JAPAN INTERNATIONAL COOPERATION AGENCY

POSTS AND TELECOMMUNICATION DEPARTMENT
THE STATE OF WESTERN SAMOA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF RURAL TELECOMMUNICATIONS
IN
THE STATE OF WESTERN SAMOA

DECEMBER 1993

NTT INTERNATIONAL CORPORATION

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PREFACE

In response to a request from the Government of Western Samoa, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Rural Telecommunications and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Western Samoa a study team headed by Mr. Akira Nasu, Special Advisor for International Cooperation, Ministry of Posts and Telecommunications, and constituted by members of NTT International Corporation, from July 25 to August 26, 1993.

The team held discussions with the officials concerned of the Government of Western Samoa, and conducted a field survey at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Western Samoa in order to discuss a draft report 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 sincere appreciation to the officials concerned of the Government of Western Samoa for their close cooperation extended to the teams.

December, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

December, 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design report on the Project for Improvement of Rural Telecommunications in the State of Western Samoa.

This study was conducted by NTT International Corporation, under a contract to JICA, during the period of July 19 to December 22, 1993. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Western Samoa, and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Posts and Telecommunications. We would also like to express our gratitude to the officials concerned of the Posts and Telecommunication Department, the JICA Western Samoa Office and the Embassy of Japan in New Zealand for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

H. Shimoida

Hideo Shimoida
Project Manager
Basic Design Study Team on
the Project for Improvement of
Rural Telecommunications
NTT International

SAVAI'I ISLAND

UPOLU ISLAND

WESTERN SAMOA

REFERENCE

- Political District Boundary
- Faipule District Boundary
- Roads
  - Sealed
  - Metalled
  - Unmetalled
  - Tracks (foot)
- Coral Reef
- Spot Heights in Metres — 1858
- Vegetation Cover
- Airstrip

SOUTH PACIFIC OCEAN

Scale 1:400 000 approx

Kilometres 5 0 10 20 30

Nautical Miles 4 2 0 4 8 12 16 20

Inter Island Service 22km Approx Trip Takes 1½ hours Approx

LOCALITY MAP OF WESTERN SAMOA

NORTH PACIFIC OCEAN

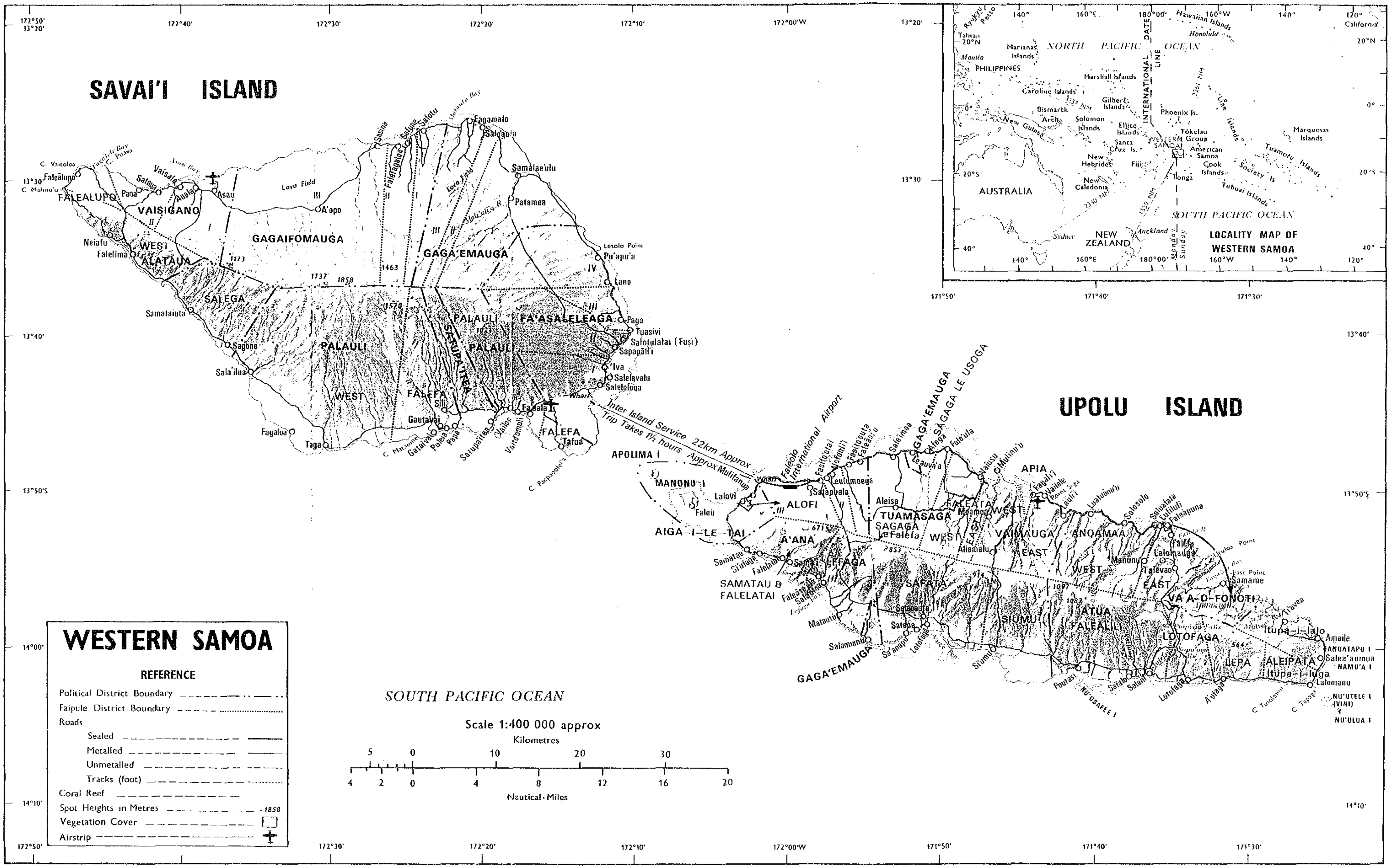
SOUTH PACIFIC OCEAN

AUSTRALIA

NEW ZEALAND

PHILIPPINES

INTERNATIONAL DATE LINE



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SOUTH PACIFIC OCEAN
Scale 1:400 000 approx
Kilometres
5
0
10
20
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2
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4
8
12
16
20
Nautical Miles
LOCALITY MAP OF
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NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
INTERNATIONAL DATE LINE
AUSTRALIA
NEW ZEALAND
PHILIPPINES
Hawaiian Islands
Honolulu
California
Marianas Islands
Marshall Islands
Caroline Islands
Gilbert Islands
Phoenix Is.
Line Islands
Marquesas Islands
Solomon Islands
Ellice Islands
Tokelau Group
WESTERN SAMOA
American Samoa
Cook Islands
Society Is
Tuamotu Islands
Tubuai Islands
Tonga
Fiji
New Hebrides
New Caledonia
Santa Cruz Is.
Bismarck Arch
New Guinea
Auckland
Sydney
Taiwan
Manila
Inter Island Service 22km Approx
Trip Takes 1½ hours Approx Mulifanua
Faleolo International Airport
FALEALUPO
VAISIGANO
GAGAIFOMAUGA
GAGA'EMAUGA
WEST ALATAUA
SALEGA
PALAULI
SATUPA'ITEA
FA'ASALELEAGA
FALEFA
WEST
APOLIMA I
MANONO I
AIGA-I-LE-TAI
A'ANA
ALOFI
TUAMASAGA
SAGAGA LE FALEFA
SAGAGA LE USOGA
FALEATA
VAIMAUGA
ANOAMAA
LEFAGA
SAFATA
SIUMU
FALEALILI
LOTOFAGA
LEPA
ALEIPATA
VA'A-O-FONOTI
SAMATAU & FALELATAI
GAGA'EMAUGA
APIA
Asau
A'opo
Fagamalo
Samalae'ulu
Patamea
Pu'apu'a
Lano
Faga
Tuasivi
Safotulafai (Fusi)
Sapapali'i
Iva
Salelavalu
Salelologa
Falealupo
Neiafu
Falelima
Samataiuta
Sala'ilua
Fagaloa
Taga
Gautavai
Fa'ala
Tafua
Lalovi
Faleū
Leulumoega
Aleisa
Mulinu'u
Solosolo
Falefa
Lalomauga
Falevao
Samame
Manunu
Matautu
Salamumu
Poutasi
Lotofaga
A'ufaga
Amaile
Lalomanu
Itupa-i-lalo
Itupa-i-luga
Salea'aumua
FANUATAPU I
NAMU'A I
NU'UTELE I
NU'ULUA I
NU'USAFEE I
1858
1737
1173
1463
1570
1021

SUMMARY

SUMMARY

Western Samoa, consisting of Upolu, Savaii and other small islands, is an island country of 2,830 square kilometers, whose population is approximately 160,000. Around 50% of the gross national product depends on agriculture, and the main products are coconuts and cocoa. In addition, forestry and wood processing industry are also prosperous. Over 70% of the total population is engaged in agriculture and most of the population is distributed primarily around coastal areas of Upolu and Savaii islands.

In the field of telecommunications, the total number of subscribers as of October, 1993 is 6,605, and 5,564 of these subscribers are concentrated in Apia, the capital city of Western Samoa. The nationwide telephone density is 4.05 per 100 people. The number of waiting applicants of the whole country amounts to 1,082. The Government of Western Samoa has completed the digitalization of four telephone exchanges as well as Lalovaea exchange in Apia, the transmission lines between these exchanges and international telecommunication circuits, and installation of the TDMA subscriber radio system in three regional areas, in order to modernize the telecommunications network. However, in the rural areas, only the TDMA system and single channel radio systems to 30 villages via Lalovaea office are being served.

Thus, the telephone network in the rural areas is grossly insufficient and its quality is poor. Improving the rural telecommunication network is expected to be useful for the provision of emergency services following natural disasters such as cyclones, in addition to the stimulation of industry which will result from improved information exchange between Apia and the rural areas.

With this background, the Government of Western Samoa requested Japan's grant aid to improve rural telecommunications in 50 villages, and to replace the existing single channel radio system mentioned above as one of the balanced telecommunication network development plans in rural areas.

In response to the request, the Japanese Government decided to conduct a basic design study and the Japan International Cooperation Agency (JICA) dispatched a basic design study team to Western Samoa from July 25 to August 26, 1993. The team had discussions with the officials concerned to study the suitability as a grant aid project and the content and scale of the cooperation. The team also conducted a survey of project sites to confirm the radio wave propagation conditions in the planned sections, and studied the present situation and future plans of the telecommunication facilities and services,

operation/maintenance and administration systems.

Based on the field survey results and collected data and information, a basic design regarding the necessary and optimum content and scale of the project was worked out and a basic design study report was prepared.

Further, JICA sent a mission for consultation of the draft final report from October 22 to November 2, 1993 to explain and discuss with officials concerned of the Government of Western Samoa.

The outline of the project based on the basic design study is summarized in the table of the next page.

The scope of work under the project to be borne by Western Samoa is as follows:

(1) To provide and secure land and equipment rooms necessary for implementation of the project,
(2) To construct foundations for antenna poles under the supervision of Japanese engineers,
(3) To install connection cables between MDF and existing switching equipment,
(4) To install cables to connect subscriber station equipment to the subscriber premises and telephone apparatus,
(5) To secure access roads necessary for the construction of facilities, and to construct fences,
(6) To arrange lead-in of commercial power to sites.

Item	Description		
Objective Area	Lufilufi, Faleasiu, Salelologa and Auala		
Scale of the Project	Number of base stations:		4
	Number of repeater stations:		16
	Number of subscriber stations:		43
	Number of subscriber lines:		250
Outline of Equipment	System: Digital multiple access radio system		
	Max. 512 subscribers per base station		
	Main equipment and materials to be provided:		
	Radio equipment	Base station	4
		Repeater station	7
		Repeater with subscriber	9
		Subscriber station	43
	Antenna pole	10 m	17
		15 m	13
		20 m	10
		25 m	17
	Antenna	Omni-directional	13
		Yagi	15
		Horn	47
		1.8 m Parabolic	4
	Power supply	Solar power system	18
		Rectifier, battery	39
	Local cable	10-pair	46.5 km
		25-pair	18.5 km

A total cost of one million Tala will be borne by the Western Samoan Government. The implementation period of the project is scheduled to be 5.5 months for detailed design, tendering and contract awarding, and 12 months for the equipment procurement and installation.

The implementation of the project is considered to create the following effects by improving rural telecommunication network of Western Samoa:

Present Situation	Measures Taken in the Project	Effects of the Project
The lack of communication media creates a wide cultural gap between urban and rural areas.	250 telephone sets are to be installed in 86 villages in Upolu, Savaii and Manono islands, connecting each other and to major towns.	56,000 residents can have access to telephone services. Improvement of living standard can be expected by means of quick communication between urban and rural areas.
The lack of communication media fosters damage of natural disasters such as cyclones.	Towers, wooden poles and batteries are designed in consideration of natural disasters.	Getting information on weather forecast and current situation from the scene of disaster will decrease further damage.
There is little communication media between emigrants and their relatives left behind in Western Samoa.	This system is to be connected to international communication circuits.	Communication between emigrants and their relatives becomes easy, resulting in increase of business opportunities and acquisition of foreign currencies.
The lack of communication media makes difficult in adjusting timing and amount of shipments of exports.	This system is to be connected to Apia port.	Timing and amount of shipments can be adjusted, resulting in increase of exports due to improvement of efficiency of exporting.

It is expected that the rural telecommunication network of Western Samoa will be stabilized and improved greatly through the implementation of this project, and that it will contribute to the socio-economic development of rural areas. It is also expected that Western Samoa will itself expand the TDMA subscriber radio system to develop the rural telecommunication network, since the system to be introduced under this project is capable of further expansion to accommodate future demand.

Taking into consideration the fact that a large number of Western Samoan people can get benefit from the project, the project itself is not profitable, there seems no difficulty in maintaining the system after its service-in, it is recommendable to realize the project under Japan's Grant Aid scheme.

In order to execute the project more smoothly and efficiently, the following items are recommended to PTD:

(1) To secure necessary budget and laborers for implementation and maintenance of the project,
(2) To complete reinforcement and/or repair work of existing facilities before construction work of the system,
(3) To secure necessary technology for maintenance of the system, through on-the-job training (OJT) during the construction work,
(4) To maintain the system properly after the completion of construction work.

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

Western Samoa has planned and implemented a series of 5-year National Development Plans, changed to a 3-year period from 1985, aimed at the development of country and activation of economy, since their independence in 1962. It is now implementing the seventh National Development Plan covered from 1992 to 1994. The long-term objectives of development under this plan are as follows:

(1) Sustained economic growth,
(2) Improved quality of life for all nationals,
(3) Greater degree of national self-reliance,
(4) Improved regional balance,
(5) Equitable distribution of socio-economic opportunities,
(6) Protection of the environment.

Due to the various projects undertaken by the Government, the economy has improved steadily and the GDP per capita reached US$ 727 in 1990. However, the economic performance was badly affected by two severe cyclones which struck the country in 1990 and 1991; homes, crops and infrastructure were all seriously damaged.

As for the telecommunications field, the Posts and Telecommunication Department (PTD), which is an exclusive telecommunication operator in this country, is implementing various projects to modernize the existing analog telecommunications facilities and to develop the telecommunications network, including in the rural areas using the loans from the Asian Development Bank (ADB), International Development Association (IDA), European Community (EC), etc. However, in rural areas, the number of telephone sets is still extremely low and there are yet no telephones in many villages. To cope with this situation, the PTD started to develop the rural telecommunications network as the most urgent matter for National Development Plan, but due to the shortage of the funds, any nationwide development has yet to occur.

For this reason, the Government of Western Samoa requested Japanese grant aid to assist in the development of rural telecommunications.

In response to the request, the Japanese Government decided to conduct a basic design study regarding the development plan of the rural telecommunication network, following the request of the Government of Western Samoa in April, 1990. The Japan International Cooperation Agency (JICA), which was responsible for the study, sent a study team

headed by Mr. Akira Nasu, Special Advisor for International Cooperation, Ministry of Posts and Telecommunications, to Western Samoa for 33 days, from July 25 through August 26, 1993.

The study team had discussed with the officials concerned of PTD to study the suitability as a grant aid project and the contents, scale of the cooperation. The team also conducted a survey on the project sites to study the present situation, future plans of telecommunication services, radio wave propagation conditions in the planned sections, and maintenance and administration systems.

In order to explain and to consult on the contents of the draft report, JICA sent another mission from October 22 to November 2, 1993 to Western Samoa.

This report summarizes the results of study and analysis of the data and information obtained through the field survey.

The members of the study team, survey schedule, member list of the relevant party in Western Samoa, minutes of discussions, list of collected data and installation cost breakdown for the work to be borne by Western Samoa are attached at the end of this report.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Background of the Project

2.1.1 Status of Telecommunication Services

(1) Operating Organization

The Posts and Telecommunication Department (PTD) operates telecommunication services in Western Samoa. These services consist of seven sections, i.e., Planning, Line & Cable, Telegraph & Data, Radio, Telephone, Satellite and Sale & Service, and are under the Telecommunication Controller who has responsibility for operation, maintenance, and repair work of the telecommunications facilities. The number of PTD's personnel is shown in Table 2-1.

Figure 2-1 shows the organization chart of PTD. The post section headed by the Financial Controller manages the financial and administrative work for both post and telecommunication sections.

Table 2-1 Number of PTD's Personnel

Section	Number of Personnel
Administration	24
Accounting	22
Post	69
Telecommunication	100
Total	215

(2) Financial Status

PTD has a long record of credit balance every year. However, as other sections of the Government consume these profits, PTD is not able to use all of them. Tables 2-2 and 2-3 show the financial status of PTD.

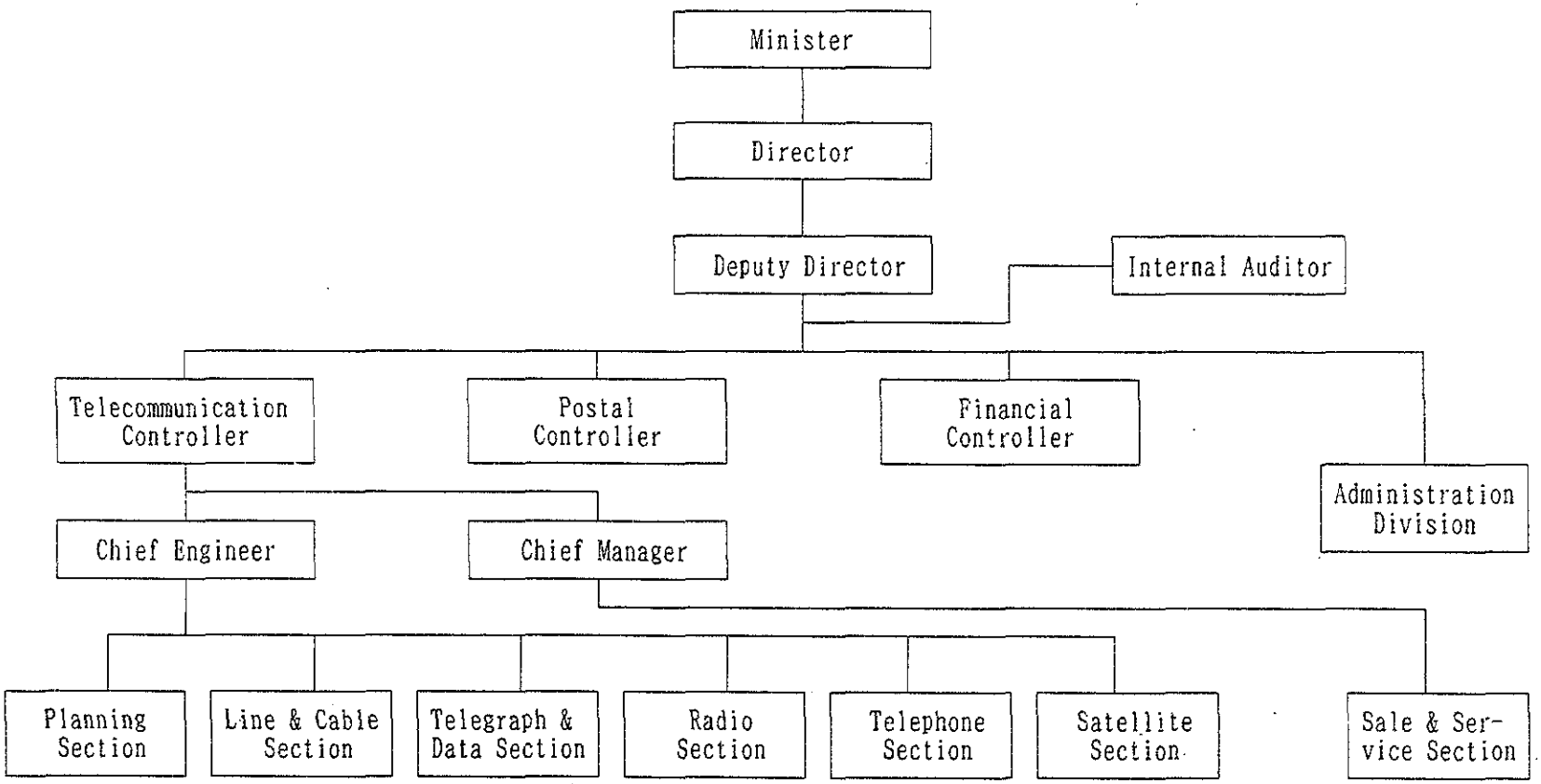


Figure 2—1 Organization of PTD

Table 2-2 Telecommunications Financial Status

(1,000 Tala)

	Revenue	1990	1991	Expenditure	1990	1991
Tele-	Installation	907	1,026	Personnel	1,327	1,330
phone	Domestic Calls	593	765	Transportation	1,710	1,101
	Operator Assisted Calls	200	152	Maintenance	1,050	764
	International Calls	5,692	6,885	Vehicles	186	145
	Total	7,392	8,828	Service Lease	3	3
Other	Telex	396	250	Expendable Supplies	195	238
	In Payments	7,456	3,716	Bad Debts	226	118
				Depreciation	737	742
				Loan Interests	157	95
	Total	7,852	3,966	Exchange Rate	1,360	
Total Revenue		15,244	12,794	Total Expenditure	6,951	4,536

Table 2-3 Profit and Loss Statement

(1,000 Tala)

Item		1988	1989	1990	1991
Revenue	Operating Revenue	6,082	7,793	7,788	9,078
	Other Revenues	4,971	3,007	7,456	3,716
	Total	11,053	10,800	15,244	12,794
Expenditure		4,965	6,430	6,951	4,536
Yearly Profit		6,088	4,370	8,293	8,258

2.1.2 Present Status of Telecommunications Services

(1) Telephone Service

The total number of subscribers in the whole country of Western Samoa as of October, 1993 is 6,605, and 5,564 of which are concentrated in Apia. The nationwide telephone density per 100 people is 4.05. The number of waiting applicants in the whole country amounts to 1,082.

On the other hand, although the digital exchange system, TDMA subscriber radio system, and single channel radio system are operated in some parts of the rural areas, there exist problems in its capacity and quality, particularly in the single channel radio system. Table 2-4 shows the present status of telephone service.

Table 2-4 Present Status of Telephone Service

Item	Quantity	Content
Telephone Lines	6,605	Business: 1,692
		Residential: 4,635
		Official: 278
Density per 100 people	4.05	
Rate of Automatization	100%	
Waiting Applicants	1,082	

Table 2-5 shows the increase of telephone lines in the past six years.

Table 2-5 Increase in Telephone Lines

Year	Population	Telephone Lines	Density	Rate of Increase
1988	158,814	4,330	2.73	0 %
1989	159,642	4,330	2.71	0 %
1990	160,470	4,330	2.70	0 %
1991	161,298	4,330	2.68	0 %
1992	162,126	5,380	3.32	24.2 %
1993	162,969	6,605	4.05	22.8%

(2) Telex Service

There exist 59 telex terminals in Apia. However, they are decreasing in number with the spread of facsimile services.

2.1.3 Billing System

(1) Connection Fee and Rental Fee

The connection fee and rental fee are shown in Table 2-6.

Table 2-6 Connection Fee and Rental Fee

Category	Connection Fee	Rental Fee
Business	50 Tala	15 Tala/month
Residential	50 Tala	10 Tala/month

(2) Call Charge

The call charges are shown in Table 2-7.

Table 2-7 Call Charge

Category	Automatic Call	Operator Assisted
Intra-office Call	12 Sene/call	
Inter-office Call	20 Sene/minute	50 Sene/3 minutes

2.1.4 Present Status of Telecommunications Facilities

(1) Telephone Exchange Facilities

There are five telephone exchanges in Western Samoa as of August, 1993 as shown in Table 2-8. Analog exchanges have all been replaced with digital ones, as mentioned previously. The rate of exchange automatization is 100%.

Table 2-8 Present Status of Exchange Facilities

Island	Exchange Name	Exchange Type	Connected Lines	Number of Lines Furnished
Upolu	Lalovaea	AXE 10	5,564	7,040
	Faleasiu	AXE 105	366	768
	Lufilufi	AXE 105	280	384
Savaii	Salelologa	AXE 105	241	768
	Auala	AXE 105	154	256
Total			6,605	9,216

Figure 2-2 shows the trunk circuits between telephone exchanges.

(2) Transmission Facilities

Figures 2-3 and 2-4 show the analog and digital transmission circuits, respectively. The analog transmission circuits are all single channel radio systems. The transmission system and capacity of each digital transmission route are shown in Table 2-9.

Table 2-9 Present Status of Transmission Facilities

Section	Transmission System	Transmission Capacity
Lalovaea-Maluafou	PCM Cable	660 CH
Maluafou-Mt. Vaea	1.8 GHz Digital Radio	720 CH
Mt. Vaea-Lufilufi	1.8 GHz Digital Radio	240 CH
Mt. Vaea-Faleasiu	1.8 GHz Digital Radio	240 CH
Mt. Vaea-Salelologa	1.8 GHz Digital Radio	240 CH
Mt. Vaea-Mt. Lepiutai	1.8 GHz Digital Radio	240 CH
Mt. Lepiutai-Auala	1.8 GHz Digital Radio	240 CH

(3) TDMA Subscriber Radio Facilities

Table 2-10 shows the present status of TDMA subscriber radio system. The service areas of this system are shown in Figure 2-5.

Table 2-10 TDMA Subscriber Radio System

Island	Base Station	Repeater Station (with Subscriber)	Subscriber Station	Number of Connected Subscribers	Number of Terminals
Upolu	Lalovaea			(102)	(230)
			Mt. Fiamoe	36	54
		Mt. Sigaele		3	14
			Faleolo Airport	25	62
Savaii			Tuasivi	38	62
Total				102	192

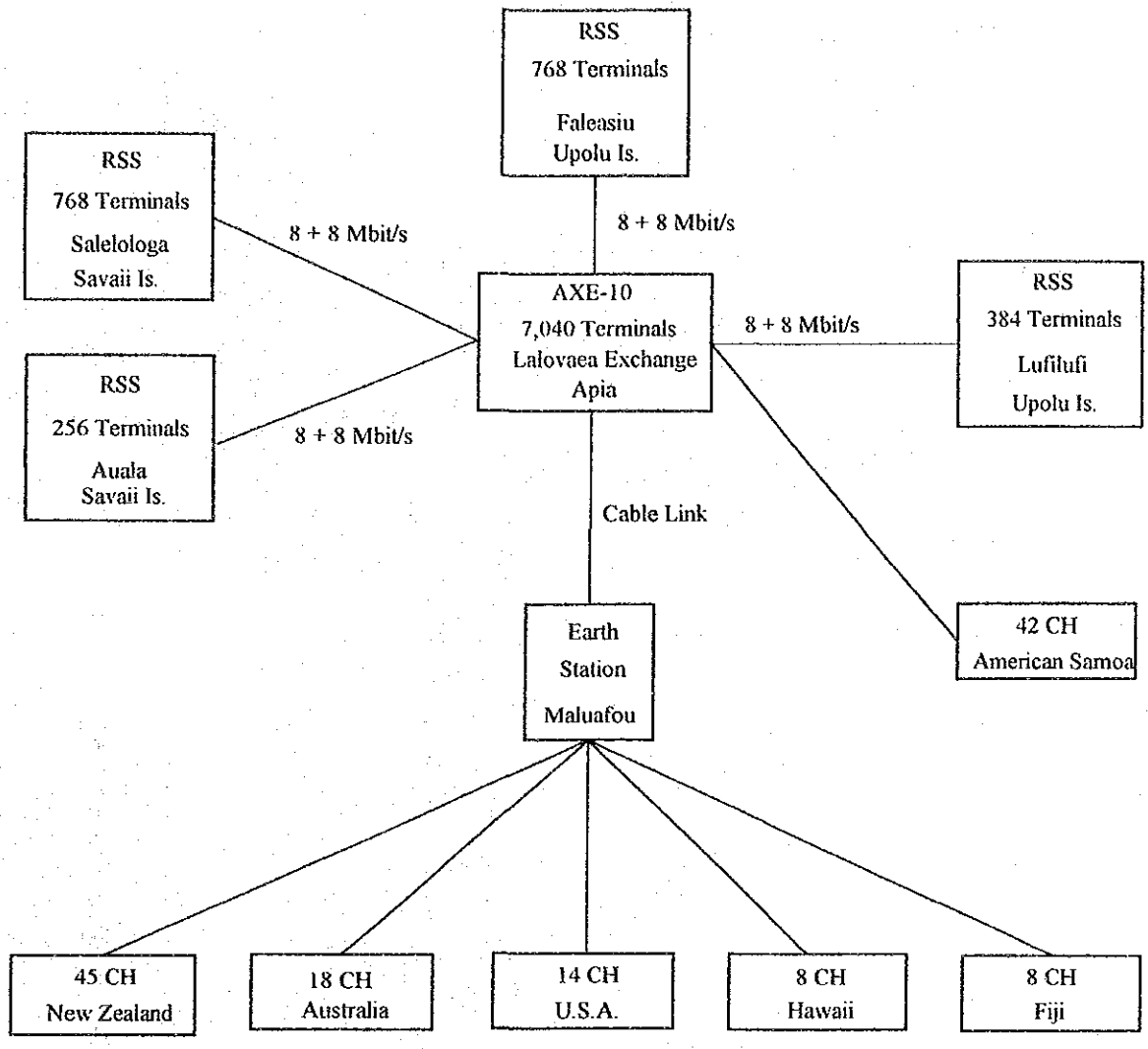


Figure 2-2 Trunk Circuits betwen Exchanges

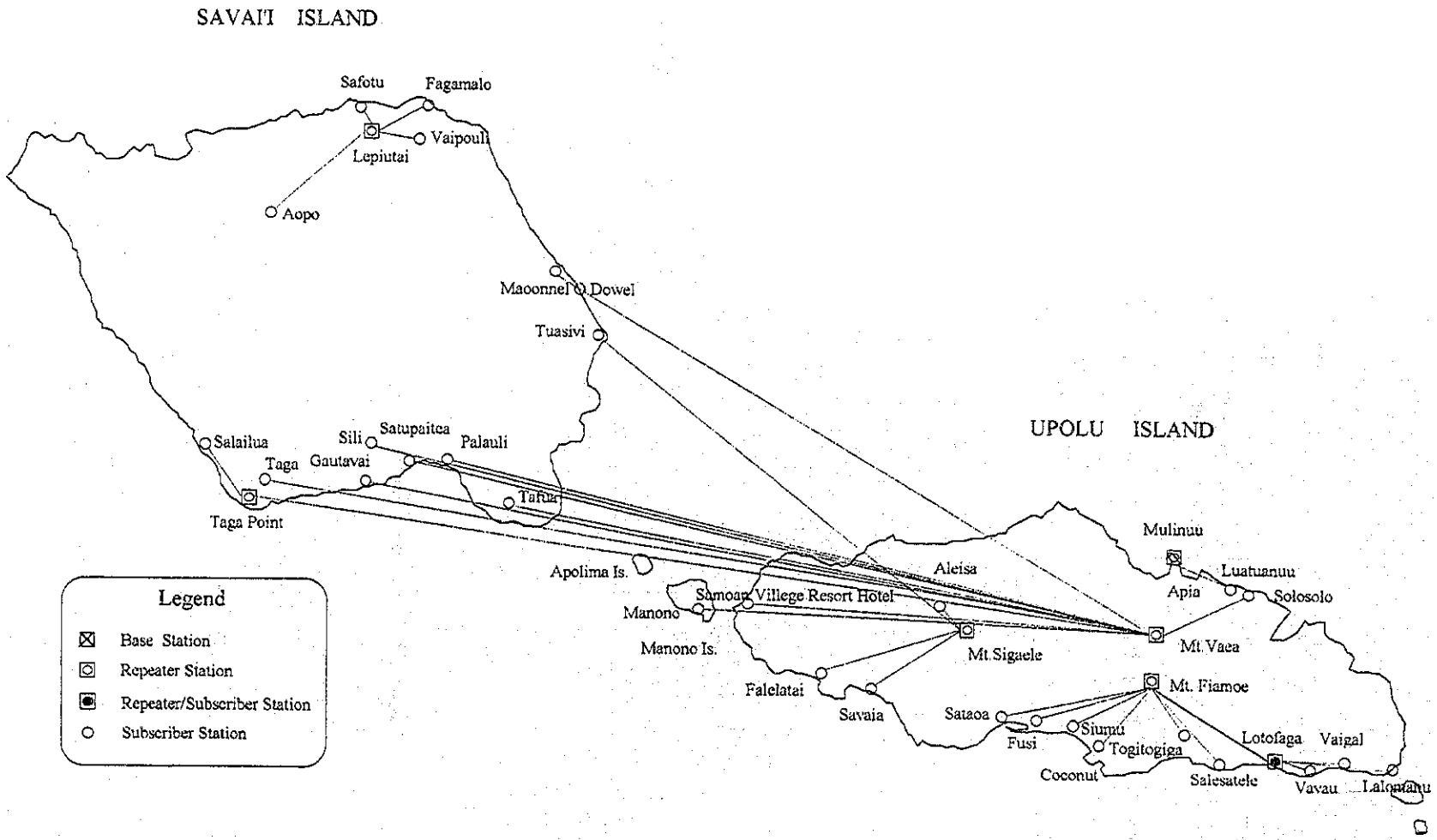


Figure 2-3 Analog Transmission Route

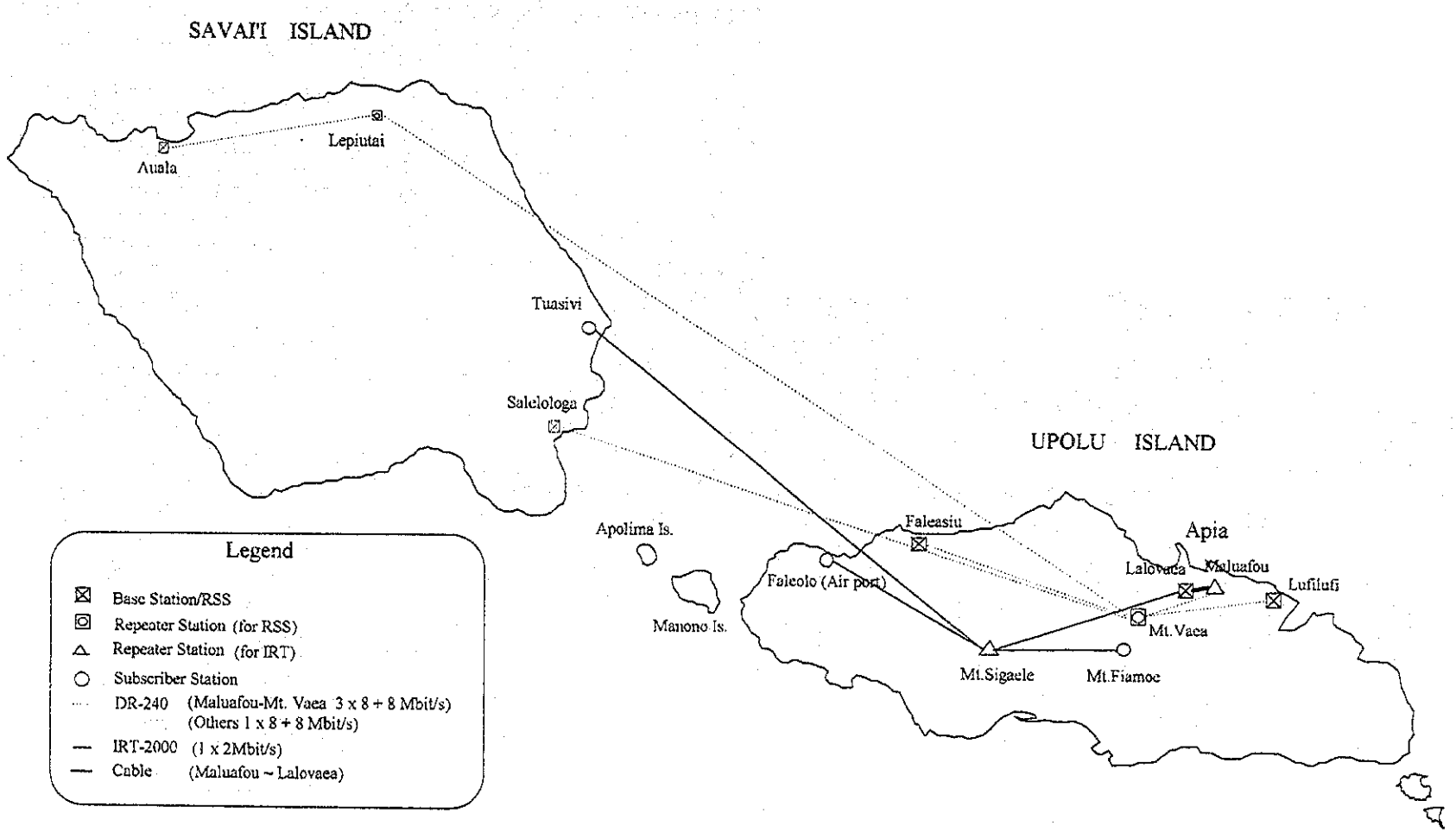


Figure 2-4 Digital Transmission Route

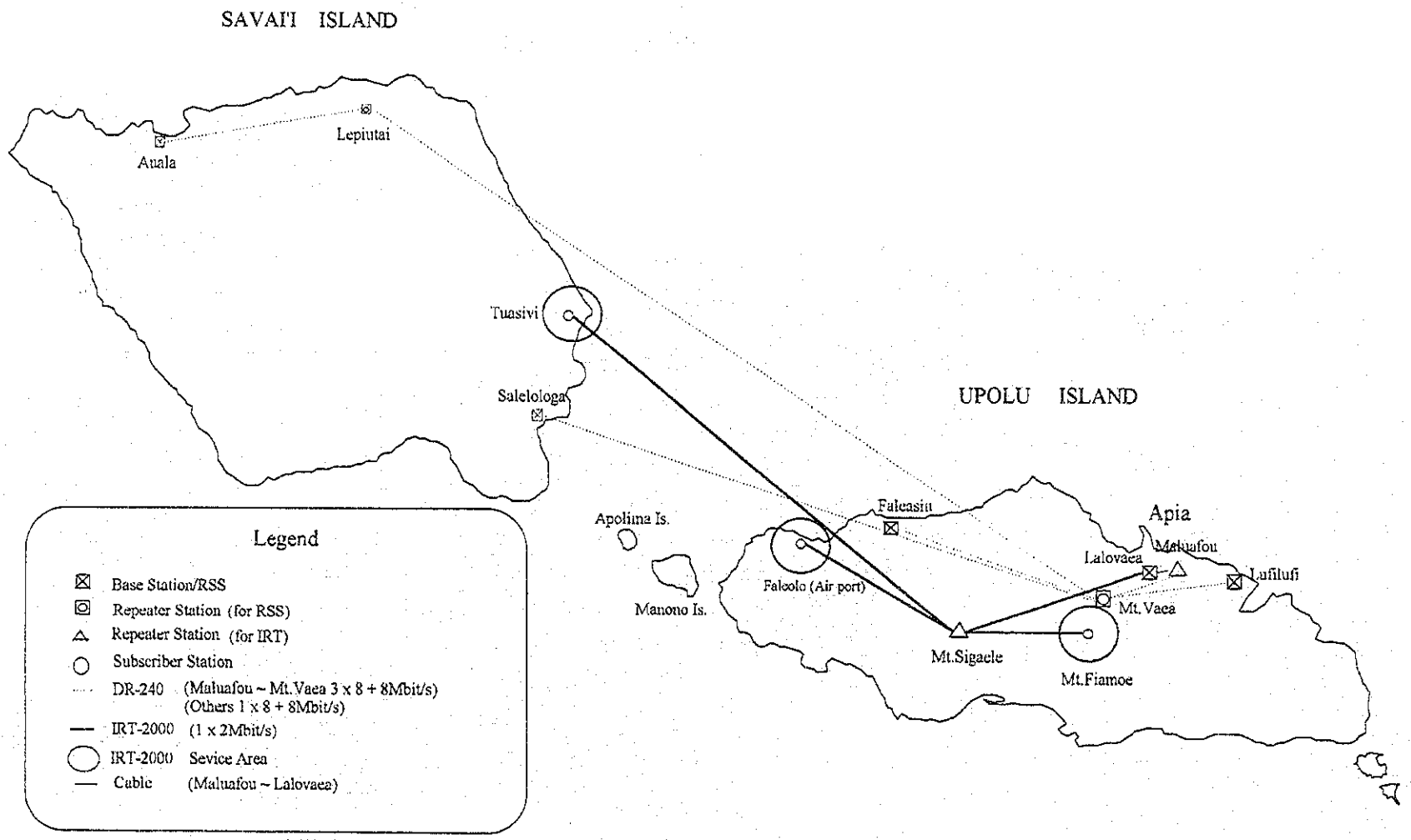


Figure 2-5 Service Area of TDMA Subscriber Radio System

(4) International Communications Facilities

The present status of international communications facilities in Western Samoa is shown in Table 2-11.

Table 2-11 International Communication Facilities

Item	Description	
International Exchange	Lalovaea Office: AXE 10	
Transmission System	INTELSAT Standard A Lalovaea-American Samoa: UHF Radio System	
Destination and Number of Circuits	New Zealand	45
	Australia	18
	USA	14
	Hawaii	8
	Fiji	8
	American Samoa	42

2.1.5 Present Status of Maintenance of Transmission Facilities

(1) Technical Level

PTD is operating a number of digital transmission systems, such as DR-240 (8+8 Mb/s), IRT-2000 (2Mb/s) and Cable PCM (2Mb/s), for which operation and maintenance are managed by PTD's maintenance personnel.

The training for engineers and technicians of PTD is performed at the training institute located in Fiji and the Solomon Islands. The training in new technology is provided by the suppliers and related organizations of the project every time a new system is introduced. It would seem that the personnel in charge have sufficient basic knowledge of digital technology following the digitalization of exchanges and transmission facilities and expansion of the local cable system at the five exchange areas.

It is expected that the engineers of PTD will able to absorb the necessary maintenance technology of the TDMA subscriber radio system to be introduced under the project, because they constructed and are operating a similar type of TDMA radio system and single channel radio system, and also practical training in construction and testing will be provided through on-the-job training (OJT).

(2) Maintenance System

The maintenance of telecommunication facilities is performed by the PTD's personnel stationed at Maluafou. When a failure occurs or a periodic test is to be performed, maintenance personnel goes to the site from Maluafou. This method is possible because the country is small, and time restrictions are not so severe on recovery following failure of communication facilities.

The number of maintenance staff of PTD is as follows:

Telephone Section:	1 chief, 5 engineers, 5 technicians and 1 worker
Radio Section:	1 chief, 3 engineers, 7 technicians and 1 worker
Line and Cable Section:	1 chief, 1 sub-chief, 1 senior engineer, 8 engineers, 3 technicians and 4 workers

As for maintenance of the TDMA subscriber radio system to be introduced under the project, the centralized supervisory system will be installed at Maluafou in Apia. PTD will have to increase the number of maintenance staff members for this system.

2.1.6 Telecommunication Development Plan

The country is now implementing the following projects to modernize the telecommunications network, including in rural areas, and to digitalize the existing analog network through loans from the Asian Development Bank (ADB), International Development Association (IDA), European Community (EC), etc:

(1) Digitalization of Existing Exchanges

A digitalization plan of five exchanges in Lalovaea, Lufilufi, Faleasiu, Salelologa and Auala was executed and put in service in 1992, through a loan from the ADB.

(2) Construction of Digital Radio Transmission Route

The digital transmission circuits were established between Lalovaea and four other exchanges and were put in operation in 1992, through an IDA loan.

(3) Expansion Plan of Local Cable Network

The expansion of the underground cable network in Apia and expansion of the aerial local cable network in Lufilufi, Faleasiu, Salelologa and Auala are now being implemented by PTD's direct construction team using an IDA loan.

(4) Construction of TDMA Subscriber Radio System

A TDMA subscriber radio system has been put in service at Fiamoe, Sigaele and Faleolo International Airport in Upolu Island, and Tuasivi in Savaii Island with the assistance of a French loan. The telephone subscribers of the new system to be introduced under the project will be able to inter-connect the subscribers of existing TDMA radio system. The project sites for the new TDMA radio system do not duplicate the existing TDMA system.

(5) Digitalization of International Telecommunication Facilities

With an EC's loan, PTD has finished the replacement project of Afiamalu earth station with Maluafou earth station in October, 1993, considering the inconvenience and deterioration of existing facilities. In addition, the analog radio transmission circuits to American Samoa via Tapuivi Point are to be replaced with transmission via Lufilufi exchange office using the digital radio circuits.

2.2 Outline of the Request

According to the request submitted from Western Samoa in April, 1990, it is to establish a TDMA subscriber radio system which consists of four base stations, 12 repeater stations, 42 subscriber stations and 261 subscriber lines in four rural areas.

Table 2-12 and Figure 2-6 show the name and location of the project sites respectively. The number of subscriber lines in each subscriber station is also shown in Table 2-13.

Table 2-12 Project Site (Requested)

Station	Lalovaea Area	Lufilufi Area	Salelologa Area	Auala Area
Base Station (4)	Lalovaea	Lufilufi	Salelologa	Auala
Repeater Station (12)	Mulinuu Mt. Fiamoe Olepupu Lotofaga Lalomanu Saleaaumua Tiavea Pass	Fagaloa Pass	Mt. Tafuatai	Mt. Lepiutai Papauta Samataitai
Subscriber Station (42)	Savaia Salamumu Sataoa Fusi Mulivai Siumu Saagafou Togitogiga Poutasi Tafatafa Sapuanaoa Utulaelae Vaigalu Tiavea	Tapuivi Point Taleafaga Salimu Samamea	Manono Samea Apolimafou Samatau Falelatai Palauli Satuapaitea Gautavai Sili Taga	Aopo Samalaeulu Faletagaloa Fagamalo Safotu Vaipouli Tafutafoe Falealupo Falelima Faiaai Sagone Foailuga Satuiatua Salailua
Total 58	22	6	12	18

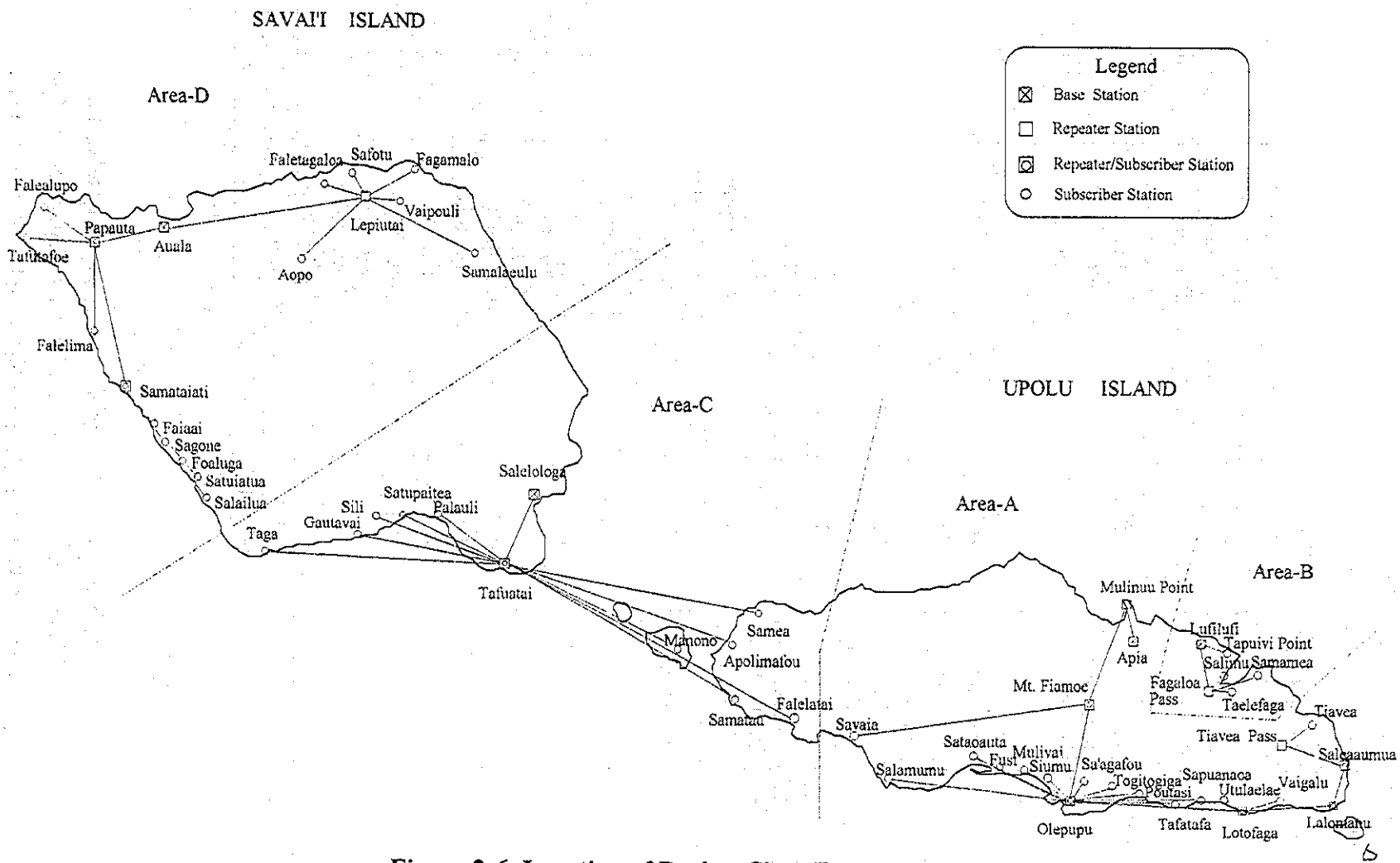


Figure 2-6 Location of Project Sites (Requested)

Table 2-13 Number of Subscriber Lines (Requested)

Area Name	Subscriber Name	No. of Lines	Area Name	Subscriber Name	No. of Lines
Lalovaea	Mt. Fiamoe	3	Salelologa	Manono	3
	Savaia	6		Samea	6
	Olepupu	3		Apolimafou	6
	Salamumu	3		Tafuatai	3
	Sataoa	3		Samatau	10
	Fusi	3		Falelatai	15
	Mulivai	3		Palauli	6
	Siumu	3		Satuapaitea	10
	Saagafou	3		Gautavai	10
	Togitogiga	3		Sili	3
	Poutasi	3		Taga	10
	Tafatafa	3			
	Sapuanaoa	3			
	Lotofaga	10			
	Utulaelae	9			
	Vaigalu	3			
	Lalomanu	6			
	Saleaaumua	10			
	Tiavea	3			
Area Total		83	Area Total		82
Lufilufi	Tapuivi Point	3	Auala	Aopo	3
	Taleafaga	3		Samalaeulu	6
	Salimu	3		Faletagaloa	6
	Samamea	3		Fagamalo	6
				Safotu	6
				Vaipouli	3
				Papauta	3
				Tafutafoe	3
				Falealupo	3
				Falelima	3
				Samataitai	10
				Faiaai	10
				Sagone	10
				Foailuga	3
				Satuiatua	3
				Salailua	6
Area Total		12	Area Total		84
Grand Total					261

2.3 Outline of Project Sites

The objective area of the project for improvement of rural telecommunications requested includes the villages spread out in the coastal area of Upolu, Savaii and Manono islands. They produce coconuts, taro, bananas and fish, and raise domestic animals such as

cows and pigs. Most villages are located along the beach road, which is of six meters in width and encircles the island.

The houses of each village are generally spread on a gentle slope in groups from 20 to 200. The population of most villages is from 100 to 1,600 people. In the center of the village, public facilities such as a post office, telephone office, police station, hospital, school, etc., and semi-public facilities such as a church, women's committee building, Matai's house etc., are located. These facilities can be considered appropriate as locations for subscriber stations to be installed under the project.

The single channel radio system is already put in service in 30 villages. However, its quality is not so good with noise in some villages due to the lack of maintenance work.

CHAPTER 3

OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objective

The Government of Western Samoa intends to promote the development of rural areas, which account for 50% of its GNP and 80% of its population, to realize balanced national development free from regional differences between urban and rural areas. For this purpose, the country is trying to increase its public investment to develop rural infrastructure and raise the productive and economic activity in rural areas.

In the telecommunication field, Western Samoa began the modernization of the telecommunication network using digital technology in 1990, to meet the growing demand for telephone services in urban areas. However, the telephone facilities in rural areas have remained undeveloped, because of the shortage of funds due to damages by cyclones.

The lack of telecommunications facilities does not only make rural people to feel isolated but also forms a barrier between urban and rural areas, causing great difficulties in the public administration, stabilization of people's livelihood and development of industries in the rural areas.

The project aims to develop the rural telecommunications network in order to resolve various problems arising from the lack of reliable communications media, and to encourage investment in rural areas by promoting infrastructure improvement.

3.2 Study and Examination of the Request

3.2.1 Rationality and Necessity of the Project

Since Western Samoa is divided into two main and several small islands, the people spend considerable time and cost in communicating between islands. Even within rural areas, because public transportation is poor, similar time wastage and costs are incurred. To cope with this situation, PTD determined to start the development of the rural telecommunications network. However, as progress has not been as scheduled due to the lack of funds, the request was made to Japan for grant aid. In response to the request, the Japanese government dispatched a basic design study team to Western Samoa to study the contents of the request. The team decided the most appropriate telecommunication system, decided the scale of the project and investigated the object areas.

The introduction of a TDMA subscriber radio system under the project was determined to be the most suitable, because it excels the cable system in both construction period and cost performance, especially when only a small number of telephone sets is to be installed in villages widely distributed in an island country like Western Samoa. The TDMA system can be established in short period by installing radio stations only, and is economic due to low construction cost as well as its equipment cost. This system is also free from any difficulty in construction, and in maintenance work after the completion of the construction by means of a remote supervisory and control system.

3.2.2 Project Implementation/Operation Plans

PTD will undertake the project implementation and operation, as it is exclusively responsible for providing telecommunications services in the country. The organization and financial status of PTD are as described in Chapter 2. PTD will carry out the following construction work under the project:

(1) To provide and secure land and equipment rooms necessary for implementation of the project,
(2) To construct foundations for antenna poles under the supervision of Japanese engineers,
(3) To install connection cables between MDF and existing switching equipment,
(4) To install cables to connect subscriber station equipment to the subscriber premises and telephone apparatus,
(5) To secure access roads necessary for the construction of facilities and to construct fences.
(6) To arrange lead-in of commercial power.

Items (3) and (4) above are included in PTD's routine work, and other items can be performed by a suitable local construction company.

As for the cost of the above construction work, it is estimated the PTD's share will amount to approximately one million Tala. PTD will find no difficulty in paying this amount, because it gained net profit sufficient to cover the construction cost in the past years. The maintenance and administration of the system after completion of the construction work will also be free from any difficulties, and the cost of maintenance services will be covered with the profit above.

3.2.3 Similar Project and Other Aid Projects

The TDMA subscriber radio system introduced in Western Samoa through a loan from the Government of France can be cited as a project similar to this project. This is a time division multiple access subscriber radio system, made in France and called IRT-2000 System, having 480 terminals as a maximum capacity per base station and 128 subscribers as a maximum capacity per subscriber station, with 30 time-slot transmission line and 1.5 GHz frequency band. The service area of TDMA subscriber radio system to be installed under the project does not duplicate that of the existing TDMA system.

3.2.4 Contents of Requested System

The system requested to be supplied is a TDMA (Time Division Multiple Access) subscriber radio system. Figure 3-1 is a conceptual drawing of the TDMA system. According to the request, a base station accommodates from 12 to 84 subscribers, a subscriber station accommodates from 3 to 15 subscribers, and the total number of subscribers is 261, with an area of approximately 100 Km radius by installing repeater stations. However, in the course of discussion with PTD, the project sites and the number of telephone lines to be installed under the project were revised, because three years have already passed since the request was issued, and the telecommunications and social conditions were changed. In this section, the study was done based on the revised contents and the results of field survey. The contents of revision are as follows:

(A) Lalovaea base station was eliminated because of establishment of the IRT-2000 system. Lufilufi base station is to accommodate a part of subscribers to be connected to Lalovaea base station.

(B) Faleasiu base station is to accommodate the subscribers of Upolu Island side to be connected to Salelologa exchange, due to the establishment of Faleasiu exchange.

(C) Salelologa base station is to accommodate a part of subscribers to be connected to Auala exchange, due to difficulty in realizing transmission circuits.

(D) The sites to be involved in this project were modified.

Table 3-1 shows the results of field survey, showing coordinates, elevation, hop distance, lot owner, status of line-of-sight, status of existing facilities and local cable length in each proposed site.

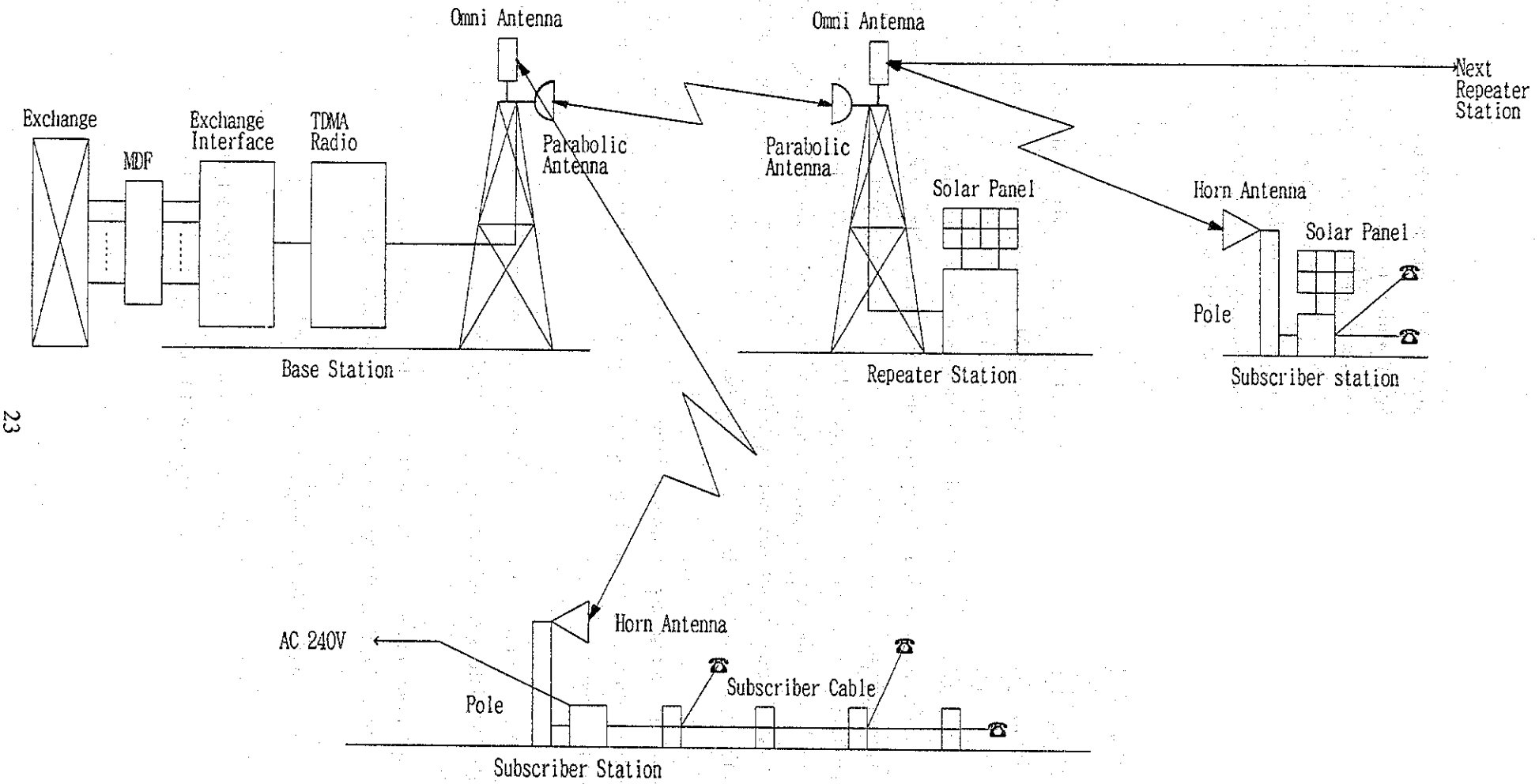


Figure 3-1 Concept of TDMA Subscriber Radio System

Table 3-1 Results of Field Survey (1/4)

Sys	Name of Station	Type of Station	Location			Hop Distance	Lot	Line-of-Sight TRX Test	Tower		Power	Building	Access Road	Cable (km)
			Latitude	Longitude	Elevat.				State	Spec.				
1	Lufilufi	Base	13.52.05S	171.35.44W	10 m		PTD		Existing	SS 30 m	Existing	Existing		
	Cape Utumauu	Repeater	13.51.14S	171.39.38W	3 m	7.8 km	Private	Clear	New	Pole 20 m	AC 240V			
	Laulii	Repeater/Sub	13.51.13S	171.41.42W	5 m	3.8 km	Private	Tree/TRX OK	New	Pole 20 m	AC 240V			1.30
	Luatuanuu	Subscriber	13.51.17S	171.40.26W	3 m	2.3 km	Private	Tree/TRX OK	New	Pole 15 m	AC 240V			1.60
	Manunu	Subscriber	13.54.30S	171.36.52W	150 m	5.2 km	Private	Tree/TRX OK	New	Pole 25 m	AC 240V			0.30
	Fagaloa Pass	Repeater	13.56.00S	171.34.42W	250 m	7.3 km	Government	Clear	New	Pole 20 m	Solar			
	Falevao	Subscriber	13.54.52S	171.34.53W	30 m	2.1 km	CCCS	Clear	New	Pole 10 m	AC 240V			0.40
	Lalomauga	Subscriber	13.54.33S	171.35.43W	35 m	3.3 km	Private	Clear	New	Pole 10 m	AC 240V			0.30
	Lemafa Pass	Repeater	13.57.15S	171.36.06W	310 m	3.4 km	Private	Tree/TRX OK	New	Pole 20 m	Solar		300 m	
	Taelefaga	Repeater/Sub	13.56.09S	171.33.48W	4 m	1.7 km	Private	Clear	New	Pole 10 m	AC 240V			0.30
	Lona	Subscriber	13.56.20S	171.32.20W	2 m	4.2 km	PTD	Tree/TRX OK	New	Pole 15 m	Solar			0.60
	Samamea	Subscriber	13.55.34S	171.31.34W	3 m	5.6 km	Private	Tree/TRX OK	New	Pole 10 m	Solar			0.30
	Musumusu	Subscriber	13.55.22S	171.33.11W	4 m	1.8 km	Private	Clear	New	Pole 20 m	Solar			0.20
	Mt.Fogalepulu	Repeater	13.58.13S	171.33.28W	450 m	5.2 km	Government	Clear	New	Pole 20 m	Solar		Foot P. *1	
	Afugalu	Repeater/Sub	13.59.03S	171.29.18W	310 m	7.6 km	Private	Tree/TRX OK	New	Pole 20 m	AC 240V		400 m	0.90
	Samusuuta	Repeater/Sub	13.59.14S	171.29.13W	170 m	3.8 km	Private	Tree/TRX OK	New	Pole 25 m	AC 240V			0.70
	Saleaaumua	Repeater/Sub	14.00.12S	171.25.13W	1 m	4.0 km	RC	Tree/TRX OK	New	Pole 25 m	AC 240V			3.10
	Lalomanu	Repeater/Sub	14.02.29S	171.25.46W	5 m	4.3 km	PTD	Tree/TRX OK	New	Pole 20 m	AC 240V		*2	3.90
	Lepa	Subscriber	14.02.01S	171.30.58W	2 m	9.4 km	Hospital	Tree/TRX OK	New	Pole 10 m	AC 240V			2.10
	Aufaga	Subscriber	14.02.07S	171.32.05W	28 m	11.4 km	Private	Tree/TRX OK	New	Pole 10 m	AC 240V			0.60
	Vavau	Subscriber	14.02.03S	171.32.55W	60 m	12.9 km	Private	Tree/TRX OK	New	Pole 10 m	AC 240V			0.60
	Siuniu	Repeater/Sub	14.00.47S	171.36.42W	60 m	7.4 km	Private	Tree/TRX OK	New	Pole 25 m	AC 240V			0.10
	Lotofaga	Subscriber	14.02.10S	171.33.56W	7 m	5.6 km	PTD	Tree/TRX OK	New	Pole 25 m	Existing	Existing		0.80
	Utulaelae	Subscriber	14.01.58S	171.36.03W	2 m	2.5 km	Private	Tree/TRX OK	New	Pole 15 m	AC 240V			1.10
	Salani	Subscriber	14.01.43S	171.36.27W	2 m	1.8 km	Private	Tree/TRX OK	New	Pole 15 m	AC 240V			0.70
	Salesatele	Subscriber	14.01.40S	171.36.51W	3 m	1.7 km	Hospital	Tree/TRX OK	New	Pole 15 m	AC 240V			1.30
	Satalo	Subscriber	14.01.52S	171.37.30W	2 m	2.5 km	W's Comm.	Tree/TRX OK	New	Pole 15 m	AC 240V			2.00
	Malaemaluuta	Subscriber	14.01.33S	171.38.14W	15 m	3.1 km	W's Comm.	Tree/TRX OK	New	Pole 15 m	AC 240V			0.50
	Area Total													23.70

Table 3-1 Results of Field Survey (2/4)

Sys	Name of Station	Type of Station	Location			Hop Distance	Lot	Line-of-Sight TRX Test	Tower		Power	Building	Access Road	Cable (km)
			Latitude	Longitude	Elevat.				State	Spec.				
2	Faleasiu	Base	13.47.56S	171.55.13W	5 m		PTD		Exsisting	SS 30 m	Existing	Existing		
	Mt. Afolau	Repeater	13.51.37S	172.00.06W	265 m	11.1 km	Government	Clear	New	Pole 25 m	Solar		Existing	
	Matautu	Subscriber	13.54.21S	172.00.26W	2 m	5.1 km	P. School	Tree/TRX OK	New	Pole 20 m	AC 240V			2.00
	Siufaga	Subscriber	13.54.06S	172.01.49W	3 m	5.6 km	CCCS	Tree/TRX OK	New	Pole 10 m	AC 240V			0.80
	Samatau	Subscriber	13.53.33S	172.03.02W	2 m	6.4 km	P. School	Tree/TRX OK	New	Pole 25 m	AC 240V			1.20
	Apolimafou	Subscriber	13.51.14S	172.03.37W	3 m	6.3 km	P. School	Tree/TRX OK	New	Pole 15 m	AC 240V			2.80
	Faleu	Subscriber	13.51.05S	172.06.03W	2 m	10.7 km	W's Comm.	Clear	New	Pole 10 m	Solar			1.50
	Salua	Subscriber	13.50.14S	172.06.02W	2 m	10.9 km	CCCS	Clear	New	Pole 10 m	Solar			0.70
	Area Total													9.00

Table 3-1 Results of Field Survey (3/4)

Sys	Name of Station	Type of Station	Location			Hop Distance	Lot	Line-of-Sight TRX Test	Tower		Power	Building	Access Road	Cable (km)
			Latitude	Longitude	Elevat.				State	Spec.				
3	Salelologa	Base	13.43.36S	172.13.08W	4 m		PTD		Existing	SS 25 m	Existing	Existing		
	Mt. Tafua	Repeater/Sub	13.46.38S	172.15.04W	60 m	6.7 km	Private	Tree/TRX OK	New	Pole 25 m	Solar		200 m	1.60
	Taga Point	Repeater	13.47.35S	172.31.25W	3 m	29.3 km	PTD	Tree/TRX OK	Existing	Guy 60 m *3	Solar	Exist. *4	Exist. *5	
	Samataitai	Repeater/Sub	13.38.12S	172.39.38W	45 m	22.8 km	Private	Tree/TRX OK	New	Pole 25 m	AC 240V			1.50
	Palauli	Subscriber	13.45.09S	172.17.38W	3 m	5.4 km	W's Comm.	Clear	New	Pole 10 m	AC 240V			3.30
	Satuapaitea	Subscriber	13.45.35S	172.19.12W	2 m	7.7 km	Private	Clear	New	Pole 10 m	AC 240V			2.60
	Sili	Subscriber	13.45.00S	172.22.18W	30 m	13.3 km	W's Comm.	Tree/TRX OK	New	Pole 25 m	AC 240V			0.50
	Papa	Subscriber	13.45.55S	172.21.32W	5 m	11.7 km	W's Comm.	Tree/TRX OK	New	Pole 15 m	AC 240V			1.70
	Gautavai	Subscriber	13.46.09S	172.22.35W	5 m	13.5 km	W's Comm.	Tree/TRX OK	New	Pole 15 m	AC 240V			2.60
	Taga	Subscriber	13.47.07S	172.30.23W	8 m	2.1 km	Hospital	Tree/TRX OK	New	Pole 10 m	AC 240V			1.00
	Salailua	Subscriber	13.42.32S	172.35.25W	3 m	11.8 km	PTD	Tree/TRX OK	New	Pole 25 m	AC 240V			3.40
	Sagone	Subscriber	13.40.31S	172.37.04W	55 m	16.5 km	P. School	Tree/TRX OK	New	Pole 25 m	AC 240V			1.10
	Vaipua	Subscriber	13.40.13S	172.37.42W	40 m	5.1 km	Private	Tree/TRX OK	New	Pole 25 m	AC 240V			0.80
	Fogatuli	Subscriber	13.39.06S	172.38.31W	80 m	2.6 km	Private	Tree/TRX OK	New	Pole 20 m	AC 240V			2.00
	Falelima	Subscriber	13.35.06S	172.43.07W	5 m	8.3 km	W's Comm.	Tree/TRX OK	New	Pole 25 m	AC 240V			1.00
	Neiafu	Subscriber	13.33.23S	172.45.10W	13 m	13.2 km	Private	Tree/TRX OK	New	Pole 15 m	AC 240V			1.00
	Area Total													24.10

Table 3-1 Results of Field Survey (4/4)

Sys	Name of Station	Type of Station	Location			Hop Distance	Lot	Line-of-Sight TRX Test	Tower		Power	Building	Access Road	Cable (km)
			Latitude	Longitude	Elevat.				State	Spec.				
4	Auala	Base	13.30.04S	172.39.10W	20 m		PTD		Existing	Guy 35 m	Existing	Existing		
	Mt.Lepiutai	Repeater	13.27.00S	172.23.16W	188 m	29.1 km	PTD	Clear	Existing	SS 30 m	Existing	Existing	Exist. *6	
	Aopo	Subscriber	13.32.01S	172.30.48W	190 m	16.3 km	Private	Tree/TRX OK	New	Pole 25 m	Solar			0.40
	Letui	Subscriber	13.29.21S	172.27.52W	83 m	9.3 km	Private	Tree/TRX OK	New	Pole 25 m	Solar			0.40
	Matavai	Subscriber	13.27.57S	172.25.02W	8 m	3.6 km	Private	Clear	New	Pole 15 m	Solar			0.30
	Sasina	Subscriber	13.27.49S	172.26.37W	3 m	6.2 km	Private	Clear	New	Pole 10 m	Solar			1.40
	Samauga	Subscriber	13.27.08S	172.24.30W	15 m	2.4 km	Private	Clear	New	Pole 10 m	Solar			0.60
	Safotu	Subscriber	13.26.48S	172.24.10W	8 m	1.7 km	PTD	Clear	New	Pole 10 m	AC 240V			1.20
	Fagamalo	Subscriber	13.26.02S	172.21.00W	3 m	4.4 km	PTD	Clear	New	Pole 10 m	AC 240V			0.70
	Saleaula	Subscriber	13.26.31S	172.19.44W	3 m	6.4 km	Private	Clear	New	Pole 15 m	Solar			0.60
	Samalaeulu	Subscriber	13.29.28S	172.17.33W	31 m	11.2 km	Private	Tree/TRX OK	New	Pole 25 m	Solar			0.50
	Area Total													6.10
	Total													62.90

Note:
*1 Foot path leading to Mt. Fogalepulu RS needs repair. It seems impossible to make access road.
*2 Resident near Lalomanu RS is complaining about invasion of access road in his premises. PTD should resolve the problem.
*3 Guy tower at Taga Point RS needs repair.
*4 Building at Taga Point RS needs repair.
*5 Access road leading to Taga Point RS needs repair.
*6 Access road leading to Mt. Lepiutai RS needs repair.

(1) Number of Base Stations

In this project, four base stations are to be installed in the existing exchange offices except Apia. It is necessary to establish these four base stations taking into consideration the number of terminals of existing exchanges, PTD's plans for system expansion after the completion of the project as well as billing and numbering plans.

(2) Capacity of Base Station

The maximum capacity of the base station is not specified in the request. Therefore, it is to be studied in Chapter 4, taking the future demand into consideration.

(3) Propagation Conditions

The study team conducted a map-survey using a 1/20,000 scaled map, and actual field survey on all the project sites. The line-of-sight for any section among base, repeater and subscriber stations was investigated. As a result, it was determined that all the radio sections are within line-of-sight of each other, taking into consideration the propagation obstacles such as trees around some stations, short distance, and good results in transceiver talking tests with 1.2 GHz band.

(4) Antenna Towers

There are existing towers which can be utilized in the project at the sites of all base stations, Lepiutai, Taga Point repeater stations. It is necessary to install new antenna poles on other sites for repeater and subscriber stations. It is noted, however, that some repair work such as re-painting, and replacement of bolts, nuts and iron braces will be needed on Taga Point site.

(5) Power Supply Units

In all the base stations, the existing power source of DC-48V can be utilized for TDMA equipment. Other repeater and subscriber stations to be established need new power supply units.

(6) Capacity of Exchanges

The equipment of base station is to be connected to existing exchange in the same office. The capacity of exchanges is to be studied in Chapter 4.

(7) Capacity of Existing Transmission Network

The existing digital transmission network is to be used for the TDMA subscriber radio system. The necessary number of circuits and transmission capacity are to be studied in Chapter 4.

(8) Number of Telephone Sets

In the original request, 261 telephone sets are to be installed. However, the number of telephone sets is to be studied based upon the results of field survey, because the project service area and sites were revised.

(9) Local Cable System

In the original request, a local cable system with 60-kilometer length is to be installed. However, the cable length is to be studied based upon the results of field survey, because the project service area and sites were revised.

(10) Numbering and Billing Plans

Subscriber numbers consist of five digits, of which the first two digits are used as a trunk call number, i.e., trunk code. Since each telephone exchange, to which the base station is to be connected, has sufficient capacity for TDMA subscriber demand for the project, the trunk code assigned for normal subscribers is also to be assigned as a trunk code for TDMA subscribers. A pulse metering system, depending on time duration and distance between exchanges, is adopted for domestic calls. The calls of TDMA subscribers will be charged in accordance with their trunk codes.

3.2.5 Necessity of Technical Cooperation

As mentioned in Chapter 2, the technical level of PTD's maintenance personnel is considerably high, because PTD has already been operating the similar TDMA subscriber radio system, called IRT-2000 manufactured in France. However, since the TDMA subscriber radio system to be introduced under the project uses a partly different technology, it is advisable to conduct on-the-job training (OJT) during the construction

period to operate and maintain the system properly. However, as the system is to cover whole country and the new personnel needs training, it is prudent to provide technical cooperation for efficient improvement for the maintenance of the system. The major items of the training are as follows:

(1) Equipment outline of the system,
(2) Technology of centralized supervisory system,
(3) Repairing technology in case of equipment failure.

3.2.6 Conclusion of Studies

As a result of the studies above, it can be concluded that the implementation of the project is appropriate, considering that the project will improve the rural telecommunications and contribute to the development of people's livelihood in rural areas, and there exists no specific problem in the maintenance work after the completion of the project. Thus, the outline of the project will be studied and the basic design will also be implemented in the following sections, on condition that the project is implemented as Japanese grant aid.

3.3 Project Description

3.3.1 Project Executing Agency and Operating System

The project will be implemented by PTD, whose organization chart is presented in Figure 2-1 of Chapter 2. The Telecommunication Department will be directly responsible for the project implementation, and will assign a number of staff members. These staff members and the transmission maintenance engineers and technicians stationed at Maluafou maintenance center will participate in the equipment installation work to learn the necessary technology. The equipment maintenance and inspection services will be undertaken by radio transmission personnel at Maluafou maintenance center. The system operation will be performed by the subscriber service staff using centralized supervisory equipment to be installed in Maluafou.

3.3.2 Project Scale and Sites

The project will be of the following scale:

Number of base stations	4
Number of repeater stations	16
Number of subscriber stations	43

Figures 3-2 and 3-3 illustrate the location of the project sites and benefited area of the project, respectively. The information on all project sites is summarized in Table 3-1, and the following are specific notes on the project sites.

(1) Base Stations

All base stations will be installed at the following four existing exchange offices:

Lufilufi, Faleasiu, Salelologa and Auala

(2) Repeater Stations

The repeater stations will be installed at 16 sites below:

Upolu Island:	Fagaloa Pass, Lemafa Pass, Mt. Fogalepulu, Mt. Afolau, Laulii, Cape Utumauu, Taelefaga, Afugalu, Samusuuta, Saleaaumua, Lalomanu and Siuniu
Savaii Island:	Taga Point, Mt. Lepiutai, Mt. Tafua and Samataitai

(3) Subscriber Stations

The number of subscriber stations are 43 as shown in Table 3-1.

3.3.3 Outline of System Facilities

Table 3-2 outlines the TDMA subscriber radio system to be provided under the project.

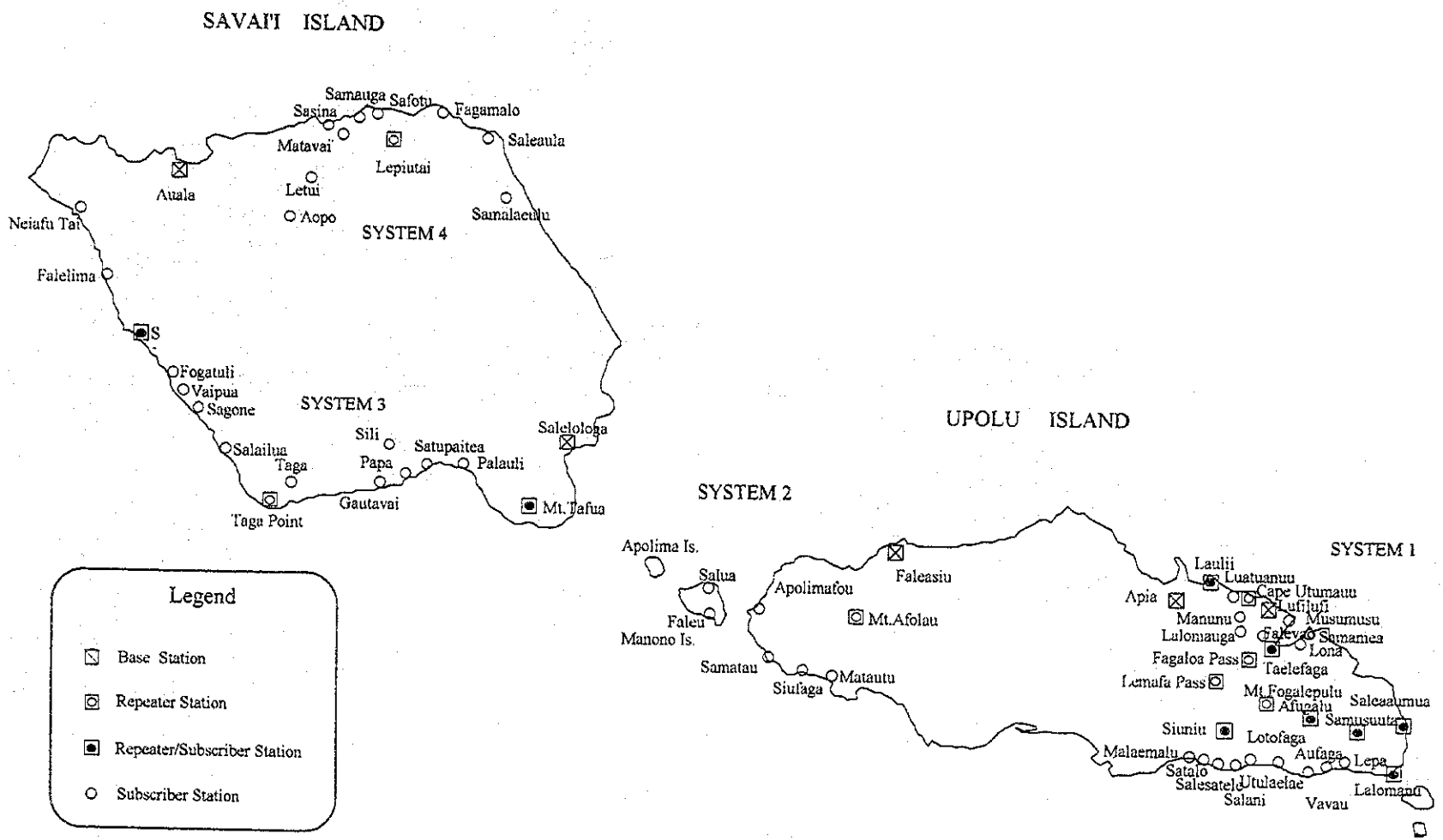


Figure 3-2 Location of Project Sites

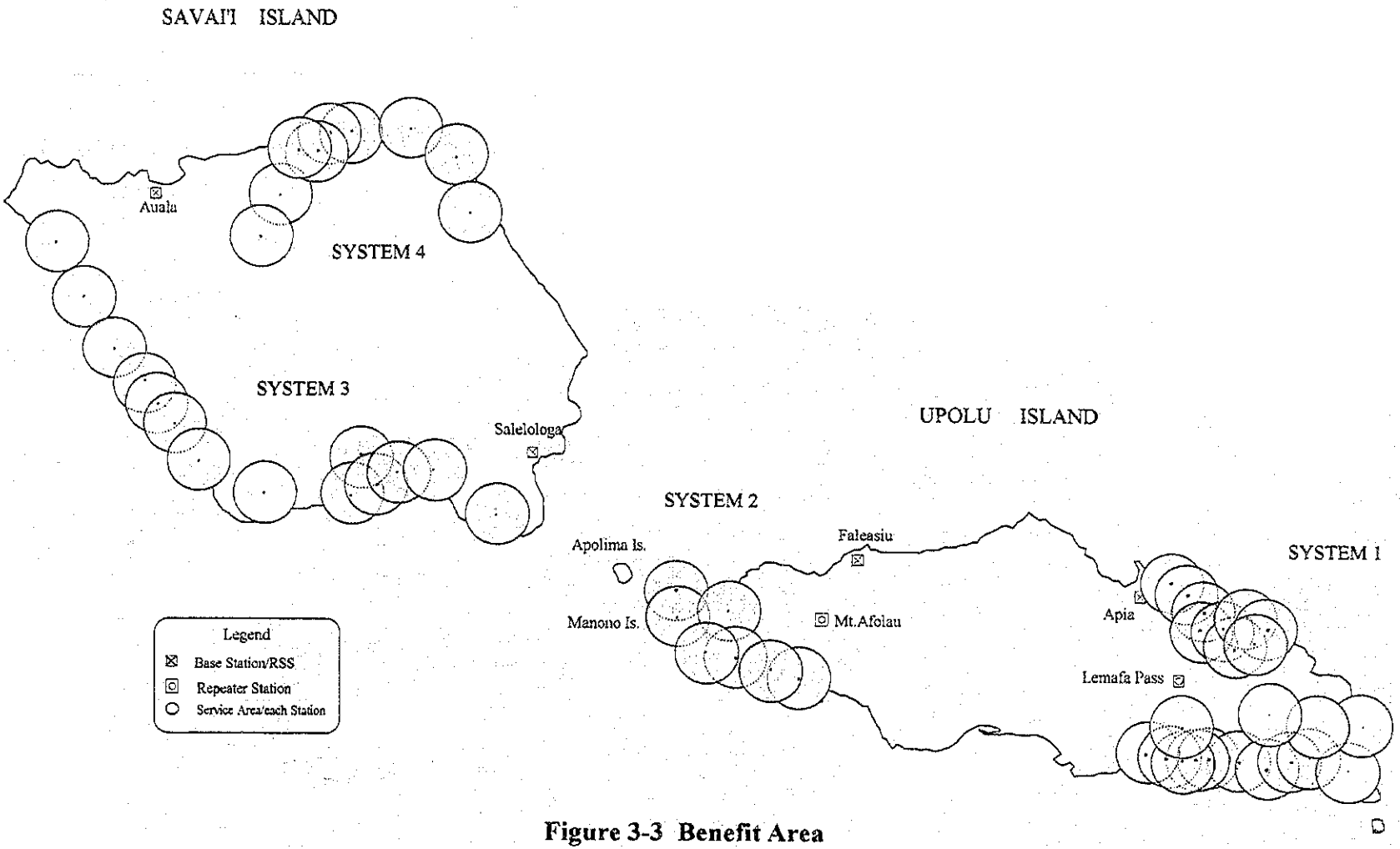


Figure 3-3 Benefit Area

Table 3-2 Outline of TDMA Subscriber Radio System

Item		Description
System		Time Division Multiple Access System
Number of Areas		4 areas
TDMA Radio Equipment	Base Station	4 stations
	Repeater Station	16 stations
	Subscriber Station	43 stations
Tower	Base Station	Use of existing towers
	Repeater Station	14 towers
	Subscriber Station	43 towers
Power Supply Unit	Base Station	Use of existing power supply units
	Repeater Station	AC240V: 9 sets Solar Power: 6 sets
	Subscriber Station	AC240V: 30 sets Solar Power: 12 sets
Building	Base Station	Use of existing buildings
	Repeater Station	Outdoor type except Taga Point and Mt. Lepiutai
	Subscriber Station	Outdoor type except Lotofaga
Access Road	Repeater Station	Lemafa Pass: 300 m, Afugalu: 400 m, Mt. Tafua: 200 m

3.3.4 Maintenance and Administration System

The TDMA subscriber radio system to be introduced under the project will be operated and maintained by using a centralized supervisory system installed in Maluafou maintenance center. Figure 3-4 illustrates the outline of the centralized control and supervisory system for the TDMA radio system. The maintenance system for each facility is shown in Table 3-3.

The number of maintenance personnel newly required for the project amounts to three: one of them will supervise the system and perform the subscriber services such as service order and complaint reception, and the other two will perform equipment maintenance work such as routine tests, failure recovery etc. The routine test includes periodic visits to sites, twice a year in principle, to check the working conditions of the equipment and to clean solar panels, etc. The repair work of telephone sets and local cables is fulfilled by the personnel of outside plants stationed in Maluafou maintenance center. As for the training of maintenance staff, the OJT during the installation work of the project will be conducted.

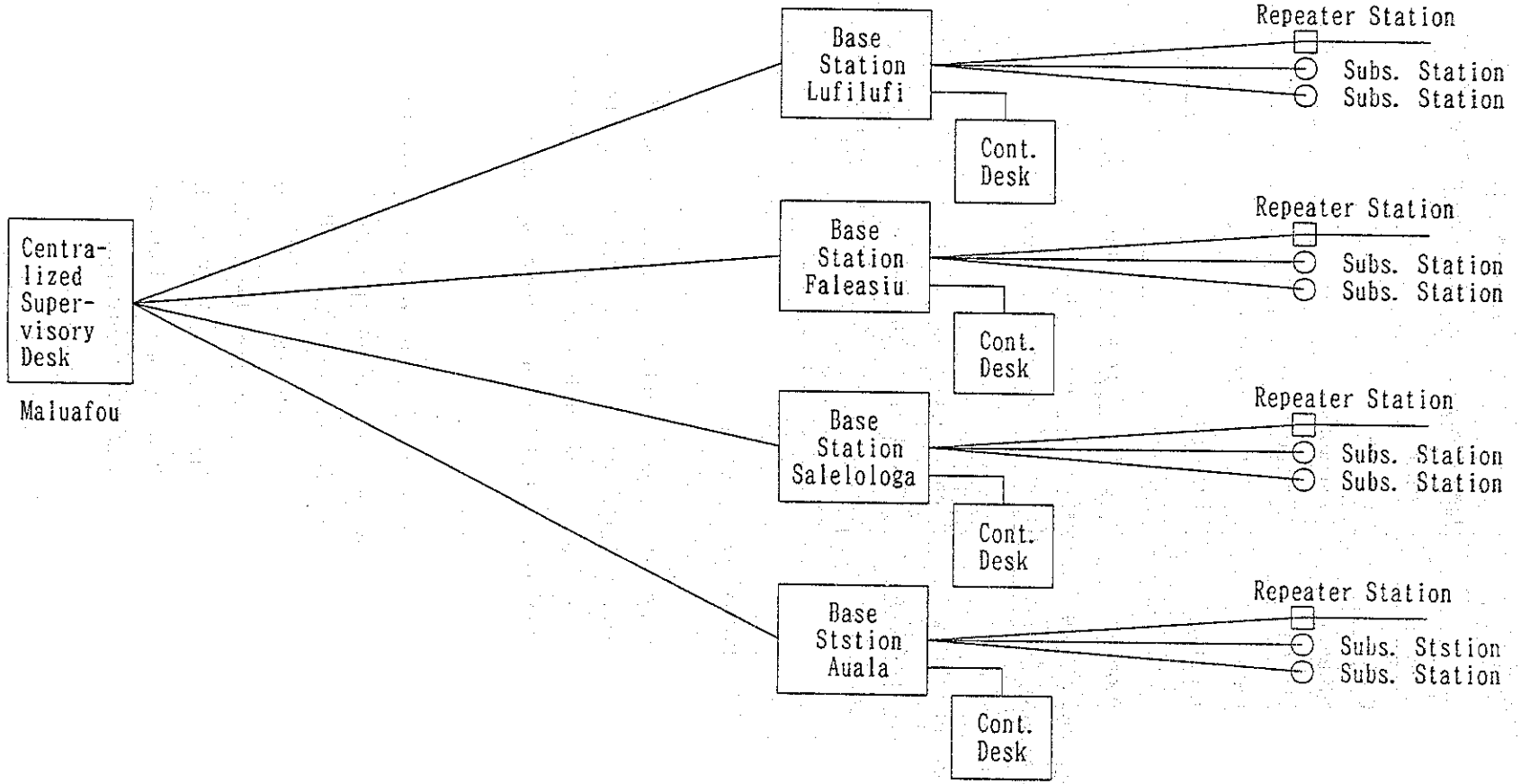


Figure 3-4 Centralized Supervisory System

The materials good for two-year maintenance are necessary for the maintenance work of the system. After two-year period, the PTD itself will prepare necessary maintenance materials. The profit of PTD will cater for the cost necessary for the new maintenance personnel and maintenance materials.

Table 3-3 Maintenance System

Type of Station	Personnel	Maintenance Equipment	Mode
Maintenance Center	Attended	Centralized remote supervisory equipment	
Base Stations	Unattended	Supervisory and control equipment (Master)	Routine visit
Repeater Stations	Unattended	Supervisory and control equipment (Slave)	Routine visit
Subscriber Stations	Unattended	Supervisory and control equipment (Slave)	Routine visit

3.4 Technical Cooperation

In order to maintain the system efficiently after the completion of the project, it is prudent to provide technical cooperation in the training for maintenance person of PTD. The details of technical cooperation are as follows:

(1) Major Items of Training

(A) Equipment outline of the system
(B) Technology of centralized supervisory system
(C) Repairing technology in case of equipment failure

(2) Method of Technical Cooperation

It is advisable that training for key person for system maintenance on the items above be conducted in Japan. As for training in Japan, there are two types; one is training to be conducted by the equipment supplier at its factory, the other is ordinary training undertaken by the training center of JICA. After the training in Japan, the key person is to train other staff to be in charge of construction and maintenance work of the project. The

key person also is to play an important role in preparing operation and maintenance manuals.

CHAPTER 4

BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Basic Design Policy

The project intends to establish a new TDMA subscriber radio system to improve the telecommunication network in the rural areas of Lufilufi, Faleasiu, Salelologa and Auala. The basic policy of system design is as described below.

(1) System Scale

The project is to establish a new rural telecommunications network which will have a scale large enough to meet service demand at the time the system is put in operation, which is estimated at 1995. The basic portion of the system, such as the maximum capacity of a base station, is to be based on the anticipated demand for ten years after the beginning of service, so as to avoid unnecessary investment. The number of telephone sets to be installed under the project is determined based on the requested number, 261, and results of the field survey. The telephone sets will be installed in the public places of each village.

(2) TDMA Subscriber Radio System

(A) Base station will be installed in each area, taking into consideration future demand, billing and numbering plans.

(B) Repeater station will be installed at proper location so that the stabilized radio path can be secured for the proposed project sites.

(C) Subscriber station will be installed in the center of a village when the distance from the nearest subscriber station exceeds approximately five kilometers in consideration of the allowable resistance of local cable, or when it is difficult to install a cable system due to the topography of the land.

(3) Power Supply Units

Existing power supply units will be utilized, if available. New power units will not be installed where DC-48V is available. If the commercial power with AC240V is available, a charger and storage battery set will be newly installed. If existing power units are not available or no stabilized commercial power is guaranteed, a solar power system will be

installed.

(4) Local Cable System

The local cable of 10 or 25 pairs will be supplied. The main cable itself and materials such as wooden poles, drop wires etc. will be supplied by the grant aid. The Government of Western Samoa will procure the telephone apparatus and perform construction work.

(5) Antenna Tower

Existing towers will be utilized in principle. If no existing tower is available, a steel pole will be newly installed. The poles are classified into four types, i.e., 10m, 15m, 20m and 25m in height. The pole itself is supplied by the grant aid, but its foundation work and the repair or reinforcement of existing tower will be performed by the Government of Western Samoa.

(6) Station Buildings

Existing station buildings will be utilized, if available. In places where no such building exists, the equipment will be of outdoor type, rather than constructing a new building.

(7) Access Roads

Other factors being equal, locations for repeater stations requiring the shortest access road length were selected. However, if the slope between main road and proposed site is too steep to construct a new access road, the existing footpath will be properly improved.

(8) Spare Parts and Measuring Apparatus

One spare per type of packages will be provided for each type of base and repeater stations, and four spares for subscriber stations. As for power supply units, one spare per type of packages will be provided for each group of solar power units and rectifiers, classifying into repeater type and subscriber type. The expendable supplies will be provided in quantity sufficient for two-year normal use. The minimum quantity of tools and measuring apparatus will be provided at Maluafou maintenance center in Apia.

4.2 Design Criteria

4.2.1 Demand Forecast

The status of telephone lines, density and the number of waiting applicants in the existing service areas are presented in Table 2-4 in Chapter 2. However, there are no data on telephone demand in the subject area of this project. Therefore, in this report the macroscopic demand in Western Samoa will be obtained by using a formula recommended by the International Telecommunication Union (ITU) in cases where little data can be acquired. In addition, the demand forecast in this project area will be adjusted based on the hearing results to the macroscopic demand obtained.

(1) Conditions for Macroscopic Demand Forecast

(A) Trend of GDP

The trend of GDP in Western Samoa is shown in Table 4-1. The total GDP up to year 1990 is actual, and from 1991 a rate of increase of 6.9% has been applied for estimation purposes.

Table 4-1 Trend of GDP

(million Tala)

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total GDP	218	240	254	266	284	304	325	347	371

(B) Increase of Population

The growth in population of Western Samoa is shown in Table 4-2. The figures up to the year 1991 are actual, and a rate of increase of 0.52% has been used for estimation from 1992.

Table 4-2 Increase of Population

(x 1,000)

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total Population	158.0	158.8	159.6	160.5	161.3	162.1	163.0	163.8	164.7
Urban Population	33.2	33.4	33.5	33.7	33.9	34.0	34.2	34.4	34.6
Rural Population	124.8	125.4	126.1	126.8	127.4	128.1	128.8	129.4	130.1

(2) Formula for Macroscopic Demand Forecast

Based on the data of ITU, the formula for macroscopic demand forecast using GDP per capita is as below:

Log Y = -2.34475 + 0.95821 Log X .....Formula (1)

where X = GDP per capita
Y = Telephone density per 100 people

The correlation factor between X and Y is high at 0.94.

(3) Demand Forecast in Rural Area

The demand was forecast under the following conditions because of the lack of the data for demand forecast in rural areas:

(A) The major industry in the rural areas is primary industry, including agriculture, fishery and stock raising.

(B) GDP per capita in rural area is estimated from the ratio of primary industry GDP to that of total, divided by the rural population. The ratio is actual up to 1990, and from 1991, a 2.25% ratio of decrease per annum has been used.

The results of estimation are shown in Table 4-3.

Table 4-3 GDP per Capita in Rural Area

Year	1989	1990	1991	1992	1993	1994	1995
Total GDP (million Tala)	254	266	284	304	325	347	371
Ratio of GDP of primary industry to total GDP (%)	53.9	50.5	49.2	48.0	46.8	45.6	44.5
GDP of primary industry	136.9	134.3	139.7	145.9	152.1	158.2	165.1
Rural Population (x 1,000)	126.1	126.8	127.4	128.1	128.8	129.4	130.1
Exchange Rate	0.4367	0.4310	0.4159	0.4041	0.3940	0.3940	0.3940
GDP per capita in rural area (US$)	474.0	456.6	456.1	460.3	465.3	481.7	500.0

The results of demand forecast in the project area by using formula (1) are shown in Table 4-4.

Table 4-4 Demand Forecast

Year	1993	1994	1995
Telephone density per 100 people	1.63	1.68	1.74
Population in project area (x 1,000)	39.1	39.3	39.5
Telephone demand in project area	637	660	687

4.2.2 Number of Telephone Sets

The place and number of telephone sets to be installed under the project were studied after the survey on requested sites for the subscriber radio stations was completed. Public buildings such as post and telephone offices, police stations, hospitals, schools, chief's houses and women's committee houses as the proper places for the people's usage of telephones were selected as recommended by the chiefs of villages and residents. The following were considered for selection:

(1) The figure of 261, which is the total number of requested telephone sets, is distributed in accordance with the ratio of population in each village. This is considered to be the aimed-for number of telephone sets to be installed in each village. The specific conditions were added to the number obtained in each village, e.g., in the villages where its population density is high, the number of telephones per resident was reduced.

(2) If the aimed-for number is two, three telephone sets will be installed in the optimum public places which are located in the center and at two points on the edge of the village for the fairness of people's usage of telephone.

(3) If the aimed-for number is one, two telephone sets will be installed in consideration of back-up in case of equipment failure.

The population, number of public organization, demand forecast and number of telephone sets in each village are presented in Table 4-5.

Table 4-5 Result of Demand Investigation on Project Site (1/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
1	1	Laulii	1,523	27	10	7				①	7	②	②	②
	2	Luatuanuu	1,241	22	8	6								
		Luatuanuu	(871)			(3)				1	7	②	①	
		Leusoalii	(370)			(3)				2/①	2	①	①	
	3	Manunu	269	5	2	3				①	①		①	
	4	Falevao	418	7	3	3				1	①	①	①	
	5	Lalomauga	380	7	3	3				1	①	①	①	
	6	Taelefaga	140	2	1	2				1	1		①	①
	7	Lona	269	5	2	3	①			1	3	1	①	①
	8	Samamea	98	2	1	2					①		①	
	9	Musumusu	93	2	1	2			①		2		①	
	10	Afugalu	82	1	1	2						①	①	
	11	Samusu Uta	403	7	3	3				1	①		①	①
	12	Saleaaumua	1,777	31	12	12								
		Saleaaumua	(576)			(3)				1	②	①	1	
		Amaile	(279)			(2)			①		1	1	①	
		Samusu	(562)			(3)	①			1	3	①	①	
		Mutiatele	(223)			(2)				1	4	①	①	

Note : The circled numbers indicate the number of telephone sets to be installed in each location.

Table 4-5 Result of Demand Investigation on Project Site (2/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
1		Malaela	(137)			(2)	①				①	1	1	
	13	Lalomanu	1, 835	32	12	14								
		Lalomanu	(789)			(6)	①	①	①	1		①	②	
		Satitoa	(530)			(3)				1	4	①	②	
		Ulutogia	(196)			(2)				1	①	①	1	
		Vailoa	(320)			(3)				1	①	①	1	①
	14	Lepa	578	10	4	5								
		Lepa	(163)			(2)			①	1	1	1	①	
		Saleapaga	(415)			(3)				1	1	①	②	
	15	Aufaga	593	10	4	3				1	4	①	②	
	16	Vavau	370	6	2	3					3	①	②	
	17	Siuniu	164	3	1	2					1	①	①	
	18	Lotofaga	944	16	6	5			①	1	2/①	①	①	①
	19	Utulaelae	266	5	2	3								
		Utulaelae	(152)			(2)					①	1	①	
		Sapoe	(114)			(1)				1	3	①	1	
	20	Salani	503	9	3	3				1	2	①	②	
	21	Salesatele	393	7	3	3			①	1	1	①	①	

Table 4-5 Result of Demand Investigation on Project Site (3/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
1	22	Satalo	870	15	6	5								
		Satalo	(421)			(3)				1	②		①	
		Sapunaoa	(449)			(2)				1	①	①	1	
	23	Malaemalu Uta	306	5	2	3	①			1	2	①	①	
Area-total	23	34	13, 515	236	92	97	5	1	6	28	69	30	41	7

Table 4-5 Result of Demand Investigation on Project Site (4/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
2	1	Matautu	1,579	28	10	8								
		Matautu	(243)			(4)				②	1	①	①	
		Pata	(461)			(2)					1	①	①	
		Nefunefu	(157)			(0)						1	1	
		Levi	(162)			(0)						1	1	
		Matanofo	(153)			(0)						1	1	
		Falevai	(227)			(2)						①	①	
		Samai	(176)			(0)						1	1	
	2	Siufaga	582	10	4	4			①	①	2	①	①	
	3	Samatau	967	17	6	5				①	4	①	①	②
	4	Apolimafou	393	7	3	3				2	4	①	1	②
	5	Faleu	345	6	2	3			①	1	4	①	①	
	6	Salua	294	5	2	3								
		Salua	(175)			(2)				①	3	1	①	
		Satuilagi	(119)			(1)						1	①	
Area-total	6	13	4,160	73	27	26			2	8	19	13	13	4

Table 4-5 Result of Demand Investigation on Project Site (5/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
3	1	Tafuatai	349	6	2	3			①	①	2	1	①	
	2	Samatai Uta	1, 502	26	10	8								
		Samatai Uta	(670)			(3)					①		①	①
		Samataitai	(553)			(3)				1/①	3		②	
		Fagafau	(279)			(2)				1	1		②	
	3	Palauli East	2, 602	45	17	14								
		Faala	(948)			(5)			①		3	①	③	
		Vaitoomuli	(785)			(4)				①	3	1	②	①
		Vailoa	(869)			(5)				②	3	①	②	
	4	Satupaitea	1, 833	32	12	12								
		Satufia	(448)			(4)			①	①	4	1	①	①
		Vaega	(572)			(4)				①	①	①	1	①
		Pitonuu	(434)			(2)		①			3	1	①	
		Moosula	(379)			(2)					2		①	①
	5	Sili	1, 099	19	7	5			①	①	3/①	①	①	
	6	Papa	591	10	4	4								
		Papa	(308)			(2)					2/①	①	1	
		Puleia	(283)			(2)				①	1/①	1	1	
	7	Gautavai	1, 343	23	9	6								

Table 4-5 Result of Demand Investigation on Project Site (6/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
3		Gautavai	(191)			(3)					①	①	①	
		Gataivai	(1152)			(3)				2	1/①	①	①	
	8	Taga	721	13	5	5	①		①	1	5/①	1	①	①
	9	Salailua	2, 931	51	19	16								
		Salailua	(880)			(4)	①			①	3	①	①	
		Siutu	(806)			(4)		①			①	①	①	
		Satuiatua	(277)			(2)				1	①		①	
		Foailuga	(589)			(3)					2/①	1	②	
		Foailalo	(379)			(3)			①		1/①		①	
	10	Sagone	802	14	5	5				1/①	③		①	
	11	Vaipua	844	15	6	5								
		Vaipua	(460)			(3)				1	②		①	
		Fogasavaii	(384)			(2)				1	①		①	
	12	Fogatuli	792	14	5	5								
		Fogatuli	(310)			(3)				1	3		②	①
		Faiaai	(482)			(2)					6		②	
	13	Falelima	543	9	4	3				1	2/②	①	1	
	14	Neiafutai	447	8	3	3				①	①		①	
Area total	14	29	16, 399	285	108	94	2	2	6	23	74	17	38	7

Table 4-5 Result of Demand Investigation on Project Site (7/7)

Area	Subscriber Station Number	Name of Village	Population	Demand Forecast (1.74%)	No. of Aimed-for Telephone Sets	No. of Telephone Sets to be Installed	Post & Telephone Office	Police Station	Hospital	School	Church	Women's Committee Houses	Official Persons' Houses	Other Public Facilities
4	1	Aopo	413	7	3	3	①		①	①	3		1	
	2	Letui	278	5	2	3				1	①	①	①	
	3	Matavai	213	4	1	2				1	2	①	①	
	4	Sasina	879	15	6	4								
		Sasina	(629)			(3)					5	①	①	①
		Fagaee	(250)			(1)				1	1		①	
	5	Samauga	429	7	3	3				1	1	①	②	
	6	Safotu	1, 453	25	10	8	①		①	①	4	①	④	
	7	Fagamalo	371	6	2	3	①	①	①	1	2		1	
	8	Saleaula	568	10	4	3				1	5	1	①	②
	9	Samalaeulu	805	14	5	4	①		①		3/①	①	1	
Area-total	9	10	5, 409	93	36	33	4	1	4	8	28	7	14	3
Sum total	52	86	39, 483	687	263	250	11	4	18	67	190	67	106	21

4.2.3 Capacity of Existing Transmission Network

(1) Calling Rate of TDMA Subscribers

The actual trunk calling rate at each base station is shown in Table 4-6. These rates are utilized in estimating the traffic of the TDMA subscriber radio system.

Table 4-6 Calling Rate in Each Exchange

	Category	Calling Rate
Lufilufi	Originating	0.038
	Terminating	0.032
	Total	0.070
Faleasiu	Originating	0.030
	Terminating	0.022
	Total	0.052
Salelologa	Originating	0.054
	Terminating	0.029
	Total	0.083
Auala	Originating	0.038
	Terminating	0.032
	Total	0.070

(2) Traffic Estimation and Calculation of Necessary Number of Circuits

The following conditions are used for the traffic calculation:

(A) The time the system is put in service is estimated at 1995, and estimated number of subscribers are the numbers of telephone apparatus and demand.

(B) The actual traffic data of each exchange are used as the trunk traffic of TDMA system.

(C) The calling loss of trunk circuit is 0.01.

Table 4-7 shows the necessary number of circuits calculated under the conditions above. This shows that the existing digital transmission circuits will be able to

accommodate whole traffic derived from the telephones to be installed at the beginning of the service of the system. However, in order to cover the traffic against the demand anticipated at the time of service-in, seven additional circuits will be necessary between Salelologa and Lalovaca exchanges.

Table 4-7 Traffic and Necessary Number of Circuits

Exchange	Category	No.of Sub-scribers		Calling	Traffic (erlang)		No.of Circuits		Existing Circuits
		For Tel.Sets	For Demand	Rate	For Tel.Sets	For Demand	For Tel.Sets	For Demand	Circuits
Lufilufi	Normal	300	300	0.070	21.00	21.00			
	TDMA	97	236	0.070	6.79	16.52			
	Total	397	536		27.79	37.52	39	50	60
Faleasiu	Normal	516	516	0.052	26.83	26.83			
	TDMA	26	73	0.052	1.35	3.80			
	Total	542	589		28.18	30.63	40	42	60
Salelo-	Normal	350	350	0.083	29.05	29.05			
loga	TDMA	94	285	0.083	7.80	23.66			
	Total	444	635		36.85	52.71	49	67	60
Auala	Normal	184	184	0.070	12.88	12.88			
	TDMA	33	93	0.070	2.31	6.51			
	Total	217	277		15.19	19.39	24	29	60

4.2.4 Exchange Capacity

Table 4-8 shows the capacity of exchanges connected to base stations and terminal utilization status as of October, 1993. As seen in the table, the existing exchanges at Faleasiu, Salelologa and Auala have sufficient capacity. In Lufilufi exchange office, it is estimated that there is a need for 13 more terminals. However, it will be possible to increase the number of subscribers by purchasing the line circuits, because basic equipment catering to up to 512 subscribers has already been installed.

Table 4-8 Exchange Capacity

Island	Station Name	Type of Exchange	Connected Subscribers	Expected No. of Subscribers	Capacity
Upolu	Faleasiu	AXE 105	366	542	768
	Lufilufi	AXE 105	280	397	384
Savaii	Salelologa	AXE 105	241	444	768
	Auala	AXE 105	154	217	256

4.2.5 Equipment Design

(1) Study of Capacity of Base Station

There is no specification of maximum capacity of base station in the original request. From the results of field survey, the estimated number of telephones demanded at the time the system is put in service (in 1995) amounts to from 73 to 285, as shown in Table 4-5. Since the system has a long life span of operation with appropriate maintenance work, future demand can be absorbed by adding the necessary panels to the base, repeater and subscriber radio station equipment. PTD intends to execute an expansion plan of TDMA system which will include the neighboring villages with their own budget after the completion of this project. The number of telephones demanded per base station is estimated at between 300 and 500 approximately. Therefore, it is reasonable to have a capacity of 512 for a base station, from the viewpoint of avoiding unnecessary investment due to the increase in future telephone demand.

(2) Frequency Band

The frequency band between 1.5 GHz and 2.6 GHz is generally utilized for TDMA subscriber radio system. In this project area, the lowest frequency band of 1.5 GHz is recommended, due to losses which are expected from trees around the site, and propagation over the sea. However, the radio interference from/to existing IRT-2000 system needs to be studied further.

(3) Radio Propagation Conditions

The status of radio propagation can be estimated from the radio path profile between

stations. The clearance factor of the trunk circuit between base and repeater stations will be more than 1.0 in principle, in the case of a 1.5 GHz band and 4/3 of K factor. The clearance factor between repeater and subscriber stations will be more than 0.6 in the same conditions above. The tree height will be considered in calculating the clearance factor.

(4) Subscriber Interface Panel

The capacity of subscriber interface panel in each subscriber station will be determined in accordance with the demand forecast so that PTD itself is able to expand the local cable network after the completion of the project.

(5) Power Supply Units

The monthly hours of sunshine in Apia are shown in Table 4-9. These are sufficient for the use of solar power systems. The battery capacity will be designed so that the equipment can be operated continuously for more than ten days at the repeater station and five days at the subscriber station without sunshine.

Table 4-9 Hours of Sunshine

(Hours)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1990	-	-	119.0	145.2	182.2	213.4	214.5	232.5	211.2	251.9	153.1	120.3
1991	166.8	134.9	193.3	207.5	211.1	205.7	214.5	189.3	223.8	169.3	147.2	-
1992	120.9	123.7	119.0	173.2	100.5	128.6	201.8	199.0	184.2	173.7	160.3	135.4
1993	172.8	133.9	122.0	167.3	171.6	164.5	157.1					

(6) Antenna Poles

The antenna poles are of steel and can be assembled on site. The designed poles will be able to withstand wind velocities of up to 200 km per hour (55 m per second) on sites where the wind blows very hard e.g., in the seashore and mountain areas, which the Electric Power Corporation of Western Samoa is employing for the construction of electric poles.

(7) Access Roads

The access roads are gravel-surfaced. The road width will be more than three meters.

4.2.6 System Configuration

The contents of the system are summarized in Table 3-2 in Chapter 3. Figures 4-1 through 4-4 show the system configuration of the project. The transmission route plan is also shown in Figure 4-5.

4.3 Basic Plan

(1) Radio Equipment

Major equipment necessary for this project is shown in Table 4-10.

(2) Power Supply Units

The power supply units shown in Table 4-10 will be installed based on the availability of existing power facilities.

(3) Antenna Poles

The steel poles shown in Table 4-10 will be installed at repeater and subscriber stations where no existing towers can be utilized.

(4) Station Buildings

As a rule, the system equipment will be installed in the space of existing buildings of PTD. In the sites where no existing buildings are available, the equipment is of outdoor type.

(5) Access Roads

Access roads of a total of 900 meters in length will be constructed by PTD for three (3) repeater stations, i.e., 300 m for Lemafa Pass, 400 m for Afugalu and 200 m for Mt. Tafua. It is impossible to construct a new access road in Mt. Fogalepulu repeater station, because the footpath of 100 meters length is too steep. The footpath will be properly improved by PTD.

(6) Local Cable System

The local cable of a total length of 65 km, which includes a safety margin, will be supplied by the Government of Japan. The cable is classified into 10-pair cable in 46.5 km length and 25-pair cable in 18.5 km length.

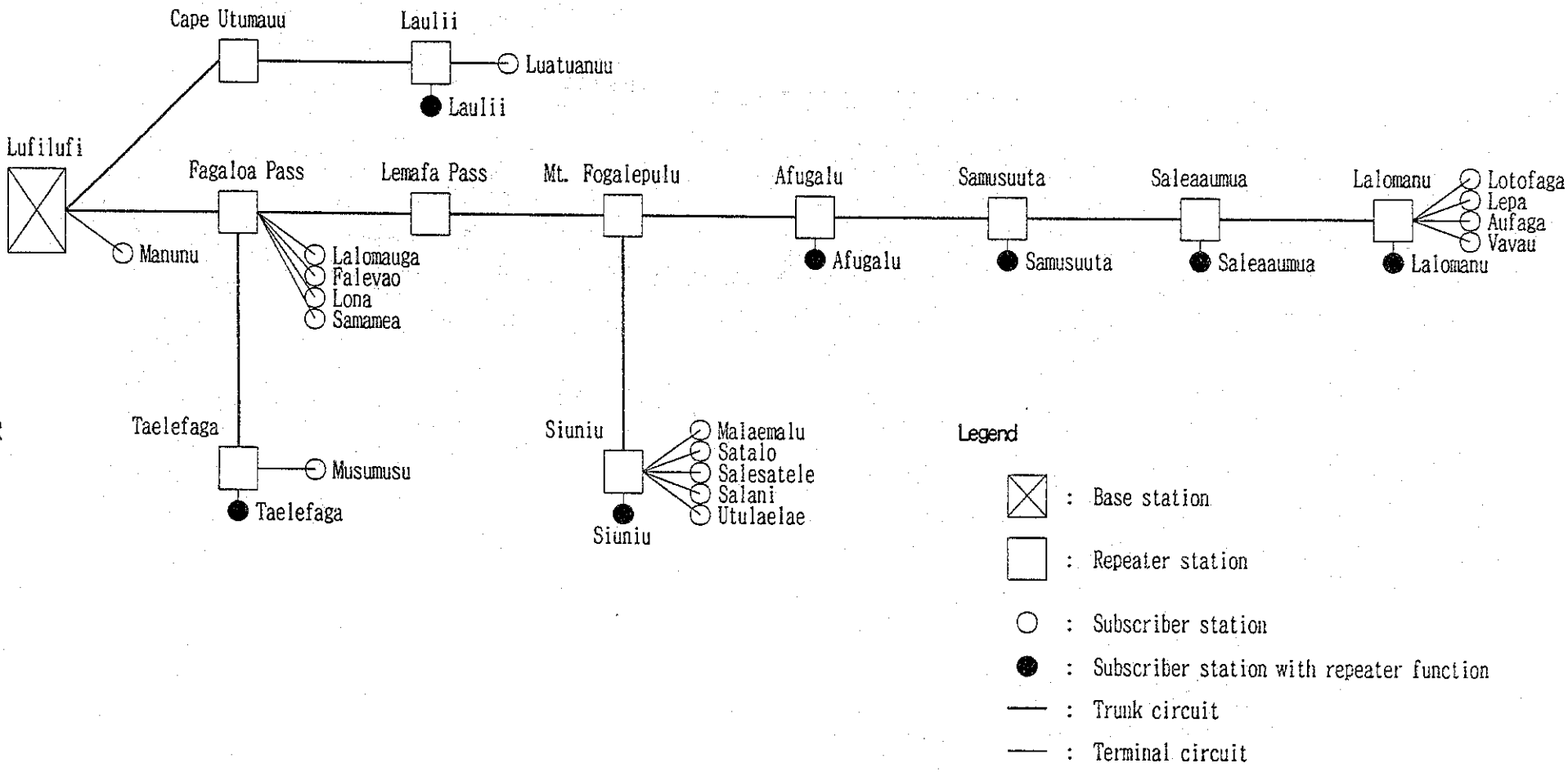
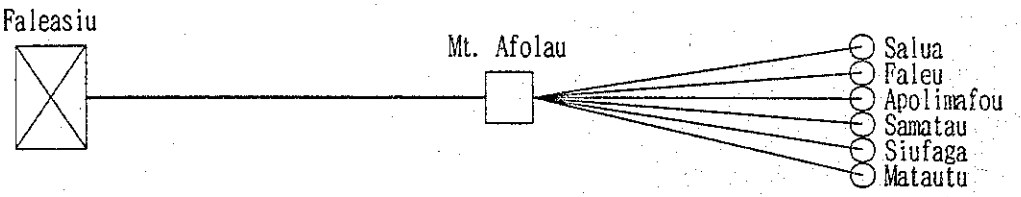


Figure 4-1 System Configuration (System 1: Lufilufi Area)



Legend

: Base station

: Repeater station

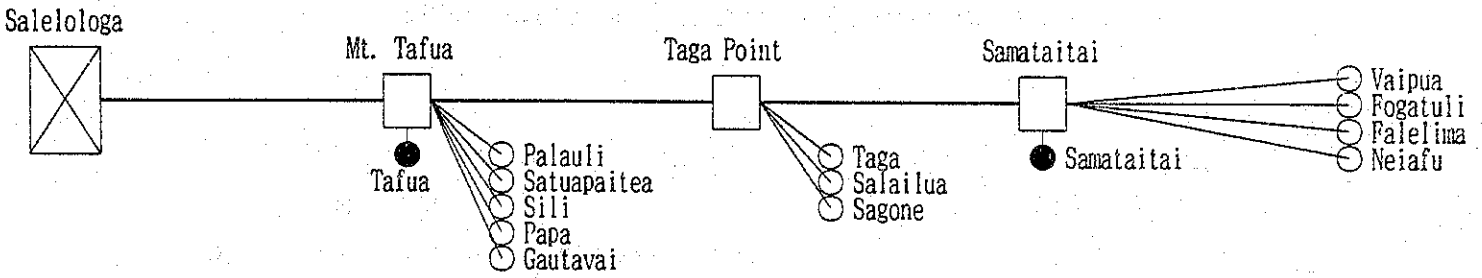
: Subscriber station

: Subscriber station with repeater function

: Trunk circuit

: Terminal circuit

Figure 4-2 System Configuration (System 2: Faleasiu Area)



Legend

: Base station

: Repeater station

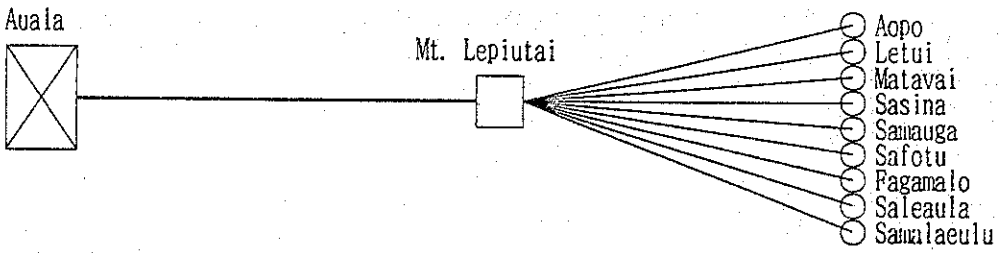
: Subscriber station

: Subscriber station with repeater function

: Trunk circuit

: Terminal circuit

Figure 4-3 System Configuration (System 3: Salelologa Area)



Legend

: Base station

: Repeater station

: Subscriber station

: Subscriber station with repeater function

: Trunk circuit

: Terminal circuit

Figure 4-4 System Configuration (System 4: Auala Area)

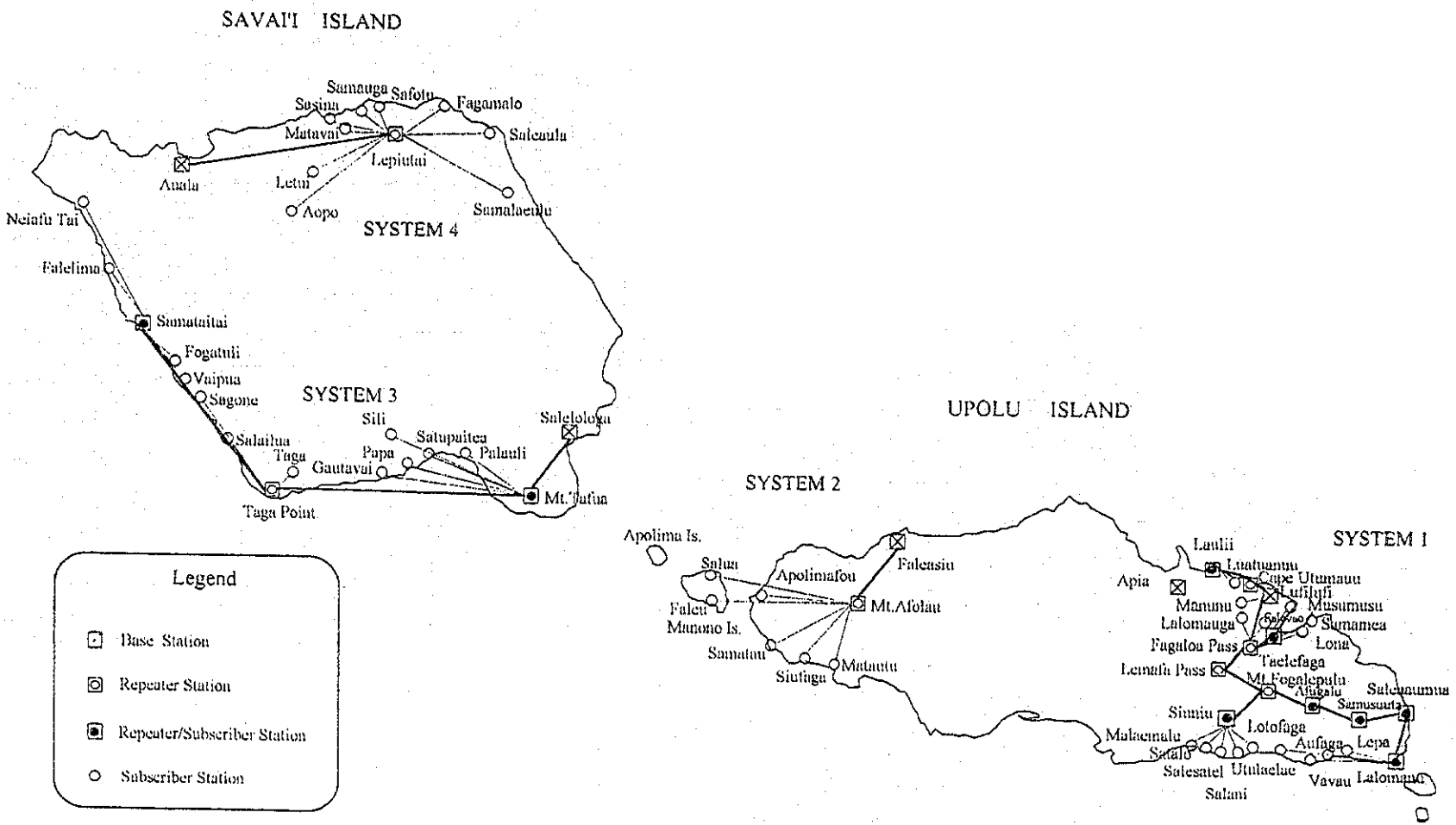


Figure 4-5 Transmission Route Plan

Table 4-10 Main Equipment List (1/6)

Item \ Site	Base Station					Repeater Station																Subscriber Station											Sub-total
	Maluafou	Lufiluti	Faleasiu	Salelologa	Aualua	C.Utumauu	Lauliii	Fagaloa P	Lemafa P	Taelefaga	Fogalepulu	Afugalu	Samusuuta	Saleaaumua	Lalomanu	Siuniu	M.Afolau	M.Tafua	Taga Point	Samataitai	M.Lepiutai	Luatuanuu	Manunu	Falevao	Lalomauga	Lona	Samamea	Musumusu	Lepa	Aufaga	Vavau	Lotofaga	
Exchange Interface		1	1	1	1																												4
Base Station		1	1	1	1																												4
Repeater Station						1		1	1		1						1		1		1												7
Repeater Station (8L)										1		1	1			1		1															5
Repeater Station (32L)							1							1	1					1													4
Subscriber Station (8L)	1	1	1	1	1																		1	1	1	1	1	1			1		7
Subscriber Station (16L)		1	1	1	1																								1	1		1	3
Subscriber Station (24L)																						1											1
Subscriber Station (32L)																																	0
Subscriber Station (48L)																																	0
Subscriber Station (56L)																																	0
Supervisory & Control	1	1	1	1	1																												5
Omni-directional (7dB)							1			1																							2
Omni-directional (10dB)		1				1		1			1				1	1	1	1	1	1	1												11
Horn Antenna			1	1		1	1	1	2	1	1	2	2	2	1	1	1	1					1						1	1	1	1	24
Yagi Antenna																						1		1	1	1	1	1					6
Parabolic Antenna (1.8m)					1														1	1	1												4

Table 4-10 Main Equipment List (2/6)

Item \ Site	Subscriber Station																															Sub-total	Total
	Utulaelae	Salani	Salesatele	Satalo	Malaemalu	Matautu	Siufaga	Samatau	Apolimafou	Faleu	Salua	Palauli	Satuapaite	Silii	Papa	Gautavai	Taga	Salailua	Sagone	Vaipua	Fogatuli	Faleima	Neiafu	Aopo	Letui	Matavai	Sasina	Samauga	Safotu	Fagamalo	Saleaula	Samalaeulu		
Exchange Interface																																0	4
Base Station																																0	4
Repeater Station																																0	7
Repeater Station (8L)																																0	5
Repeater Station (32L)																																0	4
Subscriber Station (8L)	1		1		1				1	1	1												1	1	1	1		1		1			12	19
Subscriber Station (16L)		1		1			1								1		1		1	1	1	1					1				1	1	12	15
Subscriber Station (24L)								1						1		1																	3	4
Subscriber Station (32L)						1							1																	1			3	3
Subscriber Station (48L)												1																					1	1
Subscriber Station (56L)																		1															1	1
Supervisory & Control																																0	5
Omni-directional (7dB)																																0	2
Omni-directional (10dB)																																0	11
Horn Antenna	1	1	1	1	1			1	1			1	1	1	1	1		1	1	1	1	1	1	1	1		1				1	1	23	47
Yagi Antenna						1	1			1	1						1									1		1	1	1			9	15
Parabolic Antenna (1.8m)																																0	4

Table 4-10 Main Equipment List (3/6)

Site / Item		Base Station				Repeater Station																Subscriber Station											Sub-total
	Malualafou	Lufilufi	Faleasiu	Saleloga	Aualua	C.Utumauu	Lauiii	Fagaloa P	Lemafa P	Taeleiaga	Fogaleputu	Afugaiu	Samusuuta	Saleaaumua	Lalomanu	Siuniu	M.Afolau	M.Tafua	Taga Point	Samataitai	M.Leputai	Luatuanuu	Manunu	Falevao	Lalomauga	Lona	Samamea	Musumusu	Lepa	Aufaga	Vavau	Lotofaga	
Feeder Cable (20mm): m		40	40	35	45	60	60	60	60		60	60	60	70	70	70	70	70	140	70	80		35						30			35	1,320
Feeder Cable (10mm): m										40												25		20	20	25	20	20		20	20		210
Connector (20mm)		2	2	2	2	4	4	4	4		4	4	4	4	4	4	4	4	4	4	4		2						2			2	74
Connector (10mm)										4												2		2	2	2	2	2		2	2		20
Rectifier (Repeater)						1	1			1		1	1	1	1	1				1													9
Rectifier (Subscriber)																						1	1	1	1				1	1	1		7
Solar Battery (Repeater)								1	1		1						1	1	1														6
Solar Battery (Subscri.)																										1	1	1					3
Battery (Repeater)						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
Battery (Subscriber)																						1	1	1	1	1	1	1	1	1	1		10
10m Pole										1														1	1		1	1	1		1		7
15m Pole																						1				1							2
20m Pole						1	1	1	1		1	1	1																	1			8
25m Pole														1	1	1	1	1		1			1									1	8
Battery Cabinet (2-Cell)																						1	1	1	1				1	1	1		7
Battery Cabinet (6-Cell)																										1	1	1					3
Battery Cabinet (8-Cell)						1	1			1		1	1	1	1	1			2	1													11
Battery Cabinet (12-Cell)								2	2		2						2	2															10

Table 4-10 Main Equipment List (4/6)

Item \ Site	Subscriber Station																															Sub-total	Total
	Utuiaelae	Saiani	Saiesatele	Satalo	Malaemalu	Matautu	Siufaga	Samatau	Apolimafou	Faleu	Saua	Palauli	Satuapaite	Silii	Papa	Gautavai	Taga	Saiailua	Sagone	Vaipua	Fogatuli	Faieiima	Neiafu	Aopo	Letui	Matavai	Sasina	Samauga	Safotu	Fagamalo	Saleaulia	Samalaeulu		
Feeder Cable (20mm): m						30		35						35				35	35	35	30	35		35	35							35	375	1695
Feeder Cable (10mm): m	25	25	25	25	25		20		25	20	20	20	20		25	25	20						25			25	20	20	20	20	25		475	685
Connector (20mm)						2		2						2				2	2	2	2	2		2	2							2	22	96
Connector (10mm)	2	2	2	2	2		2		2	2	2	2	2		2	2	2						2			2	2	2	2	2	2		42	62
Rectifier (Repeater)																																	0	9
Rectifier (Subscriber)	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1						1	1			23	30
Solar Battery (Repeater)																																	0	6
Solar Battery (Subscri.)										1	1													1	1	1	1	1			1	1	9	12
Battery (Repeater)																																	0	15
Battery (Subscriber)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32	42
10m Pole							1			1	1	1	1				1										1	1	1	1			10	17
15m Pole	1	1	1	1	1				1						1	1							1			1					1		11	13
20m Pole						1															1												2	10
25m Pole								1						1				1	1	1		1		1	1							1	9	17
Battery Cabinet (2-Cell)	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	2	1	1	1	1	1						1	1			24	31
Battery Cabinet (6-Cell)										1	1													1	1	1	1	1			1	1	9	12
Battery Cabinet (8-Cell)																																	0	11
Battery Cabinet (12-Cell)																																	0	10

Table 4-10 Main Equipment List (5/6)

Item \ Site		Base Station				Repeater Station															Subscriber Station											Sub-total
	Malualafou	Lufilufi	Faleasiu	Salelologa	Aualala	C.Utumauu	Laulii	Fagaloa P	Lemafa P	Taeleifaga	Fogaleputu	Afugalu	Samusuuta	Saleaaumua	Lalomanu	Siuniu	M.Afolau	M.Tafua	Taga Point	Samataitai	M.Lepiutai	Luatuanuu	Manunu	Falevao	Lalomauga	Lona	Samamea	Musumusu	Lepa	Aufaga	Vavau	Lotofaga	
Spare Parts	1																																1
Tools, Measuring Sets	4																																4
Installation Materials	1																																1
Manual, Documents	1																																1

Table 4-10 Main Equipment List (6/6)

Item \ Site	Subscriber Station																																Sub-total	Total
	Utuiaelae	Salani	Salesatele	Satalo	Malaemalu	Matautu	Siufaga	Samatau	Apolimafou	Faleu	Salua	Palauli	Satuapaite	Silii	Papa	Gautavai	Taga	Salailua	Sagone	Vaipua	Fogatuli	Faleima	Neiafu	Aopo	Letui	Matavai	Sasina	Samauga	Safotu	Fagamalo	Saleaula	Samalaeulu		
Spare Parts																																	0	1
Tools, Measuring Sets																																	0	4
Installation Materials																																	0	1
Manual, Documents																																	0	1

CHAPTER 5

IMPLEMENTATION PLAN

CHAPTER 5 IMPLEMENTATION PLAN

5.1 Implementation Policy

Since the installation, adjustment, and performance test of the equipment in this project require high technical knowledge and experience, the main contractor in Japan will send engineers and technicians in each technical field to assist with each process and give guidance to local engineers, technicians and workers.

PTD has responsibility for the construction of tower foundations due to its favorable financial status and technical level of the local contractor. However, as mountainous and seashore areas which make the construction work difficult are included in the project, special engineers will be sent to supervise the construction work of the local contractor.

Since the construction site spreads over wide areas in the actual implementation, some appropriate teams will be formed from the Japanese and local engineers to promote the smooth execution of construction work.

The engineers sent from Japan will transfer the knowledge required for the operation/maintenance and the construction of the TDMA radio equipment to the engineers or technicians of PTD through OJT training.

5.2 Scope of Installation Work

At the time of their visit to Western Samoa, the basic design study team discussed with the personnel concerned, including the Director of PTD as to how the installation work should be shared by two countries where the grant aid project to be implemented. The results of discussions were recorded and confirmed by making the minutes of discussions, as attached at the end of this report. The scopes of work to be borne respectively by Japan and Western Samoa are described below.

5.2.1 Scope of Work of Japan's Grant Aid

(1) To install TDMA subscriber radio system equipment,
(2) To install power supply units and solar power systems,
(3) To construct antenna poles and to install antennas and feeder cables,
(4) To adjust, test and inspect the system.

5.2.2 Scope of Work of Western Samoa

(1) To provide and secure land and equipment rooms necessary for implementation of the project,
(2) To construct foundations for antenna poles under the supervision of Japanese engineers,
(3) To install connection cables between MDF and existing switching equipment,
(4) To install cables to connect subscriber station equipment to the subscriber premises and telephone apparatus,
(Refer to Figure 5-1, for the details of major cable and materials, and scope of work.)
(5) To secure access roads necessary for the construction of facilities and to construct fences.
(6) To arrange lead-in of commercial power to sites.

5.3 Implementation Management Plan

For the management of the construction work for the project, a Japanese consultant in contract with PTD will perform the following management work in relation to the project implementation.

(1) Detailed Design

The detailed design will be made to decide the general and special conditions, and detailed technical specifications which are required for the project implementation under the cooperation with PTD on the basis of the results of field survey for the basic design. Then the consultant will prepare the documents required for tendering on the basis of the results of the detailed design.

(2) Management of Construction Work

(A) Works relating to tender for selecting contractor

The consultant will call for tender, receive and evaluate the tender proposal and assist in reaching agreement between PTD and Japanese applicant for the contract.

(B) Factory inspection

The consultant will perform equipment inspection at the supplier's factory to ensure that equipment manufactured conforms to the contract specifications, prior to

the shipment of the equipment.

(C) Supervision of the construction work

In accordance with the agreement between PTD and the consultant, the consultant will examine the construction method and schedule which will be submitted by the contractor and give instructions to the contractor. The consultant will also visit the sites periodically to make sure that the construction work conforms to the contract specifications, and will manage the construction schedule.

(D) Witness for acceptance test

The consultant will witness for the acceptance test when the construction work is completed to ensure that the inspection results conform to contract specifications, and if so, then to recommend that the Government of Western Samoa accept the system.

5.4 Procurement Plan of Equipment and Materials

In general, except for those items for the construction to be procured by the Western Samoan Government, all equipment and materials will be procured in Japan. However, the wooden poles, and some accessories for the construction of local cable system which do not have any specific influence to the system quality, may be procured from neighboring countries.

5.5 Project Implementation Process

For this project, both the Japanese and Western Samoan Governments will sign the exchange of notes. Immediately upon signing, the contract of consultancy services will begin. The consultant will first undertake the detailed design, and tender documents will be prepared. After competitive tendering, a contract for equipment and materials procurement and construction work will be formed. The project implementation schedule is shown in Figure 5-2.

5.6 Estimate of Project Cost Borne by Western Samoa

A breakdown of the cost to be borne by Western Samoa under the conditions below is as follows:

(1) Cost to be borne by Western Samoa

(A) Foundation construction for antenna poles	71 thousand Tala
(B) Construction of access roads	65 thousand Tala
(C) Construction of fences	183 thousand Tala
(D) Construction of local cable system including telephone apparatus	428 thousand Tala
(E) Lead-in of commercial power	20 thousand Tala
(F) Administration expenses	230 thousand Tala
(G) Total	997 thousand Tala

Refer to ANNEX-6 for the cost breakdown.

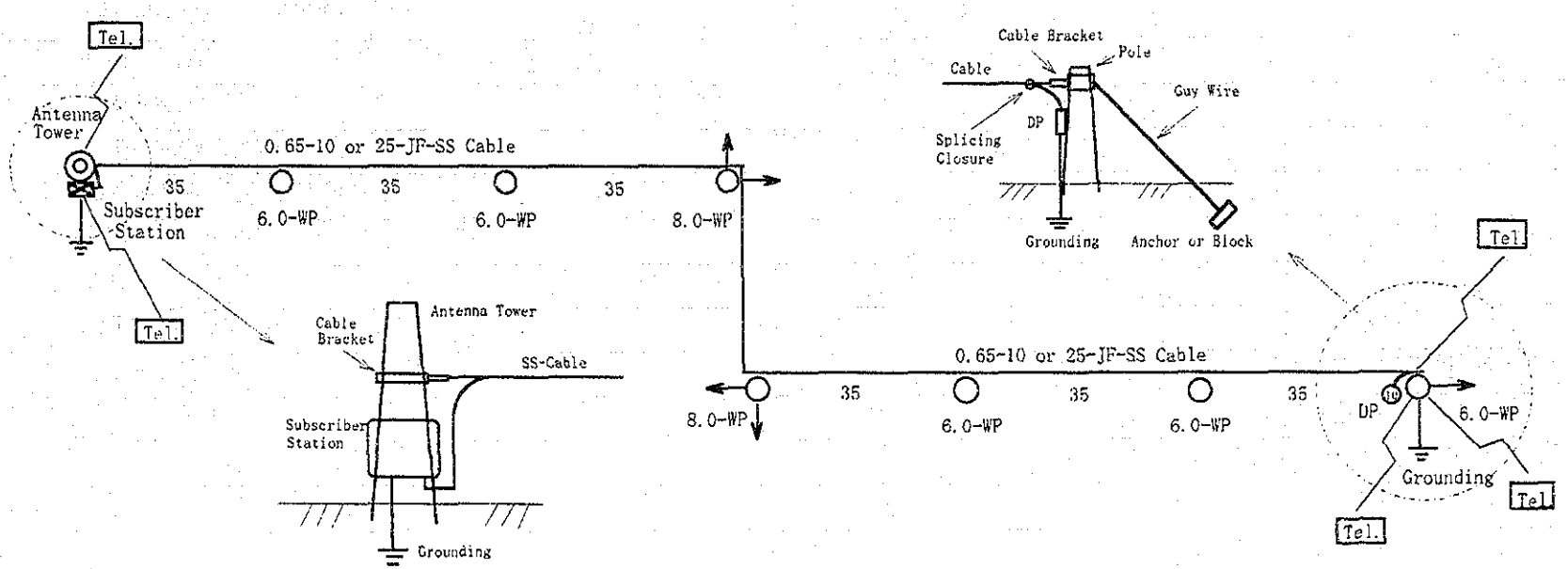
(2) Estimate Conditions

(A) Time of Estimate
September, 1993.

(B) Implementation Period
As shown in Figure 5-2.

(C) Other
The project will be carried out under the system of grant aid of the Japanese Government.

(1) Configuration of Aerial Line Structure



(2) Scope of Work

No.	Item	To be covered by Grant Aid	To be covered by Recipient	Remarks
1	Cable Line Construction		O	
2	Subscriber Connection		O	

Figure 5-1 Major Materials and Sharing of Installation Work (1/2)

(3) Scope of Provision of Cable and Materials

A. Cable Line

No.	Goods	To be covered by Grant Aid	To be covered by Recipient Country		Remarks
1	0.65mm-10p and/or 25p JF-Self-supporting Cable	O			Including Cable Hanger every 3 poles
2	Distribution Point	O			
3	Pole (6.0m and/or 8.0m)	O			Wooden Pole
4	Splicing Closure	N/A	N/A		
5	Connector	O			
6	Grounding (earth)	O			
7	Guy Wire	O			7/16 or 30mm², & Grip
8	Anchor or Block		O		Screw type anchor
9	Cable Bracket		O		Including Bolts & Nuts
10	Other Accesories		O		
11	Cable Arrestor	O			

B. Subscriber Connection (house wiring)

1	Drop wire (2 or 4wires)	O			
2	Subscriber Protector	O			
3	Grounding (earth)	O			
4	Interior Wire		O		
5	Interior Wire Protector		O		
6	Telephone Set		O		

Figure 5-1 Major Materials and Sharing of Installation Work (2/2)

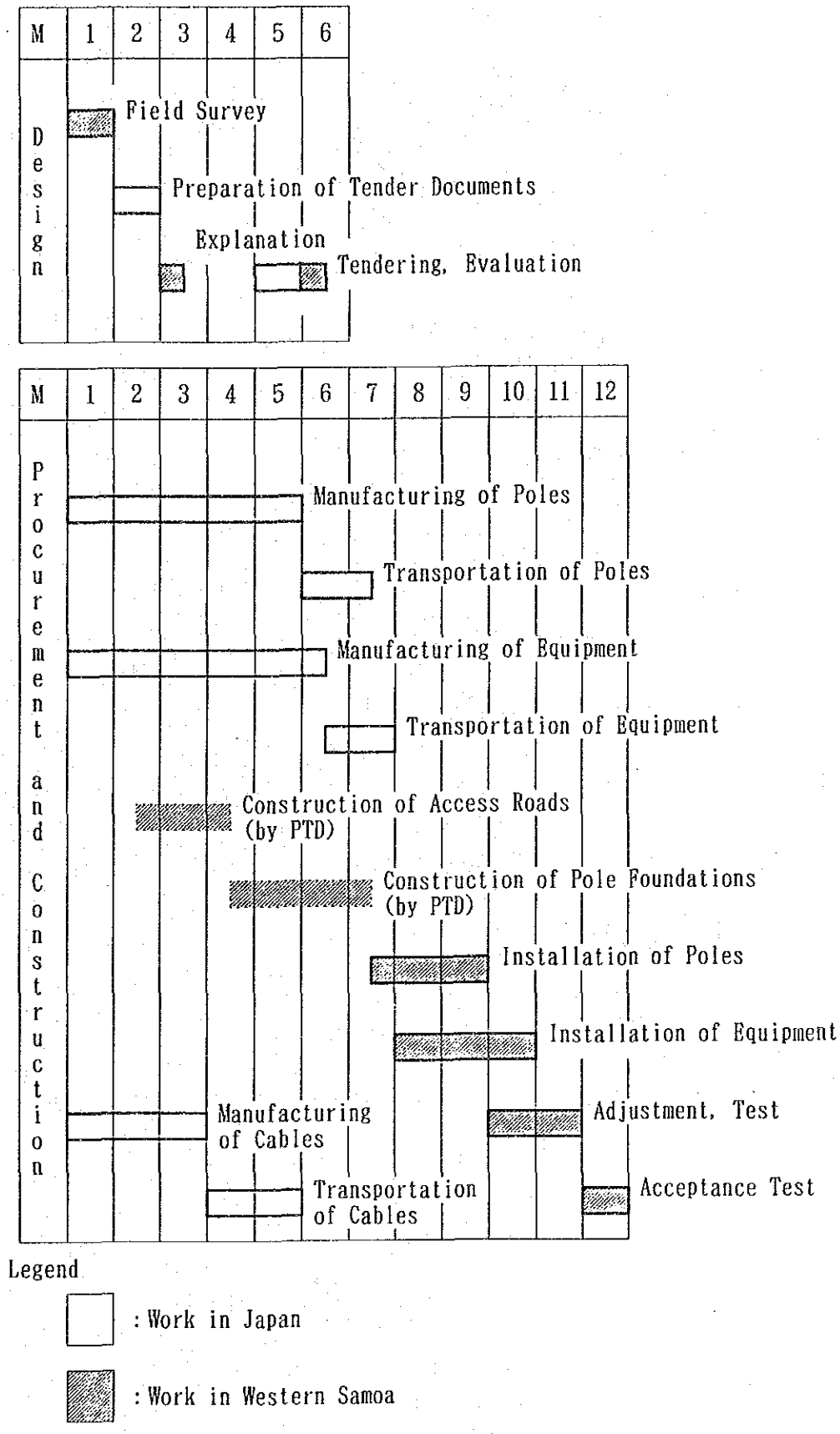


Figure 5-2 Implementation Schedule