


BASIC DESIGN STUDY REPORT
ON
THE TELECOMMUNICATIONS NETWORK REHABILITATION PROJECT
IN
DAR ES SALAAM AREA
IN
THE UNITED REPUBLIC OF TANZANIA

MAY, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

G R S

89 - 62

BASIC DESIGN STUDY REPORT
ON
THE TELECOMMUNICATIONS NETWORK REHABILITATION PROJECT
IN
DAR ES SALAAM AREA
IN
THE UNITED REPUBLIC OF TANZANIA

JICA LIBRARY



1076299(5)

19852

MAY, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団

19652

P R E F A C E

In response to the request of the Government of the United Republic of Tanzania, the Government of Japan has decided to conduct a Basic Design Study on the Telecommunications Network Rehabilitation Project in Dar es Salaam Area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a survey team headed by Mr. Takuo Kidokoro, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, from 16th January to 14th February, 1989.

The team exchanged views with the officials concerned of the Government of Tanzania and conducted a field survey in Dar es Salaam Area. After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Hiroshi Yoshida, International Cooperation Division, Ministry of Posts and Telecommunications was sent to Tanzania from 17th April to 28th April, 1989 in order to discuss the draft report and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

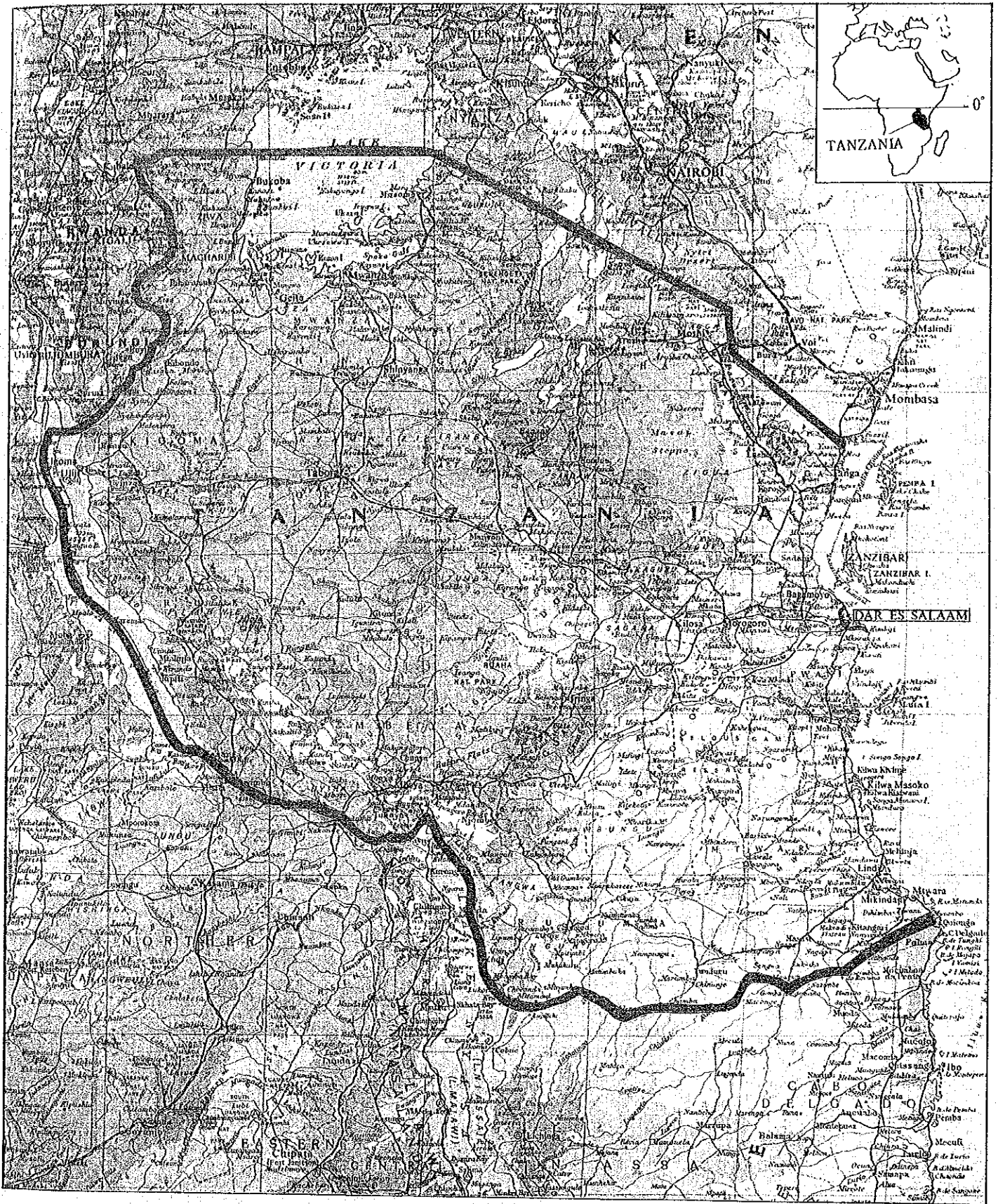
I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

May, 1989



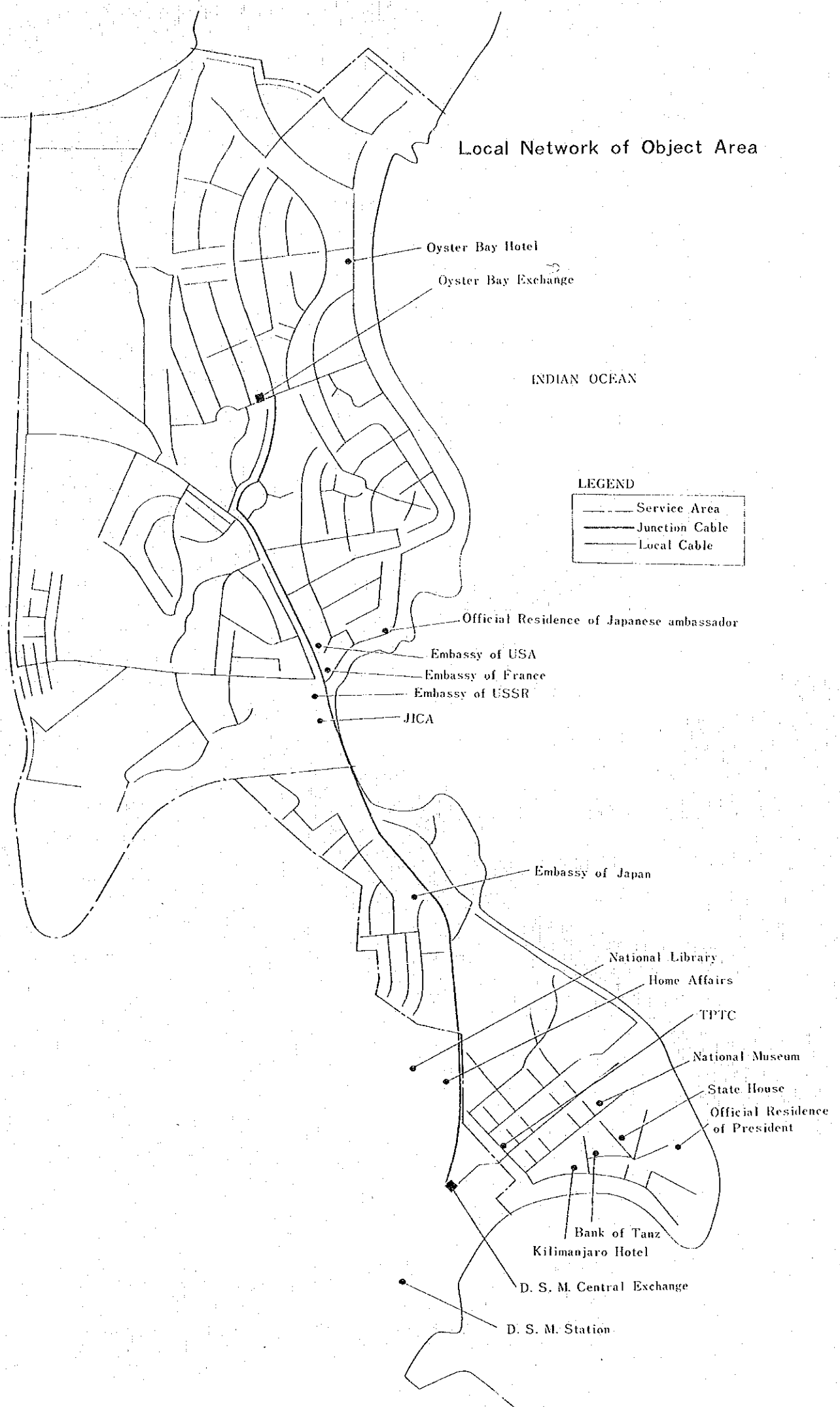
Kensuke Yanagiya
President
Japan International Cooperation Agency

THE UNITED REPUBLIC OF TANZANIA



0 50 100 150 200 250 300 350 400 Kilometres

Local Network of Object Area



SUMMARY

SUMMARY

An economic development plan was instituted in the United Republic of Tanzania in 1961. At the present time, the Economic Recovery Program (1986 - 1989) is being implemented. This program is concerned primarily with developing agriculture and creating a social and economic infrastructure. A top priority task, in this context, is to modernize and expand the country's superannuated telecommunications facilities. In particular, the telephone facilities in the capital city of Dar es Salaam are the oldest in the country, having been installed more than 30 years ago. Accordingly, the modernization of Dar es Salaam's telephone facilities is the most urgent task now facing the Tanzania Posts and Telecommunications Corporation (TPTC). In undertaking this task, TPTC drafted the Telecommunications Network Rehabilitation Project in the Dar es Salaam Area. Within this Project, the most critically urgent task is the modernization of telephone facilities in areas of Dar es Salaam where important subscribers such as government offices and agencies, financial institutions and foreign embassies are concentrated. In order to implement this portion of the Project, a request for grant aid was submitted to the Government of Japan.

In response to this request, the Government of Japan decided to carry out a basic design study concerning the Project. Accordingly, the Japan International Cooperation Agency (JICA) sent a basic design study team to Tanzania from January 16 to February 14, 1989 to conduct a fact-finding survey.

The survey team surveyed the condition of Tanzania's telecommunications facilities, as well as related conditions, project background factors, and project particulars. The team also conferred repeatedly with representatives of the Government of Tanzania, examined existing telecommunications facilities, studied their patterns of use, and surveyed the project sites. After the survey team returned to Japan, the results of the fact-finding survey were analyzed in Japan, and a draft of the team's final report was explained to Tanzanian officials. Then the basic design for the Project was consolidated into this Basic Design Study. That basic design is broadly outlined below.

(1) Modernization of Subscriber Cable Facilities

Subscriber cable facilities in the northeast section of the Dar es Salaam Central exchange area and in the entire Oyster Bay exchange area will be modernized, and underground facilities pertaining thereto will be constructed. The gas pressurization system, conventionally used for subscriber cable facilities, will be abandoned, and jelly-filled polyethylene insulated cables, which are easy to maintain and highly reliable will be used instead.

Installing the facilities noted above will eliminate such line failures as water penetration or breaks in the conductor cable, which currently cause call faults.

(2) Modernization of Telephone Switching Facilities

The switching equipment currently operated at the Oyster Bay exchange is antiquated, having been installed more than 30 years ago. This equipment suffers from pronounced deterioration, and it has become difficult to acquire parts and materials to repair it. It will therefore be replaced with mobile type switching facilities with a 3000-line unit capacity. As a result of this installation, all subscribers belonging to this exchange (numbering 2500), including those temporarily handled by other exchanges due to inadequate line capacity, will be handled properly, and calls that had been difficult to make due to poor switching connections will become easy to make.

(3) Modernization of Junction Cable Facilities

The junction cable facilities between the Dar es Salaam central exchange and the Oyster Bay exchange are superannuated. Accordingly, new junction cable facilities will be installed, and the necessary civil facilities will be serviced. This will make it easy to place calls between these two exchanges. (Such calls are presently difficult to make due to line failure.) This project may be outlined as follows:

a) Subscriber cable facilities

- No. of terminated pairs: 12,600
- Primary cable : 16.2 km
- Secondary cable : 109.0 km
- Underground conduit : 20.6 km

in the northeast section of the central exchange area and in the entire Oyster Bay exchange area.

b) Switching facilities

- Mobile type digital switching equipment (3000 line units) in the Oyster Bay exchange (including power facilities)
- Equipment for interfacing with the Oyster Bay exchange

c) Junction cable facilities

Fiber optic transmission system between Dar es Salaam central and Oyster exchanges (5.5 km) (including power facilities)

It is projected that the work which needs to be done by Tanzania in this project will cost 6.395 million Tanzanian shillings.

The time required for completion of the project, following the exchange of notes (E/N) by government representatives from both countries, is expected to be 26 months (4 months from design to the completion of contractor bidding, and 22 months for the actual construction). Project implementation is to be managed and day-to-day supervision provided primarily by TPTC. The budgetary outlays for the portion of the project undertaken by Tanzania are to be appropriated from the national development budget of the Government of Tanzania.

Upon completion of this project, line failure caused by poor switching connections and rainwater penetration into communications cables will cease, and it will be possible to provide stable communications services. These stabilized communications services may be expected to speed up the transmission of information, make administrative work more efficient, stimulate economic activity, enhance social welfare, and reduce the volume of road traffic (which has grown as a substitute for telecommunications).

Tanzania is currently endeavoring to implement its Economic Recovery Program. The implementation of a modernized telecommunications network will complement that program greatly by stimulating economic growth in Tanzania and enhancing the welfare of the people. Hence the grant aid provided by Japan is of enormous significance.

C O N T E N T S

PREFACE

SUMMARY

CHAPTER 1	- INTRODUCTION	3
CHAPTER 2	- PROJECT BACKGROUND	7
2-1	Conditions in United Republic of Tanzania	
2-1-1	Land and population	
2-1-2	National economy	
2-1-3	Economic recovery program	
2-2	Overview of telecommunications	
2-2-1	General description of telecommunications operations	
2-2-2	General condition of telecommunications facilities	
2-2-3	Organization and management	
2-3	General condition of facilities targeted by the plan	
2-4	International cooperation in the telecommunications field	
2-5	Request background and particulars	
2-5-1	Request background	
2-5-2	Request particulars	
CHAPTER 3	- PROJECT PARTICULARS	25
3-1	Areas affected by the plan	
3-2	Socio-economic conditions	
3-3	Project objectives	
3-4	Examination of request particulars	
3-4-1	Examination of project particulars	
3-4-2	Study of requested facilities and materials	
3-4-3	Implementing agencies	
3-4-4	Plan of operations	
CHAPTER 4	- BASIC DESIGN	35
4-1	Basic design policies	
4-1-1	External facilities	
4-1-2	Internal facilities	
4-2	Basic design conditions	
4-2-1	External facilities	
4-2-2	Internal facilities	
4-3	Basic plan of facilities	
4-3-1	Project areas	
4-3-2	Modernization and renovation particulars	
4-3-3	Financing responsibilities of Japan, Tanzania	

CHAPTER 5	- PROJECT IMPLEMENTATION PLAN	55
5-1	Organization of project implementation	
5-2	Implementation plan and material procurement plan	
5-2-1	Implementation plan	
5-2-2	Implementation supervision plan	
5-2-3	Material procurement plan	
5-3	Project implementation schedule	
5-4	Financing responsibilities of Tanzania	
CHAPTER 6	- MAINTENANCE AND MANAGEMENT PLAN	63
6-1	Maintenance and management organizations	
6-2	Maintenance and management plan	
CHAPTER 7	- PROJECT EVALUATION	69
CHAPTER 8	- CONCLUSIONS AND RECOMMENDATIONS	73
8-1	Conclusions	
8-2	Recommendations	
 ANNEXES		
Annex 1	Minutes of discussions (on survey)	
Annex 2	Minutes of discussions (on draft report explanation)	
Annex 3	Organization of basic design study team (on survey)	
Annex 4	Organization of basic design study team (on draft report explanation)	
Annex 5	Itinerary of basic design study team (on survey)	
Annex 6	Itinerary of basic design study team (on draft report explanation)	
Annex 7	List of persons met with basic design study team	
Annex 8	List of data collected	

BASIC DESIGN DRAWINGS

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

Telecommunications operations in the United Republic of Tanzania are conducted by the Tanzania Posts and Telecommunications Corporation (TPTC) under the authority of the Ministry of Communications and Works (MOCW). TPTC is also in charge of postal services in Tanzania.

Receiving grants from the World Bank, the African Development Bank, Italy, Sweden, and France, TPTC is now pushing ahead to modernize and expand Tanzania's telecommunications facilities. These efforts constitute one aspect of improving the social and economic infrastructure, which is a crucial task of the Economic Recovery Program (1986 - 1989).

The telecommunications facilities in Tanzania are still in an extremely poor state, in terms of both quantity and quality. In particular, the telecommunications equipment operated in the capital city of Dar es Salaam, the governmental, social, and economic center of the country, is the oldest anywhere in Tanzania. This equipment has already deteriorated to a considerable degree, and acquiring the parts and materials to repair it has become very difficult. There are 22,000 telephone subscribers in the city, with another 26,000 or so applicants waiting (as of the end of 1988). The demand for telephone services is thus rising sharply. To cope with this pressing situation, TPTC created the Dar es Salaam Telecommunications Network Rehabilitation Project, in which the most urgent task is to modernize the telephone facilities in the areas of the city where government offices and financial institutions are concentrated. Japan was then asked to implement this project in the form of grant aid.

In response to this request, the Government of Japan decided to carry out a basic design study concerning the Project. Accordingly, the Japan International Cooperation Agency (JICA) sent a basic design study team to Tanzania from January 16 to February 14, 1989 to conduct a fact-finding survey. The team was headed by Mr. Takuo Kidokoro, Assistant Director of the Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs.

The survey team was commissioned to study the appropriateness of the project as a subject of grant aid and the nature and scale of cooperation envisioned. For this purpose, the team conducted on-site surveys to ascertain the state of existing telecommunications facilities, utilization profile, maintenance and operating conditions, and training programs, as well as the current state of the social and economic infrastructure. The survey team also conferred repeatedly with Tanzanian officials concerning the project. As a result, matters of basic agreement were drawn up in the form of minutes of discussions and signed by both sides.

Upon the survey team's return to Japan, its findings were further studied and analyzed. This resulted in the drafting of a grant aid proposal for the project, which was approved. A basic design study (draft) comprising the basic design, a project implementation plan, a maintenance plan, and project evaluation provisions was then drawn up.

A study team was then sent to Tanzania from April 17 to April 28, 1989 to explain the basic design study (still in draft form) to Tanzanian officials. This second team was headed by Mr. Hiroshi Yoshida, International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications. After discussions between both parties concerning the draft of the basic design study, the basic matters of agreement were drawn up in the form of minutes of discussions and signed by both sides.

This report deals with the result of the basic design study carried out under the above circumstances.

The organization of the study team, itinerary of the study team, list of people with whom the study team spoke, and minutes of discussions are included in this report as annex.

CHAPTER 2

PROJECT BACKGROUND

CHAPTER 2

PROJECT BACKGROUND

2-1 Conditions in United Republic of Tanzania

2-1-1 Land and population

The name Tanzania is a combination of three elements, namely the TAN from Lake Tanganyika on the country's western border, the ZAN from Zanzibar Island, which lies off the coast of Tanzania, and the NIA from Azania, the name of the ancient civilization of the Bantu tribe. The mainland portion of the country gained its independence on February 9, 1961, and the two islands of Zanzibar became independent on December 10, 1963. These territories were merged into the United Republic of Tanzania in 1964.

Tanzania occupies a land area of 945,087 square kilometers (942,626 square kilometers on the mainland). The population was estimated at 22.4 million in 1985, and is growing at an annual rate of 3.4%.

2-1-2 National economy

The backbone of Tanzania's economy is agriculture. The gross national product (GNP) was estimated at \$5.84 billion in 1985, yielding a per-capita GNP of approximately \$270. The annual growth rate in GNP from 1973 to 1985 was 1.6%. Imports totaled \$1,017 million and exports \$255 million in 1985. In 1986 imports from Japan amounted to 16,765.90 million yen, with exports to Japan reaching 3,838.07 million yen. Tanzania's foreign currency reserves totaled \$16 million in 1985. From 30 to 35% of the nation's export revenues are accounted for by a single commodity, namely coffee. Other major exports include cotton (13%), cloves (10%), sisal (5%), and diamonds (5%).

The economy has been in a precarious condition since the early 1980s as a result of extended droughts. In order to deal with the distressing situation, new investments were discouraged, priority was given to investments in improving the nation's social and economic infrastructure in projects already underway, and the use of domestically procurable materials was promoted to reduce the trade deficit. The Economic Recovery Program was set in motion and economic liberalization promoted in conjunction with devaluing the currency, reorganizing public corporations and foundations, liberalizing trade, and removing price controls. However, it was not possible to alter the direction of entrenched socialistic policies so quickly, and the economy continued to be plagued by shortages of foreign capital. The country was therefore obliged to look overseas for new extensions of aid.

2-1-3 Economic recovery program

Receiving aid from the IMF, the Government of Tanzania drafted a new plan for the period 1982 to 1984 (the Structural Adjustment Plan) and began to implement it. In 1986 the government drew up the New Economic Recovery 3-Year Program, which is still being implemented today. The main objectives of the Economic Recovery Program are as follows:

- 1) Promote increased production of food and export produce by making grants to stimulate production, improving distribution mechanisms, and providing agricultural production materials.
- 2) Create/improve social and economic infrastructure to stimulate production activity.
- 3) Allocate foreign currency to high-priority segments of the economy and raise the operation rates in those segments.
- 4) Institute suitable policies to decrease the national deficit and improve the international balance of payments.

In support of these objectives, the following three policies were to be implemented:

- 1) Raise producers' prices.
- 2) Lower the official exchange rate and liberalize trade.
- 3) Adopt fiscal and monetary policies to curb inflation and improve the efficiency of resource allocation, and implement institutional reforms to rationalize the public sector and improve economic management.

The program calls for a 4.5% average annual growth in GDP over the next 5 to 7 years, and places heavy emphasis on agriculture and related transportation fields.

2-2 Overview of telecommunications

2-2-1 General description of telecommunications operations

The Tanzania Posts & Telecommunications Corporation (TPTC) was formed on February 3, 1978, coinciding with the demise of the East African Community. This corporation was commissioned to administrate the postal, telegraph, and telephone services which had been handled by the East African Community.

TPTC conducts both domestic and international communications services. The international services include telephone, telex, and telegraph services, with telephone and telex traffic accounting for most of the volume (telex traffic being slightly greater than telephone traffic). Telex traffic has been increasing in recent years, while telephone communications have been declining. This is understood to be due to the use of telex communications as a substitute for telephone communications. Domestic communications services include telephone, telex, telegraph, and telegraphic transfer services, with telephone

traffic accounting for the major portion. In particular, long-distance calls are becoming steadily more numerous as social and economic activity intensifies and broadens geographically.

2-2-2 General condition of telecommunications facilities

As of December 1987, there were 0.25 main telephones installed per 100 persons in Tanzania, and 0.53 telephone sets per 100 persons. Most of the exchanges currently operated are of the analog type, although digital exchanges have been introduced in the cities of Zanzibar and Morogoro (to total 2 exchanges).

The current state of telecommunications facilities in Tanzania is outlined below (as of October 1988).

(1) Local telephone facilities

- 1) Number of line units : 80,553
 - Automatic : 61,900
 - Manual : 18,653
- 2) Number of automatic exchanges : 37
- 3) Number of manual exchanges : 155
- 4) Main telephone units : 64,958
- 5) Average annual growth rate in main telephones : 7.7%
- 6) Main telephone percentage: 80.6%
- 7) Number of applicants waiting for service : 88,714

(2) Trunk facilities

Automatic trunk connection service is currently provided between 14 cities nationwide.

(3) Telex facilities

Three telex exchanges are now being operated, comprising one international exchange and two domestic exchanges. There are currently 1351 telex subscribers with 2112 applications waiting for service.

(4) International communications facilities (excluding those connecting to Kenya and Uganda)

- 1) Telephone lines : 107
- 2) Telex lines : 79
- 3) Telegraph lines : 9

2-2-3 Organization and management

(1) Organization

The primary authority for telecommunications in Tanzania is the Ministry of Communications and Works (MOCW). Under the authority of MOCW, the Tanzania Posts and Telecommunications Corporation (TPTC) functions as the business and operating organization to provide a unified management of telecommunications operations and postal operations.

The telecommunications operations comprise such public communications services as domestic and international telephone, telex, and telegraph services.

As of the end of 1988, TPTC employed 8258 persons. The breakdown is as follows:

<u>Division</u>	<u>Number of employees</u>
Postal services	1,661
Postal savings services	99
Communications operations	1,544
Communications engineering	1,806
General Workers (postal + telecom)	3,148

In the telecommunications area, the employee figure in the communications engineering division may be further broken down as follows:

<u>Job category</u>	<u>Number of employees</u>
Engineers	607
Technicians	1,199
Laborers	429

The organizational chart is given in Figure 2-2.

(2) Conditions of activity

1) General Conditions

Since TPTC was established in 1978, it has been handling mail, telegraph, and telephone work, and has been providing both domestic and international communications services.

At present, TPTC is implementing its own five-year development plan (1984 to 1989) to promote progress in telecommunications fields. This is just one of its plans for promoting economic development with specific goals for solidifying the infrastructure and economic foundations of society.

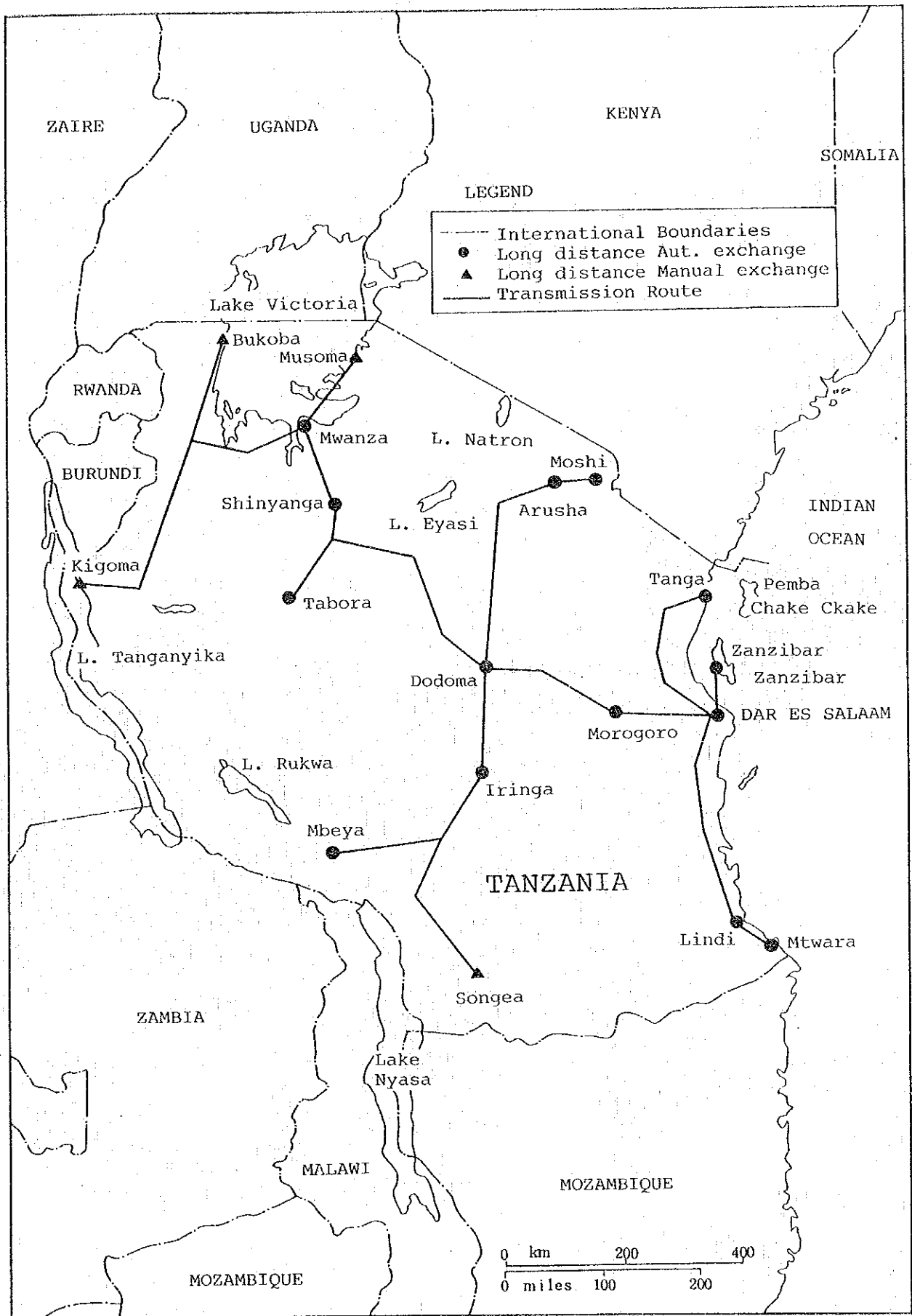


Figure 2-1 Long distance Network

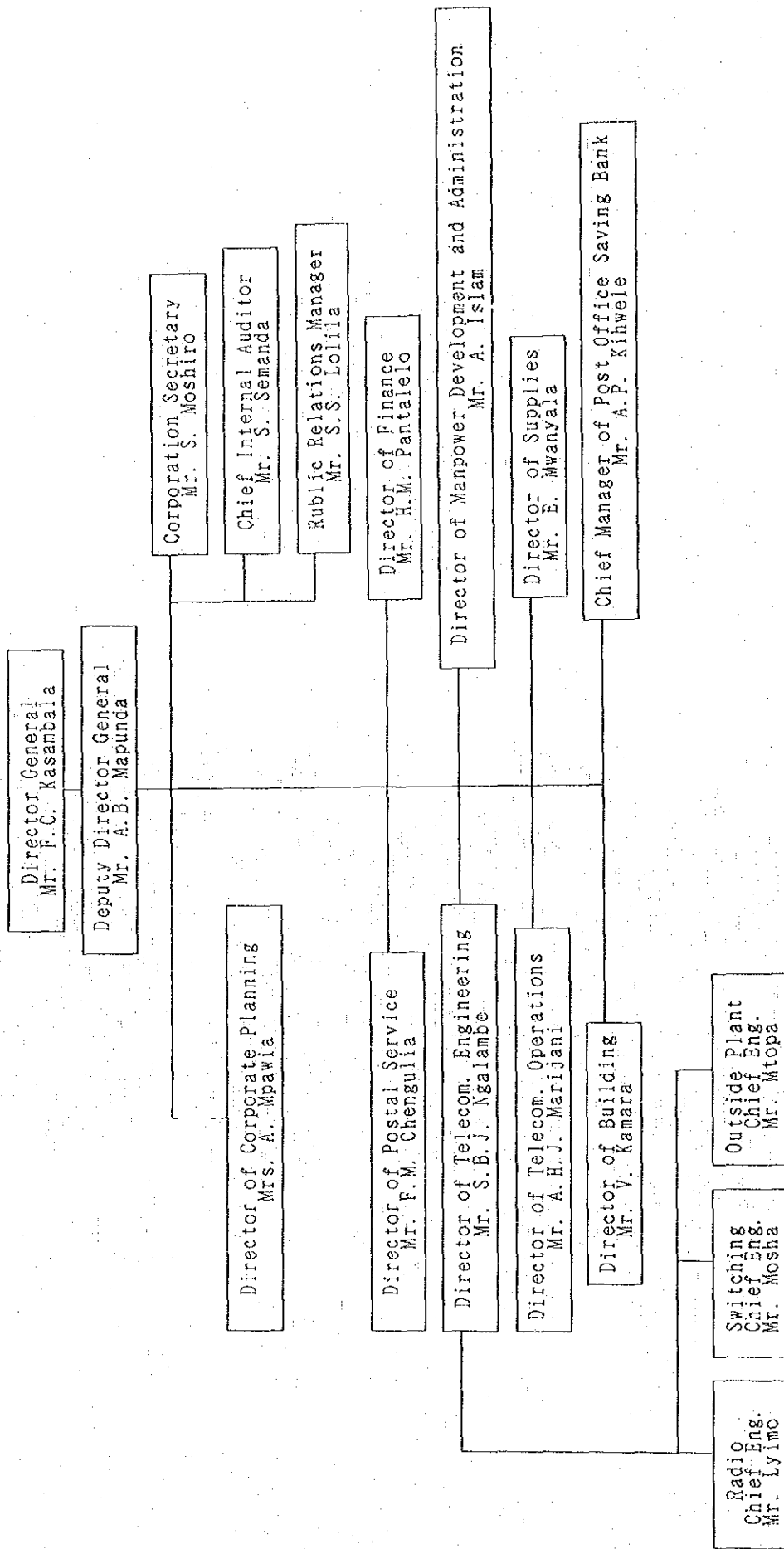


Figure 2-2 TPTC's organization

2) Five-Year Development Plan

In the plan statement, TPTC states that the greatest obstacles to providing telecommunications services are the age and deterioration of existing facilities, inadequate supply of maintenance parts, and insufficient work vehicles and personnel. The plan was in fact drafted with the aim of solving these various problems, and it sets the greatest priority on establishing an internal telecommunications network for the capital city, Dar es Salaam, as well as strengthening services between the large cities and medium size cities, and increasing the scale of facilities.

However, inadequate foreign currency, as well as a lack of spare parts and work vehicles have been serious obstacles to implementing the plan, and only about 60% of the work that had been scheduled has been completed.

(3) Financial Conditions

The following tables contain data on the revenue and expenditure conditions and funds procurement conditions for the telecommunications work of TPTC.

- 1) The following table contains the data on TPTC revenue and expenditure between 1980 and 1987.

Table 2-1 Revenue and Expenditure

Unit: Million Tanzanian Shillings

Item	Year							
	1980	1981	1982	1983	1984	1985	1986	1987
Revenue:								
1) Telephone	333.4	290.1	391.0	390.1	580.4	1078.6	1161.2	1270.1
2) Telegraph	55.7	62.4	60.4	80.0	102.8	134.9	144.5	423.6
3) Telegram, dedicated lines, etc.	14.7	19.5	20.4	21.5	28.4	42.6	34.0	41.0
4) International communications	21.7	27.7	33.9	33.0	53.2	89.4	366.5	368.0
5) Total of 1) to 4)	425.5	399.7	505.7	524.6	764.8	1345.0	1706.3	2102.7
6) Amount not yet collected	8.5	15.0	10.1	14.0	17.0	22.0	34.1	42.1
Overall total (A)	417.0	384.7	495.5	510.5	747.8	1323.0	1672.2	2060.6
Expenditure:								
1) General operating cost	92.1	101.3	93.3	121.2	122.8	467.2	794.5	978.3
2) Maintenance and operation	23.8	31.0	41.6	44.6	93.0	123.0	125.0	143.7
3) International communications	32.6	45.2	57.3	122.7	130.0	146.0	448.3	621.3
4) Repairs	8.8	8.9	12.8	12.1	13.0	17.9	15.5	13.5
5) Depreciation costs	43.7	46.9	48.9	52.1	48.0	45.7	176.3	404.4
6) Other	8.8	22.3	31.8	25.9	30.0	-	-	-
7) Interest payments	15.0	20.0	25.0	45.0	75.0	80.0	220.0	460.0
Total expenditures (B)	224.8	275.6	310.7	423.6	511.8	879.8	1779.6	2621.2
Pre-tax profit (A) - (B)	192.2	109.1	184.8	86.9	236.0	443.2	-107.4	-560.6
Tax (50%) (C)	96.1	54.6	92.4	43.5	118.0	221.6	0	0
After tax profit (A) - (B) - (C)	96.1	54.6	92.4	43.5	118.0	221.6	-107.4	-560.6
Expenditure-income ratio (B)/(A) %	53.9	71.6	62.7	83.0	68.4	66.5	106.4	127.2

The data given in Table 2-1 for TPTC revenue and expenditure shows that the average percentages for telephone income and other income in the total income are as follows. The uncollected amount is approximately 2%.

Telephone income	: Approximately 71%
Telegraph income	: Approximately 14%
Income from telegrams and dedicated lines, etc:	Approximately 2%
Income from international communications	: Approximately 13%
Total	: 100%

Average percentage for each type of expenditure in the total expenditure is as follows.

General operating costs	: Approximately 39%
Maintenance and operating costs	: Approximately 11%
International communications costs	: Approximately 23%
Depreciation costs	: Approximately 12%
Interest payments	: Approximately 13%
Other	: Approximately 2%
Total	: 100%

Since 1980, income has been increasing steadily, and expenditure has been increasing in proportion, but while the ratio of expenditure to income between 1980 and 1985 averaged 67%, it deteriorated in 1986 to 106.4%, and in 1987 to 127.2%. The increase in general operating costs is one important factor behind this. As Table 2-1 shows, between 1980 and 1984, general operating costs on average accounted for 18% of the total expenditure, but they increased dramatically in 1985 to 53%. Compared with the 77% growth in income over the previous year for 1985, the growth in general operating costs over the previous year reached a staggering 380%.

In 1986 and 1987, general operating costs declined somewhat to 44% and 37%, respectively, but general operating costs have a very big influence on the balance of revenues and expenditures, and consequently TPTC should work hard to reduce significantly the proportion of general operating costs in the overall expenditure.

As Table 2-2 shows, TPTC's funds procurement involved funds on hand and external funds.

Between 1980 and 1983, TPTC procurement of external funds was steady with respect to its requirements, but from 1984, the procurement ratio rapidly decreased, falling to 0 in 1987.

Because of an inadequate procurement of external funds and the deterioration in the balance of revenue and expenditure, in 1986 and 1987 TPTC had to incorporate money made in asset sales and loans from domestic banks in funds on hand and allot these as part of its funds for the respective financial years.

However, as a result of problems like the inadequacy of overseas funds, only 60% of development work specified in its plans for 1987 was actually implemented. From 1988, funds have been procured from the World Bank, the Africa Development Bank, and also in bilateral assistance (from countries such as Italy, Sweden, and France). Refer to Section 2-4 below for details of international cooperation in the telecommunications field.

2) Funds Procurement

The following table contains the data on TPTC funds procurement between 1980 and 1987.

Table 2-2 Funds Procurement

Unit: Million Tanzanian Shillings

Item	Year							
	1980	1981	1982	1983	1984	1985	1986	1987
Funds on hand:								
1) Carried over from previous year	81.3	171.4	118.0	125.6	60.8	82.8	190.6	314.9
2) Net profit	96.1	54.6	92.4	43.5	118.0	221.6	107.4	560.6
3) Depreciation costs	43.6	46.9	48.9	52.1	48.0	45.7	176.3	404.4
4) Re-evaluation of assets and liabilities collected (Sale of assets & debt, etc.)	-	-	-	-	-	-	2568.7	4474.8
Total of 1) to 4) (A)	221.1	272.9	259.3	221.2	226.8	350.1	2828.2	4633.5
External funds:								
World Bank, Sweden, etc.	95.1	95.1	117.5	285.8	234.9	44.0	101.0	0
Total (B)	95.1	95.1	117.5	285.8	234.9	44.0	101.0	0
(TPTC foreign capital requirements)	64.8	85.4	146.6	283.2	347.2	413.4	798.7	1533.1
(Ratio of funds procured abroad %)	146.8	111.4	79.6	100.9	67.7	10.6	12.6	0
Funds procurement total (A)+(B)	316.2	368.0	376.8	507.0	461.7	394.1	2929.2	4633.5

2-3 General condition of facilities targeted by the plan

The Dar es Salaam central exchange area and Oyster Bay exchange area are both characterized by high concentrations of government offices, foreign embassies, commercial offices, and other important subscribers. The deterioration in telecommunications services in these areas has adversely affected government, social, and economic activity in Tanzania. The causes of this decline in service are the conditions in communications facilities noted below.

(1) External facilities

Such existing external facilities as subscriber cables and junction cables were installed more than 30 years ago. A considerable portion of these facilities exhibit deterioration which has been left unrepaired due to shortages of parts and materials needed to make the repairs. Hence the restoration of the external facilities has fallen behind.

The cables currently in use are of an extremely outdated type, consisting of lead-sheathed paper-insulated wire, which is susceptible to water penetration. Another factor which is inhibiting the maintenance of the external facilities is the lack of the spare conduits necessary for replacing damaged cable.

(2) Switching facilities

The automatic telephone switching equipment (having a 2000-line switching capacity) operated in the Oyster Bay exchange, and slated for modernization, consists of step-by-step switches made in Britain and installed more than 30 years ago. Such switching equipment represents a very primitive stage in the development of automatic exchange equipment, and the acquisition of spare equipment and parts needed to make repairs is extremely difficult. The situation has reached the point where, when a malfunction occurs, it is left inadequately repaired.

2-4 International cooperation in the telecommunications field

The current situation with respect to foreign funding and technological aid in the field of telecommunications, and to the status of projects in the field, is outlined below.

(1) World Bank (IDA Second Loan)....Total aid = US\$23 million

- 1) Contributing cables and related hardware for the repair of cable facilities in regional exchange areas. A contract has been concluded for the purchase of these repair-related materials.
- 2) A project to modernize and expand the international telex exchange has been concluded.

- 3) Work to modernize the local switching equipment in the telephone exchanges in Sinigida and Mtwara has not started yet.
- 4) Installation of a digital exchange with 6000 line units in the telephone exchanges at Moshi and Tanga. Bids on this work are still being evaluated.
- 5) A contract has been concluded for the purchase of telephone sets, teleprinters, public telephone instruments, line security equipment, and repair vehicles.

(2) African Development Bank....Total aid = US\$5 million

- 1) Installation of digital exchanges with 4000 line units in the Kigoma and Bukoba exchanges. Contract negotiations are now in progress.
- 2) Contract negotiations are now being conducted for the installation of international lines connecting Tanzania with Burundi, Rwanda, and Uganda.

(3) Italy (Bilateral Aid)....Total aid = US\$15 million

- 1) Install and expand satellite earth station equipment.
 - 2) Install communications lines between Muanza and Musoma and related regions.
- Items 1) and 2) above are now being studied by both countries.

(4) Italy (SADCC Aid)....Total aid = US\$16.5 million

- 1) Contribute digital microwave facilities between Dodoma and Dar es Salaam and between Dar es Salaam and Zanzibar.
- 2) Contribute trunk switching equipment for Dar es Salaam.

The above projects were contracted in December, 1988. Work is scheduled to begin in 1989.

(5) Sweden (Bilateral Aid)....Total aid = 60 million Sweden krone

- 1) Contribute external drop wires, cable accessories, and tools needed to repair telephone facilities in Dar es Salaam, Dodoma, and Zanzibar.
The provision of these repair materials is intended as an emergency measure and does not pertain to the areas affected by the 5-year plan.
- 2) Consulting work for maintenance operations and preparatory drafting of master plan covering the entire country.

(6) France (Bilateral Aid)....Total aid = 70 million French francs

- 1) Contribute telex exchange equipment for Dodoma.
- 2) Contribute telephone switching equipment for Lake Victoria region.

Items 1) and 2) above are now being studied by both countries.

2-5 Request background and particulars

2-5-1 Request background

The United Republic of Tanzania is currently implementing its Economic Recovery Program (1986 - 1989), giving priority to the enhancement of the country's societal and economic infrastructure. Particular priority is being given, in this context, to the modernization and expansion of telecommunications facilities, which are being undertaken by TPTC (the primary project authority) through the implementation of a 5-year development plan and the acquisition of aid from the World Bank, the African Development Bank, Italy, Sweden, and France.

The telecommunications facilities in Tanzania are still in an extremely poor condition, in both qualitative and quantitative terms. In particular, the telecommunications equipment currently operated in the capital city of Dar es Salaam (the center of the nation's governmental, social, and economic activity) are the oldest in the country, having been installed more than 30 years ago. These outdated facilities suffer pronounced deterioration due to age, and it is very difficult to procure the parts and materials needed to repair them. There are currently some 22,000 subscribers in Dar es Salaam, with some 26,000 more applicants waiting for service (as of the end of 1988). Hence subscriber growth is steady.

To deal with this pressing situation, TPTC has made the modernization of facilities in Dar es Salaam the most urgent task of all in its 5-year development plan. Accordingly, TPTC drew up the Dar es Salaam Telephone Network Modernization Project and requested that Japan implement this project in the form of grant aid.

2-5-2 Request particulars

The details of the request made by the Government of Tanzania to the Government of Japan are as follows:

(1) Modernization of subscriber cable facilities

1) Areas To Be Modernized

Northeast section of Dar es Salaam exchange area and all of Oyster Bay exchange area

2) Scale of Modernization

- Primary cable network : Cable replacement 24.0 km
- Secondary cable network : Cable replacement 100.0 km

(2) Modernization of junction cable facilities

Replace junction cable facilities between Dar es Salaam central exchange and Oyster Bay exchange : 5.5 km

(3) Construction of civil facilities

1) Construct the civil engineering facilities needed to modernize subscriber cable facilities and junction cable facilities.

2) Renovate manholes and handholes (60 locations) and lay conduit (40 km).

(4) Modernization of switching facilities

Replace existing switching facilities (2000-line capacity) at Oyster Bay exchange with mobile type digital telephone switching equipment (4000-line capacity).

CHAPTER 3
PROJECT PARTICULARS

CHAPTER 3

PROJECT PARTICULARS

3-1 Areas affected by the plan

The areas affected by this plan are the northeast section of the central area of the capital Dar es Salaam and the Oyster Bay area which is adjacent to the central area on the north side.

The line of division between these two areas is formed by the Msimbazi River, which transects Dar es Salaam from southwest to northeast as it flows toward the Indian Ocean.

The areas affected by the plan are bordered on the east by the Indian Ocean, on the west by the residential district of Magomeni, on the south by the Dar es Salaam harbor district, and on the north by the exclusive residential districts of Msasani and Kijitonyama. The figure 3-1 shows the areas affected by the plan and major offices, etc. in the areas.

3-2 Social and economic conditions

Dar es Salaam is an important center of trade and transportation in East Africa which developed long ago as a harbor town.

(1) The northeast section of the central district

The northeast section of the central district is the center of governmental, bureaucratic, and economic activity. Located here are the Presidential residence and such government agencies as the Ministry of Finance, Planning and Economic Affairs, the Ministry of Communications and Works, the Ministry of Information, the Ministry of Home Affairs, the Ministry of Development and Planning, the Ministry of Health and Social Welfare, the Supreme Court, State Parliament Building, and the Tanzania Posts and Telecommunications Corporation (which has prime responsibility for this project). Also located here are such financial institutions as the Bank of Tanzania and various city banks, museums, large hotels (including the state-run Kilimanjaro Hotel), various foreign embassies, large hospitals, and the offices of insurance companies. The population in the area was estimated at 41,000 in the end of 1988 and the land area is 2.7 square kilometers.

(2) The Oyster Bay district

The Oyster Bay district is a newly developed area in which are located the embassies of the United States, the Soviet Union, France, Rumania, and Hungary, as well as the residences of foreign ambassadors and embassy personnel, residences of other high Tanzanian officials, and such social institutions as hotels, a bus terminal, hospitals, schools,

and police headquarters. The population in the area was estimated at 65,000 in the end of 1988 and the land area is 9.7 square kilometers.

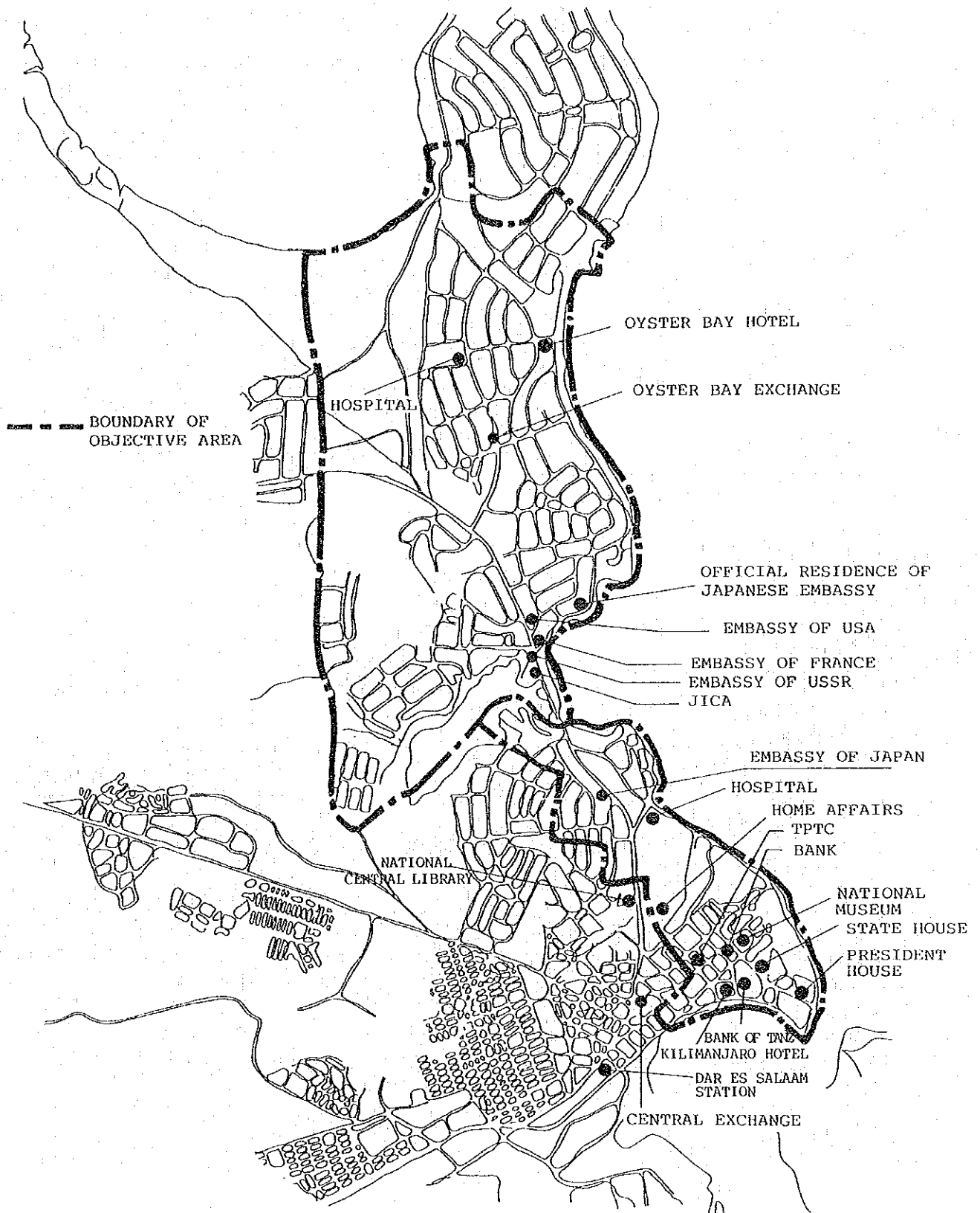


Figure 3-1 Objective area

3-3 Project objectives

As part of the previously instituted Economic Recovery Program, TPTC formulated its own 5-year plan for modernizing and expanding Tanzania's telecommunications facilities with aid obtained from the World Bank, the African Development Bank, Italy, France, and Sweden. Implementation of this plan has been hampered, however, by shortages of foreign currency, spare equipment, and work vehicles.

One of the projects given the highest priority was the modernization of the telephone network in Dar es Salaam. Emergency project status was given, however, to the modernization and improvement of the telephone networks in two critical districts (the northeast section of the Dar es Salaam central exchange area and the entire Oyster Bay exchange area) in which are concentrated government offices, foreign embassies, other public institutions, and financial institutions. Japan was then requested to implement this portion of the project in the form of grant aid. The purpose of this project is to provide better telecommunications services by modernizing the telephone networks in the aforesaid areas, and thereby to contribute to Tanzania's Economic Recovery Program, stimulate economic activity, and promote better telecommunications operations.

3-4 Examination of request particulars

3-4-1 Examination of project particulars

This project will replace the superannuated subscriber cables and civil facilities in the northeast section of the Dar es Salaam central exchange area and the entire Oyster Bay exchange area, replace the outdated switching facilities in the Oyster Bay exchange, and modernize the junction cable facilities connecting the Dar es Salaam central exchange and the Oyster Bay exchange.

(1) Subscriber cables and civil facilities

The request pertains to the restoration and modernization of:

- 1) cable facilities including other associated facilities in the project areas, and
- 2) civil facilities including the conduits (which accommodate and protect the cables), manholes, and other associated hardware.

The existing superannuated cable facilities have been left in a state of disrepair due to shortages of repair materials. Maintaining the line facilities is rendered even more difficult by damage to underground conduits and the unavailability of empty conduits. Accordingly, there is a need to implement radical restorative measures according to this project.

(2) Switching facilities

The British-made step-by-step automatic telephone switching equipment (2000-line capacity) currently being operated in the Oyster Bay exchange is antiquated, and is difficult to keep in repair and operate due to shortages of spare parts. The request envisions, therefore, the removal of all existing switching equipment and the installation in its place of new mobile digital switching equipment (4000-line capacity).

With respect to the requested 4000-line capacity, the following has been decided. The telephone subscribers affected by this modernization total approximately 2,500 when we include those now served by the Oyster Bay exchange (approximately 1900), those accommodated temporarily by Kijitonyama (approximately 100) and by the Dar es Salaam central exchange (approximately 500) as a result of inadequate facility capacity. Allowing for the extra line capacity (10 - 20%) that is always needed in maintaining and operating such a system, and in switching subscriber exchanges, a line capacity of 3000 is believed to be adequate. However, it is desirable that Tanzania be able to expand these facilities easily in the future. Accordingly, the system should be expandable to a maximum 4000-line capacity and have a capability of call processing to be suitable to the line capacity.

(3) Junction cable facilities

The Government of Tanzania, in its original request, proposed the adoption of the same loaded cable system that is used in the existing trunk facilities. During the fact-finding survey, however, this request was changed from the loaded cable system to an optical fiber cable system. It is concluded that the optical fiber cable system should be adopted due to its advantages in maintainability (no repeater and no electrical damage, etc.), cost reduction of conduit facilities by using sub-duct system and facility expandability.

It is proposed in the official request that the junction cable facilities be given a line capacity of approximately 700 circuits. As noted above, however, a switching facility capacity of 3000 line units (expandable to a maximum capacity of 4000 lines) has been decided upon, and the capacity of the junction facilities should be matched with that of the switching facilities. Preliminary calculations reveal that approximately 500 circuits are necessary to handle the traffic generated from an exchange having a capacity of 3000 lines. Accordingly, the capacity of the junction facilities is to be approximately 500 circuits. However, the system should be expandable for a future expansion.

3-4-2 Study of requested facilities and materials

(1) Subscriber cable and civil facilities

In addition to being superannuated, the existing subscriber cables in the project areas present the following problems:

Cables that should be protected by conduits are buried directly in the ground at a depth of 30 to 50 cm, resulting in line failures due to water penetration. TPTC has tried to observe cable damage by water penetration by implementing a gas-pressurization system, but the facilities are superannuated, and this method is not working well. In this project, the gas pressurization method will be abandoned in favor of jelly-filled polyethylene-insulated cable. The latter is easy to maintain and highly reliable.

(2) Switching facilities

At the present time, three types of automatic telephone switching equipment are being operated, namely the step-by-step system, the cross-bar system, and the digital system. As part of its 5-year plan, TPTC is implementing a modernization project with the use of digital switching equipment. The switching equipment now in use at the Oyster Bay exchange (which is to be modernized in this project) is of the step-by-step system. More than 37 years have passed since its installation in 1951.

In the request it is proposed that this switching equipment be replaced with digital switching equipment. For the reasons given below, this proposal is thought to be very appropriate.

The history of the development of automatic switching equipment is one of continual improvements in function, advancing from a step-by-step system to a cross-bar system to an analog electronic switching system and most recently to a digital switching system. As is evident from the history of switching equipment, it is digital exchange equipment which is now positioned in the forefront in terms of improved functionality. Exchange equipment manufacturers are putting great effort into the manufacture and sale of their latest models. At present, the cross-bar switching equipment which was the standard equipment in 1960s in Japan is being manufactured only for repair purpose. Its production, therefore, is very limited and the future procurement for expansion or repair of the cross-bar switching equipment can hardly be guaranteed.

(3) Junction cable facilities

For the following reasons, the adoption of optical fiber cable in the junction facilities is judged to be appropriate:

Optical fiber cable systems employ light as the medium for transmitting calls. Hence they are impervious to electrical damage by lightning, etc. Optical fiber cable is lighter and smaller in diameter than conventional cable, therefore, multiple fiber cables can be

accommodated in a single underground conduit. This results in lower civil construction costs. However, if a cable were cut, the effect on the system would be enormous. Therefore, a dual-conduit sub-duct system will be adopted to protect the optical fiber cable. This method of cable protection has been adopted internationally.

(4) Exchange building facilities

The following measures will be taken with respect to the telephone exchange buildings which will house the exchange facilities that are to be installed in this project:

1) Oyster Bay exchange

At the Oyster Bay exchange new switching and transmission equipment, as well as the necessary power supply facilities, will be installed. TPTC requested a mobile-type exchange. Ferro-concrete buildings or the like are used in most cases for the telephone exchange buildings which house exchange facilities.

However, in this project, it is possible that delays in the construction of such exchange buildings will result in delays in the overall project, including the installation of communications equipment. To guard against such an eventuality, it is preferable that mobile exchange equipment be installed. This type of equipment is easy to install and permits shorter construction times.

2) Dar es Salaam central exchange

This project calls for the installation of new optical transmission equipment and its associated power supply facilities in the central exchange building, in addition to the facilities already installed there. The new equipment will be located in available unoccupied space in the existing exchange building.

3-4-3 Implementing agencies

The governmental agency having prime authority over telecommunications in Tanzania is the Ministry of Communications and Works (MOCW). Actual operations are the responsibility of the Tanzania Posts and Telecommunications Corporation (TPTC).

This project will be carried out by TPTC, under the authority of MOCW. In the interest of implementing the project smoothly, TPTC will select a project manager who will be responsible for the business matters relating to project implementation. The project manager will manage the implementation of the project, working closely with consultants.

TPTC will be responsible for the removal of existing facilities that are no longer needed. TPTC will also be responsible for the renovation of interior wiring facilities, including the replacement of telephone sets installed in residences, and it will carry out such work as the installation of interface equipment provided by grant aid.

3-4-4 Plan of operations

After studying the request particulars, it has been decided to carry out the following renovation matters:

(1) Subscriber cable facilities

The subscriber cable facilities and related civil facilities will be renovated as follows in the northeast section of the Dar es Salaam central exchange area and in the entire Oyster Bay exchange area.

1) Subscriber cable facilities

The subscriber cable facilities are made up of cable termination equipment, primary cables, cross-connection cabinets, secondary cables, and distribution boxes.

2) Civil facilities

The civil facilities consist of conduits, manholes, and handholes. These facilities accommodate cables and repeaters. They will be protected against external damage when work is done on water mains or roads.

(2) Switching facilities

The step-by-step switching equipment (2000-line capacity) currently in use in the Oyster Bay exchange will be replaced by mobile type digital switching equipment (3000-line capacity). This system will allow for future expansion to a capacity of 4000 lines. In addition, the interface equipment required in the Dar es Salaam central exchange in conjunction with this modernization project will be installed.

(3) Junction facilities

In order to modernize the junction facilities between the Dar es Salaam central exchange and the Oyster Bay exchange, optical fiber cable will be laid, and transmission equipment, together with the necessary power facilities, will be installed in the two exchange buildings to terminate the optical fiber cable.

CHAPTER 4
BASIC DESIGN

CHAPTER 4

BASIC DESIGN

4-1 Basic design policies

The particulars to be implemented in this modernization and renovation project were discussed in Chapter 3. The following basic design policies are set forth and are to be duly considered so that no confusion arises in the basic design in such areas as the maintenance of the facilities modernized or renovated in this project.

4-1-1 External facilities

External facilities are composed encompass cables and civil facilities. With respect to these facilities, the following basic design policies have been established:

(1) Cable facilities

- 1) The cable distribution system to be adopted employs cross connection cabinets in the interest of ease of maintenance and distribution efficiency.
- 2) For sections of primary and secondary cable that are laid underground, jelly-filled polyethylene cable will be used to prevent water penetration into the cable and enhance maintenance efficiency.
- 3) Conduit will be used for the primary cable to prevent damage from other construction work (on roads, electrical lines, water mains, etc.) and to simplify maintenance.
- 4) Secondary cable will either be buried directly in the ground (buried system) or strung from telephone poles (aerial system).
- 5) Two types of outdoor distribution box will be used, namely a pole-mounted box and a wall-mounted box. For large-scale subscribers such as buildings, indoor distribution boxes will be employed.
- 6) Existing cable will not be reused, but such hardware as cross connection cabinets, distribution boxes, and telephone poles will be reused in facilities where appropriate.

(2) Civil facilities

The construction of underground conduit facilities require enormous amounts of funding. Accordingly, within the scope of this

design, appropriate decisions will be made on the selection of underground conduit routes, estimating the number of conduits required, and determining the shapes and dimensions of the manholes. Due consideration will be given to economy, safety, maintainability, and workability.

1) Selection of conduit routes

Conduit route selection will be based on city planning resources, and will be made after due consideration is given to the technical problems involved in the construction and maintenance of the routes.

2) Number of conduits

On determination of the number of conduits in a conduit route, one additional conduit for one additional emergency cable will be included with the conduits for the other new cables (to provide a substitute cable in the event of a cable malfunction). The number of conduits will be determined, moreover, so as to enable effective renovation, giving due consideration to technical problems involved in the construction work and in the entire TPTC project.

4-1-2 Internal facilities

Internal facilities comprise switching facilities, the indoor portions of junction facilities (i.e. transmission facilities), and the necessary power facilities for providing electrical power to the aforesaid facilities. The basic design policies for internal facilities are as follows:

(1) Switching facilities

The modernization/renovation particulars for the switching facilities are as follows, based on the results of the studies discussed in Chapter 3. The existing step-by-step switching equipment at the Oyster Bay exchange is superannuated and it will be replaced. For this purpose, new mobile type switching equipment having a line capacity of 3000 expandable to 4000 will be installed.

The following basic design policies will apply to the implementation of the aforesaid modernization/renovation particulars.

1) Traffic capacity

There is another factor which determines the capacity of switching equipment, namely traffic capacity. Digital switching equipment is essentially computer-based, so the traffic capacity is fixed from the start. Accordingly, in this modernization project, the traffic capacity is to be such as will allow a maximum line capacity of the mobile digital switching equipment installed in the Oyster Bay exchange.

2) Technical standards for switching

The functional specifications of the switching facilities are to accord with the technical standards of TPTC in order to assure compatibility with the existing communications network. In cases where TPTC has not established specifications, international standards (CCITT standards) will be applied.

(2) Junction cable facilities

The following basic design policies will apply to the installation of the optical fiber cable system in modernizing the junction facilities between the Dar es Salaam central exchange and the Oyster Bay exchange (approximately 5.5 km).

The circuit capacity will be matched with the capacity of the digital switching equipment installed in the Oyster Bay exchange. Accordingly, as with the switching facilities, the junction cable facilities installed as part of this project will have a line unit capacity of 3000 (corresponding roughly to 500 junction circuits). The system will allow, however, for a future expansion of the digital switching capacity to 4000 lines (corresponding to approximately 700 junction circuits).

(3) Power facilities

The following basic design policies will apply to the power supply facilities. The power facilities are to be auxiliary to the internal facilities and provide electrical power for the switching, transmission, and air-conditioning equipment. In order to prevent interruptions in communications service due to power failure (power outage), batteries and engine-driven generators will be provided as backup power facilities. However, at the Dar es Salaam exchange in which fiber optic transmission equipment will be installed, the existing engine-driven generator will be used for this purpose.

4-2 Basic design conditions

4-2-1 External facilities

(1) Cable facilities

1) Cable termination on MDF

The primary cable will be connected to PVC termination cables and terminated on MDF. In order to prevent water penetration at the points where the primary cable and PVC termination cable is joined, moisture dams will be installed and a compound filler will be used.

2) Primary and secondary cable

The subscriber cable used in this project will comply with the specifications adopted by TPTC so long as this causes no confusion in maintaining the facilities.

a) Type of cable

The primary and secondary cable used in the conduits is to be PE (polyethylene)-insulated, jelly-filled cable which prevents water penetration and exhibits good insulating properties.

The buried secondary cable is to be PE-insulated, jelly-filled cable. Since this cable will not be in a conduit, it is to be steel-tape-armored cable.

The aerial secondary cable is to be PE-insulated, self-supporting cable which is easy to string.

b) Combinations of disparate conductor diameters

In the interest of avoiding design complexities and maintenance difficulties, combinations of disparate conductor diameters will not be used in the same primary cable or secondary cable.

c) Depth of buried cable

The secondary cable which is buried directly in the ground will be buried to a depth of 60 cm or greater, measured from the surface of the ground to the top of the cable.

3) Cross-connection cabinets

Cross-connection cabinets will be installed to adjust the connections between primary and secondary cables in order to employ the cables more efficiently.

a) Position of cross-connection cabinets

The cross-connection cabinets are to be located within the distribution blocks so that the secondary cable can be distributed efficiently, and so that the position will not have to be changed in the future.

b) Capacity of cross-connection cabinet

The cross-connection cabinets are to have capacities of 1200 and 2400 pairs, and the capacity of each terminal block is to be 100 pairs.

c) Direct distribution block

In neighborhoods where subscriber density is high or where there is almost no subscriber mobility, there is no need to install cross-connection cabinets and direct distributing will be used.

4) Distribution boxes

a) Distribution box type and number of pairs

The pole-mounted and wall-mounted distribution boxes to be used will have capacities of 10 pairs and 20 pairs, respectively. The indoor distribution boxes installed inside buildings are to have capacities of 30 pairs, 50 pairs, 100 pairs, or 200 pairs, depending on the size of the building.

b) Position of distribution boxes

The telephone poles to which pole-mounted distribution boxes are attached are to be positioned so that drop wire can be easily installed to each house served and so that road traffic is not obstructed. These positions should be such that they will not need to be changed in the future, and should be selected with ease of maintenance in mind.

The positions of wall-mounted distribution boxes (attached to the exterior walls of buildings) should be such that it is easy to install drop wires to the building on which the box is attached and to neighboring houses. These boxes should only be attached to sound structures. The installation position should be one that is not likely to require change in the future, and it should be in a location that will discourage damage by a third party.

The position in which indoor distribution boxes are installed inside buildings is to be selected so that it is easy to run the wiring to the telephone sets in the building. The location should also be readily accessible by maintenance personnel and provide good working conditions.

c) Protection of lead-in cables to wall-mounted distribution boxes

Vertical segments of lead-in cables coming to the distribution box are to be protected by a U-shaped guard or by steel pipe of either 25-mm or 50-mm bore, depending on the diameter of the cable.

(2) Civil facilities

1) Conduit type

The underground conduits are to be PVC pipe. In places where high strength is required, such as at river crossings, steel pipe is to be used.

2) Manhole spacing

In locating manholes over the underground conduit routes, consideration is to be given to the locations of cable branchings, cross-connection cabinets, and road configuration, with the following maximum intervals:

Straight road sections : Max. 200m

Curved road sections : Interval shortened as necessitated by road configuration.

3) Positions occupied by conduit route

The construction and maintenance work is to be performed so as to mutually minimize interference with traffic, giving precedence to pedestrian walkways where they are clearly delineated from the roadway, and occupying the shoulder of the roadway where they are not.

4) Manhole and handhole types

Manholes or handholes are to be positioned at cable connection points, branches, and other locations as necessary for cable maintenance or construction. The following points are to be considered in determining the size of such holes. Those shapes and dimensions are shown in figure 4-1.

- a) Hole able to accommodate necessary number of conduits.
- b) Hole allows for necessary work space.
- c) Hole allows for necessary radius of curvature of cable.

5) Manhole renovation

When installing new conduits in existing manholes, the manholes will be renovated if they allow no leeway.

6) Handhole repair

Handholes in poor repair in the project area are to be repaired.

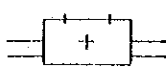
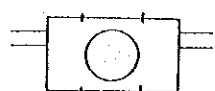
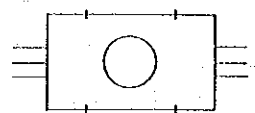
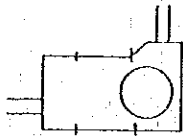
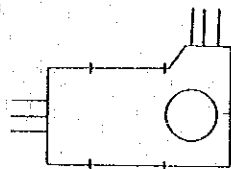
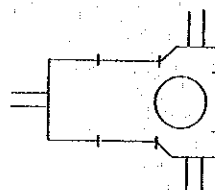
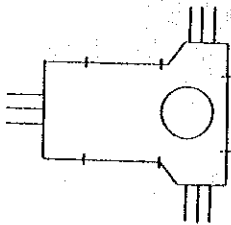
7) Depth of underground conduits

Underground conduits are to be buried to a depth of 70 cm or more, measured from the surface of the ground to the top of the conduit.

8) Warning tape

To prevent damage to underground conduits from future excavation work done for power lines or water mains, etc., a warning tape is to be buried between the underground conduit and the ground surface to draw attention to the presence of communications cables.

Table 4-1 Type and Dimension of Manhole & Handhole

Type	Number of ducts	Inner dimension			Type of cover	Cable bearer	Plan View
		L (M)	W (M)	D (M)			
HH	1 - 3	1.20	0.60	1.10	□	One-side racking	
S - 1	1 - 4	1.80	1.00	1.80	○	"	
S - 2	5 - 9	2.30	1.30	1.80	○	Both sides racking	
L - 1	1 - 4	1.90	1.00	1.80	○	One-side racking	
L - 2	5 - 9	2.50	1.30	1.80	○	Both-sides racking	
T - 1	1 - 4	2.30	1.10	1.80	○	"	
T - 2	5 - 9	2.50	1.30	1.80	○	"	

4-2-2 Internal facilities

(1) Switching facilities

The design conditions for switching facilities are to conform to TPTC standards as noted below, giving due consideration to compatibility with the existing facilities which configure the telephone network.

1) Exchange hierarchy and numbering

a) Exchange hierarchy

Tanzania's telephone network is made up of an international exchange in Dar es Salaam and a four-tiered domestic network. The four tiers or ranks in the domestic network are as follows:

Tertiary Center (TC) : Top-level transit trunk exchange
(5 exchanges, including Dar es Salaam)
Secondary Center (SC): Middle-level transit trunk exchange
(13 exchanges)
Primary Center (PC) : Low-level trunk exchange
Local Exchange (LE) : Terminal exchange (contains subscribers)

The Oyster Bay exchange is a branch exchange within the multi-exchange area of Dar es Salaam, and ranks as a local exchange in the four-tiered structure noted above. The Dar es Salaam central exchange functions at all four of the above levels. Accordingly, the switching facilities at the Oyster Bay exchange are to satisfy the exchange levels noted above.

b) Numbering

When calls are made in the telephone system, all call destinations are identified and processed numerically. Accordingly, the numbering plan is set up so that telephones can function organically.

The telephone numbering plan in Tanzania is made up of subscriber numbers which include an international access code, a trunk code, and an exchange code. Special 3-digit numbers are also established for special services like time of day and information.

In the Oyster Bay exchange, the exchange code will be left as it is, and 4-digit subscriber numbers will be newly added.

The numbers currently in use and those which will be newly added are as follows:

- 6 - 7000-8999 (current numbers)
- 6 - 5000-5999 (numbers to be newly added)

2) Average calling rate per subscriber

The traffic capacity of a switching equipment is represented as the product of the line capacity and the average calling rate per subscriber. According to a TPTC's traffic measurement in the existing switching equipment in the Oyster Bay exchange, the average calling rate per subscriber is 0.144 Erlangs.

3) Traffic routing

At the present time, all incoming and outgoing calls between the Oyster Bay exchange and other exchanges are routed through the Dar es Salaam central exchange. After the old step-by-step switching equipment at the Oyster Bay exchange has been replaced with digital switching equipment, the calling load from the new Oyster Bay exchange will be distributed between the step-by-step switching equipment and C400 cross-bar switching equipment at the Dar es Salaam central exchange. This will be done to avoid cost increases due to such things as routing complexity, call concentration at one location, and increases in the number of interworking sites called at the other exchange.

4) Loss probability

Loss probability is expressed in terms of the probability of losing a call which has been originated. The TPTC standards are as follows for the purpose of insuring compatibility with the existing communications network.

a) Trunk connections

The trunk circuits for handling trunk (long-distance) calls (including international calls) between the Oyster Bay exchange and the Dar es Salaam central exchange have a loss probability of 1%.

b) Local connections

The local junction circuits for making calls from the Oyster Bay exchange to any of the several exchanges in Dar es Salaam have a call loss rate of 1%. Calls made entirely within one's own exchange in an Oyster Bay subscriber area have a loss probability of 2%.

c) Other connections

Special number service lines have a loss probability of 1%.

5) Signalling

A telecommunications network is a collection of such subsystems as switching facilities, transmission facilities, and terminals. The vast overall system functions as a result of the organic interconnection between its subsystems. This necessitates the transfer of various signals between the various subsystems. The signalling system is the means employed to make these transfers.

a) Subscriber line signalling

A subscriber line signalling system comprises loop signals as supervisory signals, and dial pulse signals (for dial pulse telephones) and/or multi-frequency (MF) signals (for push-button telephones) as selection signals.

In Dar es Salaam, due to the functional limitations of the existing switching facilities, dial pulse signals are used as the selection signals. In areas where digital switching equipment has been installed, both dial pulse signals and multi-frequency signals are employed. Both types of signal will be employed also in the Oyster Bay exchange after the new digital switching equipment has been installed.

b) Inter-exchange signalling

An inter-exchange signalling system employs loop signals and E&M signals as supervision signals, and both dial pulse signals and multi-frequency code (MFC) signals as selection signals. This will be true in this project also. Digital switching equipment will be installed in the Oyster Bay exchange, and digital transmission system will be established between the Oyster Bay exchange and the Dar es Salaam central exchange, so a signal converter will be installed in the central exchange.

6) Charging

A charging system is a mechanism by which the switching equipment calculates the charges for a call based on the tariff system. The charges vary according to the type and length of the call.

In Tanzania, calls are categorized broadly as local calls and long-distance (trunk) calls, with the tariff system worked out for each category. The charging system to be employed in this project will be also based on the currently effective tariff system as noted below.

a) Local calls

For local calls, a unit rate is assessed for each call irrespective of the length of the call.

b) Trunk calls

Charges for trunk (long-distance) calls are assessed according to the length of the call and the distance to the call destination.

c) International calls

Charges for international calls are assessed according to the length of the call and the country called.

(2) Junction facilities

The transmission standards for specifying the performance parameters of junction facilities are to be based on TPTC standards in order to insure compatibility with existing facilities.

1) Transmission loss

Transmission loss is to accord with the TPTC standard, with the value of the transmission loss distribution being 11.5 dB from local exchange to local exchange (2 wire switching).

2) Bit error rate

The bit error rate in junction sections using optical fiber cable is to be 1×10^{-6} or less which is according to CCITT recommendation (G.821). The number of measuring intervals over 1×10^{-6} to total measuring interval should be 1.5% or less.

3) Digital hierarchy

The digital hierarchy adopted for the optical fiber cable transmission system implemented in this project is to be as following CCITT recommendations.

Digital 1st order (2,048 Kbit/s) : CCITT recommendation G.732
Digital 2nd order (8,448 Kbit/s) : CCITT recommendation G.742
Digital 3rd order (34,368 Kbit/s) : CCITT recommendation G.751
Digital 4th order (139,264 Kbit/s): CCITT recommendation G.751

Note: Hierarchy: Refers to the multiplexing step applied when multiplexing various types of information.

4) Electrical connection conditions

The respective electrical connection conditions in the digital hierarchy are to accord with CCITT recommendation G.703.

5) Protection of optical fiber cable

Conduits are to be used in all areas where optical fiber cable is installed, and warning tape is to be buried over the cable to warn of its presence and thus prevent damage by civil engineering work done on water mains and roads, etc., under the authority of other agencies. Cables and connection points are also to be protected in manholes. Secondary conduit (sub-duct system) is to be used, first enclosing the cables within narrow-gauge protective pipe and then introducing them into the primary conduit.

(3) Power facilities

The power facilities are made up of initial power receiving equipment, rectifiers, batteries, and engine-driven generators, etc. The capacity of this equipment is to match the capacities to which the switching facilities and junction facilities can be expanded.

1) Power receiving equipment

The power receiving equipment is to be of a scale large enough to satisfy the following capacities:

- a) Rectifier input capacity
- b) Power consumption of air-conditioning equipment
- c) Electrical power required for lighting and wall outlets

2) Rectifiers

The rectifier units are to be large enough for their capacity to satisfy the maximum capacities to which the switching facilities and junction facilities can be expanded. The number of units is to have a redundancy factor of $n+1$ so that steady DC power can be supplied to the communications equipment.

3) Engine-driven generators

The emergency generators are to be equipped so that they automatically start when a commercial power outage occurs, and automatically stop when commercial power is restored. The necessary fuel tanks are also to be installed.

4) Batteries

The battery facilities are to be of adequate size to satisfy the maximum capacities to which the switching facilities and transmission facilities can be expanded. In view of commercial power outages and outages for maintenance and inspection of the engine-driven generators, these facilities are to have sufficient capacity to supply electrical power for 4 hours under conditions of maximum loading.

(4) Exchange buildings

The Oyster Bay exchange will be provided with air-conditioning facilities capable of maintaining the temperature and humidity inside the mobile type exchange building at levels suitable for the operation of equipment. The air-conditioning facilities will be equipped for dust removal, and will be properly grounded to protect the communications and other electrical equipment in the building.

4-3 Basic plan for facilities

The basic renovation plans for the facilities affected by this project are set forth below. These basic plans satisfy the results of the fact-finding surveys and the study results discussed through the preceding section. However, the final decisions on such matters as the positioning of underground conduits, cross-connection cabinets, and equipment inside the exchange will be made after reconfirmation when the detailed design work is done, which is the next stage of this project.

4-3-1 Project areas

The project areas are as follows:

- 1) Northeast section of Dar es Salaam central exchange subscriber area
- 2) Entire Oyster Bay exchange subscriber area

4-3-2 Modernization and renovation particulars

The modernization/renovation particulars are noted below for each facility affected. Details are shown in the basic design drawings attached.

(1) External facilities

- 1) Replacement of subscriber cable facilities in the aforesaid project areas.
- 2) Renovation of the civil facilities necessary for the replacement of the subscriber cable facilities and the junction cables between the Dar es Salaam central exchange and the Oyster Bay exchange.

(2) Internal facilities

- 1) Mobile type digital switching equipment (having a 3000-line capacity) will be newly installed to replace the existing step-by-step switching equipment (2000-line capacity) in the Oyster Bay exchange. The new equipment will be expandable to a 4000-line capacity.

- 2) In conjunction with the installation of digital switching facilities in the Oyster Bay exchange, the necessary interface equipment will be installed in the Dar es Salaam central exchange.
- 3) New junction facilities will be installed between the Oyster Bay exchange and the Dar es Salaam central exchange. However, the new facilities for the Oyster Bay will be installed in the mobile type exchange, while the new facilities for the Dar es Salaam central exchange will utilize the existing exchange building.
- 4) The power facilities required by the installation of the aforesaid internal facilities will also be installed.

4-3-3 Financing responsibilities of Japan, Tanzania

The burden of implementing these basic plans is to be shared between the two countries as follows:

(1) Financing responsibilities of Japan

- 1) Renovation of external facilities in the project areas, with the exception of service order installation and renovation work on the MDF facilities in the Dar es Salaam central exchange.
- 2) Installation of mobile digital switching facilities in the Oyster Bay exchange and junction facilities between the Oyster Bay exchange and the Dar es Salaam central exchange (including power facilities).
- 3) Provision of the test equipment, tools, spare parts, and manuals which are necessary for ordinary maintenance operations on the aforesaid facilities.
- 4) Provision of the interface equipment and miscellaneous materials required in the Dar es Salaam central exchange by the installation of digital switching facilities in the Oyster Bay exchange.

(2) Financing responsibilities of Tanzania

- 1) Installation and removal of dropwire and jumper in objective areas
- 2) Rearrangement of test room partition in Central exchange
- 3) Site renovation work in Oyster Bay exchange
- 4) Installation of interface equipment in Central exchange

5) Rearrangement of equipment and grading for step-by-step switching equipment in Central exchange

The figure 4-1 shows the facilities to be provided by this project.

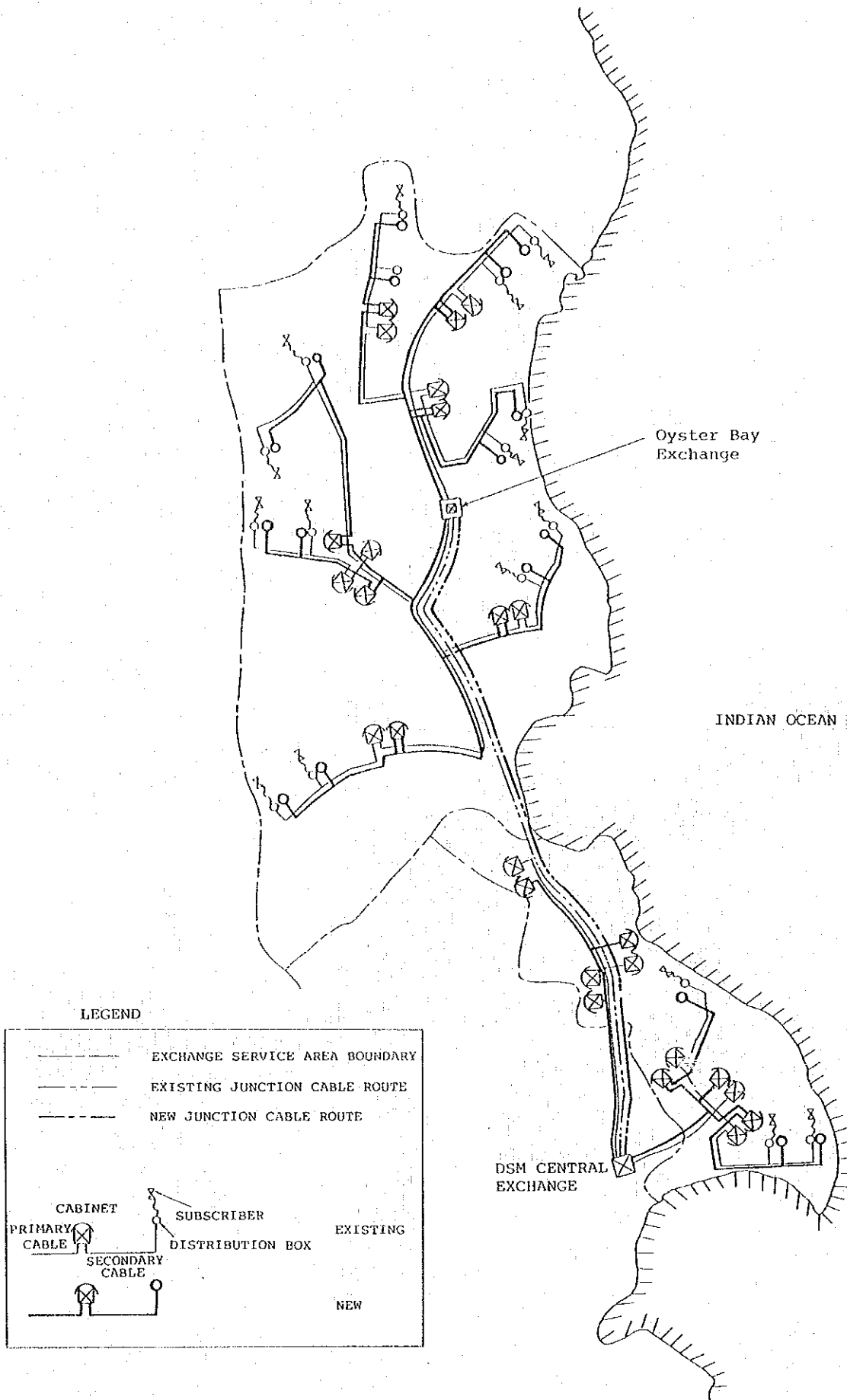


Figure 4-1 Facilities to be Provided by this Project

CHAPTER 5

PROJECT IMPLEMENTATION PLAN

CHAPTER 5

PROJECT IMPLEMENTATION PLAN

5-1 Organization of project implementation

These facilities are to be completed by operations carried out by Japanese and Tanzanian authorities. In other words, the project envisions joint operations between Japan and Tanzania.

In order to carry the project through to completion smoothly and without delays, TPTC--the agency primarily responsible for the implementation of this project--must manage the project operations so that mismanagement does not arise between the involved parties, particularly with respect to the implementation schedules and implementation particulars pertaining to each area of responsibility. Therefore, it is suggested that the operational organization as shown in the figure 5-1 be established within TPTC.

TPTC will select a project manager who will, prior to the start of construction, work together with the consultant firm to review the various individual work schedules as well as such basic technical tasks as the replacement of subscriber cable facilities, switching facilities, and junction facilities, and to fine-tune the overall project and coordinate its implementation, making adjustments where necessary.

As of the end of 1988, TPTC had a total of approximately 3800 employees, including 1800 engineers, 430 assistant engineers, and 1500 operators. The corporation thus is believed to retain adequate managerial and technical resources, and the necessary organizational resources, to implement this project.

5-2 Implementation plan and material procurement plan

5-2-1 Implementation plan

This rehabilitation project includes the modernization and renovation of cable facilities, civil facilities, switching facilities, and junction facilities. In order to renovate and modernize these facilities in a short time and implement the project efficiently, the portions of the project which Japan is financing will all be implemented on a complete turnkey basis.

5-2-2 Implementation supervision plan

(1) Examination of installation drawings

The consultant, working on behalf of TPTC, will examine the installation drawings submitted by the contractors, and will report his findings to TPTC.

(2) Factory inspections

The consultant will make on-site inspections in factories prior to the shipment of equipment and materials by contractors to verify that the equipment and materials shipped meet the contract specifications. The contractors will ship the equipment and materials after obtaining the approval of the consultant. The consultant will report the results of his inspections to TPTC.

(3) Installation supervision

The installation methods and bill of quantities submitted by the contractors will be studied by TPTC officials and the consultants, who will then issue any necessary instructions. While the installation work is in progress, the consultant will dispatch engineers to the work sites to conduct inspections for the purpose both of ascertaining whether or not the installation work done conforms to the contract specifications and of monitoring the progress of the installation work.

(4) Acceptance test

At the completion of installation work, the consultant will conduct an on-site inspection. Once the consultant has verified, as a result of such inspection, that the completed work conforms to the particulars noted in the contract, he shall advise TPTC to accept the facilities.

5-2-3 Material procurement plan

Of the materials needed for this project, it was determined by surveys made in Tanzania at the time of the basic design survey that cement, sand, gravel, and crushed rock could be procured locally. Moreover, of the materials needed for the renovation of the subscriber cable facilities, telephone poles cannot be purchased in Japan, so they are to be procured from the neighboring country of Zambia. All other materials are to be procured from Japan.

5-3 Project implementation schedule

With respect to the arrangements necessary for the implementation of this project, after the exchange of notes (E/N) between the Government of Japan and the Government of Tanzania, a Japanese consultant will be selected by the Government of Tanzania, and a design and supervision contract concluded between the Government of Tanzania and the consultant.

The consultant will prepare detailed designs for the facilities to be financed by the Government of Japan, as well as the tender documents. The consultant will then receive bids from tenderers, after which implementation contracts will be executed between the successful tenderer and the Government of Tanzania, actual construction work will begin.

The detailed design work, bidding operations, and supervision for the installation work to be financed by the Government of Tanzania will be carried out by organizational and operational entities within TPTC. After the signing of exchange of notes, approximately 26 months will be needed to complete the project. The implementation schedule is given in Table 5-1.

5-4 Financing Responsibilities of Tanzania

(1)	Installation and removal of dropwire and jumper wire in objective areas	: 4340.7 thousand Tsh
(2)	Rearrangement of test room partition in Central exchange	: 13.5 thousand Tsh
(3)	Site renovation work in Oyster Bay exchange:	1921.5 thousand Tsh
(4)	Installation for interface equipment in Central exchange	: 85.5 thousand Tsh
(5)	Rearrangement of equipment and grading for step-by-step switching equipment in Central exchange	: 34.0 thousand Tsh
	TOTAL	: 6395.2 thousand Tsh

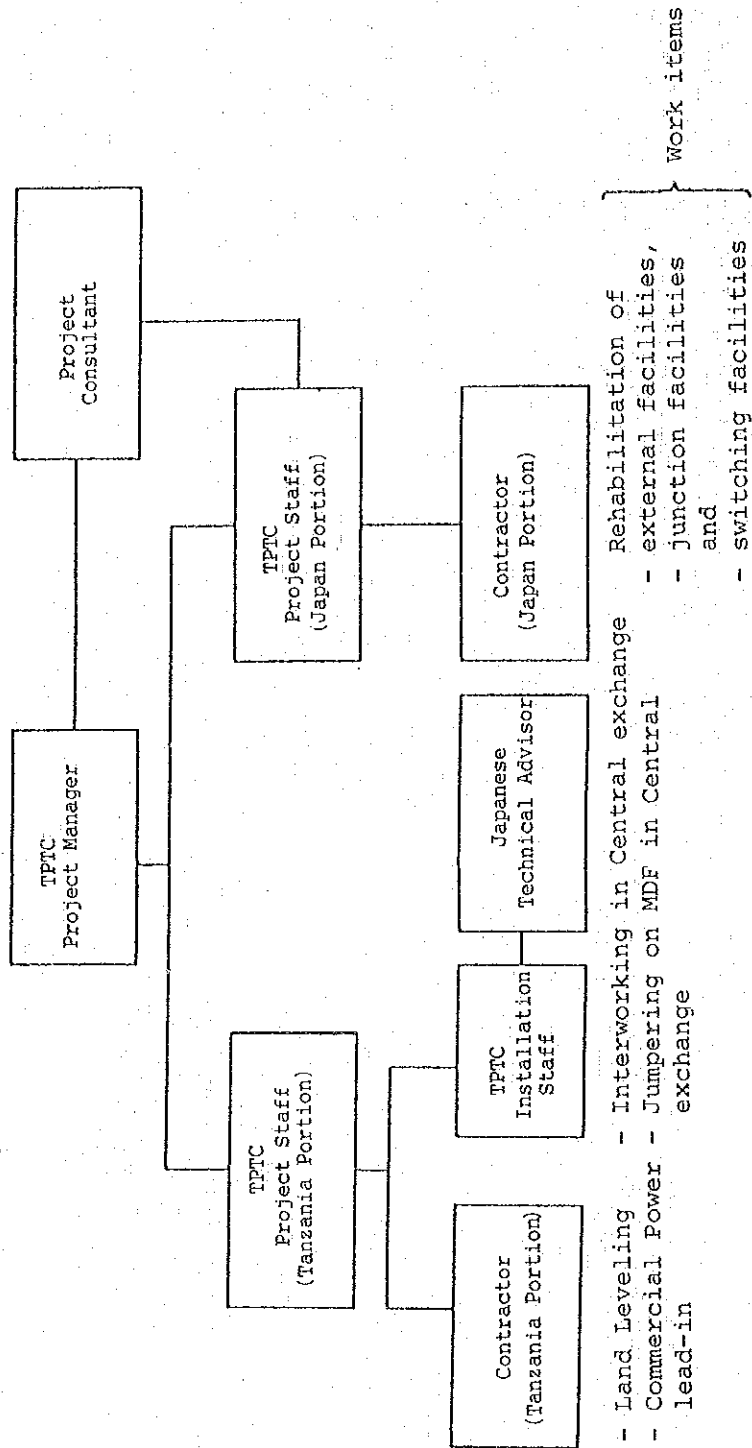


Figure 5-1 Organization of project implementation

Table 5-1 Installation schedule

Phase I : Phase II

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
E / N	▼										▼																			
Detailed Design Tender Specification	—																													
Ordering Specification											---																			
Tender				—																										
Signing of Contract							▼					▼																		
Manufacturing (Phase I)																														
Manufacturing (Phase II)																														
Delivery (Civil & Cable)																														
Delivery (Switch & Transmission)																														
Preparatory Work																														
Civil Construction																														
Cable Installation																														
Installation (Switch and Transmission)																														
Acceptance Test																														

CHAPTER 6
MAINTENANCE AND MANAGEMENT PLAN

CHAPTER 6

MAINTENANCE AND MANAGEMENT PLAN

6-1 Maintenance and management organizations

This rehabilitation project is part of a plan to modernize and renovate Tanzania's existing nationwide telecommunications network. The objectives of the project are to improve international and domestic communications services and to provide good communications services for and between local subscribers in Dar es Salaam. After the completion of this project, the renovated communications network should be operated and maintained by existing organizational entities within TPTC in order to insure the service quality and functionality aimed at by TPTC.

The maintenance and management of the local telephone network which is to be modernized by this project are the responsibilities of operating divisions which now exist in the TPTC organization. These responsibilities will be divided among those divisions according to the type of facility, as noted below.

External division	: Cable facilities, civil facilities
Switching and network division	: Switching facilities
Transmission and radio division	: Transmission facilities
Power division	: Power facilities

6-2 Maintenance and management plan

(1) Key personnel placement, maintenance and management

Two persons will be selected from the present TPTC switching and network division and placed in charge of managing and maintaining the digital switching equipment at the Oyster Bay exchange. One senior engineer will be assigned to TPTC headquarters and given overall responsibility for digital switching in the Exchange Maintenance Division. There is currently a permanent staff of 6 maintenance personnel at the Oyster Bay exchange.

Maintenance responsibilities for the transmission facilities in the Dar es Salaam multi-exchange area are now concentrated at the Dar es Salaam central exchange. The management and maintenance of equipment installed in this project will be the responsibility of two persons from existing staffs and a senior engineer in charge of transmission and radio operations at TPTC headquarters.

The management and maintenance of external facilities (subscriber cables, civil facilities, junction facilities) is being handled currently by the Dar es Salaam area construction and maintenance division (approx. 140 personnels) which belongs to the external division of TPTC

headquarters. The management and maintenance of the modernized/renovated facilities will also be handled by the existing organization and staff.

Currently, the communications power facilities in the city of Dar es Salaam are managed and maintained by the power division in TPTC headquarters. After the renovation and modernization are complete, there will be no particular need to increase staff. Facility management and maintenance will continue to be performed by the existing organization and staff.

(2) Management and maintenance costs

In the TPTC communications divisions in 1987, the annual budget, annual maintenance budget, and number of faults were as follows:

- 1) Annual budget : 4,633.1 million Tsh
- 2) Ratio of above to national budget : approx 5.5%
- 3) Annual maintenance budget : 171.6 million Tsh
- 4) Annual maintenance budget / annual budget : approx 3.7%
- 5) Annual maintenance budget for DSM : 70.1 million Tsh
- 6) Ratio of above to annual maintenance budget : 40.8%
- 7) Breakdown of annual maintenance budget for DSM:
 - External facilities : 35.04 million Tsh (50.0%)
 - Internal facilities, etc. : 35.04 million Tsh (50.0%)
- 8) Average repair cost per fault : 2,175 Tsh
- 9) Average annual salary per maintenance personnel: 42,000 Tsh
- 10) Breakdown of number of faults per day in project areas:
 - External facilities in DSM central exchange : 37 cases (64%)
 - External facilities in Oyster Bay exchange : 11 cases (19%)
 - Other facilities : 10 cases (17%)
 - Total : 58 cases(100%)

With the completion of this project, the following reductions in the number of faults per day in the areas can be expected according to NTT's (Nippon Telegraph and Telephone Corporation) maintenance statistics. This will enable surplus resources to be directed toward the maintenance and repair of other superannuated facilities, resulting in better maintenance efficiency.

After the implementation of this plan, the equipment will be equal to the materials being used at NTT, and TPTC's equipment maintenance control system will also be regulated, so the same level of efficiency can be expected.

- 1) No. of external facilities faults : 48 cases to 3 cases (1/15)
- 2) No. of other facilities faults : 10 cases to 5 cases

Note: Included the "other facilities" are telephone sets not subject to this modernization project, resulting in a decline by one half.

The savings in annual repair costs resulting from the reduction in the number of faults noted above will amount to 44.0 million Tsh, which corresponds roughly to 63% of the annual maintenance budget in Dar es Salaam area. This will have a large favorable impact on TPTC's annual budget.

Table 6-1 and Table 6-2 show comparisons of the maintenance and operating supplies costs, personnel costs, repair costs, power costs, and other expenses before implementation of the plan and afterwards for the regions covered by the plan.

The average number of personnel required for repairs per breakdown at TPTC is 1.9, and the average repair costs per breakdown are, as given above, 2175 Tanzanian shillings. Thus, the personnel costs and material costs per breakdown are 220 Tanzanian shillings and 1955 Tanzanian shillings, respectively, which means that while personnel costs amount to approximately 10%, material costs amount to about 90% of expenditure for dealing with breakdowns.

As can be seen from the tables above, 120 people, approximately 7% of the 1800 employees in all technical divisions of TPTC, have been removed, and it was possible to apply the resulting savings to installation of equipment in the designated regions. Also, annual maintenance and operating costs were reduced by 72% to almost 17 million Tanzanian shillings, which is approximately 0.4% of the TPTC annual budget for telecommunications.

Thus, we can say with confidence that considering the figures for personnel and budgets, TPTC operations after implementation of this plan are very good.

Table 6-1 Comparison of Personnel Required for Maintenance and Operation

Unit: Persons

		Operating personnel	Repair personnel	Total	Remarks
Before implementation	Outside plant	26	105	131	
	Exchange	4	4	8	Two at Central Ex., Six at Oyster Bay Ex.
	Transmission	1	1	2	
	Total (1)	31	110	141	
After implementation	Outside plant	3	12	15	
	Exchange	2	2	4	Two at Central Ex., Two at Oyster Bay Ex.
	Transmission	1	1	2	
	Total (2)	6	15	21	
(1) - (2)		25	95	120	

Table 6-2 Comparison of Annual Maintenance and Operating Costs

Unit: Thousand Tanzanian Shillings

	Personnel costs	Material costs	Power costs	Total
Before implementation (1)	5,922	53,298	1,650	60,870
After implementation (2)	882	798	8,052	16,872
(1) - (2)	5,040	45,360	6,402	43,998