社会開発協力部報告書

THE FEASIBILITY STUDY REPORT
ON
KALIMANTAN-SULAWESI SUBMARINE CABLE SYSTEM
IN
THE REPUBLIC OF INDONESIA
(PHASE 1 STUDY)

VOLUME I

MARCH, 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Republic of Indonesia, the Japanese Government has decided to conduct a study on the Kalimantan-Sulawesi Submarine Cable Project and entrusted the study to the Japan International Cooperation Agency (JICA).

The JICA sent to Indonesia a study team headed by Mr. Seiichiro KAMIMURA, the Nippon Telecommunications Consulting Co., Ltd. from August 17 to November 4, 1987 and January 25 to February 7, 1988.

The team exchanged views on the Project with the officials concerned of the Government of Indonesia and conducted a series of field surveys. After the team returned to Japan, further studies were made and the present report has been prepared.

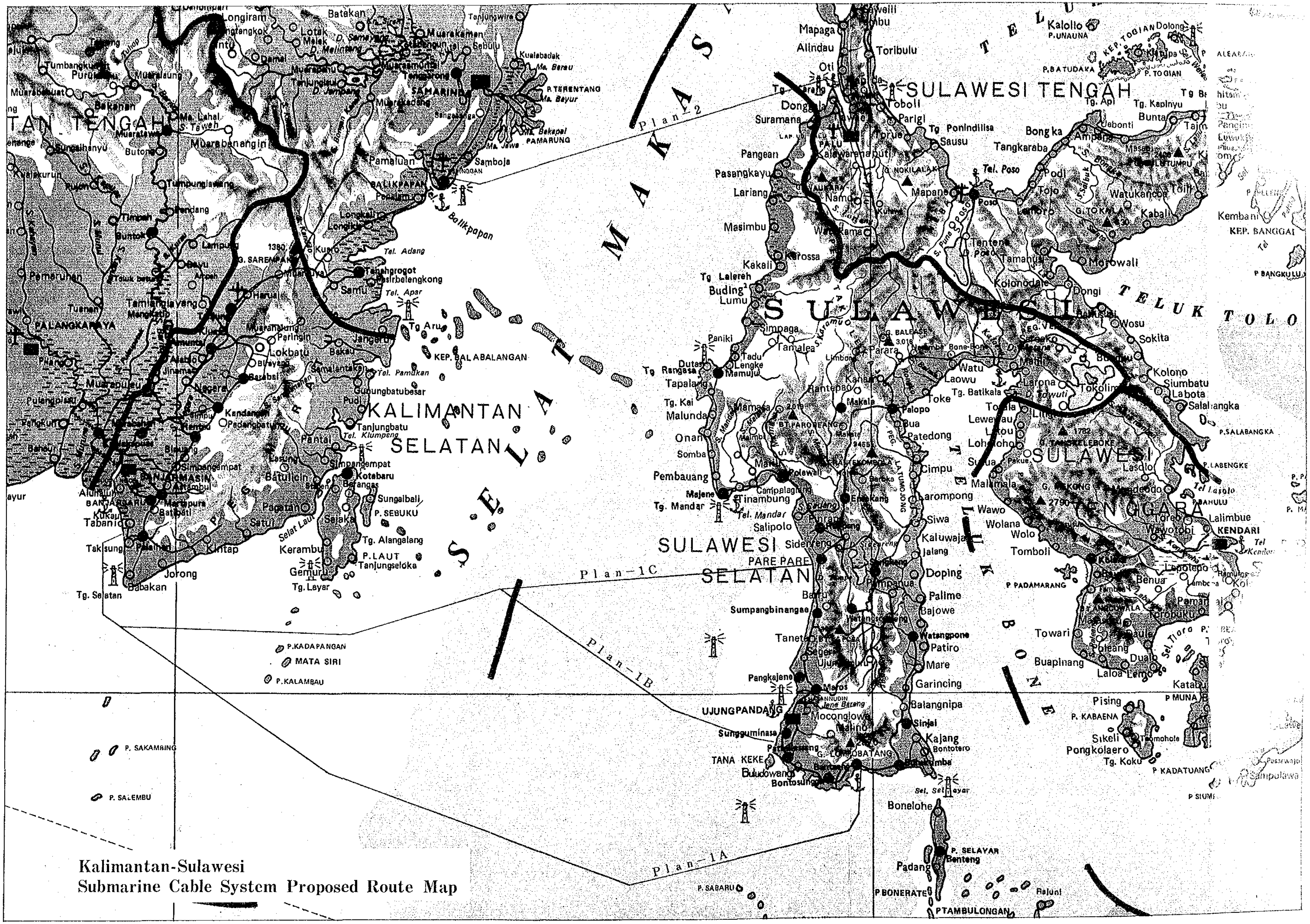
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the team.

March, 1988

Kensuke Yanagiya

Kensuke YANAGIYA
President
Japan International Cooperation Agency



Kalimantan-Sulawesi
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The Republic of Indonesian is proceeding with digitalizing national transmission system and exchanges aiming at constructing the ISDN. As a part of the program, in Sulawesi island, with digitalization of exchanges now underway construction of Trans-Sulawesi Digital Microwave Radio Network is planned in the 5th Five-year Plan.

As part of the said telecommunications development planning, it is now being planned, in the 5th Five-year Plan, to expand digital telecommunication network by means of connecting digital telecommunication networks in Kalimantan and Sulawesi islands with submarine cable.

The Republic of Indonesia recognizing the importance of the said submarine cable system, and has requested the Japanese Government to conduct the Feasibility Study on Kalimantan - Sulawesi Submarine Cable System (hereinafter referred to as "the Study").

The purpose of the Study is to examine the feasibility of the plan to construct the submarine cable system between Kalimantan and Sulawesi in the final target year 2019.

The Study is divided into two phases. That is, Phase-1 to mainly aim at selection of submarine cable route and its feasibility study and Phase-2 to aim at ocean survey. This report covers the rseult of Phase-1.

2. DEMAND AND TRAFFIC FORECASTS, TRAFFIC ROUTING, AND CIRCUITS CALCULATION

2.1 Methods for Demand Forecast, Traffic Estimate and Circuits Calculation

As to the demand forecast, traffic estimate and circuits calculation, the same method employed in the following JICA Studies were adopted in principle:

(1) Long-term Planning for Development of Telecommunication System (Master Plan) JICA 1987

(2) Fundamental Study on Rural Telecommunications Network (Rural Study) JICA 1987

(3) Trans-Sumatra Terrestrial Digital Transmission System (Sumatra Micro) in progress

2.2 Demand Forecast

In the Study, as in (3) above, "Sumatra Micro", a GDP growth of five (5) percent per annum and Supply Plan (demand fulfillment plan)-2 are adopted as conditions for demand forecast, which is the main plan. However, as an alternative plan, a forecast with a GDP growth of three (3) percent per annum and Supply Plan-1 is also made, and a comparison is made between the two forecasts.

Main Plan: GDP 5%, Supply Plan-2
Alternative Plan: GDP 3%, Supply Plan-1

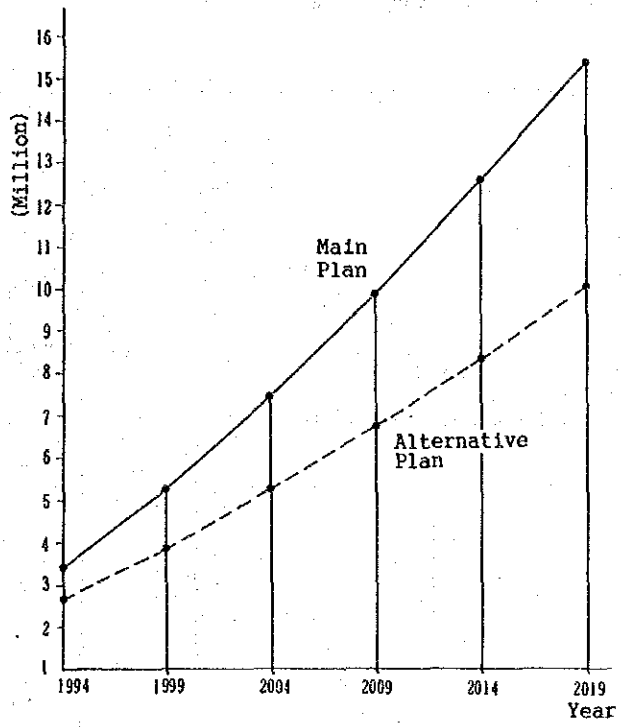
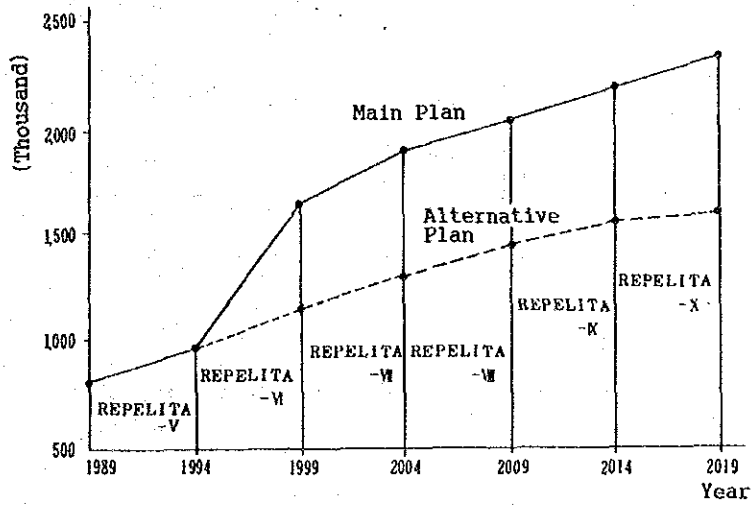


Figure S-1 Outline of Demand Forecast

2.3 Supply Plan

Supply plan for the above estimated demand is as follows.



* 1994 figures is based on the PERUMTEL, REPELITA-V Program (draft).

Figure S-2 Outline of Supply Plan

2.4 Demand Forecast for Nontelephone

Demand for nontelephone is as follows.

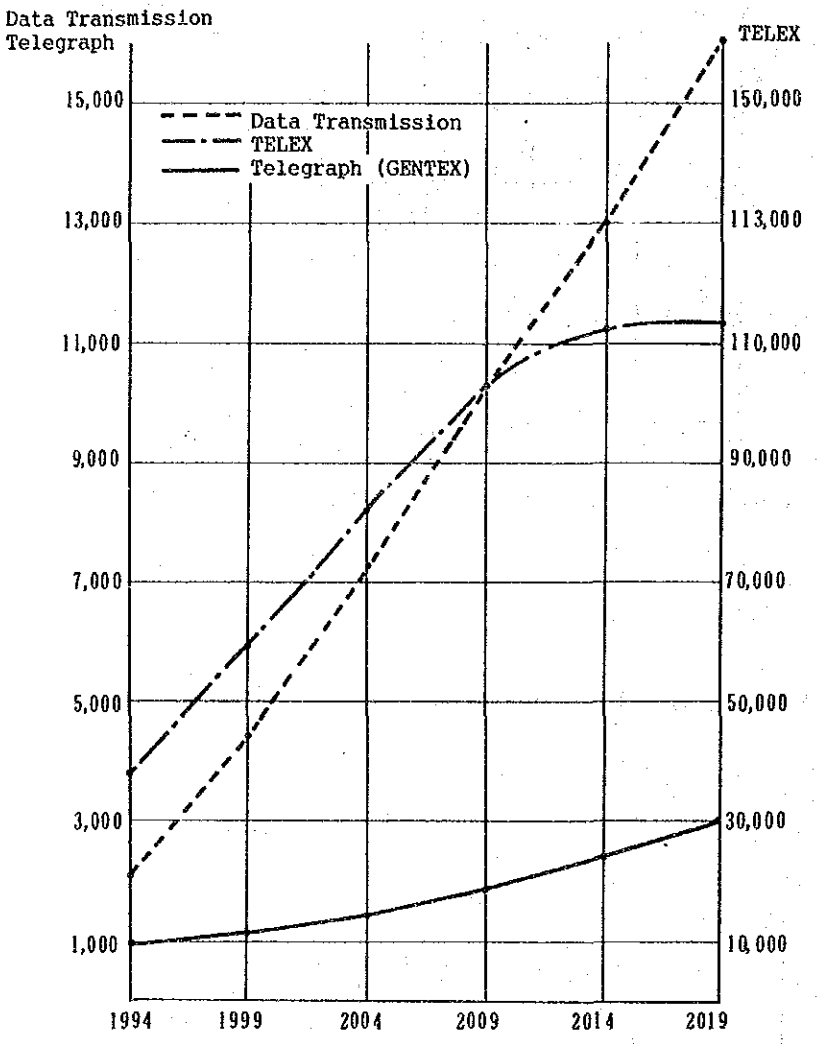


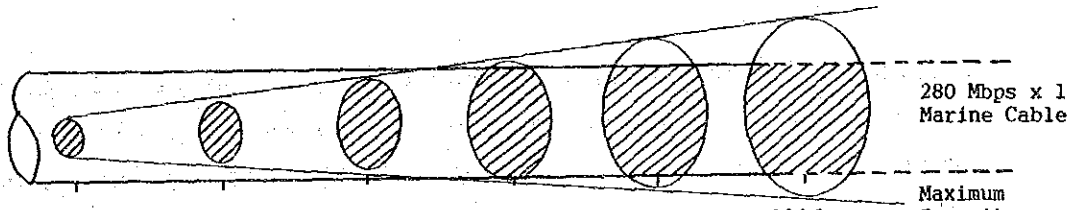
Figure S-3 Outline of Demand Forecast

2.5 Traffic Forecast and Traffic Routing

The method of traffic forecast is also based on the aforementioned "Sumatra Micro". In terms of telecommunication network hierarchy, this submarine cable system will be the backbone trunk transmission system that connects Kalimantan with Sulawesi's TC (Tertiary Center); therefore, the system's terminal stations are both the Banjarmasin and the Ujung Pandang TCs.

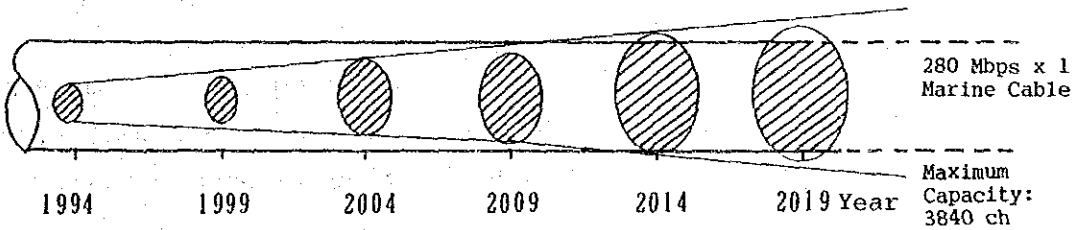
2.6 Circuits Calculation

The necessary circuits are calculated as follows.



	1994	1999	2004	2009	2014	2019
Needed Circuits	778	1,971	3,614	4,390	5,126	6,124

Figure S-4 Outline of Circuits Calculation (Main Plan)



	1994	1999	2004	2009	2014	2019
Needed Circuits	778	1,729	2,956	3,156	4,096	4,838

Figure S-5 Outline of Circuits Calculation (Alternative Plan)

3. CONDITION OF JAWA SEA

3.1 Condition of Geology

In terms of the structure of the earth's crust, Indonesia is placed on the Eurasian Plate, and the Australian Plate from the south and the Pacific Plate from the west are pushing each other around there; therefore, earthquakes due to movements in the earth's crust are frequent, and also there are many volcanoes. The occurrence of earthquakes concentrates around the Jawa Trench where the Australian Plate is sinking and in the northeastern part where the Pacific Plate is pressing forward.

3.2 Earthquakes

According to the seismic danger map of the world seismic activity zones, the north area of Sulawesi is listed among strong earthquake zones. Particularly, there is an active fault stretching from northwest toward southwest near the neighborhood of Palu, and many earthquakes with a magnitude of more than 4 on the Richter scale are frequent.

3.3 Fishing Activities

Trawling that may possibly give damages to submarine cables is prohibited by law, and generally small-scale fishing like pole-and-line fishing is most popular.

3.4 Shipping Activities

Although there are important ports, such as Banjarmasin, Balikpapan, Ujung Pandang, Pare Pare, Palu, on the route of this submarine cable construction plan, it does not seem that ships entering and leaving each port will give a direct damage on the submarine cables, because all the proposed submarine cable landing points were selected in places located away from those ports.

3.5 Marine Petroleum Development

Developing submarine petroleum is active, especially in the vicinity of Balikpapan.

3.6 Mine-perilous Sea Area

There still exists an sea area near Ujung Pandang where mines land during World War II have not been get rid cf. Since the marine cable route (Plan-1B) is recommended in the this report, it is necessary to detect mines by a magnetic survey and confirm their locations, and shift the cable route for a safe distance or adopt other construction method than to lay them under the seabed so that the danger can be avoided.

4. SYSTEM'S BASIC DESIGN

4.1 Optical Fiber Submarine Cable System

A. Optical fiber submarine cable system with a wavelength of 1.3 μm is to be used.

B. (280 Mbps x 1) system is to be used.

4.2 Backhaul System

For the backhaul system,

1) Digital Microwave Radio System
2) Optical Fiber Cable System

are to be considered, and for each submarine cable route, economically and technically most suitable system has been designed.

5. SELECTING OF THE OPTIMUM SUBMARINE CABLE ROUTE

5.1 Proposed Routes Submarine Cable

The following routes were compared for the Kalimantan - Sulawesi's submarine cable system.

Plan-1A:

Banjarmasin (Takisung) - Bantaeng (Lamalaka) route

Plan-1B:

Banjarmasin (Takisung) - Ujung Pandang (Balang) route

Plan-1C:

Banjarmasin (Takisung) - Pare Pare (Bojo) route

Plan-2:

Balikpapan (Lemaru) - Palu (Towaja) route

( ) shows proposed landing points.

5.2 Comparison Items and Status-quo of Each Route

The items that were compared among the routes for selecting the optimum submarine cable route, and the status-quo of each route are outline in Table S-1.

5.3 Financial, Economic Analysis Among Routes

Although the optimum submarine cable route is to be selected based on the above environmental conditions, financial and economic analysis were further made with each proposed route as shown in Table S-1.

5.4 Assessment of Each Route

In selecting the optimum submarine cable route, a marking method is adopted, in which 1 point for (no problem) or 0 point for (not preferable) is given to each item of the following environmental conditions. The marking is shown below.

	Plan-1A	Plan-1B	Plan-1C	Plan-2
Landing Points	9	11	8	7
Planned Route	4	4	5	5
Backhaul System	1	1	2	1
Technical Points	14	16	15	13
Evaluation	(3)	(1)	(2)	(4)

For reference, ranking in financial and economic comparison is shown below.

	Plan-1A	Plan-1B	Plan-1C	Plan-2
Financial and Economic Comparison	3	1	2	4

As the result of this assessment, Plan-1B has been selected as the optimum submarine cable route.

Table S-1 Comparison among Submarine Cable Routes

A (Comparison among Landing Points)

	Plan-1A				Plan-1B		Plan-1C		Plan-2			
	Takisung		Lamalaka		Balang		Bojo		Lemaru		Towaja	
Sandy Beach	1	Much sand accumulation	0	Thinly accumulated plumstone	1	Much sand accumulation	0	Exposed rock bed	0	Exposed rock bed	0	Pebbly beach, not much sand
Drift Sand	0	Much	0	Much	1	No drift sand	0	Much	0	Much	0	Much
Harbor Facility	1	Nil more than 50 km away	1	Nil more than 50 km away	1	Nil more than 20 km away	1	Nil about 5 km away	1	Nil more than 20 km away	1	Nil more than 20 km away
Site for Buildings	1	Yes	0	Narrow	1	Yes	0	Narrow	1	Yes	1	Yes
Roads Condition	1	Paved road	1		1	Unpaved road	1	Paved road	1	Unpaved roads	0	About 0.5 km to a road
Dwelling Environment	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad
Commercial Power Source	0	Unstable	1	Yes	0	Nil	0	Yes, unstable	0	Nil	0	Nil
Total		(9)				(11)		(8)				(7)

B (Comparison among Planned Routes)

	Plan-1A		Plan-1B		Plan-1C		Plan-2	
Horizontal Distance	0	772.0 km	0	656.0 km	0	650.0 km	1	330.0 km
Mine-perilous Sea Area	1	---	0	22 km	1	---	1	---
Coral Reefs	0	Yes	0	Yes	0	Yes	1	Nil
Oil Development	0	239 km	0	232 km	0	232 km	0	85 km, in operation
Sea Depth	0	934.0 m	1	1911.0 M	1	2333.0 m	1	2300.0 m
Seabed Inclination	1	1/14	1	1/12	1	1/4	0	1/2
Fishing Activities	1	Small-scaled	1	Same as left	1	Same as left	1	Same as left
Earthquake	1	Not many	1	Same as left	1	Same as left	0	Many, Fault Zone
Total	(4)		(4)		(5)		(5)	

C (Comparison among Backhaul System)

	Plan-1A		Plan-1B		Plan-1C		Plan-2	
System Length	1	145 km	1	93 km	1	267 km	0	1134 km
Existing Facilities	0	JA-KAL System Nothing on Up Side	0	Same as left	1	JA-KAL System TR.Sulawesi M/W	1	BJM-BLK M/W TR. Sulawesi M/W
Total	(1)		(1)		(2)		(1)	

6. PROJECT IMPLEMENTATION SCHEDULE

6.1 Guideline of Project Implementation

(1) The whole system is to be a turn-key works by one contractor.

(2) Employment of consultants

(3) Since this project is positioned in REPELITA-V, it should be completed by the end of 1993.

(4) Materials are to be procured locally as much as possible.

(5) Technical assistance for the operation and maintenance of the system by the contractor is to be given for one year.

6.2 Project Implementation Schedule

A project implementation schedule is shown in Table S-2.

6.3 Project Cost Estimate

The initial investment amount and the additional investment amount are shown in Table S-3, in which Plan-2' shows the case where the existing 34 Mbps system is used as the backhaul system between Banjarmasin and Balikpapan on the Balikpapan - Palu route (Plan-2), with the bearer increased.

In comparison, the initial investment amount is the smallest for Plan-1B that was selected as the optimum route.

Table S-2 Line Schedule of Project Implementation

Item \ Year / Quarterly	1989				1990				1991				1992				1993				1994			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1. Conclusion of Loan Agreement			▼																					
2. Approval of Consultant Contract				▼																				
3. System Design, Survey and Preparation of Tender Document					———	———	———																	
4. Bidding and Evaluation						———	———	———																
5. Approval of Suppliers Contract							———	———																
6. Equipment Manufacturing (Including Detailed Design and Survey)								———	———	———	———	———	———	———										
7. Shipment and Installation										▽ 1st Shipping	———	———	———	———	———									
8. Approval of Test																———								
9. Service-in																	▼							
10. Assistant Service for Operation and Maintenance																	———	———	———	———				
11. Building Construction by PERUMTEL								———	———															

Table S-3 (1/2) Project Cost (Initial Investment Amount)

(Million yen, million Rp.)

	Plan-1A		Plan-1B		Plan-1C		Plan-2		Plan-2'	
	Japanese currency	Domestic currency	Japanese currency	Domestic currency	Japanese currency	Domestic currency	Japanese currency	Domestic currency	Japanese currency	Domestic currency
1. Materials & Equipment Cost Total	6807	0	5755	0	5891	0	6604	0	6184	0
2. Construction Cost Total	1956	1534	1622	1543	1620	2333	1705	6065	1396	3077
3. Consultant Cost	368	321	310	322	315	487	349	1267	318	643
4. Contingency	365	146	308	147	313	223	346	579	316	294
5. Total (1+2+3+4)	9496	2001	7995	2012	8139	3043	9004	7911	8214	4014

Table S-3 (2/2) Project Cost (Interim Investment Amount)

(Million Rp.)

	Plan-1A	Plan-1B	Plan-1C	Plan-2	Plan-2'	
					Kalimantan Side	Sulawesi Side
Increasement Investment	1998: 342	Same as left	Same as left	Same as left	-	1998: 342
Renewal Investment	2008: 7036	2008: 5050	2008: 9327	2008: 38,760	1998: 19,746 2013: 19,404	2008: 19,699

7. FINANCIAL AND ECONOMIC ANALYSIS

7.1 Method of Analysis

The feasibility on the System and Investment Schedule was examined by the following:

(1) Financial Internal Rate of Return (FIRR)

(2) Economical Internal Rate of Return (EIRR)

7.2 Alternative Plan

The following plans were examined financially and economically:

(1) Each Proposed Submarine Cable Route

Plan-1A
Plan-1B
Plan-1C
Plan-2

(2) Plan-2': Alternative plan of Plan-2, using 34 Mbps existing microwave radio system as backhaul system

(3) Comparison of (280 Mbps x 1 System) and (280 Mbps x 2 System)

(4) Sensitivity analysis for Plan-1B

In case of ±10% Revenue or Expenses

(5) Pessimistic case of Demand Growth (GDP: 3%, Supply Plan-1)

The results of the calculations for the above alternative plans are shown in Table S-4.

Table S-4 List of Calculation Results

	Case	EIRR	FIRR	
1	Plan-1A	18.39%	16.72%	Comparison among routes
2	Plan-1B	20.08%	18.14%	
3	Plan-1C	19.67%	17.85%	
4	Plan-2	17.59%	15.87%	
5	Plan-2'	18.30%	16.46%	Alternative plan for Plan-2
6	Plan-1B (GDP 3% Case)	17.48%	15.80%	Pessimistic alternative plan for Plan-1B
7	Plan-1B (REVENUE +10%)	21.14%	19.18%	Sensitivity analyses
8	Plan-1B (REVENUE -10%)	18.81%	17.01%	
9	Plan-1B (Cost +10%)	18.93%	17.09%	
10	Plan-1B (Cost -10%)	21.30%	19.30%	
11	280 Mbps x 2	20.03%	18.21%	Alternative plan of 280 Mbps

7.3 Evaluation on the Result

(1) IRR

A. From the view point of Financial Condition, it is regarded that Plan-1B with more than 18% IRR is the most effective.

B. EIRR for each cost is approximately 2% higher than FIRR. Consumer surplus of the System is regarded as big enough.

C. According to the result of Sensitivity Analysis for Plan-1B, FIRR in the pessimistic case is calculated to more than 17%. It means for the Project to be durable.

D. Because of big additional investment for the backhaul system, Plan-2 and 2' indicate the lower benefit curve.

E. According to the Sensitivity Analysis of Plan-1B, the total revenues of GDP 3% case and Revenue -10% case are Rp.8300 and 8600 x 10^8, respectively. Even if such total revenue is different each other, FIRR of GDP 3% case is too small. This means the difference of Revenue Curve between both cases.

(2) Financial Comparison

A. According to Balance Sheet for Plan-1B, yearly benefit from 3 years after commencement (1997) and accumulate benefit from 7 years after commencement (2000) will come profitable. The stable benefit will be expected by 2019.

B. According to the balance sheet of Plan-1B, the financing will be difficult during 2 years after commencement due to increment of interest payment. However, after that, the short term loan is not to be scheduled. In addition to that, the additional investment for the backhaul system will be covered by the internal reservation fund.

C. Assets for the System is calculated as follows:

(Billion Rp.)

	1993	2003	2018
Assets			
Liquid assets	0	71	509
Fixed assets	116	55	2
Total	116	126	511
Liabilities			
Liquid liabilities	0	11	0
Fixed liabilities	114	46	0
Total	114	57	0
Equity			
Paid-in capital	2	2	2
Retained earning	0	67	509
Total	2	69	511
Liabilities, Equity	116	126	511

D. As the result of the financial evaluation, Plan-1B is regarded as "Feasible".

(3) Economic Evaluation

For Plan-1B which is regarded as the most feasible case by financial evaluation, the influence on national industry and economy by the cost which is consumed within Indonesia was measured by economic analysis model.

A. By implementation of the Project, increment of Provision Investment and Public Consumption are Rp.30 x 10^8 and Rp.30 x 10^8, respectively. Therefore, net income of the System is estimated as Rp.40 x 10^8, because the project cost is Rp.70 x 10^8.

B. According to the activity of national economy, Import will be increased to approximately Rp.60 x 10^8. Therefore, GDP increment by the Project will be decreased to Rp.50 x 10^8.

C. In comparison with the industrial induction, it will be reached to Rp.100 x 10^8. Therefore, to increment of employment opportunity will be 11,000 persons by the Project.

8. CONCLUSION AND RECOMMENDATION

The System can be said to be quite feasible according to the Study.

Therefore, implementation of the project through Plan-1B route is recommended during REPELITA-V.

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1. BACKGROUND

The Republic of Indonesia intends to complete its ISDN (Integrated Services Digital Network), by the year 2000 and thus has been directing its efforts to digitalize its transmission routes and exchanges in its IV-th (1984-1989), V-th (1989-1994), VI-th (1994-1999) and VII-th (1999-2014) Five-year Telecommunications Development Plans. And as part of this digital telecommunications network expansion for the V-th Five-year Plan (REPELITA-V), the digital telecommunication networks in Kalimantan and Sulawesi islands will be connected by submarine cable.

In Kalimantan, the digital microwave radio network between Banjarmasin and Balikpapan having been completed, further construction of a digital microwave radio network between Banjarmasin and Pontianak is being planned.

The Jawa-Bali digital network connected to the capital city of Jakarta will be connected further to the "Surabaya - Banjarmasin Submarine Cable System" which is now being built. Therefore, with the construction of the "Kalimantan - Sulawesi Submarine Cable System", digital communication from the capital city of Jakarta will expand to Sulawesi.

In Sulawesi island, digitalization of exchanges is now under way. And construction of the Trans-Sulawesi Digital Microwave Radio Network is planned for the V-th Five-year Plan. Therefore, once the "Kalimantan -

Sulawesi Submarine Cable System" (called "The System"), is completed, the National Digital Telecommunications Network (includes Sulawesi island), also, would have been completed.

The Republic of Indonesia recognizes the importance of the said submarine cable system and thus, intends to complete the "Kalimantan - Sulawesi Submarine Cable System" within its V-th Five-year Plan. Therefore, it has requested the Japanese Government to make a Feasibility Study of the Kalimantan - Sulawesi Submarine Cable System (called "the Study"). Consequently, in response, the Japanese Government sent in March 1987, a preliminary survey group through the Japan International Cooperation Agency (called "JICA").

The Group consulted with the Indonesian Government about the Scope of Work relative to the Study. Accordingly, information and reference material data needed to plan and map out the Study were gathered.

The Scope of Work (Appendix 1), is organized into two phases: Phase-1 aims mainly at selecting the submarine cable route and its feasibility study, and Phase-2 aims at ocean surveying. This report deals with the results of Phase-1.

The Japanese Government, on 17th August, 1987, sent the Survey Team, through JICA, for the Study.

Based upon the Scope of Work previously agreed upon and signed, the JICA Survey Team conducted an on-site survey between 17th August and 4th November 1987, and examined the information and data collected therein. Preparing

the Interim Report on the results of study and examination, consultative meetings were held with the Indonesian Agencies concerned.

Thereafter, further examination was made in Japan, and a draft of the Final Report was then prepared.

2. OBJECTIVE AND SUMMARY

2.1 Objective

The objective of Study is to examine the feasibility of the Kalimantan - Sulawesi Submarine Cable System in Indonesia with the year 2019 targeted as the final year of completing the system.

2.2 Scope

The Scope of Study entails a Feasibility Study of the Kalimantan - Sulawesi Submarine Cable System according to the Scope of Work agreed upon and signed 17th March 1987 and to the Minutes of Meetings, Phase-1 portion.

2.3 Summary

2.3.1 Regions for Study

The regions for Study, besides the Kalimantan and Sulawesi islands, include other regions involved in this submarine cable project.

2.3.2 Contents

This study comprises on-the-spot surveying, data and information gathering (both in Japan and Indonesia), and collected data and information analyzing.

Contents of Study include:

(1) Preliminary Study in Japan

Using the results of the preliminary survey conducted by JICA in March 1987, an Inception Report was prepared after examining the objectives, plans, organizations, procedures, and man-power schedules.

(2) Field Survey

1) Collection and analysis of data and information

2) Field survey of landing points for the Submarine Cable

3) Map survey of the submarine cable route on the Nautical Chart

4) Selection of the submarine cable route

5) Basic design of the submarine cable system

6) Basic design of the backhaul system

7) Estimation of the project cost

8) Analysis of economy and financing

9) Preparation of the implementation plan

The Interim Report was prepared according to the result of analysis, after explanations and discussions with the Indonesian Agencies concerned.

(3) Works done in Japan

A Draft Final Report was organized after further study in Japan, using the results of explanations and discussions incorporated in the Interim Report.

Finally, Final Report was prepared and presented using the results of explanations and discussions on the Draft Final Report.

3. SURVEY GROUP AND SURVEY SCHEDULE

3.1 Survey Group Composition

3.1.1 Preliminary Survey Team

Name	Responsibility	Agency & Position
Haruo AZAMI	Leader	Special Advisor International Cooperation Division, Ministry of Posts and Telecommunications
Kouji NOGUCHI	Submarine Cable System	International Cooperation Division, Ministry of Posts and Telecommunications
Keiichi KUSAWAKA	Radio System	Frequency Sect., Radio Div., Telecommunication Bureau, Ministry of Posts and Telecommunications
Shigeo YAMAMOTO	Ocean Survey	Assistant to Director Submarine Cable Systems Dept., Kokusai Denshin Denwa Co., Ltd. (KDD)
Ryutaro TOTSUKA	Coordinator	Second Development Survey Division, Social Development Cooperation Dept., Japan International Cooperation Agency (JICA)

3.1.2 Survey Team Composition

(1) Advisory Committee

Name	Responsibility	Agency & Position
Haruo AZAMI	Chairman	Special Advisor International Cooperation Division, Ministry of Posts and Telecommunications
Toshiaki KONTA	Member (Terrestrial System)	Frequency Sect., Radio Dept., Telecommunications Bureau, Ministry of Posts and Telecommunications
Shigeo YAMAMOTO	Member (Ocean Survey)	Assistant to Director Submarine Cable Systems Dept., Kokusai Denshin Denwa Co., Ltd. (KDD)
Akira NAGAI	Member (Submarine Cable System)	Cable Planning Division, Submarine Cable Systems Department, Kokusai Denshin Denwa Co., Ltd. (KDD)
Ryutaro TOTSUKA	Member (Coordinator)	Second Development Survey Division, Social Development Cooperation Dept., Japan International Cooperation Agency (JICA)
Kazuaki HAYASHI	Member (Coordinator)	Senior Officer System Development and Data Processing Div., General Affairs Department, Japan International Cooperation Agency (JICA)
Michio KANDA	Member (Coordinator)	Head Second Development Survey Division, Social Development Cooperation Dept., Japan International Cooperation Agency (JICA)

(2) Study Group

Name	Responsibility	Agency & Position
Seiichiro KAMIMURA	Surey Leader and Backhaul System Design	Senior Engineer Telecommunication Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Ryushi SUENAGA	Assistant Survey Leader and Network Planning	Deputy Manager Marketing Department Telecommunications Divisions (NTC)
Noboru MIHARA	Radio Link Planning	Senior Engineer Telecommunications Divisions (NTC)
Iwao IWAMOTO	Submarine Cable System	Senior Engineer Telecommunications Divisions (NTC)
Shigeyoshi YOSHIDA	Submarine Cable System	Engineer Ocean Survey Department Rinkai Ocean Survey Co., Ltd. (ROS)
Shigeru KIMURA	Economic Financial Analysis	Economist Century Research Center Co., Ltd. (CRC)

3.1.3 Indonesian Government Agencies Concerned and Participants

The requesting Agency for the Study and the operating Agency of the System are Direktorat Jenderal Pos Dan Telekominikasi (called "POSTEL") and Perusahaan Umum Telekomunikasi (called "PERUMTEL").

The participants from POSTEL/PERUMTEL and the names of other Agencies involved appear in Table 1-1.

3.2 Survey Itinerary

The initieary of the survey is shown in Table 1-2.

Table 1-1 Indonesian Governmental Agencies Concerned and Members Participating (1/2)

1. POSTEL	
Ir. Rollin	Deputy Director General
Mr. R.I. Soemardi Bc.T.T.	Director of Planning (Former)
Ir. Sri Slamete	ditto
Mr. Tjaroso Bc.T.T.	Director of Engineering
Ir. Koesmarihati Sugondo	Planning Division
Ir. Tanti Dewi S.	ditto
Mr. Samlawi Bc.T.T.	ditto
Drs. Bambang Suseno	ditto
Mr. Soedarpo Bc.T.T.	Engineering Division
Mr. Sukarso Bc.T.T.	ditto
Mr. Soeharsono Bc.T.T.	Operation Division
Mr. Benyamin Sura Bc.T.T.	ditto
Mr. Rachmat W. Bc.T.T.	ditto
Mr. H.V.R. Saragih Bc.T.T.	ditto
2. POSTEL	
(1) BANDANG	
Ir. Syonan Sembiring	Chief of Terrestrial Transmission Planning
Mr. Nurman Burhan Bc.T.T.	Terrestrial Transmission Planning
Ir. Imam Soebekti	ditto
Ir. Tjahjono Djatmiko	ditto
Mr. Sugeng Winarto	ditto
Mr. Usman Azroni B.S.c.	ditto
Mr. Maman	ditto
Mr. Nono Leksono	ditto
Ir. Lumumba Sirait	System Engineering Planning
Ir. Indro Wuryanto	ditto
Ir. Undang Sudirman	ditto
Mr. Hari Purnomo M.S.c. Bc.T.T.	Chief of Traffic Planning
Mr. Gutomo Gandjar Bc.T.T.	Traffic Planning
Ir. Yaya Wahya	ditto
Mr. R.E. Sudradjat Bc.T.T.	Exchange Planning
Mr. Indro Wuryanto Bc.T.T.	ditto
Mr. Suyanto Bc.T.T.	ditto
Mr. Agus Nursjamsah Bc.T.T.	ditto
(2) WITEL	
WITEL IX	Mr. Soegiyano
	Mr. Pudjadi Slamat (Banjarmasin MW)
	Mr. Suradi
	Mr. Kodrat (Balikpapan MW)
WITEL X	Mr. Soeharto, Bc.T.T.
	Mr. Bambang
	Mr. Yasuf Adjam (Ujung Pandang MW)
	Mr. Bunjin (Palu Station)

Table 1-1 Indonesian Governmental Agencies Concerned and Members Participating (2/2)

3. Other Authorities

Banjarmasin

1. WITEL XI
2. Direktorat Jenderal Permbungan Laut Kantor Wilayah V
3. Pemerintah Propinsi Daerah Tingkat I Kalimantan Selatan Dinas Perikanan
4. Pemerintah Propinsi Daerah Tingkat I Kalimantan Selatan Badan Perencanaan Pembangunan Daerah (BAPPEDA)
5. PERUTAMINA Bnajarmasin Branch Office

Ujung Pandang

1. WITEL X
2. Direktorat Jenderal Permbungan Laut Kantor Wilayah VI
3. Pemerintah Propinsi Sulawesi Selatan Dinas Perikanan
4. Pemerintah Propinsi Sulawesi Selatan Badan Perencanaan Pembangunan Daerah (BAPPEDA)

Table 1-2 Study Itineary (1/3)

Date	(Leader, Submarine Route, System)	Network Planning & Economist
	Description	Description
1987		
Aug. 17	Tokyo to Jakarta	Same as at left
18	Meeting with POSTEL	"
19	Jakarta to Bandung	"
20	Meeting with PERUMTEL	"
21	Internal Meeting	"
22	Meeting with PERUMTEL	"
23	Bandung to Jakarta	"
24	Meeting with POSTEL	"
25	Data Arrangement	"
26	"	"
27	"	"
28	"	Jakarta to Tokyo
29	Internal Meeting	Arrive at Tokyo
30	Jakarta to Banjarmasin	
31	Meeting with WITEL	
Sep. 1	Survey (Banjarmasin)	
2	Survey (Kalamaian,Takisung)	
3	Banjarmasin to Balikapapan	
4	Survey (Balikpapan)	
5	Survey (CLP)*	
6	Balikpapan to Banjarmasin	
7	Data Arrangement	
8	Banjarmasin - Ujung Pandang	
9	Survey (Ujung Pandang)	
10	Ujung Pandang to Palu	
11	Survey (Palu)	

* CLP: Cable Landing Point

Table 1-2 Study Itineary (2/3)

Date	(Leader, Submarine Route, System)	Network Planning & Economist
	Description	Description
1987		
Sep. 12	Data Arrangement	
13	Survey (Palu)	
14	Palu to Ujung Pandang	
15	Survey (Ujung Pandang)	
16	Same as above	
17	Ujung Pandang to Pare Pare	
18	Survey (CLP)	
19	Pare Pare to Ujung Pandang	
20	Internal Meeting	
21	Meeting with WITEL	
22	Internal Meeting	
23	Ujung Pandang to Jakarta	
24	Arrive at Jakarta	Tokyo to Jakarta
25	Data Arrangement	Same as at left
26	"	"
27	Jakarta to Bandung	"
28	Office Arrangement	"
29	Preparation of Interim Report	"
30	"	"
Oct. 1	"	"
2	"	"
3	"	"
4	"	"
5	"	"
6	"	"
7	"	"
8	"	"
9	"	"

Table 1-2 Study Itineary (3/3)

Date	(Leader, Submarine Route, System)	Network Planning & Economist
	Description	Description
1987		
Oct. 10	Preparation of Interim Report	Same as at left
11	"	"
12	"	"
13	"	"
14	"	"
15	"	"
16	"	"
17	"	"
18	"	"
19	"	"
20	"	"
21	"	"
22	"	"
23	"	"
24	"	"
25	"	"
26	"	"
27	"	"
28	Internal Meeting	"
29	Meeting with PERUMTEL	"
30	Data Arrangement	"
31	Data Arrangement	"
Nov. 1	Bandung to Jakarta	"
2	Meeting with POSTEL, JICA, Japan Embassy	"
3	M/M Signature	"
4	Arrive at Tokyo	

CHAPTER 2 GENERAL

CHAPTER 2 GENERAL

1. TELECOMMUNICATION STATUS-QUO IN INDONESIA

1.1 General

Public telecommunication services in Indonesia include Domestic Terrestrial Telecommunications (also domestic satellite networks), and International Telecommunications administered and controlled by POSTEL. This Inner Organization of the Ministry of Tourism and Posts & Telecommunications has operations done by PERUMTEL at PT. INDOSAT. Likewise, domestic marine communication is handled by the Direktorat Jenderal Permbungan laut, an Inner Organization of the Ministry of Transportation.

Available today, for both domestic and international communications are the telephone, telegraph, telex, packet data communication, mobile telephone (only in limited areas in the country) and various leased circuit services.

The telephone penetration rate of as low as 0.3/100 (1985), is considered to be lower than those of the other ASEAN countries. Public Coin Telephones are installed only in some of bigger hotels.

Indonesia has a geographical area almost the same size as that of the United States of America; expanding 5000 km from west to east and 1800 km from north to south, with 14,000 islands.

Faced with the urgent need for a domestic telecommunication network configuration to connect these islands, the Indonesian Government promoted domestic telecommunications, using a domestic communication satellite (PARAPA-A) launched in 1976. Today, 121 satellite earth stations installed throughout the country provide telecommunication services to almost every city in it.

The satellite communication system now provides telecommunication services, using the PARAPA-B1 launched in 1983 and the PARAPA-B2P in 1987.

By introducing satellite communication systems, the telecommunication in Indonesia has made great strides, but because of its limited capacity, it is still impossible to furnish enough transmission channels which would satisfy the yearly increasing telephone demand. Therefore, Indonesia is now expanding its terrestrial transmission networks for bigger capacities along with its satellite communication networks. Both microwave radio systems and submarine cable systems are now being built here and there.

Together with the expansion plan for transmission networks, Indonesia also plans to build ISDN (Integrated Services Digital Network) for telecommunication networks by the year 2000. Both exhanges and transmission routes are now going digital under the IV-th Five-year Telecommunication Development Plan (PELITA-IV: 1984-1989).

1.2 Telecommunication Service Varieties and Status-quo

(1) Varieties

Telecommunication services now available include:

a. Telephone Service

b. Telex Service

c. Telegraph Service

d. Facsimile Service

e. Leased Circuits Service

f. Data Communication Service

g. Mobile Telephone Service

A. Telephone Service

The telephone service is much lower in its penetration rate in ASEAN countries as previously stated, and as indicated below, the number of waiting applicants is increasing yearly. Indonesia plans to increase 1,069,000 L.U. in PELITA-IV; anticipating remarkable improvement when PELITA-IV is completed.

Item \ Year	1981	1982	1983	1984	1985	1986
Subscribers	427,185	475,459	503,253	536,102	591,747	657,882
Number of applicants waiting	66,513	137,953	221,084	307,210	378,245	399,678

B. Telex Service

Indonesia's Telex Service is also lower in penetration rate than in other ASEAN countries. The change in the number of subscribers for each year is shown below.

Item \ Year	1981	1982	1983	1984	1985	1986
Number of Subscribers	6740	8105	9292	10,289	11,299	11,738

The number of telex subscribers will be affected by the increase in number of data service subscribers in the future.

C. Telegraph Service

The number of telegraph calls is increasing yearly because of the low penetration rate of telephone, telex, and facsimile. But, corresponding to the increase in penetration of these services, the number of telegraphs, will not change much. The number of telegraph calls is as shown below.

(x1000)

Item \ Year	1981	1982	1983	1984	1985	1986
Number of Telegraph calls	6921	7142	7861	8429	9087	10,377

D. Facsimile Service and Data Service

Both facsimile and data service show no noteworthy development because both have just started recently. The number of subscribers for data service is about 300 in 1986 (source: BINPROSENTEL, July 25, 1987). This service is anticipated to increase in the future taking over the existing telegraph and telex service.

E. Leased Circuits Service

The demand for leased circuits service also is increasing yearly, but the capacity for lease of local junction circuits as well as toll transmission channels is limited. Therefore, increase in its number is limited.

F. Mobile Telephone Service

Now, this service is provided mainly in JAKARTA. However, it will soon be introduced in other bigger cities as well.

(2) Transmission Network Status-quo

The Indonesian domestic transmission network comprises a terrestrial transmission network and a satellite transmission network.

The terrestrial transmission network consists of radio systems such as Microwave, UHF, VHF and Short Wave and cable systems such as Coaxial Cable, Optical Fiber Cable, and Open Wire Carrier.

The backbone transmission route, now, is mainly an analog microwave radio. The location of the existing backbone microwave radio networks and their economic life appear as in Figure 2-1. Indonesia plans to achieve an ISDN by the year 2000 (final year) gradually through digitalization of all the facilities (excludes subscriber network facilities), and through conversion of the existing analog circuits to new digital circuits.

Following is the construction plan for the main digital transmission systems to be included in the PELITA-IV, now underway:

A. Trans-Sumatra Terrestrial Digital Transmission System

B. Digitalization of the Jawa-Bali Toll Transmission Route

C. Construction of a Digital Microwave Radio System (Banjarmasin - Balikpapan)

D. Surabaya - Banjarmasin Submarine Cable System

Because of the satellite transmission network, using PARAPA-A1 and A2 launched in 1976 and 1977, local bigger cities once considered technically and economically difficult to connect by terrestrial transmission networks are now connectable. Thus, the telecommunications between Sumatra and Irian Jaya ranging 5000 km from west to east, has also become possible, making it possible to TV-broadcast country-wide. (The administrative agency of TV broadcast is the Ministry of Information). Today, telecommunication is by the PARAPA-B1 (launched in

1983) and by he PARAPA-B2P (launched in 1987). Portions of the satellite transmission network are being leased for other Government Agencies as well as for other ASEAN countries.

The domestic satellite earth stations number 121 throughout Indonesia. Itemized, there are 19 of the bigger capacity, 20 of the medium capacity and 82 of the smaller capacity.

(3) Telephone Exchange Network Hierarchy

The hierarchy of the Indonesian domestic telephone exchange network appears in Figure 2-1.

The number of the telephone exchanges is ISC2, TC7, SC33, PC190 and LE453. ISCs are installed in Jakarta, and Medan. And TCs are installed in Jakarta, Surabaya, Medan, Palenbang, Banjarmasin, Ujung Pandang and Ambon.

In the TC and SC exchanges and in some of the PCs, automatic exchanges have been introduced. The automatization rate is about 86% against the number of subscribers. However, manual exchanges with smaller capacities in some of the SC, PC and LE brings about a lower figure of 26% against the number of telephone exchanges.

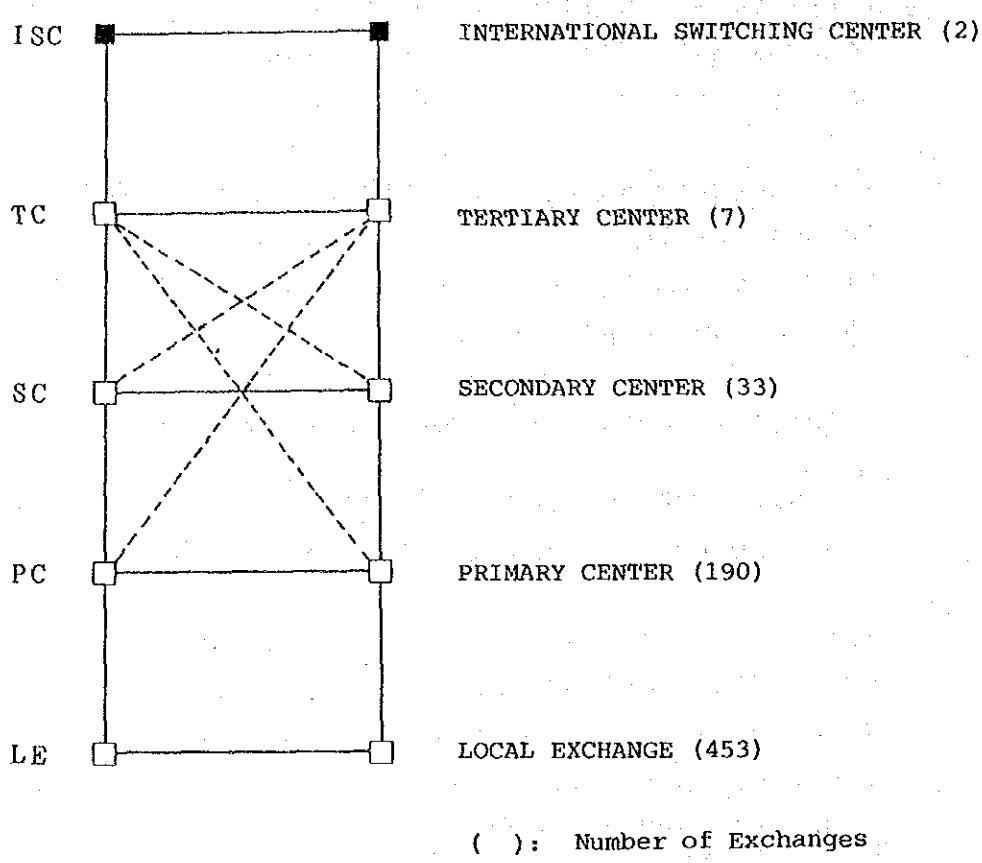


Figure 2-1 Hierarchy of the Indonesian Domestic Telephone Exchange Network

(4) TV Transmission Status-quo

TV broadcast is operated by TVRI (Televisi Republik Indonesia).

The precursor of TVRI was established in 1962 to televise scenes of the Asian Games. In 1963 it became a public corporation and in 1966 it was placed under the Ministry of Information. And, 1976, it started televising in color by PAL System.

The key stations with studios are as shown below. Also, there are about 140 satellite stations.

TVRI Key Station Locations

Region	Location
JAWA	Jakarta, Yogyakarta, Surabaya
SUMATRA	Medan, Palembang
SULAWESI	Ujung Pandang
KALIMANTAN	Balikpapang
BALI	Denpasar

The broadcasting hours is about 60, with most of the broadcast programs compiled and produced in Jakarta. These are relayed by PARAPA satellite through the receiving earth stations (4-GHz band, existing stations are about 50, with about 70 stations now in the planning stage). Local TV stations with facilities for producing local programs, now allocate 2 to 3 hours of country-wide relay programs to their own local programs.

1.3 Telecommunication Services Future Program

1.3.1 Telecommunication Long-term Development Program

With Indonesia's long-term program for telecommunications, there is a "Long-term Planning for Development of Telecommunication Systems" (JICA, 1987), as was approved by POSTEL PERUMTEL.

This Long-term Development Program conforms with the policy of telecommunications by the year 2000 as indicated in the "Strategic Development Plan, Indonesia" published by POSTEL.

With the Long-term Development Program, a telecommunications development plan will be set up at Supply Plan-2. The conditions would be a GDP of 5% and a population of 2%. The present telephone penetration rate of 0.3/100 would then improve by up to 2.54/100 in the year 2004. And by the year 2004 (the end of REPELITA-VII), the ISDN network will have been arranged completely.

1.3.2 Transmission Network Expansion Plan in the Long-term Development Program

The Long-term Development Program is organized every five years from 1984 to 2004.

IV-th Five-Year Telecommunication Development Plan - (PELITA-IV): 1984-1989

V-th Five-Year Telecommunication Development Plan - (REPELITA-V): 1989-1994

VI-th Five-Year Telecommunication Development Plan - (REPELITA-VI): 1994-1999

VII-th Five-Year Telecommunication Development Plan - (REPELITA-VII): 1999-2004

The expansion plan for the transmission network in each Five-Year Plan appears in Figures 2-3 to 2-6. But, for technical reasons, the Eastern Microwave Radio System connecting the Jawa - Bali Microwave Radio System, and the Trans-Sulawesi Microwave Radio System will not be replaced with a digital system from the existing analog. The Eastern Microwave Radio System's economic life will end in 1998. Therefore, without this System, thereafter, telecommunications traffic between (Sulawesi island and islands east of Sulawesi) and (Jawa island and other islands) will exceed the maximum capacity of the System (see Chapter 3). Accordingly, the toll transmission channels must be expanded after the year 2004, by some other media or by some other route, or both.

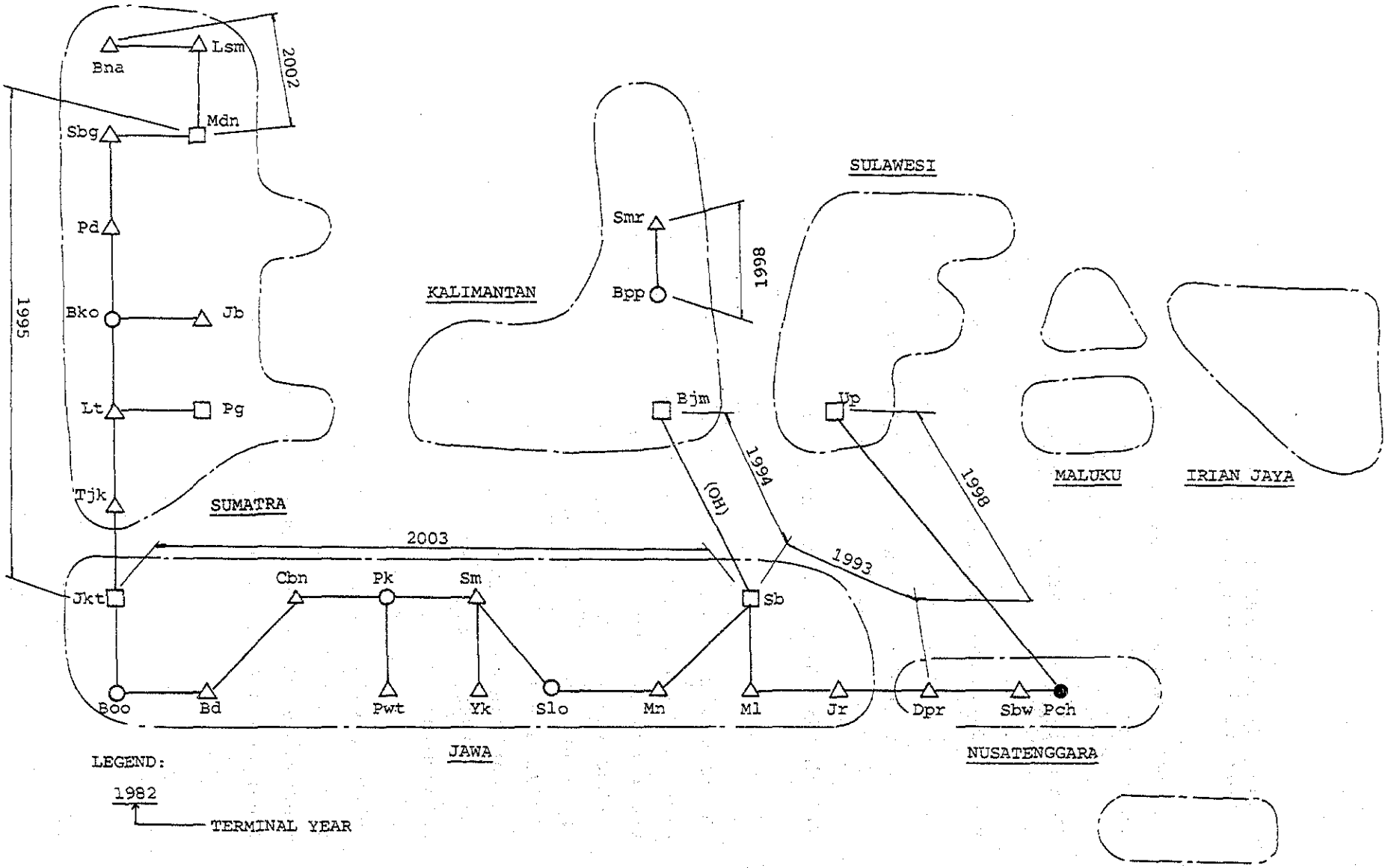


Figure 2-2 Existing Terrestrial SLDD Transmission Routes and Their Economic Life

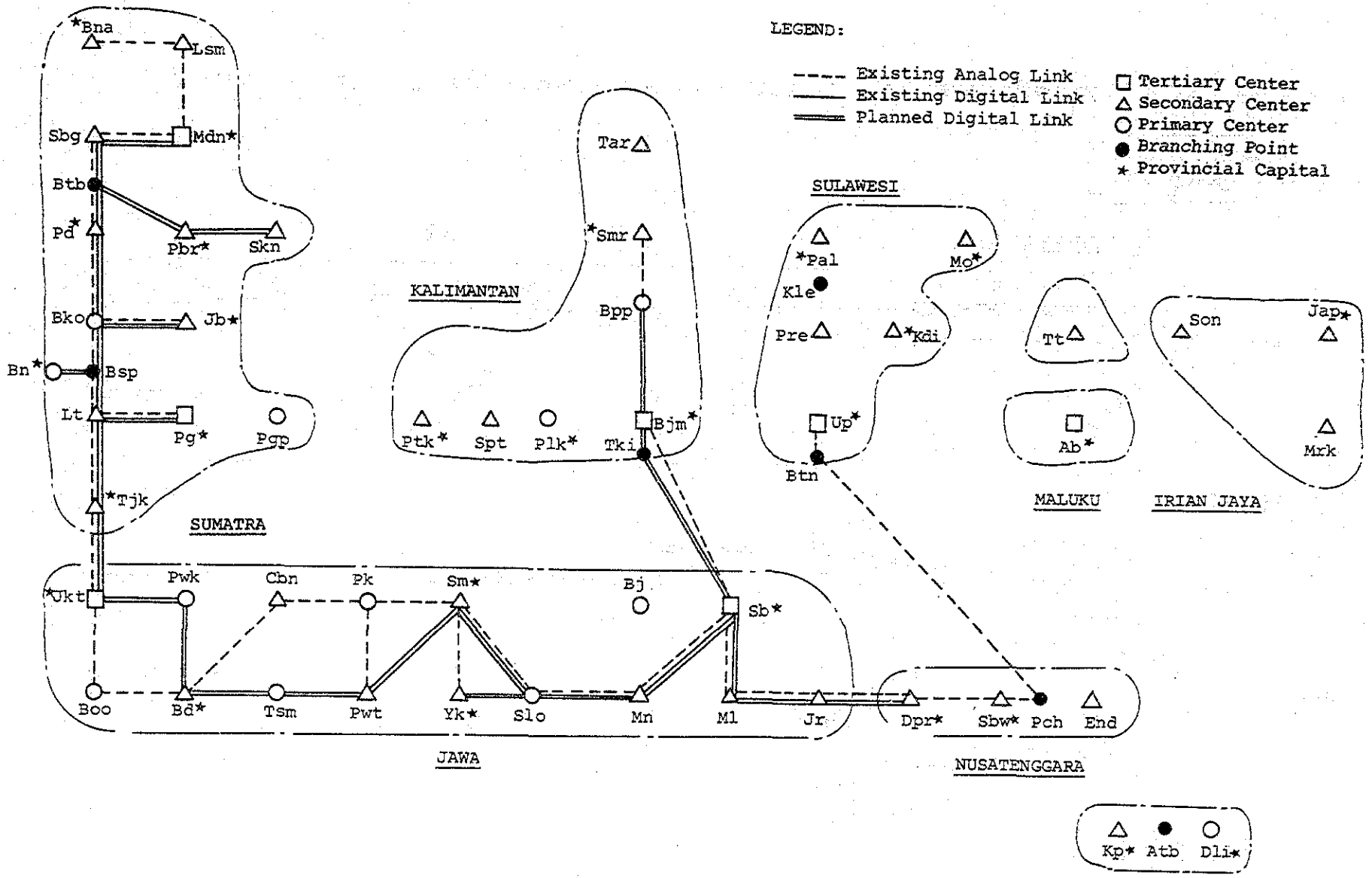


Figure 2-3 SLDD Transmission Route (REPELITA-IV, 1984-1989) Expansion Plan

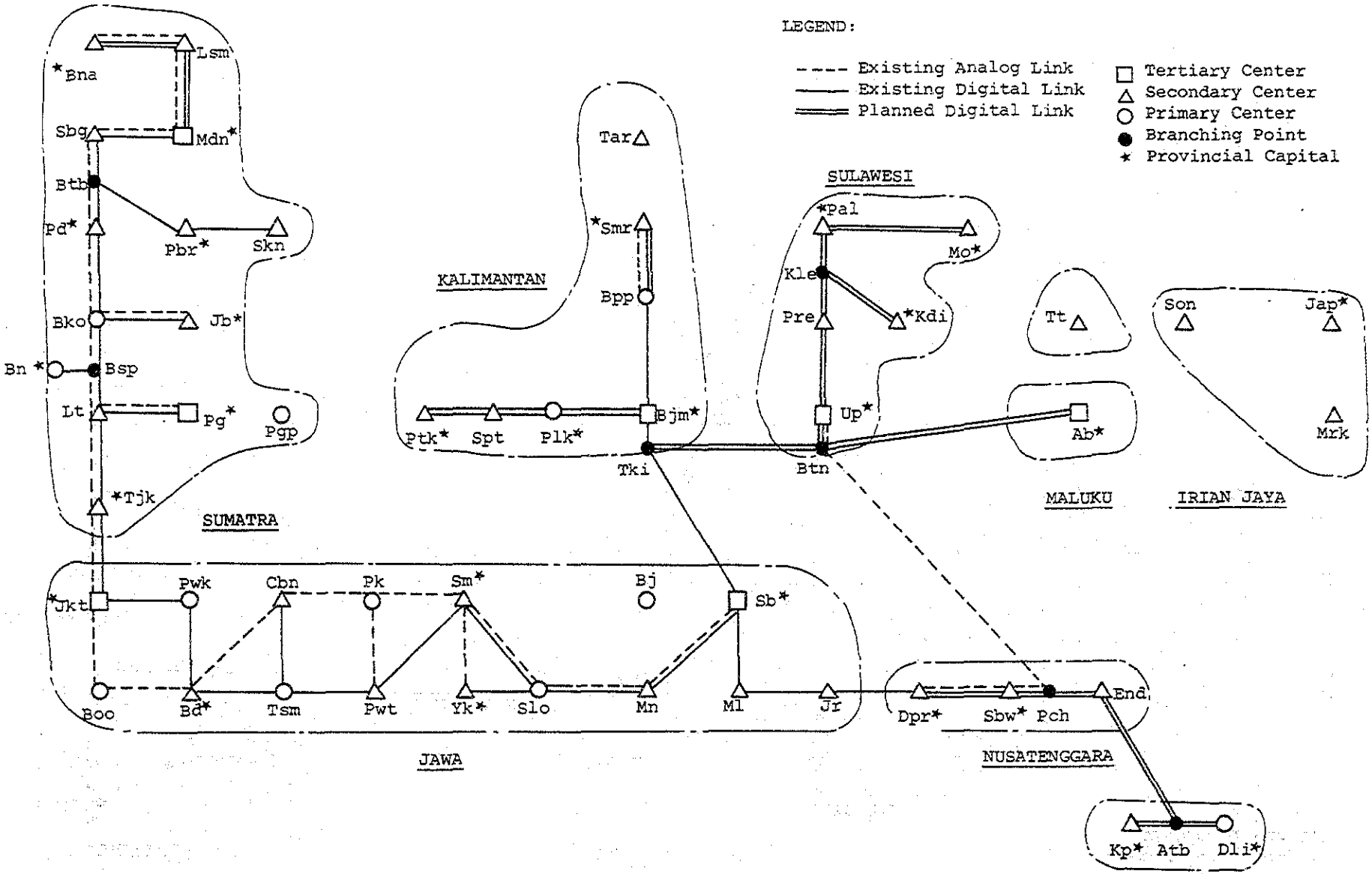


Figure 2-4 SLDD Transmission Route (REPELITA-V, 1989-1994) Expansion Plan

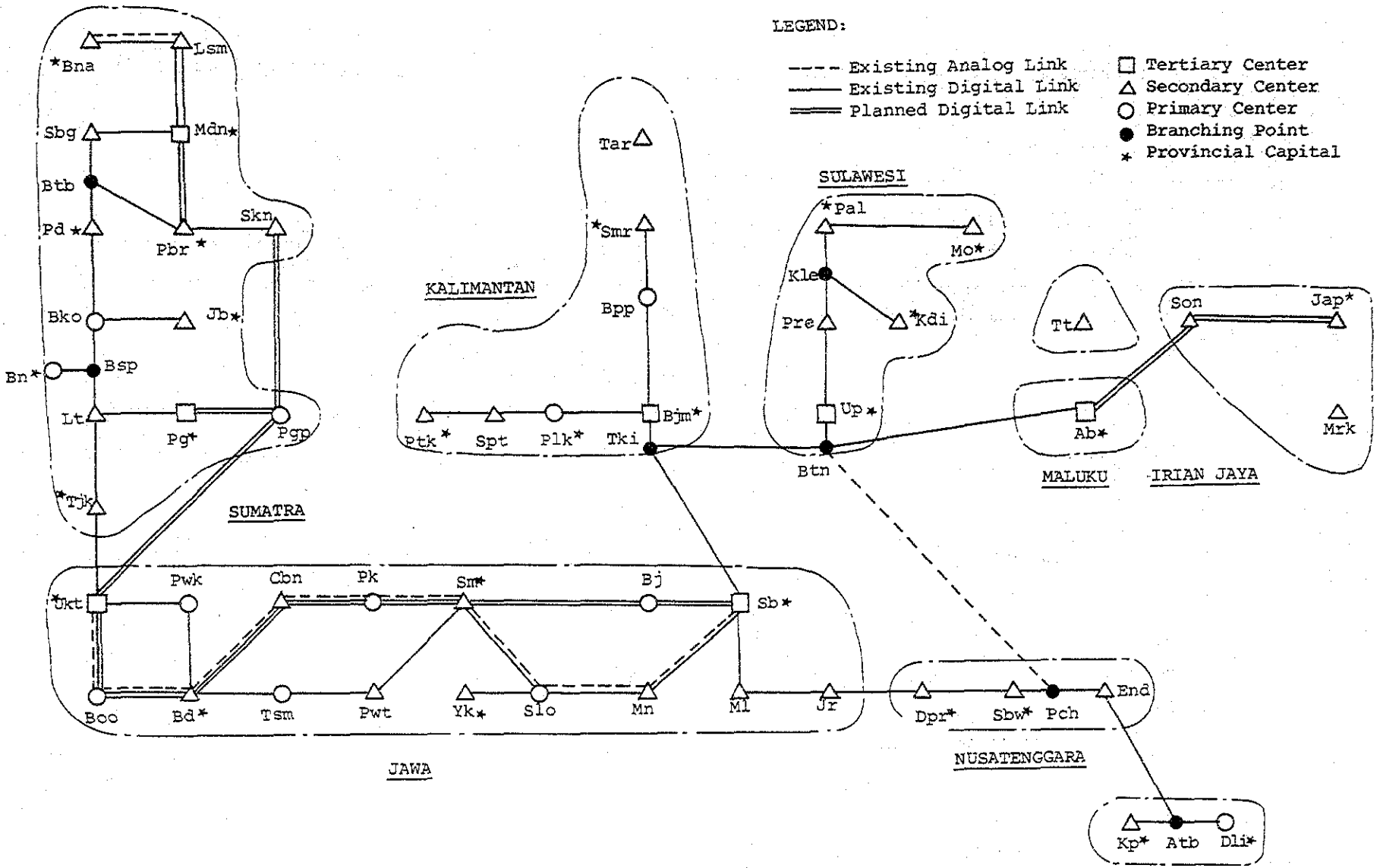


Figure 2-5 SLDD Transmission Route (REPELITA-VI, 1994-1999) Expansion Plan

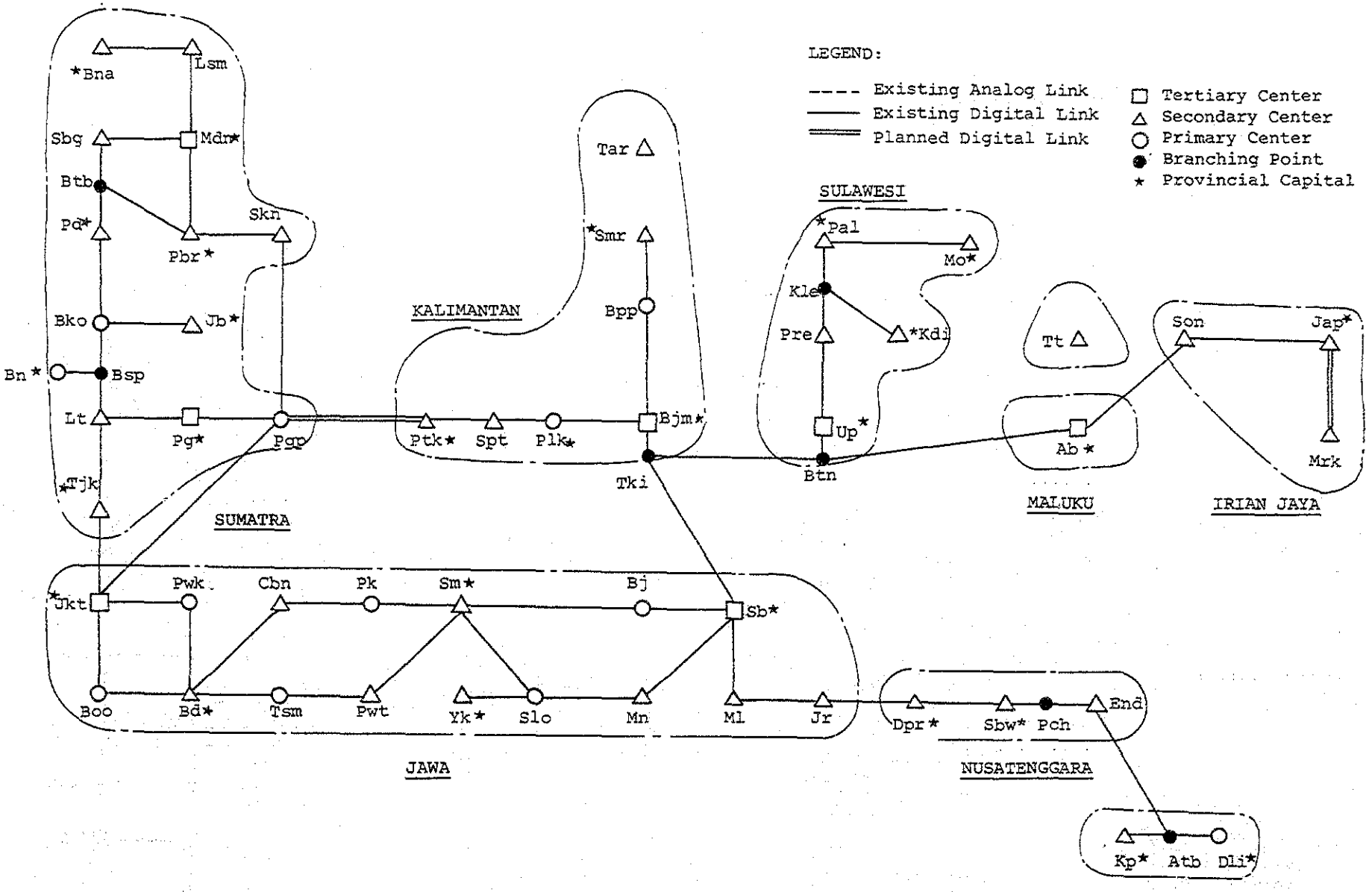


Figure 2-6 SLDD Transmission Route (REPELITA-VII, 1999-2004) Expansion Plan

2. PROJECT POSITIONING

The Kalimantan - Sulawesi submarine cable system is included in the V-th Five-Year Telecommunication Development Plan (REPELITA-V), as previously described in paragraph 1.3.2.

In Sulawesi Island, the "Trans-Sulawesi Microwave Radio System" will be completed round the same time. Therefore, the digital network will be expanded from the capital city Jakarta to the inland of Sulawesi through this submarine cable system.

Also, in the V-th Five-Year Plan, construction of a submarine cable system between Sulawesi and Maluku Island is planned. Thus the digital network will be expanded from Sulawesi farther to Maluku Island.

3. GOVERNMENTAL AGENCY RESPONSIBLE FOR PROJECT IMPLEMENTATION AND ITS ORGANIZATION

The Governmental Agencies responsible for implementing this project, are POSTEL of the Ministry of Tourism, Posts & Telecommunications and PERUMTEL.

The Organizational Chart of the Ministry of Tourism, Posts & Telecommunications and its Subordinate Agencies is as shown below.

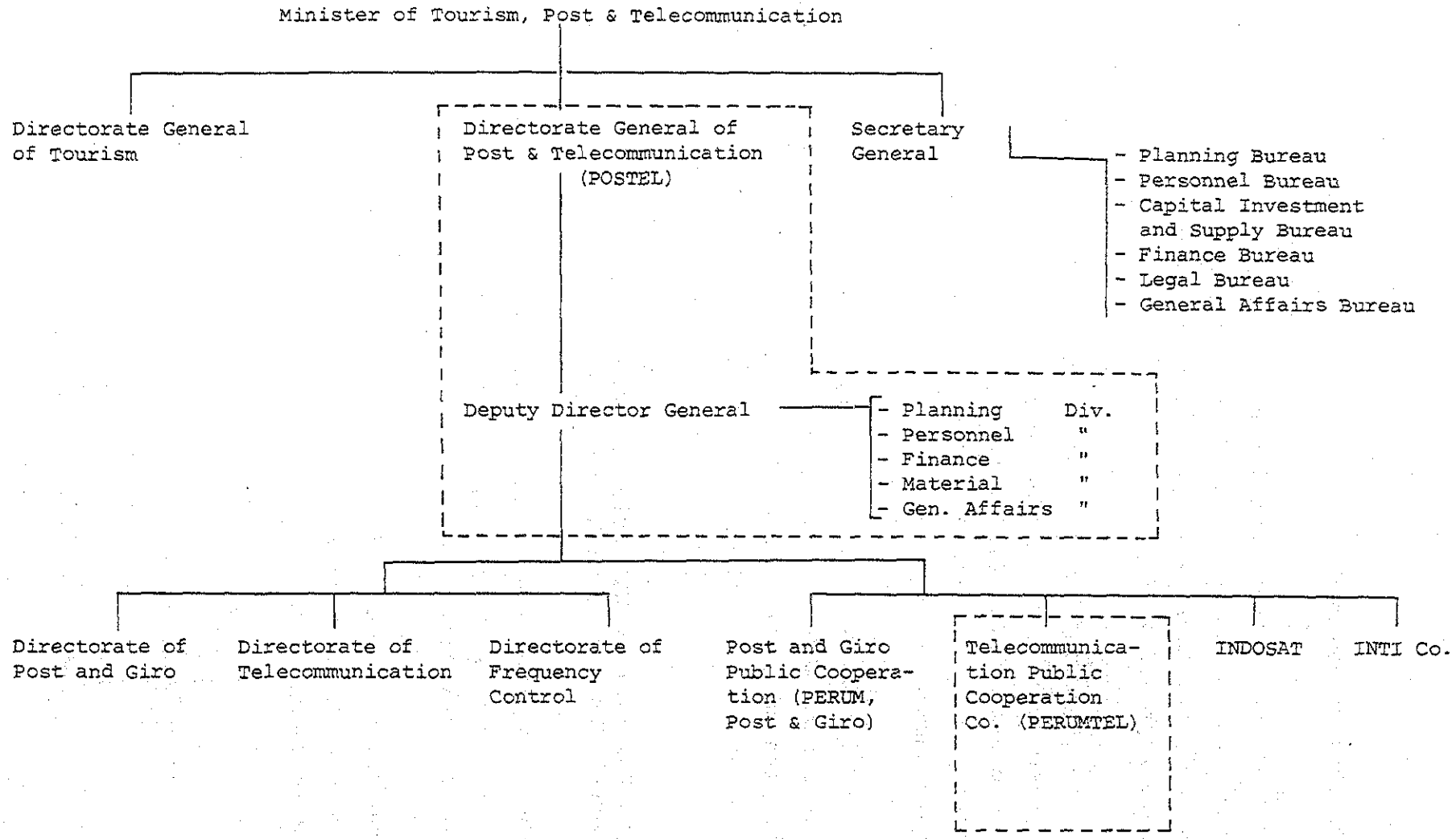


Figure 2-7 POSTEL and PERUMTEL Ministry Organizational Chart

CHAPTER 3 DEMAND FORECAST, TRAFFIC ESTIMATE, TRAFFIC ROUTING AND CIRCUIT CALCULATIONS

CHAPTER 3 DEMAND FORECAST, TRAFFIC ESTIMATE, TRAFFIC ROUTING AND CIRCUIT CALCULATIONS

1. METHODS FOR DEMAND FORECAST, TRAFFIC ESTIMATE AND CIRCUIT CALCULATIONS

Regarding demand forecast, in principle, the traffic was estimated and the circuit calculated, using the same method applied in the following JICA studies:

(1) Long-term Planning for Development of Telecommunication Systems JICA 1987

(2) Fundamental Study on Rural Telecommunication Networks JICA 1987

(3) Trans-Sumatra Terrestrial Digital Transmission Systems in progress

In particular, the "(3) Trans-Sumatra Terrestrial Digital Transmission System" schedule is the same as in the Study. Thus, the information and data collected mutually corresponds. The estimation formulas used for various estimates and the economic indexes, used as variants are all the same.

The year 2004 is set as the objective year for completing the "Trans-Sumatra Terrestrial Digital Transmission System" in the following conditions. But the year 2019 is set as the final objective year for the Study.

	Economic life	Start of Operation
Trans-Sumetra Transmission System	15 years	1992
K-S submarine cable system	25 years	1993

The estimate up to the year 2019 after 2004 is done first by the Study. The national policy for national telecommunication development until the year 2000 such as "Strategic Development Plan, Indonesia", "Telekomunikasi Indonesia Menjelang Tahun 2000" has already been made public. But neither the policy nor the planning after the year 2000 has yet been formulated. Therefore, for fixing, at the numerical values for the year 2004 a simple method was used for estimating various factors, such as:

GDP, Population growth rate, subscriber originating and terminating calling rate, traffic distribution rate between satellite links, and terrestrial telecommunication networks.

2. OBJECTIVE AND PROCEDURE FOR EACH ESTIMATE

The estimate for demand and traffic in this Chapter differs from that for deciding the policy of telecommunications long-term planning. Therefore, this estimate examines the process for figuring out the final number of circuits needed for the System. The procedures entail:

(1) Using the method authorized by the ITU (ITU Model to estimate the demand in correlation with the GDP and telephone demand), the international model was prepared according to actual data on 18 countries for 12 years. Then the country-wide telephone demand was estimated. The results were referred to work out the target of the Supply Plan as stipulated below.

(2) In the aforementioned "Strategic Development Plan, Indonesia", the minimum target for the telephone penetration rate in 1995 was set at 1.2 each/100 persons. The supply plan (demand fulfillment plan) was worked out based on the estimated country-wide demand in (1) and on the estimated population at the aforementioned target.

(3) This submarine cable system is the SLDD transmission route which connects WITEL X, XI, and XII with other WITELs. Therefore the country-wide supply plan estimated in (2) above must be distributed for each WITEL.

Accordingly, from the data (number of subscribers and number of waiting applicants), prepared for the past five years by each WITEL, the demand growth is put into the numerical formula as the WITEL model.

And based on the total 100% covering all WITEL, the ratio for each WITEL was estimated. With these ratios, the supply plan figures estimated in (2) above are distributed for each WITEL. However, after the year 2004, expecting a balanced investment for all WITELs before the nationwide digital telecommunication network is completed, after the year 2004 and up to the year 2019, the distribution ratio for the year 2004 is applied for up to the year 2019.

Also, this is dispersed from the data at WITEL to each Secondary Center: SC.

(4) The toll outgoing and incoming call traffic for each SC is acquired from the supply plans and subscribers' toll outgoing and incoming calling rate for each SC.

Traffic flow between all SCs is calculated by the function between the SC traffic calculated above and the distance between the SCs. These will be adjusted to satisfy the actual situation.

(5) The number of circuits needed between SCs was acquired from the traffic between SCs.

(6) Also, by dividing the number of needed circuits into a satellite communication network and terrestrial telecommunication network, the number of circuits needed for the System was acquired for each year.

3. DEMAND FORECAST

3.1 Various Forecast Formulas

3.1.1 International Model

In an international model, the following forecast formula was applied using actual results for the past 12 years in 18 countries.

$$\ln\left(\frac{MLA_t + W_t}{N_t - ML_{t-1}}\right) = -1.009505 - 0.533327 \ln (SF_t) + 0.1815022 \ln\left(\frac{GDP_t}{N_t}\right) + 0.6072295 \ln\left(\frac{ML_{t-1}}{N_{t-1}}\right) \qquad (R = 0.86)$$

where, MLA_t: No. of increments in main telephone lines in year t ($x10^6$)

W_t: No. of applicants waiting in year t ($x10^6$)

$N_{t/t-1}$: No. of population in year t/t-1 ($x10^6$)

ML_{t-1}: No. of main telephone lines in year t-1 ($x10^6$)

SF_t: Per-subscriber telephone revenue in year t

GDP_t: Real GDP in year t-1975 constant price-(US$ $x10^6$)

R: Multiregression correlation coefficient

As in the forecast formula above, the only primary factor to suppress the demand is the telephone revenue per subscriber. This means that the higher the telephone charges, the less the demand.

3.1.2 WITEL Model

For depression of demand and supply to each WITEL the following forecast formula was applied:

This formula is the one examined in "Long-term Planning for Development of Telecommunications System" (JICA, 1987) and revised by inputting the newest data in 1985 and 1986 acquired by the "Trans-Sumatra Terrestrial Digital Transmission System".

$$\ln\left(\frac{D_{it}}{N_{it} - ML_{it-1}}\right) = -6.932086 - 0.408515 \ln(PI_{it}) + 0.2862410 \ln(Y_{it}) + 0.4971982 \ln(TD_{it}) + 0.5416949 (D_0) + 0.5021028 (D_3) + 1.7332294 (D_4) + 0.3553089 (D_9) - 0.231578 (D_{10}) \qquad (R = 0.93)$$

where,
- D_{it}: Stimulated demand in WITEL i in year t
- N_{it}: No. of population in WITEL i in year t
- ML_{it-1}: No. of main lines in WITEL i in year t-1
- PI_{it}: Installation fee in WITEL i in year t (in real-terms)
- Y_{it}: Income in WITEL i in year (in real-terms)
- TD_{it}: Telephone density in WITEL i in year t
- D_0-D_{10}: Dummy variables
  - D_0: 1 for 1985/1986, 0 for other years
  - D_3: 1 for WITEL III, 0 for others
  - D_4: 1 for WITEL IV, 0 for others
  - D_9: 1 for WITEL IX, 0 for others
  - D_{10}: 1 for WITEL X, 0 for others
- R: Multiregression correlation coefficient

3.1.3 Demand Forecast for Nontelephone Services

The method for forecasting the demand for nontelephone system services followed the one employed in the "Trans-Sumatra Terrestrial Digital Transmission System", as in case of telephone service demand.

(1) Formula for Data Communication Service Demand Forecast

$$\ln(SD) = -8.7778 + (0.7707 + 0.1487 \times \ln(TD)) \times \ln(S) + 3.1724 \times ID \qquad (R = 0.97)$$

where, SD: Data communication service demand (x1000)

TD: Telephone density

S: No. of telephone subscribers (x1000)

ID: Dummy variable for Indonesia

R: Multiregression correlation coefficient

The nation-wide demand calculated with the estimate above will be dispersed to each WITEL by the aforementioned WITEL model.

(2) Formula for TELEX Service Demand Forecast

For TELEX service, it is known from the data on eight developed countries (includes Indonesia), that telex service will decrease in proportion to the increase in data service stated in (1).

$$\ln(SX/S) = -1.7934 + 0.72074 \times \ln(SX/S)_{t-1} - 0.0303506 \times \ln(SD/S)_{t-1} + 0.35164 \times ID$$

(R = 0.99)

where, SX: Telex service demand (x1000)

S: No. of telephone subscribers (1000)

SD: Data communication service demand (1000)

ID: Dummy variable for Indonesia

R: Multiregression correlation coefficient

(3) Formula for Telegraph Service Demand Forecast

The telegraph service includes GENTEX service.

$$TLG = -5.652 + (122.36 + 523.5 \times TD) \times N + (0.33 - 147 \times TD) \times Y - 131.98 \times ID$$

(R = 0.99)

where, TLG: No. of domestic telegram messages (x1000)

TD: Telephone density

N: Population in million

Y: Real GDP in million US dollars (1980 constant price)

ID: Dummy variable for Indonesia

R: Multiregression correlation coefficient

The number of telegraph terminals is calculated with the formula above based on a yearly-average of 14,000 calls treated at one telegraph terminal.

3.2 Demand Forecast Results

3.2.1 Demand Forecast for Telephone

For demand forecast, as in the "Trans-Sumatra Terrestrial Digital Transmission System", Plan-2 was employed and examined from:

Plan-1 (GDP increase rate 3%)
Plan-2 (GDP increase rate 5%) and
Plan-3 (GDP increase rate 7%);

tried in "Long Term Planning for Development of Telecommunication Systems".

Concerning Sumatra, on the average, it was well developed. And it is expected to contribute to increase in the national GDP, as well as Jawa. But the slowdown of development is anticipated in the regions of WITEL-X, XI and WITEL-XII to be involved in this submarine cable project. Plan-1 was also examined as a pessimistic alternative.

Also, in the supply plan (demand fulfillment plan) the "Trans-Sumatra Terrestrial Digital Transmission System" adopted the values scheduled in REPELITA-V until 1994. Thereafter, the said study has adopted the Plan-2 described in the "Long Term Planning for Development of Telecommunication Systems". This includes Plan-1 and Plan-3 as shown below. The Study also employed these same methods, as a principal approach. In a pessimistic alternative, Plan-1 was employed after 1994.

Supply Plan

REPELITA	Plan-1	Plan-2	Plan-3
IV	0.11 x 5	0.15 x 5	0.19 x 5
V	0.17 x 5	0.24 x 5	0.30 x 5
VI	0.22 x 5	0.33 x 5	0.45 x 5
VII	0.26 x 5	0.38 x 5	0.56 x 5

(1) Plan-2 (GDP increase rate 5%)

A. National Telephone Demand

Year	Population (x000)	Demand (x000)	Penetration
1994	198,698	3373	1.69
1999	218,556	5230	2.39
2004	249,557	7508	3.01
2009	270,020	9933	3.68
2014	292,162	12,536	4.29
2019	316,119	15,381	4.87

B. Telephone Demand for Each WITEL

WITEL	1994	1999	2004	2009	2014	2019
I	241,191	393,263	592,287	782,720	987,837	1,212,023
II	94,425	150,762	222,993	295,010	372,319	456,816
III	200,485	316,039	463,852	612,866	733,471	949,008
IV	1,336,406	1,977,722	2,690,401	3,557,007	4,489,142	5,507,936
V	353,571	546,780	784,270	1,036,012	1,307,505	1,604,238
VI	284,103	450,594	664,357	878,077	1,108,182	1,359,680
VII	410,033	656,318	975,165	1,288,310	1,625,919	1,994,916
VIII	126,434	200,963	295,199	390,367	492,665	604,473
IX	139,984	227,932	344,549	454,931	574,149	704,450
X	144,222	238,328	363,799	480,757	606,742	744,440
XI	22,516	37,486	57,490	75,491	95,273	116,896
XII	24,387	40,410	61,698	81,451	102,795	126,124
Total	3,377,755	5,236,598	7,516,039	9,399,000	12,536,000	15,381,000

C. National Supply Plan (demand fulfillment)

Year	Five-year Plan	No. of Supply	Total Supply	Demand Fulfillment Ratio
1989	PELITA-IV	1,069,000	1,728,869	
1994	REPELITA-V	968,000 (Replacement: 44,026)	2,652,843	0.786
1999	REPELITA-VI	1,650,000 (Replacement: 21,906)	4,280,937	0.819
2004	REPELITA-VII	1,900,000	6,180,937	0.823
2009	REPELITA-VIII	2,000,000	8,180,937	0.824
2014	REPELITA-IX	2,150,000	10,330,937	0.825
2019	REPELITA-X	2,350,000	12,680,937	0.825

D. Supply Plan for Each WITEL

In the supply plan for PELITA-IV the plan for the project until 1989, is concretely designated. There is also a concrete plan REPELITA-V until 1994. The distribution to each WITEL until 2019 and thereafter is based on a distribution rate of 2004 of the WITEL model during the demand forecast.

WITEL	1994	1999	2004	2009	2014	2019
I	(34,000)	337,337	487,057	644,657	814,077	999,922
II	(17,800)	127,143	183,573	242,973	306,828	376,874
III	(43,200)	264,133	381,363	504,763	637,418	782,934
IV	(579,000)	1,533,003	2,213,393	2,929,593	3,699,508	4,544,063
V	(94,200)	446,501	644,671	853,271	1,077,516	1,323,501
VI	(47,000)	378,434	546,394	723,194	913,254	1,121,740
VII	(67,500)	555,237	801,663	1,061,067	1,339,922	1,645,811
VIII	(31,800)	168,240	242,910	321,510	406,005	498,692
IX	(21,100)	196,066	283,086	374,686	473,156	581,173
X	(23,600)	207,197	299,157	395,957	500,017	614,165
XI	(3,600)	32,535	46,975	62,175	78,515	96,439
XII	(5,200)	35,103	50,683	67,083	84,713	104,052
Total	(968,000)	4,280,937	6,180,937	8,180,937	10,330,937	12,680,937

Note: ( ) No. of Expansion L.U.

(2) Plan-1 (GDP increase rate 3%)

A. National Telephone Demand

Year	Population (x000)	Demand (x000)	Penetration
1994	198,698	2726	1.37
1999	218,556	3948	1.81
2004	249,557	5450	2.18
2009	270,020	6942	2.57
2014	292,162	8428	2.88
2019	316,119	10,014	3.17

B. National Supply Plan

Year	Five-year Plan	No. of Supply	Total Supply	Demand Fulfillment Ratio
1989	PELITA-IV	1,069,000	1,728,869	
1994	REPELITA-V	968,000 (Replacement: 44,026)	2,652,843	0.79
1999	REPELITA-VI	1,100,000 (Replacement: 21,906)	3,752,843	0.95
2004	REPELITA-VII	1,300,000	5,052,843	0.93
2009	REPELITA-VIII	1,450,000	6,502,843	0.94
2014	REPELITA-IX	1,550,000	8,052,843	0.96
2019	REPELITA-X	1,600,000	9,652,843	0.96

3.2.2 Demand Forecast for Nontelephone

Year	Data Communication	TELEX	GENTEX
1994	2087	38,281	994
	(134)	(2450)	(64)
1999	4418	59,412	1167
	(283)	(3802)	(75)
2004	7791	83,245	1449
	(499)	(5328)	(93)
2009	10,307	99,119	1917
	(660)	(6344)	(123)
2014	13,009	112,584	2419
	(833)	(7205)	(155)
2019	15,961	124,321	2968
	(1021)	(7957)	(190)

4. TRAFFIC ESTIMATION

4.1 Traffic Estimation Method

The traffic was also estimated using the same method as that for the "Trans-Sumatra Terrestrial Digital Transmission System". Details are shown in the Plan's Study Report. The procedures for the estimate are as summarized below.

(1) The toll outgoing and incoming calling rate for each subscriber was figured out from the newest toll traffic data for each Secondary Center (SC). The nationwide outgoing and incoming calling rate on average per subscriber for 1985 was 3.95 mErl.

Toll Traffic Outgoing and Incoming Calling Rate

	1985(*)	1994	1999	2004
Average	3.95 mE	5.51	5.70	5.80

(*): Measured data

(2) The relationship between the number of subscribers throughout the country and the total number of charged pulses was analyzed from the records for 15 years (1971 to 1985). And it was found that the number of charged pulses for each subscriber had actually increased each year even with the increase in telephone tariff, several times. With this tendency, it is likely that the outgoing and incoming toll calling rate for each subscriber figured in (1) will increase accordingly. Then the total toll outgoing and incoming calling rate in

1994, 1999 and 2004 was acquired while the total outgoing and incoming traffic was acquired by multiplying the number of subscribers in the respective year of each SC.

For the period of 2004 to 2019, no national telecommunication policy has yet been worked out as stated in the beginning of Chapter 3. Therefore, the figures for 2004 were used to anticipate that the toll outgoing and the incoming calling rate per subscriber from 2004 to 2019 would not exceed that of 2004.

(3) Traffic between the SC was figured out by partially adjusting, with the newest record. That is; the regression model (function of distance between SC and number of subscribers), was employed in the "Long Term Planning for Development Telecommunications System".

(4) Further, the traffic between the SC acquired in (3) was adjusted by the "Kruithof Algorithm" proposed by ITU, GA3 Manual to satisfy the actual toll transmission routing.

4.2 Traffic Estimation Formula

4.2.1 Charged Pulse Estimation Formula per Subscriber

$$Y = 15{,}000 \times \exp[-\exp(0.341056 - 0.137943 \times T + 0.7322842 \times D)] \qquad (R = 0.96)$$

where, Y: Annual metering pulses per subscriber

T: 1 for the year 1971

D: Dummy variable (1 for T=15, 0 for others)

R: Correlation coefficient

4.2.2 Estimation Formula for Traffic Between SC

$$\ln Xij = -3.764853 + 0.5006986 \ln Si + 0.4487037 \ln Sj + (-0.681247 + 0.1563939 \times D1) \times \ln Dij + 0.4646919 \times D2 - 0.766746 \times D3 - 1.266141 \times D4 \qquad (R = 0.9)$$

where, Xij: The traffic flow from the i-th SC area to the j-th SC area (Erl.)

Si/Sj: The number of automatic subscribers in the i-th/j-th SC area

Dij: Crow flight distance between the i-th SC and the j-th SC (km)

D1: Dummy variable (1 for incoming and outgoing from/to JAKARTA, 0 for others)

D2: Dummy variable (1 for incoming and outgoing from/to MEDAN, 0 for others)

D3: Dummy variable (1 for incoming and outgoing from/to CIREBON, 0 for others)

D4: Dummy variable (1 for incoming and outgoing from/to SUMBAWA BESAR, 0 for others)

R: Multiregression correlation coefficient

4.3 Traffic Matrix Between Secondary Centers

The traffic matrix between SCs is shown in Annex II.

5. *TRAFFIC ROUTING*

5.1 Traffic Routing Strategy

When routing the traffic for positioning this submarine cable system as part of the toll transmission network configuration, the following must be considered:

(1) Hierarchy of Exchange and Category of Circuits

(2) Expansion Plan for Trunk Exchange

(3) Dispersion of Circuits for Regions Concerned

(4) Routing of Transit Traffic

Also, the basic role of backhaul must be considered.

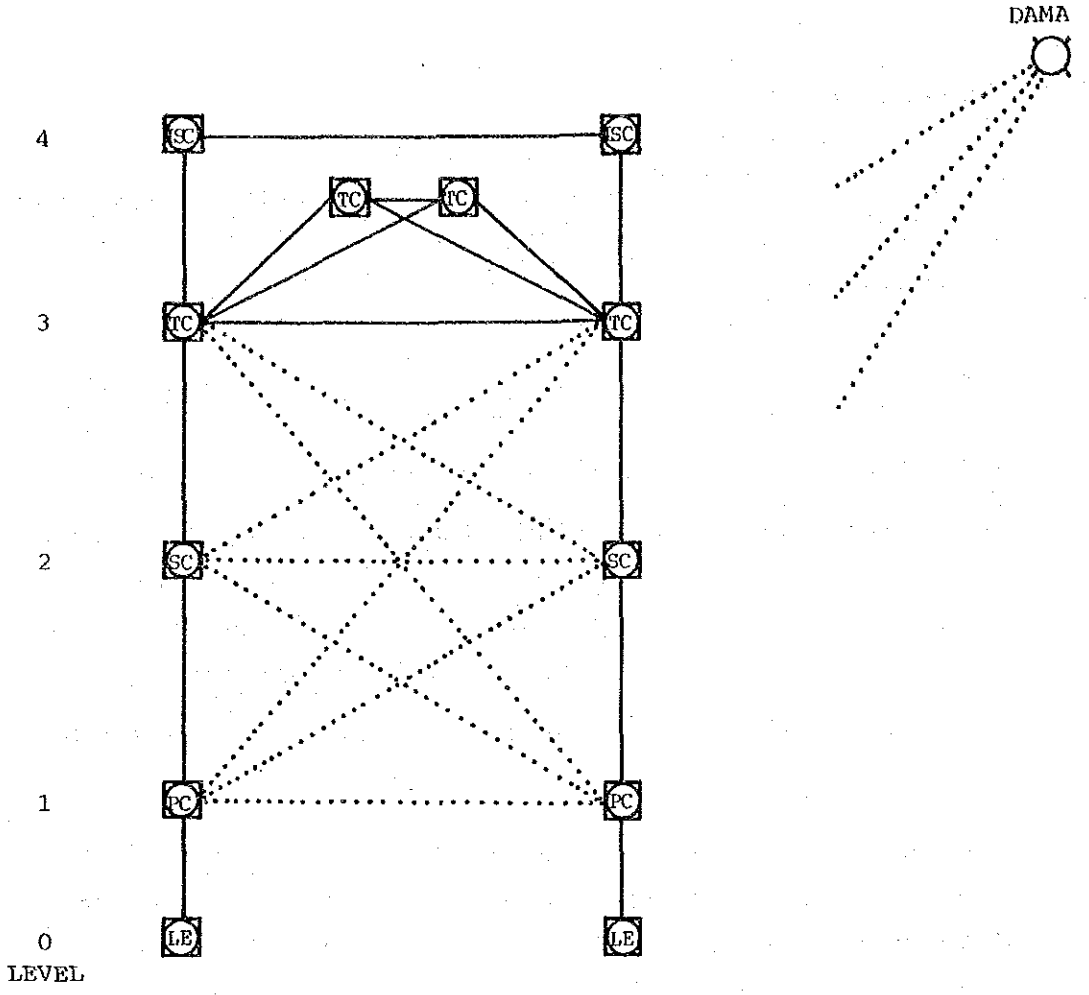
5.2 Exchange Hierarchy

WITELs involved in the System are WITEL-IX (Kalimantan) and WITEL-X (Sulawesi). The hierarchy of the exchanges is as follows:

	WITEL-IX (Kalimantan)	WITEL-X (Sulawesi)
Tertiary Center	Banjarmasin (BJM)	Ujung Pandang (UP)
Secondary Center	Samarinda (SMR)	Pare-Pare (PRE)
	Tarakan (TAR)	Palu (PAL)
	Sampit (SPT)	Kendari (KDI)
	Pontianak (PTK)	Manado (MO)
Primary Center	Palangkaraya (PLG)	Butaeng (BTN)

The interrelationship between the exchange hierarchy and the transmission route appears in Figure 3-1 (source: Strategic Development Plan, Indonesia). Here the transmission route (in solid line) is the transmission route, called the Final Route (Backbone Route), must always be prepared for the telecommunication network configuration. The dotted-line portion, called the High-usage Route (Alternative Route), must be prepared when:

- It would be more economical to prepare a direct link between SCs than to prepare the route through three links of the trunk circuit and two TC toll exchanges.



LEGEND:

ISC	:	International Switching Center	2x
TC	:	Tertiary Center	6x
SC	:	Secondary Center	33x
PC	:	Primary Center	360x
LE	:	Local Exchange	
DAMA	:	Demand Assigned Multiple Access	
▢	:	Switching Center (either digital or analog)	
——	:	Link, always provided	
·····	:	Possible link	

(Source: Strategic Development Plan, Indonesia - POSTEL -)

Figure 3-1 Exchange Hierarchy and Transmission

Four alternative routes considered for the System are:

A. In Plan-1A and Plan-1B, the system terminals are nearer the TCs of both WITELs. Therefore, these will be the final route between TCs.

B. For Plan-1C, the TC for Kalimantan and the Pare-Pare for Sulawesi would make an Alternative Route between the TC and SC. In short, it would become an irregular transmission network with no Final Route.

C. In Plan-2 as well, supposing Balikpapan - Palu to be both terminals, an Alternative Route between the PC and SC with no Final Route, will be made.

Judging from the principles of a transmission network configuration this submarine cable system should be the Final Route between TCs: Banjarmasin and TC: Ujung Pandang regardless of the submarine cable route.

5.3 Expansion Plan for Trunk Exchange

In the terminal office of the submarine cable system, besides the radio terminal equipment of 140 Mbps, transmission terminal equipment for connection with the trunk exchange and the trunk exchange to handle toll traffic will be required.

Traffic through the System is expected to be about 2200 Erlangs in 2004 as indicated in Section 4 of this chapter. The exchanges needed to satisfy the traffic volume must have more processing capacity. But at present the POSTEL/PERUMTEL has no plan to install big-capacity exchanges besides the installation in TC.

5.4 Related Traffic Dispersion

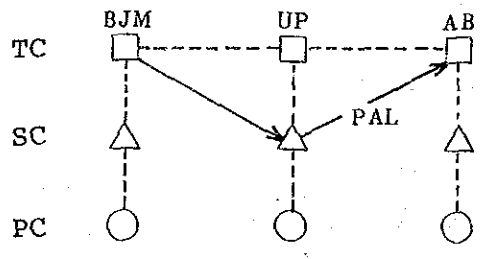
As stated in paragraph 5.2, an Alternative Route will be considered when the traffic volume to specific areas gets bigger. For the Alternative Route in Plan-1C and Plan-2, traffic in the year 2004 will be:

Plan-1C:	Banjarmasin - Pare-Pare	8.79 Erlang
Plan-2:	Banjarmasin - Palu	9.48 Erlang

The traffic here is too small to install a specific Alternative Route for Plan-1C and Plan-2.

5.5 Transit Traffic Routing

The System is expected to transit the traffic of WITEL-XI, XII. However, regarding Palu as the system's terminal, the transit route to Ambon will become (TC) - (SC) - (TC) as an example (see below). At present, for the telecommunication network configuration, the transit route is through (TC) - (TC) - (TC) normally, and not through (TC) - (SC) - (TC).



5.6 Backhaul System Definition

The backhaul of the submarine cable system is regarded strictly as land facility of submarine cable and is to be composed only of equipment to be compatible to submarine cable. The equipment for 280 Mpbs, 3840 channels of submarine cable will be secured from the cable landing office of the submarine cable to the system's terminal office (TC). Therefore, traffic drop and/or insertion on the way are not to be considered at all. If the backhaul system has a reserve available for expansion, the expanded portion will be made available for general public toll transmission route, but the radio bearer must be strictly separated.

5.7 System Positioning in the Transmission Route

Consequently, the System is positioned as a Final Route to connect Banjarmasin TC and Ujung Pandang TC and the backhaul system as its part will have no traffic drop/insertion. This applies to the four submarine cable route alternatives considered.

6. CIRCUIT CALCULATION

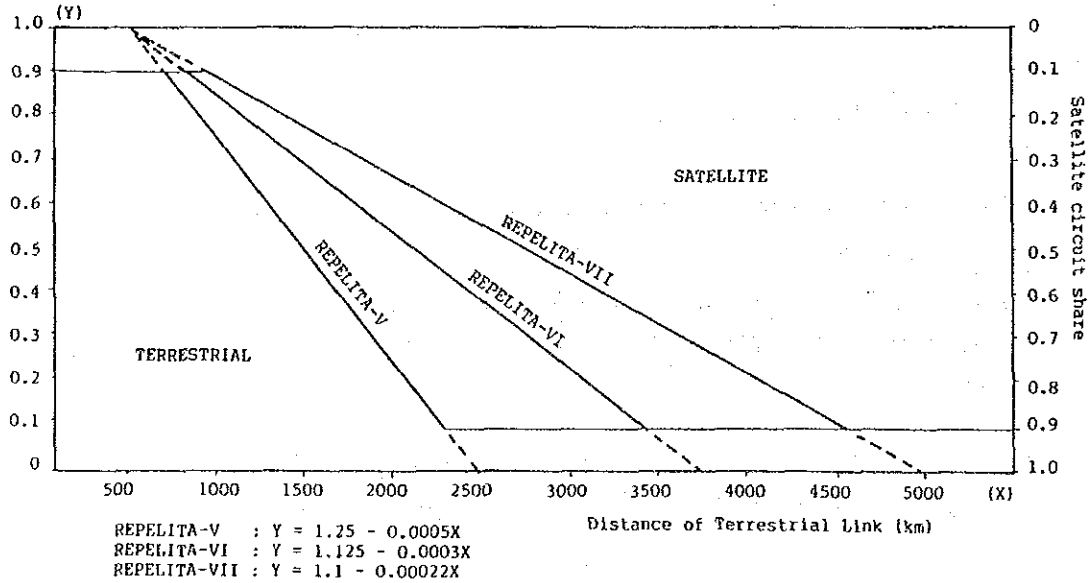
This submarine cable system is a toll transmission route. It will connect Tertiary Center - TCs in the route planning. The TC of WITEL-IX in Kalimantan is Bajarmasin and the 10th TC of WITEL-X in Sulawesi is Ujung Pandang.

6.1 Circuit Calculation Procedures

(1) Considering the traffic between the SCs in Section 4, the number of circuits was calculated by Grade of Service (G.O.S) 0.01.

(2) Besides the number of circuits calculated in (1), 10% additional circuits are added for nontelephone services and leased circuits services. (The telephone channel is calculated with 64 Kbps, and the nontelephone service channel with 16 Kbps or 32 Kbps).

(3) The number of circuits was distributed into terrestrial and satellite transmission route. The method of distribution was based on the same method examined in the "Long Term Planning for Development of Telecommunications System". This distribution plan however, deals only with the period up to 2004. The conditions for 2004 were applied similarly, to traffic estimate from 2004 to 2019. The method of traffic distribution is as shown below.



(4) Circuit Grouping

The traffic through this submarine cable system will be a toll transmission route connecting WITEL-X, XI and XII with others. This also applied to the connection between WITEL-IX and X, when WITEL-XI and XII are connected by a new submarine cable in the future. The necessary number of circuits in each year was estimated in this condition, grouping the related circuits from a number of circuits between the SCs calculated in (3).

(5) The Eastern Microwave Radio System, a toll transmission route between Jawa island and WITEL-X, are now in operation. Here, the Submarine Cable System will start to operate in 1993, and the traffic will be shared in 1998 with the above Microwave System, when the said radio system's economic life ends. But in the future, digitized traffic will increase. The said analog radio system however will not suitable for ISDN and any other digital transmission system is not considered in "Strategic Development Plan, Indonesia", therefore, no traffic distribution to this microwave radio system was considered from 1998 on.

6.2 Nationwide Toll Transmission Traffic Matrix

The nationwide toll transmission traffic matrix was calculated according to the procedures in Annex III. The number of circuits includes circuits to be distributed to the terrestrial transmission route as well as to the satellite transmission route.

6.3 Necessary Circuit Number for Submarine Cable

According to the procedures mentioned in the above Section 6.1, calculation of necessary circuits between Kalimantan and Sulawesi was done for both cases of GDP growth rate, Plan-2 (GDP: 5%) and Plan-1 (GDP: 3%). The results are shown as follows:

(Plan-2)

Year	1994	1999	2004	2009	2014	2019
Necessary Number of Circuit	778	1971	3614	4390	5126	6124

(Plan-1)

Year	1994	1999	2004	2009	2014	2019
Necessary Number of Circuit	778	1729	2956	3156	4096	4838

7. COMPARISON BETWEEN PLAN-1 AND PLAN-2

Below is a summary of the demand forecast, traffic estimation and calculation of the number of circuits, compared between Plan-2 (for main study) and Plan-1 (for pessimistic alternative):

	Plan-2	Plan-1 (Alternative)
(1) Demand Estimate (x1000)		
1994	3373	2726
1999	5230	3948
2004	7508	5450
2009	9933	6942
2014	12,536	8428
2019	15,381	10,014
(2) Supply Plan (x1000)		
1989	1729	1729
1994	2653	2653
1999	4281	3853
2004	6181	5053
2009	8181	6503
2014	10,331	8053
2019	12,681	9653
(3) Necessary Circuit Number		
1994	778	778
1999	1971	1729
2004	3614 (Full by 2003)	2956
2009	4390	3516 (Full by 2008)
2014	5126	4096
2019	6124	4838

CHAPTER 4 THE SEA CONDITIONS

CHAPTER 4 THE SEA CONDITIONS

1. JAWA SEA'S NATURAL CONDITION OUTLINE

1.1 Sea and Geology Characteristics

The route for this submarine cable construction plan involves the sea area from the eastern part of Kalimantan to the western part of Sulawesi crossing the Makassar Straits from west to east.

Kalimantan makes up the west, south and east coasts of Borneo. It is in the center of the Republic of Indonesia. Sulawesi, east of Borneo, is the fourth largest island of Indonesia. Its shape is irregular and grotesque, and four long peninsulas protrude from the center part of the island to form three big bays on the east side of the island.

On the northwestern part of this sea area, there is a relatively table mass of the earth's crust under an old orogenic belt of the shallow Jawa Sea and Borneo. And a young orogenic belt belonging to the Indonesian system runs as if it surrounded the southern and eastern sides of the mass. This forms Jawa Island and the archipelago of Nusa Tenggara that ranges from Jawa Island eastward to the Banda Sea. And this includes Sulawesi and the group of islands in its eastern direction. Some of the young orogenic belt are under the sea. These ring-shaped orogenic belt embrace many of somewhat deep basins, and they are separated by rocky rises at various depths. This orogenic belt is limited on the Indian Ocean side with a narrow belt between two trenches that run parallel with Jawa and Nusa Tenggara. The analyses based on the

modern geological theory of plate tectonics show the crustal plate under the Indian Ocean being subducted deep under the archipelago of Indonesia. These trenches are being formed at the subduction zone. This subduction phenomenon causes frequent volcanic activities and earthquakes on the Indonesian islands, especially in the southern and eastern areas. (Refer to Figure 4-1.)

The conditions of the sea bottom in the shallow sea area of the Jawa sea and the western Makassar Straits that face the east coast of Borneo are affected mostly by the function of the sedimentation of clastics flowing out from rivers. And also by the function of coral growing at a relative distance from areas where the clastics are accumulated. There are some patches of rock and stone around small islands and shallows off the shore. There are also some coral patches along the south coast of Borneo and the north coast of Jawa, but there are no vast coral areas except for the east edge of the Sunda shelf. That seems because alluvial soil that is apt to control the growth of coral holds a dominant position. The sea bottom consists mainly of mud or a mixture of mud and sand, and some parts above it are accumulated with shells. But from the Little Paternoster Is. along the east edge of the Sunda Shelf to Kpn. Kangean, more parts are sandy bottom rather than muddy one. The very clear sea water here enables the growth of coral, and therefore coral forms vast dangerous lots and many a separate small patch.

The area from the southeast part of the Makassar Straits south of 5 degrees S Lat. to the transitional part toward the Flores Sea comprises a chain of sharply deepening ocean basins separated by islands and rocky rises. There are several shallow banks that are separate and vast.

Among them are those unnamed banks which are particularly outstanding and in which the Kpn. Tengah, Kpn, Liukang, and Pu. Kalukuang (5 degrees 12 minutes S, 117 degrees 40 minutes E). Within the sea area surrounded by these three banks are several small banks. All of these banks seem to be on the shelf that extend eastward from the edge of the Sunda Shelf and is at a depth of less than 550 m. Besides these banks, several shallows and islands separate and small rise sharply from the deep area. There are probably the peaks of dead submarine volcanos. The bottom material of these shallows and banks is coral, but that of the deep water section is mud, which was formed mainly from the substance that came out directly or indirectly of the volcanos of Nusa Tenggara.

1.2 Earthquakes

Indonesia rides basically on the Eurasian Plate, but the Australian Plate from the south and the Pacific Plate from the west are squeezing each other near Indonesia. Therefore, there are a lot of volcanic activities and earthquakes due to the motion of these plates. Earthquakes that register a magnitude of about 4 on the Richter scale take place as many as 400 times a year. There are sometimes big ones that cause disasters. Earthquakes center in the area around the Jawa Trench where the Australian Plate is subudcted and the northeast part where the Pacific Plate presses on.

According to the seismic danger map of the world seismic activity zones, the north area of Sulawesi is listed among strong earthquake zones.

The vicinity of Palu on the Sulawesi side is situated on an active fault zone that extends from northwest to southeast. It is now active and earthquakes registering a magnitude of more than 4 on the Richter scale are frequent.

The damage caused by the earthquake that occurred off Palu on 14 August 1968 (7-3/4 on the Richter scale) includes a tidal wave of about 3 m high being registered in the north region of Tg. Labeia and Tondo. The death toll was more than 200 in the neighborhood of Palu.

The number of earthquakes observed at a seismological observatory near the Makassar Straits, an earthquake outbreak location chart published in 1985 and 1986 by Stasiun Geofisika Gowa and a figure in which boundary earthquakes occurred between the Eurasian Plate and Australian Plate are plotted every 20 years are shown in Table 4-1 and Figure 4-2, respectively.

Table 4-1 Number of Seismic Perception (Year 1985)

	Teleseismic	4 > M	4 ≦ M	M = ?
Palu	386	1161	123	1515
Ujung Pandang	172	194	30	537
Balikpapan	132	-	-	-

* Teleseismic distance ≧1200 km

Submarine cables are sometimes cut off by earthquakes. An earthquake that occurred at the Grand Banks about 400 km southward off Newfoundland in 1929, cut off six cables that run in this area southward one after another with in 13 hours after the earthquake. This cable

cutting occurred in the deep sea plain, the abyssal fan at the foot of the continental slope andt he abyssal plain far away from the foot. According to the theory of Heezen and Ewing, a landslide and a turbidity current caused by the landslide occurred because of the shock of the earthquake and consequently, cut off the cables. Also it was reported that similar accidents occurred at Orléansville, Algeria.

For information on how an earthquake affects submarine cables, examples of submarine cable severance accidents by earthquakes published by the KOKUSAI KYORYOKU HOGO IINKAI (ICPC) are shown below.

(1) Guam (America) to Madang (New Guinea)

1) Nov. 20, 1970

2) Jun. 26, 1979

(2) Madang (New Guinea) to Cairns (Australia)

1) Oct. 1, 1968

2) Nov. 15, 1970

3) Feb. 13, 1978

4) Jun. 26, 1979

(3) Okinawa (Japan) to Taiwan

1) Nov. 14, 1986

(4) Taiwan to Guam (America)

1) Nov. 14, 1986

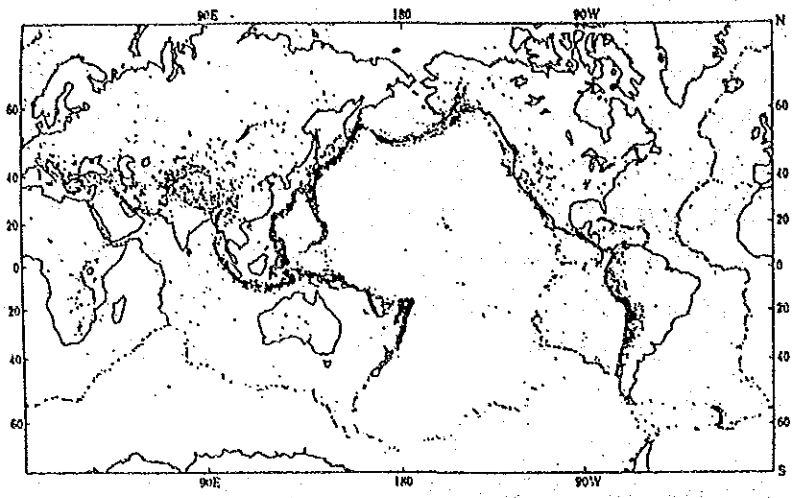


Figure 4-1 World Earthquake Distribution Chart

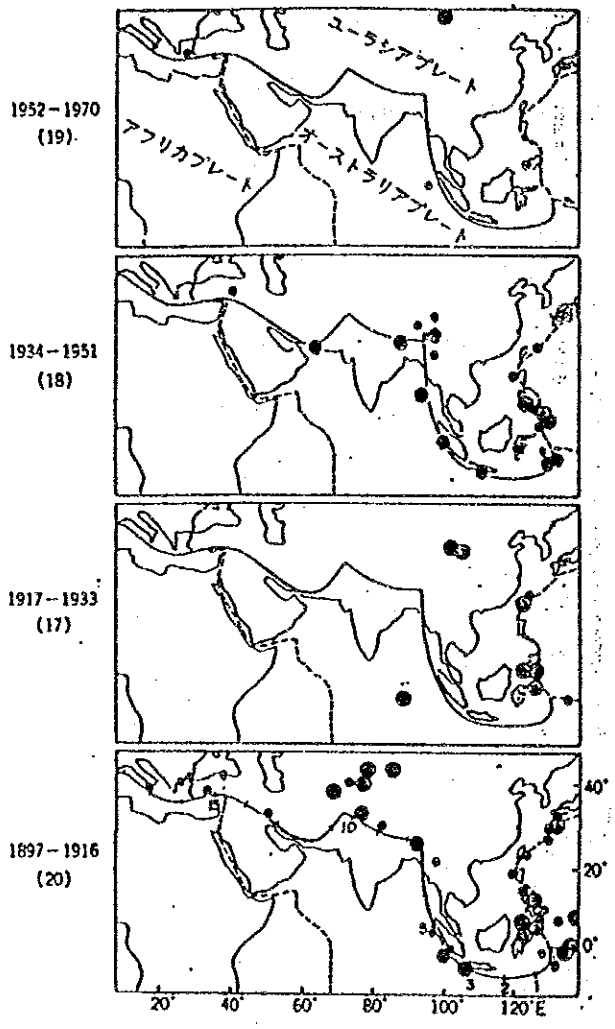


Plate boundary earthquakes that broke out along the boundary line between the Eurasian and Australian Plates are plotted almost every 20 years in the figures. They show that an active period and quiet period are repeated clearly.

Large circle: M ≧ 8.0

Small circle: 8.0 > M ≧ 7.7

Figure 4-2 Plate Boundary Earthquakes (every 20 years)

2. FISHERY ACTIVITIES

The information on fishery activities obtained from the Fishery Offices (PERIKANAN) and the General Development Offices (BAPPEDA) of Banjarmasin and Ujung Pandang is as follows:

(1) Trawling that may possibly give damages to submarine cables was prohibited by a Presidential decree (January 1982) over the entire sea area of Indonseia on and after 1 January 1983. However, trawling in the middle layer above the depth of 12 m is allowed.

(2) All fishery is limited within 30 nautical miles from shore.

(3) As for fishing methods, there are Bagan, fishing by netting, and pole-and-line fishing.

Based on these information, field investigations were made.

Most fishing boats are small ones under one ton, and the number of boats that a village owns is 20 to 30. Fishery in the neighborhood of the site that is intended for landing place is being carried on up to about 2 to 3 nautical miles from shore.

Bagan is a fishing method that lures fishes into a device (a structure) made of bamboos and wood within a water depth of less than 10 m. This fishing was frequently seen especially around the Balikpapan sea area.

Many fishing boats gather around the sea area off the southeast coast of Borneo, and fishing activities by small boats are thriving in these sea areas.

When the marine survey was made from Banjarmasin to Surabaya for an optical fiber submarine cable, floating fishing devices made of bamboos were seen here and there more than 30 nautical miles offshore. Fishing like this is against the rule, but keeping control over it thoroughly is impossible.

To protect the submarine cables, countermeasures, such as to reinforce their sheaths, and to lay them under the seabed, are necessary.

3. SHIPPING ACTIVITIES

The Makassar Straits is a main sea route located between the east coast of Borneo and the west coast of Sulawesi situated to the east of it. This channel is divided into two channels by Little Paternoster Island between latitude 2 degrees S and 3 degrees S. The west channel, 10 nautical miles wide, is used frequently. The east channel exists between two depth contour lines of 183 m (100 fm) with minimum width of 22 nautical miles and of great depth. This east channel is widely used by all vessels. Supertankers unable to sail through the Malacca and Singaporr Straits because their deep draft navigates from the Indian Ocean through the Lobmok Straits lying between Bali and Lombok, then cruise through the Makassar Straits toward the north.

Among shipping that sails through Makassar Straits are large vessels that navigate from the Indian Ocean toward the Philippines sea area, ferries an cargo-passenger ships that ply between Kalimantan and Sulawesi, and cargo-passenger boats that connect the surroundings of both islands.

Near the proposed cable landing sites for Plan-1 and Plan-2 of this submarine cable construction plan are the main ports of Banjarmasin, Balikpapan, Ujung Pandang, Pare Pare, Palu and so on.

Banjarmasin is among the most important centers of foreign trade in Kalimantan. Coasting ships of 3.7 m draft are able to lie alongside any piers at Banjarmasin.

Balikpapan is a base of petroleum enterprises with a big refinery. There are modern and sufficient facilities for cargo ships and tankers to lie alongside.

Ujung Pandang is the most important port of the west coast of Sulawesi. This port comprises an urban area, a camber for small ships and facilities for large ships to moor at. An offshore anchorage for large vessels is in the west of the breakwater.

Pare Pare Port is inside the mouth of Pare Pare Bay. Villages are toward the east, and there is administrative headquarters there.

The State of South of Sulawesi make efforts to develop the industries in the neighborhood of Pare Pare and the tourist industry in Tana Traja and outwards. There is an expansion plan for Pare Pare harbor facilities.

Palu is a large village lying on the west bank of a river at the recesses of Palu Bay. Usual anchorage is about one nautical mile to the northeast of Palu. Besides this one, in Palu Harbor there are anchorages off Wani, Mamboro and Panteluan.

Since every landing site for submarine cables was selected off those ports, it is not believed that ships coming in and out of the ports will cause direct damage to submarine cables.

4. MARINE PETROLEUM DEVELOPMENT

Marine petroleum development is thriving on the Kalimantan side, especially in the vicinity of Balikpapan which is a cable landing site for Plan-2. Further, the crude output there is more than 50,000 barrels a day.

The relationship between the planned submarine cable route and the mining area nearby Balikpapan is shown in ANNEX IV, 3. Here, the planned submarine cable route will pass between Bekapai Field on the north side, now being devloped by a French petroleum developing company, Total and Sepinggan Field on the south side, which is being developed by an American company, Unocal. The offshore platform and the land is connected with oil pipelines.

At present marine petroleum development has not yet been put in operation near the Plan-1 site. But Pertamina plans to resume submarine petroleum development in the Jawa Sea off the southeast of Kalimantan soon.

In the petroleum developing mining areas they work with mobile drilling rigs. With the operations, buoys and lighing buoys are installed near the rigs. The positions of these rigs and buoys are frequently changed. When a rig is identified, that can be known by the Navarea XI navigation notice.

According to people in the oil industry, those who first put their hands to actual operations even in a petroleum development mining area acquire a priority. And if submarine cables have been laid, oil drilling points and facilities have to avoid the submarine cable route. But when an oil or gas development is urged, the developing side needs to compensate properly concerning the transfer of the cables.

Concerning natural resources, such as manganese nodule and cobaltic crust on the deep seabed, this objective area is a field that is not yet to be developed.

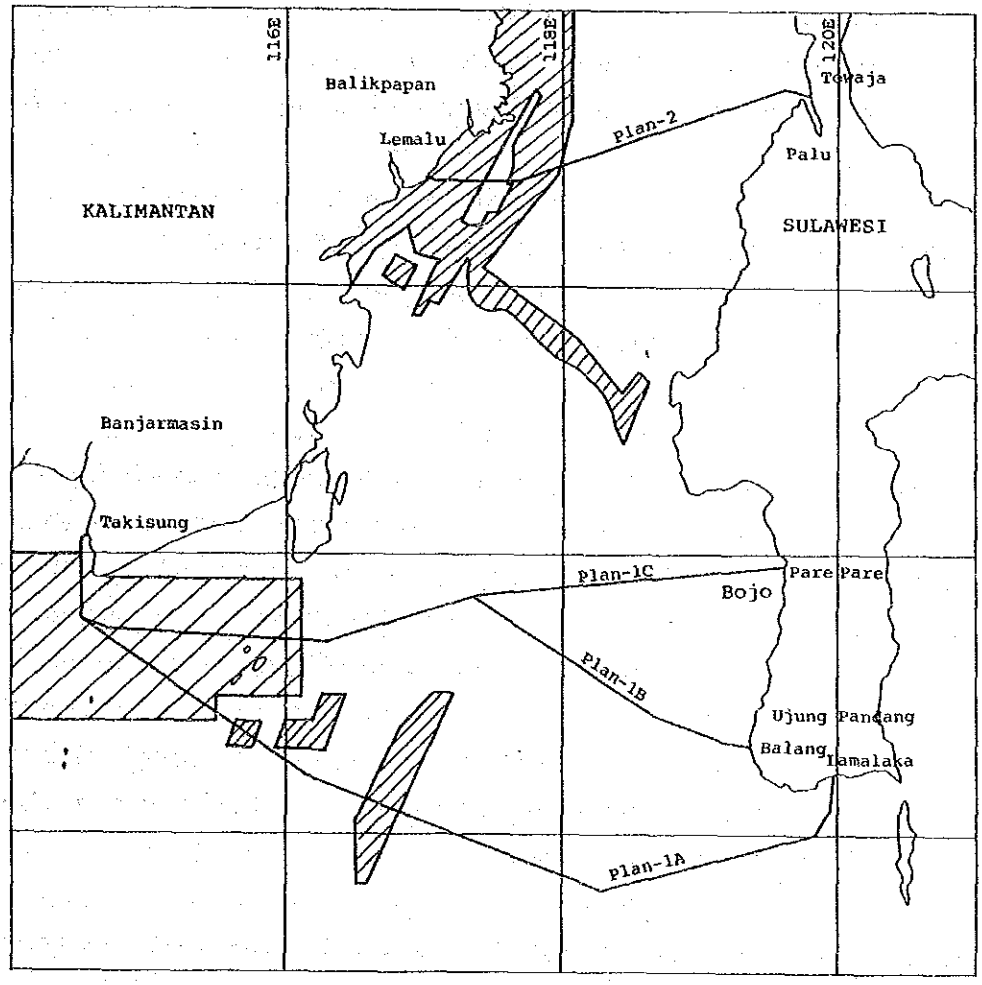


Figure 4-3 Petroleum Developing Mining Areas