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No. 7

THE REPUBLIC OF INDONESIA
FEASIBILITY STUDY
ON
IMPROVEMENT PROJECT OF TELEPHONE NETWORK IN MEDAN, SEMARANG AND SOLO

NOVEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF INDONESIA

FEASIBILITY STUDY

ON

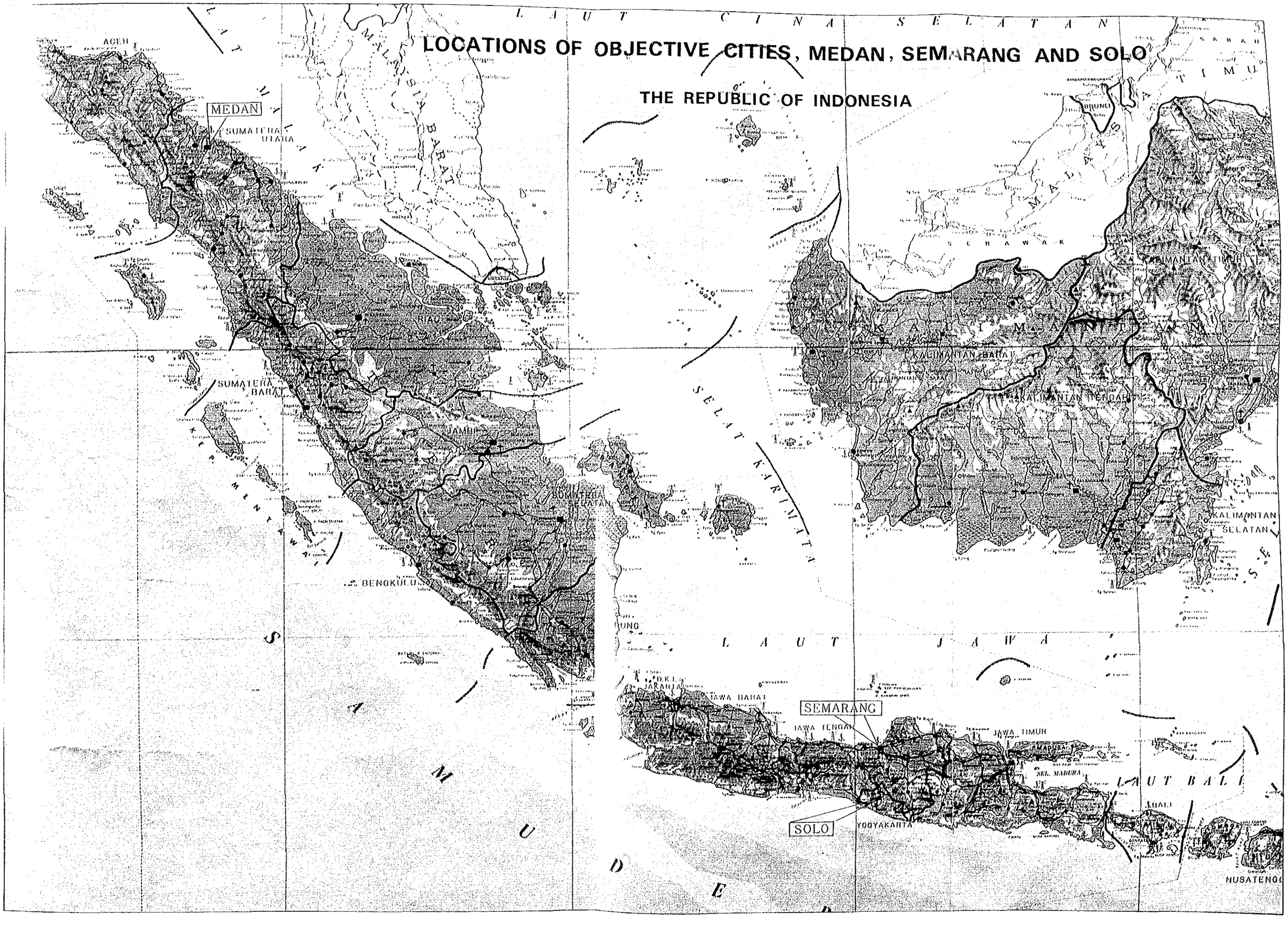
IMPROVEMENT PROJECT OF TELEPHONE NETWORK IN MEDAN, SEMARANG AND SOLO

NOVEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATIONS OF OBJECTIVE CITIES, MEDAN, SEMARANG AND SOLO

THE REPUBLIC OF INDONESIA



PREFACE

In response to the request of the Government of the Republic of Indonesia, the Japanese Government decided to conduct a Feasibility Study on Improvement Project of Telephone Network in Medan, Semarang and Solo and entrusted the study to the Japan International Cooperation Agency (JICA).

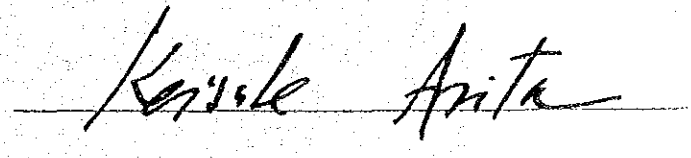
The JICA established an Advisory Committee, headed by Chairman Shinichi Takeuchi, Special Advisor for International Cooperation, Ministry of Posts & Telecommunications, and sent to Indonesia a survey team for a period from November 13, 1984 to March 23, 1985.

The team had discussions on the Project with the officials concerned of the Government of Indonesia, and conducted a field survey in Medan, Semarang and Solo. After the team returned to Japan, further studies were made and the present report has been prepared.

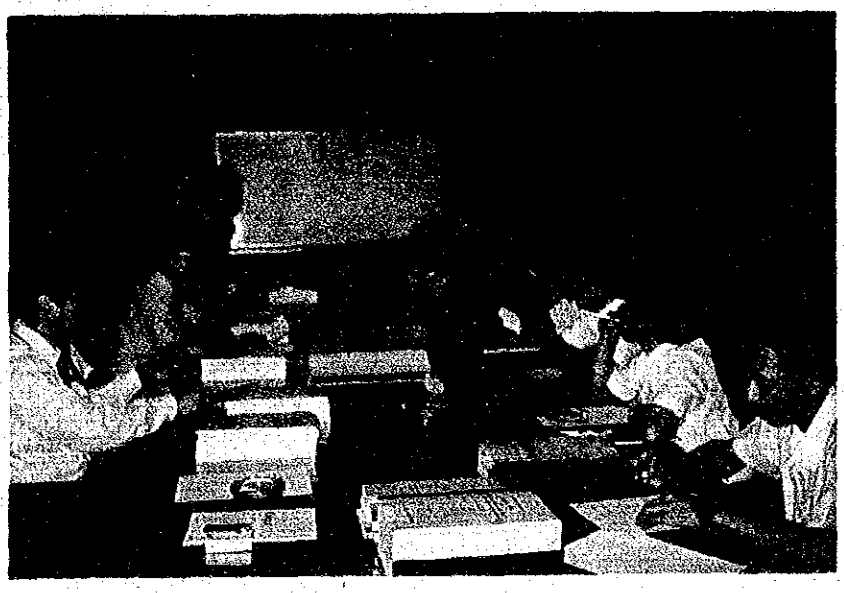
I hope that this report will serve for the Project and contribute to the promotion of friendly relations between our two countries.

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.

November, 1985



Keisuke Arita
President
Japan International Cooperation Agency

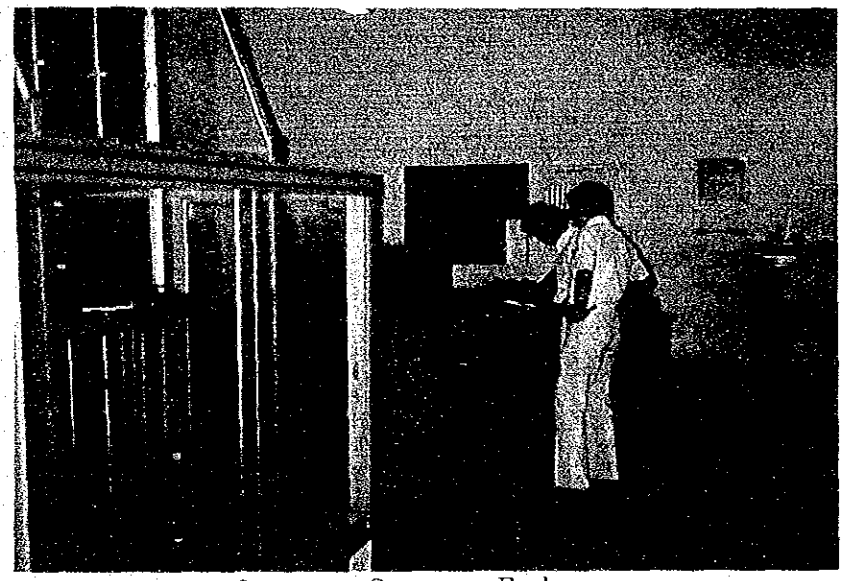


Meeting at DITJEN POSTEL

Discussion with PERUMTEL Key persons at PERUMTEL Head-office

Completion of Draft Final Report

Field Survey in Medan Exchange Area



Survey at Semarang Exchange

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SUMMARY

1. OBJECTIVES AND SCOPE OF STUDY

(1) Study Objectives

1) To formulate long term telephone network plans for three cities of Medan, Semarang and Solo with 2005 as final year.

2) To execute feasibility study for outside plant (subscriber and junction cable networks) expansion project for three cities of Medan, Semarang and Solo as part of REPELITA-IV Program.

(2) Scope of Study

1) Collection and scrutiny of necessary data/ information for feasibility study

2) Telephone demand forecast up to 2005

3) Traffic forecast up to 2005

4) Formulation of long term local telephone network plan up to 2005

5) Basic design for outside plant (subscriber and junction cable networks) expansion project as part of REPELITA-IV Program

6) Project cost and service revenue estimate

7) Financial, economic and social analyses of project

8) Formulation of project implementation plan

9) Proposal concerning outside plant maintenance and operation

2. FUNDAMENTALS AND PRECONDITIONS

Fundamentals and preconditions determined for this report making are as follows:

(1) Completion of Project: end of year 1988 (fiscal)

(2) Project Life: year 1986 - 2005

(3) Demand Forecast Year: for macroscopic forecast, year 1988, 1993, 1998 and 2005

for microscopic forecast, year 1995 and 2005

(4) Installation Design Year

1) Subscriber Cable Network

Primary Cable Capacity: commensurate with demand as of year 1993

Secondary Cable Capacity: commensurate with demand as of year 2005

2) Junction Cable Network

Cable Capacity: commensurate with traffic as of year 1998

PCM Transmission Equipment:	commensurate with traffic as of year 1993

3) Underground Facilities

Manhole capacity and number of ducts:	to meet cable requirements as of year 2005

(5) System Application

1) Subscriber Cable Network:	cross-connecting cabinet system to be adopted in view of flexibility for cable distribution and advantages in future maintenance and demand management.
2) Junction Cable Network:	Cable PCM System to be atopted according to PERUMTEL's policy for digitalization of telecommunication network.
(6) Technical Standards:	To comply with PERUMTEL's technical standards or CCITT Recommendations

3. TELEPHONE DEMAND FORECAST

In this study, telephone demand forecast is made from two angles. One is from macroscopic (top-down) angle. The other is from microscopic (bottom-up) angle.

(1) Macroscopic demand forecast is made as follows:

First, to obtain demand in the whole of Indonesia by regression equation. Then, to allocate this national demand to each related region and then to each objective city of study, in due consideration of factors intimately related to demand growth in each area.

(2) Microscopic demand forecast is made as follows:

First, to estimate subscriber distribution by categories (e.g., geographical distribution of business office and residence subscribers, etc.) for each forecast year. For this estimate, demand allocated to each objective city after the macroscopic demand forecast and demand distribution status quo made known by field surveys are used as basic data.

Then, to forecast future demand by subscriber categories and by areas, based on growth forecast for demand density by subscriber categories.

Finally, to analyze results of the foregoing estimate and forecast, and, by such analysis, forecast demand share of each objective city of study.

(3) Microscopic demand forecast results are coordinated to macroscopic demand forecast results. After this coordination, microscopic forecast results are used

as basic data for installation program to be formulated by this study.

3-1 Macroscopic Demand Forecast

(1) National Demand Forecast

For national demand forecast, regression model which shows correlation between main telephone density (number of main telephones per population of 100) and GDP per capita (in U.S. dollars) is used.

Regression model is obtained by least square method based on telephone density and GDP per capita statistics of 56 countries of the world. Regression model thus obtained is

$$Y = 0.000115X^{1.372} \quad (r = 0.952)$$

where

Y: Main telephone density
X: GDP per capita (in U.S. dollars, 1981)

Figure calculated in 3% of growth rate of GDP per capita are selected as national forecasted demand in this study and shown below.

Year	Demand Forecast (x 10^3)
1988	1,689
1993	2,299
1998	3,089
(2000)	3,475
2005	4,699

(2) Area by Area Demand Forecast

As seen in population forecast by areas and GRDP calculation results, data of forecasted demand factor in related areas presents practically the same trend as 1981 statistical data by areas. This fact supports judgment that regression equation is fully applicable to demand forecast calculation for related ares. That is,

$$Y = 0.492\ a_1\ x_1 + 0.029\ a_2\ x_2 + 0.653$$

where

Y:	Main station distribution (%)
x_1:	Population distribution (%)
x_2:	GRDP distribution (%)
a_1, a_2:	Correlation factors

provided

Jakarta:	$a_1 = 15.0$	$a_2 = 3.5$
Witel I:	$a_1 = 2.0$	$a_2 = 1.0$
Witel VII:	$a_1 = 1.5$	$a_2 = 1.0$
Other areas:	$a_1 = 1.0$	$a_2 = 1.0$

The demand forecasts for WITEL I (including Medan) and WITEL VI (including Semarang and Solo) are calculated by this regression and the results are shown below.

Year	WITEL I	WITEL VI
1988	141,500	165,400
1993	195,600	216,600
1998	267,800	281,100
(2000)	303,000	312,400
2005	414,000	406,500

(3) Demand Forecast for Objective Cities of Study

Intimate correlation between population distribution and main telephone distribution in each principal local city, is fully applicable to telephone demand forecast for objective cities of study. That is,

$$Y = K - a \cdot b^{x}$$

where

Y: Main telephone distribution (%)

Y is expressed by

$$\frac{\text{No. of main telepones in objective cities of study}}{\text{No. of main telepones in related region}} \times 100$$

: Population distribution (%) is expressed by

$$\frac{\text{Population in objective city of study}}{\text{Population in related region}} \times 100$$

K = 100

a = 74.56

b = 0.96

Year	Medan	Semarang	Solo
1988	79,700	59,900	19,800
1993	111,500	79,700	26,000
1998	154,800	105,100	33,700
(2000)	176,000	117,800	37,500
2005	245,100	156,100	48,800

This results are confirmed with the estimations of demand density of objective cities for each forecast year.

3-2 Microscopic Demand Forecast

(1) Area Segmentation

Whole area of each objective city is divided into 5 area segments for microscopic demand survey.

1) Residential Area
2) Office Area
3) Commercial Area
4) Industrial Area
5) Other Area

(2) Schematic Survey (Subdivision of Area Segments)

Prior to in-depth survey, schematic survey was made on sampling basis for collection of data to be used for further division of each area segment. At the same time, for each area segment, data of present telephone demands comprising the number of existing main telephones and subscriber backlog per unit area (1 hectare) was collected for estimation of demand density per different area segment.

(3) In-depth Survey

1) Formulation of Area Classification Map

In-depth survey consists of field survey throughout three objective cities, area classification according to subdivision of area segments by schematic survey, and projection of area classification result on city maps. By this means, area classification map was formulated.

2) Formulation of Demand Distribution Diagram

Demand distribution diagram is formulated with a view to totalization of demand in the whole area of each objective city. That is to say, the aforementioned area classification map was divided into 200 m x 200 m segments and each segment was filled with demand numeral corresponding to demand density area segment. Therefore, when demand numerals given by area segments are totalized, total demands in each objective city can be obtained.

(4) Calculation of Demand Forecast by Objective Cities

By totalizing demand numerals given in 200 m x 200 m segments of demand distribution diagram for each objective city according to forecast years of 1985, 1995 and 2005, calculation was made for demand forecast values by forecast years. In the course of this calculation, adjustment was made with macroscopic forecast. Calculation result is as under.

Year	Medan	Semarang	Solo
1985	64,600	43,200	15,900
1995	125,600	91,300	32,800
2005	254,900	165,800	52,800

4. EXCHANGE SITE SELECTION

For subscriber cable network in multi-exchange area, main cost determinants are as under.

(1) Maximum capacity of exchange
(2) Number of exchanges
(3) Size of exchange service area
(4) Locations of exchanges
(5) Junction network structure

The undermentioned non-economic factors also are intimately related to exchange site selection.

(6) Signalling limitations and transmission loss limitations on subscriber cables and junction circuits
(7) Existing exchange building capacity and building expansion availability
(8) Subscriber cable network dimension of existing exchange
(9) Natural boundary conditions, such as rivers, railways and main roads

Therefore, to achieve economically most advantageous exchange site selection, the number and locations of exchanges, as well as the size of each exchange service area, must be so determined as can minimize total cost of local network. In this case, the foregoing non-economic factors must also be duly considered.

Figures 1 to 3 present the proposed locations of exchanges in objective cities.

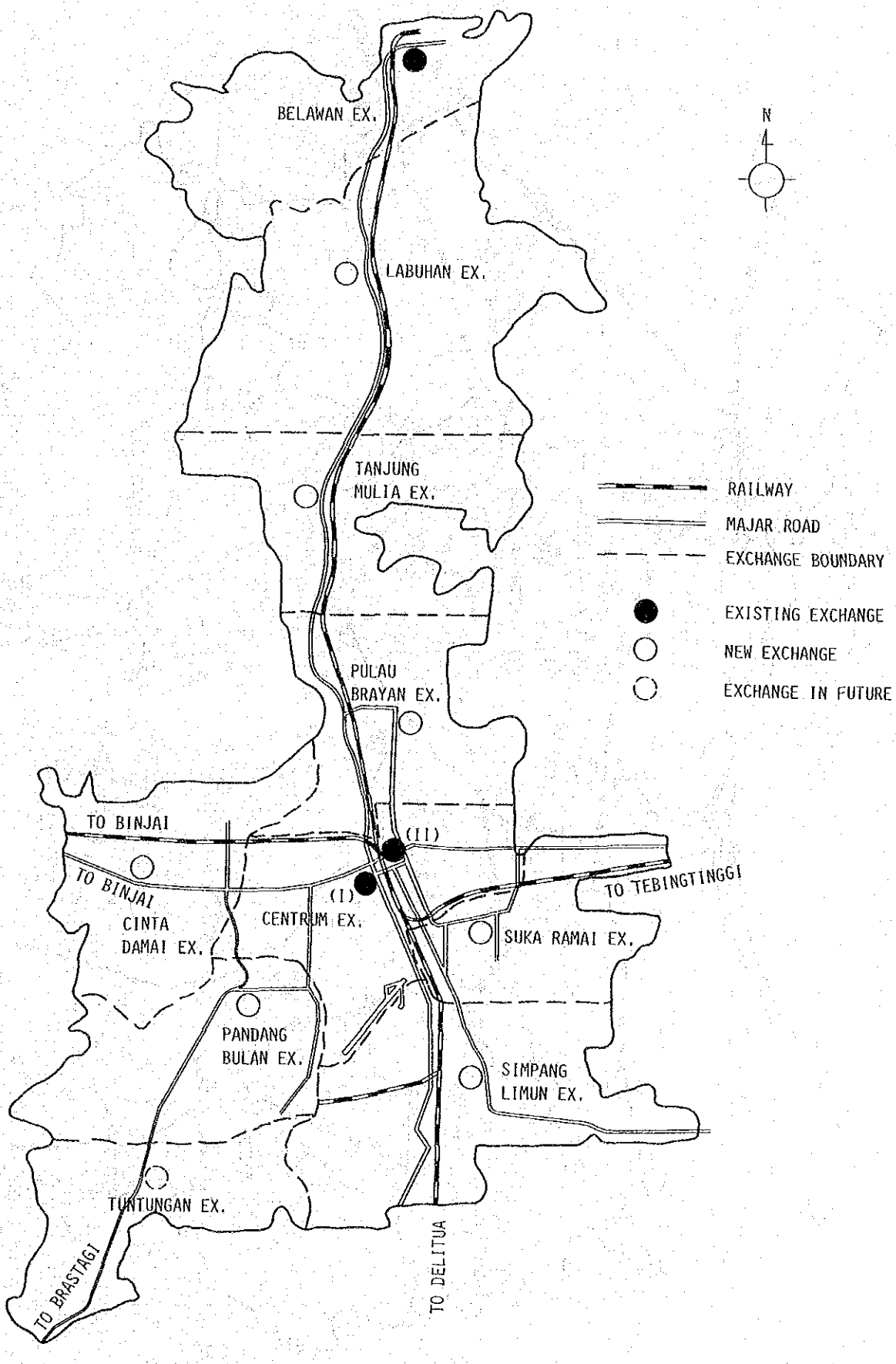


Figure 1 Proposed Locations of Exchanges (Medan)

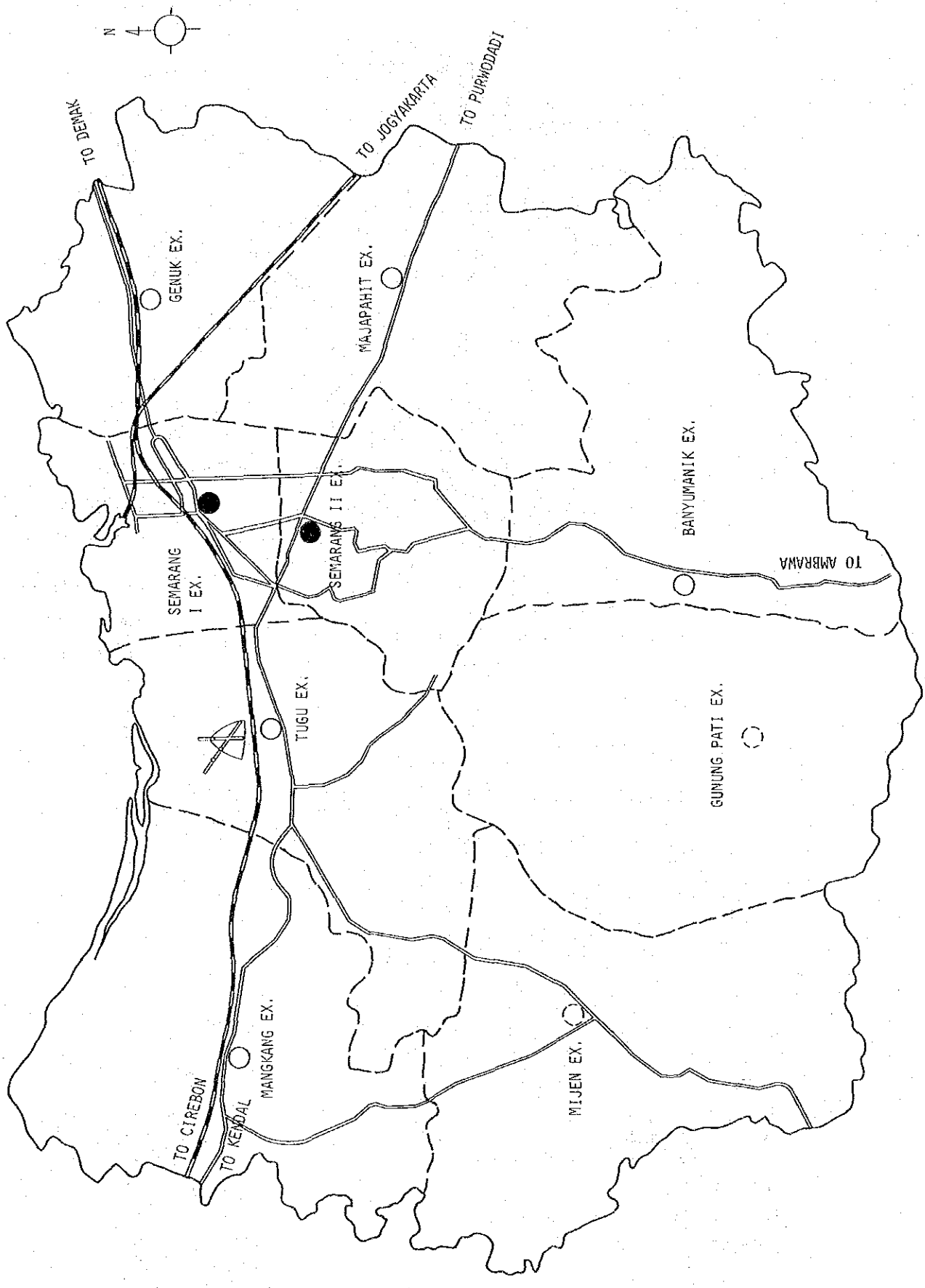


Figure 2 Proposed Locations of Exchanges (Semarang)

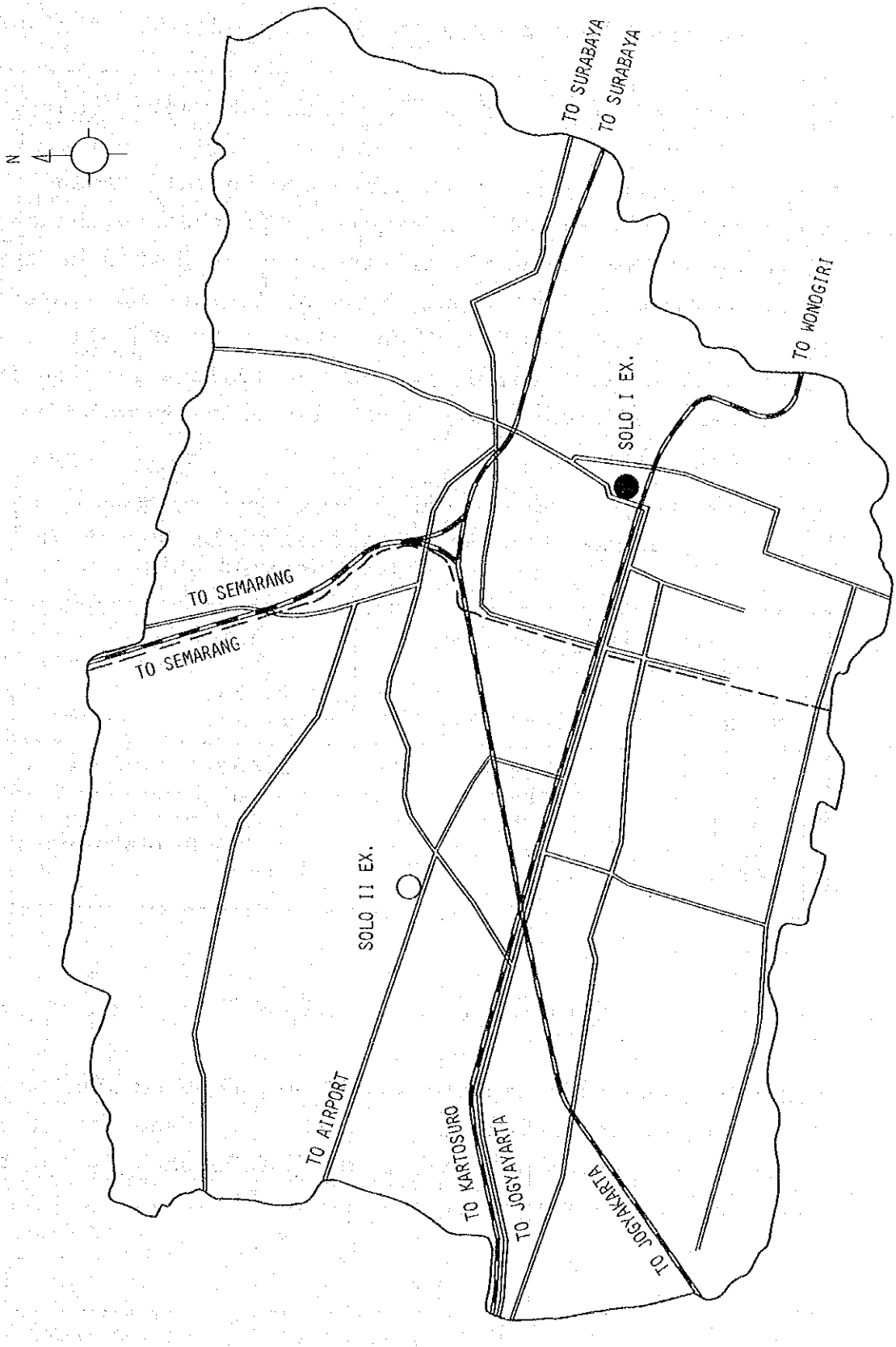


Figure 3 Proposed Locations of Exchanges (Solo)

5. INSTALLATION PLAN OBJECTIVE

5-1 Telephone Exchange Installation Plan for Whole Country

Insofar as PERUMTEL is to achieve demand fulfillment completely in 2000, the prerequisite is that in the case of telephone switching facilities, design period be three years so that in 2000, the number of line units commensurate with demand as of 2003 can already be installed. To attain this objective, design values of installation in final years of prospective five-year plans must be as specified below.

Year	Demand Forecast ($\times 10^3$)	Installation Objective (No. of line units: $\times 10^3$)
1985	1,404	913.6
1986	1,501	1,167.4
1987	1,578	1,376.1
1988	1,689	1,613.6
1993	2,299	2,397.1
1998	3,089	3,561.1
(2000)	(3,475)	(4,172.0)
2003	4,172	4,985.0 (estimated)
(2005)	4,699	-

5-2 Telephone Installation Plan for Objective Cities of Study

Table 1 presents telephone installation objectives for three objective cities, i.e., Medan, Semarang and Solo. These installation objectives are established by the same principle as in Paragraph 5-1.

Table 1 Telephone Installation Plan for Objective Cities

No.	Exchange	1988	1991	1994	1997	2000	2003	Remark
1	Centrum	36.9	43.9	50.0	57.0	62.6	65.4	
2	Suka Ramai	10.2	13.5	18.5	23.5	29.8	33.4	
3	Pulau Brayan	9.8	13.0	16.3	22.3	28.7	33.7	
4	Padang Bulan	4.0	6.0	9.6	13.2	17.6	20.5	
5	(Tuntungan)	-	-	1.5	3.3	9.6	13.1	
6	Cinta Damai	6.0	8.4	12.7	17.8	25.2	29.9	
7	Simpang Limun	4.2	6.0	9.3	13.9	21.4	26.6	
8	Tanjung Mulia	1.6	2.4	3.9	6.5	12.6	17.7	
9	Belawan	1.8	2.4	3.4	4.4	5.5	6.1	
10	Labuhan	0.7	1.0	1.6	3.0	6.2	8.5	
	Total (Medan)	75.2	96.6	127.0	164.9	219.2	254.9	
1	Semarang I	16.6	20.9	25.8	31.1	37.4	41.2	
2	Semarang II	11.8	14.7	18.3	21.6	26.3	28.8	
3	Genuk	2.3	3.6	6.8	9.3	13.5	15.6	
4	Tugu	7.0	9.5	13.5	16.2	21.1	22.7	
5	(Mijen)	-	-	-	0.8	1.0	1.1	
6	Banyumanik	6.8	8.6	10.9	12.3	15.2	17.1	
7	(Gunung Pati)	-	-	-	1.0	1.7	1.9	
8	Majapahit	5.4	7.8	12.7	16.8	22.8	25.9	
9	Mang Kang	2.3	3.5	5.7	7.5	10.5	11.5	
	Total (Semarang)	52.2	68.6	93.7	116.6	149.5	165.8	
1	Solo I	11.0	13.6	16.0	19.2	22.1	24.0	
2	Solo II	8.7	12.5	17.6	22.3	27.0	28.8	
	Total (Solo)	19.7	26.1	33.6	41.5	49.1	52.8	
	Grand Total	147.1	191.3	254.3	323.0	417.8	473.5	

5-3 Non-telephone Service Expansion Plan

(1) Items shown under are the main non-telephone services in this study.

1) Telex
2) Leased circuit
3) Data communication

(2) Demand forecast results in objective cities are shown under.

Service	1988	1993	1998	2005
1) Medan				
- Telex	1,380	2,430	3,740	5,630
- Leased circuits	90	160	245	370
- Data	50	120	245	480
2) Semarang				
- Telex	520	910	1,400	2,100
- Leased circuits	35	60	90	140
- Data	20	45	90	180
3) Solo				
- Telex	90	150	230	350
- Leased circuits	5	10	15	25
- Data	-	10	15	30

(3) Precondition to calculate the number of local junctions required is shown under.

1) Subscriber circuits for data communication, telex and leased circuit services be first connected to nearest exchange MDF via subscriber telephone cables and then extended via local junctions for telephones to non-telephone centers.

2) Calculation to determine the number of junction circuits required for non-telephone services is on 64 Kbit/s base. This means that 20 telex circuits (3.2 Kbit/s) or 5 data circuits (9.6 Kbit/s) correspond to one(1) telephone circuit (64 Kbit/s). For ordinary leased circuits, 9.6 Kbit/s base calculation is made.

5-4 Proposal on Installation Plan Under REPELITA-IV

(1) General

1) In this study, long-term installation objective defines the final goal at year 2005, and on the way to final goal, in year 2000, 100% of telecommunication demands are to be satisfied. In connection with the long-term installation objectives, the program for REPELITA-IV is to be made up as the first phase program to reach the final goal. In order to cope with the increasing and spreading telephone and non-telephone demands in objective cities, the following minimum requirement for expansion of existing exchanges and building-up of new exchanges should be at least satisfied during REPELITA-IV period.

2) This project is to be implemented as a part of REPELITA-IV program and to cover improvement and expansion of subscriber and junction cable networks relating to the following telephone and non-telephone facilities.

(2) Expansion of Local Telephone Exchanges

	Exchange	Installation Target (10^3 line units)	PERUMTEL's Plan (10^3 line units)	Forecasted Demands - 1988 (: 10^3)
1)	Medan	36.9	45.0	38.6
	Centrum	10.2	12.0	10.7
	Pulau Brayan	9.8	11.0	10.3
	Padang Bulan	4.0	8.0	4.2
	Cinta Damai	6.0	7.0	6.3
	Simpang Limun	4.2	7.0	4.4
	Tanjung Mulia	1.6	3.0	1.8
	Belawan	1.8	2.0	1.9
	Labuhan	0.7	-	0.6
	Total (Medan)	75.2	95.0	78.8
2)	Semarang			
	Semarang I	16.6	25.4	17.3
	Semarang II	11.8	15.0	12.4
	Genuk	2.3	1.0 (DIC)	2.4
	Tugu	7.0	1.0 (DIC)	7.3
	Banyumanik	6.8	1.0 (DIC)	7.1
	Majapahit	5.4	0.6 (DIC)	5.7
	Mang Kang	2.3	-	2.4
	Total (Semarang)	52.2	44.0	54.6
3)	Solo			
	Solo I	11.0	13.0	11.5
	Solo II	8.7	4.0	9.1
	Total (Solo)	19.7	17.0	20.6

(3) Expansion of Non-telephone Facilities

For expansion of non-telephone facilities, this project should cover provision of local and junction circuits to be connected to non-telephone centre via telephone cable network. For this purpose, 3% of telephone local lines and junction circuits to be installed in this project should be assigned to non-telephone use.

6. SUBSCRIBER CABLE NETWORK PLAN

(1) Network Composition

Subscriber cable network composing systems are twofold. They are cross-connecting cabinet system and direct wiring system. In this project, cross-connecting cabinet system is adopted, in principle.

Cross-connecting cabinet capacity is for 1,600 cable pairs so as to accommodate 700 lines as estimated demand as of year 2005.

(2) Kinds of Subscriber's Cable

1) Primary Cable

Cable to be used is, in principle, PE sheathed and insulated, unit quad and jelly filled cable. For cutover of existing air-core type cable, PE sheathed and insulated, unit quad, air-core type cable is used.

2) Secondary Cable

For secondary cable, PE sheathed and insulated, jelly filled, steel tape armoured and quad type cable is used, in principle. Usually, secondary cable is direct-buried. However, in the cases mentioned below, PE-sheathed and insulated, quad and self-supporting type aerial cable is used.

i) In case where cable line re-location is anticipated due to river and/or road improvement work.

ii) In case where direct burying is not appropriate because road planning remains undecided.

iii) In case where area concerned is agricultural area.

(3) Amount of Major Works

Amount of major works is presented under.

Item	Unit	Medan	Semarang	Solo	Total
Primary Cable	km	229	275	77	581
Secondary Cable	km	528	726	154	1,408
Cross-connecting cabinet	pcs	266	226	69	561
Manhole	pcs	509	608	199	1,388
Conduits	km	95	107	34	236

7. JUNCTION CABLE NETWORK PLAN

(1) For transmission system to be used in junction networks in objective cities, this time, selection is made for PCM cable system (digital primary group transmission system). Reason is that PCM cable system is compatible with digital switching equipment and does not cost too much for construction.

PCM cable system uses pair cable or quad cable as transmission media. As such, it constitutes wire transmission system that makes regenerative repeating of 2,048 Kbit/s digital signals which correspond to 30 telephone channels.

(2) Junction network, this time, is of star network formation. That is to say, it constitutes star-form transmission network wherein junction lines are concentrated at tandem exchange or toll exchange.

(3) Cable to be used for junction network is of Indonesian standard specifications, i.e., Z screen cable, or equivalent. Cable pairs to be used are 20 pairs, 40 pairs, 80 pairs, 100 pairs and 200 pairs. All cables are installed in ducts. Regenerative repeaters are established in manholes.

(4) Cable system capacity at initial stage is to be commensurate with circuit demand as of 1998, i.e., 10 years after commissioning. Digital transmission equipment capacity at initial stage is to be commensurate with circuit demand as of 1993, i.e., five years after commissioning. Therefore, the number of PCM systems (links) required is 208 in Medan area, 161 in Semarang area and 26 in Solo area. For power supply to all these PCM systems, selection is made for full floating system composed of storage battery and rectifier equipment. Power supply system construction is included in the scope of work of this project.

(5) Amount of Major Works

Construction work completion dateline is set at February 1989. This is to comply with REPELITA-IV termination dateline.

Main work items are as under.

Medan area:	Junction cable,	200 pairs x 12 km
		100 pairs x 12 km
		80 pairs x 14 km
		40 pairs x 7 km
	PCM system,	208 systems (links)
Semarang area:	Junction cable,	200 pairs x 9 km
		100 pairs x 24 km
		80 pairs x 8 km
	PCM system,	161 systems (links)
Solo area:	Junction cable,	80 pairs x 5 km
	PCM system,	26 systems (links)

8. PROJECT COST ESTIMATION

(1) Preconditions

1) Implementation work be executed by turn key base contract.

2) Consultant be employed to expedite smooth progress of project implementation including detail design screening, bid evaluation, work supervision acceptance inspection.

3) Cost of training for operation and maintenance of equipment installed by this project be included in project cost.

4) Rate of exchange to be used in cost calculation be US$1 = Rp.1,100 = ¥250.

5) Installation cost be calculated for outside plant (subscriber cables, junction cables and civil works), indoor facilities (transmission equipment

and power supply equipment), measuring equipment/ vehicles, etc., training, and consulting service, respectively, and for Medan, Semarang and Solo severally.

(2) Procurement Conditions

1) Outside Plant: Main materials (i.e., cable, pole, PVC pipe, manhole, etc.) are procured by local currency portion.

2) Indoor Facilities: Main materials (i.e., digital transmission equipment, power supply equipment, etc.) are procured by foreign currency portion.

3) Measuring equipment, vehicles, etc.: These materials are procured by foreign currency portion.

(3) Project Cost

Amounts of project costs necessary for completion of all the works are as follows:

Objective City	Foreign Currency Portion: Mil. Yen	Local Currency Portion: Mil Rp
Medan	1,833	62,632
Semarang	1,772	71,460
Solo	497	19,691
Gross Budget	4,102	153,783
(US$: 1,000 Dollar)	(16,408)	(139,803)

Details of project cost is shown in Table 2.

Table 2 Project Cost Estimation

(Foreign currency portion in ¥ million)
(Local currency portion in Rp. million)

Item	Medan		Semarang		Solo	
	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency
1. Outside Plant						
1.1 Cable Lines						
(1) Primary Cables	261	11,619	237	11,724	76	3,542
(2) Secondary Cables	514	28,888	638	34,345	131	8,161
(3) Junction Cables	14	494	13	466	1	42
Sub-total	789	41,001	888	46,535	208	11,745
1.2 Civil Works						
(1) Manholes		3,067		3,901		1,184
(2) Conduits		12,201		13,884		4,679
Sub-total		15,268	17,785	5,863		
2. Indoor Facilities						
(1) Transmission Equipment	283	35	208	26	26	3
(2) Power Supply Equipment	45	5	33	3	7	1
Sub-total	328	40	241	29	33	4
3. Measuring Equipment, Vehicles, etc.						
(1) Measuring Equipment, Tools	37		37		23	
(2) Vehicles	118		98		50	
Sub-total	155		135		73	
4. Training, Others						
(1) Training	90	20	70	16	26	5
(2) Factory Inspection	3	3	2	4	1	1
(3) Maintenance Service	30	21	22	18	3	3
Sub-total	123	44	94	38	30	9
5. Total (1 + 2 + 3 + 4)	1,395	56,353	1,358	64,387	344	17,621
6. Consulting Service	271	585	253	577	108	280
7. Total (5 + 6)	1,666	56,938	1,611	64,964	452	17,901
8. Contingency	167	5,694	161	6,496	45	1,790
9. Project Cost	1,833	62,632	1,772	71,460	497	19,691
10. Gross Budget	Foreign currency	4,102(16,408)		Local currency	153,783(139,803)	

Note: Rate of exchange is Rp.1,100 = ¥250 = US$1.
Figure in ( ) is given in US dollars (unit: US$1,000).

9. PROJECT IMPLEMENTATION PLAN

(1) Execution of Work

Major items of works be undertaken by Contractor awarded to successful bidder in international competitive bidding, and executed on turn-key basis.

(2) Completion of Work

Target of completion of works be at the end of February, 1989, according to the end of REPELITA-IV. However, installation works of outside plants for some exchangs where installation works of inside plants were finished may be completed before target date and subscriber service may be partially commenced in such exchanges. Such partial commencements of subscriber service be scheduled from the latter half of year 1987.

(3) Cordination with Other Projects

In order to make this project to be smooth in progress and to be completed at target date, cordination be made with progress of other projects such as construction work of new exchange building and installation work of inside plants, etc.

(4) Subscriber's Premise Work, etc.

Drop wire work and subscriber's premise wiring, as well as telephone set installation be undertaken by PERUMTEL in view of specific nature of this work category.

(5) Training

All the training courses for technical staff to maintain new outside plants and digital transmission facilities be completed by Contractor within this project period.

(6) Maintenance Assistance

Maintenance assistance, especially for new digital transmission system, be undertaken by Contractor for the period of 1 year after completion of this project.

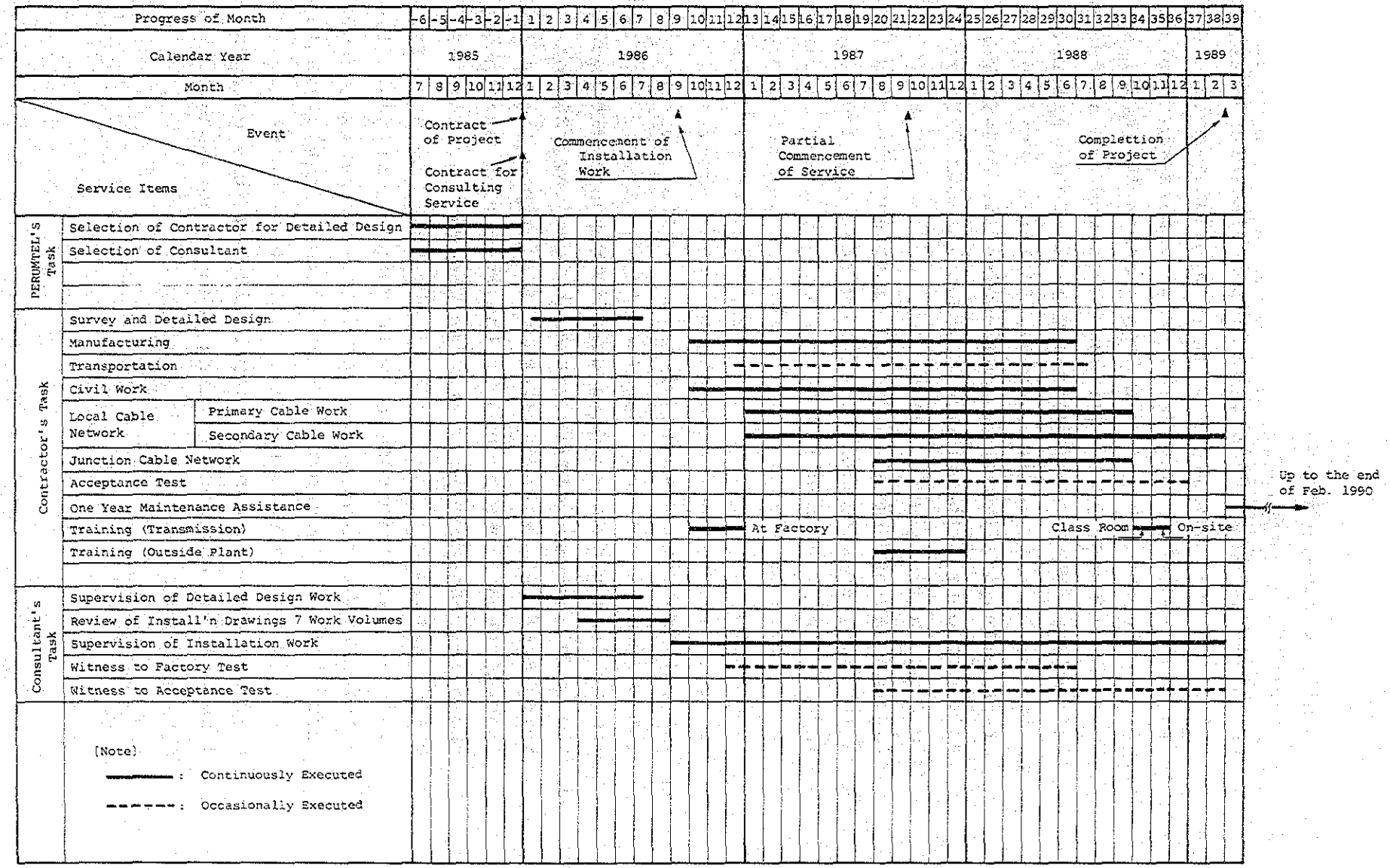
(7) Employment of Consultant

This is to take full advantage of the Consultant's expertise in project planning and basic design making, and in adjustment to other projects, detail design screening, witness to factory inspection, work supervision and final workmanship assessment.

(8) Implementation Schedule

Implementation schedule for this project is shown in Table 3.

Table 3 Project Implementation Schedules



10. PROJECT EVALUATION

During the project life from 1986 to the year 2005, this project itself yields Internal Financial Rate of Return of 21% with the revenue and the total investment cost estimated as above. The FIRRs for the said three cities are 21.8% for Medan, 20.9% for Semarang, and 18% for Solo. In the case where no supplementary investments are not made after 1994, the project yields 17% FIRR. While inclusion of incoming traffic revenue (resulted in 20% increase in total revenue), the project pushes its own FIRR to 27%.

The FIRR for PERUMTEL assuming financing structure of 11% soft-loan, 60% domestic long-term loan (lended by the Indonesian government) and the rest by internal finance, is obtained as 16.8%. Even with this return this project appears to be very viable to PERUMTEL, since the real interest is considered to lie between 8 to 12% with current interest rate and inflation rate.

The inclusion of in-coming traffic revenue with more stringent assumptions than the above (i.e., 20% of out-going traffic), FIRR for PERUMTEL climbs up to 24.1%. (Based on the lower bound of the in-coming traffic against the out-going traffic currently recorded in the said three cities (i.e., 37%, the FIRR for PERUMTEL goes up to 31.4%). The difference between FIRR for project itself and for PERUMTEL stems mainly from tax treatment in these case. In these outcome the project is highly viable. The sensitivity analysis provides also persistent nature of this project's financial capability against changes in expenses and enormous earning generating capability with revenue increase.

The financial statements analyses on the case with inclusion of in-coming traffic suggest that this project can repay the loan assumed easily without any destruction in retained earnings because of generated cash in hand. If the cash in hand is reinvested the larger FIRR is in view. The return on its own equity climbs from 11.7% in 1991 to 90.9% in the final year of the project and thus presents very attractive investment opportunities. The operating ratios and profitability ratios are in both strong and reaffirms the position found by FIRR analysis.

The economic rate of return is calculated as 38.5% with inclusion of consumers' surplus and deduction of transfer items in the costs, i.e. taxes, implying that this project provides a fine opportunity for the Indonesian economy to utilize her limited financial resources.

The cities under this project are envisaged to grow as major growth poles for the regions where these cities are located. In addition to these financial/economic capability of the project, the epansion/improvement of telecommunication system in these cities certainly contributes the social/economic capability of cities themselves and in turn these pre-investment nature of telecommunication infra-structure would generate the momentum for those cities to be major growth poles. In concluding, it is worth noting that the 173.2 billion Rp. total investment of this project would bring up Indonesian economic outputs to 269.1 billion based on the 1980 national input/output table.

11. SUGGESTIONS OF FACILITIES MAINTENANCE AND MANAGEMENT

In order to improve efficiency of maintenance work for outside plants in objective cities, it is recommendable to establish lineman center where maintenance organization for outside plants in whole objective city is to be centralized.

Required lineman center functions are as under.

1) To make thorough facilities maintenance management and thereby hold correct knowledge about operating conditions of facilities.

2) To carry out equipment/materials inventory management so that there will be no difficulty in the supply of necessary equipment/materials for routine work.

3) To keep up-to-date all apparatuses including work vehicles and measuring equipment with a view to work efficiency elevation.;

4) To administer work oriented training to staff workers so as to improve their capabilities.

5) To make plant record updating promptly every time new facilities are established or existing facilities are modified in the course of subscriber cutover work besides maintenance work.

6) To create new workshop environment and thus enhance workers' morale.