3. Recommendation

3-1 Planning and Design

Following are the essentials for the telephone network planning and design:

(1) Demand Management

The telephone network planning, regardless of a long term or short term planning, to be in accordance with the actual telephone demand requires that the demand be accurately estimated. Such demand management is indispensable in the following areas:

1) The whole area of Jakarta City
2) The service area of each exchange
3) The cabinet area

(2) Traffic Management

The monthly and yearly variations of the amount of traffic must be carefully studied. Especially important is the traffic management in the following categories:

1) Periodical measurement and analysis of the amount of traffic by routes
2) Periodical measurement and analysis of the amount of traffic by destinations

(3) Plant Record Management

The plant record management is extremely importnat for the maintenance of facilities and their additional installation. Therefore, in the plant record formulation and management, the following items must be taken into full consideration:

1) To adopt the uniform plant record symbols and format.
2) To create personnel who specialize in plant record management, whereby to establish an independent ad hoc system.
3) To expedite necessary revision of the existing plant record after the completion of work concerned.
4) To introduce the numerical data filing of the exchange facilities by use of computer.

(4) Review of Long Term Plan

At the time the next five-year plan is formulated, a demand forecast and traffic forecast must be newly carried out. On the basis of such forecasts, the long term plan formulated this time must be reviewed and revised where necessary.

3-2 Technical Innovations Required

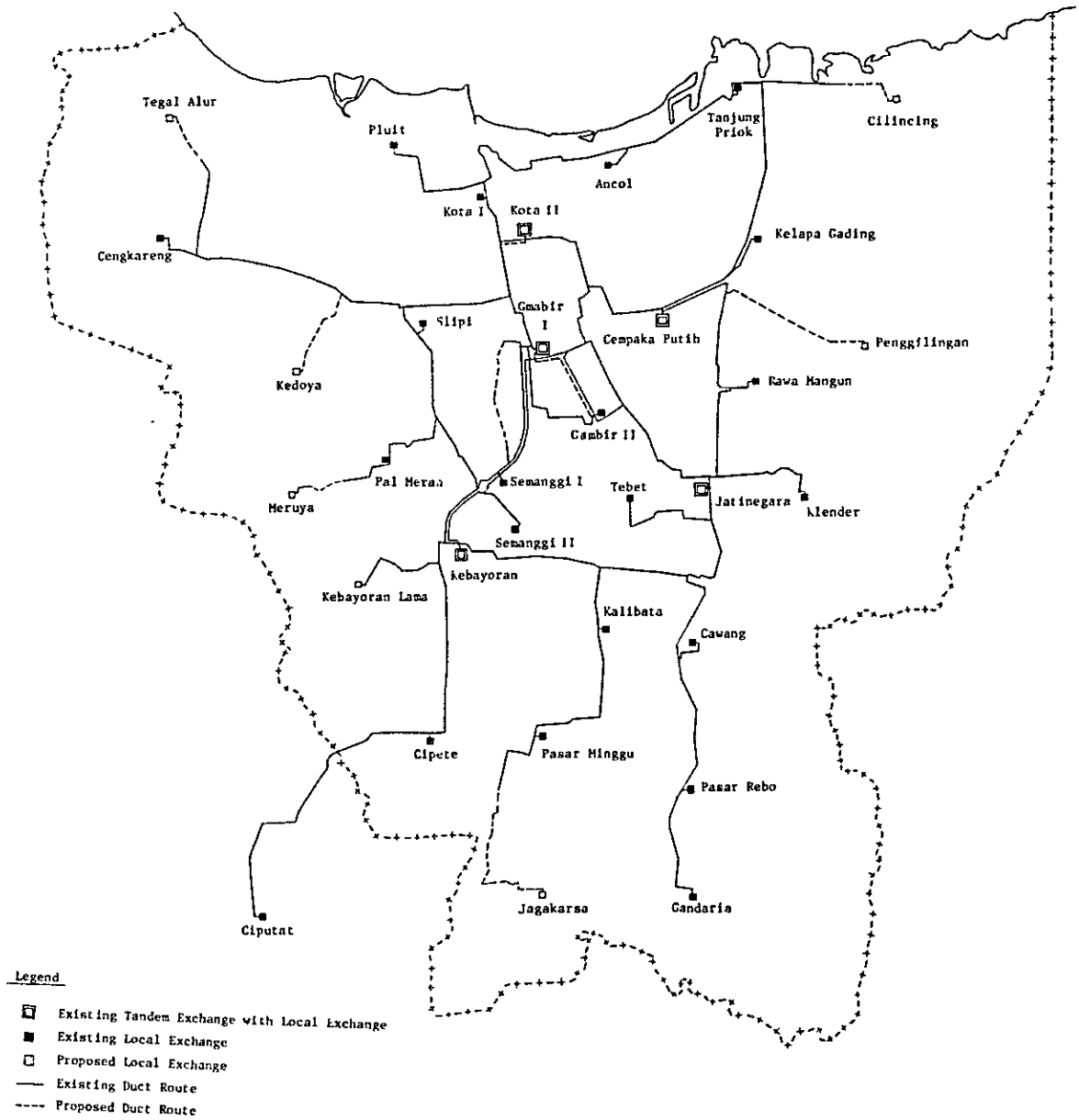
1) In the Jakarta Telephone Network where the amount of traffic is large, the switching system with a large call handling capacity of processor is required.

2) The PCM system, which is positively introduced in the telephone network expansion plan this time, will become more and more advantageous economically as the local junction transmission system. For the purpose of effective utilization of cable pairs, the PCM cable to be newly introduced should preferably be the screened core cable. Futhermore, the introduction of optical fiber system as new transmission media to replace the conventional cable system is also worth consideration. The advisability of adopting the optical fiber system in the future plans will have to be studied in due consideration of field trial record, economic merit and reliability of this new system.

3) For the primary cable and junction cable, the use of jelly filled cable is desirable from the viewpoints of system maintenance and reliability. Also, for the purpose of effective utilization of underground ducts, the adoption of large-pair cable is preferred.

4) The type of materials used in the existing outside plant facilities varies from exchange to exchange. The adoption of uniform type for such materials will be necessary for the convenience of design, construction and maintenance.

5) Idle outside plant facilities should be withdrawn. They are poles, cross-connecting cabinets, terminal boxes, etc.



Jakarta Telephone Network

PART I TELEPHONE DEMAND FORECAST

PART I TELEPHONE DEMAND FORECAST

The purpose of the survey is to review and assess the long term planning prepared by JICA mission in March 1976. The telephone demands for years 1979, 1983 and 1993 have been estimated.
The objective area of the survey is the whole Jakarta City excluding the islands. In the execution of telephone demand forecast, both the Macroscopic and Microscopic Approaches are used.

1. Macroscopic Approach

The telephone demand is closely related to the economic and social environments of the country. Therefore, in the execution of telephone demand forecast, the basic facts and assumptions, the economic and demographic backgrounds and the growth factors have been studied.
In general, unforeseen social and economic changes may take place over a long period. It is important, therefore, to review the forecast regularly and make necessary modification whenever information is received which will significantly affect the forecast.

1-1 Establishment of Basic Factors

Various basic facts can be obtained from the Statistical Year Book of Indonesia and United Nations. Based on these basic facts, and after careful examination thereof, the necessary values for telephone demand forecast are estimated.

1-1-1 Population of Indonesia

Based on the 1976 Intercensal Population Survey, the estimated population of Indonesia covering a 25 years period was calculated by the Government.
The estimated population is used in this telephone demand forecast.
The population of Indonesia would reach 183 million in 1993. The past and projected populations of Indonesia are shown in Table I-1.
The population breakdown of the selected countries in the past is shown in Table I-2, for the purpose of reference.

Table I - 1 Population of Indonesia

Year	Population (x1000)
1971	120,148.0
1972	122,301.5 *
1973	124,492.6 *
1974	126,723.0 *
1975	128,993.3 *
1976	131,304.3
1977	133,940.2
1978	136,630.7
1979	139,376.3
1980	142,178.8
1981	145,038.8
1982	147,939.7
1983	150,900.8
1984	153,923.7
1985	157,009.5
1986	160,159.4
1991	176,400.9
1993	182,952.9 *
1996	193,240.1
2001	210,233.7

Source: Statistical Year Book of Indonesia 1977

* Estimated by JTP '79

Table I-2 Population, Area, Density and Rate of Population Growth of Selected Countries

Country	1976 Population (x1000)	Area (Sq. Km)	Density	Rate of Increase	
				1963 - 1969	1970 - 1976
England & Wales	49,184	151,126	326	0.6	0.2
Japan	112,768	372,313	303	1.1	1.3
West Germany	61,513	248,577	247	1.0	0.2
Sri Lanka	13,730	65,610	209	2.4	1.6
India	610,077	3,268,590	186	2.5	2.1
Philippines	43,751	300,000	146	3.5	2.9
France	52,915	547,026	97	0.9	0.7
Thailand	42,960	514,000	84	3.1	2.8
Indonesia	139,616	1,904,345	69	2.5	2.6
Burma	30,843	676,552	46	2.2	2.2
Afghanistan	19,803	647,497	31	2.1	2.5
U.S.A.	215,118	9,363,123	23	1.2	0.8
Sweden	8,222	449,964	18	0.8	0.4
Australia	13,916	7,686,848	2	2.0	1.8

Source: Statistics Year Book of Jakarta 1977

1-1-2 Population of Jakarta City

According to the Second Five-Year Development Plan, the net rate of population increase in Jakarta City is 4% annually, i.e., 2% by natural increase and 2% as a result of social increase. However, various plans and policies of Indonesia, such as the balancing of regional development plans, program of migration, restriction of population inflow into Jakarta City, and family planning, would reduce the population growth rate. Here is a comparison between Jakarta City and other big cities of the world in the population density. If the population density of Jakarta City is assumed to be practically the same as that of present-day Paris, the ultimate maximum population of Jakarta City should be 13,000,000. Based on the population data of Jakarta City, the estimated population of Jakarta City has been calculated by Logistic Curve.

Logistic Curve: $$Y = \frac{K}{1 + m\,e^{-at}}$$

where

Y = Population

K = 13,000,000

t = 1 as of 1961

$$Y = \frac{13{,}000{,}000}{1 + 3.5818\,e^{-0.0547t}} \qquad (r = 0.98)$$

As the result, the total population of Jakarta City would reach 8,181,000 by 1993. The past and estimated future populations of Jakarta City are shown in Table I-3 and Figure I-1. The population breakdown of the selected major cities is shown in Table I-4.

Table I-3 Population of Jakarta City

Year	Population (x1000)	Estimated Population	
		Logistic Curve (x1000)	4% Growth (x1000)
1961	2,906		
1962	3,022		
1963	3,154		
1964	3,302		
1965	3,463		
1966	3,639		
1967	3,807		
1968	3,982		
1969	4,272		
1970	4,437		
1971	4,576		
1975	4,810 *		
1976	5,047 *		
1977		5,387	5,249
1978		5,560	5,459
1979		5,735	5,677
1980		5,911	5,904
1981		6,087	6,140
1982		6,265	6,386
1983		6,442	6,642
1984		6,620	6,907
1985		6,798	7,183
1986		6,975	7,471
1987		7,151	7,770
1988		7,327	8,080
1989		7,501	8,404
1990		7,674	8,740
1991		7,845	8,089
1992		8,014	9,453
1993		8,181	9,831
1994		8,346	10,224
1995		8,508	10,633
1996		8,667	11,059

Source: Statistics Year Book of Jakarta 1977

* Statistical Year Book of Indonesia 1977

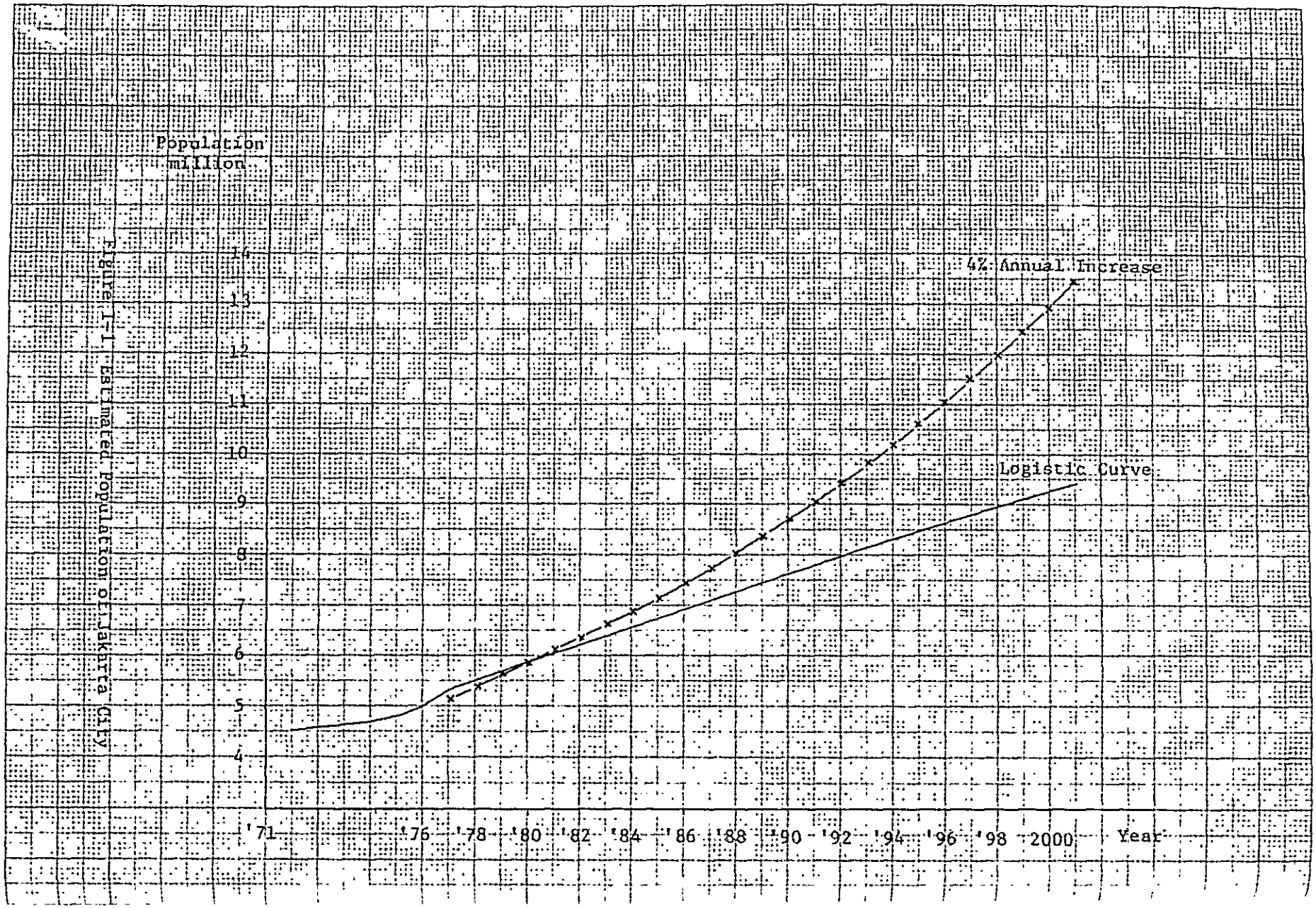


Figure 1.1 Estimated population of Jakarta City

Table I-4 Population, Area and Density of Selected Major World Cities

Year	City	Area (SQ.KM)	Population	Density
1976	Manila	38.3	1,457,849	38,064
1971	Calcutta	104.3	3,148,746	30,276
1971	Saigon	62.6	1,820,553	29,082
1976	Paris	105.4	2,226,000	21,120
1977	Tokyo	581.0	8,543,775	14,703
1973	Tehran	364.0	4,154,998	11,415
1974	Seoul	627.1	6,541,500	10,432
1976	New York	829.5	7,646,818	9,219
1975	Jakarta	587.6	5,403,957	9,196
1976	Moscow	886.5	7,734,000	8,600
1977	Mexico	2,017.0	13,906,016	6,894
1977	Yokohama	421.5	2,694,569	6,393
1976	Chicago	590.8	3,110,600	5,265
1976	London	1,601.0	7,027,600	4,390
1976	Vienna	414.5	1,593,000	3,843
1976	Singapore	596.8	2,278,200	3,784
1976	New Delhi	1,485.0	5,081,951	3,380
1976	Bangkok	1,556.0	4,545,608	2,921
1975	Baghdad	863.0	2,350,000	2,723
1976	Hamburg	747.7	1,698,615	2,272

Source: Statistics Year Book of Jakarta 1978

1-1-3 Economic Index

Economic factors, particularly GDP (Gross Domestic Product) and NI (National Income), are indispensable to the telephone demand forecast. The target of economic growth anticipated in the Third Five-Year Development Plan is 6.5% a year on the average. This means that the rate of economic growth per capita averages 4.5% a year when the rate of population growth is 2%. According to the above growth rate and based on the data from Statistical Year Book of Indonesia 1977, GDP and NI per capita in 1979, 1983 and 1993 have been estimated. GDP and NI per capita as of 1993 will be 312.5 and 262.9 U.S. dollars, respectively. GDP and NI per capita in the past and the estimates in the future by various growth rates are shown in Table I-5 and Table I-6.

1-1-4 Past Data for Number of Telephone Stations

The number of telephone stations and the number of main telephone stations in the past are shown in Table I-7, as derived from Traffic in Figures 1977 - 1978.

The number of telephone stations in Indonesia and Jakarta City is shown in Table I-8.

1-2 Telephone Demand Forecast for Indonesia

The telephone demand forecast for Indonesia has been carried out by the following methods:

The results of forecast are shown in Table I-11 and Figure I-6.

1-2-1 Methods of Telephone Demand Forecast

(1) Correlation to GDP per capita, based on the historical data of Indonesia (Table I-5 and Table I-7).

$$\log Y = \log A + B \log X$$

where

Y = Telephone demand density

X = GDP per capita (US$)

The result is:

$\log Y = -3.036 + 1.119 \log X$

or

$Y = 0.000921\ X^{1.119}$ $(r = 0.99)$

(2) Correlation to NI per capita, based on the historical data of Indonesia (Table I-6 and Table I-7).

$\log Y = \log A + B \log X$

where

Y = Telephone demand density

X = NI per capita (US$)

The result is:

$\log Y = -3.239 + 1.2573 \log X$

or

$Y = 0.000576\ X^{1.2573}$ $(r = 0.98)$

(3) Extrapolation Model based on the Time Series Analysis (Table I-7)

$Y = a \cdot b^t$

$\log Y = \log a + t \log b$

where

Y = Telephone demand density

t = 1 as of 1971

The result is:

$Y = 0.174 \times 1.0625^t$

or

$\log Y = -0.7587 + 0.026\ t$ $(r = 0.98)$

(4) Correlation to GDP per capita, based on Correlation Model by 92 countries (Table I-9 and Figure I-2)

$\log Y = \log A + B \log X$

where

Y = Telephone demand density

X = GDP per capita (US$)

The result is:

$\log Y = -3.5074 + 1.3968 \log X$

or

$Y = 0.000311\ X^{1.3968}$ $(r = 0.96)$

(5) Correlation to NI per capita, based on Correlation Model by 81 countries (Table I-9)

$\log Y = \log A + B \log X$

where

Y = Telephone demand density

X = NI per capita (US$)

The result is:

$\log Y = -3.386 + 1.350 \log X$

or

$Y = 0.00041\ X^{1.35}$ $(r = 0.93)$

(6) Correlation among Telephone Installation Fee, GDP per Capita and Telephone Density by 37 countries (Table I-10)

By using a Multiple Regression Analysis a close correlation among the above three factors can be obtained as shown in the following formula:

$Y = A + B\ P + C\ X$

where

Y = Telephone demand density

P = Installation fee

X = GDP per capita in 1975 at 1973 constant (US$)

The result is:

$Y = -1.5739 - 0.0033\ P + 0.0092\ X \quad (r = 0.94)$

However, in the case of Jakarta City, the telephone installation fee of US $862 which is on the very high side and GDP per capita of US $136 which belongs to the lowest in the world are too far apart to produce a valid result from the application of the above formula. Figure I-3 representation of this correlation formula could not possibly show the position of Indonesia (Jakarta City) because such a position is out of the range of the regular correlation curves. Installation fees in a number of countries are shown in Table I-10, Figure I-4 and Figure I-5.
After the study of telephone demand forecast, the telephone installation fee in Jakarta City has been reduced from Rp. 500,000 to Rp. 350,000 since May 1, 1980. However, it still remains to be the highest in the world.

1-2-2 Estimated Telephone Demand in Indonesia

The estimation of telephone demand in Indonesia, based on the correlation between telephone demand density and GDP per capita in 92 countries, is the most recommendable estimation for the following reason:

Telephone demand estimated by GDP and that by NI leave a difference of one to two years. The higher level of estimated figure will give advantages to telephone facilities planning and construction.
Estimation by the historical trend method is not reliable, because the accurate number of applicants on the waiting lists in the past could not be obtained.

Applied telephone demands in Indonesia in 1979, 1983 and 1993 are represented by 557,500, 770,000 and 1,738,000 telephone stations, respectively. Estimated telephone demands in Indonesia in the said three years, with the economic growth rate changes taken into consideration, are shown in Table I-12.

Table I-5 Gross Domestic Product and Gross Domestic Product per Capita of Indonesia

Item	Year	1971	1972	1973	1974	1975	1976	1977	1979	1983	1993
GDP	At Current Market Price (Billion Rp.)	3,672.0	4,564.0	6,753.4	10,708.0	12,642.5	15,446.7	19,046.7			
	At Constant 1973 Market Price (B.Rp.)	5,544.7	6,067.2	6,753.4	7,269.0	7,630.8	8,156.3	8,770.1			
	Index Number	82.1	89.8	100	107.6	113.0	120.8	129.9			
GDP per Capita	At Current Market Price (Rp.)	30,909	37,533	54,201	83,918	96,803	115,682	138,230			
	At Constant 1973 Market Price (Rp.)	46,673	49,895	54,201	56,967	58,429	61,004	64,109			
	At Constant 1973 Market Price (US$)	112.5	120.2	130.6	137.3	140.8	147.0	154.5			
	Index Number	86.1	92.1	100	105.1	107.8	112.6	118.3			
	Growth Rate 6% (US$)								173.6	219.2	392.5
	Growth Rate 4.5% (US$)								168.7	201.2	312.5
	Growth Rate 3% (US$)								163.9	184.5	247.9

1 US $ = Rp. 415

Source: Statistical Year Book of Indonesia 1977
Main Tables of The National Income of Indonesia 1971 - 1977

Table I-6 National Income and National Income per Capita of Indonesia

Item	Year	1971	1972	1973	1974	1975	1976	1977	1979	1983	1993
NI	At Current Factor Cost (Billion Rp.)	3,137.6	3,871.9	5,740.7	9,057.9	10,745.8	13,721.6	16,386.7			
	At Constant 1973 Factor Cost (B.Rp.)	4,832.8	5,207.5	5,740.7	6,075.8	6,403.9	6,859.9	7,379.9			
	Index Number	84.2	90.7	100	105.8	111.6	119.5	128.6			
NI per Capita	At Current Factor Cost (Rp.)	26,411	31,841	46,073	70,987	82,280	102,630	119,786			
	At Constant 1973 Factor Cost (Rp.)	40,680	42,825	46,073	47,616	49,035	51,308	53,945			
	At Constant 1973 Factor Cost (US$)	98.0	103.2	111.0	114.7	118.2	123.6	130.0			
	Index Number	88.3	93.0	100	103.4	106.4	111.4	117.1			
	Growth Rate 6% (US$)								146.1	184.4	330.2
	Growth Rate 4.5% (US$)								142.0	169.3	262.9
	Growth Rate 3% (US$)								137.9	155.2	208.6

1 US $ = Rp. 415

Source: Statistical Year Book of Indonesia 1977
Main Tables of The National Income of Indonesia 1971 - 1977

Table I-7 Number of Telephone Stations and Number of Main Telephone Stations in Indonesia

Item \ Year	1971	1972	1973	1974	1975	1976	1977	1978
Number of Telephone Stations in Indonesia	221,779	240,828	266,437	288,974	305,188	318,919	349,098	392,563
Number of Main Telephone Stations in Indonesia	152,146	168,205	183,365	197,571	207,478	219,428	241,019	275,125
Percentage of Main Telephone Stations (%)	68.6	69.8	68.8	68.4	68.0	68.8	69.0	70.1
Telephone Density (Number of Telephone Stations per 100 Inhabitants)	0.18	0.20	0.21	0.23	0.24	0.24	0.26	0.29

Source: Traffic in Figures 1977 - 1978

Table I-8 Number of Telephone Stations in Indonesia and Jakarta City

Item \ Year	1971	1972	1973	1974	1975	1976	1977
Number of Telephone Stations in Indonesia	*229,636	240,828	262,991	284,831	305,455	314,445	347,030
Number of Telephone Stations in Jakarta City	*51,965	59,055	73,985	80,239	88,624	86,454	102,773
Distribution Rate for Jakarta City (%)	22.6	24.5	28.1	28.2	29.0	27.5	29.6

Source: Statistical Year Book of Indonesia 1977

* World Telephone

Table I-9 G.D.P. per Capita, N.I. per Capita and Telephone Density in 1973 (1/4)

( ): National Income

Country	G.D.P. (NI) in 1973 Million (*Billion)	National Currency Exchange Rate per US $		Population in 1973 Million	G.D.P. (NI) per Capita	Telephone Density
Algeria	*29.7	4.185	Dinar	15.77	450	1.4
Australia	*50.7 (*46.7)	0.672	Dollar	13.13	5,746 (5,293)	35.5
Austria	*533.3 (*476.7)	19.85	Schilling	7.53	3,568 (3,189)	24.6
Bangladesh	*69.1	8.165	Taka	73.21	116	0.1
Barbados	425.9	2.07	Dollar	0.24	857	15.6
Belgium	*1,774.0 (*1,630.0)	41.32	Franc	9.74	4,408 (4,050)	25.7
Benin	*73.6	235.4	Franc	2.95	106	0.3
Bolivia	21,459.0 (18,492.0)	20.0	Peso	5.33	201 (173)	0.9
Botswana	192.1 (185.5)	0.6712	Pula	0.65	440 (425)	0.9
Brazil	*477.2 (*449.1)	6.22	Crueiro	100.56	763 (718)	2.3
Burma	11,735.0	4.862	Kyat	29.04	83	0.1
Canada	*124.5 (*109.4)	0.9958	Dollar	22.13	5,650 (4,964)	52.8
Colombia	*243.2 (*221.2)	24.89	Peso	22.27	439 (399)	4.6
Costa Rica	10,162.0 (9,310.0)	6.65	Colon	1.87	817 (749)	4.6
Cyprus	335.7 (331.3)	0.361	Pound	0.62	1,500 (1,480)	9.7
Denmark	*164.9 (*150.1)	6.29	Krone	5.02	5,222 (4,754)	40.0
Dominican Republic	2,345.0 (2,127.0)	1.00	Peso	4.43	529 (480)	1.9
Ecuador	*64.6 (*57.2)	25.0	Sucre	6.73	384 (340)	1.9
Egypt	3,663.0 (3,634.0)	0.3913	Pound	35.62	263 (261)	1.3
El Salvador	3,332.0 (3,146.0)	2.5	Colon	3.77	354 (334)	1.2
Ethiopia	5,005.0	2.09	Birr	26.55	90	0.2
Fiji	338.3 (318.7)	0.8092	Dollar	0.55	760 (716)	4.1
Finland	*66.7 (*59.7)	3.85	Markka	4.67	3,710 (3,320)	32.9
France	1,114.2 (*1,004.8)	4.708	Franc	52.18	4,535 (4,090)	21.7
Gabon	*161.1 (*123.8)	235.4	Franc	0.52	1,316 (1,011)	1.2
Germany	*918.6 (*824.4)	2.703	D.Mark	61.97	5,484 (4,922)	28.7
Ghana	3,501.0 (3,255.0)	1.15	Cedi	9.36	325 (302)	0.6

Table I-9 G.D.P. per Capita, N.I. per Capita and Telephone Density in 1973 (2/4)

( ): National Income

Country	G.D.P. (NI) in 1973 Million (*Billion)	National Currency Exchange Rate per US $		Population in 1973 Million	G.D.P. (NI) per Capita	Telephone Density
Greece	*484.0 (*467.0)	29.7	Drachma	8.93	1,825 (1,761)	18.7
Guatemala	2,569.0 (2,226.0)	1.00	Quetzal	5.74	448 (388)	1.0
Guyana	643.4 (581.8)	2.24	Dollar	0.76	378 (342)	2.3
Haiti	3,129.0 (3,061.0)	5.00	Gourde	4.44	141 (138)	0.2
Honduras	1,814.0 (1,675.0)	2.0	Lempira	2.78	326 (301)	0.5
Iceland	*95.4 (*82.9)	83.81	Krone	0.21	5,420 (4,710)	38.1
India	*576.8 (*545.6)	8.13	Rupee	574.42	124 (117)	0.3
Indonesia	*6,753.0 (*6,069.0)	415.0	Rupiah	129.15	126 (113)	0.2
Iran	*1,861.0	67.63	Rial	31.3	879	1.7
Iraq	1,626.0 (1,451.0)	0.2961	Dinar	10.41	528 (471)	1.2
Ireland	2,689.0 (2,500.0)	0.4305	Pound	3.05	2,048 (1,904)	12.0
Israel	41,875.0 (36,670.0)	4.2	Pound	3.21	3,106 (2,720)	20.8
Italy	*82,143.0 (*75,004.0)	607.92	Lira	54.91	2,461 (2,247)	22.9
Ivory Coast	*556.2 (*528.6)	235.4	Franc	4.65	508 (483)	0.6
Jamaica	1,752.0 (1,546)	0.9091	Dollar	1.98	973 (859)	4.3
Japan	*111,061.0 (*97,069.0)	280.0	Yen	108.70	3,649 (3,189)	35.7
Jordan	268.5 (281.6)	0.3289	Dinar	2.54	321 (337)	1.6
Kenya	829.0 (785.0)	0.345	Pound	12.48	193 (182)	0.9
Korean Republic	*4,939.0 (*4,492.0)	398.0	Won	34.10	364 (331)	2.5
Kuwait	2,111.0 (1,626.0)	0.2967	Dinar	0.89	7,994 (6,158)	10.7
Lesotho	84.1 (112.9)	0.6712	Rand	0.99	127 (170)	0.3
Liberia	544.9 (419.2)	1.0	Dollar	1.63	334 (257)	0.2
Libyan Arab Jamahiriya	2,246.0 (1,816.0)	0.2961	Dinar	2.25	3,371 (2,726)	2.8
Luxembourg	*72.7 (*62.3)	41.32	Franc	0.35	5,027 (4,308)	38.2

Table I-9 G.D.P. per Capita, N.I. per Capita and Telephone Density in 1973 (3/4)

( ): National Income

Country	G.D.P. (NI) in 1973 Million (*Billion)	National Currency Exchange Rate per US $		Population in 1973 Million	G.D.P. (NI) per Capita	Telephone Density
Madagascar	*297.6 (*283.0)	235.4	Franc	7.57	167 (159)	0.4
Malawi	400 (371.0)	0.8475	Kwacha	4.79	99 (91)	0.4
Malaysia	14,401.0 (16,634.0)	2.45	Ringitt	11.31	520 (600)	2.1
Malta	115.7 (119.2)	0.3867	Pound	0.32	935 (963)	14.4
Mauritius	1,852.0 (1,868.0)	5.739	Rupee	0.86	375 (378)	2.7
Mexico	*619.6 (*566.6)	12.5	Peso	56.16	883 (807)	4.2
Morocco	*21.3 (*19.4)	4.29	Dirham	16.31	304 (277)	1.3
Nepal	9,969.0	10.56	Rupee	12.07	78	0.1
Netherlands	*168.1 (*154.7)	2.824	Ghilder	13.44	4,429 (4,076)	32.0
New Zealand	8,767.0 (8,046.0)	0.7001	Dollar	2.95	4,245 (3,896)	47.5
Nicaragua	7,655.0 (7,004.0)	7.026	Cordoba	2.01	542 (496)	0.8
Nigeria	9,001.0	0.6579	Naira	59.66	229	0.2
Norway	*111.8 (*95.3)	5.73	Krone	3.96	4,927 (4,200)	32.9
Oman	169.4 (129.2)	0.3454	Rialamani	0.72	681 (520)	0.3
Pakistan	*86.2	9.931	Rupee	66.23	131	0.3
Panama	1,472.0 (1,292.0)	1.0	Balbou	1.57	938 (823)	5.5
Papua New Guinea	1,040.6 (895.3)	0.672	Kina	2.56	605 (520)	1.3
Paraguay	*125.4 (*116.8)	126.0	Guarani	2.50	398 (371)	1.0
Peru	381.9 (*336.0)	38.7	Sol	14.71	671 (590)	2.2
Philippines	*71.8 (*65.2)	6.74	Peso	40.12	266 (241)	1.0
Portugal	*281.1 (*269.4)	25.85	Escudo	8.56	1,270 (1,217)	10.9
Saudi Arabia	*40.6 (*30.1)	3.55	Riyal	8.45	1,353 (1,003)	1.0
Senegal	*230.6	235.4	Franc	3.87	253	0.8
Seychelles	168.0	5.739	Rupee	0.06	488	4.5
Sierra Leone	478.0 (433.0)	0.8609	Leone	2.67	208 (188)	0.3
Singapore	10,205.0	2.49	Dollar	2.19	1,871	11.4

Table I-9 G.D.P. per Capita, N.I. per Capita and Telephone Density in 1973 (4/4)

( ): National Income

Country	G.D.P. (NI) in 1973 Million (*Billion)	National Currency Exchange Rate per US $		Population in 1973 Million	G.D.P. (NI) per Capita	Telephone Density
South Africa	19,074.0 (16,788.0)	0.6712	Rand	24.31	1,169 (1,029)	7.5
Spain	*4,129 (*3,808.0)	56.85	Peseta	34.86	2,083 (1,921)	18.1
Sri Lanka	17,053.0 (16,028.0)	6.748	Rupee	13.25	191 (179)	0.5
Sudan	1,246.0 (1,137.0)	0.3482	Pound	15.0	239 (218)	0.3
Sweden	220.2 (*198.2)	4.588	Krone	8.14	5,896 (5,307)	59.4
Switzerland	*130.1 (*119.3)	3.244	Franc	6.43	6,237 (5,719)	56.0
Syrian Arab Republic	9,413.0	3.8	Pound	6.89	360	2.1
Thailand	216.5 (*201.3)	20.38	Baht	39.69	268 (249)	0.6
Trinidad & Tobago	2,689.0	2.07	Dollar	1.06	1,226	6.3
Tunisia	1,163.0 (1,093.0)	0.445	Dinar	5.44	480 (452)	1.8
Turkey	*296.0 (*293.0)	14.15	Lira	37.36	560 (554)	2.1
United Kingdom	*72.0 (*66.3)	0.4304	Pound	55.93	2,991 (2,754)	34.0
United Republic of Cameroons	*416.0	235.4	Franc	6.17	286	0.4
Tanzania	13,103.0 (12,179.0)	6.9	Shilling	14.37	132 (123)	0.4
U.S.A.	*1,302.0 (*1,171.0)	1.0	Dollar	210.41	6,188 (5,565)	65.7
Uruguay	*2,537.5 (*2,443.5)	937.0	Peso	2.99	906 (872)	8.3
Venezuela	*72.5 (*63.6)	4.28	Bolivar	11.28	1,502 (1,317)	4.6
Yemen	3,710.0 (3,640.0)	4.575	Rial	6.29	129 (126)	0.1
Yemen Democratic	68.0	0.3454	Dinar	1.56	126	0.6
Zaire	1,501.8 (1,296.0)	0.5	Zaire	23.56	127 (110)	0.2
Zambia	1,616.0 (1,322.0)	0.6435	Kwacha	4.64	541 (443)	1.4

Source: Statistical Yearbook 1977 United Nations

Table I-10 Installation Fee in Various Countries

Country	Installation Fee (US $)	Telephone Density	G.D.P. per Capita at 1973 Constant (US $)
Australia	152.9	39.0	5,746
Austria	53.8	28.1	3,629
Belgium	91.2	28.5	4,408
Canada	10.7	57.2	5,746
Colombia	258.2	5.5	463
Denmark	187.6	45.4	5,128
El Salvador	81.2	1.4	374
Ethiopia	55.7	0.3	87
Finland	154.5	38.9	3,870
France	246.0	26.2	4,617
Germany	76.3	31.7	5,385
Greece	151.8	22.1	1,840
Indonesia	862.0	0.2	136
Iran	326.8	2.0	1,351
Ireland	82.8	14.1	2,048
Israel	159.4	23.1	3,208
Italy	119.0	25.9	2,417
Kenya	42.7	0.9	188
Korea	519.1	4.0	414
Luxembourg	19.1	41.1	4,665
Mexico	14.5	5.0	908
Morocco	51.9	1.0	322
Netherlands	74.4	36.8	4,469
Pakistan	51.1	0.3	132
Paraguay	241.4	1.4	427
Peru	31.7	2.0	696
Philippines	134.2	1.2	281
Portugal	55.3	11.3	1,113
Singapore	19.8	12.9	2,009
South Africa	35.1	7.8	1,215
Spain	161.3	22.0	2,170
Sweden	67.5	66.1	6,120
Switzerland	147.6	61.1	5,832
Turkey	272.3	2.5	629
United Kingdom	93.1	37.9	2,937
United States	15.3	69.5	5,965
Venezuela	124.3	5.3	1,576

Source: Telephony October 31, 1977

Table I-11 Forecasted Telephone Demand Comparison by Various Methods in Indonesia

		1979	1983	1993
2-2-1	GDP per capita by Historical Data	404,200 (0.29)	528,200 (0.35)	1,042,800 (0.57)
2-2-2	NI per capita by Historical Data	404,200 (0.29)	558,300 (0.37)	1,170,900 (0.64)
2-2-3	Extrapolation by Time Series	418,100 (0.30)	573,400 (0.38)	1,280,700 (0.70)
2-2-4	GDP per capita by Correlation Model by Countries	557,500 (0.40)	770,000 (0.51)	1,738,100 (0.95)
2-2-2	NI per capita by Correlation Model by Countries	459,900 (0.33)	633,800 (0.42)	1,372,100 (0.75)

( ): Telephone Demand Density

(Number of Telephone Stations per 100 inbabitants)

Table I-12 Forecasted Telephone Demand in Indonesia by Number of Telephone Stations

	1979	1983	1993
Optimistic Growth Rate 6%	585,000 (0.42)	875,000 (0.58)	2,378,000 (1.30)
Expected Growth Rate 4.5%	557,500 (0.40)	770,000 (0.51)	1,738,000 (0.95)
Pessimistic Growth Rate 3%	544,000 (0.39)	679,000 (0.45)	1,262,000 (0.69)

( ): Telephone Demand Density

(Number of Telephone Stations per 100 inhabitants)

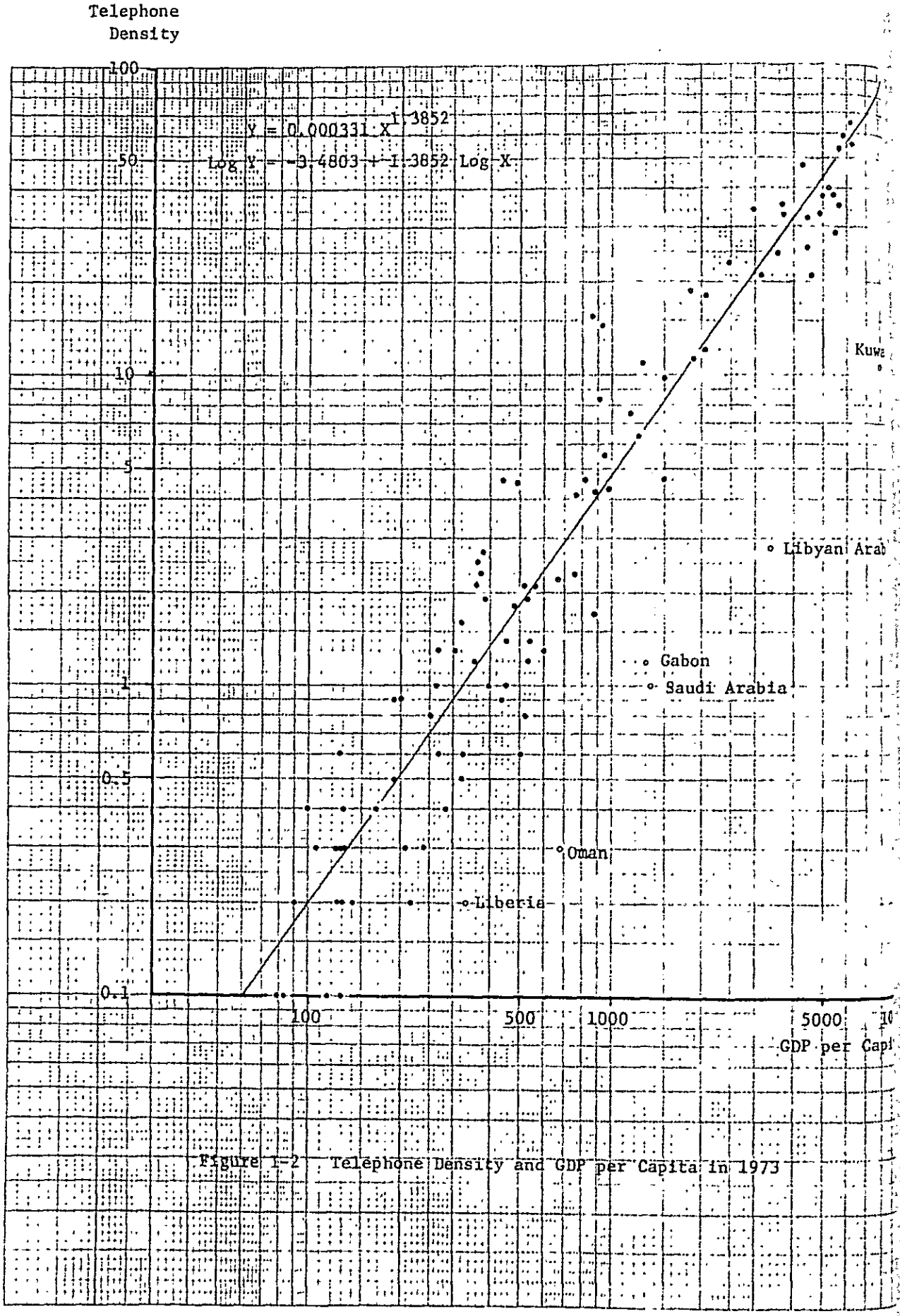


Figure 1-2 Telephone Density and GDP per Capita in 1973

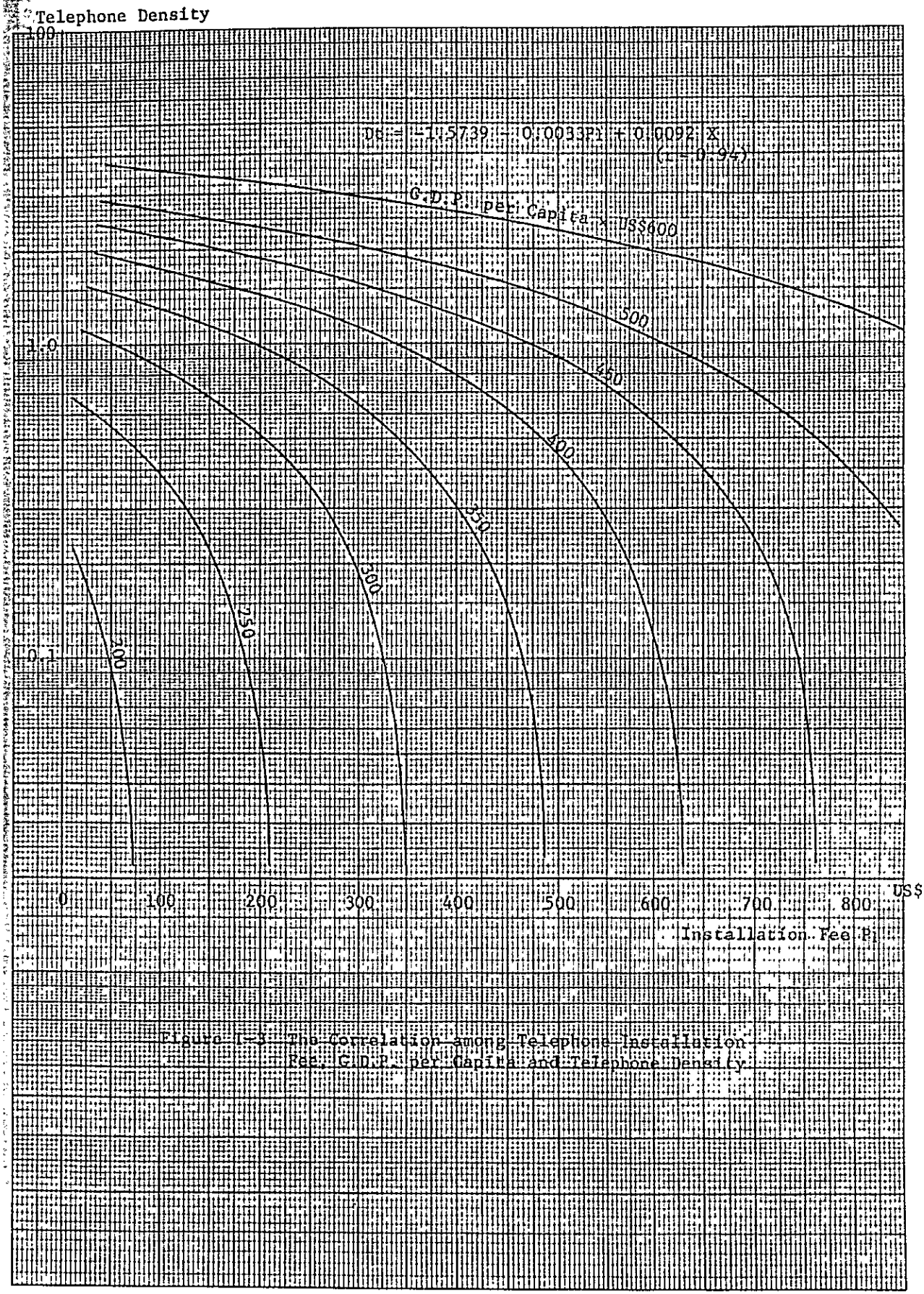


Figure I-3 The Correlation among Telephone Installation Fee, G.D.P. per Capita and Telephone Density

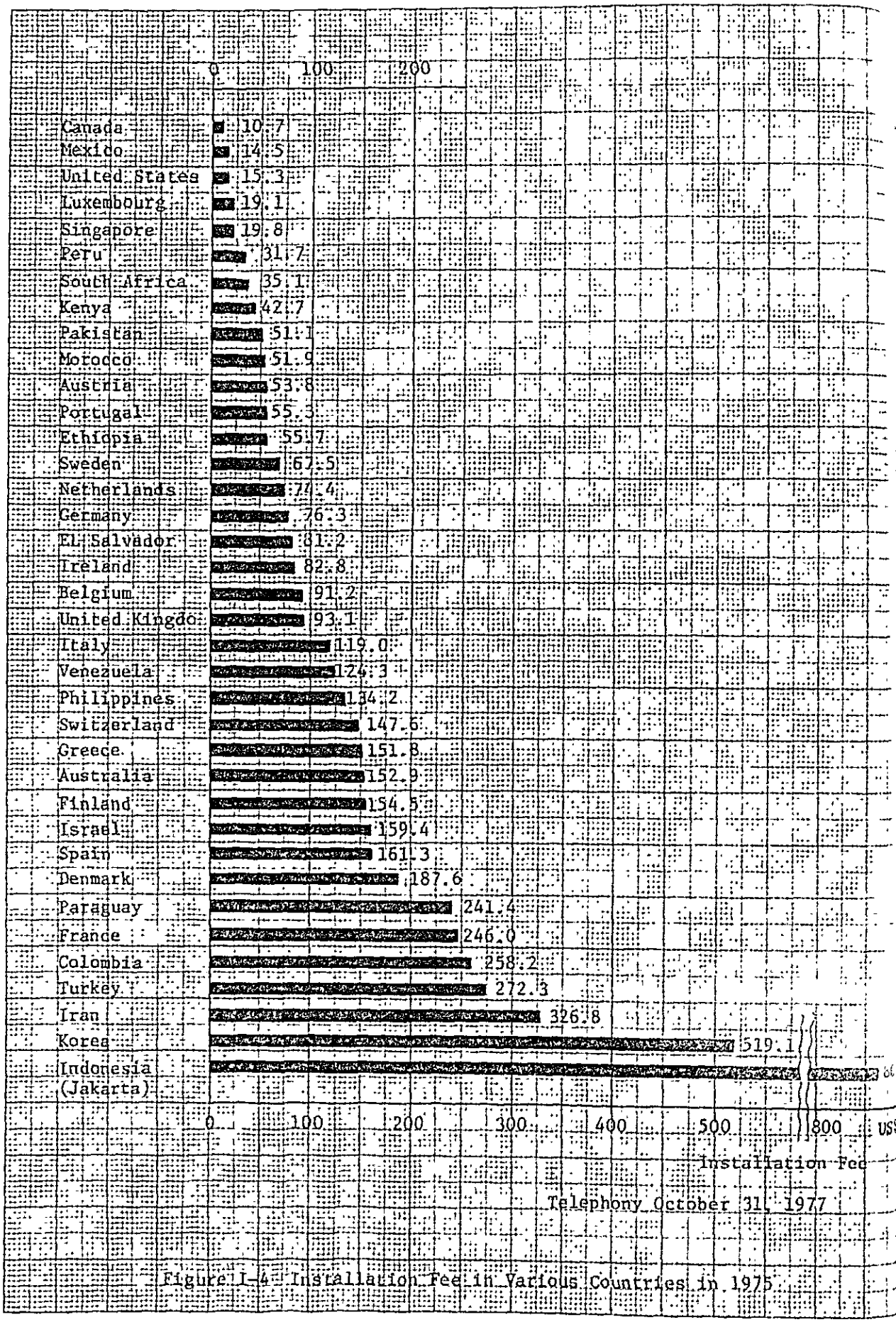
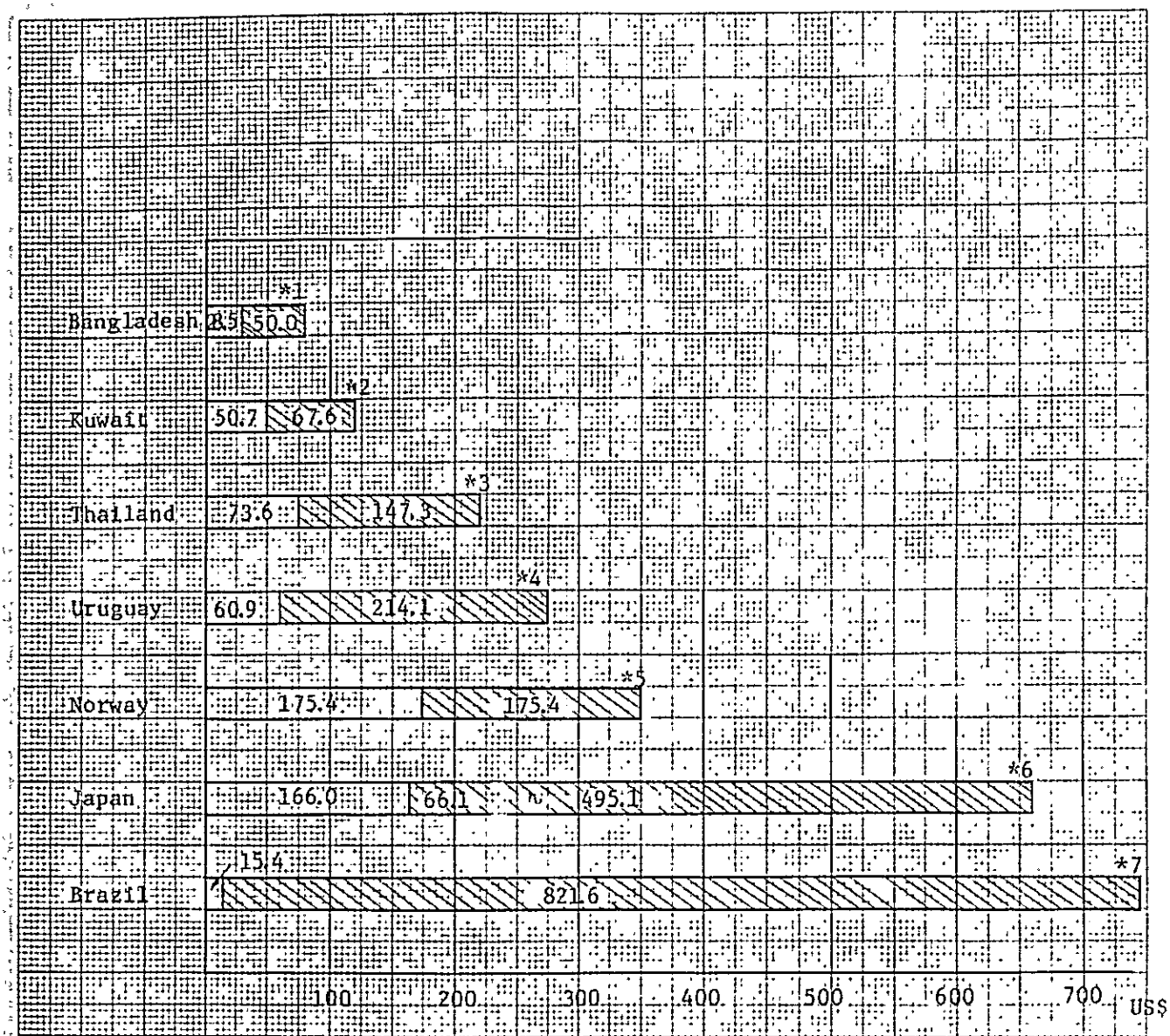


Figure I-4 Installation Fee in Various Countries in 1975



Note *1 50.0$ deposit repaid after giving up connection
*2 67.6$ "
*3 147.3$ deposit
*4 214.1$ guarantee repaid after giving up connection
*5 175.4$ Loan interest 6.5% p.a.
*6 66.1 ~ 495.1$ Loan according to size of local network, interest 6.8% p.a. repaid after 10 years
*7 821.6$ share

Source: Telephony, October 31, 1977

Figure I-5 Installation Fee and Loan or Share in 1975

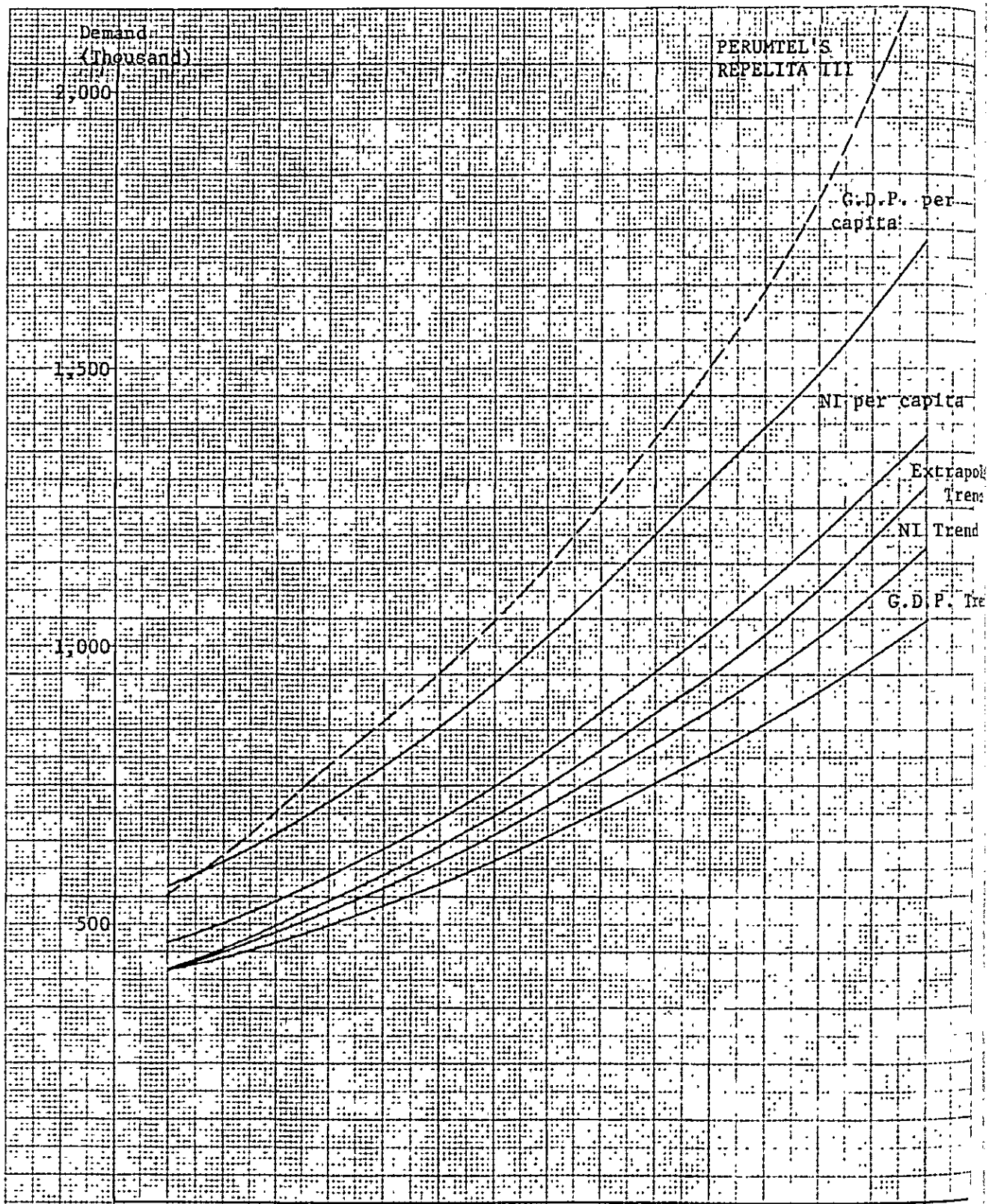


Figure I-6 Forecasted Telephone Demand in Indonesia by Telephone Stations

1-3 Telephone Demand Forecast for Jakarta City

For the purpose of telephone demand forecast for Jakarta City, the ratio of telephone distribution in Jakarta City to the distribution over the rest of Indonesia and the ratio of the number of telephone stations to the number of main telephone stations have been analyzed by various methods.

1-3-1 Analysis of Distribution Rate in Jakarta City

(1) Time Series Analysis

The trend of telephone distribution in Jakarta City can be known from the past data. (Table I-8)

However, due to the high level of installation fee in Jakarta compared with other cities in Indonesia, the telephone demand in that city is correspondingly suppressed. Consequently, the present trend analysis cannot be considered to represent the actual telephone distribution rate of Jakarta City.

The formula is as follows:

$$Y = 22.90 + 3.43 \log e^{t} \qquad (r = 0.92)$$

where

Y = Telephone distribution rate (%)

t = 1, 2, 3 .... (1971, 1972, 1973 ...)

The distribution rates (%) in 1979, 1983 and 1993 are 30.4%, 31.7% and 33.7%, respectively.

(2) Correlation Model Equation

The relationships among GDP per capita, population concentration rate to capital city, and telephone distribution rate of capital city in other countries were taken into consideration when using the correlation method in the form of a Multiple Regression formula (Table I-15). The result shows that the telephone distribution rate will increase in proportion to the population concentration rate, but will decrease in inverse proportion to the GDP per capita. At present, it is considered that this method is by far the most suitable approach for projecting the distribuition rate of Jakarta City.

The result is as follows:

$$Y = 39.131 + 1.28827\ X_1 - 7.6458\ X_2 \times 10^{-3} \qquad (r = 0.92)$$

where

Y = Telephone distribution rate (%)

X_1 = Population concentration rate (%)

X_2 = GDP per capita (US$)

The telephone distribution rate and telephone demand of Jakarta City in the years 1979, 1983 and 1993 are shown in Table I-13.

(3) Study by Various Data

Based on various data and by other methods than the above, the study has been carried out concerning social and economic activities as seen in TV and motor vehicle diffusion, income standings and so forth. The conclusion is that there is no discernible relationship between the telephone distribution rate and telephone demand.

Table I-13 Forecasted Telephone Demand in Jakarta City by Number of Telephone Stations

	1979	1983	1993
Optimistic Growth Rate 6%	252,000 (4.39) ((43.10))	376,000 (5.84) ((42.96))	996,000 (12.17) ((41.89))
Expected Growth Rate 4.5%	241,000 (4.20) ((43.14))	332,000 (5.15) ((43.09))	739,000 (9.03) ((42.50))
Pessimistic Growth Rate 3%	235,000 (4.10) ((43.17))	293,000 (4.55) ((43.22))	543,000 (6.64) ((42.99))

( ): Telephone Density

(( )): Distribution rate in %

1-3-2 Main Telephone Stations for Jakarta City

In most statistical data, each telephone station is used for a unit. Then, the number of telephone stations and the telephone density (number of telephone stations per 100 inhabitants) are generally used as basic forecast units. After the in-depth study and analysis, the forecasted telephone demand by telephone stations has been converted to the number of main telephone stations. In the planning of a telecommunication investment program, the number of main telephone stations can serve as a suitable indicator of the demand. In the case of Indonesia, party lines are few; therefore, it can be assumed that the number of main telephone stations and the number of main lines are identical.

The conversion rate, i.e., the ratio expressed in percentage of the number of main telephone stations to the number of telephone stations, was studied from the data of various countries and Indonesia (Table I-7 and Table I-16).

The arithmetic mean of such conversion rate of various countries is 66.2% and that of Indonesia is 68.9%. The latter figure is used for the conversion rate, this time.

The expected telephone demands in Jakarta City by main telephone stations in 1979, 1983 and 1993 are figured at 166,000, 228,000 and 509,200, respectively.

Further details appear in Table I-14.

Table I-14 Forecasted Telephone Demand in Jakarta City by Number of Main Telephone Stations

	1979	1983	1993
Optimistic Growth Rate 6%	173,600	259,000	686,000
Expected Growth Rate 4.5%	166,000	228,700	509,200
Pessimistic Growth Rate 3%	161,000	201,900	374,100

Table I-15 Telephone Distribution Rate and Population of Various Countries in 1973

Country	Y Telephone Distribution Rate in Capital City (%)	X1 Population Concentration Rate to Capital City (%)	X2 G.D.P. per Capita at 1973 Constant (US $)
Algeria	40.5	6.0	450
Australia	26.9	21.9	5,746
Belgium	25.6	12.4	4,408
Bolivia	47.7	11.6	201
Botswana	47.0	3.1	440
Costa Rica	77.5	25.9	818
Denmark	40.7	27.2	5,222
Dominican Republic	74.5	19.0	529
Egypt	55.6	15.2	263
Finland	23.3	10.8	3,710
France	17.6	4.6	4,535
Ghana	57.1	9.9	325
Greece	59.3	28.5	1,825
Guyana	65.7	22.5	378
Honduras	64.4	10.9	326
Iceland	59.4	46.7	5,420
Iran	50.4	11.3	879
Ireland	50.6	25.6	2,048
Israel	45.7	29.0	3,106
Jamaica	72.0	30.5	973
Japan	12.8	7.8	3,649
Jordan	72.3	22.2	321
Luxembourg	35.5	22.3	5,027
Madagascar	55.4	5.3	167
Malawi	44.4	3.4	99
Malaysia	36.0	7.7	520
Mexico	45.6	17.3	883
Netherlands	9.4	5.7	4,429
New Zealand	2.0	2.1	4,245
Nigeria	45.3	1.6	229
Pakistan	38.4	5.4	131
Panama	76.1	28.9	938
Portugal	34.9	9.1	1,270
Syria Arab Republic	43.2	13.5	360
Turkey	34.1	6.5	560
United Kingdom	22.0	13.0	2,991
Uruguay	80.0	48.1	906
Venezuela	63.0	20.9	1,502
Zaire	40.5	8.5	127

Source: Statistical Yearbook 1977 United Nations
World Telephone

Table I-16 Telephone Density and Percentage of Main Telephone Stations in Various Countries

Country	Telephone Density (Telephone Stations per 100 inhabitants)						% of Main Telephone Stations					
	'71	'72	'73	'74	'75	'76	'71	'72	'73	'74	'75	'76
Argentina	7.68	8.10	8.0	9.0	9.66	9.8	79.0	79.5	79.9	73.2	72.2	71.2
Australia	32.62	33.95	35.0	37.0	39.01	39.5	69.4	69.4	68.8	69.0	69.7	71.4
Bulgaria	6.24	6.77	7.0	8.0	8.9	9.7	66.6	65.5	66.5	66.8	67.4	68.3
Canada	47.35	49.98	52.0	55.0	57.15	60.4	66.8	65.1	64.4	63.4	63.0	61.9
Denmark	35.84	37.93	40.0	42.0	44.97	48.9	73.7	73.2	73.9	73.9	74.3	73.2
Finland	27.83	30.47	33.0	36.0	38.89	40.9	68.0	68.2	68.1	68.2	68.1	67.9
France	18.54	19.91	22.0	24.0	26.20	29.3	48.7	49.1	49.6	50.0	51.3	53.9
Germany	24.88	26.79	29.0	30.0	31.70	34.2	64.8	65.6	66.0	66.3	66.9	68.6
Greece	14.01	16.32	19.0	21.0	22.12	23.8	85.4	85.5	84.8	84.5	84.0	82.8
India	0.25	0.27	0.3	0.3	0.3	0.3	73.3	74.1	73.8	73.6	73.6	74.9
Italy	19.09	20.76	23.0	25.0	25.88	27.1	67.7	67.3	66.9	66.4	66.8	66.7
Japan	25.22	28.76	32.0	36.0	38.44	40.8	72.1	73.1	73.5	74.1	74.2	73.7
Mexico	3.37	3.79	4.0	4.0	4.76	5.2	54.0	54.6	53.6	54.0	54.0	56.0
Netherlands	28.05	29.91	32.0	34.0	36.75	39.2	65.1	65.5	65.2	66.5	62.2	66.8
New Zealand	44.04	44.61	46.0	48.0	50.18	52.0	65.5	64.9	64.3	63.6	62.8	62.1
Norway	30.70	32.0	33.0	34.0	35.03	36.6	60.7	60.1	59.6	59.6	59.4	59.1
Portugal	9.34	9.89	10.0	12.0	12.3	12.9	72.0	71.7	71.2	70.8	71.0	71.3
South Africa	7.17	7.30	8.0	8.0	8.1	8.3	61.6	61.0	60.6	60.3	57.4	57.6
Spain	15.02	16.45	18.0	20.0	12.98	23.9	61.3	60.2	58.2	56.8	60.0	56.2
Sweden	57.58	59.29	61.0	63.0	66.07	68.9	74.7	74.1	73.7	73.1	72.3	71.5
Switzerland	50.91	53.95	55.0	59.0	61.09	63.8	64.0	63.6	63.4	63.1	62.9	62.8
Turkey	1.79	1.94	2.0	2.0	2.52	2.8	65.2	65.0	65.8	66.6	67.3	68.1
U.K.	28.88	31.39	34.0	36.0	37.51	39.4	58.3	58.7	58.8	59.0	62.4	63.9
U.S.A.	60.13	62.75	65.0	68.0	69.49	71.8	56.9	56.1	55.3	54.7	54.0	53.0
U.S.S.R.	4.86	5.31	6.0	6.0	6.63	7.0	65.4	66.7	67.1	66.9	71.9	75.0
$\bar{x}$							66.4	66.3	66.1	65.8	66.0	66.3

Source: World Telephone

2. Microscopic Approach

Telephone demand in 1993 is estimated from the field survey results and the Master Plan for Jakarta City prepared by D.K.I. (Jakarta Special Municipality). Also, telephone demand in 1979 is estimated by analysis of D.K.I's research results of 1978 and collected information. Then, from both the above estimates is derived the telephone demand in 1983 by means of linear logarithmic regression equation, and this estimate is rectified according to the exchange area characteristics and degrees of development.

2-1 Telephone Demand in 1993

Telephone demand in 1993 is estimated by the following procedures:

1) With a survey map of a scale of 1:5,000, field surveys were carried out to make a physical investigation of the areas under study in the whole of Jakarta City excluding islands in July, August and September 1979.

2) In the survey at sites, various information which might affect telephone demand, especially the information concerning housing complex plans of private companies, was collected.

3) The pattern map, which classifies each area as either Residential, Business Office, Commercial, Industrial, Other or Non-demand area, was made, based on the results of the surveys, D.K.I.'s Master Plan and the information from the sites.
Area classification and area pattern are shown in Table I-17.
Total demand in Jakarta City is shown in Table I-18.

4) Telephone demand for classified area pattern per hectare was estimated by in-depth analysis of the reference values prepared by JTP '73. The underlying concept is that telephone density on the same area pattern would be equal in 1993.

5) Based on each exchange area pattern map, telephone demand in each exchange area in 1993 is estimated. The pattern map and demand in classes of each exchange area are shown in PART VIII TELEPHONE EXCHANGE DESCRIPTION.

Table I-17 Telephone Demand Pattern

Area Classification	Area Pattern	Applied Density Classification	Demand per Hectare in 1993
Residential Area	R - 1	High Class Residential Area	20
	R - 2	Medium Class Residential Area	23
	R - 3	Low Class Residential Area	7
	A	Covers all low telephone demand areas	1
Business Office Area	O - H	High Telephone Demand Area	400
	O - 1	Medium Telephone Demand Area	100
	O - 2	Low Telephone Demand Area	50
Commercial Area	S - 1	High Telephone Demand Area, such as Shopping Centers	100
	S - 2	Medium Telephone Demand Area	60
	S - 3	Low Telephone Demand Area	40
Industrial Area	I - 1	High Telephone Demand Area, such as large warehouses and industrial estates	5
	I - 2	Medium and Low Telephone Demand Areas, such as small factories and workshops	10
Other Area	H	Hotels	20 - 300
		Schools & Universities	5 - 50
		Hospitals	10 - 50
		Army & Police	10 - 150
		Airport	200 - 500
		Sports Centers	5 - 200
Non-demand Area	N	Ponds, Cemeteries, Rivers, Parks, Wide Roads, etc.	

Table I-18 Jakarta City Area Telephone Demand

Pattern	Item	Area (Ha)	1983 Demand	1983 Density	1993 Demand	1993 Density
R	R-1	2,126	17,390	8.2	42,520	20.0
	R-2	7,382	57,780	7.8	169,820	23.0
	R-3	9,777	22,280	2.3	68,470	7.0
	Agriculture	11,206	2,550	0.2	11,200	1.0
	Sub-Total	30,491	100,000	3.3	292,010	9.6
B	O-H	49	10,000	204.1	19,600	400.0
	O-1	456	27,510	60.3	45,600	100.0
	O-2	1,314	32,790	25.0	65,700	50.0
	S-1	131	9,490	72.4	13,100	100.0
	S-2	755	25,280	33.5	45,300	60.0
	S-3	408	6,540	16.0	16,320	40.0
	I-1	2,020	3,410	1.7	10,140	5.0
	I-2	1,628	4,810	3.0	16,180	10.0
	Others	1,719	2,240	1.3	4,480	2.6
	Sub-Total	8,470	122,070	14.4	236,420	27.9
Non-Demand		26,024				
Total		64,985	222,070	3.4	528,430	8.1
Fraction raised			30		1,270	
Total Demand			222,100		529,700	

2-2 Telephone Demand in 1979 and 1983

Telephone demands in 1979 and 1983 are estimated by the following procedures:

1) Analysis on small village basis of the results of D.K.I.'s research executed by the end of 1978, indicating the population, size of each area, number of houses, number of office buildings, number of industries and shops, etc. (Table I-19)
   The data on each exchange area basis are shown in PART VIII TELEPHONE EXCHANGE DESCRIPTION.

2) Re-composition of the above data on exchange area basis and estimate of telephone demand in 1979. (Table I-20)

3) Calculation of both business and residential category demands in 1983 from the above estimated demand in 1979 and 1993, by a linear logarithmic regression equation.

4) Modification of the demand in 1983 in several exchange areas in accordance with the area characteristics and development degrees.

Table I-19 D.K.I. Jakarta City Research Result

Item	Number
Area (Sq. Km)	649.85
Population	5,174,334
Households	971,007
Offices (No. of Buildings)	4,581
Industries & Shops	16,194
Houses	702,595
Others	10,741

Table I-20 Telephone Demand in 1979

End of 1978

No.	Exchange	Household	Office	Industry & Shop	Other	Total	Demand
1.	Kota I	530	4,750	2,100	50	7,430	7,400
2.	Kota II	6,160	11,240	2,750	450	20,600	20,600
3.	Cengkareng	660	180	180	90	1,110	1,110
4.	Pluit	2,160	1,860	400	90	4,510	4,500
5.	Ancol	1,650	1,250	120	210	3,230	3,300
6.	Tegal Alur	450	60	40	100	650	700
7.	Gambir I	4,870	14,220	1,260	200	20,550	20,600
8.	Gambir II	8,300	20,040	1,330	470	30,140	30,100
9.	Semanggi I	2,280	1,920	430	90	4,720	4,700
10.	Semanggi II	1,210	2,000	660	120	3,990	4,000
11.	Slipi	3,690	580	1,920	220	6,410	6,400
12.	Pal Merah	1,870	620	100	220	2,810	2,800
13.	Kedoya	920	80	110	70	1,180	1,200
14.	Meruya	380	30	10	80	500	500
15.	Cempaka Putih	5,710	1,060	620	310	7,700	7,700
16.	Rawa Mangun	2,990	1,200	390	170	4,750	4,800
17.	Tanjung Priok	1,550	3,980	760	330	6,620	6,600
18.	Kelapa Gading	1,060	150	30	40	1,280	1,300
19.	Cilincing	520	250	100	70	940	900
20.	Penggilingan	850	80	280	90	1,300	1,300
21.	Kebayoran	5,880	4,680	470	140	11,170	11,200
22.	Kebayoran Lama	880	90	180	90	1,240	1,200
23.	Cipete	1,670	410	230	150	2,460	2,500
24.	Pasar Minggu	600	120	10	110	840	800
25.	Kalibata	1,470	1,020	160	190	2,840	2,800
26.	Jagakarsa	390	40	0	80	510	500
27.	Jatinegara I	1,090	1,160	230	120	2,600	2,600
28.	Jatinegara II	4,540	1,500	840	210	7,090	7,100
29.	Cawang	1,000	590	950	190	2,730	2,700
30.	Pasar Rebo	570	190	60	120	940	900
31.	Tebet	2,300	890	360	330	3,880	3,900
32.	Gandaria	380	150	80	90	700	700
33.	Klender	740	80	80	100	1,000	1,000
	Total	69,320	76,470	17,240	5,390	168,420	168,400

2-3 Telephone Demand in Each Exchange Area

The demands in 1983 and 1993 by Macroscopic Approach (expected values) are estimated at 228,700 and 509,200, respectively. On the other hand, the corresponding values by Microscopic Approach are 222,100 and 529,700. The difference between the estimates by both methods is under 5%. Therefore, the telephone demand estimate by Microscopic Approach is applied to the Telephone Network Expansion planning.

Comparison between telephone demand projections by Macroscopic and Microscopic Approaches is shown in Figure I-7. The final telephone demand estimate in each exchange area in 1979, 1983 and 1993 is shown in Table I-21 and Figure I-8.

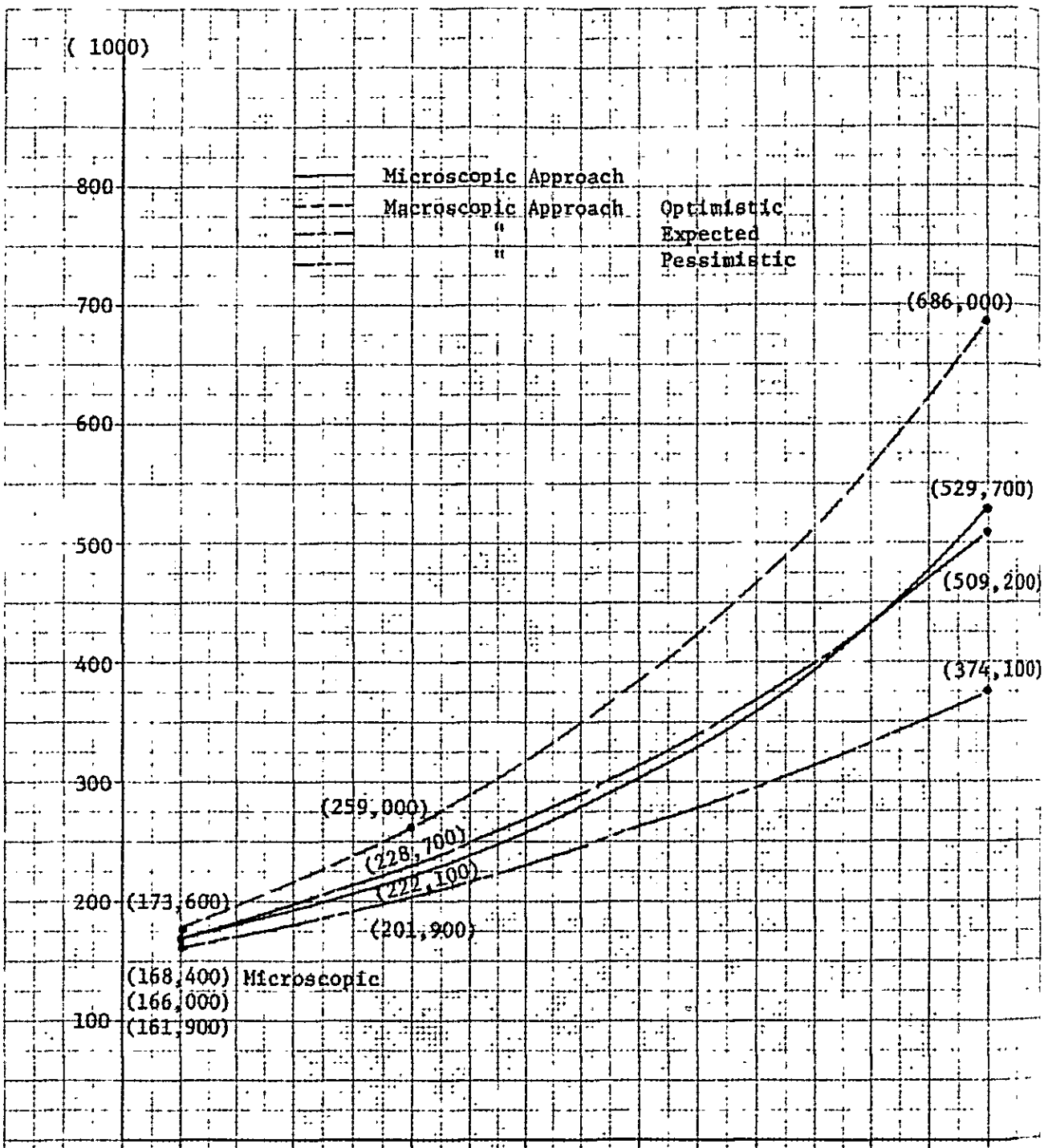


Figure I-7 Comparison Between Telephone Demand Projections by Macroscopic Approach and Microscopic Approach

Table I-21 Telephone Demand in Each Exchange Area

No.	Exchange Area	1979			1983			1993		
		Business	Residential	Total	Business	Residential	Total	Business	Residential	Total
1.	Kota I	6,870	530	7,400	8,000	800	8,800	11,280	2,020	13,300
2.	Kota II	14,440	6,160	20,600	16,500	7,700	24,200	22,870	13,430	36,300
3.	Cengkareng	440	660	1,100	900	1,500	2,400	4,820	12,580	17,400
4.	Pluit	2,340	2,160	4,500	3,000	3,400	6,400	5,590	10,510	16,100
5.	Ancol	1,650	1,650	3,300	2,200	2,800	5,000	4,720	9,880	14,600
6.	Tegal Alur	250	450	700	300	800	1,100	750	3,650	4,400
7.	Gambir I	15,730	4,870	20,600	18,000	5,600	23,600	24,990	8,010	33,000
8.	Gambir II	21,800	8,300	30,100	23,400	9,200	32,600	27,980	11,920	39,900
9.	Semanggi I	2,420	2,280	4,700	3,900	2,900	6,800	13,160	5,240	18,400
10.	Semanggi II	2,790	1,210	4,000	4,400	2,000	6,400	13,360	7,240	20,600
11.	Slipi	2,710	3,690	6,400	3,600	6,000	9,600	7,440	19,360	26,800
12.	Pal Merah	930	1,870	2,800	1,300	3,100	4,400	3,390	11,110	14,500
13.	Kedoya	280	920	1,200	400	2,300	2,700	640	10,560	11,200
14.	Meruya	120	380	500	200	900	1,100	340	7,360	7,700
15.	Cempaka Putih	1,990	5,710	7,700	3,400	7,000	10,400	12,940	11,560	24,500
16.	Rawa Mangun	1,810	2,990	4,800	2,600	4,500	7,100	6,760	12,540	19,300
17.	Tanjung Priok	5,050	1,550	6,600	5,900	2,400	8,300	8,440	6,860	15,300
18.	Kelapa Gading	240	1,060	1,300	600	1,900	2,500	4,660	7,640	12,300
19.	Cilincing	380	520	900	900	900	1,800	6,600	3,200	9,800
20.	Penggilingan	450	850	1,300	1,000	1,200	2,200	7,260	3,140	10,400
21.	Kebayoran	5,320	5,880	11,200	5,500	7,900	13,400	6,140	16,760	22,900
22.	Kebayoran Lama	320	880	1,200	400	1,500	1,900	820	5,480	6,300
23.	Cipete	830	1,670	2,500	900	3,100	4,000	1,290	15,210	16,500
24.	Pasar Minggu	200	600	800	300	1,200	1,500	910	5,890	6,800
25.	Kalibata	1,330	1,470	2,800	1,700	3,000	4,700	3,400	18,100	21,500
26.	Jagakarsa	110	390	500	200	700	900	1,060	3,740	4,800
27.	Jatinegara I	1,510	1,090	2,600	2,100	1,600	3,700	4,490	3,810	8,300
28.	Jatinegara II	2,560	4,540	7,100	3,800	5,400	9,200	9,580	8,420	18,000
29.	Cawang	1,700	1,000	2,700	2,900	1,800	4,700	10,430	7,370	17,800
30.	Pasar Rebo	330	570	900	500	1,200	1,700	1,630	7,270	8,900
31.	Tebet	1,600	2,300	3,900	2,200	3,600	5,800	4,940	11,460	16,400
32.	Gandaria	320	380	700	600	800	1,400	3,050	5,050	8,100
33.	Klender	260	740	1,000	500	1,300	1,800	1,960	5,640	7,600
	Total	99,080	69,380	168,400	122,100	100,000	222,100	237,690	292,010	529,700
		58.8%	41.2%	100%	55.0%	45.0%	100%	44.9%	55.1%	100%

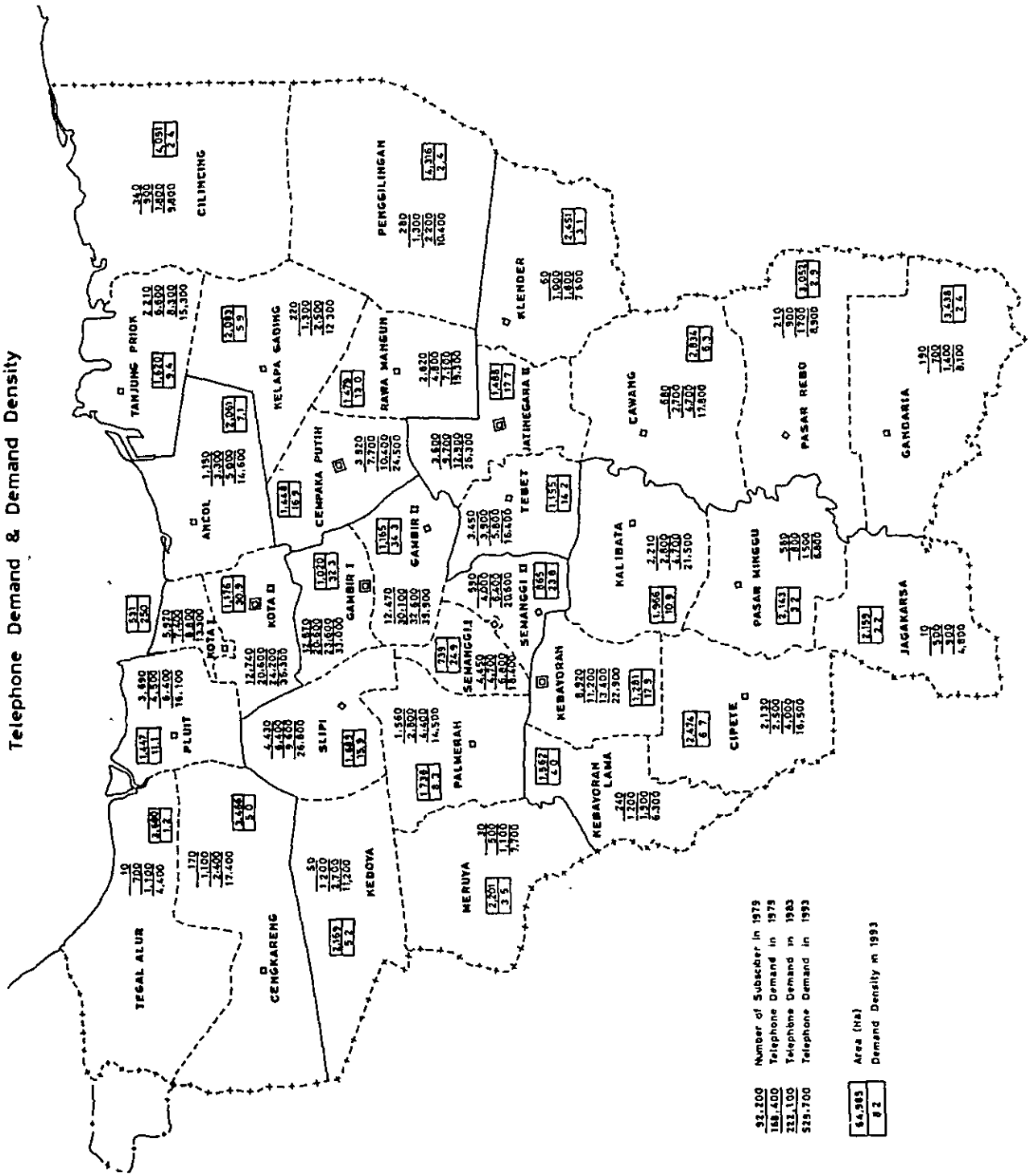


Figure I-8 Telephone Demand & Demand Density

PART II TELEPHONE TRAFFIC FORECAST

PART II TELEPHONE TRAFFIC FORECAST

When planning telecommunication services, it is necessary to have a complete picture of the potential traffic flow in every part of the future network. The reliability of these traffic figures is a deciding factor on whether the network will be satisfactory or not from economic and service points of view.

For the purpose of junction cable network planning, traffic forecast for the years 1983, 1987 and 1993 is carried out.

1. Traffic Data

On the subject of telephone traffic forecast, careful analysis must be made on the basis of an accurate traffic measurement for a long period. Even though traffic data collected at present do not cover a long period, monthly traffic data of PRX exchanges since June 1978 are available. As for EMD exchanges, a number of traffic data of recent months have been gathered with the exception of Ciputat and Pasar Minggu Exchanges where traffic measuring equipments are not in operation.

With regard to mobile cross-bar exchanges, no traffic data have been collected. Traffic measurement of the above two EMD exchanges and mobile cross-bar exchanges has been carried out by JTP '79.

1-1 PRX Exchange

The monthly traffic data collected contain figures of the past 11 months since June 1979 for certain exchanges, while other exchanges where operation started recently provide only few figures.

Traffic measurement is made by use of the TRD 1 - program which executes the scanning of the switching equipment at the time interval of every 6 minutes.

The configuration of PRX switching network is shown in Figure II-1.

Traffic data collected are classified as follows:

a) Total originating traffic (AJ)
b) PABX originating traffic
c) Total terminating traffic (BJ)
d) Outgoing traffic by routes (OT)
e) Incoming traffic by routes (IT)

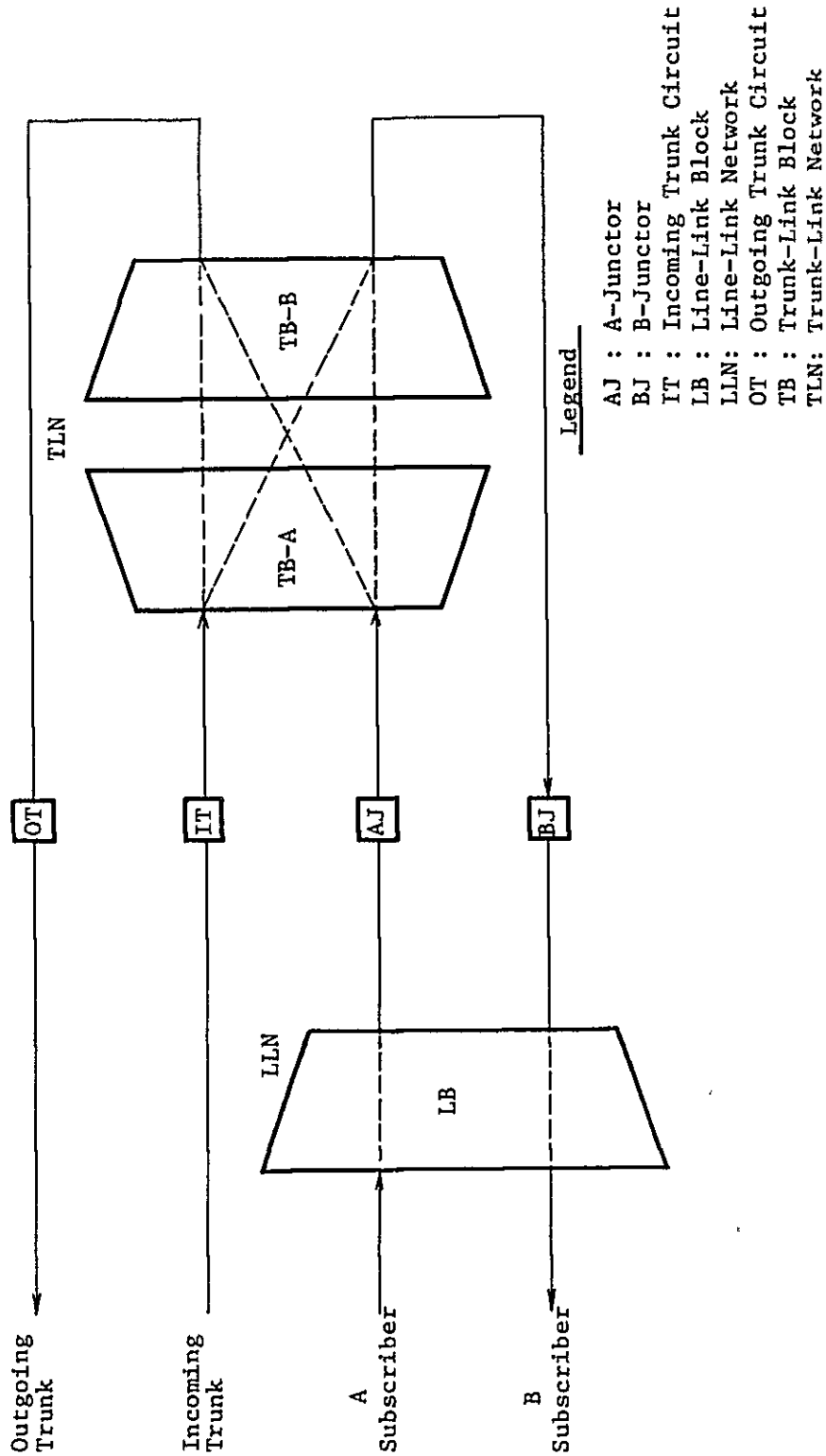


Figure II-1 PRX Switching Network

Certain traffic types, such as digit reception and busy tone sending, are included in traffic AJ; therefore, traffic related to junction circuits will be calculated with the exclusion of this miscellaneous traffic. Average efficiency of one AJ in Jakarta is 0.86 at present.

1-2 EMD Exchange

Traffic data measured by PERUMTEL cover all switching stages including line finder stage, while the date of measurement varies in correspondence with the line finder group. However, these data are effective as basic data for junction circuit forecast.

Traffic data of Pasar Minggu and Ciputat Exchanges are not available because traffic measuring equipments in these exchanges are not yet in operation. Traffic measurement by peg count of 1st GS for these exchanges was carried out by JTP '79 at intervals of two minutes during one busy hour. Traffic is converted into Erlang value by the following formula:

Traffic Measurement at EMD Exchange

$$\text{Traffic (Erl.)} = \frac{\text{Number of operating 1st GS in the unit measuring time}}{\text{Number of measurement}}$$

1-3 Mobile Cross-bar Exchange

Mobile cross-bar system is in operation at Pasar Rebo and Gandaria Exchanges.

Traffic data of these two exchanges were not available. Traffic measurement was carried out, and traffic was estimated on the basis of the relationship between the number of calls by category and the average holding time of call by category.

The number of calls by category is measured by the installed call meter, and the holding time of call is measured by the lamp illumination of operating relay-set concerned.

Traffic is converted into Erlang value by the following formula:

$$\text{Traffic (Erl.)} = \frac{\text{Number of calls x Average holding time (sec.)}}{\text{3600 (sec)}}$$

2. Estimation of Originating Calling Rate

The subscriber originating calling rate generally varies depending on factors, such as the change of composition of subscriber category, the change of social situation, the change of telephone tariff, and the proportion of telephone diffusion to demand.

2-1 Present Originating Calling Rate

Table II-1 shows the collected traffic data of the existing telephone exchanges in 1979 which present the originating calling rate of each exchange. The originating calling rate per subscriber of each exchange as of 1979 is examined and estimated on the basis of traffic data collected in consideration of the seasonal fluctuations because of the limited period of traffic measurement.

In the case of Cengkareng Exchange, no data are available because of less subscribers accommodated; therefore, traffic is estimated on the basis of subscriber category, calling rate of adjacent exchange, and so on. Table II-2 shows the originating calling rate per subscriber in the measured value by Atkinson and in the values obtained by JTP in 1974 and 1979.

2-2 Estimation of Originating Calling Rate

The subscriber calling rate is usually estimated by the study of time series data of a long period in the past. Otherwise, traffic data of other comparable cities are used as reference for such forecast. However, the subscriber calling rate of Jakarta for junction network planning is to be estimated in a different way for the following reasons:

Table II-1 Traffic Data of Telephone Exchanges in 1979

No.	Exchange	Type of Switching System	Number of Subscribers	Measured Originating Traffic (Erl.)	α = (BJ+OT)/(AJ+IT)	Originating Traffic (Erl.)	Originating Calling Rate (Erl.)
1	Kota I	EMD	9,528	708.32	-	708.32	0.0743
2	Kota II A	PRX	6,273	351.29	0.9175	434.27	0.0504
3	Kota II B	PRX	2,338	122.68	0.9126		
4	Pluit	PRX	2,931	117.48	0.8907	104.64	0.0357
5	Ancol	PRX	719	35.79	0.8396	30.05	0.0418
6	Gambir I A	EMD	6,558	625.60	-	625.60	0.0954
7	Gambir I C	PRX	5,218	378.85	0.8756	655.78	0.0730
8	Gambir I D	PRX	3,760	362.65	0.8936		
9	Gambir II A	PRX	1,631	144.83	0.8762	126.70	0.0778
10	Semanggi I	EMD	4,187	365.00	-	365.00	0.0872
11	Semanggi II	PRX	407	27.21	0.8600	23.40	0.0575
12	Slipi	EMD	4,018	206.77	-	206.77	0.0515
13	Pal Merah	PRX	1,362	75.50	0.8730	65.91	0.0484
14	Cempaka Putih	PRX	2,747	154.37	0.9097	140.43	0.0511
15	Rawamangun	PRX	2,420	123.31	0.8249	101.72	0.0420
16	Tanjung Priok	PRX	2,367	199.14	0.8698	173.21	0.0732
17	Kebayoran I A	EMD	5,923	334.17	-	334.17	0.0564
18	Kebayoran II B	PRX	2,850	173.21	0.8608	149.10	0.0523
19	Ciputat	EMD	220	8.83	-	8.83	0.0401
20	Cipete	PRX	1,692	69.46	0.8900	61.82	0.0366
21	Pasar Minggu	EMD	557	23.14	-	23.14	0.0401
22	Kalibata	PRX	1,648	75.61	0.8584	64.90	0.0394
23	Jatinegara I	EMD	3,208	263.78	-	263.78	0.0822
24	Jatinegara II	PRX[f]	1,823	92.97	0.8203	76.26	0.0418
25	Cawang	PRX	280	17.94	0.8645	15.51	0.0554
26	Pasar Rebo	MCX	139	10.72	-	10.72	0.0771
27	Tebet	PRX	2,126	103.48	0.9024	93.38	0.0439
28	Gandaria	MCX	220	38.53	-	38.53	0.1751

Table II-2 Originating Calling Rates in Erlang

No.	Exchange	Average Originating Calling Rates in Erlang		
		By Atkinson 1973	By JTP 1974	By JTP 1979
1	Kota I	0.074	0.070	0.038
2	Kota II	-	-	0.053
3	Pluit	-	-	0.038
4	Ancol	-	-	0.044
5	Gambir I (EMD)	0.077	0.068	0.100
6	Gambir I (PRX)	-	-	0.077
7	Gambir II	-	-	0.082
8	Semanggi I	0.042	0.066	0.092
9	Semanggi II	-	-	0.061
10	Slipi	0.046	0.043	0.054
11	Pal Merah	-	-	0.051
12	Cempaka Putih	-	-	0.054
13	Rawa Mangun	-	-	0.044
14	Tanjung Priok	0.050	0.061	0.077
15	Kebayoran (EMD)	0.047	0.038	0.059
16	Kebayoran (PRX)	-	-	0.055
17	Ciputat	-	-	0.042
18	Cipete	-	-	0.038
19	Pasar Minggu	-	-	0.042
20	Kalibata	-	-	0.041
21	Jatinegara I	0.050	0.048	0.086
22	Jatinegara II	-	-	0.044
23	Cawang	-	-	0.058
24	Pasar Rebo	-	-	0.081
25	Tebet	-	-	0.046
26	Gandaria	-	-	0.184

1) Some exchanges accommodate subscribers of other exchange areas in addition to the subscribers of their own exchange areas. In certain exchanges, 50% of the total subscribers to be replaced to the home exchange are located in other exchange areas.

2) Application of a fixed value of originating calling rate to all exchanges is considered to be non-realistic because the trend of change of subscriber category varies from one exchange to another.

3) Time series data for a long period are not available.

4) Data from other comparable cities are not available because of the limited extent of telephone diffusion and the slow tempo of increase of telephone demand in Jakarta.

Consequently, the subscriber calling rate is determined in the following way:

The number of subscribers based on demand forecasts for 1983 and 1993 is classified as follows:

Np : PBX
No : Business subscriber
Ns : Commercial subscriber
Nr : Residence subscriber

The originating calling rates classified by subscriber categories are estimated to be as follows:

Subscriber Category	Originating Calling Rate in Erl.
Cp : PBX	0.20
Co : Business subscriber	0.06
Cs : Commercial subscriber	0.06
Cr : Residence subscriber	0.02

These values are based on the data from CCITT text book "Local Telephone Networks" and the JTP'74 report. However, calling rate of the PBX subscriber is based on the PRX traffic data.

Therefore, the total originating traffic (A) of the exchange is expressed as follows:

$$A = Np \times Cp + No \times Co + Ns \times Cs + Nr \times Cr \text{ (Erl.)}$$

Then, the average originating calling rate per subscriber (CR) is obtained as follows:

$$CR = \frac{A}{Np + No + Ns + Nr} \text{ (Erl.)}$$

The originating calling rate per subscriber of 1987 is calculated according to the values of 1983 and 1993 as follows:

$$CR'87 = CR'83 + (CR'93 - CR'83) \times \frac{4}{10}$$

The originating calling rate of each exchange for the years 1983, 1987 and 1993 is shown in Table II-3.

The estimated average originating calling rate per subscriber in Jakarta is then summarized as follows:

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

Table II-3 Estimated Originating Calling Rates as of 1983, 1987 and 1993

No.	Exchange	Originating Calling Rates in Erlang		
		1983	1987	1993
1	Kota I	0.085	0.080	0.080
2	Kota II	0.055	0.050	0.050
3	Cengakareng	0.045	0.040	0.035
4	Pluit	0.050	0.050	0.045
5	Ancol	0.050	0.050	0.045
6	Tegal Alur	0.060	0.055	0.045
7	Gambir I	0.070	0.070	0.070
8	Gambir II	0.070	0.070	0.070
9	Semanggi I	0.060	0.065	0.070
10	Semanggi II	0.070	0.070	0.065
11	Slipi	0.045	0.040	0.040
12	Pal Merah	0.040	0.040	0.035
13	Kedoya	0.030	0.030	0.025
14	Meruya	0.030	0.025	0.025
15	Cempaka Putih	0.045	0.050	0.055
16	Rawamangun	0.045	0.045	0.040
17	Tanjung Priok	0.065	0.060	0.055
18	Klapa Gading	0.040	0.040	0.050
19	Cilincing	0.055	0.060	0.065
20	Penggilingan	0.050	0.055	0.060
21	Kebayoran	0.045	0.045	0.040
22	Kebayoran Lama	-	-	0.030
23	Ciputat	0.035	0.035	0.030
24	Cipete	0.035	0.035	0.025
25	Pasar Minggu	0.035	0.035	0.030
26	Kalibata	0.045	0.040	0.035
27	Jagakarsa	0.035	0.035	0.035
28	Jatinegara	0.050	0.050	0.050
29	Cawang	0.065	0.065	0.060
30	Pasar Rebo	0.040	0.040	0.035
31	Tebet	0.045	0.045	0.040
32	Gandaria	0.050	0.050	0.050
33	Klender	0.040	0.040	0.040

3. Composition of Originating Calling Rate

Originating traffic consists of three major traffic categories in Jakarta Telephone Network: Local, special service and subscriber long distance including suburban traffic. The originating calling rate which is described in the previous paragraph is the total value of these three traffic categories.

3-1 Present Situation

Trunk and special service traffics have been obtained from PRX exchanges, while no traffic data were available on EMD and mobile cross-bar exchanges.

Accumulated traffic data of the past consecutive months for fourteen (14) PRX exchanges in Jakarta Telephone Network are shown below:

Traffic Category	Accumulated Traffic(Erl.)	Accumulated Number of Subscribers	Calling Rate(Erl.)	Remarks
SLDD	558.46	190,455	0.00293	Trunk
Suburban	123.37	ditto	0.00065	ditto
10X	141.83	ditto	0.00074	Sp'l Serv.
11X	52.49	ditto	0.00028	ditto
Total	876.14	-	0.00460	-

3-2 Calling Rate of Trunk Call

Originating trunk calling rate including 5% fluctuations can be assumed as follows:

$$(0.00293 + 0.00065) \times 1.05 = 0.00376 \text{ Erl.}$$

Up to a certain time in the future the trunk calling rate will show a rapid increase parallel to the national SLDD network expansion throughout the country. However, a deceleration of this rate will occur before the country-wide SLDD network expansion reaches its ultimate goal.

The application of the regression curve for the period from 1969 until 1980 and of the logistic curve for the period from 1981 until 1993 was adopted by JTP '74, and this method is being followed by JTP '79, as shown below.

Year	Originating Trunk C.R. (Erl.)
1979	0.00375
1983	0.00538
1987	0.00618
1993	0.00629

The value of 0.00375 (Erl.) in 1979 shows close approximation to the measured value of 0.00376 (Erl.). In the Jakarta Telephone Network, trunk traffic is divided into two categories: SLDD and suburban traffic. As a consequence, the forecast of these two traffic categories should be made independently. Suburban traffic is at present the one which is concerned with three suburban exchanges, i.e., Cibinong, Tanggerang and Bekasi Exchanges. Even though the total traffic to suburban exchanges from the exchanges in Jakarta may increase as the number of subscribers in Jakarta increases, the originating calling rate of this traffic category is assumed to retain its present value. Therefore, the originating trunk calling rate for each planned year is finally summarized as follows:

	Originating Trunk Calling Rate in Erl.		
Year	SLDD	Suburban	Total
1979	0.00308	0.00068	0.00376
1983	0.00470	0.00068	0.00538
1987	0.00550	0.00068	0.00618
1993	0.00561	0.00068	0.00629

3-3 Calling Rate of Special Service Call

Special service traffic in Jakarta is divided into two categories: 10X and 11X. The 10X traffic consists of booking for operator assisted trunk and manual delayed calls, information on trunk call and local directory information services. In general, traffic of call booking tends to decrease as SLDD network is expanded. Contrarily, traffic of trunk call information will increase as SLDD network is expanded. Traffic of local directory information services will increase as the number of subscribers in the area concerned increases. Therefore, in this junction cable network planning, the present value of originating calling rate for "10X" traffic is conceived to continue in the future.

Originating calling rate for "11X" traffic is assumed not to change due to its nature. The present value of special service calling rate is summarized as follows:

Special Service	Originating Calling Rate (Erl.)
10X	0.00074
11X	0.00028

3-4 Calling Rate of Local Call

Local calling rate is the balance after trunk and special service calling rates are subtracted from the average originating calling rate. The originating calling rate of local traffic for each planned year is summarized as follows:

Year	Originating Local C.R. (Erl.)
1979	0.05992
1983	0.04690
1987	0.04400
1993	0.04009

3-5 Proportion of Originating Calling Rate

Based on the breakdown of originating calling rate by traffic category, the proportion of originating calling rate is clarified as shown in Table II-4. Each proportion is used in the succeeding work of traffic forecast for individual exchanges in Jakarta Telephone Network.

4. Local Traffic Distribution

Local traffic distribution for the years 1979, 1983, 1987 and 1993 is carried out on the basis of demand forcast by JTP '79 and estimated originating calling rate.

4-1 Local Traffic Distribution Formula

Local traffic distribution between two local exchanges in a multi-exchange area is determined by the inter-exchange distance and the prevailing economic and social relations in the area concerned.

The traffic calculation formula adopted by JTP '79 is shown below:

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

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

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

Table II-4 Originating Calling Rates and Their Proportions by Traffic Categories

Year	1979		1983		1987		1993	
Traffic Category	Originating CR(Erl.)	Proportion (%)	Originating CR(Erl.)	Proportion (%)	Originating CR(Erl.)	Proportion (%)	Originating CR(Erl.)	Proportion (%)
Local	0.05992	92.62	0.04690	87.99	0.04400	85.93	0.04009	84.58
SLDD	0.00308	4.76	0.00470	8.82	0.00550	10.74	0.00561	11.84
Suburban	0.00068	1.05	0.00068	1.27	0.00068	1.33	0.00068	1.43
10x (Special)	0.00074	1.14	0.00074	1.39	0.00074	1.45	0.00074	1.56
11x (Special)	0.00028	0.43	0.00028	0.53	0.00028	0.55	0.00028	0.59
Total	0.06470	100.00	0.05330	100.00	0.05120	100.00	0.04740	100.00

4-2 Number of Subscriber Lines

In this traffic calculation, the maximum line capacity of switching system is used as the number of subscribers. The maximum line capacity of switching system is drawn up to meet the telephone demand forecast by JTP '79 (refer to Paragraph 3-1-3 of PART III).

4-3 Data for Calculation

The calculation of traffic for each planned year is carried out by use of computer. The following are the input data for computer calculation:

1) Originating calling rate and number of subscribers for each planned year. (Table II-5, 6, 7, 8)

2) Proportion of originating calling rate by traffic category. (Table II-4)

3) Inter-exchange distance in Km. (Table II-9)

Table II-5 Exchange List in 1979

No.	Exchange	Type of Switching System	* Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
1	Kota I	EMD	9,721	0.078	758.24
2	Kota II	PRX	9,628	0.053	510.28
3	Pluit	PRX	3,393	0.038	128.93
4	Ancol	PRX	861	0.044	37.88
5	Gambir I	EMD	14,381	0.100	1,438.10
6	Gambir I	PRX	8,960	0.077	689.92
7	Gambir II	PRX	2,230	0.082	182.86
8	Semanggi I	EMD	4,151	0.092	381.89
9	Semanggi II	PRX	681	0.061	41.54
10	Slipi	EMD	4,364	0.054	235.66
11	Pal Merah	PRX	1,852	0.051	94.45
12	Cempaka Putih	PRX	3,223	0.054	174.04
13	Rawamangun	PRX	3,625	0.044	159.50
14	Tanjung Priok	PRX	2,699	0.077	207.82
15	Kebayoron	EMD	6,047	0.059	356.77
16	Kebayoran	PRX	3,391	0.055	186.51
17	Ciputat	EMD	228	0.042	9.58
18	Cipete	PRX	2,202	0.038	83.68
19	Pasar Minggu	EMD	575	0.042	24.15
20	Kalibata	PRX	2,278	0.041	93.40
21	Jatinegara I	EMD	2,698	0.086	232.03
22	Jatinegara II	PRX	2,471	0.044	108.72
23	Cawang	PRX	484	0.058	28.07
24	Pasar Rebo	MCX	233	0.081	18.87
25	Tebet	PRX	2,901	0.046	133.45
26	Gandaria	MCX	234	0.184	43.06
	Total	-	93,511	(Weighted Average) 0.068	6,359.40

*Note: Figures for December, 1979.

Table II - 6 Exchange List in 1983 (1/2)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
1	Kota I	EMD	9,700	0.085	824.5
2	Kota II A	PRX	5,900	0.055	324.5
3	Kota II B	PRX	5,900	0.055	324.5
4	Kota II C	PRX	5,900	0.055	324.5
5	Kota II D	PRX	5,900	0.055	324.5
6	Cengkareng	PRX	4,000	0.045	180.0
7	Pluit A	PRX	4,000	0.050	200.0
8	Pluit B	New	5,000	0.050	250.0
9	Ancol A	PRX	4,000	0.050	200.0
10	Ancol B	New	2,000	0.050	100.0
11	Tegal Alur	New	1,000	0.060	60.0
12	Gambir I A	EMD	9,700	0.070	679.0
13	Gambir I B	EMD	9,400+300*	0.070+0.200*	718.0
14	Gambir I C	PRX	4,600	0.070	322.0
15	Gambir I D	PRX	4,600	0.070	322.0
16	Gambir II A	PRX	4,600	0.070	322.0
17	Gambir II B	PRX	4,600	0.070	322.0
18	Gambir II C	New	15,000	0.070	1,050.0
19	Gambir II D	New	8,000	0.070	560.0
20	Semanggi I A	EMD	5,800	0.060	348.0
21	Semanggi I B	New	3,000	0.060	180.0
22	Semanggi II A	PRX	4,600	0.070	322.0
23	Semanggi II B	New	3,000	0.070	210.0
24	Slipi A	EMD	5,000	0.045	225.0
25	Slipi B	New	6,000	0.045	270.0
26	Pal Merah A	PRX	4,000	0.040	160.0
27	Pal Merah B	New	2,000	0.040	80.0
28	Kedoya	New	3,000	0.030	90.0
29	Meruya	New	1,000	0.030	30.0

*Note: GBDID

Table II - 6 Exchange List in 1983 (2/2)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
30	Cempaka Putih A	PRX	6,000	0.045	270.0
31	Cempaka Putih B	New	7,000	0.045	315.0
32	Rawamangun A	PRX	7,200	0.045	324.0
33	Rawamangun B	New	3,000	0.045	135.0
34	Tanjung Priok A	PRX	5,000	0.065	325.0
35	Tanjung Priok B	New	3,000	0.065	195.0
36	Kelapa Gading	New	3,000	0.040	120.0
37	Cilincing	New	3,000	0.055	165.0
38	Penggilingan	New	4,000	0.050	200.0
39	Kebayoran A	EMD	9,700	0.045	436.5
40	Kebayoran B	PRX	7,200	0.045	324.0
41	Kebayoran C	PRX	7,200	0.045	324.0
42	Ciputat	EMD	2,000	0.035	70.0
43	Cipete	PRX	8,000	0.035	280.0
44	Pasar Minggu	EMD	2,000	0.035	70.0
45	Kalibata	PRX	7,200	0.045	324.0
46	Jagakarsa	New	1,000	0.035	35.0
47	Jatinegara A	PRX	6,500	0.050	325.0
48	Jatinegara B	New	7,000	0.050	350.0
49	Cawang A	PRX	4,000	0.065	260.0
50	Cawang B	New	3,000	0.065	195.0
51	Pasar Rebo	New	3,000	0.040	120.0
52	Tebet	PRX	7,200	0.045	324.0
53	Gandaria	New	2,000	0.050	100.0
54	Klender	New	2,000	0.040	80.0
	Total	-	271,700	(Weighted Average) 0.0552	14989.0

Table II - 7 Exchange List in 1987 (1/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
1	Kota I	New	12,000	0.080	960.0
2	Kota II A	PRX	5,900	0.055	324.5
3	Kota II B	PRX	5,900	0.055	324.5
4	Kota II C	PRX	5,900	0.055	324.5
5	Kota II D	PRX	5,900	0.055	324.5
6	Kota II E	New	8,000	0.055	440.0
7	Cengkareng A	PRX	4,000	0.040	160.0
8	Cengkareng B	New	4,000	0.040	160.0
9	Pluit A	PRX	4,000	0.050	200.0
10	Pluit B	New	8,000	0.050	400.0
11	Ancol A	PRX	4,000	0.050	200.0
12	Ancol B	New	5,000	0.050	250.0
13	Tegal Alur	New	3,000	0.055	165.0
14	Gambir I A	EMD	9,700	0.070	679.0
15	Gambir I B	EMD	9,300+400*	0.070+0.200*	731.0
16	Gambir I C	PRX	4,600	0.070	322.0
17	Gambir I D	PRX	4,600	0.070	322.0
18	Gambir II A	PRX	4,600	0.070	322.0
19	Gambir II B	PRX	4,600	0.070	322.0
20	Gambir II C	New	15,000	0.070	1,050.0
21	Gambir II D	New	13,000	0.070	910.0
22	Semanggi I A	EMD	5,800	0.065	377.0
23	Semanggi I B	New	7,000	0.065	455.0
24	Semanggi II A	PRX	4,600	0.070	322.0
25	Semanggi II B	New	7,000	0.070	490.0

*Note: GBDID

Table II - 7 Exchange List in 1987 (2/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
26	Slipi A	EMD	5,000	0.040	200.0
27	Slipi B	New	15,000	0.040	600.0
28	Pal Merah A	PRX	4,000	0.040	160.0
29	Pal Merah B	New	4,000	0.040	160.0
30	Kedoya	New	6,000	0.030	180.0
31	Meruya	New	4,000	0.025	100.0
32	Cempaka Putih A	PRX	6,000	0.050	300.0
33	Cempaka Putih B	New	11,000	0.050	550.0
34	Rawamangun A	PRX	7,200	0.045	324.0
35	Rawamangun B	New	6,000	0.045	270.0
36	Tanjung Priok A	PRX	5,400	0.060	324.0
37	Tanjung Priok B	New	7,000	0.060	420.0
38	Kelapa Gading	New	8,000	0.040	320.0
39	Cilincing	New	5,000	0.060	300.0
40	Penggilingan	New	7,000	0.055	385.0
41	Kebayoran A	EMD	9,700	0.045	436.5
42	Kebayoran B	PRX	7,200	0.045	324.0
43	Kebayoran C	PRX	7,200	0.045	324.0
44	Ciputat	EMD	4,000	0.035	140.0
45	Cipete	PRX	8,000	0.035	280.0
46	Pasar Minggu	EMD	4,000	0.035	140.0
47	Kalibata A	PRX	8,000	0.040	320.0
48	Kalibata B	New	4,000	0.040	160.0
49	Jagakarsa	New	3,000	0.035	105.0

Table II - 7 Exchange List in 1987 (3/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
50	Jatinegara A	PRX	6,500	0.050	325.0
51	Jatinegara B	New	12,000	0.050	600.0
52	Cawang A	PRX	4,000	0.065	260.0
53	Cawang B	New	8,000	0.065	520.0
54	Pasar Rebo	New	5,000	0.040	200.0
55	Tebet A	PRX	7,200	0.045	324.0
56	Tebet B	New	3,000	0.045	135.0
57	Gandaria	New	4,000	0.050	200.0
58	Klender	New	5,000	0.040	200.0
	Total	-	376,200	(Weighted Average) 0.0535	20,121.5

Table II - 8 Exchange List in 1993 (1/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
1	Kota I	New	15,000	0.080	1200.0
2	Kota II A	PRX	6,500	0.050	325.0
3	Kota II B	PRX	6,500	0.050	325.0
4	Kota II C	PRX	6,500	0.050	325.0
5	Kota II D	PRX	6,500	0.050	325.0
6	Kota II E	New	11,000	0.050	550.0
7	Cengkareng A	PRX	4,000	0.035	140.0
8	Cengkareng B	New	14,000	0.035	490.0
9	Pluit A	PRX	4,000	0.045	180.0
10	Pluit B	New	13,000	0.045	585.0
11	Ancol A	PRX	4,000	0.045	180.0
12	Ancol B	New	13,000	0.045	585.0
13	Tegal Alur	New	5,000	0.045	225.0
14	Gambir I C	PRX	4,600	0.070	322.0
15	Gambir I D	PRX	4,600	0.070	322.0
16	Gambir I E	New	24,000	0.070	1680.0
17	Gambir II A	PRX	4,600	0.070	322.0
18	Gambir II B	PRX	4,600	0.070	322.0
19	Gambir II C	New	15,000	0.070	1050.0
20	Gambir II D	New	17,000	0.070	1190.0
21	Semanggi I A	EMD	5,800	0.070	406.0
22	Semanggi I B	New	13,000	0.070	910.0
23	Semanggi II A	PRX	5,000	0.065	325.0
24	Semanggi II B	New	18,000	0.065	1170.0
25	Slipi A	EMD	5,000	0.040	200.0
26	Slipi B	New	22,000	0.040	880.0
27	Pal Merah A	PRX	4,000	0.035	140.0
28	Pal Merah B	New	12,000	0.035	420.0

Table II - 8 Exchange List in 1993 (2/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
29	Kedoya	New	12,000	0.025	300.0
30	Meruya	New	8,000	0.025	200.0
31	Cempaka Putih A	PRX	5,900	0.055	324.5
32	Cempaka Putih B	New	11,000	0.055	605.0
33	Cempaka Putih C	New	13,000	0.055	715.0
34	Rawamangun A	PRX	8,000	0.040	320.0
35	Rawamangun B	New	12,000	0.040	480.0
36	Tanjung Priok A	PRX	5,900	0.055	324.5
37	Tanjung Priok B	New	10,000	0.055	550.0
38	Kelapa Gading	New	13,000	0.050	650.0
39	Cilincing	New	10,000	0.065	650.0
40	Penggilingan	New	11,000	0.060	660.0
41	Kebayoran A	EMD	9,700	0.040	388.0
42	Kebayoran B	PRX	8,000	0.040	320.0
43	Kebayoran C	PRX	8,000	0.040	320.0
44	Kebayoran Lama	New	7,000	0.030	210.0
45	Ciputat A	EMD	4,000	0.030	120.0
46	Ciputat B	New	2,000	0.030	60.0
47	Cipete A	PRX	8,000	0.025	200.0
48	Cipete B	New	11,000	0.025	275.0
49	Pasar Minggu A	EMD	4,000	0.030	120.0
50	Pasar Minggu B	New	3,000	0.030	90.0
51	Kalibata A	PRX	8,000	0.035	280.0
52	Kalibata B	New	16,000	0.035	560.0
53	Jagakarsa	New	5,000	0.035	175.0

Table II - 8 Exchange List in 1993 (3/3)

No.	Exchange	Type of Switching System	Number of Lines	Originating Calling Rate (Erl.)	Total Originating Traffic (Erl.)
54	Jatinegara A	PRX	6,500	0.050	325.0
55	Jatinegara B	New	12,000	0.050	600.0
56	Jatinegara C	New	8,000	0.050	400.0
57	Cawang A	PRX	4,000	0.060	240.0
58	Cawang B	New	14,000	0.060	840.0
59	Pasar Rebo	New	9,000	0.035	315.0
60	Tebet A	PRX	8,000	0.040	320.0
61	Tebet B	New	10,000	0.040	400.0
62	Gandaria	New	8,000	0.050	400.0
63	Klender	New	8,000	0.040	320.0
	Total	-	569,200	(Weighted Average) 0.0495	28151.0

Table II-9 Inter-Exchange Distance in Km

FROM \ TO	KT1	KT2	CKG	PLT	ANC	TGL	GB1	GB2	SM1	SM2	SLP	PLM	KED	MER	CPP	RMG	TPR	KPG	CLC	PGG	KBY	KBL	CPA	CPE	PSM	KAL	JGA	JTG	CAW	PSR	TBT	GAN	KLD	GBDID			TO \ FROM
KT1		1.8	10.5	3.1	3.7	10.5	5.2	7.7	9.0	10.2	4.5	8.8	7.5	10.4	6.7	10.7	8.6	8.7	12.7	12.5	11.2	12.8	23.1	16.7	16.7	14.4	21.2	11.3	15.2	19.2	10.4	22.2	13.6	5.2			KT1
KT2			11.5	4.7	3.2	11.9	3.6	6.1	7.8	8.9	4.1	8.2	7.9	10.1	5.0	9.1	8.0	7.4	11.9	10.9	10.1	12.0	22.2	15.5	15.2	12.8	19.2	9.6	13.5	11.6	8.7	20.5	11.9	3.6			KT2
CKG				8.0	14.1	3.4	12.6	15.0	13.3	14.2	8.9	10.0	5.5	8.7	15.9	19.7	18.9	18.9	23.1	22.1	13.2	12.7	23.3	17.4	19.3	18.7	23.1	18.8	20.9	23.5	16.8	25.9	21.8	12.6			CKG
PLT					6.5	7.5	7.7	10.3	10.9	12.0	5.3	9.5	6.7	10.4	9.7	13.8	10.9	11.7	15.3	15.7	12.5	13.6	23.9	17.9	18.4	16.5	22.9	14.1	17.6	21.4	12.9	24.1	16.5	7.7			PLT
ANC						13.9	5.9	7.5	10.1	11.2	7.3	11.1	10.9	13.2	5.0	8.5	4.9	5.4	9.1	9.8	12.7	14.8	24.9	18.0	17.3	14.6	21.8	10.2	14.7	19.0	10.1	22.0	11.7	5.9			ANC
TGL							13.8	16.3	15.4	16.4	10.3	12.5	7.9	11.7	16.6	20.7	18.2	19.0	20.7	22.8	15.8	15.6	24.6	20.4	22.0	21.1	26.1	20.3	20.9	26.0	18.6	28.5	21.1	13.5			TGL
GB1								2.7	4.2	5.4	3.7	5.8	7.7	8.4	3.7	7.2	10.0	7.7	13.0	9.8	6.9	9.1	19.1	12.3	11.7	9.2	16.4	6.6	10.0	14.0	5.3	17.0	9.3	~			GB1
GB2									3.6	4.3	6.1	6.8	9.8	9.4	3.4	5.3	10.7	7.5	13.0	8.1	6.4	9.0	18.3	11.0	9.8	7.0	14.4	4.0	7.4	11.6	2.7	14.6	6.9	2.7			GB2
SM1										1.2	5.5	3.8	7.9	6.2	6.9	8.7	14.0	11.1	16.5	11.6	2.8	5.4	14.9	7.8	7.6	5.7	12.2	6.2	7.5	8.8	3.8	13.5	9.4	4.2			SM1
SM2											6.7	3.8	8.8	6.7	7.5	8.9	14.8	11.7	17.1	11.8	2.4	5.0	14.0	6.9	6.4	4.7	11.1	6.1	6.7	9.7	3.6	12.4	9.2	5.4			SM2
SLP												4.3	4.1	6.0	7.2	11.3	12.1	10.8	15.8	13.6	7.0	8.3	18.7	12.5	12.9	11.3	17.5	10.0	12.8	16.3	8.2	19.1	12.9	3.7			SLP
PLM													4.6	2.7	9.3	12.0	15.7	13.5	18.8	14.8	3.4	4.1	14.4	8.5	9.5	8.8	13.8	10.0	11.0	13.6	7.6	16.1	13.1	5.8			PLM
KED														4.1	11.3	14.8	15.8	14.9	19.7	17.4	8.0	6.0	11.7	12.7	14.1	13.4	18.3	13.6	15.4	18.2	11.4	20.7	16.6	7.7			KED
MER															12.0	14.7	12.9	16.0	21.3	17.5	4.9	4.0	13.8	8.7	10.7	10.7	14.5	12.5	13.1	15.2	10.1	17.4	15.8	8.4			MER
CPP																4.1	7.4	4.2	9.6	6.2	9.7	12.2	21.6	14.4	13.1	9.9	17.5	5.2	9.7	14.1	5.5	17.3	6.9	3.7			CPP
RMG																	9.1	4.9	9.3	2.9	11.3	13.9	22.0	14.9	12.6	9.2	16.7	3.4	7.9	12.3	5.4	15.3	3.2	7.2			RMG
TPR																		4.3	4.7	8.7	16.8	19.1	28.8	21.8	20.5	17.3	24.9	12.0	16.7	21.1	12.8	24.2	12.3	10.0			TPR
KPG																			5.4	4.8	14.0	16.5	25.8	18.5	16.8	13.6	21.2	8.0	12.7	17.1	9.3	20.2	8.0	7.7			KPG
CLC																				7.6	19.4	21.8	31.0	23.8	21.9	18.5	26.0	12.8	17.3	21.5	14.3	24.5	11.9	13.0			CLC
PGG																					14.2	16.8	24.6	17.6	15.1	11.7	18.9	6.0	10.0	14.1	8.3	17.0	4.3	9.8			PGG
KBY																						2.7	12.3	5.7	6.3	5.9	10.7	8.4	8.3	10.4	6.0	12.8	11.6	6.9			KBY
KBL																							10.3	4.7	4.8	7.5	10.3	11.1	10.3	11.6	8.7	13.5	14.1	9.1			KBL
CPA																								7.2	9.7	12.9	8.0	18.7	15.3	13.1	16.8	12.7	20.9	19.1			CPA
CPE																									3.5	6.2	5.8	11.5	9.8	8.3	9.5	9.5	14.0	12.3			CPE
PSM																										3.4	4.7	9.2	5.6	4.9	7.7	6.7	11.2	11.7			PSM
KAL																											7.7	5.9	2.7	5.1	4.6	7.9	7.9	9.2			KAL
JGA																												13.2	8.9	5.4	12.1	4.7	14.6	16.4			JGA
JTG																													4.8	9.2	2.7	12.3	2.9	6.6			JTG
CAW																														4.6	4.8	7.5	5.8	10.0			CAW
PSR																															8.9	3.2	9.7	14.0			PSR
TBT																																12.1	5.6	5.3			TBT
GAN																																	12.7	17.0			GAN
KLD																																		9.3			KLD
GBDID																																					GBDID
																																					TOTAL