CHAPTER 3 SOCIO-ECONOMIC FACTORS IN RURAL AREAS AND TELECOMMUNICATIONS

CHAPTER 3 Socio-Economic Factors in Rural Areas and Telecommunications

3-1 Present States of the Rural Areas

The present states of the rural areas in Indonesia are summarized as follows:

1) Agriculture

1) There exist many poor farmers of small scale operations. (average farming area of 0.25 ha)

2) They operate in labor intensive production methods. Labor force is mainly supplied by family members (The 58% of all employed workers in the rural areas are engaged in farming)

3) They earn low money income. Approximately farms make a half of what non farmers can make.

4) There exist many disguised unemployed people. The 25% of farm employees work less than 24 hours in a week.

5) Social overhead capital such as irrigation facilities is not well supplied.

6) Labor force in young generations tends to move out of the rural areas.

7) Farming techniques are fairly underdeveloped.

8) Farms maintain high degree of self-sufficient production. They do not generally produce items which can be sold in markets.

9) Shipping and sales through cooperatives are not well organized.

2) Commercial Business

1) There are not many retail stores they do not keep many goods. Commodity circulation rates are also slow.

2) Retail store owners do not in general possess good knowledge of commodities. Qualities of commodities are usually not of high grades.

3) Administration

1) Local administrations receive orders of the central administration offices only and do not generally transmit wants and needs of local people to the central administration.

2) Many local administration offices exchange information by messengers and short-wave radios.

3) Instructions and supervision on development policies, welfare policies, educational policies are slow to be transmitted and poorly communicated.

4) Standard of Living

1) Medical services are poorly supplied.

2) Educational standard is low.

3) The rural areas keep closed communication systems and do not have wide interactions with other local areas.

4) Exchange of information or communication among people is usually done by letters or face-to-face meetings of people or messengers.

5) There are not many entertainment facilities.

5) Industry

1) There exist unskilled craftsmen who can only repair minor problems of farming equipments. There also exist some rice mills.

2) There also exist traditional craftsmen who are engaged in home manufacturing.

ANNEX 3-1-1 - 3-1-9 show basic data to compare urban and rural situations. Urban areas have much higher levels in income, social overhead capital, education etc.

Many people migrate to urban areas in hoping to obtain the same standard of living the current urban people are enjoying. Employment opportunities in urban areas are, however, not enough to be able to provide jobs to new migrants. Further urban migration may create social instability because traditional social structures in the rural areas change too rapidly for rural people to adjust themselves. Development of the rural areas is, therefore, inevitable through the transmigration policy.

3-2 Socio-economic Framework up to the year 2000

1) After 1990 the growth of the secondary industry will reach a "momentum" in such a way so that it may constitute as self generating dynamics.

2) In such condition GDP up to the year 2000 is expected to achieve an order of 5% per annum.

3) If the fertility rate decreases by 25% where as GDP increases at 5% per annum during the period of 1980 up to 2000, the Indonesian standard of living in terms of per capita income will be US$ 1,030 in 2000 (price standard 1981).

4) The role of agricultural sector in the national economy will diminish from 40% in 1973 to 27% in 1990 and them will continue to diminish down to 22% in 2000. On the other hand, the services sector will increase its share in GDP, will grow from 38% in 1973 to 42% in 1990 and grows further to 45% in 2000.

5) Population growth rate is predicted to 2.06% per annum from 1980 to 2000. Population will increase from 148 million in 1980 to 223 million in 2000.
Refer to Figure 3-2-1.

6) Table 3-2-1 shows how population share charges in each main islands.

Table 3-2-1: Population Share Changes in Main Islands (%)

Island	1971	1980	2000
Jawa	63.83	61.88	56.75
Sumatera	17.75	19.00	23.09
Kalimantan	4.32	4.56	5.37
Sulawesi	7.15	7.65	7.19
Others	7.25	7.51	7.60

7) Urban population share will increase from 22.4% in 1980 to 37% in 2000. Table 3-2-2 shows how urban population shares change in main islands.

Table 3-2-2 Changes of Urban Population Shares (%)

Island	1971	1980	2000
Jawa	18.0	25.1	46.4
Sumatera	17.1	19.6	26.0
Kalimantan	20.4	21.5	24.2
Sulawesi	16.1	16.8	18.5
Others	31.6	27.5	33.5
Indonesia	17.3	22.4	37.1

8) Electricity will be provided to all desa by the year 2000. Refer to ANNEX 3-2-1.

3-3 Planning Outlines of Rural Area Development Policies

The following points are often mentioned as characteristics of the rural areas.

1) large primary sector share
2) low income level
3) small social overhead capital stock
4) low population density
5) located far from administrative centers
6) large administrative area
7) high development costs due to geographical and meteorological conditions.

etc.

The Indonesian government plans to solve the problems, which are often created by the above rural characteristics, by classifying desa into three categories so that different policies can be employed. Three classifications are

A. SWA SEMBADA (Partially Developed)
infrastructure exists, small scale industries in operation, education at an acceptable level.

B. SWA KARYA (Initial Development Stage)
infrastructure underdevelopment, industry at the initial stage, education facilities below average.

C. SWA DAYA (Underdeveloped)
no development yet, follows traditional pursuits, educational facilities poor.

The fundamental development strategy is firstly to increase employment opportunities by expanding production, secondly to implement policies which promote improved production techniques, thirdly to increase nutritional level, health level and educational level through welfare policies, and finally to provide more hospitals, schools, and telecommunication services.

3-4 Socio-economic Effects of Rural Telecommunication Network.

Main media of communications in rural areas are face to face meetings, messengers, letters, telegraphs, short-wave radios and manual telephone services. Effects of automatic telephone services in the rural areas will be as follows;

A. Administration
   1) Cost savings through abolishing the existing short-wave radio systems
   2) Cost savings through diminished frequencies of face-to-face meetings and messenger services.
   3) Increase in administrative efficiency due to faster transmission of information.
   4) Increase in accuracy and secrecy in transmitting information

B. Industry
   1) Decrease of information costs in industrial and agricultural operations
   2) Increase in efficiency of inventory management
   3) Increase in speed of commodity orders
   4) Increase in profit opportunities due to expanded transaction areas
   5) transformation from the closed self-sufficient economy to the nationwide inter-regional economy
   6) Restructuring of cooperative systems.

C. Living standards

1) Expansion of individual activity areas
2) Increase of efficiency in consumption activities
3) Increase in speed of contacting medical doctors
4) Increase in speed of asking for aids in case of natural disasters.

Effects of telecommunications are predicted to be much smaller in rural areas than in urban areas because (A) people in rural areas are not generally accustomed to utilize information efficiently and (B) social and economic structures in rural areas are not generally organized in such a way that information plays a role of catalyst in relating one socio-economic factor to other factors to generate compound effects.

It will be necessary to make efforts in creating a socio-economic structure in which information plays a catalystic role as well as constructing telecommunication network systems. Cost comparison of communication media were made for the sample areas (the detailed discussion can be found in chapter 8). The cost effect of automatic telephone services increases rapidly as communication distance increases in comparison with other existing media.

CHAPTER 4 SUBSCRIBER DEMAND AND CALL DEMAND ANALYSIS

CHAPTER 4 SUBSCRIBER DEMAND AND CALL DEMAND ANALYSIS

To estimate telephone subscriber demand on Kabupaten basis, analysis was made, using Kabupaten model based on statistical data of Indonesia and field survey findings. Also, to estimate telephone subscriber demand in the whole of Indonesia, analysis was made, using international model based on 10-year (1973-1982) statistical data of 20 countries. Furthermore, to analyze and estimate telephone call demand in the whole of Indonesia and on Province basis, Province level call demand model was formulated, using statistical data of each Province.

4-1 Kabupaten Level Subscriber Demand

For analytical estimate of Kabupaten level telephone subscriber demand both at present and in the year 2000, Kabupaten level subscriber demand function (i.e., Kabupaten model) was formulated. This was based of statistical data obtained in specially selected five Provinces, 10 Kabupatens and 69 Kecamatans, as well as field survey findings.

4-1-1 Definition

Telephone subscriber demand is defined as total number of telephone owner corporations and individuals in a certain Kabupaten in a certain year, plus total number of corporations and individuals who do not yet own telephone but desire to do so and who are considered to be able to bear telephone installation and maintenance expenses.

4-1-2 Theoretical Study

In consideration of variables likely to exert influence on telephone subscriber demand, including price effect, income effect and other socio-economic indices, in the correlations of telecommunications and socio-economic activities, subscriber demand function is formulated as under.

$$D = f\ (C,\ S,\ P,\ Inc,\ X)\quad Pop \quad \ldots\ldots\ldots \quad (4\text{-}1)$$

where

D : Telephone subscriber demand
C : Call charge
S : Subscription fee
P : General price
Inc : Income (GRDP)
X : Socio-economic variable else than the above, considered to exert influence on D
Pop : Population

4-1-3 Data Used

To presume the above formula 4-1, announced statistical data of various kinds and data collected by field surveys in Indonesia were used.

(1) Field Surveys

Field surveys were carried out at Kecamatan level during the period from the closing part of September to late December 1984. Data obtained were assorted at Kabupaten level. Following is an outline of proceedings:

1) Province Selection

A total of five Provinces, i.e., Jawa and Sumatera plus one Province each out of Kalimantan, Sulawesi and Maluku islands, were selected as typical rural Provinces. These five Provinces were used as sample areas.

2) Kabupaten Selection

Out of the five selected Provinces, as many Kabupatens as possible, considered to be typically rural area, were selected at random within the time length available. Selection was made in consideration of i) whether automatic or manual exchange exists or not, ii) whether Kecamatan that comprises urban village* exists or not, and iii) geographic characteristics (sea shore, mountain, river, etc.)

3) Selection Results

From Sumatera, Jawa, Kalimantan, Sulawesi and Maluku islands, five Provinces and 10 Kabupatens were selected, and out of these 10 Kabupatnes, 69 Kecamatans were selected at random.

- Sumatera
  - Province Riau - Kabupaten Indragiri Hulu - 7 Kecamatans
  - Kabupaten Kampar - 8 Kecamatans

- Jawa
  - Province Jawa Tengga -
    - Kabupaten Cilacap - 10 Kecamatans
    - Kabupaten Banyumas - 10 Kecamatans
    - Kabupaten Purbalingga - 10 Kecamatans

*Note: This is defined by Biro Pusat Statistik in 1980

- Kalimantan

  Province Kalimantan Selatan -

  Kabupaten Hulu Sei Selatan -

  5 Kecamatans

  Kabupaten Hulu Sei Tengah -

  5 Kecamatans

- Sulawesi

  Province Sulawesi Selatan -

  Kabupaten Sinjai -

  5 Kecamatans

  Kabupaten Pankep -

  5 Kecamatans

- Maluku

  Province Maluku - Kabupaten Maluku Tengah -

  4 Kecamatans

These 69 Kecamatans constitute the maximum number of Kecamatans where survey could be made within the time length available.

4) Potential Subscriber Classification

In the subscriber demand study covering the 69 Kecamatans, potential subscribers were classified into four categories. They are:

a) Public subscribers (A)

   Military, police and administrative organizations (include PCO)

b) Public subscribers (B)

   Public/social service facilities (postal service, medical service and educational institutions)

c) Industrial subscribers

Corporations or individuals engaged in primary, secondary and tertiary industries

d) Residential subscribers

Individuals with financial capability to bear expenses

5) Potential Subscriber Calculation

For the foregoing four categories of potential subscribers, at field calculation was made. Calculation standards are as under:

a) Public subscribers (A)

Number of military, police and administrative organizations

b) Public subscribers (B)

Number of post offices, hospitals, clinics and high schools

c) Industrial subscribers

Number of large and medium scale factories and merchant houses

d) Residential subscribers

Number estimated by each Kecamatan Office

6) Potential Subscriber Assortment at Kabupaten Level

So as to study subscriber demand in as many Kabupatens as possible within the time length available, demand survey was not made for all Kecamatans in each Kabupaten. Instead, the survey was made for average 60% of Kecamatans per Kabupaten, selected by sampling.

Based on data obtained, and by population ratio elsewhere than Kabupaten capitals, Kecamatans having automatic/manual exchanges and Kecamatans that assume strategic importance for local development, the number of potential subscribers in Kecamatans not covered by field demand survey was estimated.

Then, the estimates were assorted at Kabupaten level. Meanwhile, for Kecamatans where automatic or manual exchanges exist, PERUMTEL data were consulted.

The number of potential subscribers by subscriber categories, covering each of 10 Kabupatens, which was obtained by the foregoing proceedings, is used for object variable D on the left side of formula 4-1 introduced in Section 4-1-2.

(2) Statistical Data

Independent variables on the right side of formula 4-1 introduced in Section 4-1-2 are based on announced statistical data of various kinds.

1) Income (GRDP: Gross Regional Domestic Product)

a) Calculation was made for 1975-80 income ratio of each Province to national income, and its arithmetic mean was obtained. (Income calculation was at price level as of 1975.)

b) National income of 1984 in real terms (based on 1975 price level) was distributed to each Province by the arithmatic mean mentioned above. Real income of 1984 at Province level was thus obtained.

c) Real income of 1984 at Province level was distributed to each Kabupaten by 1984 Kabupaten population ratio to Province population. Real income of 1984 at Kabupaten level was thus obtained.

d) Province income distribution to each Kabupaten was by population ratio. At the same time, for gainfully occupied persons ratio, TV ownership ratio, radio ownership ratio, bicycle ownership ratio and tax revenue ratio also, calculation was made for the year 1980 as relevant statistics were available for that year. Calculation results for these ratios were compared with population ratio. As a consequence, almost the same value as population ratio was obtained for all those indices. Hence population ratio which can be utilized every year by time series was used.

2) Population (Kabupaten)

Based on 1961, 1971 and 1980 census data, calculation was made for average annual population growth rate of each Kabupaten, and, using the growth rate thus obtained, each Kabupaten population up to the year 2000 was calculated. Furthermore, in order to have the aggregation of each Kabupaten population well balanced with the estimated national population of Indonesia as of 2000 (Central Statistics Bureau data), ex post facto adjustment was made for each Kabupaten population.

4-1-4 Regression Analysis

Using cross section data of 1984 concerning sample areas and 10 Kabupatens as reference areas, prepared in Section 4-1-3, regression analysis by method of least squares was carried out for each potential subscriber category. Sample data of 10 Kabupatens are given in ANNEX 4-1-1.

(1) Results of Analysis

Results of regression analysis by potential subscriber categories follow:

1) Public Demand (A) (PDA)

$$\log PDA = -7.378 + (1.090 - 0.01315 \log PD) \cdot \log Pop \quad \ldots (4\text{-}2)$$
$$(5.323)^{**} \quad (-1.993)$$

$R = 0.904$

2) Public Demand (B) (PDB)

$$\log PDB = -13.21 + (1.448 - 0.02239 \log PD) \cdot \log Pop \quad \ldots (4\text{-}3)$$
$$(6.801)^{**} \quad (-3.262)^{*}$$

$R = 0.934$

3) Industrial Demand (ID)

$$\log ID = 0.307 + 0.0197 \log inc \cdot \log Pop \quad \ldots (4\text{-}4)$$
$$(4.699)^{**}$$

$R = 0.857$

4) Residential Demand (RD)

$$\log RD = -14.89 + 0.1401 \log \frac{Inc}{Pop} \cdot \log Pop \quad \ldots (4\text{-}5)$$
$$(8.852)^{**}$$

$R = 0.953$

where

a) log : Natural logarithm operator
b) Inc : Real income at Kabupaten level (Rupiah, 1975 price)
c) Pop : Total population of Kabupaten
d) PD : Population density of Kabupaten (population/km^2)
e) R : Multiple correlation coefficient
f) Figure in parentheses presents t value.
** is significant within 1% on both sides.
* is significant within 5% on both sides.
g) All the foregoing demand functions are formularized by logarithm so that Pop coefficient indicates demand elasticity to population.

(2) Study on Results of Analysis

Study is made on demand functions by demand categories obtained by regression analysis.

1) Public Demand (A)

With demand function PDA, as population increases by 1%, public organization subscribers increase by (1.090 - 0.01315 log PD)%. Demand elasticity varies in reverse proportion to the degree of population density. When population density heightens, the number of population that can be covered by one public organization increases. Consequently, the number of public organizations to be established can be smaller than other wise necessary. Hence the demand size reduction compared with population. Mean demand elasticity value in 10 sample Kabupatens is 1.0257.

2) Public Demand (B)

With demand function PDB, as population increases by 1%, social establishment subscribers increase by (1.448 - 0.02239 log PD)%. In this case also, demand elasticity varies in reverse proportion to the degree of population density. The reason is the same as in 1) above. Mean demand elasticity value in 10 sample Kabupatens is 1.3385.

3) Industrial Demand

With demand function ID, as population increases by 1%, industrial subscribers increase by (0.03169 log Inc)%. Demand elasticity varies in regular proportion to income increase or decrease. Mean demand eleaticity value in 10 sample Kabupatens is 0.3354.

4) Residential Demand

With demand function RD, as population increases by 1%, residential subscribers increase by $(0.1401 \log \frac{Inc}{Pop})$%. Demand elasticity varies in regular proportion to income per capita increase or decrease. Mean demand elasticity value in 10 sample Kabupatens is 1.6078.

In this study, cross section data of 10 sample Kabupatens as of 1984 were used so that call charge and subscription fee remained constant. These two factors could not be used as variables.

Also, in this study, indices considered to characterize rural areas, such as *rural literacy rate, *rural TV ownership, urban-*rural population ratio, *rural education degree and *rural radio ownership, were used as independent variables, besides income, population and population density. However, significant results could not be obtained. Thus, for independent variables, characteristic variables for rural areas were not adopted. The difference in demand functions between urban and rural areas is assumed to derive from the difference in population elasticity.

On the whole, all those demand functions hold theoretical conformity and their multiple correlation coefficient is also high. Therefore, using those demand functions the countrywide Kabupaten level demand classified by demand categories is to be estimated up to the year 2000.

4-1-5 Countrywide Kabupaten Level Demand As of 2000

By the previously introduced estimation formulas demand as of 1984 and 2000, classified by demand categories, was estimated. Kabupaten level demand estimates are aggregated into Province level demand estimates, and Province level demand estimates are aggregated into island level and countrywide demand estimates.

*Note: "Rural" in this is defined by Biro Pusat Statistiks in 1980

(1) Estimation Results

The number of all-Kabupaten (exclude Kotamadya) potential subscribers as of 2000 is estimated at 1,364,000. If this demand can be wholly fulfilled, telephone density become 0.68 (per 100 persons out of all-Kabupaten population). For the whole of Indonesia, telephone density becomes 2.20 (per 100 persons out of the country's whole population) and for all-Kotamadya, 15.19 (per 100 persons out of all-Kotamadya population). Detailed demand estimates are given in ANNEX 4-1-2 and 4-1-3.

When all-Kabupaten potential subscribers are distributed to 65,000 Desas in the country, the average number of subscribers per Desa in the year 2000 becomes 20.98. The breakdown follows:

- Public demand category (A)
  Average 2.20 subscribers/Desa
- Public demand category
  Average 0.45 subscribers/Desa
- Industrial demand category
  Average 4.80 subscribers/Desa
- Residential demand category
  Average 13.53 subscribers/Desa

Actually, nearly half the total demand in each Kabupaten is concentrated in Kabupaten capital. Therefore, demand distributed to Desas in the periphery of Kabupaten capital is about half the number shown above for each demand category.

Foregoing are the demand estimates obtained by use of cross section data of 10 sample Kabupatens as of 1984. Therefore, dynamic elements used are limited to population and income variables.

Structure factor also is not tested concerning to what extent it is dynamically stable.
Consequently, when Kabupaten level individual projects are to be implemented, in-depth demand survey should precede whereby to make sure of demand estimates.

4-2 Nationwide subscriber demand

Analysis and estimation of the nationwide telephone subscriber demands in Indonesia were conducted formulating a worldwide level of telephone demand function (termed as an international model) based on a variety of officially announced statistic data in 20 countries for 10 years (1973 - 1982).

4-2-1 Theoretical study

As a result of analysis conducted on demand and supply relation of telephone subscription, the following facts have been made clear. More and more telephones are supplied, more demands are motivated. In other words, as the conveniency of telephone is widely recognized through demonstrative effect, its extensive prevalence will enhance function as a telephone network as well as intensifying dependency on the telephone. However, as the supply reaches a certain degree of saturation, growth of demand begins to stagnate, then both demand and supply reach a saturation point, which is estimated approx. 70 per 100 inhabitants in main telephone density according to analysis. Figure 4-2-1 and 4-2-2 show typical transition status of demand and supply. In this case, the demand represents substantial volume of telephone demands subtracting amount of demands realized by supply.

The international level, telephone subscriber demand function, which satisfies the above demand and supply mechanism, has been formulated as follows:

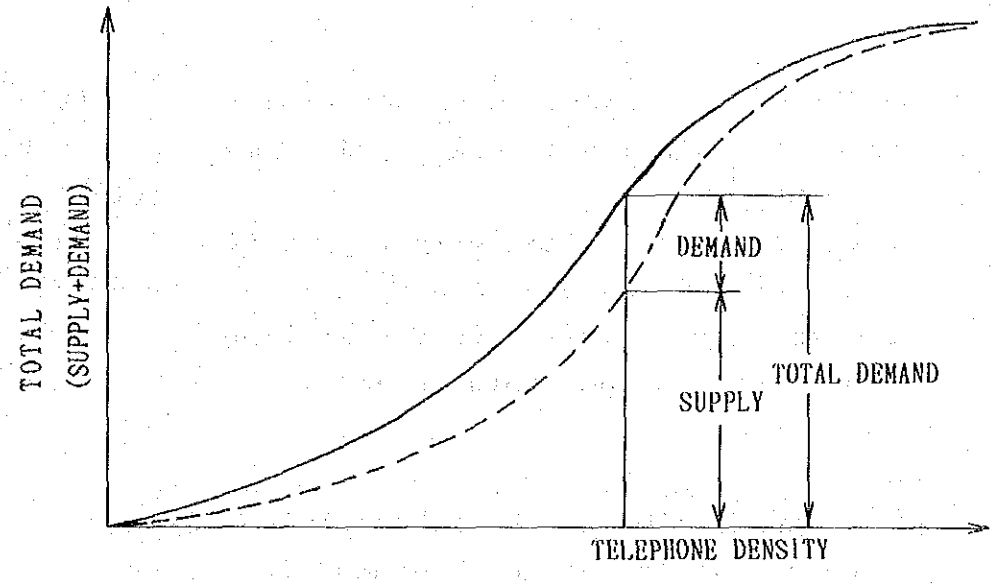


Figure 4-2-1 Relation between Telephone Density and Total Demand

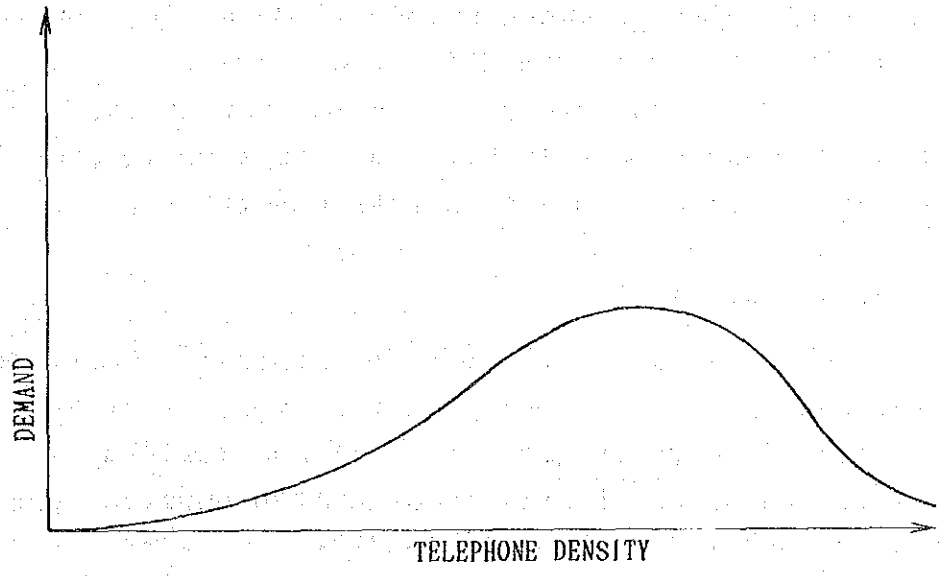


Figure 4-2-2 Relation between Telephone Density and Demand

$$MLA_t + NA_t + W_t = A_t(MPS_t - ML_{t-1}) \quad \ldots \quad (4\text{-}6)$$

where,

ML_t	:	Number of main lines in t year time	$(x10^6)$
ML_{t-1}	:	Number of main lines in t-1 year time	$(x10^6)$
MLA_t	:	$ML_t - ML_{t-1}$	$(x10^6)$
NA_t	:	Number of new applicants in t year time	$(x10^6)$
W_t	:	Number of waiting applicants in t year time	$(x10^6)$
A_t	:	Adjustment coefficient in t year time	
MPS_t	:	Mother group of possible demand in t year time	$(x10^6)$

Supplemental explanation to the above variables:
MPS_t represents a mother group of demand in t year time subject to the international marginal telephone density which is previously estimated approx. 70 per 100 inhabitants in main telephone density.
Variable At is an adjustment coefficient to determine how much percent of the remnant should be accounted for as the demands within the fiscal term after subtracting realized value (ML_{t-1} among number of Main Lines up to previous fiscal term) from MPS_t, i.e., MPS_t - ML_{t-1}. This presumably depends on the variables, which give impacts on telephone subscription demands in price effect, income effect, prevalence effect, etc.

4-2-2 Regression analysis

The regression analysis was made by minimal involution pooling the data of telecommunication indexes of 20 countries for 10 years (1973 - 1982) and various officially announced statistic data (200 observations) regarding social and economic indexes.

(1) Results of analysis

Results of analysis are as shown below:

$$\log (MLA_t + NA_t + W_t) = -2.86 - \underset{(-8.39)**}{0.408} \log SF_t + \underset{(6.0)**}{0.384} \log(\frac{GDP_t}{POP_t}) + \underset{(12.42)**}{0.590} \log (\frac{ML_{t-1}}{MPS_t}) + \log (MPS_t - ML_{t-1}) \quad .. \quad (4-7)$$

$$R = 0.875$$

or

$$MLA_t + NA_t + W_t = e^{-2.86} \cdot SF_t^{-0.408} \cdot (\frac{GDP_t}{POP_t})^{0.384} \cdot (\frac{ML_{t-1}}{MPS_t})^{0.590} \cdot (MPS_t - ML_{t-1}) \quad .... \quad (4-8)$$

where,

1) log is a natural logarithm operator
2) ML_t is the number of Main Lines in t year time ($x10^6$)
3) ML_{t-1} is the number of Main Lines in t-1 year time ($x10^6$)
4) MLA_t is $ML_t - ML_{t-1}$ ($x10^6$)
5) NA_t is the number of new applicants in t year time ($x10^6$)
6) W_t is the number of waiting applicants in t year time ($x10^6$)
7) SF_t is real average subscription fee per Main Line in t year time (US$, 1975 price)
8) GDP_t is real GDP in t year time ($x10^6$ US$, 1975 price)
9) POP_t is population in t year time ($x10^6$)

10) MPS_t is mother group of possible demand in t year time = POP_t x 0.7 ($x10^6$)

11) R is a multi-correlation coefficient

12) Figure in ( ) represents t value, ** denotes significant within 1% on both sides

Data used for this analysis weres obtained from 20 countries, which are provided with complete data, among the countries listed in Yearbook of Common Carrier Telecommunications Statistics (11 edition)(Chronological Series 1973 - 1982), published by ITU, and ANNEX 4-2-1 and 4-2-2 show these countries and relevant data respectively.

(2) Examination of results

From equation (4-6) and (4-8), the following equation was obtained:

$$A_t = e^{-2.86} \cdot SF_t^{-0.408} \cdot \left(\frac{GDP_t}{POP_t}\right)^{0.384} \cdot \left(\frac{ML_{t-1}}{MPS_t}\right)^{0.590} \quad \cdots \quad (4\text{-}9)$$

Therefore, the number of applicants ($MLA_t + NA_t + W_t$) may be determined among mother group of possible applicants ($MPS_t - ML_{t-1}$) by the adjustment coefficient A_t, which will be:

1) decreased 0.408% by 1% increase of real average subscription fee per Main Line.

2) increased 0.384% by 1% increase of real GDP per capita.

3) increased 0.590% by 1% increase of realization rate against mother group of demand (ML_{t-1}/MPS_t)

In this process, call fee was used as a variable for price effect against adjustment coefficient at though, significant result was not obtained. As a whole, this demand function is considered theoretically coordinative, while multi-correlation coefficient is also satisfactory.

Results of the international tendency analysis based on the above function are described in paragraph 4-2-5.

4-2-3 Modification of international model

In paragraph 4-1, demand was estimated for objective areas (246 Kabupatens) using a Kabupaten model. Data to make this model were based on the field demand survey, and its estimation value also includes latent and potential demands, which are not shown in the waiting list. Beside the data used to make the international model does not include these potential demands. Therefore, considering demand estimation at the equal level, the international model shall be modified by including latent and potential demands as well as systematically coordinating the past performance of Indonesia.

For this purpose, a constant term shall be modified using 1982 values of various data in Indonesia. In this case, the latent and potential demand St is presumed 10% of demand increase of the year (left part of equation 4-8), taking account of past Main Line growth, growth rate of demand increase, transition of waiting list and coordination with other plans, etc. Consequently obtained modified model is as follows:

$$\log (MLA_t + NA_t + W_t + S_t) = -1.819 - 0.408 \log SF_t + 0.384 \log \left(\frac{GDP_t}{POP_t}\right) + 0.59 \log \left(\frac{ML_{t-1}}{MPS_t}\right) + \log (MPS_t - ML_{t-1}) \quad \ldots (4\text{-}10)$$

4-2-4 Nationwide telephone demand up to 2000

Demand estimation was made for 1985, 1990, 1995 and 2000 using the estimation model (4-10) on the basis of forecasted economic growth rate (estimation by Indonesian National Development Planning Agency), estimated volume of telephone demands (past performance and recent tendency), etc. Sensitivity analysis was also made for this estimation from both optimistic (7% of annual growth rate in GDP) and pessimistic (3%) points of view.

(1) Estimation results

Total telephone subscriber demand as of year 2000 was estimated 4,898,000. Kabupaten level estimation made in paragraph 4-1-5 for objective areas was merely 1,364,000. Accordingly, the total demand in Kotamadya, which is not a objective area under this survey, becomes 3,534,000 after the offset.

If these demands are completely satisfied, main telephone density will become 2.20 per 100 inhabitants of national population for the entire Indonesia, 15.19 per 100 inhabitants of total Kotamadya population for all Kotamadyas and 0.68 per 100 inhabitants of total Kabupaten population for the whole Kabupatens, as shown in Figure 4-2-3.

Results of sensitivity analysis made by varying economic growth rate, volume of supply, etc. are shown in ANNEX 4-2-3.

As the above estimation results were obtained by pooling 10-year (1973 - 1982) data, time series factors are included in the function besides constructional coefficients are also considered stable dynamically.

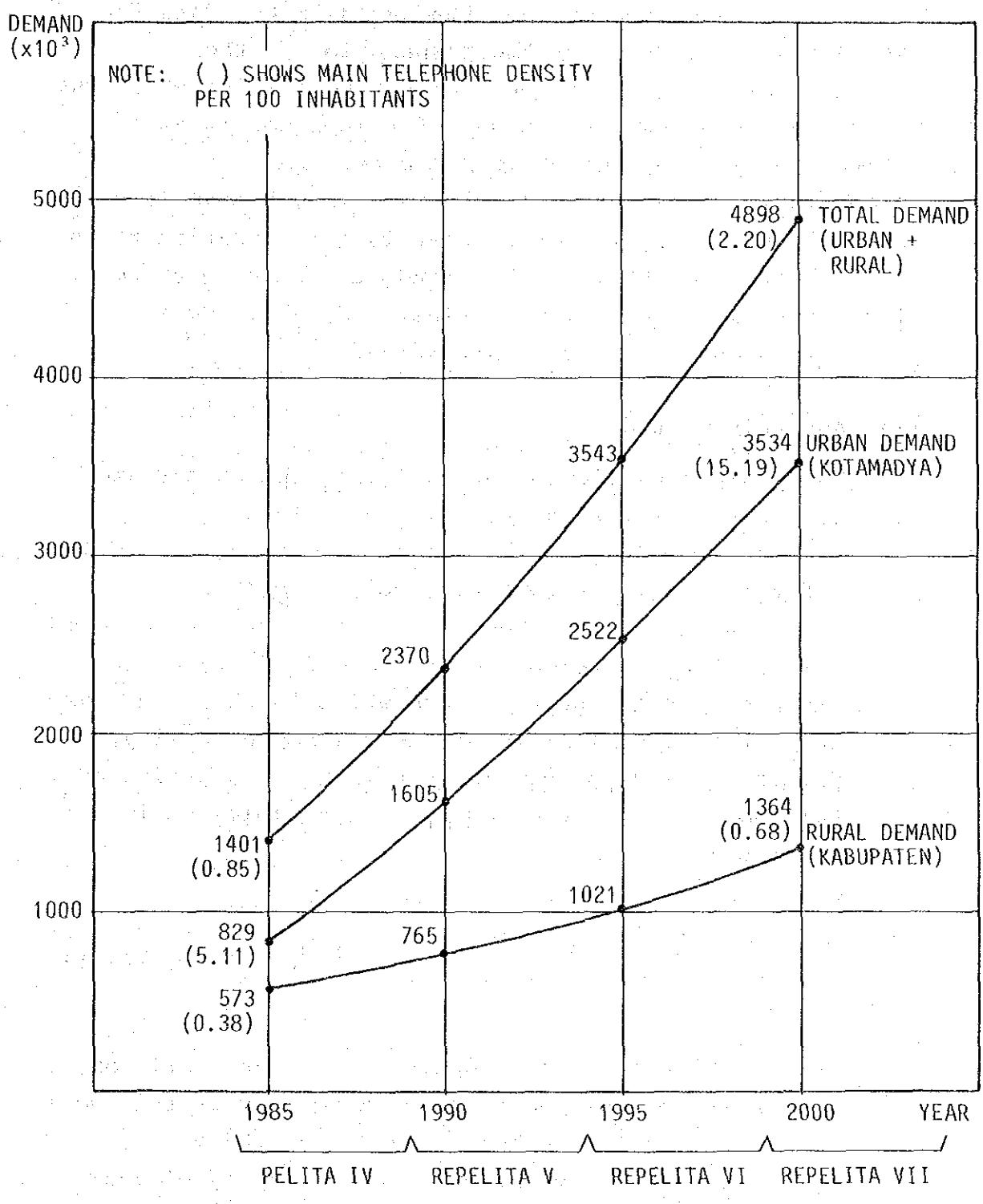


Figure 4-2-3 Main Telephone Demand in Indonesia up to Year 2000

4-2-5 International trends in the supply and demand of telephones

The analysis has been made on the basis of the data for the 20 countries used for the preparation of the international model in a ten year period (1973-1982). The trends in the supply and demand of telephones in an international level, which is one aspect of telecommunications, has been observed. Some questions posed for the analysis were: what is the situation of the trends between countries; what kind of trends do these situations have over a time series, and; where does Indonesia stand within this situation.

(1) Analysis method

There are two indexes for analyzing the supply and demand trends for the twenty countries.
They are the unsatisfied telephone demand rate (D_t) and the relative telephone supply rate (S_t).
The unsatisfied telephone demand rate is the ratio of the unsatisfied telephone demand out of the mother group of the telephone demand which is obtained from the international limit of the telephone density.
Use the following formula to obtain the unsatisfied telephone demand rate, using the variables defined in section 4-2-1.

$$D_t = \frac{MPS_t - ML_t}{MPS_t} \qquad 0 \leqq D_t \leqq 1 \quad \ldots \quad (4\text{-}11)$$

The relative telephone supply rate is the ratio of the satisfied telephone demand between year t-1 and t out of the real telephone demands for the year t including the accumulated telephone supply of year t minus that of year t-1. Use the following formula to obtain the relative telephone supply rate, using the variables defined in section 4-2-1.

$$S_t = \frac{MLA_t}{MLA_t + NA_t + W_t} \qquad 0 \leq S_t \leq 1 \quad \ldots (4\text{-}12)$$

The advantage of having two indexes is that the supply and demand trends of each country are standardized to be between 0 and 1, so that they can be compared.

(2) Analysis results

Utilizing the data accumulated for ten years (1973-1982) for 20 countries, the unsatisfied telephone demand rate (D_t) and the relative telephone supply rate (S_t) was calculated. Plotting the unsatisfied telephone demand rate (D_t) on the abscissa and the relative telephone supply rate (S_t) on the ordinate, Figure 4-2-4 was obtained. As the unsatisfied telephone demand rate (D_t) approaches 0, the penetration of the telephones is high; as it approaches 1, the penetration is low. As the relative telephone supply rate (S_t) approaches 1, the relative supply is high when new demands have been made; as it approaches 0, the relative supply is low when new demands have been made. However, with the relative telephone supply rate, the supply to the demands are relative, so there are two cases to handle: 1) relative supply rate is high because the penetration rate is high; 2) relative supply rate is high when the penetration rate is extremely low.

The transition for each of the countries in the ten year period can be observed in Figure 4-2-4. When one considers the transitions yearly, it follows the dotted arrow inserted in the figure. Group I consists of telephone developing countries, group II consists of telephone semi-developed countries, and groups III and IV consist of telephone developed countries.

Each country is undergoing a transition along the dotted arrow (to the left and up). The curve with an arrow is also shifting towards the left yearly. The changes along the abscissa show each country's telephone penetration speed. The difference between the changes in the developing countries and the developed countries are especially noticeable.

The range of the unsatisfied telephone demand rate (D_t) and the relative telephone supply rate (S_t) of the 20 countries over the 10 year period are $0.34 \leqq D_t \leqq 0.99$ and $0.062 \leqq S_t \leqq 0.99$. When the unsatisfied telephone demand rate is 0.34, it means that when the international limit for the main telephone density is set at 70 for every 100 people, the satisfied demand rate will be 66%.

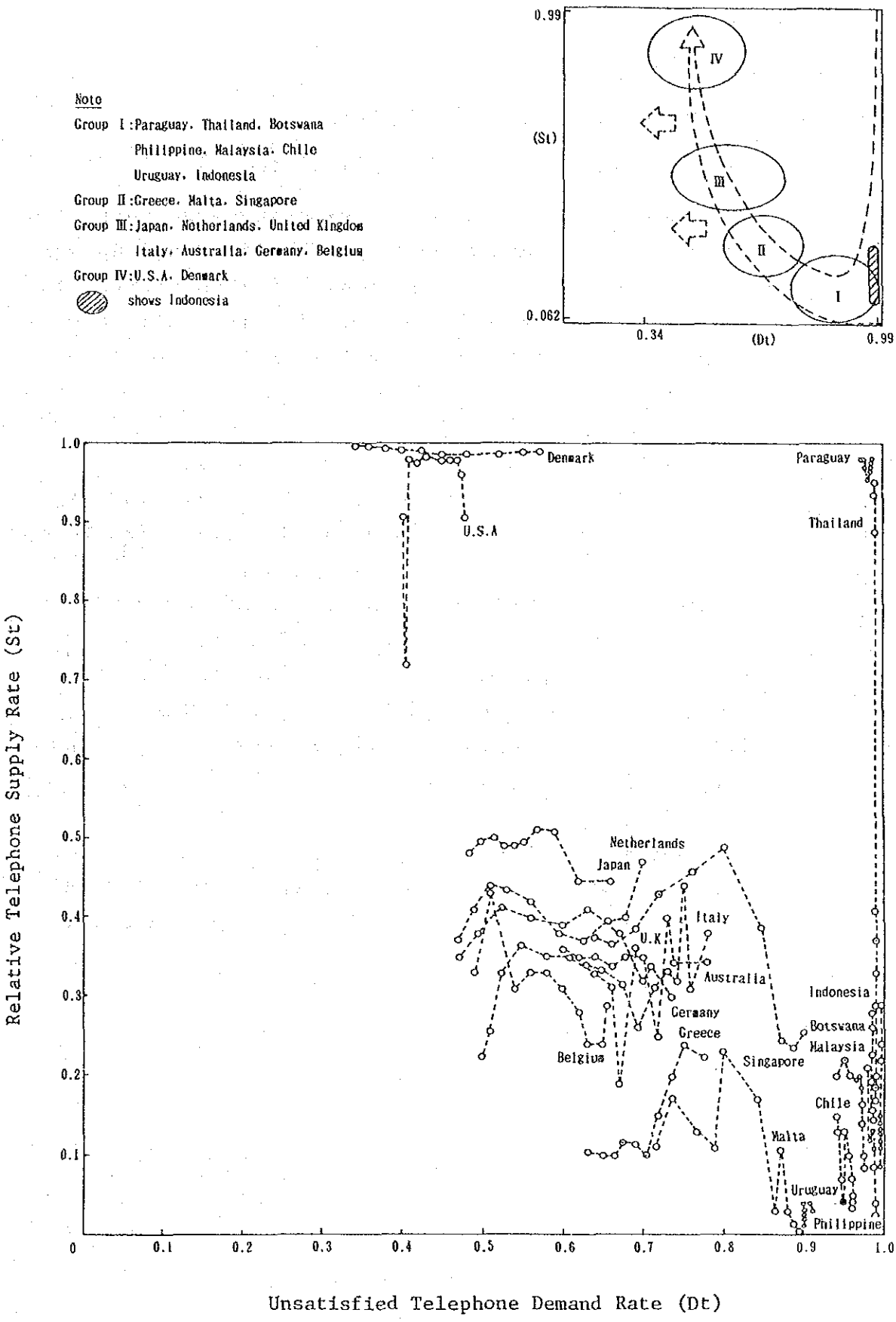


Figure 4-2-4 Relation between Unsatisfied Telephone Demand Rate and Relative Telephone Supply Rate in Twenty Countries

4-3 Call Demand Analysis

4-3-1 Existing Telephone Exchange Traffic

(1) Existing Automatic Exchange Traffic

Originating traffic data of existing main automatic exchanges (excluding those in Jakarta City) appear in Table 4-3-1. Average local and SLDD traffic is shown below. About 70% of originating calls are local calls. The remaining 30% or thereabouts are SLDD calls.

Local and SLDD	21.15×10^{-3} erl.	
Local	14.16×10^{-3} erl.	(67.0%)
SLDD	6.99×10^{-3} erl.	(33.0%)

Assume that terminating traffic is of the same volume as originating traffic and that, to allow for connection time, signal sending time and so forth, the whole traffic be 1.2 times greater. Then, automatic exchange subscribers' originating and terminating traffic is:

Local and SLDD	50.76×10^{-3} erl.	
Local	33.98×10^{-3} erl.	(67.0%)
SLDD	16.78×10^{-3} erl.	(33.0%)

Table 4-3-1 Originating Traffic of Exist. Auto. Ex.

Name of Exchange	No. of Subs	Local&SLDD		SLDD	
		Total (erl.)	[CR (m erl.)]	Total (erl.)	[CR (m erl.)]
SERANG	1,065	23.8	[22.3]	6.4	[6.0]
TEGAL	2,460	56.9	[23.1]	12.4	[5.0]
MAGELANG	1,366	44.2	[32.4]	8.3	[6.1]
PURWOKERTO	1,866	28.5	[15.3]	12.9	[6.9]
KEDIRI	1,764	42.9	[24.3]	15.5	[8.8]
PASURUAN	1,784	43.2	[24.2]	9.4	[5.3]
JEMBER	2,335	63.3	[27.1]	11.4	[4.9]
BLITAR	1,076	22.5	[20.9]	5.6	[5.2]
BOJONEGORO	819	16.6	[20.3]	4.9	[6.0]
CIRENBON	4,474	47.3	[10.6]	22.6	[5.1]
SEMARANG	15,266	434.7	[28.5]	127.3	[8.3]
KUDUS	1,151	29.0	[25.2]	9.2	[8.0]
YOGYAKARTA	3,926	53.3	[13.6]	26.6	[6.8]
SOLO	5,468	72.2	[13.2]	38.1	[7.0]
MALANG	7,542	165.4	[21.9]	48.9	[6.5]
PADANG	5,082	71.3	[14.0]	42.2	[8.3]
Total/Average	57,444	1,215.1	[21.15]	401.7	[6.99]

Source : Adetatel's Data Traffic
(TRIWULAN III & IV - 1982, TRIWULAN I - 1983)

According to CCITT Manual "National Telephone Networks for the Automatic Services" automatic exchange subscribers' originating traffic classified by subscriber categories is as shown in Table 4-3-2 below. Pay station traffic is considerably greater than other telephone traffic.

Table 4-3-2 Calling Rate per Subscriber, CR (BHT/SUB)

Private residence	0.01 - 0.04 erl.
Business office	0.03 - 0.06 "
PBX	0.1 - 0.6 "
Pay station	0.07 "

(2) Existing Manual Exchange Traffic

Existing manual exchange traffic data appear in ANNEX 4-3-1 to 4-3-3. ANNEX 4-3-1 presents 1979 - 1982 national data concerning manual exchange originating toll traffic classified by tariff zones. ANNEX 4-3-2 provides data of complete calls, real call durations, etc., concerning manual exchange origination toll traffic for one month of September 1983. ANNEX 4-3-3 deals with the number of calls, classified by calls inside the same PC area and calls outside, concerning main manual exchange originating toll traffic.

These data disclose the following facts relating to manual exchange traffic:

1) Out of all toll calls, upwards of 50% are calls within 100 km from the exchange and more than 70% are calls within 200 km from the exchange. (Refer to Figure 4-3-1.)

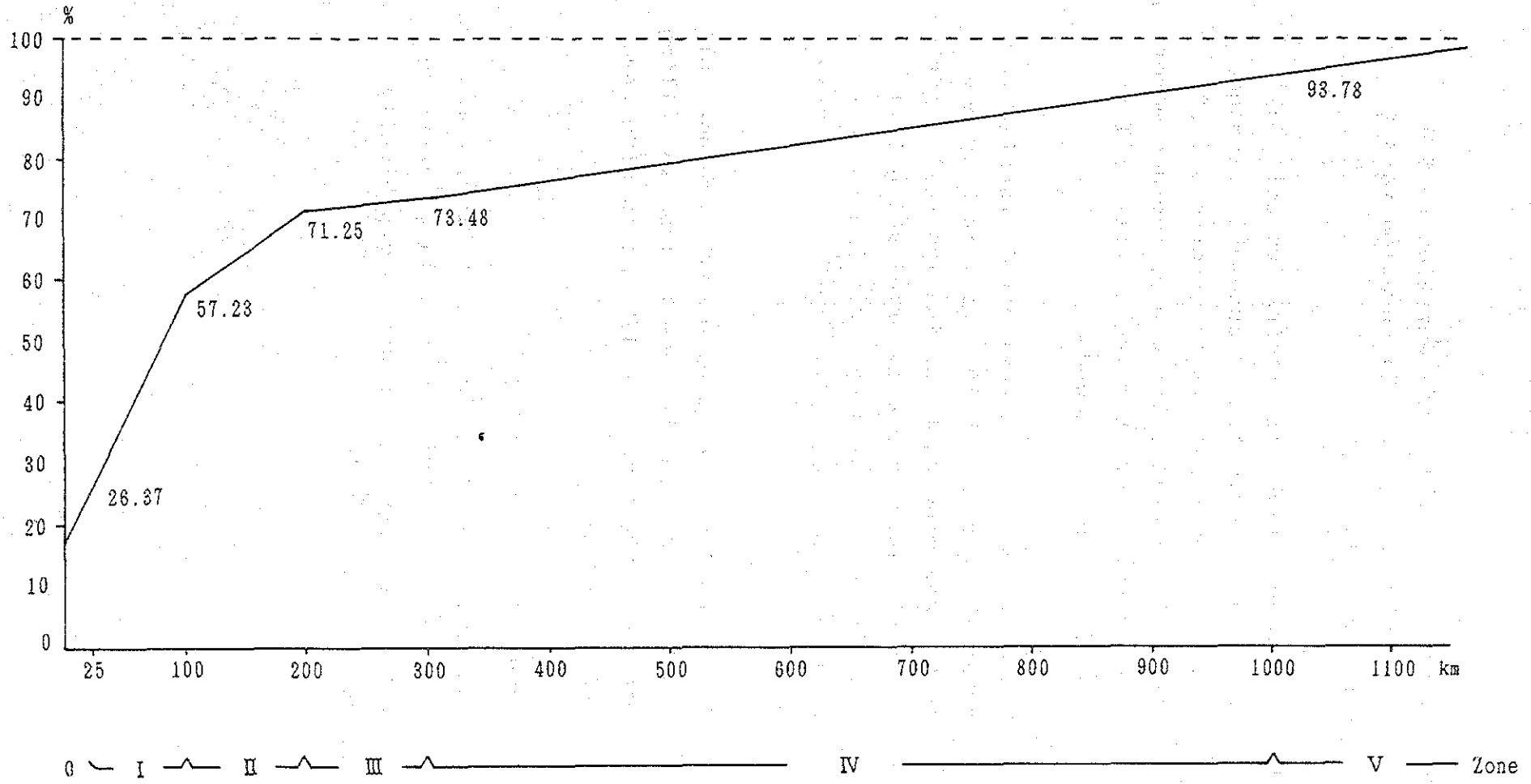


Figure 4-3-1 Changing Zone and Accumulation Percentage of Telephone Communication

2) Average chargeable call duration is 6.0 minutes/call. Real call duration is 3.9 minutes/call.

3) When manual exchange origination toll call duration is converted to automatic exchange metering, the result is 47 meterings (3.9 minutes) per call. Therefore, average metering time interval for charging on toll call is assumed to be 5.0 seconds.

4) Manual exchange origination toll traffic per subscriber is 3.21×10^{-3} erl. in busy hour mean. Assuming that terminating toll traffic is of the same volume as originating toll traffic, manual exchange toll traffic per subscriber becomes 6.42×10^{-3} erl. in busy hour main.

5) As for called parties of manual exchange toll calls, 53% are in the same PC area as calling parties. The remaining 47% are outside the same PC area.

(3) Telephone Traffic Status Quo

National telephone traffic (originating) condition that can be known from traffic data of existing automatic and manual exchanges is graphically presented in Figure 4-3-2.

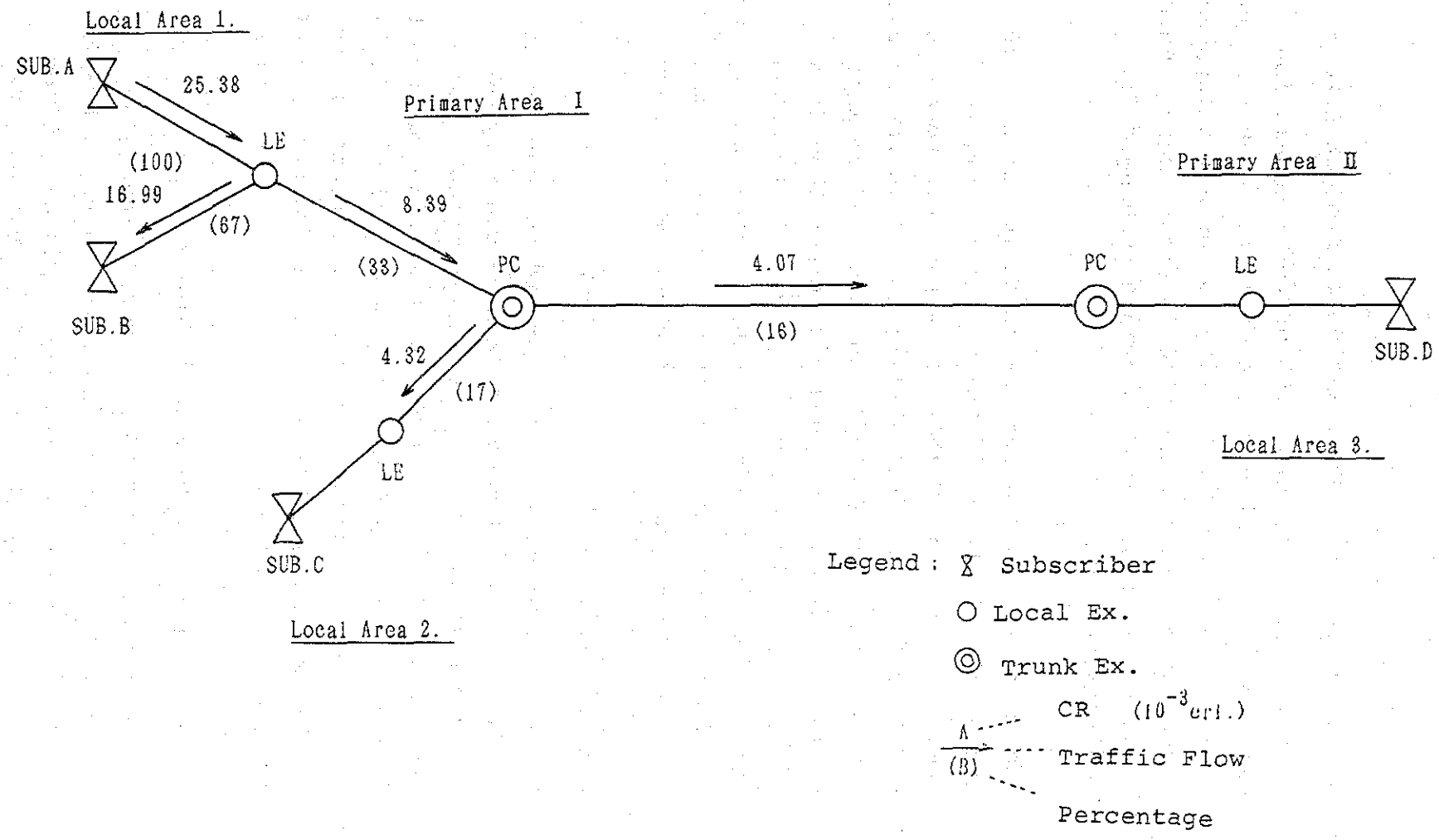


Figure 4-3-2 Status of Traffic Flow (1983)

4-3-2 Traffic Forecast

(1) Status of Telephone Utilization in Project Area

In Indonesia, only about 20% of total population estimated at 160 million (as of 1984) inhabit urban areas whereas the 85% majority out of all telephone installations is concentrated in urban areas. This situation is considered to remain unchanged for some time to come.

When more telephones are installed in rural areas where the telephone diffusion rate is low, the number of times the inhabitants use telephones is considered to be still smaller than in urban areas. However, the number of persons who have to make common use of one telephone is larger than in urban areas. For this reason, the degree of telephone utilization in rural areas can be safely assumed to be almost the same as in urban areas at present, especially among automatic exchange subscribers.

(2) Call Frequency Forecast

Telephone network from now forward is required to be STD network. Otherwise, a huge quantity of telephone traffic cannot be carried stably and at low cost. Therefore, even for switching equipment in rural areas, the automatic type will have to be introduced. Consequently, traffic forecast is by regression analysis using the past traffic data of automatic exchanges.

1) Regression Analysis Methodology

Regression analysis was made, using data considered to be intimately related to traffic variations in 26 Provinces (excluding Timor Timur) during the period from 1979 to 1982.

TRFC = f (SUB, CF, GDP, POP, WSUB)

where

TRFC : Province by Province gross metering pulses (x 1,000 pls)

SUB : Province by Province number of automatic exchange subscribers (x 1,000 subscribers)

CF : Real unit call tariff (Rp/pls)

GDP : Real gross domestic product (x 1,000 Rp)

POP : Province by Province population (person)

WSUB : Number of automatic exchange subscribers outside Province concerned, weighted by distance (subscriber)

Consideration is made so that in the regression formula, TRFC = 0 at SUB = 0 holds true. CF and GDP are quoted at price level as of 1975 by reason of data availability.

2) Result of Analysis

As the result of regression analysis, the correlation formula appearing below proves to be optimum for the forecast of metering pulses.

$$\ln (TRFC) = 9.51 + \underset{**(4.56)}{0.583} \ln (SUB) + \underset{**(4.26)}{0.0744} \text{ in } (\frac{GDP}{POP}) \ln (SUB)$$

$$R = 0.989$$

R denotes multiple correlation coefficient.
Figure in parentheses provides t-value.
** indicates that the coefficient is significant at 1% on both sides.

Thus, for formula to forecast future call frequency (by Province), the formula appearing below could be obtained.

$$TRFC = 13500 \cdot (SUB)^{\{0.583 + 0.0744 \text{ in } (GDP/POP)\}}$$

3) Result of Forecast

Forecasted telephone traffic as of the year 2000 appears in Table 4-3-3. This forecast is by the forecast formula obtained by the regression analysis and in consideration of the fact that public telephone traffic is about three times the average traffic of other telephones (refer to Table 4-3-2). The above traffic forecast indicated local and toll calls of about 13,700 call meter pulses in the average among subscribers throughout the country.

Judging from the fact that the average call volume among automatic exchange subscribers in the country is about 11,800 pulses as of 1983, it can be safely assumed that the call volume will continue to increase.

Meanwhile, in the forecast formula referred to above, real unit call tariff elements are not considered so that the result in Table 4-3-3 is on condition that the present real unit call tariff level will continue unchanged, or, more precisely, the call tariff raise by the real tariff decrement will be repeated. The result of regression analysis using 1969-83 national data shows that when the real call tariff decrement is by a%, the call volume increases in inverse proportion to $\sqrt[3]{1 - a/100}$.

Table 4-3-3 Traffic Forecast in 2000 A.D.(exclude Kotamadya)

WITEL No.	Province	Subscriber	Total Pulse (1000pls)	Puls/Sub. (pls)
I	D.I. ACEH	41,646	646,480	15,523
I	SUMATERA UTARA	98,923	1,416,250	14,317
II	SUMATERA BARAT	17,517	280,747	16,027
II	RIAU	22,404	353,939	15,798
III	JAMBI	10,376	174,812	16,848
III	SUMATERA SELATAN	62,118	923,400	14,865
III	LAMPUNG	44,362	551,136	12,424
III	BENGKULU	5,620	94,853	16,878
IV	JAKARTA	-	-	-
V	JAWA BARAT	361,764	4,405,864	12,179
VI	JAWA TENGAH	164,906	2,106,683	12,775
VI	D.I. YOGYAKARTA	16,165	235,654	14,578
VII	JAWA TIMUR	278,450	3,636,181	13,059
IIX	BALI	20,701	309,476	14,950
IIX	NUSA TENGGARA BARAT	14,480	218,941	15,120
IIX	NUSA TENGGARA TIMUR	14,150	226,812	16,029
IIX	TIMOR TIMUR	1,938	34,573	17,839
IX	KALIMANTAN BARAT	22,592	362,368	16,040
IX	KALIMANTAN TENGAH	10,251	181,457	17,701
IX	KELIMANTAN SELATAN	16,020	263,690	16,460
IX	KALIMANTAN TIMUR	18,828	317,115	16,843
X	SULAWESI UTARA	20,791	314,805	15,141
X	SULAWESI TENGAH	9,838	165,849	16,858
X	SULAWESI SELATAN	40,152	616,951	15,365
X	SULAWESI TENGGARA	7,758	132,882	17,128
XI	MALUKU	13,132	216,873	16,515
XII	IRIAN JAYA	28,660	505,066	17,623
	Total or Average	1,363,542	18,692,856	13,709

(3) Traffic Forecast

Based on the forecasted call frequency as per Section 4-3-2 (2), subscriber traffic forecast is made. For future traffic distribution, the present traffic distribution is used intact because index data is not available.

1) Call Frequency Distribution

For distribution of the forecasted call frequency to local call and toll call sectors, real local call traffic of 14.16×10^{-3} Erlang and real toll call traffic of 6.99×10^{-3} Erlang, based on the existing status of traffic obtained in Section 4-3-1 (1), are used. For toll calls, the mean metering time interval is about 5 seconds, whereas, for local calls, one call is covered by one metering in average so that the mean metering time interval is set at 100 seconds, the mean holding time of local call determined in CCITT Handbook, "Choice of Telephone Switching System - GAS6 1981." Then, the local to toll call frequency distribution ratio is

$$\frac{\text{Toll}}{\text{Local}} = \frac{6.99 \times 10^{-3} \times 3600 \div 5}{14.16 \times 10^{-3} \times 3600 \div 100}$$

$$= \frac{5.03}{0.510} = 9.9$$

At this ratio, the mean annual call frequency per subscriber in the year 2000 is

Local call frequency	:	1,258 pls
Toll call frequency	:	12,451 pls
Total		13,709 pls

2) Mean Calling Rate Forecast

Annual total of mean holding time is

Local call holding time = 1,258 x 100 ÷ 3600
= 34.94 (hours/year)

Toll call holding time = 12,451 x 5 ÷ 3600
= 17.29 (hours/year)

Conversion to busy hour calling rate is by the following formula:

$$A = CH_t \cdot \frac{1}{12} \cdot \frac{1}{D} \cdot \alpha \cdot \beta$$

where

A : Mean originating calling rate (erl.)

CH_t : Annual originating call duration per subscriber (hour)

12 : Number of months per year

D : Number of working days per month (25 days)

α : Busy hour concentration rate (0.125)

β : Coefficient allowing for connection time, signal sending time incomplete call, etc. (1.2)

Originating calling rate obtained by the above formula is 17.47×10^{-3} Erlang for local calls and 8.65×10^{-3} Erlang for toll calls. When terminating call rate is assumed to be the same as originating calling rate, local and toll calling rates are as under.

Local originating and termination calling rate: 34.94×10^{-3}erl. (67%)
Toll originating and terminating calling rate: 17.30×10^{-3} erl. (33%)
Total: 52.24×10^{-3} erl.

Estimated national telephone traffic (originating) as of 2000 is graphically presented in Figure 4-3-3. For traffic distribution, the assumption is that the present status will continue without change.

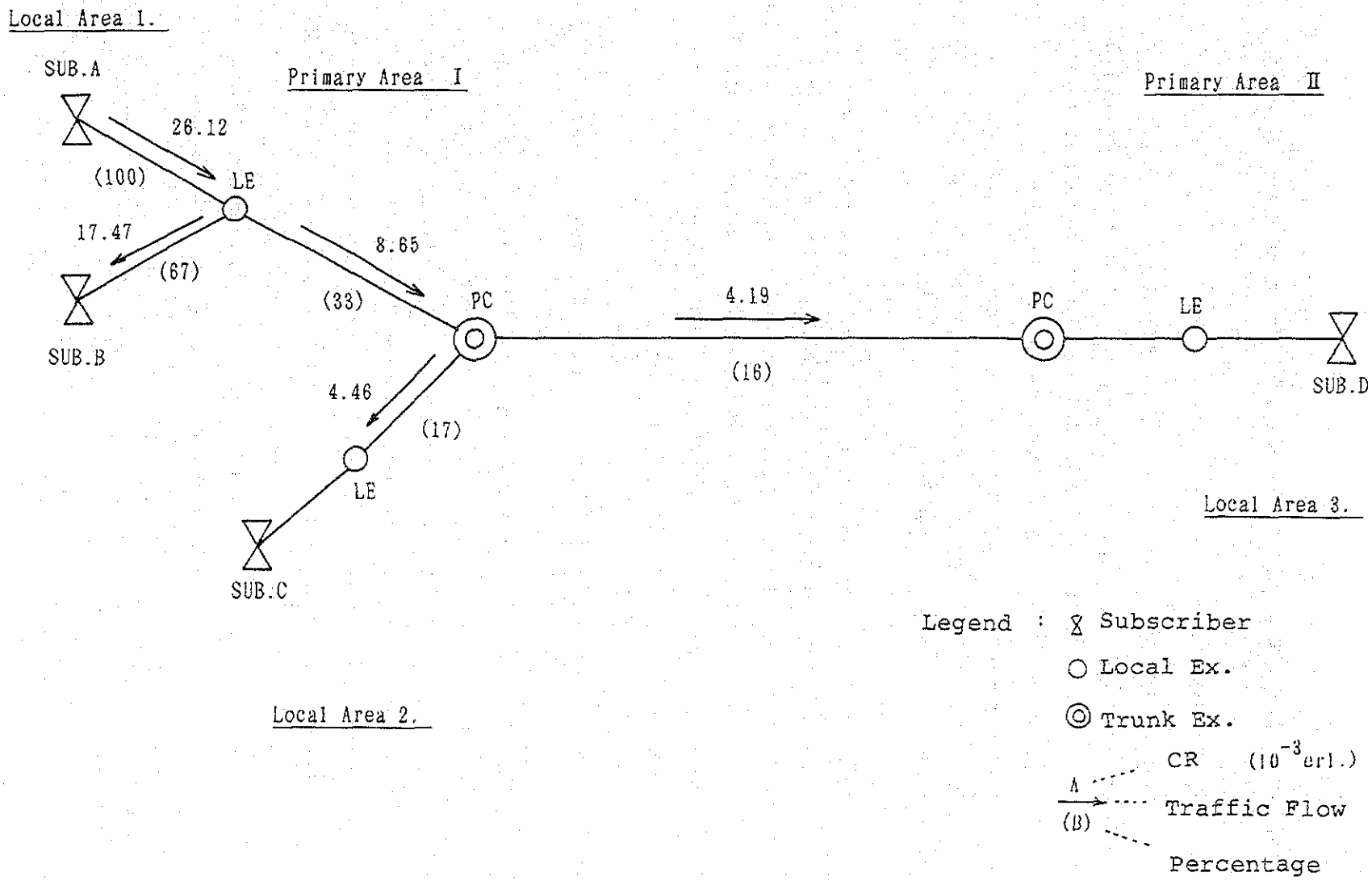


Figure 4-3-3 Estimated Traffic Flow (2000)

4-4 Non-Telephone Services

4-4-1 Transitions in Telex and Telegraph Services in Various Countries

(1) Telex services

Fig.4-4-1 shows the relationship between main telephone set density (the number of main telephone sets per 100 inhabitants) and telex terminal density (the number of telex terminals per 1,000 inhabitants). For a main telephone set density of 20 or less, the telex terminal density tends to increase year by year.

Fig. 4-4-2 shows a curve for main telephone set density versus telex terminal density, based upon data collected in various countries as of 1981. In this case, the relationship between telex terminal density (y) and main telephone set density (x) is expressed by the following equation:

$$y = 0.049 + 0.064x \qquad (r = 0.996)$$

The demand for telex is on the increase, both in developed countries and in developing countries. Especially in developed countries, it is noteworthy that the demand for such new media as data communication and facsimile devices has grown at a rapid rate (exceeding 20% in the past decade). The demand for telex service (which mainly consists of message communications) has also increased during the same period, except in a limited number of countries.

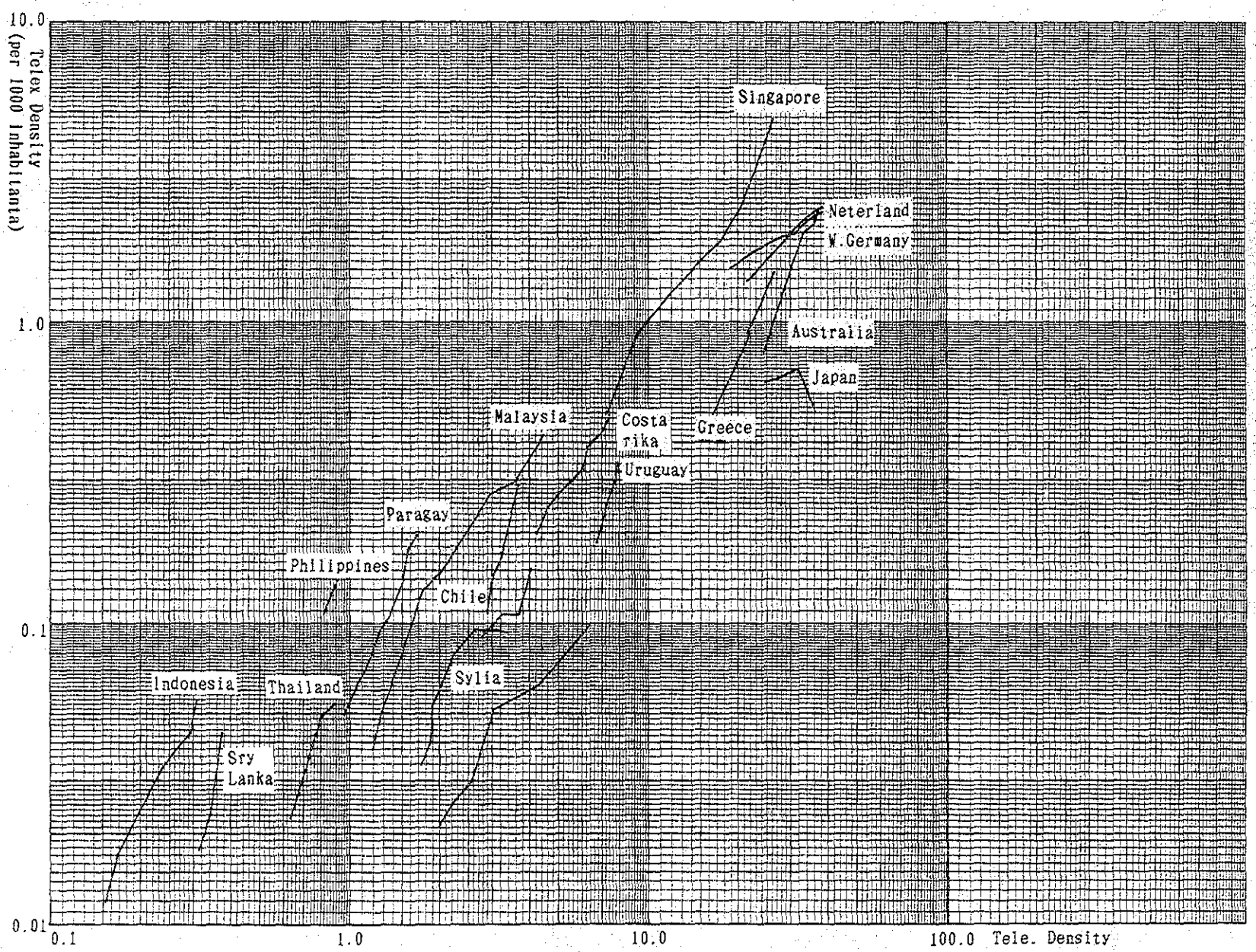


Figure 4-4-1 Telephone Density and Telex Density

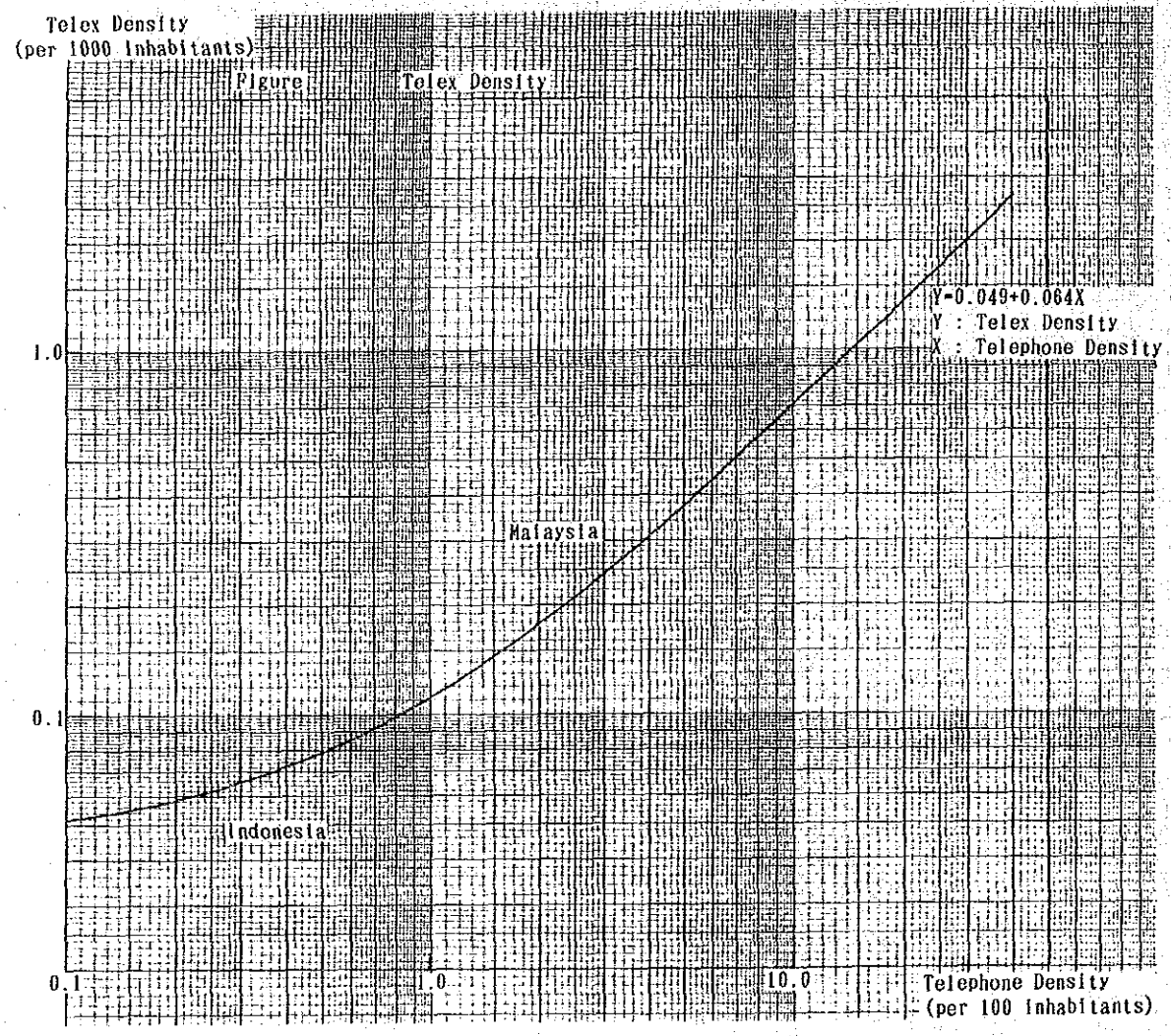


Figure 4-4-2 Telex Density (1981)

(2) Telegraph and other services

Fig. 4-4-3 indicates the relationship between main telephone set density and the number of domestic telegrams per 100 inhabitants in various countries. For those countries which have a main telephone set density of 1.0 or less, the number of domestic telegrams tends to increase gradually year after year. However, once the main telephone set density has reached a fixed range (1.0 to 10.0), the growth of telegram use in those countries slows down and levels off. When the main telephone set density has exceeded 10, the number of domestic telegrams tends to decrease sharply.

In every developed nation, the demand for domestic telegrams is on a downward trend. However, it is generally on the increase in developing countries. This is attributable to the fact that, in developed countries, the expanded use of telephone and telex has replaced the demand for telegrams. In developing countries, however, the use of telephone and/or telex has not yet become popular enough to replace the demand for telegrams.

Fig. 4-4-4 shows transitions in the main telephone set density, the total number of subscribers, the number of business subscribers, the number of residential subscribers, the percentage of business subscribers, the number and density of telex terminals, the number of domestic telegrams, and the number of data terminals in Japan for the period from 1962 to 1982.

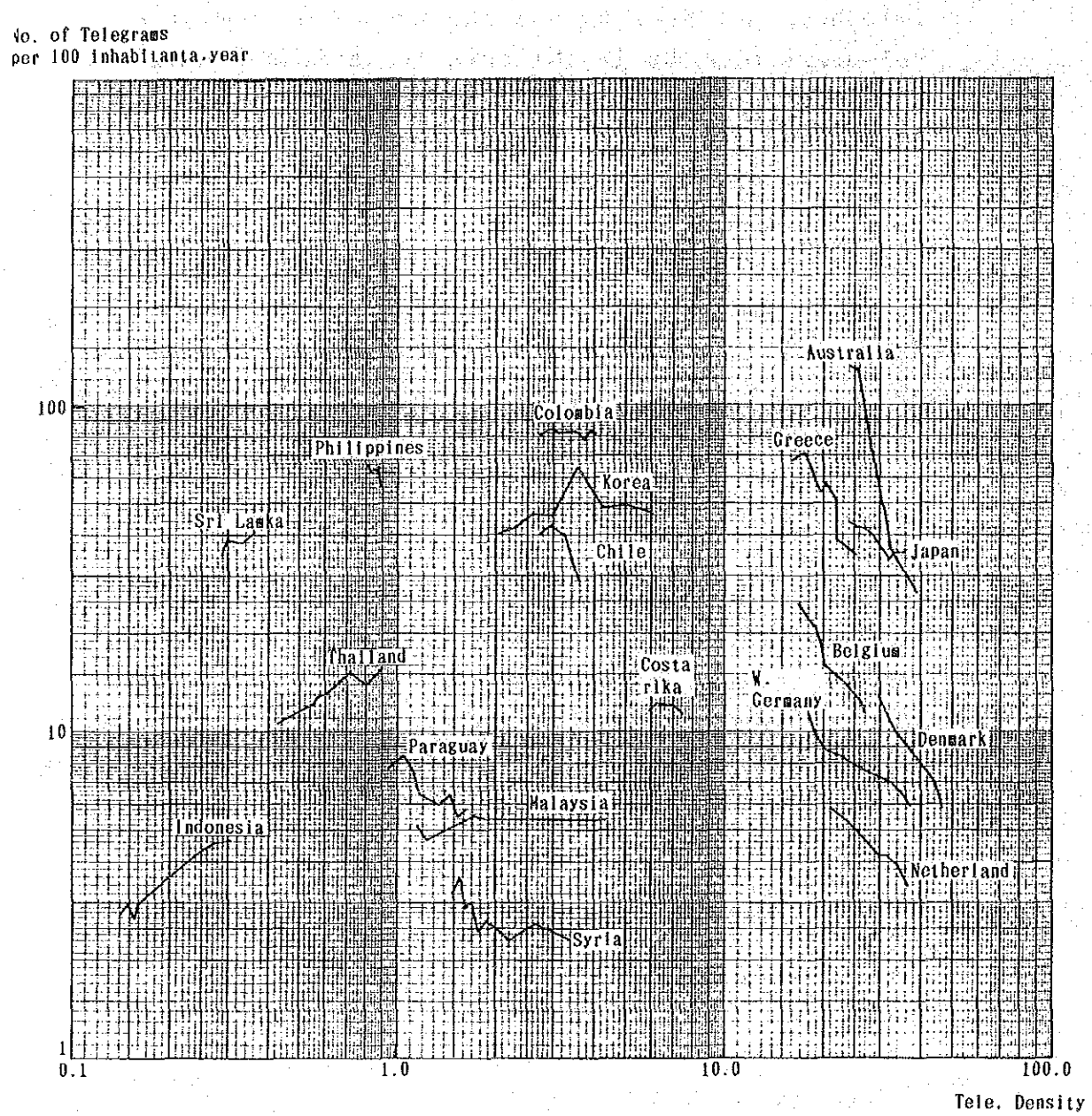
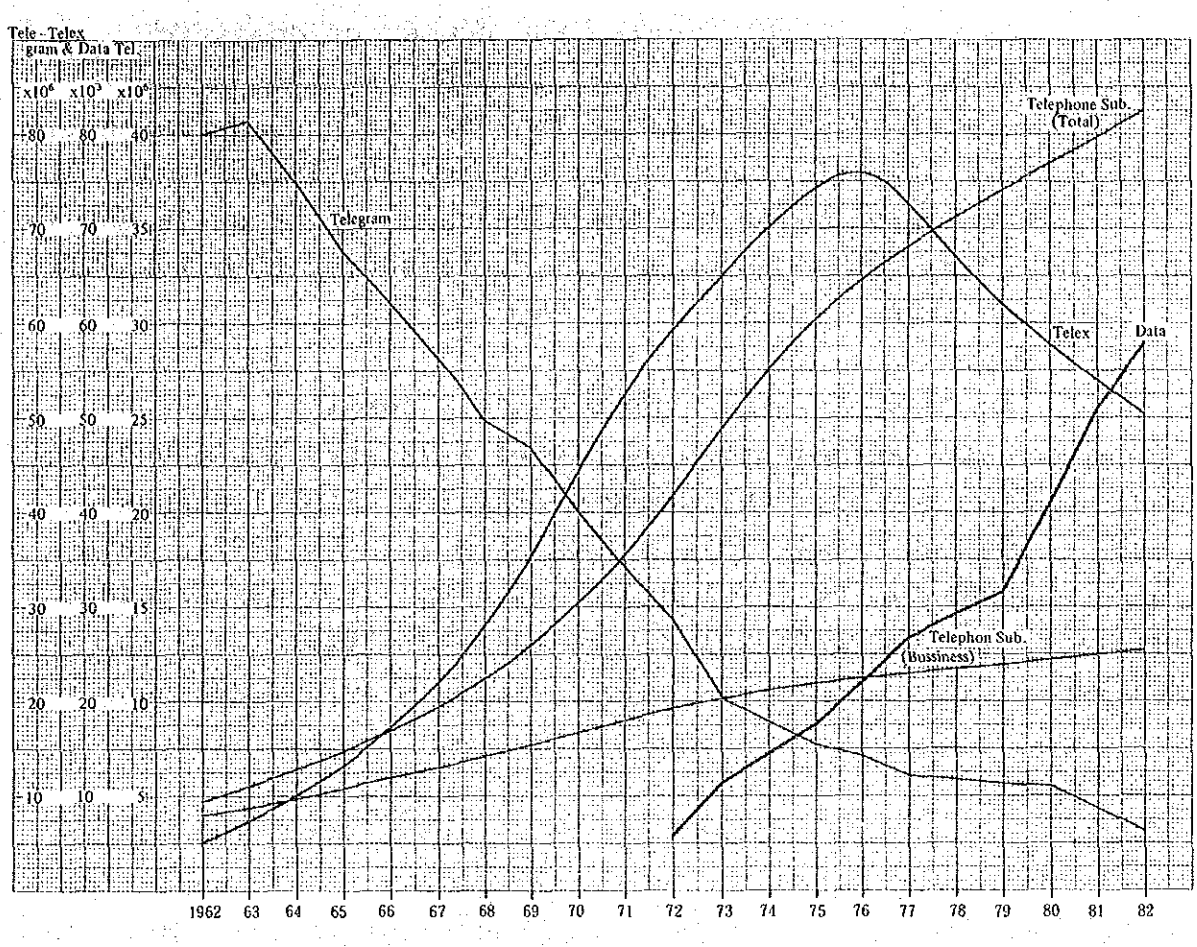


Figure 4-4-3 No. of Telegrams and Tele. Density



Main Tele. Density	–	–	6.5	7.5	8.7	10.2	11.8	13.6	15.7	18.2	20.8	23.4	26.1	28.2	29.7	30.6	31.5	32.4	33.3	34.2	35.0
Telephone Sub. (Total) x 10^3	4781	5477	6309	7303	8486	9889	11362	13005	15173	17818	20985	24166	27444	30343	32427	33945	35491	37046	38490	39930	41195
" " (Bussiness)x10^3	3994	4455	4946	5455	6010	6643	7182	7712	8339	8949	9617	10214	10691	11077	11362	11534	11782	12049	12301	12581	12831
" " (Residence)x10^3	787	1022	1363	1848	2476	3246	4180	5293	6834	8869	11368	13952	16753	19266	21065	22411	23712	24997	26189	27349	28369
Percent of Bussiness Sub.	83.5	81.3	78.4	74.7	70.8	67.2	63.2	59.3	55.0	50.2	45.8	42.3	39.0	36.5	35.0	34.0	33.2	32.5	32.0	31.5	31.1
No. of Telex terminalsx 10^3	5230	7356	9933	13286	17325	21889	27575	34721	44634	52384	58975	64947	70433	74442	75969	72919	67452	62927	57524	54224	50224
Telex Density per 1000 inhabit.	–	–	0.10	0.14	0.18	0.23	0.29	0.36	0.46	0.54	0.58	0.63	0.67	0.69	0.70	0.66	0.60	0.55	0.50	0.46	0.43
No. of Telegram x10^4	8005	8130	7492	6748	6188	5641	4987	4722	3980	3438	2876	2055	1783	1620	1440	1220	1175	1119	1104	878	619
No. of Data terminalsx 10^3	–	–	–	–	–	–	–	–	–	–	5.5	11.4	14.6	17.4	21.8	26.6	28.8	31.4	41.0	51.0	58.0

Figure 4-4-4 No. of Telephone Subscriber, Telex Terminal, Data Terminal and Telegram in Japan (1962-1982)

As shown in the figure, the number of domestic telegrams reached a peak in 1963 and then dramatically declined. In 1982, it was approximately 619,000,000 or one thirteenth of the 1963 level. The number of telex terminals reached a peak of 76,000 in 1976. Since then, it has decreased by 50%, to 50,000 in 1982.

In contrast, the number of data terminals, which first were introduced around 1972, has increased at an average annual rate of 26% (or slightly higher) during the 10-year period from 1972 to 1982. As a result, the total number of data terminals exceeded the number of telex terminals in 1982.

4-4-2 Future Trends in Non-Telephone Services

The demand for new communication services remains variable. Particularly, for new media such as video communication and TV-telephone, etc., a large potential is expected. However, it is very difficult to forecast precisely what the future demand for these new media will be.

Media such as data communication and facsimile devices, which are currently in operation in various countries, are expected to orient toward higher transmission speeds than those they use at present. Against this background, the future trend in non-telephone services in Indonesia should be investigated and studied as an integral part of digital networks, with careful consideration of the international trends.

The following analysis of the current status of, and future trend in competition between selected pairs of services should be used as a reference in forecasting the future demand for each of those types of services:

- Telephone and telegraph

  As a general trend, the expansion of telephone use into general households will sharply decrease the demand for telegrams.

- Telex and telegraph

  Because telex requires initial installation costs, a monthly rental fee, and other charges, telex subscriptions are generally restricted to business enterprises and public agencies.

Telegrams have found acceptance among a wider category of users than telex, partly because telegrams only require the payment of message transmission costs. However, it is commonly believed that, with the increasing volume of information to be handled, the demand will shift from telegram to telex (which offers lower overall transmission costs for high volume).

- Telex and new media

Both data communication and facsimile services are mainly intended for such subscribers as business firms and public agencies. Some of the existing telex terminals will be replaced with these new media, which better fit the increasing volume of information and the characteristics of the information. In other words, the tendency will be that the portion of present telex demand that involves.
Data transmission will be replaced by data terminals; and the portion that involves message transmission will be replaced by facsimile.

4-4-3 Macroscopic Forecast of Demand for Non-Telephone Services

(1) Background

a) Projection of economic growth in Indonesia
Under the 4th 5-year Plan published by the Indonesian Government, the annual growth rate of GDP per capita of 3% is expected to be maintained in the future.

b) The demand for telex has grown at the high rate of about 22% per year from 1970 to 1983.

c) Under the Long-Term Telecommunications Expansion Program (The Year 2000 Program) developed by PERUMTEL, it is estimated that fulfilment of the target installation of about 47,000 telex terminals will require facility expansion at an annual rate of approx. 10.4%.

d) The demand for domestic telegrams has grown at a rate of about 8% per year from 1973 to 1983, while the demand for international telegrams during the same period declined at the rate of approx. 16% per year.

e) Trends in demand in developed and developing countries

- In developed countries, before the rapidly expansion new services (such as data communication and facsimile devices), the demand for telex had been on the increase. However, the demand has leveled off recently, and is even on a downward trend in some of those countries.

- Demand for domestic telegrams will continue growing in those developing countries which have an extremely low telephone set density. When a certain level of telephone set density has been reached, the demand will level off.

f) Competition among various types of services
The general trend in strongest demand has been from telegraph service to telex, and then to such new services as data communication and facsimile transmission.

With a steady growth in the national economy, it is expected that the demand for telex and domestic telegrams will continue to grow for the time being supported by the demand for non-telephone services (mainly from business firms and public agencies). In the future, the demand for data communication, facsimile devices, etc. will increase, too. The existing demand for domestic telegrams is expected to saturate sooner than the demand for telex will.

(2) Projection of Demand for Non-Telephone Services

a) Telex terminals

In the short term, the demand for telex terminals is estimated to grow at an average annual rate of about 22%. Over the long term, it will slowly be replaced by the new services (data communication, facsimile devices, etc.).
When the new services are first introduced for use, the demand for telex will still grow at a steady rate. It is believed that part of the total demand for telex in Indonesia will have been replaced by the new services by the year 2000, resulting in a slowdown of the telex growth rate, but still not a saturation. The index of telex terminal use as of the Year 2000 is estimated at 0.18 to 0.20 terminals per 1,000 inhabitants.

b) Domestic Telegrams

In the short term, the demand for domestic telegrams will grow at a rate of 8% per year. Over the long term, part of the demand will be replaced by the expanded use of telephone and telex services in business firms and public agencies. Thus a gradual slowdown in the growth rate of telegraph services is expected. It is estimated that the demand will decline to a total of some 2,500,000 telegrams in the Year 2000, leveling off thereafter. The index of domestic telegram use as of the Year 2000 is estimated at approx. 11.2 telegrams per 100 inhabitants.

Table 4-4-1 Number of Telephones and Telex Terminals

Year	Population	Telephone			Telex		
		3 %	5 %	7 %	3 %	5 %	7 %
		Demand / X	Demand / X	Demand / X	Y / Demand	Y / Demand	Y / Demand
1989	179,461,200	2,133,300 1.19	2,177,400 1.21	2,222,500 1.24	0.125 22,400	0.126 22.600	0.128 23,000
1990	183,457,800	2,317,400 1.26	2,370,200 1.29	2,424,500 1.32	0.130 23,800	0.132 24,200	0.133 24,400
1995	202,748,100	3,407,200 1.68	3,543,200 1.75	3,687,700 1.82	0.157 31,800	0.161 32,600	0.165 33,500
2000	222,752,600	4,636,200 2.08	4,897,800 2.20	5,186,300 2.33	0.182 40,500	0.190 42,300	0.198 44,100

Note : X --- Telephone Density / 100 inhabitants
Y --- Telex Density / 1000 inhabitants

$Y = 0.049 + 0.064\ X$

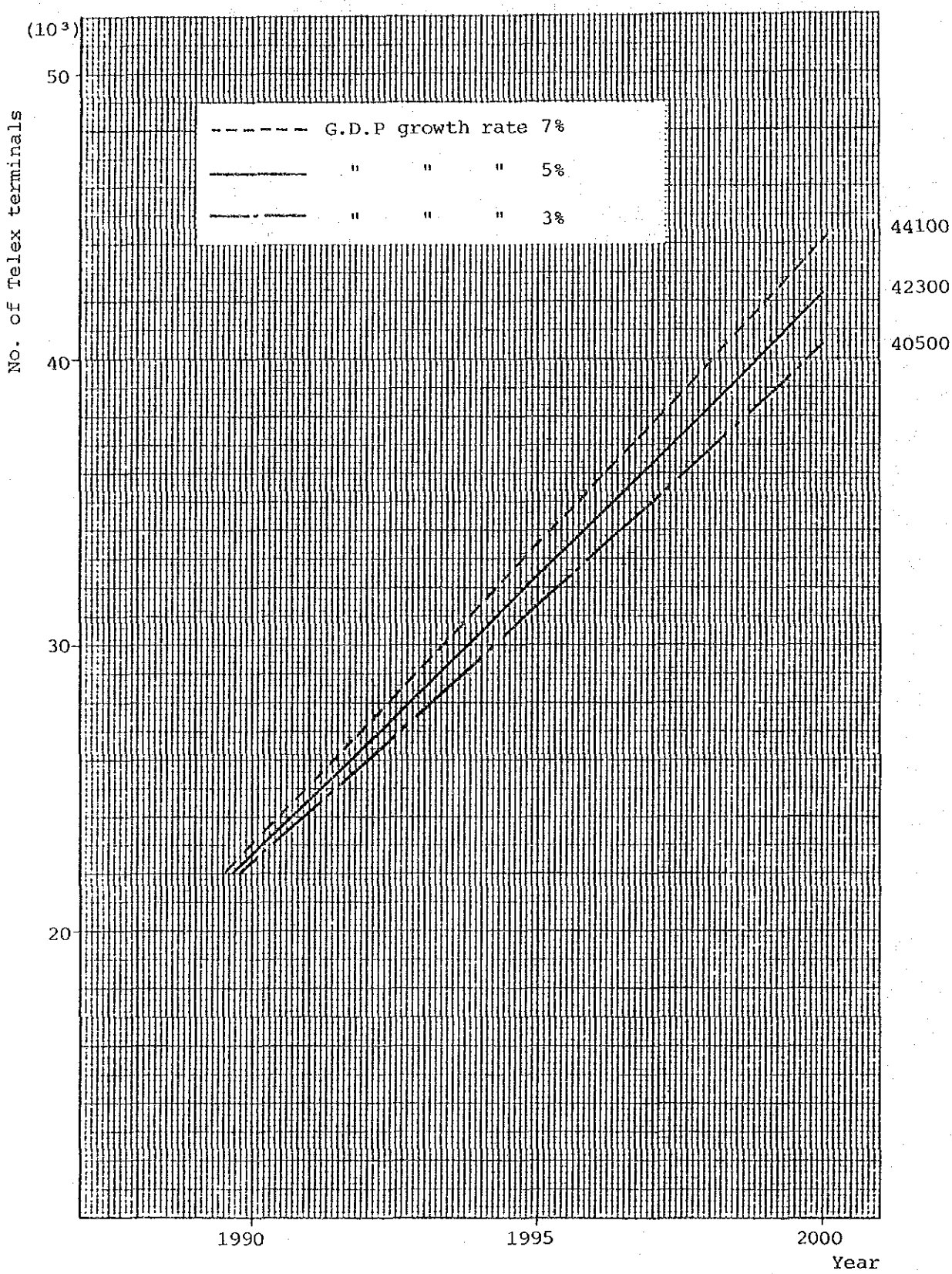


Figure 4-4-5 Forecast for Telex Terminals

c) International telegrams

Since 1973, the demand for international telegrams has declined sharply, at the rate of about 16% per year. In the short term, the same situation will continue with the minimum demand decreased substantially to 50,000 telegrams in the Year 2000. Fig. 4-4-6 shows the demand forecast for both domestic and international telegrams according to fiscal year.

d) New services (data communications, facsimile, and others)

Following the example of the advanced countries, the demand for new services is estimated to grow at an annual rate of 20% or more during the first stages of use expansion. The potential subscribers to these new services are mainly business firms and public agencies. The demand from these sources depends upon the type of information to be handled and the distribution of subscribers across the various sectors of the business world.

At present, it is very difficult to project the demand for these new services in Indonesia. Therefore, this issue should be a subject for further investigation.

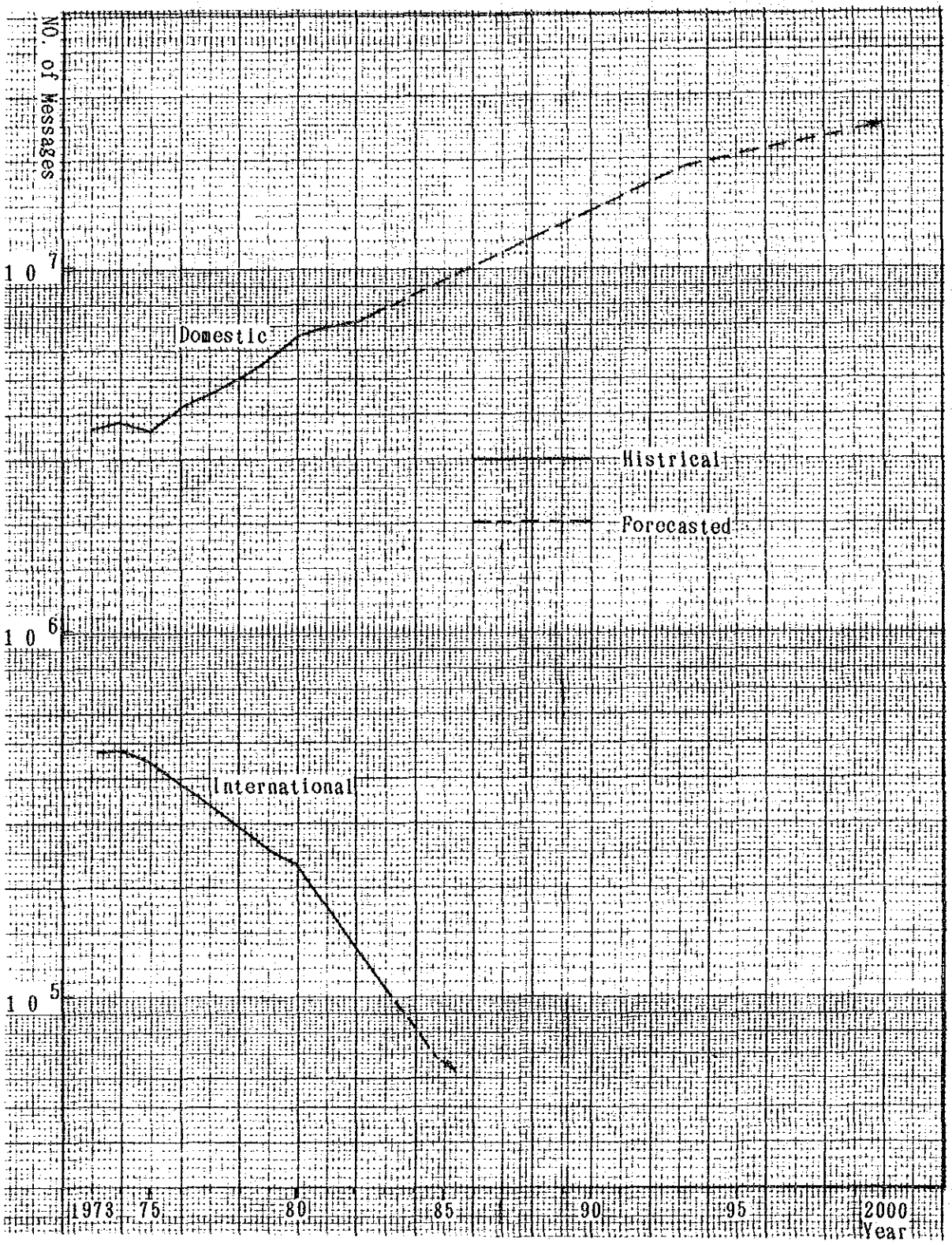


Figure 4-4-6 Forecast for Telegram Service (Whole Indonesia)

4-4-4 Significance of Non-Telephone Services in Areas Covered by This Study

As stated above, the number of telex terminals (one component of total non-telephone services) is estimated to become between 40,000 and 44,000 in the Year 2000. Currently, 43% of the total number of telex terminals are located in Jakarta, with most of the rest (52%) distributed in Kotamadya. This tendency is assumed to remain steady in the future. This means that a very small number of telex terminals will be installed in the areas covered by this study - - approx. 3,000. The revenue from telex service in these areas is assumed to be equivalent to about 8% of the expected revenue from telephone service in the same areas.

The revenue PERUMTEL gains from its domestic and international telegraph services (as of 1983) is equivalent to about 1.7% of the revenue from its telephone service. In the future, with expanded use of telephone service, there will be no increase in the number of telegrams. Thus, there is little expectation for revenue from telegraph services.

In regard to the demand for new services (including data communications and facsimile transmission), it is difficult to make any definite forecast at present. Generally, there is the expectation of at least one facismile being installed at each of the major local agencies. Under these circumstances, this study does not include non-telephone service equipment in its scope; it covers, only the supply schedule for telephone sets.

4-4-5 Traffic Forecast for Non-Telephone Services

(1) Telex

Telex traffic A_{xx} is calculated by using the following expression:

$$A_{tx} = \text{Number of telex terminals} \times \text{Rate of telex calls per terminal} \quad \text{(Erl.)}$$
$$= \text{Number of telex terminals} \times 0.04 \quad \text{(Erl.)}$$

(2) Telegram

Telegram traffic A_{tg} is given by the following expression:

$$A_{tg} = \text{Annual number of telegrams sent out} \times 1/12 \times 1/25 \times 1/8 \times 125 \text{ sec} \div 3600 \text{ sec} \quad \text{(Erl.)}$$

where,

1/25: the average number of working days per month

1/8 : the coefficient of peak load

125 sec: the average time required for handling one telegram

(3) Other new services

Because no time series data are available, the forecast for new services traffic is normally made with reference to the results of a market survey or to known actural figures (obtained for similar services). After the service has been in actual operation for a sufficient time period to obtain actual data, the methodology used in the forecast and the results of the forecast will be reviewed (if necessary).

On a preliminary basis, the new service traffic A_{ns} is given by the following expression:

$$A_{ns} = \text{Demand in number} \times \text{Rate of calls for subscriber (Erl.)}$$
$$= \text{Demand in number} \times 0.05 \quad \text{(Erl.)}$$

For example, 90 seconds/sheet, the transmission of two sheets per hour results in 180/3600 = 0.05 (Erl.)

CHAPTER 5 TELECOMMUNICATIONS SYSTEM FOR RURAL AREA

CHAPTER 5 Telecommunications System for Rural Area

5-1 Geographic Characteristics of Rural Area in Indonesia

5-1-1 Geography of Indonesia and Telecommunications Network

Rural telecommunications network classification by pattern, using administrative section as unit, is reasonable from the viewpoint of social and economic activities. Administrative sections in Indonesia and average area of each section are in Table 5-1-1.

Table 5-1-1 Administrative Sections in Indonesia

Class	Administrative Section	Number	Average Area
1	Propinsi	27	71,090 km^2
2	Kabupaten/Kotamadya	300	6,398
3	Kecamatan	3,420	561
4	Desa/Kelurahan	Approx. 65,000	30

Which of the four administrative section categories above to use as communication network unit constitutes and important point of this study. The fittest unit is Kabupaten. Reasons are as under.

(1) According to the national telecommunications network concept, at least one PTC (Primary Toll Center) is to be established in each Kabupaten Capital. Already, in almost all (95%) Kabupaten Capitals, PTC exists.

(2) To consider PTC established in Kabupaten Capital to be the rural network and national network interface point is realistic.

(3) Kabupaten base telephone demand estimates as of 2000 A.D. are between 1,000 and 50,000. The average is 5,500. This demand size is almost equal to the operating scale of common type main exchange.

Average Kabupaten area by island is in Table 5-1-2.

Table 5-1-2 Average Kabupaten Area by Island

Island	Total Area (km^2)	No. of Kabupaten	Average Area per Kabupaten (km^2)
SUMATERA	473,606	71	6,671
JAWA	132,187	106	1,247
NUSA TENGGARA	88,488	39	2,269
KALIMANTAN	539,460	33	16,347
SULAWESI	189,216	37	5,114
IRIAN JAYA	496,486	14	35,463
Total	1,919,443	300	6,398

Average Kabupaten area varies widely from 1,247 km^2 in JAWA Island to 35,463 km^2 in IRIAN JAYA Island. This means that the transfer link length differs broadly from one Kabupaten to another.

5-1-2 Telephone Demand Density

Kabupaten level telephone demand distribution by size is in Figure 5-1-1. Kabupaten level telephone demand density (demand size per unit area) classification is Figure 5-1-2.

Corollary of these two illustration is as under.

1) Demand size of 75% Kabupaten ranges from 1,000 to 6,000 on a Kabupaten basis.

2) Distribution patterns of demand density per Kabupaten differ characteristically from each other island.

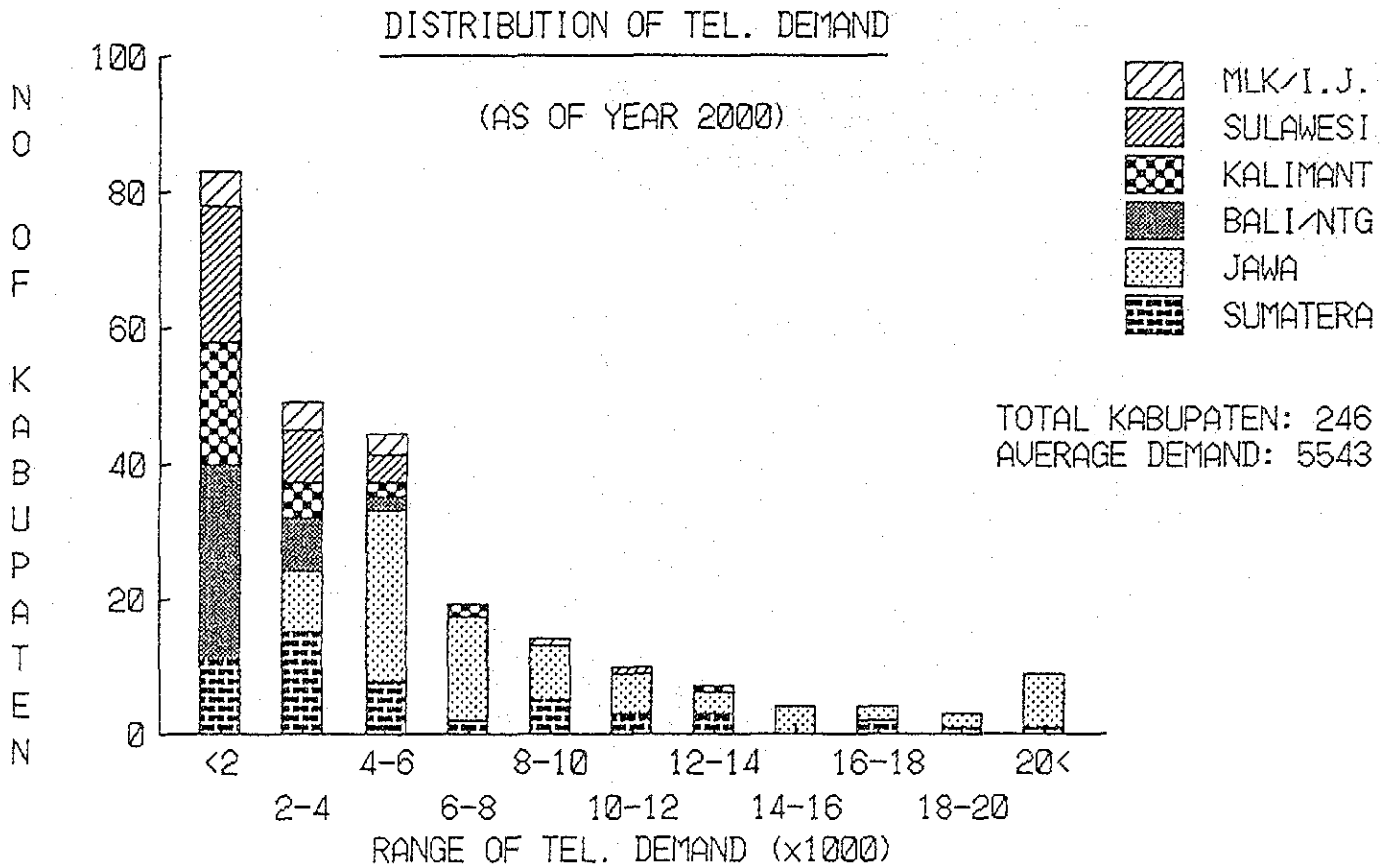


Figure 5-1-1 Distribution of Tel. Demand (as of Year 2000)

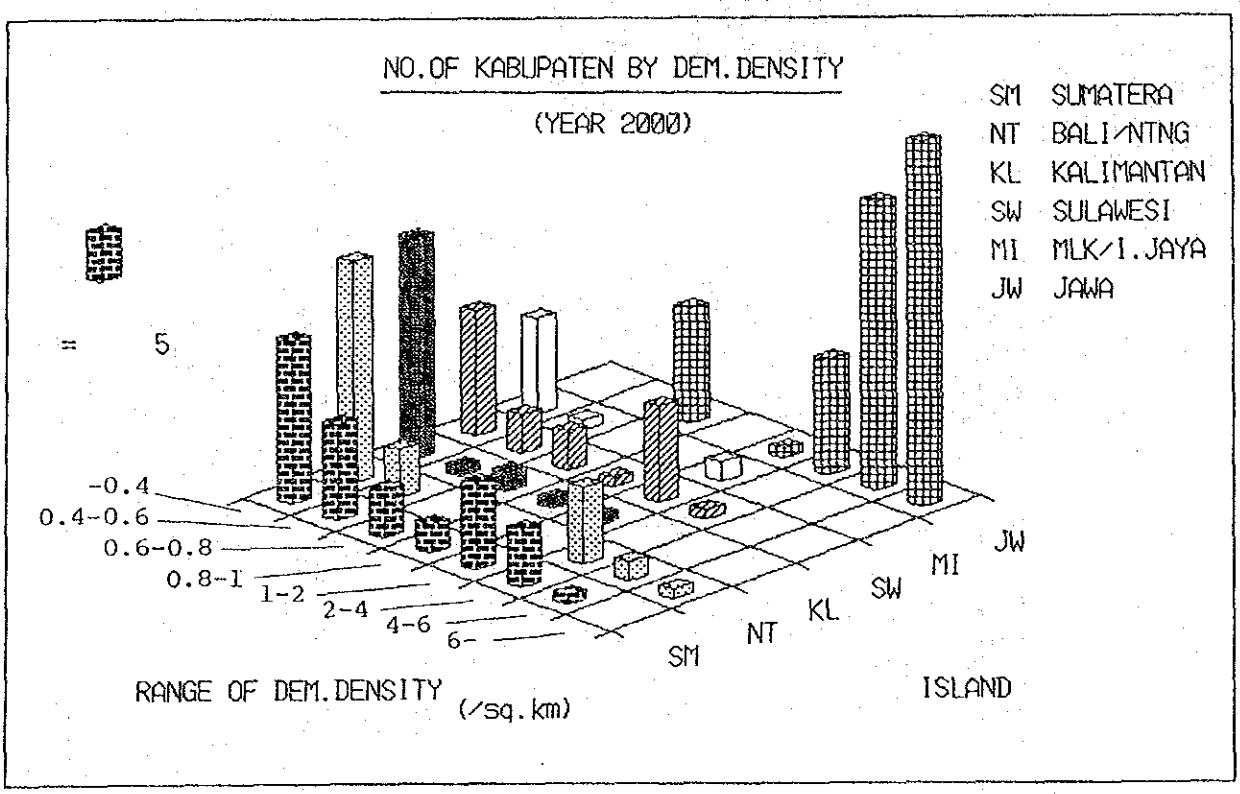


Figure 5-1-2 Kabupaten Level Demand Density

Demand density of Jawa Island is highest among all islands. Sumatera and Nusa Tenggara Islands have the secondly highest demand density. Demand density of the respective islands other than the above is less than $0.2/km^2$.

3) Demand size per Kecamatan ranges from 100 to 1,500.

5-1-3 Demand Distribution in Rural Area

For two sample areas, i.e., JAWA TENGAH and RIAU, analysis was made concerning space distribution of Kecamatan level telephone demand. Results obtained are in Figure 5-1-3 and Figure 5-1-4.

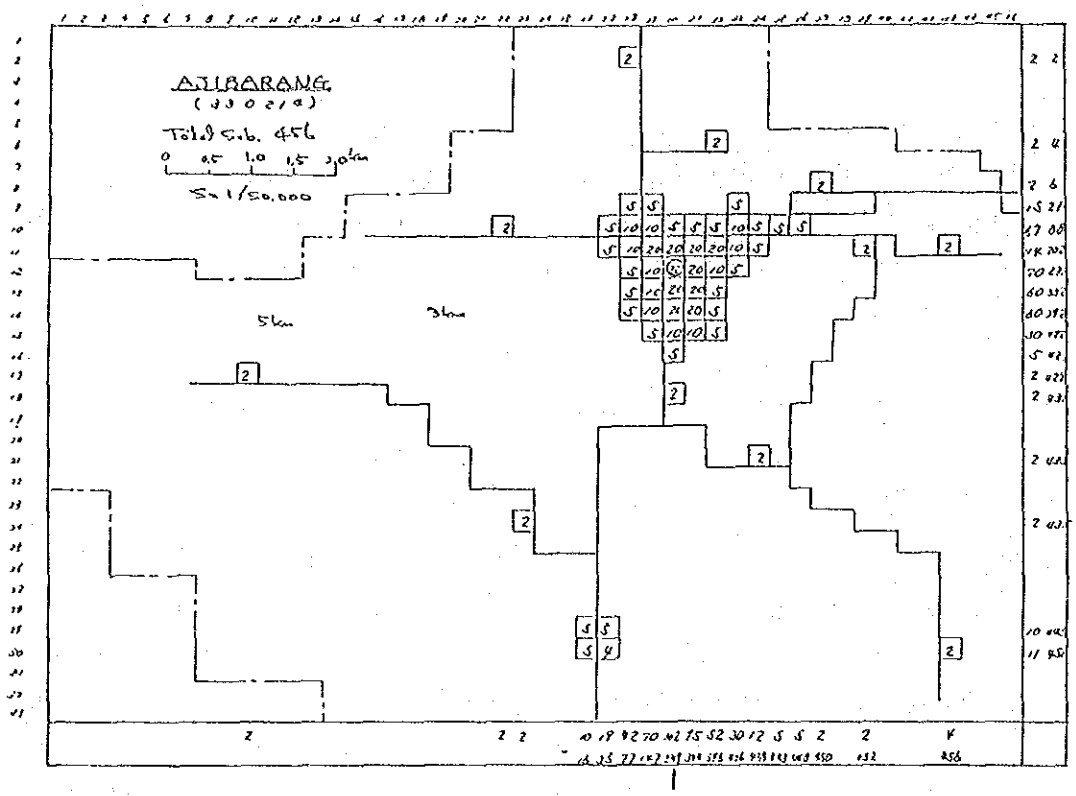
The most part of demand is concentrated in Kecamatan Capital and periphery. Demand in peripheral area is scant and scatterd along road or river. Blank section in each illustration is the uninhabited farmland and woodland.

Average characteristics of Kecamatan level telephone demand distribution in JAWA TENGAH and RIAU as sample areas are in Figure 5-1-5. This illustration indicates telephone demand distribution trends in the two sample areas. Trends are as under.

(1) Within distance of 5 km from Kecamatan Capital, no distinction in demand distribution pattern is found between JAWA TENGAH and RIAU. However, in numerical size of demand, RIAU falls behind.

(2) In JAWA TENGAH, no demand exists beyond distance of 10 km from Kecamatan Capital

(3) In RIAU, at a location 10 km from Kecamatan Capital, a small peak is distinguishable. This peak is the now growing second village.



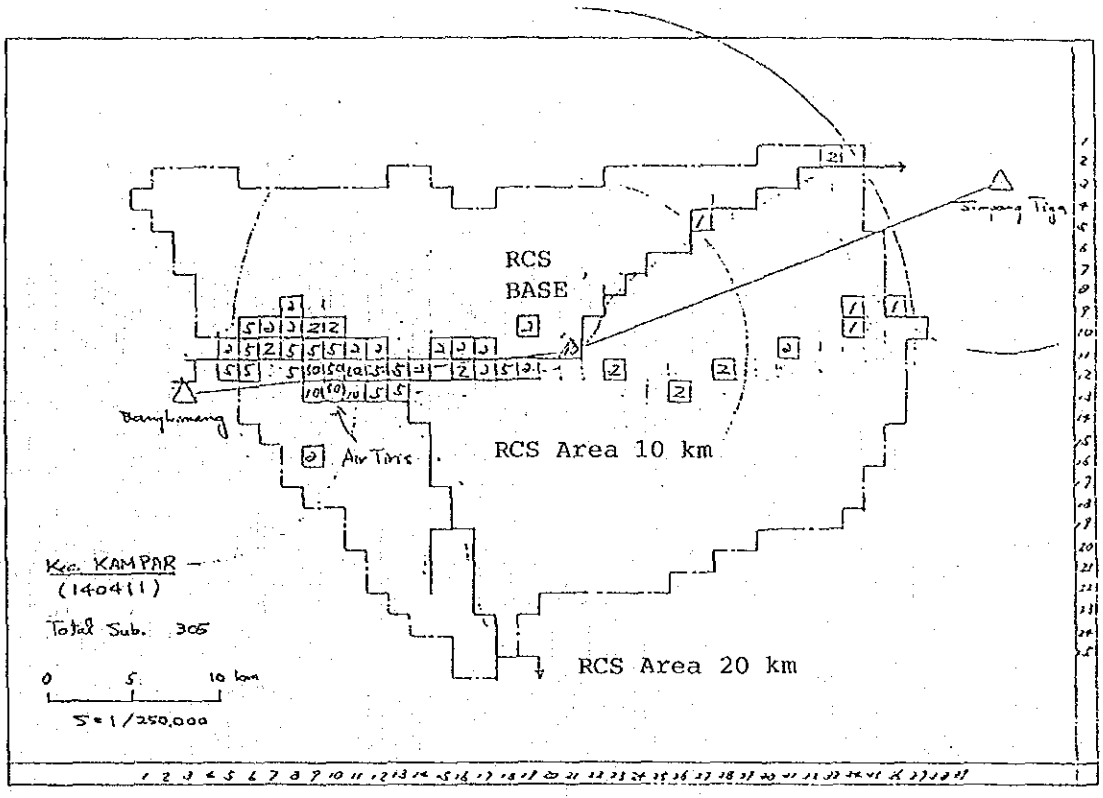
***** DISTANCE TO SUBSCRIBERS *****

DATA FILE NAME	330214
CELL WIDTH (CHRS)	4
UNIT LENGTH (km)	.25
X-AXIS WIDTH (NO.) ...	46
Y-AXIS WIDTH (NO.) ...	33
Xc-POINT (NO.)	30
Yc-POINT (NO.)	12

DIST(km)	SUB	0.....40.....80.....120.....160.....200.....240.
0.0	20	¦****
0.1	0	¦
0.2	70	¦**********
0.3	70	¦**********
0.4	0	¦
0.5	125	¦************************
0.6	0	¦
0.7	75	¦**********
0.8	0	¦
0.9	25	¦*****
1.0	34	¦*******
2.0	10	¦**
3.0	4	¦*
4.0	19	¦****
5.0	4	¦*
6.0	0	¦
7.0	0	¦
8.0	0	¦
9.0	0	¦
10.0	0	¦
20.0	0	¦
30.0	0	¦
40.0	0	¦
50.0	0	¦

TOTAL SUB	456
AVR DIST(km)	0.8

Figure 5-1-3 Distribution of Demand in Kecamatan (Kec. Ajibarang in Kab. Banyumas)



***** DISTANCE TO SUBSCRIBERS *****

DATA FILE NAME	140411
CELL WIDTH (CHRS)	4
UNIT LENGTH (km)	1.25
X-AXIS WIDTH (NO.) ...	38
Y-AXIS WIDTH (NO.) ...	25
Xc-POINT (NO.)	10
Yc-POINT (NO.)	13

DIST(km)	SUB	0.....40.....80.....120.....160.....200.....240
0.0	50	!**********
1.0	130	!**************************
2.0	27	!*****
3.0	23	!*****
4.0	4	!*
5.0	16	!***
6.0	14	!***
7.0	4	!*
8.0	2	!
9.0	2	!
10.0	21	!****
20.0	7	!*
30.0	5	!*
40.0	0	!
50.0	0	!
60.0	0	!
70.0	0	!
80.0	0	!
90.0	0	!
100.0	0	!
200.0	0	!
300.0	0	!
400.0	0	!
500.0	0	!

TOTAL SUB 305
AVR DIST(km) 3.9

Figure 5-1-4 Distribution of Demand in Kecamatan (Kec. Kampar in Kab. Kampar)

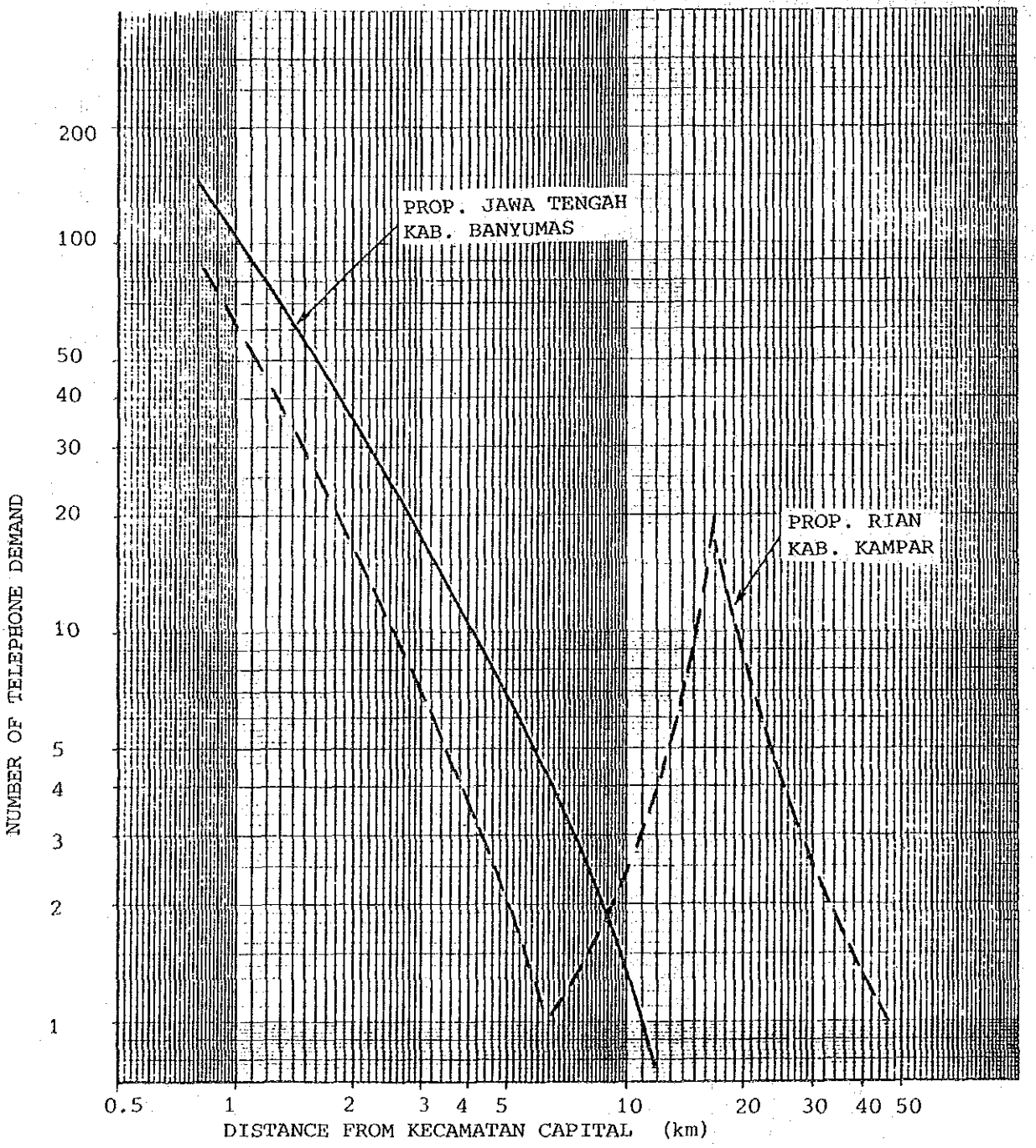


Figure 5-1-5 Telephone Demand Distribution in the Area of Kecamatan

5-2 Rural Telecommunications System Philosophy

5-2-1 System Characteristics

Rural telecommunications network, differing from urban telecommunications network, are characterized as under.

(1) Subscribers per unit area are few. They are scattered either individually or in small groups.

(2) In many cases, the objective areas, are geographically alienated from main telecommunications network.

(3) Allied infrastructural facilities (such as electric power supply system and roads) are underdeveloped.

Therefore, in the early stage of its development, rural telecommunications network is not infrequently for point-to-point communication. Then, in the subsequent stages of development, the network gradually expands at plane level. Typical development patterns of rural telecommunications network are in Figure 5-2-1.

5-2-2 Optimum System Study Flow

Classification of the now operating telecommunications systems by sub-systems and by transmission media is in Figure 5-2-2. Out of these system menus, optimum system for each rural area of Indonesia must be selected in logical, cogent manner in due consideration of technical and financial requirements. Study flow whereby to determine optimum system selection procedures is in Figure 5-2-3.

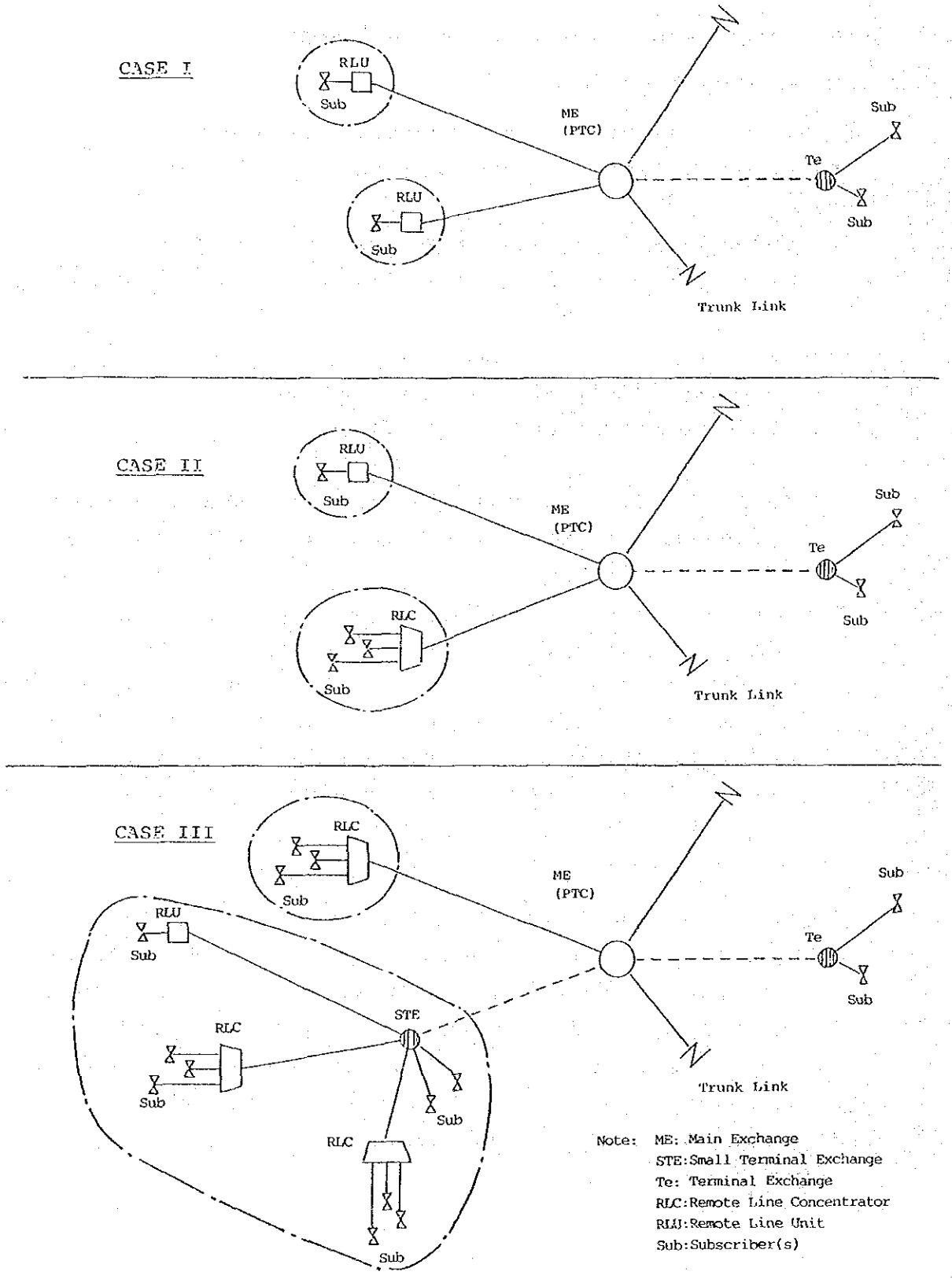
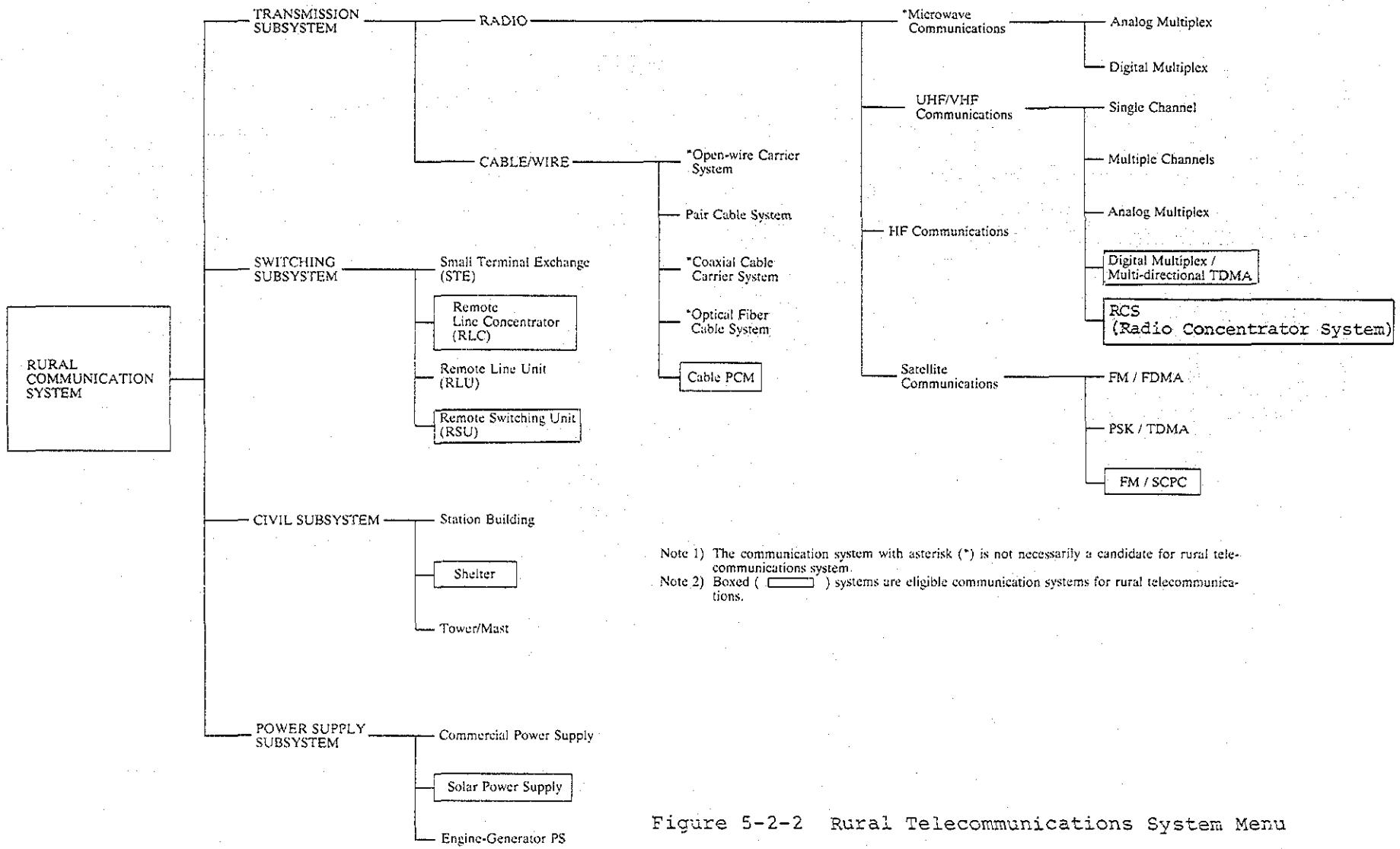


Figure 5-2-1 Typical Development Cases of Rural Telecommuniations Network



Note 1) The communication system with asterisk (*) is not necessarily a candidate for rural telecommunications system.
Note 2) Boxed (▭) systems are eligible communication systems for rural telecommunications.

Figure 5-2-2 Rural Telecommunications System Menu

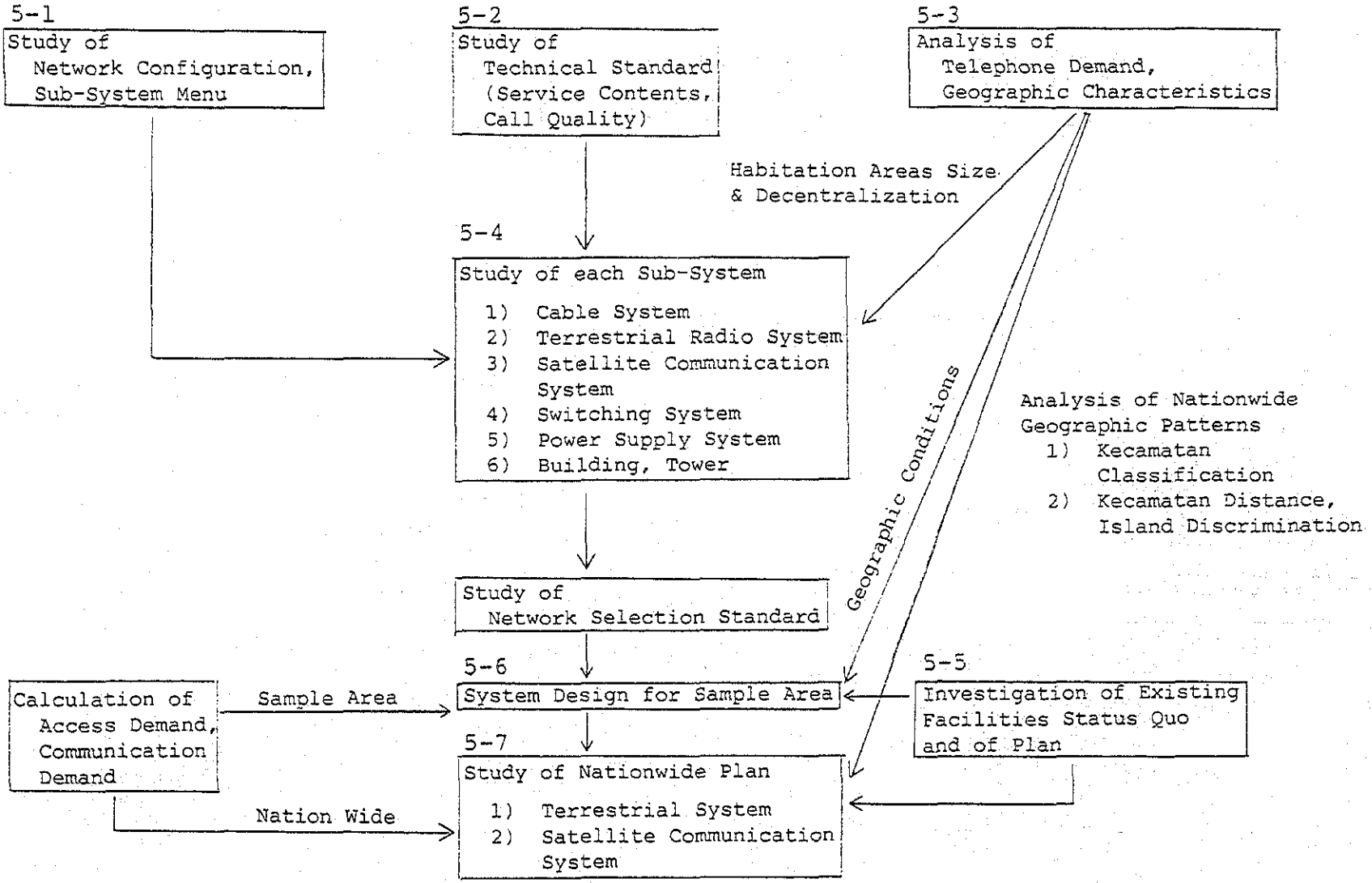


Figure 5-2-3 Study Flow for Applicable System Selection

5-2-3 Digital System Application

Present-day telecommunications facilities are of digital system in most cases. The transfer from conventional analog system to up-to-date digital system reflects digital system advantages that include:

1) High reliability of digital equipment;
2) Small floor space required for equipment installation;
3) Small transmission loss in the whole network;
4) Economy in maintenance cost;
5) Applicability to diversified services.

In Indonesia also, development research intended for the best use of digital system advantages is being promoted. One typical example is a plan to realize nationwide ISDN (Integrated Service Digital Network) is Item 3) which allows reduction of subscriber's line cost. Thus, for rural telecommunications network, adoption of digital system in all aspects of network is recommendable.

5-3 Technical Criteria

As the guideline for national telecommunication network improvement, PERUMTEL established in 1981 "Fundamental Plan 1981." This fundamental plan is being adjusted at present so that it can apply to ISDN (Integrated Services Digital Network) also which will be constructed in the future.

Fundamental Plan 1981 covers these items:

1. Numbering Plan
2. Charging Plan
3. Routing Plan
4. Transmission Plan
5. Signalling Plan

All these plans constitute the basic requirements for telecommunication network planning. In this study also, which is aimed at formulation of rural telecommunication network plan, study work will be carried out, based on the fundamental plan.

Following is a summary description of Fundamental Plan 1981.

5-3-1 Numbering Plan

(1) Service Codes for Toll and International Subscriber Diallings

Service code for toll calls ..... "0"

Service code for international calls ..... "00"

(2) National Telephone Numbering Structure

1) National Subscriber Numbering

	(Toll Code)	+	(Subscriber Number)
That is	ABC		S1, S2, S3, S4, S5, (S6)
Or,	AB		S1, S2, S3, S4, S5, (S6), (S7)

Subscriber Number includes Local Office Code. PBX extension number of Direct Inward Dialling (DID) is included in National Subscriber Numbering Plan.
S1, S1 S2 and S1 S2 S3 are called Office Numbers.

2) Special Numbering Plan

1XY (X, Y = 0 - 9)

3) Toll Code (ABC or AB)

The whole country is divided into seven blocks. The first figure of Toll Code is allocated as specified below, the whole country thus being divided into 300 areas, and each area is furnished with Toll Code. For details, refer to ANNEX 5-3-1.

A-Code Allocation:

1 ... For the time being, reserved for international calls to Singapore and other neighboring countries.
2 ... Jawa Barat, Jawa Tengah, Jakarta, Yogyakarta
3 ... Jawa Timur, Bali, Nusa Tenggara Barat, Nusa Tenggara Timur, Timor Timur
4 ... Sulawesi
5 ... Kalimantan
6 ... Aceh, Sumatera Utara
7 ... Sumatera Barat, Sumatera Selatan, Riau, Jambi, Bengkulu, Lampang

8 ... Public mobile telephone, public data communication, etc.

9 ... Maluku, Irian Jaya

0 ... International code

(3) International Call Numbering Structure

In the case of ISD (International Subscriber Dialling), numbering plans are twofold.

1) For international dialling without tariff indication

International Code	+	National Number	+	National Subscriber Number
00		C1 (C2) (C3)		N1 ... (N9) (N10) (N11)

2) For international dialling with tariff indication

International Code	+	Tariff Indication Request	+	National Number	+	National Subscriber Number
00		0		C1 (C2) (C3)		N1 ... (N9) (N10) (N11)

To IOD (International Operator Dialling), Operator Service Number, etc., "Fundamental Plan 1985" is to apply.

5-3-2 Charging Plan

In Indonesia, charging on telecommunication services is on charging area basis. Charging areas are established on the same basis as PTC areas, or, more precisely, one PTC area corresponds with one charging area.

Charging components are

a) Application fee (installation expense)
b) Monthly charge (service charge)
c) Equipment rent

Tariff system should be established in careful consideration of study findings concerning national welfare policy, financial status of existing and prospective subscribers, as well as PERUMTEL as service managing entity, plus future system extension, cost required and degree of service to be provided.

These charging plan principles assume paramount importance in telecommunication services. They must be faithfully observed in rural area telecommunication network construction and management also.

Chargeable call categories are fourfold. They are:

a) Local calls
b) Calls within the same toll number area
c) Toll calls
d) International calls

For local calls, charging is on call by call basis without regard to each call duration. (In Jakarta, however, call charging is for every three minutes.) For SLDD calls, charging rates differ according to distance and time zone. Charging criteria and method are as provided for in the existing "Fundamental Plan 1981."

5-3-3 Routing Plan

The existing network architecture consists of four exchange hierarchies, i.e., Tertiary Trunk Center (TTC), Secondary Trunk Center (STC), Primary Trunk Center (PTC) and Terminal Exchange (TE).

Toll call routing is by "far to near rotation" alternative trunking, in principle. (Satellite circuit is excepted.)

Exchange offices to be newly established by this Project are identified, some as Trunk Centers and some as TE or lower echelon, in the network architecture.

Communication traffic in rural areas is concentrated in such places that constitute centers of rural society, culture and economy (usually the places where PTC is located). The most part of such traffic consists of calls inside each PTC area. Therefore, the network is considered to be the star connection network centering upon PTC. Thus, for the routing plan, the existing "Fundamental Plan 1981" applies.

To carry traffic in the areas without terrestrial transmission system, the domestic satellite communication system will be used, in principle. The satellite system will be utilized as a backup system also in the event of failure of toll transmission system.

When using the domestic satellite system, it is essential to avoid multi-hop connection. For this purpose, part of routing must be restricted as specified in "Fundamental Plan 1985." For details, refer to Figure 5-3-1 to Figure 5-3-4.

For communication by the satellite system, either the pre-assignment or demand assignment system is used in consideration of traffic volume. Whichever the system adopted, the basic routing plan whereby to avoid multi-hop connection must be strictly observed.

Connection criteria for circuit groups which are used in the routing plan are as under.

- High Usage Circuit Group
  CCITT Rec. E. 522 shall apply.

- Fully Provided Circuit Group
  Loss probability: 1%

- Final Circuit Group
  Loss probability shall not exceed 1%.

- High Usage Transit Circuit Group
  Same as High Usage Circuit Group.

Typical example of circuit configuration using circuit group mentioned above appears below.

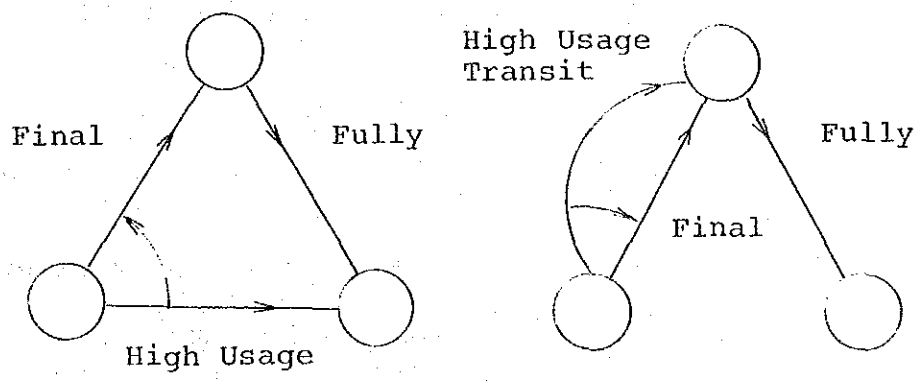


Figure 5-3-1 Direct and Transit Link

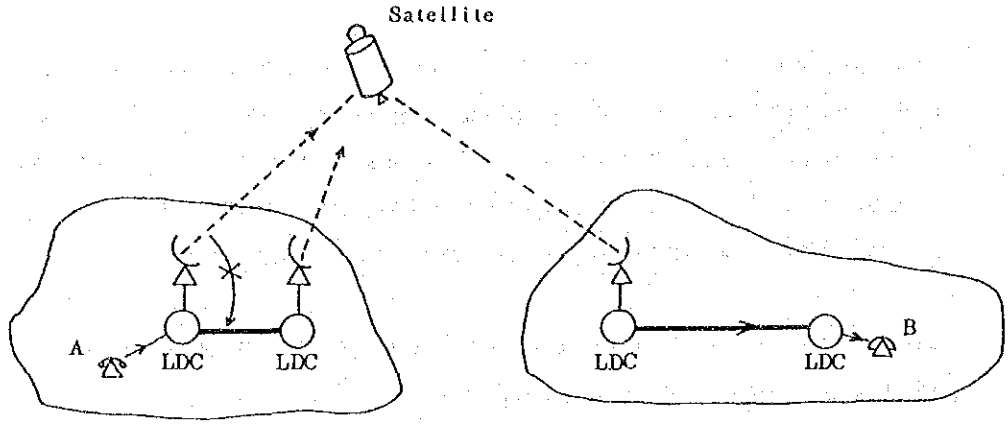


Figure 5-3-2 Destination not Connected to Terrestrial Network

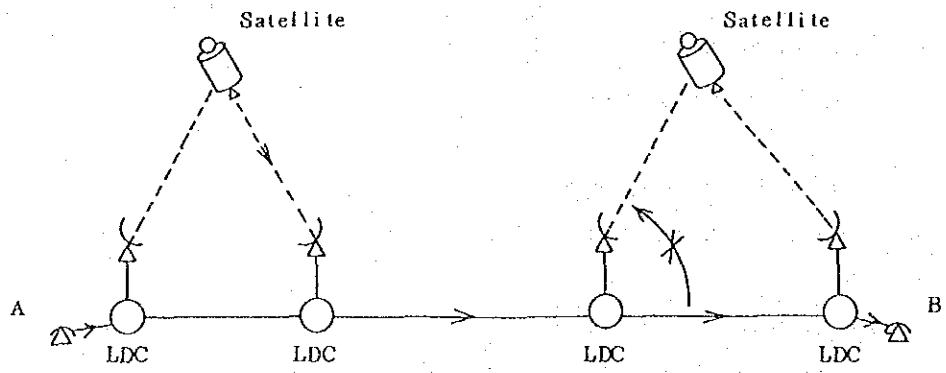


Figure 5-3-3 Destination Connected to Terrestrial Network (1)

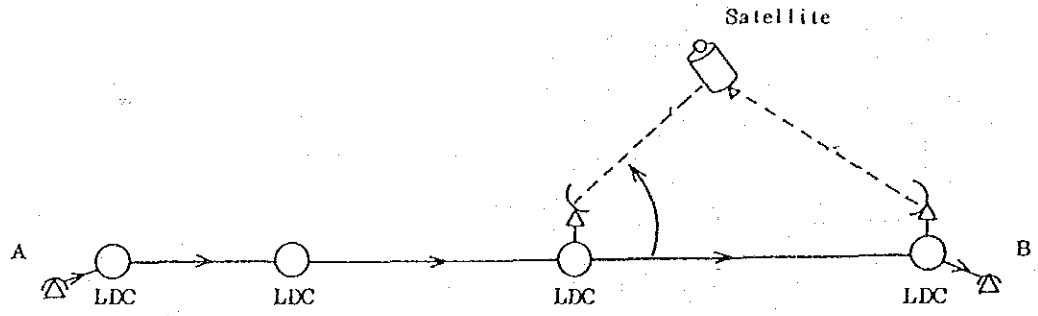


Figure 5-3-4 Destination Connected to Terrestrial Network (2)

LDC	·····	Long Distanec Center (e . g . PC , SC , TC)
——	·····	Terrestrial Link
A	·····	Originating Subscriber
B	·····	Terminating Subscriber
	·····	"not overflow allowed"