



MEASUREMENT OF ELECTRIC FIELD STRENGTH TO DETERMINE THE COVERAGE AREAS OF VHF AND UHF TELEVISION SIGNALS IN NIGER STATE, NIGERIA.

M. O. Ajewole¹, O. D. Oyedum², *A. S. Moses² and J. O Eiche²

¹Department of Physics, Federal University of Technology, Akure.

²Department of Physics, Federal University of Technology, Minna.

*E-mail: hiswordmakesit@yahoo.com

Abstract

This study investigated the coverage areas of VHF and UHF signals of three television stations in Niger State at the onset of rain season, by means of quantitative measurement of the electric field strength. The signal levels of the Nigeria Television Authority, (NTA), Minna, Channel 10, (210.25 MHz); Nigeria Television Authority, (NTA), Kotangora, Channel 8, (196.25 MHz), and Niger State Television, Minna, UHF 25, (503.25 MHz) transmitters were measured radially along several routes with the transmitting stations at focus. Their corresponding distances from the transmitting stations and locations were also measured. These measurements were taken using Digital Signal Level Meter, GE-5499, having a signal level range 30 dB μ V - 120 dB μ V, and GPS 72 – Personal Navigator. Measurements were taken all around the towns and villages in all the Local Government Areas in Niger State. From the data obtained, Surfer 8 application software was used to draw the contour maps of the electric field strength around the transmitting stations to show the coverage areas around the state. The results obtained showed that the present configurations of the transmitters for all the three television stations did not give an optimum coverage area. Only 25.82% of the entire land mass of the state has television signal coverage during the onset of rain season. Consequently, some areas in the state are completely out of television signal coverage. So there is need to have repeater stations at certain intervals to provide reception of television signals for all the part of the states.

Keywords: coverage areas, signal levels, VHF and UHF signals, transmitting station, contour map.

1. Introduction

Radio communications, like all other communications, rely on the atmosphere as the medium through which the signals travel from the transmitter to the receiver. As a result, the quality of the communications is dependent on the physical factors that influence the propagation of electromagnetic (EM) signals in this medium. (www.radio-electronics.com, 2010).

At broadcast frequencies in the VHF and UHF band (30 MHz – 3 GHz), propagation is usually by ground waves which consist of direct wave, ground reflected and surface wave. Therefore, in the frequency band, the electrical parameters of the ground, curvature of the earth surface, height of the antenna and weather conditions influence wave propagation. The degree to which these influences affect propagation depends primarily on the frequency of the wave and the polarization, (Hall, 1991). The electric field at a distance from the transmitter is attenuated by these parameters, with the result that radio services in the VHF and UHF band are limited to distances close to the transmitter. The present trend in broadcasting is to use wide spread broadcast transmitter of medium or VHF or UHF range of frequencies to serve area not far away from the transmitter. (L. W. Barclay, 1991)



Coverage areas of broadcast stations are usually classified into primary, secondary and fringe area. The size of each of these areas depends on the transmitter power, the directivity of the aerial, the ground electrical conductivity and the frequency of propagation. The coverage area decreases with increase in frequency and reduction in the ground conductivity. (Ajayi G. O. and Owolabi I. E., 1975)

The primary coverage area is defined as a region about a transmitting station in which the signal strength is adequate to override ordinary interference in the locality at all times. The primary coverage area corresponds to the area in which the field strength is greater than 60 dB μ V. The appropriate value of the field strength for this quality of service is dependent on the atmosphere and man-made noise in the locality. The relevant field strength also depends on whether the locality is rural, industrial or urban. The quality of service enjoyed in this area can be regarded as Grade A1.

The secondary coverage area is a region where the field strength is often sufficient to be useful but is insufficient to overcome interference completely at all times. The service provided in this area may be adequate in rural areas where the noise level is low. The secondary coverage area corresponds to the area in which the field strength is at least 30 dB μ V but less than 60 dB μ V. The quality of service enjoyed in this area can be regarded as Grade B1.

The fringe service area can be regarded as that in which the field can be useful for some periods, but its service can neither be guaranteed nor be protected against interference. This is an area in which the electric field strength is greater than 0 dB μ V but less than 30 dB μ V. Such an area may be said to enjoy Grade B2 service. (Ajayi G. O. and Owolabi I. E., 1979).

This study investigated the coverage areas of the Nigeria Television Authority, (NTA), Minna, Channel 10, (210.25 MHz); Nigeria Television Authority, (NTA), Kotangora, Channel 8, (196.25 MHz), and Niger State Television, Minna, UHF 25, (503.25 MHz), by means of quantitative measurement of the electric field strength.

2. Methodology

The work was carried out for three different television stations, namely:

1. Nigeria Television Authority, Minna. (NTA Minna, Channel 10)
2. Nigeria Television Authority, Kotangora (NTA Kotangora, Channel 8)
3. Niger State Television, UHF 25, Minna.

The transmitter output power of NTA Minna, Channel 10 during the period of this work was substantially constant at 7.5 kW and the power output of NTA Kotangora, Channel 8 throughout the period of this work was 2 kW. Because of the state of the transmitter of the Niger State Television, UHF 25, Minna, the power output used to fluctuate between 100 W and 500 W but it was more stable at 250 W.

The signal levels of the three stations were taken radially along several routes from the transmitting stations with the transmitting stations at focus. Their corresponding distances and locations were also measured. These measurements were taken using Digital Signal Level Meter GE-5499, having a signal level range, 30 dB μ V - 120 dB μ V, and GPS 72 – Personal Navigator. Measurements were taken all around the towns and villages in all the Local Government Areas in Niger State until all the signals faded away completely.

The measurements were carried out at the onset of rain season in the month of May for the three television stations. From the data obtained, contour maps around the transmitting stations for signal levels were drawn to show the coverage areas around the state.

3. Results and Discussion

Fig. 1 and fig. 2 show the contour maps for signal levels around the three transmitting stations, showing the television signal coverage areas in the state and table 1 to table 4 quantifies the results in percentage. The results obtained show that:

- i. The present configurations of the transmitters for all the three television stations did not give an optimum coverage area. Only 25.82% of the entire land mass of the state has television signal coverage during the onset of raining season. So, greater percentage of the state is completely out of television signal coverage in Niger State.
- ii. The contour maps show the need for repeater stations at certain intervals to provide reception of television signals for all the parts of the state.

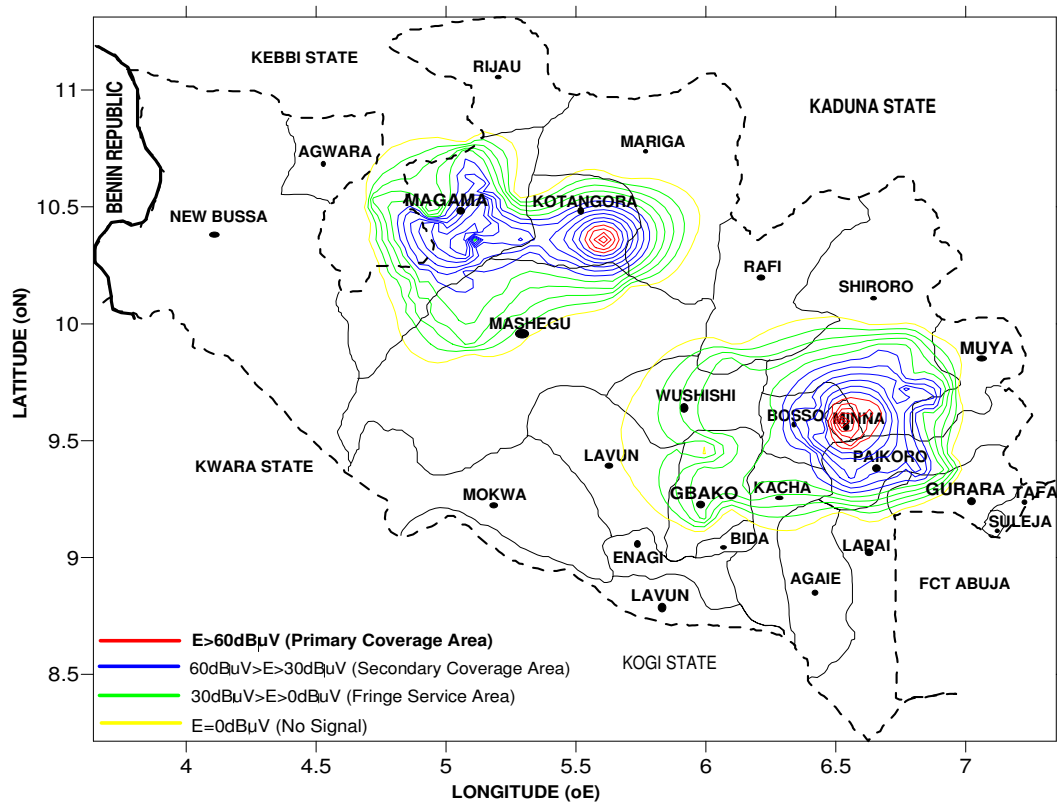


Figure 1: Coverage Areas of the NTA Minna, Channel 10 and NTA Kotangora, Channel 8 Transmitting Stations in Niger State during the Onset of Rain Season

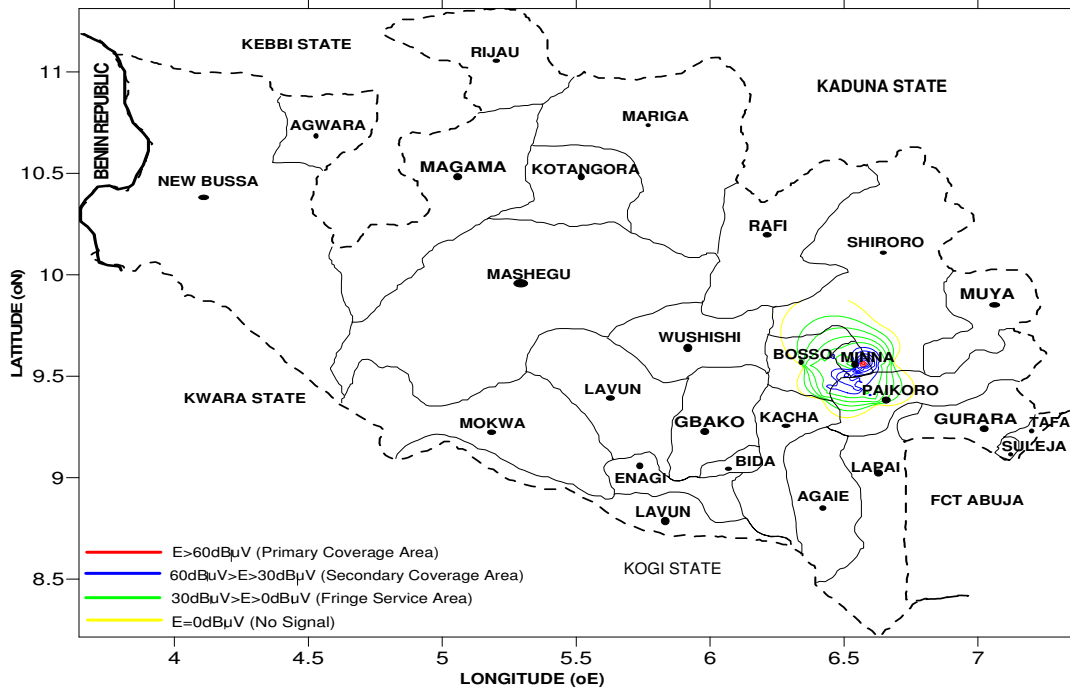


Figure 2: Coverage Area of Niger State Television, UHF Channel 25 Transmitting Station in Niger State during the Onset of Rain Season

Table 1: Percentage of the Coverage Areas of the Television Transmitting Stations in Niger State at the Onset of Rain Season

Stations	% of primary coverage area	% of secondary coverage area	% of fringe coverage area	Total % of coverage area
NTA Minna, channel 10	0.65%	4.15%	9.38%	14.18%
NTA Kotangora, channel 8	0.22%	4.74%	6.68%	11.64%
Niger State Television, UHF 25 Minna	0.005%	0.32%	1.97%	2.295%

Table 2: Percentage of the Local Government Areas Covered by the NTA Minna, Channel 10, Transmitting Station in Niger State at the Onset of Rain Season

L.G.A	% of L.G.A. with primary coverage area	% of L.G.A. with secondary coverage area	% of L.G.A. with fringe coverage area	Total % of L.G.A. coverage area
Minna	100%	-	-	100%
Bosso	7.14%	64.29%	28.57%	100%
Paikoro	3.80%	46.20%	7.70%	57.70%
Shiroro	2.80%	22.20%	19.40%	44.40%
Kacha	-	2.27%	45.45%	47.72%
Muya	-	5%	2.50%	7.50%
Wushishi	-	-	69.20%	69.20%
Gurara	-	-	25%	25%
Gbako	-	-	73.10%	73.10%
Rafi	-	-	13.60%	13.60%
Lavun	-	-	5.26%	5.26%
Agai	-	-	3.85%	3.85%
Lapai	-	-	6.70%	6.70%

Table 3: Percentage of the Local Government Areas Covered by the NTA Kotangora, Channel 8, Transmitting Station in Niger State at the Onset of Rain Season

L.G.A	% of L.G.A. with primary coverage area	% of L.G.A. with secondary coverage area	% of L.G.A. with fringe coverage area	Total % of L.G.A. coverage area
Kotangora	7.70%	61.50%	23.10%	92.30%
Magama	-	37.90%	27.60%	65.50%
Meshegu	-	3.60%	29.10%	32.70%
Mariga	-	2.60%	7.90%	10.50%
Meshegu	-	2.70%	27.27%	29.97%
Mariga	-	1.32%	7.89%	9.21%

Table 4: Percentage of the Local Government Areas Covered by the Niger State Television, UHF 25 Minna, Transmitting Station in Niger State at the Onset of Rain Season

L.G.A	% of L.G.A. with primary coverage area	% of L.G.A. with secondary coverage area	% of L.G.A. with fringe coverage area	Total % of L.G.A. coverage area
Minna	3%	47%	50%	100%
Bosso	-	3.13%	50%	50.13%
Paikoro	-	6.67%	20%	26.67%
Shiroro	-	-	7.50%	7.50%



4. Conclusion

This study presents the contour maps around the transmitting stations for signal levels to show coverage areas of VHF and UHF signals of three television stations in Niger State at the onset of rain season, by means of quantitative measurement of the electric field strength. Hence, the primary, secondary and fringe coverage areas for all the television stations were obtained.

None of the signals from the television stations is potential interference to any of the local television stations in the neighboring states. Hence, they are in compliance to the Nigeria Broadcasting Cooperation, (NBC), regulation but the present configurations of the transmitters for all the three television stations did not give an optimum coverage area. Only 25.82% of the entire land mass of the state has television signal coverage during the onset of rain season. So, greater percentage of the state is completely out of television signal coverage in Niger State.

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