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Studies on Electric field strength distribution of uhf television signal propagation in Ekiti State. Nigeria.

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Abstract: *Researchers have continued to carry-out work to determine the actual coverage area of some broadcasting stations and the level of signal strength variation with distance from the transmitter, which is useful for radio transmission designs.In Nigeria, few works exist on the frequency modulation (FM) signals propagation, and little work has been done on the television signals. The work determines the actual coverage of the Broadcasting Service of Ekiti State Television, in Ekiti – State, southwest Nigeria, with the expected coverage area being the entire land mass of the State. The method used is such that requires the physical presence of the investigator in all the towns and villages within the State with the necessary instrument to carry out the electric field strength measurements in all the locations.The variation of signal level with distance (i.e. Propagation curve) was analysed, to reveal areas of optimum coverage and areas that are poorly serviced.The coverage of the newly installed transmitter in the station was compared to the old transmitter (which had been in use for over 30 years), and a comprehensive statistical data base provided for the UHF television broadcasting Station. The results shows the field strength distribution of the broadcasting station in major towns and villages,its elevation pattern and the various grades of coverage enjoyed by its citizens in such locations. Recommendations were made on getting areas outside optimum coverage well serviced.*
Keywords*: Coverage area, Reception, Signal strength variations, Transmission,Ultra high frequency.*

I. Introduction

In view of the importance of television broadcasting to the socio-economic development of the populace and the competition in the business, viewers interest has grown from just watching any thing on screen to qualitative, clean and sharp signals on television screen. All stations have their expected coverage area and their signals should not constitute interference to others [1]. The Broadcating Service of Ekiti State (BSES), is the electronic media outfit of the government of Ekiti State, Southwest, Nigeria. It is a combination of both the radio and television services. The television service is on channel 41 on the ultra high frequency band while, the radio services operates on 91.5MHz and 532 kHz for the FM and AM radios respectively. The BSES Ch 41 UHF (631.25MHz carrier frequency) is located at broadcasting house, Ilokun quarters, Ado Ekiti , the State capital, with a staff strength of 289. The station provides services in the areas of education, information, entertainment and social mobilization. The televisions works 15 hours daily [2]. The coverage area for broadcasting channels is the radial distance away from the transmitter in which the transmited signal, voice and picture for television and voice for radio can be received by the viewer or listeners with the aid of a receiving antenna.These are classified into three, namely: i). Primary Coverage Areadefined as a region about the transmitting station in which the signal strength is strong enough to override ordinary interference at all times, with ahigh level of dependancy and clarity, with or without the use of an active antenna. ii). Secondary Coverage Area being a region about the transmitting station, with the signal strength often sufficient to be useful but not strong enough to overried ordinary interference at all times, and requires an active receiving antennafor a clear reception. iii). Fringe/Tertiary Coverage Area is a region about the transmitting station, where the signal strength is weak and not dependable, with services neither guaranteed nor protected against interference, and where the use of an active receiving antenna may not bring about a clear reception at all times[3,4].

Free space or the earth's atmosphere is often used as a transmission medium for wave propagation [5,6]. To propagate transverse electromagnetic waves through the earth's atmosphere, it is necessary that the energy be radiated from the source (Base station) and then the energy captured at the receiving end which are functions of antennas, with radiating energy antenna called the transmitter and the capturing energy antenna called the receiver [6,7].Space wave propagation includes radiated energy that travels in the lower few miles of the earth atmosphere, and include both direct and ground – reflected waves. Direct waves travel essentially in a straight line between the transmit and receive antennas commonly called line - of - sight (LOS) transmission, while ground reflected waves are those waves that are reflected by the earths surface as they propagate between the transmit and receiver antennas. Field intensity at the receive antenna depends on the distance between the two antenna (attenuation and absorption) and whether the direct and ground reflected waves are in phase (interference) [7,8]. The curvature of the earth presents a horizon to space wave propagation called the radio

horizon, and due to atmospheric refraction, the radio horizon extends beyond the optical horizon for the common standard atmosphere[6,8]. The radio horizon is approximately four – thirds that of the optical horizon. Refraction is caused by the troposphere due to changes in its density, temprature, water vapour content, and relative conductivity, and radio horizon can be lengthened simply by elevating the transmit or receive antennas above the earth's surface with towers or by placing them on top of mountains or high buildings [8,9,10].The strength of the electric field E (in volts/meter) at a distance r from a point source is given by$E = 30P_t / r$; where P_t is the original transmitted power in watts, and one of the maxwell's equations [6,7,10]. Effective isotropic radiated power (EIRP) is defined as an equivalent transmit power and is expressed mathematically as

$$EIRP = P_r A_t \text{watts} \quad (1)$$

WhereP_r= total radiated power, A_t = transmit antenna directive gain or

$$EIRP\ (dBm) = 10 \log \frac{P_r}{0.001} + 10 \log A_t \quad (2)$$

EIRP or simply ERP (effective radiated power) is the equivalent power that an isotropic antenna would have to radiate to achieve the same power density in the chosen direction at a given point as another antenna. The power density ata given point, when expanded to include the transmit antenna gain is

$$\Im = \frac{P_r A_t}{4\pi R^2} \quad (3)$$

Antennas are reciprocal devices; an antenna has the same power gain and directivity when it is used to receive electromagnetic waves as it has for transmitting electromagnetic waves. Consequently, the power received or captured by an antenna is the product of the power density in the space immediately surrounding the antenna and the antenna directive gain. Therefore,

captured power = $c = \Im A_r = \frac{P_r A_t A_r}{4\pi R^2}$ (4)

Where A_r is the receiver antenna power gain. The captured power is not all useful; some of it is dissipated in the receive antenna [7,10]. The actual useful received power is the product of the received power density, the receive antenna's direct gain, and the receive antenna's efficiency or the receive power density times the receive antenna's power gain. If an antenna is lossless, it radiates 100%of the input power and the power gain is equal to the directive gain [8,11,13]. An antenna does not actually amplify the input power, but concentrates its radiated power in a particular direction. If gain is realized in one direction, a corresponding reduction in power density (a loss) must be realized in another direction [11,13]. The direction in which an antenna is pointing is always the direction of maximum radiation, and for maximum radiation, and maximum captured power, a receiver antenna must be pointing in the direction from which the reception is desired. Table 1 shows the radio frequency spectrum with UHF of frequency band 300MHz to 3GHz used for television broadcasting.

Table 1: Radio Frequency Spectrum and Uses [2]

Frequency Band	Descriptive Designation	Uses
3-30kHz	Very Low Frequency (VLF)	In radio navigation system
30-300kHz	Low Frequency (LF)	In submarine link
300-3000kHz	Medium Frequency	AM Radio Broadcast, Links for ships
3-30MHz	High Frequency (HF)	Broadcasting; radio link satellite communication
30-300MHz	Very High Frequency (VHF)	TV Broadcasting, point to point communication
300-3000MHz	Ultra High Frequency (UHF)	TV Broadcasting, RADAR, Radio Navigation
3-30GHz	Super High Frequency (SHF)	Satellite communications, RADAR, Radio Navigation
30-300GHz	Extremely High Frequency (EHF)	For Research

II. Materials and Methods

2.1 Materials used: The following instruments and materials were used in the course of carrying out this research;

i. The Dagatron Tm 10 Level (field strength) Meter, with frequency range (5MHz-862MHz), measurement range (15-120dBµV), resolution (0.1dB), and accuracy(+/-3dB), and Unit of measurement in dB-µV.
ii. The Global Positioning System (GPS) receiver; GARMIN MAP 76 Personal Navigator
iii. TV receiving antenna(passive), I-conductor and a coaxial cable and,
iv. Ekiti State Administrative map.

2.2 Research Methodology

The Electric Field Strength measurements were conducted on channel 41 ultra-high frequency (UHF) television signal of the Broadcasting Service of Ekiti State (BSES). As at the time of carrying out this work, only the Broadcasting Service of Ekiti State (BSES) transmits on the UHF band in the state. The transmitting station has a transmitter maximum output capacity of 40kW. However, the transmitted power by the station was 20% of the output capacity.This station is located at Ilokun quarters, Ado Ekiti, in the state capital with transmitter coordinate (Lat. 7.71^0N, Long. 5.21^0E). It has two transmitters which allows one to be on standby, while the other is on air. This transmitter is the solid state type except the power amplifier (PA) stage. The PA stage makes use of the inductive Oxide Tube Technology (IOT) which is an improved klystron technology. However, the newly installed transmitter that began transmission in February 2011 was a complete solid state type.

The Electric Field Strength measurements of this transmitting station were carried out radially along different routes from the base station (as reference). These measurements were taken using the digital field strength meter (covering the frequency range 5.0-862.0MHz and measurement range 15.0-12 dBμV). The GPS receiver (GARMIN MAP 76) model, personal navigator was used to monitor the line of sight of the different locations where data was collected from the base station. It was also used to determine the latitude, longitude and the elevation above sea level of the locations. Measurements were taken at interval of 5km in the major axes from the base station, and in majority of the towns and villages in all the local government areas visited as far as good road accessibility permitted and except in areas where the signals had faded away. These measurements were carried out in the months of June and July 2010. Arrangements were made with the station to ensure continuous operation of the transmitter during the data collation period. Transmission parameters were monitored and found to be substantially constant throughout this period.The second phase of survey (measurements) was conducted on the station in July 2011 with the primary objective of comparing the coverage of the new transmitter to the old one. The transmitted power of the new transmitter during this work was 20kW. The need to wait and take the measurement in July was to ensure uniformity in the month of measurement with the first phase. Eight local government areas were used as samples. The electric field strength of the transmitted television signal for different locations with their corresponding distances (LOS) from the base station were recorded. Also, determined and recorded were the latitude, longitude and the altitude of the various locations where data were collected.

Table 2: Transmission Parameter for Ch.41 TV. Station at Ado Ekiti for the First Phase of Measurement in the Months of June and July 2010.

S/N	PARAMETER	VALUE FOR ROUTES A,B
1	Base station transmitting power	8000W(20% of 40kW)
2	Base station carrier frequency	631.25MHz
3	Transmitter in use	Harris 40kW
4	Height of transmitting mast	200.0m
5	Height of transmitting antenna	18.29m(60ft)
6	Transmitting antenna gain	32dB
7	Height of receiving antenna	1.94m(6ft)

Table 3: Transmission Parameter for Ch.41 TV. Station at Ado Ekiti for the Second Phase of Data Collection in November 2011

S/N	PARAMETER	VALUE FOR ROUTES A,B
1	Base station transmitting power	20kW
2	Base station carrier frequency	631.25MHz
3	Transmitter in use	Harris maxima solid state type
4	Height of transmitting mast	200.0m
5	Height of transmitting antenna	13m
6	Transmitting antenna gain	13dB
7	Height of receiving antenna	1.94m(6ft)

III. Results and Discussion

3.1. Field Strength Measurement

The electric field strength data collected in the state with some communication parameters taken at data location points with the old transmitter in the months of June and July 2010 are as tabulated in Table 3 and 4. With Table 5 showings the transmission parameters.

Table 4: Result of the Electric Field Strength Measurement of Channel 41UHF Television Signal (631.25MHz), of the Broadcasting Service of Ekiti State (BSES) with the old transmitter: Data collected in the months of June and July 2010. Route A.

Observation	**Line of sight from the TX base (km)**	**Lat(°N)**	**Long(°E)**	**Elevation ASL/AGL (m)**	**Multiple reading /E/ field strength (dBμV)**	**Average reading /E/ (dBμV)**	**Description of location/Town**	**Local Government Area. (LGA)**
1	0.00	7.72582	5.2356	415.22	80.52 81.22 80.32	80.687	Base of transmitting antenna at Ado Ekiti.	Ado
2	5.02	7.191848	5.27946	409.12	66.12 67.82 66.92	66.413	UNAD, Ekiti	Ado
3	4.98	7.73537	5.26879	418.42	63.52 64.92 64.52	64.320	UNAD 2 Campus	Ado
4	6.36	7.75046	5.28120	432.12	69.02 68.92 69.22	69.053	IworokoEkiti	Irepodun/ Ifelodun
5	10.04	7.78520	5.27211	562.32	44.52 45.82 45.12	45.153	Near IfakiEkiti	IdoOsi
6	12.61	7.80841	5.26291	571.32	46.52 47.52 47.92	47.320	IfakiEkiti	IdoOsi
7	14.00	7.82055	5.25759	574.42	31.62 37.62 38.52	34.920	IfakiEkiti	IdoOsi
8	17.55	7.85246	5.25486	563.62	26.02 27.52 26.72	26.770	Orin Ekiti	IdoOsi
9	20.00	7.86561	5.20996	561.52	32.72 30.62 31.52	31.620	IdoEkiti 1	IdoOsi
10	17.80	7.86282	5.20712	588.52	42.72 49.12 45.52	45.787	FMC IdoEkiti	IdoOsi
11	22.00	7.88018	5.19668	564.22	25.32 22.72 22.92	23.653	Ido 3	IdoOsi
12	23.32	7.89160	5.19353	595.52	33.52 31.52 32.52	32.520	Usi	IdoOsi
13	24.70	7.90385	5.19096	554.52	28.72 28.52 27.92	28.287	Usi 2	IdoOsi
14	30.00	7.94513	5.16533	567.22	16.02 16.42 16.32	16.253	Ayetoro	IdoOsi
15	36.40	8.00161	5.15267	602.62	37.52 36.22 36.52	37.753	Moba Gram. Otun	Moba
16	37.40	8.00747	5.14237	548.12	16.62 15.92 16.12	16.220	Otun 7th day Church Area	Moba
17	40.04	8.02925	5.13231	559.92	20.92 20.52 20.62	20.687	Otun Extension	Moba
18	42.64	8.04945	5.11995	559.52	15.22 15.12 15.52	15.287	Obaji Gram. OkeEro	Moba
19	35.57	8.00178	5.17614	560.62	19.02	17.987	IgogoEkiti	

					16.42 18.52			Moba
20	35.48	8.00354	5.18556	559.22	17.22 16.92 16.52	16.877	Igogo 2 Ekiti	Moba
21	36.27	8.01350	5.19689	545.32	15.22 16.12 15.82	15.720	IkosuEkiti	Moba
22	35.92	8.01445	5.22030	535.32	16.22 16.52 16.12	16.287	IkunEkiti	Moba
23	31.65	7.97809	5.26189	538.82	19.02 20.32 20.52	19.953	IjesamoduEkiti	Ilejemeje
24	31.23	7.97520	5.25004	554.22	17.02 16.52 16.92	16.820	IyeEkiti	Moba
25	30.64	7.97027	5.25835	547.22	21.72 23.32 22.82	22.620	Iye LGA	Ilejemeje
26	28.37	7.94050	5.33650	574.52	22.72 20.82 21.52	21.687	IsanEkiti	Oye
27	26.26	7.91705	5.57298	603.42	39.22 41.62 40.52	40.453	AyedeEkiti	Oye
28	24.51	7.89851	5.35906	589.32	39.12 37.62 38.52	38.420	ItajiEkiti	Oye
29	17.42	7.82118	5.36037	564.12	50.22 49.42 51.52	50.387	OyeEkiti	Oye
30	16.80	7.81886	5.35412	531.52	46.22 47.12 46.92	46.753	OyeEkiti 2	Oye
31	16.82	7.81325	5.31316	551.42	36.72 36.52 36.92	36.720	AyegbajuEkiti	Oye

Table 5: Route B Result of the Electric Field Strength Measurement of Channel 41 UHF Television Signal (631.25MHz), of the Broadcasting Service of Ekiti State (BSES TV).

Observation	**Line of sight from the TX base (km)**	**Lat. (°N)**	**Long. (°E)**	**Elevation ASL/AGL (m)**	**Multiple reading /E/ field strength (dBµV)**	**Average reading /E/ (dBµV)**	**Description of location/Town**	**Local Govt. Area**
1	0.00	7.72582	5.23560	415.22	80.52 81.22 80.32	80.687	Base of transmitting station	Ado
2	20.10	7.51487	5.27425	367.52	16.12 16.02 15.92	16.020	Hospital	Ikere
3	20.77	7.51080	5.23912	368.52	28.32 36.42 24.52	29.753	Idi Isin, Ikere	Ikere
4	21.53	7.51678	5.19143	390.62	25.12 24.72 24.32	24.720	Ikere	Ikere
5	23.04	7.48925	5.24702	361.52	26.92 26.04 25.22	26.060	Amoye Gram. Sch. Ikere	Ikere
6	31.81	7.40986	5.27986	391.42	31.42 30.92 30.52	30.953	IjuItaogbolu	Ikere
7	27.35	7.52277	5.09054	378.22	16.12 16.42 16.79	16.443	Igbaraodo, St., Catholic Church	Ekiti South - West
8	27.80	7.52537	5.08243	383.02	22.72 22.52 22.42	22.553	Igbaraodo, Microfinance area	Ekiti South - West
9	29.72	7.61019	5.01202	476.32	25.92 24.52	23.920	IkogosiEkiti	Ekiti West

					21.32			
10	27.51	7.63127	5.02617	354.92	15.32 15.02 15.12	15.153	ErinjiyanEkiti	Ekiti West
11	27.41	7.63301	5.02670	465.32	15.12 15.52 15.22	15.287	Olohan's Palace Erinjiyan	Ekiti West
12	22.85	7.71279	5.06071	506.62	22.02 22.32 20.62	21.653	Aramoko (Okeiro)	Ekiti West
13	23.25	7.72662	5.05866	475.32	15.62 15.92 16.22	15.920	Aramoko 2	Ekiti West
14	26.87	7.75086	5.03015	519.52	22.52 23.02 24.02	23.187	ErioEkiti	Ekiti West
15	33.10	7.74658	4.97151	452.52	15.72 15.92 15.62	15.753	Itawure	Efon
16	34.93	7.71196	4.95069	490.02	28.82 29.12 29.92	29.287	EfonAlaaye LGA Sect. (Valley)	Efon
17	35.98	7.68755	4.94103	521.82	16.22 16.62 16.12	16.320	Efon 3, (Valley)	Efon
18	36.23	7.68194	4.93891	533.92	16.12 16.42 16.22	16.253	Efon4, (Market)	Efon
19	24.51	7.82023	5.08432	450.72	20.02 20.52 21.02	20.520	Govt. College Area, Efon	Efon
20	25.38	7.83663	5.68661	505.02	24.62 23.52 22.80	23.647	Roundabout, Ijero	Ijero
21	13.59	7.69077	5.14396	575.52	35.92 34.12 36.52	35.520	IgedeEkiti	Irepodun/Ifelodun
22	09.98	7.41517	5.10517	578.52	48.02 48.52 49.72	48.753	IyinEkiti	Irepodun/Ifelodun
23	15.12	7.70500	5.14812	450.12	35.12 34.92 35.12	35.053	Ilawe	Ekiti South West
24	32.17	7.47012	5.46521	395.02	19.51 19.52 19.53	19.520	Ise	IseOrun
25	35.22	7.42221	5.50121	380.52	16.82 16.82 16.90	16.847	Emure	Emure
26	33.02	7.67812	5.57451	396.52	16.92 17.52 17.22	17.220	Orun	Gbonyin
27	32.52	7.79512	5.54543	525.02	20.52 20.52 20.22	20.420	Ikole	Ikole

3.2. Determined Coverage Areas of BSES in Ekiti State using the Old Transmitter Output Power.

The primary coverage area between 40≤/E/≤82.0dBμV within the state covers about 18% of the total area of the state. The towns and villages in this area have access to the optimum coverage of the television station. Some of the towns and villages falling between this grade are mainly in Ado, Irepodun/Ifelodun, IdoOsi, and part of Ikere and Oye Local Government areas. The secondary coverage area between 20≤/E/≤39.0dBμV is about 28% of the State. Some of the towns and villages within this area are mainly Ido-Osi, Oye, Ikere, Ekiti South West, and Ekiti West LGAs. Others are in part of Ijero and Ikole LGAs. The tertiary or fringe coverage area 15≤/E/≤19.0dBμV area of coverage is about 29% of the State. The towns and villages in this area are mainly in Moba, Ilejemeje, Ekiti East, Efon, Isse-Orun, and Emure Local Government Areas. Others are in part of Gboyin, Ekiti West, Ikere and Ido-Osi LGAs.

Table 6. Some of the towns within the primary coverage area and their respective field strength values

S/N	TOWN	LGA	Field Strength dBµV)
1	Ado Ekiti	Ado	80.02
2	Ado Ekiti 2	Ado	65.02
3	IjeluEkiti	Oye	60.02
4	IfakiEkiti	IdoOsi	45.02
5	Ido (FMC Area)	IdoOsi	45.02
6	AyedeEkiti	Oye	45.02
7	OyeEkiti	Oye	40.02
8	AyegbajuEkiti	Oye	50.02
9	IyinEkiti	Irepodun/Ifelodun	40.02
10	IgedeEkiti	Irepodun/Ifelodun	48.80

Table 7. Some of the towns falling within the secondary coverage area and their respective field strength values.

S/N	TOWN	Field Strength (dBµV)	Local Govt.Areas
1	IdoEkiti	31.62	IdoOsi
2	Orin Ekiti	26.77	IdoOsi
3	UsiEkiti	32.52	IdoOsi
4	Moba Gramm Sch. Area, OtunEkiti	37.75	Moba
5	Itaji	38.42	Oye
6	IsanEkiti	21.72	Oye
7	Ikere (College area)	24.72	Ikere
8	IlaweEkiti	35.02	Ekiti West
9	IgbaraOdoEkiti	23.55	Ekiti West
10	IkogosiEkiti	23.92	Ekiti West
11	Aramoko	21.65	Ekiti West
12	Erio	23.20	Ekiti West
13	Ijero	22.02	Ijero

Table 8. Some of the towns falling within the Tertiary Coverage area of the station and their respective field strength value

S/N	TOWN	Field Strength (dBµV)	Local Govt. Areas
1	Ayetoro	16.23	IdoOsi
2	OtunEkiti	16.22	Moba
3	IgogoEkiti	18.00	Moba
4	IkosuEkiti	15.72	Moba
5	IkunEkiti	16.30	Moba
6	Ijesamodu	19.95	Ilejemeje
7	IyeEkiti	16.82	Ilejemeje
8	Ikere (area)	16.02	Ikere
9	ErinjiyanEkiti	15.32	Ekiti West
10	Aramoko	15.92	Ekiti West
11	Itawure	15.75	Efon
12	EfonAlaaye	16.32	Efon
13	Ise	19.52	IseOrun
14	Emure	16.82	Emure

Table 9: Table of values for the Ado – Efon Axis.

S/N	Location	LOS (km)	Field Strength dBµV	Elevation (m)
1	Tx base Ado/IlokunQrts	0.00	80.67	393.92
2	IyinEkiti	9.98	48.75	578.52
3	IgedeEkiti	13.59	36.19	575.52
4	Aramoko	22.85	21.67	506.62
5	Erio	26.87	23.19	519.52
6	Itawure	33.10	15.75	452.52
7	Efon I	34.93	16.32	521.82
8	Efon II	35.98	16.25	533.92

The deductions from the signal's propagation curve shows that signal strength decreases as distance (LOS) from the transmitter increases in all the routes. This justifies the inverse square law. The few locations with high elevation recorded higher signal strength than expected, thus confirming that high elevation enhances UHF transmission and reception. Propagation curves for all the axes show that; the signal strength of this station was good enough between 0 -15km radius from the transmitter (above 30dBµV). Beyond 15km radius from the transmitter for all routes, signal level was fair (below 30dBµV).

Table 10: Table of Values for the Ado – Otun Axis.

S/N	Location	LOS (km)	Field Strength dBµV	Elevation (m)
1	TX Base	0.00	80.67	393.92
2	Iworoko	6.38	69.05	432.12
3	Ifaki	14.02	34.92	574.42
4	Ido	20.02	31.62	562.52
5	Usi	24.72	28.30	554.52
6	Ayetoro	30.02	16.25	567.22
7	Otun I	36.42	37.75	602.62
8	Otun II	40.06	20.69	559.92

Table 11: Table of values for Ado – Ikere Axis.

S/N	Location	LOS (km)	Field Strength dBµV	Elevation (m)
1	TX Base	0.00	80.67	393.92
2	Ikere	20.10	16.02	367.52
3	Ikere (Idi Ishin Area)	20.77	26.42	368.52
4	Ikere: Amoye Gram. Schl Area	23.04	26.04	361.52
5	Iju/Itaogbolu Police Station Area	31.82	30.97	391.42

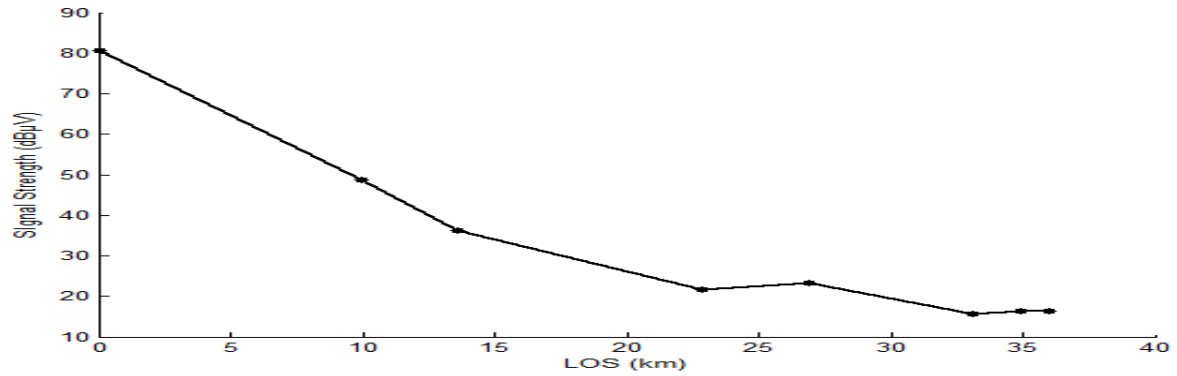

Figure 1: Signal Propagation Curve for Ado – EfonEkiti Axis

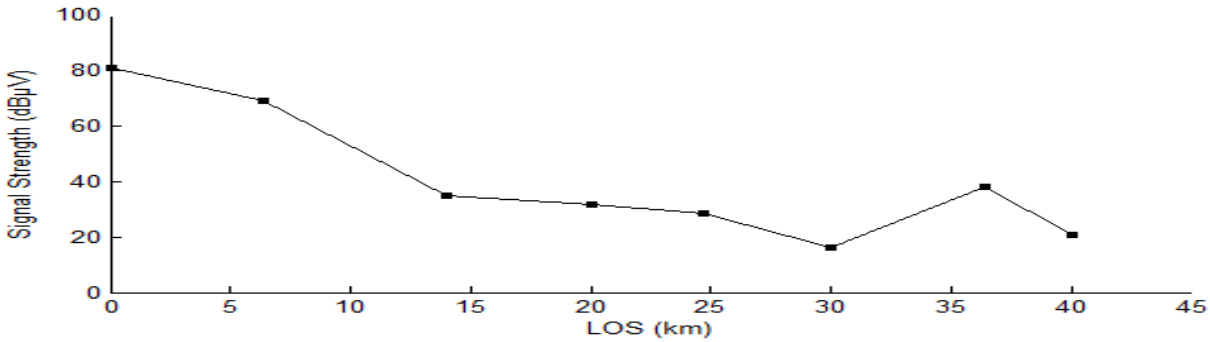

Figure 2: Signal Propagation Curve for Ado – OtunEkiti Axis

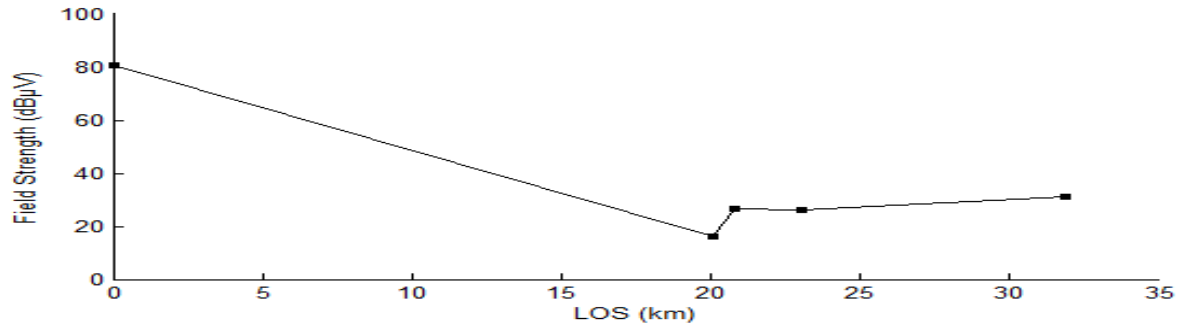

Figure 3: Signal Propagation Curve for Ado – IkereEkiti Axis.

Table 12: Table of values for Ado – Ikole Axis.

S/N	Location	LOS (km)	Field Strength dBµV	Elevation (m)
1	Ilokun TX Base	0.00	80.02	393.92
2	IworokoEkiti	6.38	69.05	432.12
3	Ifaki	12.63	47.32	574.42
4	Ayegbaju	16.84	36.72	551.42
5	Oye	16.82	46.72	564.12
6	Itapa	17.52	30.02	558.02
7	Ikole	30.12	17.22	560.02

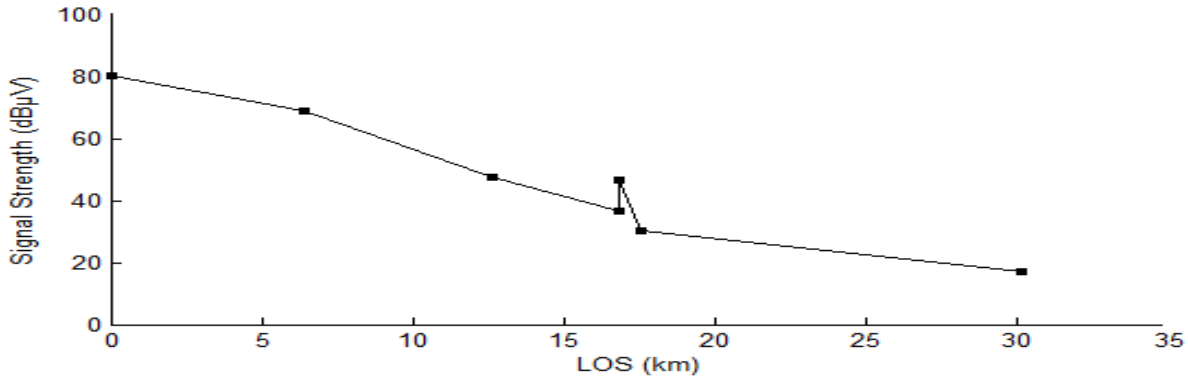

Figure 4: Signal Propagation Curve for Ado – IkoleEkiti Axis.

3.3. *Result of the second phase of measurement*

The table below shows the result of the electric field strength survey in the eight sampled local government areas of Ado, Irepodun/Ifelodun, Ikere, Ekiti South West, Ekiti West, Efon Alaaye, Ijero, and Ido Osi.

3.4. Comparison of the coverage area of the old transmitter to the new transmitter.

The comparison of the signal strength of the old transmitting system used till August 22, 2010 by the station to the new system in operation since February 1, 2011 was done. This was carried out using eight local government areas (50% of the total local government areas) where the electric field strength measurements of the signal were repeated using the new 20kW transmitted power as reference. The eight local government areas used for the comparison are; Ado, Ikere, Ekiti West and Irepodun/Ifelodun. Others are Efon, Ekiti South West, Ijero and IdoOsi. Table 4 shows the results of the measurement while table 5 shows the comparison table.

Table 13: Measurement of the Electric Field Strength of the UHF ch.41 Television Signal (BSES) in Ekiti State with the newly installed transmitter power of 20kW.Data Collected in July 2011.

S/N	**LOS (km)**	**Lat (°N)**	**Long (°E)**	**Elevation (m)**	**Field Strength (dBµV)**	**Average reading /E/dbµV)**	**Description of Location/Town**	**Local Government. Area**
1	0.00	7.7258	5.2356	393.92	95.02 95.52 96.02	95.520	Base of tx at Ilokun	Ado
2	5.05	7.7385	5.2795	409.12	80.22 82.12 80.02	80.787	UNAD Gate	Ado
3	10.02	7.4152	5.1152	578.22	60.52 60.02 61.52	60.687	IyinEkiti	Irepodun/Ifelodun
4	13.59	7.6908	5.1440	575.52	58.02 57.02 57.52	57.520	1st Round about, Igede	Irepodun/Ifelodun
5	20.07	7.5149	5.2743	367.52	32.52 31.02 32.02	31.853	Hospital	Ikere
6	23.27	7.7266	5.0587	475.32	30.02 31.02 32.02	31.020	Aramoko	Ekiti West
7	26.84	7.7508	5.0302	519.32	28.02 27.52 28.22	27.920	ErioEkiti	Ekiti West

8	27.37	7.7508	5.0267	465.02	25.02 24.52 25.12	24.887	Erinjiyan	Ekiti West“
9	33.12	7.2850	4.7715	452.32	21.52 20.02 20.52	20.687	Itawure	Efon
10	35.02	7.7120	4.9509	490.02	20.02 21.02 21.52	20.853	EfonAlaaye LGA Secretariat.	Efon
11	35.22	7.7201	4.9500	520.52	41.02 42.02 41.52	41.520	Opposite High Court, EfonAlaaye.	Efon
12	24.52	7.8200	5.0843	450.52	33.02 32.52 32.02	32.520	Roundabout Area Ijero	Ijero
13	25.37	7.8366	5.0867	505.02	40.02 41.02 41.52	40.853	Palace Area, Ijero	Ijero
14	20.02	7.8656	5.2100	502.52	42.02 42.52 43.52	42.700	IdoEkiti	Ido/Osi

3.5. Observation/Deductions from the propagation curve.

The newly installed transmitter with a transmitted power of 20kW gave a better coverage of about 96% of the state, compared to the old transmitter power of 8kW that gave about 75% coverage of the state. This was deduced using the measurement tables and the propagation curve. High altitudes influence UHF transmission and reception. Father locations with high altitudes recorded high signal values than expected.Terrestrial factors such as Hills, Mountains, trees on the path of UHF signal cause attenuation in the signal strength.

IV. Conclusion and Recommendation.

4.1. Conclusion: The coverage area of the Broadcasting Service of Ekiti State (BSES) as determined with the old transmitter as reference was about75% of the entire landmass of the State. Areas within the optimum coverage (40dBµVand above) are about 18% of the State, with some of the towns within Ado, Irepodun/Ifelodun, Ido/Osi, Ekiti South West, Ekiti West, Oye, and Ikere Local Government Areas. About 27% of the State was under secondary coverage i.e. 20-30 dBµV, with towns and villages within Ekiti South West, Ekiti West, Ijero, Ikere, Ido-Osi and Oye, Gbonyin, Ikole, Ise Orun local government areas. About 30% of the State was fairly serviced(15-19 dBµV, tertiary coverage), and the towns and villages falling within this area are mainly in Ise/Orun, Emure, Gbonyin, Ekiti East, Efon, Moba LGAs and part of Ikole, Oye LGAs. About 25% of the State was not serviced by the station and the towns and villages falling within this area are mainly in the far end of Ikole, Ekiti East, Oye, Ijero and Moba; and few areas within Efon Alaaye, Erinjiyan, Ikere local government areas because of their topographical features. With the new transmitter with 20kw power output, the result for the eight sampled local government areas showed an enhanced average signal strength of about 40% in about 0-20km line of sight from the station and about 35% in about 20-40km line of sight from the transmitter base, which justifies the investment on the station by the upgraded facilities. About 4% of the State was not serviced by the station. The towns and villages falling within this area are mainly in the far end of Ikole, Ekiti East, Oye, Ijero, and Moba Local Government areas. Others are in few areas within Efon Alaaye, Erinjiyan, Ikere, etc, because of their topological features. The new station has increased the optimum coverage of the station within the State from about 20% to about 50%. The signal of the station is now highly dependable in 50% of the entire land mass. The new coverage area of the station is about 96% of the entire landmass of the State. However, for more than 50% of the populace to enjoy the optimum coverage of the station, (40dBµV and above) more effort will still be needed by the management of the Station.

4.2. ***Recommendation*** **:** For further socio-economic development of the people of Ekiti, the following recommendations are made;

i. The State government should endeavour to site booster stations across the State to achieve about 75% optimum coverage (at lease 40dBuV) signal level in 75% of the entire landmass of the state. This is necessary to ensure that government policies and programmes are well disseminated. These booster stations will be needed in the following local government areas of the State, where the signal strength recorded had become weak. i.e. Efon-Ekiti West areas, Moba – Ilejemeje Areas, Ikole – Ekiti East Areas, Ikere-Ise Orun Areas

ii. The transmitter to be installed in any of these routes could be of 1.0kW or 1.5kW output capacity. This will increase the optimum coverage of the station and not necessarilty cause interference to any neighbouring television stations. It will equally empower the people economically by reducing the money spent on getting active antenna which do not last because they are easilydestroyed by rain and wind.

iii. The BSES management should endeavor to educate the populace through their channels on the need to make use of active antenna for proper reception at any location beyond 15km radials from the base station.

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