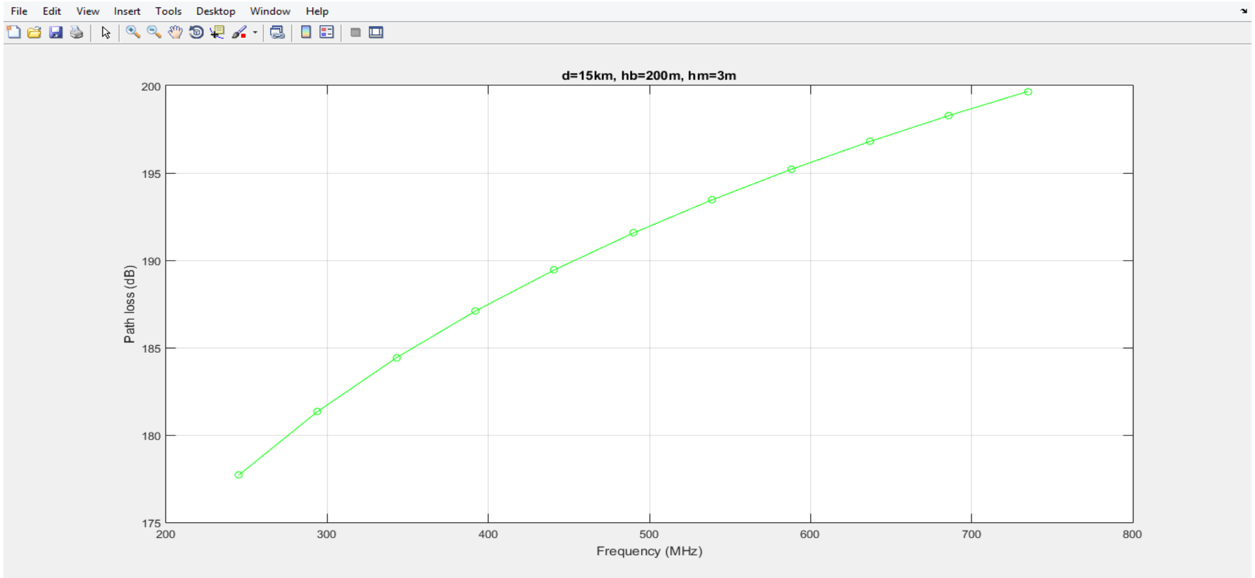

Figure 1 Path loss sensitivity analysis simulation result for varying frequency

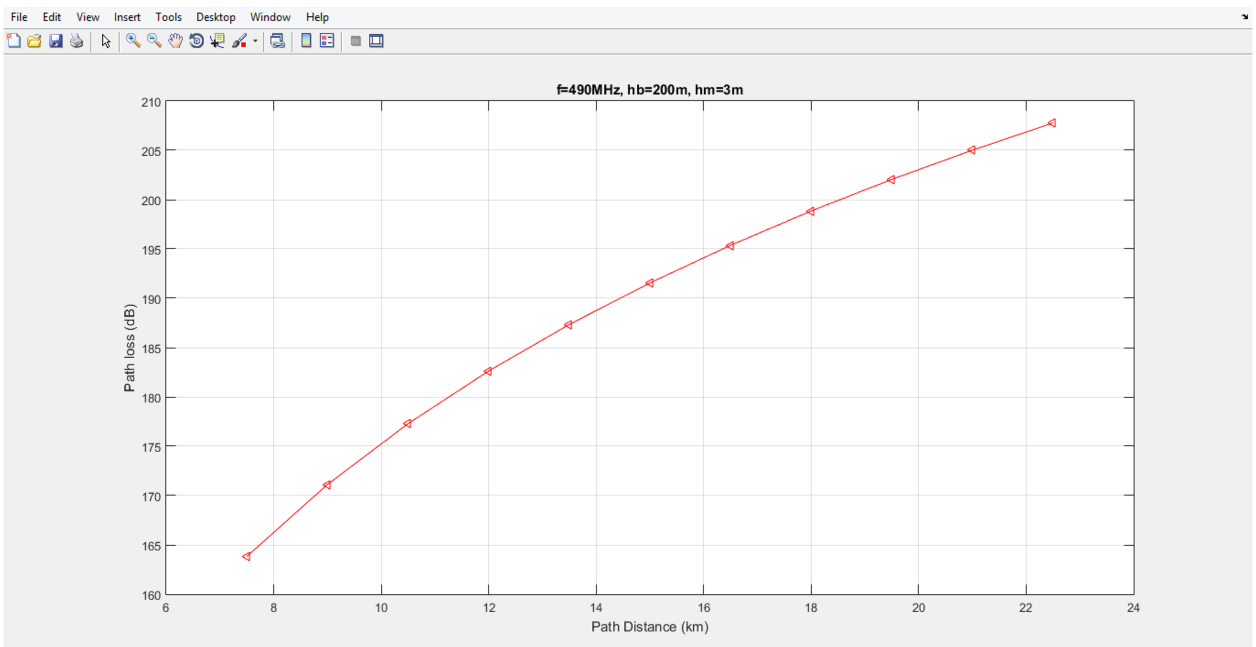

Figure 2 Path loss sensitivity analysis simulation result for Varying Path Distance

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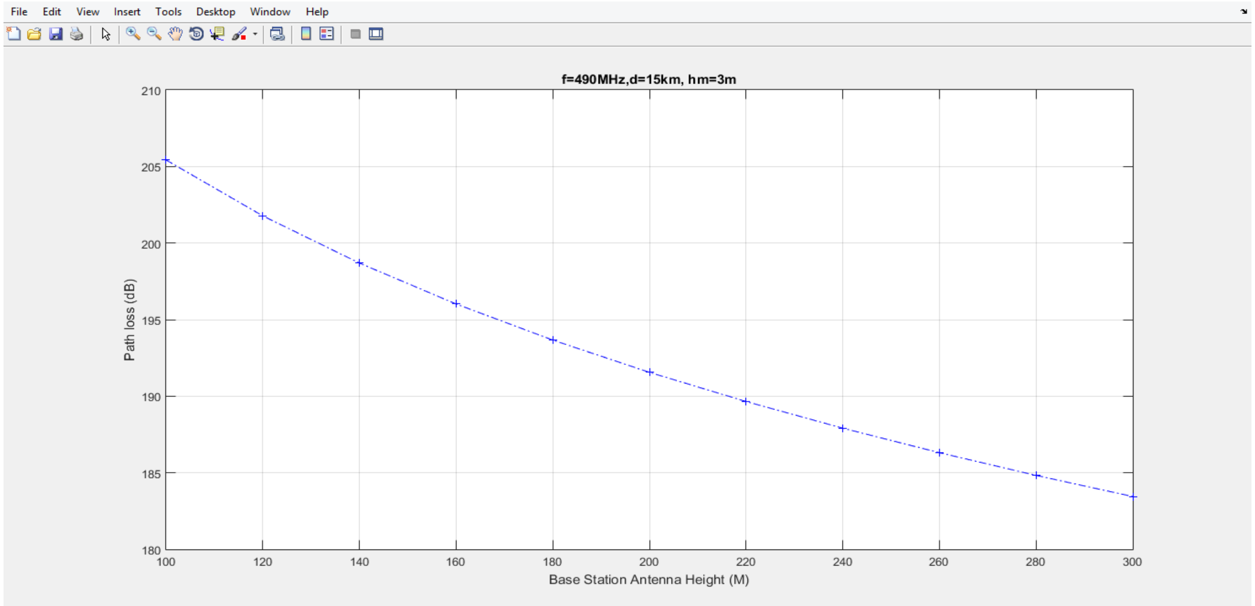

Figure 3 Path loss sensitivity analysis simulation result for Varying Base Station Antenna Height

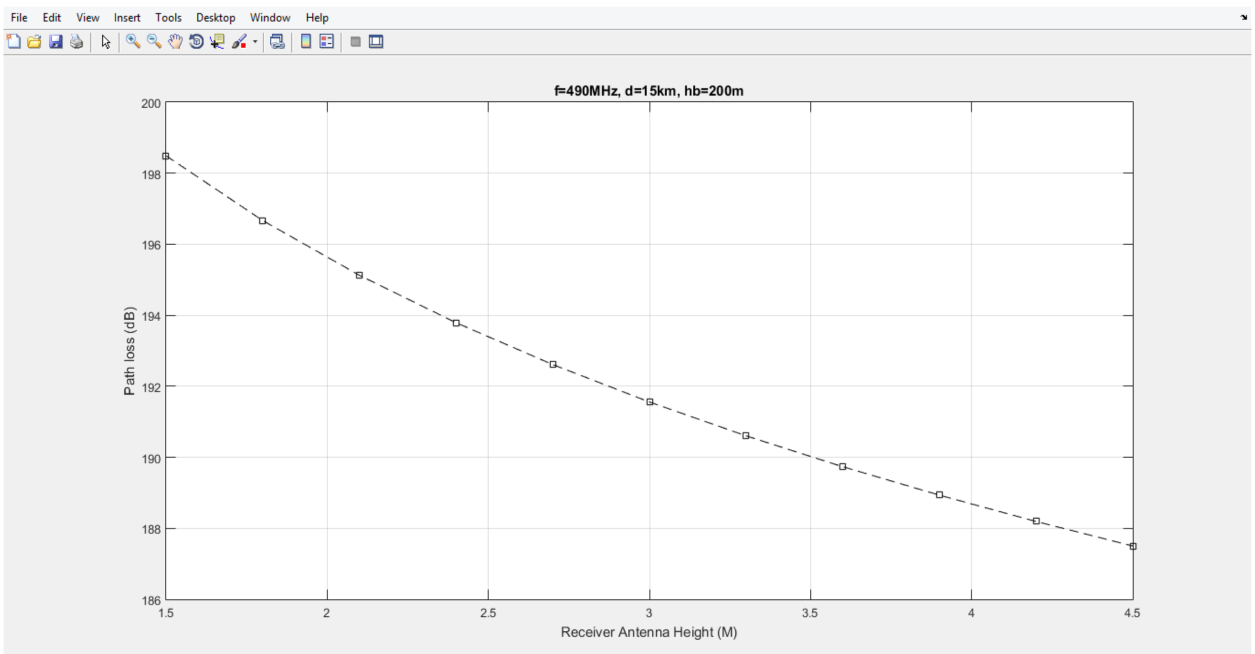

Figure 4 Path loss sensitivity analysis simulation result for Varying Receiver Antenna Height

Table 1 Influence of frequency in path loss mitigation

FREQ (MHz)	DIST (km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
245.00	15	200	3	177.6947	-93.4347
294.00	15	200	3	181.3411	-97.0811
343.00	15	200	3	184.4241	-100.164
392.00	15	200	3	187.0948	-102.835
441.00	15	200	3	189.4504	-105.19
490.00	15	200	3	191.5576	-107.298

539.00	15	200	3	193.4638	-109.204
588.00	15	200	3	195.2041	-110.944
637.00	15	200	3	196.8049	-112.545
686.00	15	200	3	198.2871	-114.027
735.00	15	200	3	199.6669	-115.407

Table 2 Influence of Distance in path loss mitigation

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	7.50	200	3	163.8318	-79.5718
490.00	9.00	200	3	171.1246	-86.8646
490.00	10.50	200	3	177.2906	-93.0306
490.00	12.00	200	3	182.6319	-98.3719
490.00	13.50	200	3	187.3432	-103.083
490.00	15.00	200	3	191.5576	-107.298
490.00	16.50	200	3	195.3701	-111.11
490.00	18.00	200	3	198.8505	-114.591
490.00	19.50	200	3	202.0522	-117.792
490.00	21.00	200	3	205.0165	-120.757
490.00	22.50	200	3	207.7762	-123.516

Table 3 Influence of Base Station Antenna Height in path loss mitigation

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	15	100	3	205.4206	-121.161
490.00	15	120	3	201.7742	-117.514
490.00	15	140	3	198.6911	-114.431
490.00	15	160	3	196.0205	-111.761
490.00	15	180	3	193.6649	-109.405
490.00	15	200	3	191.5576	-107.298
490.00	15	220	3	189.6514	-105.391
490.00	15	240	3	187.9112	-103.651
490.00	15	260	3	186.3104	-102.05
490.00	15	280	3	184.8282	-100.568
490.00	15	300	3	183.4483	-99.1883

Table 4 Influence of the Receiver Antenna Height in path loss mitigation

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm
490.00	15.00	200	1.50	198.4891	-114.229
490.00	15.00	200	1.80	196.6659	-112.41
490.00	15.00	200	2.10	195.1244	-110.86
490.00	15.00	200	2.40	193.7891	-109.53
490.00	15.00	200	2.70	192.6113	-108.35

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490.00	15.00	200	3.00	191.5576	-107.30
490.00	15.00	200	3.30	190.6045	-106.34
490.00	15.00	200	3.60	189.7344	-105.47
490.00	15.00	200	3.90	188.934	-104.67
490.00	15.00	200	4.20	188.1929	-103.93
490.00	15.00	200	4.50	187.503	-103.24

Path Loss Sensitivity Analysis Simulation Results for Poor Gotv Network Reception Point at 16.88km

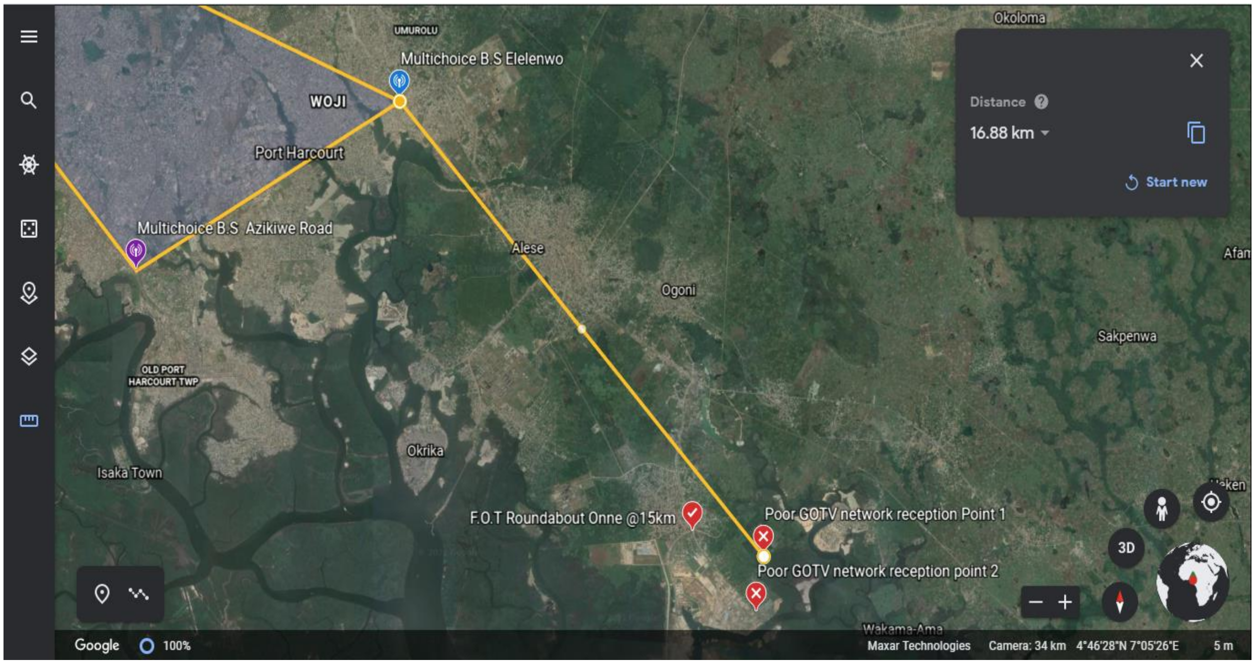

Figure 5 Google earth capturing the distance between MULTICHOICE Base Station at Elelenwo and the Poor GOTV network reception point at 16.88km in Onne, Rivers State.

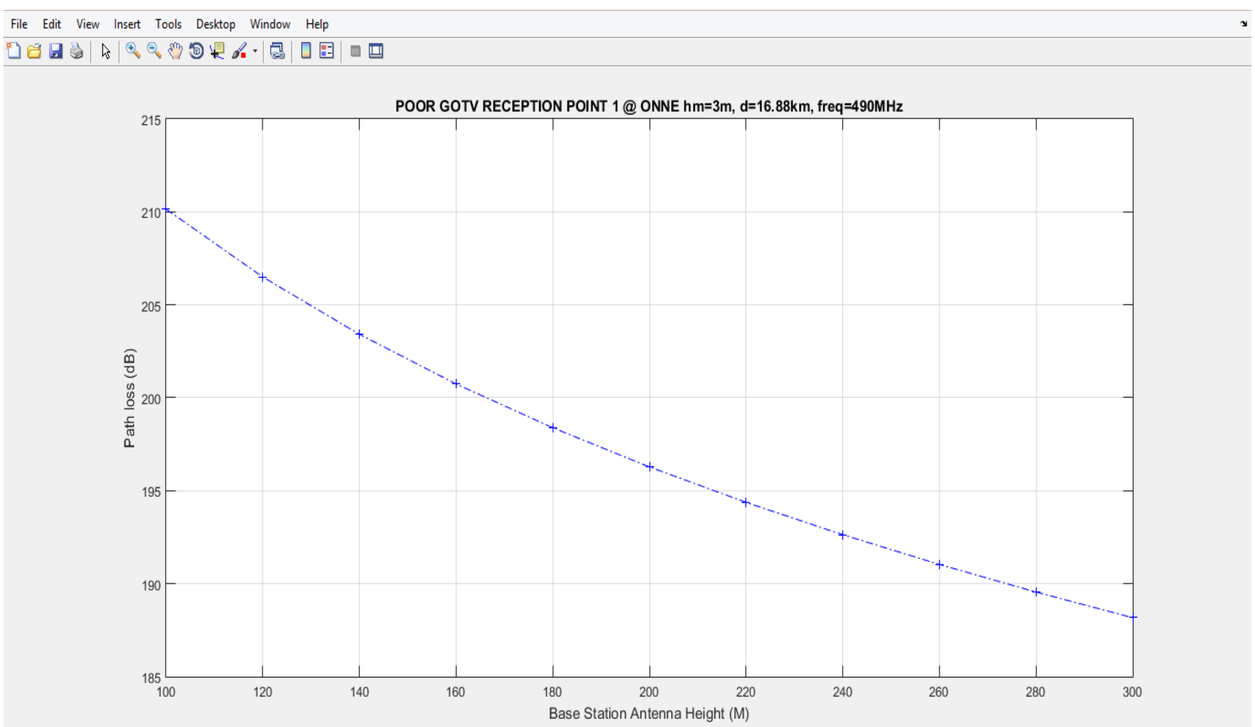

Figure 6 Simulation result showing influence of Base station Antenna height at 16.88km in Onne for 3m M.S antenna

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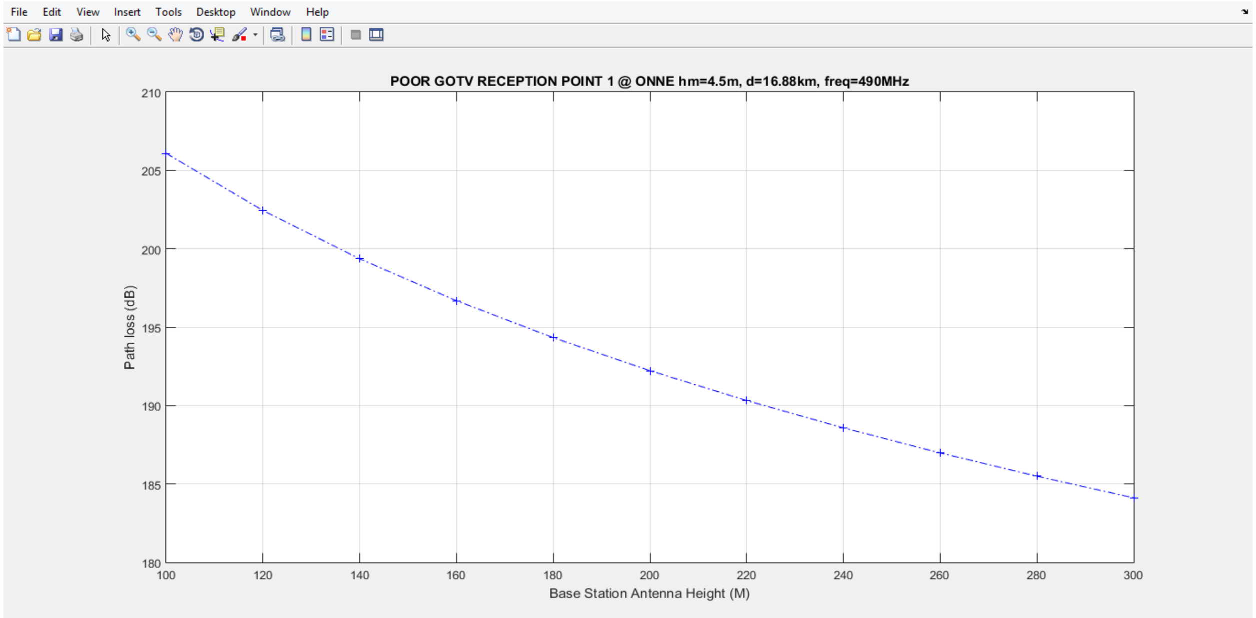

Figure 7 Simulation result showing influence of Base station Antenna height at 16.88km in Onne for 4.5m M.S antenna height

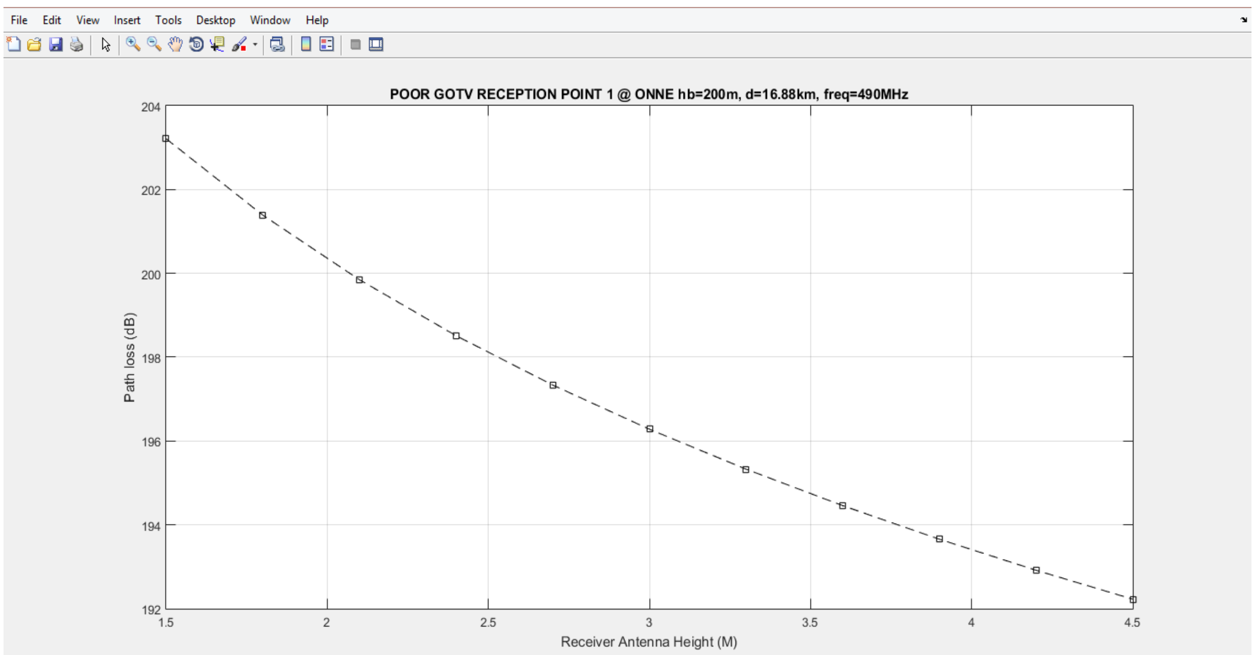

Figure 8 Simulation result showing influence of Receiver Antenna height at 16.88km in Onne for 200m B.S antenna height

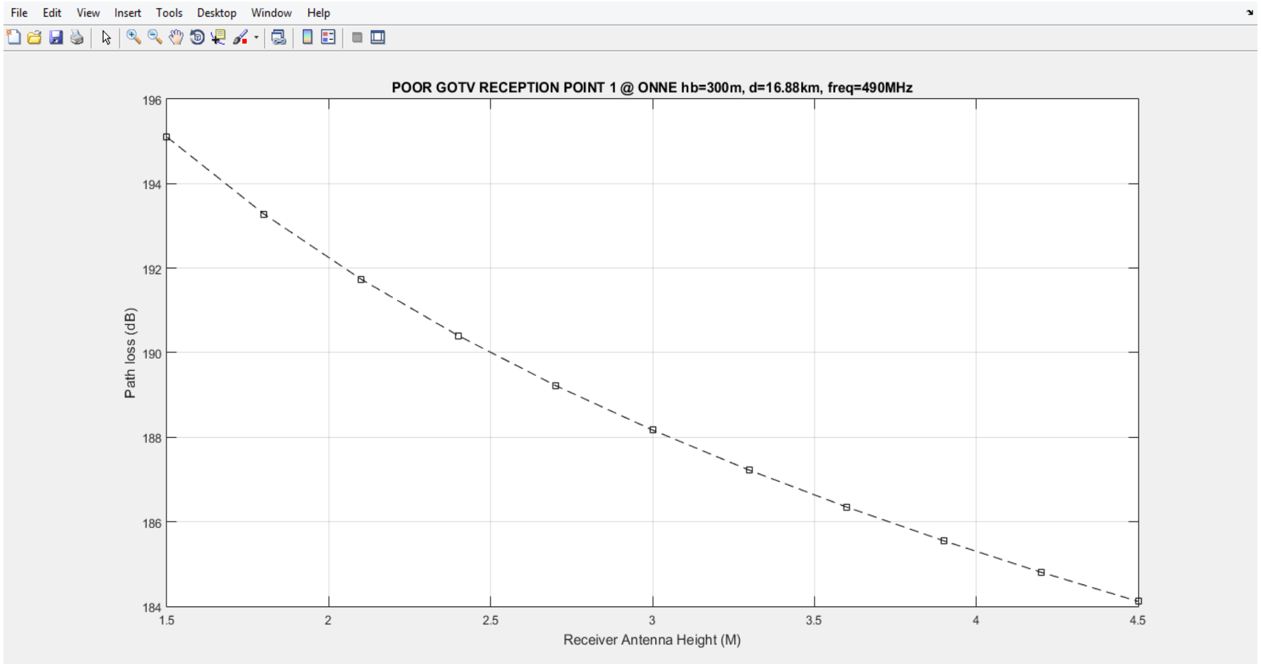

Figure 9 Simulation result showing influence of Receiver Antenna height at 16.88km in Onne for 300m B.S antenna height

Table 5 Influence of B.S antenna height at 16.88km for 3m M.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	16.88	100	3	210.1438	-125.8838
490.00	16.88	120	3	206.4973	-122.2373
490.00	16.88	140	3	203.4143	-119.1543
490.00	16.88	160	3	200.7437	-116.4837
490.00	16.88	180	3	198.388	-114.128
490.00	16.88	200	3	196.2808	-112.0208
490.00	16.88	220	3	194.3746	-110.1146
490.00	16.88	240	3	192.6344	-108.3744
490.00	16.88	260	3	191.0335	-106.7735
490.00	16.88	280	3	189.5514	-105.2914
490.00	16.88	300	3	188.1715	-103.9115

Table 6 Influence of B.S antenna height at 16.88km for 4.5m M.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	16.88	100	4.50	206.0891	-121.8291
490.00	16.88	120	4.50	202.4427	-118.1827
490.00	16.88	140	4.50	199.3597	-115.0997

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490.00	16.88	160	4.50	196.6890	-112.4290
490.00	16.88	180	4.50	194.3334	-110.0734
490.00	16.88	200	4.50	192.2262	-107.9662
490.00	16.88	220	4.50	190.3200	-106.0600
490.00	16.88	240	4.50	188.5797	-104.3197
490.00	16.88	260	4.50	186.9789	-102.7189
490.00	16.88	280	4.50	185.4967	-101.2367
490.00	16.88	300	4.50	184.1169	-99.8569

Table 7 Influence of Receiver Station Antenna height at 16.88km for 200m B.S Antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	16.88	200	1.50	203.2123	-118.9523
490.00	16.88	200	1.80	201.3891	-117.1291
490.00	16.88	200	2.10	199.8476	-115.5876
490.00	16.88	200	2.40	198.5123	-114.2523
490.00	16.88	200	2.70	197.3344	-113.0744
490.00	16.88	200	3.00	196.2808	-112.0208
490.00	16.88	200	3.30	195.3277	-111.0677
490.00	16.88	200	3.60	194.4576	-110.1976
490.00	16.88	200	3.90	193.6572	-109.3972
490.00	16.88	200	4.20	192.9161	-108.6561
490.00	16.88	200	4.50	192.2262	-107.9662

Table 8 Influence of Receiver Station Antenna height at 16.88km for 300m B.S Antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	16.88	300	1.50	195.103	-110.843
490.00	16.88	300	1.80	193.2798	-109.0198
490.00	16.88	300	2.10	191.7383	-107.4783
490.00	16.88	300	2.40	190.403	-106.143
490.00	16.88	300	2.70	189.2251	-104.9651
490.00	16.88	300	3.00	188.1715	-103.9115
490.00	16.88	300	3.30	187.2184	-102.9584
490.00	16.88	300	3.60	186.3483	-102.0883
490.00	16.88	300	3.90	185.5479	-101.2879
490.00	16.88	300	4.20	184.8068	-100.5468
490.00	16.88	300	4.50	184.1169	-99.8569

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Path Loss Sensitivity Analysis Simulation Results for Poor Gotv Network Reception Point 17.96km

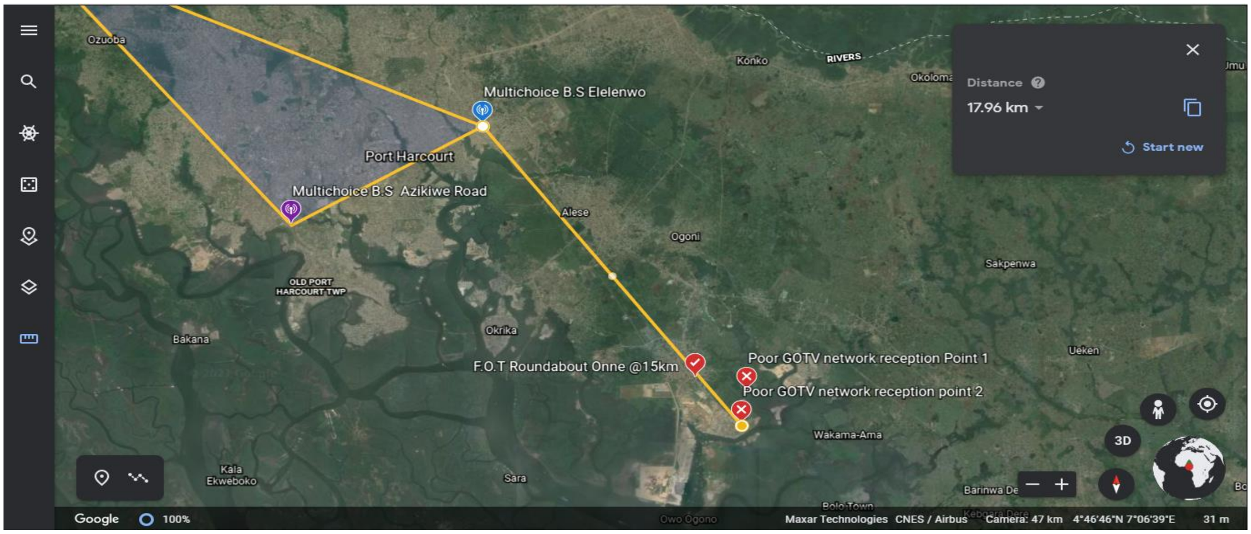

Figure 10 Google earth capturing the distance between MULTICHOICE Base Station at Elelenwo and the Poor GOTV network reception point at 17.96km in Onne.

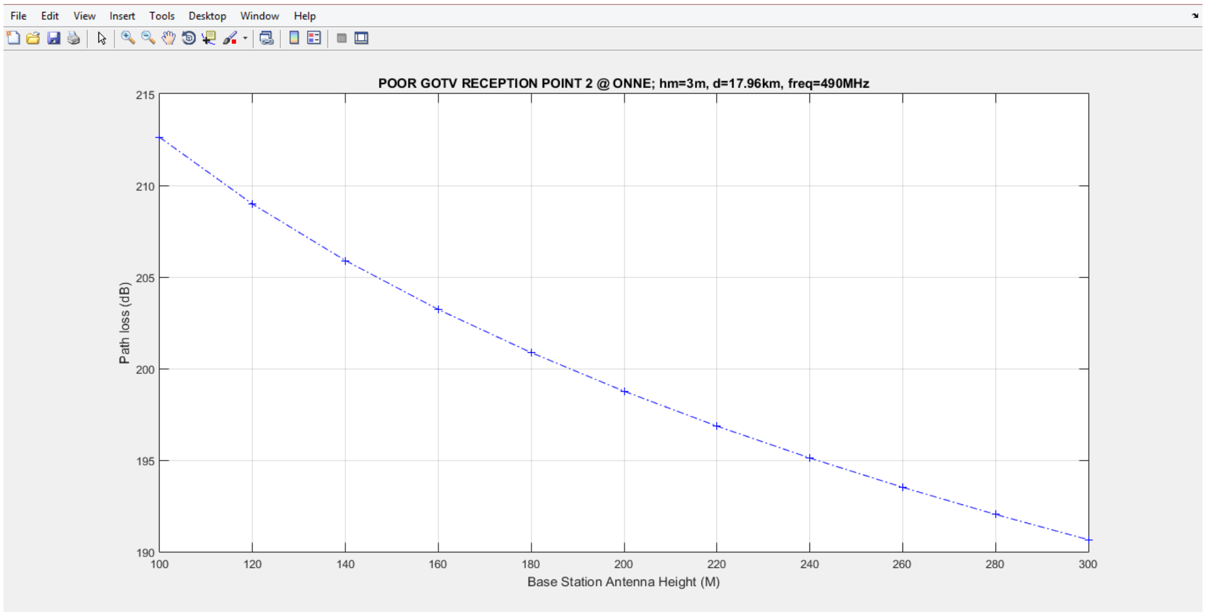

Figure 11 Simulation result showing influence of Base station Antenna height at 17.96km in Onne for 3m M.S antenna height

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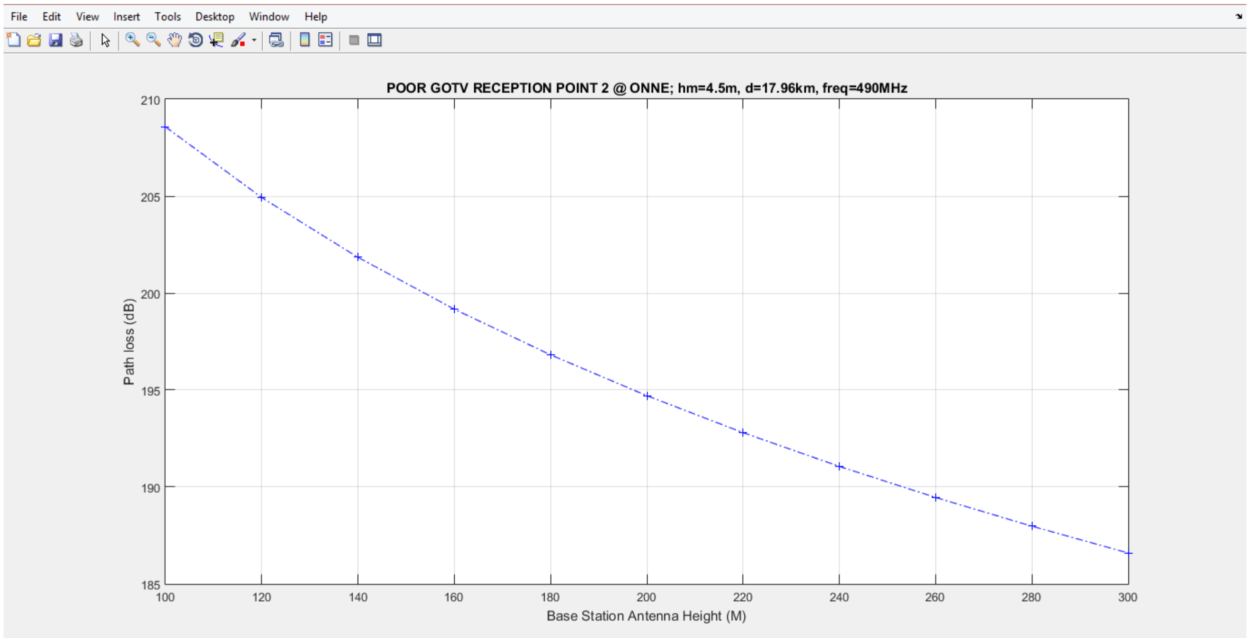

Figure 12 Simulation result showing influence of Base station Antenna height at 17.96km in Onne for 4.5m M.S antenna height

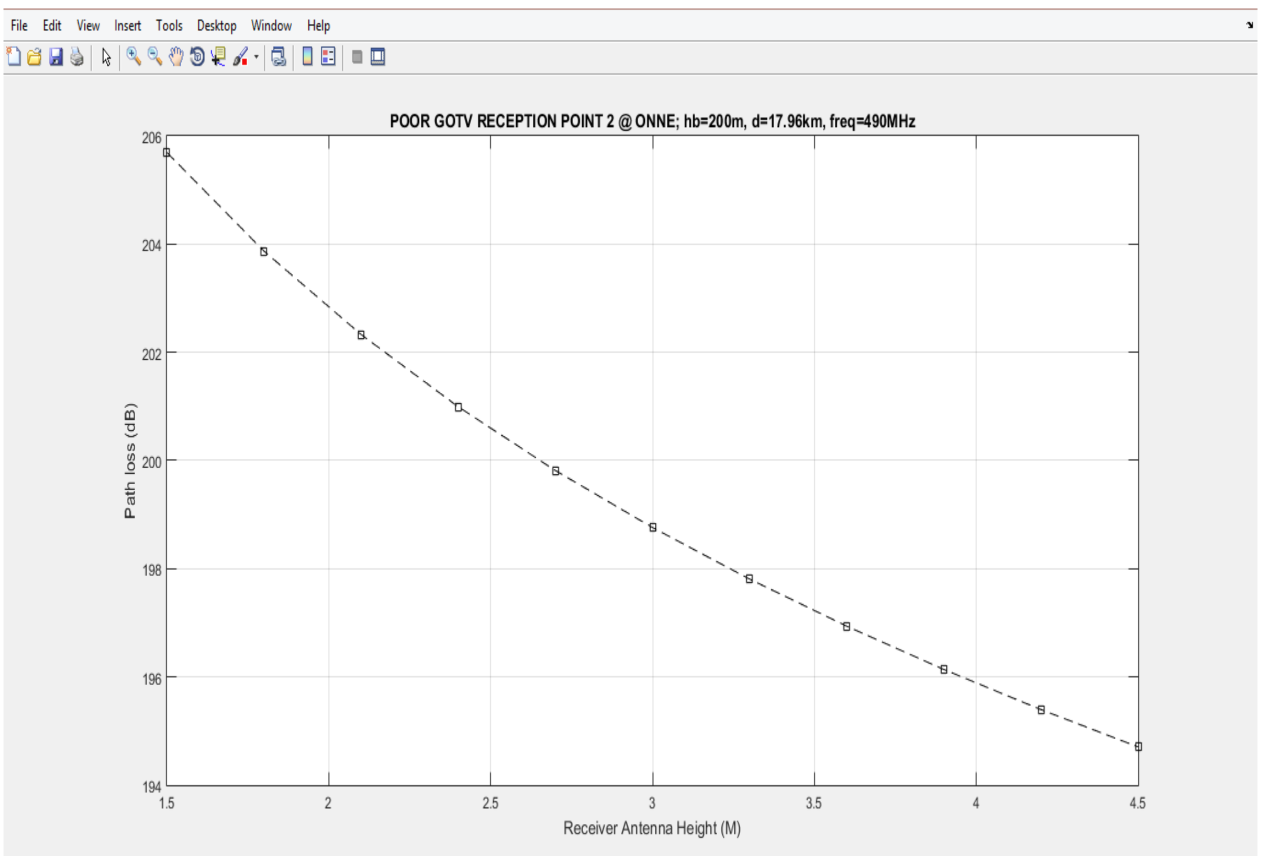

Figure 13 Simulation result showing influence of Receiver Antenna height at 17.96km in Onne for 200m B.S antenna height

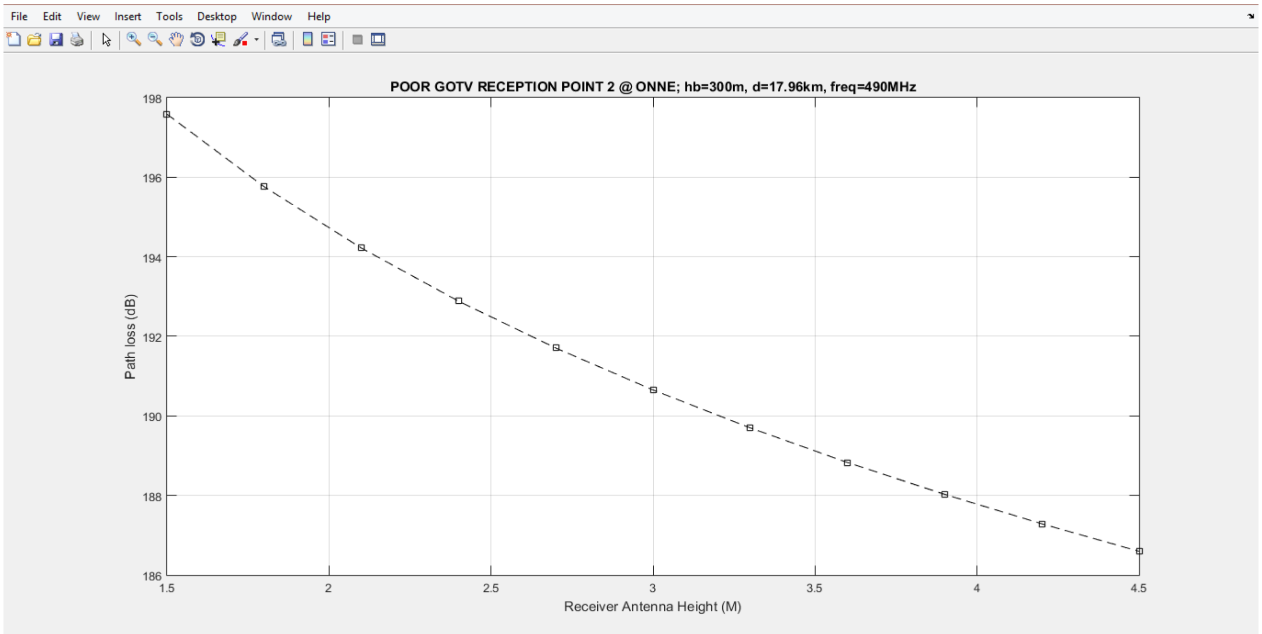

Figure 14 Simulation result showing influence of Receiver Antenna height at 17.96km in Onne for 300m B.S antenna height

Table 9 Influence of B.S Antenna height at 17.96km for 3m M.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	17.96	100	3	212.6245	-128.3645
490.00	17.96	120	3	208.978	-124.7180
490.00	17.96	140	3	205.895	-121.6350
490.00	17.96	160	3	203.2244	-118.9644
490.00	17.96	180	3	200.8687	-116.6087
490.00	17.96	200	3	198.7615	-114.5015
490.00	17.96	220	3	196.8553	-112.5953
490.00	17.96	240	3	195.1151	-110.8551
490.00	17.96	260	3	193.5142	-109.2542
490.00	17.96	280	3	192.0321	-107.7721
490.00	17.96	300	3	190.6522	-106.3922

Table 10 Influence of B.S Antenna height at 17.96km for 4.5m M.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	17.96	100	4.5	208.5698	-124.3098
490.00	17.96	120	4.5	204.9234	-120.6634

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490.00	17.96	140	4.5	201.8404	-117.5804
490.00	17.96	160	4.5	199.1697	-114.9097
490.00	17.96	180	4.5	196.8141	-112.5541
490.00	17.96	200	4.5	194.7069	-110.4469
490.00	17.96	220	4.5	192.8007	-108.5407
490.00	17.96	240	4.5	191.0604	-106.8004
490.00	17.96	260	4.5	189.4596	-105.1996
490.00	17.96	280	4.5	187.9774	-103.7174
490.00	17.96	300	4.5	186.5976	-102.3376

Table 11 Influence of Receiver Antenna height at 17.96km for 200m B.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	17.96	200	1.5	205.6930	-121.4330
490.00	17.96	200	1.8	203.8698	-119.6098
490.00	17.96	200	2.1	202.3283	-118.0683
490.00	17.96	200	2.4	200.9930	-116.7330
490.00	17.96	200	2.7	199.8151	-115.5551
490.00	17.96	200	3.0	198.7615	-114.5015
490.00	17.96	200	3.3	197.8084	-113.5484
490.00	17.96	200	3.6	196.9383	-112.6783
490.00	17.96	200	3.9	196.1379	-111.8779
490.00	17.96	200	4.2	195.3968	-111.1368
490.00	17.96	200	4.5	194.7069	-110.4469

Table 12 Influence of Receiver Antenna height at 17.96km for 300m B.S antenna height

FREQ (MHz)	DIST (Km)	B.S HEIGHT (m)	M.S HEIGHT (m)	PATH LOSS (dB)	RECEIVER SENSITIVITY (dBm)
490.00	17.96	300	1.50	197.5837	-113.3237
490.00	17.96	300	1.80	195.7605	-111.5005
490.00	17.96	300	2.10	194.219	-109.9590
490.00	17.96	300	2.40	192.8837	-108.6237
490.00	17.96	300	2.70	191.7058	-107.4458
490.00	17.96	300	3.00	190.6522	-106.3922
490.00	17.96	300	3.30	189.6991	-105.4391
490.00	17.96	300	3.60	188.829	-104.5690
490.00	17.96	300	3.90	188.0286	-103.7686
490.00	17.96	300	4.20	187.2875	-103.0275
490.00	17.96	300	4.50	186.5976	-102.3376

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In Path Loss Analysis Simulation Results **,** the following was established; that the most effective and sensitive parameter for mitigating path loss is the base station and receiver station antenna height. Analyzing

Path Loss Sensitivity Analysis Simulation Results for Poor Gotv Network Reception Point at **16.88km**, the following was also demonstrated that the signal strength at 16.88km in Onne (the reception end) can be increased by reducing the propagation loss. This can be achieved by increasing the base station antenna height by 50% and further increasing the receiver antenna height from 3 to 4.5m. Furthermore, by observing the Path Loss Sensitivity Analysis Simulation Results for Poor Gotv Network Reception Point 17.96km the following claims were deduced; the signal strength at 17.96km in Onne (the reception end) can be increased by reducing the propagation loss. This can be achieved by increasing the base station antenna height by 50% and further increasing the receiver antenna height from 3 to 4.5m.

Taking a closer look at the effect of adjusting the base station antenna height by 50%, we can see a lower value of path loss at 16.88km (188.1715dB) and 17.96km (190.6522dB) when compared to the reference path loss value (191.5576dB) at 15km distance and 200m B.S antenna height assuming the receiver is kept constant at 3m. This shows that if the transmitter height is increased to 300m, there will be good signal reception at 16.88km and 17.96km. Also, if we consider adjusting the receiver station antenna height by 50%, we will notice a higher path loss value at 16.88km and 17.96km when compared to the reference path loss value at 15km and 200m B.S antenna height.

Putting all analysis into consideration, it can be denoted that the decrease in the base station frequency and the coverage distance results to decrease in signal loss, while the decrease in the base station and receiver station antenna height causes rise in signal loss along the transmission path in Onne, Rivers State. Furthermore, it is also shown that increase in the base station frequency and the coverage distance demonstrated rise in signal loss along the transmission path, while the increase in the base station and receiver station antenna height demonstrated a decline in signal loss along the transmission path in Onne, Rivers State.

Considering the fact that MULTICHOICE DTT system (GOTV) is locked on 490 MHz and her clienteles are spread over different locations, we can say that decrease in the frequency and separation distance will not be viable in mitigating signal loss in Onne, River State. Therefore, the two most important variables that must be considered when mitigating signal losses between MULTICHOICE base station and the receiver (her clienteles) are;

a) The Base station antenna height
b) The Receiver antenna height

In summary, the base station antenna height gave a lower value of path loss at 50% increase (300m) when compared to that of the receiver antenna height at 50% increase (4.5m).

4. CONCLUSIONS

In this paper, simulation results were presented for possible mitigation of path loss for digital terrestrial transmission in Onne, Rivers state using the Egli propagation model and the receiver sensitivity model applied at two different locations experiencing poor network coverage. The simulation results were compared and analyzed based on the influence of distance, frequency, base station antenna height and receiver antenna height. Based on our simulation results, to reduce the signal losses adequately along a given path distance, the base station antenna height should be increased followed by that of the receiver station antenna height when necessary. Therefore, to reduce signal losses in Onne, Rivers state, the base station antenna height should be increased by 50% of its current height (300m). Subsequently followed by the increase of the receiver antenna height between 3m and 4.5m.

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Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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