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MODERN AIDS TO EDUCATION

Project 620-11-690-208

U.S.A.I.D./Nigerian Ministries of Education/Washington County, Maryland

SPECIAL REPORT

Survey of Nigerian Broadcast Services
by
John R. Brugger, Consultant

BOARD OF EDUCATION OF WASHINGTON COUNTY

Hagerstown, Maryland

INTRODUCTION

The main thrust of the Modern Aids to Education Project is to provide technical advice and assistance in the development of a program designed to utilize educational radio and television and supporting materials as one of the major learning resources in the instructional program in Nigeria.

As an adjunct to the development of the project, it was determined that a technical review of radio and television facilities in Nigeria would provide much assistance and, in particular, ascertain the area of Northern Nigeria that is now served by radio.

It was these motives which prompted this survey.

Gratitude is extended to the administrative and technical personnel at Lagos, Enugu, Aba, Kaduna, and Ibadan television stations who discussed and demonstrated the range of production facilities of their respective operations. This, together with an opportunity to observe a number of regular in-school telecasts, provided a firsthand view of techniques employed in instructional telecasts.

Cooperative assistance was likewise received in contacts with NBC personnel at Lagos, Kaduna, and the Northern Region where visits were made at a number of NBC local stations. Conferences were held with BCNN personnel who were very helpful and cordial.

Working with all of these professionals of radio and television was a very pleasant experience. I was continuously impressed with their expressions of dedication to and enthusiasm for their endeavors. I found an abundance of friendliness and sincerity in all of the Nigerian people with whom I had any contact.

A special thanks is extended to Mr. M. E. (Gene) Mittel and the various A.I.D. officers and employees who always stood ready to assist in any way possible to insure every need was provided Gene and me to carry out our activity. It is my conviction that Gene Mittel went far beyond regular duty to assist in carrying out this phase of the project.

John R. Brugger

MODERN AIDS TO EDUCATION PROJECT
U.S.A.I.D./Nigeria/Washington County, Maryland

SURVEY AND REPORT OF BROADCAST SERVICES
by
John R. Brugger, Consultant

INTRODUCTION

The Board of Education of Washington County, Maryland, is presently engaged in a project in Nigeria, Africa, under a U.S.A.I.D. contract. The program is entitled Modern Aids to Education, Project No. 620-11-690-208. Initial stages are concerned mainly with expanding the use of radio and television for instructional purposes. A staff of seven full-time technicians from Washington County, Maryland, now living in Nigeria, are assisting Ministries of Education school personnel, and A.I.D. officials in developing the program. Actual work began in September, 1963.

Officers administering the project determined that the services of a consultant in the field of radio and television broadcasting were needed to assist in solving some of the problems related to technical equipment, in both transmitting and receiving radio broadcasts. The process of selecting such a consultant was undertaken by the Board of Education, Hagerstown, Maryland.

OBJECTIVES AND PURPOSES OF THE ASSIGNMENT

The pertinent problems were identified and a consultant was selected. The consultant was to go to Nigeria, Africa, to survey, study, and report his findings in these chief interest areas:

1. Visit appropriate installations of radio and television transmitting and receiving facilities to make an evaluation of the technical proficiencies of the installations

2. Through conferences with representatives of A.I.D. and Nigerian technical personnel, assist in the establishment of pilot workshops for Ministry and school personnel, in the specific area of providing technical training in broadcasting and related activities

3. Establish the approximate coverage areas of existing radio and television stations in the Northern Region, Nigeria

4. Predict future coverage based on current planning and developments by the respective broadcasting organizations in the Northern Region, Nigeria

5. Advise the contractor and U.S.A.I.D. on technical matters related to the selection of equipment to be procured as a part of the contract

6. Make such recommendations as deemed appropriate regarding broadcast facilities that may affect the work to be carried out under the contract

SELECTION OF A CONSULTANT

A candidate was selected for the assignment and necessary arrangements were completed in early October, 1964. Approval was granted to me by the Associate Commissioner, U. S. Office of

Education, to accept the assignment. An agreement was reached between the Office of Education and the State Department wherein I would be relieved of my regular duties as program officer and deputy director of the Educational Television Facilities Program for approximately thirty days to serve as a consultant on the project.

My experiences include four years as program officer, U. S. Office of Education; five years as director of engineering, Board of Education, Hagerstown, Maryland, Closed-Circuit Educational Television Project; and over ten years as chief engineer of the University of Illinois Broadcasting Services, Urbana, Illinois. Professional training, together with these and other experiences in the fields of education and broadcasting, provides unique qualifications for this specific assignment.

I reported to the project chief of party in Lagos, Nigeria, October 17, 1964, and proceeded to work on the assignment as directed.

METHOD OF ATTACKING THE PROBLEM

1. A visitation was made to a representative group of television and radio broadcast installations in Nigeria.

    a. Matters pertaining to present broadcast operations were reviewed and discussed with technical representations.

    b. An assessment was made of present operations and equipment.

    c. Methods of improving present operations by utilizing present technical apparatus, the possibility of attaining new frequency assignments and related engineering considerations were reviewed and discussed with Nigerian representatives.

2. Field tests were conducted to determine the radii of coverage of various broadcast transmitters by:

    a. Measuring radiated field intensities of various transmitters in service

    b. Evaluating broadcast signal quality at various distances from operating transmitters

    c. Recording observations of medium and short wave transmissions at selected receiving points in Northern Nigeria

3. Reception problems were investigated and evaluated for the purpose of determining:

    a. The kinds of problems encountered in typical classroom installations for receiving broadcasts

    b. The readability of transmitted signals at distant classrooms where broadcasts are utilized for in-school instructional purposes

    c. The utility of received signals in distant locations (with regard to signal to noise "S/N" ratio)

    d. The geographical limits where presently received signals can be used productively in the in-school instructional program

e. Service problems related to presently installed receiving equipment

4. The following major communities were visited in Northern Nigeria and a review of selected broadcast facilities was made:

   Kana, Kaduna, Keffi, Zaria, Sokoto, Katsina, Potiskim, Maiduguri, Ilorin, Jos, and Bauchi

   Test equipment was set up and field readings were made in each of the major communities and intervening points along routes traveled, of respective radio broadcast services, as follows:

   a. 3.326 megacycles (mcs) - Nigerian Broadcasting Company (NBC), short wave (sw) - Kaduna

   b. 6.175 mcs. (sw) - NBC, Kaduna

   c. 9.655 mcs. (sw) - NBC, Kaduna

   d. 6.090 mc. (sw) - Broadcasting Corporation of Northern Nigeria (BCNN) - Kaduna

   e. 940 kilocycles (kcs) - BCNN, medium wave (mw) - Kaduna

   f. Medium wave broadcast frequencies, as utilized by NBC in Kano, Zaria, Sokoto, Katsina, Maiduguri, Ilorin, and Jos, respectively

5. Monitoring points were selected along major roads traversed, precise location of each monitoring point was identified and recorded by referring to mileage posts established on main roads by civil engineers of the Northern Nigerian Ministry of Works. Measurements and observations were made at various monitoring points following standard procedures; that is, free space fields, unaffected by absorption or re-radiation factors caused by utility lines, fences, buildings, etc. Cognizance was made of various other procedures which are generally recommended as good engineering practices regarding field strength measurements. Evaluations were made only during the hours of daylight, observing the fact that radiated signals are subject to extreme ironospheric variations during hours of darkness, for two hours after sunrise and two hours prior to sunset, as compared to the intervening daylight hours.

6. Inspection trips were made to each of the following television production centers:

   Enugu, Aba, Kaduna, Ibadan, Kano, and Lagos

RESULTS AND EVALUATIONS

The technical broadcast facilities operated by permission of and wholly or partly supported by Federal, Eastern, Northern, and Western Nigerian governments provide for the people of Nigeria an essential and a very valuable educational resource. In most respects, these facilities provide the people of Nigeria a mass communication service considered vital to every modern country of the world. Much credit is extended to governments, educational and community leaders who were instrumental in the planning and development of such extensive communication facilities which

now serve such a major role in the growth of their new nation. The benefits which accrue educationally, economically, socially, and culturally from utilization of mass communications are great indeed.

One of the chief purposes of the Board of Education, Hagerstown, Maryland, in this project is to improve utilization of radio and television for in-school instructional programs. This field survey was undertaken to assist in providing additional information necessary to achieve the greatest measure of success.

A number of factors relating to the propagation characteristics of radio waves should be reviewed to provide background information affecting judgments made and data reported. Opinions resulting from factors observed are conditioned by acknowledged variables peculiar to radio wave transmissions. Briefly, the following factors summarize several important considerations:

1. Propagation characteristics of broadcast frequencies are generally subject to more favorable transmission distances during night-time than in daylight hours. Although night-time broadcast service is extended through secondary service (sky waves), secondary service is often subject to interference and extensive fading. Generally, in-school instructional program services should not rely on secondary service.

2. Transmissions of programs specifically designed for in-school instructional purposes are subject to more stringent requirements regarding clarity, freedom from fading, signal-to-noise ratios, and other signal interferences as compared to ordinary broadcasts. Transmission quality of public interest and informational programs provides many valuable services to the general public and may fall considerably below the signal quality essential to good instructional in-school programs. Opinions stated in this report are based on what is judged to be acceptable broadcast transmission quality for effective and dependable classroom instructional utilization.

3. Transmitters and associated electronic equipment in use for broadcasting during the intervals this field survey was conducted may have been other than that which would normally be anticipated for specific locations. Adjustments were made where similar field experiences have prompted certain engineering judgments and are incorporated where appropriate.

4. Radio transmissions vary during seasons. A series of observations during each of the seasons would be necessary to encounter the variable atmospheric conditions and radio wave propagation characteristics peculiar to this segment of Africa. Weather conditions during the period these particular field evaluations were made were predominantly clear and fair.

5. The term "readability" as used in Table I combines in a figure of merit, signal strength, and listener understandability of broadcast program materials in terms of freedom from (electrical) interferences and other distractions manifested as noise in the received signal. Generally, the summation of undesired signals or noise (appearing as seemingly a part of the received signal) is expressed in the technical term "signal-to-noise" ratio (expressed S/N). When the desired signal is fifty decibels (db) or more above the undesired signal, the listener is unaware of noises. As the difference of signal-to-noise ratio decreases to less than fifty db, the relative noise level becomes objectionable to the listener. "Perfect" reproduction of a program by radio receiver occurs when the clarity of the program is essentially free from any electrical interferences; theoretically the same as listening to the program amplified with no distortion or detectable noise observable by the listener.

Signal-to-noise ratio varies proportionately with distance from a transmitter; that is, the farther one moves away from a transmitter, the lower the ratio. The signal actually decreases, the noise level is relatively constant. As the signal level decreases with distance from the transmitter, a point is reached where the broadcast is unreadable, and the program ceases to be of any practical use. This report attempts to establish limits of useful service areas of the various transmitters in Northern Nigeria.

Noise of distant transmissions characteristic of amplitude modulation (AM) can be overcome in part by utilization of frequency modulation (FM). It is recommended that future planning of transmission facilities for broadcasting take into consideration the advantages of FM modulation techniques. This is not to infer that FM is a panacea - but rather in evaluating and planning broadcast facilities, there are values which should be considered

6. Since frequencies allocated for broadcast use are based on precedent and international agreements, it is not feasible to circumvent existing agreements and related technical considerations. Basically, medium wave frequencies - particularly the lower portion of the medium wave band - are the most favorable for long distance transmissions. Limits are imposed by international agreements.

   Distance served by a given transmitter is directly related to operating power (at a square ratio). Generally, the higher the frequency the poorer the wave propagation. Compensation can be affected by power increases, within limits. However, in accordance with international agreements, short wave (sw and, in fact, other spectrum of) frequencies are allocated to enable geographical segments of all areas of the world to have available multiple transmissions services; that is, to have many channels of communication. Through the development of high power transmitters, broadcast services can be established within keeping of established agreements - to serve distant areas, even through the use of sw equipment. Nigeria is adhering to principles of good engineering practices and is operating equipment in accordance with international agreements. Also, investigations have been instituted with the hopes of acquiring new benefits consonant with international agreements (new frequencies and power).

7. Although broadcast signals are reaching a good portion of Nigeria, as is reflected within this report, it is to be noted that many areas are receiving very limited coverage by the various transmitters during the daylight hours and either increases in power or additional installation of broadcast equipment is essential to assure all communities of potential service during both day and night hours. The ability of distant areas to receive useful signals is both a transmitter (frequency and power) and receiver consideration. Many communities in Nigeria now receive broadcast signals sufficient for good reception, the quality of which is related to receiver performance. Field tests made during this survey indicate the results of several different quality receivers. The use of a high quality receiver has the dual effect of extending the service range of stations and also providing a better signal as compared to lesser receivers. Additional benefits accrue under adverse reception conditions. In other words, the distance that may be served by a given transmitter requires an assessment of two factors:

   a. The signal strength (and noise factor) of the signal at a given distance

   b. The characteristics of receivers used at distant points in relation to their ability to operate under adverse conditions

This report focuses on this relationship and it is recommended that future planning and acquisition of equipment take into account the relative considerations. Assistance from technical counsel should be utilized in evaluating and planning services (transmitting and receiving) related to current and future operations.

8. The Ionsphere Research Section, Ionsphere Research and Propagation Division, National Bureau of Standards, Boulder Laboratories, Boulder, Colorado, U. S. A., has proposed a study on the propagation of medium wave and short wave transmission at short distances in Africa. Information regarding ground conductivity will also be compiled through a series of tests surrounding Kaduna, Nigeria, using 940 kcs. Specifics of the studies have been prepared and it has been proposed that such tests be accomplished by late spring, 1965.

   Data collected from this study will provide vital scientific information which, in the future, will assist engineers to predict radio coverage with given parameters of power, frequency, etc. in this area of Africa. Details of the study have been negotiated by officials of the Broadcasting Company of Northern Nigeria (BCNN).

9. Ideally, to establish complete field strength data for a given broadcast station, measurements of the radiated field are made on each of eight uniformly spaced radials around the station from one mile to ten miles at one-mile intervals with several measurements less than one mile. This procedure was followed only in part in this survey. For the purpose of the project, the data herein reported is intended to provide the kinds of immediate information needed even though it does not incorporate complete data with accompanying degree of accuracy.

Test points where field readings were evaluated (identified by noting mileage posts on routes where tests were made) were carefully projected on maps from which coverage areas were established.

Table I presents a convenient analysis of areas where sufficient broadcast signals for instructional purposes were monitored. The designations for the respective quality of signals are based on a Zenith R 3000 receiver performance. Lesser signal quality was observed on a Diamond and Philips receiver. Limited use of the latter two receivers is demonstrated in the annotated maps within this report.

Random observations made include the following:

Jos, Keffi, Kontagora, and Jebba receive sufficiently good short wave transmissions from Ibadan to judge them usable for classroom utilization.

Bauchi receives medium wave transmissions from Enugu well enough to deem them usable for classroom listening.

Tegina receives a relatively good signal from the Enugu medium wave transmissions and they are considered suitable for classroom use.

Complete reporting of Federal, Eastern, and Western Region transmissions was not attempted and these random observations are not to be interpreted as the extent of transmissions reaching the Northern Region. Rather they are reported as interest items. These monitoring results, too, are to be associated with the performance of a Zenith R 3000 receiver.

TABLE I

	BCNN 940 kcs 10 kw*	BCNN 6.090 mcs 10 kw	NBC 3.326 mcs 7.5 kw	NBC 6.175 mcs 20 kw	NBC 9.655 mcs 10 kw (directional)	Medium Wave local station	
Kaduna	R5	R5	R5	R5	R5	R5	Medium Wave 1.0 kw
Gusau	P	P	P	R4			
Sokoto		P		R4	R5	R5	Medium Wave .250 kw
Katsina	R4-	R4	R4	R3	R5	R5	Medium Wave .250 kw
Kano	R5	R4	P	R3+	R5	R5	Medium Wave 1.0 kw
Potiskum		R4	R4-	R4			
Maiduguri		R4-	R4-	R4	R5	R5	Medium Wave .250 kw
Jos	R4	R4	R4	R3	R5	R5	Medium Wave .250 kw
Bauchi	R4	P	R4-				
Keffi	R4-	P					
Zaria	R4	P	R4	R4	R5	R5	Medium Wave .250 kw
Tegina	R4	R4					
Kontagora	R4	R4	P	P			
Jebba		R4	P	P			
Ilorin		R4		R5	R5	R5	Medium Wave .250 kw

P - Areas where sufficient signal probably exists for classroom use
R1 - Unreadable signal, unusable signal
R2 - Barely readable signal, unusable signal
R3 - Readable with difficulty, marginal use for classroom
R4 - Readable with some interference, usable signal for classroom
R5 - Perfectly readable signal, no interference

*BCNN (940 kcs) 10 kw power; .250 kw power daytime provides nominal signal over essentially all Northern Nigeria as well as the entirety of Nigeria.

Readability is based on Zenith R 3000 receiver with normal sensitivity of 48 microvolts at 930 kcs, 7.1 microvolts at 3.0 mcs, 10 microvolts at 6.25 mcs, 2.0 microvolts at 9.7 mcs, and 2.0 microvolts at 9.7 (for 50 milliwatts output above noise).

Letters indicated in Table I refer to signal values observed in the respective communities listed. Letter "P" designates areas where signals are predicted, based on observations made at similar distances in other directions. Since the schedule of operation of various transmitters was of such a nature as not to coincide with the travel itinerary, all transmitting equipment could not be monitored at the particular times all field stops were made. Therefore, engineering judgment was exercised to determine the predicted coverage area as appropriate. R1 to R5 designate readability, R1 representing the poorest quality signal and R5 representing the practically perfect signal.

Kaduna equipment operating on 9.655 mcs is directional and as a result of the limited excursions made during this survey, insufficient data was recorded to provide a decisive pattern of coverage for this particular station. All other transmitters monitored in Northern Nigeria, and reported in this survey, are omni-directional.

Calibrated instruments designed for use in making field strength measurements are used in standard procedures for establishing radio station coverage. Since a complete complement of test instruments was not available to measure the field intensity of the various frequencies under study, selected receivers were utilized to provide, besides relative field strengths, a method for observing signal-to-noise ratios and, in general, the readability (signal quality) of transmissions. Characteristics of receivers vary considerably in terms of sensitivity (defined as the ability of a receiver to perform acceptably with a very small amount of signal) and selectivity (defined as ability of a receiver to readily tune one of several adjacent signals). It can be stated that generally, the more expensive receivers, because of design characteristics, provide a much higher performance (i.e., higher sensitivity and high selectivity).

Three receivers were used in the field survey:

A Diamond (of Nigeria) Model NELIR-8T3 with the following nominal sensitivities - medium wave band, 200 microvolts; short wave I, 200 microvolts; and short wave II, 100 microvolts

A Philips (of Nigeria) Model B3AN36T with nominal sensitivities of 20 microvolts on each of the short wave bands

A Zenith (of the United States) Model R 3000 with a nominal sensitivity - 48 microvolts at 930 kcs, 7.1 microvolts at 3 mcs, 10 microvolts at 6.25 mcs, and 2 microvolts at 9.7 mcs

It is pointed out that these are not considered competitively priced receivers but rather three ranges of cost and performance. Each is a portable model, transistorized with built-in aerial (antenna). Comparative performance is demonstrated in the shaded maps.

Several tests were made using external antennas on receivers in the field. The utilization of external antennas has certain desirable effects but produce some nullifying effects. Directional antennas appropriately designed, installed, and orientated improve reception the most effectively. The combination of a high performance receiver (one possessing high sensitivity and high selectivity) together with a directional antenna has the effect of extending the service range of a broadcast station considerably. The addition of an external antenna not possessing directional characteristics to a receiver with relatively low sensitivity and low selectivity provides little improvement in reception. While it is true that the addition of the external antenna increases the "input" to a receiver, generally the relationship of the (desired to undesired) signals is little improved, and

the increased but nondiscriminant ouput of the receiver is merely a result of greater amplification with little increase in the desired signal quality. These remarks pertain especially to the consideration of classroom use of broadcast signals.

> Note: An antenna is basically an untuned device which picks up electromagnetic waves of all sorts; the receiver tuning selects specific signals over others (referred to as selectivity). As stated earlier, a receiver with low selectivity is not capable of improving its performance particularly with the addition of an antenna. Thus, it is imperative to add a directional antenna designed and installed specifically for the task. Economically, it is more prudent to acquire better designed receivers than to design and install sophisticated antennas, particularly as the problem in Northern Nigeria is viewed by this consultant.

With this consideration, it is recommended that Diamond receivers as now distributed in the outlying communities of Northern Nigeria (with respect to broadcast station locations) be relocated so as to make better utilization of the sets possible. Relative limits of usefulness is indicated on the shaded maps. Better receivers should be used to replace those in the more distant areas. Specifically, the Diamond receivers should be used within an eighty- to ninety-mile radius of Kaduna for use on 940 kcs (10 kws power), 6.090 mcs, 6.175 mcs, and 3.326 mcs, and within fifteen miles of medium wave transmitters except up to thirty miles for the reception of the medium wave transmitters operated at Kano and Kaduna. (These two communities operate transmitters with 1 kw power.) Since the 9.655 mcs transmitter located at Kaduna utilizes a directional antenna with an east to west orientation, the Diamond receiver might be located as far east as Potiskum where it operated quite satisfactorily on this frequency. It should be noted that in order to use the receiver at such a distance, it must be kept in the major lobe of the radiation pattern. Data compiled during the field survey is insufficient to define the relative coverage pattern on 9.655 mcs. It was observed that Maiduquri, Sokoto, and Kontogora received sporadic service; that is, rather intermittent signal as monitored on a Zenith R 3000 receiver. Maiduquri (NBC) relayed program materials from 9.655 mcs on a regular basis with signal dropout at sunrise and sunset prevalent.

Although the equipment operated by NBC on 6.175 mcs has an output of 20 kw as compared to BCNN-6.090 mcs transmitter operated at 10 kw, the signal intensity is not proportionately greater. The field strength about a broadcast station, in general, varies proportionately as the power squared. (That is, it is necessary to increase the effective radiated power by a multiplication factor of four to double the field strength at a given point, by nine to triple the field strength, etc.)

The technical specifications and performance characteristics of the Philips receiver (Model B3AN36T) are measurably better than the Diamond receiver referred to above. However, extreme caution should be exercised in substituting the Philips for the Diamond in all cases since its limits, too, are reached well within the borders of Northern Nigeria. (A suggested rule of thumb is that a receiver similar to the Philips Model B3AN36T mentioned above might be placed at a distance not more than thirty per cent greater than the Diamond.)

The performance of the Zenith R 3000 was of a kind to produce a useful signal over wide areas as is demonstrated on the shaded maps. It is again emphasized that areas indicated as receiving satisfactory service from the standpoint of sufficient signal for classroom use of radio indicated in Table I is based primarily on the Zenith radio. The maps are appropriately marked indicating where the different receivers may be used successfully without additional antennas. Tests to improve reception by using an arbitrary length of external antennas was quite unproductive.

Selected entries transcribed from the log book of field observations:

10/28	Keffi	8:55 a.m.	3.326 mcs at Catering Rest House (CRH), Zenith R4, Diamond R4-
		9:10 a.m.	940 kcs 40 microvolts Zenith R4, Diamond R3 6.175 mcs Zenith R4, Diamond R4- (Diamond usable but marginal) Ibadan sw signal monitored with difficulty; hardly suitable for classicom use. Interference and noise high.
		4:00 p.m.	55 miles SE of Kaduna 1416 kcs 40 microvolts, 940 kcs 2.5 millivolts (BCNN @125 kw) 6.175 mcs Zenith R4, Diamond R4-
10/28	Jos	4:00 p.m.	6.175 mcs Zenith R4, Diamond R2, signal not usable from Diamond 940 kcs .1 millivolt, discernible interference, 9.655 mcs Zenith unable to detect 1396 kcs 18 miles out from Jos, 80 microvolts
10/29	Jos	10:00 a.m.	6.175 mcs Zenith R4, Diamond R3 940 kcs 100 microvolts, noise level high (just on the east side of city of Jos)
10/29	Jos	11:20 a.m.	15 miles E of Jos toward Bauchi 1396 kcs 100 microvolts 6.175 mcs Zenith R4, Diamond R3 signal fades, noise level high. Diamond marginal quality reception. 9.655 mcs Zenith R3-, Diamond R2
10/30	Bauchi	8:30 a.m.	940 kcs 50 microvolts (at CRH) 3.326 mcs Zenith R3+, Diamond R2 unusable V. Gwani reported Philips receiver does quite well. The performance of the Zenith receiver was judged usable but marginal.
10/31	Jos - Kaduna	8:45 p.m.	86 mi. post 940 kcs 340 microvolts 3.326 mcs Zenith R4, Diamond R2, Diamond signal unusable 6.175 mcs slight fade, Zenith R4, Diamond R2 6.090 mcs Zenith R4, Diamond R2
		10:40 a.m.	35 miles from 1416 kcs transmitter 70 microvolts (Kaduna)
11/2	Gusaw	11:00 a.m.	6.175 mcs Diamond receiver and Zenith receiver tune signal R4, medium to objectionable interference on Diamond. Zenith tunes without interference. 9.655 mcs Diamond R4- interference, Zenith R4, clear

11/2	Sokoto	1:30 p.m.	6.175 mcs Diamond receiver and Zenith receiver tune signal R4. Slight fade observed on Diamond with objectionable interference. 9.655 mcs Diamond R3, not usable, Zenith R4- reasonably good 1396 kcs 125 microvolts 19 miles SE Sokoto Noise level quite high R4- signal, usable but approaching marginal value
11/3	Katsina	8:30 a.m.	3.326 mcs Zenith R4, Diamond R3, not usable 6.175 mcs Zenith R3, not usable, Diamond R2 to S3, not usable
		10:00 a.m.	6.090 mcs Zenith R4 Diamond R2 to R3, not usable 940 kcs 78 microvolts at 8:30 a.m., 15 microvolts at 10:00 a.m.
		1:30 p.m.	1396 kcs 100 microvolts at 20 miles SE of Katsina
11/4	Kano	10:30 a.m.	6.175 mcs Zenith R4, Diamond R3 9.655 mcs Zenith R3, Diamond R1 (9.655 mcs transmitter in difficulty) 940 kcs 130 microvolts
		12:00 p.m.	1396 kcs 180 microvolts at 20 miles E of Kano toward Potiskum 6.175 mcs Zenith R4, Philips and Diamond R4- 9.655 mcs Zenith R4, Philips and Diamond R2 to R3 (9.655 mcs transmitter seems to be in difficulty operationally as was noted 11/4 at 10:30 a.m.)
11/5	Potiskum	8:00 a.m.	3.326 mcs Zenith R4-, Diamond and Philips R3 not usable 6.090 mcs Zenith R4-, Diamond and Philips R3 not usable
		10:55 a.m.	9.655 mcs 20 miles W of Maiduguri Zenith R4, Diamond R3 with high noise level
11/5	Maiduguri	10:55 a.m.	1396 kcs 58 microvolts 20 miles W of Maiduguri
		12:15 a.m.	1396 kcs 50 millivolts 1 mile W of Maiduguri Observations included severe fading of 6.175 mcs about 8:30 a.m. and 4:30 p.m. - same was reported by NBC in Maiduguri.
		12:15 p.m.	9.655 mcs Zenith R4, Diamond R3, Philips R3+ Noise level high on Diamond. Not considered usable for classroom on Diamond or Philips receivers, marginal on Zenith

11/7	Maiduguri	10:20 a.m.	15 miles NE of Zaria 1396 kcs 70 microvolts 940 kcs 3.6 millivolts, 6.090 mcs Zenith R4, Philips R4-, 9.655 mcs Zenith R3, Diamond R3-, 6.175 mcs Zenith R4, Philips R3+, R3 judged marginal; poor quality
11/9	Kontagora	10:00 a.m.	1 mile S of Kontagora 940 kcs 30 microvolts 6.090 mcs Zenith R4, Philips R4-, 6.175 mcs Zenith R4, Philips R4-, Diamond R3-
11/9	S of Kontagora	11:35 a.m.	75 miles S of Kontagora 940 mcs - no field strength reading obtainable, signal too weak. 6.175 mcs Zenith tunes R3, poor signal, marginal for use in classroom with Zenith receiver of this type, Diamond and Philips receivers do not tune, R2 6.090 mcs marginal on Zenith R3, Diamond and Philips do not tune well enough for classroom use 9.655 mcs Zenith tunes R4-, signal flutters, signal to noise ratio poor. Diamond and Philips receivers do not tune well enough to make signal usable in this area.
11/9	N of Ilorin	2:50 p.m.	20 miles N of Ilorin 1396 kcs 55 microvolts 6.175 mcs (Kaduna) Zenith R4+, Philips R3+, Diamond R3-, 6.090 mcs (Kaduna) Zenith R4+, Philips R3, Diamond R2+

COMMENTS AND RECOMMENDATIONS

1. A visit was made to various radio and transmitting installations as well as receiver locations. Radio broadcast facilities are quite complete. Observations confirmed the expressed need for more test equipment and replacement parts. Breakdowns are usually prolonged because of the difficulty in obtaining suitable replacements or appropriate repair through substitute parts. It is recommended that a review be made of presently available test equipment for the maintenance of the broadcast and receiving equipment and that steps be initiated to acquire the essential additional apparatus. Further, an analysis should be made of the more common failures of components. Needed replacement parts should be an "on-shelf" availability. A determination should be made as to causes of such failures which can be alleviated (e.g. inadequate ventilation, excessive heat problems, component under design problems, air flow, and air filter insufficiencies, modifications recommended by the manufacturer to meet environmental conditions, etc.).

   Television stations are well equipped and well operated, particularly BCNN, Kaduna, the Lagos, Enugu, and Aba installations. The Ibadan installation, though well equipped, did not appear to be as well maintained as the other operations. It was reported that in most cases, it is difficult to attract and retain a sufficient number of capable personnel to keep various equipment in use at optimum performance.

2. The need for technical people will continue in Nigeria, as it has in all countries of the world. Particularly, people who possess skills in communication technology are needed to maintain

facilities now used for classroom instructional broadcast activities related technologies. It is recommended that the Board of Education of Washington County, Hagerstown, Maryland, be given the opportunity to:

a. Provide specialized technical training to a core of Nigerians in order to supply an immediate source of skilled people

b. At a later date, institute a continuing program of technical training in Nigeria

The first phases of such an activity may be approached by bringing prospective trainees to Hagerstown, Maryland, for a short-term accelerated program. Later, facilities should be established in several central locations in Nigeria. The Board of Education, Hagerstown, Maryland, has facilities and curriculum to implement the program.

3. Embodied in this report are maps reflecting relative coverage areas of respective radio broadcast services of Northern Nigeria. Television stations are located in Kaduna, Zaria, and Kano and reach a potential audience of approximately 300,000; primarily the urban and suburban communities are served. Coverage data has been prepared and is available from BCNN, Kaduna.

4. Present studies by administrative technical representatives of BCNN and NBC of Nigeria include a review of available frequencies to improve radio coverage. While such deliberations include in some cases international agreements, work should continue to acquire more suitable broadcast frequencies and increases in station power. Further and, in fact, continuous studies in changes of frequency allocations and related pertinencies should be assigned to an appropriate task force with the responsibility of analyzing immediate and long-term values of all broadcast communication services for Nigeria and Africa. Such planning should include the counsel of professional people to represent educational, governmental, public, industrial, commercial, and domestic interests. Plans developed must include educational goals and objectives to be served through electronic media in terms of national, regional, and inter-regional utilization. One of the chief purposes of such investigations and studies should be to determine interconnect facility requirements - both present and future - for radio, television, and related communication services (for various governmental, military, industrial, commercial, domestic, and public services). Obviously, such a task force should function continuously and should maintain a plan for years ahead.

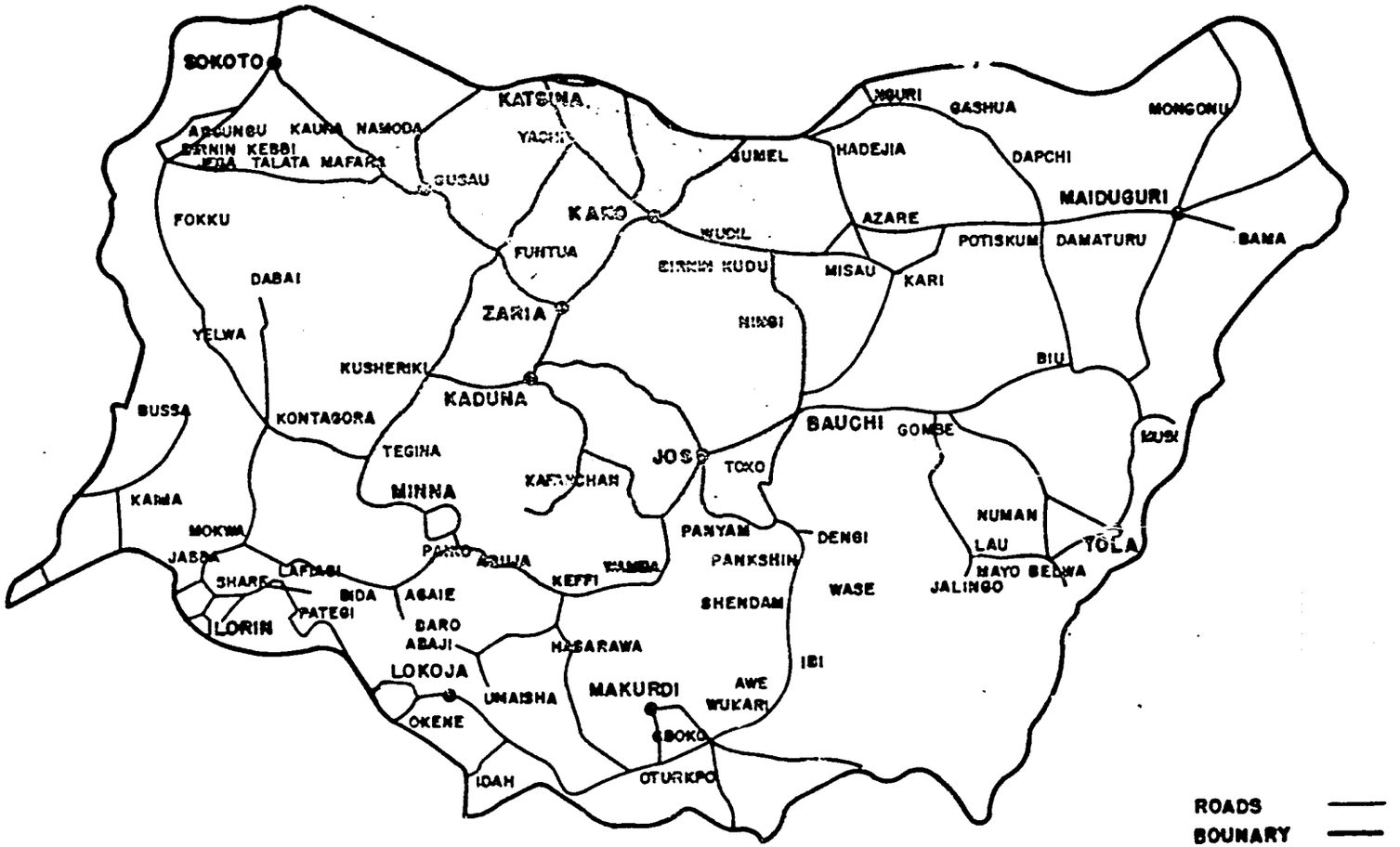
5. Airways are a national resource. Their use must be Federally controlled to assure that the potential utilization may be reached in the interest, necessity, and convenience of the citizens of the country.

Related to this fundamental principle is the need for technical standards to promulgate engineering practices commensurate with this ideal. To achieve this goal, a compendium of technical rules and regulations pertaining to broadcasting must be maintained. Areas in which a high degree of accuracy and control must be exercised include output power of transmitters, power measuring instruments (including ampere and volt meters), station frequency measuring instruments, percentage modulation indicators, transmitter performance specifications, studio production apparatus standards, availability of replacement parts recommended, necessary standardized test equipment and procedures (to be performed at regular and frequent intervals by competent technicians) to provide assurance that operating transmitting equipment meets appropriate minimum standards for broadcasting.

Technical personnel responsible for broadcast facilities must have attained a level of proficiency to be capable of assuming related responsibility, must record and report pertinent operating information through stations log records which reflect hours of operation, schedule of programs aired, operational irregularities, recommended or performed remedies for such irregularities, the nature and extent of corrective and preventive maintenance on operating transmitting equipment, and sundry reporting as is determined useful in achieving the ultimate goal of broadcasting - that being, continuous and reliable program service.

Administratively, the demands to accomplish all these things are enormous, yet with the extensive radio facilities now available in Nigeria, the challenge is real and the rewards would be great.

6. It is hoped that the information reported herein, resulting from the survey undertaken, will assist in carrying forward the purposes of the Modern Aids to Education Project.



BCNN KADUNA
Nominal coverage
940 kcs 10 kw
(50 microvolts)

NORTHERN NIGERIA

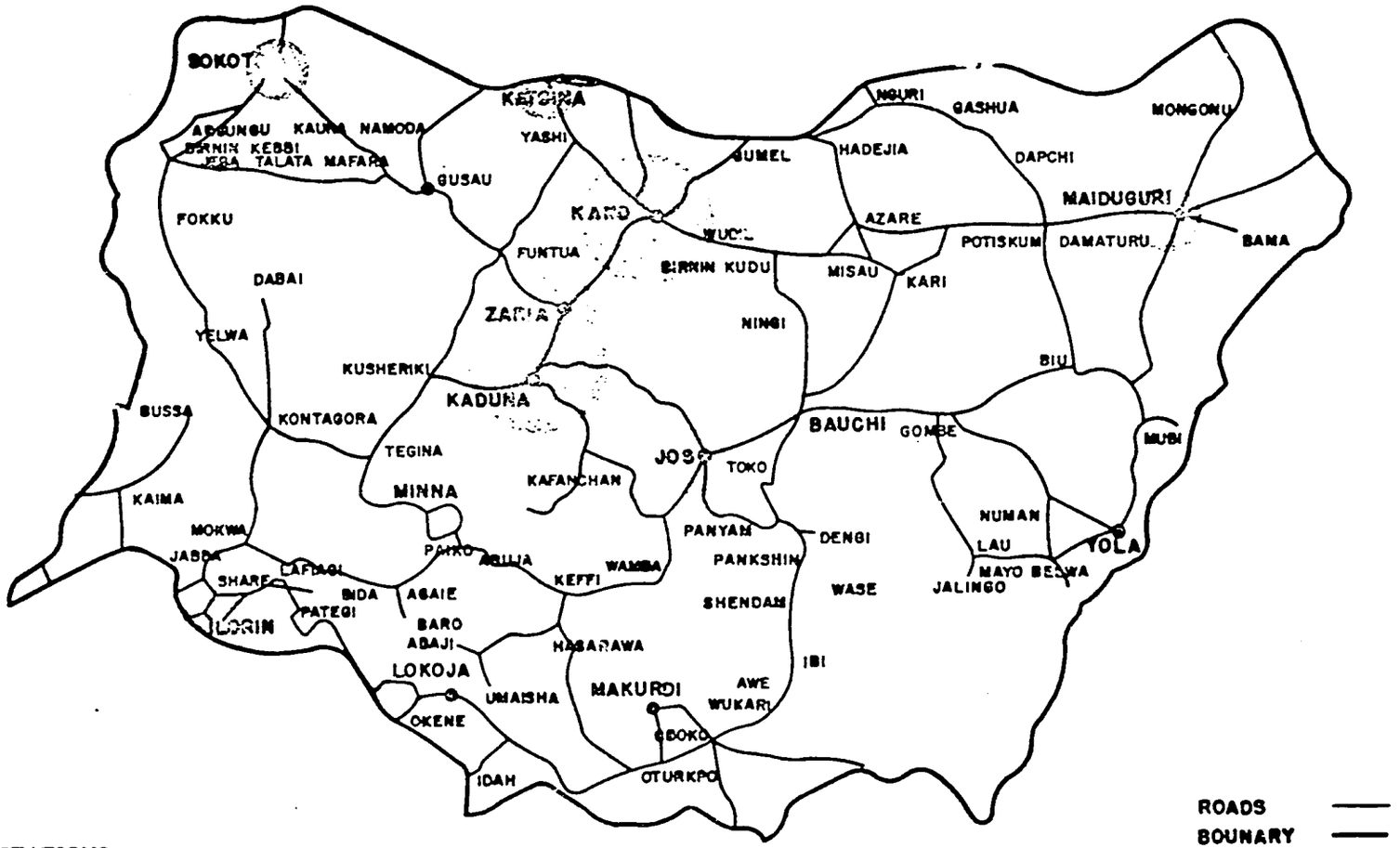
Practical limits for use of Diamond Receiver on 6.090 and 6.175 mcs

(Diamond Receiver Model NELIR-ST3)

NORTHERN NIGERIA

Practical limits for
use of Diamond Receiver
on 3.326 mcs

NORTHERN NIGERIA

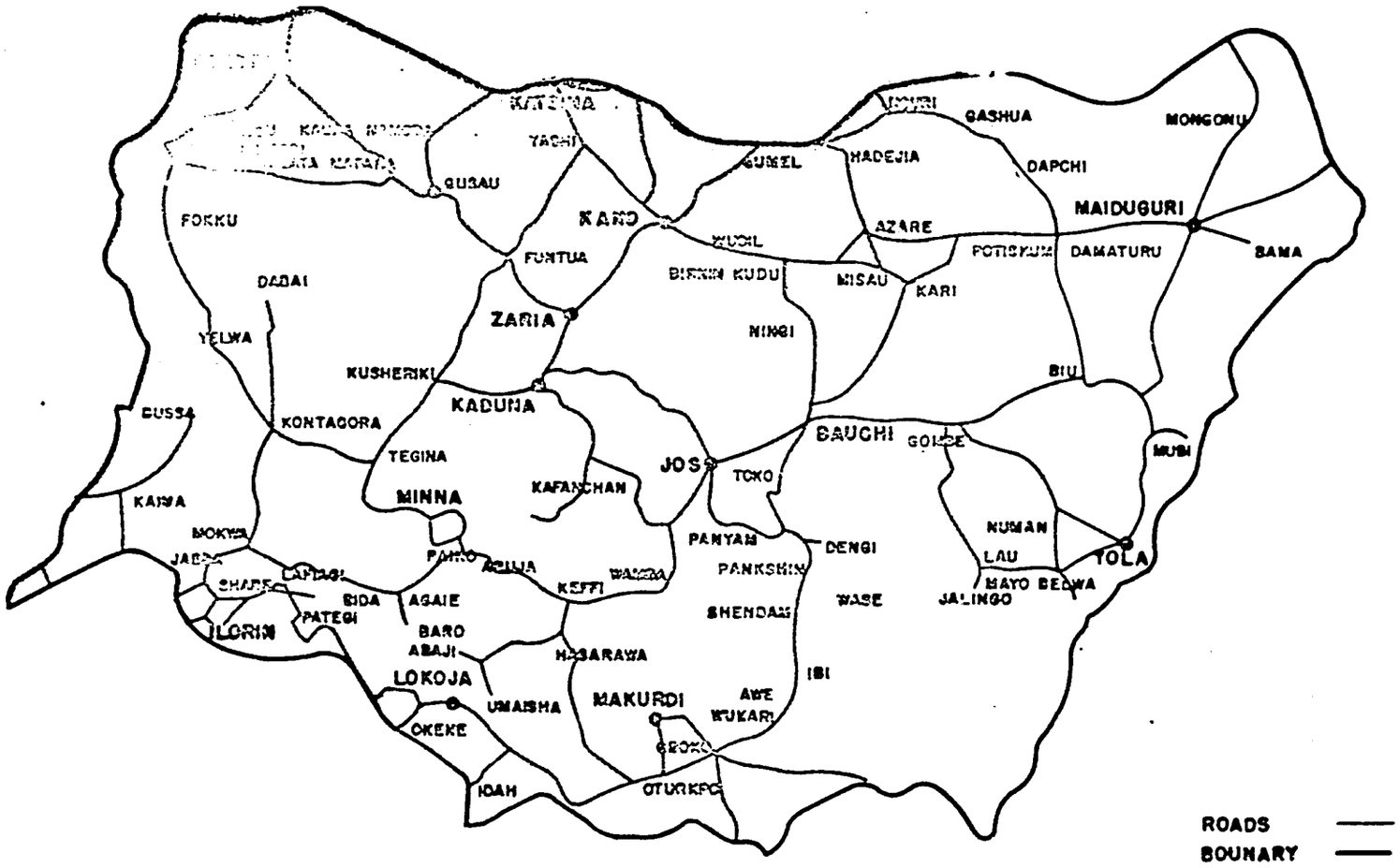


ROADS
BOUNARY

LOCAL STATIONS
MEDIUM WAVE
Nominal coverage
(50 microvolts)

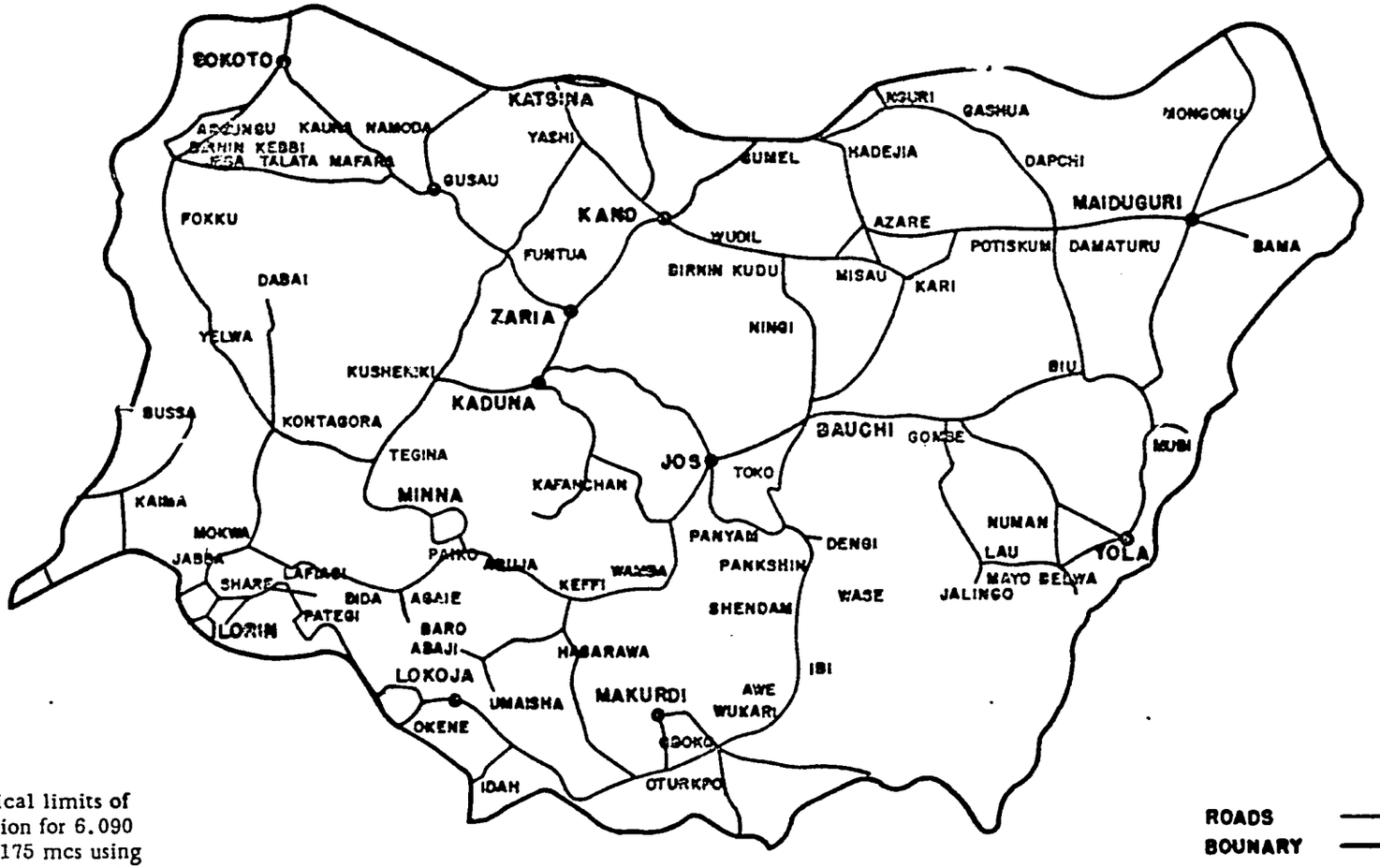
250 watt stations
-22 mile radius
1000 watt stations
-45 mile radius

NORTHERN NIGERIA



Practical limits of
reception for 3.326 mcs
for Zenith R 3000 receiver

NORTHERN NIGERIA



Practical limits of reception for 6.090 and 6.175 mcs using Zenith R 3000 receiver

(Essentially all Northern Nigeria with possible exception of North-eastern corner)

NORTHERN NIGERIA