AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
BATCH 61

1. SUBJECT CLASSIFICATION
A. PRIMARY
TEMPORARY
B. SECONDARY

2. TITLE AND SUBTITLE

A report on engineering and technical aspects of educational broadcast services in Nigeria

3. AUTHOR(S)

Halstead, W. S.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1968	138p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Wash. County, Md.

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

(In Modern Aids to Education rpt.)

9. ABSTRACT

(EDUCATION R&D)
(COMMUNICATION R&D)

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-AAD-853	
12. DESCRIPTORS	13. PROJECT NUMBER
	14. CONTRACT NUMBER AID/air-367 GTS
	15. TYPE OF DOCUMENT

AID 590-1 (4-74)

A REPORT
ON ENGINEERING AND TECHNICAL ASPECTS OF EDUCATIONAL BROADCAST SERVICES IN NIGERIA

Prepared for the Modern Aids to Education (M. A. T. E.)
Project, U. S. A. I. D. / Nigerian Ministries of Education /
Washington County Board of Education, Maryland

by
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TABLE OF CONTENTS

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SCOPE OF REPORT

The Report is in six parts: (I) a summary of observations and comments of the Consultant resulting from a study of broadcasting and telecommunication facilities in Nigeria; (II) observations and comments with respect to operation of the School Broadcasting Units in Lagos, Ibadan and the Kaduna-Kano area; (III) comments and recommendations relating to expansion and improvement of educational broadcasting on a coordinated national basis; (IV) suggested plans for extension and improvement of broadcasting services by microwave-relay method; (V) comments relating to new technological developments that might find application in Nigerian broadcasting and (VI) a listing of recommendations that, in the opinion of the Consultant, may assist in providing guidelines for expansion and improvement of educational broadcast services in Nigeria.

Illustrations, technical data, cost estimates and other supplementary material are contained in an Appendix.

I. Observations and Comments Relating to Educational Broadcasting Facilities and Services in Nigeria

A. The Existing Broadcast Structure

1. Introduction

In order that the Consultant could become acquainted with existing broadcasting operations in Nigeria, particularly with respect to educational aspects of the broadcasting services, visits were made during the month of July, 1968, to television and radio stations, studios and educational programming centers at Lagos, Ibadan, Kano and Kaduna, in order as listed. With the exception of the southeastern section of the country where entry is difficult because of the military conflict, all television stations and programming centers, as well as all major radio stations in Nigeria, are located within the area visited by the Consultant.

On the field trips, by car, between Lagos and Ibadan, and from Kano to Kaduna, it was possible to inspect the microwave-relay facilities of two of the broadcasting organizations -- Western Nigeria Government Broadcasting Corporation and Broadcasting Company of Northern Nigeria, Ltd. During the trip from Lagos to Ibadan, opportunity also was provided to inspect one of the new microwave-relay stations, installed about two years ago as a part of Phase I system of the national telecommunications network plan. This station now is employed in the relay system between Lagos and Ibadan for intercity telephone and telegraph services of the Posts and Telecommunications Department of the Ministry of Communications.

Arrangements for visits to broadcasting stations, studios and school broadcasting units, as well as all field trips, were made by Mr. Griffith Davis, Communications Media Advisor, Education Division, U.S.A.I.D., Lagos, and Mr. Blair MacKenzie, M.A.T.E. Chief of Party, Lagos, both of whom were of invaluable assistance to the Consultant during his stay in Nigeria.

2. Outline of Facilities

Television and radio broadcasting services in Nigeria are provided by four organizations: (1) Nigerian Broadcasting Corporation (NBC), based in Lagos; (2) Western Nigeria Government Broadcasting Corporation (WNBC), Ibadan; (3) The Broadcasting Company of Northern Nigeria, Ltd., (BCNN), with headquarters in Kaduna; and (4) the Eastern Nigeria Broadcasting Corporation (ENBC), at Enugu.

The Nigerian Broadcasting Corporation, a statutory corporation of the Federal Government, provides the only national radio service by means of 17 stations in different parts of the country, located as shown in Figure 1, Appendix. NBC also operates a television station, with range of about 50 miles, in Lagos, and has installed a television transmitter at Ibadan. The latter is not operative in regular service at the present time, largely as the result of technical difficulties in relaying programs from Lagos.

Because of lack of suitable telephone circuits throughout the country, national radio programs are transmitted from Lagos to outlying stations, such as those in the north, by means of the shortwave broad-

casting stations of NBC. However, where very high frequency (VHF) radio-relay circuits of the Posts and Telecommunications Department are available and can be used for program signals, as in the Lagos, Ibadan and Kaduna areas visited by the Consultant, these can be employed to supplement the shortwave facilities.

The Western Nigeria Government Broadcasting Corporation, a statutory corporate agency of the Western State, operates two television and radio stations, located at Ibadan and at Abafon. The Abafon station, located about 18 miles northeast of Lagos, functions only to repeat the program signals from studios in Ibadan in order to reach the Lagos area. The studios in Ibadan and the Abafon station are interconnected by an intermediate microwave and VHF relay station at Ishara, as illustrated in Figure 2, installed and operated by the broadcasting corporation. Relay of programs is in one direction only -- from Ibadan to Abafon.

The Broadcasting Company of Northern Nigeria is a corporation in which ownership is by the Granada Group, Ltd., EMI, Ltd. (both of England) and a common service agency of the six northern states, the latter holding a 50% interest. BCNN operates a television and radio station at Jaji, 22 miles north of Kaduna, where studios are located, and a television station at Kano, programmed by microwave relay interconnection from the Kaduna studios, as indicated by Figure 3. Microwave-relay stations are at Auchan and Wak, shown on the map. A microwave link also is utilized between the Kaduna studios and station

site at Jaji. All relay of program signals is one way in a northern direction-- from Kaduna to Kano.

The Eastern Nigeria Broadcasting Corporation, formed by the government of the former Eastern Region, operated television and radio stations at Enugu and Aba, as shown in Figure 4, prior to the outbreak of the civil war. As this part of Nigeria is not within the scope of the Consultant's assignment, no further information concerning the broadcasting facilities in the area, beyond the data in Figure 4, is incorporated in this Report.

3. Location and Mode of Operation of School Broadcasting Units

It was noted by the Consultant that all programming activities that relate to use of television for educational purposes in the geographical areas within the scope of this Report are conducted by School Broadcasting Units of the Federal Ministry of Education at Lagos and Kaduna, and by the Western State Ministry of Education at Ibadan. It is primarily with these activities that the M. A. T. E. project has been concerned since the outbreak of civil war in 1967. However, until that year, educational television programs were produced, with assistance of M. A. T. E. personnel, by the School Broadcasting Unit at Enugu, under the Ministry of Education of the former Eastern Region.

The School Broadcasting Unit at Lagos, based in a government office building in the center of the city, is wholly dependent for studio

production work on utilization of the operating personnel and studio facilities of the Nigerian Broadcasting Corporation, located on Victoria Island, about three miles by road from the SBU offices. All educational television programs are recorded on videotape at the NBC studios for subsequent transmission on a scheduled date by the NBC station at Lagos.

The School Broadcasting Units at Ibadan and Kaduna also are situated in office quarters that are separate from the television studios in these two cities. As at Lagos, they are dependent on shared use of the facilities of the broadcasting organizations in producing educational television programs and their subsequent transmission during school hours by stations in the Ibadan, kaduna and Kano areas, utilizing video tape as at Lagos.

Production of radio programs for transmission throughout the country by stations of the Nigerian Broadcasting Corporation during school hours is centered in the Schools Unit of NBC at Ibadan. Sound tapes are employed by the Schools Unit as a means of recording radio program material for later use by stations in transmissions during scheduled hours.

B. Comments Relating to Broadcasting Operations

1. Limitations in Interconnecting Stations

As may be observed from the outline of broadcasting facilities in Nigeria, as set forth in the preceding section and in Figures 1-4, inclusive, there is no means for interconnection between the television sta-

tion of NBC in Lagos and stations in the Kaduna-Kano area. There also is no suitable interconnection at present between television stations of NBC in Lagos and Ibadan. This situation precludes the possibility of relay of educational programs and others of national interest or importance from Lagos to the stations in outlying areas, including the most densely-populated sections of Nigeria. Thus the potential that television presents as a powerful unifying force is inhibited by lack of an intercity relay facility that would enable programs in the national interest to be seen by viewers in the several states where television stations have been established.

Use of shortwave for transmission of educational or other radio programs from Lagos to stations in various parts of the country, under conditions as observed by the Consultant in the Kano and Kaduna areas, severely hampers the effectiveness of the sound broadcasting service. Intercity telephone lines cannot be utilized to link stations because of noise, distortion and frequency limitations of existing wire circuits. It was noted by the Consultant during a visit to the NBC station in Kano, that received shortwave signals from Kaduna or Lagos for re-broadcast by the Kano station were of very poor quality as the result of fading, distortion and the atmospheric noise from electrical storms that are common in West Africa.

This situation, in the opinion of the Consultant, can seriously impair the overall effectiveness of radio as an educational tool in the classroom where poor quality of reproduced sound can detract the attention of students and make it difficult to assimilate the information contained in instructional programs.

2. Comments Relating to Possible Use of Microwave Relay for Interconnection between Stations

It appears to the Consultant that a logical long-range solution to the intercity transmission problem will be in the utilization of the microwave relay method as a means of interconnecting existing or future radio and television stations in various parts of the country.

Although a microwave relay system has been established at very substantial cost by the Posts and Telecommunications Department in the southern part of Nigeria and within several years will provide interconnection between Lagos and all principal cities of Nigeria, as illustrated in Figure 5, no arrangements have been made, so far as the Consultant is aware, for use of this national network for relay of radio or television programs.* While the network, as now planned, will have the technical capability of relaying television signals between terminals in cities throughout the country, additional equipment will be required at terminal and repeater stations to accommodate video signals. Otherwise, there would be a substantial reduction in the ability of the system to carry the large number of telephone circuits for which it was designed (one television circuit requires the equivalent bandwidth of about 600 telephone channels.)

* A discussion of this matter and its relationship to development of a nationally-coordinated educational broadcasting service, to supplement local or regional facilities, is set forth in a brief that was prepared by the Consultant while in Lagos, at the request of U. S. A. I. D. Nigeria. A copy is attached in the Appendix, Section II.

It is pointed out by the Consultant that the relay system can accomodate high-quality radio program signals without technical difficulty if a relatively small amount of terminal equipments, designed for broadcast programs within the audio-frequency range 50-10,000 Hz, are added at the P&T terminal stations in the microwave relay system between Lagos and cities where radio broadcasting stations are located.

But in order for this to be accomplished, some form of agreement between the broadcasting organizations and P&T will be a prerequisite. It is unfortunate, in the opinion of the Consultant, that the broadcasting companies and P&T have not heretofore been able to arrive at some arrangement through which the new telecommunications network could meet all requirements of the intercity telephone and telegraph services as well as those of the broadcasting organizations.

The matter of possible usage of the national telecommunications network for broadcast relay purposes, the various factors that are involved, including cost estimates, and suggestions of the Consultant with respect to possible ways and means by which the microwave system could provide the intercity links for a high-quality national broadcasting service are discussed in Part IV of this Report.

In reviewing with the Chief Engineer of BCNN, Mr. Geoffrey White, the matter of broadcast of programs from Lagos by the television stations of that company in northern Nigeria, in the event that the P&T system were adapted for relay of television signals from Lagos, it was

the understanding of the Consultant that this would present no serious problem. This assumes that the quality of signals as relayed by the microwave system is satisfactory and that costs of operation of the BCNN stations during transmission of educational programs are defrayed by the agency for whom the service would be provided. (The latter is the case at present during periods when the facilities of BCNN are utilized in transmitting the television programs of the School Broadcasting Unit in Kaduna. Such usage of the facilities of BCNN does not conflict with the commercial programming activities of the company as educational broadcasts are during school hours, whereas all commercial broadcasts are in the evening.)

3. Observations Relating to Need for a Nationally-Coordinated Educational Broadcasting System.

It was observed by the Consultant, during meetings with educators and officials of the Ministries of Education and School Broadcasting Units in Ibadan and in Kaduna that there appeared to be general agreement with respect to the need for and advantages that would be presented by a national television and radio system for educational purposes, supplementing the limited facilities of state or regional type.

In this connection, it was pointed out to the Consultant at these meetings that it now is difficult to utilize television and radio in the most effective manner for educational purposes because of factors such as: (1) lack of a central agency through which all educational broadcasting

activities could be coordinated on a national basis; (2) a shortage of teachers with experience in use of the broadcast media for educational purposes; (3) difficulty in obtaining trained technical and programming personnel; and (4) lack of well-equipped facilities within the School Broadcasting Units for production of educational programs, requiring shared use of studios, personnel and equipment of the broadcasting organizations.

4. Example of a National Educational Television Service in East Africa

The Consultant was able to obtain confirmation of the advantages that are presented by a national educational television service during a brief visit to Uganda, on his return trip from Nigeria. In that country, educational broadcasting functions are provided on a national basis, under the Ministry of Education, at Kampala.

All educational television programs are originated at a national center at Kampala and are transmitted to schools throughout much of the country by a network of interconnected stations, operated by the Uganda Television Service, an agency of the Ministry of Information, Broadcasting and Tourism. This arrangement avoids the problems that would be involved in originating programs at a number of outlying points where transmitting stations have been established and where

it would be difficult to maintain educational programming facilities and staff. By centralization of facilities for production of educational programs of the national television service at Kampala, it has been possible to minimize personnel and equipment requirements as well as operating costs. A description of the Uganda network system, together with related material, is included in the Appendix, Section III.

The Consultant was informed that the Uganda network has demonstrated its value as a unifying force in regions where political and tribal differences have presented serious problems in the past. In view of this experience, it appears to the Consultant that an interconnecting network system in Nigeria, providing means for transmission of educational and other programs of national interest or importance from Lagos to outlying sections of the country would materially assist in the unification effort of the Federal Government. Such capability would not, however, preclude the use of state or regional programming facilities to meet the special requirements of different sections of Nigeria.

II. Observations and Comments Relating to the Television Programming Facilities Employed by the School Broadcasting Units

A. Lagos

In observing the programming facilities employed by the School Broadcasting Unit in Lagos, it appeared to the Consultant that the overall effectiveness of the Unit is seriously limited by the need to utilize the studios and personnel of NBC in recording of programs on video tape.

The distance between the SBU offices, where educational programming personnel are based, and the NBC studios is nearly three miles. This separation of facilities hampers all activities relating to program production and requires transportation of SBU personnel and program materials between the two locations. With increasing traffic congestion in the Lagos area, it is probable that the difficulties introduced by the present arrangement will become more serious in the future.

Additional problems are presented because of the shared use of studio facilities and operating personnel, available for limited periods of time. Settings must be improvised, graphic materials set up and equipment checked within a brief period prior to start of each recording session. Studio production and control personnel of NBC must be familiarized with the program scripts and procedures rehearsed in the limited time that is available before the program is recorded, often resulting in misunderstanding of instructions and need to re-record sections of programs.

Further, as observed by the Consultant during a visit to the NBC studio for one of the recording sessions, when SBU staff members arrive there is no assurance that all required studio personnel and equipment will be on hand. In this instance, it was necessary to delay the recording operation until arrival of all of the studio staff.

In this connection, reference is made to the "End of Tour" report of Mr. Peter Callas, a M. A. T. E. advisor, in his summary of recommendations relating to the need for more frequent rehearsals and the use of videotape equipment of SBU to improve quality control of all educational television programs.

As the Consultant has indicated in preceding paragraphs, it appears to be difficult, under present conditions, to arrange for use of the NBC studios for any substantial rehearsal time, beyond what is essential immediately before recording sessions.

The helical-scan Ampex videotape recorder (VR-650), of portable type, supplied by A. I. D. for use by SBU, now installed at the NBC studios, was originally intended for use by the Unit to facilitate its recording procedures, including rehearsals. However, NBC engineering personnel have stated that this type of recorder, in their opinion, is not satisfactory for broadcasting use. The result is that SBU programs are recorded on a large RCA videotape machine used in the regular programming work of NBC. This equipment employs a transverse-scanning mode of operation and produces a tape recording that cannot be used on helical-scan machines.

(The latter type of equipment later was observed in successful broadcasting operation at the studios of the Broadcasting Company of Northern Nigeria at Kaduna, where the Ampex helical-scan recorder is in regular use.)

In view of the above situation, it appears to the Consultant that if the most effective results are to be obtained in the educational broadcasting service and the medium of television is to be utilized more extensively to assist in resolving the serious educational problems in Nigeria, a well-equipped programming center for the exclusive use of the School Broadcasting Unit should be established at Lagos.

If, as has been recommended to the Joint Consultative Committee on Education, a decision is made to coordinate all educational broadcasting functions in Nigeria within the Federal Ministry of Education, it appears to the Consultant that a national center for educational broadcasting at Lagos will be an essential requirement. This matter is discussed in further detail and recommendations are presented by the Consultant in Part III of this Report.

B. Ibadan

Observation of the facilities of the School Broadcasting Unit in this city and discussions with members of the staff indicated that the problems that are presented by shared use of the studios and personnel of the Western Nigeria Government Broadcasting Corporation are similar, in

general, to those experienced at Lagos. However, unlike the situation in Lagos, the building occupied by the Unit is within a short distance from the studios of WNBC.

Although the Western State has purchased television studio equipment of recent design from U. S. suppliers to permit establishment of a small programming center by the Unit, this apparatus has not been placed in operation andat present is stored in an air-conditioned room of the SBU building. The Consultant was informed that the Unit has not been able to obtain the required funds or otherwise make arrangements with the Western State Ministry of Education that would permit them to construct a studio. Therefore, all programming activities must be carried out at the WNBC studios.

Assuming that studio facilities are established by the Unit at Ibadan, the Consultant believes that the value of the center could be increased substantially by addition of videotape recording equipment of the type that utilizes the transverse-scanning mode of operation in order to effect a maximum degree of compatibility of recordings and picture quality. This matter is discussed in further depth in connection with the recommendations of the Consultant in Part III of the Report.

C. Kaduna

The Consultant was very favorably impressed with the television and radio facilities of the Broadcasting Company of Northern Ni-

geria. The equipment at the studios, employed by the School Broadcasting Unit at Kaduna, and all facilities at the transmitting site at Jaji appeared be be in excellent condition. Transmitted pictures and sound of the television service were of high quality, reflecting good maintenance and operating procedures. The same remarks apply to the radio broadcasting service of BCNN.

As in Lagos, the SBU center is at a substantial distance from the studios of BCNN. The Unit occupies a one-story building in which there appears to be sufficient space for a small studio, with ample ground for expansion if the need develops. Programming activities of the Unit make effective use of one of the portable Ampex videotape recorders of helical-scan type, Model VR-650, supplied by A.I.D., now in regular use at the BCNN studios in connection with the educational and other broadcasts of the station. The Consultant was informed by the Chief Engineer of BCNN that the operation of the helical-scan recorder was satisfactory, although, during initial tests, it was necessary to install a voltage-reducing transformer for operation of the unit at the proper scanning speed for 625-line, 50-field standards.

While at the SBU center in Kaduna, the Consultant observed the operation of the workshop where classroom receivers are repaired. It appeared that the test facilities were rather limited when compared with those normally available at commercial repair shops. In this connection,

it is suggested that when and if a nationally-coordinated educational broadcasting service is established, as has been recommended, a standard receiver-servicing facility should be incorporated as a part of each School Broadcasting Unit. Each of these facilities should be supplied, in the opinion of the Consultant, with a full complement of modern test and measurement equipment in order to expedite the repair and adjustment of receivers. Recommendation to this effect is included in Part III of this Report in which receiver problems are discussed in further detail.

Observations at Kaduna, discussions with SBU personnel and a review of M. A. T. E. reports have indicated that in order to attain the most effective use of the broadcast media for education in Nigeria, it will be necessary to resolve the problem that is presented in many schools where receivers are inoperative or in unsatisfactory condition. In the opinion of the Consultant, this will require a larger servicing staff, closer liaison with schools in each SBU area, and improved means for pickup of defective receivers and their return to classrooms after repairs have been made.

D. Kano-Zaria Area.

Although there are no School Broadcasting Units at Kano or Zaria, these cities are within the service range of BCNN stations. As indicated in Part I of the Report and in the illustration of Figure 3, the

television transmitting station of BCNN at Kano is interconnected by microwave relay with the broadcasting station of that company at Jaji, near Kaduna. This arrangement makes it possible for schools in the Kano and Zaria areas to receive SBU programs from the BCNN studios in Kaduna.

In visiting the BCNN station at Kano, where a television transmitter (but no studio) is located, it was noted that pictures and sound, as received from the Kaduna studios, were of high quality. Later, in traveling by car between Kano and Kaduna, the Consultant was able to inspect one of the microwave relay stations that is employed in carrying program signals in the area between Kaduna and Kano. As at other facilities of BCNN, the equipment appeared to be in excellent condition.

While at Kano, a visit was made to the Advanced Teachers Training College to observe operation of the closed-circuit television system that is employed at this modern center. A small, but well-equipped, studio and associated control room are utilized in originating instructional programs that are transmitted by coaxial cable to television receivers in classrooms of the college. The principal function is to enable one teacher to reach students in a large number of classrooms at a given time and to present information that cannot readily be observed by students when blackboards or other conventional teaching aids are used. Also, as pro-

grams can be recorded on videotape, they may be repeated when desired.

The videotape recorder employed at the College is a portable Ampex of helical-scan type, basically of the same design as that of the equipment supplied by U. S. A. I. D. to the School Broadcasting Units, although intended for closed-circuit applications. Quality of recorded pictures and sound, as observed by the Consultant, was excellent.

The engineer in charge of the television facility, Mr. Edward Phinney, informed the Consultant that the operation of the videotape recorder has been satisfactory and has met all requirements. In discussing the possibility of exchange of tapes between the College and the BCNN studios at Kaduna for use by the School Broadcasting Unit in that city, it appeared that this would present no technical difficulty if the helical-scan Ampex equipment at both locations can be adjusted for exact synchronous operation by means of a standard test tape, made by Ampex for this purpose. It was understood by the Consultant that such test tapes have been ordered and later can be used with the videotape recorders at the College and at the BCNN studios in Kaduna.

E. Comments Relating to Possible Interconnection between the College Studio and the Television Station at Kano

The Consultant also discussed with Mr. Phinney the matter of possible interconnection, by microwave relay, between the College studio and the BCNN television station at Kano. This would permit the

instructional programs of the College to be received at other teacher-training centers or educational facilities within range of the Kano station.

Mr. Phinney stated that he had queried the Raytheon Company, Lexington, Mass., one of the principal U.S. suppliers of microwave relay equipment, and the firm from which the television equipment employed at the College programming center had been purchased, concerning the estimated cost of microwave equipment to provide a link between the studio and the television station at Kano. According to notes of the Consultant, the estimated cost was about $30,000 (approximately £N 10,700); estimated installation cost, including erection of the microwave transmitting antenna at the College and the receiving antenna with associated equipment at the television station, was about $10,000 (approximately £N 7,100). Estimates of the Consultant, based on current price quotations of the Raytheon Company and the General Electric Company, Ltd., are as set forth in Section IV of the Appendix.

As the airline distance between the two points is less than eight miles, with line-of-sight conditions over flat terrain, assuming location of the transmitting antenna at about roof height and receiving antenna at a height of about 150 feet on the microwave-relay tower at the television station, no technical problem is anticipated in providing good transmission between the two locations.

F. Considerations Relating to Possibility of Future Relay of Program Signals from Kano to Kaduna

As requested by Mr. Davis, U.S.A.I.D. Nigeria, the Consultant has given consideration to the possibility of relay of program signals from the television studio at the College to the BCNN studios in Kaduna, or to the broadcast transmitter site at Jaji, in the event that this is desired at a later date in connection with the operation of the School Broadcasting Unit in Kaduna.

From a study that the Consultant has made, based on cost data from the Raytheon Company and the General Electric Company, Ltd., Coventry, England, it is indicated that this would involve a very substantial expenditure and may present technical problems because of several factors. One is that the existing relay system between the Kaduna and Kano areas was designed for one-way transmission of television programs from Kaduna to the north. A second factor is that the first microwave-relay station in the system extending northward from the Jaji area is located at an airline distance of 51 miles from the Jaji transmitter site. Off-air television signals from the Jaji station are received at this relay location, Auchan (as shown in the map, Figure 3), then are applied to the microwave system for relay to the north. In the event that microwave equipment were to be added at each relay point to permit transmission southward from Kano, at least one new relay station, including a tower with height of about 265 feet, would have to be established at a suitable site between the exist-

ing relay station at Auchan and the television station at Jaji in order to bridge the 51-mile distance between these two points--beyond range of microwave relay equipment under the terrain conditions that exist in the area.

However, in order to provide some indication as to the estimated cost of adapting the existing relay system of BCNN for two-way operation, the Consultant has included cost estimates in the Appendix, Section V. Estimates are based on recent data from the Raytheon Company and the General Electric Company, Ltd., Coventry, England.

As both firms have indicated that there may be substantial engineering problems involved in adapting the existing system to two-way operation and as there is no indication with respect to the attitude of BCNN on this matter, the Consultant believes it necessary to emphasize that the estimated costs may be well below those that would be derived from a detailed engineering study, with full knowledge of all design details of the BCNN system. Because of unknown factors, the General Electric Company, Ltd., has stated that it would decline to undertake adaptation of the present system of BCNN for relay of television signals in the reverse direction. GEC has indicated that the P&T system could be adapted without problem to relay television signals from Kano to Kaduna. Information from that company has enabled the Consultant to estimate the approximate cost, as set forth in Section VII, Appendix, page 10.

III. Considerations and Recommendations Relating to Improvement and Expansion of Educational Broadcasting on a Coordinated National Basis.

A. Establishment of a National Center at Lagos

In line with recommendations that have been made to the Joint Consultative Committee on Education, as mentioned in the Appendix, Section II, and in order to attain maximum effectiveness of a coordinated educational broadcasting service, the Consultant would recommend for consideration the establishment of a national center in which would be housed all staff and facilities for production of television and radio programs for educational use.

Assuming that it is desired to establish a nationally-coordinated service, as meetings with many officials of the School Broadcasting Units appeared to indicate, then there seems to be no logical reason, as viewed by the Consultant, for continued separation of television and radio production facilities in creation and distribution of educational programs. Both require much of the same type of equipment, administrative, operating and maintenance personnel, as well as teachers with experience in use of television and sound broadcasting for educational purposes. Therefore, it is recommended that consideration be given to a unified broadcasting service, functioning on a nationally-coordinated basis under the Federal Ministry of Education, centered at Lagos.

B. Location of Educational Broadcasting Center

While the details of the suggested center for educational broadcasting are not within the scope of this Report, it appears to the Consultant that if a national programming center is to be established, the site should be selected with care. Among the factors that should be given consideration are the following:

(1) Availability of ample space for future expansion in order to avoid problems, at a later date, when it becomes necessary to enlarge facilities and staff; (2) general suitability of the site for programming purposes -- such as low ambient noise levels and adequate separation from radio-signal sources that could cause interference with operation of studio equipment; (3) use of a location that can be reached conveniently by staff personnel as well as by teachers or specialists in various fields who may, from time to time, be called upon to participate in programs; (4) availability, reliability and general overall adequacy of electric-power, telephone and other public-utility facilities; and (5) suitability of the site with respect to interconnection with the television center of NBC on Victoria Island and Broadcasting House to avoid problems in relay of high-quality video and sound program signals.

While it is probable that there are many locations in the Lagos area that would be suitable for an educational broadcasting center, the Consultant believes that there would be certain advantages in locating such a facility within the grounds of the University of Lagos. There are several

reasons for choice of such a location, as viewed by the Consultant, assuming that land for a new building or sufficient space within an existing building would be available: (1) the environment of the University is compatible with the function of a national educational broadcasting center; (2) the University would provide the reservoir of teaching talent and specialists in various educational fields or professions that can contribute much to educational programming; and (3) the location is such that a good transmission path would be provided for a microwave-relay link between the site and the NBC television station or between the site and Broadcasting House by VHF or UHF radio-relay method, assuming in each instance that a tower or mast with height of 150 - 200 feet is utilized at the educational center.

A second possible location that would, in the opinion of the Consultant, present advantages with respect to the technical aspects of educational broadcasting is on ground adjacent the NBC television center. Because of space limitations in the existing building where studios and transmission facilities are located, it appears that a new building, or construction of an annex to the present structure would be required for the educational programming center.

The principal advantages of the latter location would be in the (1) elimination of need for a microwave-relay link between the center and the NBC television station; (2) proximity of engineering personnel who might be of assistance in event of technical difficulties that could

not be corrected by the technical staff of the educational center; and (3) possibility of a higher degree of coordination between the staffs of the educational center and the broadcasting organization than would be the case if the facilities were at separate locations.

From a long-range viewpoint, it appears to the Consultant that a preferred location would be on the University grounds, principally for the reason that the environment and facilities of a large university can augment various phases of educational broadcasting activities. Also, if, in the future, it is desired to establish additional television or radio transmission facilities for an expanded educational broadcasting service in the Lagos area--such as transmission of programs of extension-course type to adults during evening hours when the NBC station could not be used--it is probable that adequate ground space could be provided more readily at the University than at the NBC station site.

C. Estimated Cost of Equipment for Proposed Educational Broadcasting Center at Lagos

Preliminary estimates of cost of equipment for a national educational programming center, including all apparatus required to originate television and radio programs for use in a coordinated national service, are set forth in the Appendix, Section VI. It will be noted that the total estimated cost of all equipment, including relay links and tower or mast required to establish interconnection between the center, if located at the University, and the NBC television station as well as between

the educational center and Broadcasting House, is approximately ₦N 100,000.

If located at the NBC television station site, the cost of equipment would be reduced because of the elimination of the microwave-relay link, tower or mast and certain minor accessories that would be required if the center were to be at the University.

D. Mode of Operation of the Proposed National Center for Educational Broadcasting; Relationship to School Broadcasting Units at Other Locations

It is anticipated that a national center for educational broadcasting would logically function under the Federal Ministry of Education and serve as a primary coordinating means to assist in attaining maximum effectiveness in use of television and radio as teaching aids. It is probable, in the opinion of the Consultant, that the center would serve as a national clearing house on all matters relating to programming activities. It also is probable that the center would provide a valuable function as a coordinating point and national programming source in connection with future educational network operations.

In the latter respect, the relationship of the national center to state or regional School Broadcasting Units would, as visualized by the Consultant, be somewhat similar to that between the programming center of a national broadcasting network and its affiliates. The latter may be physically interconnected with the national programming center while con-

tinuing to serve local or regional requirements by use of their respective programming and transmission facilities, thus enhancing the overall service potential of the affiliated stations and giving them access to programs of national or international importance that the individual stations otherwise could not obtain.

The Consultant does not feel that he is qualified to suggest the details of the organizational pattern or to comment on the specific means by which a national educational broadcasting service could be established. The suggestions and recommendations, as outlined above, are intended to relate broadly to operational aspects rather than to administrative functions. However, as the result of the Consultant's observations in Lagos and other cities that he visited while in Nigeria and the expression of views in discussions with officials of the School Broadcasting Units and educators, he is convinced of the need for a coordinated national approach to the matter of use of radio and television as aids to education. It also appears that the principal channel through which such coordination can be attained would be that provided by the Federal Ministry of Education in collaboration with the various State Ministries of Education.

E. Comments and Recommendations Concerning Technical Aspects of a Coordinated Educational Broadcasting Service.

1. Videotape Recording Facilities

Experience in development of national educational broadcasting services in the United States and elsewhere has emphasized the need for use of compatible techniques, particularly in recording of television programs

by videotape or in utilizing other methods that permit exchange of programs between educational broadcasting centers.

Inasmuch as videotape equipment now provides a principal means of recording of programs and permits their transmission at designated hours by the television stations that are employed by the School Broadcasting Units in their educational service, it appears to the Consultant that this mode of operation should be expanded and made more effective in the future by use of videotape recording equipment of transverse-scanning type, in lieu of the portable helical-scan recorders initially supplied to the Units to assist in their programming work.

While the portable machines can provide good results if they are carefully adjusted and maintained, the general experience in Africa is that the large transverse-scan recorders, such as made by Ampex and RCA, are the most satisfactory. This equipment is of heavier construction, parts are more accessible and they usually can be maintained more easily. In addition, a higher degree of picture quality normally can be obtained on the large machines and there is no difficulty in maintaining compatibility of operation with respect to tapes made on other recorders. The portable machines can present problems in this respect as has been noted in operating this type of equipment in Nigeria.

The Consultant is of the opinion that if the School Broadcasting Units at the different locations can produce videotape recordings that are interchangeable, it will then be feasible for them to share the

sizeable task of production of educational programs that will be required in the future as television is employed more extensively in schools.

For example, tapes on certain subjects or specifically relating to the Western State could be produced by the Unit at Ibadan. At the same time, tapes on other subjects and pertaining to the national area could be produced in Lagos. As is the practice elsewhere, these tapes can be exchanged, copies can be made and retained at certain locations, or, if microwave-relay interconnections are available for transmission of television program signals between different locations, the signals from a standard type of videotape recorder can be carried by the microwave link to a similar type of equipment operated by a School Broadcasting Unit in another city, recorded and then broadcast at a specified time in accordance with the program schedule of the Unit.

Another factor that has led the Consultant to recommend use of the transverse-scan type of videotape equipment in the future is that as this mode of scanning is in accordance with international broadcasting standards it presents the possibility of exchange of tapes of educational broadcasting services in other countries of Africa or any area where 625-line, 50-field video-scanning standards are employed.

2. Interconnection between Educational Programming Center and Broadcasting Station

In the event that the School Broadcasting Units have their own studio facilities for origination of television programs as a means of

improving and expanding the educational broadcasting services, interconnections between the studios and broadcasting centers in each area should, when installed, be adequate to meet future requirements.

In the Lagos area, where microwave-relay methods would be required between the educational programming facilities and the television broadcasting station if at different locations, the Consultant believes that it would be desirable to anticipate that in the future there will be need to record educational program signals from another city at the national center for educational broadcasting. This assumes that in the future, the educational facilities would be linked with the national telecommunications network, as recommended in this Report. In such event, the local interconnection between the educational programming center and the television station should permit transmission of video and associated sound signals in either direction. Such arrangement would enable maximum utilization of the services that an intercity telecommunication network could provide and would facilitate the matter of exchange of educational television programs. Additional comments on network operation are included in Part IV of this Report.

3. Maintenance and Repair of Receivers

The Consultant has noted in reviewing reports relating to the M. A. T. E. project and from observations in Nigeria that a problem is presented by classroom receivers that get out of adjustment or for other reason cannot be utilized effectively as teaching aids. While

the introduction of new types of television receivers in which transistors replace vacuum tubes probably will lead to improvement in reliability of operation of classroom equipment, as discussed in Part V of this Report, it appears to the Consultant that the facilities for servicing and repair of receivers should be given more attention.

It would help matters, for example, if a full complement of test and measurement equipment of the types employed in commercial service centers or repair shops were to be made available as a part of the facilities of each School Broadcasting Unit. A representative list of such equipment is included in the Appendix, Section VI-A.

Stock of spare receivers should be maintained in good working order to permit replacement of defective classroom receivers without depriving schools of equipment while repairs are being made.

Consideration should be given, in the opinion of the Consultant, to the possibility that, in the future, it may be desirable to maintain and service classroom receivers under contract with commercial organizations that have facilities for work of this type. This is a pattern that has been found to be satisfactory in other areas and might prove to be an effective means of minimizing the servicing problem that, at present, lowers the overall value of television receivers in schools.

IV. Suggested Plans for Expansion and Improvement of Television and Radio Broadcast Services by Use of Microwave-Relay Method

A. Need for Expansion and Improvement of Broadcast Services

As has been stated in preceding sections of the Report, the effectiveness of television and radio broadcasting for educational and other purposes is severely hampered by lack of adequate interconnecting links between Lagos and cities where television and radio stations are located.

In view of the fact that the Government of Nigeria now is placing strong emphasis on ways and means to strengthen and unify the nation, the Consultant believes that consideration should be given at this time to the contribution that an expanded and improved broadcasting system could make in this direction.

By means of microwave-relay method, permitting transmission of high-quality picture and sound signals between Lagos and stations in different parts of Nigeria, television viewers and radio listeners would be aware that they are being served by a national system. The television and radio audience in urban and rural areas, while far from Lagos, will have a sense of participation, as observers, in important national events. Thus, better understanding of national issues and attainments can be developed.

An effective network system to link existing and future stations would enable high-quality relay of educational programs from a national center in Lagos to supplement those from state or regional centers. Enlarged scope of educational programming, utilizing the talents of an aug-

mented teaching staff and facilities at Lagos, could be attained. In addition, students in schools and colleges, while viewing programs from Lagos, would feel that they were in direct touch with the capital, thereby strengthening the one-nation concept.

Such possibilities, attractive as they may appear, may not be realized for many years if the required relay links between cities are to be established by the broadcasting service. The expenditures involved in establishing a relay system solely for broadcast purposes would, in the opinion of the Consultant, be very great. Such a project would require costly engineering surveys, erection of many relay and terminal stations with their associated towers, buildings and equipment, as well as very substantial operating and maintenance costs. In effect, such a system would duplicate, in large part, the intercity relay network of P&T.

However, interconnecting links could be provided within several years if a collaborative arrangement, satisfactory to all parties, can be evolved between the Ministry of Communication and the broadcasting organizations that would enable additional equipment for program relay purposes to be installed at terminals and relay stations of the national telecommunications network, presently scheduled for completion in 1971.

The value of a microwave network in permitting interconnection of television and radio stations in various parts of Nigeria appears to be so great in terms of assisting in the unification of the country and in improving television and radio-broadcast services that the Consultant believes that every effort should be made at this time, prior to construction of the Phase III

portion of the National Telecommunication Network, to adapt the system for relay of television and radio program signals.

As is set forth in the Consultant's brief relating to this situation, attached in the Appendix, Section II, that was prepared in Lagos for presentation to the Joint Consultative Committee on Education, there are understandable differences of opinion within the Posts and Telecommunications Department of the Ministry of Communications and the broadcasting organizations that, if not resolved, would preclude the use of the national microwave relay system for intercity transmission of television and radio program signals.

The P&T Department has made a proposal that would enable the broadcasting organizations to utilize the microwave system, if accepted by the latter. Such use of the system, for technical reasons and to minimize loss of revenue from telephone service, would require that P&T purchase and install additional equipment, not now included within the scope of the Phase III project, for broadcast relay purposes. The broadcasting organizations have declined to accept the proposal of P&T on the grounds that the service charges, in their opinion, are far too high and they do not believe that the P&T circuits will provide the quality and reliability of transmission that they need.

The Consultant believes that it should be possible, and in the basic interest of Nigeria, to work out a satisfactory solution to this problem. Experience in many countries has shown that the national telecommuni-

cation services that provide intercity telephone and telegraph circuits are best equipped to perform the function of linking television and radio broadcasting stations on a national basis.

It is probable, in the Consultant's opinion, that many of the difficulties that the broadcasting organizations have experienced in the past in using circuits of P&T have been the result of limitations and technical inadequacies of the older wireline systems, subject to the effects of moisture, line breakage, poor electrical connections and malfunctions of many types. With modern microwave-relay systems, such as those of the national telecommunication network, a very high degree of reliability and transmission quality can be attained in the intercity circuits. There appears to be no basic reason why the P&T system cannot meet all requirements, in terms of transmission reliability and quality, of the broadcast services. If maintenance problems develop, these can be resolved as they have been elsewhere. In any event, such problems would exist, whether relay facilities were operated by P&T or broadcast technical personnel.

It appears that the major difficulty, if technical differences of opinion can be resolved and operating standards can be established, would then be that of economics. Who will assume the costs of the additional equipment that will be required to adapt the telecommunication network to carry high-quality television and radio program signals between stations? Who will defray the costs of operating and maintaining the required inter-

city circuits utilized by the broadcasting organizations?

In the Consultant's opinion, the answer is that it is only the Federal Government that could provide the means and carry the responsibility for the funding of adaptation of the P&T network system to permit its use for broadcast relay purposes. It appears to the Consultant that if the mass-communications media of television and radio broadcasting are to become most effective as a unifying force and if their potential is to be utilized to a maximum degree in informational and educational services, a national network that will provide high-quality interconnecting links between broadcasting stations is an essential requirement.

It appears to the Consultant that the technical and economic problems that would be involved in adapting the national telecommunications network could be resolved through the medium of a governmental committee, including representatives of the broadcasting organizations, P&T, Federal Ministry of Education and other Government agencies that would have a direct interest in the matter. .

In order to provide an indication of the costs that might be involved in adapting the P&T network system for broadcast relay purposes and to outline the framework of the facility that would be required for intercity relay of television and radio program signals, the Consultant has drafted three suggested plans for consideration by those who may be concerned with the matter of improvement and extension of the broadcast services.

B. Outline of Suggested Plans for Intercity Relay of Broadcast Program Signals

In considering the matter of relay of television and radio program signals between Lagos and cities where television and radio broadcasting stations are located it appears that it would be logical as an initial step to provide network relay facilities from Lagos to Ibadan, Kaduna and Kano. This is the area within which the majority of television and radio broadcasting stations now are in operation, with the largest audience. Also, as the Broadcasting Company of Northern Nigeria has a microwave link between its studios in Kaduna and the television station of that company in Kano, the initial stage of network development could terminate at Kaduna. In order to identify this first stage, as suggested, it is designated as Plan A. Estimated costs and related data are included in the Appendix, Section VII. Equipment cost estimates are based on information from the the General Electric Company, Ltd., Coventry, England, the supplier of microwave-relay and associated equipment, as well as general contractor, in establishment of the Phase I and III network systems of the Posts and Telecommunications Department.

The second suggested step in the direction of adaptation of the P&T network to accomodate relay of television and radio program signals would be that of adding the required equipment in the Phase I system between Lagos and the Enugu-Aba area where television and radio stations are located. This step in network development is designated as Plan B.

Equipment cost estimates relating to Plan B also are contained in the Appendix, Section VII.

Plan C, as suggested, would involve long-range aspects by addition of equipment on the P&T network to permit relay of radio-program (and later, television) signals to outlying points such as Sokoto, Maiduguri, Makurdi and other locations that will be served by the broadband circuits of the Phase III system, assuming that it is planned to install improved medium-wave stations at these points and later establish television broadcast facilities. Estimates of approximate cost of equipment to adapt these portions of the network for relay of radio-program signals of NBC are set forth in Section VII of the Appendix.

Although estimates relating to Plans A and B are based on cost of equipment that would be required to adapt the P&T system primarily for one-way relay of television and radio program signals from Lagos to the various cities, including the local links between P&T terminals and broadcasting studios or stations, it has been possible to estimate roughly the approximate costs of adaptation to permit two-way relay of program signals, or, alternatively, dual-path relay from Lagos outward. These figures also are included in Section VII of the Appendix.

V. Comments with Respect to Possible Application of New Technological Developments in Educational Broadcasting Services in Nigeria

A. Advances in Solid-State Technology

Perhaps one of the most significant areas of technological development in the electronics field is in the rapidly-growing use of improved forms of transistors and other solid-state devices in lieu of vacuum tubes in almost all types of broadcasting and communications equipment. Some of these recent developments may find application in Nigeria, particularly in expanding and improving the educational broadcasting service.

Transistors and other solid-state components now are employed in (1) new types of radio and television broadcast transmitters to reduce their size, lower power requirements, improve overall performance characteristics and increase reliability; (2) advanced forms of studio equipment, especially television cameras and associated apparatus to improve picture quality, minimize lighting problems and to simplify operation; (3) new types of relay equipment to upgrade performance, reliability and to reduce power requirements and (4) design of television and radio receivers to minimize size and power requirements, as well as to improve reliability, thus minimizing servicing problems.

Broadcast transmitters that utilize solid-state components are well-suited for automatic, unattended operation at locations in rural areas where it would be difficult and costly to maintain technical staffs.

Possible application of low-power transmitting equipment of this type in Nigeria might be in connection with the new P&T telecommunications network to enable television and radio programs from Lagos to be broadcast in outlying towns and cities, such as Maiduguru, Potiskum, Bauchi, Jos, Makurdi, Gusau and Sokoto, thereby reaching schools in these areas. Such application assumes, of course, that the broadcasting organizations and P&T have a satisfactory working arrangement and that the intercity network of P&T would be adapted for use in relay of television and radio programs to outlying sections of the country.

The trend toward the adoption of solid-state components for nearly all forms of electronic equipment is of particular significance in connection with the future use of television receivers in Nigerian schools, many of which are not served by electric-power circuits In rural areas, where television could perhaps render its most valuable service, lack of electric power has precluded the use of receivers that require connection with lighting mains. This situation, in addition to the cost of television receivers, has inhibited more general use of the video broadcasting medium in Nigeria where, according to a sales official of the Philips organization in Kaduna, the total number of television receivers in use throughout the country is only about 10,000. (The Chief Engineer of BCNN placed the number of television sets in use in northern Nigeria at about this figure.)

Although solid-state radio receivers now are used widely in Nigeria and some are manufactured in that country, the application of solid-state technology to permit satisfactory operation of television receivers from batteries has, to date, been restricted primarily to small portable receivers, with screen sizes that are inadequate for classroom use. However, it is anticipated that large-screen (23-inch or greater) receivers, suitable for school use, will be developed in future years to permit operation from storage batteries that may be recharged at intervals of 1-2 weeks at local points where electric power is available.

The significance of advances in this direction is so great that all major receiver manufacturers, particularly in Japan, are concentrating much of their research and development effort in adapting solid-state devices to large-screen receivers that may be operated from batteries or electric-power mains. The Consultant believes that when such receivers are in large production, they will be marketed internationally within a lower price range and will be especially suited to assembly or manufacture in Nigeria because of the use of modular, or unitized, forms of construction in transistor-type television sets that can greatly simplify and reduce the cost of manufacturing operations. If these locally-made receivers can be marketed at substantially lower prices, and they also can be operated satisfactorily from batteries for reasonable periods of time, such a development could have a marked effect on the growth of the television audience in Nigeria.

Advanced forms of thermo-electric generators, permitting operation of transistor-type television receivers without batteries, are under development. Devices of this type are in the solid-state category; they employ no moving parts and can utilize butane gas as a heat source. While at present these are too costly to be practicable for use in schools, it is probable that further research and development work on devices of this type will reduce selling prices to the point where they may provide a satisfactory resolution to the problem that is presented in rural areas or other locations not reached by power lines.

Although use of transistors and other solid-state components in lieu of vacuum tubes in electronic equipment in general presents many advantages in terms of lowering cost, improving reliability and extending life of nearly all forms of radio and television apparatus, wide-spread introduction of solid-state technology within a relatively short period of time also has created problems. For example, the Consultant has noted, particularly in African countries, that broadcasting engineers and technicians have expressed concern because of difficulties, usually not experienced with apparatus in which vacuum tubes are used, that can develop when transistor-type equipment is to be serviced and repaired.

The problem, in this instance, appears to stem from the fact that many broadcast engineers and technicians in Africa have received their training with tube-type equipment. The matter is further complicated by the tendency of many manufacturers to assume, erron-

eously, that engineering personnel who carry the responsibility for servicing and repair of equipment in overseas areas are well-versed in solid-state technology and are familiar with the proper testing and servicing procedures. The end result is that technical personnal connected with broadcasting operations in these areas often do not have adequate instruction in operating, maintaining and servicing apparatus that employs transistors and other solid-state components. They therefore prefer, with good reason, to use familiar types of equipment that utilize vacuum tubes, even though transistor-type apparatus may have superior performance characteristics and may have replaced the earlier models of the equipment in which tubes were used.

It appears to the Consultant that this troublesome problem might be minimized by requiring that equipment manufacturers or suppliers provide (1) adequate manuals of instruction in use, maintenance and repair of their products, particularly with respect to proper testing and servicing of solid-state components and circuits, (2) technical training at practical -- rather than theoretical -- level in servicing and repair of products that utilize solid-state devices, (3) equipment in which components and circuitry are reached easily, may be checked or tested readily and (4) wherever practicable, components, circuit boards or modules of replaceable "plug-in" type. In the latter case, sufficient spares should be supplied to permit quick replacement of critical parts that may fail and cannot readily be repaired in local workshops.

As practically all forms of electronic equipment now are employing solid-state components or are in process of being adapted to permit their use, the Consultant believes that it may be necessary for the broadcasting organizations, technical training centers and schools to provide opportunity for engineers, technicians and students to become fully versed in operation and maintenance of apparatus in which solid-state circuitry and components are utilized.

B. Developments Relating to FM Broadcasting as a Potential Means for Improvement of Educational Radio Service

More extensive use of FM broadcast methods in Nigeria undoubtedly has been inhibited by economic factors. As there are relatively few FM broadcast receivers in public use, there would be little justification, at present, for installation of FM broadcasting equipment with sufficient power output to provide coverage that would be comparable to that of groundwave (daytime) range of medium-wave transmitters. To date, use of FM broadcasting equipment by Nigerian stations has been confined primarily to that of providing program-transmission links between studio locations, such as Broadcasting House in Lagos, and medium-wave/shortwave transmitter sites. *

* This refers to the sound broadcasting services. FM transmission and reception methods are used to carry the sounds associated with all television programs.

C. Developments in Multiplex Technology as Related to Broadcasting Services

While the FM mode of broadcasting has found wide public acceptance in many countries because of its technical superiority as a radio transmission means, it also is the only broadcasting method that permits use of multiplex techniques for transmission of high-fidelity stereophonic radio programs and subsidiary services of "multicast" type. Because of these factors, the United States now has more than 2,000 authorized FM broadcasting stations, of which nearly 400 are educational stations. The rate of growth of this improved form of broadcasting is such that as of September, 1968, the number of FM station construction permits in the U.S. has exceeded that of AM (medium-wave) stations by a factor of nearly three to one. Within less than five years, if the present rate of growth is maintained, it is anticipated that FM will be the dominant sound-broadcasting medium in the United States.

In application of multiplex technology in the FM broadcasting field, inaudible "subcarriers" (above 20,000 Hz) are impressed on the same carrier wave that is used for transmission of high-fidelity programs in the public broadcast service. There is no interference from the multiplex signals in ordinary FM receivers used by the public; only receivers designed for multiplex service will respond to the subcarrier signals. In stereophonic transmission, the main channel and a multiplex subchannel are employed to carry the "right" and "left" program signals. In subsidiary services, subcarriers are employed in transmission of specialized types of programs

which may comprise background music, continuous news summaries, extension courses on specific subjects and other material intended for reception only by authorized subscribers.

As subsidiary services produce additional revenue for the broadcasting stations and can provide several transmitting channels* at little additional cost, the majority of FM stations in the United States utilize multiplex methods. All FM broadcast transmitters made in the U. S. now are designed for such service.

Because of the growing use of FM multiplex technology in the broadcasting field, it is logical to anticipate its future application by the sound broadcasting services in Nigeria, particularly in the field of education. An example of a possible application of the FM multiplex method in Nigeria would be its use to enable an FM station at a given location to transmit simultaneously two or three instructional programs, each intended for different age groups.

In this illustrative type of service, the main (public broadcast) channel of the station would carry program material directed to students in primary schools; a subchannel would be used for programs addressed to classes in secondary schools. An FM multiplex receiver, of commercially-available type, in each school would enable the teacher to select the proper program.

*A commercial organization in the United States now provides training courses by an FM multiplex system termed "Educasting." Three or four subchannels are used in this service without interfering with public broadcasts on the main channel.

Multiplex technology also has been applied to the FM sound transmitters associatdd with television broadcast services. In Uganda, for example, multiplex subchannels are used for intercommunication between network stations in lieu of wire-telephone circuits which, in rural areas, are not reliable and usually involve long delays in placing calls. It also is planned to use multiplex methods to meet problems that are presented by indigenous languages in different parts of the country.

D. Comments Relating to Possible Use of UHF Television Channels for Educational Service in Nigeria

Provision was made in the Regional Agreement at the African VHF/UHF Broadcasting Conference at Geneva in 1963 for future utilization of UHF channels 21 to 81, inclusive, in providing local television broadcast services, including those of educational type. Thus, if in the future, at a time when all available VHF channels in Nigeria have been occupied, a need develops for establishment of local television services that could be used exclusively for educational purposes, channels in the UHF band could be employed for this function.

As the result of a Federal requirement that all television receivers sold in the United States must, under law, be operable in the UHF as well as the VHF band, manufacturers in North America, England,

Western Europe and Japan now market receivers that can be used in both bands. *

If a national center for educational broadcasting is established at Lagos in the near future, it may be desired to install a low-power television transmitting facility for a local educational service to schools and to provide training in operation of broadcast transmitters. While it would be logical, in some respects, to advocate establishment of such a transmission facility on a channel in the UHF band, practical considerations would indicate, in the opinion of the Consultant, that operation should be on a channel in the upper portion of the VHF television band where channels 5 to 12, inclusive, are located. This would enable the use of the same types of VHF receivers that now are employed in Nigeria.

Frequencies in this portion of the VHF television band are well-suited for local use, especially in flat terrain; transmitting antenna systems are of relatively-small size and cost as compared with the situation on the lower channels (2-4) and they can provide high orders of effective radiated power (a power gain of 20 times in the antenna system for the upper channels is not difficult to attain because of the relatively-small size of the antenna elements.) Directional receiving antennas are of smaller size than those for the lower channels, can provide higher gain and normally are less expensive than

* Receivers for the North American market are designed to meet U. S. television system standards. Modification would be required for use in Nigeria.

those designed for use on the lower channels.

E. Developments Relating to Use of "Closed Circuit" Television (CCTV) Systems in Educational Services.

While this report is directed primarily toward matters pertaining to educational broadcasting services in Nigeria, the Consultant believes that it would be desirable to comment on related developments of non-broadcast type in the educational television field that utilize cable or super-high frequency (SHF) radio transmission means in distributing television programs from a central studio to students within a designated area.

These systems are classified, in general, as those of "Closed Circuit" type since they utilize coaxial cables or specialized types of wideband radio equipment to establish transmission circuits on a "closed" point-to-point, rather than public broadcast, basis between a central studio and specific receiving or viewing points. The latter maybe classrooms in the same building or group of buildings within a campus area, as in the case of the coaxial-cable system at the Advanced Teachers Training College at Kano. The receiving points also may be in classrooms of schools in different parts of a community or within a number of communities in a given area that are linked with the program-originating point by coaxial cable or by radio-transmission method of point-to-point type.

The radio transmission method, as now utilized for educational or instructional television services of "closed-circuit" type in the

United States, employs channels in the 2500 megaHertz band. Under the U. S. frequency-allocation plan, a total of 31 channels in the 2500 MHz band, arranged in seven groups, each with 4 television channels, and one group with 3 channels, is available for use as authorized by the Federal Communications Commission, by educational institutions, medical societies and other designated types of organizations.

The 2500 MHz systems utilize special types of transmitting antennas of uni-directional or omni-directional type and "dish" receiving antennas -- the latter of the same basic type as the parabolic-reflector antennas that are commonly employed in microwave relay services. "Down Converters" also are required at receiving points to change the carrier frequency of the transmitted signal in the 2500 MHz band to a lower frequency that can be utilized by standard television receivers. Receiving antennas and frequency-conversion equipment employed in the SHF systems are very expensive as compared with costs of standard VHF antennas and receivers.

The principal reasons for use of systems of this type in the United States are to (1) avoid the interference problem that is presented in large urban areas where it would be difficult to obtain channels for educational or instructional television in the VHF or UHF portion of the radio spectrum under the national frequency allocation plan of the Federal Communications Commission; (2) minimize "ghosting" and electrical noise problems that are prevalent in the VHF and UHF bands in metro-

politan areas; (3) provide several transmission channels from the programming point to schools; and (4) afford a relative degree of "closed-circuit" privacy of transmission since reception requires special equipment.

While the 2500 MHz systems serve a useful purpose under the conditions that exist in the United States, the Consultant does not anticipate that there would be a logical application of similar systems in Nigeria for educational use. When and if in the future all available channels in the VHF band in each geographical section of Nigeria are occupied and a requirement develops for additional channels for educational television, then it would be logical to give consideration to use of channels in the UHF television broadcast band for educational services rather than to utilize 2500 MHz systems with their much larger costs. However, the latter type of television system may find application in Nigeria for point-to-point services of the police, military or other governmental agencies where a degree of security may be involved and the higher costs may be justified.

F. Developments in Communication Satellite Technology

The Consultant believes that it is pertinent to the subject matter of this Report to comment at this point on developments in the area of communication satellites. These may relate, in the future, to broadcasting service in Nigeria since the Federal Ministry of Communications has made plans for the establishment of an earth station at Igbu Ora, about

40 miles west of Ibadan.

This facility, scheduled for operation in about two years, will provide an interconnecting link with a synchronous-orbit (fixed-position) satellite system now operated by INTELSAT, an international consortium of countries of which Nigeria is a member. It is understood that microwave relay circuits will be used between the earth station and a terminal of Nigerian External Telecommunications, Ltd., in Lagos, where interconnection would be made with the domestic telephone facilities of Posts and Telecommunications.

From experience of countries that now are interconnected by the INTELSAT system, it has been shown that there is extensive usage of the satellite-communication facilities for relay of television and radio programs of international interest between North America and the European area, as well as between North America and Japan. It is probable, in the opinion of the Consultant, that as the satellite project develops in Nigeria, there will be a growing interest in the possibility of use of the system to bring television programs of international importance to audiences in Lagos and at other locations served by television stations.*

However, before this is possible, it will be necessary to provide suitable equipment in the microwave relay system between the earth station and Lagos as well as between a terminal in Lagos and cities where television stations are located.

* Or, in the reverse direction, as in relaying from an originating point in Nigeria to other countries.

If during the period of construction of these microwave relay systems, now primarily intended for telecommunication services, additional equipment that would accommodate television program signals could be installed, the costs would be lower, in the opinion of the Consultant, than would be the case after the systems have been constructed and engineers of overseas suppliers have left the country. Whether or not such costs can be justified would, of course, be a matter that could be decided only by the officials of the broadcasting and telecommunication organizations or other Nigerian Government agencies that would have an interest in the subject.

With respect to possible application of communication satellite technology to provide a national television service, as is advocated in India, it is the opinion of the Consultant that, at the present state of the art, this would be impractical. In any event, use of such a system in Nigeria, in the Consultant's judgment, would be far more costly than in the case of utilization of ground-based relay methods for interconnection between television stations in different parts of the country.

While consideration is being given in India to use of an advanced type of synchronous-orbit satellite that theoretically would enable relay of television programs directly to community receivers in villages, the estimated costs of the special receivers and antennas at this time appear to be such as to raise serious questions as to the feasibility of the proposal.

Unlike the case in India, where there are no plans for a national microwave network and only one experimental television station exists, Nigeria shortly will have a network with potential for adaptation, at reasonable cost, to provide means for interconnection of existing stations in different parts of the country. For this reason, and others as outlined above, it appears to the Consultant there is no practical application of satellite-relay methods to meet domestic requirements in Nigeria other than those relating to international services.

VI. Recommendations

Specific recommendations of the Consultant are listed as follows:

1. Use of the national telecommunications network as a means of interconnecting television and radio broadcasting stations in different sections of the country. The purpose would be to provide the necessary backbone for a national television and radio service of high-grade type at minimum cost. Recommended stages and directions of extension of service are as set forth in Part IV of the Report.

2. Establishment of a national educational broadcasting center at Lagos. To provide a facility, with all required equipment, operating and programming personnel, for origination of educational television and radio programs. The center would also serve as the means for coordinating the programming work of School Broadcasting Units at other locations and avoid problems now presented by shared use of studio facilities and staff of the Nigerian Broadcasting Corporation.

3. Establishment of educational programming facilities as an integral part of School Broadcasting Units in state or regional areas. To minimize the problems involved in shared use of studios, equipment and personnel of the broadcasting organizations. By microwave interconnections with the national center at Lagos, better coordination of all programming activities should be attained and duplication of effort minimized.

4. Coordination of all educational broadcasting functions on a national basis, under the Federal Ministry of Education. To increase the overall effectiveness of educational television and radio services.

5. Use of videotape recorders of transverse-scanning type, made in accordance with international broadcasting standards, for recording of educational television programs. To minimize technical difficulties that have been noted in use of portable videotape recorders of helical-scan type, to upgrade picture quality and attain a maximum degree of compatibility of tapes as recorded at different locations.

6. Interconnection of the CCTV studio facilities at the Advanced Teachers Training College and the television station of BCNN at Kano. To enable programs of the College to be observed at other colleges and schools within the service area of the station at Kano.

7. Augmentation of facilities for maintenance and repair of receivers used in classrooms, including closer liaison with schools. To minimize out-of-service time when receivers become defective, improve receiver performance and overall effectiveness of educational television and radio programs in classrooms.

9. Consideration of use of the FM mode of transmission for educational radio services. To improve quality of broadcasts as received in classrooms for more effective use of radio as an educational aid as well as in the public broadcast service.

10. Consideration of use of FM multiplex methods as a future means of providing additional channels for educational radio programs. To increase scope and flexibility of programs directed to schools by enabling one FM broadcast transmitter at a given location to provide the equivalent function of several transmitters.

11. Adaptation of proposed microwave relay facilities between the satellite earth station and the national telecommunication network to accomodate television signals. To enable television programs of international importance from other continental areas to be seen in Nigeria or those originating in Nigeria to be relayed overseas.

APPENDIX

SECTION I

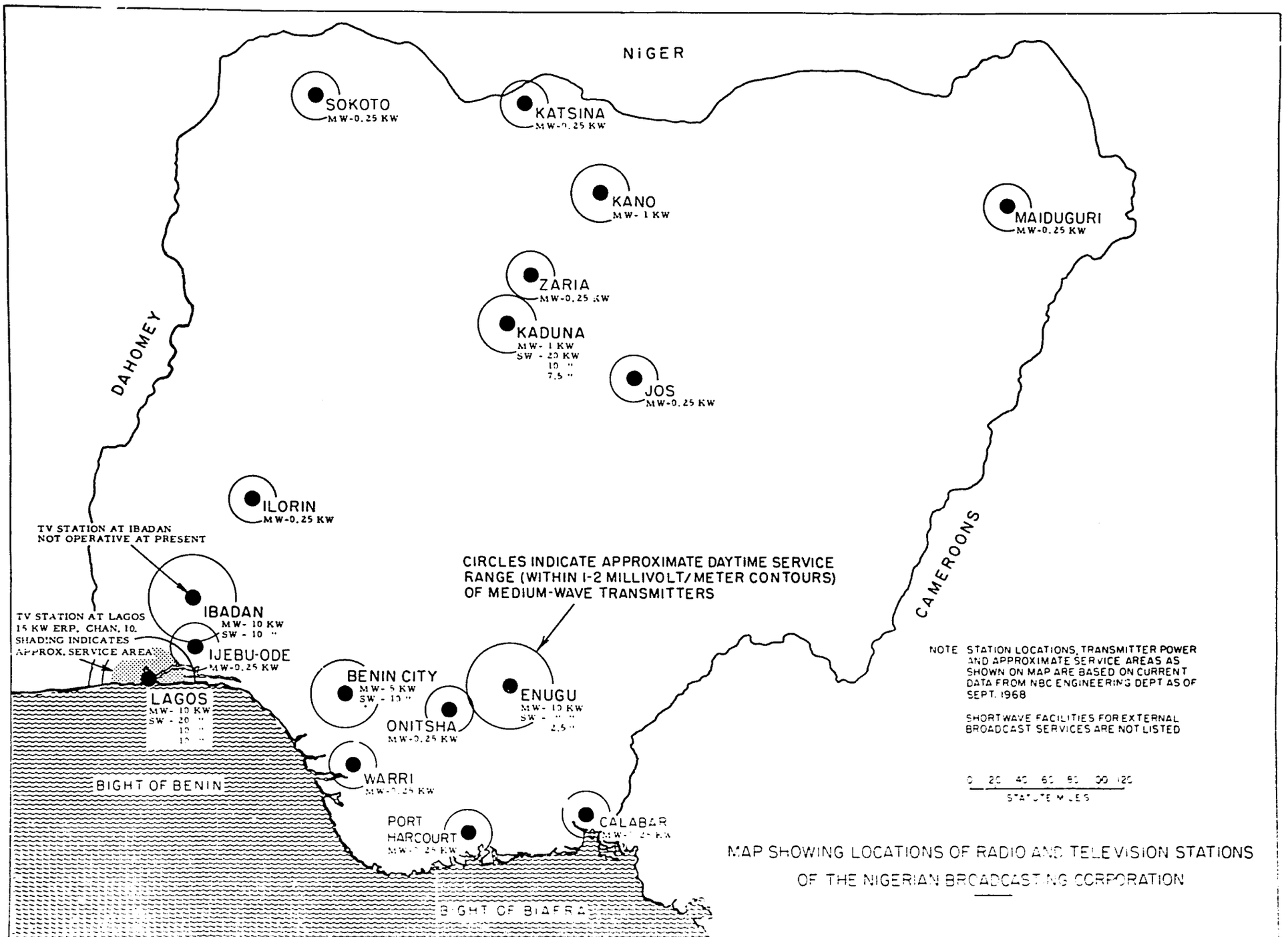

NIGER
SOKOTO
MW-0.25 KW
KATSINA
MW-0.25 KW
KANO
MW- 1 KW
MAIDUGURI
MW-0.25 KW
ZARIA
MW-0.25 KW
KADUNA
MW- 1 KW
SW - 20 KW
10 "
7.5 "
JOS
MW-0.25 KW
DAHOMEY
ILORIN
MW-0.25 KW
TV STATION AT IBADAN
NOT OPERATIVE AT PRESENT
CIRCLES INDICATE APPROXIMATE DAYTIME SERVICE
RANGE (WITHIN 1-2 MILLIVOLT/METER CONTOURS)
OF MEDIUM-WAVE TRANSMITTERS
CAMEROONS
IBADAN
MW- 10 KW
SW - 10 "
TV STATION AT LAGOS
15 KW ERP, CHAN. 10.
SHADING INDICATES
APPROX. SERVICE AREA
IJEBU-ODE
MW-0.25 KW
BENIN CITY
MW- 5 KW
SW - 10 "
ENUGU
MW- 10 KW
SW - " "
2.5 "
LAGOS
MW- 10 KW
SW - 20 "
10 "
10 "
ONITSHA
MW-0.25 KW
WARRI
MW-0.25 KW
BIGHT OF BENIN
PORT
HARCOURT
MW-0.25 KW
CALABAR
MW-0.25 KW
BIGHT OF BIAFRA
NOTE STATION LOCATIONS, TRANSMITTER POWER
AND APPROXIMATE SERVICE AREAS AS
SHOWN ON MAP ARE BASED ON CURRENT
DATA FROM NBC ENGINEERING DEPT AS OF
SEPT. 1968
SHORTWAVE FACILITIES FOR EXTERNAL
BROADCAST SERVICES ARE NOT LISTED
0 20 40 60 80 100 120
STATUTE MILES
MAP SHOWING LOCATIONS OF RADIO AND TELEVISION STATIONS
OF THE NIGERIAN BROADCASTING CORPORATION

FIGURE 1

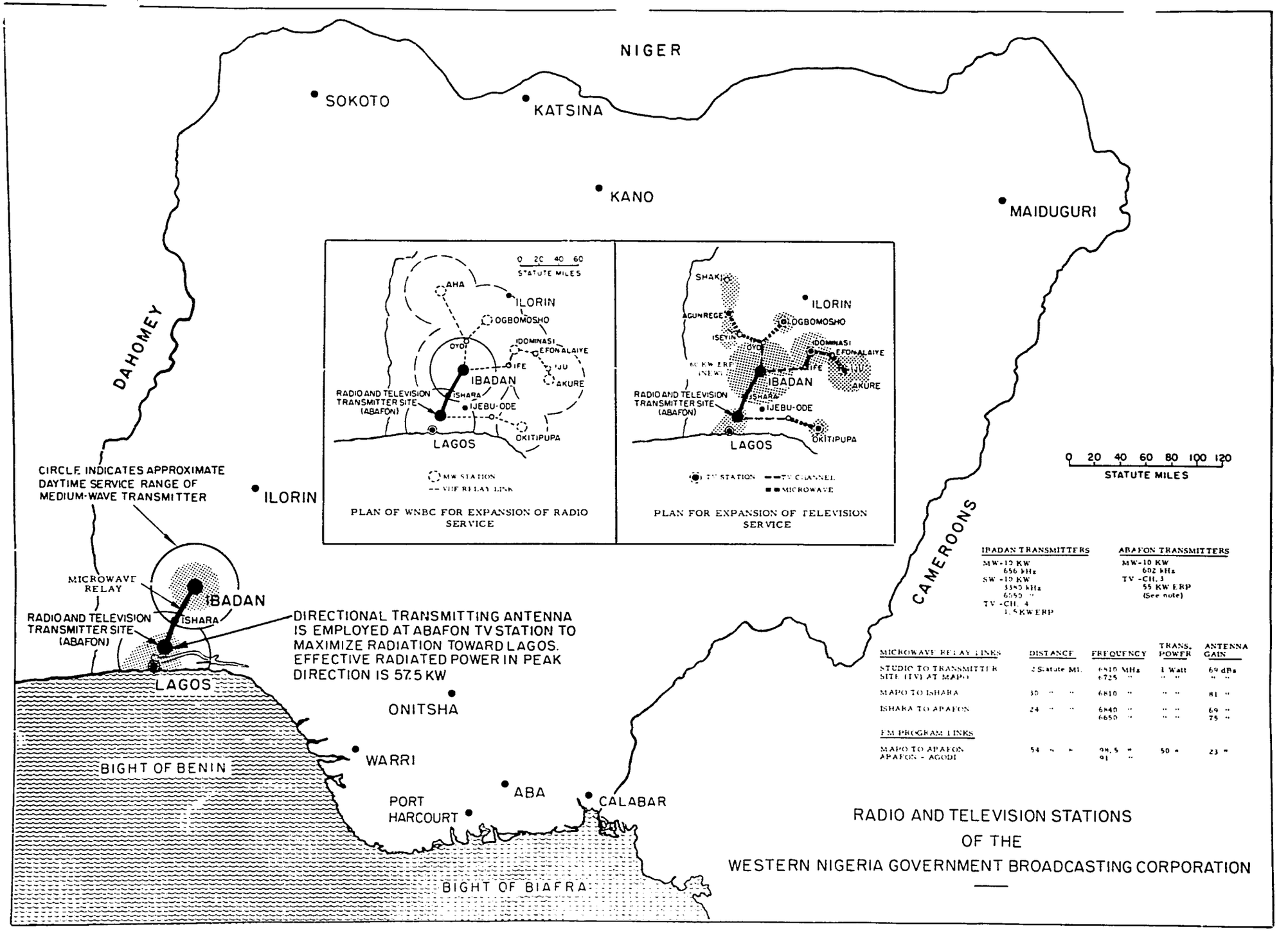

NIGER
SOKOTO
KATSINA
KANO
MAIDUGURI
DAHOMEY
CAMEROONS
ILORIN
IBADAN
LAGOS
ONITSHA
WARRI
ABA
PORT HARCOURT
CALABAR
BIGHT OF BENIN
BIGHT OF BIAFRA
CIRCLE INDICATES APPROXIMATE DAYTIME SERVICE RANGE OF MEDIUM-WAVE TRANSMITTER
MICROWAVE RELAY
RADIO AND TELEVISION TRANSMITTER SITE (ABAFON)
ISHARA
DIRECTIONAL TRANSMITTING ANTENNA IS EMPLOYED AT ABAFON TV STATION TO MAXIMIZE RADIATION TOWARD LAGOS. EFFECTIVE RADIATED POWER IN PEAK DIRECTION IS 57.5 KW
0 20 40 60 STATUTE MILES
AHA
OGBOMOSHO
OYO
IDOMINASI
EFON-ALAIYE
IFE
IJU
AKURE
IJEBU-ODE
OKITIPUPA
MW STATION
VHF RELAY LINK
PLAN OF WNBC FOR EXPANSION OF RADIO SERVICE
SHAKI
AGUNREGE
ISEYIN
TV STATION
TV CHANNEL
MICROWAVE
PLAN FOR EXPANSION OF TELEVISION SERVICE
0 20 40 60 80 100 120
STATUTE MILES
IBADAN TRANSMITTERS
MW-10 KW
656 kHz
SW-10 KW
3345 kHz
6050 "
TV-CH. 4
1.5 KW ERP
ABAFON TRANSMITTERS
MW-10 KW
602 kHz
TV-CH. 3
55 KW ERP
(See note)
MICROWAVE RELAY LINKS
DISTANCE
FREQUENCY
TRANS. POWER
ANTENNA GAIN
STUDIO TO TRANSMITTER SITE (TV) AT MAPO
2 Statute Mi.
6810 MHz
6725 "
1 Watt
69 dBa
MAPO TO ISHARA
30 " "
6810 "
81 "
ISHARA TO APAFON
24 " "
6840 "
6650 "
69 "
75 "
FM PROGRAM LINKS
MAPO TO APAFON
APAFON - AGODI
54 " "
90.5 "
91 "
50 "
23 "
RADIO AND TELEVISION STATIONS OF THE WESTERN NIGERIA GOVERNMENT BROADCASTING CORPORATION

FIGURE 2

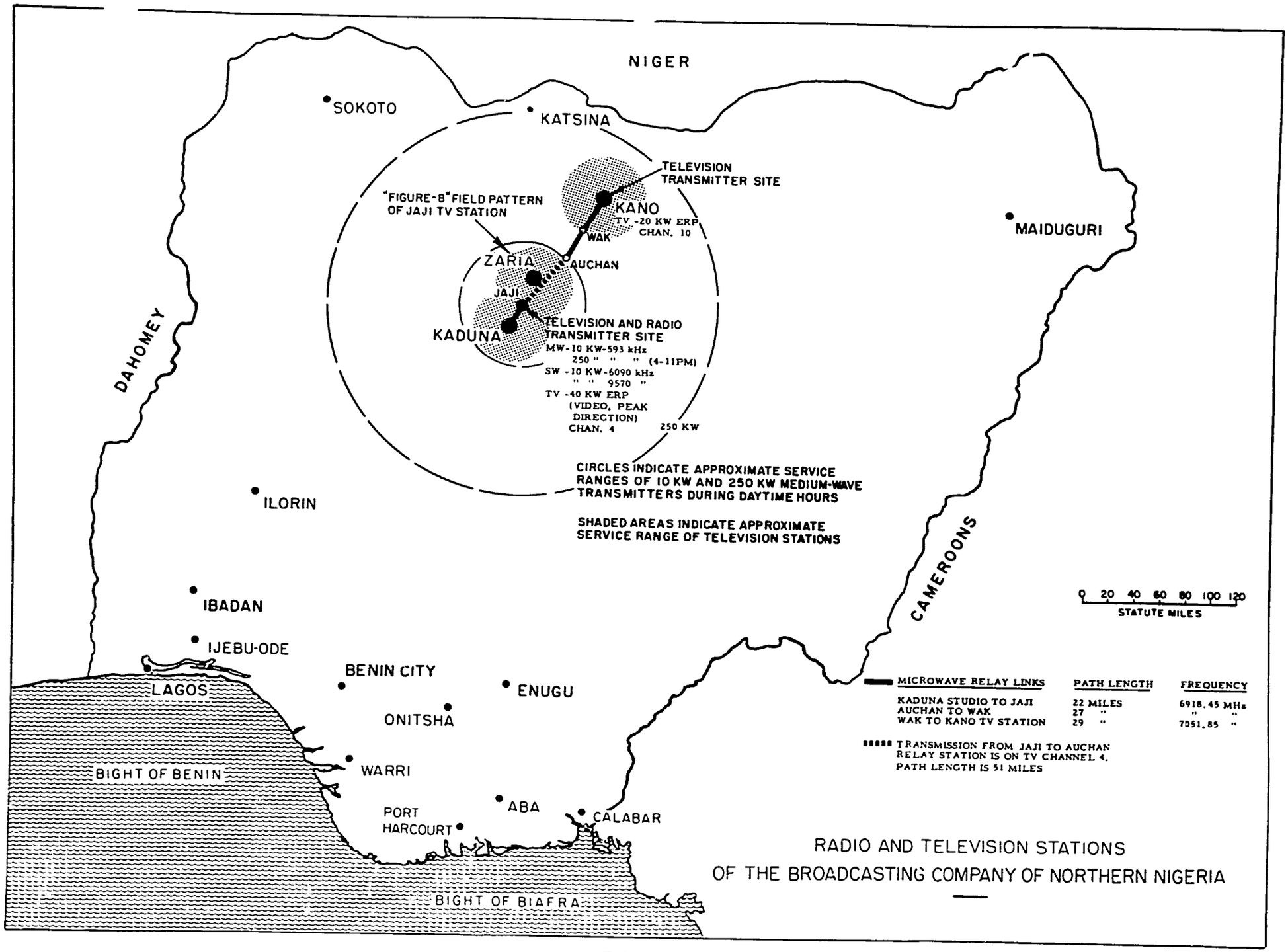

NIGER
SOKOTO
KATSINA
MAIDUGURI
"FIGURE-8" FIELD PATTERN OF JAJI TV STATION
TELEVISION TRANSMITTER SITE
KANO
TV -20 KW ERP
CHAN. 10
WAK
ZARIA
AUCHAN
JAJI
KADUNA
TELEVISION AND RADIO TRANSMITTER SITE
MW-10 KW-593 kHz
250 " " " (4-11PM)
SW -10 KW-6090 kHz
" " 9570 "
TV -40 KW ERP
(VIDEO, PEAK DIRECTION)
CHAN. 4
250 KW
DAHOMEY
ILORIN
CIRCLES INDICATE APPROXIMATE SERVICE RANGES OF 10 KW AND 250 KW MEDIUM-WAVE TRANSMITTERS DURING DAYTIME HOURS
SHADED AREAS INDICATE APPROXIMATE SERVICE RANGE OF TELEVISION STATIONS
CAMEROONS
IBADAN
IJEBU-ODE
LAGOS
BENIN CITY
ENUGU
ONITSHA
WARRI
BIGHT OF BENIN
PORT HARCOURT
ABA
CALABAR
BIGHT OF BIAFRA
0 20 40 60 80 100 120
STATUTE MILES
MICROWAVE RELAY LINKS
PATH LENGTH
FREQUENCY
KADUNA STUDIO TO JAJI 22 MILES 6918.45 MHz
AUCHAN TO WAK 27 " " "
WAK TO KANO TV STATION 29 " 7051.85 "
TRANSMISSION FROM JAJI TO AUCHAN RELAY STATION IS ON TV CHANNEL 4. PATH LENGTH IS 51 MILES
RADIO AND TELEVISION STATIONS
OF THE BROADCASTING COMPANY OF NORTHERN NIGERIA

FIGURE 3

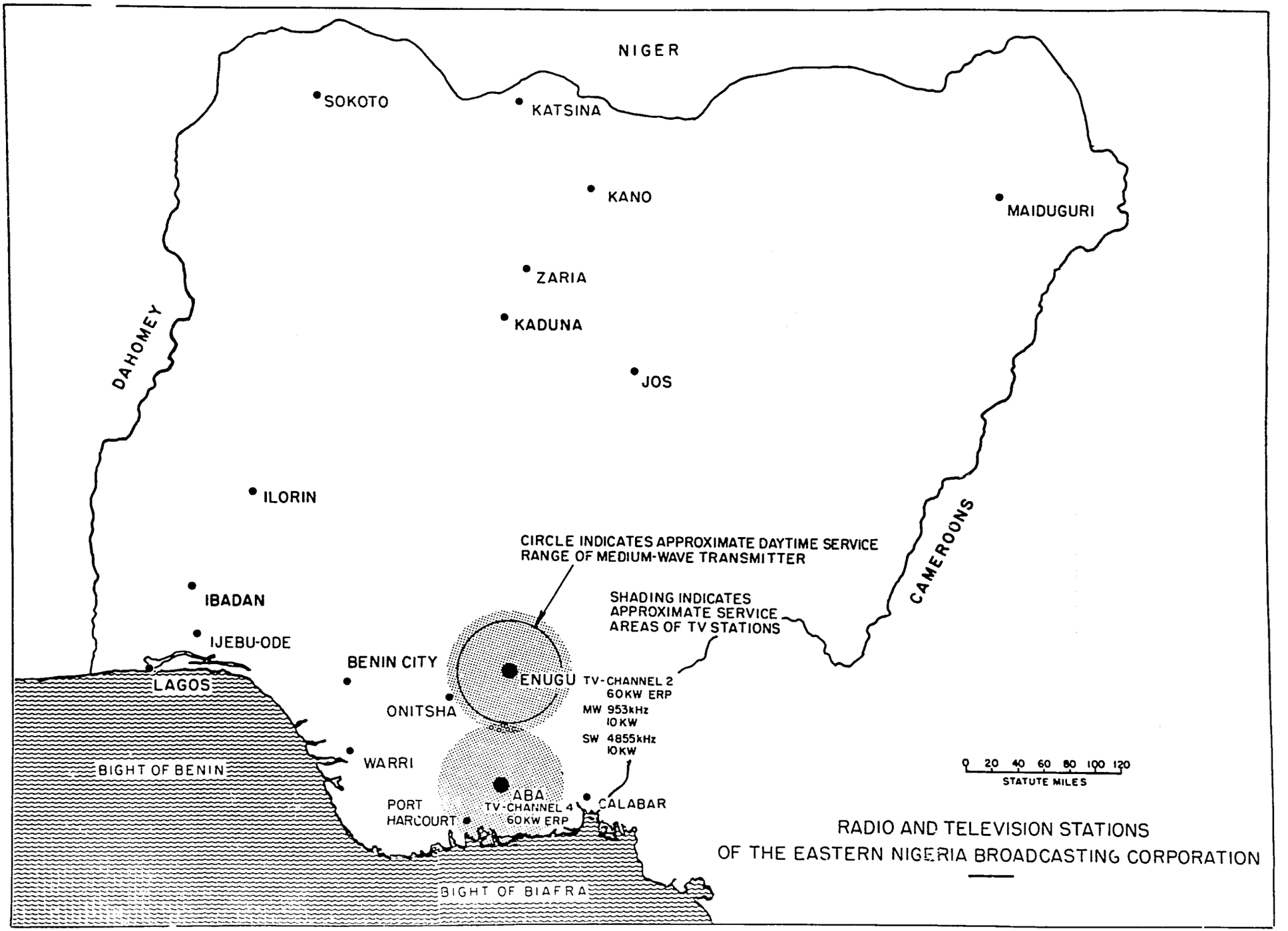

NIGER
SOKOTO
KATSINA
KANO
MAIDUGURI
ZARIA
KADUNA
JOS
DAHOMEY
ILORIN
CAMEROONS
CIRCLE INDICATES APPROXIMATE DAYTIME SERVICE RANGE OF MEDIUM-WAVE TRANSMITTER
SHADING INDICATES APPROXIMATE SERVICE AREAS OF TV STATIONS
IBADAN
IJEBU-ODE
BENIN CITY
LAGOS
ENUGU
TV-CHANNEL 2
60KW ERP
MW 953kHz
10KW
SW 4855kHz
10KW
ONITSHA
WARRI
BIGHT OF BENIN
ABA
TV-CHANNEL 4
60KW ERP
PORT HARCOURT
CALABAR
0 20 40 60 80 100 120
STATUTE MILES
BIGHT OF BIAFRA
RADIO AND TELEVISION STATIONS
OF THE EASTERN NIGERIA BROADCASTING CORPORATION

FIGURE 4

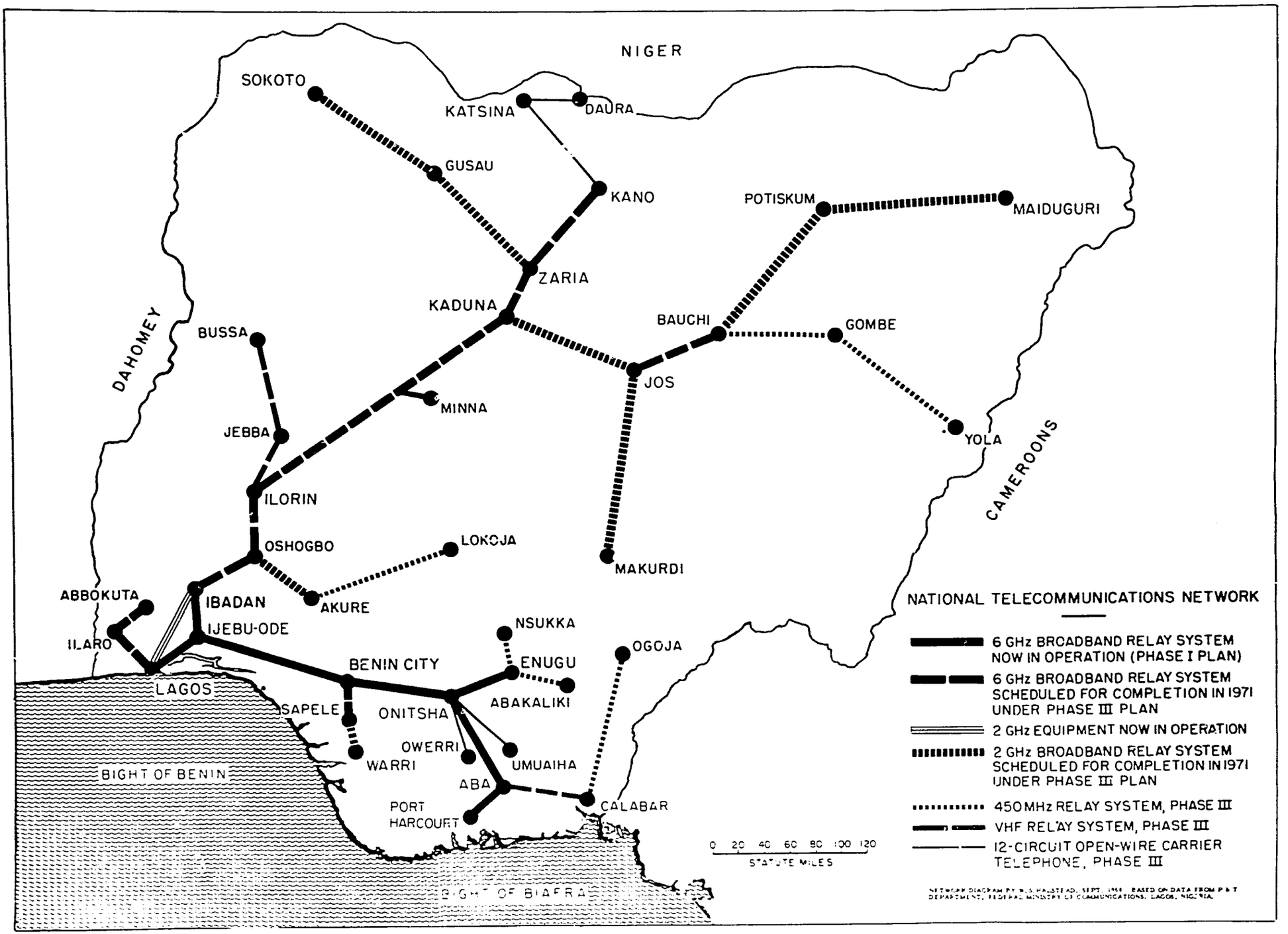

NIGER
SOKOTO
KATSINA
DAURA
GUSAU
KANO
POTISKUM
MAIDUGURI
ZARIA
KADUNA
BAUCHI
GOMBE
DAHOMEY
BUSSA
JOS
MINNA
JEBBA
YOLA
CAMEROONS
ILORIN
OSHOGBO
LOKOJA
MAKURDI
ABBOKUTA
IBADAN
AKURE
IJEBU-ODE
NSUKKA
ILARO
OGOJA
BENIN CITY
ENUGU
LAGOS
ABAKALIKI
SAPELE
ONITSHA
OWERRI
WARRI
UMUAIHA
BIGHT OF BENIN
ABA
PORT HARCOURT
CALABAR
BIGHT OF BIAFRA
0 20 40 60 80 100 120
STATUTE MILES
NATIONAL TELECOMMUNICATIONS NETWORK
6 GHz BROADBAND RELAY SYSTEM NOW IN OPERATION (PHASE I PLAN)
6 GHz BROADBAND RELAY SYSTEM SCHEDULED FOR COMPLETION IN 1971 UNDER PHASE III PLAN
2 GHz EQUIPMENT NOW IN OPERATION
2 GHz BROADBAND RELAY SYSTEM SCHEDULED FOR COMPLETION IN 1971 UNDER PHASE III PLAN
450 MHz RELAY SYSTEM, PHASE III
VHF RELAY SYSTEM, PHASE III
12-CIRCUIT OPEN-WIRE CARRIER TELEPHONE, PHASE III

FIGURE 5

APPENDIX

SECTION II

COPY

SOME ENGINEERING CONSIDERATIONS RELATIVE TO THE FUTURE DEVELOPMENT OF EDUCATIONAL BROADCASTS ON A NATIONAL BASIS

Prepared by

William S. Halstead
Engineering Consultant, RTV International, Inc.,
New York City
for the
Schools Broadcasting Unit,
Federal Ministry of Education, Lagos

During the period 10-30 July, 1968, Consultant has discussed with educators, officials of the Schools Broadcasting Units and broadcasting corporations, as well as engineering administrators of Posts and Telecommunications, the matter of future development of educational radio and television on an integrated national basis.

The cities within which these discussions took place were Lagos, Ibadan, Kaduna, Zaria and Kano where educational radio and television service now is provided through use of the facilities of the broadcasting organizations during school hours.

There appeared to be general agreement, among all officials of the Schools Broadcasting Units as well as educators with whom discussions were held, that a national educational radio and television service, supplementing that of regional type, would be desirable and would contribute to educational development in Nigeria and national unity.*

*As emphasized in a brief presented to the Joint Consultative Committee on Education at a meeting on 20 June, 1968, at the Federal Ministry of Education, Lagos. The many advantages of a nationally-coordinated educational broadcasting system were outlined in the brief.

The Consultant has prepared these notes for the purpose of reviewing certain engineering factors that are involved in the future establishment of an integrated national service through which both educational radio and television programs could effectively reach schools in all sections of the country.

In order that such a service can exist, permitting, in the case of television, all students to see the same program from a national center (as well as programs from a local or regional source) the basic requirement is for a suitable microwave relay network to interconnect local or regional television broadcasting facilities, such as the five television stations that now exist in Nigeria and others that may be added in the future.

A relay system of this type can also carry educational radio programs from a national center to all radio stations in various parts of Nigeria, thereby providing means for effecting a very substantial improvement in the sound clarity of national educational programs as received in schools. In this connection, it has been observed by the Consultant in receiving shortwave broadcasts from Lagos in Kano and Kaduna that the program quality is impaired seriously because of noise and the fading characteristics that are common in the shortwave bands. Such conditions, in the opinion of Consultant, reduce the effectiveness of radio for educational purposes where maximum intelligibility of voice and a quiet background in the received program signal are important factors in holding the attention of students.

Several microwave relay networks now are operating successfully in Nigeria. The Broadcasting Company of Northern Nigeria, Ltd., has construc-

ted and is utilizing a microwave relay system to interconnect its television broadcasting stations in Kaduna and Kano; the Western Nigeria Government Broadcasting Corporation is using a microwave relay system to link its television stations in Ibadan and Abafon, near Lagos. Posts and Telecommunications has constructed a microwave system between Lagos and Ibadan, as well as one extending between Lagos, Benin City, Onitsha, Enugu and Port Harcourt. P & T also has signed contracts for a national microwave system which will extend from the existing terminus at Ibadan through Kaduna to Kano, with branches to Sokoto, Jos, Bauchi, Maiduguri, Makurdi and other principal cities.

Although the P &T microwave system could provide a logical means through which existing or future radio and television stations could be interconnected by the addition of suitable equipment at each relay station, at present there is no provision for utilizing this modern and very costly (£20M) system to relay television broadcast signals. To date, so far as Consultant is aware, no arrangement has been made to employ the system for the relay of radio broadcast signals, although the system will have this capability.

In discussing this matter with engineering officials of P & T, the Consultant has been informed that proposals have been made to the broadcasting organizations in an effort to determine whether or not they wish to utilize the P & T system to provide network interconnections for relay of television or radio programs, but the broadcast organizations have declined to enter into any contracts that would permit use of the P & T network for broadcast relay purposes.

The Consultant has been informed by officials of the broadcast services that they could not accept the P & T proposals because of (1) the rate schedules, which the broadcasting groups consider to be excessively high, and (2) lack of faith in the ability of P & T to provide the degree of reliability and signal quality that the broadcast operation requires. For these reasons, Nigerian Broadcasting Corporation, for example, would prefer to establish its own microwave relay system at some future date. This obviously would be an extremely costly operation and would require a substantial increase in engineering manpower. Also, such a development would, in effect, duplicate much of the P & T's microwave relay system.

In discussing this situation with officials of P & T, the broadcasting organizations and the educational groups, it appeared to the Consultant that the conflicting interests of P & T and the broadcasting companies should, in some manner, be resolved in order that the national network of P & T could be used on some mutually acceptable basis for relay of educational television and radio programs or others of national importance.

If some acceptable arrangement can be made before the national P & T network is constructed, now scheduled for completion in about three years, it is the Consultant's opinion that additional equipment for television and radio broadcast use could be installed at the P & T relay stations at reasonable cost. Otherwise, after completion of the system and installation engineers have left the country, cost of such additions would be substantially higher.

The Consultant has observed, by inspection of relay stations of WNBC

and BCNN that a high degree of reliability and satisfactory picture quality can be obtained on the intercity relay facilities of these organizations under the conditions that exist in Nigeria. Consultant also has inspected microwave relay facilities of P & T and can see no reason why, with the advanced types of equipment employed in the Lagos-Ibadan links and to be used in the national network, equally high standards of operations cannot be attained.

Another factor to which consideration has been given by the Consultant is the matter of the international communications satellite project, scheduled for completion within several years, and its relationship to Nigerian broadcasting operations. The Commissioner of Communications has stated, as reported in Nigerian newspapers, that when the earth station (to be located about 40 miles west of Ibadan) is completed and the system is operative, television programs from overseas can be seen by viewers in all parts of the country. However, it is evident that unless there is a national relay network to interconnect the satellite system with existing or future television stations, such a possibility will not exist -- at least at the present state of technology.

In view of the factors as outlined above, it appears to Consultant that if a national television and radio broadcasting service, for educational or other purposes, is desired, there should be assembled a high-level committee or council for establishing basic policy that would resolve the conflicting interests and efforts of the broadcasting organizations versus P & T in order that both television and radio can be utilized most effectively as a mass communication medium at minimum cost.

While Consultant is not in a position to make specific engineering recommendations at this time without considerably more study, it does appear that a wise policy would be to establish a single, high efficiency relay network that would meet all broadcasting requirements, in addition to all public or governmental needs.

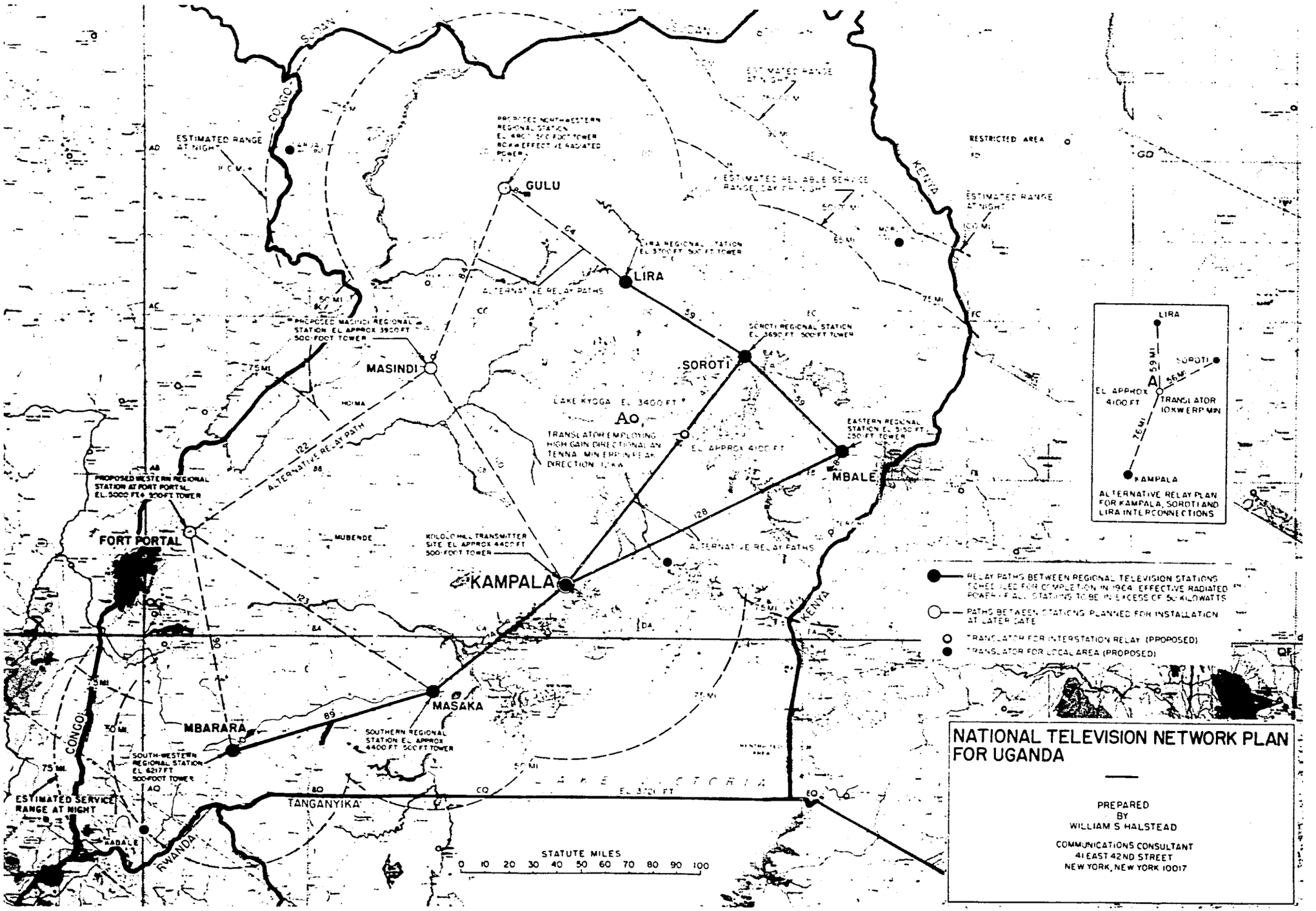
Otherwise, it appears to the Consultant that, from an engineering viewpoint, the possibility of realization of a national, well-integrated, educational television and radio service may be many years in the future.

Lagos - 31 July 1968

#

APPENDIX

SECTION III



NATIONAL TELEVISION NETWORK PLAN FOR UGANDA

PREPARED
BY
WILLIAM S HALSTEAD

COMMUNICATIONS CONSULTANT
41 EAST 42ND STREET
NEW YORK, NEW YORK 10017

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
JUNE 1964 Vol. IV, Issue No.10

THE

multiplier

IN INTERNATIONAL DEVELOPMENT

Tenth Anniversary Issue

TENTH ANNIVERSARY ISSUE
June 1964
Vol. IV, Issue No. 10

The Multiplier

PUBLISHED BI-MONTHLY BY
COMMUNICATIONS TECHNIQUES BRANCH OF
COMMUNICATIONS RESOURCES DIVISION

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FEATURES

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COVER. A Ministry of Education Instructor of the Government of Sudan utilizing a silkscreen poster produced by the Publications Bureau, Instructional Materials Center in a village adult education class. Three of the Publications Bureau staff members were A.I.D.-sponsored participants at the University of Indiana. The Instructional Materials Center has two American technicians on its staff. It represents one aspect of U.S. A.I.D.'s program support to the Republic of Sudan's improvement and expansion program in general and technical education, and teacher training. Photograph by Ministry of Information, Sudan.

LOW-COST NATIONAL TELEVISION Comes To East Africa*

This article was written by a noted U.S. private consultant working with the Ministry of Information, Broadcasting and Tourism in Kampala, Uganda. It is not an A.I.D. project and no A.I.D. money is involved. Technicians will find Mr. Halstead's story of great interest and value, however, since it illustrates one way to effective and inexpensive television installations for educational purposes.

By **WILLIAM S. HALSTEAD**
Planning Consultant, Uganda Television Service

In opening the Uganda Television Service at Kampala in October, 1963, Prime Minister Milton Obote stressed the importance of the new mass-communications medium as a channel of information and education in reaching 'the common man.' Observing that while he expected the initial audience would largely be those who could afford receivers, Dr. Obote declared that it was the firm intention of his Government to make television available to all by use of community receivers to be installed in village centers, schools and other public places. Noting that television could make a valuable contribution to all forms of education in Uganda, Dr. Obote added: "But it is the people in the villages who should be shown what they are expected to do and what they can do."

These words, spoken by the leader of a newly-independent nation in the heart of tropical Africa, were transmitted over a wide area extending for more than 100 miles in all directions from a television station on a mountaintop at Kampala, high above Lake Victoria. Cameras and studio controls were manned by Ugandans who, until several weeks before, had never seen a television picture. All of this would have seemed utterly fantastic a

*Reprinted from the MULTIPLIER by permission of the Agency for International Development

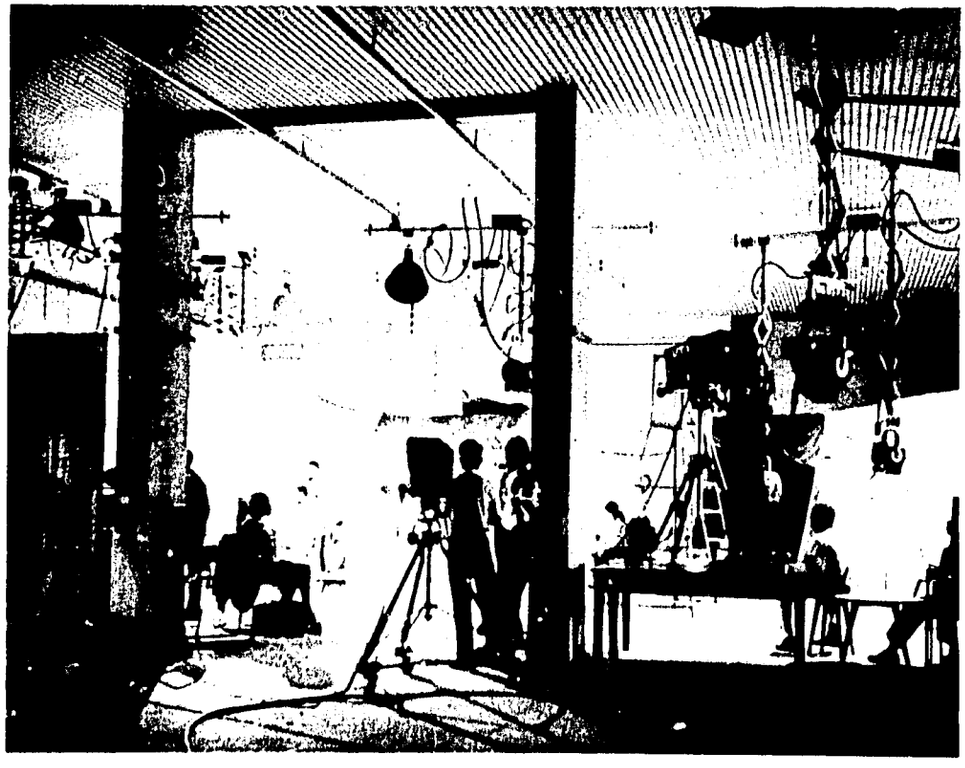
few short years ago. Today, the rapid development of the Uganda Television Service (UTV) exemplifies the spirit and determination of that country in attacking basic social problems such as those presented in rural areas that heretofore have been isolated, to a large extent, from the outside world into which the emerging nations of Africa suddenly have been plunged.

Dr. Obote's remarks also reflect the fundamental planning concept from which the Uganda television system has stemmed—namely, that to utilize the power of television most effectively in reaching people in outlying rural sections as well as in urban communities of a small country that can afford only modest expenditures, a unified national network based on the most economical method of attaining broadcast coverage of large areas, and utilizing a minimum of technical personnel, is a prerequisite.

The television network plan on which the Uganda project is based was presented during the latter part of 1962 to the Minister of Information, Broadcasting and Tourism, Mr. Adoko Nekyon, by two cooperating U.S. firms. The plan, from the outset, was premised on the underlying idea of 'maximum coverage at minimum cost.' The key factors involved in attaining this objective are summarized as follows:

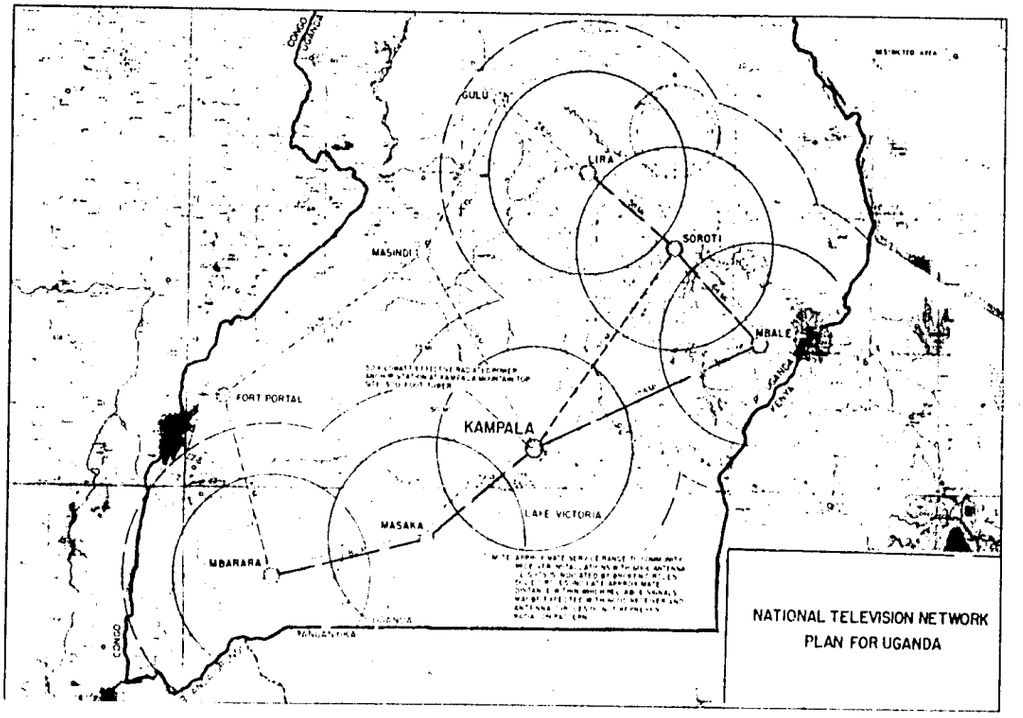
1) The network must provide reliable reception of programs in isolated rural areas as well as in the larger

UTV'S STUDIO AT KAMPALA - APPROXIMATELY 50 BY 70 FEET.



towns and cities by utilizing strategically-located mountaintop transmitting sites, wherever available and accessible, to extend transmission range. This permits a substantial reduction in the number of stations and technical operating personnel, and enables direct station-to-station relay in either direction over the network system without involving the installation and maintenance costs of intermediate microwave links. This planning concept also, by its inherent nature, provides a degree of overlapping of service areas of adjacent stations, as indicated on the accompanying map pictured herein, thereby enabling choice of the best signal from two or more stations at intermediate receiving locations in valleys where localized 'shadow' effects may be produced by nearby hills or other obstructions in the transmission path from any single station.

UGANDA TV NETWORK. MBALE, SOROTI AND LIRA STATIONS TO BE CONSTRUCTED THIS SPRING; MASAKA AND MBARARA LATER THIS YEAR. DASH LINES INDICATE DIRECT AIR-RELAY PATHS BETWEEN STATIONS.



2) Selection of equipment should be based on cost and functional capability, avoidance of all unessential items, and by taking advantage of new technological developments in the television field. At the same time, the equipment must meet the operational requirements inherent in providing a reliable, high-quality television service.

3) Use of multiplex transmission techniques between network stations to meet the varying language requirements of different sections of Uganda. These methods permit simultaneous transmission of two or three languages without interference over the same television channel and eliminate the need for supplemental radio or telephone circuits between stations.

When not used for multi-lingual relay, the multiplex 'subchannels' could be used for cueing purposes or for two-way intercommunication between the Kampala control center and outlying stations to coordinate network operations.

The first step in implementing plans for the Uganda television project after governmental authorization in the early part of 1963 was the establishment of the Kampala transmitting station on Kololo Hill, at an elevation of about 4,400 feet above sea level, where a 500-foot guyed tower and small transmitter building of purely functional design were erected. Effective radiated power of the picture signal is approximately 50,000 watts. To minimize costs and time required to provide a national programming center, the maternity ward of an abandoned hospital on Nakasero Hill was converted into a large studio within a

PICTURE MONITOR AND CONTROL CONSOLES. THE STUDIO SEEN THROUGH THE OBSERVATION WINDOW.

period of a few weeks. A microwave system then was installed to link the program center and transmitter site, separated by about 1-1/2 miles. Both picture and sound signals are carried by this apparatus.

All equipment with the exception of the main transmitter, of British make, was manufactured in the United States. With the help of air transportation to supplement ocean shipment of tower sections and other heavy items, it was possible to place the station in regular operation on schedule, less than five months from time of arrival of the first shipments in Uganda. The cost of all basic transmitting, studio and test equipment required for operation of the station was approximately 53,000 English pounds

FLASH PHOTO OF SMALL GROUP AT MBALE WATCHING TEST RECEIVER IN FIELD TRUCK.

(about $150,000), excluding overseas shipping charges–well within the Government's budget limitation of 60,000 pounds. The transmitter, antenna and tower made up a sizeable part of the cost.

By concentrating on functional aspects of television studio operation and by eliminating all non-essentials, construction and installation costs were held within a fraction of those involved in the relatively elaborate structures and other facilities associated with television centers in other parts of Africa. For example, cameras and other studio equipments are of inexpensive and simple type. They are easily operable by non-technical African personnel and installed and maintained by a small staff of three experienced engineers. Newly-developed vidicon studio cameras, costing only a fraction of the price of the more elaborate and complicated image-orthicon type, are employed–yet the picture as received by television viewers is comparable to that provided by major stations of Europe or North America.

Within a few days from inauguration of service by UTV, hundreds of Ugandans in villages and towns within range of the Kampala station were watching receivers installed in store windows and in public gathering places. As in the early phase of television in the United States and other countries, receivers were installed by the proprietors of small establishments eager to attract customers. Although many of the 'live' and news programs are presented in the Luganda language, spoken throughout the service area of the Kampala station, villagers watch with equal interest jet-transported news reels and entertainment films from the other parts of the world. A number of the programs are sponsored by commercial firms, such as soft drink companies, airlines, and a variety of international and local concerns.

During the current introductory period in which emphasis is placed on development of a large audience and increase in number of sets in use so as to pave the way for educational programs, UTV's programs for the most part are in the general entertainment or information category. Preliminary plans are now under consideration to initiate an educational service in conjunction with the school syllabus during the spring of 1964. It is anticipated that these programs at the outset will be of 'enrichment' type, supplementing school activities.

Because of the enthusiastic acceptance of television by Ugandans and the popularity of group-viewing methods among those who cannot afford to purchase their own receivers, the Uganda Government has begun the installation of community receivers in

outlying villages. This activity will be expanded when five outlying network stations in different sections of the country are completed, as scheduled for the spring and summer of 1964.

Sites for these 'up-country' stations already have been selected and immediate construction of some has been authorized. From a mountain location at Mbale, near the Kenya border, the broad plateau area of eastern Uganda will be served by the late spring of 1964; stations also will be installed in the towns of Soroti and Lira within the same period. By late summer of 1964, stations to serve the mountainous southwestern region will be established at the main towns of Masaka and Mbarara. Both of these stations will be erected at dominant elevated points in the area. All outlying stations will include, within a small, one-story building of functional design, transmitter and control equipment to permit relay of programs from the national center at Kampala. Or, by means of a small studio in each transmitter building, programs may be originated to meet local vernacular requirements. The picture transmission facilities of each station will provide an effective radiated power of the order of 50,000 watts, with 500-foot guyed masts being employed in all but one location. Programs from outlying stations may, if desired, be relayed throughout the network, thus acquainting Ugandans with all parts of their country, and assisting in the unification and strengthening of the nation.

The writer, in making field surveys in different sections of Uganda in connection with the selection of network transmitter sites, has experienced the emotional response of Ugandans in small villages far from Kampala when, for the first time, they see television from UTV's initial mountaintop transmitter. Here, the enormous potential of the new picture-and-sound communication channel in opening a new world to these people becomes apparent. One is strongly reminded of an ancient and prophetic saying . . . "Lift up thine eyes unto the hills whence cometh thy strength." □

TRUCK USED IN FIELD SURVEY WORK AT MBALE, NEAR THE KENYA BORDER. DIRECTIONAL ANTENNA CAN BE RAISED TO 30 FEET ABOVE THE GROUND, USING PORTABLE MAST SECTIONS. GOOD PICTURES WERE RECEIVED AT THIS LOCATION - ABOUT 126 MILES FROM THE KAMPALA STATION.

APPENDIX

SECTION IV

APPENDIX

SECTION IV

Estimates of cost of microwave relay equipment for use in transmitting television program signals from studio at Advanced Teachers Training College to BCNN Television Station at Kano

Explanatory Note:

Estimates of cost of microwave relay equipment are based on data obtained by the Consultant from the Raytheon Company, Norwood, Mass., and the General Electric Company, Ltd., Telecommunications Division, Coventry, England.

In each case, the estimates include (1) facilities for transmitting picture and associated sound signals from the studio at the AdvancedTeachers Training College to the BCNN Television Station at Kano, and (2) a two-way radiotelephone link to provide reliable voice communication between operating personnel at the studio and television transmitter sites.

Rough estimates of overseas shipping costs, supervisory engineering and local installation costs also are included.

A. Estimate based on current data from Raytheon Company

Item 1

Microwave transmit and receive terminal equipment for studio and television transmitter sites, including multiplex sound channel; antennas; waveguides and power supplies for operation on 240 volts, 50 Hz, FOB manufacturer's plant	$ 18,055

Item 2

Spare modules and consumable spares based on 20% of equipment cost	$ 3,610

Item 3

Two-way radiotelephone equipment for use at studio and transmitter sites -- estimate based on information from International Division, Motorola, Inc., Chicago, Ill., as follows:

Two 10-watt transmitter-receiver equipments, desk console type, with microphone and loudspeakers, for operation in 140-150 MHz band; also including step-down transformers (240 volts to 120 volts, 50 cycles), directional antennas and coaxial cable for each site, @ $1,000	$ 2,000

Total above equipment, FOB manufacturer's plant	$ 23,665
Estimated overseas shipping (by air), plus insurance, based on 10% of equipment cost	$ 2,365

TOTAL, DELIVERED EQUIPMENT COST ..... $ 26,030

Equipment costs, carried forward			$ 26,030
Estimated supervisory engineering fee during installation, as per Raytheon charge, 2 weeks @ $1,200 (includes living expenses)	$ 2,400		
Estimated travel costs, supervisory engineer	$ 1,300		
Total estimated supervisory engineering cost		$ 3,700	
Estimated local costs (engineering, riggers, construction labor and materials)		$ 5,000	
Total estimated supervisory and local engineering, labor and materials			$ 8,700
TOTAL, EQUIPMENT AND INSTALLATION			$ 34,730

(If standby microwave equipment is desired, total cost, including shipping, will be increased by about $ 15,000. Standby equipment is recommended by the Consultant.)

* * * * * * *

BUDGETARY ESTIMATE, without standby equipment ----------	$ 38,000
(Round figure, total of estimated costs as listed above, plus 10% contingency)	(LN 13,600)
BUDGETARY ESTIMATE, with standby equipment ----------	$ 55,000
	(LN 19,600)

B. Estimate based on current data from the General Electric Company, Ltd., Coventry, England.

Item 1

a) Microwave relay (transmit) equipment for studio site at College, including multiplex sound channel, antenna, waveguide and miscellaneous items

FOB plant in England £ 3,231 — $ 7,754

b) Microwave relay (receive) equipment for Kano TV transmitter site

FOB plant in England £ 3,921 — $ 9,410

Total, Item 1 — $ 17,164

Item 2

Spares based on 20% of equipment cost — $ 3,433

$ 20,597

Item 3

Two-way radiotelephone equipment -- estimate based on data from Motorola; 2 units @ $1,000; FOB Chicago — $ 2,000

Equipment Total ---------- $ 22,597

Estimated shipping and insurance costs (based on 5% of equipment cost) — $ 2,260

Total Equipment Costs plus Shipping and Insurance ---------- $ 24,857

Estimated costs of supervisory engineer from factory @ $900/week for 2 weeks — $ 1,800

Estimated travel costs — $ 900

Estimated local costs (engineering; riggers; construction labor and materials) — $ 5,000

$ 7,700

TOTAL this page ---------- $ 32,557

BUDGETARY ESTIMATE, without standby equipment ---------- $ 36,000

(Round figure, total of estimated costs as listed above, plus 10% contingency) (£N 12,900)

BUDGETARY ESTIMATE, with standby equipment ---------- $ 52,000

(£N 18,600)

APPENDIX

SECTION V

APPENDIX

SECTION V

Estimates of costs to adapt BCNN relay system for southbound transmission of television program signals from BCNN station at Kano to BCNN studios at Kaduna

Explanatory Note:

Estimates of cost of microwave relay equipment are based on data obtained by the Consultant from the Raytheon Company, Norwood, Mass., and the General Electric Co., Ltd., Coventry, England. Estimate of cost of tower materials required at a new repeater station (between Auchan and Jaji) is based on data from Rohn Manufacturing Co., Peoria, Ill.

Estimates include cost of additional microwave transmitting and receiving equipment for southbound relay of picture and associated sound signals that would be required at the following points: (1) transmit terminal at Kano TV station site; (2) Wak repeater station; (3) Auchan repeater station; (4) new repeater station between Auchan and Jaji transmitter site; (5) Jaji transmitter site and (6) receive terminal at Kaduna studio building.

A. Estimates based on data from Raytheon Company

Item 1

Additional microwave relay equipment required for southbound transmission of television program signals from BCNN station, Kano, to a receive terminal at BCNN studios, Kaduna. This includes two terminal equipments and four repeaters		
FOB manufacturer's plant	$ 73,675	

Item 2

Spares based on 10% of microwave equipment cost	$ 7,367	
Equipment total		$ 81,042

Item 3

Materials for 265-foot self-supporting tower (with lighting) at new repeater station required at site between Auchan relay station and Jaji transmitter site.		
FOB Peoria, Ill. (Rohn Mfg. Co.)	$ 12,444	
Equipment and Tower Materials Total		$ 93,486
Estimated all shipping costs, microwave equipment (10% of equipment cost), in round figures	$ 8,100	
Estimated shipping cost of tower materials, in round figures	$ 1,200	
		$ 9,300
Total, equipment and tower materials, including shipping costs ... carried forward ----------		$102,736

Total Equipment and Tower Materials, including Shipping Costs ... carried forward		$ 102,786
Supervisory engineering, 2 factory engineers, 16 man weeks @ $1,200/man week*, plus $1,500 total travel cost/man	$ 19,200	
Estimated local costs (engineers and technicians; labor and materials, including tower foundations and erection of tower; cement-block building at new relay site between Auchan and Jaji; two 5 KW Diesel-electric generators (1 active, 1 standby); fuel tank and miscellaneous items.)	$ 25,000	
* Includes overseas living costs		$ 44,200
TOTAL, EQUIPMENT AND INSTALLATION ----------		$ 146,986

* * * * * * *

BUDGETARY ESTIMATE ----------	$ 176,000
	(£N 62,900)

(Round figure, total of estimated costs as listed above, plus 20% contingency)

B. Estimate based on data from the General Electric Co., Ltd. Coventry, England

Item 1

Microwave transmit terminal equipment at Kano TV station, including multiplex sound channel, waveguide coupling to permit use of existing microwave antenna system, and other required items.

£3,231, less estimated amount of £300 for antenna and feeder, not required, or £ 2,931 — $ 6,734

Item 2

Four microwave repeater equipments, one at each of the following points: (1) Wak, (2) Auchan, (3) new station between Auchan and Jaji, (4) Jaji.

4 @ £ 3,038 = £ 12,152 — $ 28,165

Item 3

Microwave receive terminal at Kaduna studio building.

£ 3,921, less estimated amount of £ 300 for antenna and feeder, not required, or £ 3,621 — $ 8,690

Item 4

Spares, based on 10% of microwave equipment cost, Items 1-3, inclusive, (totaling $43,589) — $ 4,359

Carried forward ---------- $ 47,948

Brought forward		$ 47,948
Item 5		
Two parabolic antennas (Andrew), six-foot diameter, with radomes for use at new relay station; two 6 x 8-foot passive reflectors; mounting brackets, waveguides and connectors	$ 3,000	
Item 6		
Materials for 265-foot self-supporting tower for new relay station between Auchan and Jaji (Rohn Mfg. Co.)	$ 12,444	
		$ 15,444
Total, Equipment and Tower Materials		$ 63,392
Estimated air shipping costs from U.K., microwave equipment (5% of $47,948 equipment cost, in round figures)	$ 2,400	
Estimated shipping cost of antenna and tower materials from U.S.	$ 1,500	
Total, Equipment and Tower Materials, including Shipping Costs		$ 3,900
Supervisory engineers (2 factory engineers), 16 man weeks, @ $1,000/week/man *	$ 16,000	
Estimated local costs (engineers and technicians; labor and materials, including tower foundation and erection of tower; building at new relay site; two 5 KW Diesel-electric generators; miscellaneous items)	$ 25,000	
* Includes travel and living expenses		$ 41,000
TOTAL, EQUIPMENT AND INSTALLATION		$ 108,292

* * * * * * *

BUDGETARY ESTIMATE ---------- $ 130,000
(£N 46,400)

(Round figure, total of estimated costs as listed above, plus 20% contingency)

APPENDIX

SECTION VI

APPENDIX

SECTION VI

Estimates of cost of equipment for proposed national center for educational television and radio broadcasting services

Explanatory Note:

Estimates are based on current price data (as of September 1968) from equipment suppliers in the United States.

Equipment and cost estimates as listed under functional categories are representative and are derived from data provided by overseas sales representatives of a number of manufacturers.

SECTION VI

Estimates Relating to Cost of Equipment for a Suggested National Programming Center for Educational Television and Radio Services

NOTE: As the purpose of the estimates is to provide an indication of the approximate cost of equipment for a suggested national programming center for television and radio, estimates are arranged in categories, as set forth below, to avoid listing a large number of individual items.

The Consultant has checked the totals for each category with suppliers of television and radio programming equipment. They have advised that the estimates are in line with current price quotations.

All totals as listed for each equipment category are in round figures, based on delivery at international airport, New York City.

A. Television Studio Equipment

1. Studio Cameras

Two Vidicon viewfinder-type cameras, each with high-resolution Vidicon tube; 15:150 mm zoom lens; elevator tripod with pan and tilt head, roller base; remote control unit; camera cables (30, 50 and 75 feet for each camera) and connectors; intercom headsets. Round-figure total, FOB New York — $ 14,000

2. Control and Monitor Equipment

Control and monitor consoles for two studio cameras and telecine equipment, including dual synchronizing generator for 625-line, 50-field standards with change-over switch; picture and waveform monitors; master switcher-fader and monitor; film and slide projector controls; videotape control unit; two 23" picture monitors; six distribution amplifiers; equipment rack; intercom headsets; cables and connectors. Estimate includes all interunit cabling and testing of complete system by supplier before shipment. — $ 15,000

Total this page ..... $ 29,000

Brought Forward ----------		$ 29,000
3. Telecine and Slide Projector Equipment		
Two Bell & Howell 16 mm telecine film projectors for 50 Hz operation with optical and magnetic sound heads; remote-control panel; automatic magazine-type slide projector; prism multiplexer for 2 film projectors and slide projector; telecine camera; pedestal bases; cables and connectors.	$ 11,000	
4. Video Tape Equipment		
1 Transverse-Scan Recorder, for 625-line, 50-field standards, Ampex Type 1200-A or equivalent, with picture and waveform monitors, remote control, electronic editor and all essential accessories.	$ 51,000	
1 Helical-Scan Recorder, for 625-line, 50-field standards, for rehearsals and emergency standby, Ampex Type VR-7800 or equivalent, including electronic editor. (Note: Ampex states that the VR-7800 is a new recorder, meeting broadcast standards. It will replace the VR-650 and is scheduled to be marketed in February 1969. Ampex also states that the recorder is of new design in which difficulties noted in the VR-650 have been eliminated.)	$ 13,000	
5. Audio Equipment		
Control console with minimum of 7 inputs; 4 cardioid microphones; 2 boom stands; 3 floor stands; 2 desk stands; 2 lavalier microphones; 2 audio-tape recorders; 2 turntables for disc records; cables and connectors; headphones; 2 monitor speakers and amplifiers	$ 5,000	
6. Lighting Equipment		
Lighting equipment, including switchboard, cables and all connectors, for studio with maximum dimension of 40 x 60 feet	$ 5,000	
Total this page		$ 114,000

Brought Forward ..... $ 114,000

7. Film Equipment

Film editing, filing and storage equipment including photographic equipment for producing slides and 16 mm films $ 2,000

8. Test and Measurement Equipment

a) Test films, video test tapes and slides

Standard assortment of SMPTE picture and sound (optical and magnetic) test films; video test tapes; standard set of test patterns on 2" x 2" slides and on 8" x 10" cards and slides; lightbox for 8" x 10" test slides. $ 500

b) Essential test and measurement equipment

Including wideband dual-trace (10 MHz) oscilloscope; service oscilloscope; video sweep-signal generator, bar and dot generator, noise and distortion meter, audio signal generator, vacuum-tube voltmeters, multimeters, tube and transistor tester, etc. $ 5,500

9. Air-Conditioning Equipment

a) For Studio (required to minimize temperature rise caused by studio lighting and to protect electronic equipment from dust and high humidity.) $ 3,000

b) For Control Room and Technical Workshop (required to protect electronic equipment from dust and high humidity.) $ 2,000

c) For Film Editing, Film and Tape Storage Rooms (required to protect films, tapes and equipment from dust and high humidity.) $ 2,000

Total this page ..... $ 129,000

Brought Forward.....	$ 129,000
10. Miscellaneous Studio Items	$ 1,000
Total, Above Items	$ 130,000
Spares, based on 10% of equipment cost	$ 13,000
Estimated overseas shipping cost (10% of total equipment cost, including spares), in round figures	$ 14,000
Estimated supervisory engineering cost during installation	$ 4,000
Equipment Total	$ 160,000

* * * * * * * * *

BUDGETARY ESTIMATE --
TELEVISION STUDIO EQUIPMENT

(Total of estimated costs as listed above, plus 10% contingency, in round figures) ---------- $ 176,000
(£N 63,000)

* * * *

Note: The above represents a minimal budget. It is probable that there will be a requirement for a second, or rehearsal studio, after an initial period of operation. In this event, the equipment cost is increased by $60,000 (approx. 21,500 Nigerian pounds) to permit addition of equipment in categories 1, 2, 3, 5, 6 and 9. This would provide, in category 1, for example, two additional studio cameras; similarly, equipment in the other categories would be doubled.

BUDGETARY ESTIMATE FOR TWO STUDIOS ..... $ 248,000
(£N 88,600)

(Total of estimated costs of equipment, including shipping and contingency)

B. Radio Studio Equipment

1. In-Studio Equipment

6 cardioid microphones; 4 lavalier microphones; 3 floor stands; 2 boom stands; 4 desk stands; intercom equipment; shielded cables and connectors	$ 2,000

2. Control-Room Equipment

Control console with minimum of 8 inputs; monitor amplifiers and speakers; line amplifiers; AGC amplifiers; patch panels and cords; dual-turntable equipment for 230 volts, 50 Hz operation; 4 portable tape recorders for 230 volts, 50 Hz operation, Ampex Series 602 or equivalent; 2 console-type tape recorders; Ampex Series 300 or equivalent; intercom equipment; cabinet racks	$ 10,000

3. Miscellaneous, including tapes, reels and small items	$ 1,000

4. Air-Conditioning Equipment

(Shared with TV studio)

5. Test and Measurement Equipment

(Shared with TV studio)

Total, items as listed above	$ 13,000
Spares, based on 10% of estimated equipment cost	$ 1,300
Estimated overseas shipping costs, based on 10% of equipment cost, including spares, in round figures	$ 1,400
Total equipment cost	$ 15,700

* * * * * * * *

BUDGETARY ESTIMATE, RADIO STUDIO EQUIPMENT

(Total of estimated costs as listed above, plus 10% contingency, in round figures)	$ 17,000 (£N 6,000)

C. Studio-to-Transmitter Relay Links

1. Microwave relay equipment, with standby, for transmission and reception of television program signals between suggested educational programming center and NBC studio-transmitter site on Victoria Island (Same as for budgetary estimates of cost of equipment for relay link between Advanced Teachers Training College and BCNN television station at Kano, Section IV, Pages 3 and 5)		
Estimate based on Raytheon equipment, with standby	$ 55,000	
2. VHF (FM) relay equipment, including antenna (transmitting and receiving) for sound broadcast programs (includes estimated equipment shipping costs) -- in round figures	$ 5,000	
3. Materials for 250-foot tower, self-supporting type, for use at educational programming center in connection with relay equipment employed in television and sound broadcast services (Tower material cost same as Item 3, Appendix, Section V, Page 1, including shipping cost) -- round-figure estimate	$ 14,000	
Estimated erection cost of tower	$ 10,000	
Total above items		$ 84,000

* * * * * * * * *

Total, BUDGETARY ESTIMATE, RELAY LINKS Equipment for Educational Programming Center (In round figures, plus 10% contingency) $ 92,000

(£ N 33,000)

SUMMARY OF ESTIMATED COSTS OF EQUIPMENT FOR TELEVISION AND RADIO PROGRAM SERVICES AT SUGGESTED EDUCATIONAL CENTER

	Round Figure Totals U. S. Dollars	Nigerian Pounds
A. TELEVISION STUDIO EQUIPMENT	$ 176,000	£ 63,000
B. RADIO STUDIO EQUIPMENT	17,000	6,000
C. STUDIO-TO-TRANSMITTER RELAY LINKS	92,000	33,000
TOTALS	$ 285,000	£ 102,000

SECTION VI-A

Suggested list of typical test and measurement equipment to facilitate servicing of television and radio receivers by School Broadcasting Units.

NOTE: The list incorporates types of equipment, marked by asterisk, employed successfully by a commercial firm in Uganda that services the majority of television receivers in that country.

Description	Model	Manufacturer	Approximate Cost in Round Figures
1. TV Pattern Generator* for 625-line, 50-field standards.	5G3	Grundig (West Germany)	£N 125
2. Sweep/Marker Generator (Requires 230 v. -115 v. stepdown transformer, 50 Hz)	KG-687	Knight (Allied Radio Co., Chicago, Ill., USA)	£N 70
3. TV Analyst* (Requires 230 v. -115 v. stepdown transformer, 50 Hz)	1076-ES	B & K Mfg. Co., Chicago, Ill., USA	£N 120
4. Avometer* (Multimeter)	Model 8	Avo, Ltd., London, England	£N 40
5. Vacuum Tube Voltmeter (Requires 230 v. -115 v., 50 Hz stepdown transformer)	WV-98C	RCA, Camden, N.J., USA	£N 30
6. Oscilloscope*	LBO-3A	Ohmatsu Electric Co., Tokyo, Japan	£N 60
7. R.F. Signal Generator (Requires 230 v. -115 v., 50 Hz stepdown transformer)	KG-686	Knight (Allied Radio Co., Chicago, Ill., USA)	£N 50

Equipment Total	£N 495
Estimated air-shipping charges (10% of equipment total)	50
Total. incl. shipping.....	£N 545
BUDGETARY ESTIMATE (including 10% contingency)	£N 600

APPENDIX

SECTION VII

APPENDIX

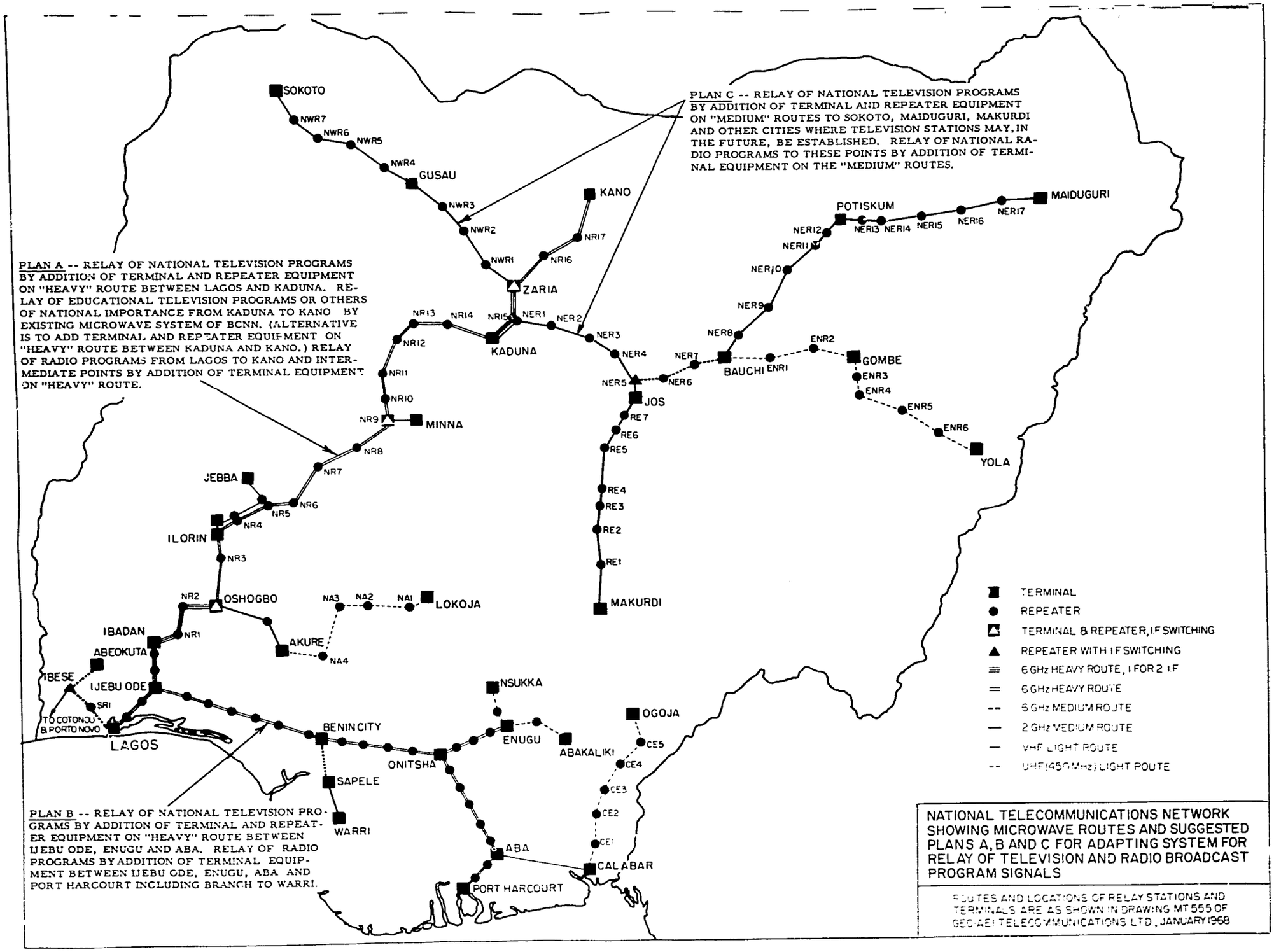
SECTION VII

Estimates of cost of microwave relay equipment required in Plans A-C, inclusive, as additions to the National Telecommunications Network of P&T to permit relay of television and radio program signals between Lagos and cities served by the system.

Explanatory Note:

Estimates are based on current price data (as of September 1968) from General Electric Company, Ltd., Coventry, England, suppliers of microwave relay equipment employed in the telecommunications network system.

Rough estimates of overseas shipping costs, supervisory engineering and local installation costs also are included.



NATIONAL TELECOMMUNICATIONS NETWORK SHOWING MICROWAVE ROUTES AND SUGGESTED PLANS A, B AND C FOR ADAPTING SYSTEM FOR RELAY OF TELEVISION AND RADIO BROADCAST PROGRAM SIGNALS

ROUTES AND LOCATIONS OF RELAY STATIONS AND TERMINALS ARE AS SHOWN IN DRAWING MT 555 OF GEC-AEI TELECOMMUNICATIONS LTD., JANUARY 1968

PLAN A — To Provide Intercity Relay Links for Television and Radio Broadcast Services by Addition of Microwave Equipment on the Route Between Lagos, Ibadan, Kaduna and Kano

1. General Description

a) Television Relay

Facilities for relay of video and associated sound signals would be provided by addition of microwave equipment, exclusively for use by the broadcast service, at a total of 24 relay stations, including terminals, on the "Heavy" route of the national telecommunications network in the area between Lagos and Kaduna, including these two cities. The routing plan for the network is shown in the attached illustration, based on drawing No. MT555, General Electric Co., Ltd., suppliers of equipment for the national network, Phases I and III.

Relay of television program signals between Kaduna and Kano would be by (1) use of the existing microwave system of BCNN or (2) by addition of microwave equipment on the P&T system between these two cities.

b) Radio-Program Relay

This function would be provided by addition of multiplex carrier equipment, each accommodating high-quality program signals in the range 50-10,000 Hz, at terminals on the "Heavy" route between Lagos and Kano.

Interconnection between the Broadcasting House of NBC and the P&T terminal in Lagos would be provided either by high-quality landline circuit or, preferably, by FM relay method, utilizing carrier frequencies in the VHF or UHF bands generally employed for such purpose.

2. Basis of Estimates

Estimates are based on quotations and descriptive material to which reference is made in the copy of letter from GEC-AEI Telecommunications, Ltd., 27 September 1968, attached in Appendix, Section VII-A. Because of the bulk of this material, the required equipment combinations and prices as listed in GEC Quotation QT-40292 have been tabulated in simplified form in the attached Appendix, Section VII-B.

Estimate Data

PLAN A

1) Addition of microwave equipment for single-path (one-way) relay of television signals on P&T "Heavy" route from Lagos to Kaduna.

a) At P&T Terminal Stations	Required Additional Equipment as per GEC Data in Appendix, Section VII-B	Quoted Cost per Station in English Pounds	
1. Lagos (Route is twin-path with standby)*	C5 (Video Transmit)	£ 4,730	
	F1 (TV Sound Transmit)	311	
			£ 5,041
2. Ijebu Ode** (Twin-path with standby)*	C6 (Video Receive)	5,242	
	C3 (Video Transmit)	3,190	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive)	492	
			9,235
3. Ibadan (Twin-path with standby)*	C6 (Video Receive)	5,242	
	C3 (Video Transmit)	3,190	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive)	492	
			9,235
4. Oshogbo** (Twin-path with standby)*	C6 (Video Receive)	5,242	
	C3 (Video Transmit)	3,190	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive)	492	
			9,235
5. Ilorin** (Twin-path)	C3 (Video Transmit)	3,190	
	C4 (Video Receive)	3,023	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive	492	
			7,016
	Total, this page		£ 39,762

*Designated on Route Map and in tabulated equipment data as "1 for 2 I.F."

**Although no television stations are located at present in these towns, terminals are provided to facilitate establishment of local stations and to extend service area in the future.

Brought Forward.....			£ 39,762
	Required Additional Equipment	Quoted Cost	
At P&T Terminal Stations			
6. Beji (NR9) ** (Twin-path)	C3 (Video Transmit)	£ 3,190	
	C4 (Video Receive)	3,023	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive)	492	
			7,016
7. Kaduna (See Footnote) (Twin-path)	C4 (Video Receive)	3,023	
	F2 (TV Sound Receive)	492	
			3,515
Total Additional Equipment at 7 P&T Terminals			£ 50,293

* * * * * * *

b) At P&T Repeater Stations

1. "Heavy" 1 for 2 I.F. route between Lagos and Oshogbo; (twin-path with standby); total of 6 repeaters required @ £ 6,121	C8 (Repeater; relays video and TV sound on 1 for 2 I.F. route) at all repeaters in this section of system.	£ 6,121	£ 36,726
2. "Heavy" twin-path 1 for 1 I.F. route between Oshogbo and Kaduna; total of 11 repeaters required @ £ 3,038	C7 (Repeater; relays video and sound on 1 for 1 I.F. route) at all repeaters in this part of system.	3,038	£ 33,418
Total Additional Equipment at 17 Repeater Stations			£ 70,144

NOTE: If TV relay is to be extended from Kaduna to Kano on the P&T "Heavy" route, the following additional equipment will be required: (a) at Kaduna P&T terminal station, items C3 and F1, totaling £ 3,500; (b) at Kano terminal station, items C4 and F2, totaling £ 3,500; (c) at four intermediate stations, repeater equipment C7 @ £ 3,038, totaling approximately £ 12,000, FOB plant. With shipping, engineering, spares and contingency, estimated total for additional equipment is approximately £ 28,000 (LN 24,700).

2) Addition of multiplex channeling equipment to P&T system to permit relay of high-quality sound-broadcast signals from Lagos to Kano (for the radio broadcasting service) *

At P&T Terminals	Required Additional Multiplex Equipment as per Data in Appendix, Section VII-B	Quoted Cost per Station in English Pounds	
1. Lagos	G1 (Sound Transmit)	£ 971	£ 971
2. Ijebu Ode	G2 (Sound Receive)	919	
	G1 (Sound Transmit)	971	
			1,890
3. Ibadan	Same as at #2		1,890
4. Oshogbo	"		1,890
5. Ilorin	"		1,890
6. Beji (NR9)	"		1,890
7. Kaduna	"		1,890
8. Zaria	"		1,890
9. Kano	"		1,890

Total additional multiplex equipment for sound channel for the radio broadcast service ..... £ 16,091

* Program channel for the radio broadcasting service, accommodating audio frequencies in the range 50-10,000 Hz "

3) Local relay links for TV program signals between P&T terminals and television studios

	Required Additional Multiplex Equipment as per Data in Appendix, Section VII-B	Quoted Cost per Station in English Pounds
1. Lagos	Same as for equipment cost, proposed link between Advanced Teachers Training College and Kano TV station, Appendix, Section IV, Page 4 (shown as total of $22,597)	£ 9,400
2. Ibadan	Same as for #1	18,600
3. Kaduna	Same as for #1	18,600
	Local Relay Link Total	£ 46,600

NOTE: If TV relay is extended to Kano via the P&T system, a local relay link will be required at Kano, at estimated cost of £ 18,600.

4) Local relay links for sound broadcast programs between P&T terminals and NBC radio stations

1. Lagos	VHF or UHF relay equipment*	£ 5,000
2. Ijebu Ode	Same as for #1	5,000
3. Ibadan	"	5,000
4. Ilorin	"	5,000
5. Kaduna	"	5,000
6. Zaria	"	5,000
7. Kano	"	5,000
	Local Sound Relay Link Total	£ 35,000

* Assumes use of low-power (10-50 watt) FM transmitter and associated relay receiver; antenna of directional type at each end of link; antenna mounted on P&T tower at terminal and on existing tower or mast at radio station.

Plan A (Continued)

Summary of equipment costs, as listed in preceding pages, additional equipment required for single-path, one-direction, relay of television and radio program signals to points as listed in preceding pages.

	Estimated Equipment Cost in English Pounds
a) At terminal stations for TV relay	£ 50,293
b) At repeater stations for TV relay	70,144
c) At terminal stations for sound program relay (radio service)	16,091
d) Local TV relay links between P&T terminals and TV studios	46,600
e) Local relay links for sound programs between P&T terminals and NBC radio stations	35,000

Total, Equipment Cost (FOB plant in England) ..... £ 227,328

ROUND FIGURE EQUIPMENT TOTAL ---------- £ 227,300

PLAN A (Continued)

Estimated costs of shipping, engineering supervision, installation and spares, plus contingency

	Estimated Shipping Costs, plant to site, 10% of Equipment Cost	Estimated Engineering & Installation, based on 20% of Equipment Cost	Spares & Contingencies, based on 20% of Equipment Cost	TOTALS
a) Terminal Stations for TV relay	Ł 5,029	Ł 10,058	Ł 10,058	Ł 25,145
b) Repeater Stations for TV relay	7,014	14,028	14,028	35,070
c) Terminal Stations for Sound Program Relay	1,091	2,182	2,182	5,455
d) Local TV Relay Equipments	4,660	9,320	9,320	23,300
e) Local Sound Relay Equipments	3,500	7,000	7,000	17,500
	Ł 21,293	Ł 42,586	Ł 42,586	Ł 106,470

Plan A (Continued)

SUMMARY OF COSTS, PLAN A	English Pounds
a) Total of Equipment Costs, single-path, one-direction system, in round figures (from page 7)	£ 227,300
b) Total of shipping, engineering supervision and installation, spares and contingency costs, in round figures	106,500
BUDGETARY ESTIMATE, PLAN A	
Total in English Pounds	£ 333,800
	($ 801,000)
	(£N 286,100)

* * * * *

Estimated additional cost to adapt single-path, one-direction system, as itemized above, for two-way operation or, alternatively, for dual-path, one-direction (Lagos to north) operation.

a) Equipment cost, based on 90% of £ 227,300 figure as set forth in a) above, in round figures	£ 204,600
b) 1. Shipping, based on 90% of £ 21,293 total for one-way system, in round figures	19,000
2. Supervisory Engineering and Installation, based on 10% of £ 42,586 for one-way system, in round figures	4,3000
3. Spares and Contingency, based on 90% of £ 42,586 for one-way system, in round figures	38,300
BUDGETARY ESTIMATE	
Additional Cost Total in English Pounds	£ 266,200
	($ 638,900)
	(£N 245,700)

PLAN A - SUPPLEMENT

Estimated cost to add microwave relay equipment to the P&T network system between Kano and Kaduna to enable relay of television program signals from the Advanced Teachers Training College at Kano to the BCNN studios at Kaduna.

NOTE: Estimates are based on existence of a microwave relay from the College to the Kano TV station of BCNN (refer to Appendix Section V.) Also based on existence of a microwave relay between Kaduna P&T terminal and BCNN studios at Kaduna, as in Plan A.

a) Terminals

Kano	Add C3 (Video Transmit) @	£ 3,190		
	F1 (Sound Transmit) @	311		
			£ 3,501	
Kaduna	Add C4 (Video Receive) @	3,023		
	F2 (Sound Receive) @	492		
			3,515	

b) Required at Repeaters and Zaria

Four repeater equipments (includes Zaria) Add C7 (Repeater), four points @ £ 3,038		12,152	
		£ 19,168	£ 19,168
Estimated Shipping Costs (10% of equipment)	£	1,917	
Supervisory engineering, installation (20%)		3,834	
Contingencies, spares (20%)		3,834	
			9,585
TOTAL			£ 28,753

BUDGETARY TOTAL, round figures, English pounds £ 28,800
($ 69,100)
LN 24,700)

Estimate Data

PLAN B

1) Addition of microwave equipment for single-path (one-way) relay of television signals on P&T "Heavy" route between Ijebu Ode, Enugu and Aba, providing interconnection with Lagos.

	Required Additional Equipment as per GEC Data in Appendix, Section VII-B	Quoted Cost per Station in English Pounds	
a) At P&T Terminal Stations			
1. Ijebu Ode	C5 (Video Transmit)	£ 4,730	
	FI (TV Sound Transmit)	311	
			£ 5,041
2. Benin City	C6 (Video Receive)	5,242	
	C3 (Video Transmit)	3,190	
	F1 (TV Sound Transmit)	311	
	F2 (TV Sound Receive)	492	
			£ 9,235
3. Onitsha (Branches to Enugu and Aba)	C1 (Video Twin-path Trans.)	6,094	
	C6 (Video Receive)	5,242	
	F1 (2) (TV Sound Transmit)	622	
	F2 (TV Sound Receive)	492	
			£ 12,450
4. Enugu	C4 (Video Receive)	3,023	
	F2 (TV Sound Receive)	492	
			£ 3,515
5. Aba	C4 (Video Receive)	3,023	
	F2 (TV Sound Receive)	492	
			£ 3,515
Terminal Equipment Total			£ 33,756

Plan B (Continued)

	Required Additional Equipment	Quoted Cost per Station
b) At P&T Repeater Stations		
1. On "Heavy" route between Ijebu Ode and Benin City, 6 additional repeater equipments required, @ £ 3,038	C7 (Repeater)	£ 18,228
2. On "Heavy" route between Benin City and Onitsha, 4 additional repeater equipments required @ £ 3,038	C7 (Repeater)	12,152
3. On "Heavy" route between Onitsha and Enugu, 3 additional repeater equipments required @ £ 3,038	C7 (Repeater)	9,114
4. On "Heavy" route between Onitsha and Aba, 5 additional repeater equipments required @ £ 3,038	C7 (Repeater)	15,190
Repeater Equipment Total		£ 54,684

2) Addition of multiplex channeling equipment to P&T microwave relay system to permit simultaneous relay of high-quality sound-program signals of NBC from terminal at Ijebu Ode (connecting with Lagos) to Benin City, Warri, Onitsha, Enugu, Aba and Port Harcourt.

a) At P&T Terminals

1. Ijebu Ode	G1 (Sound Transmit)		£ 971
2. Benin City (Branch to Warri and Onitsha)	G2 (Sound Receive)	£ 919	
	G1 (2)(Sound Transmit)	1,942	2,861
3. Warri	G2 (Sound Receive)		919
4. Onitsha (Branch to Aba and Enugu)	G2 (Sound Receive)	919	
	G1 (2) (Sound Transmit)	1,942	2,861
	Carried Forward ----------		7,612

Plan B (Continued)

	Brought Forward ----------		£ 7,612
	Required Additional Equipment	Quoted Cost per Station	
5. Enugu	G2 (Sound Receive)		£ 919
6. Aba	G2 (Sound Receive)	919	
	G1 (Sound Transmit)	971	
			1,890
7. Port Harcourt	G2 (Sound Receive)		919
	Terminal Equipment Total ----------		£ 11,340

3) Local relay links for TV program signals between P&T terminals and television stations

1. Enugu	Same as at Ibadu and Kaduna, Plan A		£ 9,400
2. Aba	Same as above		9,400
	Total, Local TV Relay Links ----------		£ 18,800

4) Local relay links for sound-broadcast programs between P&T terminals and NBC radio stations

1. Benin City	Same as for Ijebu Ode, Plan A		£ 5,000
2. Warri	Same as above		5,000
3. Onitsha	Same as above		5,000
4. Enugu	Same as above		5,000
5. Aba *	Same as above		5,000
6. Port Harcourt	Same as above		5,000
	Total, 6 Relay Links ----------		£ 30,000

* For planned NBC station at this location.

Plan B (Continued)

Summary of equipment costs, as listed in preceding pages, Plan B, additional equipment required for single-path, one-direction, relay of television and radio program signals from Ijebu Ode (connecting with Lagos) to terminals as specified.

a) At terminal stations for TV relay	£ 33,756
b) At repeater stations for TV relay	54,684
c) At terminal stations for sound-program relay, radio service	11,340
d) Local TV relay links between P&T terminals and TV stations	18,800
3) Local relay links for sound programs between P&T terminals and NBC radio stations	30,000
Equipment Total	£ 148,570

Plan B (continued)

Estimated costs of shipping, engineering supervision, installation and spares plus contingency items

	Estimated Shipping Costs, 10% of Equipment Total	Estimated Engineering and Installation, 20% of Equipment Total	Spares and Contingency based on 20% of Equipment Total	TOTALS
a) At terminal stations for TV relay	£ 3,376	£ 6,752	£ 6,752	£ 16,880
b) At repeater stations for TV relay	5,467	10,934	10,934	27,335
c) At terminal stations for sound-program relay (radio service)	1,134	2,268	2,268	5,670
d) Local TV relay links between P&T terminals and TV stations	1,880	3,760	3,760	9,400
e) Local relay links for sound programs between P&T terminals and NBC radio stations	3,000	6,000	6,000	15,000
TOTALS	£ 14,857	£ 29,714	£ 29,714	£ 74,285

Plan B (Continued)

	English Pounds
B-I	
a) Total of Estimated Equipment Costs, single-path, one-direction system, in round figures	£ 148,600
b) Total of Estimated Shipping, Engineering Supervision and Installation, Spares and Contingency Items, in round figures	74,300
Total above items in English Pounds, in round figures	£ 222,900 ($ 535,000) (£N 191,000)
B-II	
Additional cost to adapt single-path, one-direction system as estimated in B-I to two-way, single-path operation or, alternatively, for dual path, one direction (Lagos to east) operation.	
a) Equipment cost, based on 90% of £ 148,600 figure as set forth in B-I, in round figures	£ 133,700
b) 1. Shipping, based on 90% of £ 14,857 total for one-way system, in round figures	13,400
2. Supervisory engineering and installation, based on 10% of £ 29,714 total for one-way system, in round figures	3,000
3. Spares and contingency based on 90% of £ 29,714 total for one-way system, in round figures	26,800
TOTAL	£ 176,900 ($ 324,600) (£N 115,900)

Estimate Data

PLAN C

1. Addition of multiplex channeling equipment for relay of NBC sound programs

	Additional Equipment Required	Cost in English Pounds	
a) At P&T Terminal Stations on "Medium" Route, Zaria to Sohoto			
1. Zaria	GI (Sound Transmit)		£ 971
2. Gusau	G2 (Sound Receive)	£ 919	
	G1 (Sound Transmit)	971	
			1,890
3. Sokoto	G2 (Sound Receive)		971
Equipment Total, Zaria-Sohoto			£ 3,832
b) At P&T Terminal Stations on "Medium" Route, Kaduna to Maiduguri			
1. Kaduna	G1 (Sound Transmit)		971
2. Bauchi	G2 (Sound Receive)	919	
	G1 (Sound Transmit)	971	
			1,890
3. Potiskum	G2 (Sound Receive)	919	
	G1 (Sound Transmit)	971	
			1,890
4. Maiduguri	G2 (Sound Receive)		919
Equipment Total, Kaduna to Maiduguri			£ 5,670

Plan C (continued)

	Additional Equipment Required	Cost in English Pounds	
c) At P&T Terminal Stations on "Medium" Route, Jos to Makurdi			
1. Jos	G2 (Sound Receive)	£ 919	
	G1 (Sound Transmit)	971	
			£ 1,890
2. Makurdi	G2 (Sound Receive)		919
Equipment Total, Jos to Makurdi			£ 2,809

* * * * *

Summary of Costs for Relay of Radio Programs on "Medium" Routes

a) Equipment		
1. Zaria to Sohoto	£ 3,832	
2. Kaduna to Maiduguri	5,670	
3. Jos to Makurdi	2,809	
Equipment Total, in round figures		£ 12,300
b) Estimated shipping costs, based on 10% of equipment costs, in round figures		1,200
c) Estimated supervisory engineering and installation costs, based on 20% of equipment costs, in round figures		2,500
d) Estimated spare costs and contingency, based on 20% of equipment costs		2,500
Total, Equipment Plus Items b-d inclusive		£ 18,500
		($ 44,400)
		(£N 15,900)

APPENDIX

SECTION VII-A

GEC—AEI TELECOMMUNICATIONS LIMITED

A Management Company of The General Electric Company Ltd., of England.

Telephone: Coventry 52152
Cablegrams: Springjack, Coventry.
Telex: 31361

P.O. Box No. 53
Telephone Works
Coventry CV3 1HJ.

Your Ref.

Our Ref. TXCM/ES/DWRC/QT.4029 Tel. Ext.

Mr. William S. Halstead,
Communications Consultant,
41, East 42nd Street,
NEW YORK, NY10017.

27th September, 1968.

Dear Mr. Halstead,

T.V. Links for Nigeria

Further to your visit to these Works and your letter dated 3rd September, we now have pleasure in submitting budgetary prices for the addition of T.V. Links and Programme Channel Equipment to the Nigerian Telecommunication Network.

We must stress that the prices submitted are to enable you to prepare an estimate of the equipment requirements and budgeatry costs for the purpose of your report and do not in any way constitute a firm quotation on which an order could be placed. In the time available it has not been possible to obtain quotations from outside suppliers or to do a detail study of the Additional Supervisory Equipment etc. entailed, but trust, nevertheless, that the information submitted is adequate for your purpose.

To enable you to make an accurate interpretation of the equipment requirement we enclose a copy of our Drawing MT.555 Sheet 2 Issue C which illustrates the existing and proposed Radio Routes in Nigeria. The heavy routes on this diagram indicate 6,000 MHz Radio Equipment; the medium route our 2,000 MHz equipment and the light route our 450 MHz 12-Channel Equipment. Both the heavy and medium routes are suitable for carrying Television and Sound Programme Channels either as part of the T.V. Channel Equipment or for operation over the Multiplex Network but the 450 MHz Equipment on the light route is not suitable for T.V. and we would also not recommend the use of this equipment as a carrier for Sound Programme Channels. This equipment would not meet the CCIR Recommendations with regard to Signal-to-Noise Ratio for this facility, but if de-graded performance is acceptable we should be pleased to advise on the performance anticipated on any of the individual routes in question.

The prices quoted cover the supply of equipment only and do not include for Installation and Commissioning work which will be involved.

The following information is given with respect to our Schedule:

1. Under Section A covering the One Way Unprotected T.V. Radio Links at Kano and Lagos, one Sound Programme Channel has been provided on the T.V. Links; a foot-operated Aerial Feeder Pressurising Arrangement is provided; 8 Local Alarms are included but no ECW facilities are provided as the system is one-way.

AEI

2. At a 2,000 MHz and 6,00 MHz Twin Path Terminal, 1 for 2 I.F. Switching has been provided.

3. T.V. on Standby can only be applied to the 6,000 MHz route with I.F Switching.

4. Aerial and Feeder is provided at existing 1 for 2 Terminals; Aerial Feeder Lengths 30 metres.

5. No Additional Supervisory has been provided on the existing routes.

6. Programme Equipment is One Channel with T.V. i.e. no Standby Programme Equipment is provided.

7. No Branching is provided for T.V. or Sound.

8. Ilorin - Jebba: On this 2,000 MHz route, separate T.V. and Sound is provided (i.e. not branched from 6,000 MHz station at NR5).

9. Kaduna - Jos and Bauchi: Separate T.V. and Sound is also provided on this route (i.e. not branched from the 6,000 MHz repeater at NR15). As equipment comes down to baseband at NER5, three sets of T.V. and Sound Equipment are provided, alternative systems will probably be provided in the event of an order. Similarly, two sets of equipment have been provided at Bauchi, Potiskum and Gusau.

We trust that the above and the enclosed schedules give you sufficient information for your purposes and must apologise for the delay in submitting these proposals. Should you require any further information, please do not hesitate to let us know.

Yours sincerely,

on behalf

For Export Sales Manager,
Transmission.

KW

APPENDIX

SECTION VII - B

Schedule of Equipment with Price Data from General Electric Company, Ltd. (Quotation No. QT. 40292)

		Cost of Additional Equipment per Station English Pounds
SECTION A	2 GHz TV RADIO LINK	
PART 1	Equipment to be provided at Kano Training College and Lagos University	£ 3,231
PART 2	Equipment to be provided at Kano TV Station and Lagos TV Station	£ 3,921
SECTION B	EQUIPMENT REQUIRED FOR TV ON STANDBY, USING P & T CIRCUITS*	£ 523
SECTION C	EQUIPMENT REQUIRED FOR ADDITIONAL ONE-WAY TV CHANNEL ON 6 GHz ROUTES	
PART 1	Equipment required for a Twin Path, Transmit, Terminal	£ 6,094
PART 2	Equipment required for a Twin Path, Receive, Terminal	£ 5,927
PART 3	Equipment required for a 1 for 1, Transmit Terminal	£ 3,190
PART 4	Equipment required for a 1 for 1, Receive Terminal	£ 3,023
PART 5	Equipment required for a 1 for 2, Transmit Terminal	£ 4,730
PART 6	Equipment required for a 1 for 2, Receive Terminal	£ 5,242
PART 7	Equipment required for a 1 for 1, Repeater	£ 3,038
PART 8	Equipment required for a 1 for 2, Repeater	£ 6,121
SECTION D	EQUIPMENT REQUIRED FOR ADDITIONAL TWO-WAY TV CHANNEL ON 6 GHz ROUTES	
PART 1	Equipment required for a Twin Path, Terminal	£ 8,355

*When channel space is available. Not recommended.

		Cost of Additional Equipment per Station English Pounds
PART 2	Equipment required for a 1 for 1 Terminal	£ 5,446
PART 3	Equipment required for a 1 for 2 Terminal	£ 6,954
PART 4	Equipment required for a 1 for 1 Repeater	£ 5,656
PART 5	Equipment required for a 1 for 2 Repeater	£ 8,945
SECTION E	EQUIPMENT REQUIRED FOR ADDITIONAL TV CHANNEL ON 2 GHz ROUTES	
PART 1	Equipment required for a Twin Path, Transmit Terminal	£ 5,263
PART 2	Equipment required for a Twin Path, Receive Terminal	£ 6,188
PART 3	Equipment required for a Twin Path, Two-Way Terminal	£ 8,166
PART 4	Equipment required for a One-way Repeater	£ 2,845
PART 5	Equipment required for a Two-Way Repeater	£ 5,652
SECTION F	EQUIPMENT REQUIRED FOR ADDITION OF SOUND PROGRAMME TO A TV CHANNEL	
PART 1	Equipment required for a One-Way TV Channel (Transmit)	£ 311
PART 2	Equipment required for a One-Way TV Channel (Receive)	£ 492
PART 3	Equipment required for a Two-Way TV Channel	£ 534

		Cost of Additional Equipment per Station English Pounds
SECTION G	EQUIPMENT REQUIRED FOR ADDITION OF SOUND PROGRAMME TO MULTIPLEX NETWORK	
PART 1	Equipment required for a One-Way Channel (Transmit)	£ 971
PART 2	Equipment required for a One-Way Channel (Receive)	£ 919
PART 3	Equipment required for a Two-Way Channel	£ 1,675

ADDITIONAL EQUIPMENT REQUIRED TO ADD A ONE WAY TV CHANNEL TO THE 6 GHz ROUTES (REFER TO MT555 SHT 2 ISSUE C)

		Ibadan to Each Repeater	Oshogbo to Repeater	Ilorin to Each Repeater	Beji (NR9) to Each Repeater	Kaduna to Repeater	Zaria to Each Repeater	Kano	Lagos to Repeater	Ibese
Section C.5.	Tx	1				1			1	
Section C.6.	Rx		1				1			1
Section C.8.		1				1			1	
Section C.3.	Tx		1	1	1		1			
Section C.4.	Rx			1	1	1		1		
Section C.7.			1	1	1		1			
ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A ONE WAY SYSTEM										
Section F.1.	Tx	1	1	1	1	1	1		1	
Section F.2.	Rx		1	1	1	1	1	1		1
ADDITIONAL EQUIPMENT REQUIRED TO ADD A TWO WAY TV CHANNEL TO THE 6 GHz ROUTE										
Section D.3.		1	1			1	1		1	1
Section D.2.			1	2	2	1	1	1		
Section D.5.		1				1			1	
Section D.4.			1	1	1		1			
ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A TWO WAY SYSTEM										
Section F.3.		1	2	2	2	2	2	1	1	1

ADDITIONAL EQUIPMENT REQUIRED TO ADD A ONE WAY TV CHANNEL TO THE 2 GHz ROUTES (REFER TO MT555 SHT 2 ISSUE C)

		Oshogbo to Repeater to Akure	Ilorin to Repeater to Repeater to Jebba	Beji (NR9) to Minna	Kaduna to Repeater (Gidan) to	Each Repeater to Ung Saya (NER5) to Jos and	Each Repeater to Bauchi to	Each Repeater to Potiskum to	Each Repeater to Maiduguri	Jos to Each Repeater to Makurdi	Zaria to Each Repeater to Gusau to	Each Repeater to Sokoto
Section E.1.	Tx	1	1	1	1	2	1	1		1	1	1
Section E.2.	Rx	1	1	1		1 1	1	1	1	1	1	1
Section E.4		1	1 1		1	1	1	1	1	1	1	1
		ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A ONE WAY SYSTEM										
Section F.1.	Tx	1	1	1	1	2	1	1		1	1	1
Section F.2.	Rx	1	1	1		1 1	1	1	1	1	1	1
		ADDITIONAL EQUIPMENT REQUIRED TO ADD A TWO WAY TV CHANNEL TO THE 2 GHz ROUTES										
Section E.3.		1 1	1	1 1	1	3 1	2	2	1	1	1	2 1
Section E.5.		1	1 1		1	1	1	1	1	1	1	1
		ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A TWO WAY SYSTEM										
Section F.3		1 1	1	1 1	1	3 1	2	2	1	1	1	2 1

A-1

ADDITIONAL EQUIPMENT REQUIRED TO ADD A ONE WAY TV CHANNEL TO A TWIN PATH 6 GHz SYSTEM
(REFER TO MT555 SHT 2 ISSUE C)

		Benin City to Sapele to Warri		Ibese to Abeokuta	
Section C.1.	Tx	1	1	1	
Section C.2.	Rx	1	1	1	
		ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A ONE WAY SYSTEM			
Section F.1.	Tx	1	1	1	
Section F.2.	Rx	1	1	1	
		ADDITIONAL EQUIPMENT REQUIRED TO ADD A TWO WAY TV CHANNEL TO A TWIN PATH 6 GHz SYSTEM			
Section L.1.		1	2 1	1	1
		ADDITIONAL EQUIPMENT REQUIRED TO ADD ONE PROGRAMME CHANNEL TO A TWO WAY SYSTEM			
Section F.3.		1	2 1	1	1

A-31