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No. 8

THE REPUBLIC OF INDONESIA
FEASIBILITY STUDY REPORT
ON
SULAWESI TERRESTRIAL TRANSMISSION NETWORK PROJECT

FEBRUARY, 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF INDONESIA

FEASIBILITY STUDY REPORT

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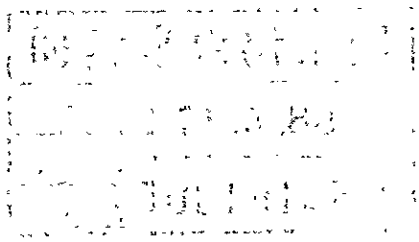


JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a feasibility study on the Sulawesi Terrestrial Transmission Network Project and entrusted the study to the Japan International Cooperation Agency (JICA).

The JICA sent to Indonesia a survey team headed by Mr. Yosuke Mihara, Special Assistant to Director, Technical Investigation Division, Radio Regulatory Bureau, Ministry of Posts and Telecommunications, from September 28 to November 6, 1982.

The team had discussions on the Project with the officials concerned of the Government of the Republic of Indonesia, Directorate General of Posts and Telecommunications (DITJEN POSTEL), Ministry of Transport, Communications and Tourism, and Perusahaan Umum Telekomunikasi (PERUMTEL), and conducted a field survey in Sulawesi area. 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 the Republic of Indonesia for their close cooperation extended to the team.

February 1983

Keisuke Arita
President
Japan International Cooperation Agency

SULAWESI

THE REPUBLIC OF INDONESIA

L A U T S U L A W E S I

SELAT MAKASSAR

T E L U K T O M I N I

(GORONTALO)

T E L U K T O L O

T E L U K B O N E

L A U T B A N D A

L A U T F L O R E S

L A U T M A L U K U

P. KALIMANTAN

SULAWESI UTARA

SULAWESI TENGAH

SULAWESI SELATAN

SULAWESI TENGGARA

P. TALIABU

P. MANGOLE

P. SANGIHE

P. MANADO TUA

P. LEMBEH

P. BANGGAI

REP. TOGIAN

P. TOGIAN

P. BATUDARA

P. WALEABAHI

P. TALATAKOH

REP. SULA

P. TAHAKOLA

P. MANGOLE

P. BURU

P. MANUI

P. MUNA

BUTON (BUTUNG)

P. WOWONI

P. KABAENA

P. BATUATA

P. TANAHJAMPEA

P. KALEDUPA

P. WANGIWANGI

P. TUKANGBESI

BINONGKO

KEP. TALAUD

KANARELONG

P. SALIBABU

KABURUANG

LAUT MALUKU

LEGENDA

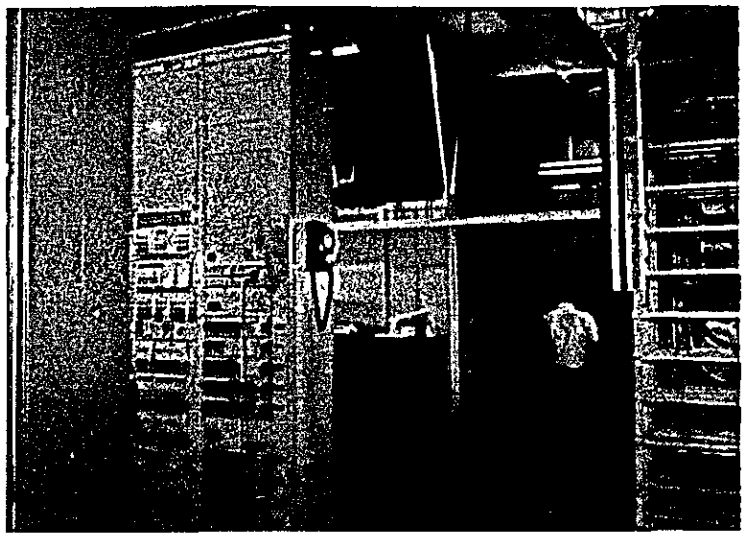
PT PEMMUNA

1979

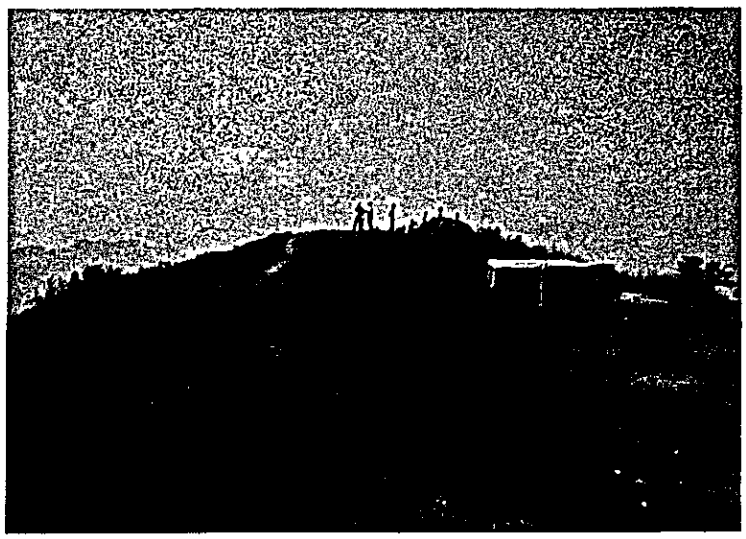
Member of the survey team explaining the Inception Report to key individuals of DITJEN POSTEL.
(Sep. 29, 1982, at Directorate General of the POSTEL, Jakarta)

Member of the survey team explaining the Inception Report to key individuals of PERUMTEL.
(Oct. 1, 1982, at PERUMTEL Headquarters, Bandung)

Member of the survey team discussing survey schedules and works with key individuals of WITEL-X.
(Oct. 4, 1982, WITEL-X, Ujung Pandang)

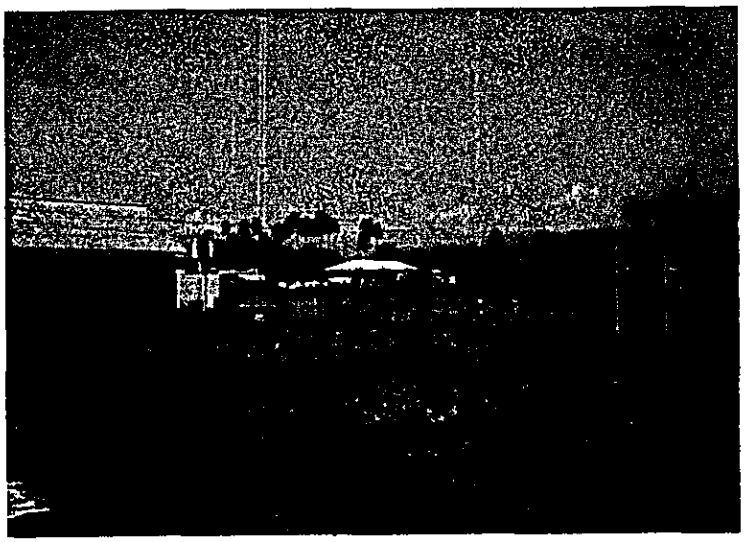


Radio & Mux Room, Ujung Pandang Radio Terminal Station.



Survey at the proposed radio repeater site, Rantepao.

Telephone Office at Palopo.



Gorontalo HF station

Meeting regarding the draft final report at PRANTRA in PERUMTEL.
(Jan. 31, 1983, at PERUMTEL Headquarters, Bandung)

Final meeting at DITJEN POSTEL
(Feb. 2, 1983, at Directorate General of the POSTEL, Jakarta)

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SUMMARY

Summary

1. Objective of Study

The objective of this Study is to formulate the Sulawesi area terrestrial transmission network plan and, at the same time, to evaluate economic and financial feasibility of the plan.

2. Motivation of Plan

This plan is to introduce digital terrestrial transmission system in Sulawesi area and to make the system interwork with existing domestic satellite communication network (PALAPA system). This arrangement is motivated to realize quantitative expansion and qualitative improvement of telephone service in the areas.

3. Demand Forecast

(1) Telephone Demand Forecast

Telehone demand forecast is made in the form of macroscopic and microscopic forecasts. In these forecasts, demand factors, such as population growth and economic development, as well as regional characteristics, of Sulawesi area, are duly considered.

a) For macroscopic demand forecast, two methods are used. One is to forecast demand from correlations between telephone diffusion rate and GDP per capita. The other is to grasp telephone diffusion rate variations by time series.

b) For microscopic demand forecast, check and review are made for present telephone services, based on field survey results. The purpose consists of subscriber estimates by Primary Center areas. For such check and review, the Telecommunications Network Development Plan for Eastern Part of Indonesia (hereinafter to be called Master Plan) and the 4th Five-Year Development Plan (draft) of PERUMTEL are used as guidelines.

After comparative study of the two kinds of forecast results, microscopic forecast results are adopted as telephone demand values. They are:

1994:	97,000	subscribers
1999:	136,000	"
2005:	203,000	"

(2) Non-Telephone Service Demand Forecast

Demand forecast for non-telephone services is by analysis of the undermentioned demand factors:

- Sulawesi area economic growth outlook
- PERUMTEL's Long Term Telecommunications Expansion Plan
- PERUMTEL's 4th Five-Year Development Plan (draft)
- Master Plan
- Non-telephone service demand trends in Sulawesi area
- Competitions among telecommunication services of all kinds
- Non-telephone service demand trends in foreign countries

Forecasted demand values for non-telephone services, based on above analysis, are:

a) Telex Terminals

1994:	1,220	terminals
1999:	1,870	"
2005:	2,660	"

b) Annual Total Telegram Messages

1994:	2,495,000	messages
1999:	2,892,000	"
2005:	2,892,000	"

c) New Service Subscriber Terminals
(Facsimile, data communication services)

1994:	80	terminals
1999:	190	"
2005:	560	"

4. Traffic Forecast

(1) Telephone Traffic Forecast

Study is made about toll calling rate of telephone subscribers in Sulawesi area. The points of analysis are these three:

- Toll traffic status quo
- Forecasted values for Master Plan
- ITU data of all kinds

The sum of toll originating traffic based on forecasted toll calling rate and that based on demand forecast appears below.

1994: 501 Erlangs
1999: 690 "
2005: 987 "

(2) Non-Telephone Service Traffic Forecast

Non-telephone service traffic in Sulawesi area is forecasted, based on calling rate in Master Plan.

Results follow:

1994: 106 Erlangs
1999: 155 "
2005: 232 "

(3) Traffic Distribution between Terrestrial System and Satellite System

Calculation of toll traffic via terrestrial transmission system is made, using the distribution ratio shown by PERUMTEL.

Case 1:

When $X < 500$ km: $Y = 80\%$
When $X \geq 500$ km: $Y = 40\%$

Case 2:

When $X < 800$ km: $Y = (100 - \frac{X}{10})\%$
When $X \geq 800$ km: $Y = 20\%$

Where
X : Inter-office crow-flight distance
Y : Ratio of distribution to terrestrial system

Comparison between Case 1 and Case 2 in the number of channels required to carry toll traffic that flows via terrestrial transmission system as determined by the above distribution ratio, follows:

	Case 1	Case 2
1994:	1,148 CH	1,008 CH
1999:	1,688 CH	1,503 CH
2005:	2,371 CH	2,151 CH

In this report, the plan based on Case 1 distribution ratio is handled as main plan. The plan based on Case 2 distribution ratio is handled as alternative plan.

5. Transmission Route Plan

In this Project, the transmission route between Tertiary Center and Secondary Center is called the main route. Routes that ramify from the main route, extending to Primary Centers, are called spur routes.

For selection of main route and spur route, comparative study is made for various route plans. Factors considered in the comparative study are, among others, exchange locations in the whole Project, access road curtailment, and means to avoid ground and sea reflections. As a result, optimum routes are selected.

For selection of radio transmission system, study is made about frequency band, transmission system capacity, modulation system, and so forth. Selected for the main route is 6 GHz (upper band) 480 CH or 1,440 CH system. For spur routes, 2 GHz band 60 CH or 240 CH system is selected.

Radio transmission system is composed of working plus protection radio channels, i.e., the system commonly known as (n + 1) System.

For transmission system to be used in sections where the distance between radio repeater station and main exchange is relatively short, selection is made for 30 CH PCM system that uses symmetric pair-cable. And the use of this cable PCM system is scheduled in three spur route sections. Selection of cable PCM system is the result of economic comparison concerning the aforesaid 6 GHz and 2 GHz radio systems and various cable systems (optical fiber cable system, coaxial cable system and symmetric pair-cable system).

Selected transmission routes and transmission systems are illustrated in Figure 1.

Differences between the main plan and the alternative plan are:

- In the main plan, radio channels required up to the year 2005 comprise (2 + 1) channels between Ujung Pandang and Kalaena radio repeater* on the main route, and (1 + 1) channels in other main route sections and spur routes.

  *: Kalaena radio repeater is the branching station to Kendari route.

- In the alternative plan, radio channels required up to the year 2005 are (1 + 1) in all routes.

6. Construction Cost and Work Schedule

Route by route construction periods coincide with the Five-Year National Development Plan periods. That is to say, initial stage work is to be completed within the 4th Five-Year Development Plan period, intermediate stage work within the 5th Five-Year Development Plan period, and final stage work within the 6th Five-Year Development Plan period.

Figure 2 presents period by period divisions of terrestrial transmission system construction work. Volume of facilities required in each such division is listed in Table 1. In the alternative plan, additional installation of second radio channels as part of final stage work as shown in Table 1 is not necessary.

Construction cost breakdown by three work stages appears below. The amount of cost quoted does not include contingency. Consultant service cost is included in initial stage work cost only. Thus, in intermediate and final stages, PERUMTEL is to promote project implementation at his own discretion and responsibility.

(1) Construction Cost - Main Plan

Unit: Million Yen
(Million Rupiahs)

	Foreign Currency	Local Currency	Total
Initial stage work cost	15,177 (37,098)	12,808 (31,309)	27,985 (68,407)
Intermediate stage work cost	1,203 (2,940)	1,082 (2,645)	2,285 (5,585)
Final stage work cost	2,730 (6,673)	1,656 (4,048)	4,386 (10,721)
Total	19,110 (46,711)	15,546 (38,002)	34,565 (84,713)

(Exchange rate: Rp.660/¥270/US$, as of the middle of October, 1982)

(2) Construction Cost - Alternative Plan

Unit: Million Yen
(Million Rupiahs)

	Foreign Currency	Local Currency	Total
Initial stage work cost	15,155 (37,046)	12,807 (31,306)	27,962 (68,352)
Intermediate stage work cost	1,190 (2,909)	1,080 (2,640)	2,270 (5,549)
Final stage work cost	2,369 (5,791)	1,644 (4,018)	4,013 (9,809)
Total	18,714 (45,746)	15,531 (37,964)	34,245 (81,710)

(Exchange rate: Rp.660/¥270/US$)

7. Project Implementation Time Schedule

Implementation time schedule for this Project is given in Table 2. For the main plan and the alternative plan, the same work period applies.

8. Financial and Economic Analyses

(1) Analyses

For the purpose of evaluation of this Project, financial analysis and economic analysis are made for the main plan (Case 1). Sensitivity analysis is also made, assuming unfavorable conditions that may arise in the course of project implementation.

For the alternative plan (Case 2) also, financial and economic analyses are made.

Results of all these analyses are as follows:

Main Plan

a) Financial Analysis

Internal Financial Rate of Return (IFRR) is 14.38%.

b) Economic Analysis

Internal Economic Rate of Return (IERR) is 12.10%.

c) Sensitivity Analysis

- When the amount of capital investment increases by 10%, IFRR and IERR become 11.64% and 10.84%, respectively.

- When the operating revenue decreases by 10%, IFRR and IERR become 12.34% and 10.64%, respectively.

- When the work period protraction causes system commissioning to delay two years behind schedule, IFRR and IERR become 9.79% and 10.82%, respectively.

- When all the foregoing conditions take place simultaneously, IFRR and IERR become 8.98% and 8.41%, respectively.

Alternative Plan

a) Financial and Economic Analyses

When the project implementation is by the alternative plan (Case 2), IFRR is 14.62% and IERR 12.29%.

(2) Project Evaluation

IFRR of 14.38% of this Project indicates that this Project is financially feasible.

IERR of 12.10% of this Project indicates that the Project is economically feasible and its implementation is desirable in a national economic sense.

According to the sensitivity analysis findings, even in case the operating revenue decreases by 10%, this Project still proves to be financially feasible to a certain extent. However, when the amount of capital investment increases by 10% or when the work period protraction causes system commissioning to delay two years behind schedule, this Project cannot be said to be financially feasible. Even in either case, this Project, when economically considered, can still be feasible to some extent.

In case where the three conditions mentioned take place simultaneously, this Project cannot be feasible both financially and economically.

When this Project is implemented by the alternative plan (Case 2), the results of financial and economic analyses attest to project feasibility in both financial and economic senses. This is the same as with the main plan (Case 1).

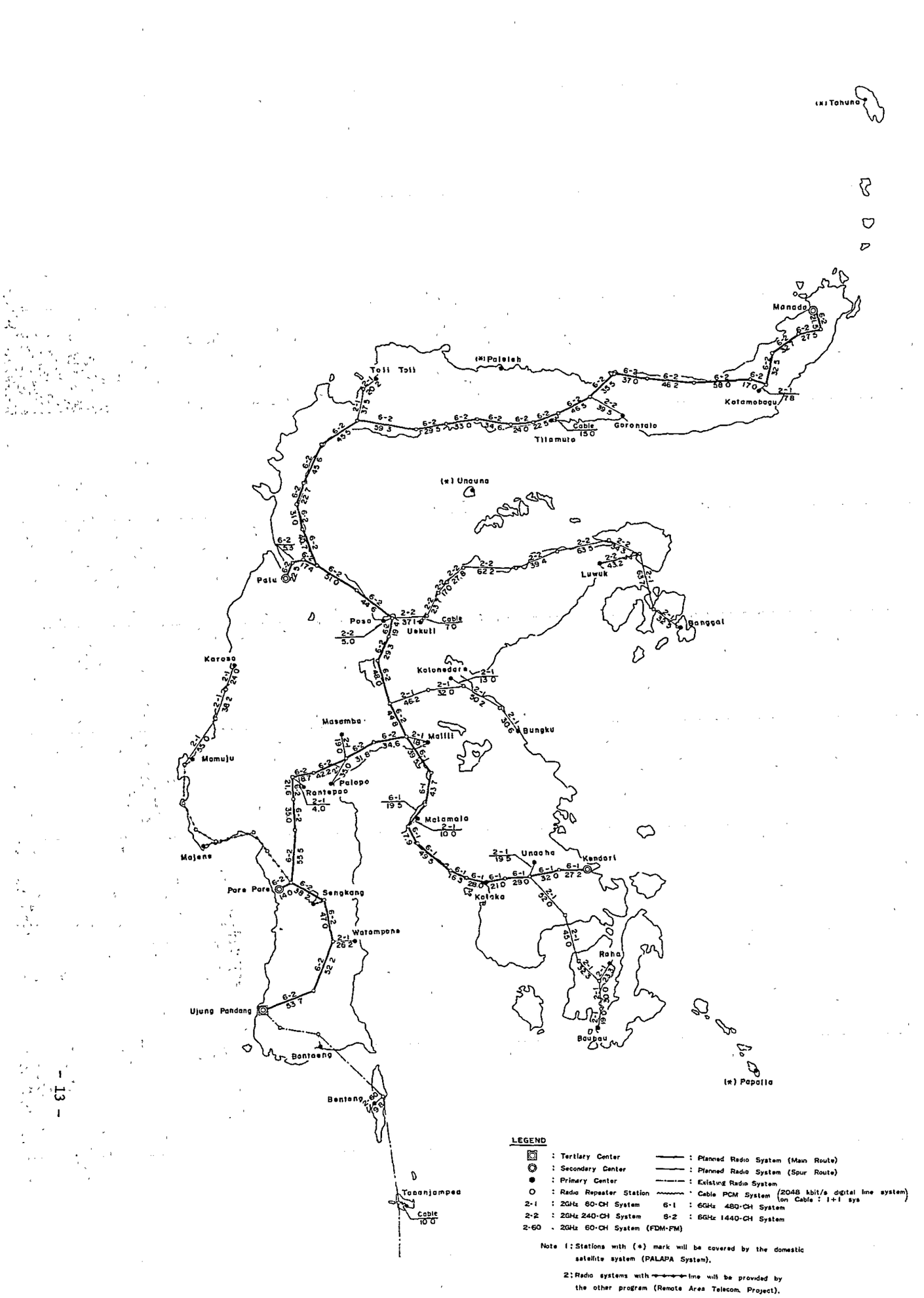


Figure 1 Transmission Route Map

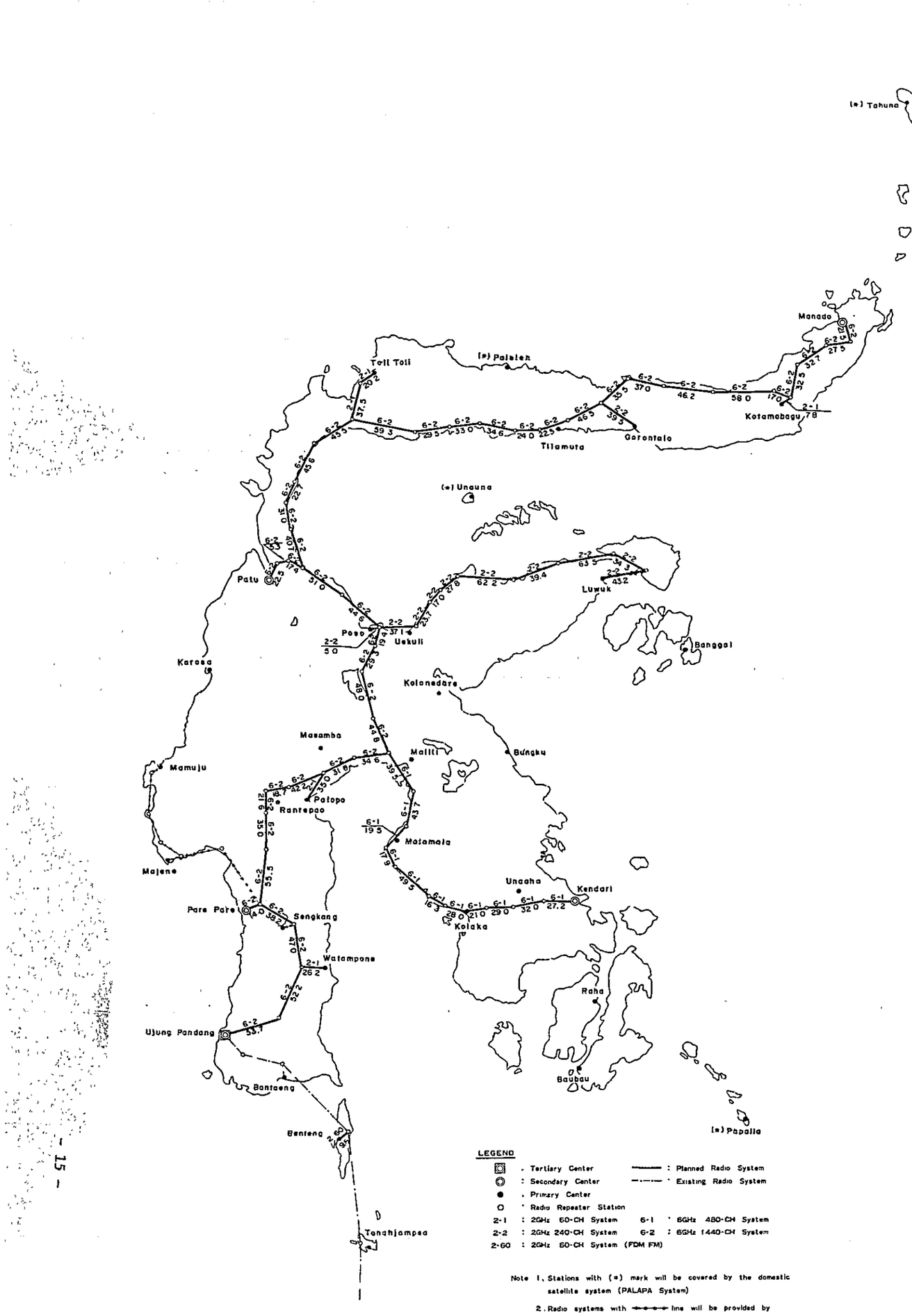


Figure 2 (1/3) Period by Period Divisions of Terrestrial Transmission System Construction Work (Initial Stage)

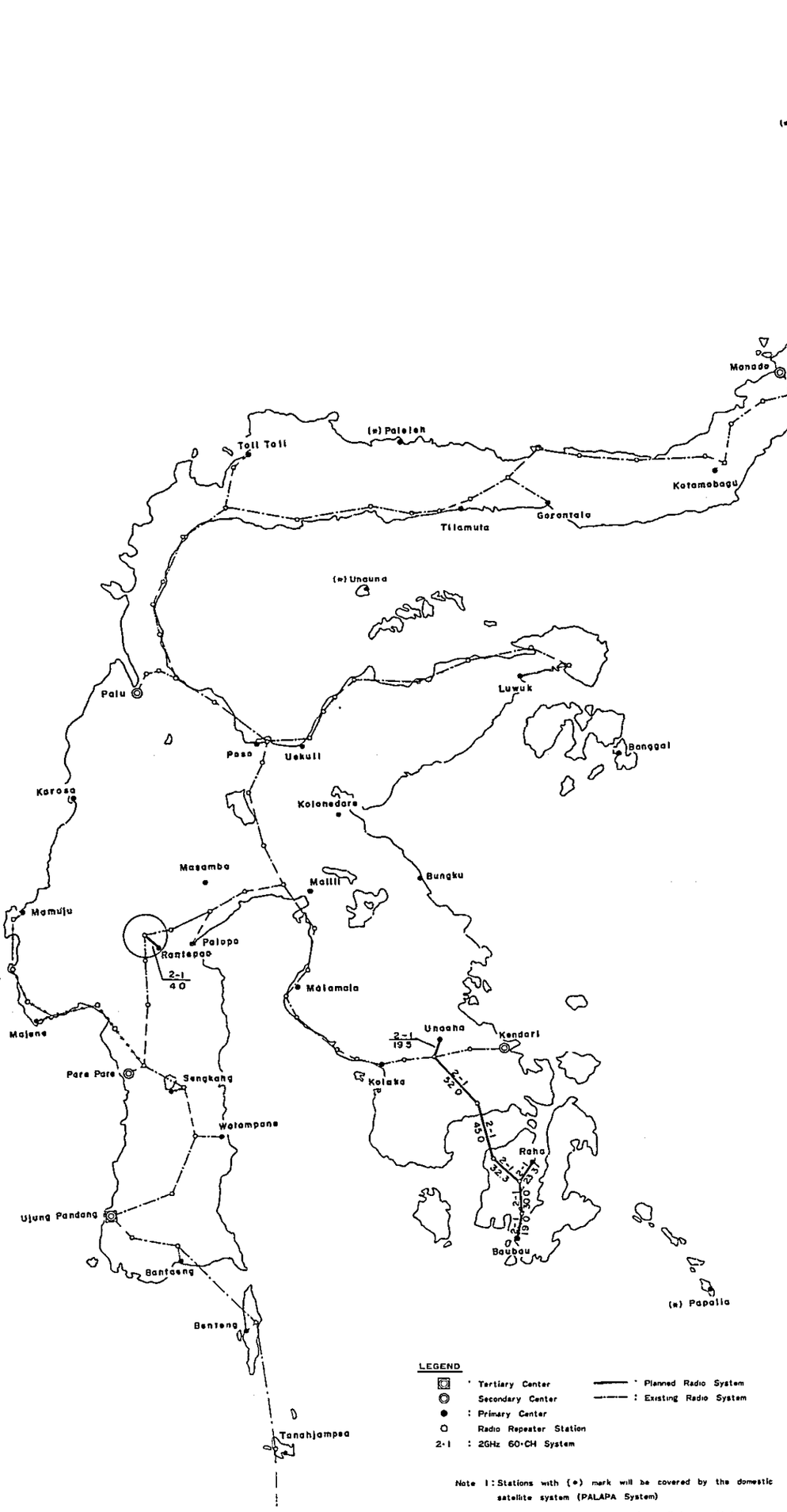


Figure 2 (2/3) Period by Period Divisions of Terrestrial Transmission System Construction Work (Intermediate Stage)

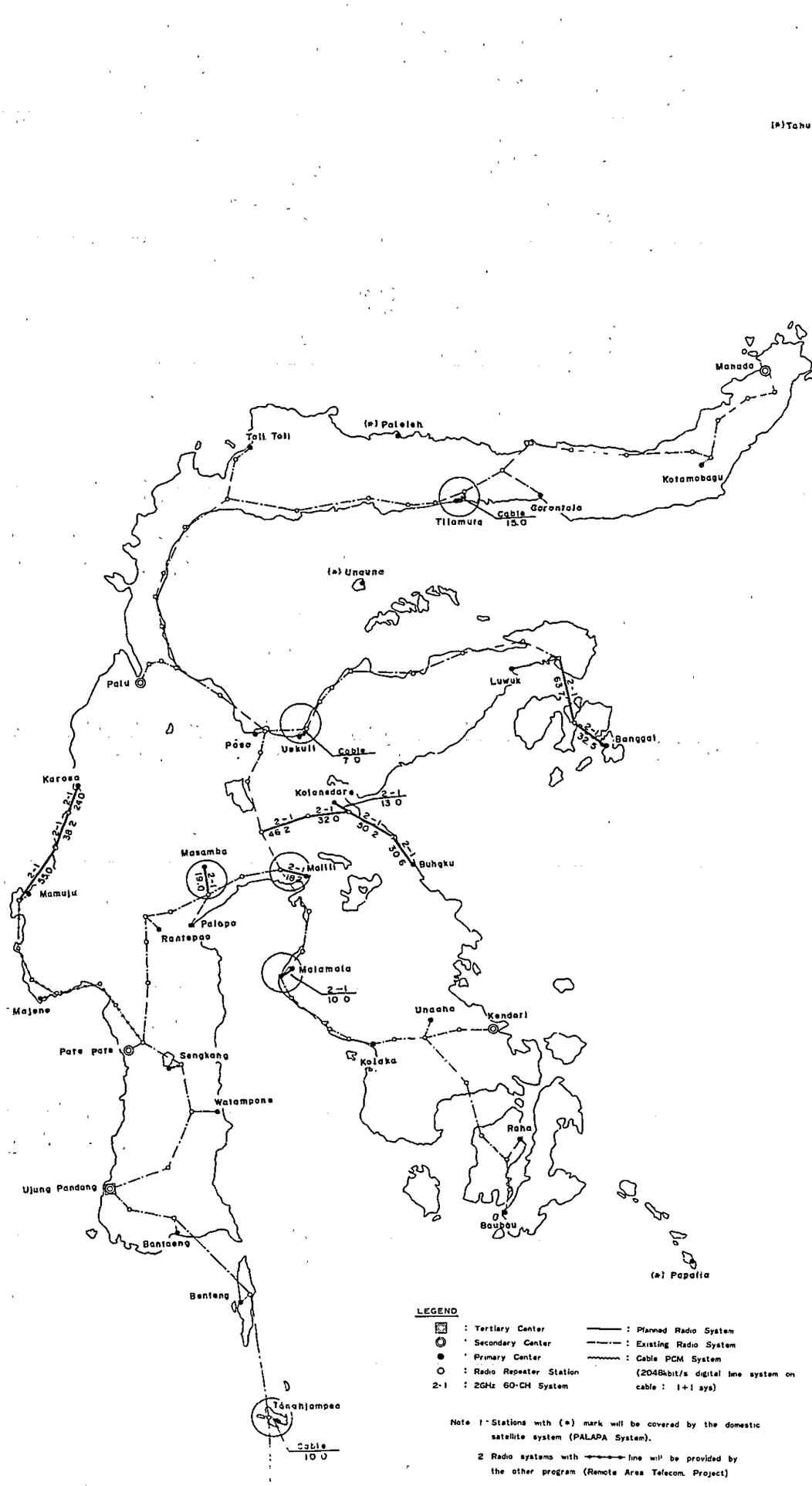


Figure 2 (3/3) Period by Period Divisions of Terrestrial Transmission System Construction Work (Final Stage)

Table 1. Volume of Facilities

Facilities Item	Initial Stage (REPELITA-IV)	Intermediate Stage (REPELITA-V)	Final Stage (REPELITA-VI)
1. Digital Facilities			
(1) 6GHz Radio for 1440 CH	42 hops (4 t.s.) (39 r.s.)	—	(*1)
(2) 6GHz Radio for 480 CH	11 hops (2 t.s.) (*2) (9 r.s.)	—	—
(3) 2GHz Radio for 240 CH	11 hops (3 t.s.) (8 r.s.)	—	—
(4) 2GHz Radio for 60 CH	5 hops (4 t.s.) (1 r.s.)	7 hops (4 t.s.) (3 r.s.)	13 hops (7 t.s.) (6 r.s.)
(5) Multiplex Facilities	27 st. (*3)	4 t.s.	7 t.s.
(6) Cable Facilities	—	—	3 sections
2. Analog Facilities			
(1) 2GHz Radio	1 hop (1 r.s.)	—	—
(2) Multiplex	1 t.s.	—	—
3. Power Plants	13 t.s. 57 r.s.	4 t.s. 4 r.s.	7 t.s. 6 r.s.
4. Shelters (for r.s.)	57 r.s.	4 r.s.	6 r.s.

(Note) :

(*1) : In case of the Main Plan, an expansion of one RF channel will be required between Ujung Pandang and Kalaena repeater station.
In case of the Alternative Plan, the expansion of RF channel will not be required in all hops.

(*2) : This number of terminal stations includes one repeater station which is located on the transmission route, and which will become a terminal station in the intermediate stage.

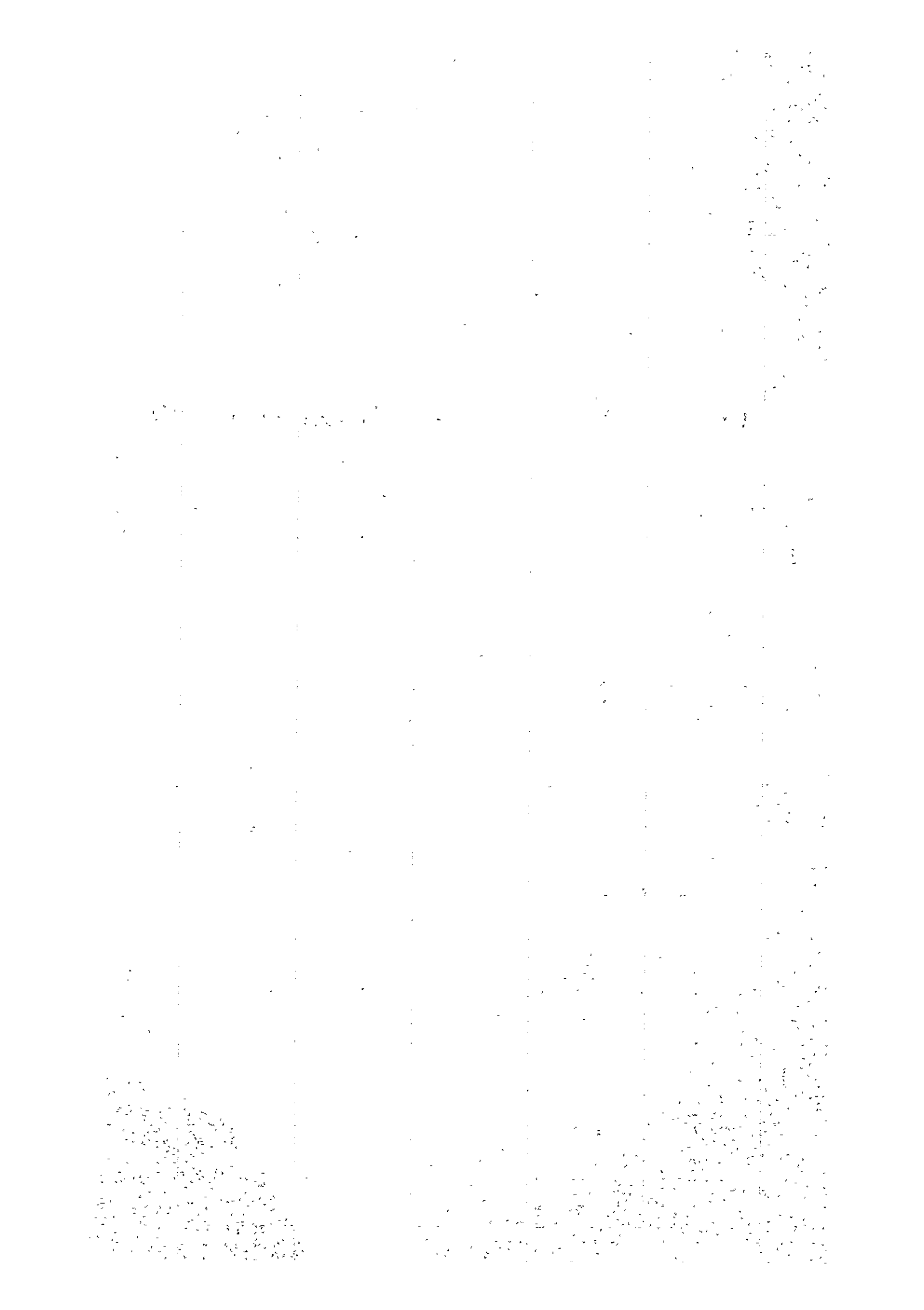
(*3) : This number of stations includes 15 repeater stations where multiplex facilities will be installed.

Legend :
t.s. : Radio Terminal Station
r.s. : Radio Repeater Station

Table 2 Implementation Schedule for Sulawesi Terrestrial Transmission Network Project

Item		Fiscal Year 1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Initial Stage Implementation	Procurement of Budget																							
	Selection of Consultant																							
	Detailed Design																							
	Selection of Contractor																							
	Land Procurement, Ground Levelling & Land Formation																							
	Manufacturing, Construction & Installation																							
	Commencement of Service							▲																
	One-Year Maintenance																							
Intermediate & Final Stages Implementation	Manufacturing, Construction & Installation									(Intermediate Stage)						(Final Stage)								

CONCLUSION AND RECOMMENDATION



Conclusion and Recommendation

For the further social and economic growth of the Republic of Indonesia, the development of Sulawesi area assumes paramount importance. Industry in the area is mainly the primary industry, such as agriculture, forestry and fishery. Nowadays, investment in mining/manufacturing industry is also pulling up momentum, promoting cement manufacturing and copper, chrome and iron ore mining.

Telecommunication, like power generation and transportation, is indispensable for modern economic and social development. Itself a means of development strategy and hence a vital infrastructure, telecommunication service holds an important role to play.

Investment in telecommunication service depends a great deal upon import of advanced technology. As such, it is capital intensive. Nevertheless, its external economic effect is significant indeed.

As seen in the results of financial and economic analyses contained in this Report, the current Project is feasible as public telecommunication service project. In a national economic sense also, its implementation is desirable. Recommendation is hereby made that this Project be implemented as planned, i.e., in strict accordance with the implementation schedule.

The critical point lies in whether or not the required fund can be procured in full by the present-day Indonesia alone.

An approach to solution may possibly be found in inviting long term, low interest financial assistance from foreign source. In this connection, the project implementation, this time, by a foreign soft loan is recommended.

Following are the main points of conclusion and recommendation in the technical aspect relating to the implementation of this Project:

1. Digital Radio System

   For digital radio system to constitute the most part of transmission route to be constructed by this Project, 6 GHz (upper band) system be adopted for main route and 2 GHz system for spur route.

2. Route Selection

   Out of the two transmission route plans proposed in the Master Plan, Plan A that does not include long distance oversea sections be adopted with partial modifications based on findings in this Study.

   Selection of Plan A is to reduce circuit performance compensation measures, such as space diversity, to the necessary minimum in the way of realizing the required circuit performance, and, in turn, to curtail transmission route construction cost.

   However, for detail design, new field survey covering all further details should be carried out whereby to make final selection of transmission route.

3. Shelter Type Building

   For the purpose of work period retrenchment, shelter type buildings be adopted for all radio repeater stations.

4. Independent Power Generation System

   For independent power generation system, dual prime mover system by diesel engine generators be adopted.

This selection is based on judgement that dual prime mover system is the most advantageous system presently available from the viewpoint of economical operation and maintenance. However, considering the fast progressing technical renovation of these days, above is just the conclusion by judgement during this Study. That is to say, when detail design work is commenced, further study should be made in due consideration of technical development degrees of all kinds of independent power generation systems.

5. Synchronization in a Switched Digital Network

In the digital network composed of digital switching equipment and digital transmission system, switching system performs major role in network synchronization.
Whatever the synchronization system between digital switching equipments related to this Project, transmission system synchronization signal supply be from the switching system.

6. Prevention of Double/Triple Hop Connection of Domestic Satellite Communication System

Exchange offices related to this Project, except a few of them, use both terrestrial link and satellite link. Hence the importance of establishing a measure to prevent double hop or trip hop connection of satellite link.

Such preventive measure be to establish PA (pre-assignment) system satellite link between Tertiary Centers and to establish DA (demand assignment) system satellite link at each Secondary Center and Primary Center.

7. Operation and Maintenance

For the purpose of economical and effective operation and maintenance of terrestrial transmission system in Sulawesi area, Maintenance Center be established at each Secondary Center and at main Primary Center, and Central Maintenance Management Center at Ujung Pandang Tertiary Center.

8. Staff Training

Existing analog technology to up-to-date digital technology changeover training be administered by equipment supplier to part of maintenance staff and PERUMTEL's Training Center instructors. Therefore, staff training clause should be included in contract provisions for this Project.

1. PREFACE

1. Preface

1-1. Background of Survey

1-1-1 Overall View of Indonesia

The Republic of Indonesia embraces national territories of 1,920,000 km^2. The population totals 147 million (based on 1980 census). The population growth rate in the past 10 years (1971 - 1980) stands at 2.32% in annual average. Transmigration is presently in progress from overpopulated Jawa area (which occupies 7% of total national territories and contains upwards of 60% of all population) to mainly Sumatera, Kalimantan and Sulawesi areas.

In the aspect of national economy, Gross National Product (GDP) as of 1979 amounts to approximately 30,000,000 million Rupiahs, and GDP per capita to an estimated 210,000 Rupiahs (US$340). Real annual average growth rate of GDP in 1973 - 1979 registers 6.7%.

In the Republic of Indonesia, the First and Second Five-Year National Development Plans have already been completed. Presently, the Third Five-Year National Development Plan (REPELITA III for April 1979 through March 1984) is being carried out.

In the field of telecommunications also, the progress is remarkable. Already in service are terrestrial backbone transmission systems comprising Jawa - Bali Microwave System, Trans-Sumatera Microwave System and Eastern (Denpasar - Ujung Pandang) Microwave System, plus Surabaya - Banjarmasin Troposcatter System. In addition, the domestic satellite communication system (PALAPA system) has also been constructed and is already in operation.

Telecommunications facilities improvement plans to be implemented from now forward are primarily concerned with improvement and upgrading of service systems in Eastern Indonesia (east of Ujung Pandang). Those plans include construction of new terrestrial main transmission routes and spur routes from existing terrestrial main route, and expansion of regional service networks.

In the national development of NUSANTARA (in English, the Archipelago of Indonesia) that extends more than 5,000 km from east to west, the main target is being shifted from the relatively developed Jawa and Sumatera to Sulawesi. This fact is evident in the fast progressing Trans-Sulawesi Highway construction, one of major development items in REPELITA III.

1-1-2 Outline of Sulawesi Area

Sulawesi area, where the field survey was carried out, this time, consists of four provinces: Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan and Sulawesi Tenggara. Land size and population (including population growth rate and population density) of each province are presented in Table 1-1.

Population density is 55 persons/km^2 or somewhat lower than the national average of 77 persons/km^2. However, population growth rate during the past 10 years is practically at the same level as the national average. Especially in Sulawesi Selatan, the main target of transmigration policy of the Indonesian Government, population growth rate is considered to draw further upcurve.

The southern part of Sulawesi area is the rich rice field zone that forms "Granary of Indonesia". However, in the whole Sulawesi area, agriculture and forestry flourish with palm oil, cloves, ebony and rattan among main products. Fishery also prospers, busy with tuna, as well as lobster, shrimp and prawn, catches. These days, cement production and copper, chrome, iron and tin ore mining constitute another industrial feature, being carried out with financial assistance from oversea.

Gross regional domestic product by province in Sulawesi area appears in Table 1-2 and per capita of gross regional product by province in Table 1-3. As seen in these tables, gross regional domestic product in Sulawesi area still remains limited in absolute amount but its growth rate exceeds the national average.

Trans-Sulawesi Highway between Ujung Pandang and Manado is now under construction with a view to completion in the final year of REPELITA III or, more precisely, in March 1984. Generally, in Sulawesi area, the improvement of social overhead capital, such as roads and power plants, is making steady progress. To be sure, Sulawesi is the area that claims, after Jawa and Sumatera areas, development investment priority from now forward.

1-1-3 Status Quo of Telecommunication Services

(1) Indonesia as a Whole

As of 1981, telephone subscribers in the whole of Indonesia number 417,000. Telephone density per population of 100 is 0.27. Breakdown consists of 363,000 (87%) accommodated in automatic exchanges, 8,000 (2%) in common battery exchanges, and 46,000 (11%) in magneto exchanges. The total number of

telephone exchanges is 619, of which 150 (24%) are automatic exchanges, 15 (3%) are common battery exchanges, and 454 (73%) are magneto exchanges.

Annual income of PERUMTEL in 1981 amounts to approximately 282,200 million Rupiahs.

Stuff employees of PERUMTEL total 27,100. Growth rate during 1977 - 1981 is 1.77% in annual average.

REPELITA II gross investment in telecommunication projects aggregated 560,000 million Rupiahs including foreign exchange. During REPELITA II period, 450,000 telephones were to be additionally installed, but actually installed were 75% of them. As of the end of REPELITA II period, the number of existing telephones increased to 540,000.

On-going REPELITA III gross investment is scheduled to total 440,000 million Rupiahs. New telephone installations comprise 152,000 sets carried forward from REPELITA II plus 80,000 sets on REPELITA III list. These 80,000 sets include 7,000 remote telephones to be served by PALAPA-using small earth stations (75 stations).

Existing main terrestrial transmission systems composed of microwave links are the following four categories:

a) Trans-Sumatera Microwave System that extends from Banda Aceh at the northern end of Sumatera Island to Jakarta, traversing Sumatera area;

b) Jawa - Bali Microwave System that extends from Jakarta to Denpasar in Bali Island, traversing Jawa Island;

c) Eastern Microwave System that extends from Denpasar through Flores Island and proceeding north, to Ujung Pandang, the administrative and economic center of Sulawesi area;

d) Surabaya - Banjarmasin Troposcatter System that extends from Surabaya on main transmission route to Banjarmasin in Kalimantan area.

Combined total length of all these transmission systems reaches approximately 5,000 km.

In addition, domestic satellite communication system is in operation. This system consists of Cibinong Earth Station as master station plus 19 SBBs (large capacity station), 21 SBSs (medium capacity earth station) and 121 SBKs (small capacity earth station).

(2) Sulawesi Area

Telephone subscribers in Sulawesi area, the objective area of field survey carried out, this time, number 22,800. Telephone density per population of 100 is 0.21. Telephone offices total 49 including 7 automatic and 42 manual exchanges. Subscriber breakdown (as of June 1982) consists of 16,300 (71%) accommodated in automatic exchanges and 6,500 (29%) accommodated in manual exchanges.

Main terrestrial transmission systems comprise two. One is Eastern Microwave System that extends north from Flores Island to Ujung Pandang. The other is Ujung Pandang - Pare Pare single core coaxial cable system.

Eastern Microwave system proceeds via Tanahjampea and Selayar islands that are part of island group located south of Sulawesi. Therefore, this system can cater for telephone demand in those two islands.

Both the aforementioned systems are analog transmission systems. However, as part of Remote Area Telecommunication Network Project now being planned, medium and small capacity digital radio transmission systems are to come into being between Pare Pare and Majene, and between Pare Pare and Sengkang.

Besides the terrestrial transmission systems, domestic satellite communication system is also available to Sulawesi area. (Refer to Figure 1-1.)

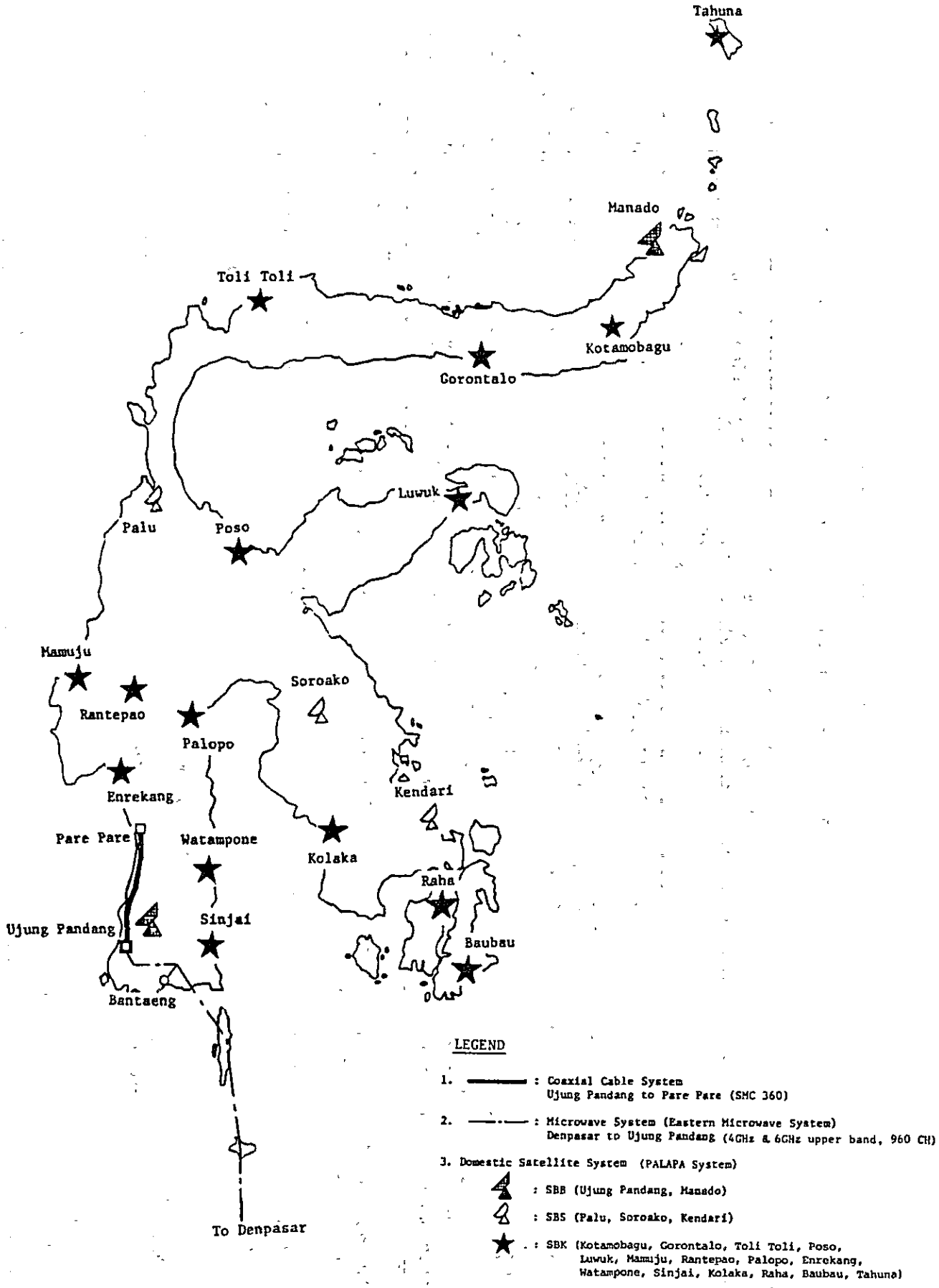


Figure 1-1 Existing Transmission System in Sulawesi
(as of the end of REPELITA-III)

Table 1-1 Areas, Population, Population Growth and Population Density in Sulawesi Area

Province	Area (km^2)	Percentage of Whole Indonesia Area (%)	Number of Population in 1980	Percentage of Whole Indonesia Population in 1980 (%)	Population Growth 1971 - 1980 (%)	Population Density in 1980 (per km^2)
Sulawesi Utara	19,023	0.99	2,115,384	1.43	2.31	111
Sulawesi Tengah	69,726	3.63	1,289,635	0.87	3.86	18
Sulawesi Selatan	72,781	3.79	6,062,212	4.11	1.74	83
Sulawesi Tenggara	27,686	1.44	942,302	0.64	3.09	34
Whole Sulawesi	189,216	9.85	10,409,533	7.05	2.22	55
Whole Indonesia	1,919,443	100.0	147,490,298	100.0	2.32	77

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

Table 1-2 Gross Regional Domestic Product by Province in Sulawesi (1975 - 1978)

(in bracket: annual growth rate)

unit: Million Rupiah

Province	At Current Market Prices				At Constant 1975 Market Prices			
	1975	1976	1977	1978	1975	1976	1977	1978
Sulawesi Utara	154,783.80 (-)	185,186.13 (19.6%)	290,525.02 (56.9%)	-	146,132.63 (-)	155,410.68 (6.3%)	206,519.81 (32.9%)	-
Sulasesi Tengah	56,834.12 (-)	80,313.84 (41.3%)	104,046.41 (29.5%)	137,579.08 (32.2%)	56,834.12 (-)	65,584.06 (15.4%)	71,333.03 (8.8%)	75,398.65 (5.7%)
Sulawesi Selatan	358,623.53 (-)	428,377.46 (19.5%)	544,136.05 (27.0%)	666,814.48 (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%)	76,814.80 (16.2%)	38,820.53 (-)	43,202.33 (11.3%)	48,535.31 (12.3%)	55,222.17 (13.8%)

Source: Pendapaten Regional Propinsi-Propinsi di Indonesia, 1975 - 1978
Biro Pusat Statistik

Table 1-3 Per Capita of Gross Regional Domestic Product by Province in Sulawesi (1975 - 1978)

unit: Rupiah

Province	At Current Market Prices				At Constant 1975 Market Prices			
	1975	1976	1977	1978	1975	1976	1977	1978
Sulawesi Utara	181,465	94,967	143,362	-	76,912	79,698	101,909	-
Sulawasi 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

Source: Pendapaten Regional Propinsi-Propinsi di Indonesia, 1975 - 1978
Biro Pusat Statistik

1-2. State of Affairs Prior to Survey

To expedite the telecommunication network improvement and expansion plan for eastern area (Sulawesi, Nusa Tenggara Timur, Timor Timur, and Irian Jaya) of the Republic of Indonesia, the Government of Indonesia requested the Government of Japan to assist formulation of long term terrestrial transmission network plan (hereafter to be called Master Plan) for the area mentioned.

The Government of Japan accepted the request and decided to carry out fact-finding survey. Based on this decision, Japan International Cooperation Agency dispatched the preliminary survey team to Indonesia in December 1981. The preliminary survey team negotiated with the Government of Indonesia with regard to scope of work, survey period and so forth, and exchanged the written Scope of Work with the Government of Indonesia on December 14, 1981.

Work, categories to be performed, based on the Scope of Work, were twofold as identified below.

- Investigation for the purpose of Master Plan formulation and report making about investigation results

- Feasibility study for first-priority project based on Master Plan and report making about feasibility study findings

For the former of the above two work categories, Japan International Cooperation Agency dispatched an ad hoc investigation team to Indonesia. The investigation was carried out for a period from January 28 through March 20, 1982. As a result of this investigation, the team recommended Sulawesi as the area where to carry out feasibility study on priority basis.

The Government of Indonesia then requested the Government of Japan for assistance in feasibility study for construction of terrestrial transmission network in Sulawesi area (hereinafter to be called Feasibility Study).

In response to this Indonesian request, the Government of Japan decided to dispatch the Feasibility Study team.

1-3. Objective of Study

The objective of Feasibility Study, this time, is to formulate Sulawesi area terrestrial transmission network plan and to evaluate economic and financial feasibility of that plan.

1-4. Study Team Organization and Time Schedule/Itinerary

The Feasibility Study team organization appears in Table 1-4. Study period is from September 28 to November 6, 1982. Time schedule and itinerary are given in Table 1-5.

Table 1-4 Member of Feasibility Study Team

Name	In Charge of	Affiliated to
Yosuke Mihara	Leader	Special Assistant to Director Technical Investigation Division Radio Regulatory Bureau Ministry of Posts and Telecommunications
Hideaki Koizumi	Sub-Leader (Network Planning)	Staff Engineer Station Establishment Group Microwave Division Nippon Telgraph and Telephone Public Corporation (NTT)
Tetsuya Ogino	Survey-Leader (Multiplex Engineering)	Senior Engineer International Operation Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Yoshihiro Nishikawa	Traffic and Switching Engineering	Senior Engineer Communication Engineering Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Sumio Shimizu	Outside Plant Engineering	Senior Engineer International Operation Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Takeshi Komiya	Economic Analysis	Economist Marketing Department International Operation Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Ryoji Sasaki	Radio System Engineering	Senior Engineer Engineering department International Operation Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)

Name	In Charge of	Affiliated to
Yuichi Nakajima	Radio System Engineering	Engineer Engineering Section Engineering Department International Operation Division The Nippon Telecommunications Consulting Co., LTd. (NTC)
Shinichiro Igari	Radio System Engineering	Engineer Engineering Section Engineering Department Communication Engineering Division The Nippon Telecommunications Consulting Co., Ltd. (NTC)
Norimoto Ohtake	Coordinator	Special Assistant to Director Social Development Cooperation Department Japan International Cooperation Agency (JICA)

Table 1-5 Time Schedule/Itinerary

Date	Leader, Sub-Leader and Coordinator	Survey Group A	Survey Group B	Survey Group C
Sep. 28	Leave Narita and arrive at Jakarta	Same as the left	Same as the left	Same as the left
Sep. 29	Courtesy call to the Embassy of Japan. Meeting with DITJEN POSTEL and JICA staff.	Same as the left	Same as the left	Same as the left
Sep. 30	Jakarta —— Bandung	Same as the left	Same as the left	Same as the left
Oct. 1	Meeting with PERUMTEL staff	Same as the left	Same as the left	Same as the left
Oct. 2	Meeting with PERUMTEL staff Bandung Jakarta	Same as the left	Same as the left	Same as the left
Oct. 3	Jakarta —→ Ujung Pandang	Same as the left	Same as the left	Same as the left
Oct. 4	Meeting with WITEL-X	Same as the left	Same as the left	Same as the left
Oct. 5	Ujung Pandang —→ Jakarta	Inspection in Bantaeng Rep. station.	Ujung Pandang —→ Palu. Inspection in Palu Tel. Office.	Meeting with counterpart officials.
Oct. 6	Meeting with Embassy and JICA staff	Inspection in Sengkang and Pare Pare Tel. Offices.	Inspection in Kulawi area.	Ujung Pandang —— Manado

(to be contineud)

Date	Leader, Sub-Leader and Coordinator	Survey Group A	Survey Group B	Survey Group C
Oct 7	Leave Jakarta and arrive at Narita	Inspection in Pare Pare and Majene Tel. Offices.	Palu ⟶ Luwuk Inspection in Luwuk Tel. Office.	Inspection in Manado Tel. Office.
Oct. 8		Inspection in Rantepao area	Visit Luwuk BAPEDA and P.U. Offices Luwuk ⟶ Anpana	Visit Manado Statistic and Meteorological offices, and Manado Tel. Office.
Oct. 9		Inspection in Palopo, Masamba and Malili area	Visit Poso BAPEDA Office and inspection in Poso Tel. Office.	Visit Manado Meteoro-logical and Bina Marga Offices.
Oct. 10		Soroako ⟶ Rantepao	Poso ⟶ Palu	Filing of collected data
Oct. 11		Rantepao ⟶ Pare Pare Inspection in Rantepao area	Filing and study of collected data	Manado ⟶ Ujung Pandang
Oct. 12		Pare Pare ⟶ Ujung Pandang	Filing and study of collected data	Visit WITEL-X and inspection in Ujung Pandang Tel. Office.
Oct. 13		Ujung Pandang ⟶ Kendari Inspection in Kendari Tel. Office	Palu ⟶ Gorontalo Inspection in Gorontalo Tel. Office.	Visit statistic Office and PLN Office
Oct. 14		Inspection in Watumohati area.	Visit P.U. Seksi Gorontalo Inspection in Gorontalo area	Visit Bina Marga Office and PLN Office

(to be contineud)

Date	Leader, Sub-Leader and Coordinator	Survey Group A	Survey Group B	Survey Group C
Oct. 15		Inspection In Unaaha area	Visit Bina Marga Gorontalo Gorontalo ⟶ Manado	Visit Bina Marga Office
Oct. 16		Inspection in Malaka and Ladongi area	Visit P.U. Bina Marga Office. Inspection in Manado Tel. Office.	Visit Meteorological Office.
Oct. 17		Inspection in Kolaka, B. Motaba and G. Makaleo area	Inspection in Manado, G. Makaweinbeng area	Filing and study of collected data.
Oct. 18		Kendari ⟶ Ujung Pandang	Filing and study of collected data	Filing and study of collected data.
Oct. 19		Inspection in Ujung Pandang Toll Tel. Office	Manado ⟶ Ujung Pandang	Filing and study of collected data.
Oct. 20		Meeting with WITEL-X staff	Same as the left	Same as the left
Oct. 21		Ujung Pandang ⟶ Jakarta	Same as the left	Same as the left
Oct. 22		Filing and study of collected data	Same as the left	Same as the left
Oct. 23		Filing and study of collected data	Same as the left	Same as the left
Oct. 24		Jakarta ⟶ Bandung	Same as the left	Same as the left

(to be contineud)

Date	Leader, Sub-Leader and Coordinator	Survey Group A	Survey Group B	Survey Group C
Oct. 25		Meeting with PERUMTEL staff	Same as the left	Same as the left
Oct. 26		Filing and Study of collected data	Same as the left	Same as the left
Oct. 27		Filing and Study of collected data	Same as the left	Same as the left
Oct. 28	Leave Narita and Arrive at Jakarta	Filing and study of collected data	Same as the left	Same as the left
Oct. 29	Meeting with JICA staff Jakarta Bandung	Filing and study of collected data	Same as the left	Same as the left
Oct. 30	Meeting by F/S Team	Same as the left	Same as the left	Same as the left
Oct. 31	Meeting by F/S Team	Same as the left	Same as the left	Same as the left
Nov. 1	Meeting with PERUMTEL staff	Same as the left	Same as the left	Same as the left
Nov. 2	Bandung Jakarta	Same as the left	Same as the left	Same as the left
Nov. 3	Meeting with DITJEN POSTEL staff	Same as the left	Same as the left	Same as the left
Nov. 4	Meeting with JICA staff	Same as the left	Same as the left	Same as the left
Nov. 5	Preparation for departure	Same as the left	Same as the left	Same as the left
Nov. 6	Leave Jakarta and arrive at Narita	Same as the left	Same as the left	Same as the left

1-5. Agencies/Personnel in Charge

Government agencies on Indonesian side having to do with the Feasibility Study, this time, are DITJEN POSTEL that belong to Ministry of Transport, Communication and Tourism, and PERUMTEL. Personnel of these two Government agencies, who were directly concerned with the Feasibility Study, including Counterparts, are listed below.

(1) DITJEN POSTEL

Ir. Rollin, Deputy Director General

Ir. Agus Darman, Director of Planning

(2) PERUMTEL

Headquarters:

Ir. Saleh Gunawan, Deputy Director of Telecommunication Facilities Planning.

Ir. Abdul Muhaimin, Chief of Terrestrial Transmission Planning Division

Mr. Harjana Soetarja Soemnitapradja Bc.TT, Chief of Satellite Planning Division

Mr. Azwar Mohamad Bc.TT

Mr. Achmad Yasin Rivai Bc.TT (Counterpart)

Ir. Saleh Effendi

Mr. Roesmijanto Bc.TT

Ir. Adi Prasetya

WITEL-X:

Mr. R.I. Soemardi Bc.TT, Chief of WITEL-X

Mr. R. Soenaryo H.

Mr. Masburham Bc.TT

Mr. C. Pandjaitan

Mr. Subandi (Counterpart)

Mr. Soepardi (")

Mr. Halim (")

Mr. Sofyan Usmar (")

Mr. Pujadi (")

Mr. Sofian (")

Mr. A.S. Sande (")

Personnel concerned on Japan side are:

Mr. Yasuo Suzuki,	Clerical Officer, Japanese Embassy, Jakarta
Mr. Ken Inomata,	Jakarta Office, Japan International Cooperation Agency
Mr. Kenzo Hirata,	Expert dispatched by Japan International Cooperation Agency
Mr. Motonori Ando,	ditto
Mr. Tatsuichi Hidaka,	Resident Representative, Jakarta Office, Nippon Telegraph & Telephone Public Corporation

2. FUNDAMENTALS AND PRECONDITIONS

2. Fundamentals and Preconditions

Fundamental requirements and preconditions determined for this report making are as follows:

(1) Commencement of service:
1989

(2) Project life:
1984 - 2005

(3) Demand forecast years:
1994, 1999, 2005

(4) Facilities capacity:
Up to 5 years after commencement of service

(5) Type of contract:
On turn-key basis

(6) Demand forecast method:

Demand forecast is made, based on population and other relevant data (e.g., GDP and degrees of necessity from social and economic angles).

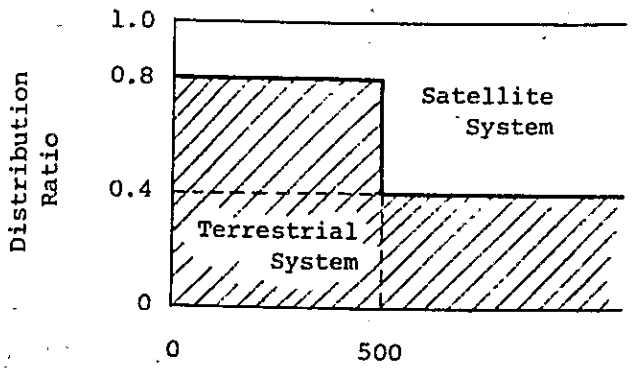
(7) Traffic forecast method:

Traffic forecast is made, based on SLDD service records, analysis result of traffic measuring data, and gravity models.

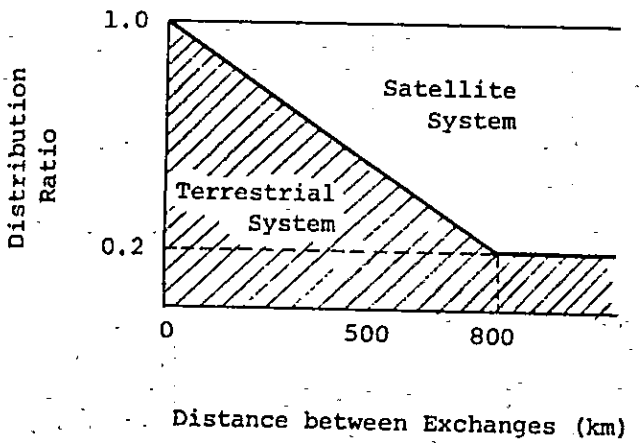
(8) Main Plan and Alternative Plan:

Main plan and alternative plan differ in the traffic distribution ratio of terrestrial transmission system to satellite transmission system. Study result about Alternative Plan is described in ANNEX-1. Traffic distribution ratio for each plan is:

a) Main Plan (Case 1)



b) Alternative Plan (Case 2)



(9) System Classification:

Digital system is to be applied.

(10) Technical Standard:

To comply with PERUMTEL's technical standard or CCITT/CCIR recommendations.

3. OUTLINE OF PROJECT

3. Outline of Project

3-1. Objective

Existing long distance telecommunication services in Sulawesi area are via satellite communication system except in part of sulawesi Selatan where such services are via terrestrial transmission system.

Objective of telecommunication sector in the 4th Five-Year Development Plan (hereinafter to be called REPELITA IV) (April 1984 - March 1989) is to improve telephone service both qualitatively and quantitatively, to fill the waiting demand. To attain this objective, the Project, this time, will construct terrestrial transmission network in Sulawesi area and, through interdependence with existing satellite communication network, will realize Subscriber Long Distance Dialing (hereinafter to be called SLDD) service in the area.

Meanwhile, this Project is to establish terrestrial transmission route only and does not include switching equipment installation. It is assumed that switching equipment installation on the route will be carried out in REPELITA IV and succeeding REPELITA series.

3-2. Cities/Towns to be covered

Selection of cities to be connected by terrestrial transmission route to be established by this Project is based on PERUMTEL draft for REPELITA IV and on the Master Plan Report (draft final report).

In this selection of cities, views of PERUMTEL were taken into full consideration.

Cities selected to complete terrestrial transmission route are:

- Tertiary Center : Ujung Pandang
- Secondary Centers: Pare Pare, Kendari, Palu and Manado
- Primary Centers : Watampone, Rantepao, Masamba, Palopo, Malili, Malamala, Kolaka, Raha, Baubau, Tanahjampea, Benteng, Bantaeng, Poso, Uekuli, Luwuk, Toli Toli, Tilamuta, Gorontalo, Kotamobagu, Karosa, Unaaha, Kolonedare, Bungku, Banggai

3-3. Outline of Terrestrial Transmission Route Plan

Transmission systems to be adopted are 6 GHz (upper band) digital radio system for main route and 2 GHz digital radio system and cable PCM system (2,048 kbit/s) for spur routes.

In this Project, routes that connect Tertiary Center and Secondary Centers are called main routes. Routes that branch in many directions from the main route to connect Primary Centers are called spur routes.

Projected routes and their transmission system capacities are shown below. Refer to route map (Figure 3-1) also.

(1) Main Route

a) Ujung Pandang - Pare Pare - Palu - Manado

34 Mbit/s x 3 / RF CH (1,440 CH/RF CH)

b) Radio branching station - Kendari

34 Mbit/s x 1 / RF CH (480 CH/RF CH)

(2) Spur Routes

a) Radio branching station - Poso

8 Mbit/s x 2 / RF CH (240 CH/RF CH)

b) Radio branching station - Luwuk

8 Mbit/s x 2 / RF CH (240 CH/RF CH)

c) Radio branching station - Gorontalo

8 Mbit/s x 2 / RF CH (240 CH/RF CH)

d) From each Radio branching station to the undermentioned Primary Center

2 Mbit/s x 2 / RF CH (60 CH/RF CH)

- Watampone
- Rantepao
- Palopo
- Masamba
- Malili
- Kolonedare - Bungku
- Raha - Baubau
- Unaaha
- Malamala
- Banggai
- Toli Toli
- Kotamobagu
- Karosa

e) From each radio branching station to the undermentioned Primary Center

2 Mbit/s cable PCM (30 CH/SYS)

- Uekuli
- Tilamuta
- Tanahjampea

f) Bt. Patahakayua - Benteng

2 GHz analog radio system
(60 CH / RF CH: FDM system)

g) Bt. Tino - Bantaeng

This route is of existing 6 GHz (upper band) analog radio system (FDM system).

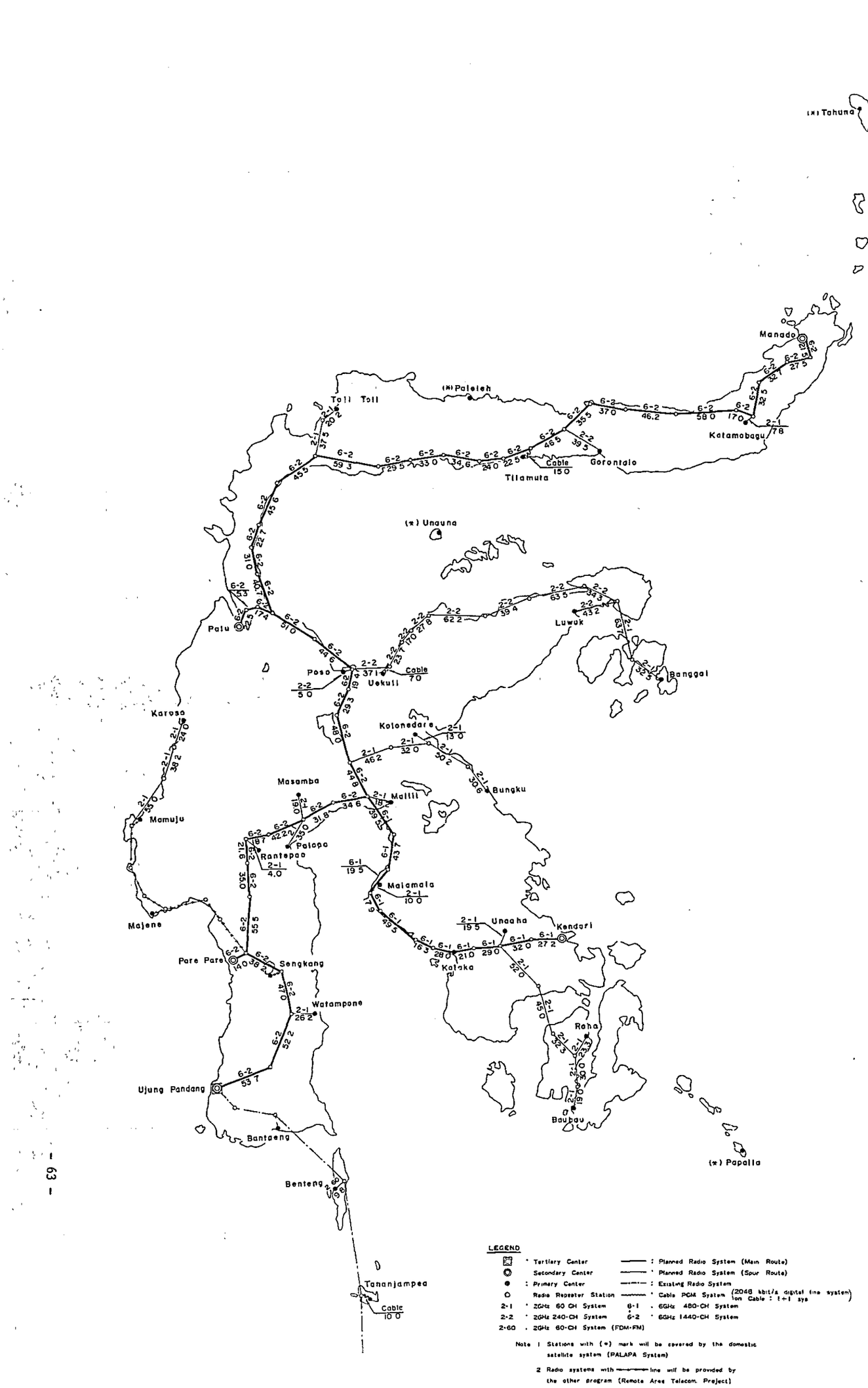


Figure 3-1 Transmission Route Map

3-4. Project Implementation Plan

Construction period for transmission routes outlined in the preceding paragraph is divided into three stages in accordance with REPELITA series. The three stages are (1) initial stage (inside of REPELITA IV period), (2) intermediate stage (inside of REPELITA V period), and (3) final stage (inside of REPELITA VI period).

Terrestrial transmission route segments to be constructed in different stages are illustrated in Figure 3-2, Figure 3-3 and Figure 3-4.

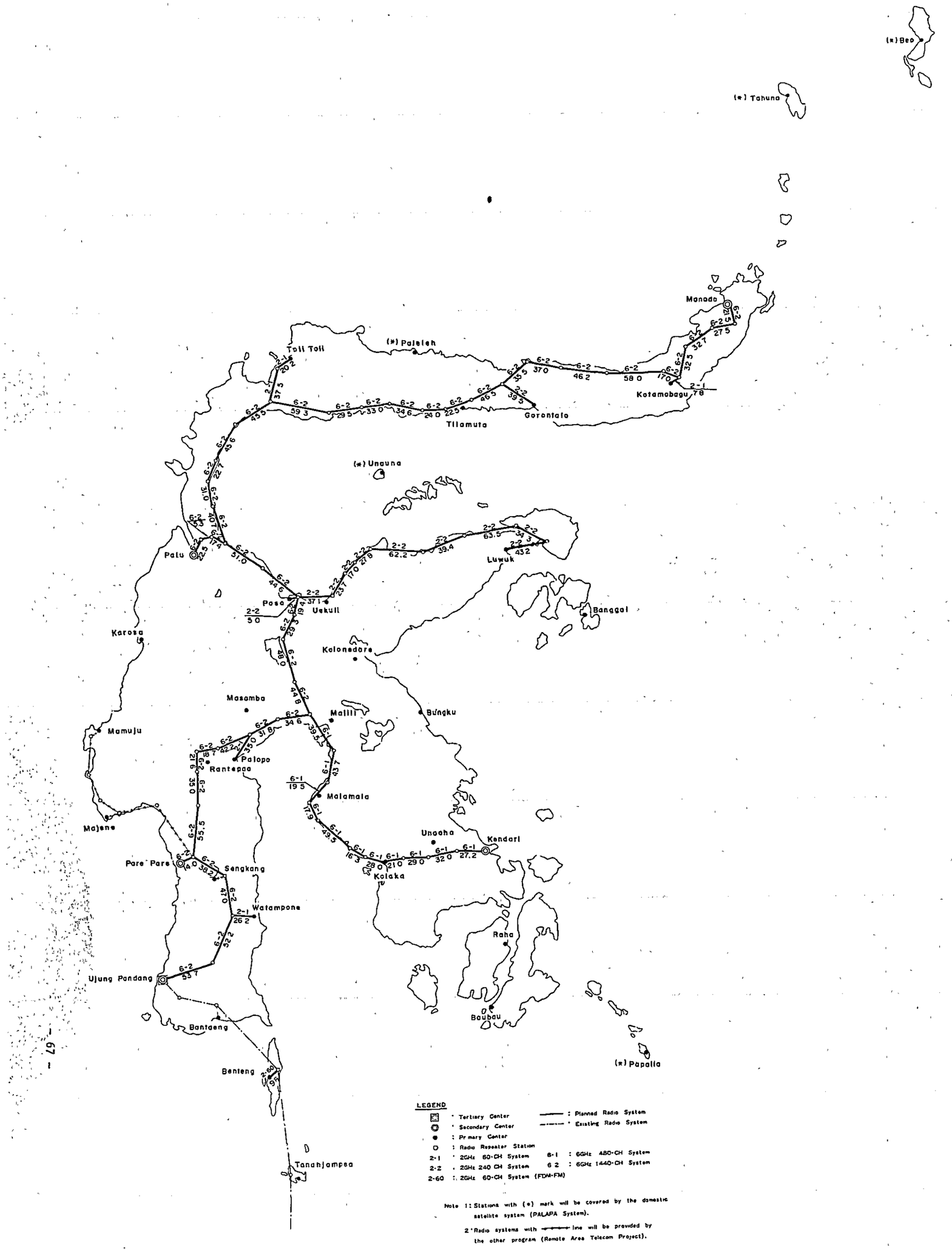


Figure 3-2 Initial Stage Implementation of Transmission Routes

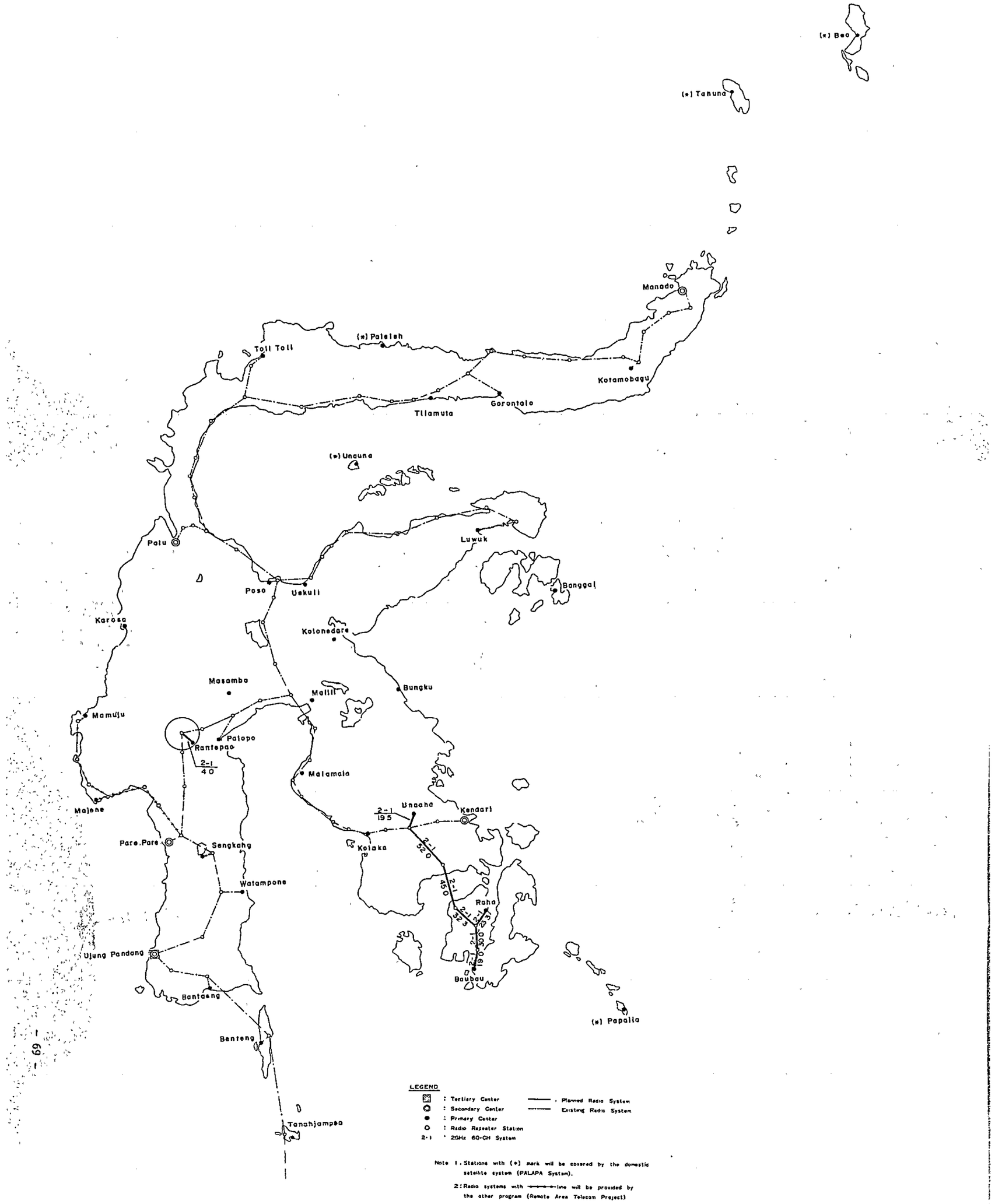


Figure 3-3 Intermediate Stage Implementation of Transmission Routes

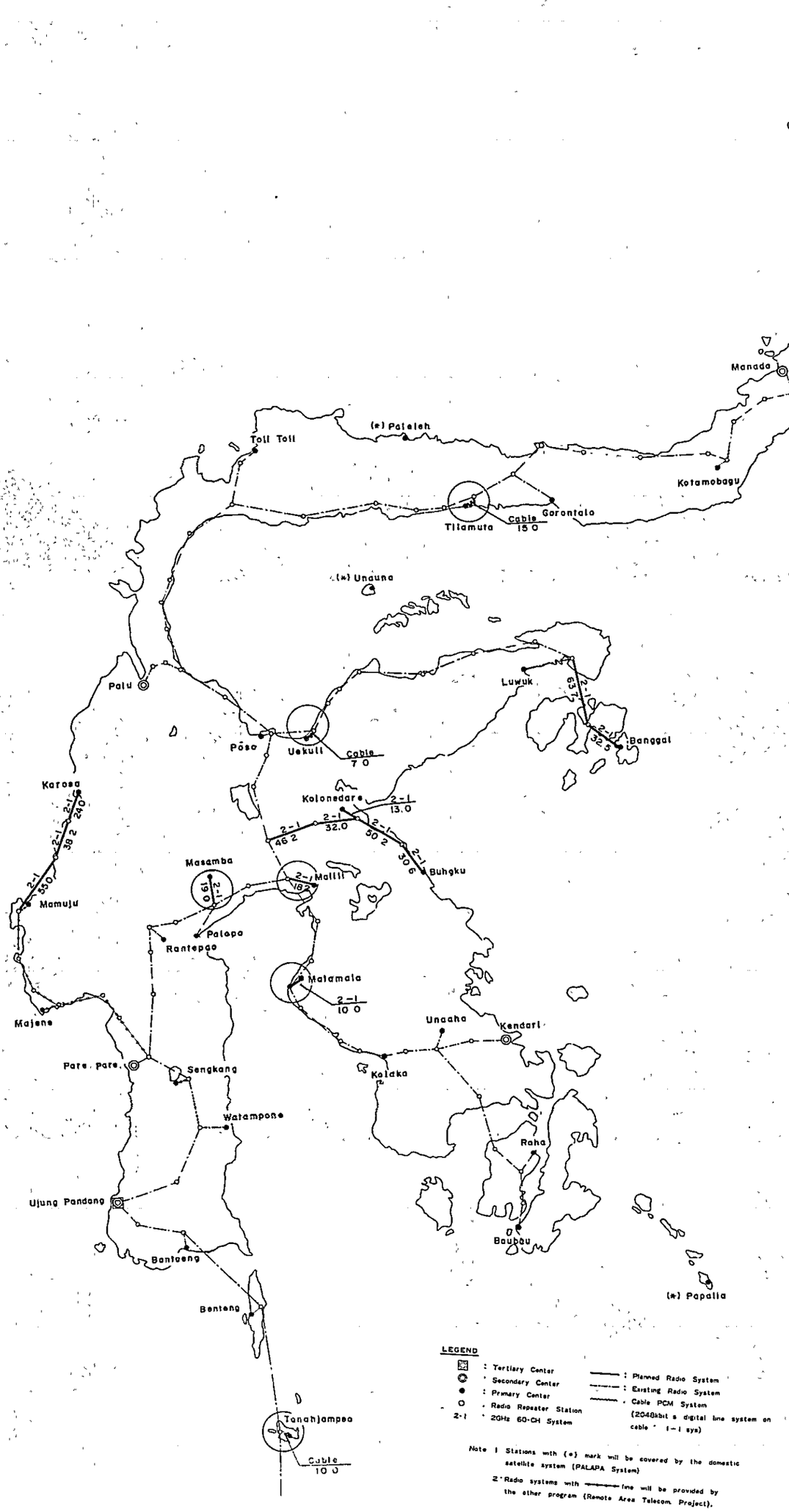


Figure 3-4 Final Stage Implementation of Transmission Routes