THE FEASIBILITY STUDY
ON
RURAL TELECOMMUNICATION DEVELOPMENT PLAN
IN
PAPUA NEW GUINEA

VOLUME 1

November 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of Papua New Guinea, the Japanese Government decided to conduct a study on the Rural Telecommunication Development Plan and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a survey team headed by Mr. Masami Kato, NTT International Corporation from April to May and from July to August, 1989.

The team held discussions with concerned officials of the Government of Papua New Guinea and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincerest appreciation to the officials concerned of the Government of Papua New Guinea for their close cooperation extended to the team.

November, 1989

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

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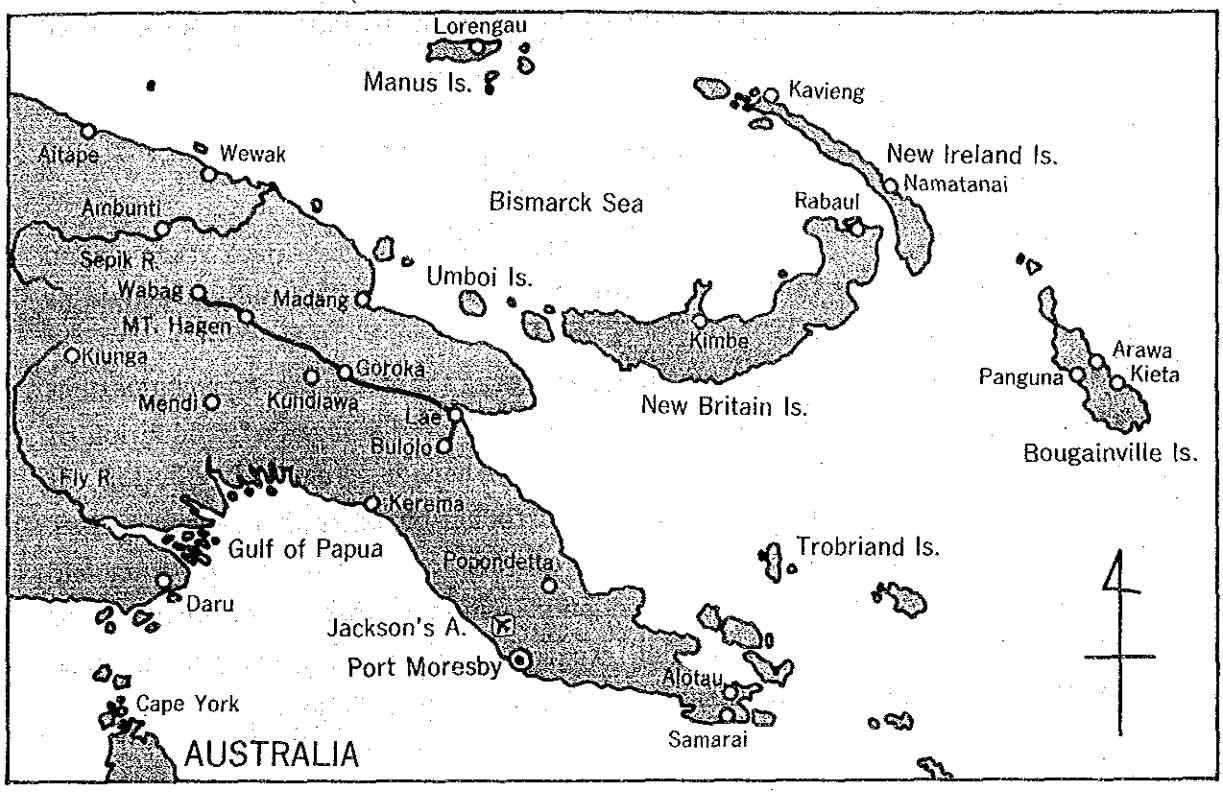


PAPUA NEW GUINEA

CHAPTER 1. SUMMARY

1.1 Purposes of Rural Telecommunication Development Plan and Its Objective Villages

1.1.1 Purpose of Rural Telephone Introduction

About 87% of the population of Papua New Guinea (hereafter called PNG), which amounts to about 2.6 million of the country's 3 million people as per 1980 census, live in rural areas where telecommunications services are far less than adequate. In fact, in many villages, there are no communications services at all. For such rural areas, "conquest of distance" or "reduction of time" can be considered to be a direct impact from introduction of telecommunications. In such areas, the introduction of rural communications can also be expected to have such effects as activation of economic activities, improvement of the residents' welfare, and modernization of agriculture, which will in turn bring greater stability to society and increase the standard of living. This concept is shown in Figure 1-1-1.

1.1.2 Selection of Objective Villages

There are a total of 10,129 villages in the 19 provinces of PNG. The procedure indicated in Figure 1-1-2 was applied to these villages to select objective villages for the feasibility study, with the following results:

- Throughout PNG — 374 Villages

  - Morobe, Western, New Ireland Provinces — 40 Villages
  - Other 16 Provinces — 334 Villages

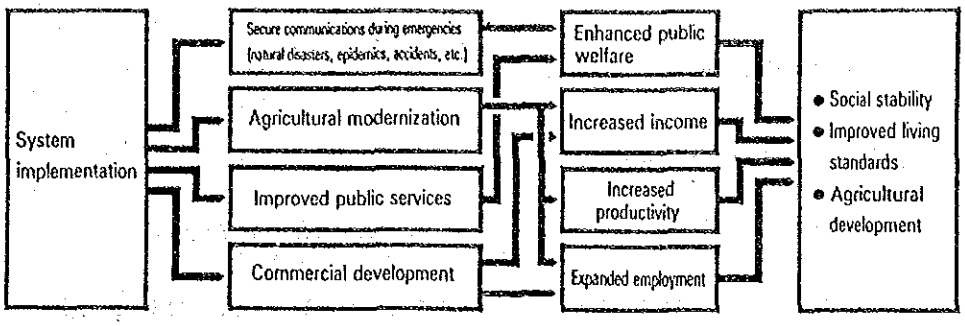


Fig.1-1-1 Benefits Rural Telecommunications System Introduction

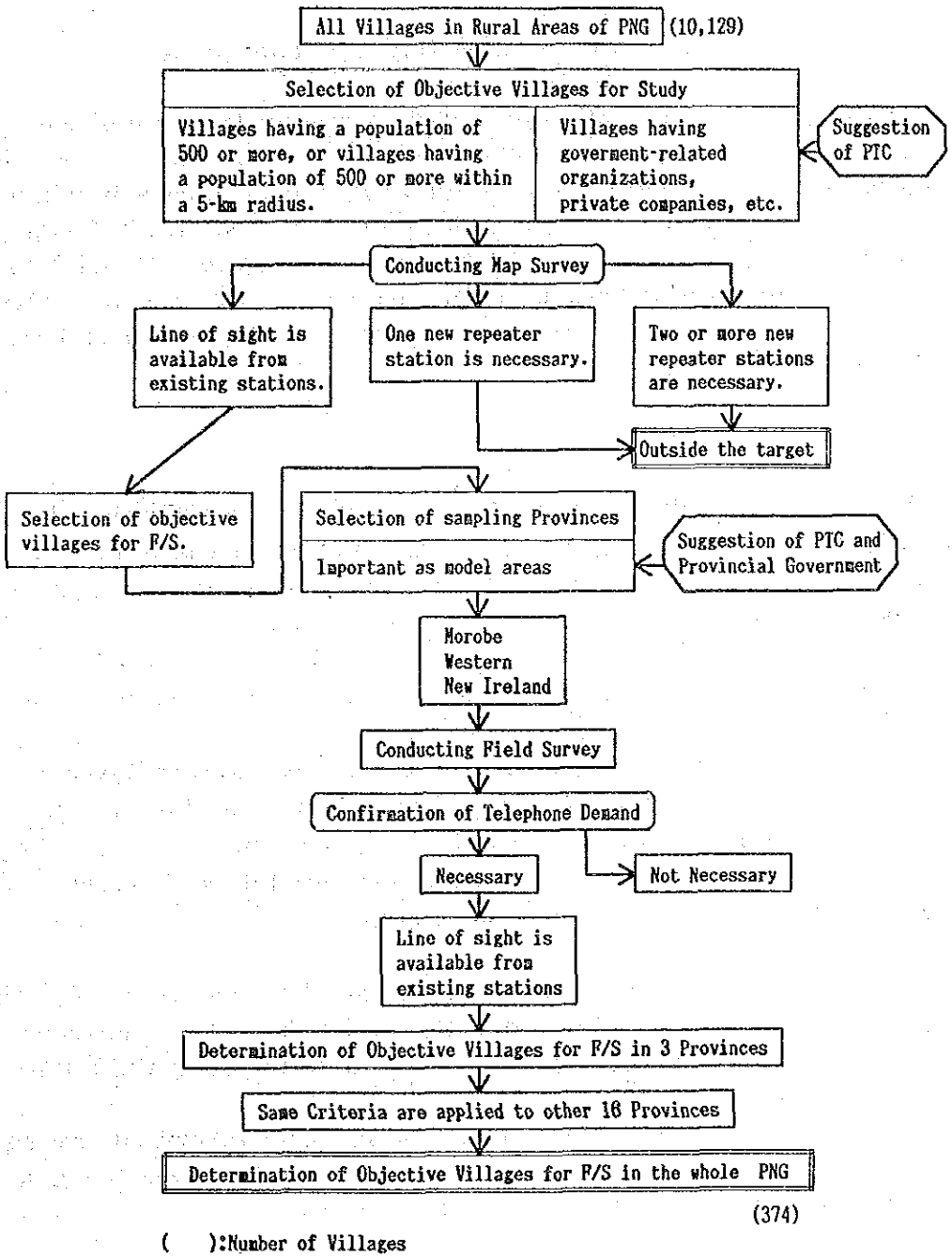


Fig.1-1-2 Objective Village Selection Flow

1.2 Demand Forecast

1.2.1 Macroscopic Demand

(1) Demand in PNG as a Whole (Rural Areas + Urban Areas)

The nationwide macroscopic demand in 1997, when this project is to be completed, was calculated using a correlation formula of telephone density and per capita GDP in 56 countries. The annual ratio of increase in demand from 1987 to 1997 thus calculated is 5.8%.

(2) Establishing a Telephone Penetration Target in Rural Areas

Telephone density in rural areas in PNG at present is as low as 0.02 per 100 persons. This figure is 1/275 compared to urban areas. For other countries having a similar per capita GDP, the difference is within a range about 1/10 to 1/50. Under this project, the penetration target in objective villages was fixed at 0.1 by 1997, which narrows the difference in telephone densities between urban and rural areas from the current ratio of 1/275 to 1/50. The trend of macroscopic demand in PNG is shown in Figure 1-2-1.

1.2.2 Microscopic Demand

The following criteria were established for microscopic demand calculations in each village, based on the average demand per village calculated from telephone density and the results of on-site investigation in the three provinces (Western, Morobe and New Ireland).

(1) In principle, one pay phone should be installed in each objective village.

(2) The demand for private phones is expected in villages where government-related institutes, post offices, police stations, health centers and missionary facilities are located. However, the demand in such villages with small populations is not included in the initial demand because these public institutes serve little function there.

Accordingly, this figure is decided as the initial demand in the objective villages for study. Table 1-2-1 shows the initial demand of the objective villages for the feasibility study obtained from the above mentioned criteria.

The annual ratio of increase in future demand after this initial demand is fulfilled through the implementation of this project will be almost the same as that of the macroscopic demand for the whole of PNG.

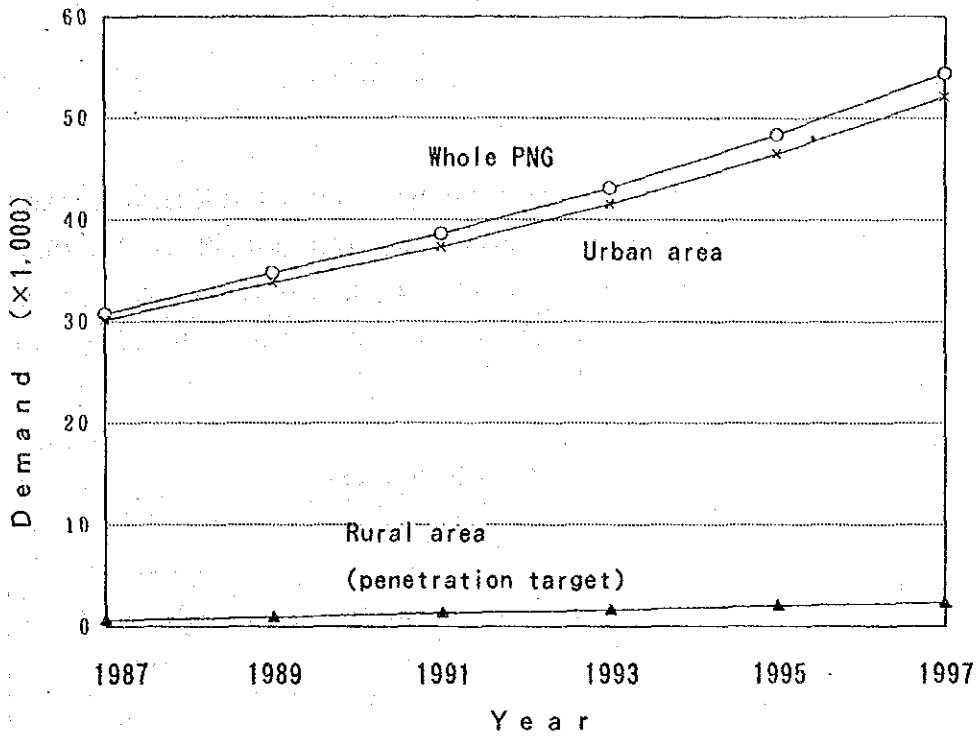


Fig. 1-2-1 Macroscopic Demand & Rural Area Penetration Target

Table 1-2-1 Initial Demand in Objective Villages

Province Name	Number of Villages	Pay Phones	Private Phones	Total
Western	9	9	5	14
Morobe	17	20	15	35
New Ireland	14	16	10	26
West Sepik	10	10	9	19
East Sepik	23	23	19	42
Madang	13	13	8	21
Southern Highlands	59	59	41	100
Enga	41	41	48	89
Western Highlands	51	51	61	112
Chimbu	25	25	24	49
Eastern Highlands	20	20	24	44
Gulf	16	16	17	33
Central	25	25	28	53
Northern	7	7	9	16
West New Britain	2	2	2	4
East New Britain	19	19	17	36
Milne Bay	8	8	7	15
North Solomons	13	13	13	26
Manus	2	2	2	4
Total	374	379	359	738

1.3 Traffic

1.3.1 Traffic Forecast

The traffic forecast for objective villages was made based on traffic data in Barakau. Calculations were made using the flow chart described in Figure 1-3-1. The villages were then classified into ranks of A, B, C by population. Table 1-3-1 lists the estimated amount of traffic by village rank.

Table 1-3-1 Traffic Forecast

Rank	Population (including surrounding villages)	Busy-Hour Traffic (erl)	Average Traffic (erl)
A	2000 or more	0.74	0.22
B	1000 - 2000	0.44	0.13
C	Fewer than 1000	0.24	0.07

1.3.2 Traffic Dispersion

To forecast the traffic flow when telephone sets are installed in each village, interviews were held in the objective villages and mail flow at the post office was observed. The results are shown in Figure 1-3-2, which shows that most traffic is to the capital of the province, followed by traffic to the capital of PNG and to nearby towns. Accordingly, it is desirable in terms of network configuration that subscribers in rural areas are connected to existing switching facilities in towns handling a lot of traffic on a centralized basis, rather than distributing them to numerous small-capacity switching facilities.

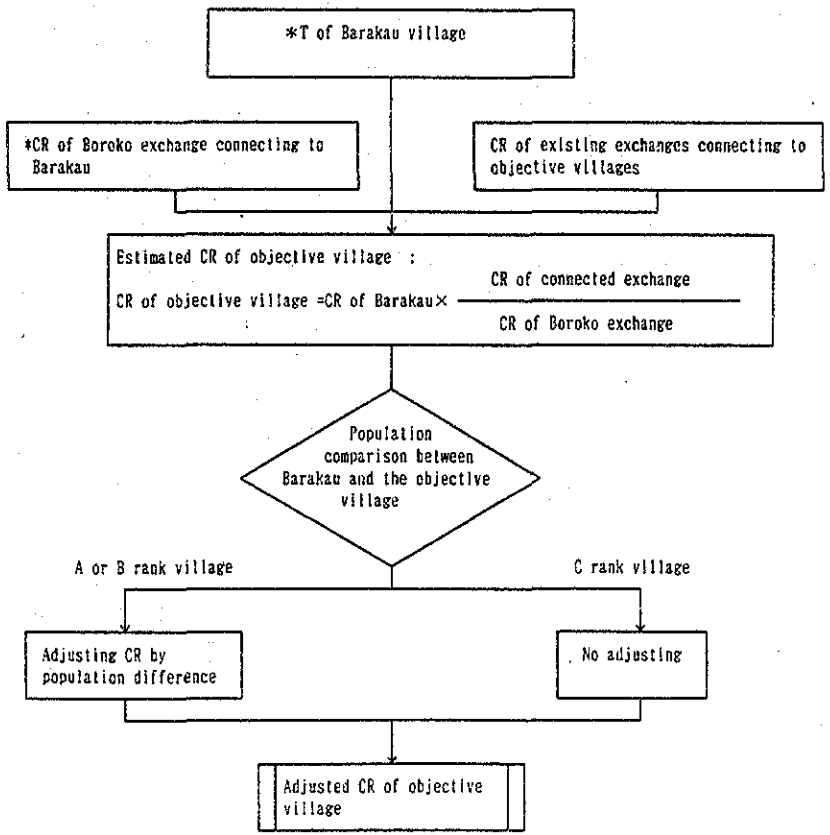


Fig.1-3-1 Flow Chart of Traffic Forecast for Objective Villages

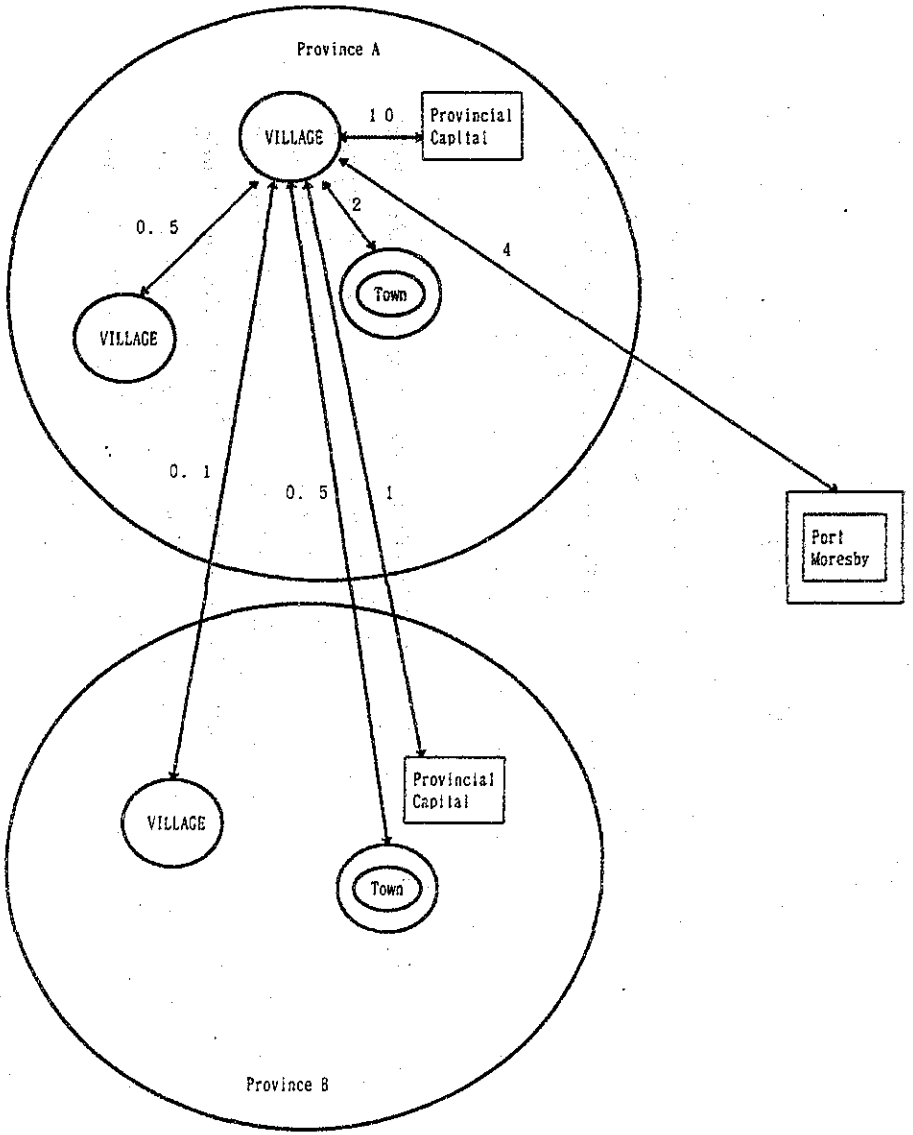


Fig.1-3-2 Forecasted Traffic Dispersion

1.4 Rural Telecommunications System

1.4.1 Various Rural Telecommunications Systems

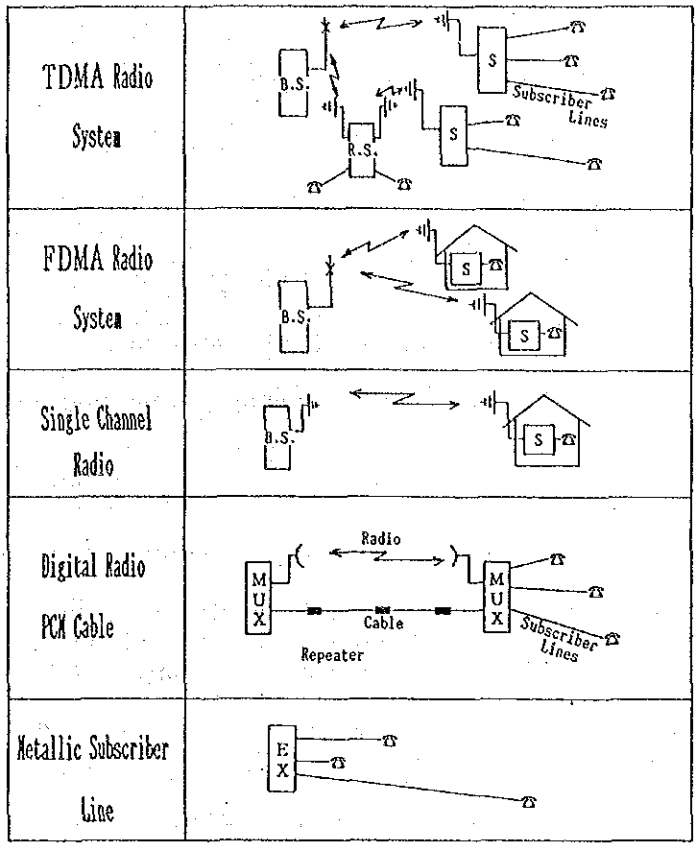
Generally, the phrase "rural telecommunications system" is used in the same meaning as "small-capacity telecommunications system". Figure 1-4-1 gives a general schematic outline of major rural telecommunications systems.

1.4.2 Optimal Rural Telecommunications System

In order to determine which rural telecommunications systems are most suitable for use in the rural telecommunications network plan, three provinces were selected as representative models of PNG's varied geography: Morobe (mountainous), New Ireland (islands) and Western (flat and swampy). Various rural telecommunications systems were then applied to each model and their technical and economic characteristics were studied (Figure 1-4-2). The results of that study showed that it would be best to construct a rural telecommunications network using the following two systems:

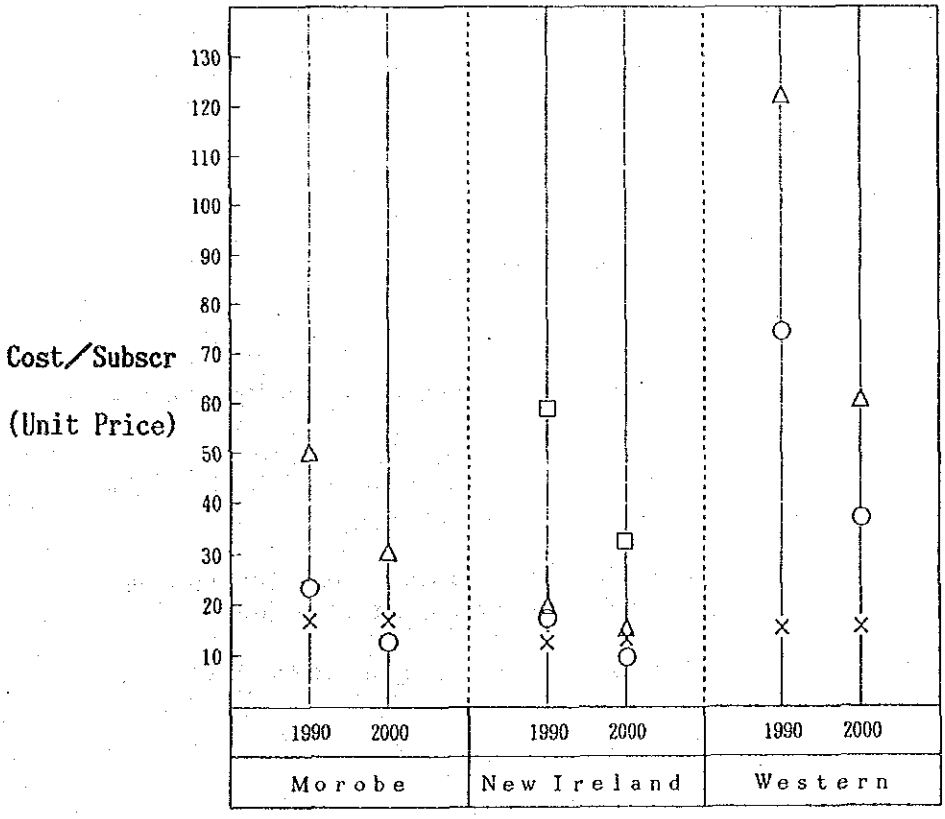
(1) TDMA radio system;

(2) Single-channel radio system.



cf. B.S.=Base Station
R.S.=Repeater Subscriber Outstation
S =Subscriber Outstation
EX =Exchange
MUX =Multiplexer

Fig.1-4-1 Rural Telecommunication Systems



○=TDMA Radio
△=Digital Microwave+Single Channel
□=PCM Cable
×=Single Channel

Fig.1-4-2 Cost/Subscriber Comparison between Model Areas

1.5 System Design

1.5.1 Basic Policy

- Connect subscribers to existing switching facilities;
- In principle, use existing radio repeater stations;
- In principle, conform to existing message areas and numbering plans.

1.5.2 Circuit Quality

The targets for circuit quality in the rural telephone network should be:

- For digital links, a bit error rate (BER) exceeding 10^{-3}, should be considered an outage, and outage time should be less than 5.88 x 10^{-7}/km (0.015 x 10^{-2}/255 km) during any month.
- For analog links, circuit quality of S/N $\geq$ 30 dB must be maintained.

1.5.3 Traffic Conditions

In this rural telecommunication development plan, the traffic handled by one switching office is at most about 10 erl, so the TDMA radio system with the circuit capacity of 15 time slots (equivalent to 10 erl at 0.05 probability of loss) is preferable.

1.5.4 Radio Frequency Bands

- TDMA radio system: 1.5 GHz
- Single-channel system: 450 MHz/150 MHz

1.5.5 Estimated System Parameters

Table 1-5-1 lists the estimated system parameters.

1.5.6 Circuit Design

Figures 1-5-1 and 1-5-2 show the standard circuit design figures based on the estimated system parameters.

- The standard propagation distance between repeater stations for the TDMA radio system is 45 km.
- The standard propagation distance between repeater stations and subscriber stations for the TDMA radio system is 30 km.
- The standard propagation distance for the single-channel system is from 45 km to 60 km.

Table 1-5-1 Estimated System Parameters

Item	TDMA Radio	Single Channel
Radio Frequency Band	1.5 GHz	450 MHz/150 MHz
Transmitting Output Power	3 W	10 W
Modulation	PSK	FM
Circuit Capacity	15 Time Slots	1 Channel
Base Band Signal	Digital	Analog
Required Minimum Receiver Input	-94 dBm (BER = 10^{-3})	-103 dBm (S/N = 30 dB)

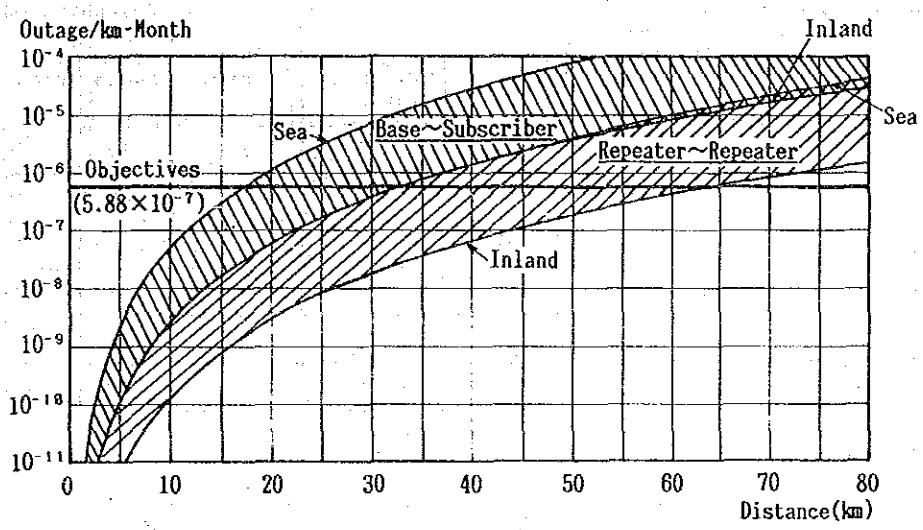


Fig.1-5-1 TDMA Radio Propagation Characteristics

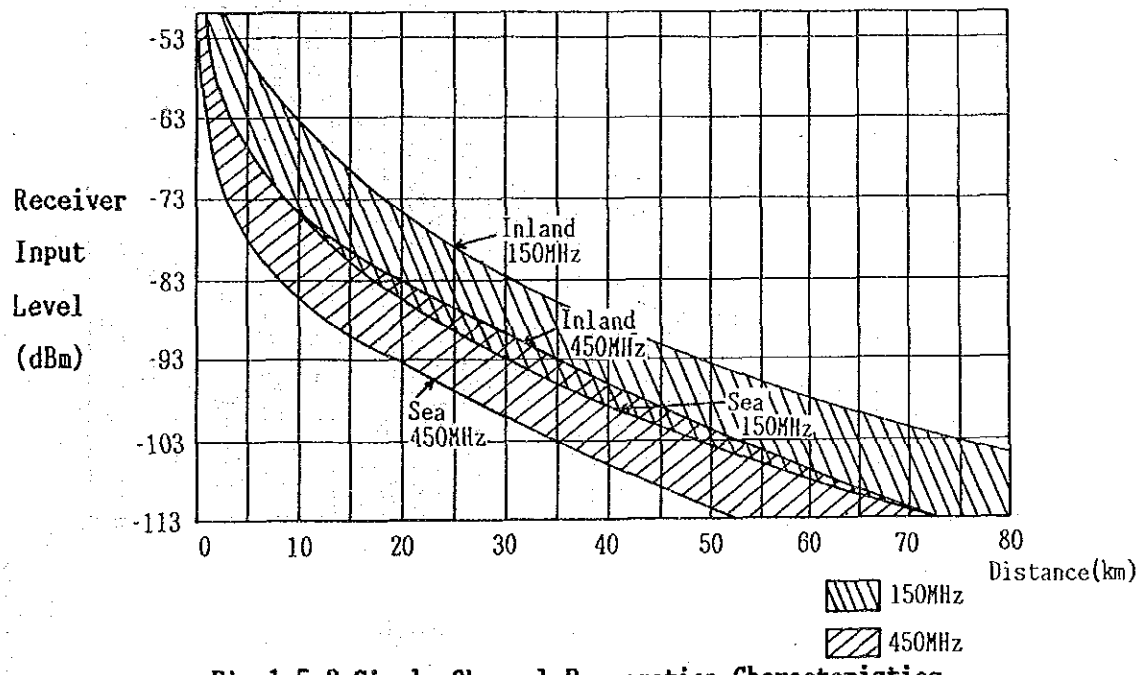


Fig.1-5-2 Single-Channel Propagation Characteristics

1.6 Network Plan and Project Schedule

1.6.1 Network Plan

Figure 1-6-1 shows the rural telecommunication network plan (base station - repeater station).

1.6.2 Order of Priorities

Table 1-6-1 lists the phase classification and facilities required for each phase of implementation of the rural telecommunication development plan.

1.6.3 Implementation Schedule

Figure 1-6-2 shows the schedule for implementation.

Table 1-6-1 Phase Classification and Facilities Required

Phase	Number of Objective Villages	Number of TDMA Base Stations	Number of TDMA Repeater Stations	Subscriber Stations		Telephone Sets	
				Number of TDMA Sub Stations	SCHs (Pair)	Pay Phone	Private Phone
I	40	4	16	21	14	45	30
II	69	5	14	60	18	69	76
III	102	5	20	76	21	102	84
IV	87	7	14	75	15	87	84
V	76	3	8	73	3	76	85
Total	374	24	72	305	71	379	359

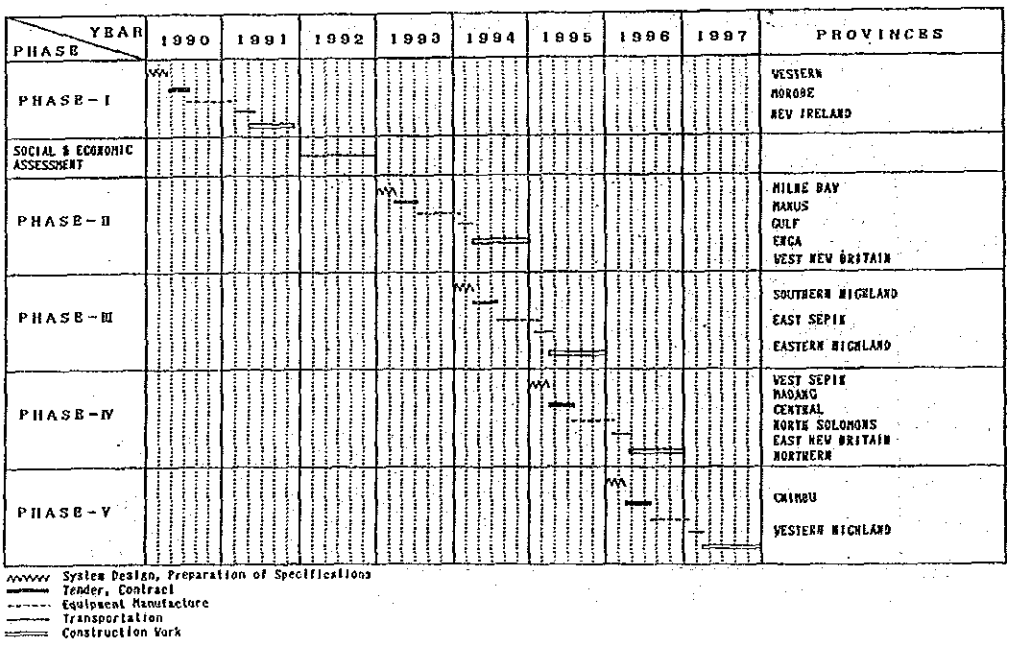


Fig.1-6-2 Implementation Schedule

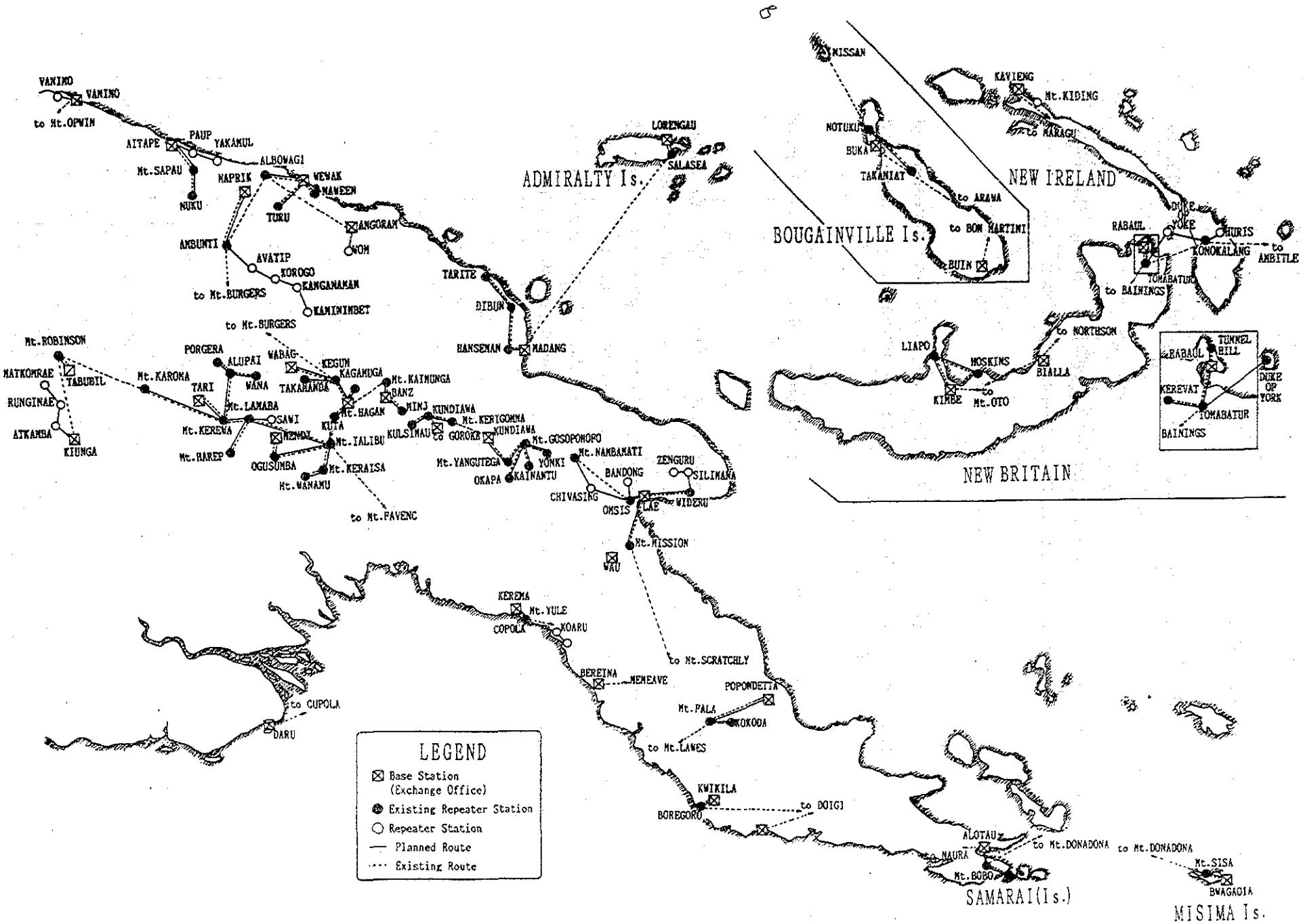


Fig.1-6-1 Network Plan for Rural Telecommunications Development

1.7 Maintenance and Operation

(1) For rational and effective maintenance and operation, the following matters are taken into account in this plan.

- Maintenance and operation should be carried out by the eight existing district maintenance stations on a centralized basis.
- Base, repeater and subscriber stations should be unattended.
- A remote monitoring system should be provided for each repeater and subscriber station so that inspections and maintenance can be carried out by remote function tests.

Figures 1-7-1 and 1-7-2 show the maintenance districts and monitoring system, respectively.

(2) As training programs for engineers/technicians prior to work implementation of this plan, training by facility suppliers provided at their factories, and on-the-job training should be provided. Training programs to improve their skills after completion of the implementation are also required. Figure 1-7-3 shows the relationship between implementation of this plan and the training of engineers/technicians.

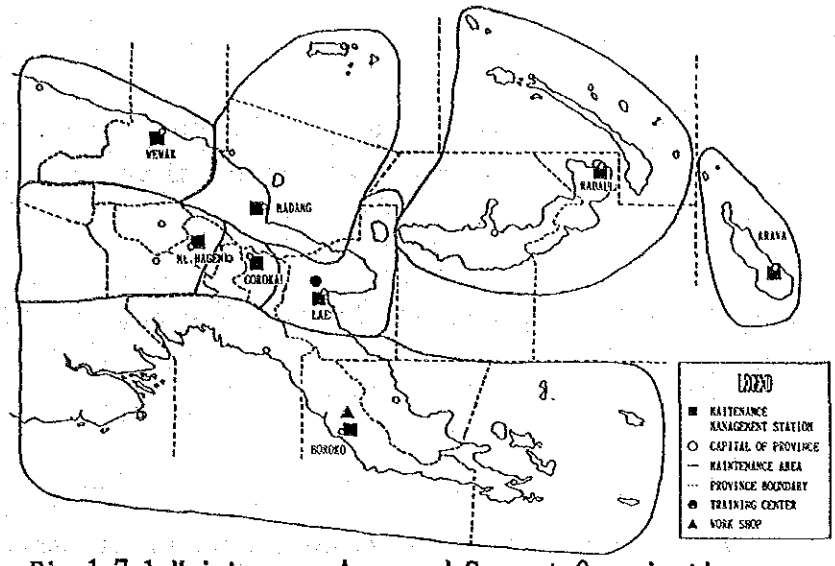


Fig.1-7-1 Maintenance Area and Support Organizations

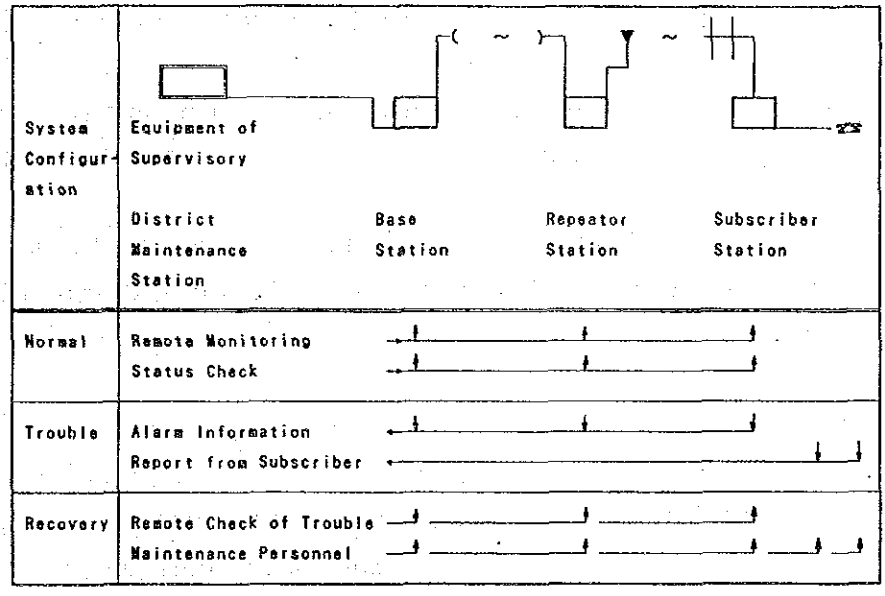


Fig. 1-7-2 Outline of Supervisory System

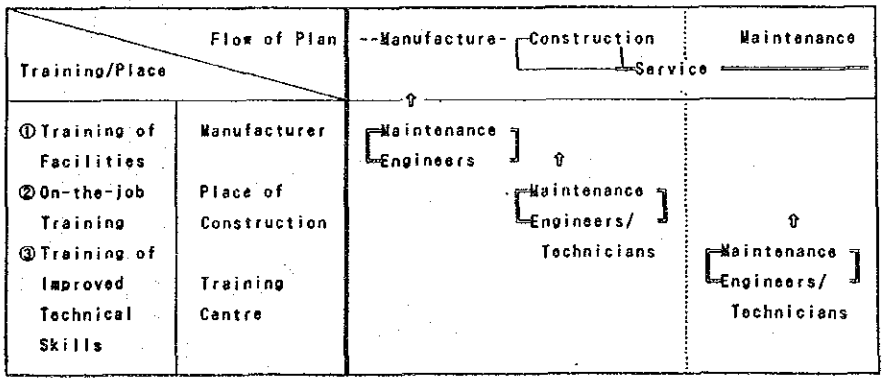


Fig. 1-7-3 Relationship Between Implementation of This Plan and Training of Engineers

1.8 Project Cost

Construction costs were estimated based on the project plan described in Chapter 6. The result is shown in Table 1-8-1. The estimate was made based on the following preconditions:

(1) The exchange rate between the Japanese Yen and the PNG kina is set at

1 kina = 153.63 yen,

according to the average exchange rate of the last 12 months.

(2) Construction work must be implemented by PTC under the supervision of engineers from the manufacturer(s) and/or consultant.

(3) Maintenance parts must be provided for one year, and their costs are included in the estimate.

(4) As far as possible, existing buildings, power facilities, antenna towers and so on should be used for the rural telecommunication development plan.

(5) The estimate includes a price contingency with an annual rate of 5% for domestic currency. For foreign currency, however, price increases and cost reductions due to technological innovation are expected to offset each other, so no price contingency is included. In addition, a physical contingency of 10% is provided for both foreign and domestic currencies.

Table 1-8-1 Budgetary Cost of Construction

(Unit: Thousand Kina)

ITEM \ PHASE / CURRENCY	PHASE-I		PHASE-II		PHASE-III		PHASE-IV		PHASE-V		SUB TOTAL		GRAND TOTAL
	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	
1, EQUIPMENT													
RADIO	1,243	—	1,295	—	1,530	—	1,427	—	1,106	—	6,601	—	6,601
POWER PLANT	327	2	592	4	749	6	588	5	497	5	2,753	22	2,775
TOWER	209	10	333	15	485	24	423	22	362	19	1,812	90	1,902
TELEPHONE & LINE	117	—	183	—	267	—	229	—	201	—	997	—	997
EQPT TOTAL (FOB)	1,896	12	2,403	19	3,031	30	2,667	27	2,166	24	12,163	112	12,275
EQPT TOTAL (CIF)	1,965	(* 12)	2,490	(* 19)	3,140	(* 30)	2,763	(* 27)	2,244	(* 24)	12,602	(* 112)	12,714
2, INSTALLATION	167	856	211	1,198	267	1,590	235	1,468	191	1,248	1,071	6,360	7,431
3, TRAINING	24	33	16	24	16	25	8	13	—	—	64	95	159
4, CONSULTANT	367	149	457	209	576	279	507	256	412	217	2,319	1,110	3,429
SUB TOTAL (1+2+3+4)	2,523	1,050	3,174	1,450	3,999	1,924	3,513	1,764	2,847	1,489	16,056	7,677	23,733
5, PHYSICAL CONTINGENCY	252	105	317	145	400	192	351	176	285	149	1,605	767	2,372
TOTAL (1+2+3+4+5)	2,775	1,155	3,491	1,595	4,399	2,116	3,864	1,940	3,132	1,638	17,661	8,444	----------
GRAND TOTAL	3,930		5,086		6,515		5,804		4,770		----------		26,105

(Unit: Million Yen)

GRAND TOTAL	804	781	1,000	892	733	4,010

* : Equipment/Material sourced within PNG are not subject to CIF

1.9 Project Evaluation

1.9.1 Revenue Estimate

The estimate of installation fees and basic fees for the systems used in this plan are based on the charging methods for the radio telephone systems (radio subscriber system, single channel system) currently in use. Income from call charges is based on actual results from the villages of Menyamya and Aseki in Morobe Province, in which telephones are already installed.

1.9.2 Cost Estimate

Expenses during the project life consist of the following items.

(1) Construction Costs:

Equipment, installation work, training, consultation, etc.

(2) Working Capital:

Cash and deposits, accounts receivable, inventory costs (estimated from previous PTC financial statements)

(3) Operating Costs:

Maintenance and operation of facilities.

1.9.3 Internal Rate of Return (IRR)

Financial Internal Rate of Return (FIRR): -0.62%

(Although facilities have a salvage value at the last year of the project life, it is assumed in this project that the salvage value offsets the expenses for removal/usage for other purposes after expiration of the useful life.)

1.9.4 Sensitivity Analysis

(1) Additional Installation of Telephones

In case additional telephones corresponding to the increase in demand are installed, the FIRR shifts to a positive figure of 2.65%.

(2) Increase in Traffic

Estimated FIRR data taking annual traffic increase into account are shown in Table 1-9-2.

(3) Salvage Value Factor in FIRR Calculation

When the salvage value at the last year of the project life is calculated as a minus cost, the FIRR stands at +2.70%.

(4) Change in Construction Costs

FIRR data when construction costs vary in a range of ±5% or ±10% are shown in Table 1-9-3.

Table 1-9-1 Cash Flow Table
(Project Installations Only)

Unit:Thousand Kina

YEAR	CASH INFLOW				CASH OUTFLOW				BALANCE
	INSTALLATION FEES	BASIC FEES	CALL CHARGES	TOTAL REVENUE	CONSTRUCTION COST	WORKING CAPITAL	OPERATION COST	TOTAL COST	
1990					1,965.0			1,965.0	-1,965.0
1991	10.5	2.8	42.4	55.7	1,965.0	8.9		1,973.9	-1,918.2
1992		17.9	254.1	272.0	0.0	34.4	17.4	51.8	220.2
1993		* 17.9	* 254.1	* 272.0	2,543.0	0.0	17.7	2,560.7	-2,288.7
1994	24.5	63.0	742.7	830.2	5,800.5	88.8	18.1	5,907.4	-5,077.2
1995	25.2	112.1	1,197.9	1,335.2	6,159.5	80.3	49.2	6,289.0	-4,953.8
1996	26.1	161.5	1,645.6	1,833.2	5,287.0	79.2	68.9	5,435.1	-3,601.9
1997	25.5	211.2	2,222.3	2,459.0	2,385.0	99.5	108.7	2,593.2	-134.2
1998		211.2	2,222.3	2,433.5		0.0	123.9	123.9	2,309.6
1999		211.2	2,222.3	2,433.5		0.0	126.4	126.4	2,307.1
2000		211.2	2,222.3	2,433.5		0.0	128.9	128.9	2,304.6
2001		211.2	2,222.3	2,433.5		0.0	131.5	131.5	2,302.0
2002		211.2	2,222.3	2,433.5		0.0	134.1	134.1	2,299.4
2003		211.2	2,222.3	2,433.5		0.0	136.8	136.8	2,296.7
2004		211.2	2,222.3	2,433.5		0.0	139.5	139.5	2,294.0
2005		211.2	2,222.3	2,433.5		-391.1	142.3	-248.8	2,682.3
TOTAL	111.8	2,276.0	24,137.5	26,525.3	26,105.0	0.0	1,343.4	27,448.4	-923.1

Basic Case FIRR= -0.62%

Note 1: This table does not include revenues from additional telephone to be installed after the completion of this project, nor any increase of revenues from the growth in traffic.

Note 2: * No new installation in 1993

Table 1-9-2 Changes in FIRR Reflecting Increased Traffic

Traffic Increase	FIRR
2%	+ 2.34%
5%	+ 6.79%
7%	+ 9.76%

Table 1-9-3 Changes in FIRR Reflecting Construction Cost Variation

Construction Cost Variation	FIRR
-10%	+1.22%
- 5%	+0.27%
+ 5%	-1.44%
+10%	-2.22%

1.10 Conclusion

The development and expansion of a telecommunications network in rural areas will help modernize agriculture, improve the marketing system and advance the people's welfare, thus making it possible to expect improved productivity, increased income and increased employment opportunities and efficient usage of skilled manpower. Consequently, it will contribute to narrowing the differences between urban and rural areas and to the stabilization of society.

According to the result of the financial analysis, the FIRR of this project remains as low as -0.62% because of the following reasons:

(1) The objective villages of this project are scattered all over the country.

(2) The number of telephones to be installed in each objective village is small, averaging only two sets per village.

(3) As commercial power sources are not available in each objective village, in many cases it will be necessary to depend on solar energy to supply power to the telecommunications equipment.

(4) Because of the severe geographical conditions, there are many areas that do not have a road network. For the purposes of this project, therefore, helicopters will be required for the transport of technical personnel, equipment and materials.

As we calculated in the sensitivity analysis, however, the FIRR will become positive considering the traffic increase, demand increase, decrease of construction costs, and so on.

This project should be implemented by attaching importance to the above mentioned social and economic benefits.

CHAPTER 2

INTRODUCTION

CHAPTER 2. INTRODUCTION

2.1 Background of Study

2.1.1 Background of Request

In PNG, 87% of the entire population of 3 million people live in rural areas. However, the number of telephone subscriber lines installed in those areas accounts for only 5% of the total number due to such geographic features as jungles, mountains and marshlands, as well as many isolated islands. Those features have restricted expansion of PNG's rural telecommunications network. Another factor hindering development of the telecommunications network has been the nationwide spread of small villages, each of which is economically and culturally independent in its own area. The geographical features mentioned above have also curtailed road construction, so that contact or exchange between villages and cities is quite difficult.

This lack of social infrastructure obstructs the progress of local development and penetration of government services. Thus, the provision of and securing a means of information exchange is an urgent task for the development of rural areas. For that reason, the PNG government in September 1988 asked the Japanese government to help with creation of a short-term plan (up to 1993) for construction and expansion of the rural telecommunications network and a plan to set up pay phones in at least 400 villages.

2.1.2 Dispatch of Preliminary Study Team

In response to the request from the PNG government, the Japanese government decided to conduct a study concerning the establishment of a rural telecommunication development plan in the country, and has placed the Japan International Cooperation Agency (JICA) in charge of its execution.

JICA dispatched a preliminary study team to PNG from December 5 to 16, 1988, to confirm the requested items, perform initial field investigation in the areas concerned, collect data, and hold discussions and make

arrangements with relevant government organizations concerning the policies of future study. On December 16, mutual agreement was reached on the details of the study for the rural telecommunication development plan.

2.1.3 Dispatch of Feasibility Study Team

Based on the agreement reached by the preliminary study team, JICA organized a Feasibility Study Team to conduct a study concerning the "Rural Telecommunication Development Plan" and the "Initial Plan."

2.2 Study Purpose

The purpose of this study was to carry out detailed and independent investigation and make an evaluation of the rural telecommunications network included in the "Five-Year Development Plan" already established by PTC and the "Network Development Plan" developed with funding by the World Bank.

The following plans are to be made after such investigation and evaluation.

(1) Nationwide "Rural Telecommunication Development Plan" up to 1997

(2) "Initial Plan" to select the areas having priority in implementing this plan and to encourage early introduction of this plan

2.3 Composition of Study Team

JICA organized the Feasibility Study Team consisting of members from NTT International Corporation and established Advisory Committee in order to provide them with recommendations necessary in terms of technology and work progress throughout the study period and to promote the smooth implementation of the study.

The names and positions of the members of the Feasibility Study Team and the Advisory Committee are listed in Tables 2-3-1 and 2-3-2, respectively.

Table 2-3-1 Feasibility Study Team Members

Name	Responsibilities	Position
Masami Kato	Coordination, Operation and Plant Planning.	General Manager, Telecommunications Consulting Division, NTTI
Hiroshi Kuwata	Communications Systems.	Senior Manager, Telecommunications Consulting Division, NTTI
Seisaku Baba	Network Planning, Demand Forecast, Outside Plant.	Manager, Telecommunications Consulting Division, NTTI
Koichi Uto	Radio Transmission.	Chief, Telecommunications Consulting Division, NTTI
Susumu Kato	Facility Design, Switching Systems.	Chief, Telecommunications Consulting Division, NTTI
Tetsuo Takatsuka	System Design	Chief, Telecommunications Consulting Division, NTTI
Hidenobu Kobayashi	Project Evaluation	Telecommunications Consulting Division, NTTI

Table 2-3-2 Advisory Committee Members

Name	Title	Position
Junji Ogawa	Committee Chairman	Deputy Director, Monitoring and Examination Division, Radio Department, Telecommunications Bureau, Ministry of Posts and Telecommunications (MPT)
Hitosu Watanabe	Committee Member	Chief, Third Frequency Section, Frequency Planning Division, Radio Department, Telecommunications Bureau, MPT
Yasuo Suzuki	Committee Member	Development Specialist, Japan International Cooperation Agency (JICA)
Kin-ichi Umeya	Committee Member	Second Development Study Division, (JICA)
Kiyoshi Noritake	Committee Member	Second Development Study Division, (JICA)

2.4 Study Schedule

According to the schedule indicated in the Interim Report concluded between the Feasibility Study Team and the PNG government/PTC, the feasibility study was carried out in the following three phases shown in Figure 2-4-1.

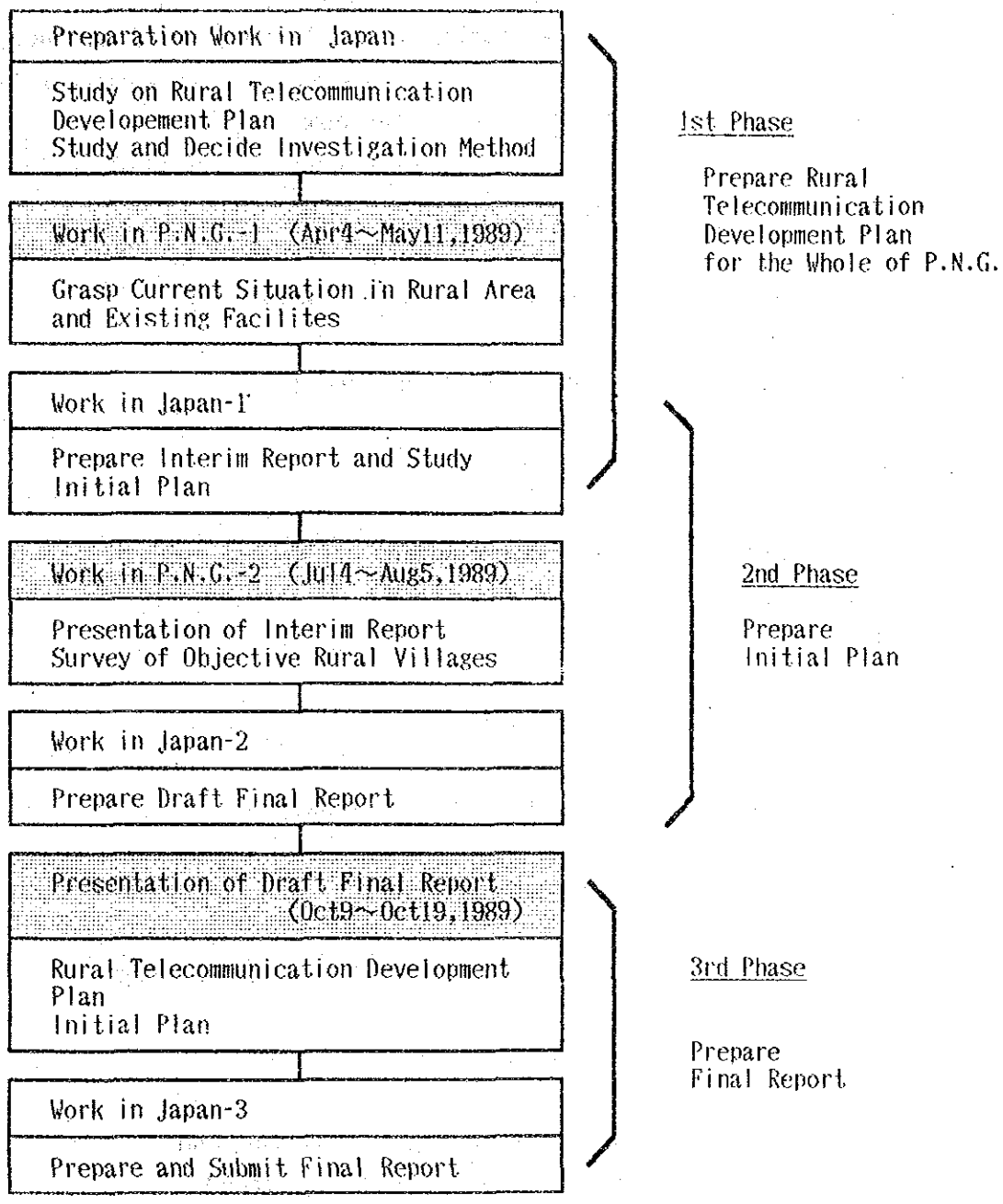


Fig 2-4-1 Study Schedule

2.5 Visiting Organizations and Pertinent Officers

Pertinent officers of PTC, which originated the request for this study and the Department of Finance and Planning are as follows.

(1) Department of Finance and Planning

Robert Igara	Director, Office of International Development Assistance
Chris Mero	Acting Assistant Director
Baluwe Umetrifo	Assistant Secretary - CSA
Fiu Williams	Assistant Secretary - Foreign Aid
George Paru	Principal Programs Officer
Yoichi Suzuki	Aid Adviser
Francis Wagaia	Corporate Planner

(2) PTC

Ron Elias	Managing Director
Dale Kamara	Director, Corporate Relations
John Kamblijambi	Corporate Secretary
Jim Bantegui	Executive Manager, Corporate Planning
Kilori Sepoe	Associate
Peter Simpson	Executive Manager, Marketing and Commercial Services Department

Clark Kaluniasi	Executive Manager, Engineering Planning
Alan Olden	Former Executive Manager, Engineering Planning
Murray Robinson	Manager, Network Planning Branch
Ian Macklin	Supervisor, Rural Networks, Engineering Planning Department
Alphonse Bade	Engineer
Kametan Kitchawen	Principle Technical Officer
Charles Litau	Engineer

CHAPTER 3

OUTLINE OF PAPUA NEW GUINEA

CHAPTER 3. OUTLINE OF PAPUA NEW GUINEA

3.1 General Affairs

Formal Country Name:	The Independent State of Papua New Guinea
System of Government:	Constitutional monarchy
Date of Independence:	September 16, 1975
Capital:	Port Moresby
Total Area:	Approximately 462,000 Km^2 (about 1.25 times larger than Japan)
Total Population:	Approximately 3 million people (as of 1980)
Currency:	Kina, toea 1 Kina = 100 toea 1 Kina = 1.1947 U.S. dollars (April 1989)
Gross National Product:	2,280 million U.S. dollars (1985)
Per Capita National Income:	790 U.S. dollars (1985)

3.2 Nature

3.2.1 Location

PNG is located between the equator and a latitude of 12 degrees in the South Pacific, between 141 and 160 degrees east longitude. It consists of the eastern part of the main New Guinea Island and about 700 large and small islands, including New Britain, New Ireland, Bougainville and Manus. The country is divided into 19 provinces.

West of 141 degrees east longitude lies Irianjaya, the western part of the main New Guinea Island which is under Indonesian dominion. Figure 3-2-1 shows locations of PNG and neighboring countries.

3.2.2 Geographic Features

(1) New Guinea Island

The central part of the island contains the Owen Stanley Range, a mountain chain more than 1,000 kilometers long that includes mountains that rise more than 4,000 meters above sea level. The highest mountain is Mt. Wilhelm (4,706 meters above sea level). The Papua coast along the southern part of the island includes a lot of damp ground and swampland that is not suitable for human habitation.

(2) New Britain and Bougainville Islands

These islands are part of the Pacific volcanic zone, and include 25 active volcanoes.

(3) Major Rivers

Northeast Papua New Guinea ... Sepik River, Ramu River, Markham River.
South Papua New Guinea ..... Fly River, Kikori River, Purari River.

The Sepik river and Fly Rivers are connected by a watershed in the central mountain range. The Fly River, which is the country's longest, has a total length of about 1,040 km.

3.2.3 Climate

The country generally has a tropical climate divided into two seasons: a rainy season from December through April and a dry season from May through November although there are many localized variations. Typical weather conditions for each area of the country are listed in Table 3-2-1.

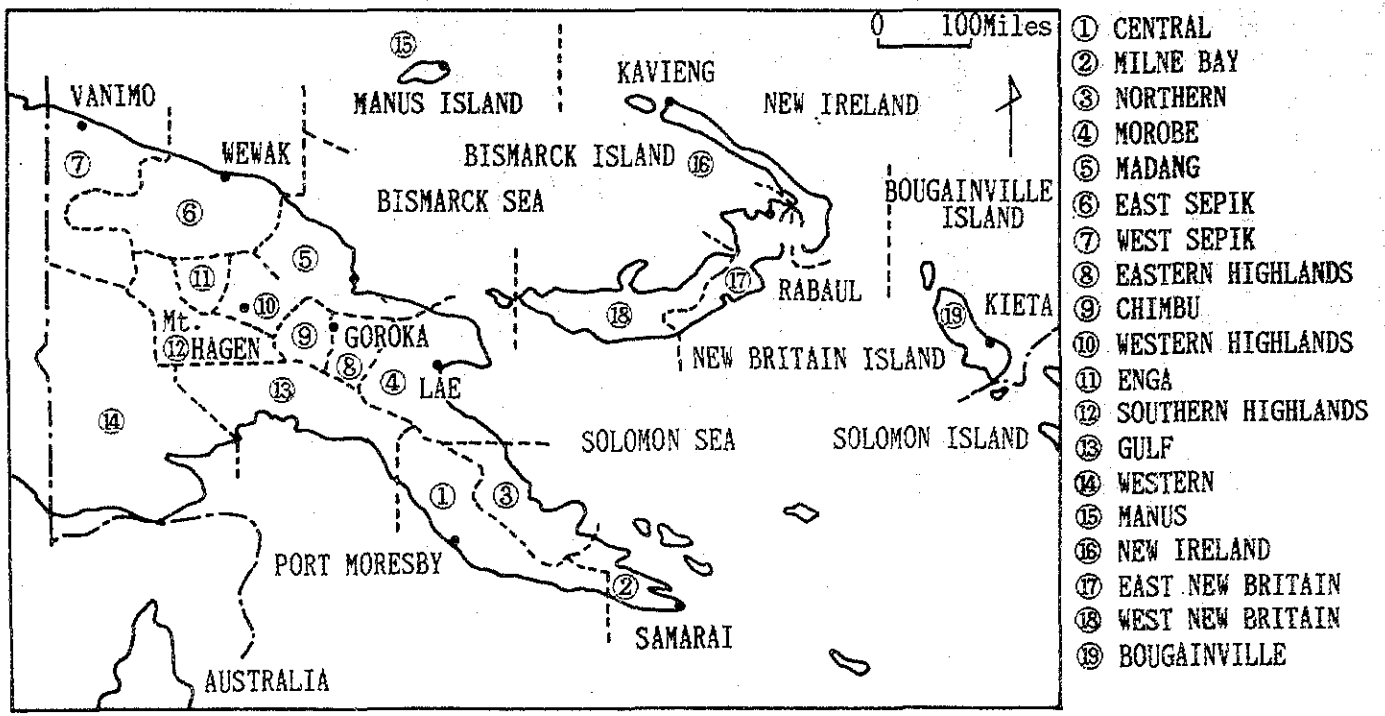


Fig.3-2-1 PAPUA NEW GUINEA

Table 3-2-1 Weather Distribution

Area	Most Areas	Port Moresby and Surrounding Areas	Highlands of New Guinea Island
Climate	Tropical Rain Forest	Tropical Savanna	Tropical Highlands
Average Rainfall Per Year	Approx. 2,000 mm Exceeds 12,000 mm in Some Places of the Kikori Area, Southern Part of the Island	Approx. 1,200 mm	
Average Daily Temperature	Low: 21 degrees C High: 32 degrees C Little variation throughout the year		16 degrees C 25 degrees C
Seasons/Winds	Rainy Season (Dec. - Apr.)/ Northwest Monsoons Dry Season (May - Nov.)/ Southeast Trade Winds		

3.3 Features of Rural Areas

3.3.1 Definition of Rural Area

The following definitions are used for cities and rural areas in a census of PNG.

(1) Urban area

Population of more than 500 and a population density of 195 people/ km^2 or more

(2) Rural Area: All areas other than urban areas

3.3.2 Population Distribution

The population ratio for rural areas totals 87%. They live in the following community forms.

(1) Large rural non-villages (e.g., government stations, etc.)

About 1,500 throughout the country

(2) Small, isolated villages

Between 2,000 to 5,000 said to be in existence

Table 3-3-1 lists the population distribution for urban and rural areas based on the census conducted in 1980.

Table 3-3-1 Population Distribution in Urban and Rural Areas

Name of Province	Rural Village	Rural non-village	Rural Total (%)	Urban (%)	Total
Western	67,189	1,744	69,933 (87.7)	9,642 (12.3)	78,575
Gulf	56,576	1,365	57,941 (90.4)	6,179 (9.6)	64,120
Central	101,622	11,100	112,722 (96.4)	4,242 (3.6)	116,964
National Capital District	0	0	0 (0)	123,624 (100)	123,624
Milne Bay	116,271	5,382	121,653 (95.1)	6,322 (4.9)	127,975
Northern	58,244	12,769	71,013 (91.7)	6,429 (8.3)	77,442
Southern Highlands	226,486	4,820	231,306 (98.0)	4,746 (2.0)	236,052
Enga	158,288	3,886	162,174 (98.6)	2,380 (1.4)	164,534
Western Highlands	220,268	28,419	248,687 (93.6)	16,969 (6.4)	265,656
Chimbu	169,223	2,844	172,067 (96.5)	6,223 (3.5)	178,290
Eastern Highlands	242,156	10,601	252,757 (91.3)	23,969 (8.7)	276,726
Morobe	224,083	14,055	238,138 (76.7)	72,484 (23.3)	310,622
Madang	173,986	14,493	191,479 (90.7)	22,590 (9.3)	211,069
East Sepik	192,350	5,648	197,998 (89.2)	23,892 (10.8)	221,890
West Sepik	106,624	1,129	107,753 (94.4)	6,439 (5.6)	114,192
Manus	19,821	806	20,627 (79.2)	5,409 (20.8)	26,036
New Ireland	53,860	6,782	60,642 (91.8)	5,386 (8.2)	66,028
East New Britain	95,902	19,280	115,182 (86.5)	18,015 (13.5)	133,197
West New Britain	59,626	24,032	83,658 (94.1)	5,283 (5.9)	88,941
North Solomons	98,796	7,090	105,886 (82.2)	22,908 (17.8)	128,794
Total	2,441,351	176,245	2,617,596 (86.9)	393,131 (13.1)	3,010,727

3.4 Industrial Trends

3.4.1 Industrial Structure

(1) Major products:

G + 4C + 2T + P [Gold, Copper, Cocoa, Coffee, Copra, Timber, Tea, Palm Oil]

(2) Increase in the relative importance of the mining industry:

Traditionally, the agricultural sector has been the most important industry. However, the trend shows a shift to mining as the leading source of growth in output and export. The share of total domestic production for 1988 by industrial sector was as follows:

Agriculture:	31%
Mining:	63%
Manufacturing:	3%

3.4.2 Trends by Industry

(1) Mining

In addition to the mining of gold and copper ore, the extraction of oil and exploration for deposits of manganese, iron, chrome, nickel, bauxite, and zinc are also being promoted.

(2) Agriculture

Emphasis and financial support are still given to agriculture as it records the highest revenue earning sector and provides major domestic employment opportunity. Therefore, the government is devoting much of its efforts into further development of agriculture, including the breeding of cattle, pig farming, poultry farming, planting of palm oil trees and cultivation of dalmatian pyrethrum.

(3) Fishing

There are rich marine resources in the sea around PNG, so fishing is a promising industry that holds the possibility of development. The government welcomes foreign investment in large-scale fishing operations.

(4) Forestry

The policy of the government is to encourage domestic processing of forestry resources. It is planned to expand the production of lumber, plywood, wood chips, etc.

(5) Manufacturing

The government is making efforts to promote manufacturing as a means of expanding employment opportunities and promoting those industries that can replace imports. Major manufactured products include lumber, plywood, coconut oil, dalmatian pyrethrum and palm oil; however, production of beer, paints, vinyl, cloth, matches and furniture is also being expanded.

3.5 Country Development Plan

At present, a Five-Year Economy Plan (1988 - 1992) is under progress. The outline of that plan is as follows.

3.5.1 Targets

(1) Annual economic growth rate: 3%, actual

(2) Amount of government investment: a 30% increase over the five years

3.5.2 Major Plans

(1) Receipt of aid from foreign countries

- Positively accept aid from foreign countries to renovate industry and furnish a national infrastructure.

(2) Establishment of an economic base

- Develop mining and marine resources;
- Promote agriculture to increase the rate of food self-sufficiency;
- Renovate processing industries and promote technology transfer through joint ventures with foreign companies;
- Promote imports and exports.

(3) Furnishing a national infrastructure

- Construct and/or fix roads, harbors, bridges, etc., and establish a transportation system.
- Furnish water-supply, sewerage, electric and communications facilities.

CHAPTER 4

CURRENT STATUS OF TELECOMMUNICATIONS IN PNG

CHAPTER 4. CURRENT STATUS OF TELECOMMUNICATIONS IN PNG

4.1 History

Prior to 1954 — The Posts and Telegraph Division was part of the Department of Finance and Planning.

1955 — The Department of Posts and Telegraphs (P&T) was organized, consisting of 17 telegraph and telephone offices and 42 post offices throughout the country, with 517 employees (including 153 foreigners).

1968 — The World Bank financed expansion of transmission lines and the postal network.

Amount invested: US$7 million

1972 — Through financing by the World Bank, a telecommunications expansion plan was implemented. The rate of subscriber direct dialing reached 97%. (At present, it is 100%.)

1975 — On gaining national independence, the number of P&T employees was 2,186.

1982 — The Post and Telecommunication Corporation (PTC) was inaugurated, with the Communications Ministry as its supervisory agency.

Services under management of PTC:

Domestic communications,
International communications,
Postal service

The main office of PTC is located in Port Moresby.

December 1987 — Number of PTC employees reaches 3,266.

4.2 Operational Organization

PTC's Telecommunications Department has eight district offices in the 19 provinces of the country. The Telecommunications Division, which is under the management of this department, handles planning, plant construction, maintenance and operations, and manages eight district offices. The organizational charts are shown in Figures 4-2-1 and 4-2-2.

4.3 Current Status of Telecommunications Services

4.3.1 Telephone service

As of the end of 1987, there are 31,439 direct exchange lines (DELs) for the entire country and 42,454 switching equipment terminals. The telephone density is about 0.89 (subscribers/100 persons).

When attention is paid to the service situation for the rural area, which is the subject of this study, and a comparison is made between the urban area and rural area in terms of DELs, the urban area accounts for 94% of the total DELs in the country, and the rural area accounts for 6%. Especially, the seven major cities (Port Moresby, Arawa, Goroka, Lae, Madang, Rabaul, Mt. Hagen) account for 77% of DELs in the country (24,271 lines). Port Moresby itself accounts for 38% (11,882 lines). This shows that the telephone density is extremely low in the rural area, which makes up 87% of the total population.

Table 4-3-1 shows the trend in the number of nationwide telephone subscribers for each District Office from the years 1978 through 1987.

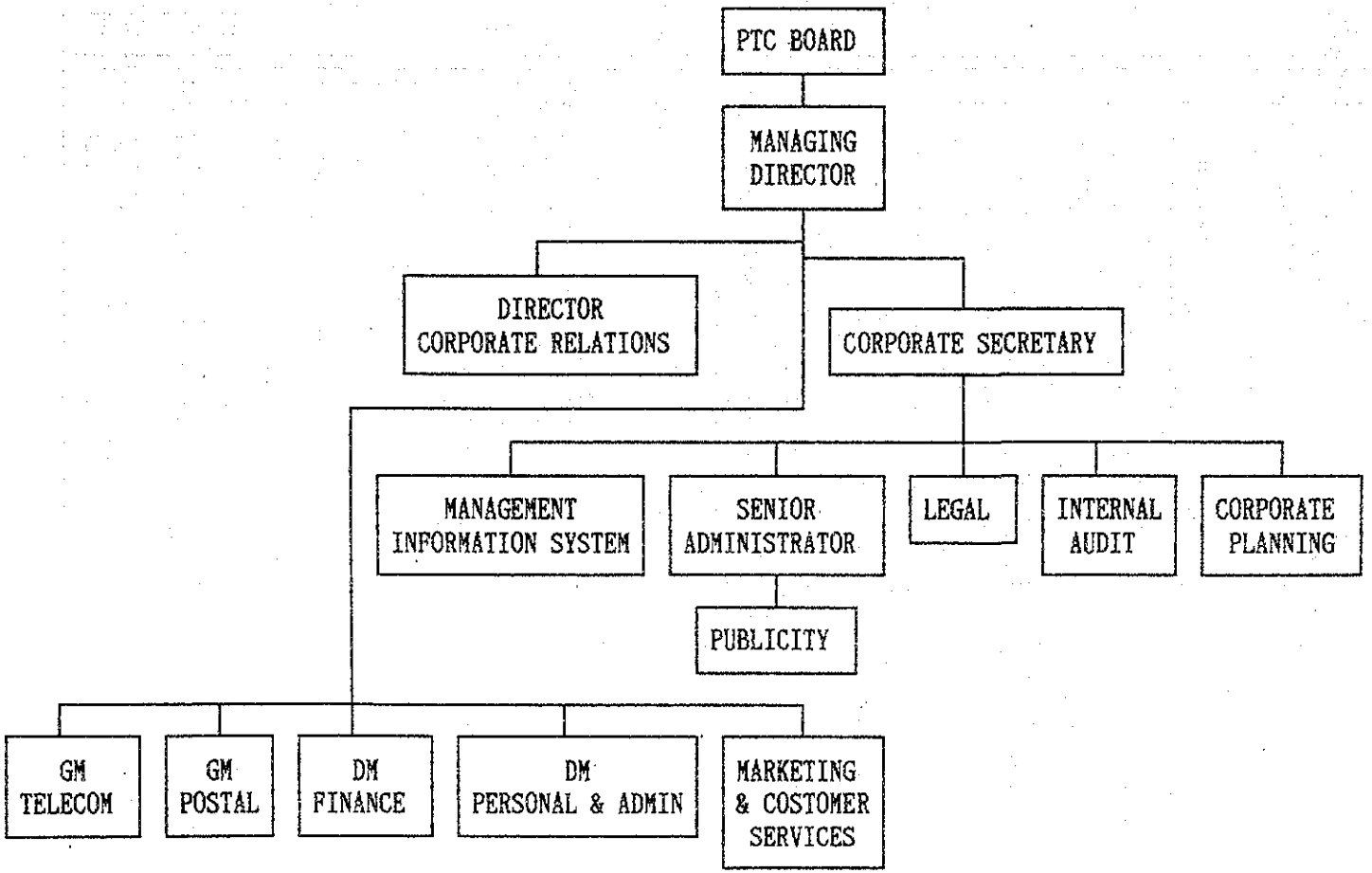


Fig.4-2-1 Organization Chart of Executive and Support Group

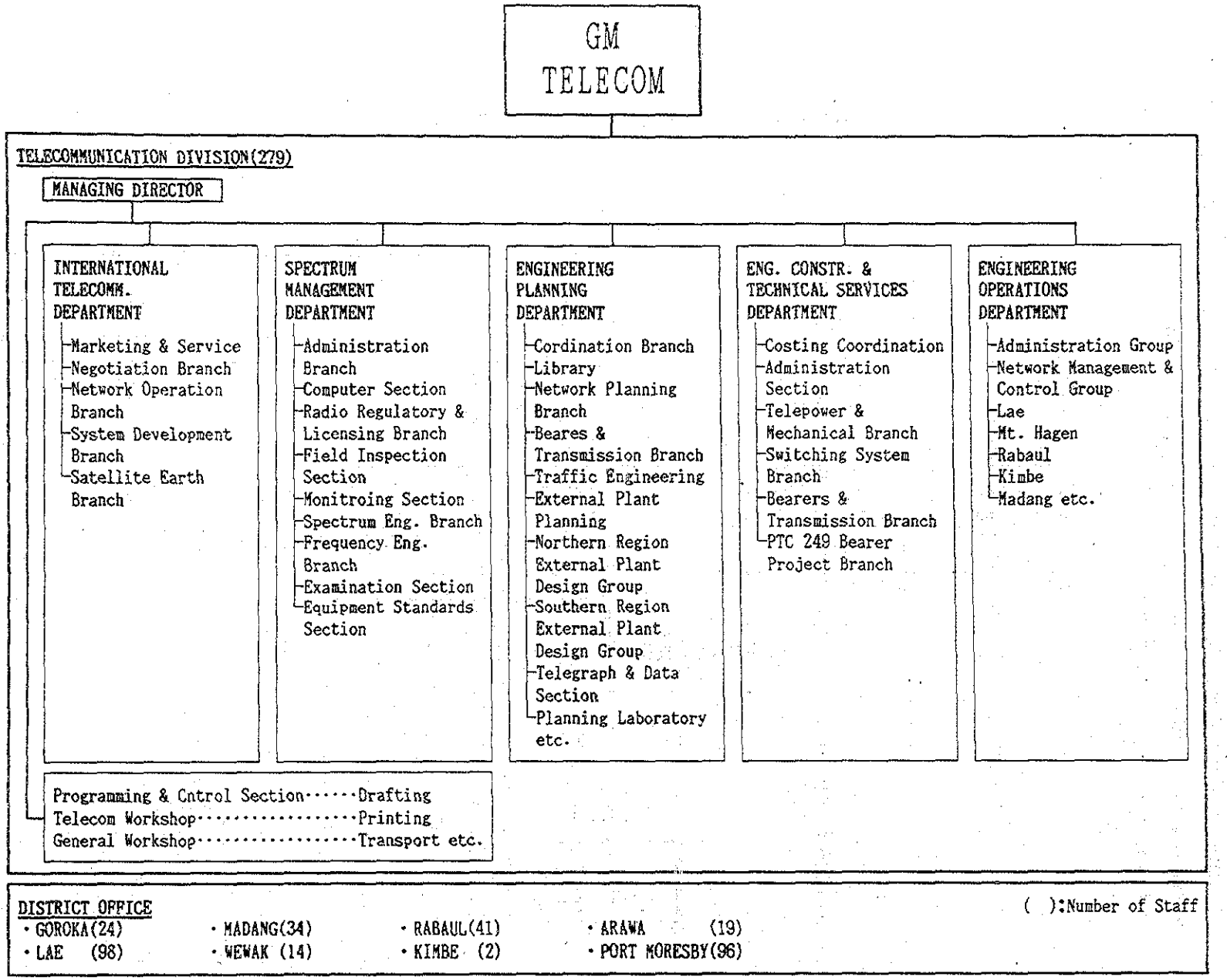


Fig.4-2-2 Organization Chart of Telecommunication Division

Table 4-3-1 Trend in the Number of Telephone Subscribers

District	1978	1984	1987
Arawa	1,917	2,543	2,840
Goroka	1,374	1,537	1,894
Mt. Hagen	1,716	2,169	2,818
Lae	3,493	4,209	5,055
Madang	1,129	1,331	1,556
Port Moresby	10,902	12,649	13,018
Rabaul	2,521	2,826	3,091
Wewak	983	1,125	1,163
Total	24,035	28,389	31,435

4.3.2 Other Services

The situation of subscribers to other services is as follows:

(1) Leased Circuits

1. Data Circuits: 397 (As of the end of 1987)

2. Speech Circuits: 104

(2) Land Mobile Telephones

1. Service Area: National Capital District (NCD)
Highlands Highway (Lae - Mt. Hagen)

2. Number of Subscribers: 28 (As of the end of March 1988)

(3) Radio Paging

1. Service Area: Port Moresby, Wewak

2. Number of Subscribers: 178 (As of the end of March 1988)

4.3.3 Charges

(1) Charging Districts

PNG is divided into 14 charging districts. The telephone switching offices assigned to each district are listed in Table 4-3-2.

Figure 4-3-1 maps the charging districts.

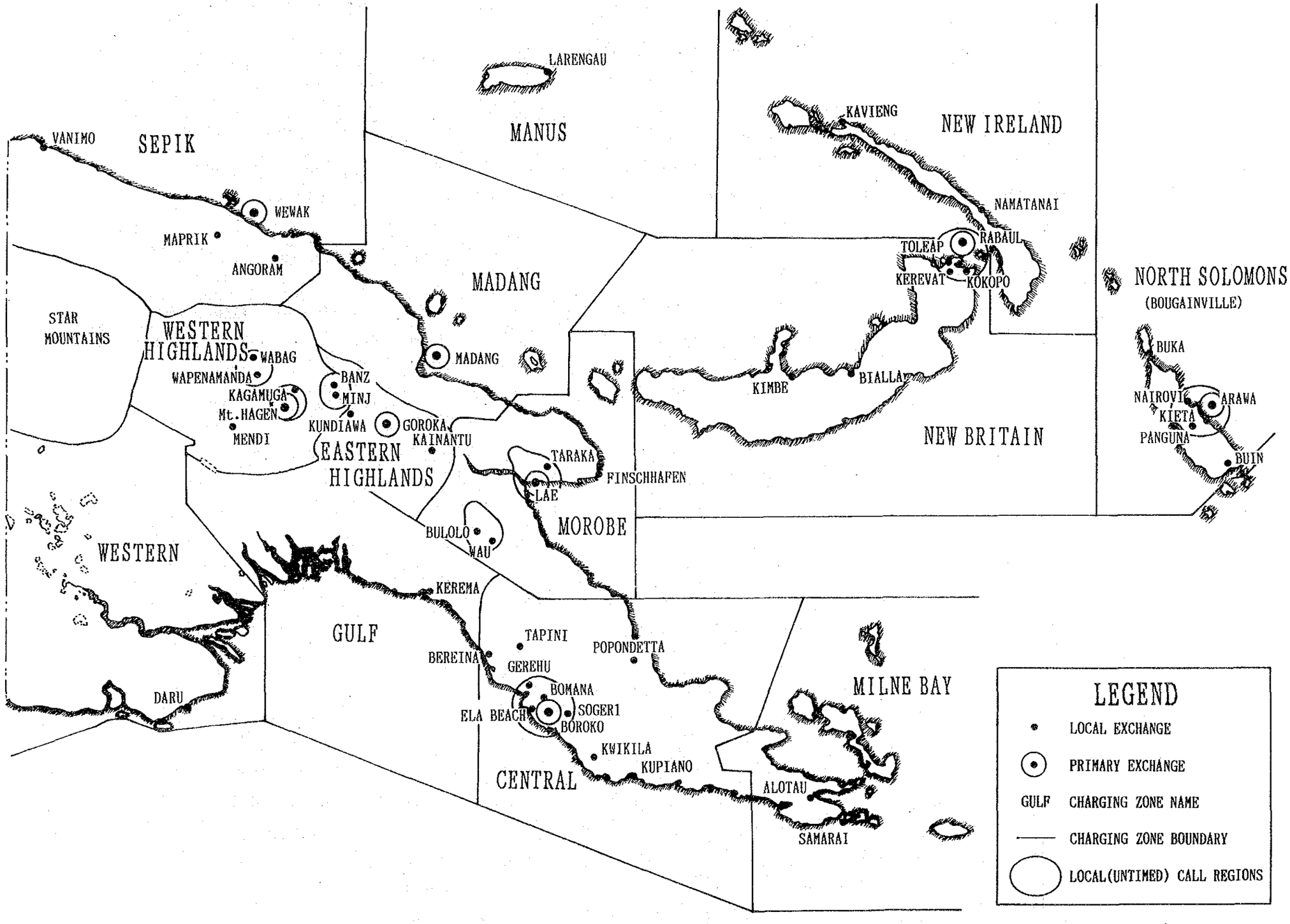


Fig.4-3-1 CHARGING DISTRICT MAP

Table 4-3-2 Charging Districts

Charging District	Offices Served
CENTRAL	BOROKO, ELA BEACH, GEREHU, BOMANA, SOGERI POPONDETTA, TAPINI, BEREINA, KUPIANO, KWIKILA.
GULF	KEREMA
WESTERN	DARU
MILNE BAY	ALOTAU, SAMARAI, MISIMA (BWAGAOIA)
MOROBE	LAE, NADZAB, TARAKA WAU, BULOLO, MUMENG FINSCHHAFEN, KAIAPIT, GUSAP (RAMU, SUGAR)
EAST HIGHLANDS	GOROKA KAINANTU KUNDIAWA
WEST HIGHLANDS	MT. HAGEN, KAGAMUGA BANZ, MINJ MENDI LIAGAM, WABAG, WAPENAMANDA, KOMPIAM TARI, KOROBA IALIBU, IMI
STAR MOUNTAINS	KIUNGA TABUBIL
MADANG	MADANG, BOGIA, SAIDOR, KARKAR
SEPIK	WEWAK, NUKU, MAPRIK, VANIMO, ANGORAM AITAPE AMBUNTI, AMANAB, BEWANI, IMONDA, GREEN RIVER
MANUS	LORENGAU
NEW BRITAIN	RABAUL, KEREVAT, KOKOPO,TOLEAP, WARANGOI KIMBE, HOSKINS, TALASEA KANDRIAN, BIALLA
NEW IRELAND	KAVIENG, NAMATANAI
BOUGAINVILLE	LOLOHO, ARAWA, KIETA, PANGUNA, NAIROVI, BIRIMPA BUKA, BUIN, TINPUTZ

4.4 Current Status of Telecommunications Facilities

4.4.1 Basic Items Concerning Telephone Network

(1) Transmission Line Configuration

Most transmission lines in PNG utilize a radio transmission system. The basic transmission lines for the Boroko (Port Moresby) - Lae - Goroka - Mt. Hagen - Boroko route are looped, but other basic transmission lines are connected to each circuit combination by a single route. Figure 4-4-1 shows the transmission line configuration in PNG as of the end of 1988.

(2) Telephone numbers

All telephone numbers consist of 6 digits.

In addition to general subscribers, subscribers to PBX direct-inward dialing service are taken into consideration in the numbering process.

(3) Charging System

Basically, the periodic pulse metering is applied as the charging system. For local calls, the relevant office creates one meter pulse regardless of call duration. For direct dialing calls, multiple metering pulses are outputted from the primary exchange.

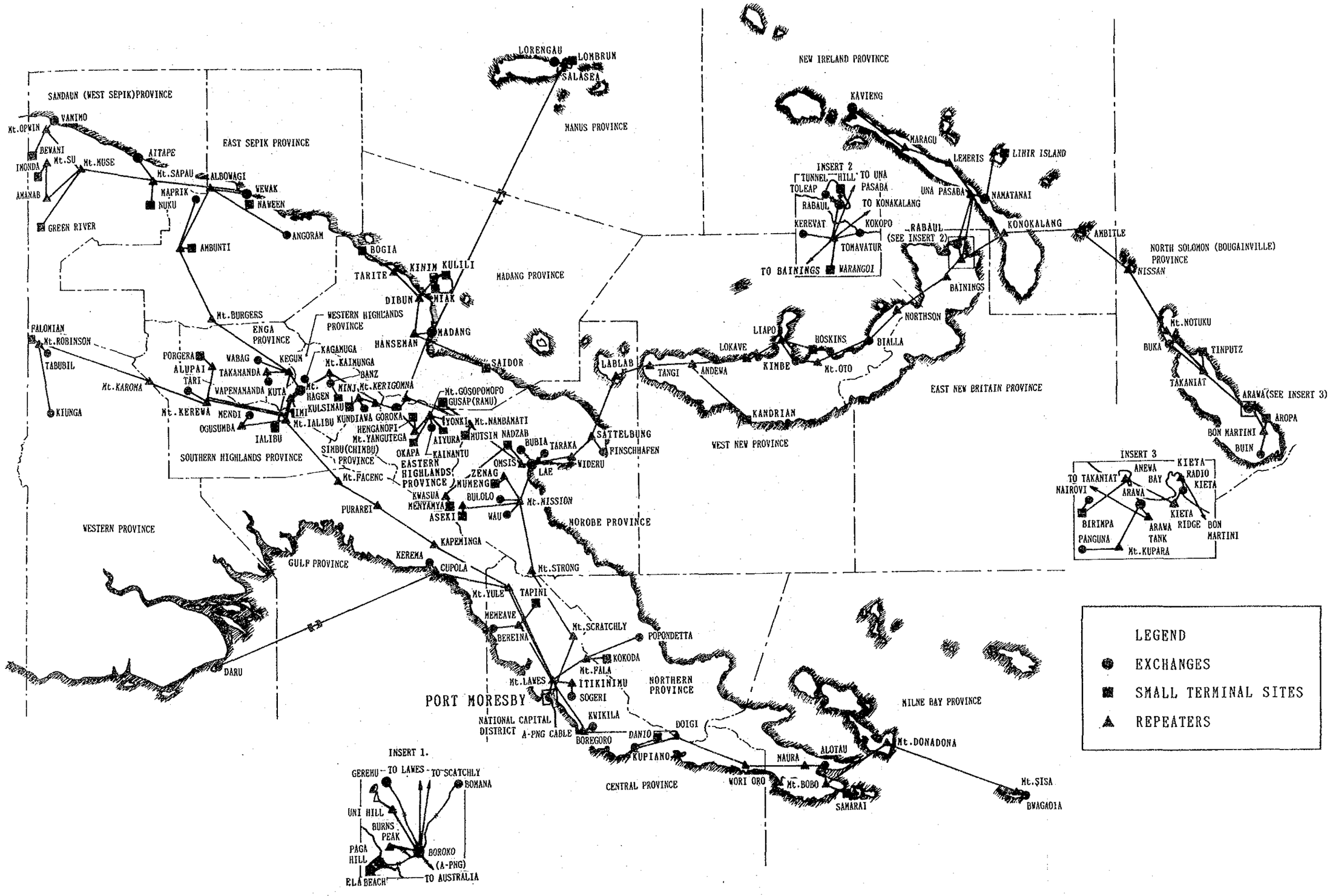


Fig.4-4-1 Telecommunications Network Configuration in PNG

(4) Signaling System

The following signaling system is used in PNG.

a. Loop disconnection

b. E and M (T pulse)

c. Modified R2

The MFC Ericson System is applied for register signals, but decadic pulses are sometimes used between ARK and the parent switching office.

(5) Technical Standards

The quality and technical standards, such as traffic engineering and transmission engineering standards, are in conformity with CCITT recommendations. The frequency allocation is also in accordance with CCIR recommendations.

4.4.2 Transmission Facilities

Tables 4-4-1, 4-4-2, and 4-4-3 list the frequencies, capacities, construction years and manufacturers of the basic transmission lines and local transmission lines.

4.4.3 Switching Equipment

Tables 4-4-4 and 4-4-5 list the type of exchanges, capacity, installation year and allocated telephone numbers for each switching office. Half of the switching equipment installed in 52 stations have been in use for more than ten years. Thus, in the near future, they should be up-dated in consideration of service life.

Table 4-4-1 Basic Transmission Lines

Route	Capacity (Channels)	Frequency (GHz)	Maker	When Installed (FY)	System (Channels)
BOROKO - LAE	1,260	6	NEC	1988	3+1s (Telephone 960 x 2 + TV)
LAE - GOROKA	1,260	6	NEC	1988	3+1s (Telephone 960 x 2 + TV)
GOROKA - MT. HAGEN	1,260	6	NEC	1988	3+1s (Telephone 960 x 2 + TV)
BOROKO - MT. LAWES	1,800	4	TELETTRA	1978	1+1s (Telephone 1800)
MT. LAWES MT. HAGEN	1,260	6	T-CSF	1983	1+1s (Telephone 1260)
LAE - TOMAVATUR	960	2	TELETTRA	1979	1+1s (Telephone 960)
TOMAVATUR - RABAUL	960	6	T-CSF	1983	1+1s (Telephone 960)
TOMAVATUR - ARAWA	960	6	T-CSF	1983	1+1s (Telephone 960)
MT. HAGEN - WEWAK	960	2	TELETTRA	1978	1+1s (Telephone 960)
GOROKA - MADANG	960	2	TELETTRA	1972	1+1s (Telephone 960)

Table 4-4-2 Local Transmission Lines for Microwave System

Route	Capacity (Channels)	Frequency Band	Maker	When Installed (FY)
MT. LAWES - ALOTAU	300	Microwave	TELETTRA	1978
MT. LAWES - CUPLA	120	"	"	1980
MT. LAWES - KWIKILA	120	"	"	--
MT. LAWES - POPONDETTA	300	"	"	1974
MT. LAWES - SOGERI	120	"	NEC	1984
MT. SHUNGOL - BULOLO	120	"	TELETTRA	1980
MT. NAMBAMATI - RAMU	120	"	NEC	1984
MT. YANGUTEGA - KAINANTU	24	"	STC-ML5	1981
MT. KERIGOMNA - KUNDIAWA	120	"	TELETTRA	--
MT. KAIMUNGA - BANZ	120	"	"	--
MT. IALIBU - MENDI	120	"	"	--
MT. ROBINSON - KIUNGA	300	"	T-CSF	--
MT. ROBINSON - TABUBIL	300	"	"	--
MT. KEGUM - WABAG	120	"	TELETTRA	--
MT. ALBOWAGI - ANGORAM	24	"	STC	--
MT. SAPAU - AITAPE	120	"	T-CSF	--
MT. SAPAU - NUKU	120	"	"	--
MT. SAPAU - GREEN RIVER	120	"	"	--
MT. SAPAU - AMANAB	120	"	"	--
MT. SU - IMONDA	120	"	"	--
MT. OPWIN - BEWANI	120	"	"	--
ANDEWA - KANDRIAN	120	"	TELETTRA	1981
UNA PASABA - NAMATANAI	120	"	T-CSF	--
ANEWA - KIETA	300	"	FARINON	1972
KUPARA - PANGUNA	120	"	"	1972
TAKANIAT - TINPUTZ	120	"	T-CSF	1984
MT. MIUS - VANIMO	300	"	T-CSF	--
MT. KEREWA - TARI	120	"	TELETTRA	1981
MT. MARAGU - KAVIENG	300	"	T-CSF	--

Table 4-4-3 Local Transmission Lines for UHF System

Route	Capacity (Channels)	Frequency Band	Maker	When Installed (FY)
MT. LAWES - DOA	6	UHF	NEC	--
MT. LAWES - MEMEAVE	60	"	"	--
MT. LAWES - ROUNA	6	"	"	--
MEMEAVE - BEREINA	5	"	MSK	--
MEMEAVE - TAPINI	5	"	MSK	--
ALOTAU - SAMARAI	60	"	NEC	1987
ALOTAU - GAMADOUDOU	6	"	NEC	--
MT. KAINDI - MUMENG	5	"	GEC	1981
MT. KAINDI - WAU	15	"	GEC	1981
MT. NAMBAMATI - MUTZIN	120	"	NEC	1984
OOMIS -	120	"	NEC	1984
SATTELBURG - FINSCHHAFEN	60	"	NEC	1981
WAU - GOLDFIELDS	6	"	NEC	1985
NADZAB - MENYAMYA	4	"	NOKIA	1987
MADANG - DIBUN	120	"	NEC	1983
DIBUN - BOGIA	60	"	NEC	1983
DIBUN - KINIM	60	"	NEC	1983
KINIM - MIAK	6	"	NEC	1983
KINIM - KULILI	6	"	NEC	1983
YABOB - YAGAUM	5	"	MSK	--
AMBUNTI - MAPRIK	60	"	NEC	--
GOROKA - URITOKA	12	"	NEC	1985
MT. HAGEN - KAGAMUGA	120	"	NEC	1985
MT. KEGUM - IALIB	60	"	NEC	1985
MT. KEGUM - IMI	120	"	NEC	1985
MT. ROBINSON - FALOMIAN	60	"	NEC	--
TOMAVATUR - KOKOPO	6	"	NEC	--
NAMATANAI - LIHIR	4	"	NOKIA	--
LORENGAU - LOMBRUM	6	"	NEC	--
MT. KEREWA - PORGERA	8	"	NOKIA	--
TARI - BPHIDES	4	"	NOKIA	--

Table 4-4-4 TELEPHONE SYSTEM SIZE STATISTICS (1/2)

Exchange	Type	Prefix	Capacity	Allocated	Connected	Usage
Arawa District						
Arawa	ARF	951-952	2300	1899	1898	82.0%
Buin	ARK	961	100	39	39	39.0%
Buka	ARK	966	200	111	106	55.0%
Kieta	ARK	956	500	491	483	98.0%
Nairovi	ARK	959	100	51	51	51.0%
Panguna	ARK	958	400	341	336	85.0%
District Total:			3600	2932	2913	
Goroka District						
Goroka	ARF	721-722	2000	1431	1360	71.0%
Kainantu	ARK	771	300	187	166	62.0%
Kundiawa	ARK	751	400	257	243	64.0%
District Total:			2700	1875	1769	
Mt. Hagen District						
Banz	MCR	562	256	90	88	35.0%
Kagamuga	MCR	552	384	191	189	49.0%
Kiunga	MCR	581	320	120	111	37.0%
Mendi	MCR	591	400	253	247	63.0%
Mount Hagen	ARF	521-522	2000	1344	1311	67.0%
Tabubil	MCR	589	384	270	256	70.0%
Tari	MCR	508	128	57	54	44.0%
Wabag	ARK	571	300	177	177	59.0%
Wapenamanda	ARK	574	100	35	35	35.0%
District Total:			4272	2537	2468	
Lae District						
Bulolo	ARK	445	300	128	123	42.0%
Finschhafen	ARK	447	100	57	55	57.0%
Lae	ARF	421-426	5600	3835	3757	68.0%
Taraka	MCR	457	512	390	381	76.0%
Wau	ARK	446	200	148	140	74.0%
District Total:			6712	4558	4456	
Madang District						
Lorengau	ARK	409	400	244	222	61.0%
Madang	ARF	822-823	1600	1398	1264	87.0%
District Total:			2000	1642	1486	

Table 4-4-5 TELEPHONE SYSTEM SIZE STATISTICS (2/2)

Exchange	Type	Prefix	Capacity	Allocated	Connected	Usage
Port Moresby District						
Alotau	ARK	611	500	391	378	97.0%
Bereina	RURAX	299	50	20	19	40.0%
Bomana	ARK	281	400	276	262	69.0%
Boroko	ARF	251-259	9000	7559	7222	83.0%
Daru	ARK	659	300	171	165	57.0%
Ela Beach	ARE11	211,4,7	5000	3986	3840	79.0%
Gerehu	ARE11	260-261	1800	423	405	23.0%
Kerema	ARK	681	200	128	127	64.0%
Kupiano	ARK	292	100	51	46	51.0%
Kwikila	ARK	295	100	34	29	34.0%
Popondetta	ARK	297	500	357	341	71.0%
Sogeri	RURAX	282	100	47	37	47.0%
District Total:			18050	13443	12871	
Rabaul District						
Bialla	ARK	931	200	123	109	61.0%
Kavieng	ARK	942	400	370	350	92.0%
Kerevat	ARK	926	100	58	58	58.0%
Kimbe	ARK	935	600	547	546	91.0%
Kokopo	MCR	928	256	189	167	73.0%
Namatanai	MCR	943	128	59	55	46.0%
Rabaul	ARF	921-923	2400	2010	2004	83.0%
Toleap	ARK	927	230	135	128	58.0%
District Total:			4314	3491	3417	
Wewak District						
Aitape	MCR	872	128	72	70	56.0%
Angoram	ARK	883	100	31	27	31.0%
Maprik	MCR	881	128	97	69	75.0%
Vanimo	ARK	871	300	235	213	78.0%
Wewak	ARF	862	1000	780	779	78.0%
District Total:			1656	1215	1158	
PNG Total:			43304	31693	30538	73.0%

4.4.4 Current Status of Rural Communications Facilities

At present, PTC has the following communications systems for the rural area.

(1) Line Concentrators

(2) RSSs (Rural Subscriber Systems)

These FDMA radio systems provide four or eight common channels.

(3) Single Channel Radio Systems

These systems include FM 880, SR10, TR3E1 and TR4E1.

Tables 4-4-6 and 4-4-7 list the rural communications facilities currently provided.

Table 4-4-6 Rural Telecommunications Facilities

Province	Office in which Installed	System Name	Number of Units	Remarks
Central	Bomana	FM880	1	
	Kupiano	FM880	4	
	Kwikila	FM880	2	
	Mt. Lawes	FM880	3	
		SR10	1	
		RSS	47	8 ch. systems
	Memeave	SR10	3	
	Paga Hill	FM880	4	
		RSS	10	4 ch. systems
	Sogeri	TR3E1	1	
		FM880	1	
	Mt. Yule	FM880	2	
East New Britain	Tomavatur	FM880	10	
		RSS	51	8 ch. systems
	Observatory	RSS	18	4 ch. systems
Eastern Highlands	Goroka	FM880	7	
		TR3E1	2	
	Kanantu	FM880	2	
		TR3E1	1	
	Mt. Kiss	RSS	43	8 ch. systems
East Sepik	Angoram	FM880	2	
	Maprik	FM880	4	
	Naween	FM880	4	
	Wewak	FM880	2	
		SR10	2	
Gulf	Cupola	FM880	1	
	Favenc	TR4E1	2	
	Kaeminga	FM880	1	
Madang	Hanseman	FM880	2	
		TR3E1	2	
	Madang	FM880	1	
	Tarite	FM880	1	
		SR10	1	
	Bogia	FM880	1	
	Kulila	SR10	1	
	Dibun	RSS	21	8 ch. system
Manus	Salasia	FM880	3	
Milne Bay	Alotau	FM880	8	
		TR3E1	1	
	Samarai	FM880	5	

Table 4-4-7 Rural Telecommunications Facilities

Province	Office in which Installed	System Name	Number of Units	Remarks
Morobe	Sulolo	TR3E1	1	
		FM880	1	
	Finschafen	FM880	2	
		SR10	5	
		TR3E1	1	
	Lae	FM880	1	
	Nadzab	SR10	1	
		TR3E1	2	
	Ramu	FM880	7	
		TR3E1	1	
	Oomsis	RSS	44	8 ch. systems
New Ireland	Kavieng	FM880	1	
	Namatanai	FM880	1	
		TR3E1	1	
North Solomons	Arawa	FM880	7	
		SR10	1	
	Buka	FM880	2	
	Takaniat	RSS	48	8 ch. systems
Northern	Popondetta	SR10	2	
		FM880	1	
		RSS	11	8 ch. systems
Chimbu	Kundiawa	FM880	9	
		TR3E1	1	
		TR4E1	1	
Western Highlands	Banz	TR4E1	1	
	Mt. Hagen	FM880	2	
	Kegum	FM880	2	
		RSS	45	8 ch. systems
	Kuta	RSS	36	8 ch. systems
Southern Highlands	Kerewa	FM880	3	
	Mendi	FM880	3	
	Tari	FM880	3	
West New Britain	Bialla	FM880	4	
		TR3E1	1	
		SR10	1	
	Kandrian	SR10	1	
	Kimbe	TR3E1	1	
	Liapo	RSS	30	8 ch. systems
Western	Kiunga	FM880	1	
West Sepik	Mius	FM880	1	
	Sapau	FM880	1	
	Vanimo	FM880	1	
	Aitape	SR10	1	

4.5 Five-Year Development Plan

4.5.1 Overall Development Plan

(1) PTC's Development Targets

PTC indicated its targets for telecommunications network development to be the following:

(a) Integration and increased reliability, primarily for the existing network.

(b) Expansion of the existing network in the rural area.

(2) Outline of the Five-Year Development Plan

(a) Period: 1988 - 1992

(b) Expansion of Telephone Service

(i) Increase in telephone demand: 6% per year, on average

(ii) Number of DELs: 30,428 (March 1988) --> 38,000 (1990)

(iii) Share of telephones for household use: 29% (current) --> 33%

(iv) Share of local cities: 26% (current) --> 30%

(c) Investment Amount

(i) Direct investment (telecommunication and postal facilities): 144 million kina (1988 - 1992)

(ii) Investment items:

Transmission line facilities: 15%

Switching facilities: 12%

Office buildings: 30%

Power supply: 8%

Rural communications: 7%

Terminals, such as telephone sets: 7%

(d) Forecasts of annual expenditures and revenues are given in Tables 4-5-1, 4-5-2 and 4-5-3.

(3) Establishment of a Master Plan

PTC requested the establishment of a "Telecommunications Network Development Plan", which can be called the master plan for the telecommunications network, as follows and has received the final report.

(a) Requested to: DETECON Co. of West Germany
(Detsche Telepost Consulting GMBH)

(b) Study Period: October 1987 - May 1988

(c) Study Subjects:

1. Network digitization plan in 1989 - 1993, aiming at the year 2002.

2. PTC management improvement plan.

Table 4-5-1 Forecast of PTC's Financial Condition

(Unit: 1,000 kina)

Fiscal year	1988	1989	1990	1991	1992
Income Statement					
Sales	93,031	97,696	104,621	112,393	122,354
Operating Expenses	77,095	81,523	86,231	90,827	96,607
Operating Profit	15,936	16,173	18,390	21,566	25,747
Funds Statement Internally					
Supplied Funds	32,075	34,999	40,622	47,501	54,921
Funds to be Used	11,754	14,444	15,223	16,810	23,016
Available Funds After Deduction	20,321	20,555	25,399	30,691	31,905
Operating Funds/ Investment in Other Assets	1,251	(2,143)	1,394	501	1,196
Facilities Investment	33,670	42,448	39,620	33,852	32,246
Total	34,921	40,305	41,014	34,353	33,442
Necessary Funds After Deduction	14,600	19,750	15,615	3,662	1,537
Balance Sheet					
Fixed Assets (After Depreciation)	138,598	162,220	179,609	187,526	190,598
Current Assets	31,320	30,411	32,328	38,970	41,194
Other Assets	3,909	3,909	3,909	3,909	3,909
Total Assets	173,827	196,540	215,846	230,405	235,701
Current Liabilities	30,887	31,552	32,231	39,031	41,546
Fixed Liabilities	29,455	48,088	62,486	64,933	60,253
Other Liabilities	10,284	10,284	10,284	10,284	10,284
Profit/Surplus	33,788	37,203	41,432	46,744	54,205
Capital	69,413	69,413	69,413	69,413	69,413
Total Liabilities and Capital	173,827	196,540	215,846	230,405	235,701

Table 4-5-2 Forecast of Funding Operations Plan
(Annual Expenditures)

(Unit:1,000 kina)

Fiscal Year	1988	1989	1990	1991	1992
Telecommunications/ Postal Facilities					
Office Buildings	9,434	15,915	12,343	3,365	3,110
Transmission Line Network Facility	4,908	3,594	5,281	4,498	2,845
Speech System Terminals	2,663	2,816	2,601	2,696	2,567
Public Switching Equipment	1,993	5,569	3,383	3,367	3,146
Power Facilities	2,745	2,346	2,212	2.093	1,858
Rural Radio End-Office Equipment	3,402	2,341	1,438	1,238	1,338
Subscriber Network Facilities	1,449	1,882	1,613	1,278	1,331
International Circuit Equipment	1,274	656	475	430	433
Telegram Data Units	777	621	622	571	572
Postal Processing Equipment	184	184	184	184	184
Other	100	160	1,750	5,111	5,100
Subtotal	28,929	36,084	31,902	24,820	22,484
Additional/ Related Facilities					
Vehicles	1,625	1,625	1,625	1,625	1,625
Machine Parts, Tools	1,747	1,244	870	870	870
Furnishings/Equipment	955	631	525	449	328
Data Processing	414	700	457	475	780
Subtotal	4,741	4,200	3,477	3,419	3,603
Amount of facilities investment before interest is added to assets (Actual)	33,670	40,284	35,379	28,239	26,087
" (Nominal)	33,670	42,298	39,005	32,690	31,709
Interest to be added to assets	0	150	615	1,162	1,537
Total Facilities Investment	33,670	42,448	39,620	33,852	33,246

Table 4-5-3 Forecast of Funding Operations Plan
(Investment)

(Unit: 1,000 kina)

Fiscal Year	1988	1989	1990	1991	1992
Sources of Funds					
Operating Profit	15,936	16,173	18,390	21,566	25,747
Depreciation	16,139	18,826	22,232	25,935	29,174
Total	32,075	34,999	40,722	47,501	54,921
Application of Funds					
Payment of Interest	2,180	4,041	5,817	7,108	7,040
Repayment of Loans	1,893	1,117	1,217	1,215	6,217
Payment of Taxes	3,996	4,815	4,246	4,401	5,060
Payment of Dividends	3,686	4,471	3,943	4,086	4,699
Total	11,754	14,444	15,223	16,810	23,016
Investment					
Operating Funds/ Other assets	1,251	(2,143)	1,394	501	1,196
Facilities Investment	33,670	42,448	39,620	33,852	32,246
Total	34,921	40,305	41,014	34,353	33,442
Surplus Funds (Shortfall)	(14,600)	(19,750)	(15,615)	(3,662)	(1,535)
Loan Plan					
Development Loans	1,800	8,500	8,200	0	0
Private Loans	11,300	5,600	2,300	0	0
International Loans	1,500	5,650	5,115	3,662	1,537
Total	14,600	19,750	15,615	3,662	1,537

4.5.2 Expansion of the Rural Communications Network and Its Necessity

(1) Necessity of Rural Communications Network

The construction and expansion of a rural communications network is an urgent task for PNG for the following reasons:

(a) Contribution to promotion of industry

Construction of an adequate communications network will enable timely transportation and supply of the primary products that support the country's economy, which will contribute to the promotion and activation of industry. In addition, efficient mining of underground resources, which are abundant in the country, will become possible by using the communications network which enables well-timed dispatch of personnel, equipment and materials.

(b) Correction of regional differences

Now, there are large differences in education, culture and living standards between areas. Development of a means of communications will promote the exchange of information and distribution of goods, which should prove useful for correction of such differences.

(c) Improvement of living standards for rural residents

Construction of a communications network will enable the speedy implementation of administrative work. It will also provide smooth contact in case of emergency, thus contributing to improvement of the living standards of rural residents.

(2) Expansion of the Rural Communications Network

(a) PTC's Plan

(i) Experimental installation of village pay-phones

- Barakau Village

  Installation Period: 1987

  Location: Fishing village 30 km south east from Port Moresby, part of Central Province.

  Facilities: (Power source) -- Solar cell and battery
  (System) -- RSS via Mt. Lawes

  Operation: Village chief selects a responsible person (Village Telephone Chief) from among the residents of the village, and gives him responsibility for monitoring facilities. PTC periodically visits and collects the money.

- Hula Village

  Installation Period: March 1988

  Location: Village 100 km south east from Port Moresby, part of Central Province.

  Facilities: (Power source) -- Solar cell and battery
  (System) -- RSS via Danio Hill

(ii) Expansion of the public telephone network

PTC plans to expand the public telephone network as part of rural communications facilities during the five years between 1988 - 1993.

(b) Effects of expansion of the rural communications network

(i) Expansion area

Traditional villages have been by-passed in development because of their low population density and geographic conditions and financial constrains.

(ii) Effect of expansion

Connection of the communications network to meeting places in the village, such as schools, or mining development sites and farm lands, is expected to increase the number of calls on a shared-use basis.

CHAPTER 5

DEMAND FORECAST

CHAPTER 5. DEMAND FORECAST

5.1 Demand for Telephone Service

5.1.1 Introduction

The objective villages for this study are at the initial stage of telephone penetration. The primary interest of the PNG government is therefore placed on the elimination of non-telephone areas by installing telephones in as many villages as possible through the implementation of this project.

The means of communications currently employed in the rural areas of PNG are:

— direct contact after traveling on foot or by canoe;

— postal service, and;

— HF radio.

Due to geographic conditions, however, these means of communications cannot fully meet the requirements of standard communications media, such as (1) fast delivery, (2) convenience, (3) reliability, (4) confidentiality, and (5) economic efficiency.

The introduction of direct dialing telephone service would sufficiently satisfy these conditions. It was confirmed through interviews we conducted on site in three provinces (Western, Morobe and New Ireland) that there is good potential for telephone installations among local agencies of national administrative organizations and social service entities.

Accordingly, in this study, a macroscopic demand forecast for telephone service in rural areas was made using the telephone density vis-a-vis population, while microscopic demand in each village was forecast with the basic aim of fulfilling the needs of public institutions for telephones and the penetration of pay phones.

5.1.2 Macroscopic Demand

The macroscopic demand forecast was made for all of PNG (rural areas + urban areas) and the objective villages for this study.

(1) Demand in All of PNG (Rural Areas + Urban Areas)

The future demand for all of PNG was macroscopically forecast based on the correlation between per capita GDP and telephone density. Figure 5-1-1 shows the correlation between per capita GDP and telephone density for 1981 in 56 countries in the world. The following formula was obtained by regressive analysis of this relationship.

$$Y = 0.000113 \times X^{1.372} \quad (r=0.952)$$

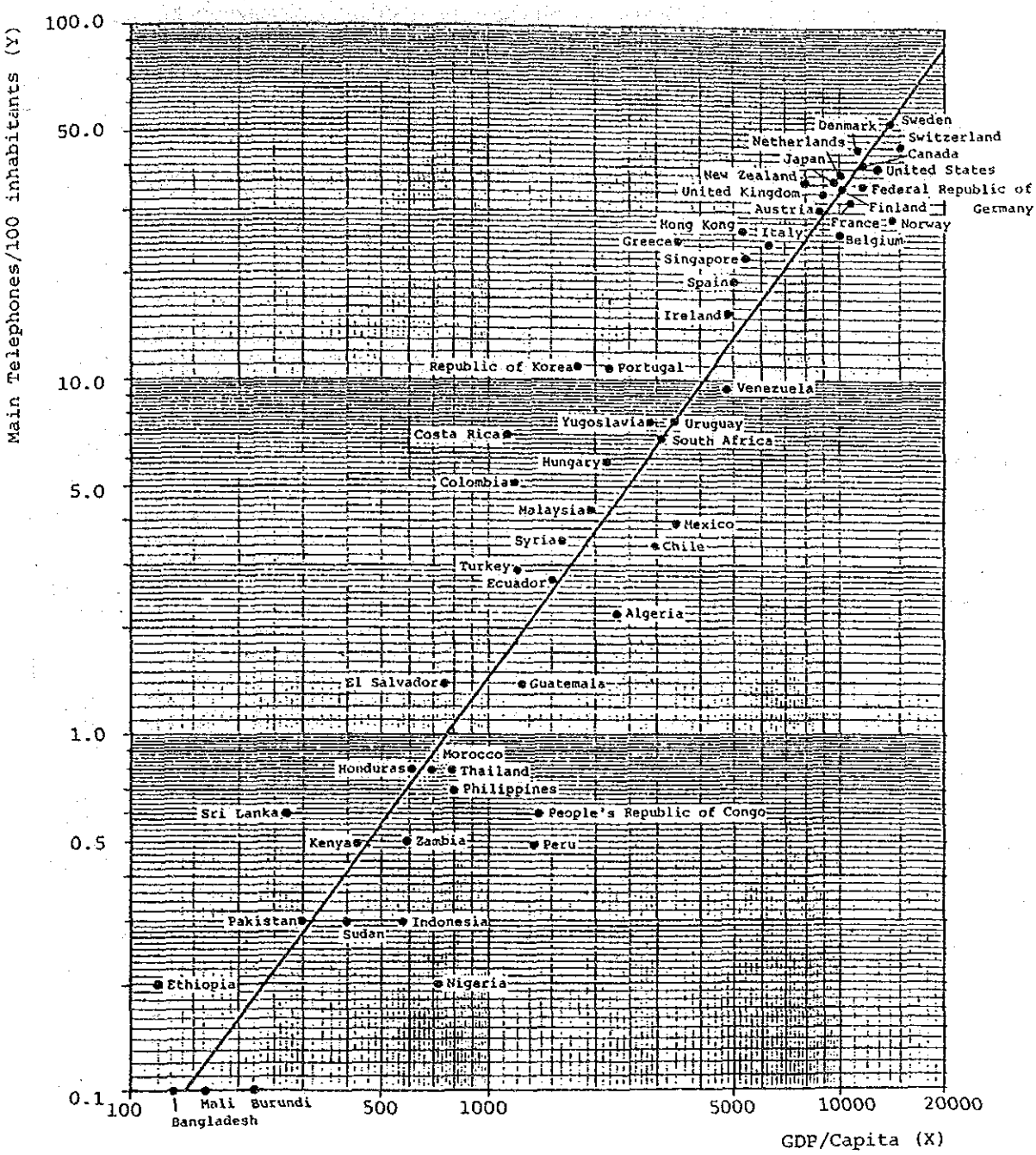
Y: Telephone density per 100 population

X: GDP per capita (US$: 1981 prices)

r: Correlation factor

For application of this formula, the numbers in Figure 5-1-1 were used for the GDP growth rate in 1981 prices, and the numbers in Table 5-1-2 were used for the population forecast. In forecasting population, the annual rate of 2.3% that has been used in various public data was used as the population increase rate.

The telephone density calculated according to the above formula and the demand for all of PNG in 1997 calculated on the population forecast are both close to the figures that DETECON, the German consulting company, calculated by a different method. If it is assumed that the demand from 1987 to 1997 shows an almost constant increase rate, the annual increase rate is 5.8%.



$$Y = 0.000113 \times^{1.372} \quad \text{(Correlation Factor: 0.952)}$$

Source: World Development Report 1983 (Data as of 1981)
The World's Telephones 1982 (Data as of Jan. 1, 1982)

Figure 5-1-1 Correlation between Per Capita GDP and Telephone Density

Table 5-1-1 GDP Growth Rate

(Average Annual Percentage Change at Constant Prices)

Year	1980 - 87	88 - 90	90 - 92	92 - 95	88 - 95
Growth rate(%)	1.9	4.0	3.1	3.4	3.4

Source: Data provided by PNG authorities and staff estimates.

Table 5-1-2 Population Forecast for PNG

PROVINCE	POPULATION 1980	GROWTH RATE %	1989	1990	POPULATION 1991	1992	1993	2002
NCD	123,624	3.9	174,439	181,242	188,310	195,654	203,285	286,843
WESTERN	78,575	2.6	98,994	101,568	104,209	106,918	109,698	138,206
GULF	64,120	1.8	75,288	76,643	78,022	70,427	80,856	94,939
CENTRAL	116,964	2.1	141,021	143,982	147,006	150,093	153,245	184,765
MILNE BAY	127,975	2.7	162,652	167,043	171,554	176,186	180,943	229,972
NORTHERN	77,442	2.6	97,567	100,104	102,706	105,377	108,117	136,213
W-HIGHLANDS	165,656	2.1	320,296	327,022	333,890	340,901	348,060	419,649
S-HIGHLANDS	236,052	1.5	269,899	273,948	278,057	282,228	286,461	327,537
ENGA	164,534	1.3	184,816	187,219	189,653	192,118	194,616	218,607
CHIMBU	178,290	0.7	189,842	191,171	192,509	193,857	195,214	207,862
E-HIGHLANDS	276,726	1.8	324,923	330,771	336,725	324,786	348,956	409,733
MADANG	211,069	2.6	265,920	272,834	279,927	287,206	294,673	371,250
MOROBE	310,622	2.6	391,344	401,519	411,958	422,669	433,659	546,254
E-SEPIK	221,890	2.3	272,282	278,544	284,951	291,505	298,209	365,933
MANUS	26,036	2.3	31,949	32,684	33,435	34,204	34,991	42,938
W-SEPIK	114,192	1.9	135,271	137,841	140,460	143,128	145,848	172,770
N.IRELAND	66,028	2.6	83,187	85,350	87,569	89,846	92,182	116,137
EN.BRITAIN	133,197	2.7	169,289	173,860	178,554	183,375	188,326	239,356
WN.BRITAIN	88,941	3.2	118,092	121,871	125,770	129,795	133,949	177,851
N.SOLOMONS	128,794	3.4	174,013	179,929	186,047	192,372	198,913	268,749
TOTAL	3,010,727	2.3	3,681,082	3,765,144	3,851,313	3,939,645	4,030,200	4,955,663

(2) Establishing a Telephone Penetration Target in Rural Areas

It is considered to be inappropriate to make demand forecasts with the previous formula in rural areas, as most of these areas have no telephone service at present. Moreover, as other correlations with any significant demand factors were not discovered either, it was decided in this section to estimate the index of telephone density by referring to other countries having a similar per capita GDP.

Figure 5-1-2 shows differences in telephone density between urban and rural areas by country. As shown in this figure, in countries with a per capita GDP of US$500 to $1,000, telephone density in rural areas is 0.1 to 0.3, which is 1/10th to 1/50th the density of urban areas. On the other hand, as shown in Table 5-1-3, the current situation of PNG is that the telephone density in rural areas is very low, and the difference with urban areas amounts to some 1/275th, indicating a delay in rural development compared to similar countries.

Table 5-1-3 PNG's Telephone Density (per 100 people)

All of PNG	0.85
Rural Area	0.02
Urban Area	5.50

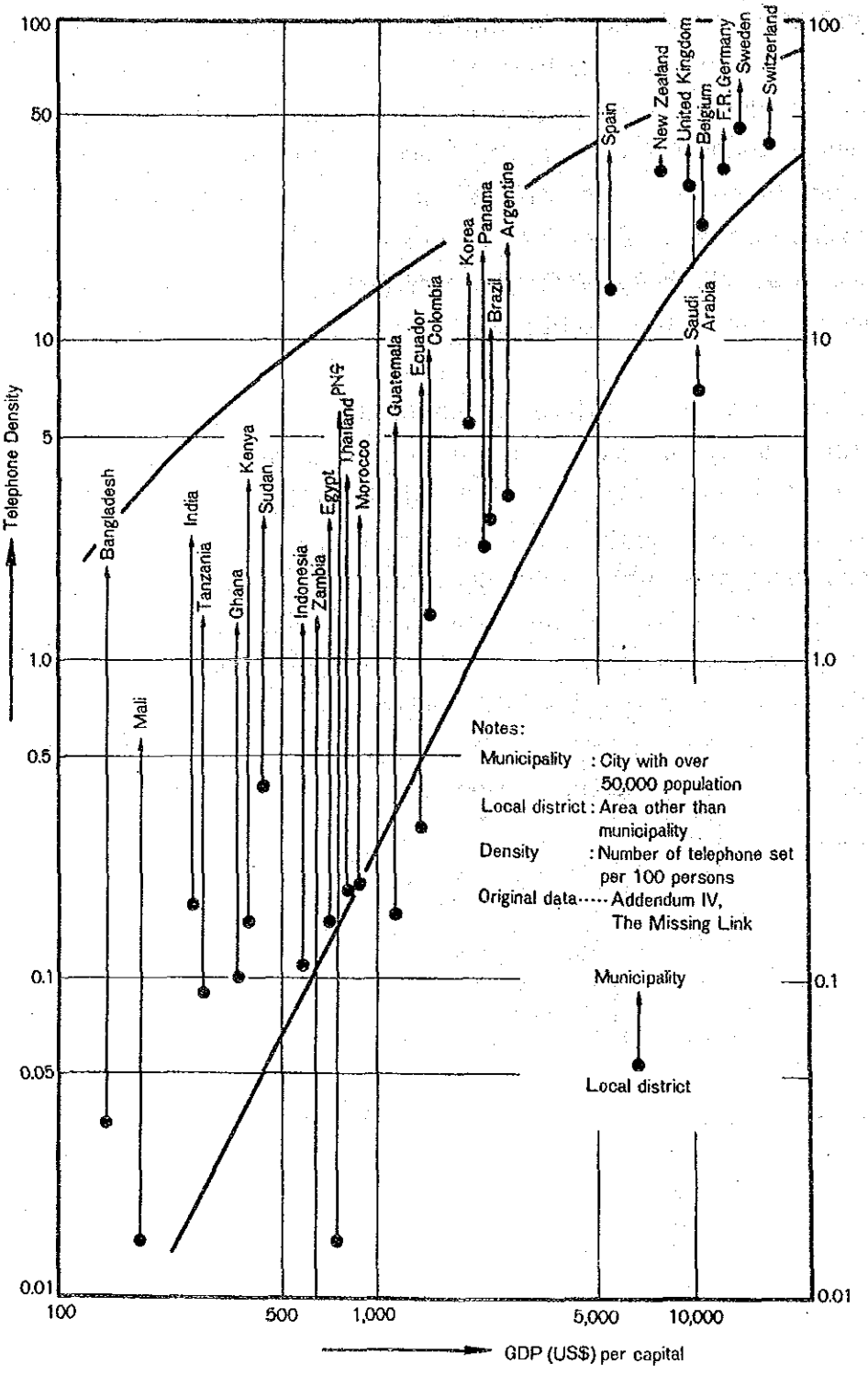


Figure 5-1-2 Differences in Telephone Density between Urban and Rural Areas by Country

In order to narrow this difference in PNG to the level of similar countries, it is necessary to improve telephone density in rural areas to over 0.1, which is 1/50th the density of urban areas. However, as some 10,000 villages are scattered in rural areas of PNG, many of which still depend on a self-sufficiency economy, studying overall density with these villages included makes little sense. For this study, therefore, only villages which have the possibility of generating demand at the earliest time were selected as objective villages for study from among rural areas meeting the following criteria.

Selection criteria of objective villages for study:

(a) The population of the pertinent village alone, or including surrounding villages within 5 km, is over 500.

(b) Government-related institutions or private companies are located in the village.

Under this study, therefore, the telephone penetration target of these objective villages was set at 0.1, and the number of telephones required was calculated accordingly.

(3) Telephones Required in Objective Villages for Study

The number of telephones in the selected 892 villages was projected on the target telephone density against the population of the objective villages, including surrounding villages within 5 km. As a result, the demand in 1997 is 1,680 including surrounding villages. Accordingly, the average demand per objective village is estimated to be 1.9. Table 5-1-4 presents population forecasts in the objective villages for study.

The forecast macroscopic demand in PNG is shown in Figure 5-1-3.

Table 5-1-4 Population Forecasts of Objective Villages for Study

Number of Villages for Study	Population of Objective Villages (1,000 persons)		Population Including Surrounding Villages	
	1980	1997	1980	1997
892	750	1,050	1,200	1,680

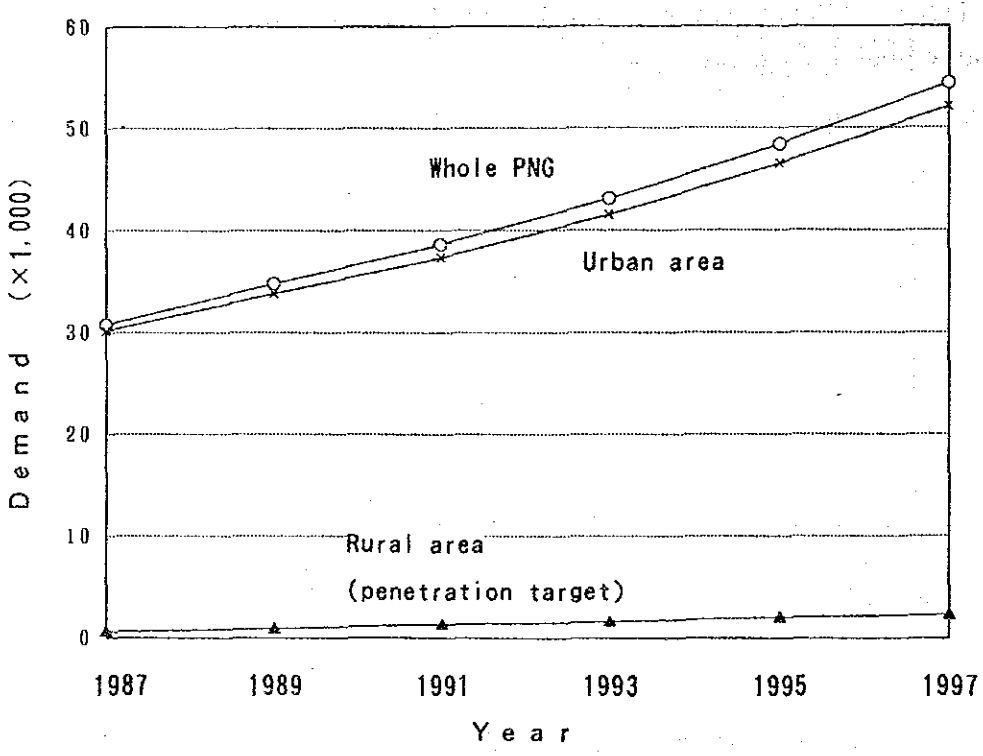


Figure 5-1-3 Macroscopic Demand & Rural Area Penetration Target