COMPREHENSIVE REPORT

•

ECONOMIC AND ENGINEERING DEVELOPMENT OF BURMA

•

PREPARED FOR THE
GOVERNMENT OF THE UNION OF BURMA

VOLUME II

AUGUST 1953

KNAPPEN TIPPETTS ABBETT McCARTHY
ENGINEERS
IN ASSOCIATION WITH
PIERCE MANAGEMENT, INC.
AND
ROBERT R. NATHAN ASSOCIATES, INC.

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TELECOMMUNICATIONS

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CHAPTER XVIII

TELECOMMUNICATIONS

A. INTRODUCTION

1. PURPOSE AND SCOPE

The object of this report is to record and evaluate the findings of a general survey of the functions of the Department of Telecommunications, Ministry of Transport and Communications, and to recommend expanded, supplementary or new services, within the framework of the people's needs and purchasing power.

2. SOURCES OF INFORMATION

Data have been gathered from any and all sources believed to afford factual information. Such records as are available of pre-independence operations have been discussed with departmental officials. District as well as headquarters workings and organization have been observed, and personnel have been interviewed throughout Burma. All of this has involved some 1,800 miles of travel by rail, 1,200 miles by air, and 350 miles by highway beyond Rangoon and its environs. Facilities presently in operation and planned have been analyzed from the standpoints of efficiency and economy. When pertinent, facilities of neighbouring countries have also been studied.

B. HISTORICAL

1. DEVELOPMENT AND PREWAR STATUS

a. Telegraph

The development of communications services in Burma has been closely linked with that of India for about a century. First came the military telegraph which expanded gradually until general public service was opened in 1895. By the beginning of World War II, Burma had an extensive network of telegraph lines involving some 33,000 miles of wire connecting 656 telegraph offices, including two landlines to India, one via Akyab and Chittagong (now in East Pakistan), and one via Tamu and Manipur. Lines from Bhamo into China, and through Moulmein into Siam were abandoned as uneconomic because of their light traffic and the difficulty of maintenance.

b. Telephone

It is recorded that telephone installation in Burma began in 1888, although it was only after 1937 that the smaller communities received such facilities. The tempo of expansion increased until, just before the invasion, the populated areas of Burma enjoyed adequate local and long-distance telephone service. Vacuum-tube repeaters had been introduced in 1922 to improve trunk operation. In 1940, carrier operation was begun on the Rangoon–Prome route so that one line could provide several speech and/or telegraph circuits. All telephone services were operated by the Government's Posts and Telegraphs Department with the exception of the Rangoon and Moulmein exchanges. Plans were being made to take these over when Burma was invaded by the Japanese. Connection to the international radiotelephone network was provided by a link between Rangoon and Madras.

c. Radio

Wireless (radio) was utilized in Burma, as in other nations, for shipping, aeronautical, meteorological, broadcasting and international services. The Posts and Telegraphs Department was responsible for these expanding services and for such licensing and enforcement of national and international regulations as was necessary. Over a half-million messages in various categories were handled by the radio services in the fiscal year 1939–40. It is recalled that the relay through India to the rest of the world was not as efficient as was desired, and message delays caused considerable grumbling. A broadcasting service was inaugurated in 1938, and modern equipment was installed in 1940. Over 6,000 receiver licenses were issued on an annual renewal basis.

2. WAR DAMAGES

It is not essential to this Report that a detailed record of war damage be included, other than to observe that telecommunications facilities were almost completely destroyed either by denial or enemy action. Most of the personnel escaped to India and served brilliantly in the Allied armies, while others were caught by the invaders and forced to work on local projects. If there is any solace at all in this picture of near total destruction of facilities, it is in the fact that the bulk of trained personnel returned to the Department at the end of hostilities.

3. REHABILITATION

Restoration after World War II was speeded through the joint efforts of the British Army Signal

Corps, the Civil Affairs Service (Burma), and the returning civil Government. Equipment from military stocks, some civil-type equipment which had been ordered by the Government-in-exile (Simla), supplemented by such remnants as remained in Burma, were combined to rehabilitate the most important services to prewar effectiveness.

a. Telegraph

By the end of 1947, the telegraph network was largely restored, although certain lines, in particular the one from Prome to Akyab connecting with the line to Chittagong (Pakistan), were abandoned for economic reasons. The more modern practices of using teleprinter and superimposed voice-frequency signals on telephone carrier channels were adopted on a limited scale during this period. It is recorded that up to early 1948, a total of 1,355 miles of earth return telegraph circuit, 5,255 miles of phantom telegraph circuit, and 889 miles of voice-frequency telegraph traffic channels has been put into operation. Inland telegraph traffic was averaging about 190,000 messages for a total of Rs. 10 lakhs per annum.

b. Telephone

The demand for telephone service caused considerable improvisation because of equipment shortages in the years following the war. A more extensive and better trunk (long distance) line system than before, including lines correctly transposed for carrier operation, had been installed by the military. Enough terminal and repeater equipment had been obtained to meet all requirements. Technicians were trained in the necessary installation and operating techniques to round out the new carrier program. It should be noted that by the end of 1946, test calls were put through to New Delhi from Rangoon on an all-carrier circuit. Line construction was slowed in the Delta area by difficult river crossings and marshy terrain, so that the idea of utilizing v.h.f. radio began to receive consideration. However, exchanges and local outside plant were not so well established. Seventy telephone exchanges served about 3,000 subscribers in the towns and cities of Burma, principally with ex-military equipment. The poorest equipment was in use in the city of Rangoon where the program for telephone rehabilitation fared very badly because of engineering and equipment inadequacies. It is to be noted that during the war period the private company which had originally operated this system had been taken over by the Government. At that time, also, radio was being suggested for the Arakan because of both the initial expense of new lines and the difficulty of construction in the face of continuing dacoit attacks.

Trunk operations revenue was obtained as a lump sum in the rental of all telephones having access to the trunk network. This made the average telephone rental a very high figure. There seems to have been no well-organized telephone accounts office to set rates or handle the revenue, which amounted to Rs. 16 lakhs annually.

c. Radio

(1) Foreign Circuits

The tremendous application of radio during the war gave Telecommunications personnel further training in this, the youngest and most versatile of communications media. The prewar arrangement for handling foreign telegraph traffic via the India radio circuit was slow and cumbersome. Consequently, when the British Army Signal Corps established a direct circuit to Colombo from Rangoon, the way was paved for a commercial circuit over the same route. Telecommunications absorbed this high-speed (automatic Morse) operation in mid-1946, and by early 1948 was handling 175,000 messages annually for almost Rs. 6 lakhs in revenue. The Rangoon–Madras radiotelegraph circuit handled Burma's India–Pakistan traffic, although high-speed operation was not utilized because of deficiencies at the India terminal. The traffic volume on this circuit reached about 275,000 messages per year, netting Burma over Rs. 3 lakhs of revenue.

(2) Domestic Circuits

Because of the inaccessibility of some communities to landline facilities, radio stations had been installed to furnish telegraphic contact with the rest of the country. About 30 of these utilized former military equipment. The scarcity of trained personnel, power sources and spare parts so necessary for this operation hampered the program. The fact that it expanded at all speaks well for the ability and courage of the "wireless staff."

(3) Marine Station

The marine radio station at Monkey Point went on the air January 21, 1946, and has operated continuously since then. During the reconstruction period, a new transmitter and antenna system were installed to give the Port of Rangoon a service modern in every respect. Several thousand messages are handled annually with ships at sea.

(4) Police, Aeronautical and Broadcast

A v.h.f. radiotelephone system for the Rangoon Police was installed in 1946, to include ten mobile, 25 fixed, and one headquarters station. The maintenance

of this equipment was later assumed by the Police. The broadcasting services were absorbed by the Ministry of Information, and aeronautical radio operation by the Department of Civil Aviation.

From the foregoing picture of telecommunications activities during the rehabilitation period and up to the time of independence, it is obvious that with few exceptions communications facilities were as good as or superior to those destroyed by the war.

4. STATUS AFTER INDEPENDENCE

a. New Department

Prior to independence (January 4, 1948), the telecommunications were directed by the Chief Engineer, Telecommunications, under the Department of Posts and Telegraphs. Because of the close integration of the postal and telegraph services, many towns had combined offices presided over by the local postmasters. The same employees handled both mail and telegrams, and provided reliable and economical service. Effective with independence, however, the two branches were separated, and the telecommunications affairs were put into an independent department whose Director reported to the Deputy Secretary of the parent ministry.

b. Responsibilities

The responsibilities of this new department remained unchanged, and included:

(1) The engineering, construction, operation and maintenance of all domestic and foreign civil telecommunications services, telephone, telegraph and radio.

(2) The maintenance and operation of a maritime radio station at Rangoon to work with ocean shipping.

(3) The installation and maintenance of lines or systems required by other civil branches of the Government.

(4) The licensing of private communications systems, broadcast receivers, amateur radio stations and radio operators.

(5) The handling of Burma's affairs at international telecommunications conventions, and the enforcement of treaty regulations in domestic radio operations.

C. THE INSURRECTION

1. GENERAL

When independence was achieved, there was a flurry of staff changes based on a policy of employing only Burma nationals in government posts. Since Telecommunications had been staffed largely with non-nationals, the release of these trained men had a most depressing effect on the various services. Concurrently with the introduction of this policy there occurred the insurrection with its tremendous destruction and loss of facilities of all categories.

2. TELEPHONE AND TELEGRAPH LINES

Telecommunications does not have an accurate record of the losses suffered by the trunk telephone and telegraph lines systems. The loss is known to be large and widespread, and has effectively ended most long-distance telephone and landline telegraphy. Some equipment has been captured and put to use by the insurgent groups.

3. RADIO

With wire facilities made useless, the responsibility for internal communications became a matter for the Wireless Division of the Department. This emphasis on radiotelegraph communications has strained the resources of the department. Training classes were added to alleviate the shortage of operators, but the whole program appears to have been born of expediency rather than adequate planning. Fortunately, the foreign circuits and the shipping service were beyond the reach of the insurgents, and have continued normal operations.

4. RESULTS

Insurgent damage to landline communications services has been nearly as devastating, at least from the curtailment of operations, as was World War II. Lack of security in many areas has precluded any reliable survey of the extent of the damage and has delayed planning for expanded or new services. Attention to a rehabilitation program is developing slowly. Since the Wireless Division has rallied to handle the bulk of the inland traffic, new thought is being given to eliminating landlines altogether. This latter move, however, is considered uneconomical and unwarranted.

D. THE PRESENT SITUATION

1. LANDLINE FACILITIES

a. Telegraph

Burma Telecommunications has commercial telegraph services over the following circuits:

From	*To*	*Via*
Rangoon	Prome	Tharrawaddy
Mandalay	Lashio	Maymyo
		Nyaungkio
		Kyaukme
		Hsipaw
Prome	Paungde	Thegon
Mandalay	Sagaing	Amarapura

From	*To*	*Via*
Mandalay	Thazi	Kyaukse Meiktila
Rangoon	Nyaunglebin	Pegu Pyuntaza Daiku
Prome*	Shwedaung	
Rangoon CTO*	University College (Rangoon)	
Rangoon*	Mingaladon	
Rangoon*	Insein	Ahlone Kamayut
Rangoon	Pyapon	Twante Maubin Kyaiklat
Rangoon	Yandoon	Maubin
Chauk	Sagu	Singu Salin
Kalaw	Taunggyi	Aungban

* Local circuit operation.

These circuits include 800 miles of line, and 37 telegraph offices. The Burma Railways are not yet accepting prepaid telegrams at telegraph offices in railway stations.

b. Telephone

(1) Trunk Operation

There are 75 telephone exchanges of various sizes, accommodating some 4,500 subscribers. Trunk operation is limited to the following circuits:

From	*To*	*Via*
Rangoon	Tharrawaddy and Prome	Taikkyi
Rangoon	Maubin	Twante
Rangoon	Nyaunglebin	Pegu
Mandalay	Maymyo	(direct)
Mandalay	Sagaing	(direct)
Mandalay	Myitnge	(direct)
Mandalay	Meiktila	Kyaukse Thazi
Maymyo	Lashio	Kyaukme Hsipaw

No repeaters are used in these circuits, and services are of less than commercial quality. Most of the exchanges are isolated and furnish only local service (see Plate 1).

An experimental low-power radio link connects the Rangoon and Moulmein exchanges for limited (primarily government) service. A v.h.f. single channel link, planned several years ago, is now being installed to connect Rangoon, Maubin, Wakema and Bassein. The application of radio to commercial telephony will be covered in some detail under "Burma's Domestic Communications," Section E–2.

There is, as yet, no radiotelephone connection from Burma to other parts of the world. This is regarded as a serious deficiency in the communications system, and is one of the problems confronting the Department for early solution. A project report, "An International Radiotelephone Connection for Burma," has been submitted.

(2) Rangoon and Mandalay Exchanges

While all of Burma's telephone exchanges are essential, the most important, from the standpoints of size and service rendered, are those of Mandalay and Rangoon. Mandalay, within the past few months, has installed a new 400-line magneto switchboard, and considerable underground cable. With a population of 182,000 this gives a very low saturation figure, even if all of the lines were in use. Once trunk operation to Rangoon is re-established, the demand will increase tremendously.

Rangoon's system is a "hodge podge" of ex-military boards never intended for "big city" operation. Their small capacity necessitates a great deal of transfer operation. This wastes time, reduces the quality of the connection, and increases the possibility of premature cutoff at any of the exchanges involved in the call. There are five exchanges containing 2,618 lines in the system proper, and 97 private branch exchanges (PBX) using 192 junction lines to serve a total of 1,134 telephones.

Disintegration of outside plant, both underground and aerial, has outstripped Telecommunications' maintenance efforts to the extent that satisfactory telephone service is no longer available. This situation is a serious threat to the optimum performance of the new manual auto-ringing boards, and is irreconcilable with full automatic operation.

The public has complained about the telephone service, and high annual rate of K600. Plans for conversion to an automatic system have been discussed for years. However, because of the time required for engineering, manufacturing, and installing, it was decided in 1950 that new manual boards should be ordered to alleviate the danger of a creeping paralysis of the exchange system. Units of 1,000 lines which can be broken down into 500, 300, and 200-line sections for future use in the districts, were selected. Two of the three units ordered have already arrived in Rangoon from UK, and installation has begun in the 40th Street Telephone Building. If present plans are realized, these boards should be rendering service within a few months. Further exchange facilities are provided by a 400-line PBX board which has recently been installed in the Secretariat.

Two surveys from which details of an automatic exchange are to be developed have been made in Ran-

goon. The first was concluded two years ago by BPO, London, under contract with GUB, but final specifications have not been submitted. The second survey was recently concluded by engineers of the L. M. Ericsson Co., Stockholm, at no cost to Government. Specifications have been proposed by this firm and a price quoted to the Ministry. This latter survey is based on the recommendation by the authors of this Report that the modern crossbar system be considered before committing Rangoon to the much older Strowger system recommended by BPO. A project report entitled, "An Automatic Telephone System for Rangoon," and embodying these recommendations has been submitted. It is planned to house the selected exchange in a functional building located to the West of Sule Pagoda Road, between Dalhousie and Fraser Streets.

Maintenance for the present system leaves much to be desired. Lack of adherence to standards, planning, spare parts and materials, tools and facilities is critical. Records and maps are incomplete and deficient in test data. The greatest need, however, has been for a technically and administratively trained organization whose sole function is to manage and operate the Rangoon telephone system. On the recommendation of the authors, this need was recognized and a divisional engineer appointed.

2. RADIO

The inland telegraph service is almost completely a radio service. At the moment, 66 stations are connected to Rangoon, or to each other in several nets so that traffic can move from one end to the other of Burma by relay. Plate 1 indicates the stations now in operation, and includes those now planned for installation this year. The message service is generally considered slow. The public, as well as Government, has complained about the time required for telegrams to reach their destinations via this radio system. For example, messages relayed but once, at Mandalay, required 26 hours to reach Kalewa from Rangoon. These shortcomings inherent in a high-frequency radio net have been pointed out previously (see Interim Report, page 248).

Two circuits handle Burma's communications with the outside world. The Rangoon–Madras link clears traffic to and from India and Pakistan, while the Rangoon–Colombo circuit handles the rest. All Rangoon transmitters, foreign and domestic circuits, are located in a rented bungalow at the 6½ Mile, Prome Road, and the receivers are housed on the second floor of the 40th Street Telephone Building. Keying and order circuits are carried over telephone lines from the Central Telegraph Office. By no stretch of the imagination are these facilities even moderately satisfactory. The crowning deficiency is the lack of space for the essential directional antennas.

By existing commercial standards, Burma's transmitters cannot be classified as "high-powered." For the primary foreign circuits, three 1·2-kW, Standard Telephone, Ltd., units are available. For secondary foreign and divisional headquarters circuits, three 300-watt RCA transmitters are utilized. To operate over shorter distances to district stations ten 50-watt transmitters of both modern and former military types are provided. Effective radiated power is reduced through interaction and absorption between the crowded antennas. Several Marconi 300-watt transmitters were ordered recently for use in Rangoon and district headquarter stations.

The receiving facilities by commercial standards are less satisfactory than those for transmitting. No diversity grouping is possible, and the antennas are limited to simple vertical "whips." In all, there are 18 receivers, old military or ancient commercial units. Expansion plans for seven more are being implemented.

The use of substandard equipment and systems has a most derogatory influence on the service. However, foreign traffic fares much better in this respect than does local inland traffic.

3. ORGANIZATION

The Director of Telecommunications is the Chief Executive of the Department, and reports directly to the Deputy Secretary of the Ministry. To assist him, the Director has a Deputy and two Personal Assistants, one for Engineering and one for Traffic. The Department is divided into five main divisions:

(*a*) The Burma Wireless (Radio) Division under the Divisional Engineer, Wireless, at Rangoon, with responsibility for all the Department's radio matters in Burma.

(*b*) The South Burma Division (Telegraphs) under the Divisional Engineer, Telegraphs, at Rangoon, dealing with engineering, traffic, telegraph and telephone (except the Rangoon telephone system) matters in lower Burma.

(*c*) The North Burma Division (Telegraphs) under the direction of the Divisional Engineer, Telegraphs, at Maymyo, with similar responsibilities in Upper Burma.

(*d*) The Independent Arakan Division, under the direction of the Officer in Charge, Telecommunications, Akyab, with similar responsibilities in that area.

(*e*) The Rangoon Telephone Division under the Divisional Engineer, Telephones (Rangoon) deals with engineering, management and operation of the Rangoon telephone system.

The Director also has reporting directly to him the

Superintendent of each of the following important posts:

Telecommunications Stores, Rangoon.
Central Telegraph Office, Rangoon.
Central Telegraph Office, Mandalay.

Further details are shown in the Organization Chart.

E. TELECOMMUNICATIONS OPERATIONS, PLANS AND PROBLEMS

1. BURMA'S FOREIGN COMMUNICATIONS CIRCUITS

a. General

Planning new and improving existing foreign circuits involves both radiotelephone and radiotelegraph activities. Because they will supplement each other in Burma's communications pattern, and will share housing and operating facilities, it is advantageous to treat them together. Since efficient dependable foreign circuits are second only to dependable domestic communications for the welfare of the country, these matters must receive prompt consideration.

b. Present Traffic Situation

(1) Routes

At the moment, two radiotelegraph circuits handle Burma's foreign traffic. One of these works between Rangoon and Madras with messages to and from India, Pakistan and Ceylon. The other circuit, between Rangoon and Colombo, where it connects into the world network of Cable and Wireless, Ltd., handles all other foreign traffic.

(2) Message Totals

Spot checks reveal that weekly totals (in both directions) average around 5,250 messages over the Rangoon–Madras circuit, and 8,200 over the Rangoon–Colombo circuit. The Madras circuit at times requires up to three Rangoon transmitters, one automatic Morse, and two manual circuits. The Colombo circuit usually clears its traffic with one automatic Morse circuit, but when necessary another can be added. By Western standards, these circuits cannot be considered either fast or heavily loaded, but there are many complaints from the distant terminals about the quality of the Burma signals which at times are unreadable. The difficulties under which they operate are substantial, but not insurmountable.

c. Improvement Possible

(1) Location

Any communications link utilizing the high-frequency spectrum is subject to various kinds of transmission difficulties. While these cannot be entirely avoided, their effects can be minimized by the application of certain radio-engineering principles. The failure to locate the transmitting and receiving stations in surroundings sufficiently adaptable to directional antennas is responsible for a large measure of the present substandard operation. Until these locations have been corrected, optimum operation cannot be achieved.

(2) Frequency Shift Keying

Keying a transmitter by shifting its frequency a small amount offers an important advantage over the conventional on-off method. The effects of noise on the operation of frequency-shift keyed circuits are reduced considerably. A signal-to-noise ratio of but six decibels permits satisfactory operation. This means that any given circuit will be "commercial" rather than "marginal" for a greater portion of the day. Obviously, Burma's transmitters can be made more efficient by adopting f.s.k.

(3) Diversity Reception

For commercial operation, the principal circuit requirement is that the received signal-to-noise ratio be above a certain minimum, even in deep fades. Because enormous power increases would be necessary to make a noticeable improvement, it is far more effective to apply every possible means for decreasing the fading range than to increase power. Since the gain in circuit performance due to diversity reception varies with the degree of reliability of the circuit, the improvement may be of the order of from 12 to as much as 30 decibels. To achieve this by increasing transmitter power would be a most unrealistic approach. Consequently, space diversity reception (not used heretofore by Telecommunications) should be utilized at both ends of the circuit.

(4) Teleprinter

In discussing telegraph-traffic handling, it must be observed that automatic Morse operation has had its day, and is being supplanted by teleprinter at an ever-increasing rate. The adoption of teleprinter has always resulted in higher traffic volumes, faster service, lower rates and greater accuracy. Few telecommunications administrations feel that they can afford to ignore this modern trend.

(5) Possible Economies

To summarize, if one of Telecommunications' 1·2-kW transmitters utilizing frequency shift keying (f.s.k.) were worked into a properly designed direc-

tional antenna on a frequency suitable for the distance and time of day, and the signal at the distant point was picked up by directional antennas and diversity receivers, one efficiently handled teleprinter circuit could handle the Burma–India traffic. This is true also of the Colombo circuit. Telecommunications can therefore defer buying higher powered telegraph transmitters until the present units are worn out.

(6) Cost Estimate

Frequency shift keying can be added to the Madras and Colombo transmitter for a very modest sum. Conversion to teleprinter operation would add little more to the investment, and could release skilled man-power for other operating duties at the Central Telegraph Office.

No. Required		*Unit Cost Kyats (Foreign Exchange)*	*Total*
2	Frequency Shift Exciter	10,000	20,000
2	Frequency Shift Converter	7,000	14,000
2	Telegraph Converter	4,500	9,000
3	Teleprinter (No. 15 Send-Receive)	6,000	18,000
–	Spare Parts		5,000
	Total		K66,000

However, this modest modernization scheme, regardless of its desirability, cannot be implemented into maximum effectiveness until the long-pending receiver and transmitter centers are in operation.

d. New Circuits Desirable

Direct telegraphic connections to other neighboring countries are desirable, but full-time circuits cannot be justified from the direct revenue standpoints. To illustrate this point, the following table lists the number of messages handled in an average week's operations:

Burma	*UK*	*USA*	*Thailand*	*Indonesia*	*Phil. Rep.*
Outgoing Mgs.	797	138	61	67	5
Incoming Mgs.	746	175	47	18	3
Total	1,543	313	108	85	8

It is quite possible to connect with various countries on a split-schedule for periods long enough to handle mutual traffic. However, until those arrangements are made and until the facilities are at hand for carrying them out, it is necessary to continue to work through Colombo at the higher rates and accepting the delays in the requisite relay operations. Plate 2 shows several desirable radio routes in relation to Rangoon.

e. Revenue

Telecommunications' financial records for 1951–52 foreign and domestic telegraph services are as follows:

Total Earned	K38,53,671.42
Total Expenditure (Salaries and Materials	K9,52,953.73

f. International Radiotelephone Link

(1) General

Burma's telephone system was connected to India's telephone network by a radio link from 1936 until the beginning of World War II. This facility has never been re-established in spite of the insistent demand for it. The Department of Telecommunications has arranged with Indian P. & T. to commence operations between Madras and Rangoon at some future date. The Radio Section of the Department planned the necessary technical facilities, and prepared a specification for equipment to which tenders were submitted late in 1952 by several European and American manufacturers. A project report covering this whole matter has been submitted.

(2) Selection of Equipment

Early in their correspondence, Telecommunications had been urged by India P. & T. to use equipment identical to that installed in their Madras station. Consequently, Telecommunications contacted Westinghouse, USA, for particulars and prices of their "MW" combination which features telegraph and telephone transmitters operating from a common power supply. This equipment meets the need of administrations requiring heavy traffic-handling capacity, but does not represent the "best buy" for Burma in this case, inasmuch as a radiophone system only is required.

(3) Review of Planning

(a) Amplitude modulation. Since an amplitude modulated (A3) system was originally planned, it is believed that Telecommunications is not evaluating correctly the advantages of the Single Sideband Suppressed Carrier (A3a) or Independent Sideband (A3b) operation as used by many overseas telephone services.

(b) Route and terminal. Incomplete planning is also evident in agreeing to the location of the Indian terminal at Madras which requires a carrier connection across the sub-continent to Poona, for all relays beyond India. The standard telephone toll rate between Madras and Poona is Rs. 8–10 which will increase the total charge appreciably, without benefit to Burma. Wire transmission over that distance will

also degrade the signal, and is more subject to interruptions. Calcutta is scheduled to have a direct radiotelephone connection with UK in the very near future (a Calcutta–London radiotelegraph circuit was opened in March 1953), certainly by the time Burma's overseas telephone can be put into operation. The transmission path between Rangoon and Calcutta is 450 miles (40%) less than that between Rangoon and Madras. A cursory examination of Burma–India telegrams over a period of a few days shows about equal distribution between the Madras area and the Calcutta area. Since radiotelephone calls might be expected to follow the same pattern, there are good reasons for reconsidering the route of this proposed link.

(4) Single and Independent Sideband Operations

(a) Advantages. In conventional amplitude modulation (AM), the transmitted carrier requires two thirds of the power, and yet serves no useful purpose after modulation. In Single Sideband Suppressed Carrier and Independent Sideband systems, the carrier is suppressed, and in SSSC one of the sidebands is dropped. There is therefore a material saving in transmitting power. Since the transmitted signal requires less spectrum space, the receiver can be made more selective to provide a better signal-to-noise ratio. Consequently, interference is reduced. With the carrier generated in the receiver, selective fading is of little consequence, and the signal is further improved. When all of these advantages are integrated, the use of SSSC is equivalent to a nine-decibel increase (factor of eight) of transmitter power.

One or two telegraph (or teleprinter) channels can be transmitted simultaneously with the voice channel to provide a reliable combined service. When ISB is used, the power-consuming carrier is suppressed, and both sidebands are transmitted to carry separate intelligence channels. In this arrangement, one transmitter can accommodate as many as four voice channels, or an equivalent band-width combination of voice and telegraph channels.

(b) Disadvantages. Both ISB and SSSC equipment are more expensive than AM, and more difficult to adjust and maintain. When considered from standpoints of cost per channel, and greater reliability, however, the advantages far outweigh the disadvantages as attested by their increasing popularity on overseas circuits. Unfortunately, AM and SSSC equipment are incompatible for commercial operation.

(5) India's Equipment

The Indian P. & T. has invested heavily in AM equipment (Westinghouse, USA) for internal radiotelephone circuits, and expected (at last intimation) to use the same on the Burma–India link. It is possible that they will change their view (they already use SSSC on the Poona–London circuit) if Burma approaches them with a plan showing the mutual advantages of SSSC on the India–Burma link.

(6) Expansion of Overseas Telephone Service

Once the Burma–India link is in operation, pressure will be felt for connections with other countries. Indonesia, Japan, Malaya and the Phillipine Republic use SSSC in their overseas telephone services. It would be a simple matter, at least from the technical point of view, to "hook-up" with them if Burma possessed a similar equipment. This point is made because it is feasible to use the same equipment for working some, or all, of these countries on part-time schedules until growth requires full-time service. Plate 2, an outline map of Burma and her neighbours, shows the route of this projected radiotelephone circuit as well as other desirable circuits.

(7) Other Essential Elements

The receivers and transmitters of this service would be located at the centers, and would be attended by the regular shift engineers. Connections to the telephone exchange would be through the same medium, v.h.f. radio or wire, as the telegraph circuits. Directional antennas for day and night frequencies are necessary for optimum performance of overseas radiotelephone circuits. Connecting high-frequency radio circuits to landline systems always raises problems. The instability of the radio link is responsible for most of the difficulty and makes it essential to employ rather elaborate equipment for a satisfactory junction. The radiotelephone terminal equipment has all of the facilities required to make the circuit operative in only one direction at any one instant. It also controls signal levels in both directions, filters out line noises, and by the privacy system, renders speech unintelligible to unauthorized listeners. It follows that a skilled operator is required at the controls of this terminal equipment.

(8) Estimate of Costs

In compiling the following figures, cognizance has been taken of the fact that this service will share certain Rangoon facilities with other communications services. Therefore against such items as land, buildings, connections to the central office and auxiliary power supply, there will be shown only a proportionate amount as chargeable to the proposed project.

(a) Capital investment

Item	*Life (years)*	*Foreign Exchange (kyats)*	*Local (kyats)*
1. Transmitter	15	1,50,000	
2. Receivers	15	70,000	
3. Terminal and Privacy Equipment	15	45,000	
4. Connections to Exchange	15	65,000	
5. Emergency Power Supply	15	16,000	
6. Transmitting Antennas	5	10,000	8,000
7. Receiving Antennas	5	5,000	4,000
8. Housing (Radio and Power)	25		30,000
9. Sites for Buildings and Antennas			40,000
		3,61,000	82,000
Engineering and Contingency (10%)		36,100	8,200
		3,97,100	90,200
Total Capital Investment		K4,87,300	

It is reasonable to expect items 1–5 to render service for 15 years or possibly longer, if operated and maintained properly. An antenna life (items 6–7) of five years appears to be a low estimate, but was so chosen to permit the changes that are often necessary for expanding transmitting and receiving center operations.

(b) Annual costs. The annual cost of this service is comprised of (i) the annual investment charge of interest and amortization, (ii) maintenance and operation costs and (iii) administration costs.

(i) *Annual Investment Charge*

Items	*Amount (kyats)*	*Rate (%)*	*Annual Investment Charge (kyats)*	
1–5	3,46,000	9·634	33,333.64	
6 and 7	15,000	23·098	3,464.70	
6 and 7	12,000	22·463	2,695.56	
8	30,000	6·401	1,920.30	
				41,414.20

(ii) *Maintenance and Operation Costs*

Items	*Amount (kyats)*	*Rate (%)*	*Maintenance and Operation (kyats)*	
1–5	3,46,000	10·00	34,600	
6 and 7	27,000	5·00	1,350	
8	30,000	5·00	1,500	
				37,450.00

(iii) *Administration Costs*

Items	*Amount (kyats)*	*Rate (%)*	*Administration (kyats)*	
1–9	4,87,300	5·00	24,365	
				24,365.00
Total Annual Costs				K1,03,229.20

The administration charge may appear to be low. However, this project will be a small operation among the many activities of Telecommunications, and should carry only its proportionate percentage of the department's overhead.

(9) Service Charge to the Public

Besides indicating the order of yearly expenditure required to operate this radiophone system, the above estimate permits an approximate unit service charge to be computed. For example, it is believed that the maximum number of calls that the system could handle might reach 200, over an 18-hour day. This figure takes into consideration the time required for "person-to-person" arrangements as required by most overseas calls. However, it is unlikely that the saturation point of the system would be reached for several years. The local expense is the same for all calls regardless of destination; so a direct compilation of Burma's minimum fee can be made for various daily totals.

Calls per day	*Burma's local charge per call*
20	K14.10
50	K5.65
100	K2.85

In computing the cost of a trans-ocean call, it is necessary to add the local charges (as shown above) and applicable taxes to those of the foreign agencies. When agreements are made between telecommunications agencies of the various countries, flat rates are usually assigned to ordinary types of service. This facilitates the rapid and accurate compilation of costs on the standard "three-minute plus overtime" basis.

(10) Using the International Radiotelephone Service

In operation, the overseas telephone is little different from an ordinary long-distance landline system. A typical call would be handled in the following manner: a Rangoon subscriber wishing to converse with an associate in India, would simply call the telephone exchange and ask for the overseas operator. When connected, the operator records the particulars for reaching the desired party, and the caller disconnects. When the overseas operator has reached the desired individual over the radio link and foreign telephone system, she calls the subscriber back through the local exchange. The conversation then proceeds in the normal manner. During the talking period, the overseas operator has an opportunity to fill out the necessary toll ticket so that an accurate billing can be made. It is, of course, possible to have arrangements for several calls to proceed at the same time. Operators, with practice, become very proficient in handling these circuits.

Trans-oceanic radiotelephone services have been in operation all over the world for many years. Excellent relaying and interconnecting agreements permit calls to be made between most countries today, and at charges becoming increasingly reasonable as facilities are added and modernized.

g. Landlines to Other Countries

Because of the low traffic totals involved and the expense of maintenance through difficult border country, landlines between Burma and her neighbors cannot be justified in the foreseeable future. High-frequency radio can provide the traffic capacity and the required reliability at a fraction of line costs, once Telecommunications puts its radio operations on a modern commercial basis.

h. Rangoon Radio-station Centers

(1) General

In sizable radiotelegraph and radiotelephone operations, it is standard commercial practice to concentrate all activities in specialized areas. These are known as the Transmitter Center (TC), Receiving Center (RC), and Central Telegraph Office (CTO), respectively. Great efficiency in the utilization of manpower and machines is possible if these centers are correctly designed and adequately equipped. The Telecommunications Department has not achieved much in these respects because of the small, badly located areas available for receiver and transmitter centres.

(a) **Antennas.** Directional antennas are essential for optimum h.f. performance (both transmitting and receiving), but unfortunately require considerable land area. Receiving is further complicated by the multiple (two or three) well-spaced antennas required for diversity working. However, provided that the frequency and direction of the array is appropriate, several receivers may operate from one antenna. Antennas located some distance from the equipment are connected by untuned transmission lines of the correct impedance for optimum energy transfer. The layout of both types of centers deserves first-class engineering.

(b) **Other requirements.** Engineers, operators and technicians are usually employed on rotating shifts so that the advantages of working during certain hours can accrue to all hands in turn. Quarters, at least for key personnel, within the immediate neighborhood are highly desirable. Electricity, water and sanitation facilities are necessary for quarters as well as for the station proper.

(2) Planning

(a) **Layout.** On a large-scale map of the plot, antennas and station can be laid out to meet the present and future requirements for foreign and domestic circuits and equipment. From this information, clearing, leveling and road and powerline construction can be accurately laid out, and provisions made for water and sanitation. High-frequency operation does not require the low-resistance ground connection so essential to low-frequency equipment.

(b) **Transmission lines.** It should be kept in mind that untuned transmission lines are to be used, and arrangements made for all transmitters (and receivers) to work into the same value of impedance. Only in this way can the maximum flexibility be achieved. Because of negligible radiation of properly constructed and terminated lines, small, well-shielded transmitters can be stacked without harmful interaction.

(c) **Buildings.** The station buildings required at the transmitting and receiving sites do not have to be unduly large, but they must be extremely functional. A small shop for limited maintenance, calibration and adjustment is essential, as well as adequate storage facilities for the most essential spares. Since the amount of clerical routine handled by the engineer in charge is negligible, a small office will suffice. A locker room with the usual facilities must be provided for staff convenience.

(d) **Emergency power.** The highest importance must be attached to the ability of these centers to function at all times. Consequently, emergency power supplies in the form of diesel-driven three-phase alternators must be ready at a moment's notice to take over the station load of lights and power from the commercial mains. Adequate housing for these machines as well as transmission and switch-over facilities must be included at each site.

(e) **Center control board.** At the receiver center, all signals must pass through the control board to the CTO by cable or radio. Since the order circuit between the two points also terminates at this board, any complaint involving signal level or quality can be resolved without delay or inconvenience. At the transmitting center, the keyed impulses from the CTO are distributed to the transmitters through a similar board which includes patching, ordering and monitoring facilities. For possible emergency operation, it is advisable to provide separate order and traffic-handling circuits.

(3) Connection to Central Telegraph Office

Plate 3 illustrates the physical relationship of the desired radio-station centers and the Central Telegraph Office. The distance from the CTO is not of much importance provided that it does not exceed eight to ten miles, but the transmitting and receiving centers should be as widely separated (three to five miles) as possible to attenuate interference. For connecting these areas to the CTO, there are two possibilities: telephone cable or v.h.f. radio. The trend in most countries is to utilize radio since it has considerable channel expansion properties, and facilitates connecting to the CTO without the hardships associated with laying and maintaining cable. In this particular instance, the first cost, convenience and reliability are slightly in favor of radio.

(4) Cost Estimate

These centers, as mentioned previously, will be the Rangoon terminals of foreign and domestic radiotelegraph and radiotelephone circuits. Their cost, maintenance and operation will be absorbed in these operations. However, it is necessary to estimate these figures to determine the order of expenditure required.

(a) Capital cost

*Item**	*Life (years)*	*Foreign Exchange (kyats)*	*Local (kyats)*
1. Transmitters	15	50,000	
2. Receivers	15	2,15,000	
3. UHF/VHF Traffic and Order Circuits	15	2,50,000	1,00,000
4. Antennas, Masts and Lines	15	1,25,000	
5. Emergency Power Supplies	15	1,00,000	
6. Housing (Stations and Quarters)	30		6,00,000
7. Roads	30		60,000
8. Sites	—		4,00,000
		7,40,000	11,60,000
Engineering and Contingency (10%)		74,000	1,16,000
		8,14,000	12,76,000
Total		K20,90,000	

* Does not include equipment for International Radiotelephone Link, nor any expansion of present radiotelegraph program, but replaces some outmoded military gear.

(b) Annual cost. The annual cost is comprised of: (i) the annual investment charge of interest amortization; (ii) maintenance and operating costs; and (iii) administration costs.

(i) *Annual Investment Charges*

Item	*Amount (kyats)*	*Rate (%)*		*Charge (kyats)*
1–5	8,14,000	9·634	78,420.76	
4	1,10,000	8·994	9,893.40	
6, 7	11,66,000	5·783	67,429.78	
				1,55,743.94

(ii) *Maintenance and Operating Costs*

Item	*Amount (kyats)*	*Rate (%)*		*Charge (kyats)*
1–3	5,66,500	10·0	56,650	
4–8	15,23,500	5·0	76,175	
				1,32,825.00

(iii) *Administration Costs*

Item	*Amount (kyats)*	*Rate (%)*		*Charge (kyats)*
1–8	20,90,000	10·0	2,09,000	
				2,09,000.00
Total Annual Costs				K4,97,568.94

(5) Difficulty in Obtaining Sites

At this writing the transmitter center site is said to have been obtained, but the receiving site has become an item to be settled between the Ministries of Transport and Communications, and Agriculture and Forests. Since 1948 Telecommunications has been selecting and requesting various sites but always has had to yield to prior claim. The point has now been reached where service must be curtailed unless land for commercially acceptable centers is forthcoming. Owing to the location of the new Burma Broadcasting Service high-frequency transmitters, very little latitude for compromise in the location of a receiving center site remains.

i. Recommendations

(1) Radiotelephone and Telegraph

In connection with facilities discussed in this section, Burma's Foreign Communications Circuits, it is recommended that:

(*a*) Telecommunications arrange to operate the foreign radiotelegraph circuits with frequency-shift keying and teleprinter.

(*b*) Modern diversity receivers be used on these circuits.

(*c*) The Telecommunications administrations of neighboring countries, other than Ceylon and India, be contacted in the matter of split-schedule operation for handling mutual traffic to provide better relay facilities than now exist.

(*d*) Burma reopen immediately telecommunications matters with India, and arrange a high-level conference for an "across the table" exploration of the mutual advantage of the following:

(i) Adopting Single Sideband Suppressed Carrier (A3a) or Independent Sideband (A3b) for radiotelephone operation, and eventually a combined telephone-telegraph service. The use of ISB operation with two active telephone channels, one for Indian calls and the other for relayed calls, should be considered.

(ii) Allocating definite frequencies to this Burma–India telephone service so that they can be quoted in any further discussions, specifications or plans.

(iii) Improved high-speed (automatic Morse) operation at both ends of the present radiotelegraph circuit until (*a*) can be implemented.

(iv) Possible use of Calcutta as a telephone and/or telegraph terminal for working with Burma.

(v) Establishing flat rates for telephone landlines when used for mutual overseas calls.

(vi) Operation of the proposed radiotelephone service over an 18-hour day (minimum) to permit relays to Europe, Africa, and the western hemisphere reaching their destinations at a reasonable time of day.

(*e*) Telecommunications draft a complete specifica-