CO-CHANNEL INTERFERENCE PREDICTION IN THE VHF AND UHF FREQUENCY BANDS IN NIGERIA.

BY

IDOWU, ABIODUN OMOWUNMI

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CERTIFICATION

This is to certify that this thesis was carried out by IDOWU, ABIODUN OMOWUNMI in the department of Electrical and Electronic Engineering in partial fulfillment of the requirements for the award of Master of Engineering (M.Eng.) degree in Communication Engineering of the Federal University of Technology, Akure, Nigeria.

Bisi Adeloye

24-8-2000

Supervisor

Engr. (Dr.) V.S.A. Adeloye.

DEDICATION

This research project is dedicated to the Almighty God who in His infinite mercies has made the completion of this research project possible.

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ABSTRACT

In order to satisfy the various increasing demands by both existing and new radio services, operating within a limited and internationally controlled national frequency spectrum allocation, a number of transmitters may have to share the same frequency. One major result of frequency sharing is radio interference between stations that share the same frequency. If co-channel interference is to be avoided, adequate protection must be given to individual transmitters.

In this work, proposed broadcasting services that may have to share frequency with existing services were identified from the data of the list of proposed radiocommunication services. They were grouped together on the basis of frequency. Relevant propagation parameters are used to compute and assess what protection against co-channel interference, individual transmitters of a co-channel pair enjoy. A user friendly computer program was developed to predict the adequacy of the protection against co-channel interference enjoyed by individual transmitters, where protection was inadequate, this program will effected corrective processes that was able to achieve adequate protection for both existing and new radiocommunication services in the VHF and UHF frequency bands.

Qualitative results were deduced and shown in tables and histograms, and, appropriate recommendations were made.

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CHAPTER 1

INTRODUCTION

Communication between two separate locations may be achieved by several methods one of which is the radio network or wireless communication system.

After over a hundred years of progressive development, radio communication is entering a new era. The impact of radio communication on the society continues to increase although we still do not fully realize all consequences of it. There are numerous areas in which the radio frequency spectrum is vital; such areas include National defense, public safety, weather forecast and disaster warning, air traffic control, monitoring of the environment, among others. Radio and television broadcasting have become the main sources of everyday information for most people of the world. They play principal role in meeting information needs of both literate and illiterate people who are unable to read. The latter constitutes about two-third of the world population, and more than 70% of the Nigerian population (Aboaba, 1999).

The number of terrestrial and space radio stations grows and the frequency demands increase very rapidly as liberalization and deregulation trends encourage the introduction of new radio services and related technologies.

The basic problems are congestion of services and scarcity of radio frequencies. Spectrum scarcity is especially observed in VHF/UHF frequency bands if the population density exceeds 200 people per square km and GNP < 10.00USD per capita per annum, (Struzak, 1998). Most frequency bands are shared by different services without interference.

However, within a given service, we may need to reuse the same frequency several times while avoiding any harmful interference.

When two radio waves of the same frequency interfere with each other, they mutually nullify the benefits they offer. To avoid such interference, each application requires some amount of radio frequency spectrum for exclusive use. However, special arrangements can be made for sharing the same spectrum with other applications.

For satisfactory operation of similar systems sharing the same frequency bands, some acceptable, accurate and reliable co-channel interference propagation prediction procedures are needed.

The focus of this exercise is the development of a computer program for the prediction of co-channel interference between new and existing VHF/UHF broadcasting services in Nigeria. This predictive exercise is done by identifying stations sharing same frequency, identifying stations by their technical data and location (the above information is available with the National Communication Commission – NCC). All television transmitters sharing same frequency have been treated in pairs and considered for protection against co-channel interference. The degree of protection against co-channel interference was determined through the calculation of the protection ratio R_p. Where the protection ratio $R_p > 1$, this implies that protection against harmful interference is adequate.

If the predictive exercise done by the computer program shows that protection is inadequate, i.e. $R_p < 1$, the computer program could make $R_p > 1$ by changing some parameters of either or both of the two stations being considered.

1.1 MOTIVATION

Radio stations sharing the same frequencies are susceptible to co-channel interference. It is important to be able to predict and reduce or prevent the effect of this harmful co-channel interference on any radio receiver and this is the aim of the research work.

Efforts had been made by the International Telecommunication Union, (ITU) in the past to prevent co-channel interference through the establishment of ITU guidelines on location co-ordination in the VHF and UHF frequency bands in Nigeria. However, these guidelines have not been followed in the establishment of most television transmitters in Nigeria due to geographical and political constraints as shown in Figures 1.1 and 1.2.

Also, computer programs have been developed in the past many of which were found to be defective in one way or the other.

For instance, most of the programs available were not exactly written for the calculation of the protection ratio against co-channel interference. Some were written for the determination of any kind of interference while some were written for the determination of the field strength of a signal and noise level of a signal. Of course, the protection ratio could be determined from the above indirectly but it will lead to introduction of errors no matter how minimal.

Also, the few computer programs that were written for the determination of the level of protection against co-channel interference are non-interactive programs and have poor interface design. An example of this is the "PLANTV" for planning of VHF/UHF Broadcasting Services.

Figure 1.1: Map of Nigeria showing ITU-R Guidelines on Location Co-ordination

(Existing Channels in circles, Recommended Channels not in circles)

Figure 1.2: Violation of ITU-R Guidelines on Frequency Assignment

- increased mistakes in data entry and system operation which when it goes uncorrected can have damaging consequences if decisions are taken on the basis of incorrect data.
- user frustration
- poor system performance i.e. the accuracy of the output may not agree with the specification. Poor interface design makes it too cumbersome to use or too obscure to learn.
- system failure because of user rejection. This may seem to be an extreme case considering the tolerance of users to appalling software, but it happens.

1.2 RESEARCH OBJECTIVES

The research objectives are as follows;

- To identify proposed radio stations that share frequencies with existing ones
- To group television stations (both proposed and existing) by their frequencies.
- To collect the technical parameters of existing and proposed co-channel stations in Nigeria.
- To develop a user-friendly computer program that could be used to determine the degree of protection against co-channel interference enjoyed by VHF and UHF television services in Nigeria.
- To analyze the findings and make recommendations for improved transmission and reception of television signals in Nigeria.

- To produce a guide for technical planning of future broadcast services in the VHF and UHF frequency Bands in Nigeria.

In order to be able to achieve the above objectives, all calculations has been made to assume perfect free space and smooth earth's surface.

CHAPTER TWO

THEORIES OF WAVE PROPAGATION

2.1. PROPAGATION OF RADIO WAVES

Propagation is the transfer of energy through space and Radio wave propagation is the transfer of energy through space by means of radio waves. The simplest case of wave propagation is that of propagation from a transmitter into an infinite surrounding free space. Of course, these conditions are not met with in practice since the transmitter can never be very far from the earth's surface, and the space surrounding it is never exactly free space.

2.2 RADIO WAVE PROPAGATION MODES

Table 2.1 is an overview of the electromagnetic spectrum (Collin, 1988). It is necessary to go over this before discussing the various modes of propagation.

2.2.1 FREE SPACE PROPAGATION

Free space propagation is a type of propagation which is supposed to take place in a region of the atmosphere that is devoid of ionization, stratification, reflection, scintillation, diffraction, refraction and other sources and, where there is negligible effect of earth's conductivity on propagation content, (ITU-R, 1990).

Consider an isotropic radiator in free space. By definition, an isotropic radiator has equal radiation intensity in all directions. In free space, the resultant spherical wave spreads out with uniform intensity in all directions.

Table 2.1: Overview of the Electromagnetic Spectrum (Wiskin et. al., 1992)

λ	Frequency	Band	Name	Propagation Mechanism	Application
100Mm to 10Mm	3Hz to 30Hz	1	ELF	Penetration below the surface of the earth	Submarine communication
10Mm to 1Mm	30Hz to 300Hz	2	ELF	Guided wave between the ionosphere and the Earth's surface	Navigation, communication, time signals, etc,
1Mm to 100km	300Hz to 3 kHz	3	ULF		
100km to 10km	3kHz to 30KHz	4	VLF		
10km to 1km	30kHz to 300 kHz	5	LF	Sky and surface waves	Sound broadcast direction finding
1km to 100m	300kHz to 3MHz	6	MF	Ionosphere E and F layer reflection	Sound broadcast
100m to 10m	3MHz to 30MHz	7	HF		Fixed and mobile services, sound broadcast
10m to 1m	30MHz to 300MHz	8	VHF	Terrain/building/tree diffraction and reflection.	BD I TV/mobile BD II radio BD III TV/mobile
1m to 100mm	300MHz to 3GHz	9	UHF	Atmospheric scatter and refraction	BD IV TV BD V TV Mobile phones
100mm to 10mm	3GHz to 30GHz	10	SHF	Rain absorption	Radio navigation links, Satellite TV
10mm to 1mm	30GHz to 300GHz	11	EHF	Atmospheric gas and rain absorption	Radar astronomy
1mm to 100μm	300GHz to 3THz	12	Far Infra-red		Heating
100μm to 10μm	3THz to 30THz	13	Infra-red		Heating
10μm to 1μm	30THz to 300THz	14			
1μm to 0.1μm	300THz	15	Light		Sight
			Ultra-violet		

If P_o is the power radiated by the isotropic source, the power density S at a radial distance R is just the radiated power divided by the surface area of the surrounding imaginary sphere:

$$S = \frac{P_o}{4\pi R^2} \quad W/m^2 \qquad \text{------(2.0)}$$

This power flux density is equal to the amplitude of Poynting vector

$$S = E \times H \qquad \text{------(2.1)}$$

$$E/H = \sqrt{\mu_o/\varepsilon_o} = 120\pi \text{ ohms} \qquad \text{------(2.2)}$$

The modulus of S therefore takes the value:

$$S = E^2(\sqrt{\varepsilon_o/\mu_o}) = E^2/120\pi \qquad \text{----------(2.3)}$$

where 120π is the intrinsic impedance of free space.

From the above, the electric field strength at a radial distance R is thus:

$$E = \frac{\sqrt{(30 P_o)}}{R} \quad V/m \qquad \text{--------(2.4)}$$

2.2.2 GROUND WAVE

This is sometimes called surface wave and can exist when the transmitting and receiving antennas are close to the surface of the earth and are vertically polarized. This wave, supported at its lower edge by the presence of the ground, is of practical importance at broadcast and lower frequencies. Thus all broadcast signals received in the daytime are ground waves.

2.2.3 SKY WAVES

This represents energy that reaches the receiving antenna as a result of a bending of the wave path introduced by the ionization in the upper atmosphere. This ionized region termed the ionosphere, which begins about 80Km above the earth's surface, accounts for practically all very long – distance radio communication.

2.2.4 SPACE WAVE

This represents energy that travels from the transmitting antenna to the receiving antenna in the earth's troposphere, the portion of the earth's atmosphere in the first 16km adjacent to the earth's surface. The space wave commonly consists of at least two components. One of these is a ray that travels directly from the transmitter to the receiver, while the other is a ray that reaches the receiver as a result of reflection or refraction produced by variations in the electrical characteristics of the troposphere, and by diffraction around the curvature of the earth, hills, etc. Radio transmitter from 30MHz i.e. at the frequencies used for television, frequency modulation, radar, etc is normally classified as space wave propagation.

2.3 PROPERTIES OF VHF AND UHF SIGNALS

The propagation of electromagnetic waves is very severely affected by the order of their frequency. The higher the frequency the more pronounced is the "line of sight" distribution of the signal. That is, at higher frequencies the receiver installation ought to 'see' the transmitting aerial. The process of reflecting the signals at frequencies above 40MHz from the upper layers of the atmosphere is no longer reliable for normal communication purposes. It will also be appreciated that the signal strength will be considerably reduced as the reception area becomes more distant. In countries where the population density is low, it is necessary for the transmitter to cover a large area; in these cases VHF transmission is particularly useful, because it provides increased coverage. In countries with large population centers, UHF transmission offer better facilities in allocating the available channels without adversely affecting the reception in the neighboring areas. Additionally, since very little man-made interference is generated at UHF frequencies, transmissions in the frequency band result in better quality reception (Hutson et. al., 1990).

The reception area in the true 'line-of-sight' region is governed not only by the earth's curvature, but also by the terrain. Actually, television signals can be received beyond the horizon owing to a small amount of 'bending' (refraction and diffraction) in the line of a radiated signal. This effect is especially noticeable at frequencies in band I (40MHz – 70MHz). Raising the transmitting aerial can further extend the usable reception area. Whenever possible, the primary transmitters are on high ground and have very tall masts. The signal coverage is also influenced by the radiated power of the transmitter.

Signals at these frequencies can be reflected from the surface of the earth, from hills, tall buildings and other obstacles. When this happens the receiving aerial will get at least two signals – the direct and indirect wave. The indirect, or reflected, wave has to cover a longer distance and arrives at the receiver after the direct signal. The resulting time delay produces a second image on the screen – known as a ghost image; it is possible to receive a number of reflected signals in this way, which result in several ghost images. Some improvement is obtained by using a highly directional aerial. The signal strength at any particular location is expressed in mV/m or μV/m; it gives the voltage induced in an aerial of effective length of 1m.

2.4 RADIO LINKS

The basic systems of any radio link is as shown below:

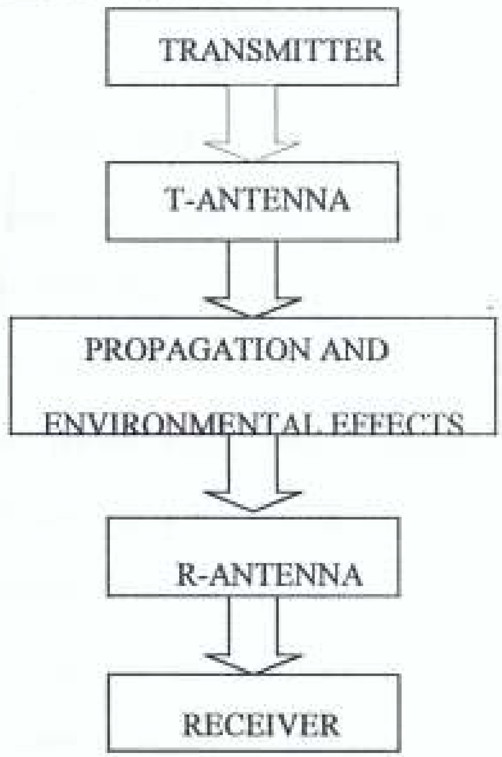


Figure 2.1. Block diagram of a radio link

2.4.1 TRANSMITTERS

The effective power of a transmission depends largely on the transmitter and its antenna system. Most transmitters are designed and factory built to user specifications which should conform to the ITU regulations. Internal losses due to components, signal -to- noise ratio at the output stage, sensitivity and selectivity of filters, the amplification and consequent output power of the transmitter, are some of the many factors that determine the quality of transmission. The frequency for which a transmitter is designed determines what portion of the spectrum the transmitter utilizes (Roberts, 1987).

2.4.1a VHF AND UHF TRANSMITTERS

These transmitters are designed to utilize radio frequency spectrum in the 30 to 300MHz for VHF and 300 to 3000MHz for UHF frequency bands. In addition to the conventional transmitters, VHF and UHF transmitters are often built with properly tuned and shielded filters to provide good carrier frequency stability, adequate channel separation, and minimum harmonic content of the power delivered to the antenna. It is necessary to provide an electrostatic shield between the power output stage of individual transmitters and the antenna coupling circuit and, a proper and effective shielding of either the entire transmitter or the building housing the transmitter in order to prevent interfering radiation from the antenna. The length of the feeder cable transmitter and its antenna should be kept to an effective minimum to minimize power loss due to dielectric hysteresis, leakage in insulating medium and an increase in conductor thermal resistance, (Green, 1979).

2.4.2 RECEIVERS

VHF and UHF receivers are designed and factory built to have high gain, highly selective well-tuned filters, particularly at the mixer stage to prevent unwanted interfering signals and harmonics from reaching the Intermediate Frequency (IF) stage. The receivers should be properly matched to their antenna feeders, each of effective minimum length. The input circuit of each receiver should be screened from any radiation emanating from the antenna. In addition to all these, a receiver and/or the building accommodating it should be properly screened against interference from any neighboring spurious radiation in order to guarantee optimum reception and consumption of spectrum at both VHF and UHF bands, (Green, 1979). However, the purity of VHF/UHF radio signals received after a tropospheric propagation depends upon both transmitting and receiving systems, variability of the vertical profile of refractive index and other characteristics of the intervening medium.

2.4.3 ANTENNAS

The purpose of an antenna is to radiate electromagnetic waves into free space (usually, but not necessarily, air). The power for this is supplied by a "feeder" which is often a length of transmission line or waveguide having a well defined characteristic impedance. One can regard an antenna as a kind of "transducer" to turn generated electrical energy into radiant energy. The acoustic equivalent of an antenna is a loud speaker, a microphone. Antennas are also used in "receiver mode" to collect electromagnetic radiation from "free space" and deliver the energy contained in the propagating wave to the feeder and receiver. Antenna fundamental properties and definitions are discussed below.

2.4.3a Isotropic Radiator

An "Isotropic Radiator" has no preferred direction of radiation. It radiates uniformly in all directions over a sphere centered on the antenna. It is a reference radiator with which other antennas are compared:

From equation 1.a;

$$S = \frac{P_o}{4\Pi R^2} \quad W/m^2 \qquad \text{-----------(1.a)}$$

This is because we are spreading the power P_o uniformly across the area $4\Pi R^2$ of a sphere of radius R. Since propagating electromagnetic waves are transverse, the electric and magnetic field vector directions are at right angles to the direction of travel of the wave. Clearly, then, we cannot realize an isotropic radiator in practice since there will be places in the unit sphere where we cannot specify a unique "polarization direction" for the direction of the electric field.

2.4.3b Antenna Directivity

Antenna Directivity is a measure of the ability of an antenna to concentrate the radiated power in a given direction, (Collin, 1988).

This is an efficient protection against interference transmission from a direction that is different from the signal direction (Boithias, 1987). In particular, as radio relay lines becomes increasingly dense, the required characteristics for antennas concerning the side lobe level becomes increasingly demanding.

2.4.3c Flux Density and EIRP

$$F = \frac{P_o}{4\Pi R^2} \quad W/m^2 \qquad \text{--------(1.b)}$$

From equation (1.b)

Where, P_o is the total radiated power

R is the Radius / Distance

F is the flux density /Field strength

For a transmitter with output P_t (W) driving a lossless antenna with gain Gt, the flux density in the direction of the antenna boresight at distance R (m) is

$$F = \frac{P_tG_t}{4\Pi R^2} \quad W/m^2 \qquad \text{---------(1.c)}$$

The product

$$P_tG_t\ (W) = EIRP \qquad \text{---------(1.d)}$$

EIRP is the Equivalent Isotropically Radiated Power.

$$EIRP = 10\log10\ (P_tG_t)\ dBW \qquad \text{----------(1.e)}$$

Where G_t is the gain of the transmitter.

2.4.3d GAIN

This is the term used to express the increase in signal for one antenna over a standard antenna, usually a half wave dipole having the same polarization. Antenna gain is generally used in connection with directional antenna systems with multiple elements and is measured in the optimum direction (Peckham, 1997). The gain is usually stated in decibels and its equation is as follows;

$$G = \frac{4\Pi A_e}{\lambda^2} \qquad \text{-----------(1.f)}$$

where G is the gain and A_e is the effective aperture.

2.4.3e EFFECTIVE APERTURE

The effective aperture of a receiving antenna A_e is defined as the ratio of received power P_R to the density S of the incident wave incident wave;

$$A_e = \frac{P_R}{S} \quad m^2 \qquad \text{----------(1.g)}$$

2.4.3f EIRP AND ERP

Equivalent Isotropically Radiated Power (EIRP) is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain).

The effective Radiated Power (ERP) of an aerial is the power that an isotropic radiator would have to radiate to produce the same field strength at a point in the direction of maximum radiation. Numerically, ERP is equal to the product of the total transmission power and the gain G_t of the aerial, i.e.

$$\text{ERP (W)} = P_tG_t \qquad \text{-------------(1.h)}$$

Or

$$\text{ERP (dB)} = \text{Transmitter Gain (dB)} + \text{Transmitted Power (dB)} \qquad \text{----(1.i)}$$

2.4.4 VHF AND UHF ANTENNAS

VHF and UHF antennas are used for communications and broadcasting to areas within about 100km of the transmitting site. As the frequency increases, propagation becomes increasingly similar to that of light, requiring the antenna to be supported as high as possible above the surrounding terrain to achieve maximum coverage. The mast or tower is only a means of supporting the antenna and plays little part in the radiation process.

2.4.5 PROPAGATION AND ENVIRONMENTAL EFFECTS

When propagation near the earth and not in free space is examined, several factors that did not exist in free space must be considered. Thus ground, mountains and buildings will reflect waves. Waves will be refracted as they pass through layers of the atmosphere that have differing densities and differing degrees of ionization. Also electromagnetic waves may be diffracted around tall, massive objects. They may even interfere with each other, when two waves from the same source meet after having travelled by different paths. Different media may also absorb waves. Environment could affect propagation of waves through reflection, refraction, diffraction and scattering.

2.4.5a Reflection

The return or change in direction of light, sound, radar or radio waves striking a surface or travelling from one medium into another is known as Reflection.

If the reflecting surface is smooth enough so each incident ray gives rise to a reflected ray in the same plane, the effect is known as direct reflection. If the surface is so rough that reflected rays are distributed in all directions, the effect is called diffuse reflection. A wave reflected from a surface, discontinuity, or junction of two different media, such as the sky wave in radio or the echo wave from a target in radar is known as a reflected wave.

The reflecting properties of an atmospheric layer depend on the severity of the refractive index gradient. Layer reflections tend to be most significant below frequency of 1GHZ. A quantitative understanding of the reflections from atmospheric layers is important since they can disturb the performance of fixed links and networks by introducing interference, anomalous fading and multipath.

One common source of reflections is the ground. It tends to be more of a factor on path in rural areas; urban settings, clusters of buildings, trees etc will block the ground reflection path.

2.4.5b Refraction

Refraction is the bending of a heat, light, radar, radio or sound wave as it passes obliquely from one medium to another in which the velocity of propagation is different.

The behavior of a ray travelling in the atmosphere is determined by the refractive index (M) of the air, which by definition is the square root of the dielectric constant. The aspect of refractive index (M), which is of importance in radio propagation, is the variation of M with height. Near the surface of the earth the dielectric constant over land usually decreases linearly with increase in height. This condition results in standard atmosphere.

However, when air masses that differ in temperature and moisture content overlay each other, the refractive index (M) curve will no longer vary with height i.e. the dielectric constant of the atmosphere increases with height, the ray path will be bent away from the earth as shown in figure 2.2. The curvature of the rays passing through the atmosphere is greater than that of the earth. As a result, energy originating in this region and initially directed approximately parallel to the earth's surface tends to be trapped and to propagate around the curved surface of the earth in a series of hops involving successive earth reflections as shown in a, b and c in figure 2.2.

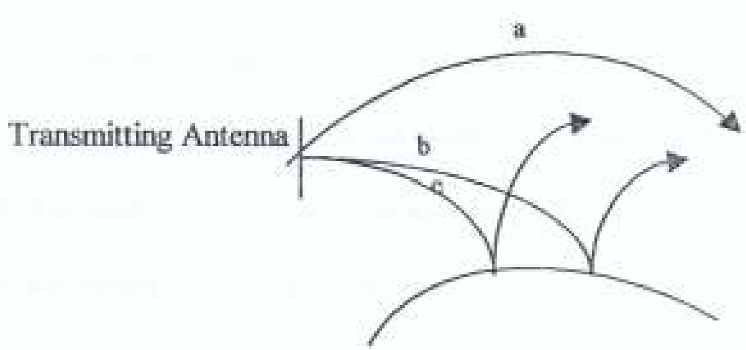


Fig. 2.2 Ray Concept of Duct Propagation.

This phenomena is known as Duct propagation or super-refraction.

This so-called ducting mechanism can mean that strong signals are propagated over long distance and the received field strength can be in excess of that due to free space propagation. In general, the effect is more prevalent over sea-paths or those in which the majority of the distance is over sea. Consequently, co - channel interference due to anomalous propagation over long distances for small percentages of the time must be put into account in planning.

2.4.5c Diffraction

Diffraction is the bending of a wave as it passes the edges of an object or opening. It is caused by interference between wave components scattered by different parts of the object. It is found that an obstruction in the path of a propagating radio wave does not cause an abrupt, dense shadow but that signals be observed behind an obstruction due to diffraction.

Diffraction occurs when the radio wave encounters a solid obstruction in its path or any component of the wave propagates over the earth's surface with irregular terrain. The curvature of the earth itself constitutes an obstruction when a long distance transmission is considered. Generally, diffraction processes result in transhorizon propagation, fading, attenuation and varied losses of radio waves.

2.4.5d Scattering

Scattering in radio waves is the dispersal of some fraction of the energy in radio waves propagating in the medium, owing to their encountering discontinuities and irregularities having dimensions of the order of a wavelength. Usually, the scattered waves of interest are either propagated in the same direction as the incident radiation (forward scatter) or those travelling in the opposite direction (called backscatter).

Scattering is usually a common occurrence in the troposphere due to clear air irregularities, irregular terrain, buildings or obstacles especially in urban areas, hydrometeors. The clear air irregularities are formed by a process that begins when large scale air masses of differing refractivity have some relative motion so that a shear exists at the interface. Shears may arise due to the horizontal movement of dissimilar air streams or through the vertical movements of warm and/or moist air particles in the air. At the shear boundary, a turbulent mixing of the two air types occur and large scale blobs or irregularities are born (Braun,1986).

Scattering in urban areas is mainly due to reflections from the surrounding obstacles mainly buildings. Hydrometeor could also cause scattering. Hydrometeor is the general term used to referring to the products of condensed water vapour in the atmosphere usually observed as rain, hail, ice, fog, cloud, or snow.

2.4.6 INTERFERENCE

Interference may be defined as an electromagnetic (or radioelectric) disturbance due to the superimposition of an unwanted signal on a wanted signal. Various levels of interference have been defined by the Radio Regulations;

1. Permissible interference corresponds to a level of interference, which, under given

conditions, implies degradation in reception quality to an extent which is regarded as insignificant. The value of this level generally appears in the recommendations of the International Telecommunication Union (ITU) or other international agreements and must be taken into account in system projects.

2. Acceptable interference corresponds to higher level of interference than in the previous case, implying moderate degradation in reception quality under given conditions, has been agreed between the authorities concerned.
3. Harmful interference corresponds to a level of interference that seriously degrades, obstructs or repeatedly interrupts a radio communication service. This definition is obviously very vague in numerous regulatory texts, where its vague nature is undoubtedly an advantage.

Problems and level of interference may be determined through evaluation of propagation factors, considering different propagation mechanisms such as line-of-sight, reflections, refraction, diffraction, tropospheric scatter and other anomalies, (Hall, 1996)

2.4.6a Co-channel Interference

Co-channel Interference occurs when applications of radio waves using the same Frequency channel, interfere with each other and mutually nullify the benefits they offer. Stations using the same channels must be separated by a particular distance if co-channel interference is to be avoided.

In Television, if the interfering signal is strong enough, its picture will be superimposed on the desired picture. In addition, there is usually a bar pattern resulting from the beat between the two picture carriers because of their offset frequencies (Conor, 1989).

2.4.7 ATTENUATION AND LOSSES

In a radio link, the ratio of the power supplied by the transmitter to the power available at the input of the receiver depends on such factors as attenuation, losses, etc, along the transmission path, (Hall, 1996). The combined effects of the troposphere and the terrain must be considered in considering the radio signal attenuation and losses along a propagation link.

For a point-to-point link, the free space attenuation between isotropic antenna, known as the basic transmission loss, L_b, is given by:

$$L_b \quad = \quad 20 \log_{10} \frac{4\pi d}{\lambda} \text{ dB} \qquad \text{---------(2.12)}$$

where d is the distance apart, λ is the wavelength, both of which are expressed in the same unit.

Equation (2.12) may also be written in the form:

$$L_b \quad = \quad 32.5 + 20\log_{10} f_{MHz} + 20\log_{10} d_{km} \qquad \text{-------(2.13)}$$

The concept of transmission losses may be extended to include the effects of the propagation medium, and of the antennas and the radio system actually in use. Free - space basic transmission loss, L_{bf}, relates to isotropic antennas and loss - free propagation;

Basic transmission loss, L_b, includes the effect of the propagation medium:

e.g. - absorption loss (ionospheric, atmospheric gases or precipitation) ;
diffraction loss

- effective reflection or scattering loss, in the ionospheric case including the results of any focusing or defocusing due to curvature of a reflecting layer;
- polarization coupling loss; this can arise from any polarization mismatch between the antennas for the particular ray path considered ;
- aperture-to-medium coupling loss or antenna gain degradation, which may be due to the presence of substantial scatter phenomena on the path ;
- effect of wave interference between the direct ray and rays reflected from the ground, other obstacles or atmospheric layers (Barclay, 1997).

Transmission Loss, L, includes the directivity of the actual transmitting antennas, disregarding antenna circuit losses;

System loss, L_s, is obtained from the powers at the antenna terminals; and

Total loss, L_t, is the ratio determined at convenient, specified, points within the transmitter and receiver systems.

2.4.8 AREA OF ACCEPTABLE QUALITY OF RECEPTION

Table 2.3 shows the ITU-R recommended values of median field strength (dB rel. μV/m) received at the standard height of 10m above the ground level, for which protection against interference must be planned for television services in Bands I, III, IV and V, respectively. The median field strength for protection ranges between +48dB for receivers in Band I and +70dB for receivers in Band V (Terman and Emmons, 1990). This exercise considers an average protection of +60dB (rel.1μV/m) or1mV/m field strength value for VHF and UHF television broadcasting systems in Nigeria. The coverage area whose boundary gives this value of field strength is popularly referred to as the secondary coverage area of the transmitter, and, an area of an acceptable quality of reception.

Table 2.3 Median Field Strength for Television Receiver Protection (Adeloye, 1999)

BAND	I	III	IV	V
DB (μV/m)	+48	+55	+65	+70 ITU-R (1986)

Coverage areas of broadcast stations are usually classified into primary, secondary and fringe areas. The size of each of these areas depends on the transmitter power, the directivity of the aerial, the ground conductivity and the frequency of propagation (Albert and Smith, 1996).

The coverage areas decrease with increase in frequency and reduction in the ground conductivity.

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 appropriate value of the field strength for this quality of service is dependent on the atmospheric and man made noise in the locality. The relevant field strength also depends on the whether the locality is rural, industrial or urban.

The secondary coverage area is a region where the field strength is often sufficient to be useful. The area is bounded by a field strength contour of 1mV/m. The 1mV/m (rel 1μV) is the boundary of universally acceptable area of good-quality reception.

The fringe coverage 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 from interference.

2.4.9 SERVICE AREA, FEILD STRENGTH AND NOISE

Calculations indicate that a primary service area for a UHF television broadcast transmission requires a minimum field strength of 64dB and 70dB relative to 1μV/m for band IV and Band V, respectively in the absence of co-channel interference (Grob, 1984). This implies minimum field strength of 1.6 mV/m and 3.2mV/m respectively.

In the absence of other signal degradations, it is the sum of the unwanted signal and noise components present that will determine the acceptability of a television transmission. This will be the sum of interfering signals and noise picked up by the aerial, collectively called source noise, and the thermal noise generated in the aerial plus the noise generated by the receiver circuitry.

2.4.10 PROTECTED FEILD STRENGTH

The fundamental requirements behind all of the proceeding signal distribution effort has been the provision of cost-effective coverage of acceptable quality. To be considered covered by the broadcasting organizations it must be possible for a viewer using an external standard directional aerial to receive acceptable sound and vision signals, substantially free from noise, delayed images (ghosts) or interference from other transmission from a large proportion of the time (Williams, 1991).

Because of the receiver's selectivity, it is unwanted transmissions occupying the same channel that constitute the most significant interference source. If an interfering signal is received at a significant level from a transmitter occupying the same channel allocation, the patterning on vision or noise on sound that results from the beat between the two carriers is called Co-Channel Interference (CCI). Weather conditions can affect VHF television reception for a small percentage of the time.

Tropospheric weather conditions influence propagation and can result in the 'bending' of UHF television signals so that they follow the earth's surface for several hundred miles. Foggy conditions are often associated with reports of interference due to long-distance television reception.

When two UHF vision carriers are nominally at the same frequency within the current maximum permitted tolerance, subjective tests show that the required signal has to be above unwanted signals by about 55dB, or 46dB for continuous or 5 per cent time tropospheric CCI, respectively i.e. it requires a protected field strength (Wiskin et. al., 1992).

2.5 THE RADIO SPECTRUM

The Spectrum is all frequency used for a particular purpose.

The Radio Spectrum spreads from 9KHz to many GHz. It contains many and different frequency bands applicable to many and different radiocommunication services of various bandwidth requirement. This various frequency bands could be used in different applications. They are used in submarine communication, navigation, sound broadcast, direction finding, fixed and mobile services, satellite television and radar astronomy. All these applications make use of different propagation mechanism.

2.6 SPECTRUM MANAGEMENT

The concept of spectrum management embraces all activities related to planning, allocation, assignment, use, and control of the radio frequency spectrum. Three objectives shape any spectrum management system: conveying policy goals, apportioning scarcity and avoiding conflicts.

The society is composed of various groups, each with its particular interests, goals and views on how to use and manage the spectrum resources. As a consequence of the spectrum scarcity, conflicts arise also between the proponents of competing uses of the spectrum as well as between those who manage the spectrum and those who use it.

For those whose needs have already been satisfied, spectrum management should assure the continuation of the existing status. Any modification will threaten their acquired benefits. On the other hand, new comers have no access to the spectrum they need. For them, the principal aim of spectrum management would be to change the way the spectrum is apportioned and to eliminate obstacles that prevent competition. The spectrum management rules and regulations tend to reflect the relative balance of powers of the competing interest groups. As demands on the spectrum increases, the management tasks grows more complex.

2.7 FREQUENCY PLANNING

In frequency planning, special techniques are being developed to accommodate the multitude of wanted and unwanted links. The simplest approach to frequency planning is the application of frequency distance restriction rules (Struzak, 1997). They specify the minimum geographic distance between two radio stations in function of their frequency separation.

When the frequency distance rules concern two transmitting stations, each transmitter is considered twice; first as wanted transmitter and then as interfering. In both cases the distance between them must not be less than that of the sum of the coverage range of the wanted transmitter and the interfering range of the other transmitter treated as interfering.

2.8 PROTECTION RATIO

When two or more transmitters or receivers which operate at the same frequency, but at different locations are considered, the protection ratio is the ratio in dB, by which the wanted signal has to be stronger than the unwanted signal. This refers in all cases to the ratios at the input of the receiver. It could also be treated in terms of signal-to-noise ratios.

Given the effective radiated power in kilowatt and the antenna height in meters, the protection ratio could be translated into land – distance separation between a pair of transmitters sharing the same frequency. Determination of the protection ratio could be done using two methods; one of which is used in this research work. The two methods are discussed as follows:

A. A significant parameter involved in the process of frequency sharing is the receiver input signal-to-interference $(S/I)_{in}$ ratio. The minimum value of this quantity, expressed in dB, determined under specified conditions, such that a specified reception quality of the wanted signal is achieved at the receiver output, is termed the protection ratio of the receiving system (Aries et. al., 1981).

This quantity can be calculated for continuously operating systems using the expression,

$$(S/I)_{in} = (S/N)_{in} - (I/N)_{in} \quad \text{-------(2.14)}$$

$$= (S/N)_{in} - (P_t + G_t - L_b + G_r - R_s - BW_{cf} - OFR) \quad \text{------(2.15)}$$

where $(S/N)_{in}$ = Input desired signal-to-noise ratio (dB)

$(I/N)_{in}$ = Receiver input interference-to-noise ratio (dB)

P_t = Transmitter power output (dB)

G_t = Transmitter antenna gain (dB)

L_b = Basic transmission loss between isotropic antenna (dB)

G_r = Receiver antenna gain (dB)

R_s = Receiver noise level (dBm)

BW_{cf} = Bandwidth correction factor (dB)

OFR = Off-tune reception (dB)

B. Where a total of N transmitters share a frequency, if any two transmitters, T_a and T_b, are taken from N, and considered at a time, then, there shall be

$$^{N}C_2 = \frac{N!}{(N-2)!2!} \quad \text{----(2.16)}$$

pairs of transmitter operating at one particular frequency (Adeloye, 1999).

If the service range of transmitter $T_a = R_a$ and

the service range of the transmitter $T_b = R_b$, the service range of the transmitter $T_b = R_b$,

If the limiting distance between T_a and $T_b = D_m$ and

the total distance between T_a and $T_b = D_t$.

Then, in any given pair of co-channel transmitters under consideration at a time, for each transmitter to be adequately protected against any harmful interfering radiation from the other, there shall be a protection ratio, R_p, given as:

$$R_p = \frac{D_t - (R_a + R_b)}{D_m} \quad \text{---------(2.17)}$$

Considering equation (2.17),

When $R_p > 1$, protection against harmful interference is adequate.

When $R_p = 1$, indicates a critical protection against interference.

When $R_p < 1$, protection against harmful interference in not adequate.

This method has been used in this research work, for the determination of the level of protection against co-channel interference. All calculations assume perfect free space and smooth earth's surface.

2.8.1 Separating Distance Dt

The separating distance (Dt) or the total distance between the two transmitters under consideration is one of the parameters used in the work for the calculation of the level of protection against co-channel interference.

2.8.2 Service Range of a Transmitter

The Service Range, R_a, of a transmitter is that range over which reception is of an acceptable quality; i.e. the secondary coverage area boundary.

The coverage area at whose boundary the median field strength is 1 mV/m and above is acceptable as spectrum space of good reception (Zarach and Morris, 1981). Therefore, for this research work, Field strength is assumed to be 1 mV/m.

The Service Range (R_a) of a transmitter could be calculated using the equation:

$$R = \frac{\sqrt{(30 P_o)}}{E} \qquad \text{-----(2.18)}$$

From equation 2.4,

Where R, E and P_o are as defined before.

In the work assumption has been made that free space loss L_{bf} is negligible, where the Free Space Transmission Loss is given as:

$$L_{bf} = \frac{20 \log (4\pi R)}{\lambda} \qquad \text{-----(2.19)}$$

where R is the distance apart and

λ is the wavelength

If Free Space Transmission Loss L_{bf} is negligible, then

i.e. $$L_{bf} \longrightarrow 0$$

$$\frac{20 \log (4\pi R)}{\lambda} \approx 0$$

$$\frac{\log (4\pi R)}{\lambda} \approx 0$$

$$\frac{(4\pi R)}{\lambda} \approx \text{Antilog}\ (0)$$

$$\frac{(4\pi R)}{\lambda} \approx 1$$

$$\therefore \quad R = \frac{\lambda}{4\pi}$$

where

$$\lambda = C / f$$

C is the Velocity of light i.e 3×10^8 m/s

f is the frequency of the station under consideration.

$$\therefore R \approx \frac{C}{4\pi f} \qquad \text{------(2.20)}$$

Taking into consideration equation (2.19) in using equation (2.17) gives:

$$R = \left(\frac{\sqrt{(30\ Po)}}{E}\right) \times \left(\frac{C}{4\pi f}\right) \qquad \text{-------(2.21)}$$

Equation (2.20) gives the service range of a transmitter.

Where R = the Service Range in (m)

P_o = Effective Radiated Power in (W)

E = Field Strength in (V/m)

C and f are as defined above.

2.8.3 Limiting Distance (D_m)

This is the minimum line - of - sight distance between the secondary coverage area boundaries of two transmitters that may or may not share the same frequency (Struzak, 1998). This distance varies with effective radiated power, antenna height, terrain and meteorological factors.

When the frequency distance rules concern two transmitting stations, each transmitter is considered; first as wanted transmitter and then as interfering. In both cases the limiting distance between them must not be less than that of the sum of the coverage range of the wanted transmitter and the interfering range of the other transmitter treated as interfering (Struzak, 1998).

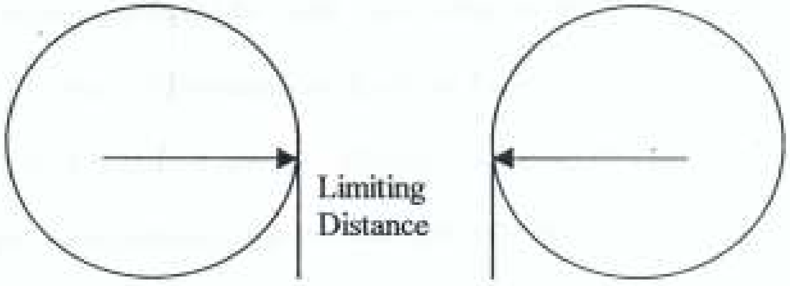


Figure 3.2 Limiting Distance between two stations.

Therefore, minimum distance is approximately given by the sum of the coverage range of the two transmitters involved. i.e.

$$D_m = (D_a + D_b) \text{ km} \qquad \text{---------(2.22)}$$

Where D_a is the coverage range of transmitter A considered as wanted and

D_b is the coverage range of transmitter B considered as interfering.

2.9 DEVELOPMENT AND GROWTH OF TELEVISION SERVICES IN NIGERIA

Television Services started with the establishment of a television station in Ibadan on October 31, 1959 with the intention of informing, educating and entertaining the people of the Western Region of Nigeria. The system had two transmitters installed in the station; one on Band I, Channel 3, at Abafon, and, the other on VHF Band I, Channel4, at Ibadan. It is now known as NTA Ibadan. Another VHF station was later established in Enugu a year later called the Eastern Nigeria Television Broadcasting Services which operated on VHF Band III, Channel 8, by the then Eastern Nigerian Government. In 1962, another VHF station was established in Kaduna, called Radio Kaduna Television. Thereafter, some other VHF stations were established in quick succession, to bring the number of fixed television transmitters to over 130 currently as shown in Table 2.2.

By Decree 24 of March, 1977, the Nigerian Television Authority (NTA) was inaugurated in May 1977. The decree empowered the NTA as the only body to undertake television broadcasting in Nigeria. In effect, the Federal Military Government, through NTA, took over all existing VHF stations in the country.

Due to the variety of cultural, social and other domestic background of the Nigerian people, the 1979 Constitution permitted individual states to own television broadcasting stations, but transmission were restricted to the UHF band.

The numerical growth of both VHF and UHF transmitting stations in Nigeria is therefore significantly influenced by the periodic socio-political restructuring of the country. Creation of new states has led to an increase in the number of television stations in the country.

On August 24, 1992 the Federal Military Government promulgated Decree No. 38 allowing private ownership of radio and television services in Nigeria (Report of the task force on planning of broadcast infrastructure, 1988). This has also caused a sudden rise in the number of radio and television installations in the country. The influence of deregulation on the growth of television services in Nigeria can be seen in table 2.2 (Adeloye, 1999).

Table 2.2 States Creation, Deregulation and VHF/UHF Frequency Utilization in Nigeria (Adeloye, 1999)

YEAR	VHF TV STATIONS	UHF TV STATIONS	TOTAL	NO OF STATES
1955	0	0	0	3
1959	1	0	1	3
1960	3	0	3	3
1963	4	0	4	4
1965	4	0	4	4
1967	4	0	4	12
1969	7	0	7	12
1970	8	0	8	12
1975	9	0	9	12
1976	10	0	10	19
1980	10	3	13	19
1984	46	14	60	19
1985	46	14	60	19
1989	48	16	64	21
1990	48	16	64	21
1992	54	20	74	30
1994	54	36	90	30
1995	58	56	114	30
1996	60	76	136	36
1998	60	86	146	36
2000 Projection	70	130	200	36

2.10 Overview of Visual Basic 5.0

Visual Basic 5.0 is an Object Oriented Programming (OOP) language developed to run on Windows NT or other higher versions of Windows operating system.

Visual Basic lets you add menus, textboxes, command buttons, option buttons, check boxes, list boxes, scroll bars, etc to blank windows. One can communicate with other Windows applications and access databases. One can have multiple windows on a screen, download little packages of code off the Internet.

2.10.1 Visual Basic Features

Visual Basic is an Object Oriented High level programming language but unlike a pure Object Oriented language such a s C++, making use of these objects in program is much easier. It just involves dragging predefined objects such as command buttons, textboxes etc. with mouse into the form.

It is also possible to insert controls such as spreadsheet features in Visual Basic program. Basically, Visual Basic involves creating the interface, setting properties and writing codes.

2.10.2 Visual Basic Advantages

The advantages of Visual Basic 5.0 are:

- Ability to design user interface with relative ease.
- Involves less coding.
- Ability to relate with other window application.

- Allows for an unlimited number of users to access the same database.

- It supports multitasking.

There are other advantages of Visual Basic 5.0 but the above are mainly the reasons why the program for this work has been written in Visual Basic 5.0.

CHAPTER 3

METHODOLOGY

3.1 FREQUENCY SHARING AND CO-CHANNEL INTERFERENCE

One of the objectives of this research work is to predict and make recommendations to reduce or prevent the effect co-channel interference on television receivers.

Interference could be predicted if the protection ratio for the systems involved is known. The protection ratio in this work was determined using the following parameters;

- frequency of the stations involved
- service range of the two transmitters involved
- separation distance between the two transmitters involved
- limiting distance between the two transmitters.

3.2 DATA COLLECTION

A list of both proposed and existing television station s in the country with their;

- name
- channel number
- frequency of operation
- location
- ERP (kW)
- Power output rated
- Antenna height
- Height above sea level
- Polarization

were obtained.

This list was obtained from two different sources; the National Communication Commission (NCC) and the Report of the Task Force on Planning of Broadcast Infrastructure, Volume 1.

These proposed and existing stations are listed frequency by frequency i.e. stations sharing the same frequency in Nigeria are grouped together for all VHF and UHF stations as shown in table1 in appendix B.

3.3 DETERMINATION OF PROTECTION RATIO

For protection ratio against co-channel interference to be determined, the proposed and existing television stations in each frequency group are paired i.e. they are considered a pair at a time.

In order to explain how the protection ratio is determined, a pair of television station is taken as a case study. The television stations used are Koko and Serti, both of which transmit at 175.25MHz (channel5).

As shown earlier in equation (2.17), the protection ratio of any two co-channel transmitters is given by:

$$R_p = \frac{D_t - (R_a + R_b)}{D_m}$$ (Adeloye, 1999)

Where D_t = Separating Distance between the two transmitters

D_m = Limiting Distance

R_a and R_b = Service range of transmitters A and B respectively.

A. **Separating Distance between Koko and Serti**

The procedures used in determining the separating distance D_t is as follows:

- Any topographical map having a scale, the latitude and longitude lines can be used.
- The places where the transmitters under consideration are sited are located on the map.
- A line-of-sight connection is made between these two places on the map using a ruler.
- This measurement is done in cm and converted to km using the map scale.
- This value is the separating distance or total distance D_t between the two transmitters under consideration.

Using this method, the separating distance between Koko and Serti is:

$$D_t = 898 \text{ km}$$

B. **Service Range for Koko (R_s)**

From equation (2.21) in section 2.8.2, the service range is given by

$$R = \left(\frac{\sqrt{(30 P_o)}}{E}\right) \times \left(\frac{C}{4\pi f}\right)$$

Where P_o is the ERP (W),

E is the field strength in V/m,

C is the speed of light in m/s and

f is the frequency in Hz.

From the data collected, for the television station named Koko;

ERP = 70KW, f = 175.25MHz,

$C = 3 \times 10^8$ m/s and E = 1mV/m for all stations as explained in section 2.8.2

$$\text{Therefore, } R_a = \left(\frac{\sqrt{(30 \times 70000)}}{0.001}\right)\left(\frac{3 \times 10^8}{4\pi \times 175.25 \times 10^6}\right)$$

$$= 197.382\text{Km}$$

Similarly, for Serti,

ERP = 100 kW, f = 175.25MHz,

$C = 3 \times 10^8$ m/s and E = 1mV/m

$$\text{Therefore, } R_b = \left(\frac{\sqrt{(30 \times 100000)}}{0.001}\right)\left(\frac{3 \times 10^8}{4\pi \times 175.25 \times 10^6}\right)$$

$$= 235.91 \text{ km}$$

C. The limiting Distance between Koko and Serti

The limiting distance according to equation (2.22) is given by:

$$D_m = (197.382 + 235.91) \text{ km}$$

$$= 434.3 \text{ km.}$$

Finally, from the above calculations, the protection ratio between the television stations Koko and Serti is given as ;

$$R_p = \frac{898 - (434.4)}{434.4}$$

$$R_p = 1.0672$$

Since the protection ratio is greater than 1, it shows that these two stations are adequately protected against co-channel interference.

3.4 SOFTWARE DESIGN

In this research work, a computer program has been written using Visual Basic 5.0 to determine the service range, limiting distance and then the protection ratio for any given pair of television station in a frequency group instead of using manual calculations.

The need for this computer program arises due to the fact that most of the stations considered are proposed and so most of their parameters could still be subjected to changes during implementation; therefore there is need for flexibility. The computer program written in this research work offers flexibility since it is able to accept changes in existing parameters and make recalculations without any stress.

The computer program written in Visual Basic 5.0 is a "user-friendly" one. Visual Basic 5.0 has been used because of its ability to design user interface with relative ease and with less coding.

The list of both existing and proposed station with their topographic and radio-electrical parameters (as shown in Asppendix B) was stored into Microsoft Access; a relational data base package. The advantage of data access object in Visual Basic is thereafter used in linking the data with the program in Visual Basic.

The flow chart below show how the program operates.

The program is divided into 6 modules which are;

- Introductory module
- Main module
- Data module
- Analysis module
- Reduction module
- Result module

Modules are series of program codes that perform a defined set of operation as designed by the programmer. The program is divided into modules in order to make accessibility and debugging easier.

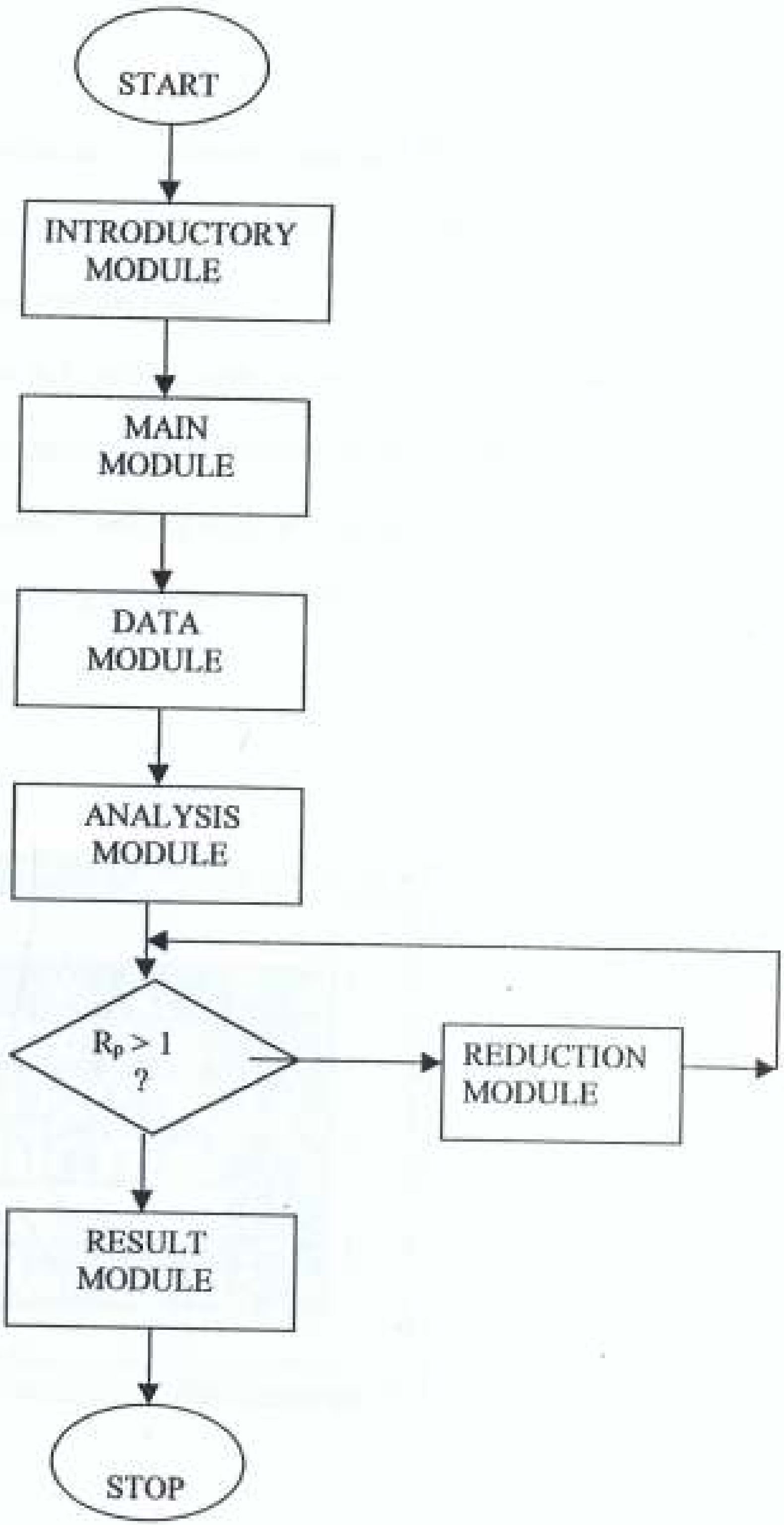


Figure 3.1 Flowchart showing the various modules in the system

3.4.1 Introductory Module

The Introductory module contains the introductory page and the introductory page and the code written for the page to function. It is designed to give the user a foreknowledge of what the project does; just like the title page.

The introductory page is shown in Figure 3.2 and the code is given in Appendix C. The computer program is designed to display this first before any other thing and it is designed to stay for 10 seconds on the screen except if there is a mouse click to which it has been programmed to respond by proceeding to the next module.

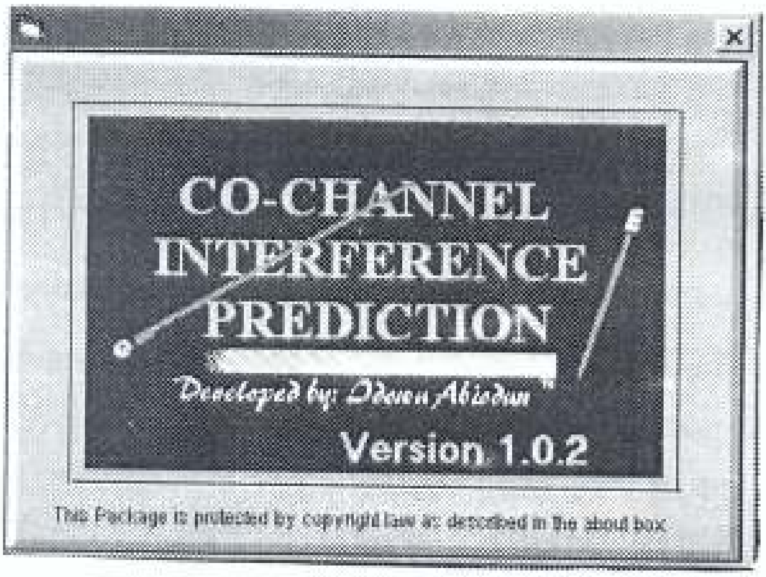


Figure. 3.2 Introductory Page

3.4.2 Main Module

The next module is the main module that has a code window. It is like the brain of the system. All other modules are linked to it. The module contains all equations necessary for the prediction of co-channel interference between two television stations i.e. it contains codes written for the program to calculate the service range , limiting distance and then the protection ratio for the two transmitters involved. This code is shown in Appendix C. All other modules are designed to support the main module in achieving the purpose for which it was designed.

3.4.3 Data Module

The data module contains the input template shown in Figure 3.3 and the code written for its operation is shown in Appendix C.

The function of this module is to accept the data needed for the calculation of the parameters necessary for the determination of the protection ratio.

For any given pair of transmitter under consideration, the information demanded by the data module are;

- Frequency of operation for the television stations
- Station name
- ERP
- Mode of propagation
- Mode of polarization
- Separating distance between the two transmitters considered.

The design is such that once a particular frequency is supplied to the input template, the stations using that frequency could be seen on the screen by clicking the list box i.e.▼. When a pair of transmitter is chosen, the ERP and distance apart is supplied from the data existing in the program (through Microsoft Access). The direction and mode of polarization is chosen by clicking the desired button.

Once all the necessary data has been supplied, the button called "process" is clicked for the calculation of the protection ratio.

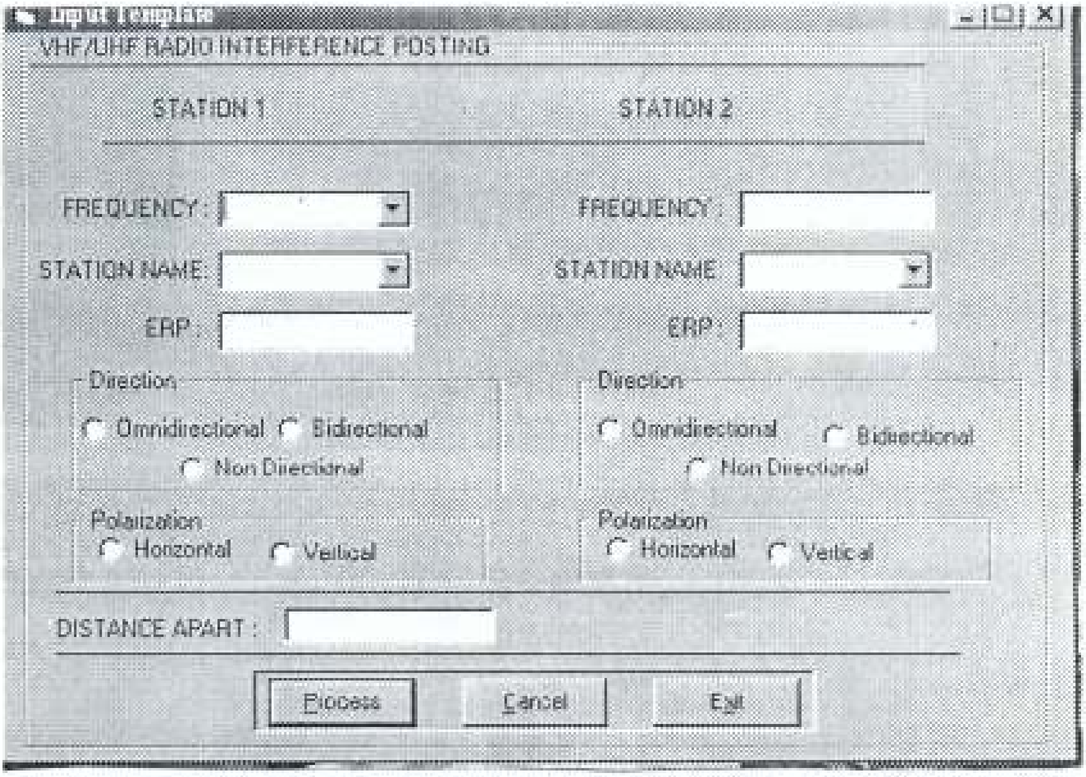


Figure 3.3. Input Template Form

3.4.4 Analysis Module

After the data required for the two transmitters has been supplied to the input template of the data module, the data is transferred to the analysis module. Here the parameters/data is supplied to it is analyzed for the presence of co-channel interference. The module consists of the "After Analysis" form and the set of code written for it. Analysis is done by considering a pair of co-channel transmitter at a time. The main module does the calculation of the protection ratio and the result is displayed on the "After Analysis" form as shown in Figure 3.4 below. The code written for this module is shown in Appendix C.

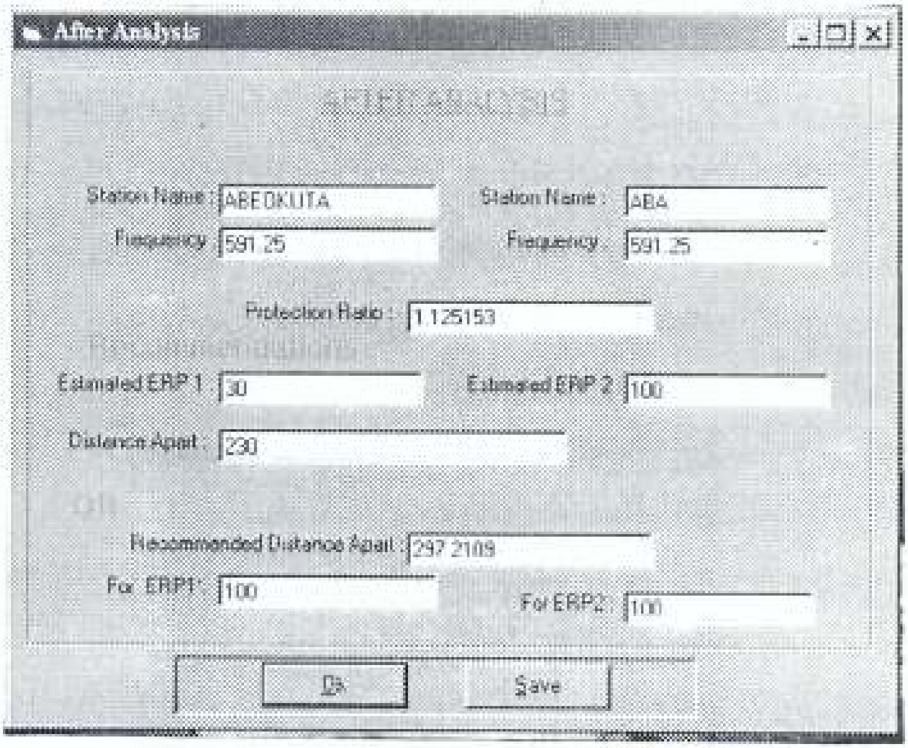


Figure 3.4 After Analysis Form

3.4.5 Reduction Module

If results, after analysis, shows that protection against harmful co-channel interference for the two transmitters is inadequate i.e. $R_p < 1$, then corrective exercise is done by the program in order to make protection adequate i.e. $R_p > 1$. This correction is done in the reduction module which consists of the "Change Parameters" shown in Figure 3.5 and the code written for it shown in Appendix C. Figure 3.6 shows the flow chart of what occurs in this module.

In a situation where protection ratio is inadequate i.e. $R_p < 1$, the system is designed in such a way that the corrective process could be done in two ways. One, by reducing the Effective Radiated Power (ERP) of either transmitters considered and two, by increasing the separating distance D_t between the two transmitters considered.

The parameters ERP and D_t are changed because field strength is directly proportional to the ERP and inversely proportional to D_t i.e. from equation 2.4;

$$E = \frac{\sqrt{(30\,P_o)}}{R} \quad \text{V/m}$$

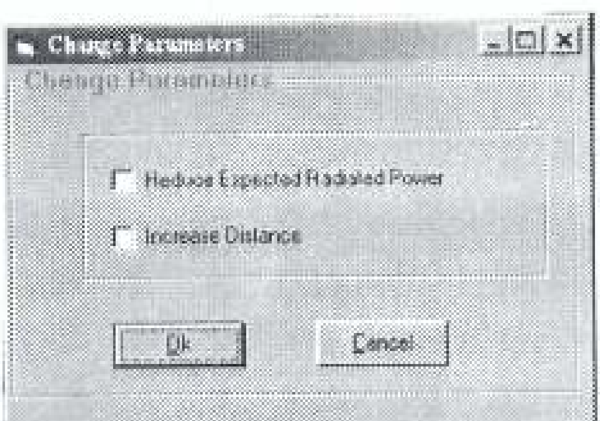


Figure 3.5 Change Parameter Form

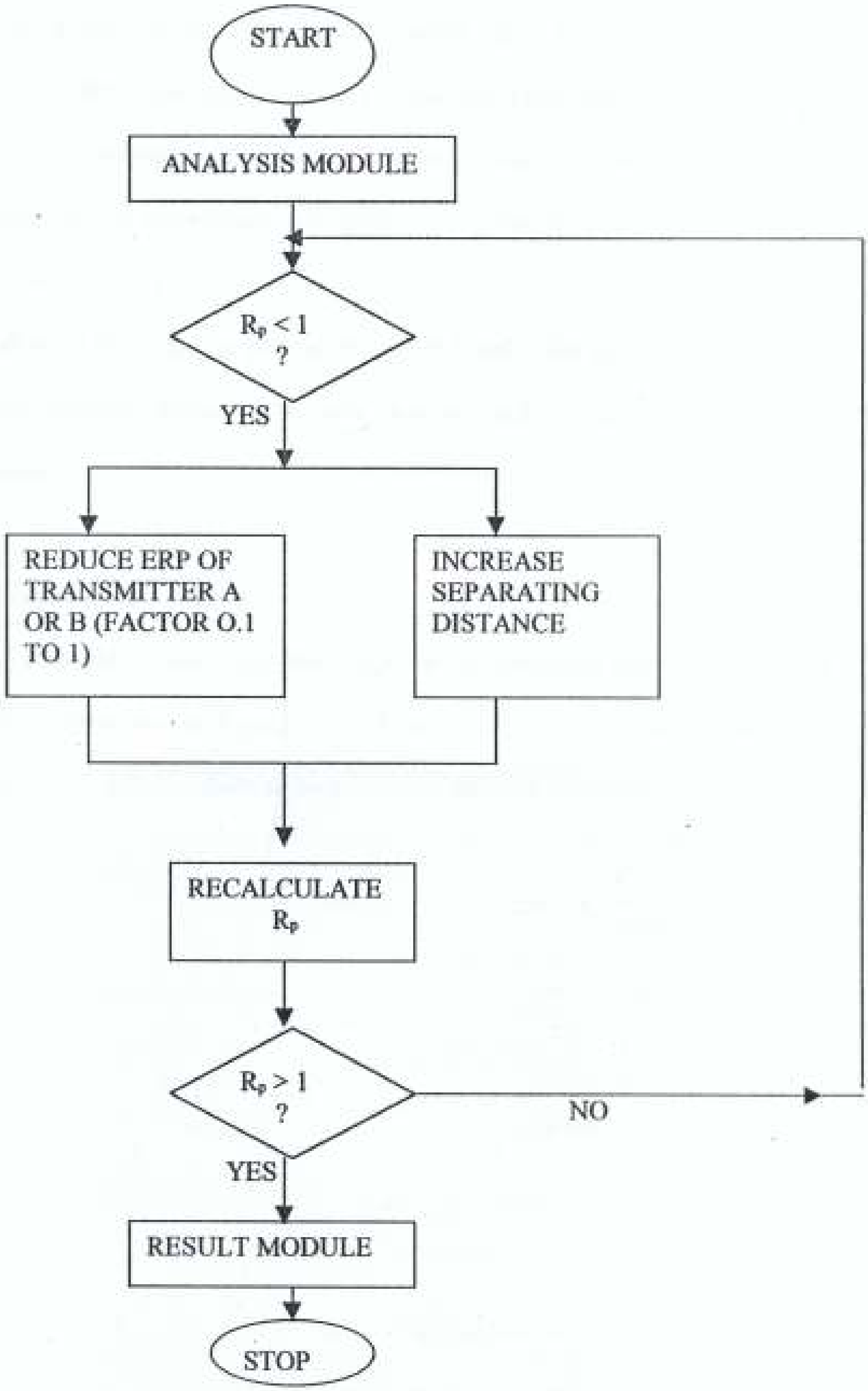


Figure 3.6 Flow Chart for Reduction Module

Therefore if the field strength of the unwanted signal must be reduced, we can either reduce the ERP of the transmitter or increase the separating distance between the two transmitters involved. After changes has been made on these two parameters, the protection ratio is recalculated with either of the two parameters until the R_p becomes greater than 1.

The reduction factor for the ERP is between 0.1 and1. The new ERP or distance used in achieving adequate protection is now recommended for use in the pair of stations considered.

3.4.6 RESULT MODULE

The result module is where the final output of the analysis is displayed. It consist of the "Result" form shown in Figure 3.7 and the code written for its operation shown in Appendix C.

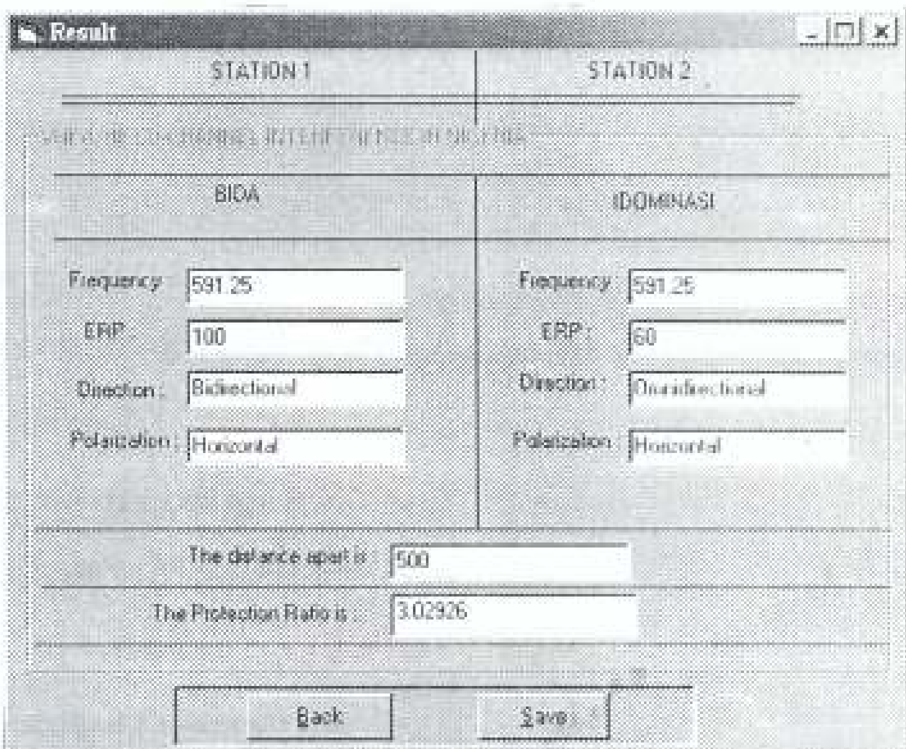


Figure 3.7: Result Form

It is able to save the results from the analysis module and recommendations made by the reduction module in database file in Microsoft Access. See Table 2 and Table 3 in Appendix B.

3.5 IMPLEMENTATION REQIREMENTS

Implementation is an important activity that defines the environmental conditions under which the system would function perfectly. The implementation requirements of this computerized system fall under two categories, namely; hardware requirements and software requirements.

3.5.1 Hardware Requirements

The hardware that would support this package must provide facilities that emphasize the package's functionality. For instance, the effect of the processing speed of the system on the package is enormous. A higher speed system would result in considerable reduction in the processing time of the package. The minimum hardware requirements for the operating system as a stand-alone are;

1. INTEL 80486 Mother board (Main board with a HZ processor speed).
2. 16MB RAM
3. 1.2GB Hard disk space
4. 1.44MB "3.5" Diskette drive
5. 1MB SVGA Card
6. Enhanced Keyboard

7. Mouse and Pad

8. Printer; that can support the 80/132 (letter grade) paper.

Other auxiliary equipment are required for perfect operations. The environmental conditioning is desirable for the effective and efficient computers. Air conditioners help reduce the effect of heat on the computers. Stabilizers and uninteruptible power systems are also needed especially in a country like Nigeria.

3.5.2 Software Requirements

Windows 95/98 operating system is required for this package. The choice is due to the fact that Windows, Microsoft's hyper-marketed operating systems controls about 85-90% of the operating systems market today (Akinyokun, 1999). This means that 8 to 9 of every computer system everywhere in the world currently runs on Windows, therefore any application developed on the window platform is sure to be widely usable.

3.5.3 Compilation and System Installation

As stated earlier, the program was written using Visual Basic language but in other to make it suitable to run in Windows environment, it had to be made into an executable form. It was made distributable by the use of Package and Deployment wizard. This wizard helps create packages that are distributable in floppy disks, compact disks, a local or network drive. The package option helps you package a project files into *. Cab file that be deployed and the deploy option helps you deliver your packaged application to the appropriate distribution media; in this case a floppy diskette.

3.5.3a Installation Procedure

The distribution medium for the system is 1.44MB diskette. The following steps highlight how to install the package on your machine:

- Boot the system
- Click on the "START" button , then "RUN" to load the "RUN" dialog box
- Click on the "BROWSE" button the "RUN" dialog box to specify the location of the setup.exe file (A:\)
- Click on the OK button on the open dialog box to return to the RUN dialog box.
- Make sure the path is correct in the PATH text box and click OK to commence the running
- Follow the instruction on the screen

OR

- Boot the system
- Click on the start button, the SETTING, then CONTROL PANEL
- On the control panel dialog box, locate ADD/REMOVE program icon and click on it
- Also on the ADD/REMOVE dialog box, make sure that no program was selected in the list box containing the applications on your machine, then click on install button and follow the instructions on the screen.
- Locate the setup.exe program in A (A:\ setup.exe), then click OK
- Follow the instructions on the screen.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 RESULTS AND DISCUSSION

Results shown in Table 2 (Appendix B) show that so many existing television stations have been operating under the effect of harmful co-channel interference and also some of the proposed television stations, if installed, will be subjected to this interference.

The chart in Figure 4.0 and Figure 4.1 shows the degree of protection for all VHF and UHF transmitters (both proposed and existing) in Nigeria. The Figures shows the result of analysis done using the developed computer program to predict the presence of harmful co-channel interference in all VHF and UHF television stations in Nigeria. The Figures also show that many television stations are not adequately protected against co-channel interference, an indication of requiring urgent attention.

Reports from some of the considered television stations visited justify the results in Table 2 (Appendix B). After analysis with the computer program the recommendation in Table 3 (Appendix B) were made for proposed VHF and UHF stations in Nigeria to prevent co-channel interference in the future.

There are two recommendations made for any pair of transmitter not adequately protected;

Recommendation 1	Increase Distance (km)	Initial ERP (kW)
Recommendation 2	Initial Distance (km)	Reduce ERP (Kw)

FIG4.0 Degree of Protection for Co-Channel VHF Transmitters.(Television)

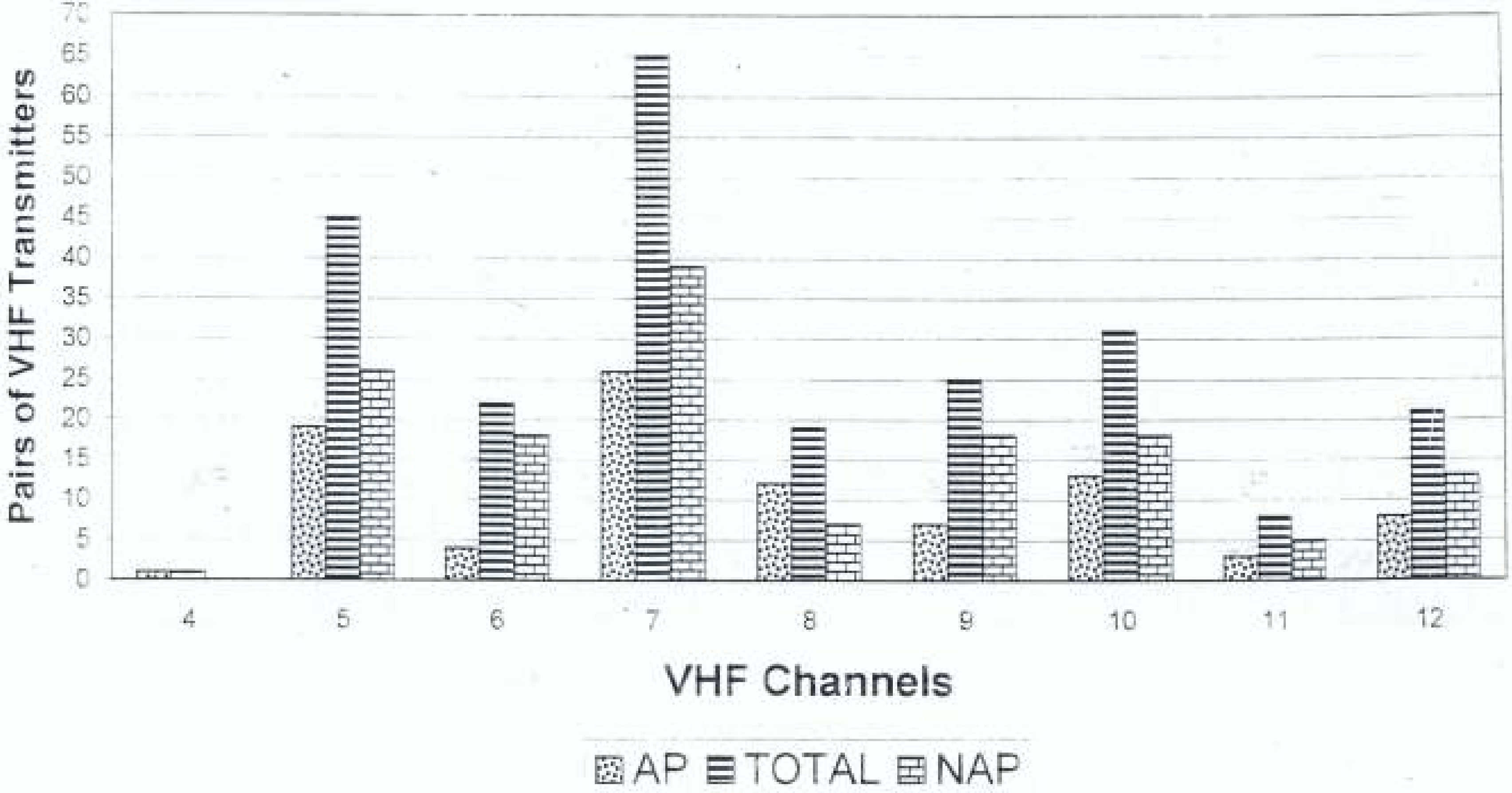
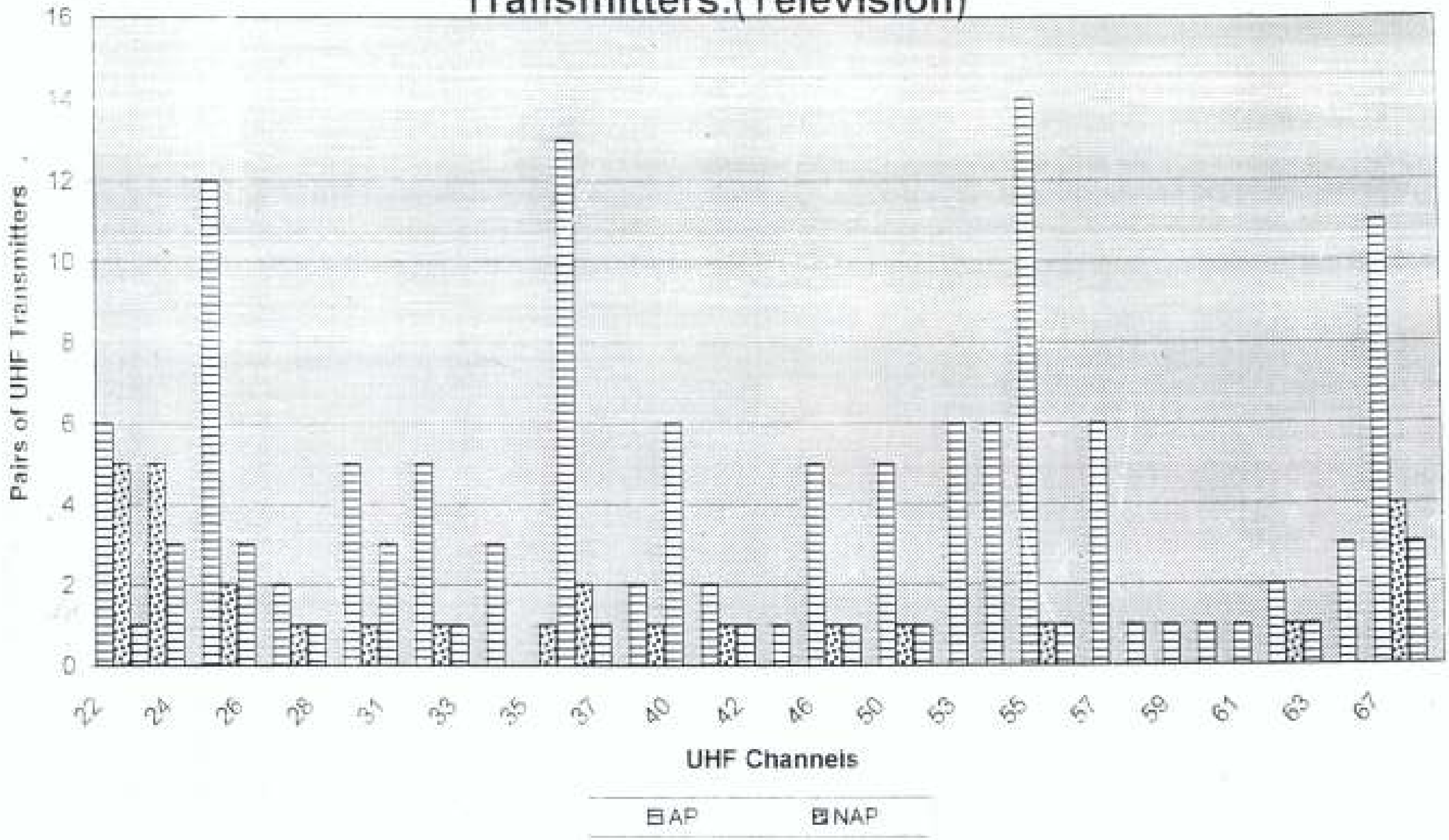


FIG.4.1 Degree of Protection for Co-Channel UHF Transmitters.(Television)



Either of these recommendations could be used to achieve adequate protection for the pair of transmitter considered. Before either of the recommendation is used, there are some factors that needs consideration. If the distance between the two transmitters considered must be changed one must ensure that the transmitter is still within the state where its services are required. If the ERP must be reduced, the cost of implementation and also the service area for which the transmitter is needed must be considered.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The problems of congestion of services and scarcity of interference-free spectrum for allocation to new services affects the radio frequency bands and it is especially observed in the VHF and UHF frequency bands. Due to this, most television stations in Nigeria share frequencies in order to operate and this exposes the stations to co-channel interference. Therefore, for satisfactory operation of similar systems sharing the same frequencies, acceptable, accurate and reliable co-channel interference prediction procedures are needed.

The focus of this exercise is to predict co-channel interference in the VHF and UHF frequency bands in Nigeria. The predictive exercise is done by determining the protection against co-channel interference enjoyed by each transmitter pair through the calculation of the protection ratio using a developed computer program.

Considering figures 4.0 and 4.1; it can be said, as observed, that installation of many of the existing television stations in Nigeria violated the ITU recommended guidelines.

The execution of this plan was manned by ethnic and political considerations that resulted in the arbitrary location of high power transmitter in places where they are not required. An example of this include Bida in Niger state which was originally planned to have a 1kW transmitter but ended up with a 10kW transmitter (Ministry of Information and Culture, 1988).

This has increased the number of stations that are not adequately protected against co-channel interference. Two television stations visited confirm this result;

- co-channel interference between Isele-Uku on channel 11 and Akure on channel 11
- co-channel interference between Ashileke on channel 7 and Tejuoso on channel 7.

Presently, there are more affected VHF stations than UHF stations in the country because VHF stations in the country were initially planned to have a nationwide coverage unlike UHF stations which are limited to their respective state of coverage. Also, this may be due to the fact that there are more existing VHF stations in Nigeria now than UHF stations.

The above has led to inefficient use of our spectrum resources and with the advancement in technology, this will eventually result into a serious problem in the nearest future.

The computer program and the results in Table 3 (Appendix B) is recommended as a planning tool for proposed stations in order to prevent a future possible increase in the number of unprotected stations in the country.

Although, the project did not make recommendation for any pair of existing, television transmitters affected by co-channel interference, the computer program could still be used. Where harmful interference arising from excessive transmitter power or excessive ERP is detected, it should immediately be corrected by power reduction or relocation of the transmitter to another place while a lower power transmitter replaces it according to the recommendation of changes and modifications that need to be effected in the short term for more efficient and economical services as stated in the Report of the Task Force on

Planning of Broadcast infrastructure, Volume1.

5.2 LIMITATIONS

- Lack of adequate funds made it impossible to visit most of the television stations which by our prediction experience co-channel interference and actually confirm these predictions.
- Unwillingness of the management of the affected television stations in implementing the recommendations provided in this research work in order to confirm its effectiveness. Their excuse is that most of the equipment used are not too good and because of the high maintenance cost, they could not be subjected to any form of adjustments if transmission must continue.

5.3 RECOMMENDATION

In this work, all calculations assumed perfect free space and smooth earth's surface. This assumption was made due to the non-availability of a suitable digitized map of the country that shows the hills, contours etc. in the country. It is not practicable to reach all existing transmitters located in the country due to the cost of travelling. Also, seasonal meteorological factors e.g. rain, temperature may be considered in order to verify the effects of their variability on the field strength and some other parameters needed in determining the protection against interference enjoyed by individual television services. It is therefore recommended that future research could be done, as soon as an appropriate digitized map of the country is available, in the area of considering the effect of environment and seasonal factors on propagation in the VHF and UHF band and how these subjects television stations in VHF and UHF bands to co-channel interference.

REFERENCES

1) Aboaba O.A., (1999). " Spectrum Management for VHF Broadcasting Services of the 21st Century". Proceedings of the 15th National Conference of COAN, Abuja, Nigeria. Vol. 10. Pp. 218-224.

2) Adeloye V.S.A., (1999). "Radio Frequency Spectrum Utilization and Utilization Efficiency in the VHF and UHF Frequency Bands in Nigeria". Unpublished Ph.D. thesis. University of Ilorin, Nigeria.

3) Akinyokun O.C., (1999). " Principles and Practice of Computing Technology". International Publishers, Nigeria. 327pp.

4) Albert A. and Smith J.R., (1996). "The Generation, Propagation and reception of Signals and Noise". IEEE Press, UK. 304pp.

5) Aries A., Sidney O.R. and John B., (1981). "Dictionary of Telecommunication". Butterworths, London. 532pp.

6) Barclay L.W., (1997). "Radio System Parameters". ICTP – URSI – ITU/BDT Workshop on the use of Radio for Digital Communication in Developing countries". 17th – 28th February. Lancaster University, UK. 41pp.

7) Grob B., (1984). "Basic Television; Principles and Servicing". 4th Edition. McGraw-Hill, New York. 464pp.

8) Boithias L., (1987). "Radiowave Propagation". McGraw Hill, New York. 330pp.

9) Braun G., (1986). "Planning and Engineering of Shortwave Links". 2nd Edition. John Willey, Berlin. 338pp.

10) Collin R.E., (1988). "Antennas and Radiowave Propagation". 3rd Edition. McGraw-Hill, London. pp. 365-369.

11) Conor F.R., (1989). "Introductory Topics in Electronics and Telecommunications; Antennas". 2nd Edition. Edward Arnold, London. pp. 88-91

12) Green D.C., (1979). "Radio Systems II", Pitman, Edinburgh. 116pp.

13) Hall M.P.H., (1996). "Overview of Radio Propagation". The Institution of Electrical Engineers". London, UK. 619pp.

14) Hutson H. G., Peter J.S. and James Brice W.S., (1990). "Colour Television; System Principles, Engineering Practise and Applied Technology". 2nd Edition. McGraw-Hill, London. 516pp.

15) ITU-R, Vol.V (1990). " Protection Ratios Required for Spectrum Utilization Investigations", Rep. 525. 4pp.

16) Peckham G., (1997). "Antennas". Radio Communication. http:// www.phy.hw.ac.uk/resources/antenna/index.html

17) Roberts R.S. Royal Television Society, (1987). Television Engineering; Broadcast, Cable and Satellite Part1, Pentech Press, London. 259pp.

18) Ministry of Information and Culture, "Report of the Task Force on Planning of Broadcast Infrastructure" (1988). Volume 1. 309pp.

19) Struzak R., (1997). "Spectrum Management, Technical Aspects: Lectures delivered at Workshop on Telecommunication", ICTP, Italy. 15th –30th February. 13pp.

20) Struzak R., (1998). "Introduction to Spectrum Management; Lectures delivered at Workshop on the use of Radio for Digital Communication in Developing Countries". ICTP, Italy. 12th – 30th January. 27pp.

21) Terman F. E., (1990). "Electronic and Radio Engineering". 4th Edition. McGraw-Hill, Auckland. 1078pp.

22) Williams I., (1991). "Radio Handbook". 2nd Edition. Howard, Indianapolis. 1189pp.

23) Wiskin G.W, Manton R.G. and Causebrook J.H., (1992). "Antennas and Service Planning". 1st Edition. Focal Press, UK. 609pp.

24) Zarach I.S. and Morris M.N., (1981). "Television Principles and Practise". 2nd Edition. Macmillan Press, London. 294pp.

APPENDIX B

1. PROPOSED/EXISTING FREQUENCY ASSIGNMENTS

Channel No	Frequency	Offset	Station_Name	Location(Lat/Long)	ERP	Power O/P Rated	Ant. Height (M)	Height Above Sea L	Polarizat
3	55.25	0	Sokoto	13 N01' 05 E06'	60	20	305	328	V
4	62.25	0	Ibadan	03 E56' 07 N42'	60	5	153	238	H
4	62.25	0	Jaji	07 E33' 10 N50'	40	5	152	662	H
5	175.25	0	Lagos (V. Island)	06 E27' 03 N27'	80	10	107	06	H
5	175.25	0	Kano	08 E38' 12 N01'	70	10	150	468	H
5	175.25	0	Koko	04 E31' 11 E28'	70	10	152	226	H
5	175.25	000	Azare	10 E11' 10 N41'	65	10	150	--	H
5	175.25	0	Mongun	09 E08' 09 N12'	56	10	107	476.3	H
5	175.25	8P	Kaduna (P)	07 E30' 10 N30'	60	10	150	--	H
5	175.25	0	Idominasi	04 N45' 07 E38'	60	15	137	366	H
5	175.25	0	Auchi (Jattu)	05 E37' 06 N19'	5	1	122	304.8	V
5	175.25	0	Serti (P)	07 N32' 11 E20'	100	10	150	--	H
5	175.25	0	Abuja	07 E30' 09 N03'	60	10	100	---	H
5	175.25	8M	Yenagoa	04 N55' 06 E17'	65	10	150	12	H
5	175.25	0	Umunede	06 N02' 06 E02'	20	0	80	248	H
6	182.25	000	Egbe	05 E30' 08 N12'	40	5	57	--	H
6	182.25	0	Kaima (P)	03 E55' 09 N34'	40	10	97	--	V
6	182.25	0	Aba	07 E24' 05 N07'	100	10	165	241	H
6	182.25	000	Ayangba	07 E08' 07 N32'	60	10	97	--	H
6	182.25	2P	Dustinam (P)	12 N26' 07 E28'	60	10	150	--	H
6	182.25	0	Jalingo	11 E02' 08 N54'	65	10	250	230	H
6	182.25	0	Kaduna (P)	07 E30' 10 N30'	50	10	100	--	H
7	189.25	0	Ikom	08 E43' 05 N58'	80	10	97	107	H
7	189.25	0	Uzalla	05 E40' 06 N22'	100	10	135	167.6	H
7	189.25	8M	Okuta (P)	08 N13' 03 E28'	100	10	150	--	H
7	189.25	8P	Utonkon	06 N57' 08 E03'	65	10	150	107	V
7	189.25	0	Sokoto (T.Amodu) (P))	04 E33' 12 N45'	65	10	122	152	H

7	189.25	0	Jos	08 E52' 09 N53'	75	10	107	464.2	H
7	189.25	0	Tejuoso	05 E40' 06 N22'	80	10	100	50	H
7	189.25	0	Funtua	07 E19' 11 E32'	80	10	125	748.4	H
7	189.25	0	Kontagora	05 E25' 10 N21'	60	10	150	384	H
7	189.25	8M	Arbus	09 E47' 12 N36'	38	5	150	530	H
7	189.25	0	Gombe	11 N09' 10 E17'	60	10	150	536	H
7	189.25	000	Asileke	04 E19' 06 N17'	30	5	136	438	H
7	189.25	8P	Damaturu (P)	11 N42' 11 E56'	70	10	150	--	H
8	196.25	0	Birnin Kudu	09 N29' 11 E28'	50	5	85	620	H
8	196.25	0	Abor Hill Enugu	07 E25' 06 N27'	100	10	208	606	H
8	196.25	81	T.Marafa	12 N34' 06 E05'	50	10	150	--	V
8	196.25	0	Ikeja	06 E27' 03 N27'	50	10	100	---	H
8	196.25	0	Yola	09 N18' 12 E21'	40	10	150	186	H
8	196.25	8P	Gudumbali (P)	12 N55' 13 E10'	100	10	150	--	H
8	196.25	0	Wukari	09 E47' 07 n53'	60	0	61	184	H
8	196.25	0	Tsanni (Katsina)	13 N00' 07 E38'	50	20	150	795	H
9	203.25	8M	Kaugama (P)	12 N28' 09 E44'	100	10	150	150	H
9	203.25	0	Lafia	08 N29' 08 E33'	80	10	150	--	H
9	203.25	0	Chokochoko	06 E30' 07 N56'	40	5	97	--	H
9	203.25	0	Isele-Uku (P)	06 E28' 06 N19'	50	10	100	--	H
9	203.25	0	Calabar (P)	08 E20' 05 N02'	50	10	105	69	H
9	203.25	000	Eku	05 E59' 05 N44'	50	5	122	--	V
9	203.25	8M	Erunwon (P)	06 N53' 04 E00'	100	10	150	--	H
9	203.25	0	Gusau	06 E42' 12 N09'	60	10	152	481	H
9	203.25	8P	Gombi (P)	10 N10' 12 E44'	80	10	150	625	H
9	203.25	0	Ilorin (Gamo)	05 E05' 08 N12'	30	10	162	329	H
9	203.25	000	Bauchi	09 E52' 10 N20'	60	10	150	176	H
10	210.25	0	Kano	08 E38' 12 N01'	80	10	150	468	H
10	210.25	0	Kachia	07 E58' 09 N48'	70	10	150	795.5	H
10	210.25	8P	Gunmi (P)	12 N10' 04 E07'	60	10	150	--	H
10	210.25	0	Lagos (V.I.)	06 E27' 03 N27'	40	10	100	06	H
10	210.25	8M	Igboho (P)	08 N10' 03 E45'	60	10	150	--	H

10	210.25	0	Maiduguri	13 E08' 11 N49'	70	10	150	333
10	210.25	0	Minna	06 E23' 09 N36'	50	10	126	36576
10	210.25	0	PortHarcourt	06 E58' 04 N52'	100	10	139	13
10	210.25	8P	Zaria	11 N00' 07 E40'	65	10	150	--
11	217.25	0	Isele-Uku	06 E28' 06 N19'	100	10	152	265.2
11	217.25	8M	Gashua (P)	12 N50' 11 E02'	65	10	150	--
11	217.25	8P	Abuja (P)	07 E30' 09 N03'	60	10	150	495
11	217.25	0	Ughelli (P)		40	10	100	500
11	217.25	0	Akure	05 E16' 07 N23'	60	10	200	373
11	217.25	0	Keffi	07 E52' 08 N51'	50	10	137	139.1
12	224.25	8P	Uyo	05 N00' 07 E54'	60	10	150	61
12	224.25	0	Langtang	09 E47' 09 N09'	50	10	107	233.6
12	224.25	000	Bida	06 E01' 09 N05'	80	10	150	179
12	224.25	0	Ughelli	06 E00' 05 N29'	40	10	152	--
12	224.25	8M	Okitipupa (P)	06 N30' 04 E50'	40	10	150	--
12	224.25	0	Kastina-Ala	09 E20' 07 N13'	70	10	97	130
12	224.25	0	Abeokuta	03 E20' 07 N09'	80	10	229	514
12	224.25 0	8P	Ranko (P)	11 N25' 05 E55'	100	10	150	--
21	471.25	0	New Bussa (P)	09 N53' 04 E33'	200	20	150	--
21	471.25	0	Okuta (P)	08 N13' 03 E28'	200	20	150	--
22	479.25	0	Gashua (P)	12 N50' 11 E02'	100	20	150	--
22	479.25	8M	PortHarcourt (P)	06 E58' 04 N52'	100	20	150	13
22	479.25	0	Ikorodu (P)		200	20	150	107
22	479.25	0	IBW.Ent. Benin	05 N40' 06 E22'	200	20	150	--
22	479.25	0	OSBC, Ibokun	06 N53' 04 E00'	200	20	150	--
23	487.25	8P	Keffi (P)	07 E52' 08 N51'	100	20	150	138.1
23	487.25	8M	Isele-Uku (P)	06 E28' 06 N19'	100	20	150	265.2
23	487.25	8P	Kontagora (P)	C5 E25' 10 N21'	100	20	150	384
23	487.25	0	S.Gida (P)	07 N29' 10 E21'	200	20	150	--
24	495.25	0	Epe	06 N35' 03 E25'	200	20	150	--
24	495.25	8M	Jalingo (P)	11 E02' 08 N54'	200	20	150	230

24	495.25	8P	Gombi (P)	10 N10' 12 E44'	100	20	150	625
25	503.25	8M	Yenagoa	04 N55' 06 E17'	200	20	150	12
25	503.25	0	Kastina (P)	13 N00' 07 E38'	200	20	150	79
25	503.25	0	Dikwa (P)	12 N00' 13 E53'	200	20	150	--
25	503.25 0	8P	Gunmi (P)	12 N10' 04 E07'	200	20	150	--
25	503.25	0	Zaria	11 N00' 07 E40'	200	20	150	--
25	503.25	8M	Abeokuta	03 E20' 07 N09'	200	20	150	51
26	511.25	8M	Azare (P)	10 E11' 10 N41'	200	20	150	-
26	511.25	000	Asileke	04 E19' 08 N17'	65	20	150	43
26	511.25	8M	Onitsha (P)	06 N08' 06 E47'	60	20	150	152
27	519.25	0	Jos (P)	08 E52' 09 N53'	100	20	150	464.2
27	519.25	0	Kaima (P)	03 E55' 09 N34'	100	20	150	--
27	519.25	8M	Chokochoko (P)	06 E30' 07 N56'	200	20	150	--
28	527.25	000	Badagry (P)	06 N25' 02 E18'	200	20	150	--
28	527.25	0	Zalau	10 N45' 08 E13'	200	20	150	--
28	527.25	0	BCOS, Ibadan	03 E56' 07 N42'	60	20	150	--
30	543.25	8M	Ibadan	03 E56' 07 N42'	200	20	150	238
30	543.25	0	Makurdi (P)	08 E32' 07 N44'	200	20	150	200
30	543.25	0	Sokoto (P)	13 N01' 05 E06'	200	20	305	328
30	543.25	8P	Owerri (P)	05 N27' 07 E01'	200	20	150	70
31	551.25	8M	Akure	05 E16' 07 N23'	200	20	150	373
31	551.25	8M	Serti (P)	07 N32' 11 E20'	100	20	150	--
31	551.25	8M	Kazaura (P)	12 N40' 08 E25'	200	20	150	476
31	551.25	8P	Ugep (P)	05 N47' 08 E04'	200	20	150	91
32	559.25	8P	Funtua (P)	07 E19' 11 E32'	80	20	150	748.4
32	559.25	0	Forcados (P)	05 N23' 05 E22'	200	20	150	--
32	559.25	0	Maiduguri (P)	13 E08' 11 N49'	100	20	150	333
32	559.25	8M	Bopo (P)	07 N37' 07 E50'	200	20	150	--
33	567.25	8P	Minna (P)	06 E23' 09 N36'	100	20	150	36576
33	567.25	0	Gombe (P)	11 N09' 10 E17'	100	20	150	536
34	575.25	8M	Oshogbo (P)	07 N45' 04 E35'	200	20	150	--
34	575.25	8M	Serti (P)	07 N32' 11 E20'	100	20	150	--

34	575.25	0	Darazo (P)	11 N00' 10 E24'	200	20	150	--	H
35	583.25	0	Kwara TV, Ilorin	05 E05 08 N12'	200	20	150	--	H
35	583.25	0	LTV, Ikeja	06 E27' 03 N27'	60	20	150	--	H
36	591.25	8M	dominasi (P)	04 N45' 07 E38'	100	20	150	366	H
36	591.25	8M	Abeokuta (P)	03 E20' 07 N09'	100	20	150	514	H
36	591.25	8M	Bida (P)	06 E01' 09 N05'	100	20	150	179	H
36	591.25	0	Sokoto (P)	13 N01' 05 E06'	200	20	305	328	H
36	591.25	8P	Aba (P)	07 E24' 05 N07'	100	20	150	241	H
36	591.25	0	Makurdi (P)	08 E32' 07 N44'	200	20	150	200	H
37	599.25	8M	Gombe (P)	06 N42' 11 E15'	200	20	150	--	H
37	599.25	8P	Ohafia (P)	06 N35' 07 E52'	200	20	150	--	H
38	607.25	8M	Akangba (P)	07 E08' 07 N32'	100	20	150	--	H
38	607.25	0	Desminus,Kaduna	07 E30' 10 N30'	200	20	150	--	H
38	607.25	0	Borno TV, Maidg.	13 E08' 11 N49'	200	20	150	--	H
39	615.25	0	Jos (P)	08 E52' 09 N53'	200	20	150	464.2	H
40	623.25	8M	Bauchi (P)	09 E52' 10 N20'	120	20	150	716	H
40	623.25	8M	Ughelli (P)	06 E00' 05 N29'	100	20	150	--	H
40	623.25	8P	Yola	09 N18' 12 E21'	200	20	150	186	H
40	623.25	8P	Bangi (P)	13 N29' 04 E38'	200	20	150	--	H
41	631.25	8M	Auchi (P)	05 E37' 06 N19'	200	20	150	438.0	H
41	631.25	8P	Meringa	10 N46' 12 E10'	200	20	150	--	H
41	631.25	0	Igboho (P)	08 N10' 03 E45'	200	20	150	--	H
42	639.25	0	Mongun (P)	09 E08' 09 N12'	200	10	150	476.3	H
42	639.25	8M	Koko (P)	04 E31' 11 N28'	200	20	150	226	H
43	647.25	0	Geidam (P)	12 N52' 11 E53'	200	20	150	--	H
43	647.25	8M	Bauchi (P)	09 E52' 10 N20'	200	20	150	716	H
44	655.25	0	Ilorin (P)	05 E05' 08 N12'	200	20	150	329	H
44	655.25	8M	Kaugama	12 N28' 09 E44'	200	20	150	--	H
45	663.25	8M	Aiyede	07 N51' 05 E20'	200	20	150	--	H
45	663.25	8P	Ogoja (P)	06 N38' 08 E49'	200	20	150	131.6	H
46	671.25	8M	Eku (P)	05 E59' 05 N44'	200	20	150	--	H
46	671.25	8P	Yola	09 N18' 12 E21'	200	20	150	186	H

46	671.25	8P	Enugu (P)	07 N25' 06 E47'	200	20	150	606	H
46	671.25	8M	Bauchi (P)	09 E52' 10 N20'	200	20	150	176	H
46	671.25	0	Dustinam (P)	12 N26' 07 E28'	200	20	150	--	H
46	671.25	0	Gudumbali (P)	12 N55' 13 E10'	200	20	150	--	H
48	687.25	8M	Kano (P)	08 E38' 12 N01'	200	20	150	468	H
49	695.25	0	Maiduguri (P)	13 E08' 11 N49'	200	20	150	333	H
49	695.25	0	Jebba	09 N53' 04 E50'	200	20	150		H
50	703.25	0	Moriki (P)	12 E54' 06 E30'	200	20	150	--	H
50	703.25	0	THC Abuja	07 E30' 09 N03'	200	20	150	--	H
50	703.25	0	Enugu TV, Enugu	07 N25' 06 E47'	200	20	150	--	H
50	703.25	8P	Abuja (P)	07 E30' 09 N03'	200	20	150	495	H
51	711.25	8P	Ikom	08 E43' 05 N58'	200	20	150	107	H
51	711.25	8M	Kano (P)	08 E38' 12 N01'	200	20	150	468	H
52	719.25	8P	Utonkon (P)	06 N57' 08 E03'	200	20	150	107	H
53	725.25	0	Galaxy, Ibadan	03 E56' 07 N42'	200	20	150	--	H
53	725.25	0	PRTV, Plateau	08 E52' 09 N53'	200	20	150	--	H
53	727.25	0	Katsina-Ala (P)	09 E20' 07 N13'	200	20	150	130	H
54	735.25	8P	Minna (P)	06 E23' 09 N36'	200	20	150	36576	H
54	735.25	8P	Calabar (P)	08 E20' 05 N02'	200	20	150	69	H
54	735.25	0	Mallamawa (P)	13 N30' 05 E51'	200	20	150	--	H
54	735.25	8M	Kano (P)	08 E38' 12 N01'	200	20	150	468	H
55	743.25	0	BBST, Benin	05 N40' 06 E22'	200	20	150	--	H
55	743.25	8M	Arbus (P)	09 E47' 12 N36'	200	20	150	530	H
55	743.25	0	Ilorin (P)	05 E05' 08 N12'	200	20	150	329	H
55	743.25	8P	Kaduna (P)	07 E30' 10 N30'	200	20	150	--	H
55	743.25	0	RSTV, Pharcourt	06 E58' 04 N52'	200	20	150	--	H
55	743.25	0	BRTV, Maiduguri	13 E08' 11 N49'	200	20	150	--	H
53	751.25	8P	Uyo (P)	05 N00' 07 E54'	200	20	150	61	H
56	751.25	8P	Uyo (P)	05 N00' 07 E54'	200	20	150	61	H
56	751.25	8M	Erunwon (P)	06 N53' 04 E00'	200	20	150	--	H
57	759.25	0	Maiduguri (P0	13 E08' 11 N49'	200	20	150	333	H
57	759.25	0	Makurdi	08 E32' 07 N44'	200	20	150	200	H

57	759.25	8M	Bauchi	09 E52' 10 N20'	200	20	150	716	H
57	759.25	8M	Abeokuta	03 E20' 07 N09'	200	20	150	514	H
57	759.25	0	Sokoto	13 N01' 05 E06'	200	20	305	328	H
58	767.25	8P	Abuja	07 E30' 09 N03'	200	20	150	495	H
58	767.25	8M	Benin	05 N40' 06 E22'	200	20	150	--	H
51	771.25	8M	Akure	05 E16' 07 N23'	200	20	150	373	H
59	775.25	0	Birnin Kebbi	12 N27' 04 E12	200	20	150		H
59	775.25	8P	Bassawa	10 N53' 06 E46'	200	20	150	--	H
59	775.25	0	Damaturu	11 N42' 11 E56'	200	20	150	--	H
50	783.25	8M	Egbe	05 E30' 08 N12'	200	20	150	--	H
60	783.25	8P	Ranko	11 N25' 05 E55'	200	20	150	--	H
60	783.25	0	Potiskum	11 N43' 11 E04'	200	20	150	--	H
61	791.25	8P	Abuja	07 E30' 09 N03'	200	20	150	495	H
62	791.25	8M	Kubli	10 N23' 04 E10'	200	20	150	--	H
61	791.25	8M	Okitipupa	06 N30' 04 E50'	200	20	150	--	H
62	799.25	0	Langtang	09 E47' 09 N09'	200	20	150	233.6	H
62	799.25	8P	Kaduna	07 E30' 10 N30'	200	20	150	--	H
63	807.25	8P	Kachia	07 E58' 09 N48'	200	20	150	795.5	H
63	807.25	0	Ilorin	05 E05 08 N12'	200	20	150	329	H
64	814.25	8P	Yola	09 N18' 12 E21'	200	20	150	186	H
64	814.25	8M	Benin	05 N40' 06 E22'	200	20	150	--	H
64	815.25	0	Gusau	06 E42' 12 N09'	200	20	150	481	H
65	823.25	8M	Ikare	07 N35' 05 E44'	200	20	150	--	H
67	839.25	0	Minaj Sys. Obosi		200	20	150	--	H
67	839.25	0	Lagos	06 E27' 03 N27'	200	20	150	06	H
67	839.25	8M	PortHarcourt	06 E58' 04 N52'	150	20	150	13	H
67	839.25	8M	Jalingo	11 E20' 08 N54'	200	20	150	230	H
67	839.25	0	ASTV, Umuahia		200	20	150	--	H
67	839.25	0	Kano BC, Kano	08 E38' 12 N01'	200	20	150	--	H
68	847.25	8M	Ibadan	03 E56' 07 N42'	200	20	150	238	H
68	847.25	8P	Owerri	05 N27' 07 E01'	200	20	150	70	H
68	847.25	0	Lafia	08 N29' 08 E33'	200	20	150	--	H

66	847.25	8P	Enugu	07 N25' 06 E47'	200	20	150	606	H
69	855.25	8P	Minna	06 E23' 09 N36'	200	20	150	36576	H

2. LEVEL OF PROTECTION FOR ALL VHF AND UHF TELEVISION STATIONS IN NIGERIA (PROPOSED/EXISTING)

Station_Name1	Station_Name2	Frequency	erp1	erp2	direction1	direction2	protect_Ratio	Protected	Distance_apart
MONGUN	YENAGOA	175.25	56	65	Bi-Directional	Bi-Directional	0.84597	False	677
MONGUN	ABUJA	175.25	56	60	Bi-Directional	Bi-Directional	0.37097	False	226
MONGUN	LAGOS (V. ISLAND)	175.25	56	80	Bi-Directional	Bi-Directional	0.02696	False	398
KANO	LAGOS (V. ISLAND)	175.25	70	80	Bi-Directional	Bi-Directional	0.89279	False	773
KOKO	LAGOS (V. ISLAND)	175.25	70	80	Bi-Directional	Bi-Directional	0.73608	False	709
ABUJA	LAGOS (V. ISLAND)	175.25	60	80	Bi-Directional	Bi-Directional	0.10476	False	435
ABUJA	YENAGOA	175.25	60	65	Bi-Directional	Bi-Directional	0.29511	False	483
KOKO	YENAGOA	175.25	70	65	Bi-Directional	Bi-Directional	1.03053	True	787
IDOMINASI	YENAGOA	175.25	60	65	Bi-Directional	Bi-Directional	0.0806	False	403
AUCHI (JATTU)	YENAGOA	175.25	5	65	Bi-Directional	Bi-Directional	2.28457	True	798
MONGUN	KOKO	175.25	56	70	Bi-Directional	Bi-Directional	0.63937	False	613
KANO	YENAGOA	175.25	70	65	Bi-Directional	Bi-Directional	1.16212	True	838
MONGUN	KANO	175.25	56	70	Bi-Directional	Bi-Directional	-0.1977	False	300
LAGOS (V. ISLAND)	YENAGOA	175.25	80	65	Bi-Directional	Bi-Directional	-0.11767	False	354
KOKO	SERTI	175.25	70	100	Bi-Directional	Bi-Directional	1.07248	True	898
YENAGOA	SERTI	175.25	65	100	Bi-Directional	Bi-Directional	1.08862	True	890
AUCHI (JATTU)	SERTI	175.25	5	100	Bi-Directional	Bi-Directional	1.07158	True	598
IDOMINASI	SERTI	175.25	60	100	Bi-Directional	Bi-Directional	1.35038	True	984
AZARE	SERTI	175.25	65	100	Bi-Directional	Bi-Directional	0.8516	False	789
MONGUN	SERTI	175.25	56	100	Bi-Directional	Bi-Directional	-0.23629	False	315
LAGOS (V. ISLAND)	SERTI	175.25	80	100	Bi-Directional	Bi-Directional	0.88846	False	844
ABUJA	SERTI	175.25	60	100	Bi-Directional	Bi-Directional	0.18952	False	498
AZARE	YENAGOA	175.25	65	65	Bi-Directional	Bi-Directional	1.19767	True	836
IDOMINASI	MONGUN	175.25	60	56	Bi-Directional	Bi-Directional	1.64415	True	950
SOKOTO	ABUJA	175.25	200	100	Bi-Directional	Bi-Directional	0.92783	False	1098
ASILEKE	ABUJA	175.25	60	100	Bi-Directional	Bi-Directional	1.57491	True	1078
ABA	ASILEKE	175.25	100	60	Bi-Directional	Bi-Directional	0.1943	False	500

IDOMINASI	AUCHI (JATTU)	175.25	60	5	Bi-Directional	Bi-Directional	1.03828	True	480
JAJI	IBADAN	175.25	40	60	Bi-Directional	Bi-Directional	0.82258	False	605
KANO	ABUJA	175.25	70	60	Bi-Directional	Bi-Directional	0.0523	False	400
IDOMINASI	KANO	175.25	60	70	Bi-Directional	Bi-Directional	0.68367	False	640
AZARE	LAGOS (V. ISLAND)	175.25	65	80	Bi-Directional	Bi-Directional	1.0463	True	821
IDOMINASI	KOKO	175.25	60	70	Bi-Directional	Bi-Directional	1.01251	True	765
IDOMINASI	ABUJA	175.25	60	60	Bi-Directional	Bi-Directional	-0.12444	False	320
IDOMINASI	LAGOS (V. ISLAND)	175.25	60	80	Bi-Directional	Bi-Directional	-0.27619	False	285
AZARE	MONGUN	175.25	65	56	Bi-Directional	Bi-Directional	0.58966	False	583
IDOMINASI	AZARE	175.25	60	65	Bi-Directional	Bi-Directional	1.11025	True	787
AZARE	KOKO	175.25	65	70	Bi-Directional	Bi-Directional	-0.3008	False	271
AUCHI (JATTU)	MONGUN	175.25	5	56	Bi-Directional	Bi-Directional	1.3812	True	546
AZARE	KANO	175.25	65	70	Bi-Directional	Bi-Directional	-0.48398	False	[illegible]
AUCHI (JATTU)	KOKO	175.25	5	70	Bi-Directional	Bi-Directional	1.88245	True	721
AUCHI (JATTU)	ABUJA	175.25	5	60	Bi-Directional	Bi-Directional	0.08708	False	256
AUCHI (JATTU)	KANO	175.25	5	70	Bi-Directional	Bi-Directional	1.4307	True	608
AUCHI (JATTU)	LAGOS (V. ISLAND)	175.25	5	80	Bi-Directional	Bi-Directional	1.60462	True	687
AUCHI (JATTU)	AZARE	175.25	5	65	Bi-Directional	Bi-Directional	1.96764	True	721
DUSTINAM	EGBE	182.25	60	40	Bi-Directional	Bi-Directional	1.22433	True	710
DUSTINAM	KADUNA	182.25	60	50	Bi-Directional	Bi-Directional	-0.26219	False	248
ABEOKUTA	ABA	182.25	100	100	Bi-Directional	Bi-Directional	1.20405	True	1000
ABA	IDOMINASI	182.25	100	60	Bi-Directional	Bi-Directional	-0.65224	False	140
ABA	ABA	182.25	100	100	Bi-Directional	Bi-Directional	-0.68041	False	145
ABEOKUTA	ABUJA	182.25	100	100	Bi-Directional	Bi-Directional	-0.66058	False	154
ABA	ABUJA	182.25	100	100	Bi-Directional	Bi-Directional	-0.68041	False	145
ABA	SOKOTO	182.25	100	200	Bi-Directional	Bi-Directional	1.73884	True	1500
DUSTINAM	KAIMA	182.25	60	40	Bi-Directional	Bi-Directional	0.82333	False	582
JALINGO	KADUNA	182.25	65	50	Bi-Directional	Bi-Directional	0.3603	False	467
ABA	JALINGO	182.25	100	65	Bi-Directional	Bi-Directional	0.47407	False	604
DUSTINAM	JALINGO	182.25	60	65	Bi-Directional	Bi-Directional	-0.02961	False	348
JALINGO	KAIMA	182.25	65	40	Bi-Directional	Bi-Directional	1.5186	True	822
ABA	EGBE	182.25	100	40	Bi-Directional	Bi-Directional	0.12332	False	416

ABA	KAIMA	182.25	100	40	Bi-Directional	Bi-Directional	0.73629	False	643
ISELE UK J	YOLA	182.25	100	100	Bi-Directional	Bi-Directional	0.56139	False	199
ABA	KADUNA	182.25	100	50	Bi-Directional	Bi-Directional	0.58031	False	612
JALINGO	EGBE	182.25	65	40	Bi-Directional	Bi-Directional	0.97627	False	645
EGBE	KADUNA	182.25	40	50	Bi-Directional	Bi-Directional	0.90203	False	578
KAIMA	KADUNA	182.25	40	50	Bi-Directional	Bi-Directional	0.64535	False	500
DUSTINA M	ABA	182.25	60	100	Bi-Directional	Bi-Directional	0.54008	False	620
EGBE	KAIMA	182.25	40	40	Bi-Directional	Bi-Directional	0.21623	False	349
ASILEKE	SOKOTO	189.25	30	65	Bi-Directional	Bi-Directional	1.17723	True	644
GOMBE	ASILEKE	189.25	60	30	Bi-Directional	Bi-Directional	1.93548	True	848
GOMBE	UTONKON	189.25	60	65	Bi-Directional	Bi-Directional	0.49412	False	516
ASILEKE	UTONKON	189.25	30	65	Bi-Directional	Bi-Directional	1.29556	True	679
ASILEKE	TEJUOSO	189.25	30	80	Bi-Directional	Bi-Directional	-0.22236	False	245
ASILEKE	IKOM	189.25	30	80	Bi-Directional	Bi-Directional	0.27596	False	402
ASILEKE	JOS	189.25	30	75	Bi-Directional	Bi-Directional	1.47691	True	765
GOMBE	DAMATURU	189.25	60	70	Bi-Directional	Bi-Directional	-0.49716	False	177
GOMBE	SOKOTO	189.25	60	65	Bi-Directional	Bi-Directional	1.05297	True	709
GOMBE	TEJUOSO	189.25	60	80	Bi-Directional	Bi-Directional	1.58899	True	944
ASILEKE	DAMATURU	189.25	30	70	Bi-Directional	Bi-Directional	2.29985	True	998
GOMBE	JOS	189.25	60	75	Bi-Directional	Bi-Directional	-0.28575	False	256
IKOM	DAMATURU	189.25	80	70	Bi-Directional	Bi-Directional	1.01227	True	761
KONTAGORA	DAMATURU	189.25	60	70	Bi-Directional	Bi-Directional	1.05965	True	725
KONTAGORA	SOKOTO	189.25	60	65	Bi-Directional	Bi-Directional	-0.16028	False	290
GOMBE	IKOM	189.25	60	80	Bi-Directional	Bi-Directional	0.53584	False	560
TEJUOSO	SOKOTO	189.25	80	65	Bi-Directional	Bi-Directional	1.05905	True	765
KONTAGORA	TEJUOSO	189.25	60	80	Bi-Directional	Bi-Directional	0.55504	False	567
ARBUS	UTONKON	189.25	38	65	Bi-Directional	Bi-Directional	1.12354	True	660
ABOR HILL ENUGU	WUKARI	189.25	100	60	Bi-Directional	Bi-Directional	-0.21586	False	304
DAMATURU	UTONKON	189.25	70	65	Bi-Directional	Bi-Directional	1.16209	True	776
SOKOTO	UTONKON	189.25	65	65	Bi-Directional	Bi-Directional	1.06096	True	726
SOKOTO	DAMATURU	189.25	65	70	Bi-Directional	Bi-Directional	1.02	True	725
IKOM	TEJUOSO	189.25	80	80	Bi-Directional	Bi-Directional	0.59928	False	625

TEJUOSO	DAMATURU	189.25	80	70	Bi-Directional	Bi-Directional	2.36348	True	1272
JOS	IKOM	189.25	75	80	Bi-Directional	Bi-Directional	0.50288	False	578
IKOM	UTONKON	189.25	80	65	Bi-Directional	Bi-Directional	-0.67432	False	121
IKOM	SOKOTO	189.25	80	65	Bi-Directional	Bi-Directional	1.32551	True	864
JOS	UTONKON	189.25	75	65	Bi-Directional	Bi-Directional	0.06206	False	388
JOS	DAMATURU	189.25	75	70	Bi-Directional	Bi-Directional	0.0834	False	403
JOS	SOKOTO	189.25	75	65	Bi-Directional	Bi-Directional	0.40149	False	512
JOS	TEJUOSO	189.25	75	80	Bi-Directional	Bi-Directional	1.02811	True	780
TEJUOSO	UTONKON	189.25	80	65	Bi-Directional	Bi-Directional	0.38615	False	515
UZALLA	IKOM	189.25	100	80	Bi-Directional	Bi-Directional	0.08731	False	450
ARBUS	ASILEKE	189.25	38	30	Bi-Directional	Bi-Directional	2.40112	True	865
UZALLA	FUNTUA	189.25	100	80	Bi-Directional	Bi-Directional	0.46908	False	608
ARBUS	KONTAGORA	189.25	38	60	Bi-Directional	Bi-Directional	1.0402	True	620
UZALLA	UTONKON	189.25	100	65	Bi-Directional	Bi-Directional	0.44452	False	570
UZALLA	DAMATURU	189.25	100	70	Bi-Directional	Bi-Directional	0.99131	False	799
ARBUS	JOS	189.25	38	75	Bi-Directional	Bi-Directional	0.64883	False	534
UZALLA	TEJUOSO	189.25	100	80	Bi-Directional	Bi-Directional	-0.27512	False	300
ARBUS	GOMBE	189.25	38	60	Bi-Directional	Bi-Directional	-0.04571	False	290
UZALLA	JOS	189.25	100	75	Bi-Directional	Bi-Directional	0.41294	False	576
UZALLA	ASILEKE	189.25	100	30	Bi-Directional	Bi-Directional	-0.21034	False	267
UZALLA	GOMBE	189.25	100	60	Bi-Directional	Bi-Directional	0.55538	False	603
UZALLA	ARBUS	189.25	100	38	Bi-Directional	Bi-Directional	1.79497	True	987
KONTAGORA	IKOM	189.25	60	80	Bi-Directional	Bi-Directional	1.03773	True	743
FUNTUA	GOMBE	189.25	80	60	Bi-Directional	Bi-Directional	0.21496	False	443
UZALLA	SOKOTO	189.25	100	65	Bi-Directional	Bi-Directional	0.98178	False	782
FUNTUA	SOKOTO	189.25	80	65	Bi-Directional	Bi-Directional	-0.24636	False	280
KONTAGORA	JOS	189.25	60	75	Bi-Directional	Bi-Directional	0.58475	False	568
KONTAGORA	ASILEKE	189.25	60	30	Bi-Directional	Bi-Directional	1.37816	True	687
KONTAGORA	GOMBE	189.25	60	60	Bi-Directional	Bi-Directional	0.85556	False	628
ARBUS	FUNTUA	189.25	38	80	Bi-Directional	Bi-Directional	0.36335	False	450
FUNTUA	DAMATURU	189.25	80	70	Bi-Directional	Bi-Directional	0.31948	False	499
ARBUS	IKOM	189.25	38	80	Bi-Directional	Bi-Directional	1.65701	True	877

FUNTUA	TEJUOSO	189.25	80	80	Bi-Directional	Bi-Directional	1.03429	True	795
FUNTUA	IKOM	189.25	80	80	Bi-Directional	Bi-Directional	1.02149	True	790
FUNTUA	ASILEKE	189.25	80	30	Bi-Directional	Bi-Directional	1.18055	True	687
KONTAGORA	UZALLA	189.25	100	100	Bi-Directional	Bi-Directional	0.50826	False	659
FUNTUA	KONTAGORA	189.25	80	60	Bi-Directional	Bi-Directional	-0.05381	False	345
ARBUS	SOKOTO	189.25	38	65	Bi-Directional	Bi-Directional	0.60553	False	499
FUNTUA	JOS (TAMODU)	189.25	80	75	Bi-Directional	Bi-Directional	0.21426	False	467
ARBUS	DAMATURU	189.25	38	70	Bi-Directional	Bi-Directional	-0.18727	False	258
FUNTUA	UTONKON	189.25	80	65	Bi-Directional	Bi-Directional	0.34578	False	500
TSANNI (KATSINA)	IKEJA	196.25	50	60	Bi-Directional	Bi-Directional	2.00737	True	896
T.MARAFA	TSANNI (KATSINA)	196.25	50	50	Bi-Directional	Bi-Directional	-0.33542	False	198
T.MARAFA	IKEJA	196.25	50	50	Bi-Directional	Bi-Directional	1.43342	True	725
T.MARAFA	WUKARI	196.25	50	60	Bi-Directional	Bi-Directional	1.1624	True	675
YOLA	WUKARI	196.25	40	60	Bi-Directional	Bi-Directional	1.15906	True	640
TSANNI (KATSINA)	WUKARI	196.25	50	60	Bi-Directional	Bi-Directional	1.37384	True	741
IKEJA	WUKARI	196.25	50	60	Bi-Directional	Bi-Directional	1.41869	True	755
T.MARAFA	YOLA	196.25	50	40	Bi-Directional	Bi-Directional	1.76746	True	781
YOLA	TSANNI (KATSINA)	196.25	40	50	Bi-Directional	Bi-Directional	1.52296	True	712
BIRNIN KUDU	IKEJA	196.25	50	50	Bi-Directional	Bi-Directional	1.01051	True	599
BIRNIN KUDU	TSANNI (KATSINA)	196.25	50	50	Bi-Directional	Bi-Directional	-0.19445	False	240
BIRNIN KUDU	T.MARAFA	196.25	50	50	Bi-Directional	Bi-Directional	0.29559	False	386
ABOR HILL ENUGU	IKEJA	196.25	100	50	Bi-Directional	Bi-Directional	-0.19642	False	289
ABOR HILL ENUGU	TSANNI (KATSINA)	196.25	100	50	Bi-Directional	Bi-Directional	1.7472	True	988
ABOR HILL ENUGU	YOLA	196.25	100	40	Bi-Directional	Bi-Directional	0.61378	False	555
ABOR HILL ENUGU	T.MARAFA	196.25	100	50	Bi-Directional	Bi-Directional	0.90191	False	684
ABOR HILL ENUGU	BIRNIN KUDU	196.25	100	50	Bi-Directional	Bi-Directional	1.08542	True	750
BIRNIN KUDU	YOLA	196.25	50	40	Bi-Directional	Bi-Directional	0.50598	False	425
BIRNIN KUDU	WUKARI	196.25	50	60	Bi-Directional	Bi-Directional	1.4347	True	760
MAKURDI	LAGOS (V.I.)	203.25	68	40	Bi-Directional	Bi-Directional	1.28413	True	677
EKU	CHOKOCHOKO	203.25	50	40	Bi-Directional	Bi-Directional	0.53034	False	417
EKU	ISELE-UKU	203.25	50	50	Bi-Directional	Bi-Directional	-0.30824	False	199
EKU	GUSAU	203.25	50	60	Bi-Directional	Bi-Directional	1.02056	True	609

BAUCHI	GAMO	203.25	60	30	Bi-Directional	Bi-Directional	1.58754	True	6[illegible]6
BAUCHI	CALABAR	203.25	60	50	Bi-Directional	Bi-Directional	1.13336	True	613
BAUCHI	CHOKOCHOKO	203.25	60	40	Bi-Directional	Bi-Directional	0.73295	False	[illegible]36
EKU	CALABAR	203.25	50	50	Bi-Directional	Bi-Directional	0.05328	False	03
BAUCHI	GUSAU	203.25	60	60	Bi-Directional	Bi-Directional	0.27249	False	01
CALABAR	GUSAU	203.25	50	60	Bi-Directional	Bi-Directional	1.14995	True	[illegible]48
MAKURDI	IGBOBO	203.25	68	60	Bi-Directional	Bi-Directional	0.74297	False	67
BAUCHI	ISELE-UKU	203.25	60	50	Bi-Directional	Bi-Directional	0.97742	False	96
EKU	GAMO	203.25	50	30	Bi-Directional	Bi-Directional	0.59842	False	08
EKU	BAUCHI	203.25	50	60	Bi-Directional	Bi-Directional	1.25944	True	381
ISELE-UKU	GUSAU	203.25	100	60	Bi-Directional	Bi-Directional	0.71754	False	620
CHOKOCHOKO	ISELE-UKU	203.25	40	100	Bi-Directional	Bi-Directional	0.58401	False	526
CALABAR	ISELE-UKU	203.25	50	100	Bi-Directional	Bi-Directional	-0.1476	False	296
CALABAR	CHOKOCHOKO	203.25	50	40	Bi-Directional	Bi-Directional	0.51199	False	412
GAMO	GUSAU	203.25	30	60	Bi-Directional	Bi-Directional	0.49081	False	401
GAMO	ISELE-UKU	203.25	30	100	Bi-Directional	Bi-Directional	0.25782	False	396
GAMO	CHOKOCHOKO	203.25	30	40	Bi-Directional	Bi-Directional	-0.1544	False	203
GAMO	CALABAR	203.25	30	50	Bi-Directional	Bi-Directional	1.31927	True	592
MAKURDI	ZARIA	203.25	68	65	Bi-Directional	Bi-Directional	0.28112	False	425
CHOKOCHOKO	GUSAU	203.25	40	60	Bi-Directional	Bi-Directional	0.84475	False	528
MAKURDI	GUNMI	203.25	68	60	Bi-Directional	Bi-Directional	0.01443	False	330
LAGOS (V.I.)	MINNA	210.25	40	50	Bi-Directional	Bi-Directional	0.97027	False	519
IGBOBO	LAGOS (V.I.)	210.25	60	40	Bi-Directional	Bi-Directional	0.18907	False	329
IGBOBO	KACHIA	210.25	60	70	Bi-Directional	Bi-Directional	0.63803	False	519
MAKURDI	MAIDUGURI	210.25	68	70	Bi-Directional	Bi-Directional	1.15501	True	704
ZARIA	LAGOS (V.I.)	210.25	65	40	Bi-Directional	Bi-Directional	1.81718	True	797
ZARIA	MINNA	210.25	65	50	Bi-Directional	Bi-Directional	-0.04902	False	283
MAKURDI	MINNA	210.25	68	50	Bi-Directional	Bi-Directional	0.494	False	450
ZARIA	KACHIA	210.25	65	70	Bi-Directional	Bi-Directional	-0.26949	False	236
IGBOBO	MINNA	210.25	60	50	Bi-Directional	Bi-Directional	0.16691	False	340
LAGOS (V.I.)	PORTHARCOURT	210.25	40	100	Bi-Directional	Bi-Directional	0.87532	False	602
LAGOS (V.I.)	KACHIA	210.25	40	70	Bi-Directional	Bi-Directional	1.63074	True	760

MINNA	PORTHARCOURT	210.25	50	100	Bi-Directional	Bi-Directional	0.7248	False	579
MINNA	KACHIA	210.25	50	70	Bi-Directional	Bi-Directional	0.08094	False	279
PORTHARCOURT	KACHIA	210.25	100	70	Bi-Directional	Bi-Directional	0.5976	False	577
ZARIA	PORTHARCOURT	210.25	65	100	Bi-Directional	Bi-Directional	1.25799	True	802
MAIDUGURI	KACHIA	210.25	70	70	Bi-Directional	Bi-Directional	1.39783	True	789
IGBOBO	ZARIA	210.25	60	65	Bi-Directional	Bi-Directional	0.89797	False	590
GUNMI	KACHIA	210.25	60	70	Bi-Directional	Bi-Directional	0.41395	False	448
GUNMI	PORTHARCOURT	210.25	60	100	Bi-Directional	Bi-Directional	1.43579	True	850
GUNMI	MINNA	210.25	60	50	Bi-Directional	Bi-Directional	-0.02872	False	283
GUNMI	LAGOS (V.I.)	210.25	60	40	Bi-Directional	Bi-Directional	1.5227	True	698
IGBOBO	PORTHARCOURT	210.25	60	100	Bi-Directional	Bi-Directional	0.75663	False	613
MAIDUGURI	PORTHARCOURT	210.25	70	100	Bi-Directional	Bi-Directional	1.75772	True	996
MAKURDI	PORTHARCOURT	210.25	68	100	Bi-Directional	Bi-Directional	0.30156	False	467
MAIDUGURI	MINNA	210.25	70	50	Bi-Directional	Bi-Directional	1.87906	True	874
MAIDUGURI	LAGOS (V.I.)	210.25	70	40	Bi-Directional	Bi-Directional	2.32304	True	960
MAIDUGURI	ZARIA	210.25	70	65	Bi-Directional	Bi-Directional	1.00271	True	647
MAIDUGURI	IGBOBO	210.25	70	60	Bi-Directional	Bi-Directional	2.57274	True	1132
MAIDUGURI	GUNMI	210.25	70	60	Bi-Directional	Bi-Directional	1.8279	True	896
MAKURDI	KACHIA	210.25	68	70	Bi-Directional	Bi-Directional	0.12342	False	367
GUNMI	IGBOBO	210.25	60	60	Bi-Directional	Bi-Directional	0.24081	False	378
IJU	ABUJA	217.25	60	60	Bi-Directional	Bi-Directional	-0.0401	False	283
UGHELLI	KEFFI	217.25	40	50	Bi-Directional	Bi-Directional	0.92995	False	492
ABUJA	GASHUA	217.25	60	65	Bi-Directional	Bi-Directional	1.27362	True	684
IJU	GASHUA	217.25	60	65	Bi-Directional	Bi-Directional	2.10462	True	934
UGHELLI	GASHUA	217.25	40	65	Bi-Directional	Bi-Directional	2.61223	True	989
UGHELLI	IJU	217.25	40	60	Bi-Directional	Bi-Directional	0.35563	False	363
UGHELLI	ABUJA	217.25	40	60	Bi-Directional	Bi-Directional	0.23239	False	330
KEFFI	IJU	217.25	50	60	Bi-Directional	Bi-Directional	0.47883	False	417
LANGTANG	BIDA	224.25	50	80	Bi-Directional	Bi-Directional	0.02957	False	304
KASTINA-ALA	BIDA	224.25	70	80	Bi-Directional	Bi-Directional	0.61363	False	515
UYO	BIDA	224.25	60	80	Bi-Directional	Bi-Directional	-0.25255	False	230
UYO	KASTINA-ALA	224.25	60	70	Bi-Directional	Bi-Directional	1.11067	True	627

OKITIPUPA	BIDA	224.25	40	80	Bi-Directional	Bi-Directional	0.77971	False	501
OKITIPUPA	KASTINA-ALA	224.25	40	70	Bi-Directional	Bi-Directional	1.22996	True	604
OKITIPUPA	UYO	224.25	40	60	Bi-Directional	Bi-Directional	0.61903	False	420
UGHELLI	BIDA	224.25	40	80	Bi-Directional	Bi-Directional	0.52749	False	430
UGHELLI	KASTINA-ALA	224.25	40	70	Bi-Directional	Bi-Directional	1.22996	True	604
UGHELLI	OKITIPUPA	224.25	40	40	Bi-Directional	Bi-Directional	-0.18956	False	189
ABEOKUTA	OKITIPUPA	224.25	80	40	Bi-Directional	Bi-Directional	-0.16165	False	236
UGHELLI	UYO	224.25	40	60	Bi-Directional	Bi-Directional	-0.11339	False	230
ABEOKUTA	UGHELLI	224.25	80	40	Bi-Directional	Bi-Directional	0.42448	False	401
LANGTANG	KASTINA-ALA	224.25	50	70	Bi-Directional	Bi-Directional	0.07863	False	307
ABEOKUTA	UYO	224.25	80	60	Bi-Directional	Bi-Directional	0.95637	False	602
ABEOKUTA	KASTINA-ALA	224.25	80	70	Bi-Directional	Bi-Directional	1.12436	True	678
ABEOKUTA	BIDA	224.25	80	80	Bi-Directional	Bi-Directional	0.18858	False	392
LANGTANG	UGHELLI	224.25	50	40	Bi-Directional	Bi-Directional	1.29177	True	566
LANGTANG	OKITIPUPA	224.25	50	40	Bi-Directional	Bi-Directional	1.61569	True	646
LANGTANG	UYO	224.25	50	60	Bi-Directional	Bi-Directional	1.6686	True	729
ABEOKUTA	LANGTANG	224.25	80	50	Bi-Directional	Bi-Directional	1.68229	True	792
NEW BUSSA	OKUTA	471.25	200	100	Bi-Directional	Bi-Directional	1.26622	True	480
OSBC, IBOKUN	IBW.ENT. BENIN	479.25	200	200	Bi-Directional	Bi-Directional	0.15571	False	282
IBW.ENT. BENIN	PORTHARCOURT	479.25	200	120	Bi-Directional	Bi-Directional	-0.07623	False	200
IBW.ENT. BENIN	IKORODU	479.25	200	200	Bi-Directional	Bi-Directional	-0.03281	False	236
OSBC, IBOKUN	IKORODU	479.25	200	200	Bi-Directional	Bi-Directional	-0.13063	False	212.13
IKORODU	PORTHARCOURT	479.25	200	120	Bi-Directional	Bi-Directional	0.80717	False	391.262
GASHUA	OSBC, IBOKUN	479.25	100	200	Bi-Directional	Bi-Directional	1.02426	True	901
GASHUA	IKORODU	479.25	100	200	Bi-Directional	Bi-Directional	4.12313	True	1067
GASHUA	PORTHARCOURT	479.25	100	100	Bi-Directional	Bi-Directional	5.10302	True	1053
OSBC, IBOKUN	PORTHARCOURT	479.25	200	100	Bi-Directional	Bi-Directional	0.94938	False	406
GASHUA	IBW.ENT. BENIN	479.25	100	200	Bi-Directional	Bi-Directional	3.99829	True	1041
S.GIDA	ISELE-UKU	487.25	200	100	Bi-Directional	Bi-Directional	-0.65341	False	71
S.GIDA	KONTAGORA	487.25	200	100	Bi-Directional	Bi-Directional	0.46447	False	300
KEFFI	KONTAGORA	487.25	100	100	Bi-Directional	Bi-Directional	0.36107	False	230.98
KEFFI	ISELE-UKU	487.25	100	100	Bi-Directional	Bi-Directional	0.88916	False	320.6

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KONTAGORA	ISELE-UKU	487.25	200	100	Bi-Directional	Bi-Directional	0.95751	False	401
S GIDA	KEFFI	487.25	200	100	Bi-Directional	Bi-Directional	0.59042	False	325.8
JALINGO	EPE	495.25	200	200	Bi-Directional	Bi-Directional	2.79465	True	896
GOMBI	JALINGO	495.25	100	200	Bi-Directional	Bi-Directional	1.10874	True	425
GOMBI	EPE	495.25	100	200	Bi-Directional	Bi-Directional	3.67891	True	943
KASTINA	ZARIA	503.25	200	100	Bi-Directional	Bi-Directional	-0.06221	False	186
KASTINA	GUNMI	503.25	200	100	Bi-Directional	Bi-Directional	0.54786	False	307
GUNMI	ZARIA	503.25	200	200	Bi-Directional	Bi-Directional	0.5923	False	370
ZARIA	DIKWA	503.25	200	200	Bi-Directional	Bi-Directional	1.6983	True	627
YENAGOA	DIKWA	503.25	200	200	Bi-Directional	Bi-Directional	4.17713	True	1203
YENAGOA	ZARIA	503.25	200	200	Bi-Directional	Bi-Directional	2.34813	True	778
YENAGOA	GUNMI	503.25	200	200	Bi-Directional	Bi-Directional	2.45142	True	802
KASTINA	DIKWA	503.25	200	200	Bi-Directional	Bi-Directional	1.83601	True	659
KASTINA	YENAGOA	503.25	200	200	Bi-Directional	Bi-Directional	2.85595	True	896
ABEOKUTA	DIKWA	503.25	200	200	Bi-Directional	Bi-Directional	4.67633	True	1319
ABEOKUTA	GUNMI	503.25	200	200	Bi-Directional	Bi-Directional	1.63805	True	613
ABEOKUTA	YENAGOA	503.25	200	200	Bi-Directional	Bi-Directional	0.72571	False	401
ABEOKUTA	KASTINA	503.25	200	200	Bi-Directional	Bi-Directional	2.65368	True	849
GUNMI	DIKWA	503.25	200	200	Bi-Directional	Bi-Directional	3.05821	True	943
AZARE	ONITSHA	511.25	65	200	Bi-Directional	Bi-Directional	3.44408	True	798
ASILEKE	AZARE	511.25	60	65	Bi-Directional	Bi-Directional	5.23437	True	797
ASILEKE	ONITSHA	511.25	60	200	Bi-Directional	Bi-Directional	1.2146	True	392
KAIMA	JOS	519.25	100	100	Bi-Directional	Bi-Directional	2.55424	True	566
JOS	CHOKOCHOKO	519.25	100	120	Bi-Directional	Bi-Directional	0.88797	False	315
KAIMA	CHOKOCHOKO	519.25	100	120	Bi-Directional	Bi-Directional	1.44537	True	408
BCOS, IBADAN	ZALAU	527.25	200	200	Bi-Directional	Bi-Directional	3.04886	True	898
OWERRI	MAKURDI	543.25	200	68	Bi-Directional	Bi-Directional	0.66033	False	282.9
IBADAN	MAKURDI	543.25	60	68	Bi-Directional	Bi-Directional	3.42037	True	538
OWERRI	IBADAN	543.25	200	60	Bi-Directional	Bi-Directional	1.56333	True	427
SOKOTO	MAKURDI	543.25	200	68	Bi-Directional	Bi-Directional	2.95569	True	674
SOKOTO	OWERRI	543.25	200	200	Bi-Directional	Bi-Directional	2.92086	True	844
SOKOTO	IBADAN	543.25	200	60	Bi-Directional	Bi-Directional	3.0521	True	675

AKURE	UGEP	551.25	200	200	Bi-Directional	Bi-Directional	1.62378	True	570
AKURE	KAZAURA	551.25	200	200	Bi-Directional	Bi-Directional	2.99057	True	810
AKURE	SERTI	551.25	200	100	Bi-Directional	Bi-Directional	3.01190	True	890
UGEP	KAZAURA	551.25	200	200	Bi-Directional	Bi-Directional	2.55906	True	755
UGEP	SERTI	551.25	200	100	Bi-Directional	Bi-Directional	1.34718	True	425
KAZAURA	SERTI	551.25	200	100	Bi-Directional	Bi-Directional	2.77758	True	684
FORCADOS	MAIDUGURI	559.25	200	100	Bi-Directional	Bi-Directional	5.46577	True	1154
BOPO	FORCADOS	559.25	200	200	Bi-Directional	Bi-Directional	0.78383	False	373
BOPO	MAIDUGURI	559.25	200	100	Bi-Directional	Bi-Directional	3.56638	True	815
FUNTUA	MAIDUGURI	559.25	80	100	Bi-Directional	Bi-Directional	3.17704	True	585
BOPO	FUNTUA	559.25	200	80	Bi-Directional	Bi-Directional	1.76551	True	472
GOMBI	MINNA	567.25	100	100	Bi-Directional	Bi-Directional	2.56038	True	519
SERTI	OSHOGBO	575.25	100	200	Bi-Directional	Bi-Directional	3.48379	True	778
SERTI	DARAZO	575.25	100	200	Bi-Directional	Bi-Directional	1.50124	True	434
OSHOGBO	DARAZO	575.25	200	200	Bi-Directional	Bi-Directional	-1	False	0
LTV, IKEJA	KWARA TV, ILORIN	583.25	60	200	Bi-Directional	Bi-Directional	0.48123	False	296.98
ABEOKUTA	IDOMINASI	591.25	100	60	Bi-Directional	Bi-Directional	0.59551	False	197.99
ABEOKUTA	SOKOTO	591.25	100	200	Bi-Directional	Bi-Directional	-0.14109	False	145
MAKURDI	ABA	591.25	200	100	Bi-Directional	Bi-Directional	1.55506	True	326
BIDA	IDOMINASI	591.25	100	60	Bi-Directional	Bi-Directional	0.90181	False	236
MAKURDI	BIDA	591.25	200	100	Bi-Directional	Bi-Directional	1.57857	True	329
MAKURDI	ABEOKUTA	591.25	200	100	Bi-Directional	Bi-Directional	3.51445	True	576
SOKOTO	IDOMINASI	591.25	200	100	Bi-Directional	Bi-Directional	2.41195	True	576
BIDA	ABA	591.25	100	100	Bi-Directional	Bi-Directional	2.61091	True	505
SOKOTO	BIDA	591.25	200	100	Bi-Directional	Bi-Directional	1.51157	True	424
GOMBE	OHAFIA	599.25	200	200	Bi-Directional	Bi-Directional	3.35066	True	849
DESMINUS,KADUNA	BORNO TV, MAIDG.	607.25	200	200	Bi-Directional	Bi-Directional	2.16245	True	609
DESMINUS,KADUNA	AkANGBA	607.25	200	100	Bi-Directional	Bi-Directional	4.56669	True	915
BORNO TV, MAIDG.	AkANGBA	607.25	200	100	Bi-Directional	Bi-Directional	4.56669	True	915
UGHELLI	YOLA	623.25	100	100	Bi-Directional	Bi-Directional	5.03739	True	801
BAUCHI	UGHELLI	623.25	120	100	Bi-Directional	Bi-Directional	4.19407	True	722
BAUCHI	BANGI	623.25	120	200	Bi-Directional	Bi-Directional	2.95838	True	659

UGHELLI	BANGI	623.25	100	200	Bi-Directional	Bi-Directional	4.45111	True	873
YOLA	BANGI	623.25	100	200	Bi-Directional	Bi-Directional	5.03806	True	967
BAUCHI	YOLA	623.25	12[illegible]	100	Bi-Directional	Bi-Directional	1.20136	True	306
IGBOBO	MERINGA	631.25	6[illegible]	200	Bi-Directional	Bi-Directional	3.11557	True	590
AUCHI	MERINGA	631.25	20[illegible]	200	Bi-Directional	Bi-Directional	3.32927	True	802
AUCHI (JATTU)	IGBOHO	631.25	20[illegible]	200	Bi-Directional	Bi-Directional	10.01283	True	720
ENUGU	BAUCHI	671.25	20[illegible]	120	Bi-Directional	Bi-Directional	2.65513	True	565
DUSTINAM	YOLA	671.25	10[illegible]	100	Bi-Directional	Bi-Directional	4.23598	True	645
BAUCHI	DUSTINAM	671.25	20[illegible]	100	Bi-Directional	Bi-Directional	1.06873	True	267
DUSTINAM	ENUGU	671.25	100	200	Bi-Directional	Bi-Directional	3.28383	True	637
ENUGU	YOLA	671.25	200	100	Bi-Directional	Bi-Directional	3.43178	True	659
JEBBA	MAIDUGURI	695.25	200	200	Bi-Directional	Bi-Directional	5.83311	True	981
THC., ABUJA	ENUGU TV, ENUGU	703.25	200	200	Bi-Directional	Bi-Directional	0.27493	False	212
ENUGU TV, ENUGU	MORIKI	703.25	200	200	Bi-Directional	Bi-Directional	3.25176	True	707
EGBE	MORIKI	703.25	40	200	Bi-Directional	Bi-Directional	3.5128	True	543
THC., ABUJA	ENUGU	703.25	200	200	Bi-Directional	Bi-Directional	0.27493	False	212
THC., ABUJA	EGBE	703.25	200	40	Bi-Directional	Bi-Directional	3.11388	True	495
ENUGU TV, ENUGU	EGBE	703.25	200	40	Bi-Directional	Bi-Directional	1.15251	True	259
THC., ABUJA	MORIKI	703.25	200	200	Bi-Directional	Bi-Directional	1.97683	True	495
GALAXY, IBADAN	UYO	711.25	200	200	Bi-Directional	Bi-Directional	2.44253	True	566
IKOM	KANO	711.25	100	200	Bi-Directional	Bi-Directional	2.93553	True	707
KATSINA-ALA	GALAXY, IBADAN	711.25	200	200	Bi-Directional	Bi-Directional	2.72231	True	612
KATSINA-ALA	UYO	711.25	200	200	Bi-Directional	Bi-Directional	2.81355	True	627
PRTV, PLATEAU	GALAXY, IBADAN	711.25	200	200	Bi-Directional	Bi-Directional	3.4461	True	731
PRTV, PLATEAU	UYO	711.25	200	200	Bi-Directional	Bi-Directional	2.58242	True	589
MALLAMAWA	KANO	735.25	200	200	Bi-Directional	Bi-Directional	0.77935	False	283
CALABAR	KANO	735.25	200	200	Bi-Directional	Bi-Directional	5.25391	True	849
CALABAR	MALLAMAWA	735.25	200	200	Bi-Directional	Bi-Directional	5.69588	True	909
MINNA	KANO	735.25	200	200	Bi-Directional	Bi-Directional	1.95385	True	401
MALLAMAWA	MINNA	735.25	200	200	Bi-Directional	Bi-Directional	1.78442	True	378
MINNA	CALABAR	735.25	200	200	Bi-Directional	Bi-Directional	4.31729	True	598
KADUNA	BRTV, MAIDUGURI	743.25	200	200	Bi-Directional	Bi-Directional	2.83894	True	604

ILORIN	BRTV. MAIDUGURI	743.25	200	200	Bi-Directional	Bi-Directional	5.59103	True	1037
KADUNA	ILORIN	743.25	200	200	Bi-Directional	Bi-Directional	1.84107	True	447
RSTV.	ILORIN	743.25	200	200	Bi-Directional	Bi-Directional	2.29233	True	518
ARBUS	ILORIN	743.25	200	200	Bi-Directional	Bi-Directional	3.64613	True	731
ARBUS	KADUNA	743.25	200	200	Bi-Directional	Bi-Directional	0.91311	False	301
ARBUS	BRTV. MAIDUGURI	743.25	200	200	Bi-Directional	Bi-Directional	6.18848	True	1131
RSTV.	ARBUS	743.25	200	200	Bi-Directional	Bi-Directional	5.20332	True	976
BBST, BENIN	BRTV. MAIDUGURI	743.25	200	200	Bi-Directional	Bi-Directional	5.85797	True	1079
BBST. BENIN	ILORIN	743.25	200	200	Bi-Directional	Bi-Directional	1.09108	True	329
BBST. BENIN	KADUNA	743.25	200	200	Bi-Directional	Bi-Directional	2.80716	True	599
BBST. BENIN	RSTV.	743.25	200	200	Bi-Directional	Bi-Directional	-0.2373	False	120
BBST. BENIN	ARBUS	743.25	200	200	Bi-Directional	Bi-Directional	4.54866	True	873
RSTV.	KADUNA	743.25	200	200	Bi-Directional	Bi-Directional	3.58893	True	722
UYO	ERUNWON	751.25	200	200	Bi-Directional	Bi-Directional	3.21484	True	560
KATSINA-ALA	PRTV, PLATEAU	751.25	200	200	Bi-Directional	Bi-Directional	1.42837	True	378
MAKURDI	BAUCHI	759.25	200	200	Bi-Directional	Bi-Directional	1.35684	True	363
SOKOTO	BAUCHI	759.25	200	200	Bi-Directional	Bi-Directional	3.48032	True	589
BENIN	ABUJA	767.25	200	60	Bi-Directional	Bi-Directional	1.72156	True	321
BASSAWA	BIRNIN KEBBI	771.25	200	200	Bi-Directional	Bi-Directional	1.60514	True	395
POTISKUM	RANKO	783.25	200	200	Bi-Directional	Bi-Directional	3.10582	True	613
ABUJA	OKITIPUPA	791.25	200	200	Bi-Directional	Bi-Directional	1.33438	True	345
KADUNA	KUBLI	799.25	200	200	Bi-Directional	Bi-Directional	1.90476	True	425
KADUNA	LANGTANG	799.25	200	200	Bi-Directional	Bi-Directional	0.9274	False	282
LANGTANG	KUBLI	799.25	200	200	Bi-Directional	Bi-Directional	3.50409	True	659
KACHIA	ILORIN	807.25	200	200	Bi-Directional	Bi-Directional	1.93384	True	425
GUSAU	YOLA	814.25	200	200	Bi-Directional	Bi-Directional	3.58862	True	659
YOLA	BENIN	815.25	200	200	Bi-Directional	Bi-Directional	5.01646	True	863
GUSAU	BENIN	815.25	200	200	Bi-Directional	Bi-Directional	3.92889	True	707
MINAJ SYS. OBOSI	PORTHARCOURT	839.25	200	150	Bi-Directional	Bi-Directional	2.46912	True	451
LAGOS	ASTV. UMUAHIA	839.25	200	200	Bi-Directional	Bi-Directional	2.55251	True	495
LAGOS	PORTHARCOURT	839.25	200	150	Bi-Directional	Bi-Directional	2.08452	True	401
LAGOS	JALINGO	839.25	200	200	Bi-Directional	Bi-Directional	7.46144	True	1179

LAGOS	MINAJ SYS. OBOSI	839.25	200	200	Bi-Directional	Bi-Directional	2.76064	True	524
PORTHARCOURT	ASTV. UMUAHIA	839.25	150	200	Bi-Directional	Bi-Directional	0.63841	False	213
JALINGO	ASTV. UMUAHIA	839.25	200	200	Bi-Directional	Bi-Directional	3.06207	True	566
MINAJ SYS. OBOSI	ASTV. UMUAHIA	839.25	200	200	Bi-Directional	Bi-Directional	1.26069	True	315
MINAJ SYS. OBOSI	JALINGO	839.25	200	200	Bi-Directional	Bi-Directional	4.5979	True	780
KANO BC. KANO	ASTV. UMUAHIA	839.25	200	200	Bi-Directional	Bi-Directional	4.41848	True	755
KANO BC. KANO	PORTHARCOURT	839.25	200	150	Bi-Directional	Bi-Directional	5.99209	True	9[illegible]
KANO BC. KANO	JALINGO	839.25	200	200	Bi-Directional	Bi-Directional	2.72476	True	519
KANO BC. KANO	MINAJ SYS. OBOSI	839.25	200	200	Bi-Directional	Bi-Directional	3.86587	True	678
KANO BC. KANO	LAGOS	839.25	200	200	Bi-Directional	Bi-Directional	5.42323	True	895
JALINGO	PORTHARCOURT	839.25	200	150	Bi-Directional	Bi-Directional	4.80751	True	755
LAFIA	OWERRI	847.25	200	200	Bi-Directional	Bi-Directional	1.66624	True	368
LAFIA	IBADAN	847.25	200	200	Bi-Directional	Bi-Directional	2.76026	True	519

3. RECOMMENDATIONS FOR UNPROTECTED VHF AND UHF TELEVISION STATION IN NIGERIA (PROPOSED/EXISTING)

				RECOMMENDATION 2			RECOMMENDATION 1		
Station name1	Station name2	Frequency	Protection ratio	Erp1	Erp2	Distance	Erp1	Erp2	Distance
MONGUN	ABUJA	175.25	1.1652	5.6	6	246	56	65	744
ABUJA	SERTI	175.25	1.171758	18	30	498	60	100	838
LAGOS (V. ISLAND)	SERTI	175.25	1.111358	64	80	844	80	100	920
MONGUN	SERTI	175.25	1.415066	5.6	10	315	56	100	900
AZARE	SERTI	175.25	1.070152	52	80	789	65	100	850
ABUJA	YENAGOA	175.25	1.047747	24	26	483	60	65	746
ABUJA	LAGOS (V ISLAND)	175.25	1.017012	18	24	435	60	80	788
KANO	ABUJA	175.25	1.353004	14	12	400	70	60	765
IDOMINASI	ABUJA	175.25	1.768769	6	6	320	60	60	732
AUCHI (JATTU)	ABUJA	175.25	1.374046	4.5	6	256	5	60	320
JALINGO	KADUNA	182.25	1.150821	26	20	467	65	50	700
EGBE	KADUNA	182.25	1.207259	20	12	578	40	50	685
DUSTINAM	ABA	182.25	1.178005	30	50	620	60	100	800
DUSTINAM	KADUNA	182.25	1.333148	6	5	248	60	50	720
DUSTINAM	JALINGO	182.25	1.169866	12	13	348	60	65	730
ABA	KADUNA	182.25	1.234897	50	25	612	100	50	840
FUNTUA	SOKOTO (T.AMODU)	189.25	1.383211	8	6.5	280	80	65	710
FUNTUA	DAMATURU	189.25	1.086276	32	28	499	80	70	720
FUNTUA	UTONKON	189.25	1.127867	32	26	500	80	65	710
KONTAGORA	SOKOTO (T.AMODU)	189.25	1.655431	6	6.5	290	60	65	690
GOMBE	UTONKON	189.25	1.113011	30	32.5	516	60	65	690
JOS	SOKOTO (T.AMODU)	189.25	1.215943	30	26	512	75	65	710
JOS	DAMATURU	189.25	1.422567	15	14	403	75	70	710
UZALLA	SOKOTO (T.AMODU)	189.25	1.034013	99	58.5	782	100	65	840
UZALLA	DAMATURU	189.25	1.112749	80	58.5	799	100	70	865
UZALLA	UTONKON	189.25	1.042857	50	32.5	570	100	65	840

ARBUS	SOKOTO (T.AMODU)	189.25	1.270557	19	32.5	499	38	65	620
ARBUS	DAMATURU	189.25	1.570064	3.8	7	258	38	65	620
TEJUOSO	UTONKON	189.25	1.191703	32	26	515	80	65	710
ABOR HILL ENUGU	IKEJA	196.25	1.541155	10	5	289	100	50	804
ABOR HILL ENUGU	T.MARAFA	196.25	1.027281	80	50	684	100	50	804
BIRNIN KUDU	T.MARAFA	196.25	1.365406	15	15	386	50	50	598
T.MARAFA	TSANNI (KATSINA)	196.25	1.101571	5	5	198	50	50	598
EKU	ISELE-UKU	203.25	1.187524	5	5	199	50	50	585
BAUCHI	ISELE-UKU	203.25	1.031935	54	50	596	60	50	598
GAMO	ISELE-UKU	203.25	1.296446	9	30	396	30	100	613
CALABAR	ISELE-UKU	203.25	1.695541	5	10	296	50	100	673
CHOKOCHOKO	ISELE-UKU	203.25	1.044954	24	60	526	40	100	620
ISELE-UKU	GUSAU	203.25	1.052853	70	42	620	100	60	687
IGBOHO	PORTHARCOURT	210.25	1.099578	42	70	613	60	100	780
IGBOHO	KACHIA	210.25	1.31653	30	35	519	60	70	724
IGBOHO	MINNA	210.25	1.130479	18	15	340	60	50	610
IGBOHO	LAGOS (V.I.)	210.25	1.170928	18	12	329	60	40	599
IGBOHO	ZARIA	210.25	1.216002	30	28	590	60	65	643
GUNMI	KACHIA	210.25	1.235649	24	28	448	60	70	724
GUNMI	MINNA	210.25	1.171853	12	10	283	60	50	610
GUNMI	IGBOHO	210.25	1.265405	18	18	378	60	60	623
KEFFI	IJU	217.25	1.091384	25	30	417	50	60	610
IJU	ABUJA	217.25	1.146396	12	12	283	60	60	620
UGHELLI	IJU	217.25	1.143436	16	24	363	40	60	518
UGHELLI	OKITIPUPA	224.25	1.562823	4	4	189	40	40	500
OKITIPUPA	BIDA	224.25	1.025435	20	30	501	40	80	612
OKITIPUPA	UYO	224.25	1.289659	20	30	420	40	60	609
ABEOKUTA	OKITIPUPA	224.25	1.651081	8	4	236	80	40	612
OS C, IBOKUN	PORTHARCOURT	479.25	1.155638	140	100	406	200	120	432
IBV ENT. BENIN	PORTHARCOURT	479.25	1.168738	40	20	202	200	120	432
IBV ENT. BENIN	IKORODU	479.25	1.208531	40	40	241	200	200	465
IKORODU	PORTHARCOURT	479.25	1.006233	160	90	392	200	120	432

OSBC, IBOKUN	IBW.ENT. BENIN	479.25	1.59342	40	40	283	200	200	465
OSBC, IBOKUN	IKORODU	479.25	1.144383	40	40	234	200	200	465
S.GIDA	KEFFI	487.25	1.147725	80	80	326	200	100	415
S.GIDA	KONTAGORA	487.25	1.767149	40	40	297	200	100	415
S.GIDA	ISELE-UKU	487.25	1.639712	20	10	171	200	100	415
KEFFI	KONTAGORA	487.25	1.14291	40	40	230	100	100	399
KEFFI	ISELE-UKU	487.25	1.125135	60	40	320	100	100	399
KONTAGORA	ISELE-UKU	487.25	1.362928	100	40	401	200	100	415
KASTINA	GUNMI	503.25	1.088966	80	80	307	200	100	415
KASTINA	ZARIA	503.25	1.504038	20	20	184	200	200	465
GUNMI	ZARIA	503.25	1.05565	120	120	370	200	200	465
JOS	CHOKOCHOKO	519.25	1.110814	80	96	315	100	120	405
OWERRI	MAKURDI	543.25	1.144237	120	40.8	283	200	200	465
BOPO	FORCADOS	559.25	1.132088	140	140	373	200	200	465
ABEOKUTA	IDOMINASI	591.25	1.584818	30	30	198	100	60	380
BIDA	IDOMINASI	591.25	1.386451	50	50	236	100	60	380
MALLAMAWA	KANO	735.25	1.005354	120	160	283	200	200	465
ARBUS	KADUNA	743.25	1.016599	180	180	301	200	200	465
KADUNA	LANGTANG	799.25	1.031654	180	180	282	200	200	465
PORTHARCOURT	ASTV, UMUAHIA	839.25	1.115179	90	120	213	150	200	415

4. SEPARATION DISTANCE BETWEEN TWO CO-CHANNEL VHF AND UHF TELEVISION STATIONS IN NIGERIA.

Station Name1	Station Name2	Distance Apart
Aba	Abeokuta	518
Aba	Egbe	416
Aba	Idominasi	434
Aba	Jalingo	604
Aba	Kaduna	612
Aba	Kaima	643
Abeokuta	Bauchi	392
Abeokuta	Bida	592
Abeokuta	Dikwa	1319
Abeokuta	Gunmi	613
Abeokuta	Idominasi	198
Abeokuta	Katsina	849
Abeokuta	Katsina-Ala	678
Abeokuta	Langtang	792
Abeokuta	Okitipupa	236
Abeokuta	Sokoto	717
Abeokuta	Ughelli	401
Abeokuta	Uyo	602
Abeokuta	Yenagoa	401
Abeokuta	Zaria	755
Abor Hill Enugu	Birnikudu	750
Abor Hill Enugu	Dustinam	637
Abor Hill Enugu	Ikeja	289
Abor Hill Enugu	T.Marafa	684
Abor Hill Enugu	Tsanni (Katsina)	988
Abor Hill Enugu	Wukari	304
Abor Hill Enugu	Yola	555
Abuja	Gashua	684
Abuja	Okitipupa	345
Abuja	Serti	498
Abuja	V.Island	435
Abuja	Yenagoa	483
Arbus	Asileke	865
Arbus	BRTV, Maiduguri	1131
Arbus	Damaturu	258
Arbus	Funtua	450
Arbus	Gombe	290
Arbus	Ikom	877
Arbus	Ilorin	731
Arbus	Jos	534
Arbus	Kaduna	301
Arbus	Kontagora	620
Arbus	Sokoto(T.Amodu)	499
Arbus	Tejuoso	890

Arbus	Utonkon	660
Ashileke	Onitsha	392
Asileke	Azare	797
Asileke	Damaturu	998
Asileke	Ikom	402
Asileke	Jos	765
Asileke	Sokoto	644
Asileke	Tejuoso	245
Asileke	Utonkon	679
Auchi	Igbobo	720
Auchi	Meringa	802
Auchi(Jattu)	Abuja	256
Auchi(Jattu)	Azare	721
Auchi(Jattu)	Kano	608
Auchi(Jattu)	Koko	721
Auchi(Jattu)	Lagos(V.Island)	687
Auchi(Jattu)	Mongun	546
Azare	Abuja	650
Azare	Kano	280
Azare	Koko	271
Azare	Lagos(V.Island)	821
Azare	Mongun	583
Azare	Onitsha	798
Azare	Serti	789
Azare	Yenagoa	836
Bassawa	Birninkebbi	395
Bauchi	Bangi	659
Bauchi	Calabar	643
Bauchi	Chokochoko	496
Bauchi	Dustinam	267
Bauchi	Eku	681
Bauchi	Gamo	696
Bauchi	Gudumbali	466
Bauchi	Gusau	401
Bauchi	Isele-Uku	596
Bauchi	Ughelli	722
Bauchi	Yola	306
BBST, Benin	Arbus	873
BBST, Benin	BRTV, Maiduguri	1079
BBST, Benin	Ilorin	329
BBST, Benin	Kaduna	599
BBST, Benin	RSTV, Pharcourt	189
BCOS,Ibadan	Zalau	898
Benin	Abuja	321
Bida	Aba	505
Bida	Abeokuta	392
Bida	Idominasi	236
Bida	Okitipupa	501
Bida	Ughelli	430

Birni kudu	Tsanni (Katsina)	240
Birni kudu	Ikeja	599
Birni kudu	T.Marafa	386
Birni kudu	Wukari	760
Birni kudu	Yola	425
Bopo	Forcados	373
Bopo	Funtua	472
Bopo	Maiduguri	815
Borno Tv, Maidg.	Akangba	915
Calabar	Chokochoko	412
Calabar	Gusau	648
Calabar	Isele-Uku	296
Calabar	Kano	849
Calabar	Mallamawa	909
Chokochoko	Gusau	528
Chokochoko	Isele-Uku	526
Damaturu	Utonkon	776
Desminus, Kaduna	Akangba	715
Desminus, Kaduna	Borno Tv, Maidg.	609
Dustinam	Aba	620
Dustinam	Egbe	710
Dustinam	Jalingo	348
Dustinam	Kaduna	248
Dustinam	Kaima	582
Dustinam	Yola	645
Egbe	Kaduna	578
Egbe	Kaima	349
Egbe	Moriki	543
Eku	Bauchi	681
Eku	Calabar	303
Eku	Chockochoko	417
Eku	Gamo	408
Eku	Gusau	609
Eku	Isele-Uku	199
Enugu	Bauchi	565
Enugu TV, Enugu	Egbe	259
Enugu TV, Enugu	Moriki	707
Forcados	Funtua	802
Forcados	Maiduguri	1154
Funtua	Asileke	687
Funtua	Damaturu	499
Funtua	Gombe	443
Funtua	Ikom	790
Funtua	Jos	467
Funtua	Kontagora	345
Funtua	Maiduguri	585
Funtua	Sokoto(T.Amodu)	280
Funtua	Tejuoso	795
Funtua	Utonkon	500

Galaxy, Ibadan	Uyo	566
Gamo	Calabar	592
Gamo	Chokochoko	203
Gamo	Gusau	401
Gamo	Isele-Uku	396
Gashua	IBW. Ent. Benin	1041
Gashua	Ikorudu	1067
Gashua	OSBC, Ibokun	901
Gashua	PortHarcourt	1053
Gombe	Asileke	848
Gombe	Damaturu	210
Gombe	Ikom	560
Gombe	Jos	256
Gombe	Minna	519
Gombe	Ohafia	849
Gombe	Sokoto	709
Gombe	Tejuoso	944
Gombe	Utonkon	516
Gombi	Epe	943
Gombi	Jalingo	425
Gunmi	Dikwa	943
Gunmi	Igboho	378
Gunmi	Kachia	448
Gunmi	Minna	283
Gunmi	P.Harcourt	850
Gunmi	V.Island	698
Gunmi	Zaria	370
Gusau	Benin	707
Gusau	Yola	659
Ibadan	Markurdi	538
Ibadan	Owerri	427
IBW.Ent. Benin	Ikorodu	241
IBW.Ent. Benin	PortHarcourt	202
Idominasi	Abuja	320
Idominasi	Auchi (Jattu)	480
Idominasi	Azare	787
Idominasi	Kano	640
Idominasi	Koko	765
Idominasi	Lagos (V.Island)	285
Idominasi	Mongun	950
Idominasi	Serti	984
Idominasi	Yenagoa	403
Igbobo	Meringa	590
Igbobo	Kachia	519
Igbobo	Minna	283
Igbobo	Portharcourt	613
Igbobo	Lagos(V.I)	329
Igbobo	Zaria	590
Iju	Abuja	283

Iju-Itaogbolu	Gashua	934
Ikom	Asileke	402
Ikom	Damaturu	761
Ikom	Kano	707
Ikom	Sokoto	864
Ikom	Tejuoso	625
Ikom	Utonkon	121
Ikorodu	PortHarcourt	392
Ilorin	BRTV, Maiduguri	1037
Isele-Uku	Gusau	620
Jaji	Ibadan	605
Jalingo	ASTV, Umuahia	566
Jalingo	Egbe	645
Jalingo	Epe	896
Jalingo	Kaduna	467
Jalingo	Kaima	822
Jalingo	Portharcourt	755
Jebba	Maiduguri	981
Jettu	Serti	598
Jettu	Yenagoa	798
Jos	Chokochoko	315
Jos	Damaturu	403
Jos	Ikom	578
Jos	Sokoto (T.Amodu)	512
Jos	Tejuoso	780
Jos	Utonkon	388
Kachia	Ilorin	425
Kaduna	BRTV, Maiduguri	604
Kaduna	Ilorin	447
Kaduna	Kubli	425
Kaduna	Langtang	282
Kaima	Chokochoko	408
Kaima	Jos	566
Kaima	Kaduna	500
Kano	Abuja	400
Kano	Koko	443
Kano	Lagos(V.Island)	773
Kano	Serti	794
Kano	Yenagoa	838
Kano BC, Kano	ASTV, Umuahia	755
Kano BC, Kano	Jalingo	519
Kano BC, Kano	Lagos	895
Kano BC, Kano	Minaj Sys. Obosi	678
Kano BC, Kano	Portharcourt	909
Katsina	Dikwa	659
Katsina	Gunmi	307
Katsina	Ikeja	896
Katsina	Yenagoa	896
Katsina	Zaria	184

Katsina-Ala	Bida	515
Katsina-Ala	Galaxy, Ibadan	612
Katsina-Ala	Okitipupa	604
Katsina-Ala	PRTV, Plateau	378
Katsina-Ala	Ughelli	604
Katsina-Ala	Uyo	731
Kazaura	Serti	684
Keffi	Abuja	142
Keffi	Gashua	613
Keffi	Iju	417
Keffi	Isele-Uku	320
Keffi	Kontagora	230
Koko	Abuja	387
Koko	Lagos(V.Island)	709
Koko	Mongun	613
Koko	Serti	898
Koko	Yenagoa	787
Kontagora	Asileke	687
Kontagora	Damaturu	725
Kontagora	Gombe	628
Kontagora	Ikom	743
Kontagora	Jos	568
Kontagora	Sokoto(T.Amodu)	290
Kontagora	Tejuoso	567
Kontagora	Utonkon	670
Lafia	Ibadan	519
Lafia	Owerri	368
Lagos	ASTV, Umuahia	495
Lagos	Jalingo	1179
Lagos	Minaj Sys., Obosi	524
Lagos	Portharcourt	401
Lagos(V.I)	Kachia	760
Lagos(V.I)	Minna	519
Lagos(V.I)	P.Harcourt	602
Lagos(V.Island)	Serti	844
Lagos(V.Island)	Yenagoa	354
Langtang	Bida	304
Langtang	Katsina-Ala	307
Langtang	Kubli	659
Langtang	Okitipupa	646
Langtang	Ughelli	566
Langtang	Uyo	729
LTV, keja	Kwara TV, Ilorin	296
Maiduguri	Gunmi	896
Maiduguri	Igboho	1132
Maiduguri	Kachia	789
Maiduguri	Minna	874
Maiduguri	P.Harcourt	996
Maiduguri	V.Island	960

Maiduguri	Zaria	647
Makurdi	Gunmi	330
Makurdi	Igboho	567
Makurdi	Kachia	367
Makurdi	Minna	450
Makurdi	P.Harcourt	467
Makurdi	V.Island	677
Makurdi	Zaria	425
Mallamawa	Kano	283
Markurdi	Aba	326
Markurdi	Abeokuta	576
Markurdi	Bauchi	363
Markurdi	Bida	329
Markurdi	Idominasi	401
Markurdi	Maiduguri	704
Markurdi	Sokoto	675
Minaj Sys., Obosi	ASTV, Umuahia	315
Minaj Sys., Obosi	Jalingo	780
Minaj Sys., Obosi	Portharcourt	451
Minna	Calabar	598
Minna	Kachia	279
Minna	Kano	401
Minna	Mallamawa	378
Minna	Potrtharcourt	579
Mongun	Abuja	246
Mongun	Kano	300
Mongun	Koko	398
Mongun	Serti	315
Mongun	Lagos(V.I)	398
Mongun	Yenagoa	677
New Bussa	Okuta	480
Ogaja	Aiyede	500
Okitipupa	K.Ala	604
OSBC, Ibokun	Ikorodu	234
OSBC, Ibokun	PortHarcourt	406
OSBC,Ibokun	IBW. Ent. Benin	283
Oshogbo	Darazo	811
Owerri	Ibadan	427
Owerri	Makurdi	283
P.Harcourt	Kachia	577
Portharcourt	ASTV, Umuahia	213
Potiskum	Ranko	613
PRTV, Plateau	Galaxy, Ibadan	731
PRTV, Plateau	Uyo	589
RSTV, Portharcourt	Arbus	976
RSTV, Portharcourt	Ilorin	518
RSTV, Portharcourt	Kaduna	722
S.Gida	Isele-Uku	171
S.Gida	Keffi	326

S.Gida	Kontagora	297
Serti	Darazo	434
Serti	Oshogbo	778
Sokoto	Aba	934
Sokoto	Abeokuta	717
Sokoto	Bauchi	589
Sokoto	Bida	424
Sokoto	Damaturu	725
Sokoto	Ibadan	675
Sokoto	Idominasi	576
Sokoto	Markurdi	679
Sokoto	Owerri	844
Sokoto	Utonkon	725
T.Marafa	Ikeja	725
T.Marafa	Wukari	675
Tejuoso	Damaturu	1272
Tejuoso	Sokoto	765
Tejuoso	Utonkon	515
THC, Abuja	Egbe	495
THC, Abuja	Enugu TV, Enugu	212
THC, Abuja	Moriki	495
Tsanni (Katsina)	T.Marafa	198
Tsanni (Katsina)	Wukari	741
Tsanni (Katsina)	Yola	712
Ugep	Kazaura	755
Ugep	Serti	425
Ughelli	Abuja	330
Ughelli	Bangi	873
Ughelli	Gashua	989
Ughelli	Iju	363
Ughelli	Keffi	492
Ughelli	Okitipupa	189
Ughelli	Yola	801
Uyo	Bida	230
Uyo	Eruwon	510
Uyo	Katsina-Ala	627
Uyo	Okitipupa	420
Uyo	Ughelli	230
Uzalla	Arbus	987
Uzalla	Asileke	267
Uzalla	Damaturu	799
Uzalla	Funtua	608
Uzalla	Gombe	603
Uzalla	Ikom	450
Uzalla	Jos	576
Uzalla	Kontagora	659
Uzalla	Sokoto(T.Amodu)	782
Uzalla	Tejuoso	300
Uzalla	Utonkon	570

Wukari	Ikeja	755
Yenagoa	Dikwa	1203
Yenagoa	Gunmi	802
Yenagoa	Serti	890
Yenagoa	Zaria	778
Yola	Bangi	967
Yola	Benin	863
Yola	Ikeja	894
Yola	Isele-uku	199
Yola	T.Marafa	781
Yola	Wukari	640
Zaria	Dikwa	627
Zaria	Kachia	236
Zaria	Minna	283
Zaria	P.Harcourt	802
Zaria	V.Island	797

APPENDIX C

SOURCE CODE

FRMANALYSIS CODE

```
Private Sub disabletext()
txtname1.Enabled = False
txtname2.Enabled = False
txtfreq1.Enabled = False
txtfreq2.Enabled = False
txtprotect.Enabled = False
txterp11.Enabled = False
txterp22.Enabled = False
txtdist.Enabled = False
txterp1.Enabled = False
txterp2.Enabled = False
txtsepdist.Enabled = False

End Sub
Private Sub enabletext()
txtname1.Enabled = True
txtname2.Enabled = True
txtfreq1.Enabled = True
txtfreq2.Enabled = True
txtprotect.Enabled = True
txterp11.Enabled = True
txterp22.Enabled = True
txtdist.Enabled = True
txterp1.Enabled = True
txterp2.Enabled = True
txtsepdist.Enabled = True

End Sub
Private Sub cmdok_Click()
Unload Me
Load frmdata
frmdata.Show
frmdata.clean
End Sub

Private Sub Command1_Click()

End Sub

Private Sub cmdSave_Click()
myanalyse.Index = "Primarykey"
myanalyse.Seek "=", frmdata.STATNAME1, frmdata.STATNAME2
If Not myanalyse.NoMatch Then
   MsgBox "This Has Already Been Saved.", vbInformation, "Information Already Exist!"
   Exit Sub
Else
```

```
  myanalyse.Seek "=", frmdata.STATNAME2, frmdata.STATNAME1
  If Not myanalyse.NoMatch Then
    MsgBox "This Has Already Been Saved.", vbInformation, "Information Already Exist!"
    Exit Sub
  Else
   With myanalyse
      .AddNew

      !station_name1 = frmdata.STATNAME1
      !station_name2 = frmdata.STATNAME2
      !frequency = txtfreq2
      !protect_ratio = txtprotect
      If whicherp = 1 Then
          !distance_apart = txtsepdist
          !erp1 = txterp1
          !erp2 = txterp2

       ElseIf Whichopt = 1 Then
           !erp1 = txterp11
           !erp2 = txterp22
           !distance_apart = txtdist
       End If

      .Update
  End With
 End If
End If
disabletext
cmdSave.Enabled = False

End Sub

Private Sub Form_Load()
Set myanalyse = db.OpenRecordset("tabanalyse", dbOpenTable)
txtname1 = UCase$(mstation)
txtname2 = UCase$(nstation)
txtfreq1 = freqstation
txtfreq2 = freqstation
txtsepdist = sepstation ' add
txtprotect = prot
If whicherp = 1 Then
   Label11.Visible = True
   Label5.Visible = True
   Label13.Visible = True
   Label14.Visible = True
   txterp11.Visible = True
   txterp22.Visible = True
   txtdist.Visible = True
   txterp1 = IIf(newerp1 = 0, erpmstation, newerp1)
   txterp2 = IIf(newerp2 = 0, erpnstation, newerp2)
   'add
   txterp11 = erpmstation
   txterp22 = erpnstation
   txtdist = recdist
  'txtsepdist = sepdistance
ElseIf Whichopt = 1 Then
```

```
   Label4.Visible = False
   Label10.Visible = False
   Label12.Visible = False
   txterp1.Visible = False
   txterp2.Visible = False
   txtsepdist.Visible = False
   txterp11 = erpmstation
   txterp22 = erpnstation
   'txtdist = distvalue
End If
End Sub
```

FRMDATA CODE

```
Dim RS As Recordset
Dim tr As Recordset
Dim mysepdist As Recordset
Dim sr As String
Dim sdt As String
Public PL1, PL2, D1, D2 As String
Public F1, F2, PR, DI, ER1, ER2, SP, CP1, CP2
Private Sub initfrm()
freq1 = ""
freq2 = ""
erp1 = ""
erp2 = ""
dist1 = ""
dist2 = ""
STATNAME1.Text = ""
STATNAME2.Text = ""
SEPDIST.Text = ""

End Sub
Private Sub ADJUSTVAR()
Dim recommerp As Single

End Sub
Private Sub disabletext()
'protect.Enabled = False
'sepdistout.Enabled = False
'freqout.Enabled = False
'freqout2.Enabled = False
'erpout.Enabled = False
'erpout2.Enabled = False
'casout1.Enabled = False
'casout2.Enabled = False
'polout.Enabled = False
'polout2.Enabled = False
'directout.Enabled = False
'directout2.Enabled = False

End Sub
Private Sub cancel_btn_Click()
initfrm
freq1.SetFocus
```

```
End Sub

Private Sub dist1_LostFocus()
End Sub

Private Sub dist2_LostFocus()
End Sub

Private Sub Command1_Click()

End Sub

Private Sub direct1_LostFocus()
D1 = UCase$(direct1)
End Sub

Private Sub direct2_LostFocus()
D2 = UCase$(direct2)
End Sub

Private Sub erp1_LostFocus()
If erp1 <> "" Then
If Not IsNumeric(erp1) Then
response = MsgBox("Only numeric values are allowed for radiation power", 0, "ERROR MESSAGE")
erp1 = " "
erp1.SetFocus
Exit Sub
End If
End If
erp1 = Format(erp1, "###.00000")
End Sub.
Private Sub erp2_LostFocus()
If erp2 <> "" Then
If Not IsNumeric(erp2) Then
response = MsgBox("Only numeric values are allowed for radiation power", 0, "ERROR MESSAGE")
erp2 = " "
erp2.SetFocus
Exit Sub
End If
End If
erp2 = Format(erp2, "###.00000")
End Sub
Private Sub exit_btn_Click()
Unload Me
End Sub
Private Sub EXIT_Click()
Unload Me
End
End Sub

Private Sub Form_Load()
Dim st As String
initfrm
freq1.Refresh
st = "Select * from FreAssign"
```

```
Set RS = db.OpenRecordset(st)
Set mysepdist = db.OpenRecordset("tabsepdistance", dbOpenTable)
If RS.RecordCount > 0 Then
RS.MoveFirst
While Not RS.EOF
freq1.AddItem (RS!frequency)
STATNAME1.AddItem RS!station_name
STATNAME2.AddItem RS!station_name
RS.MoveNext
Wend
End If
End Sub

Private Sub STATNAME1_Click()
Dim mn As Recordset
If STATNAME1 <> "" Then
w = "select [ERP] from freassign where [station_name]='" & STATNAME1 & "'"
Set mn = db.OpenRecordset(w)
With mn
erp1 = !erp
End With
STATNAME2.SetFocus
Else
MsgBox "Enter a station name to continue", vbExclamation
End If
End Sub
Private Sub STATNAME1_GotFocus()
If freq1 = "" Then
MsgBox "Kindly select the Frequency value first", vbCritical
freq1.SetFocus
Else
sr = "SELECT [Station_Name] FROM FreAssign WHERE [Frequency]= " & freq1.Text & ""
Set tr = db.OpenRecordset(sr)
'STATNAME1.Clear
'STATNAME2.Clear
'erp2 = ""
tr.MoveFirst
'Do While Not tr.EOF
'STATNAME1.AddItem (tr!station_name)
'STATNAME2.AddItem (tr!station_name)
'tr.MoveNext
'Loop
End If
End Sub

Private Sub freq1_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
'erp1.SetFocus
End If
End Sub
Private Sub freq1_LostFocus()
If freq <> "" Then
If Not IsNumeric(freq1) Then
response = MsgBox("Only numeric values are allowed for frequency", 0, "ERROR MESSAGE")
freq1 = " "
freq1.SetFocus
```

```
freq1 = Format(freq1, "###.00")
freq2 = freq1

End Sub
Private Sub freq2_LostFocus()
If Not IsNumeric(freq2) Then
response = MsgBox("Only numeric values are allowed for frequency", 0, "ERROR MESSAGE")
freq2 = " "
freq2.SetFocus
Exit Sub
End If
freq2 = Format(freq2, "###.00")
End Sub
Private Sub Option1_Click()
PL1 = "Vertical"
End Sub

Private Sub Option10_Click()
PL2 = "Vertical"
End Sub

Private Sub Option10_LostFocus()
If Option9.Value = 1 Then
PL2 = "Horizontal"
ElseIf Option10.Value = 1 Then
PL2 = "Vertical"
End If

End Sub

Private Sub Option2_Click()
PL1 = "Horizontal"
End Sub

Private Sub Option3_Click()
 D1 = "OmniDirectional"
End Sub

Private Sub Option3_LostFocus()
If Option3.Value = 1 Then
D1 = "Omnidirectional"
ElseIf Option4.Value = 1 Then
D1 = "Bidirectional"
ElseIf Option5.Value = 1 Then
D1 = "Non Directional"
End If

End Sub

Private Sub Option4_Click()
 D1 = "Bidirectional"
End Sub
```

```
Private Sub Option4_LostFocus()
If Option3.Value = 1 Then
D1 = "Omnidirectional"
ElseIf Option4.Value = 1 Then
D1 = "Bidirectional"
ElseIf Option5.Value = .1 Then
D1 = "Non Directional"
End If
End Sub

Private Sub Option5_Click()
D1 = "Non Directional"
End Sub

Private Sub Option5_LostFocus()
If Option3.Value = 1 Then
D1 = "Omnidirectional"
ElseIf Option4.Value = 1 Then
D1 = "Bidirectional"
ElseIf Option5.Value = 1 Then
D1 = "Non Directional"
End If

End Sub

Private Sub Option6_Click()
 D2 = "Non Directional"
End Sub

Private Sub Option6_LostFocus()
If Option8.Value = 1 Then
D2 = "Omnidirectional"
ElseIf Option7.Value = 1 Then
D2 = "Bidirectional"
ElseIf Option6.Value = 1 Then
D2 = "Non Directional"
End If

End Sub
Sub clean()
initfrm
freq1.SetFocus
End Sub
Private Sub Option7_Click()
 D2 = "Bidirectional"
End Sub

Private Sub Option7_LostFocus()
If Option8.Value = 1 Then
D2 = "Omnidirectional"
ElseIf Option7.Value = 1 Then
D2 = "Bidirectional"
ElseIf Option6.Value = 1 Then
D2 = "Non Directional"
End If
```

```
End Sub

Private Sub Option8_Click()
 D2 = "Omnidirectional"
End Sub

Private Sub Option8_LostFocus()
If Option8.Value = 1 Then
D2 = "Omnidirectional"
ElseIf Option7.Value = 1 Then
D2 = "Bidirectional"
ElseIf Option6.Value = 1 Then
D2 = "Non Directional"
End If

End Sub

Private Sub Option9_Click()
PL2 = "Horizontal"
End Sub

Private Sub Option9_LostFocus()
If Option9.Value = 1 Then
PL2 = "Horizontal"
ElseIf Option10.Value = 1 Then
PL2 = "Vertical"
End If

End Sub

Private Sub Process_btn_Click()
'Dim Dt, c, Q, D, J, M, T, X, H, P As Single
If Option3.Value = True Then
   D1 = "Omni-Directional"
ElseIf Option4.Value = True Then
   D1 = "Bi-Directional"
ElseIf Option5.Value = True Then
   D1 = "Non-Directional"
End If
If Option8.Value = True Then
   D2 = "Omni-Directional"
ElseIf Option7.Value = True Then
   D2 = "Bi-Directional"
ElseIf Option6.Value = True Then
   D2 = "Non-Directional"
End If
If SEPDIST <> "" Then
erpmstation = erp1
erpnstation = erp2
freqstation = freq1
sepstation = SEPDIST
mstation = STATNAME1.Text
nstation = STATNAME2.Text
prot = processit(erp1, erp2, freq1, SEPDIST)
PR = Format(prot, "###.00000")
SP = SEPDIST
```

```
F1 = freq1
F2 = freq1
ER1 = erp1
ER2 = erp2
casout = Format(D, "###.0000")
casout2 = Format(T, "###.0000")
'Frame2.Visible = True
disabletext
Me.Hide
frmresult.Show
Else
MsgBox "Distance apart might be empty", vbInformation
SEPDIST.SetFocus
End If
End Sub

Private Sub STATNAME1_LostFocus()
STATNAME1 = UCase$(STATNAME1)
CP1 = STATNAME1
If STATNAME1 = STATNAME2 Then
    SEPDIST = 0
ElseIf STATNAME1 <> "" And STATNAME2 <> "" Then
   mysepdist.Index = "primarykey"
   mysepdist.Seek "=", STATNAME1, STATNAME2
   If Not mysepdist.NoMatch Then
    SEPDIST = mysepdist!distance_apart
     found = True
   End If
   mysepdist.Seek "=", STATNAME2, STATNAME1
   If Not mysepdist.NoMatch Then
    SEPDIST = mysepdist!distance_apart
    found = True
   End If
   If found = False Then
   MsgBox "The Seperating Distance for these two stations those not exist. Enter the Seperating distance
yourself", vbCritical + vbExclamation, "Information Not Found"
   End If
End If
End Sub

Private Sub STATNAME2_Change()
'Label6.Caption = STATNAME2
End Sub

Private Sub STATNAME2_Click()
Dim mn As Recordset
w = "select [ERP] from freassign where [station_name]='" & STATNAME2 & "'"
Set mn = db.OpenRecordset(w)
With mn
If mn.RecordCount > 0 Then
erp2 = !erp
End If
Option4.SetFocus
End With
End Sub
```

```
Private Sub STATNAME2_LostFocus()
STATNAME2 = UCase$(STATNAME2)
CP2 = STATNAME2
If STATNAME1 = STATNAME2 Then
   SEPDIST = 0
ElseIf STATNAME1 <> "" And STATNAME2 <> "" Then
  mysepdist.Index = "primarykey"
  mysepdist.Seek "=", STATNAME1, STATNAME2
  If Not mysepdist.NoMatch Then
   SEPDIST = mysepdist!distance_apart
    found = True
  End If
  mysepdist.Seek "=", STATNAME2, STATNAME1
  If Not mysepdist.NoMatch Then
   SEPDIST = mysepdist!distance_apart
   found = True
  End If
  If found = False Then
  MsgBox "The Seperating Distance for these two stations those not exist. Enter the Seperating distance
yourself", vbCritical + vbExclamation, "Information Not Found"
  End If
End If

End Sub
```

FRMINTRODUCTION CODE

```
Private Sub Form_Load()
   Timer1.Interval = 30000
   'MMControl1.Notify = False
   'MMControl1.Wait = True
   'MMControl1.Shareable = False
   'MMControl1.DeviceType = "WaveAudio"
   'MMControl1.filename = "C:\WINDOWS\application data\microsoft\welcome\welcom98.wav"

   ' Open the MCI WaveAudio device.
   'MMControl1.Command = "Open"
   'MMControl1.Wait = False
   'MMControl1.From = 0#
   'MMControl1.Command = "play"
  'MMControl1.Command = "close"
End Sub

Private Sub Form_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
Form_Unload (vbCancel)
End Sub

Private Sub Form_Unload(Cancel As Integer)
'MMControl1.Command = "close"
Unload Me
frmlogin.Show
'frmdata.Show
End Sub

Private Sub Timer1_Timer()
Form_Unload (vbCancel)
```

```
End Sub
```

FRMREDUCE CODE

```
Private Sub Check2_Click()
If chech2.Value = 1 Then
Text2.Text = "DISTANCE"
Else
Text2.Text = ""
End If
End Sub

Private Sub chkdist_LostFocus()
If Chkdist.Value = 1 And Chkerp.Value = 1 Then
Text1.Text = "both"
ElseIf Chkdist.Value = 1 Then
Text1.Text = "DISTANCE"
End If
End Sub

Private Sub chkerp_LostFocus()
If Chkdist.Value = 1 And Chkerp.Value = 1 Then
Text1.Text = "both"
ElseIf Chkerp.Value = 1 Then
Text1.Text = "ERP"
End If
End Sub

Private Sub cmdcancel_Click()
Unload Me
frmdata.Show
End Sub

Private Sub cmdok_Click()
Dim Message, Title, Default, erpmValue, erpnvalue
If LTrim$(Text1.Text) = "ERP" Then
   whicherp = 1
   both = 0
      'frmboth.show
ElseIf LTrim$(Text1.Text) = "DISTANCE" Then
      'frmdistance.show
   Whichopt = 1
   both = 0
ElseIf LTrim$(Text1) = "both" Then
   whicherp = 1
   both = 1
End If
cont = 0
gr
If whicherp = 1 Or both = 1 Then
      cont = cont + 1
        Message = "Enter a value between 0.1 and 1"
        Title = "ERP Reduction for " + msiation
        Default = "0.1"
```

```
        erp1value = InputBox(Message, Title, Default)
        newerp1 = erpmstation * IIf(erp1value = "", 0, erp1value)
        newmerp = newerp1
        prot = processit(newerp1, erpnstation, freqstation, sepstation)
        If prot < 1 And erp2value < 1 Then

        'Do While prot < 1

            response = MsgBox("The Protection Ratio is still not adequate", vbInformation + vbOKOnly,
"RPP")
            Message = "Reduce the expected radiation power of station 2 "
            Message = Message + " Until the desired protection ratio is obtained"
            response1 = MsgBox(Message, vbInformation + vbOKOnly, "RPP")
            Message = "Enter a value between 0.1 and 1"
            Title = "ERP Reduction for " + nstation
            Default = "0.1"
            erp2value = InputBox(Message, Title, Default)
            newerp2 = erpnstation * erp2value
            newnerp = newerp2
            prot = processit(newerp1, newerp2, freqstation, sepstation)
            If cont = 5 Then
                Unload Me
                frmresult.Hide
                frmdata.Show
                Exit Sub
            End If
            If prot < 1 Then
                If erp1value <> 1 Then
                    response = MsgBox("The Protection Ratio is still not adequate", vbInformation +
vbOKOnly, "RPP")
                    Message = "Reduce the expected radiation power of station 1 "
                    Message = Message + " Until the desired protection ratio is obtained"
                    response1 = MsgBox(Message, vbInformation + vbOKOnly, "RPP")
                    GoTo gr
                ElseIf erp2value <> 1 Then
                    response = MsgBox("The Protection Ratio is still not adequate", vbInformation +
vbOKOnly, "RPP")
                    Message = "Reduce the expected radiation power of station 2 "
                    Message = Message + " Until the desired protection ratio is obtained"
                    response1 = MsgBox(Message, vbInformation + vbOKOnly, "RPP")
                    GoTo gr
                Else
                    Message = "The Two stations can not be made Protected Using Only There Erp, Please
Increase there Distance Apart"
                    Title = "Distance Adjustment for Station"
                    Default = "0"
                    sepstation = InputBox(Message, Title, Default)
                    prot = processit(newmerp, newnerp, freqstation, sepstation)
                    If prot < 1 Then
                        MsgBox "The Package will Suggest a Recommended distance apart"
                        prot = 1
                        sepstation = dist(prot, erpmstation, erpnstation, freqstation)
                    End If
                    frmanalyis.txtsepdist = sepstation
                    Me.Hide
                    frmanalyis.Show
```

```
            End If
          End If
        End If
ElseIf Whichopt Then
   i = 0
   Message = "Enter the Distance adjustment for stations"
   Do While i < 3

       Title = "Distance Adjustment for Stations"
       Default = "0"
       On Error Resume Next
       recdist = InputBox(Message, Title, Default)
       prot = processit(erpmstation, erpnstattion, freqstation, recdist)
       If prot >= 1 Then
        Exit Do
       Else
       Message = "The Protection Ratio is still not adequate. Enter the Distance adjustment for stations"
       End If
   Loop
   If prot < 1 Then
       MsgBox "The Package will Suggest a Recommended distance apart"
       recdist = dist(prot, erpmstation, erpnstation, freqstation)
   End If
   frmanalyis.txtdist = recdist
   Me.Hide
   frmanalyis.Show
End If
' Adjustment
recdist = dist(prot, erpmstation, erpnstation, freqstation)
Me.Hide
frmanalyis.Show
End Sub
```

FRMRESULT (FRM)

```
Private Sub disabletext()
freqout.Enabled = False
freqout2.Enabled = False
erpout.Enabled = False
erpout2.Enabled = False
directout.Enabled = False
directout2.Enabled = False
polout.Enabled = False
polout2.Enabled = False
sepdistout.Enabled = False
protect.Enabled = False
End Sub
Private Sub enabletext()
freqout.Enabled = True
freqout2.Enabled = True
erpout.Enabled = True
erpout2.Enabled = True
directout.Enabled = True
directout2.Enabled = True
polout.Enabled = True
```

```
polout2.Enabled = True
sepdistout.Enabled = True
protect.Enabled = True
End Sub

Private Sub btnBack_Click()
Unload Me
Load frmdata
frmdata.Show
frmdata.clean
End Sub

Private Sub cmdExit_Click()
Unload Me
Load frmdata
frmdata.Show
End Sub

Private Sub cmdSave_Click()
myprotect.Index = "Primarykey"
myprotect.Seek "=", frmdata.STATNAME1, frmdata.STATNAME2
If Not myprotect.NoMatch Then
   MsgBox "This Has Already Been Saved.", vbInformation, "Information Already Exist!"
   Exit Sub
Else
   myprotect.Seek "=", frmdata.STATNAME2, frmdata.STATNAME1
   If Not myprotect.NoMatch Then
      MsgBox "This Has Already Been Saved.", vbInformation, "Information Already Exist!"
      Exit Sub
   Else
    With myprotect
       .AddNew

       !station_name1 = frmdata.STATNAME1
       !station_name2 = frmdata.STATNAME2
       !frequency = freqout
       !erp1 = erpout
       !erp2 = erpout2
       !direction1 = directout
       !direction2 = directout2
       !distance_apart = sepdistout
       !protect_ratio = protect
       If protect > 1 Then
          !protected = True
       Else
          !protected = False
       End If
       .Update
    End With
  End If
End If
disabletext
cmdSave.Enabled = False
End Sub

Private Sub Form_Load()
```

```
Set myprotect = db.OpenRecordset("tabprotection", dbOpenTable)
polout = frmdata.PL1
polout2 = frmdata.PL2
directout = frmdata.D1
directout2 = frmdata.D2
erpout = frmdata.ER1
erpout2 = frmdata.ER2
freqout = frmdata.F1
freqout2 = frmdata.F2
protect = frmdata.PR
sepdistout = frmdata.SP
Label5.Caption = frmdata.CP1
Label6.Caption = frmdata.CP2
If protect < 1 Then
response = MsgBox("The Protection Ratio is not adequate", vbInformation + vbOKOnly, "RPP")
Message = "Reduce the expected radiation power of either station 1 or 2 or both"
Message = Message + " Until the desired protection ratio is obtained"
response1 = MsgBox(Message, vbInformation + vbOKOnly, "RPP")
cmdSave_Click
frmreduce.Show
Else
MsgBox "The protection ratio is adequate", vbInformation + vbOKOnly, "RPP"
Exit Sub
End If
Me.WindowState = 1
End Sub
```

MODULE 1

```
Global Const pi = 3.142
Global Const c = 300000000
Global Const freqconst = 1000000
Global mstation As String
Global Whichopt As Integer
Global distvalue As Single
Global whicherp As Integer
Global both As Integer
Global newmerp As Single
Global newnerp As Single
Global nstation As String
Global newerp1 As Single
Global newerp2 As Single
Global erpmstation As Single
Global myprotect As Recordset
Global myanalyse As Recordset
Global myuser As Recordset
Global sepstation As Single
Global erpnstation As Single
Global freqstation As Single
Global prot As Single
Global recdist As Single
Global Const erpconst = 1000
Global db As Database
Sub main()
Dim str As String
```

```
str = "C:\project\new\biodun.mdb"
Set db = DBEngine.OpenDatabase(str)
Frmintro.Show

End Sub
Function processit(merp1, merp2, freq, seperation)
Ra = Sqr(30 * merp1 * erpconst) * (c / (4 * pi * freq * freqconst))
Rb = Sqr(30 * merp2 * erpconst) * (c / (4 * pi * freq * freqconst))
dm = Ra + Rb
processit = (seperation - (Ra + Rb)) / dm
End Function
Function dist(protect, merp1, merp2, freq)
Ra = Sqr(30 * merp1 * erpconst) * (c / (4 * pi * freq * freqconst))
Rb = Sqr(30 * merp2 * erpconst) * (c / (4 * pi * freq * freqconst))
dm = Ra + Rb
dist = (protect * dm) + dm

End Function
```

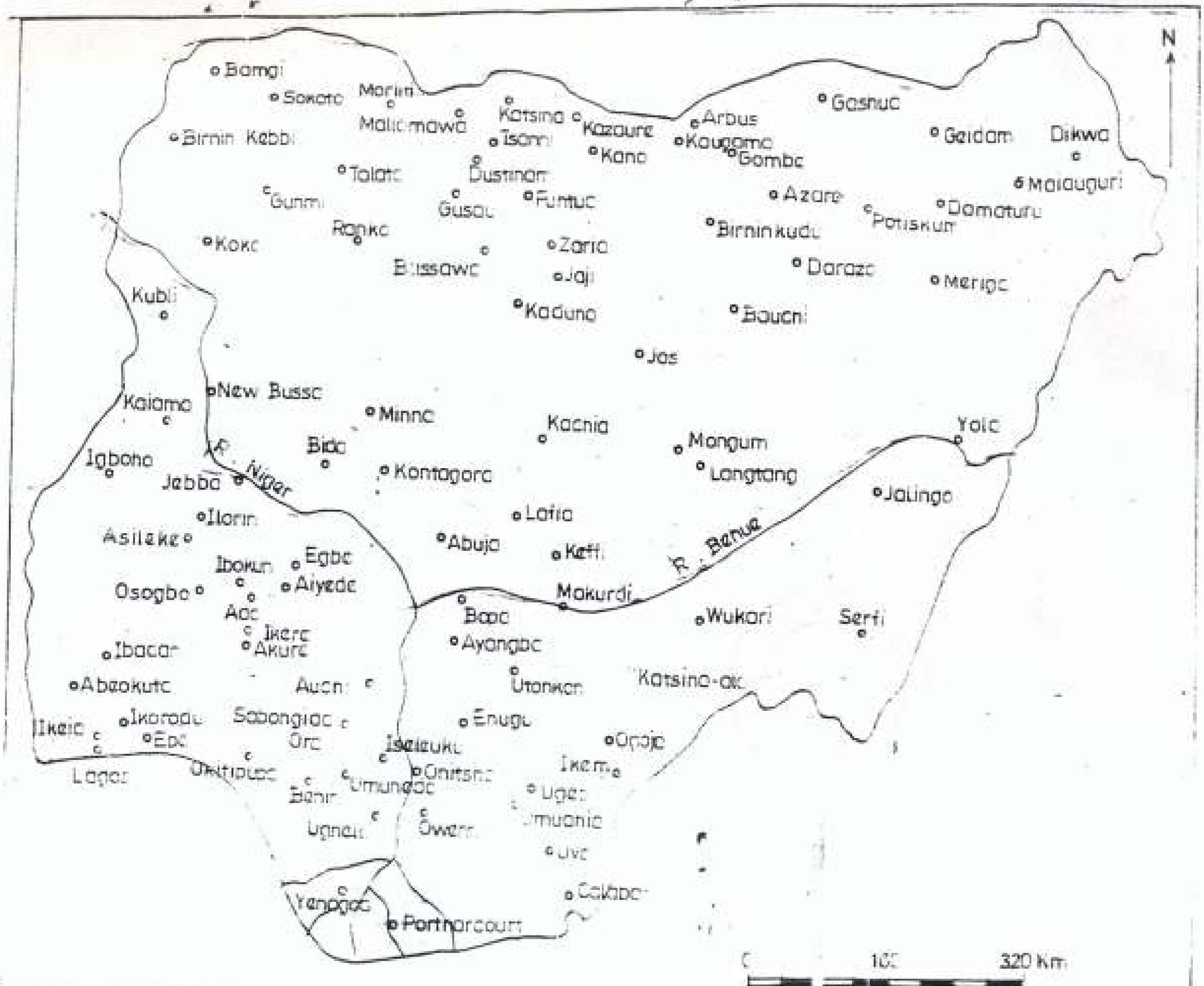

Fig :Location of VHF and UHF transmitters in Nigeria (Proposed / Existing