No. 8

THE REPUBLIC OF INDONESIA

SURVEY REPORT

ON

IMPROVEMENT OF TELEPHONE NETWORK IN THE CITY OF JAKARTA

VOLUME I

FEBRUARY, 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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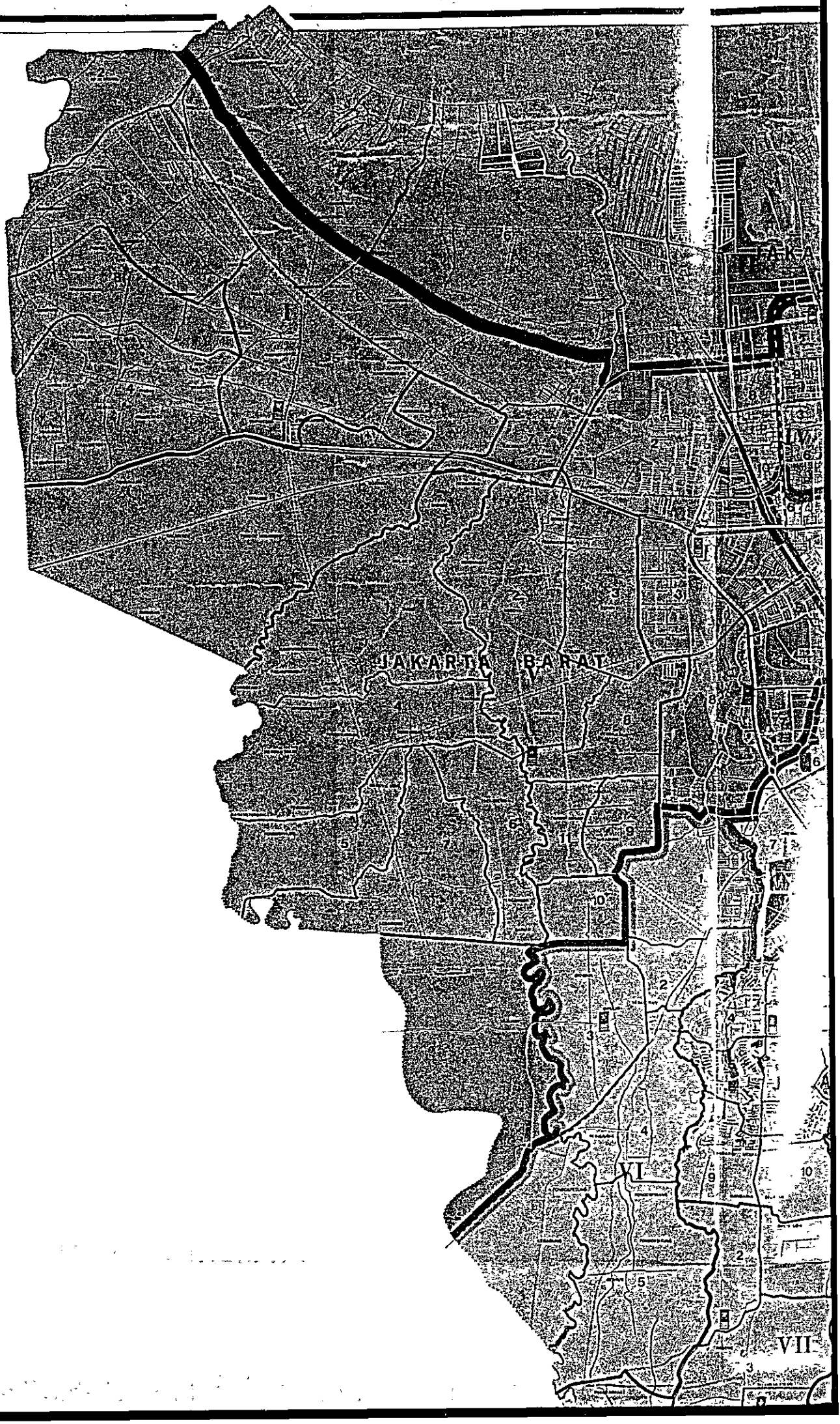
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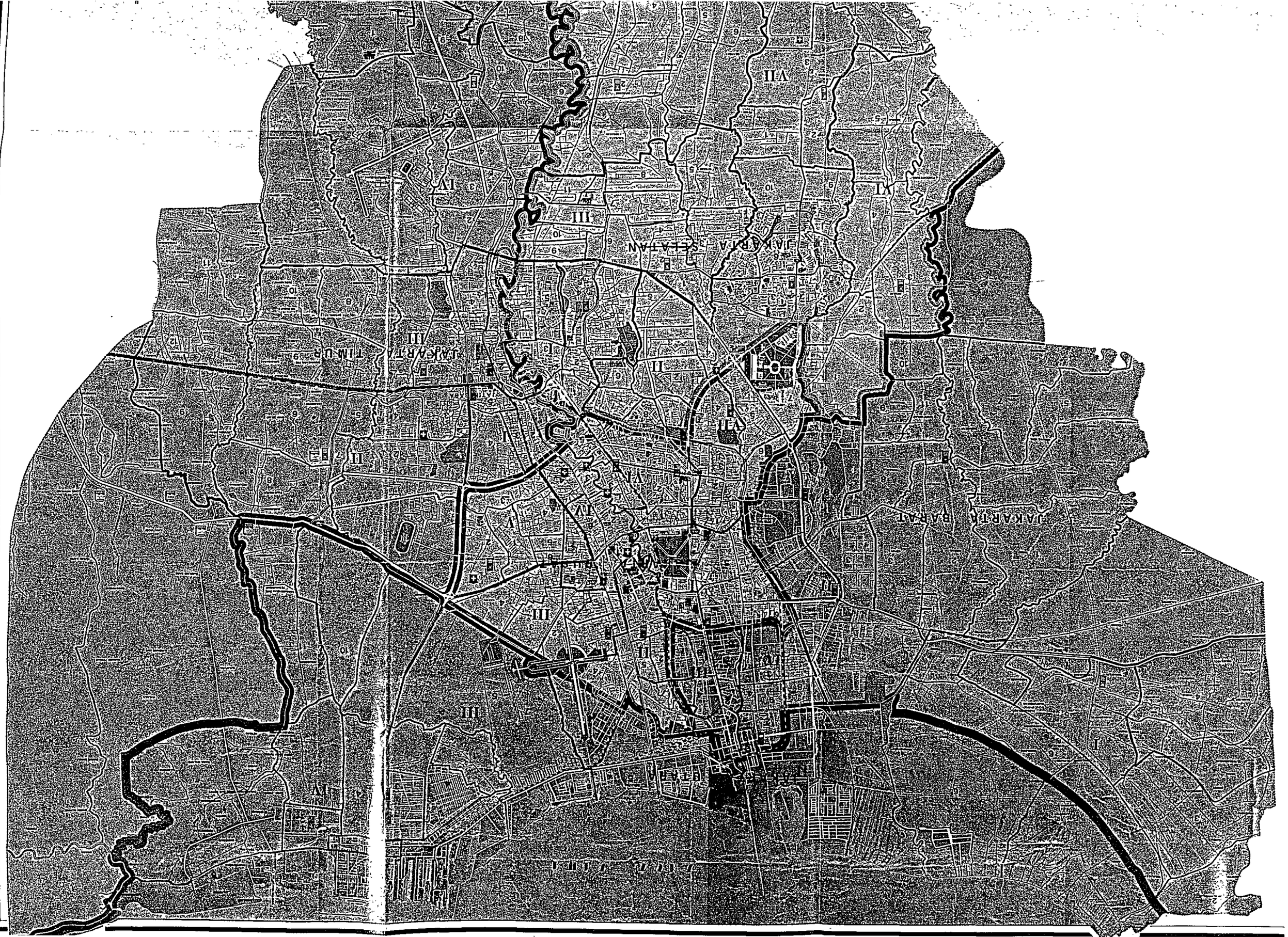
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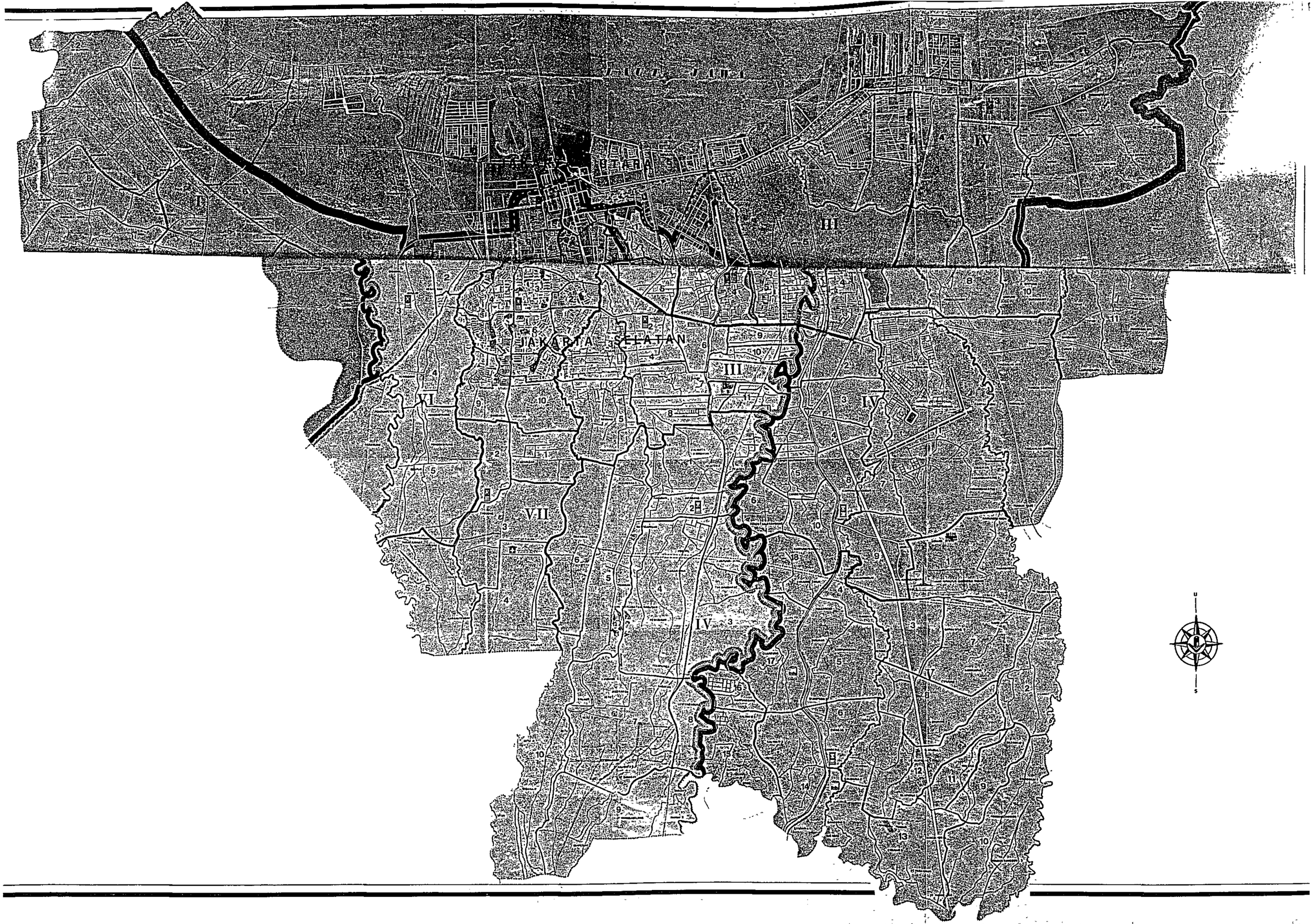
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PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a survey on improvement of telephone network in the city of Jakarta which constitutes part of Third Five-Year Plan for telecommunication services, as part of Japan's overseas technical cooperation programme, and this survey was executed by Japan International Cooperation Agency (JICA).

The JICA sent to Jakarta a survey team twice headed by Mr. Hideo SANO, chief engineer, the Nippon Telecommunications Consulting Co., Ltd. from June 16, 1979 to March 3, 1980 and from June 10, 1980 to October 7, 1980. The team conducted a field survey in close cooperation with the officials concerned of the Government of Indonesia and Perusahaan Umum Telekomunikasi (PERUMTEL). After the team returned to Japan, further studies were made and the final 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 Indonesia and Japan.

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, 1981

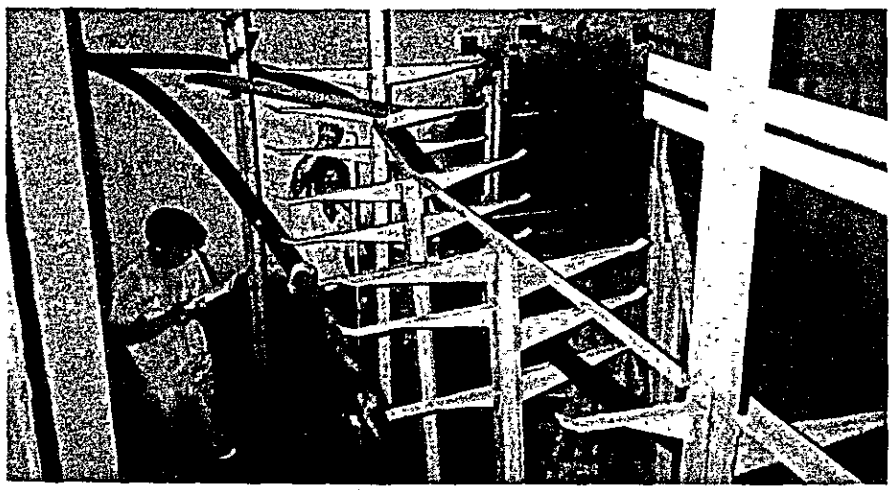
Keisuke Arita

Keisuke Arita

President
Japan International Cooperation Agency

Discussion at Directorate-General of Post and Telecommunications

Discussion with PERUMTEL Key Persons at PERUMTEL Headquater



Cable Vault Survey

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PART VIII TELEPHONE EXCHANGE DESCRIPTION IN JAKARTA CITY

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Abbreviations

Abbreviations of exchange names used in this report are as follows:

KT1	Kota I Exchange
KT2	Kota II Exchange
CKG	Cengkareng Exchange
PLT	Pluit Exchange
ANC	Ancol Exchange
TGL	Tegal Alur Exchange
GB1	Gambir I Exchange
GB2	Gambir II Exchange
SM1	Semanggi I Exchange
SM2	Semanggi II Exchange
SLP	Slipi Exchange
PLM	Pal Merah Exchange
KED	Kedoya Exchange
MER	Meruya Exchange
CPP	Cempaka Putih Exchange
RMG	Rawa Mangun Exchange
TPR	Tanjung Priok Exchange
KPG*	Klapa Gading Exchange
CLC	Cilincing Exchange
PGG	Penggilingan Exchange
KBY*	Kebayoran Exchange
KBL*	Kebayoran Lama Exchange
CPA	Ciputat Exchange
CPE	Cipete Exchange
PSM	Pasar Minggu Exchange
KBL	Kalibata Exchange
JGA	Jagakarsa Exchange
JTG	Jatinegara Exchange
CAW	Cawang Exchange
PSR	Pasar Rebo Exchange
TBT	Tebet Exchange
GAN	Gandaria Exchange
KLD	Klender Exchange
KTT	Kota Tandem Exchange
GBT	Gambir Tandem Exchange
CPT	Cempaka Putih Tandem Exchange
KBT	Kebayoran Tandem Exchange
JTT	Jatinegara Tandem Exchange
SLDD	Subscriber Long Distance Exchange
SUBT	Suburban Tandem Exchange

*Note: The names of the following three exchanges will be changed as follows:

KPG --- PLD (Pulo Gadung)
KBY --- KB1 (Kebayoran I)
KBL --- KB2 (Kebayoran II)

SUMMARY

SUMMARY

1. Background and Objective

The Perusahaan Umum Telekomunikasi of Indonesia (PERUMTEL) is now carrying out the Third Five-Year Plan (Repelita III) based on the Third National Five-Year Development Plan (1979 - 1984) of the Government of Indonesia. Repelita III for Telecommunication Services aims, as first priority, to complete the Repelita II project and to consolidate the achievements of Repelita II, and, as second priority, to implement the new development projects.

The Government of Indonesia requested the Government of Japan to arrange the survey for Improvement of Telephone Network in the City of Jakarta. The purpose of the survey was to make outside plant expansion program for the Third Five-Year Plan including the review of the long term planning prepared by JICA mission in March, 1976 and to make a fundamental designing of telecommunication network in certain Jakarta areas.

The survey was carried out for a period of six and half months in 1979 and four months in 1980.

The main contents of the report describing in the scope of work are as follows:

(1) Fundamental Planning
   1) Demand forecast by telephone exchanges for the years 1979, 1983 and 1993
   2) Originating traffic estimate classified by telephone exchanges for the years 1979, 1983 and 1993
   3) Traffic flow estimate among telephone exchanges for the years 1979, 1983 and 1993
   4) Junction cable network expansion plan

(2) Outside Plant Expansion Program for Third Five-Year Plan
   1) Supply plan
   2) Outside plant construction cost estimate

(3) Basic Design of Junction Cable Network

(4) Basic Design of Subscriber Cable Network for Five Exchange Areas

2. Result of Survey

Result of survey for the Jakarta Telephone Network expansion is summarized below.

2-1 Demand Forecast

2-1-1 Macroscopic Approach

(1) Telephone Demand in Indonesia

Demand forecast by macroscopic approach is conducted by the following formula which is the function of GDP per capita by correlation model from the data of 92 countries:

$$Y = 0.000311X^{1.398}$$

where

Y = Telephone demand density

X = GDP per capita (US$)

For the demand forecast, the following variables are assumed:

1) Annual growth rate of GDP per capita is 4.5%.
2) Population increase figures are adopted from the Statistical Year Book of Indonesia 1977.

Therefore, the telephone demand in Indonesia is calculated as follows:

Year	Telephone Demand
1979	557,500
1983	770,000
1993	1,738,100

(2) Telephone Demand in Jakarta

Telephone demand distribution for Jakarta City out of the whole telephone demand in Indonesia is calculated by the following formula which is obtained by correlation model from the data of various countries:

$$Y = 39.131 + 1.28827X_1 - 7.6458X_2 \times 10^{-3}$$

where

Y = Telephone distribution rate (%)

X_1 = Population concentration rate (%)

X_2 = GDP per capita (US$)

Number of telephone stations for Jakarta City is calculated as follows:

Year	Number of Telephone Stations	Telephone Distribution Rate (%)
1979	241,000	43.14
1983	332,000	43.09
1993	739,000	42.50

On the basis of chronological data concerning the difference in number between telephone stations and main telepone stations in Indonesia, the number of main telephone stations is assumed to be 68.9% of the number of telephone stations. Therefore, the number of main telephone stations for Jakarta City is calculated as follows:

Year	Number of Main Telephone Stations
1979	166,000
1983	228,000
1993	509,200

2-1-2 Microscopic Approach

Demand forecast by microscopic approach was conducted for the whole of Jakarta City in July, August and September 1979 by the on-the-spot survey. In the microscopic demand forecast, area characteristics are classified into the following categories: Residential, Business Office, Commercial, Industrial, Others and No-Demand Areas. A map of a scale of 1:5,000 is used in the survey to identify the area category.

Total telephone demand is estimated as follows in consideration of Jakarta city planning:

Year	Telephone Demand
1979	168,400
1983	222,100
1993	529,700

Difference between demand forecasts by macroscopic and microscopic approaches is less than 5%.

Figure by macroscopic approach is adopted as a telephone demand in Jakarta for the subsequent work of telephone network expansion planning.

2-2 Telephone Traffic Forecast

2-2-1 Originating Calling Rate Estimate

Originating calling rate (CR) is estimated by the following formula:

$$CR = A/N \quad \text{(Erlang)}$$

$$A = Np \times Cp + No \times Co + Ns \times Cs + Nr \times Cr$$

$$N = Np + No + Ns + Nr$$

where

N = Number of subscribers in each service/area category, i.e.:

- Np : PBX
- No : Business
- Ns : Commercial
- Nr : Residential

C = Originating calling rate per subscriber in each service/area category, i.e.:

Cp : PBX	0.20 Erl.
Co : Business	0.06 Erl.
Cs : Commercial	0.06 Erl.
Cr : Residential	0.02 Erl.

Estimated average originating calling rate per subscriber in Jakarta Telephone Network is summarized below:

Year	Average Originating Calling Rate in Erlang
1979	0.0670
1983	0.0533
1987	0.0512
1993	0.0474

2-2-2 Local Traffic Distribution

Local traffic distribution between two local exchanges is calculated by the following formula:

$$Aij = Ai \times \frac{Aj \times e^{-aLij}}{A1 \times e^{-aLi1} + A2 \times e^{-aLi2} + .. + Ai + .. + An \times e^{-aLin}}$$

$$= Ai \times \frac{Aj \times e^{-aLij}}{\sum_{x=1}^{n} AX \times e^{-aLix}}$$

where

Aij: Local traffic from exchange i to exchange j

Ai : Local originating traffic from exchange i

Aj : Local originating traffic from exchange j

Lij: Distance in Km between exchange i and exchange j

a : Constant for multi-exchange area concerned

2-2-3 Summary of Traffic Forecast

Calculation of traffic distribution is carried out by use of computer. The calculation result as follows:

Item	Year			
	1979	1983	1987	1993
1) Weighted Average Originating Calling Rate in Erlang	0.0680	0.0552	0.0535	0.0495
2) Number of Line Units	93,511*	271,700	376,200	569,200
3) Originating Traffic in Erlang				
a) Local	6490.08	13,188.82	17,290.40	23,810.11
b) Trunk	369.48	1,512.39	2,428.66	3,735.64
c) Special	99.84	287.79	402.43	605.25
Total	6959.40	14,989.00	20,121.49	28,151.00
4) Number of Telephone Exchanges	26	32	32	33
5) Number of Switching System Units	33	54	58	63

*Note: Number of working lines (for December, 1979)

2-3 Telephone Network Expansion Plan

2-3-1 Long Term Plan

Long term plan for the Jakarta Telephone Network expansion, which aims at gradual fulfillment of telephone facilities expansion to meet the demand as of 1987, is formulated after careful examination of the existing telephone facilities and the capacity of installation work. Thus the complete fulfillment of telephone installation to the demand will be realized after 1987. The telephone demand and the workable subscriber number are shown below in chronological order:

Year	Telephone Demand	Workable Subscribers
1979	168,400	91,850
1980	180,500	115,650
1981	193,400	137,700
1982	207,300	161,100
1983	222,100	185,400
1984	240,100	211,550
1985	259,400	239,200
1986	280,300	269,200
1987	302,900	302,900
1988	330,200	330,200
1990	395,200	395,200
1993	529,700	529,700

2-3-2 Review of Existing Telephone Network

1) 32 telephone exchanges are supposed to be established in Jakarta Telephone Network. Out of this number, 24 exchanges are now in service.

2) Number of line units in the existing switching systems in Jakarta Telephone Network is 223,000, while the number of working subscribers is 111,883 in September, 1980.

3) Number of existing junction cables is 98. Total number of cable pairs is 56,200. Out of this figure, 29,430 pairs are non-loaded and 26,770 pairs loaded.

4) Total number of primary cable pairs of 24 existing telephone exchanges is 363,887 pairs. Out of this number, 69,487 pairs are direct buried cable and 294,400 pairs are duct cable.
16,200 subscribers are currently connected to other exchange area. Cut-over work for these subscribers is to be executed.

2-3-3 Network Expansion Plan

In accordance with the practical telephone growth, the installation plan for switching system, exchange building as well as juntion and subscriber cable expansions is formulated in due consideration of exisitng telephone facilities.
Implementation schedule of network expansion is presented in the next pages.

IMPLEMENTATION SCHEDULE (1/2)

- - - - - Building Construction
--------- Switching System Installation
========= Cable Installation

Unit: Thousand

No.	Exchange	Third Five-Year Plan				Fourth Five-Year Plan					Fifth Five-Year Plan				
		Existing L.U	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Total L.U
1	Kota I	10		=======		- *A - -	12(-10) =======						3		15
2	Kota II	32	Cut-over =======			5 =======			3			3			43
3	Cengkareng	4			4 =======						10				18
4	Pluit	4		4 =======				4			5				17
5	Ancol	4		2 =======			3			3			5		17
6	Tegar Alur	0			- *B - -	2 =======			1			2			5
7	Gambir I	36				=======				- *C - -	24(-20)				40
8	Gambir II	16		- *C - - =======	23 =======			5			4				48
9	Semanggi I	6		- *C - -	3	=======		4				6			19
10	Semanggi II	8		3 =======	=======		4			5			6		26
11	Slipi	5		- *C - - |====	10 =======				5			7			27
12	Pal Merah	4		2 =======			2			4			4		16
13	Kedoya	0		- *B - -	4 =======			2			5				11
14	Meruya	0		- *B - -	3 =======				1			4			8
15	Cempaka Putih	8	- *C - -	7			=======	4			5			8	32
16	Rawa Mangun	8			3	=======		3			6				20
17	Tanjung Priok	6		5			=======		2			3			16
18	Kelapa Gading	0			5 =======				3			5			13

*Note: A. Building reconstruction
B. Building construction
C. Building expansion
D. Cut-over to Jatinegara II Exchange
( ) Removal

IMPLEMENTATION SCHEDULE (2/2)

- - - - - Building Construction
--------- Switching System Installation
========= Cable Installation

Unit: Thousand

No.	Exchange	Third Five-Year Plan				Fourth Five-Year Plan					Fifth Five-Year Plan				
		Existing L.U	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Total L.U
19	Cilincing	0		- -*B- -	---3--- =======			---2---			---5---				10
20	Penggilingan	0		- -*B- -	---4--- =======				---3---			---4---			11
21	Kebayoran	26				=======	=======								26
22	Kebayoran Lama	0										- -*B- -	---7---		7
23	Cipete	8				=======				---5---			---6---		19
24	Pasar Minggu	2				---1---		=======	---1---			---3---			7
25	Kalibata	8		=======				---4---			---7---			---5---	24
26	Jagakarsa	0			- -*B- -	---2--- =======			---1---			---2---			5
27	Jatinegara I	4	|*D ===|	===|	---(-4)---										0
28	Jatinegara II	8	- -*C- -	---7--- =======			---5---			---4---			---4---		28
29	Cawang	4			---3---		=======	---5---				---6---			18
30	Pasar Rebo	1		---3(-1)---			=======	---2---			---4---				9
31	Tebet	8				---3--- =======				---3---			---4---		18
32	Gandaria	1		- -*B- -	---3(-1)--- =======			---1---			---4---				8
33	Klender	0		---3--- =======					---2---			---3---			8
Junction Network				=======	======= =======	===|									
Total Line Units	Expansion			36	68	13	26	36	22	24	79	48	39	13	404
	Total	221		257	325	338	364	400	422	446	525	573	612	625	625

*Note: A. Building reconstruction
B. Building construction
C. Building expansion
D. Cut-over to Jatinegara II Exchange
( ) Removal

2-4 Junction Cable Network Plan

2-4-1 Number of Junction Circuits

Circuits related to junction cable are three fold: Telephone, Telex and Leased circuits.

(1) Telephone

Number of junction circuits in 1987 and 1993 are 37,234 and 49,305, respectively. Both are calculated by computer.

(2) Telex

1) Total number of telex subscribers in 1987 and 1993 are 8,517 and 13,545, respectively.
2) Total number of telex junction circuits in 1987 and 1993 are 1,608 and 2,883, respectively.

(3) Leased Circuits

1) 10% of telephone junction circuits is to be the leased circuits for the junction section between local exchanges.
2) 20% of telephone junction circuits is to be the leased circuits for the junction section between tandem exchanges.

2-4-2 Study of Optimum Transmission System

Three types of transmission systems are assumed to be used for junction cable network. They are non-loaded cable, loaded cable and PCM 30ch systems.

Cost of each transmission system is calculated on per circuit basis as a function of distance in Km. Cost of a 0.6mm non-loaded line, for example, is 74 US$ per pair Km, while that of a PCM system is 10 US$ per channel Km plus 700 US$ fixed price per channel.

Then, the selection chart for optimum transmission system is formulated, based on the category of circuit in accordance with distance. Take up Tandem to Local circuit (4.5 dB), for example: the distance of 6 Km is the application boundary between cable and PCM transmission systems.

2-4-3 Junction Cable Network Plan

(1) Existing Junction Cable Facilities

Number of junction cables to be considered as existing is 123 with 70,300 pairs. The cables, which are under installation or still in design or whose installation has been postponed, are included in the above figure. Out of this figure, 38,930 pairs are non-loaded and 31,370 pairs loaded.

(2) Determination of Transmission System

Transmission system is determined by the selection criteria with top emphasis on full utilization of the existing junction cable facilities.

(3) Junction Cable Network Plan

1) Number of proposed cables by the year 1987 is 20 with 22,200 pairs, and 21 cables with 13,800 pairs by the year 1993 after 1987.

2) Total number of PCM transmission systems for the year 1987 is 457, and 797 for the year 1993.

2-4-4 Junction Cable Network Design

Basic design of juntion cable network expansion for the year 1987 is worked out.

The amount of major work for junction cable expansion in conformity with basic design is summarized below:

(1) Cable System

1)	Number of cables	20
2)	Number of cable paris	22,200
3)	Cable length	115.0 Km
4)	Number of loaded pairs	3,000

(2) PCM System

1)	Multiplexers	914
2)	Office repeaters	1616
3)	Line repeater housings	220
4)	Line repeater units	4769

(3) Underground Duct System

1) Manholes 185

2) Duct length 28 Km

2-5 Subscriber Cable Network Plan

Basic design of subscriber cable network for five (5) local exchanges is worked out at the request of PERUMTEL. The five exchanges are Kota I, Kota II, Pluit, Gambir I and Jatinegara I.

Introduction of jelly-filled cable for subscriber cable is assumed in this design.

The amount of major work for subscriber cable expansion is summarized below:

Exchange	Number of Manhole	Duct Length (Km)	Primary Cable Length (Km)	Number of C.C. Cabinet	Secondary Cable Length (Km)
Kota I	3	1.3	9.6	16	24.5
Kota II	11	2.3	15.8	6	72.5
Cut over	2	1.4	2.7	4	0.4
Pluit	44	6.6	19.7	15	72.4
Gambir I	5	1.6	13.0	4	13.8
Jatinegara I	40	6.8	23.7	16	43.6
Total	105	20.0	84.5	61	227.2

2-6 Construction Cost Estimate

Construction cost for network expansion is estimated according to individual projects planned for the years from 1981 to 1986.

Unit cost for each installation year during the above period is calculated on the basis of unit cost as of 1980, allowing an increase at a fixed rate for each subsequent year.

In order to estimate the amount of major work for subscriber cable expansion, three kinds of design drawings, i.e., key map, primary cable plan and underground duct system plan, are prepared for all telephone exchanges except the 5 exchanges which are separately designed in detail. The amount of major work during the period mentioned is summarized below:

(1) Building

1) Reconstruction of building at Kota I Exchange;

2) Construction of building at the following exchanges: Tegar Alur, Kedoya, Meruya, Cilincing, Penggilingan, Jagakarsa and Gandaria;

3) Expansion of existing building at the following exchanges: Gambir II, Semanggi I, Slipi, Cempaka Putih and Jatinegara II.

(2) Switching System

Installation of 179,000 line units in the switching system.

(3) Subscriber Cable

Installation of subscriber cables at all exchanges except Kebayoran Lama Exchange.

(4) Junction Network

1) Installation of 457 PCM systems.

2) Installation of 20 junction cables with 22,200 pairs.

Estimated total construction cost for this period is summarized below:

Item	Foreign Currency (Million Japanese Yen)	Local Currency (Million Rupiahs)
1) Building	-	3,447
2) Switching System	17,571	-
3) Subscriber Cable Network	13,968	8,773
4) Junction Cable Network	3,332	2,188
Total	34,871 (158.5 million US$)	14,408 (23.1 million US$)

Out of the above figures, the breakdown for the present Third Five-Year Plan period (Replita III: 1979-1983) appears below:

	Item	Foreign Currency (Million Japanese Yen)	Local Currency (Million rupiahs)
1)	Building	-	3,149
2)	Switching System	9,644	-
3)	Subscriber Cable Network	8,932	6,212
4)	Junction Cable Network	3,332	2,188
	Total	21,908 (99.6 million US$)	11,549 (18.5 million US$)

2-7 Telephone Exchange Description

Exchange by exchange arrangement of data collected through survey work and study results appear in PART VIII, Volume II of this report. The book contains the following items for each exchange:

1) Area and Characterstics
2) Tandem Exchange
3) Switching System
4) Originating Calling Rate per Subscriber in Erlang
5) Number of Subscribers
6) Recent Trend of Subscriber Number
7) Existing Subscriber Cable Facilities
8) Building Layout
9) Equipment Room Layout
10) Demand Map of 1993
11) Demand in 1983 and 1993
12) Switching System Expansion Plan
13) Implementation Schedule
14) Amount of Subscriber Cable Expansion Work