REPUBLIC OF INDONESIA

REPORT ON MASTER PLAN STUDY

FOR

THE TELECOMMUNICATIONS NETWORK DEVELOPMENT

IN

THE EASTERN PART OF THE REPUBLIC OF INDONESIA

NOVEMBER, 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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EASTERN PART OF INDONESIA

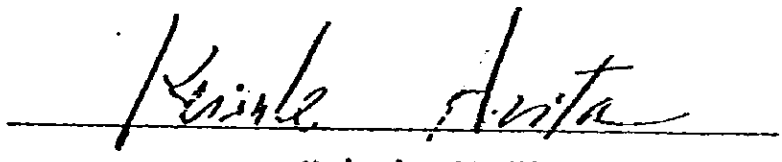
PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a survey on the Master Plan for the Telecommunications Network Project in the Eastern Part of the Republic of Indonesia and entrusted the survey to the Japan International Cooperation Agency.

The JICA sent to Indonesia a survey team headed by Mr. Shigeru FUKUDA, Special Advisor on International Cooperation, Minister's Secretariat, Ministry of Posts and Telecommunications, from January 28 to March 21, 1982.
The team had discussions on the Project with the officials concerned of the Government of Indonesia, Posts and Telecommunications (POSTEL) and Perusahaan Umum Telekomunikasi (PERUMTEL), and conducted a field survey in the Eastern Part of the Republic of Indonesia. 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.

November 1982



Keisuke ARITA
President
Japan International Cooperation Agency

General Meeting at DITJEN POSTEL

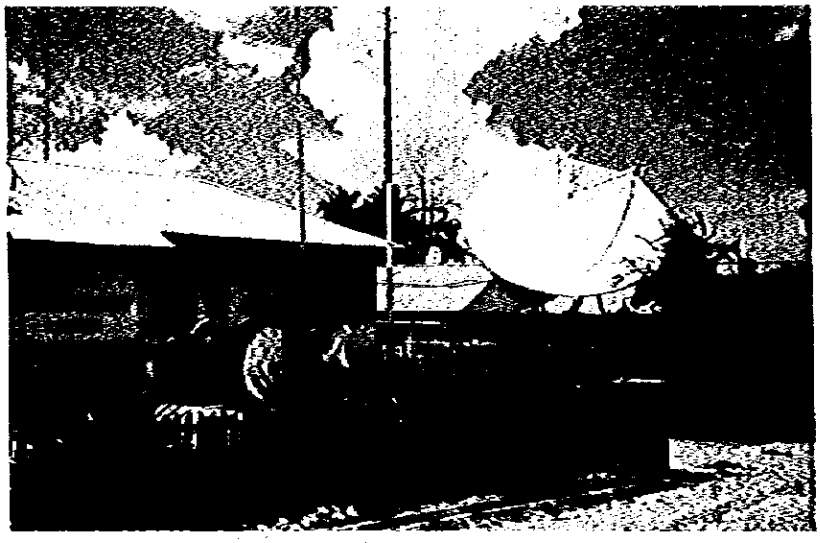
Meeting at PERUMTEL Headquarters

Meeting at PRANTRA

Meeting at SUBDITPRAN

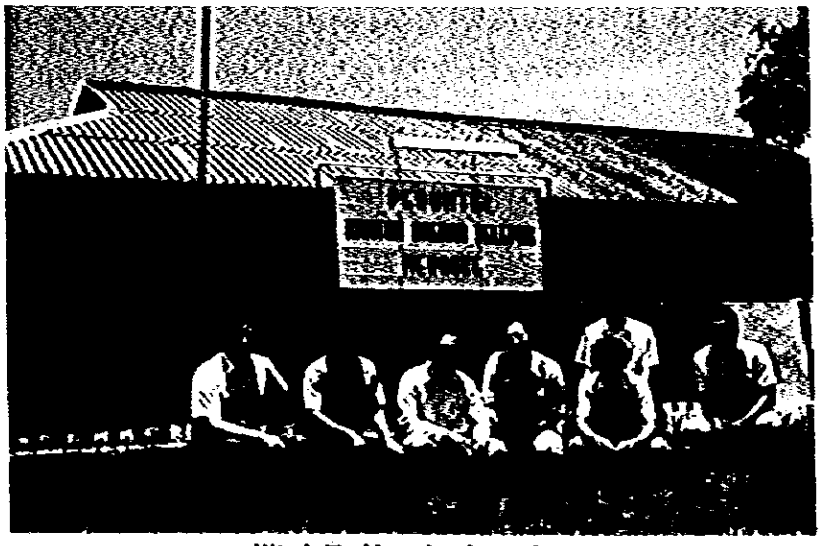
Meeting at BAPPENAS Local Office, LUWUK

Survey at Merauke Earth Station, Irian Jaya



Telephone & Telegraph Office at Luwuk, Sulawesi

Earth Station at Wamena, Irian Jaya



Witel II, Merauke, Irian Jaya

CONTENTS

Page

Page

LIST OF TABLES

LIST OF FIGURES

CONTENTS OF APPENDICES

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary, Conclusions and Recommendations

I. Summary

1. Objective

This study aims at formulating the master plan for terrestrial transmission network improvement and expansion covering the eastern region of Indonesia that comprises the five areas of Sulawesi, Nusa Tenggara Timur, Timor Timur, Maluku and Irian Jaya. The master plan is a long term plan taking into consideration all foreseeable developments up to the year 2005.

2. Basic Philosophy and Preconditions

In the eastern region of Indonesia where the study was carried out, the domestic satellite communication system (PALAPA system) is already in operation. To be added to this existing system is the new terrestrial transmission network inclusive of the submarine cable network. By these two systems, the advanced and stable telecommunication service network is to be realized throughout the region. This constitutes the basic philosophy of the investigation.

Preconditions for the study to be promoted, guided by the basic philosophy, are as follows:

(1) This study is dedicated to necessary investigations and examinations for introducing a terrestrial transmission network in the whole objective areas as far as topographically and technically possible.

(2) The basic matters relating to the study are, in principle, to be in accordance with the guidelines or standards given in the Fundamental Plan for the Telephone Network in Indonesia, 1981, instituted by the Government of Indonesia.

(3) Cities to be covered by the study are all the 99 cities in the numbering plan areas specified in the Fundamental Plan as per above. The breakdown of those 99 cities: Tertiary Centers, 2; Secondary Centers, 10; Primary Centers, 87.

(4) The terrestrial transmission networks are to be composed of the digital type radio system and the optical submarine cable system.

(5) In the terrestrial radio transmission network, the key routes, i.e., the sections, each with transmission capacity of 480 channels or more, are to be so composed that TV signals can be transmitted by the standby system. The submarine cable sections are not to have the standby system established so that the working system should be able to transmit both telephone and TV signals.

3. Demand Forecast, Traffic Forecast, and Circuit Calculation

3.1 Demand Forecast

(1) Telephone Demand Forecast

(a) The macroscopic telephone demand forecast was made, using the coefficient of correlation between GDP per capita and telephone density per 100 persons. The calculation model used is:

$$Y = 0.000331\ x^{1.3852}$$

$$\log Y = -3.4803 + 1.3852 \log X$$

where

Y : Telephone density
(No. of telephone sets per 100 persons)

X : GDP per capita (in US$)

The forecast calculation by the above model was based on the following preconditions:

(i) Growth rate of GDP per capita: 5%

(ii) For population forecast, the forecast values in Annual Statistics of Indonesia, 1979/1980 (published by Central Bureau of Statistics, Indonesia) were used as basic data.

(iii) Main telephone ratio to the number of telephone stations is assumed as 70%.

The macroscopic demand forecasts by years obtained by calculation are:

Year	No. of Telephone Stations	No. of Main Telephones
1989	1,373	961
1994	2,123	1,486
1999	3,258	2,281
2005	5,384	3,769

(No. of Telephones: $x10^3$)

Note: Generally, the construction of telephone exchange takes 3 to 5 years from the beginning of planning through the completion of construction work. The line capacity of exchange must be so determined that it does hold a surplus to fill at least the increasing demand during the period. Especially when the demand is increasing rapidly, such surplus must be most carefully considered so that it can cope with whatever demand variations.

(b) The microscopic telephone demand forecast was made in terms of demand by Primary Center areas, the lowest in hierarchy in the toll telephone network. The demand forecast for each Primary Center area, shown in PERUMTEL's short-term and long-term service plans, was used as basic data, and this basic data was corrected, where necessary, with transmigration plan and local development plan data collected during field surveys.

(c) Given in the table below is the comparison between macroscopic and microscopic demand forecasts in the objective area of investigation. Forecast divisions in the table are:

Division A: Macroscopic forecast distributed to each investigation area.

Division B: Microscopic forecast for each Primary Center area added together for each investigation area.

Table: Comparison between Macroscopic and Microscopic Forecasts

Area	Division	1989	1994	1999	2005
Nusa Tenggara Timur & Timor Timur	A	9,600	15,000	23,000	38,000
	B	10,200	16,200	25,800	38,800
Sulawesi	A	48,000	75,000	115,000	189,000
	B	50,000	79,300	126,700	190,500
Maluku	A	9,600	15,000	23,000	38,000
	B	9,300	15,000	23,500	38,000
Irian Jaya	A	14,400	22,000	34,000	56,000

(2) Non-Telephone Demand Forecast

(a) The macroscopic non-telephone demand forecast was made, using the result of analysis of the following demand factors:

(i) Growth prospect of Indonesian economy
(ii) PERUMTEL's long-term telecommunications expansion plan (up to 2000)
(iii) Demand behaviors for non-telephone services in Indonesia (1971 - 1980)
(iv) Demand behaviors for telecommunications services in various countries (1969 - 1979)
(v) Trends of demand conflict among service categories.

For non-telephone services as a whole, the demand growth will continue at as high rate as heretofore, supported by the strong demand potential among enterprises and governmental/public offices. In the background of all this lies the continued steady growth of the domestic economy.

As for individual service items, telegrams and telex will have the demand continue to grow at nearly the same pace as heretofore as far as the short-term analysis indicates. New services, such as data communication and facsimile services to be started in the near future, will also enjoy almost as prominent demand growth as in the developed countries.

In the long-term analysis, the demand conflict among service categories must be taken into account. That is to say, as the telex diffusion progresses, the demand for telegrams is bound to be saturated, and the telex service, for its part, will suffer the demand growth slowdown as new services, such as data communication and facsimile services, will absorb new demand.

The macropscopic demand forecast for non-telephone services follows:

Year	Domestic Telegrams	International Telegrams	Telex	Leased Circuits	New Services
1989	15,625	100	22,600	1,270	1,000
1994	20,917	100	31,800	1,950	2,600
1999	24,245	100	46,600	2,610	6,400
2035	24,245	100	55,600	3,500	19,000

Note: Domestic and international telegrams:
No. of meassages (10^3)
Telex: No. of subscriber's lines
Leased circuits: No. of circuits
New services: No. of subscriber's lines

(b) Although the telephone demand distribution by areas relatively conforms to the population distribution, the non-telephone demand distribution by areas, as it presently is, features the specific trend of each service category.

The microscopic non-telephone demand forecast, this time, consists of the distribution by areas of the macroscopic forecast for each service category. The distribution was made by the area by area demand distribution rate, based on the result of analysis of the existing demand by areas and using as forecast data the area by area development plans and so forth.

The microscopic demand forecast by areas as of the year 2005 follows:

Area	Telegrams	Telex	Leased Circuits	New Services
Nusa Tenggara Timur and Timor Timur	530	140	10	50
Sulawesi	2,300	1,840	120	580
Maluku	880	420	30	160
Irian Jaya	650	540	35	260
Total	4,360	2,940	195	1,050

3.2 Telephone Traffic Forecast

(a) For traffic forecast by exchange offices, the result of traffic analysis in the existing telephone network was used as basic data. This basic data was adjusted with the long-term traffic growth prospect, including the calling rate increase to accompany the growth of GDP and the service improvement to succeed the SLDD network expansion.

(b) Telephone traffic should be distributed proportionately to the terrestrial and satellite transmission systems.

(c) However, this study is dedicated to necessary investigations and examinations for introducing a terrestrial transmission network in the whole objective areas as far as topographically and technically possible. Traffic distribution was, therefore, made by the following principles:

(i) During the coverage period, the terrestrial route traffic would increase in proportion to the expansion of the terrestrial transmission system construction area.

(ii) By the final year of the coverage period, the terrestrial transmission system construction in the whole objective area of investigation would be completed. Traffic in the area where the terrestrial transmission system could not be constructed due to geographic/topographic constraints would be routed to the satellite route.

(d) For traffic forecast between exchange offices, the following gravity model was used:

$$A = K \cdot \frac{S_1 \cdot S_2}{d^{\alpha}} \qquad \text{(Erlangs)}$$

where

A	:	Traffic between exchange offices
$S_1 \cdot S_2$	:	No. of subscribers of each exchange office
d	:	Linear distance between exchange offices
α	:	Coefficient for conversion of linear distance between exchange offices to socio-economic distance
K	:	Coefficient for conversion to Erlang value

For the value of , the calculation was made, based on the result of analysis of traffic data obtained by field surveys.

(e) Traffic forecast between main toll exchange offices in the objective area of investigation as of the year 2005 (the final year of the coverage period) is given in Figure 1.

3.3 Telephone Circuit Calculation

(a) For the establishment of toll transmission route circuits, PERUMTEL's circuit establishment policy in the Fundamental Plan earlier mentioned was used as a guideline. From the viewpoint of cost saving in the digital transmission network construction, high usage circuits would be established between specific toll exchange offices.

(b) Required circuit forecast between main toll exchange offices in the objective area of investigation as of the year 2005 (the final year of the coverage period) is given in Figure 2.

3.4 Non-Telephone Traffic Forecast and Circuit Calculation

(a) Traffic forecast between exchange offices was made, based on the trends of traffic distribution by areas as obtained from the result of analysis of traffic data collected during field surveys.

(b) The required circuit establishment was made, using the existing telegraphy network centering upon the four tandem offices (Jakarta, Medan, Surabaya and Ujung Pandang) as the basic pattern of the prospective non-telephone network. This circuit

establishment was based on the non-telephone demand size estimate as of the final year (2005) of the coverage period.

(c) The non-telephone traffic forecast in the objective area of investigation as of the final year (2005) of the coverage period, as well as the required circuit calculation result, appears in Figure 3.

4. Transmission Route and Transmission System Selection

(1) Transmission Route Selection

Apart from the satellite transmission system, the transmission route selection was made, divided into terrestrial radio transmission route and submarine cable route.

(a) Terrestrial Radio Transmission Route Selection

Comparative studies were made for conceivable alternative route plans prepared according to the basic requirements for route selection, and, out of them, the optimum route was selected. Of all basic requirements, the state of roads was the most important. Therefore, the existing conditions of roads in the objective area of investigation and the road construction plans, where available, were studied carefully as the top requirement for route selection.

(b) Submarine Cable Route Selection

The study was made on the understanding that the submarine cable route be considered for the sections where the terrestrial radio transmission system cannot be constructed. As a result, the following routes were selected whereat to study the submarine cable route feasibility:

(i) Ujung Pandang - Ambon - Sorong - Biak - Jayapura route as a backbone route to connect by the shortest distance the major cities in three areas of Sulawesi, Maluku and Irian Jaya.

(ii) Ambon - Ternate route as a spur route to be connected to the backbone route mentioned in (i) above.

(iii) Ende - Kupang route as an alternative for terrestrial radio transmission route.

Next was to formulate the general requirements pertinent to the selection of submarine cable routes and cable landing points. Based on such requirements, preliminary studies by sea charts were made for the aforementioned routes and, as a result, the cable routes, as well as the cable landing points, were determined. At the same time, the typical sea bottom conditions of each cable route were outlined and the required cable length was estimated.

(2) Transmission System Selection

For the selection of terrestrial radio transmission system, comparative studies were made for several kinds of digital radio systems in terms of frequency bands, transmission capacities, modulation systems and so forth. And, as the optimum systems, UHF band, 2 GHz, 60 channels and 240 channels systems and SHF band, 6 GHz, 480 channels and 1,440 channels systems were selected. Compared with the circuit distribution result among the earlier selected transmission routes, decision was made as to which system to use in which section.

For both UHF and SHF systems, the standby system, instead of the standby equipment, is to be adopted. At the initial stage, the system operation is by one working system and one standby system, or the so-called (1 + 1) system operation. At the ultimate stage, one more working system is to be used so as to realize the (2 + 1) system operation.

As for the submarine cable network formation, the prime requisites are twofold: first, to adopt the optical fiber cable system, and second, to so arrange that by one pair of optical fibers, telephone and TV signals can be transmitted simultaneously.

As the result of study by comparison of those prime requisites and the circuit distribution among the transmission routes, the optical submarine cable system with transmission capacity of 1,920 channels (140 Mbit/s) is proposed as being the fittest to adopt.

For the submarine cable lead-in to the exchange office, two methods are proposed. One is the method to be used at Ujung Pandang and Ambon where the distance from the cable landing point to the exchange office is long. In this case, the cable station is to be established at the cable landing point and, between the cable station and the exchange office, the overland optical fiber cable system (otherwise, the microwave system as an altenative) is to be introduced. The other method is to be used elsewhere than Ujung Pandang and Ambon, where the distance from the cable landing point to the exchange office is relatively short. In this case, the cable station is not established but the optical submarine cable system is directly led into the exchange office.

5. Project Size Summary

The total project size comprising the terrestrial radio transmission network plan plus the submarine cable network plan is summarized below in terms of transmission route lengths.

(1) Terrestrial Radio Transmission Network

(a) Sulawesi Area

- 6 GHz, 1,440 channels system: 1,486 km (1,547 km)
- 6 GHz, 480 channels system : 335 km (300 km)
- 2 GHz, 240 channels system : 397 km (187 km)
- 2 GHz, 60 channels system : 1,308 km (1,106 km)

(b) Nusa Tenggara Timur and Timor Timur Areas

- 6 GHz, 1,440 channels system: - (-)
- 6 GHz, 480 channels system : 785 km (163 km)
- 2 GHz, 240 channels system : 85 km (362 km)
- 2 GHz, 60 channels system : 475 km (659 km)

(c) Maluku Area

- 6 GHz, 1,440 channels system: - (-)
- 6 GHz, 480 channels system : - (-)
- 2 GHz, 240 channels system : 152 km (-)
- 2 GHz, 60 channels system : 927 km (-)

(d) Irian Jaya Area

- 6 GHz, 1,440 channels system: - (-)
- 6 GHz, 480 channels system : 826 km (-)
- 2 GHz, 240 channels system : 85 km (-)
- 2 GHz, 60 channels system : 762 km (-)

(e) Total

- 6 GHz, 1,440 channels system: 1,486 km (1,547 km)
- 6 GHz, 480 channels system : 1,946 km (1,289 km)
- 2 GHz, 240 channels system : 719 km (785 km)
- 2 GHz, 60 channels system : 3,202 km (3,454 km)

Note: Parenthesized is the project size in case the alternative route is used.

(2) Submarine Cable Network

(a) Backbone Routes

- Ujung Pandang - Bantaeng route: - (130 km)
- Bantaeng - Among route : 1,110 km (20 km)
- Ambon - Sorong route : 530 km (80 km)
- Sorong - Biak route : 680 km (20 km)
- Biak - Jayapura route : 660 km (20 km)

Total : 2,980 km (280 km)

(b) Spur Route

- Ambon - Ternate route : 540 km (10 km)

(c) Alternative Route for Terrestrial Radio Transmission Route

- Ende - Kupang route : 320 km (30 km)

(d) Grand Total : 3,840 km (310 km)

Note:

1. Parenthesized is the cable length in land section.
2. Transmission capacity is 3,840 channels for Ujung Pandang - Bantaeng route only. For other route, 1,920 channels.

6. Project Investment

The gross investment amount required for project implementation is given below.

	Foreign Currency Portion (hundred million yen)	Domestic Currency Portion (hundred million rupiahs)
(1) Terrestrial Radio Transmission Network		
(a) Sulawesi	: 232 (227)	360 (338)
(b) Nusa Tenggara Timur and Timor Timur	: 78 (101)	129 (137)
(c) Maluku	: 48	73
(d) Irian Jaya	: 64	104
Total	: 422 (440)	666 (652)

Note: Parenthesized is the investment amount in case the alternative route is used.

(2) Submarine Cable Network		
(a) Backbone Routes		
Ujung Pandang - Ambon	: 86	28
Ambon - Sorong	: 49	23
Sorong - Biak	: 43	10
Biak - Jayapura	: 44	10
Total	: 222	71
(b) Spur Route		
Ambon - Ternate	: 37	11

7. Project Implementation Plan

For project implementation, it is proposed that in accordance with the undermentioned order of precedence the feasibility study be carried out in one area after another, and then the implementation schedule be put into practice in due sequence.

Order of Precedence:

First : Sulawesi Area

Second: Nusa Tenggara Timur and Timor Timur Areas, and Ende - Kupang Submarine Cable Installation (in case the alternative route is used)

Third : Maluku Area,
and Ujung Pandang - Ambon and Ambon - Ternate Submarine Cable Installation

Fourth: Irian Jaya Area,
and Ambon - Sorong - Biak - Jayapura Submarine Cable Installation

The project implementation schedule (draft) based on the above order of precedence appears in Table 1.

II. Conclusions and Recommendations

As regard to the specific study, the terrestrial transmission network plan in the eastern part of Indonesia formulated under this master plan study is given in Figure 4 attached hereto. However, it is subject to the economic feasibility study.

By the implementation of this master plan, the foundation can be laid for the digital transmission network formation covering the whole of Indonesia, not to mention the eastern part of the country.

The telecommunications network digitalization paves the way toward integrated transmission, switching and processing, and at top efficiency, of many kinds of information, such as voice, data and image information, on differing from another in type and speed. It requires no elaboration that, for that purpose, not only the transmission network but also the switching system and even the subscriber system must be digitalized positively.

The final objective is to attain at an early period the Integrated Service Digital Network (ISDN) that is effective throughout Indonesia. First, based on the master plan formulated this time, the digital system terrestrial radio transmission network and the submarine cable network by optical communication system are to be introduced in the eastern region of Indonesia. Second, the existing analog system transmission networks in other areas of the country are to be digitalized. Third, for the switching, as well as subscriber, systems also, the digitalization must be hastened.

However, both the digital radio transmission system and the optical fiber submarine cable system are still at the initial stage of utility application. Hence no international standards yet. Thus, for introducing the transmission network by both systems in the eastern part of Indonesia as envisaged by this master plan, there is need for further investigation and study of these subjects:

(1) Trends of research and development, as well as utility application, in the developed countries.

(2) Trends of standardization for both systems by competent international organizations, including CCITT and CCIR.

(3) Trends of system cost economy as the result of technical renovation in the years to come.

Development plans for the eastern part of Indonesia and national development plans of Indonesia, expected in the future, also deserve careful examination. Demand variations that result from the progress of these development plans will necessitate this master plan to be modified as required.

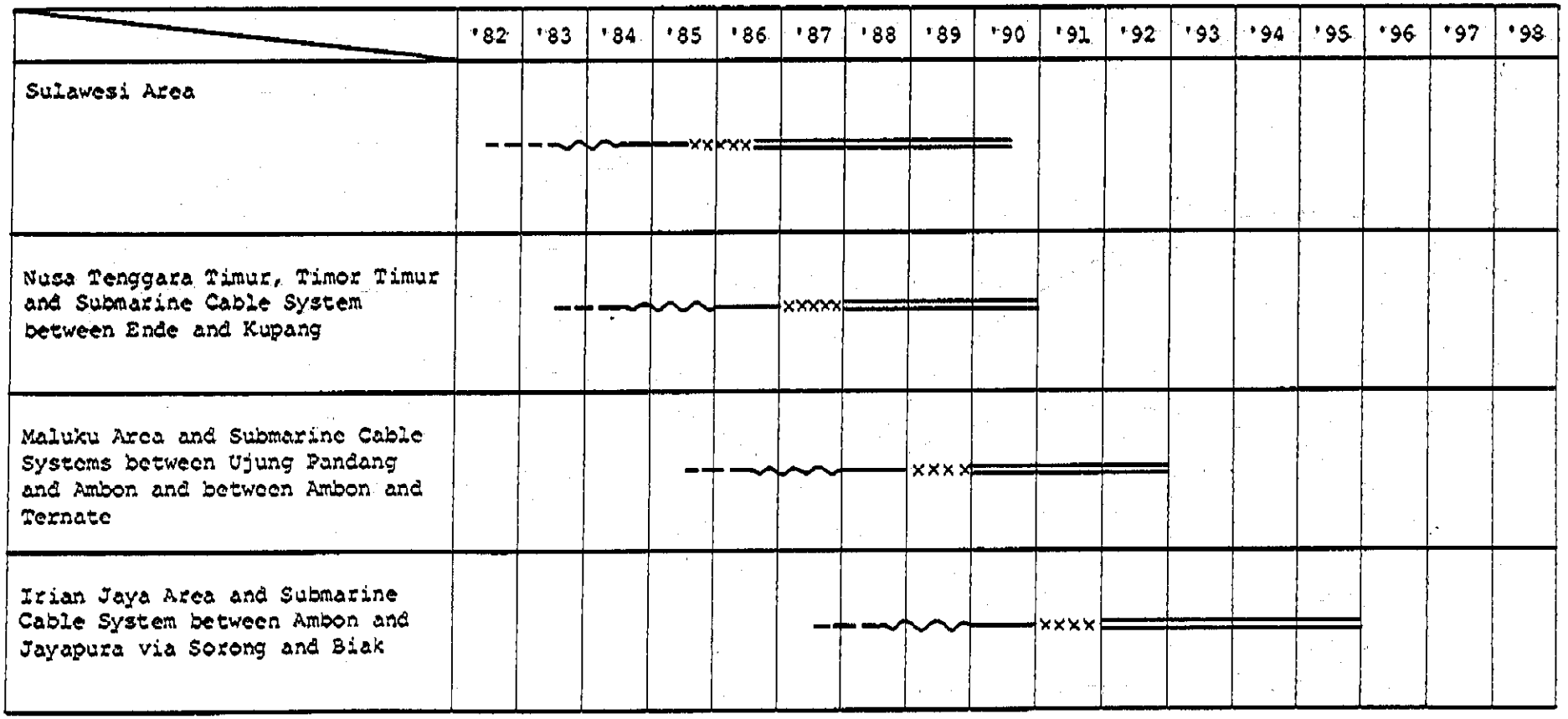
Shown below are the proposals made as being directly related to the current project though the proposed items are outside the objective area of study carried out this time.

(1) Necessity to construct the second transmission route by digital system between Jakarta and Surabaya, in addition to the existing Jawa - Bali microwave system.

(2) Necessity to construct the optical fiber submarine cable system between Surabaya and Ujung Pandang.

For these proposals also, investigation and study in concrete terms will be necessary.

Table 1 Project Implementation Schedule



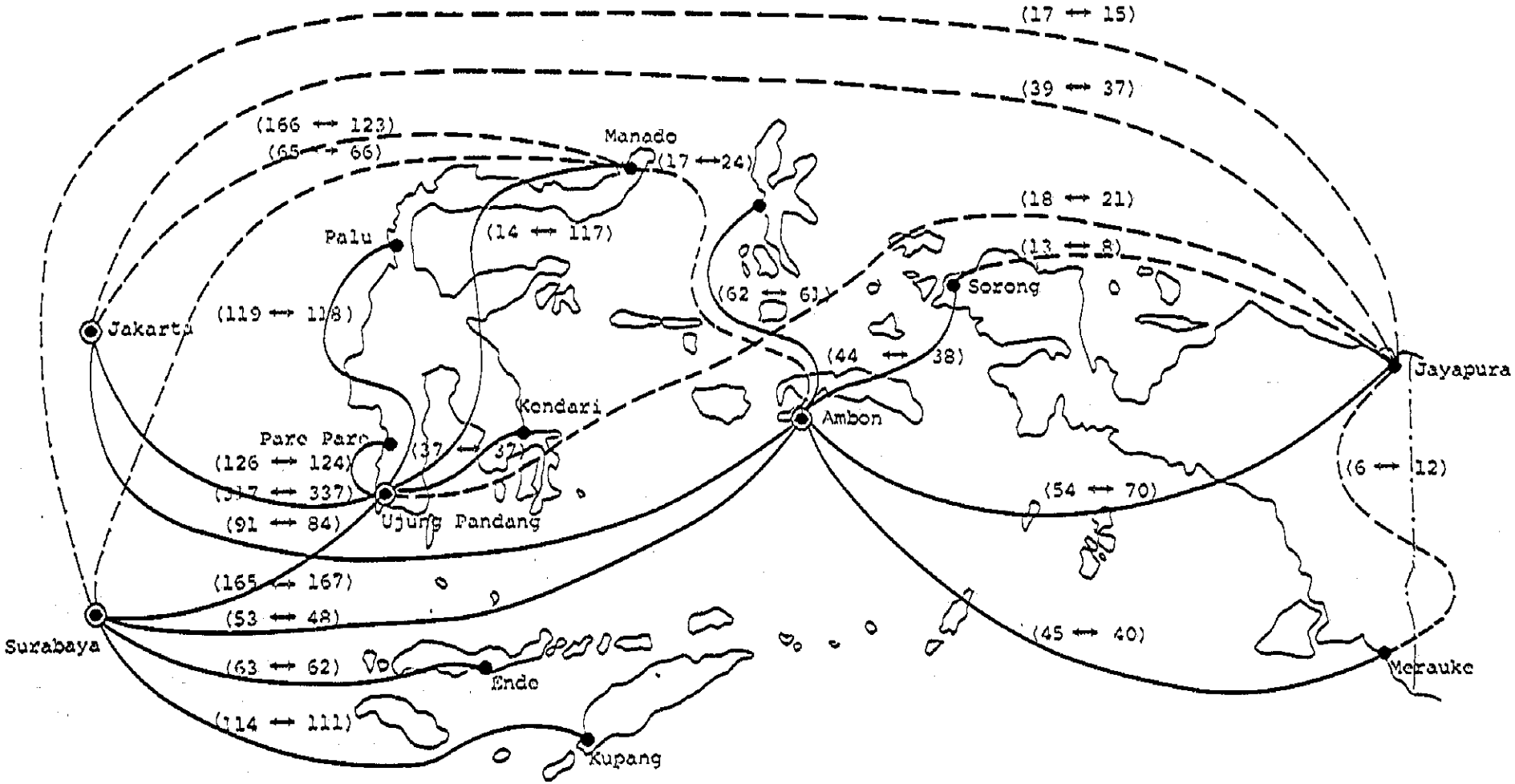
: Feasibility Study

: Procurement of Budget

: Detailed Design

xxxxx : Selection of Contractor

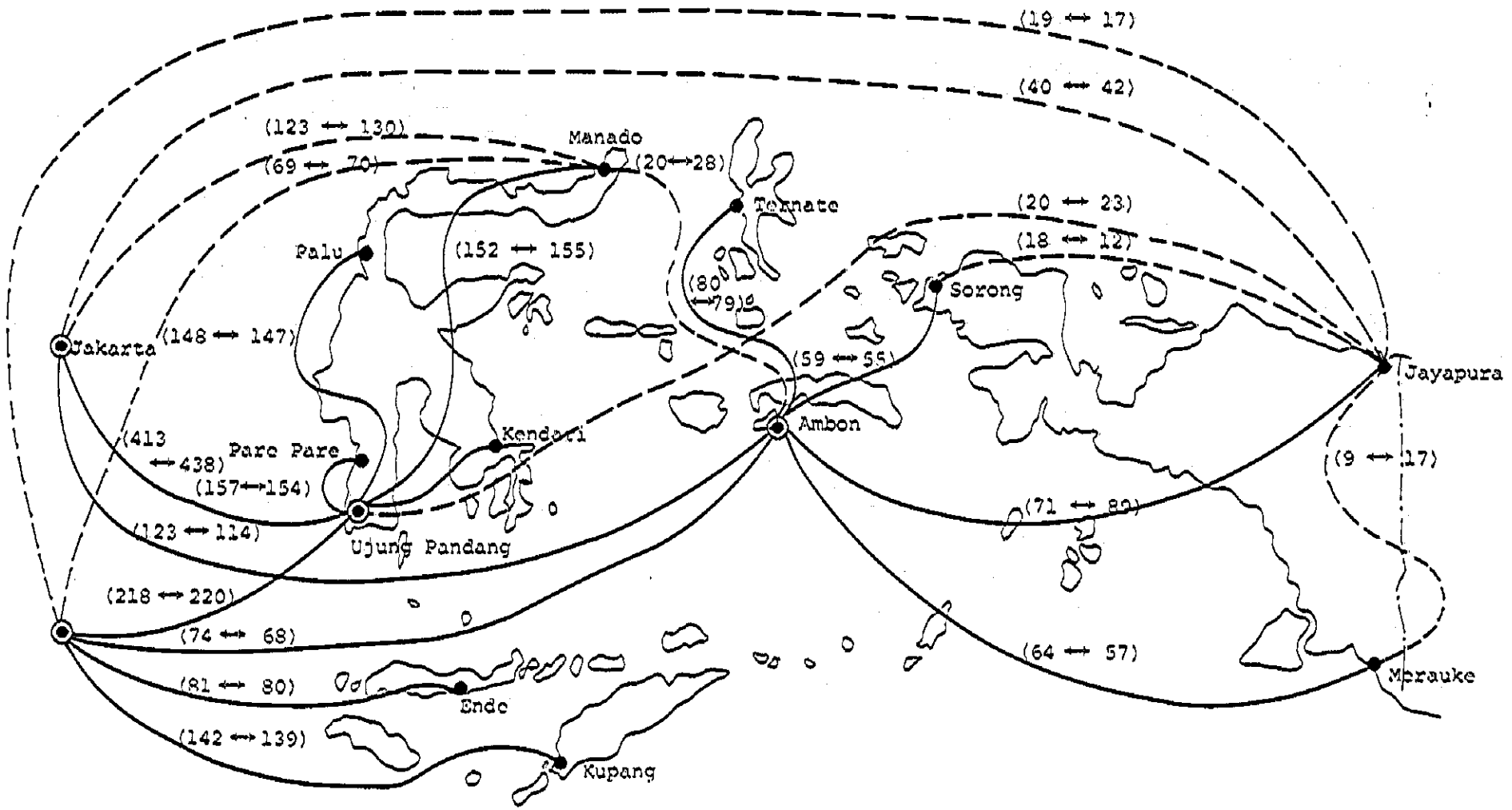
: Manufacturing and Installation



(Note) ——— : Final Route
---- : Direct Route
◉ : Tertiary Center
● : Secondary Center
Figures : Traffic (Erlangs)

Figure 1

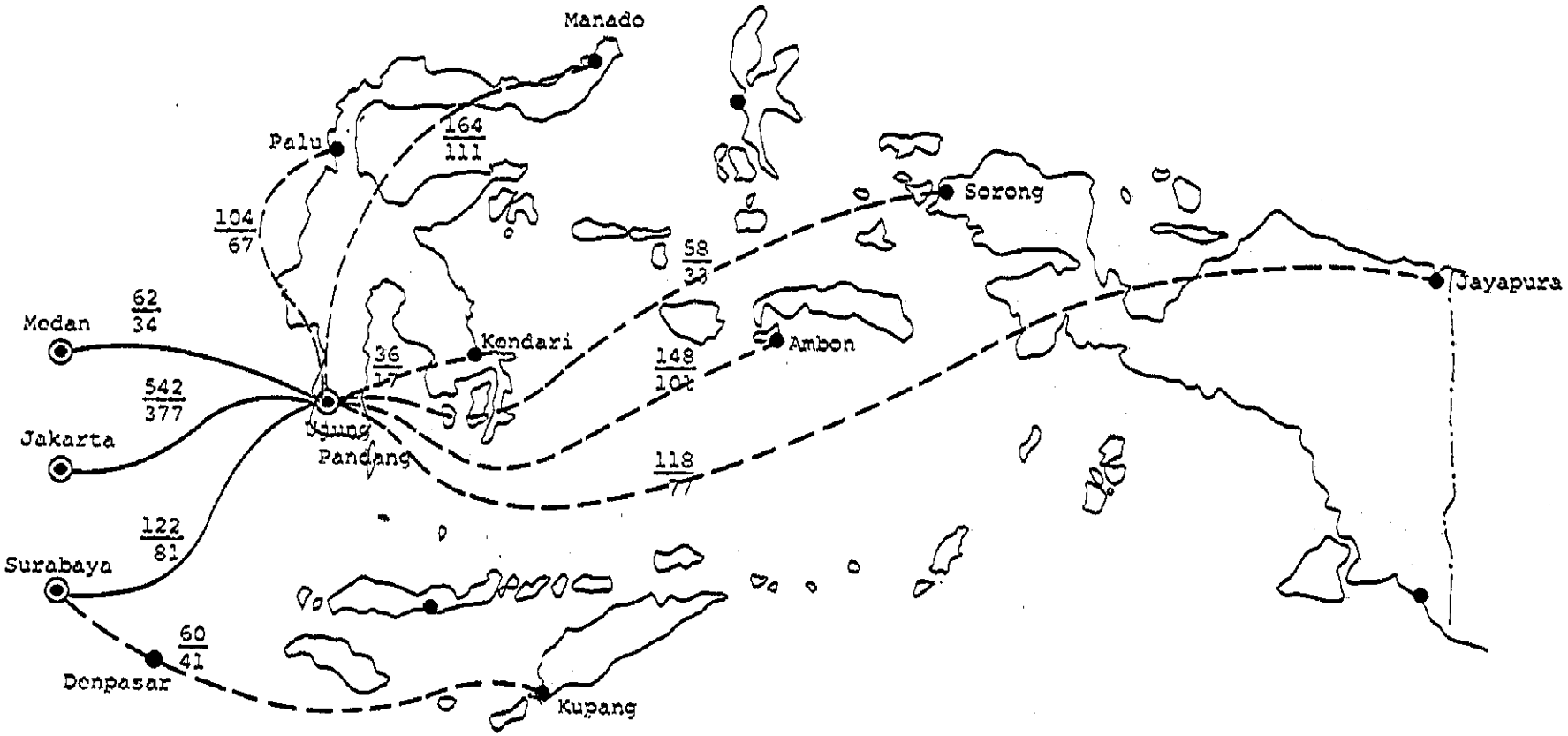
Terrestrial Telephone Trunk Traffic Forecast between Main Trunk Centers in Eastern Part of Indonesia (Year 2005)



(Note) ——— : Final Route
------ : Direct Route
◉ : Tertiary Center
● : Secondary Center
Figures : No. of Circuits

Figure 2

Number of Terrestrial Telephone Trunk Circuits between Main Trunk Centers in Eastern Part of Indonesia (Year 2005)



Note
——— : Inter-tandem Exchange Route
- - - - - : Junction Route to Tandem Exchange
◉ : Tandem Exchange
● : Auxiliary Tandem or Local Exchange
Upper figures : No. of Circuits
Lower figures : Traffic (Erlangs)

Figure 3

Number of Terrestrial Non-telephone Bothway Traffic and Circuits between Main Offices in Eastern Part of Indonesia (Year 2005)

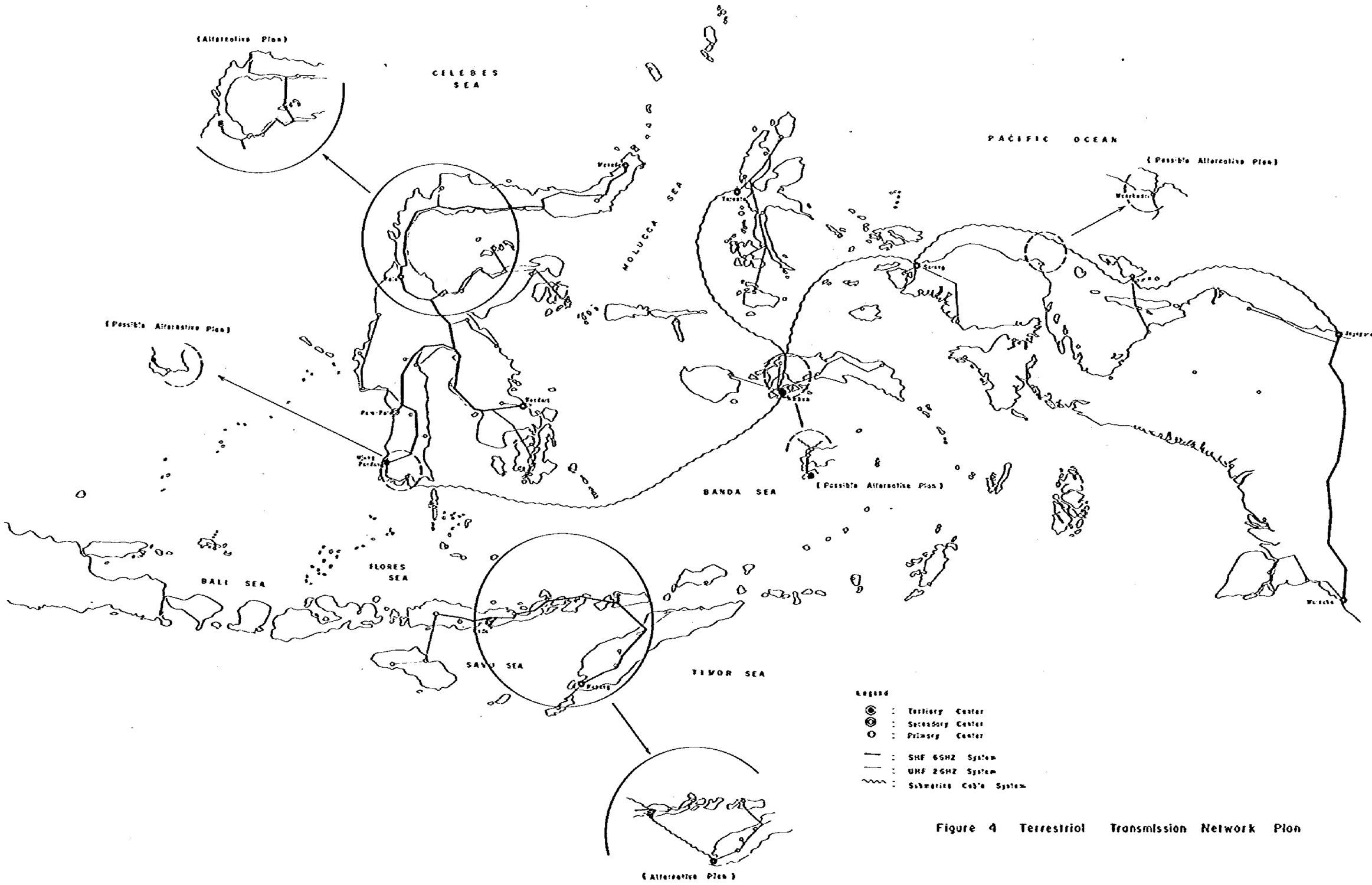


Figure 4 Terrestrial Transmission Network Plan

I INTRODUCTORY REMARKS

I. Introductory Remarks

1. Background of Study

The Government of the Republic of Indonesia, based on the National Economic Development Program, is promoting the domestic telecommunications network, an important infrastructure, improvement and expansion plan. Part of the nationwide backbone transmission network has already been completed by a terrestrial microwave system and is in service.

This transmission network extends from Banda Aceh at the northern end of Sumatra Island to such principal cities as Medan, Padang and Palembang, and extends further east to Ujung Pandang in the southern part of Sulawesi Island by way of Surabaya, Denpasar on Bali Island, and Lombok, Sunbawa and Flores Islands of Nusa Tenggara Island Group. Furthermore, in July 1976, the domestic satellite communication system was brought into service, making Indonesia the fourth country to have realized such service after the Canada, U.S.A. and U.S.S.R. This satellite communication system, together with the aforementioned terrestrial transmission network, is making significant contributions to the diffusion of telecommunications services on a nationwide scale.

However, in the eastern part of the Republic of Indonesia, i.e., the central and northern regions of Sulawesi Islands, Maluku district centering upon Ambon, Irian Jaya district, and the eastern region of Flores Island, the telecommunications network consists of the domestic satellite communication system and the out-of-date short wave communication system, covering only a part of main cities. With the progress of economic development of those regions being carried out by the Government of Indonesia,

the necessity is fast increasing for rapid telecommunications network improvement and expansion as the foundation of that economic development.

Under such circumstances, the Government of Indonesia decided to step up telecommunications network improvement and expansion in those regions, and requested the Government of Japan to assist in the formulation of a long term plan (master plan) for terrestrial transmission network establishment as an integral part of the above regional network improvement and expansion scheme.

In response to the Indonesian request, the Government of Japan decided to carry out the study for the said long term plan as part of overseas technical cooperation. The Japan International Cooperation Agency (JICA) as an executive organ of overseas technical cooperation dispatched a preliminary study team headed by Mr. Shigeru Fukuda to Indonesia in December 1981. The preliminary study team negotiated with the organizations concerned of the Government of Indonesia and made arrangements about the scope of work, tentative work period and so forth with regard to the study, and, on December 14, 1981, exchanged the Scope of Work with the Government of Indonesia.

Based on this Scope of Work, it was decided that the study be carried out in two phases: 1) formulation of a long term plan (master plan) for terrestrial transmission network establishment covering the whole eastern part of the Republic of Indonesia, and 2) formulation of a similar network plan (Feasibility study) for a specific district within the eastern zone to be designated by the Government of Indonesia after the completion of the above 1) network plan formulation.

The study which this Report convers belongs to the former out of the two phases mentioned; it was carried out for the purpose of formulation of the master plan for the whole eastern zone.

2. Objective and Target Area

The objective of this study is to work out the master plan for improvement and expansion of mainly the terrestrial backbone transmission network covering the whole eastern zone of the Republic of Indonesia, from the long term viewpoint up to the year 2005. (The master plan period is 20 years after the network improvement and expansion work begins assumedly in 1985.)

The study is also purposed to provide guidelines for stage by stage implementation of the network improvement and expansion plan and, at the same time, identify work by work priority in the implementation program.

The objective area of the study is the whole eastern zone of the Republic of Indonesia, comprising the following five regions:

Whole Sulawesi Island
- Southern District (Sulawesi Selatan)
- Northern district (Sulawesi Utara)
- Central district (Sulawesi Tengah)
- Southeastern district (Sulawesi Tenggara)

Nusa Tenggara Timur region
Timor Timur region
Maluku region
Irian Jaya region

In view of the objective of this study, i.e., the formulation of master plan for terrestrial transmission network improvement and expansion, the

investigation of specific matters, such as demand forecast and transmission system interfaces, must be carried out not only in the contiguous areas to the objective area but, in some cases, for the whole territories of Indonesia. Hence, for those specific matters, the study area is not limited to the objective area.

3. Study Team Organization and Work Categories

The study team organization is as follows:

Name	Duty	Place of Employment
Shigeru Futuda	Team leader; General administration	Ministry of Posts & Telecommunications
Mitsuru Tanaka	Telecommunications network planning	Nippon Telegraph & Telephone Public Corporation
Masahiro Yunoki	Telecommunications network planning	Nippon Telegraph & Telephone Public Corporation
Akio Mizukoshi	Satellite Communication system	Kokusai Denshin Denwa Co., Ltd.
Masao Kyogoku	Submarine cable system	Kokusai Denshin Denwa Co., Ltd.
Isao Iimura	Transmission network	The Nippon Telecommunications Consulting Co., Ltd.
Norio Obata	Terrestrial radio system	The Nippon Telecommunications Consulting Co., Ltd.
Ryoji Sasaki	Terrestrial radio system	The Nippon Telecommunications Consulting Co., Ltd.
Hideji Kajikawa	Traffic forecast, switching system	The Nippon Telecommunications Consulting Co., Ltd.
Shigeai Nitta	Traffic forecast, switching system	The Nippon Telecommunications Consulting Co., Ltd.
Tomizo Saito	Transmission system	The Nippon Telecommunications Consulting Co., Ltd.
Takeshi Komiya	Economic analysis	The Nippon Telecommunications Consulting Co., Ltd.
Tadashi Tomizawa	General coordination	Japan International Cooperation Agency
Norimoto Otake	General coordination	Japan International Cooperation Agency

Mr. Toru Miyachi, Mr. Motonori Ando and Mr. Satoru Hashimoto, who, dispatched by the Japan International Cooperation Agency, were assuming advisory duty at Perusahaan Umum telekomunikasi (PERUMTEL), Bandung, joined the study team and cooperated in its field survey activities.

Prior to the study, the preliminary study team was dispatched for 16 days from December 1 to 16, 1981. The preliminary study team was organized as follows:

Name	Duty	Place of Employment
Shigeru Fukuda	Team leader; General administration	Ministry of Posts & Telecommunications
Yoshiaki Shiota		Nippon Telegraph & Telephone Public Corporation
Yonekichi Nakada		Nippon Telegraph & Telephone Public Corporation
Shinichi Kamiyama		Nippon Telegraph & Telephone Public Corporation
Hachiro Shibasaki		Kokusai Denshin Denwa Co., Ltd.
Tadashi Tomizawa	General Coordination	Japan International Cooperation Agency

The work categories of study are fivefold. The five phases of study were carried out according to the schedule shown in the Scope of Work (signed on December 14, 1981) made by and between the preliminary study team and the Government of Indonesia.

(1) Phase 1: Preparatory Work in Japan

The preparatory work included the study of collected data, formulation of basic concept for the study, and formation of inception report.

(2) Phase 2: Field Survey

The field survey was carried out for 52 days from January 28 through March 20, 1982. Main work items follow:

1) Presentation of, as well as explanation and discussion about, inception report and basic concept for the study.

2) Negotiations with organizations concerned and consultation of their views.

3) Field survey in the target area and collection of necessary data and information.

4) Assortment of field survey results and analytical study of collected data and information.

5) Establishment of guiding principles for master plan formulation method.

6) Formulation, presentation and explanation of progress report, as well as confirmation of guiding principles in 5) above by minutes of proceedings (signed on March 18, 1982).

(3) Phase 3: Formulation of Interim Report, Presentation and Explanation Thereof

Based on field survey results, the interim report was formulated in Japan. This interim report was presented to the Government of Indonesia and, at the same time, the supplementary explanation was made during the period from August 9 to August 21, 1982.

(4) Phase 4: Formulation of Final Report (draft), Presentation and Explanation Thereof

The final report (draft), with comments by the Government of Indonesia on the interim report taken into account, was formulated in Japan. The presentation of this final report and the supplementary explanation were made during the period from October 8 to October 17, 1982.

(5) Phase 5: Finalization of Report and Presentation Thereof

After the final report (draft) presentation with the supplementary explanation, the final study report was formulated in Japan. The final report was forwarded to the Government of Indonesia on November, 1982. With this, all work categories in regard to the study, this time, were completed.

4. Government of Indonesia Offices and Personnel in Charge

The Government of Indonesia's offices in charge of telecommunications, which were the sources of request for this study, are the Directorate General of Posts and Telecommunications, Department of Communications, (DITJEN POSTEL) and Perusahaan Umum Telekomunikasi (PERUMTEL). Personnel of both offices, who were directly concerned with this study, inclusive of Counterparts, are as follows:

(1) DITJEN POSTEL

Ir. Rollin
Ir. Agus Darman
Mr. Saragih Bc. TT.
Ir. Harmaini

(2) PERUMTEL

Ir. Saleh Gunawan
Ir. Abdul Muhaimin
Mr. Achmad Yasin Rivai Bc.TT.
Mr. Azwar Mohamad Bc.TT.
Ir. Widjojo Amudji
Mr. Tamam Mulyadi
Mr. Rivai Pane
Ir. Remedi Peranginangin
Ir. Hernawan Suhardjo
Ir. Adi Rochwiatomo
Mr. Adek Julianwar B.St
Mr. Harjana Soetarja S. Bc.TT.
Ir. Sukowijono Abdullah Umar
Ir. Adi Prasetya
Ir. Cahyana
Ir. Mas'ud Bc.TT

II EASTERN INDONESIA : GENERAL CONDITIONS AND TELECOMMUNICATIONS

II. Eastern Indonesia: General Conditions and Telecommunications

1. General Conditions

1.1 Geography

Indonesia is the world's largest archipelago country consisting of 13,677 islands, large and small. (Out of these islands, 992 are inhabited.) Geographically, it lies between Asian continent and Australian Continent and between Indian Ocean and Pacific Ocean. The longest distance from north to south (from 6 degrees, North Latitude, to 11 degrees, South Latitude) measures 1,888 km; the longest distance from east to west (from 95 degrees to 141 degrees, East Longitude) measures 5,100 km. The whole territories embrace an area of 1,919,443 km^2.

Indonesia is situated in the western part of the Pacific loop volcanic zone that extends from Chile to Japan by way of Alaska and further to Indonesian Islands. Approximately 60% of the whole national territories is the forest zone. Furthermore, the Indonesian geography is featured by two mountain systems. One runs from north to eastern Indonesia via the Philippines. The other is an extension of the Burma Mountain System, running from the west coast of Sumatra to Sulawesi by way of Jawa and Bali Islands and the northeastern part of Indonesia.

The province (propinsi) by province areas of Indonesia appear in Table II-1.

1.2 Climate

The climate of Indonesia is the high temperature and high humidity tropical climate. The seasonal changes are slight. Two seasons that prevail are the dry season (April - October) and the rainy season (November - March). The average atmospheric temperature through the year is in the neighborhood of 27 degrees Centigrade, and this temperature seldom varies though it somewhat lowers in the rainy season. The amount of rainfall differs considerably from area to area but averages 2,000 mm annually. It does not suffer the influence of typhoons. The humidity remains practically unchanged at around 80% through the year.

1.3 Population

According to the 1980 census, the population of Indonesia is approximately 147 million. In the world list of population, Indonesia places 5th after China, India, U.S.S.R. and U.S.A.

The province by province breakdown of population and the population growth rates are given in Table II-2. The population percentages by provinces, as well as the population density, are shown in Table II-3.

In Indonesia, the population growth rate was 2.0% annually during 1961 through 1971 and 2.32% annually in the decade from 1971 to 1980. The distribution of population is extremely irregular. Up to 61.88% of the total population constitutes the parmanent population of Jawa and Madura, the two major islands whose combined area assumes a mere 6.89% of the gross national territories.

In the objective areas of this study, the population density compared with the national average of 77/km^2 as of 1980 is extremely low except 111/km^2 in the province of Sulawesi Utara and 83/km^2 in the province of Sulawesi Selatan. However, the population growth rate is higher than the national average in almost all provinces. With the progress of regional developments by the Government of Indonesia, the population growth rate uptrend will continue unabated in the foreseeable future.

The population estimate up to the year 2001 is in Table II-4. Although the advanced age group proportion increases to some extent, the young age group will continue to predominate in overall demography in the future also.

An outline of the internal transmigration plan is given in Appendix II-1.

1.4 Ecomonic Situation

During 1960 through 1966, the growth of national economy of Indonesia remained at low ebb. That is to say, the growth rate of GDP in the period mentioned was as low as 2.1% annually or almost the same as the growth rate of population. In 1968, the sign of improvement began to be seen. Since that time up to the present, the growth rate of GDP of 7% or so annually has been realized.

GDP behaviors during the period from 1973 to 1979 are given in Table II-5 and Table II-6. The breakdown of GDP by provinces in the objective areas of this study, as well as GDP per capital, appears in Table II-7 and Table II-8.

GDP standings in the provinces of eastern Indonesia are extremely low when compared with the national average. However, in the growth rates of GDP in those provinces, compared with the national average, a conspicuous improvement can be recognized. This certainly is an indication of the fact that the Government of Indonesia is now carrying out on a full scale the regional development of eastern Indonesia which, in the past, was outside of the priority development target. For the regional development policy of the Government is to carry out all regional developments on an equal footing, so that a further improvement of regional economies in eastern Indonesia can be expected.

The industrial structure in the whole of Indonesia is given in Appendix II-2 and that in the objective area of this Study in Appendix II-3.

1.5 Economic Development Plan

In 1951, for the first time after the independence, Indonesia established a large scale economic development plant (1951 - 1952). Then, in 1956, the First Five-Year National Development Plan (1956 - 1960) was prepared and put into practice. Furthermore, the Integral Development Plan (1961 - 1969) was prepared and put into practice. These development plans, however, could not be as successful as initially designed.

Subsequently, the economic rehabilitation and stabilization were taken up as main policy lines of the Government of Indonesia. In April 1969, a new five-year (1969 - 1974) national development plan began to be practiced. Today, this development plan is known as the First Five-Year National Development plan (Repelita I).

In this first five-year development plan, emphasis was placed on putting under control of the protracted economic irregularity in the past and on the positive development of agriculture. The result was wholesome as seen in the attainment of 7.7% growth in GDP, much higher than the growth target of 5%.

Then followed the Second Five-Year National Development Plan (1974 - 1979). This time, based on the attainment in the first five-year plan, the GDP growth rate for the entire period was set at 7.5% whereas the objectives were to smoothen the supply of good quality, reasonably priced foods and clothings and to improve and substantiate social overhead capital. The actual growth rate during the period was not more than 6.9% or somewhat lower than the target of 7.5%. This was mainly due to the smaller than planned growths of the agricultural and mining sectors. Nevertheless, the strengthening of social overhead capital was worth nothing as a sign of steady progress of this development plan.

The national development plan of Indonesia is financed by surplus government fund and foreign aid. Up to three-quarters of development expenditures during the second five-year plan were spent for the improvement of agriculture, irrigation, transportation, communications, regional development, power generation, education and culture, as well as manufacturing and mining. Not less than 33% of development expenditures were met with foreign aid, and the foreign aid investment was made mainly in transportation, communications, power generation and manufacturing/mining sectors.

A gist of the Third Five-Year Development Plan is given in Appendix II-4.

Table II-1 Areas by Provinces

PROVINCE	KM^2	% OF TOTAL AREAS
Daerah Istimewa Aceh	55,392	2.88
Sumatera Utara	70,787	3.69
Sumatera Barat	49,778	2.59
Riau	94,562	4.93
Jambi	44,924	2.34
Sumatera Selatan	103,688	5.40
Bengkulu	21,168	1.74
Lampung	33,307	1.10
SUMATERA	473,606	24.67
D.K.I. Jakarta	590	0.03
Jawa Barat	46,300	2.41
Jawa Tengah	34,206	1.78
D.I. Yogyakarta	3,169	0.17
Jawa Timur	47,922	2.50
JAWA & MADURA	132,187	6.89
Bali	5,561	0.29
Nusa Tenggara Barat	20,177	1.05
Nusa Tenggara Timur	47,876	2.49
Timor Timur	14,874	0.78
BALI & NUSA TENGGARA	88,488	4.61
Kalimantan Barat	146,760	7.65
Kalimantan Tengah	152,600	7.95
Kalimantan Selatah	37,660	1.96
Kalimantan Timur	202,440	10.55
KALIMANTAN	539,460	28.11
Sulawesi Utara	19,023	0.99
Sulawesi Tengah	69,726	3.63
Sulwasi Selatan	72,781	3.79
Sulawesi Tenggara	27,686	1.44
SULAWESI	189,216	9.85
Maluku	74,505	3.88
Irian Jaya	421,981	21.99
INDONESIA	1,919,443	100.00

Note: - Caluculated by poolplanimetre
- Result as projection area

Source: Topographical Service TNI AD.

Table II-2 Number of Population by Provinces in 1961, 1971 and 1980

PROVINCE	NUMBER OF POPULATION			POPULATION GROWTH (%)	
	31 Oct. 1961	24 Sept. 1971	31 Oct. 1980	1961-1971	1971-1980
DAERAH ISTIMEWA ACEH	1,628,983	2,008,595	2,611,271	2.14	1.93
SUMATERA UTARA	4,964,734	6,621,831	8,360,894	2.95	2.60
SUMATERA BARAT	2,319,057	2,793,196	3,406,816	1.90	2.21
RIAU	1,234,984	1,641,545	2,168,535	2.92	3.11
JAMBI	744,381	1,006,084	1,445,994	3.03	4.07
SUMATERA SELATAN	2,773,464	3,440,573	4,629,801	2.20	3.32
BENGKULU	405,249	519,316	768,064	2.51	4.39
LAMPUNG	3,667,511	2,777,008	4,624,785	5.29	5.77
SUMATERA	15,739,363	20,808,148	28,016,160	2.86	3.37
DKI JAKARTA	2,973,052	4,579,303	6,503,449	4.46	3.93
JAWA BARAT	17,614,555	21,623,529	27,453,525	2.03	2.66
JAWA TENGAH	18,407,471	21,877,136	25,372,889	1.76	1.64
DAERAH ISTIMEWA YOGYAKARTA	2,241,477	2,489,360	2,750,813	1.07	1.10
JAWA TIMUR	21,823,020	25,516,999	29,188,852	1.59	1.49
JAWA	63,059,575	76,086,327	91,269,528	1.91	2.02
BALI	1,782,529	2,120,322	2,469,930	1.77	1.69
NUSA TENGGARA BARAT	1,807,830	2,203,465	2,724,664	2.02	2.36
NUSA TENGGARA TIMUR	1,967,297	2,295,287	2,737,166	1.57	1.95
TIMOR TIMUR	-	-	555,350	-	-
NUSA TENGGARA	5,557,656	6,619,074	8,487,110	1.78	2.01 *)
KALIMANTAN BARAT	1,581,034	2,019,936	2,486,068	2.51	2.31
KALIMANTAN TENGAH	496,522	701,936	954,353	3.56	3.43
KALIMANTAN SELATAN	1,473,155	1,699,105	2,064,649	1.45	2.16
KALIMANTAN TIMUR	550,764	733,797	1,218,016	2.91	5.73
KALIMANTAN	4,101,475	5,154,774	6,723,086	2.31	2.96
SULAWESI UTARA	1,310,054	1,718,543	2,115,384	2.78	2.31
SULAWESI TENGAH	693,157	913,662	1,289,635	2.83	3.86
SULAWESI SELATAN	4,516,548	5,180,576	6,062,212	1.49	1.74
SULAWESI TENGGARA	559,594	714,120	942,302	2.49	3.09
SULAWESI	7,079,349	8,526,901	10,409,533	1.90	2.22
MALUKU	789,534	1,089,565	1,411,006	3.31	2.88
IRIAN JAYA	758,396	923,440	1,173,875	2.01	2.67
MALUKU & IRIAN JAYA	1,547,930	2,013,005	2,584,881	2.69	2.79
INDONESIA	97,085,348	119,208,223	147,490,298	2.10	2.32 *)

*) not including Timor Timur

Source: Penduduk Indonesia 1980, Menurut Propinsi dan Kabupaten/Kotamadya Biro Pusat Statistik

Table II-3 Percentage of Areas and Population Density in 1961, 1971 and 1980

PROVINCE	AREA (Km^2)	PERCENTAGE OF AREA (%)	PERCENTAGE OF POPULATION			POPULATION DENSITY		
			31 Oct. 1961 (%)	24 Sept. 1971 (%)	31 Oct. 1980 (%)	31 Oct. 1961 ($/Km^2$)	24 Sept. 1971 ($/Km^2$)	31 Oct. 1980 ($/Km^2$)
DAERAH ISTIMEWA ACEH	55,392	2.88	1.68	1.68	1.77	29	35	47
SUMATERA UTARA	70,787	3.69	5.11	5.55	5.67	70	93	118
SUMATERA BARAT	49,778	2.59	2.39	2.34	2.31	47	56	68
RIAU	94,562	4.93	1.27	1.38	1.47	13	17	23
JAMBI	44,924	2.34	0.76	0.84	0.98	17	22	32
SUMATERA SELATAN	103,688	5.40	2.66	2.89	3.14	27	33	45
BENGKULU	21,168	1.10	0.42	0.46	0.52	19	24	36
LAMPUNG	33,307	1.74	1.72	2.33	3.14	50	83	139
SUMATERA	473,606	24.67	16.21	17.65	19.00	33	44	59
DKI JAKARTA	593	0.03	3.06	3.84	4.41	5,039	7,761	11,023
JAWA BARAT	46,300	2.41	18.14	18.14	18.61	380	457	593
JAWA TENGAH	34,206	1.78	18.36	18.35	17.20	538	640	742
DAERAH ISTIMEWA YOGYAKARTA	3,169	0.17	2.31	2.09	1.87	707	785	869
JAWA TIMUR	47,922	2.50	22.48	21.41	19.73	455	532	699
JAWA	132,187	6.83	64.95	63.83	61.88	476	576	690
BALI	5,561	0.29	1.84	1.78	1.67	320	381	444
NUSA TENGGARA BARAT	20,177	1.05	1.86	1.85	1.85	93	103	135
NUSA TENGGARA TIMUR	47,876	2.49	2.03	1.92	1.86	41	49	57
TIMOR TIMUR	14,874	0.78	-	-	0.38	-	-	37
NUSA TENGGARA	88,488	4.61	5.73	5.55	5.76	63	75	96
KALIMANTAN BARAT	146,760	7.65	1.63	1.69	1.68	11	14	17
KALIMANTAN TENGAH	152,600	7.95	0.51	0.59	0.65	3	5	6
KALIMANTAN SELATAN	37,660	1.96	1.52	1.62	1.69	33	45	55
KALIMANTAN TIMUR	202,440	10.55	0.57	0.62	0.83	3	4	6
KALIMANTAN	539,460	28.11	4.23	4.32	4.56	8	10	12
SULAWESI UTARA	19,023	0.99	1.35	1.46	1.43	69	90	111
SULAWESI TENGAH	69,726	3.63	0.71	0.77	0.87	10	13	18
SULAWESI SELATAN	72,781	3.73	4.65	4.36	4.11	62	71	83
SULAWESI TENGGARA	27,686	1.44	0.58	0.60	0.66	20	26	34
SULAWESI	189,216	9.85	7.29	7.15	7.05	38	45	55
MALUKU	74,505	3.88	0.81	0.92	0.96	11	15	19
IRIAN JAYA	421,981	21.99	0.78	0.78	0.79	2	2	3
MALUKU + IRIAN JAYA	496,486	25.87	1.59	1.70	1.75	3	4	5
INDONESIA	1,919,443	100.00	100.00	100.00	100.00	51	62	77

Source: JAWATAN TOPOGRAFI TNI AD

Table II-4 Population Projection of Indonesia by Age Groups, 1976 - 2001 (1/2)

AGE GROUP	YEAR						
	1976	1977	1978	1979	1980	1981	1982
0 - 4	19,565.4	19,496.2	19,570.7	19,876.1	20,352.1	20,977.0	21,083.2
5 - 9	18,297.3	18,507.4	18,619.5	18,619.5	18,530.0	18,457.6	18,776.9
10 - 14	16,562.3	16,919.6	17,256.6	17,566.6	18,810.8	17,951.9	18,018.7
15 - 19	14,089.5	14,507.5	14,976.2	15,416.4	15,851.7	16,240.7	16,620.5
20 - 24	11,835.8	12,320.9	12,711.0	13,041.7	13,369.0	13,714.2	14,143.7
25 - 29	8,441.2	8,914.6	9,548.3	10,234.9	10,887.8	11,453.2	11,939.0
30 - 34	7,648.5	7,635.8	7,619.0	7,671.9	7,844.3	8,135.5	8,618.3
35 - 39	7,948.0	7,911.7	7,794.4	7,614.6	7,451.5	7,329.4	7,283.7
40 - 44	6,668.9	6,890.9	7,133.7	7,355.3	7,509.9	7,561.0	7,528.8
45 - 49	5,516.3	5,651.9	5,797.8	5,939.1	6,102.6	6,282.9	6,496.2
50 - 54	4,503.0	4,620.3	4,737.1	4,863.6	4,985.0	5,112.5	5,242.1
55 - 59	3,591.2	3,701.0	3,787.2	3,880.0	3,969.8	4,067.8	4,167.5
60 - 64	2,652.2	2,747.5	2,840.0	2,930.9	2,016.3	3,114.3	3,213.4
65 - 69	1,933.0	1,939.9	2,021.7	2,062.6	2,107.3	2,159.6	2,233.0
70 +	2,051.4	2,135.2	2,217.9	2,303.1	2,390.5	2,483.0	2,574.6
TOTAL	131,304.3	133,940.2	136,630.7	139,376.3	142,178.8	145,038.8	147,939.7

Table II-4 Population Projection of Indonesia by Age Groups, 1976 - 2001 (2/2)

AGE GROUP	YEAR						
	1983	1984	1985	1986	1991	1996	2001
0 - 4	21,315.2	21,529.8	21,935.7	22,572.9	23,937.9	24,728.5	25,120.2
5 - 9	19,015.5	19,374.9	19,721.2	19,961.5	21,659.8	23,145.1	24,062.3
10 - 14	18,090.1	18,111.6	18,122.4	18,153.9	19,680.1	21,401.9	22,912.6
15 - 19	16,956.0	17,253.1	17,483.5	17,643.5	17,883.2	19,429.0	21,168.7
20 - 24	14,589.4	15,042.6	15,471.4	15,852.4	17,274.4	17,560.6	19,126.8
25 - 29	12,327.6	12,650.7	12,963.7	13,315.2	15,448.3	16,894.3	17,227.0
30 - 34	9,228.2	9,898.5	10,538.7	11,078.1	12,933.2	15,065.3	16,533.1
35 - 39	7,271.6	7,351.8	7,525.8	7,828.2	10,711.5	12,561.0	14,688.8
40 - 44	7,417.9	7,474.2	7,115.3	7,006.2	7,521.3	10,341.1	12,178.0
45 - 49	6,730.5	6,957.3	7,109.7	7,160.4	6,669.7	7,197.7	9,940.4
50 - 54	5,381.4	5,534.0	5,697.3	5,856.4	6,712.8	6,288.0	6,822.5
55 - 59	4,286.3	4,400.6	4,521.8	4,649.2	5,360.4	6,185.5	5,829.1
60 - 64	3,294.2	3,370.7	3,457.4	3,556.3	4,097.5	4,761.7	5,537.3
65 - 69	2,331.2	2,409.7	2,485.1	2,561.4	2,954.7	3,439.0	4,033.9
70 +	2,665.9	2,764.2	2,860.5	2,963.8	3,556.4	4,241.3	5,053.1
TOTAL	150,900.8	153,923.7	157,009.5	160,159.4	176,400.9	193,240.1	210,233.7

Note : Figures may not add to totals because of rounding

Source: Projection Population of Indonesia Seri K No. 2 CBS.

Table II-5 Gross Domestic Product at Current Market Prices by Industrial Origin

Unit : Billion Rupiah

	1973	1974	1975	1976	1977	1978	1979	
							GDP	% of GDP
1. Agriculture, Livestock, Forestry, Fishery	2,710.0	3,437.0	4,003.4	4,812.0	5,905.7	6,706.0	9,145.0	29.8
Farm Food Crops	1,573.0	2,036.0	2,554.8	3,043.9	3,659.9	3,991.4	5,365.3	17.5
Farm non Food Crops	323.0	386.0	358.1	481.2	762.2	801.3	1,111.6	3.6
Estate Crops	152.0	191.0	183.8	213.0	325.6	406.5	624.5	2.0
Livestock and Products	173.0	223.0	302.7	345.9	305.2	452.5	550.1	1.8
Forestry	355.0	422.0	413.2	512.8	524.6	653.2	941.7	3.1
Land and Marine Fishery	134.0	179.0	190.8	215.2	328.2	333.4	551.8	1.8
2. Mining and Quarying	831.0	2,374.0	2,494.8	2,930.0	3,593.7	3,869.2	5,171.7	16.9
3. Manufacturing Industries	659.0	839.0	1,123.7	1,453.3	1,816.9	2,181.7	2,825.1	9.2
4. Electricity, Gas and Water Supply	39.4	52.0	69.8	93.1	105.6	115.8	129.7	0.4
5. Construction	262.0	406.0	583.6	812.6	1,023.3	1,242.1	1,843.7	6.0
6. Wholesale and Retail Trade	1,118.0	1,735.0	2,103.7	2,551.9	2,959.0	3,450.2	5,601.3	18.3
7. Transport and Communications	257.0	442.0	521.2	652.6	820.6	973.6	1,382.7	4.5
8. Other Financial Intermediaries	83.0	113.0	151.4	206.5	236.4	335.6	649.9	2.1
9. Ownership of Dwelling	183.0	194.0	257.8	318.9	542.2	670.6	935.7	3.0
10. Public Administration and Defence	405.0	585.0	864.3	1,074.3	1,334.2	1,685.4	2,179.6	7.1
11. Service	264.0	389.0	472.8	545.5	697.1	668.2	835.3	2.7
Gross Domestic Product	6,753.4	10,708.0	12,642.5	15,456.7	19,010.7	21,967.4	30,669.7	100.0
Growth Rate (%)		58.6	18.1	23.8	22.9	15.5	39.6	

Source: Statistical Pocketbook of Indonesia
Biro Pusat Statistik

Table II-6 Gross Domestic Product at Constant 1973 Market Price by Industrial Origin

Unit : Billion Rupiah

	1973	1974	1975	1976	1977	1978	1979	
							GDP	% of
1. Agriculture, Livestock, Forestry, Fishery	2,710.0	2,811.0	2,811.2	2,943.7	2,991.3	3,134.8	3,203.7	33.2
Farm Food Crops	1,573.0	1,621.0	1,695.1	1,755.5	1,734.2	1,835.8	1,869.9	18.7
Farm non Food Crops	323.0	307.0	312.2	325.0	332.2	338.2	402.3	4.0
Estate Crops	152.0	176.0	189.2	188.9	201.0	209.5	230.8	2.3
Livestock and Products	173.0	186.0	202.6	215.8	177.3	184.2	169.1	1.7
Forestry	355.0	325.0	273.8	309.8	317.6	351.6	358.4	3.7
Land and Marine Fishery	134.0	138.0	143.5	149.6	159.0	165.5	172.2	1.7
2. Mining and Quarrying	831.0	859.0	828.1	952.3	1,070.0	1,040.3	1,043.6	10.5
3. Manufacturing Industries	650.0	755.0	847.9	930.0	1,057.7	1,176.5	1,224.6	12.9
4. Electricity, Gas and Water Supply	33.6	37.0	41.2	45.3	49.0	53.3	59.7	0.6
5. Construction	262.0	320.0	368.8	388.5	453.8	528.9	562.8	5.7
6. Wholesale and Retail Trade	1,118.0	1,224.0	1,293.8	1,359.7	1,438.2	1,530.3	1,632.9	16.4
7. Transport and Communications	257.0	288.0	302.7	342.6	427.6	439.1	557.7	5.6
8. Other Financial Intermediaries	83.0	88.0	101.6	117.4	151.2	168.6	183.4	1.8
9. Ownership of Dwelling	143.0	176.0	198.4	269.1	252.2	287.6	306.1	3.1
10. Public Administration and Defence	405.0	443.0	564.1	535.5	683.8	767.9	737.7	8.1
11. Service	264.0	270.0	277.0	284.2	293.1	295.9	304.0	3.1
Gross Domestic Product	6,253.4	7,269.0	7,630.8	9,156.3	8,870.9	9,471.2	9,935.2	100.0
Growth Rate (%)		7.6	5.0	6.9	8.8	6.8	4.9	

Source: Statistical Pocketbook of Indonesia
Biro Pusat Statistik

Table II-7 Gross Regional Domestic Product by Provinces in Objective Area, 1975 - 1978

(in bracket : annual growth rate)

unit : Million Rupiah

	At Current Market Prices				At Constant 1975 Market Prices			
	1975	1976	1977	1978	1975	1976	1977	1978
Sulawesi Utara	154,783.83 (-)	185,186.13 (19.6%)	290,525.02 (56.9%)	-	146,132.63 (-)	155,410.68 (6.3%)	206,519.81 (32.9%)	-
Sulawesi Tengah	56,834.12 (-)	80,313.84 (41.3%)	104,046.41 (29.5%)	137,579.68 (32.2%)	56,834.12 (-)	65,584.06 (15.4%)	71,333.03 (8.8%)	75,338.65 (5.7%)
Sulawesi Selatan	358,623.53 (-)	428,377.66 (19.5%)	544,135.05 (27.0%)	665,814.48 (22.5%)	358,623.53 (-)	373,638.71 (4.2%)	438,973.55 (17.5%)	492,589.48 (12.2%)
Sulawesi Tenggara	38,820.53 (-)	54,526.48 (40.5%)	66,118.16 (21.3%)	76,824.89 (16.2%)	38,820.53 (-)	43,202.33 (11.3%)	48,535.31 (12.3%)	55,222.17 (13.8%)
Nusa Tenggara Timur	93,487.41 (-)	119,749.31 (28.1%)	142,144.67 (18.7%)	185,174.88 (30.3%)	93,487.41 (-)	99,206.80 (6.1%)	105,774.51 (6.6%)	113,372.23 (7.2%)
Maluku	102,535.58 (-)	138,250.11 (34.8%)	196,599.75 (42.2%)	213,443.63 (8.6%)	102,535.58 (-)	119,756.66 (16.8%)	132,207.43 (10.4%)	126,915.51 (4.0%)
Irian Jaya : with mining	212,485.50 (-)	269,358.63 (26.7%)	320,224.93 (19.0%)	404,455.73 (26.3%)	212,485.50 (-)	247,530.95 (16.5%)	269,768.01 (9.0%)	319.033.92 (18.3%)
(Irian Jaya : without mining)	82,801.01 (-)	108,553.69 (31.1%)	137,072.42 (26.3%)	162,093.43 (18.3%)	82,801.01 (-)	92,253.29 (11.4%)	103,837.04 (12.5%)	116.269.97 (11.9%)
Timor Timur	-	-	-	-	-	-	-	-

Source : Provincial Income in Indonesia 1975 - 1978
Biro Pusat Statistik

Table II-8 Per Capita of Gross Regional Domestic Product by Provinces in Objective Area, 1975 - 1978

unit : Rupiah

	At Current Market Prices				At Constant 1975 Market Prices			
	1975	1976	1977	1978	1975	1976	1977	1978
Sulawesi Utara	81,465	94,967	143,362	-	76,912	79,698	101,909	
Sulawesi Tengah	56,235	74,808	93,887	120,697	56,235	61,088	64,361	66,147
Sulawesi Selatan	66,532	77,213	95,723	116,630	66,532	67,347	77,223	86,157
Sulawesi Tenggara	50,892	68,428	79,819	91,841	50,892	54,217	58,233	66,001
Nusa Tenggara Timur	38,633	48,705	57,081	71,967	38,633	40,350	42,476	44,067
Maluku	83,012	109,343	152,454	161,105	83,012	94,655	102,093	95,014
Irian Jaya : with mining	205,795	254,570	295,776	364,822	205,795	234,118	249,171	287,830
(Irian Jaya : Without mining)	80,194	102,671	126,607	146,205	80,194	87,260	45,909	104,876
Timor Timur	-	-	-	-	-	-	-	-

Source: Provincial Income in Indonesia 1975 - 1978
Biro Pusat Statistik

2. Status of Telecommunications

2.1 Role of Telecommunications in Indonesia

In Indonesia, a country that embraces a huge population scattered in the vast national territories, telecommunications as an integral part of social overhead capital perform an extremely important role for the attainment of national development objectives. The exchange of information is indispensable for social life. Telecommunications as a means of information exchange are prerequisite to the development of rich natural resources, such as petroleum, natural gas, tin and nickel ore deposits, in remote areas; the development of agriculture utilizing the vast fertile lands and of opulent forestry and fishery resources; the transmigration of maldistributed population to underpopulated remote areas; and the integration of national defense.

2.2 Background of Development

2.2.1 Prior to Repelita I (before 1969)

Telecommunications facilities in Indonesia before 1969 were poor both qualitatively and quantitatively. They were far from being sufficient to meet the demand. An outline of those facilities follows:

- Telephone facilities consisted of 175,000 line units. Of this total, 57% were manual type.
- Telegraph facilities were generally obsolete. The most part of them were Morse code type.
- Transmission facilities were the open wire system and short wave radio system for the most part.
- Telephone density was as low as 0.16 in the national average. This density was among the lowest in the world.

2.2.2 Repelita I Period (1969 - 1974)

Repelita I was started as the initial step of telecommunications development. The status of facilities at the time of completion of Repelita I (1974) follows:

- Telephone facilities consisting of 63,691 line units were newly established. These new facilities were equivalent to one-third of the existing facilities. Out of the new facilities, 58,500 line units were automatic facilities.
- Jawa - Bali microwave link was put into service.
- Subscriber Long Distance Dialling (SLDD) service was started.
- Improvement of super transmission routes was carried out.
- High quality telex service became available.
- International communications facilities were improved.

2.2.3 Repelita II Period (1974 - 1979)

Following the completion of Repelita I, Repelita II was formulated and put into practice. The status of facilities at the time of completion of Repelita II (1979) follows:

- Automatic telephone facilities consisting of 427,000 line units (301,200 line units increased) were in operation.
- Telex facilities consisting of 9,170 line units (7,360 line units increased) were in operation.
- SLDD network consisting of 26,000 channels was in operation.
- Microwave network consisting of 1,316,618 channels/km was in operation.

- 40 earth stations of the domestic communication satellite system were in operation.

By the completion of Repelita II, the telephone density grew from 0.18 in 1971 to 0.29 in 1978. Figure II-1 shows the telephone set growth during the past 10 years (1971 - 1980).

2.2.4 Repelita III Period (1979 - 1984)

Repelita III now in progress is to be implemented in two phases, i.e., consolidation phase and expansion phase.

(1) Consolidation Phase

The unfinished work in the Repelita II period is to be completed in the first two years (1979 - 1980) of the Repelita III period. Main work items are:

- New/additional installation of telephone facilities by 152,000 line units.
- New/additional installation of telex facilities by 3,910 line units.
- Expansion of short wave communication facilities in Kalimantan, Maluku and Irian Jaya.
- Construction of Medan - Banda Aceh (Northern Sumatra) microwave link.
- Expansion of spur route network.
- Increase of SKSD (Domestic Satellite Communication Network) channels.

(2) Expansion Phase

The later three years (1981 - 1984) of the Repelita III period are for expansion of telecommunications facilities. Main work items are:

- Installation of additional 80,000 line unit telephone facilities. Of this total, 7,000 line units are for agricultural and remote areas.
- Improvement of transmission route capacity by means of Jawa - Bali microwave link capacity increase to 1,800 channels, Sumatra microwave link capacity increase to the maximum 1,250 channels, and Eastern microwave link capacity increase.
- Route Expansion for SLDD facilities.
- Launching of Palapa Satellites 3 and 4 and construction of 75 more earth stations.
- Construction of spur routes in Sumatra, southern Kalimantan, Southern Sulawesi and Bali.
- Construction of radio frequency monitoring system.

2.3 Status Quo of Terrestrial Transmission Routes

The existing terrestrial transmission routes comprise four backbone routes: Jawa - Bali, Trans-Sumatra and Eastern microwave links and Surabaya - Banjarmasin tropo-scatter link. (See Figure II-2.) In addition to these terrestrial transmission routes, the domestic satellite communication system is also operated. Earth station sites for the domestic communication satellites are shown in Figure II-3. As is evident in these arrangements, the western part of Indonesia is covered by large capacity, high quality terrestrial transmission routes; however, in the objective areas of this Study, no stable terrestrial transmission route exists.

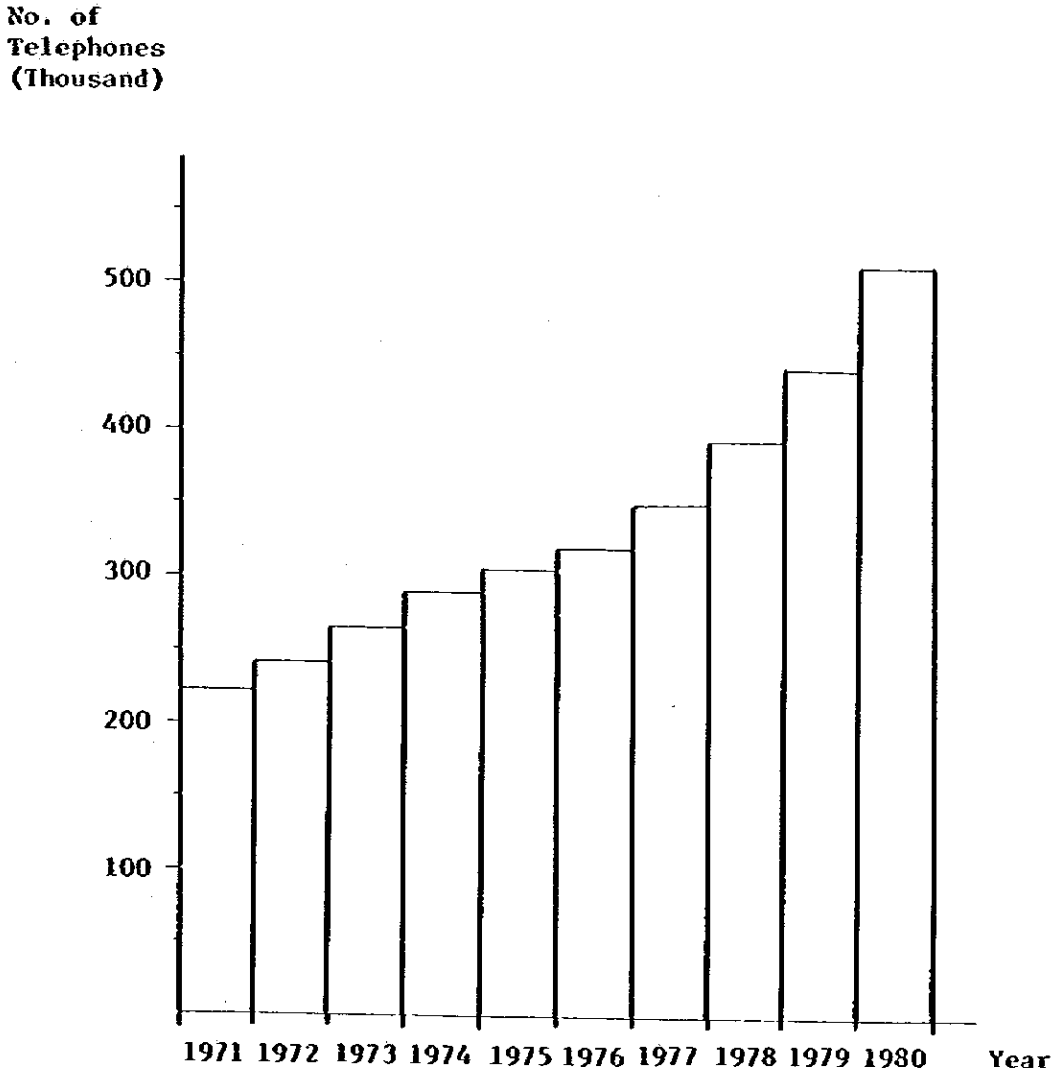


Figure II - 1 Number of Telephones within a Decade

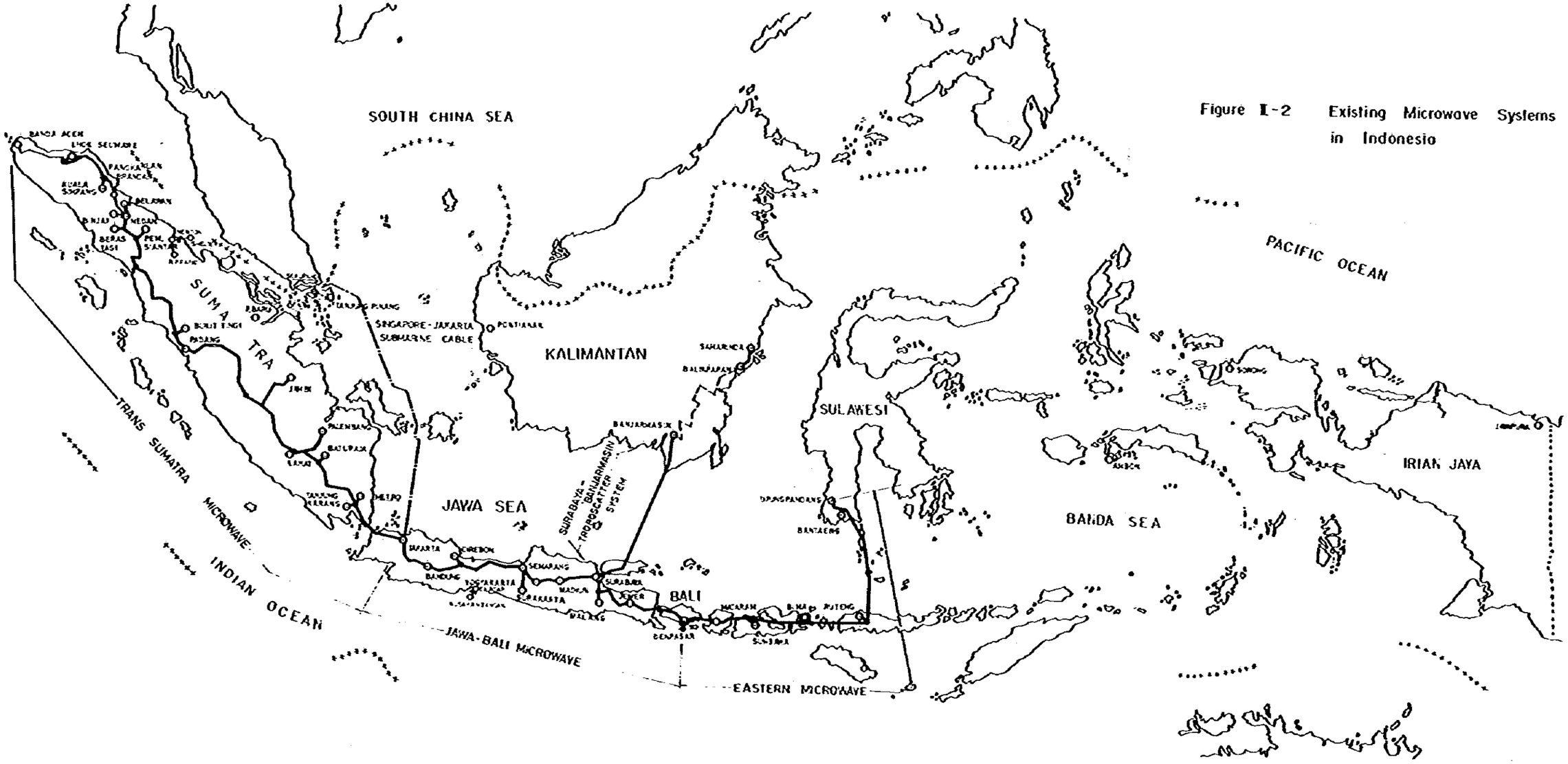


Figure II-2 Existing Microwave Systems in Indonesia

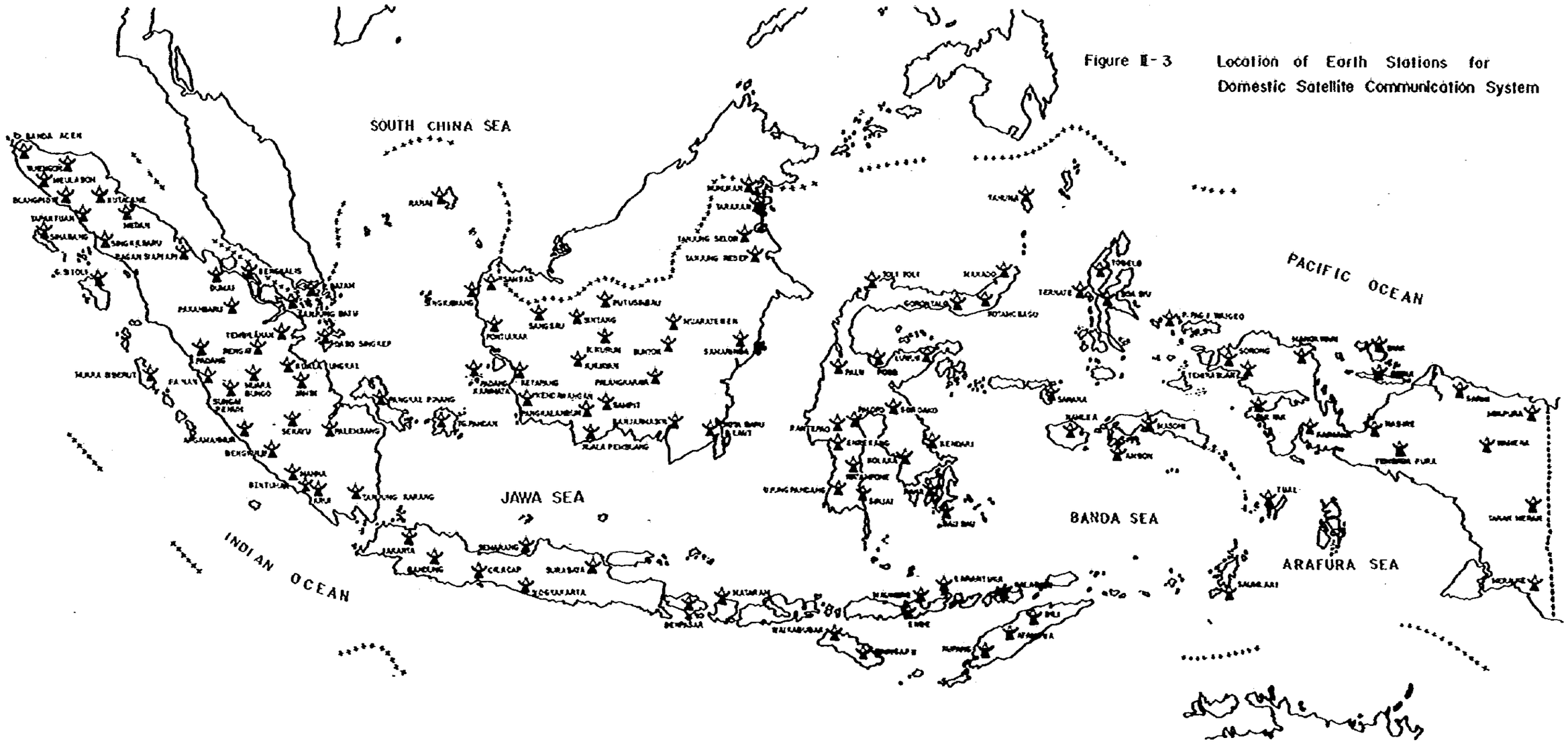


Figure II-3 Location of Earth Stations for Domestic Satellite Communication System

III BASIC PHILOSOPHY AND PRECONDITIONS OF STUDY

III. Basic Philosophy and Preconditions of Study

1. Basic Philosophy

Presently, in the eastern region of Indonesia where this study was carried out, telecommunication services by the Domestic Satellite Communcation System (PALAPA System) are being provided to 21 major cities. Further, when 24 satellite earth stations now under construction come into commercial operation, the number of cities where telecommuncation services are available will increase to 45.

As described later, this study aims at service provision to a total of 99 cities in the said region by the year 2005, so that the number of cities where the services by PALAPA System are available at present is about 20% of the total objective cities of this study. The ratio increases to about 45% when the cities where service availability is scheduled in the near future are also considered.

The prime objective of this study is to formulate the master plan for transmission network to provide services to all the objective cities in the region. To attain this objective, two methods can be considred. One is to expand services via PALAPA System, which are presently available at specific cities, to all the objective cities. The other is to construct and operate a terrestrial transmission system apart from PALAPA System.

Which of these two methods to adopt requires an intensive study by comparison between them from technical and economic viewpoints. Both methods have their merits and demerits so that the best choice is to have the merits of either method complement the demerits of the other in the transmission network formation. This especially holds true because rapid social and economic developments arouse requirements for

diversified telecommunication services - upgraded in quality, rich in quantity, sophisticated in mode, and stable in supply.

The purpose of this study is to constitute a new transmission network by a terrestrial transmission system in the objective areas, separately from the existing domestic satellite communication system, for the eventual purpose of coordinated services by both systems.

In other words, this study is dedicated to necessary investigations and examinations for introducing a terrestrial transmission network in the whole objective areas as far as topographically and technically possible.

For the purpose of reference, the findings in comparative studies of both systems in terms of their respective merits and demerits, as well as the areas of application, are summarized in Appendix III-1.

2. Preconditions

Items stated below are taken into due consideration as preconditions to formulation of the master plan. Such preconditions were identified through the series of discussions with the authorized agencies of the Government of Indonesia.

(1) PERUMTEL's Fundamental Plan

PERUMTEL, the authorized telecommunication agency of Indonesia, established in 1972 the Fundamental Plan for the Telephone Network in Indonesia as the general guideline and standard for implementation of national telecommunication network projects. And, based on this Fundamental Plan, PERUMTEL has been carrying out the domestic telecommunication network improvement and expansion programs.

However, in view of the progress of the overall national development plan, as well as the recent developmental trends of new technology in the field of telecommunication systems, PERUMTEL reviewed its Fundamental Plan and formulated the revised version in 1981.

Items contained in the revised Fundamental Plan for the Telephone Network are:

1) National Telephone Network Development Plan
2) Numbering Plan
3) Charging Plan
4) Routing Plan
5) Transmission Plan
6) Signalling Plan

All these items constitute the basic requirements for the telecommunication network planning. The revised Fundamental Plan is so established that it can cater for demand behaviors up to the year 2000. (For the Numbering Plan, the estimate is for 50 years ahead.)

In this study also, the master plan for terrestrial transmission network is formulated, based on PERUMTEL's Fundamental Plan as far as the basic requirements are concerned. For some of contents of the Fundamental Plan, which would have to be altered or modified in the course of this study, necessary suggestions or recommendations will be made.

(2) Objective Cities of Study

In the Numbering Plan of the aforementioned Fundamental Plan for the Telephone Network, the whole territories of Indonesia are divided into 300 unit numbering areas and the calling of each unit area is designated. This unit area is the minimum unit of the toll call zone system also. In each unit area, at least one toll switching center is to be established in the central part of the area.

The terrestrial transmission network covering the eastern region of Indonesia is to interlink one toll switching center to another systematically. Therefore, the master plan formulation includes the finding of approaches to the fittest terrestrial transmission network that can cover all toll switching centers to be established in the region.

Pursuant to the progress of national and regional development programs from now on, reviewing of the Numbering Plan will become necessary. The Numbering Plan adopted in the Fundamental Plan is so arranged as can comply with all requirements involved in future social changes up to 50 years ahead. Hence little or no need for major modifications or alterations. It will therefore be safe to formulate the master plan, based on the Numbering Plan.

As for the individual unit numbering areas, with cities identified, in the eastern region of Indonesia, full descriptions are made in Chapter IV. With the undermentioned 99 toll switching centers to be established, this study is proceeded.

Administrative District	Toll Call Zone Office Hierarchy			Total
	Tertiary Center	Secondary Center	Primary Center	
Sulawesi				
- Selaten	Ujung Pandang	-	4	5
		Pare Pare	8	9
- Utara		Manado	6	7
- Tengah		Paru	8	9
- Tenggara		Kendari	6	7
Maluku	Ambon	-	9	10
		Ternate	8	9
Irian Jaya	(Ambon)	Sorong	7	8
		Jayapura	9	10
		Merauke	7	8
Nusa Tenggara Timur & Timor Timur	(Surabaya)	Ende	6	7
		Kupang	9	10
Total	2	10	87	99

(3) Transmission System to be Applied

As the result of rapid development and diffusion of computer systems and intelligent terminal equipments, the demand for digitalized communication network as information transmission media is fast increasing. Furthermore, by the technical innovations in recent years, digital network is becoming economically applicable to the transmission of the analog information as in telephony.

Communication network digitalization is now the worldwide trend. CCITT, for its part, has taken up Integrated Digital Network (IDN) for study. Also in CCITT, researches aimed at eventual transition to

Integrated Service Digital Network (ISDN), i.e., the integration of telephone service and non-voice service, are in progress. (see Appendix V-1.)

In Indonesia also, the digitalization of telecommunication network is pulling up momentum. In 1981, an international tender was held for the purchase of digital telephone switching equipment. Decision has also been made to introduce PCM-30 system for digitalization of local transmission network, and the system design is now being carried out. Construction of transmission networks in rural areas by means of digital system is about to get underway.

In the light of all these developments, this study makes it the precondition to introduce the digital system in the whole terrestrial transmission network to be established in the objective areas. The undermentioned digital systems have been selected for comparative study and, according to the study results, the optimum system is to be determined.

1) Line-of-sight SHF system
2) Line-of-sight UHF system
3) Optical fiber submarine cable system

The selection of these systems has been made in consideration of the progress of system developments in technically advanced countries and CCITT's recommendations and researches.

Because of the geographical peculiarity of the objective areas, i.e., many scattered island constituting an integral part of the region, consideration was made at first to take up the

trans-horizon troposcatter radio transmission system also for comparative study. However, for the reasons stated below, this system has been eliminated from the scope of study.

1) Digitalization of this system is still in the laboratory stage even in technically advanced countries.

2) This system is used only in small capacity and for specific purposes, such as military communication, and the countries where it is used are still few.

3) This system, even in the event it comes to be used for public communication in the future, will still be limited to a small capacity use (60 channels at most) because of its tropospheric propagation mode characteristic.

4) In Indonesia, the PALAPA domestic satellite communication system is already in service so that, for remote areas and scattered islands, the transmission network formation by PALAPA system is more advantageous technically and economically.

Optical fiber transmission system can also be considred, along with SHF and UHF radio systems, as means of composing the planned terrestrial transmisson network. However, as of the present, the system can compete favorably with radio systems in terms of cost only in the case of short haul, large capacity transmission. Therefore, in this study, decision is made to apply optical fiber transmission in inter-island sections only, where the transmission route formation is impossible unless by the submarine cable system.

Depending upon the further progress of technical renovations and system development researches, the optical fiber transmission system will most possibly be an attractive system both technically and economically. Therefore, the applicability of this system deserves to be studied again when the current terrestrial transmission network plan enters into the implementation stage. For the branch and drop sections, for instance, where the branch routes from the main route are to be terminated at telephone exchanges, the system applicability should be determined after thorough examinations of distance and line capacity of each such section, as well as the degree of difficulty involved in cable installation, and after careful comparison with radio systems in all these respects.

(4) Transmission of Television Signals

Presently in Indonesia, television signals are transmitted by PALAPA System. In the terrestrial radio transmission routes, the large capacity sections, each carrying 960 channels or more, are to be so designed that the standby system, except when it takes over the working system which has failed, can transmit television signals as occasion calls. This is the keynote of transmission network planning.

This study also is to follow suit in the formulation of terrestrial transmission network plan in due regard to television signal transmission. (Refer to the Minutes of preliminary discussion dated March 18, 1982.)

Nevertheless, the transmission of color television signals by digital system requires the transmission bit rate of at least 100 Mbit/s. That is to say, the digital transmission of color television signals requires 20 times as wide frequency band as in the transmission by analog system. This runs counter to the effecitive utilization of frequency spectrum as limited resources. To remedy the situation, some countries are conducting researches for television signal transmission by means of advanced encoding (encoding by band compression), thereby reducing the transmission bit rate. CCITT, for its part, is proceeding ahead with the study to standardize the television signal transmission bit rate; at present, 34.368 Mbit/s (in case where the primary group of digital hierarchy is 2.048 Mbit/s) is considered to be suitable for the standard transmission bit rate (Refer to CCITT Report 646-1.)

The transmission bit rate of 34.368 Mbit/s corresponds to the transmission bit rate for 480 telephone channels. Therefore, in this study, decision is made for television signal transmission by standby system in the sections, each to carry 480 telephone channels or more in the final year of the master plan, i.e., 2005.

There are sources that claim that, to reduce the television signal transmission bit rate to 34 Mbit/s, a highly sophisticated frequency band compression technology is required so that for the television signal transmission bit rate, 68 Mbit/s or thereabouts would be suitable. In this connection, depending upon the R & D progress henceforward, the foregoing network formation strategy may have to be re-examined.

Ⅳ DEMAND FORECAST, TRAFFIC FORECAST AND CIRCUIT CALCULATION

IV. Demand Forecast, Traffic Forecast and Circuit Calculation

1. Status Quo of Telecommunications Services

1.1 Telephone Service

1.1.1 Automatic Local Telephone Service

During a decade from 1971 through 1980, automatic telephone facilities in Indonesia increased at the rate of approximately 20% annually. As a result, automatic telephone facilities whose line units were not more than 90,000 in 1971 increased to as many as 525,000 line units in 1980. At the same time, telephone automatization ratio which was 47% in 1971 attained to 88% in 1980. In the objective area of this investigation also, telephone automatization ratio improved, but the degree of improvement remained to be the lowest throughout the country, the area-wise average of 1980 being 68% or much below the national average.

Area	Telephone Automatization Ratio, 1980
Medan	82%
Palembang	72
Jakarta	94
Kalimantan	70
Surabaya	85
Nusa Tenggara Timur and Timor Timur	56
Sulawesi	74
Maluku	58
Irian Jaya	50
Average - Whole Indonesia	88%
Average - Objective Area	68%

(Note) Areas under the dotted line are in the objective Area

1.1.2 Long-distance Dialling Service

In the area that extends from the northern end of Sumatra, through Java and Bali, to Ujung Pandang, i.e., the area where the terrestrial backbone transmission route already exists, almost principal cities are provided with long-distance dialling service. Elsewhere than that area, especially in the eastern part of Indonesia, the terrestrial transmission route of the quality which can provide long-distance dialling service does not exist. The whole of this area, except Ujung Pandang and Pare Pare located at the end of the backbone transmission route, is connected to automatic telephone trunk network via satellite communication facilities established in major cities. Nevertheless, telephone automatization ratio is low; the trunk centers capable of automatic connections to principal cities in other areas are only the following eight:

i) Ujung Pandang
ii) Pare Pare
iii) Manado
iv) Kendari
v) Palu
vi) Kupang
vii) Ambon
viii) Jayapura

1.2 Telegraph Service

1.2.1 Telex service

Telex subscribers are accommodated in the gentex network that interconnects main cities in the country. Among those subscribers, automatic connections are possible.

1.2.2 Telegram Service

Telegram offices in main cities are connected to the gentex network so that, among those telegram offices, message sending and receiving by dialling are possible. For communication to/from remotely located telegram offices (where the terrestrial radio link and the satellite link cannot be utilized), the Morse code communication via the aged land lines or HF circuits is used in most cases.

1.3 Leased Circuits

Communication circuits for personal use are leased to large scale users, such as government offices and commercial organizations. In the objective area of this investigation, the leased circuits are mainly of telegraph use.

2. Status Quo of Telecommunications Networks

2.1 Telephone Network

According to PERUMTEL's "Fundamental Plan 1981 for the Telephone Network in Indonesia," the telephone network of the country is composed as follows:

(1) Exchange Hierarchy

The telephone exchange hierarchy is fourfold. It consists of Tertiary Center, Secondary Center, Primary Center and Terminal Exchange. In the Primary Centers and higher ranking trunk centers, toll transit exchange facilities are provided. (Refer to Figure IV-1.)

Trunk centers in the area without the terrestrial backborne transmission link establish, regardless of their exchange hierarchy and geographical locations, the final route in Demand Assignmnet (DA) System of the Domestic Communication Satellite System. In the network configuration, DA holds the same hierarchical position as Tertiary Center.

(2) Zoning

a) Tertiary Center

In Figure IV-2, the Tertiary Center zones are geographically identified. Table IV-1 presents relationships between Tertiary Center zones and administrative districts. (The Tertiary Center zones are approximate to the administrative districts.)

b) Secondary Center, Primary Center

Zoning of Secondary Center and Primary Center is seen in Table IV-2.

(3) Distribution of Trunk Centers

The distribution of all trunk centers (Tertiary Center, Secondary Center and Primary Center) in the objective area of this investigation appears in Figure IV-3. Trunk centers in the illustration include those under plan. The numeral given at each trunk center location is the area code.

In the trunk telephone network as it presently is, the network in the area that can be connected to the backbone terrestrial transmission route extending from the northern end of Sumatra Island to Ujung Pandang via Jawa Island is the sole case that conforms more or less to the homing arrangement. In the objective area of this investigation, the final route from each trunk center practically belongs to DA, as seen in Figure IV-4. Therefore, only after the completion of backbone terrestrial transmission route in the area, the trunk centers in the area will conform to the homing arrangement in their hierarchical positions as shown in PERUMTEL's Fundamental Plan for Telephone Network.

2.2 Telegraph Network

(1) Telex subscribers, as well as telegraph terminals of telegram offices, in main cities of the country are to be accommodated in the gentex exchanges. Gentex local exchanges in all parts of the country belong to either of the four, i.e., Jakarta, Surabaya, Medan and Ujung Pandang tandem exchanges. Local exchanges do not have direct circuits to other local exchanges. That is, incoming and outgoing traffic to/from local exchanges is routed at the tandem exchanges to which the local exchanges respectively belong.

(2) Tandem exchanges and their respective service areas are as follows:

Tandem Exchange	Area Code	Service Area
Jakarta	2 & 4	DKW Jakarta, Jawa Barat, Jawa Tengah, DI Yogyakarta, Jambi, Sumatra Selatan, Bengkulu, Lampung
Surabaya	3	Jawa Timur, Bali, Nusa Tenggara Barat, Nusa Tenggara Timur, Timor Timur, Kalimantan Barat, Kalimantan Tengah, Kalimantan Selatan, Kalimantan Timur
Medan	5	DI Aceh, Sumatra Utara, Sumatra Barat, Riau
Ujung Pandang	7	Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi Tenggara, Maluku, Irian Jaya

(3) The national gentex network as it presently is appears in Figure IV-5.

(4) Local exchanges in the objective area of this investigation and their existing service areas are as follows:

Local Gentex Exchange	Area Code	Service Area
Denpasar	35	Bali, Nusa Tenggara Barat, Nusa Tenggara Timur
Ujung Pandang	71	Sulawesi Selatan, Sulawesi Tenggara
Ambon	73	Maluku
Manado	74	Sulawesi Utara
Palu	75	Sulawesi Tengah
Jayapura	76	Eastern part of Irian Jaya
Sorong	77	Western part of Irian Jaya

Table IV-1 Tertiary Areas of Indonesian Telephone Trunk Network

Tertiary Zone	Area Code	Province
(1) Jakarta	2	DKI Jakarta Jawa Barat Jawa Tengah DI Yogyakarta
(2) Surabaya	3	Jawa Timur Bali Nusa Tenggara Barat Nusa Tenggara Timur Timor Timur
(3) Ujung Pandang	4	Sulawesi Utara Sulawesi Tengah Sulawesi Selatan Sulawesi Tenggara
(4) Banjarmasin	5	Kalimantan Barat Kalimantan Tengah Kalimantan Timur Kalimantan Selatan
(5) Medan	6	DI Aceh Sumatra Utara
(6) Palembang	7	Sumatra Barat Riau Jambi Sumatra Selatan Bengkulu Lampung
(7) Ambon	9	Maluku Irian Jaya

Table IV-2 Homing Arrangement in Indonesian Telephone Network (1/9)

Tertiary Area		Secondary Area		Primary Area		Province
Code	Trunk Center	Code	Trunk Center	Code	Trunk Center	
2	JAKARTA	21	JAKARTA	21	JAKARTA	DKI Jakarta
		25				
				251	BOGOR	Jawa Barat
				2	Rangkasbitung	
				3	Pandeglang	
				4	Serang	
				5	Cipanas	
		22	BANDUNG	22	BANDUNG	
		26		261	Sumedang	
				2	Garut	
				3	Cianjur	
				4	Purwakarta	
				5	Tasikmalaya	
				6	Sukabumi	
		23	CIREBON	231	CIREBON	
				2	Kuningan	
				3	Majalengka	
				4	Indramayu	
		24	SEMARANG	24	SEMARANG	Jawa Tengah
		29		291	Kudus	
				2	Purwodadi	
				3	Magelang	
				4	Kendal	
				5	Pati	
				6	Cepu	
				7	Karimunjawa	
				8	Salatiga	
		27	SOLO	271	SOLO	
				2	Klaten	
				3	Wonogiri	
				4	Yogyakarta	D.I. Yogyakarta
		28	PURWOKERTO	281	PURWOKERTO	Jawa Tengah
				2	Cilacap	
				3	Tegal	
				4	pemalang	
				5	Pekalongan	
				6	Wonosobo	
				7	Kebumen	
				8	Purworejo	

Table IV-2 Homing Arrangement in Indonesian Telephone Network (2/9)

Tertiary Area		Secondary Area		Primary Area		Province
Code	Trunk Center	Code	Trunk Center	Code	Trunk Center	
3	SURABAYA	31	SURABAYA	31	SURABAYA	Jawa Timur
		32		321	Mojokerto	
				2	Lamongan	
				3	Bangkalan	
				4	Pamekasan	
				5	Bawean	
				6	Sapudi	
				7	Kangean	
		33	JEMBER	331	JEMBER	
				2	Bondowoso	
				3	Banyuwangi	
				4	Lumajang	
				5	Probolinggo	
		34	MALANG	341	MALANG	
				2	Blitar	
				3	Pasuruan	
		35	MADIUN	351	MADIUN	
				2	Pacitan	
				3	Bojonegoro	
				4	Kediri	
				5	Tulungagung	
				6	Tuban	
		36	DENPASAR	361	DENPASAR	Bali
				2	Singaraja	
				3	Karangasem	
				4	Mataram	
		37	SUMBAWA BESAR	371	SUMBAWABESAR	Nusa Tenggara Barat
				2	Tailwang	
				3	Dompu	
				4	Raba	
		38	ENDE	381	ENDE	Nusa Tenggara Timur
				2	Maumere	
				3	Larantuka	
				4	Bajawa	
				5	Ruteng	
				6	Waingapu	
				7	Waikabubak	

Table IV-2 Homing Arrangement in Indonesian Telephone Network (3/9)

Tertiary Area		Secondary Area		Primary Area		Province
Code	Trunk Center	Code	Trunk Center	Code	Trunk Center	
3	SURABAYA	39	KUPANG	391	KUPANG	
				2	Soé	
				3	Kefamenanu	
				4	Atambua	
				5	Baa	
				6	Seba	
				7	Kalabahi	
				8	Ilwaki	
				9	Baucau	Timor Timur
				0	Dilli	
4	UJUNG PANDANG	41	UJUNG PANDANG	411	UJUNGPANDANG	Sulawesi Selatan
				2	Watampone	
				3	Bantaeng	
				4	Benteng	
				5	Tanajampea	
		42	PARE-PARE	421	PARE-PARE	
				2	Majene	
				3	Rantepao	
				4	Palopo	
				5	Singkang	
				6	Mamuju	
				7	Masamba	
				8	Malili	
				9	Karosa	
		43	MANADO	431	MANADO	Sulawesi Utara
				2	Tahuna	
				3	Beo	
				4	Kotamobagu	
				5	Gorontalo	
				6	Tilamuta	
				7	Paleleh	
		45	PALU	451	PALU	Sulawesi Tengah
				2	Poso	
				3	Toli-toli	
				4	Tojo	
				5	Kolonodale	
				6	Bungku	
				7	Katupa	
				8	Luwuk	
				9	Banggai	