CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1-1 Background of Study

(1) Background of Request

These days, in the Republic of Indonesia, demand for telephones is growing rapidly not only in Jakarta, the capital city, but in other cities in remote areas also, reflecting steady progress of social and economic development in the country.

Especially in remote cities, to solve the existing big subscriber backlog on one hand while on the other, to cater for the expected new subscriber demand, telephone network improvement/expansion constitute urgent necessity.

Under such circumstances, the Government of the Republic of Indonesia has decided to carry out urgently the telephone network improvement/ expansion plan for six major cities of Medan, Palembang, Semarang, Solo, Ujung Pandang and Denpasar, each of which assumes key position as center of regional politics and economy. Then, the Government of Indonesia has approached the Government of Japan, requesting technical assistance in realizing the plan.

(2) Dispatch of Preliminary Study Team

In response to the request from the Government of Indonesia, the Government of Japan decided to carry out investigation concerning telephone network improvement/expansion plan for remote cities of Indonesia, and arranged with Japan International Cooperation Agency (JICA) to execute the investigation. Prior to investigation by feasibility study team, JICA dispatched preliminary study team to Indonesia for the period from June 18 to June 30, 1984. The preliminary study team made status quo investigation of the six cities and studied the required scope and contents of project. Based on study findings, the preliminary study team discussed with competent authority of Indonesia and reached agreement to select three out of the six cities, i.e., Medan, Semarang and Solo, as objective cities of in-depth study. At the same time, Scope of Work whereby to execute feasibility study was concluded.

(3) Dispatch of Feasibility Study Team

Based on Scope of Work concluded by the preliminary study team, JICA dispatched feasibility study team to Medan, Semarang and Solo for the period from November 13, 1984 to March 23, 1985.

1-2 Study Objectives and Summarized Scope of Work

(1) 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 (local subscriber's lines and junction cable network) expansion project for three cities of Medan, Semarang and Solo as part of REPELITA-IV Program.

(2) Summarized Scope of Work

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 (local subscriber's lines and junction cable network) 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

1-3 Feasibility Study Team, etc., Line-ups and Study Program

(1) Feasibility Study Team, etc., Line-ups

JICA organized the feasibility study team with members from The Nippon Telecommunications Consulting Co., Ltd. (NTC), and, at the same time, established the advisory committee to give technical and service advices to the feasibility study team throughout study period with a view to study progress according to schedule.

Names and duty-in-charge of advisory committee and feasibility study team members are in Table 1-1 and Table 1-2.

Table 1-1 Line-up of Advisory Committee

Name	Duty in Charge	Place of Employment
Shinichi TAKEUCHI	Chairman	Special Advisor for International Cooperation, Ministry of Posts and Telecommunications
Masami KATO	Member (Communication System)	Ditto
Motonori ANDO	Member (Communication Network)	Senior Staff Engineer, International Affair Division, Nippon Telegraph and Telephone Co., Ltd.
Ryota ONO	Member (Coordination)	Japan International Cooperation Agency
Ryutaro TOZUKA	Member (Coordination)	Ditto

Table 1-2 Line-up of Feasibility Study Team (1/2)

Name	Duty in Charge	Place of Employment
Hideji KAJIKAWA	General Team Leader (Switching)	Deputy Manager, Engineering Department, Overseas Operation Division, NTC
Hideo MITSUHASHI	Assistant Team Leader (Outside Plant)	Senior Engineer, Engineering Department, Overseas Operation Division, NTC
Fujio ICHIKAWA	Cable Engineering, in charge of Medan	Senior Engineer, Communication Design Division, NTC
Hiroshi AOSHIMA	Cable Engineering, in charge of Semarang, Solo	Overseas Operation Division, NTC
Tatsuo TAKAHASHI	Cable Engineering, in charge of Medan	Communication Design Division, NTC
Kazuyoshi TSUCHIKO	Cable Engineering, in charge of Semarang, Solo	Ditto
Tatsuhiko NAKAJIMA	Cable Engineering, in charge of Semarang, Solo	Ditto
Kazunori KAWANO	Cable Engineering, in charge of Medan	Ditto
Kenji EGUCHI	Civil Engineering, in charge of Medan	Senior Engineer, Engineering Department, Overseas Operation Division, NTC

Table 1-2 Line-up of Feasibility Study Team (2/2)

Name	Duty in Charge	Place of Employment
Tamio YAMAGUCHI	Civil Engineering, in charge of Semarang, Solo	Technical Section Chief, Overseas Business Division, NTC
Tetsuya OGINO	Transmission	Assistant-to-General Manager, Overseas Operation Division, NTC
Masami ISHIDA	Economic Evaluation	Project Development Department, Overseas Operation Division, NTC
Noriyoshi NAGAMATSU	Economic Evaluation	Ditto

(2) Study Program

Study program was practiced in four stages as under, based on schedule in Scope of Work concluded between the Government of Indonesia and the preliminary study team (signed into effect on June 27, 1984).

1) First Stage: Preparatory Work in Japan

Preparatory work consisted of assortment and analysis of already collected data, formulation of basic philosophy for feasibility study, and preparation of inception report.

2) Second Stage: Field Survey

Field survey was carried out during the period from November 13, 1984 to March 23, 1985. Main work items during field survey period were as under.

a) Social/economic development status quo and development planning assessment

b) Review of general telecommunications situation

c) Demand forecast for the whole country and for three object cities of study

d) Long term local telephone network planning for three object cities of study

e) Schematic basic design for junction lines and subscriber's lines

f) Cost and benefit estimate

g) Preparation, presentation and explanation of Interim Report, as well as confirmation of the above-mentioned long term planning and schematic basic design by minutes (signed on March 21, 1985)

3) Third Stage: Presentation and Explanation of Final Report (draft)

Based on long term planning and schematic basic design formulated at stage of field survey, data obtained by field survey, and result of discussions with Indonesian authority, comprehensive analysis was carried out in Japan. Findings in this comprehensive analysis were brought into effect as feasibility study conclusion, and, using this conclusion, final report (draft) was made. The report presentation with explanatory comments took place in Indonesia during the period from September 24 to October 3, 1985.

4) Fourth Stage: Preparation and Presentation of Final Report

After draft final report presentation with explanatory comments, final report was prepared in Japan and presented by mail to the Government of Indonesia in November 1985. This brought feasibility study and related service to successful conclusion.

1-4 Competent Authorities and Personnel

A list that appears below carries personnel concerned and counterparts of JITJEN POSTEL, Ministry of Tourism, Post and Telecommunications, as source of request for feasibility study, this time, and of PERUMTEL as project implementing entity.

(1) POSTEL

Ir. Rollin	Deputy Director General
Ir. R.I. Soemardi Bc.T.T.	Director, Planning Division
Ir. Koesmarihati Sugondo	Chief, Planning and Programming
Mr. Soedarpo Bc.T.T.	Chief, Telecommunication Planning

(2) PERUMTEL

Head Office, Bandung

1.	Ir. Djoko Sulistiyo Hadi Bc.T.T.	Director of Development
2.	Ir. Saleh Gunawan	Sub-Director of Development Program
3.	Ir. Guntur Siregar	Chief, Cable Network Planning Division
4.	Mr. Tatang Wiegena, Bc.T.T.	Staff, "
5.	Mr. Setioro M.	Staff, "
6.	Ir. Tridjatmiko	Staff, "
7.	Mr. Sudirman	Staff, "
8.	Mr. Sunyoto Bc.T.T.	Staff, Exchange Network Planning Division
9.	Mr. Suyanto	Staff, "
10.	Mr. Tamam Mulyadi	Staff, "
11.	Mr. Ibnu Sulaiman	Staff, Transmission Planning Division
12.	Mr. Adisar	Staff, "
13.	Dr. Setyanto PR	Chief, Marketing Division
14.	Mr. H.P. Pandjaitan Bc.T.T.	Chief, Building and Supporting Facility Division

Medan

1.	Mr. Wiratno Bc.T.T.	Director, Witel I
2.	Mr. E. Pahan Bc.T.T.	Chief, Medan Exchange
3.	Mr. Tukiryono Bc.T.T.	Chief, Outside Plant Division, Medan Exchange
4.	Mr. Tatang Sumirat	Staff, "
5.	Mr. Simatupang	Staff, Telephone Technic, Witel I
6.	Mr. Sugeng Widodo	Staff, Outside Plant Division, Medan Exchange
7.	Mr. Sabang	Staff, "

Semarang and Solo

1.	Mr. Sri Slamato Bc.T.T.	Director, Witel VI
2.	Mr. Supono Bc.T.T.	Chief, Outside Plant Division, Witel VI
3.	Mr. Solihin M. Bc.T.T.	Staff, "
4.	Mr. H. Soeratno Bc.T.T.	Chief, Semarang Exchange
5.	Mr. Rizalsat Bc.T.T.	Chief, Outside Plant Division, Semarang Exchange
6.	Mr. Murwant	Staff, "
7.	Mr. Kuswontoro	Staff, "
8.	Mr. Tarkadi	Staff, "
9.	Mr. Sukarsono Bc.T.T.	Chief, Solo Exchange
10.	Mr. Soemarno Bc.T.T.	Chief, Outside Plant Division, Solo Exchange
11.	Mr. Yassir	Staff, "

CHAPTER 2 GENERAL CONDITIONS AND TELECOMMUNICATIONS

CHAPTER 2 GENERAL CONDITIONS AND TELECOMMUNICATIONS

2-1 State of Affairs in Indonesia

2-1-1 Indonesia as a Whole

(1) Topography

Indonesia is the world-largest archipelago country situated between two big continents, Asia and Australia, and between two big seas, Indian Ocean and Pacific Ocean, and consisting of 13,677 islands, large and small. Out of these Islands, 992 are inhabited.

The whole national territories spread 1,888 km long from north to south (from 6 degrees, North Latitude, to 11 degrees, South Latitude) and 5,100 km long from east to west (from 95 degrees to 141 degrees, East Longitude).

Total area is 1,919,443 km^2.

Indonesia is in the western part of round-the-Pacific volcanic zone that extends from Indonesian Archipelago, through Japan, to Alaska and further to Chile, South America.

About 60% of national territories consists of forests. The geography is featured by two mountain systems. One extends from north, through the Philippines, to eastern Indonesia. The other is an extension of Burmese mountain system, extending from western coast of Sumatera, through Jawa/Bali and northeastern region, to Sulawesi.

(2) Climate

Climate of Indonesia is tropical climate featured by high temperature and high humidity. Seasonal changes are few. Generally, the year is divided into two seasons, the dry season (April - October) and the wet season (November - March).

Temperature remains almost unchanged throughout the year. Average temperature is around 27°C. During the wet season, temperature somewhat drops. Precipitation varies considerably from area to area. Average rainfall measures 2,000 mm or thereabouts, without being influenced by typhoons.

Humidity remains practically unchanged at 80% or so throughout the year.

(3) Population

According to 1980 census, the population of Indonesia numbers about 148 million. Thus, in population, Indonesia ranks fifth in the world list, placing after China, India, U.S.S.R. and U.S.A.

Population distribution is extremely disproportioned. About 60% of total population is concentrated in Jawa Island that occupies only 6.9% of total national area. Although national average population density (per km) is 77, Jawa Island alone accounts for 691. This figure stands in striking contrast with 12 of Kalimantan Island and 2.5 of Irian Jaya Island. In Indonesia, towns, each with population of 5,000 or more, are included

in urban area. When towns/villages, each with population of less than 5,000 are classified as rural area, population distribution by these two area categories is as in Table 2-1-1.

Table 2-1-1 Urban and Rural Population of Indonesia (1980)

(Population in 1,000 persons; ratio in %)

Region	Urban Area	Rural Area	Urban Population Ratio
Jawa	22,626	70,951	24.2
Remote Islands	10,220	42,980	19.2
Sumatera	5,653	20,096	22.0
Kalimantan	1,288	5,003	20.5
Sulawesi	1,832	8,637	17.5
All Indonesia	32,846	113,931	22.4

Source: Statistics Indonesia, 1982

As of 1980, urbanization rate in Indonesia is 22.4%. Jawa Island alone occupies about 70% of all urban population.

Rural area of Jawa Island where population is almost equal to half the total national population no longer leaves room to accept further population growth. To meet the situation, the Government is proceeding ahead with transmigration to elsewhere than Jawa Island. Part of rural population is gravitating to urban area, causing urban population to inflate. That is to say, in urban area, modern professions are increasing, education is diffused,

and family life segregation by generations is making progress, and, amid these facts, population gravitation to urban area is pulling up momentum. Population growth trends in 10 major cities are in Table 2-1-2.

Table 2-1-2 Population in 10 Major Cities

(Population in 1,000 persons; growth rate in %)

City	Population as of 1980	Growth Rate Since 1971
Jakarta	6,481	41.5
Surabaya	2,018	29.7
Bandung	1,461	21.8
Medan	1,374	16.0
Semarang	1,025	58.4
Palembang	787	35.0
Ujung Pandang	708	62.8
Malan	511	21.1
Solo	470	13.5
Jogyakarta	398	16.4

Source: Hasil Pencacahan Lengkap Penduduk 1980
Seri: L No. 2, 4, 5, 6, Biro Pusat Statistik

2-1-2 Objective Cities of Study

Geographical positions of three objective cities of study, i.e., Medan, Semarang and Solo, are in Figure 2-1-1.

(1) Medan

1) Medan belongs to Sumatera Utara and is situated in coastal area facing Malacca Strait. City spreads about 16 km long from east to west (99 degrees, East Longitude) and about 31 km long from north to south (3 degrees, North Latitude). Area covers 260 km^2. Population numbers 1,379,000.

2) Sumatera Utara, whereto Medan belongs, embraces vast fertile plain which produces such farm products for export as rubber, palm oil, cocoa, tobacco, coffee and tea, as well as cereals. At Muala Tanjung, 105 km east of Medan, exists aluminum refinery operating with up-to-date equipment. Because of high productivity of this aluminum refinery, associated industry expansion in nearby area is planned.

3) Medan is capital city of Sumatera Utara and forms social and economic activities center. Belawan Port located in northern part of city is the trade base in northern Sumatera. Belawan is to have port facilities improved by REPELITA-IV. Power plant is also under construction. For Medan, prospects loom large for further development from now forward.

(2) Semarang and Solo

1) Semarang and Solo belong to Jawa Tengah. Semarang is in coastal area facing Jawa Sea. Solo is in inland area.

Semarang spreads about 25 km long from east to west (110 degrees, East Longitude) and about 18 km long from north to south (7 degrees, South Latitude). Area covers about 370 km^2. Population numbers 1,072,000. Semarang is fifth ranking main city of Indonesia.

Solo spreads about 13 km long from east to west (111 degrees, East Longitude) and about 8 km long from north to south (8 degrees, South Latitude). Area covers about 70 km^2. Population numbers 477,000. Solo is ninth ranking main city of Indonesia.

2) Jawa Tengah, whereto Semarang and Solo belong, lies in central part of Jawa Island. It spreads 350 km long from east to west and 200 km long from north to south. Area covers 3,400 km^2. Population numbers 25,370,000. For the whole area, fertile plain expands, whereof 60% is utilized as paddy fields and farm lands. Rice is main product. Forest area accounts for 20%. Teak production is well known.

Population density is highest among areas in Jawa Island. Agriculture constitutes main industrial sector. Population engaged in agriculture occupies 60% of grainfully occupied population.

Mining and manufacturing industry is not much developed.

3) Semarang is capital city of Jawa Tengah. Because marine transportation through Semarang Port is available, Semarang itself serves as distribution center in central Jawa to/from overseas marketplaces and other areas in the country. It also constitutes social and economic activities center in central Jawa.

4) Solo is located 95 km southwest of Semarang and time-honored city with former palace in it. Solo River runs in eastern outskirts of city. Traditional batik production continues to prosper. Solo is one of main tobacco production centers also in Indonesia.

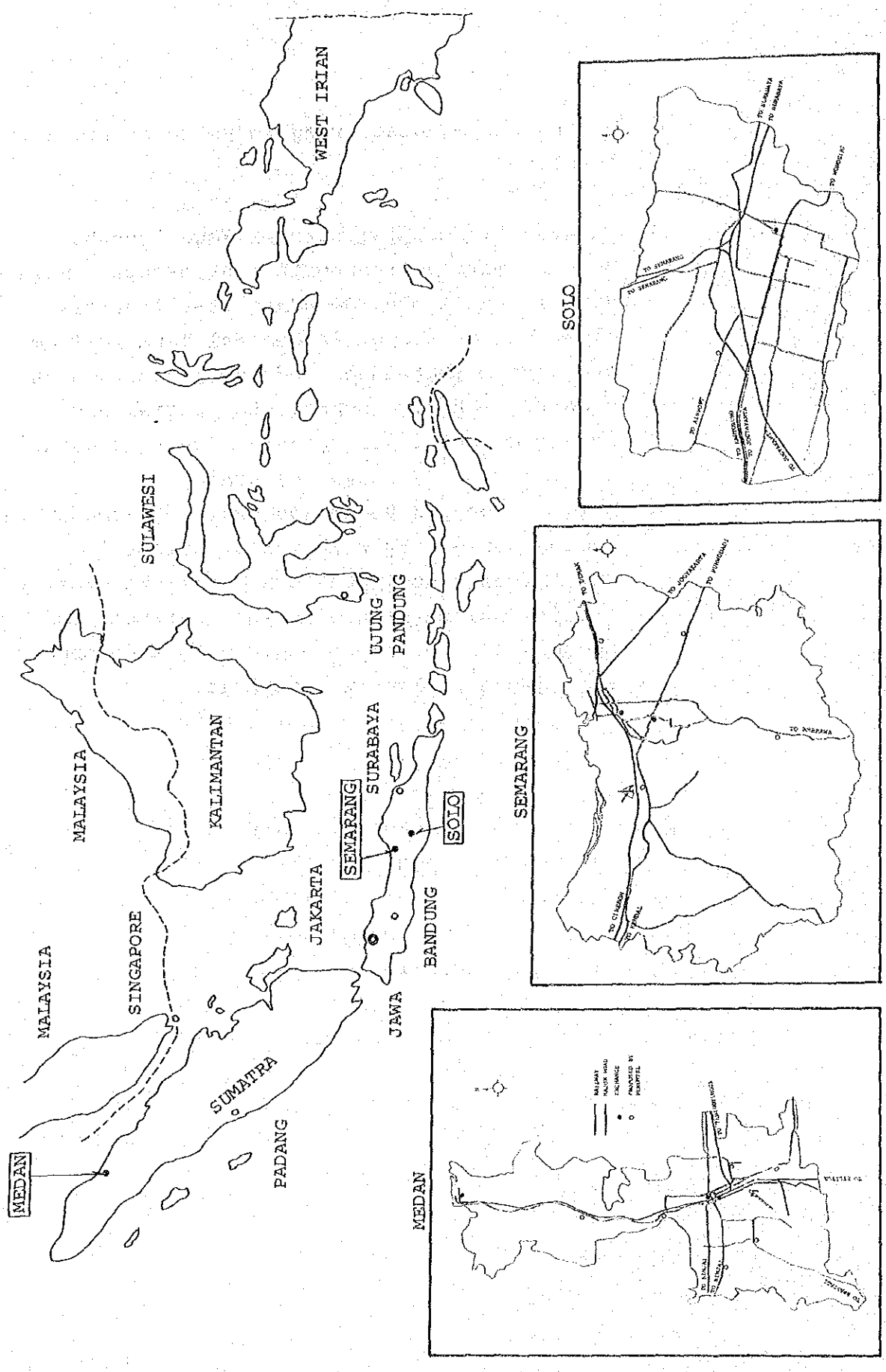

Figure 2-1-1 Geographical Locations of Objective Cities

2-2 Telecommunications

2-2-1 Role of Telecommunications in Indonesia

In Indonesia, a country with maldistributed big population in vast national territories, telecommunications as part of social overhead capital perform a role of utmost importance from the viewpoint of attaining national development objectives.

Exchange of information is indispensable for social life and telecommunications provide means thereof. For development of rich natural deposits, such as petroleum, natural gas, tin and nickel ores, in remote areas, for development of agriculture by effective use of fertile lands, for development of rich forest and fishery resources, as well as for successful execution of transmission from overpopulated urban area to underpopulated rural area and for attainment of national defense purposes also, telecommunications are the prime requisite.

2-2-2 Development Background

(1) Before REPELITA-I (before 1969)

Telecommunications facilities in Indonesia before 1969 were far from being sufficient to meet demand in both quality and quantity. State of facilities at that time was as under.

- Telephone facilities totaled 175,000 line units, whereof 57% were manual type.

- Telegraphy facilities were generally time-worn. The most part were Morse system facilities.

- Transmission facilities were mostly open wire system and HF radio system facilities.

- Telephone density was 0.16 in national average. This density was practically the lowest in the world.

(2) REPELITA-I (1969-1974)

REPELITA-I was carried out as initial step of telecommunications development along the line of national development. State of facilities as of 1974, the final year of REPELITA-I, was as under.

- 63,691 line units telephone facilities were newly established. Those new facilities were equal to one-third of the then existing facilities. Out of newly established 63,691 line units, 58,500 line units were automatic telephone facilities.

- Jawa-Bali microwave link was put into service.

- Subscriber long distance dialing (SLDD) service began.

- Non-main transmission line improvement was carried out.

- High quality telex service became possible.

- International service facilities were improved.

(3) REPELITA-II (1974-1979)

REPELITA-II was put into practice immediately after REPELITA-I termination. State of facilities as of 1979, the final year of REPELITA-II, was as under.

- 427,000 line units automatic telephone facilities (growth by 301,200 line units) were established.
- 9,170 line units telex facilities (growth by 7,360 line units) were established.
- 26,000 CH SLDD service network was established.
- 1,316,618 CH·km microwave network was established.
- 40 earth stations of domestic satellite communication system were established.

By the above program attainment, main telephone diffusion rate per 100 persons improved from 0.18 in 1971 to 0.29 in 1978.

(4) REPELITA-III (1979-1984)

REPELITA-III was mainly for quantitative expansion of telephone service and non-voice communication service networks, as well as service quality improvement. Main achievements during five-year REPELITA-III period were as under.

- Automatic telephone switching equipment expansion by 276,400 line units.
- New establishment of 3,500 public telephones.

- Telex system expansion by 6,600 line units.

- New establishment of 75 small type satellite system earth stations.

- Changeover of PALAPA satellite system from former system A to new system B.

- Toll transmission line expansion which made SLDD service available among 106 cities.

As the result of REPELITA-III, telephone switching capacity for the whole country increased to about 666,000 line units. Main telephone diffusion rate reached 0.33 per 100 persons in 1983. However, this diffusion rate still remained at low level when compared with the corresponding rates in other ASEAN countries (0.8 in Thailand, 0.7 in the Philippines and 4.3 in Malaysia as of 1981).

Out of telephone switching capacity of 666,000 line units, about 90,000 line units are for manual switches and many of them are past their useful life so that they must be replaced with new type switches so as to ensure desirable service quality. Also requiring remedies form the viewpoint of telephone service quality improvement are subscriber's cable and junction cable capacity shortage and low performance level, as well as maintenance system for those cables which still leaves room to be desired.

State of facilities as of REPELITA-III termination is in Table 2-2-1.

Table 2-2-1 Telecommunications Facilities as of REPELITA-III Termination

	No. of Facilities
(1) Automatic telephone switching equipment	577,000 line units
(2) Manual telephone switching equipment	89,000 line units
(3) National service telex switching equipment	15,840 line units
(4) Telegram handling exchanges	643 exchanges
(5) Small type satellite system earth stations	122 stations
(6) SLDD service coverage	106 cities
(7) International telephone switching equipment	4,096 line units
(8) International service telex switching equipment	1,200 line units
(9) International telephone SLDD coverage	55 countries

2-2-3 Facilities in Objective Cities of Study

Telecommunications facilities in three objective cities of study are in Table 2-2-2.

Table 2-2-2 (1/2) Telecommunications Facilities in Objective Cities of Study

(1) Medan

1) Local Switching Equipment

Exchange	Line Units	Switching System	Subscribers	Subscriber Backlog
Centrum I	8,000	UR-49A	6,754	
Centrum II	7,000	ARF-102	5,531	
Centrum II	10,000	MC-10C	7,295	17,135
Centrum II	10,000	MC-10C	6,597	
Belawan	1,000	PC-1000	789	
Total	36,000		26,966	17,135

2) Subscriber's Primary Cable

Exchange	Lead-in Cable Lines	Total Lead-in Cable Pairs
Centrum I	19	14,475
Centrum II	22	24,500
Belawan	-	416

3) Junction Cable

Section	Cable Pairs
Centrum I - II	6,000

Table 2-2-2 (2/2) Telecommunications Facilities in Objective Cities of Study

(2) Semarang

1) Local Switching Equipment

Exchange	Line Units	Switching System	Subscribers	Subscriber Backlog
Semarang I	10,400	EMD	11,518	11,120
Semarang II	9,000	MC-10C	5,229	
Total	19,400		16,747	11,120

2) Subscriber's Primary Cable

Exchange	Lead-in Cable Lines	Total Lead-in Cable Pairs
Semarang I	58	13,760
Semarang II	18	11,348

3) Junction Cable

Section	Cable Pairs
Semarang I - II	800

(3) Solo

1) Local Switching Equipment

Exchange	Line Units	Switching System	Subscribers	Subscriber Backlog
Solo	7,000	ARF-101	5,128	2,714

2) Subscriber's Primary Cable

Exchange	Lead-in Cable Lines	Total Lead-in Cable Pairs
Solo	-	7,020

2-2-4 Exchange Locations in Objective Cities of Study

Exchange locations in three objective cities of study is in Figure 2-2-1 to Figure 2-2-3.

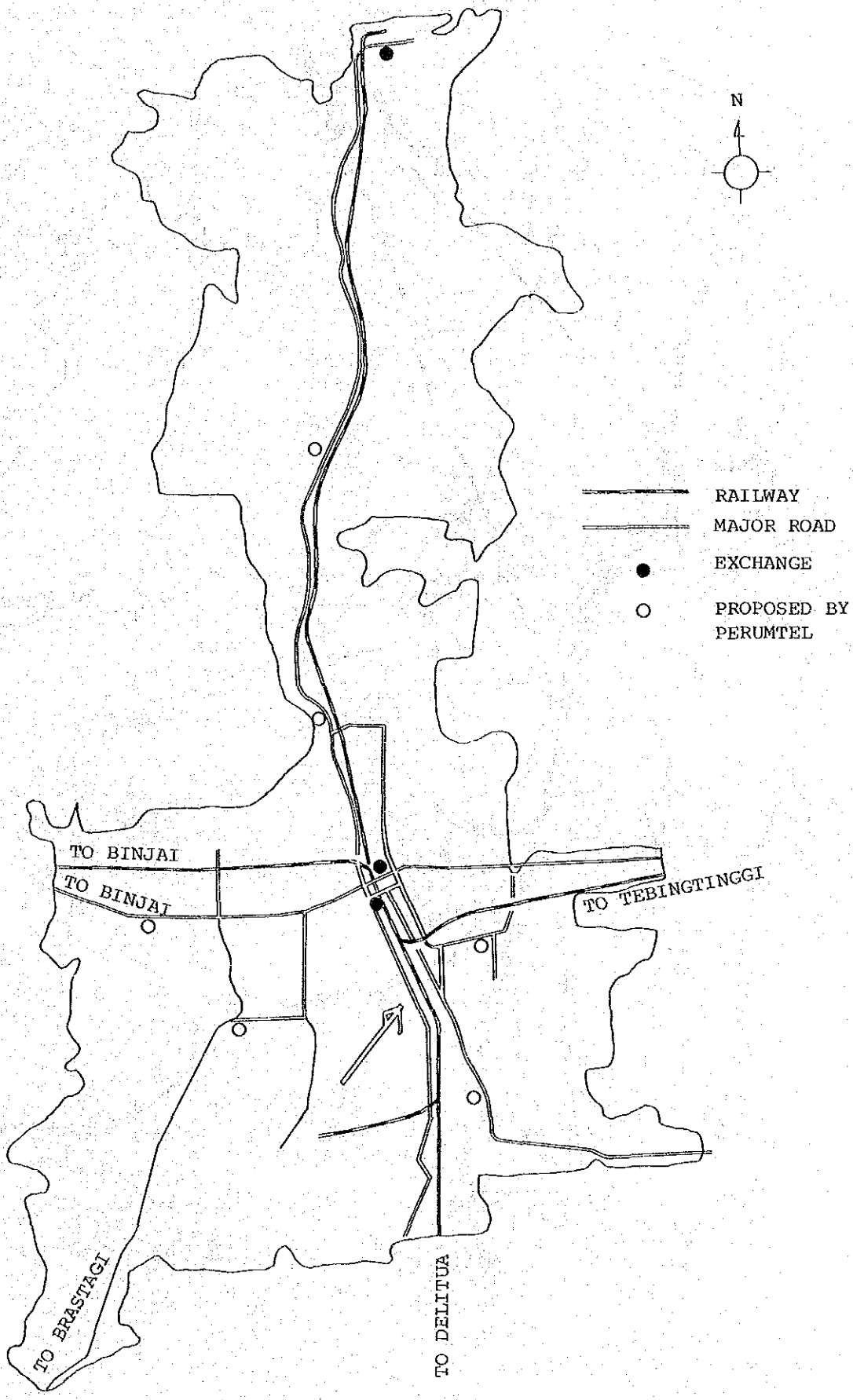

Figure 2-2-1 Locations of Telephone Exchanges in Medan

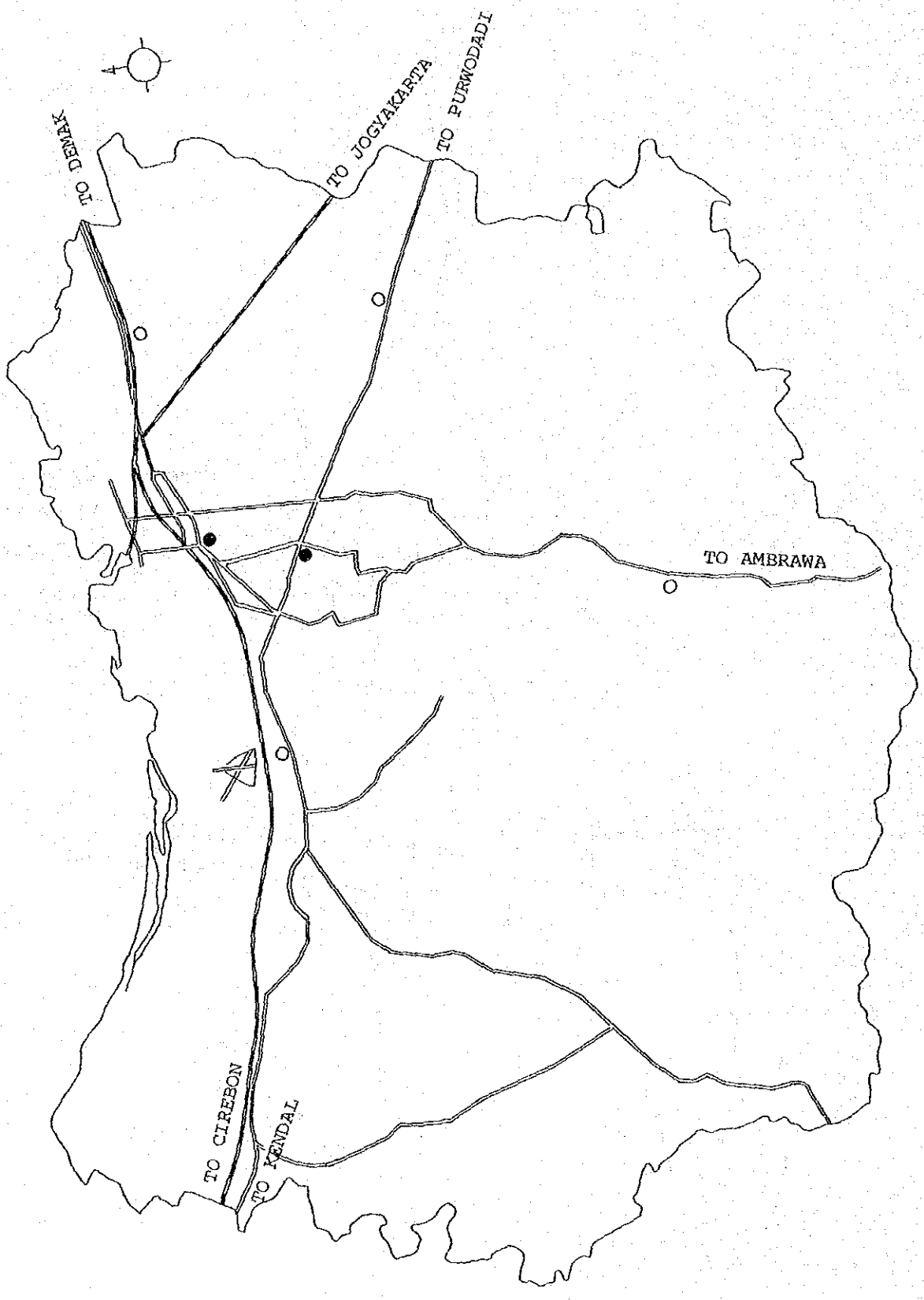

Figure 2-2-2 Locations of Telephone Exchanges in Semarang

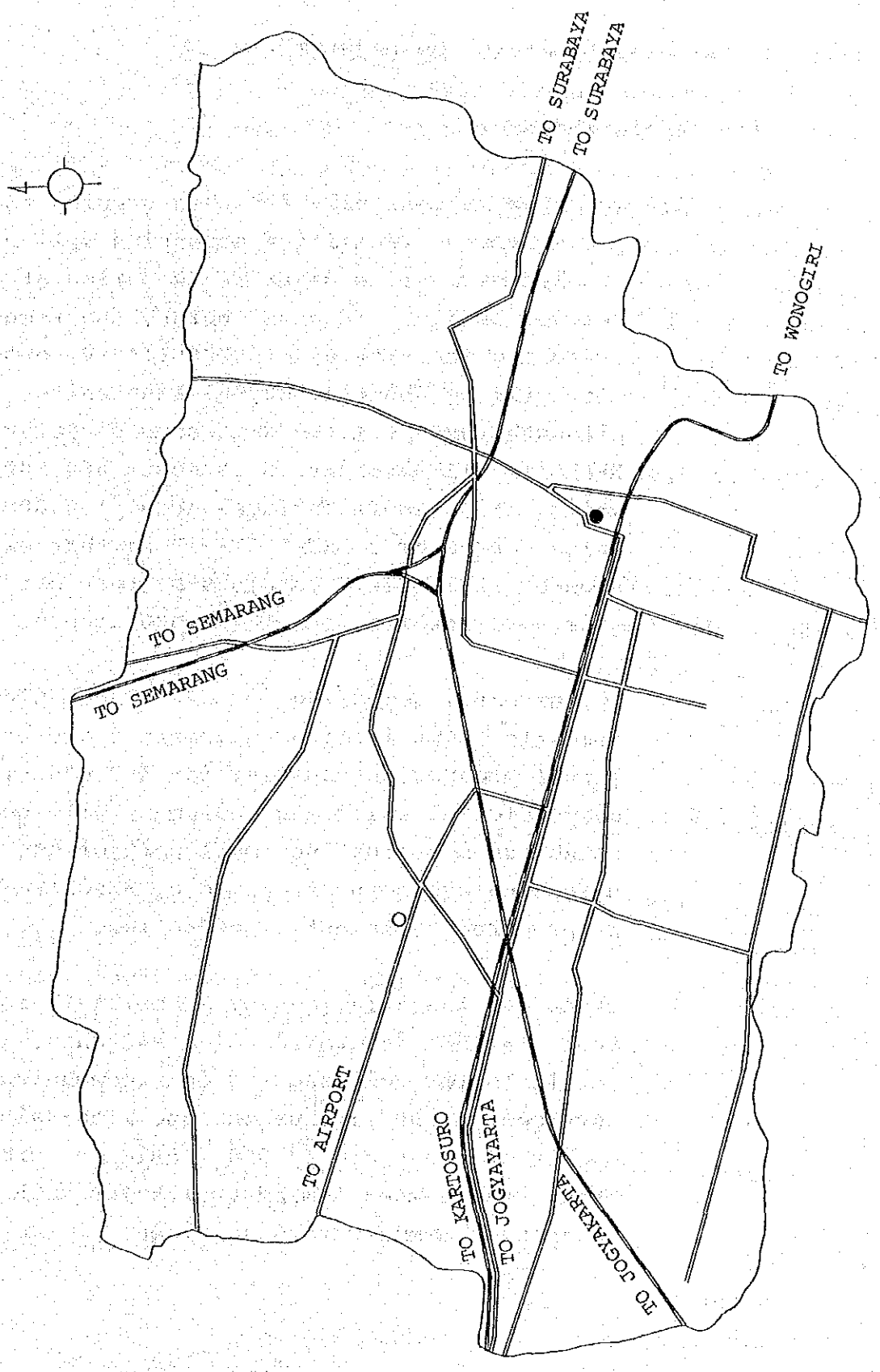

Figure 2-2-3 Locations of Telepone Exchanges in Solo

2-2-5 Facilities Expansion by REPELITA-IV

(1) Whole Indonesia

1) To cater successfully for ever-growing telephone demand, facilities expansion will be carried out during REPELITA-IV period at annual rate of 10-12%. In other words, the required switching capacity as of REPELITA-IV termination will be about 1,500,000 line units. Although the estimated switching capacity as of REPELITA-III termination is about 660,000 line units, this figure includes about 190,000 line units carryover to REPELITA-IV so that expansion by REPELITA-IV consists of that carryover plus new installation of 750,000 line units.

   Furthermore, according to REPELITA-IV plan, domestic communication equipment industry with annual production capacity for 100,000 line units digital switching equipment will be newly established so that no small part of new switching equipment required by REPELITA-IV can be procured by domestic production.

2) Other new installations by REPELITA-IV include about 16,450 line units telex switches, 10,000 terminals for telegram and data communication services, 1,500 line units satellite-using packet switches and 12,000 facsimile terminals. These are to meet demand growth for such non-telephone communication services.

3) Also, to cope with traffic growth resulting from new demand fulfillment, transmission system improvement will be carried out. This includes expansion of the existing trans-Sumatera and Jawa-Bali microwave systems and new construction of trans-Sulawesi microwave system and Surabaya-Banjarmasin submarine cable system. Besides such terrestrial transmission system improvement, means whereby to enhance domestic satellite communication system utilization will be taken and, for this purpose, 100 small type earth stations will be newly established.

4) Telecommunications facilities installation objectives of REPELITA-IV are in Table 2-2-3.

Table 2-2-3 REPELITA-IV Telecommunications Facilities Installation Objectives

	No. of Facilities
1) Domestic Service	
i) Telephony	750,000 line units
ii) Telex	16,000 line units
iii) Radio monitoring stations	32 stations
iv) Domestic communication industry	
- Digital telephone switches	100,000 l.u./year
- PABX	5,000 line units
- PCM transmission	6,000 CH
- Telephone sets	100,000 sets
- Public telephones	1,000 sets
- Small type satellite system earth stations	100 stations
2) Overseas Service	
i) Submarine cable	2 routes
ii) International telephone SLDD coverage	110 countries

(2) Objective Cities of Study

REPELITA-IV telecommunications facilities installation plan for three objective cities of study is in Table 2-2-4.

Table 2-2-4 REPELITA-IV Telecommunications Facilities Installation Plan for Objective Cities of Study

1) Medan

Exchange	Existing	Expansion	Total
Centrum (Medan I & II)	35,000	10,000	45,000
Suka Ramai	0	12,000	12,000
Pulau Brayan	0	11,000	11,000
Padang Bulan	0	8,000	8,000
Cinta Damai	0	7,000	7,000
Simpang Limun	0	7,000	7,000
Tanjung Mulia	0	3,000	3,000
Belawan	1,000	2,000 (-1,000)	2,000
Total	36,000	59,000	95,000

2) Semarang

Exchange	Existing	Expansion	Total
Semarang I	10,400	15,000	25,400
Semarang II	9,000	6,000	15,000
Genuk	0	1,000	1,000
Tugu	0	1,000	1,000
Banyumanik	0	1,000	1,000
Majapahit	0	600	600
Total	19,400	24,600	44,000

3) Solo

Exchange	Existing	Expansion	Total
Solo	7,000	6,000	13,000
Solo II	0	4,000	4,000
Total	7,000	10,000	17,000

2-2-6 Telecommunications Service Organization in Indonesia

(1) Ministry of Tourism, Post and Telecommunications

Organizational chart of Ministry of Tourism, Post and Telecommunications as competent authority for telecommunications administration is in Figure 2-2-4.

(2) DITJEN POSTEL and PERUMTEL

Responsibilities of DITJEN POSTEL (hereafter simply called POSTEL) pertinent to this study consist of posts and savings business, and national and international telecommunications services, as well as management and supervision of telecommunications equipment manufacturing sector.

Organization of POSTEL is shown in Figure 2-2-5.

Especially for telecommunications services, PERUMTEL as special corporation assumes whole responsibilities for domestic public telecommunications services. PERUMTEL adopts self-supporting accounting system for telecommunications business, whereby to enhance service operation efficiency.

Organization of PERUMTEL is shown in Figure 2-2-6.

PERUMTEL is headquartered in Bandung. With 12 WITELs under direct control of the headquarters, nationwide service management organization is constituted. Out of three objective cities of study, Medan belongs to WITEL I while Semarang and Solo are under control of WITEL VI.

Boundary of WITEL is shown in Figure 2-2-7 and Table 2-2-5.

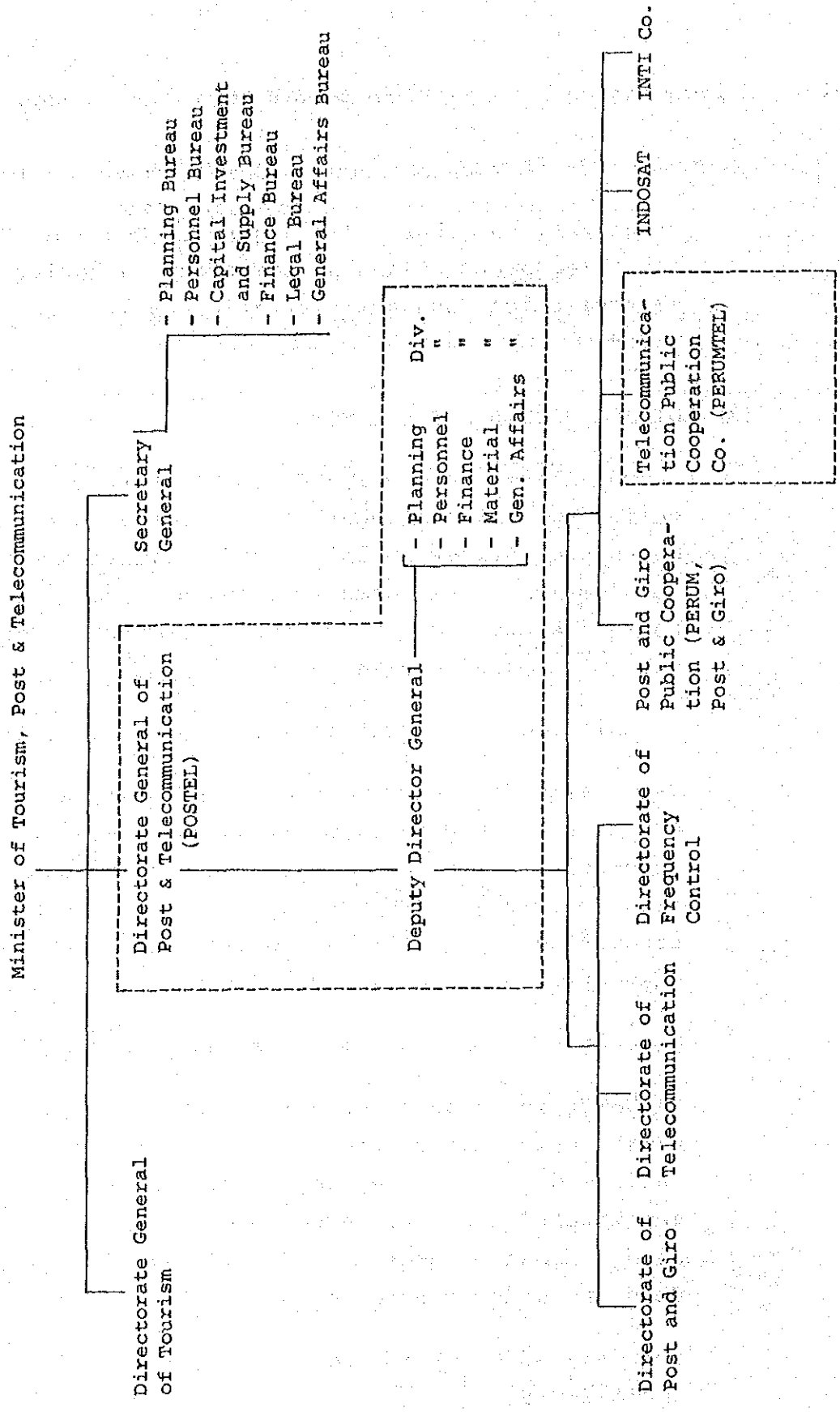

Figure 2-2-4 Organization of Ministry of Tourism, Post and Telecommunications

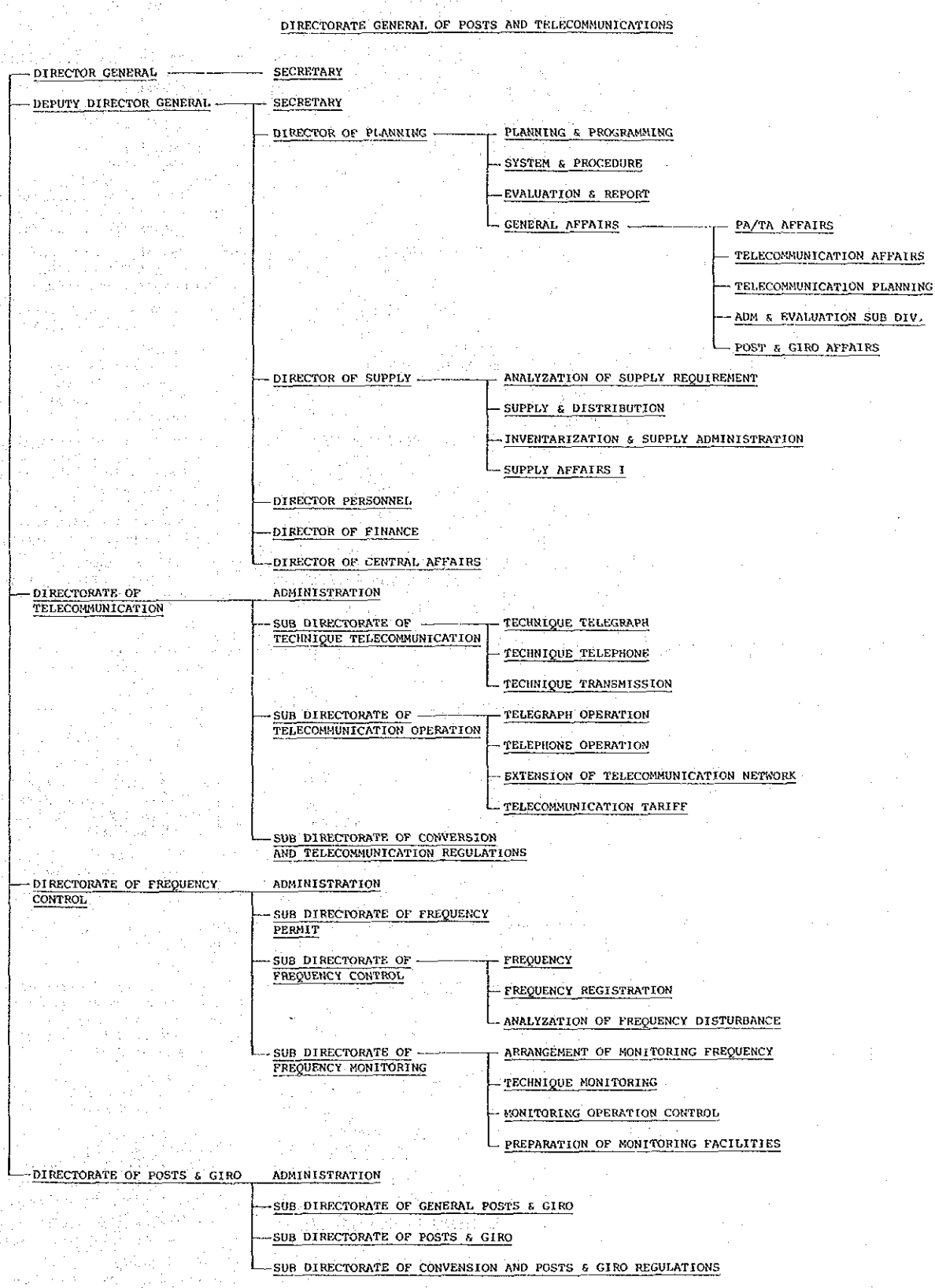

Figure 2-2-5 Organization of POSTEL

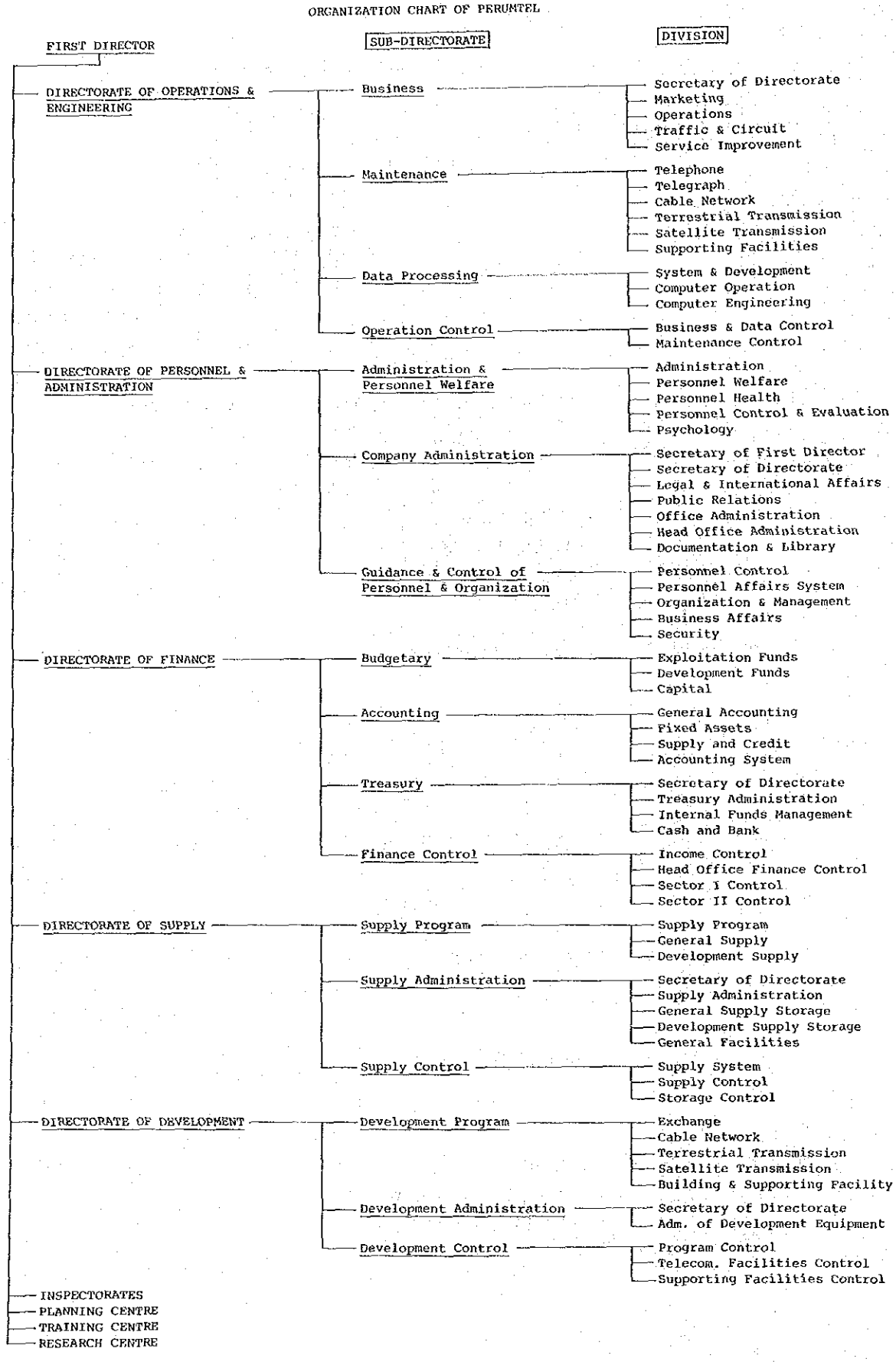

Figure 2-2-6 Organization of PERUMTEL

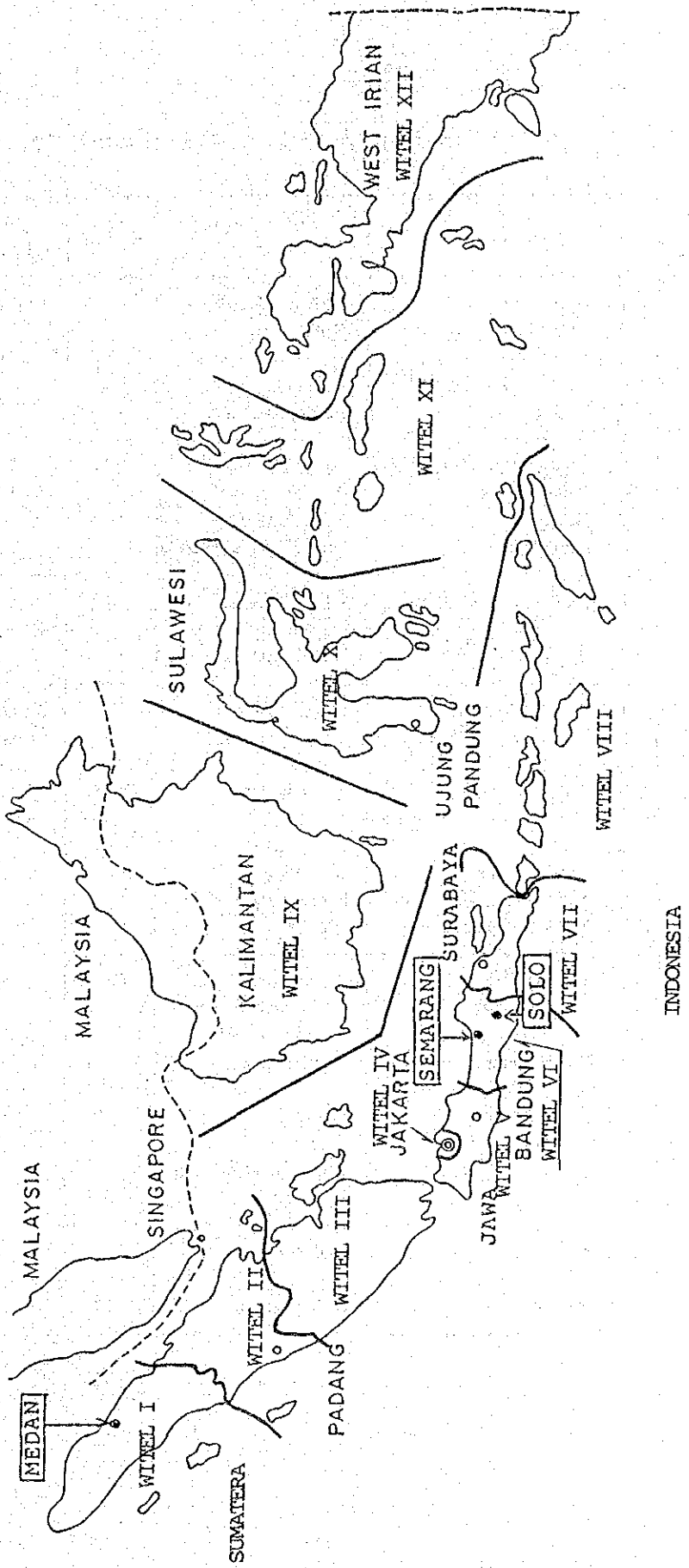

Figure 2-2-7 Boundary of WITEL

Table 2-2-5 Relationship Between WITEL and Regions

Area	Region	Regional Capital	WITEL	Objective City of Study
1. Sumatera	1. D.I. Aceh 2. Sumatera Utara	Banda Aceh Medan	I	Medan
	3. Sumatera Barat 4. Riau	Padang Pakanbaru	II	
	5. Sumatera Selatan 6. Jambi 7. Bengkulu 8. Lampung	Palembang Jambi Bengkulu Tanjung Karang	III	
2. Jawa	9. D.K.I. Jakarta	Jakarta	IV	
	10. Jawa Barat	Bandung	V	
	11. Jawa Tengah 12. D.I. Yogyakarta	Semarang Yogyakarta	VI	Semarang and Solo
	13. Jawa Timur	Surabaya	VII	
3. Nusa Tenggara	14. Bali 15. N.T. Timur 16. N.T. Barat 17. Timor Timur	Denpasar Kupang Mataram Dilly	VIII	
4. Kalimantan	18. K. Barat 19. K. Tengah 20. K. Selatan 21. K. Timur	Pontianak Palangkaraya Banjarmasin Samarinda	IX	
5. Sulawesi	22. S. Utara 23. S. Tengah 24. S. Selatan 25. S. Tenggara	Manado Palu Ujung Pandang Kendari	X	
6. Maluku	26. Maluku	Ambon	XI	
7. Irian Jaya	27. Irian Jaya	Jayapura	XII	

CHAPTER 3 TELEPHONE DEMAND FORECAST

CHAPTER 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.e., 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/construction plan formulation by this study.

3-1 Macroscopic Demand Forecast

3-1-1 Forecast Procedures

Macroscopic demand forecast procedures are as under.

(1) To analyze the past telephone diffusion trends in Indonesia and main demand factors having intimately to do with demand growth.

(2) To examine correlations between demand factors and demand growth.

(3) To select appropriate and suitable demand forecast model.

(4) To forecast demand factor growth.

(5) To estimate the forecasted demand values.

3-1-2 Telephone Diffusion Trends In Indonesia

(1) Number of Telephones Installed

1) Uptrends in the total number of telephones and the number of main stations, as well as exchange capacity, in Indonesia during 1971 through 1982 are in Table 3-1-1.

2) During the period mentioned, the total number of telephones and the number of main telephone, as well as exchange capacity, increased by 11-12% annually. This means the main telephone density (i.e., the number of main telephones

installed per population of 100) increase from 0.13 in 1971 to 0.31 in 1982. Compared with annual population growth by 2.5%, main telephone density increase was by 8% or more annually.

(2) Number of Main Telephones by Areas

1) Table 3-1-2 presents uptrends in the number of main telephones by areas during 10 years from 1972 to 1982 and their distribution by areas.

2) Especially in Jakarta, the number of main telephones increased conspicuously. Annual growth rate was as high as 16.6%. As of 1982, the number of main telephones in Jakarta occupied 36.2% out of national total. Rapid growth of telephone installations in Jakarta caused main telephone distribution rate as of 1982 in almost all other areas to fall below the share in 1972. However, even in those areas, main telephone growth rate was high at 8.8% annually.

Elsewhere than Jakarta, main telephone distribution rate in 1972 and 1982 remains at practically the same level. This fact shows that in other areas than Jakarta, main telephone growth rate remains almost unchanged for the whole period.

(3) Main Telephone Density by Area

1) Table 3-1-3 presents main telephone density in each area during the period from 1972 to 1981. Main telephone densities in the largest 10 cities during 1981 through 1984 are in Table 3-1-4.

2) Main telephone density in Jakarta as of 1981 stands at 2.09 per 100 persons. This figure is as much as 7.74 times the national average of 0.27. Average main telephone density in the nine largest cities excluding Jakarta as of 1981 is 1.23 or 4.56 times the national average.

3) Main telephone density in Medan and Semarang, two out of three objective cities, this time, is near the average for the nine largest cities excluding Jakarta. The corresponding rate for Solo, the remaining one of three objective cities, is 70-80% of the average for the said nine largest cities.

Table 3-1-1 Number of Telephones, Number of Direct Exchange Lines (D.E.L.) and Telephone Exchange Capacity in Whole Indonesia (1971-1982)

Item \ Year		Statistics												Annual Growth Rate (%)
		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
Population (Million)		120.15	122.97	125.85	128.10	131.83	134.92	138.09	141.65	144.65	148.04	151.31	154.66	
Number of Telephones	Main	152,146	168,205	183,365	197,571	207,478	219,428	241,019	275,125	317,932	369,843	427,185	475,459	
	Extension	69,633	72,623	83,072	91,403	97,710	99,491	108,079	117,438	124,169	143,037	156,996	193,842	
	Total	221,779	240,828	266,437	288,974	305,188	318,919	349,098	392,563	442,101	512,880	584,181	669,301	10.6
	Density/ 100 Inhabit	0.18	0.20	0.21	0.22	0.23	0.24	0.25	0.28	0.31	0.35	0.38	0.43	
Number of Direct Exchange Lines (D.E.L.)	Auto	77,437	95,414	105,762	115,298	130,752	138,722	156,358	192,857	253,696	319,303	375,424	420,518	
	Manual	74,709	72,791	77,603	82,273	76,726	50,706	54,661	82,268	63,419	50,540	51,761	54,941	
	Total	152,146	168,205	183,365	197,571	207,478	189,428	211,019	275,125	317,115	369,843	427,185	475,459	10.9
	Density/ 100 Inhabit	0.13	0.14	0.15	0.15	0.16	0.16	0.17	0.19	0.22	0.25	0.28	0.31	
Exchange Capacity	Auto	90,660	110,860	121,460	125,000	144,100	161,100	218,320	367,200	460,100	524,860	549,520	555,438	
	Manual	102,292	105,509	103,663	106,974	99,858	103,992	107,292	108,253	87,772	73,762	79,054	90,019	
	Total	192,952	216,369	225,123	231,974	243,958	265,092	325,612	475,453	547,872	598,622	628,574	645,457	11.6
D.E.L./Telephone Station		0.69	0.70	0.69	0.68	0.68	0.69	0.69	0.70	0.72	0.72	0.73	0.71	
D.E.L./Exchange Capacity		0.79	0.78	0.81	0.85	0.85	0.83	0.74	0.58	0.58	0.42	0.68	0.74	

Source: Traffic Dalam Angka 1979 - 1980, 1981 - 1982 (Anedatel, Perumtel)

Table 3-1-2 Historical Growth of Main Telephone Stations by Region

Witel	Area	1972 (*)		1982 (**)		Ave. Annual Growth Rate %
		No. of Main Lines	%	No. of Main Lines	%	
I	Aceh Sumatera North	15,228	9.1 (11.6)	41,338	8.7 (13.6)	10.5
II	Riau Sumatera Central	7,074	4.2 (5.4)	14,172	3.0 (4.7)	7.2
III	Sumatera South Jambi, Bengkulu Lampung	8,484	5.0 (6.5)	19,314	4.1 (6.4)	8.6
IV	Jakarta	37,036	22.0	171,894	36.2	16.6
V	Jawa West	20,530	12.2 (15.7)	47,291	9.9 (15.6)	8.7
VI	Jawa Central Yogyakarta	21,697	12.9 (16.5)	44,418	9.3 (14.6)	7.4
VII	Jawa East	33,000	19.6 (25.2)	74,440	15.7 (24.5)	8.5
VIII	Bali Nusa Tenggara	5,014	3.0 (3.8)	15,929	3.4 (5.2)	12.3
IX	Kalimantan	5,963	3.5 (4.5)	14,302	3.0 (4.7)	9.1
X	Sulawesi	10,338	6.1 (7.9)	24,209	5.1 (8.0)	8.9
XI	Maluku	1,512	0.9 (1.2)	3,399	0.7 (1.1)	8.4
XII	Irian Jaya	2,329	1.4 (1.8)	4,753	1.0 (1.6)	7.4
	Total	168,205	100.0 (100.0)	475,459	100.0 (100.0)	11.0 (8.8)

( ): % of Main Lines by Region except Jakarta

Note: (*): Proposal for Telecommunications Development in the Second Year Plan (16 page), PERUMTEL
(**): Data Potensi Telepon (PON.1), PERUMTEL

Table 3-1-3 Historical Growth of Telephone Density by Witel Area

Witel	1972			1981			Growth Rate (%)	
	Population	Main Telephone	Line Density	Population	Main Telephone	Line Density	Population	Line Density
	(x10³)		(%)	(x10³)	(June 1981)	(%)		
I	8,863	15,228	0.17	11,291	34,065	0.30	2.6	7.13
II	4,548	7,074	0.16	5,730	13,482	0.24	2.6	5.04
III	8,086	8,484	0.10	12,008	14,700	0.12	4.5	2.23
IV	4,732	37,036	0.78	6,778	141,514	2.09	4.1	12.69
V	22,205	20,530	0.08	28,244	43,416	0.15	2.7	7.92
VI	24,744	21,697	0.09	28,632	40,663	0.14	1.6	5.50
VII	25,890	33,000	0.13	29,687	64,307	0.22	1.5	6.58
VIII	6,758	5,014	0.07	8,109	13,722	0.17	2.1	11.35
IX	5,308	5,963	0.12	6,943	12,833	0.18	3.0	5.04
X	8,722	10,338	0.12	10,666	20,563	0.19	2.3	5.73
XI	1,122	1,512	0.13	1,456	2,673	0.18	2.9	4.02
XII	185	2,329	1.26	1,208	4,096	0.34	23.1	(-)
Total	121,163	168,205	0.14	151,315	406,034	0.27	2.5	8.29

Table 3-1-4 Historical Growth of Telephone Density in the Largest 10 Cities

City	1981 (June)					1984 (Oct)					Telephone Density Growth Rate (%)
	Population (x10³)	Main Telephone	Line Density (%)	Demand	Demand Density (%)	Population (x10³)	Main Telephone	Line Density (%)	Demand	Demand Density (%)	
Jakarta	6,761	141,514	2.09	-	-	7,401	198,934	2.62	335,166	4.42	7.82
Surabaya	2,088	33,275	1.59	-	-	2,282	41,970	1.84	66,173	2.90	4.99
Bandung	1,495	17,319	1.16	-	-	1,646	19,069	1.16	40,174	2.44	0
Medan	1,433	18,582	1.30	-	-	1,549	25,477	1.59	37,764	2.35	6.94
Semarang	1,049	14,247	1.36	-	-	1,094	15,094	1.32	25,546	2.24	-1.00
Palembang	819	4,946	0.60	-	-	886	6,626	0.75	12,572	1.42	7.72
U. Pandang	738	8,559	1.16	-	-	798	11,697	1.47	16,022	2.00	8.21
Malang	533	5,927	1.11	-	-	576	7,678	1.33	10,505	1.83	6.21
Padang	500	4,955	0.99	-	-	541	5,362	0.99	8,641	1.60	0
Solo	489	4,854	0.99	-	-	529	5,158	0.98	8,174	1.55	-1.00
Total except Jakarta	9,144	112,664	1.23			9,901	138,131	1.40	225,571	2.28	4.41

3-1-3 Main Demand Factor Analysis

(1) Population Growth and Distribution Trends

1) Population growth trends and population distribution by areas and by cities in Indonesia are as under.

i) National population (1971-1982): Refer to Table 3-1-1.

ii) Population distribution by areas: Refer to Table 3-1-3.

iii) Population distribution by cities: Refer to Table 3-1-4.

2) Annual population growth rate in Indonesia during 10 years from 1971 to 1981 is nearly 2.5%. Population distribution by areas during nine years from 1972 to 1981 is featured by especially high population growth rate of more than 4% annually in Jakarta and northern sector of Sumatera. Population growth rate in northern sector of Sumatera which embraces Medan, one of objective cities of study, is nearly equal to average national growth rate. Population growth rate in central Jawa, where Semarang and Solo are located, is not more than 1.6% annually. This rate is the lowest along with that in eastern Jawa.

3) Population growth rate in Jawa Island except Jakarta during nine years (1972-1981) is considerably below national average. Nevertheless, 60% out of the whole population is still concentrated in Jawa Island.

(2) Gross Domestic Product (GDP) Growth Trends

1) According to data recently announced by the Government of Indonesia, GDP growth rate in real terms during the period from 1972 to 1981 is 7.3%. GDP per capita growth rate during 1972 through 1981 is 5.5%. By this rapid growth, GDP per capita as of 1981 reaches the level of 560 U.S. dollars.

2) Table 3-1-5 presents Gross Regional Domestic Product (GRDP) as of 1975 and 1981 excluding petroleum production. (GRDP in Table 3-1-5 is given at market price of 1975.) For both years, GRDP growth rate, like population growth rate, by far exceeds national average in Jakarta and southern Sumatera, but is the lowest in central Jawa that comprises Semarang and Solo, the objective cities of study. GRDP distribution rate by areas remains practically unchanged for both years mentioned.

3-1-4 Correlations Between Number of Telephones and Main Demand Factors

(1) Area by Area Data Analysis

1) Undermentioned data are intrinsically to indicate changes with time of area by area distributions of the number of main telephones, population and GRDP. This time, those data show that in all areas except Jakarta, the distribution rates remain almost unchanged for years mentioned.

i) Number of main stations distribution by areas (1972-1981): Refer to Table 3-1-2.

ii) Population distribution by areas (1972 and 1981): Refer to Table 3-1-3.

iii) GRDP distribution by areas (1975 and 1981): Refer to Table 3-1-5.

Those data hint at intimate correlations between main telephone distribution by areas, on one hand, and population and GRDP distributions by areas, on the other. For mathematical study of such correlations, examination was made for area data of 1981 as shown in Table 3-1-6, using regression model $Y = ax_1 + bx_2 + c$. Results obtained attest to strong correlations as described in the following 2.

2) For Jakarta, data showing telephone density, main telephone growth rate and population growth rate are of especially higher values than for other areas. Adjustment of difference from data for other areas by use of correction factors produced extremely strong correlations ($r = 0.99$) as under. In this calculation, more or less corrections were made for Witel I (which includes Medan) and Witel VII (which includes Surabaya) data also. These Witels are under strong influence from those large cities in their respective areas.

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

$$(r = 0.99)$$

where

Y: Main telephone distribution by areas (%)

x_1: Population distribution by areas (%)

x_2: GRDP distribution (%)

a_1, a_2: Correction factors

provided

Jakarta:	$a_1 = 15.0$	$a_2 = 3.5$
Witel I:	$a_1 = 2.0$	$a_2 = 1.0$
Witel VI:	$a_1 = 1.5$	$a_2 = 1.0$
other area:	$a_1 = 1.0$	$a_2 = 1.0$

(2) City by City Data Analysis

Out of three objective cities of study, Medan and Semarang are regional capitals so that they constitute the centers of regional social and economic activities. For Medan, Semarang and other four regional capitals, such as Surabaya, Bandung, Ujung Pandang and Padang, all of which are the same in rank, study was made concerning correlation between population distribution and main telephone distribution. As the result, strong correlation, which can be expressed by exponential equation that appears below, was confirmed.

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

where

Y: Main station distribution (%)

Y is expressed by

$$\frac{\text{No. of main stations in each main city}}{\text{No. of main stations in related WITEL area}} \times 100$$

x: Population distribution (%)

x is expressed by

$$\frac{\text{Population of each main city}}{\text{Population in related WITEL area}} \times 100$$

K = 100

a = 74.56

b = 0.96

Comparison between statistical data and calculated value by the above exponential equation follows:

City	Population Distribution (x) (%)	Main Station Distribution (Y) (%)	
		Calculated Value	Statistical Data
Surabaya	7.0	43.9	51.7
Bandung	5.3	39.9	39.9
Medan	12.7	55.6	54.5
Semarang	3.7	35.9	35.0
Ujung Pandang	6.9	43.7	41.6
Padang	5.8	41.1	36.7

Table 3-1-5 Historical Development of GRDP Excluding Petroleum
(Billion Rupiah: 1975 Constant Price)

Witel	(Province)	GRDP	1975 (1)	1975 (2)	GRDP	1981 (3)	1981 (4)	Growth Rate (%)	
I	Aceh	211.52	2.20	2.47	292.78	1.79	2.03	5.57	(0.60)
	Sumatera Utara	688.35	7.16	8.03	1,173.82	7.17	8.14	9.30	(1.00)
II	Sumatera Barat, Riau	325.79	3.39	3.80	552.63	3.38	3.83	9.21	(0.99)
III	Sumatera Selatan, Jambi Bengkulu, Lampung	731.20	7.61	8.53	1,348.48	8.24	9.35	10.74	(1.16)
IV	DKI Jakarta	1,036.91	10.79	-	1,949.79	11.91	-	11.10	(1.19)
V	Jawa Barat	1,720.79	17.91	20.07	2,915.27	17.81	20.21	9.18	(0.99)
VI	Jawa Tengha	1,289.79	13.42	15.05	1,929.06	11.78	13.38	6.94	(0.75)
	DI Yogyakarta	146.21	1.52	1.71	199.59	1.22	1.38	5.32	(0.57)
VII	Jawa Timur	1,770.35	18.42	20.65	3,009.68	18.38	20.87	9.25	(1.00)
VIII	Bali, NTT, NTB	347.14	3.61	4.05	631.79	3.86	4.38	10.50	(1.13)
IX	Kalimantan	539.95	5.62	6.30	964.72	5.89	6.69	10.16	(1.09)
X	Sulawesi	615.66	6.41	7.18	1,065.19	6.51	7.39	9.57	(1.03)
XI	Maluku	102.54	1.07	1.20	181.97	1.11	1.26	10.03	(1.08)
XII	Irian Jaya	82.80	0.80	0.97	156.82	0.90	1.09	11.23	(1.21)
Total GRDP excluding petroleum		9,609.00	100		16,371.79	100		9.29	(1.00)
Total except Jakarta		8,572.09		100	14,422.00		100	9.06	(0.98)

Source: Perbandingan Produk Domestik Regional Bruto Propinsi - Propinsi di Indonesia.

Note: (1), (3): Percentages of GRDP / Total GRDP
(2), (4): Percentages of GRDP / Total except Jakarta

* The figures in ( ) are ratio of GRDP growth rate to Total GRDP growth rate.

Table 3-1-6 Relation Between Main Telephone Distribution by Region and Regional Correlation Factors

Witel	Propinsi	Population 1981			GRDP 1981			Main Telephone 1981		
		(x 10^3)	(1)	(2)	(Billion Rp)	(3)	(4)	Number	(5)	(6)
I	Aceh	2,693	7.46	1.86	292.78	8.96	2.03	4,205	8.39	1.59
	Sumatera Utara	8,598		5.95	1,173.82		8.14	29,860		11.29
II	Sumatera Barat, Riau	5,730	3.79	3.96	552.63	3.38	3.83	13,482	3.32	5.10
III	Sumatera Sel, Jambi, Bengkulu, Lampung	12,008	7.94	8.31	1,348.48	8.24	9.35	14,700	3.62	5.56
IV	DKI Jakarta	6,778	4.48	-	1,949.79	11.91	-	141,514	34.85	-
V	Jawa Barat	28,244	18.67	19.54	2,915.27	17.81	20.21	43,416	10.69	16.41
VI	Jawa Tengah	25,845	18.92	17.88	1,929.06	13.00	13.38	36,869	10.01	13.94
	DI Yogyakarta	2,787		1.93	199.59		1.38	3,794		1.43
VII	Jawa Timur	29,687	19.62	20.54	3,009.68	18.38	20.87	64,307	15.84	24.31
VIII	Bali, NTT, NTB	8,109	5.36	5.61	631.79	3.86	4.38	13,722	3.38	5.19
IX	Kalimantan	6,943	4.59	4.80	964.92	5.89	6.69	12,833	3.16	4.85
X	Sulawesi	10,667	7.05	7.38	1,065.19	6.51	7.39	20,563	5.06	7.77
XI	Maluku	1,456	0.96	1.01	181.97	1.11	1.26	2,673	0.66	1.01
XII	Irian Jaya	1,208	0.80	0.84	156.82	0.90	1.09	4,096	1.01	1.55
Total		151,315	100		16,371.79	100		406,034	100	
Except Jakarta		144,537		100	14,422.00		100	264,520		100

Note: (1), (3), (5): percentage (%) by region (Excluding Petroleum)
(2), (4), (6): percentage (%) by region except Jakarta.

3-1-5 Forecast of Main Demand Factor Growth

Based on data analysis results as per paragraph 3-1-4, selection is made for population and GDP/GRDP as factors having intimately to do with future telephone demand forecast. At the same time, estimation is made for each factor value for each forecast year. Meanwhile, when estimating telephone distribution by areas and by cities, it is important to note at what values are those factors allocated to Jakarta because allocated values to Jakarta exerts serious influence on allocated values to others areas and cities. Therefore, decision is made to add Jakarta related areas and cities.

(1) Population Forecast

1) National Population

For population forefast forecast for the whole of Indonesia, forecast data up to the year 2000 prepared by Central Bureau of Statistics, Indonesia, is used as basic data. This data presupposes average annual growth rate of 2.1% up to the year 2000 and growth rate of 1.9% for each of five years immediately before 2000, i.e., 1996 through 2000. These preconditions can be considered to reflect long-term population policy of the Government of Indonesia. For growth rate after 2000, this study uses 1.9% per annum.

2) Area by Area Population

a) Jakarta

For Jakarta population growth forecast, the method used in "Jakarta City Telephone Network Improvement Plan Study (JTP'79)" carried out by JICA in 1981 is employed. This method places top limit of Jakarta City Population growth at 13,000,000. Study by this precondition plus up-to-date population statistics produces forecast model as under.

$$Y = \frac{13,000,000}{1 + 3.6107e - 0.6647t}$$

where

Y: Population of Jakarta
t: 1 for 1961

b) Related WITEL Area

Out of basic data for Wital I and Wital VI (which include objective cities of study) area population forecast, data for years up to 1990 is taken from Indonesia Population program by Areas for 1980 - 1990 (Proyeski Pendndnk Indonesia per Propinsi 1980 -1990, Statistik Indonesia 1983). For population growth rates for 1990 - 2005, assumption is made that growth tempo will somewhat slow down compared with 1980 - 1990, as in the case of national population forecast. Growth rates thus assumed are as under.

Year	All Indonesia	Witel I	Witel VI
1980 - 1990	2.1 - 2.2%	2.2 - 2.4%	1.3 - 1.4%
1990 - 2005	1.9 - 2.0%	2.1 - 2.3%	1.2 - 1.3%

3) Objective Cities of Study

a) According to official publications in related areas (Sumatera Utara Dalam Angka 1983 and Jawa Tengah Dalam Angka 1983), population growth in Medan and Semarang during the period from 1980 to 1983 was by 3% and 2.6%. In Solo, population growth during 1971 through 1980 was from 414,285 to 455,043, i.e., by 1.05% annually.

b) In consideration of expected urbanization progress in objective cities of study, population growth rates in three cities concerned are assumed as under.

Medan: 3%
Semarang: 2.6%
Solo: 1.6%

(2) Economic Growth Forecast

1) In Indonesia, GDP per capita in real terms during the past 9 years (1972 -1981) (at market price as of 1981) grew by 5.5% in annual average. In REPELITA-IV program of the Government of Indonesia, growth rate of GDP in real terms during program period is set at 5% and population growth rate at 2%; hence about 3% growth in annual average for GDP per capita in real terms. Provided that no major change

in government policy will take place during and after REPELITA-IV program period, a safe assumption is that annual growth rate of GDP per capita will be in the range of 2-4% and probably near 3%.

2) As for future GRDP growth rate, more or less lower level than during 1975 through 1981 is presumed for all areas provided that forecasted GDP growth rate is 5%.

(3) Forecasted Growth Values for Population and Economy

Forecasted growth values for population and economy obtained by preconditions of Paragraphs (1) and (2) are as under.

i) Population growth forecast:
Refer to Table 3-1-7.

ii) GDP per capita growth forecast:
Refer to Table 3-1-8.

iii) GRDP in related areas growth forecast:
Refer to Table 3-1-9.

Table 3-1-7 Prospective Growth of Population ($x10^3$)

Year	Whole Indonesia	Jakarta	Outside Jakarta	Witel I	Witel IV	Medan	Semarang	Solo
1980	148,040	6,527	140,960	10,972.2	28,123.7	1,374	985	455
1981	151,315	6,778	144,537	11,290.9	28,632.1	1,419	1,020	464
1982	154,662	7,038	147,624	11,570.9	29,039.9	1,460	1,037	473
1983	158,083	7,307	150,776	11,858.6	29,449.8	1,504	1,065	483
1985	165,154	7,496	157,658	12,451.9	30,278.3	1,596	1,123	502
1988	175,904			13,303.1	31,449.8	1,744	1,206	533
(1990)	183,457	8,514	174,943	13,902.7	32,255.8	1,850	1,264	555
1993	194,800			14,979.4	33,480.6	2,022	1,358	580
(1995)	202,748	9,434	193,314	15,743.1	34,322.8	2,145	1,424	598
1998	214,524			16,829.8	35,573.2	2,344	1,529	625
2000	222,753	10,226	212,527	17,595.7	36,432.2	2,487	1,603	644
2003	235,691			18,727.7	37,647.7	2,718	1,721	673
2005	244,731	10,882	233,849	19,522.5	38,480.5	2,883	1,805	693

Source: - Proyeksi Pendudik Indonesia per Propinsi 1980 - 1990

- Sumatera Utara Dalam Angka 1983

- Jawa Tengah Dalam Angka 1983

Table 3-1-8 Future Growth of Population and GDP per Capita in Indonesia
(Major Correlation Factors for Forecasting Future Telephone Demand)

Year	Population (x 10^3)	GDP per Capita: US$ at 1981 Price			
		5.5%	4%	3%	2%
1981	151,314.6	560.0			
1982	154,661.7	590.8			
1983	158,082.7	623.3			
1984	161,579.5		648.2	642.0	635.8
1985	165,154.8		674.2	661.3	648.5
1986	168,662.0		701.1	681.1	661.4
1987	171,468.0		729.2	701.5	674.7
1988	175,903.8		758.3	722.6	688.2
1989	179,640.6		788.7	744.2	701.9
(1990)	183,457.8		820.2	766.6	716.0
1993	194,799.8		922.6	837.7	759.8
(1995)	202,748.1		997.9	888.7	790.5
(1998)	214,524.3		1,122.5	971.1	838.9
2000	222,752.6		1,214.1	1,030.2	872.8
(2003)	235,690.7		1,365.7	1,125.7	926.2
2005	244,730.9		1,477.1	1,194.3	963.6

Table 3-1-9 Prospective Growth of GRDP (1975 Market Price)

(%): Distribution rate

Year	Whole Indonesia ($\times 10^9$)	Witel I		Witel VI		Jakarta	
		GRDP$_9$ ($\times 10^9$)	(%)	GRDP$_9$ ($\times 10^9$)	(%)	GRDP$_9$ ($\times 10^9$)	(%)
1985	20,967	2,057	9.8	2,536	12.1	2,607	12.4
1988	24,282	2,398	9.9	2,812	11.6	3,061	12.6
1990	26,771	2,657	9.9	3,012	11.3	3,407	12.7
1993	30,992	3,098	10.0	3,339	10.8	3,955	12.8
1995	34,169	3,432	10.0	3,577	10.5	4,369	12.8
1998	39,554	4,002	10.1	3,966	10.0	5,015	12.7
2000	43,607	4,433	10.2	4,249	9.7	5,497	12.6
2003	50,480	5,168	10.2	4,711	9.3	6,237	12.4
2005	55,654	5,725	10.3	5,046	9.1	6,785	12.2

3-1-6 Demand Forecast Model

(1) National Demand Forecast Model

For national demand forecast model, 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)

X and Y correlation is graphically presented in Figure 3-1-1. Statistical data concerning the correlation are in Table 3-1-10.

(2) Area by Area Demand Forecast Model

As seen in population forecast by areas and GRDP calculation results (refer to Table 3-1-7 and Table 3-1-9), demand factor forecast data distribution by areas presents practically the same trend as 1981 statistical data distribution by areas wherein intimate correlation was proven in Paragraph 3-1-4 (1). This fact supports judgment that regression equation introduced in Paragraph 3-1-4 (1) 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: Collection factors

provided

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

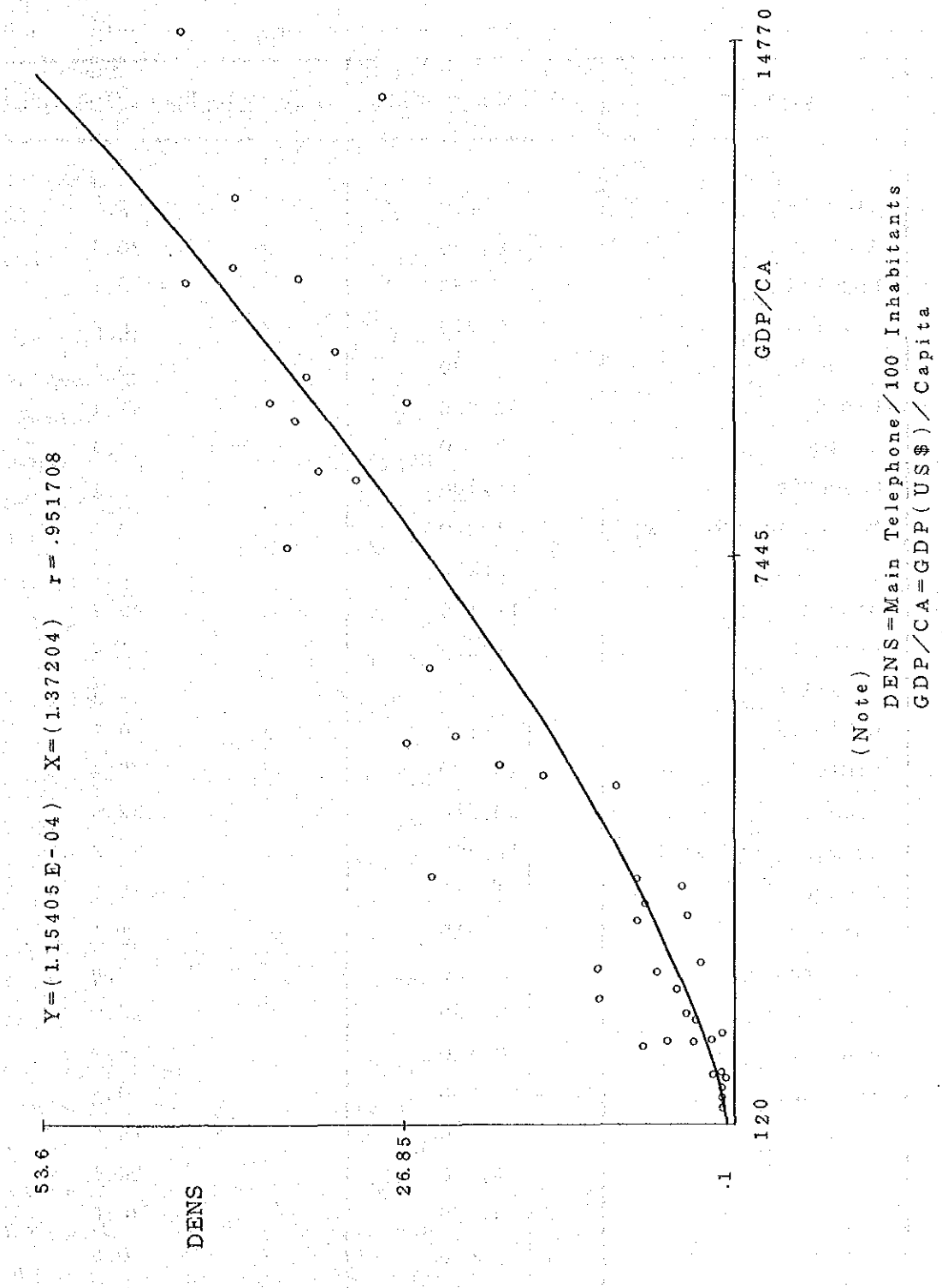

Figure 3-1-1 Telephone Density and GDP per Capita in 56 Countries in 1981

Table 3-1-10 (1/2) GDP/Capita and Telephone Density in 56 Countries

Country	GDP (US$)/Capita	Main Telephones/100 Inhabitants
Algeria	2,260	2.2
Austria	8,770	30.7
Bangladesh	130	0.1
Belgium	9,810	26.4
Burundi	220	0.1
Canada	11,610	41.1
Chile	2,890	3.4
Colombia	1,180	5.1
Congo, People's Rep.	1,340	0.6
Costa Rica	1,120	7.0
Denmark	11,380	45.2
Ecuador	1,500	2.7
El Salvador	730	1.4
Ethiopia	120	0.2
Finland	10,170	35.2
France	10,510	32.6
Germany Fed. Rep.	11,480	35.8
Greece	3,410	24.6
Guatemala	1,210	1.4
Honduras	600	0.8
Hong Kong	5,220	26.6
Hungary	2,110	5.9
Indonesia	560	0.3
Ireland	4,780	15.5
Italy	6,230	24.6
Japan	9,550	36.0
Kenya	420	0.5
Korea Rep.	1,760	10.9

Table 3-1-10 (2/2) GDP/Capita and Telephone Density in 56 Countries

Country	GDP (US$)/Capita	Main Telephones/100 Inhabitants
Malaysia	1,910	4.3
Mali	160	0.1
Mexico	3,270	3.9
Morocco	670	0.8
Netherlands	9,830	38.1
New Zealand	7,840	36.8
Nigeria	710	0.2
Norway	13,920	28.6
Pakistan	290	0.3
Peru	1,310	0.5
Philippines	780	0.7
Portugal	2,170	10.8
Singapore	5,280	22.4
South Africa	3,040	6.8
Spain	4,910	19.1
Sri Lanka	270	0.6
Sudan	390	0.3
Sweden	13,510	53.6
Switzerland	14,770	45.8
Syrian Arab Rep.	1,580	3.5
Thailand	770	0.8
Turkey	1,190	2.9
United Kingdom	8,870	34.1
United States	12,520	40.9
Uruguay	3,350	7.7
Venezuela	4,640	9.4
Yugoslavia	2,820	7.5
Zambia	570	0.5

Source: World Development Report 1983
The World Telephone 1982

(3) Demand Forecast Model for Objective Cities of Study

Judgment is reached that intimate correlation between population distribution and main telephone distribution in each principal local city, which was proven in Paragraph 3-1-4 (2), 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

$$\frac{\text{No. of main telepones in objective city of study}}{\text{No. of main telepones in related WITEL area}} \times 100$$

x: Population distribution (%)

x is expressed by

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

K = 100

a = 74.56

b = 0.96

3-1-7 Results of Demand Forecast

(1) National Demand Forecasts

1) Calculation results by regression equation introduced in Paragraph 3-1-6 (2) are shown in Table 3-1-11 and Figure 3-1-2.

The results are calculated under the assumption of the growth rates of GDP per capita in 2%, 3% and 4% respectively. Finally, in this study, figures calculated in 2% of growth rate of GDP per capita are selected as national forecasted demand and shown below.

Year	Main Telephone Density (No. per Population of 100)	Population ($\times 10^3$)	Demand Forecast ($\times 10^3$)
1985	0.85	165,154.8	1.404
1988	0.96	175,903.8	1.689
1990	1.04	183,457.8	1.903
1993	1.18	194,799.8	2.299
1995	1.28	202,748.1	2.595
1998	1.44	214,524.3	3.089
2000	1.56	222,752.6	3.475
2003	1.77	235,690.7	4.172
2005	1.92	244,730.9	4.699

2) Up the present, main telephone density in Indonesia has remained at lower level than in other countries with practically the same degree of GDP per capita as Indonesia. This fact is considered to show that in Indonesia, demand remained latent for one reason or another. However , in view of steady increase in the number of telephone installations in recent years, it can be safely assumed that latent demand will continue to come up to the surface, causing main telephone density to approach international mean level in not long future. In other words, a large gap as seen between 1985 forecast of 1.404×10^3 and actual value of 950×10^3 (working main telephones, 650,000; yet to be installed, 300,000) will be eliminated gradually as latent demand continues to transform into positive demand in the coming years.

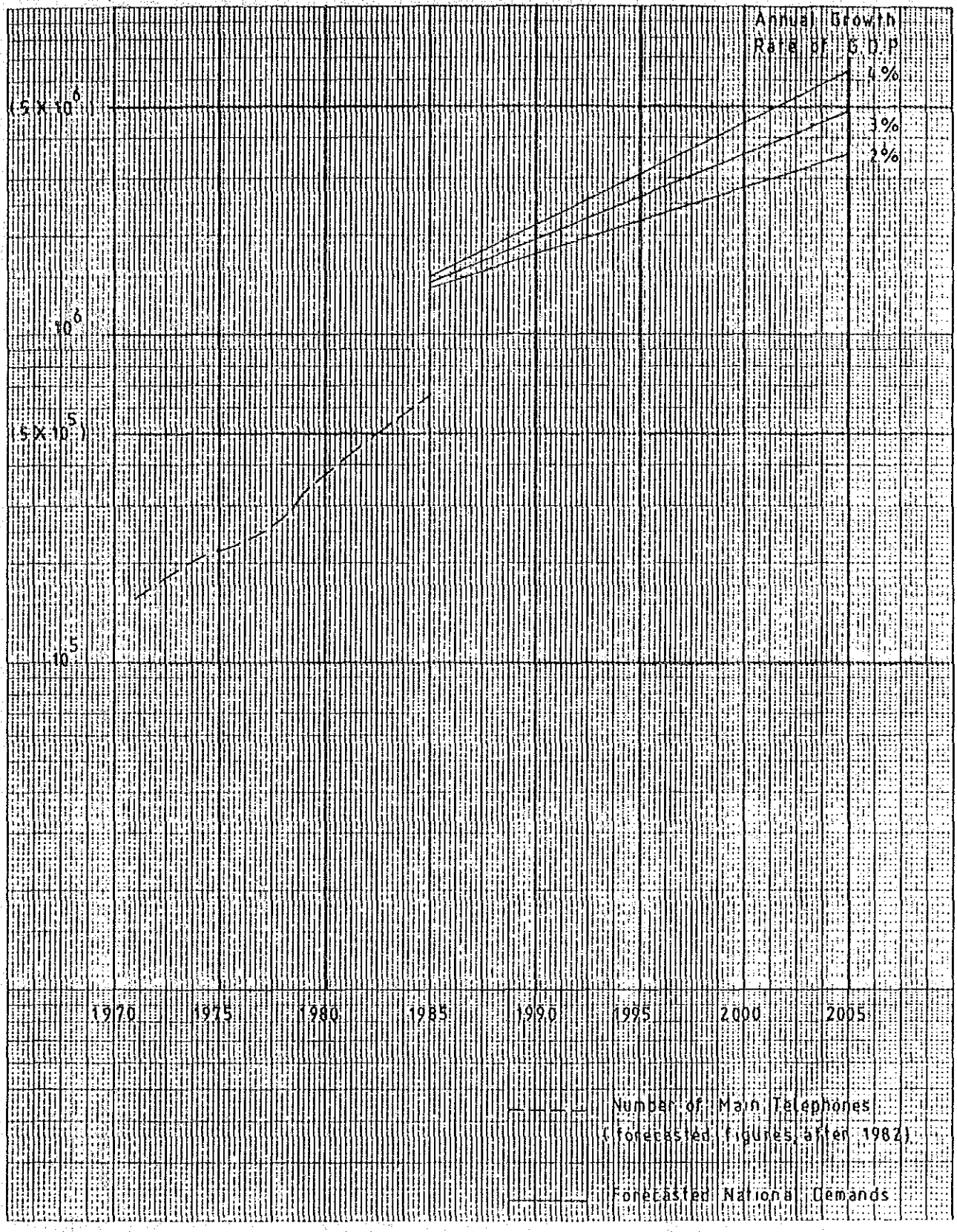

Figure 3-1-2 National Telephone Demand Forecast in Indonesia

Table 3-1-11 National Telephone Demand Forecast in Indonesia

Year	Population (x10³)	4%			3%			2%		
		GDP per Capita (X=)	Demand Density (Y=)	Total Demand	GDP per Capita (X=)	Demand Density (Y=)	Total Demand	GDP per Capita (X=)	Demand Density (Y=)	Total Demand
1985	165,154.8	674.2	0.87	x10³ 1,437	661.3	0.85	x10³ 1,404	648.5	0.83	x10³ 1,371
(1986)	168,662.0	701.1	0.92	1,552	681.1	0.89	1,501	661.4	0.85	1,434
(1987)	171,468.0	729.2	0.97	1,663	701.5	0.92	1,578	674.7	0.88	1,509
1988	175,903.8	758.3	1.03	1,812	722.6	0.96	1,689	688.2	0.90	1,583
(1989)	179,640.6	788.7	1.08	1,940	744.2	1.00	1,796	701.9	0.92	1,653
(1990)	183,457.8	820.2	1.14	2,091	766.6	1.04	1,903	716.0	0.95	1,743
1993	194,799.8	922.6	1.34	2,610	837.7	1.18	2,299	759.8	1.03	2,006
(1995)	202,748.1	997.9	1.50	3,041	888.7	1.28	2,595	790.5	1.09	2,210
(1998)	214,524.3	1,122.5	1.76	3,776	971.1	1.44	3,089	838.9	1.18	2,531
2000	222,752.6	1,214.1	1.96	4,366	1,030.2	1.56	3,475	872.8	1.25	2,784
(2003)	235,690.7	1,365.7	2.30	5,421	1,125.7	1.77	4,172	926.2	1.35	3,182
2005	244,730.9	1,477.1	2.57	6,290	1,194.3	1.92	4,699	963.6	1.43	3,500

Note: Y = 0.000115 x 1,372 (r = 0.952): Y = Demand Density (per 100 population) Total demand = Demand Density x Population 100
X = GDP per capita (1981)

(2) Demand Forecast by Areas

Results of demand forecast by areas are in Table 3-1-12.

Table 3-1-12 Demand Forecast by Areas

Year	National Demand (D: x 10^3)	Witel I		Witel VI		Jakarta	
		Demand Distri-bution	Demand	Demand Distri-bution	Demand	Demand Distri-bution	Demand
1985	1,404	8.36	117.4	10.02	140.7	35.43	497.4
1988	1,689	8.38	141.5	9.79	165.4	35.96	607.4
1990	1,903	8.40	159.9	9.63	183.7	36.19	688.7
1993	2,299	8.51	195.6	9.42	216.6	36.34	835.5
1995	2,595	8.58	222.7	9.29	241.1	36.27	941.2
1998	3,089	8.67	267.8	9.10	281.1	36.12	1,115.7
2000	3,475	8.72	303.0	8.99	312.4	35.81	1,244.4
2003	4,172	8.77	365.9	8.78	366.3	35.20	1.468.5
2005	4,699	8.81	414.0	8.65	406.5	34.74	1,632.4

Note: Demand distribution (y:%)
Demand (d = y x D : x 10^3)

Demand distribution trends reverse between Witel I and Witel VI during period from 2003 to 2005. As the result, forecasted demand for Witel VI as of 2005 exceeds that for Witel I. This is mainly due to difference between the two areas in the degree of future population distribution rate upswing.

(3) Demand Forecast for Objective Cities of Study

Demand forecast for three objective cities of study, i.e., Medan, Semarang and Solo, is calculated primarily by demand forecast model described in Paragraph 3-1-6 (3). Another calculation is made by estimated demand density of the three cities for each forecast year, and calculation result is compared for verification with the former, i.e., calculation result by forecast model.

1) Calculation by Forecast Model

Calculation results by forecast model for objective cities are in Table 3-1-13.

Table 3-1-13 Demand Forecast for Objective Cities of Study (by demand distribution rate)

Year	Witel I Demand (D: x 10^3)	Medan	
		Demand Distribution (y:%)	Demand (d = y x D)
1985	117.4	55.8	65,500
1988	141.5	56.3	79,700
1990	159.9	56.7	90,700
1993	195.6	57.0	111,500
1995	222.7	57.2	127,400
1998	267.8	57.8	154,800
2000	303.0	58.1	176,000
2003	365.9	58.7	214,800
2005	414.0	59.2	245,100
(1981)	34.1	54.5	18,582*

Year	Witel VI Demand (D: x 10^3)	Semarang		Solo	
		Demand Distribution (y_1:%)	Demand ($d = y_1 \times D$)	Demand Distribution (y_2:%)	Demand ($d = y_2 \times D$)
1985	140.7	35.9	50,500	12.0	16,900
1988	165.4	36.2	59,900	12.0	19,800
1990	183.3	36.5	66,900	12.0	22,000
1993	216.6	36.8	79,700	12.0	26,000
1995	241.1	37.1	89,100	12.0	28,900
1998	281.1	37.4	105,100	12.0	33,700
2000	312.4	37.7	117,800	12.0	37,500
2003	366.3	38.1	139,600	12.0	44,000
2005	406.5	38.4	156,100	12.0	48,800
(1981)	40.7	35.0	14,247*	11.94	4,854

Note: Figure with * is from 1981 statistical data.

2) Calculation by Demand Density

Calculation by demand density is to make sure of calculation results by forecast model as per the preceding sub-paragraph 1. When based on 1981 statistical data and forecast result as per this paragraph 3-1-7, main telephone density ratio between the whole of Indonesia and Jakarta is correlated as under for each forecast year.

Year	All Indonesia (a)	Jakarta (b)	(b)/(a)
(1981)	0.27	2.09	7.74
1985	0.85	6.60	7.76
1990	1.04	8.09	7.78
1995	1.28	9.98	7.79
2000	1.56	12.17	7.80
2005	1.92	15.29	7.96

In the table above, no significant variation is found in main telephone density ratio, (b)/(a), between whole Indonesia(a) and Jakarta(b) during the period from 1981 to 2005. From this fact, assumption is made that the said ratio in other main cities will also present the same trend as in the above table, and, on this assumption, main telephone density for each forecast year is estimated. Then, from this main telephone density estimate, demand forecast values are calculated. Calculation results are in Table 3-1-14. For Medan and Semarang, main station density is assumed to be equal to mean value for nine cities as of 1981 as per Table 3-1-4. For Solo, main telephone density is assumed to be 80% of mean value for nine cities as of 1981.

Table 3-1-14 Demand Forecast for Objective Cities of Study (by demand density)

Year	Medan		
	Population (N: x 10^3)	Telephone Density (y:%)	Demand (d = N x y)
1985	1.596	3.89	62,100
1988	1.744	4.38	76,400
1990	1.850	4.76	88,100
1993	2.022	5.38	108,800
1995	2.145	5.86	125,700
1998	2.344	6.57	154,000
2000	2.487	7.15	177,800
2003	2.718	8.07	219,300
2005	2.883	8.80	253,700
(1981)		1.30*	

Year	Semarang			Solo		
	Population (N: x 10^3)	Demand Density (y:%)	Demand (d=Nxy)	Population (N: x 10^3)	Demand Density (y:%)	Demand (d=Nxy)
1985	1.123	3.89	43,700	502	3.11	15,600
1988	1.206	4.38	52,800	533	3.50	18,700
1990	1.264	4.76	60,200	555	3.81	21,100
1993	1.358	5.38	73,000	580	4.30	24,900
1995	1.424	5.86	83,400	598	4.69	28,000
1998	1.529	6.57	100,500	625	5.26	32,900
2000	1.603	7.15	114,600	644	5.72	36,800
2003	1.721	8.07	138,900	673	6.46	43,500
2005	1.805	8.80	158,800	693	7.04	48,800
(1981)		1.36*			0.99*	

Note: Figure with * is from 1981 statistical data.

3-2 Microscopic Demand Forecast

3-2-1 Basic Data Collection

Prior to field survey, basic data collection was made. Among data collected are city maps of three objective cities, statistics of all kinds, and city planning compendia including housing plan and road plan. Sources of these data are Kabupaten offices, city offices and regional offices of central government. Data concerning the existing number of subscribers and subscriber backlog, as well as their distribution maps, are from PERUMTEL.

Table 3-2-1 presents the number of subscribers and subscriber backlog records classified by existing exchanges in each objective city as of the end of 1984.

3-2-2 Area Segmentation

For demand survey by collected data, each objective city is divided into two area segments. They are

1) Residential area
2) Business area

Business area is further divided as under according to the types of business offices that exist in the area.

1) Office area
2) Commercial area
3) Industrial area
4) Other area

3-2-3 Schematic Survey

(1) Subdivision of Area Segmentation

Prior to in-depth demand survey, schematic survey was made and, as a result, the aforementioned area segments were further subdivided so as to facilitate demand survey. Subdivision parameters for each area segment are as under.

1) Residential Area

Size of residence and number of residences per unit area (1 hectare)

2) Office Area

Total office floor space per unit area (1 hectare) and number of employees

3) Commercial Area

Operating scale of merchant house (total floor space per shop) and number of merchant houses per unit area (1 hectare)

4) Industrial Area

Operating scale of factory (total floor space per factory) and number of factories per unit area (1 hectare)

5) Other Area

Type of facility and its operating scale (total floor space per facility) and number of employees per facility

(2) Demand Density

For subdivision of each area segment, survey was made for the number of main telephones and the degree of subscriber backlog per unit area (1 hectare).

(3) Schematic Survey Result

Schematic survey was made by sampling for each area segment. Survey result concerning subdivision of area segment is in Table 3-2-2. Basic data used in subdivision of area segment and demand density in subdivision of each area segment are in Table 3-2-3 through Table 3-2-10.

The example of subdivision of area segment is shown in Figure 3-2-1 and Figure 3-2-2.

3-2-4 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.

1) Present Area Classification Map (as of 1985)

The present area classification map is the diagrammatic presentation of in-depth survey result by itself.

2) Future Area Classification Map
(as of 1995 and 2005)

This area classification is based on city plannings of each objective city. For details, refer to Figure 3-2-3 to Figure 3-2-5.

(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 in each area segment defined in Section 3-2-3. Therefore, when demand numerals given by area segments are totalized, total demands in each objective city can be obtained.

3-2-5 Calculation of Microscopic Demand Forecast

(1) Calculation 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 values obtained in Section 3-1. 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

Demand forecast values by area segments are in Table 3-2-11 to Table 3-2-13.

(2) Demand Forecast Values by Exchanges Calculation

Calculation of demand forecast values by exchanges consists of totalization of demand numerals by exchange areas clarified in Section 4-2 Exchange Site Selection. Calculation results are in Table 3-2-14 to Table 3-2-16.

3-2-6 Forecast Procedures

Microscopic demand forecast procedures are in Figure 3-2-6.

Table 3-2-1 (1/2) Working Line and Waiting Applicant in Medan

Ref. No.	Exchange Name	Working Line	Waiting Applicant	Total
1	Centrum	18,589	9,045	27,634
2	Suka Ramai	3,378	3,184	6,562
3	Pulau Brayan	1,988	1,913	3,901
4	Padang Bulan	1,212	366	1,578
5	Cinta Damai	260	1,301	1,561
6	Simpang Limun	305	842	1,147
7	Tanjung Mulia	90	123	213
8	Belawan	789	251	1,040
9	Tuntungan	3	50	53
10	Labuhan	10	60	70
Total		26,624	17,135	43,759

Table 3-2-1 (2/2) Working Line and Waiting Applicant in Semarang and Solo

Semarang

Ref. No.	Exchange Name	Working Line	Waiting Applicant	Total
1	Semarang I	8,678	2,980	11,658
2	Semarang II	5,787	1,520	7,307
3	Tugu	370	3,000	3,370
4	Majapahit	193	1,030	1,223
5	Banyumanik	196	1,790	1,986
6	Genuk	80	560	640
7	Mijen	6	50	56
8	Gunung Pati	4	50	54
9	Mang Kang	10	140	150
Total		15,324	11,120	26,444

Note: The subscriber to be in Gunung Pati Exchange is feeded from Ungarang Exchange.

Solo

Ref. No.	Exchange Name	Working Line	Waiting Applicant	Total
1	Solo I	3,827	1,683	5,510
2	Solo II	1,301	1,031	2,332
Total		5,128	2,714	7,842

Table 3-2-2 Subdivision of Area Segmentation

Area Classification	Area Pattern	Applied Area
Residential Area	R - 1	High Class Residential Area
	R - 2	Medium Class Residential Area
	R - 3	Low Class Residential Area
	R - 4	Residential Area in Agricultural Area
Office Area	O - 1	Medium Telephone Demand Area
	O - 2	Low Telephone Demand Area
Commercial Area	C - 1	High Telephone Demand Area such as Shopping Centers
	C - 2	Medium Telephone Demand Area
	C - 3	Low Telephone Demand Area
Industrial Area	I - 1	Industrial Area of Large Scale Factories
	I - 2	Industrial Area of Small Factories and Workshops
Other Areas		Hotels Schools & Universities Hospitals Army and Police Airport Sports and Recreation Facilities Warehouse
Non-demand Area		Ponds, Cemeteries, Rivers, Farm, Forest, Parks, Wide Roads, etc.

Table 3-2-3 Size and Density of House

Area Pattern	Size of Residential Estate (m^2)	Density of House (House/ha)
R - 1	600 - 1200	5 - 10
R - 2	200 - 600	10 - 30
R - 3	100 - 200	30 - 60
R - 4	600 - 1200	5 - 10

Table 3-2-4 Demand Density in Residential Area

Area Pattern	Demand per Hectare (No. of Telephone/ha)		
	1985	1995	2005
R - 1	7 - 10	9 - 11	10 - 12
R - 2	2.5 - 7	5 - 9	6 - 10
R - 3	1.5 - 2.5	3 - 5	4 - 6
R - 4	0.2 - 0.4	0.3 - 0.8	0.8 - 1.5