CHAPTER 3

PROSPECTS OF SOCIO-ECONOMIC DEVELOPMENT

CHAPTER 3. PROSPECTS OF SOCIO-ECONOMIC DEVELOPMENT AND THE ROLES OF TELECOMMUNICATIONS

3.1 Prospects of Socio-Economic Development in Thailand

Section 3.1 examines prospects of socio-economic development in Thailand from viewpoints of future opportunities and threats for the telecommunications sector development. The examination of opportunities and threats will help creating scenarios of demand forecasts in Chapter 4 on who will demand, where they demand, what they demand, and how much they demand for the telecommunications services and will provide reference materials with the analysis of the telecommunications sector weakness and strength for formulating development objectives and strategies of the Master Plan in Chapter 5.

3.1.1 Industrial Outlooks and Policies

Industrial outlooks and policy issues of Thailand will become much clearer and more probable when they are examined from the following three perspectives:

- Industrial areas in which Thai's comparative economic advantages exist among Asian countries,
- Industrial areas which are needed for the socio-economic development of Thailand,
- Political and economic roles Thailand is expected to play in the Indo-China Peninsula.

1) Industrial Areas in Which Thai's Comparative Economic Advantages Exist among Asian Countries

To examine in which industrial areas that Thailand's comparative economic advantages exist, it is important to take into account how competitive Thai industrial products are in international markets within international industrial specialization systems. Competitive advantages of industrial products a country produces depends on general factors in relation to the level of industrialization of the country and country specific factors in relation to the resource endowment and development strategies of the country.

Indonesia and China, with immense reservoirs of cheap labor, have been aiming at developing more stable and productive agricultural sector and labor-intensive light manufacturing industries. On the other hand, Asian NIEs are gradually moving into high-technology industries while losing middle range of manufacturing areas such as machinery

parts and components production and assembling, and basic industrial material production. As their manufacturing costs further increase, firms of Japan and Asian NIEs will shift their parts and components manufacturing and also final assembly operations of consumer electronics, electrical equipment, automobiles, and machinery to other Southeastern Asian countries in which they can obtain inexpensive, but reliable, good quality labor workers, tax benefits, and other incentives to maintain and increase competitive advantages of their products. They are looking for their over-sea production bases and planning to establish their "export bases" in those countries.

Thailand should be able to position itself to be the best place for investment from Japan and Asian NIEs among other Asian countries by improving the state of infrastructure services and implementing adequate industrial policies.

2) Industrial Areas Which Are Needed for the Socio-economic Development of Thailand.

To examine industrial areas which are needed for the socio-economic development of Thailand, it is important to consider the following long-term and middle and short-term perspectives:

- Industrial areas which can diversify and deepen the Thai industrial structure.
- Industrial areas which can benefit the short and middle term economic development of Thailand.

Although it is not considered the best and sometimes feasible to develop a complete industrial composition in one country from international industrial specialization perspectives, it is necessary in increasing degree of autonomy, growth sustainability, flexibility to make efforts to work towards developing a set of up-stream industries of producing basic industrial materials, middle range industries of producing parts and components, and assembly operations, and down-stream industries of producing final products.

It is expected to take advantage of the present favorable conditions for promoting further industrialization and to develop industries which bring the maximum benefits of development in the short and middle terms. Industrial development is expected to generate the following effects:

- To utilize under-employed labor workers in the agricultural sector more effectively.

- To decentralize the current industrial concentration in the BMR to the provincial areas.
- To vitalize the economies of the provincial areas and to expand the size of the domestic market.
- To promote further utilization of local resources, especially agro-resources.

3) Political and Economic Roles Thailand Is Expected to Play in the Indo-China Peninsula.

Many people foresee that political tensions and instability in the Indo-China Peninsula after the Viet Nam war will be soon eased and that Viet Nam, Laos, Kampuchea and Myanmar (Burma) will go into their recovery phases. Thailand for its locational advantage in the Indo-China Peninsula is expected not only to make its best efforts for creating political stabilization in the Peninsula, but also to play a leading role in providing economic assistance to these countries. For these purposes, it is expected for the Thai government to implement policies to establish an administrative framework for development aids, to expand transportation and communications infrastracture and urban functions of the areas towards Laos, Kampuchea, Viet Nam, and Mynmar, and to develop industries which can supply necessary goods and services for development aids.

4) Prospects and Policy Issues

Policy emphases should be especially put on to the following areas to develop industries which bring the maximum benefits of development in the short and middle terms and to develop industries which diversify and deepen the Thai industrial structure in the long run:

- To increase technological capabilities of Thai manufactures through promoting science and engineering education, technical transfer, and R&D efforts of private firms.
- To improve and expand infrastructure.
- To develop a wide range of subcontracting and supporting industries,
  - for the purpose of developing parts and components, and intermediate industrial materials manufacturing industries for export oriented industries,
  - for the purpose of increasing employment capability of the manufacturing sector and diversifying manufacturing products.

- To promote decentralization of the presently concentrated industries in the BMR, to spread the benefits of economic development to the provincial areas and to expand the size of the domestic market.
- To promote human resource development and to reform salary and compensation systems.
- To enhance promotional and public relations activities for Thai-made products in major foreign markets.
- To continue diplomatic efforts to lower tariff and non-tariff barriers in major foreign markets.

3.1.2 The Spatial Policies and Regional Outlooks

1) The Bangkok Metropolitan Region and the Central Region

The Bangkok Metropolitan Region will continue to grow and remain the leading center of Thai industries. With the improvement in basic infrastructure in outskirts of the Bangkok area, a clear trend of decentralization has emerged. This trend will continue by the following reasons:

- The government will further promote industries to locate the outside of Bangkok.
- Costs of staying in Bangkok exceed benefits for firms which can internalize economic externalities of urban concentration.

Development of the areas around Bangkok during the next five to ten years is expected to take place in the following three directions:

- The first is the Northern area of Bangkok, especially along Route 1 up to Ayutthaya via the Bangkok International Airport. This area includes two industrially prospective provinces of Nonthaburi and Pathumthani. Pathumthani has three BOI promoted industrial parks and areas such as Nava Nakorn, Mabung Khlong, and Bangkadi. There is Rpjana Industrial Park in Ayutthaya. Nonthaburi plans to transform its 4,800 rai area into industrial areas. Textile, tire, motorcycle, cement factories have been already located in this area.

- The second is the Western and South-western area of Bangkok, especially along Route 4 and Route 35 to Nakhon Pathom and Samut Sakhon via Tonburi. Fishery and ceramic industries have been already located in this area. Large fishing ports made this area a center of the fishery industry.

- The third is the Eastern and South-eastern area of Bangkok, especially along Route 3, Route 34, and Route 304 to the Eastern Sea Board via Bang Phli, Bang Pho Industrial Parks. This area is called "Growth Corridor" and includes two industrially prospective provinces of Chachoengsao and Prachin Buri besides the Eastern Sea Board. Electronics and auto industries have been already located in this area. This area has the highest growth possibility. Once Leam Chabang and Map Ta Phut deep sea ports and industrial parks are completed, growth of the area will be accelerated.

It is expected that regional and local resource utilizing industries, labor intensive industries, and export oriented industries, especially for the North American market, the Japanese market, the Asian NIEs markets, the Australia and New Zealand markets and the Bangkok market oriented industries, will be located in these areas.

Figure 3.1.2-1 shows a map of the future development trend of the BMR.

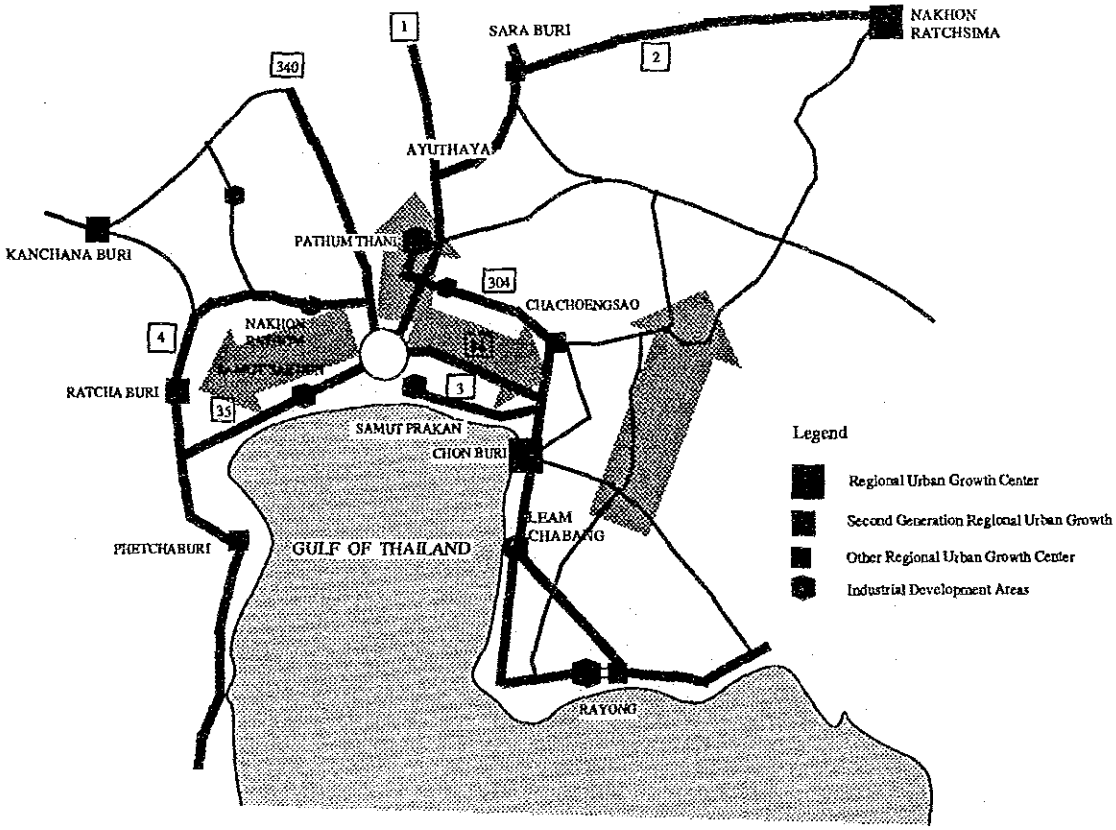


Figure 3.1.2-1 Future Development Directions in the BMR

2) Other Regions

Industrialization in Thailand started for the purpose of import substitution of consumption goods in the 1960's. This created a mass-concentration of industries in the infrastructure rich and consumer concentrated Bangkok-Tonburi area. The lack of regional development policies caused the failure of creating broad economic relations among the provincial areas and among the BMR and the provincial areas The provincial areas were, therefore, prevented from getting out of semi-autarky and quasi-monetary economy states.

The stagnation of the provincial areas halted the expansion of the domestic market and worked as one of the major reasons behind the failure of the import substitution strategy.

The stagnation of the provincial areas also hindered accumulation of sufficient local capital, cultivation of entrepreneur minds to exploit local resources for starting local businesses. At the same time, poor conditions of production, transportation, communications infrastructure, and short supply of efficient public services, business and technical information worked against attracting industries from the BMR and accelerated the stagnation of the provincial areas. Hence, local production/consumption centers in the provincial areas stayted small.

The Sixth NESDP lists the following three groups of cities as regional growth centers:

The first ranked cities

North: Chiang Mai,
Northeast: Khon Kaen, Nakhon Ratchasima
East: Chon Buri,
South: Songkhla-Hat Yai,

The second ranked cities

North: Phitsanulok, Nakhon Sawan,
Northeast: Udon Thani,
West: Ratchaburi,
South: Surat Thani, Phuket.

The third ranked cities

North: Lampang, Chiang Rai,
Northeast: Ubon Ratchathani, Roi Et, Surin, Sakhon Nakhon,
East: Rayong, Chachoengsao,

Central: Saraburi,
West: Kanchanaburi, Phetchaburi,
South: Pattani, Nakhon Si Thammarat.

a) The Northeastern Region

The Northeastern Region has been the least developed and the poorest area in Thailand for many years. The Fifth and Sixth NESDP stress special attentions for developing this area. The outlooks of this region are not so gloomy if Thailand can play major assistance roles for the recovery of three countries in the Indo-China Peninsula and the Eastern Seaboard areas become the center of Thai industries. Economic impacts and benefits of the Eastern Seaboard development are expected to spread to the areas around Nakhon Ratchasima if basic material industries such as basic chemical products, rolled steel, special steel, nonferrous metal, machinery parts and components production and assembling industries, agro-industries and subcontractors and supporting industries for those industries are located along major highways towards Nakhon Ratchasima.

If economic impacts and benefits of the Eastern Seaboard development spread towards the Northeastern Region, the East side of the BMR, the Eastern Seaboard areas and the areas up to Nakhon Ratchasima may possibly grow into becoming one large integrated industrial area. This industrial area may further stretch its expansion edges towards,

-the Laos-Northern Viet Nam Market through Khon Kaen and Udonthani,
- the Kampuchea-Southern Viet Nam Market through Surin and Ubon Ratchathani,

as economic recoveries of Laos, Kampuchea, and Viet Nam Progresses.

b) The Southern Region

The Southern Region seems to have formed its own economic zone. Major economic activities are in agricultural and mining production such as forestry, fishery, rubber plantation, rice-growing, and tin production.

Phuket and Songkla-Hat Yai are the two major cities in the Southern Region. Phuket is one of the leading provinces in tin production, has an internationally famous beach resort island, and developed a deep-sea commercial port and an international airport. Songkla-Hat Yai is the center of commerce and business of the Southern Region and the major center of communication and transportation services linking with Malaysia. Songkla has also

developed a deep-sea commercial port and an international airport. It has also become a place of great entertainment and its recent economic growth has been remarkable.

This region is expected to steadily grow with its own economic forces based on commercial and business activities linked with Malaysia, the agriculture and mining industries, and international tourism for the beautiful coastal areas. For many years people have talked and planned about building a canal between the Andaman Sea and the Gulf of Siam. If this plan or an alternative plan of building an oil pipe-line along with a highway and a railway is realized, the significance of this area as an industrial center will greatly increase.

If local resource utilizing industries, labor intensive industries, and export oriented industries for middle eastern markets and European markets are attracted into this area, the industrial concentration in the BMR will be significantly eased.

c) The Northern Region

The Northern Region does not seem to have a great development potential in comparison with the Central, Southern, and even Northeastern Regions. The main occupation of people in the region is agriculture.

Chiang Mai is the center of the region and is regarded as one of the most charming historical cities in Asia. It hosts hundreds of thousands tourists every year. The region has many more tourist attracting cities and areas.

Although transportation infrastructure to the BMR has been fairly well developed, Chiang Mai is quite distant from any major market. The government has been trying to locate manufacturing industries. It seems that prospective industries in the region are high-technology industries which heavily use air transportation. Another prospective industries seem knowledge and technology intensive industries related to computer software development and basic research activities by taking an advantage of the natural and cultural environment of the area.

Although this area is regarded as the main gateway to the Mynmar market, prospects for the Myanmar market do not seem good for at least another ten years.

Figure 3.1.2-2 summarizes regional development trends.

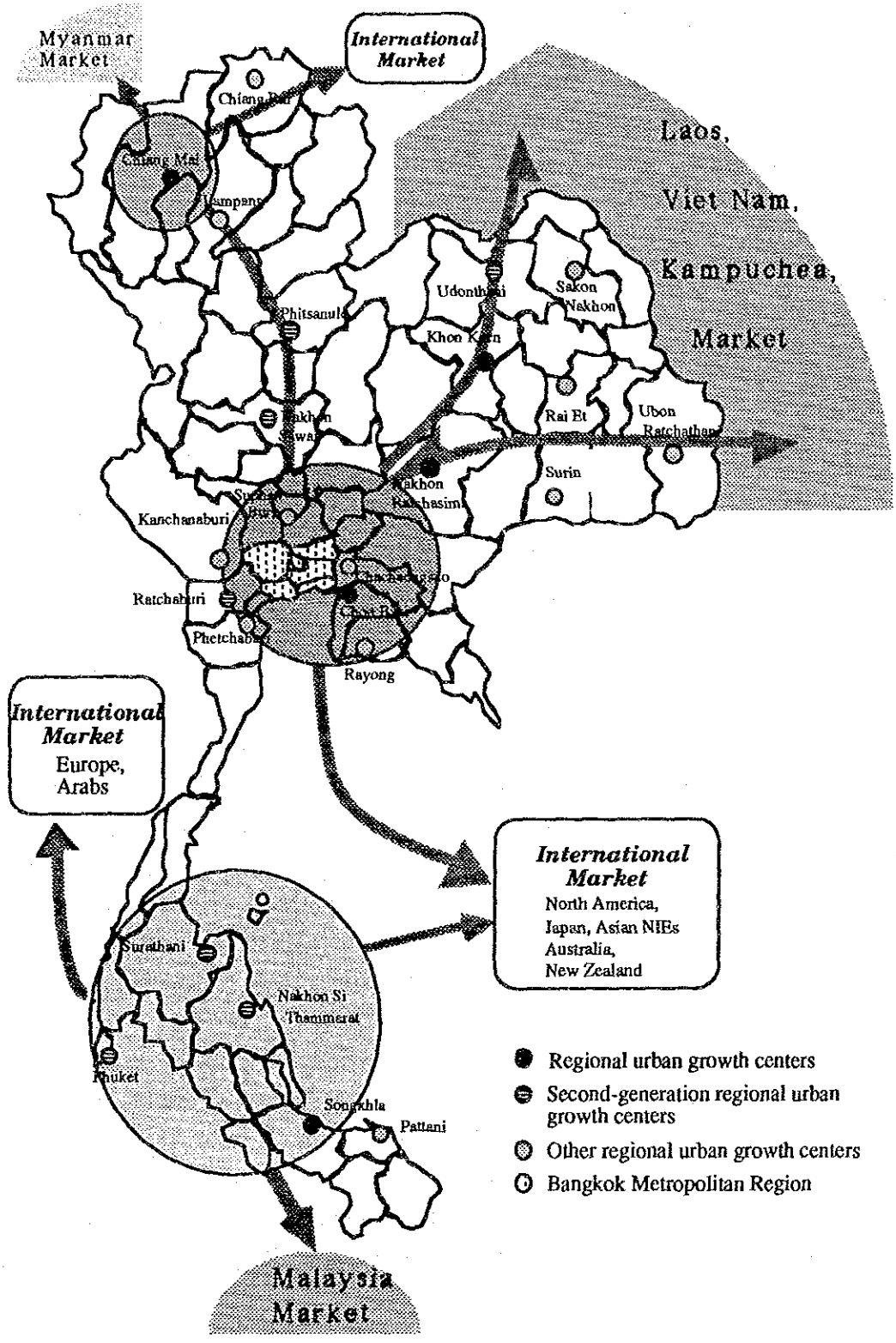


Figure 3.1.2-2 Regional Development Outlook

3.1.3 Socio-economic Situations of the Next 20 Years

Future success of Thailand depends on implementation of industrial policies discussed in 3.1.1 and continuation of favorable external conditions. Major external factors are magnitudes of external demands for Thai products, terms of trade, exchange rates of major currencies, oil price, amount of foreign direct investment, and foreign interest rates on Thailand's external borrowings.

A scenario which looks the most plausible in light of currently pursued government policies is given as follows:

1) The external conditions will stay largely unchanged. Industrial and regional developments will progress in a moderate speed. The Thai economy can expect real average annual GDP growth rate of 6% for the next 20 years. The government will increase public sector investment from 5.8% of GDP in 1988 and to 7.2% in 1989 and maintain that level thereafter. The real effective exchange rate will be kept unchanged.

2) The BMR will continue to grow into the three direction illustrated in previously presented Figure 3.1.2-1 and remain the leading center of Thai industries. At the same time, with improvement in basic infrastructure outside Bangkok and regional development efforts in the first ranked cities for development in the Sixth NESDP, the Eastern Seaboard area which will develop heavy chemical industries by utilizing natural gas produced in the Gulf of Siam and labor intensive export oriented industries, and the Southern Seaboard area which will develop further through the oil pipeline construction project between the Andaman Sea and the Gulf of Siam, a mild trend of decentralization will emerge. Disparities of growth rates and income levels among regions and industrial sectors will be slightly narrowed.

3) Thailand possesses many advantages as a country to establish export bases of both foreign and domestic export oriented firms for North American, European, Japanese, the Asian NIEs, Australia-New Zealand, and Middle Eastern markets. The BMR, the Eastern Seaboard area and its surrounding areas up to Nakhon Ratchasima, and the Southern Seaboard area around Songkla-Hat Yai will grow into major industrial areas developed around export bases. Growth of these industrial areas will be expected to generate the following development benefits:

a) To promote development of parts and components, and intermediate industrial materials manufacturing industries for export oriented industries.

b) To promote development of a wide range of subcontracting and supporting industries.

c) To promote industrial diversification.

d) To promote decentralization of the presently concentrated industries in the BMR, to spread the benefits of economic development to the provincial areas and to expand the size of the domestic market.

e) To promote employment capability of the manufacturing sector.

f) To promote technical transfer.

4) The political and economic significance of Thailand will increase as the gateway to Laos, Kampuchea, and Viet Nam.

5) Agro-industries and labor intensive industries will be further developed to exploit the advantage of the availability of inexpensive, but good quality labor workers and richly endowed agro-resources.

6) The short supply of skilled and experienced workers will become a major problem, especially in Bangkok. Firms in Bangkok will start looking for qualified professionals seriously.

7) Projections up to the year 2007 are discussed as follows:

a) <u>The World Bank Forecast</u>

The World Bank forecasted future figures of the major economic indexes according to their basic scenario which is similar to the scenario presented in this report. Table 3.1.3-1 shows the World Bank forecast.

Table 3.1.3-1 World Bank Projection

	Actual		Projected		
	1982-86	1987-88	1989-91	1992-96	1997-2001
Real Growth (%, p.a.)					
GDP	5.4	9.7	7.7	6.3	6.1
Exports	9.4	20.1	10.8	8.4	8.9
Per Capita GNP	3.5	8.2	6.2	4.4	4.5
Per Capita GNP (in 1987 US $)	809	959	1,242	1,442	1,821
Share in GDP (%)					
Investment	24.0	26.7	28.5	27.4	27.1
Savings	20.3	24.4	23.5	23.9	24.6
Current account balance	-3.7	-2.2	-5.0	-3.5	-2.5
Public sector balance	-5.8	0.0	-1.3	-1.4	-1.7
External Debt Burden					
Total debt service ratio (%)	24.2	16.6	14.0	14.6	14.0
Total Debt outstanding share in GDP (%)	39.4	41.4	39.8	39.8	38.1

Source: Thailand: Country Economic Memorandum Building on the Recent Success - A Policy Framework, The World Bank, 1989.

b) Population Projection

A national population projection (1987 - 2015), and regional population projections (1987 - 2000) were obtained from NESDB. Regional population projections (2001 - 2007) were separately obtained by a simple extrapolation. Population projections for each Changwat were obtained by proportionating the regional population projections with percentage figures of Changwat population to regional population in 1987.

Figure 3.1.3-1 and Table 3.1.3-2 show the population projections.

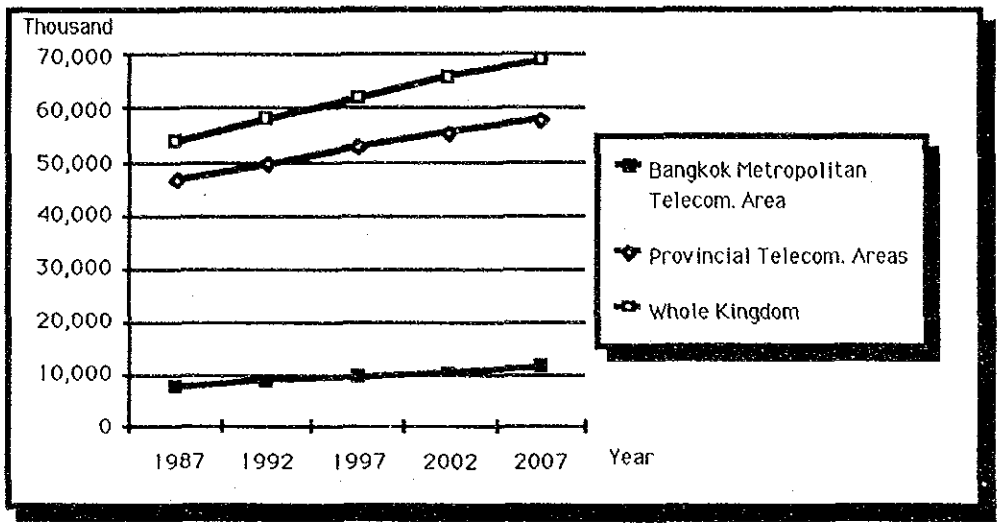


Figure 3.1.3-1 Population Projection

Table 3.1.3.-2 Population Projection

(Unit: Thousand)

Year	1987	1992	1997	2002	2007
Bangkok Metropolitan Telecom. Area	7,338	8,496	9,467	10,357	11,284
Provincial Telecom. Areas	46,535	49,545	52,635	55,508	57,881
Whole Kingdom	53,873	58,041	62,102	65,865	69,165

c) GPP and GNP Forecasts

Projected figures of GDP (1987 - 2001) were obtained from the World Bank. Projected figures of GDP for the years between 2002 and 2007 were obtained by assuming that the growth rates of the years between 1997 and 2001 will prevail after 2001 until 2007.

Projected figures of GPP (1987 - 2007) were obtained by proportionating the projected GDP figures according to the provincial share percentage figures of GPP which NESDB forecasted.

Figure 3.1.3-2 and Table 3.1.3-3 show GPP and GDP.

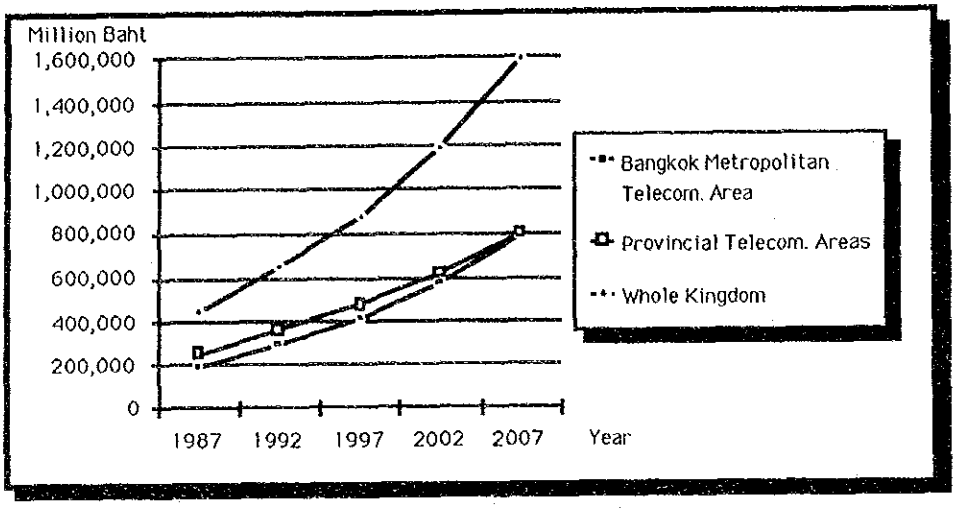


Figure 3.1.3-2 GRP and GDP Forecast

Table 3.1.3-3 GRP and GDP Forecast

(Unit: Million Baht)

Year	1987	1992	1997	2002	2007
Bangkok Metropolitan Telecom. Area	192,869	293,598	412,139	571,553	791,584
Provincial Telecom. Areas	253,492	356,641	468,751	612,847	800,901
Whole Kingdom	446,361	650,239	880,890	1,184,401	1,592,486

3.2 Roles and Significance of Telecommunications for Socio-Economic Development in Thailand

Significance and roles of telecommunications for social and economic development have been increasing not only in developed countries but also in developing countries since increasing importance of information is universal. This, however, does not mean that significance and roles of telecommunications are exactly the same in all countries. The development pattern and stage of one country is greatly different from those of other countries. Hence, to discuss how significant telecommunications are and what roles they play for social and economic development of a country, the following two issues must be clarified:

- Significance and roles of telecommunications along with development stages.
- The present situation and the future prospects of the development of the country.

3.2.1 Roles of Information in Information Society

As a result of technical innovations in the field of telecommunications, it has become easier and less costly to gather widely scattered pieces of information, to obtain information about socio-economic phenomena and business opportunities not known before, and to transmit them more quickly and accurately, and to create new information based on newly acquired information. Creation and acquisition of information will greatly affect industrial structures and business practices. Information especially plays crucial roles in industries which are strategically heading toward the direction of product diversification and sophistication.

A term, "Informationization of a society", is often used to imply a socio-economic state that creation and acquisition of information greatly affect socio-economic structures. "Informationization" creates the following phenomena:

- Knowledge and information industries increase their business activities.
- Significance and roles of information in industries increase relative to those of primary production factors such as energy, capital, and labor.

The most important changes in industrial structures by "Informationization" are development of new industrial integrations and networknization. Barriers and borders between existing industries, businesses, and firms are lowered or eliminated. New cooperations, new business integrations and network development are promoted as business strategies.

Progress of "Informationization" in a society transforms the society from industrial society to information society. An industrial society is characterized by mass-production, and standardized products and production methods. A basic factor that produces surpluses for the society is decrease of unit business costs through quantitative expansion (called economies of scale). An information society is characterized by product diversification and sophistication, and wide availability of refined services. Basic factors that produce surpluses for the society are effective utilization of common resources and reduction of common costs through producing many products in a firm and integrating business efforts among different firms (called economies of scope or economies of networking).

There are numerous new developments that managers of firms should learn in the frontier of the telecommunications field. Taking a lazy attitude towards learning new developments on telecommunications will put the firm into extremely disadvantageous

position in market competition by the beginning of the 21 century. It has been more and more strategically important to ponder about how to develop and use telecommunications systems in order to lead, follow, or catch up with its competitors.

Telecommunications systems can become strategic resources in the following business practices:

-To increase competitive advantages in market places,
- grasping market trends in more accurate and faster manners and satisfying custamer needs in better ways,
- by differentiating products through integrating information and services,
- by providing more satisfactions to customers through improving customer accessibility, handling complaints in better ways, and providing more and better information,
- by reducing lost opportunities in sale of timing critical products such as seat reservations, currency dealings, financial dealings through improving successful calling rates,

-To improve managerial efficiency,
- by reducing amount of inventory through decentralized inventory management,
- by collecting and providing more adequate information from and to field operators through establishing direct communications links,
- by improving communications within organizations,
- by obtaining a wide range of necessary and real time information for top management to make strategic decision makings

- To discover innovations,
- by creating new businesses, products and services through integrating and restructuring the existing businesses, products and services,
- by lowering or eliminating the existing boundaries of businesses,
- by creating advantages that others have difficulty in catching up through establishing information networks.

Telecommunications systems will become critical strategic management resources in the following industries:

- Financial service businesses,

- Manufacturers, especially subcontractor depending businesses, export oriented businesses, multi-national businesses,
- Airlines, Travel agents, Tourism business, Surface carriers,
- Distribution businesses,
- Retail businesses,
- Printing and publishing businesses.

What is critically important for long-term development of the telecommunications sector is for people working in the sector to recognize the future trend of socio-economic structures and to understand what telecommunications can offer for socio-economic development in new societies and what they can contribute to promote the telecommunications sector development.

As "Informationization" and "Economies of Networking" become more common concepts and practices, the character of the telecommunications sector will also change from "Plain Simple Voice Messages Transmission Business" to more complex "Information Carrier Business" and to "Intelligent Business and Life Style Supporting Business". It becomes critical for the sector to not only establish a system which can quickly respond to customer demands but to establish a system which aggressively promotes telecommunications services and contributes to creation of an intelligent society.

Management styles of telecommunications operating entities should also change from "engineering oriented management" style to "customer service oriented management" style.

In case of "engineering oriented management", the management policy is to develop the most adequate systems and to utilize them in the most efficient manner to fulfil the social responsibilities of public enterprises. In case of "customer service oriented management", the management policy is to provide services in competitive prices that the customers demand and to become a leader to create an intelligent society.

Figure 3.2.1-1 illustrates social development stages and the relationship between development stages and the roles of telecommunications.

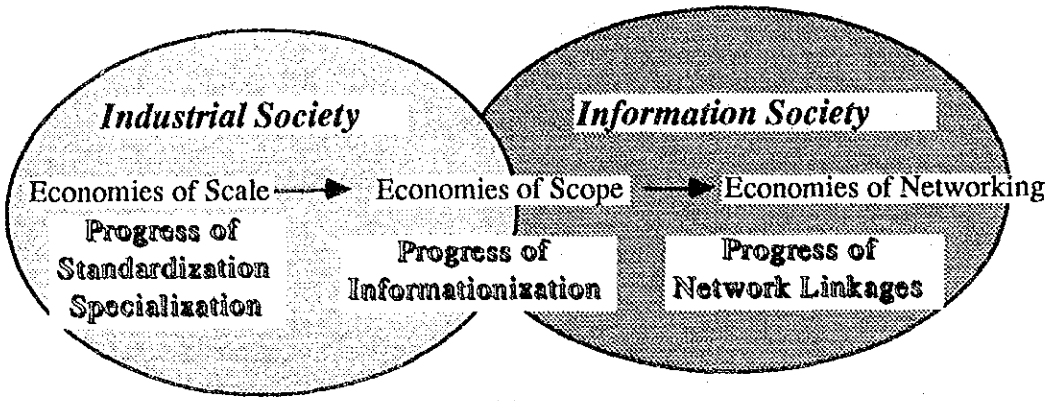
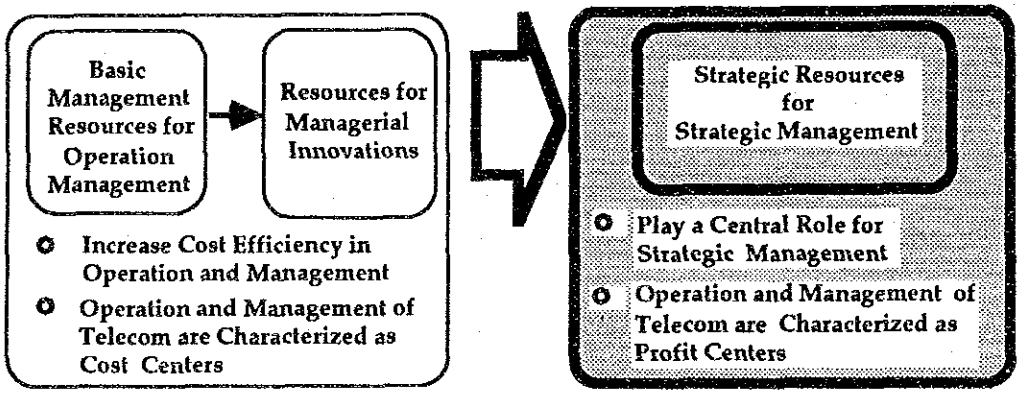


Figure 3.2.1-1 Social Development Stages and the Roles of Telecommunications (1/3)

From the Perspectives of Telecommunications Users

Industrial Society → Information Society

Roles of Telecommunications



Needs for Telecommunications

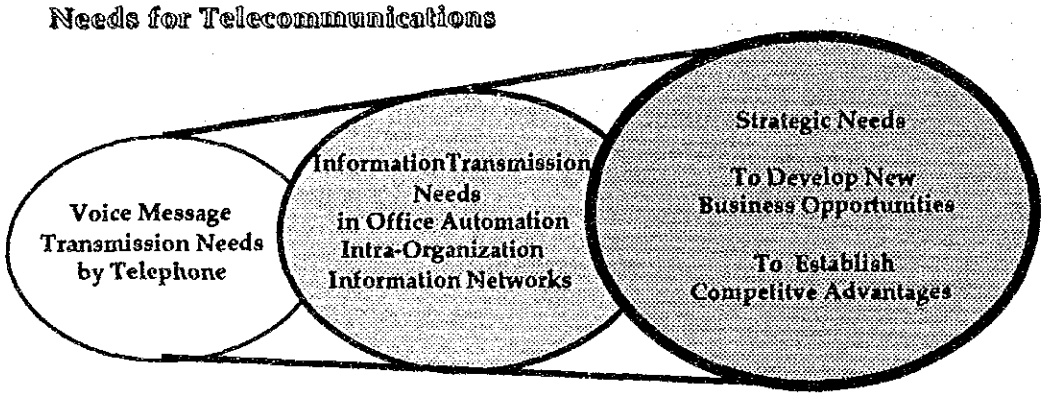
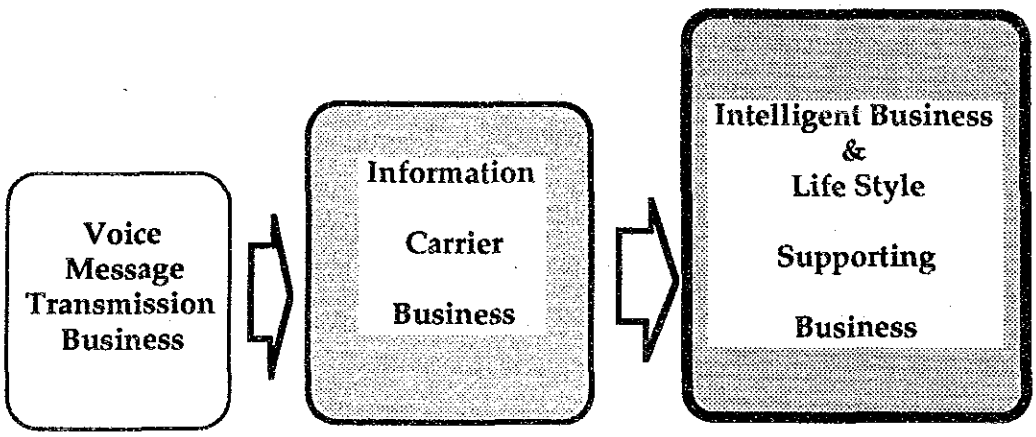


Figure 3.2.1-1 Social Development Stages and the Roles of Telecommunications (2/3)

From the Perspectives of a Telecommunications Operating Entity

Industrial Society → **Information Society**

Main Features of Telecommunications Businesses



Management Policies

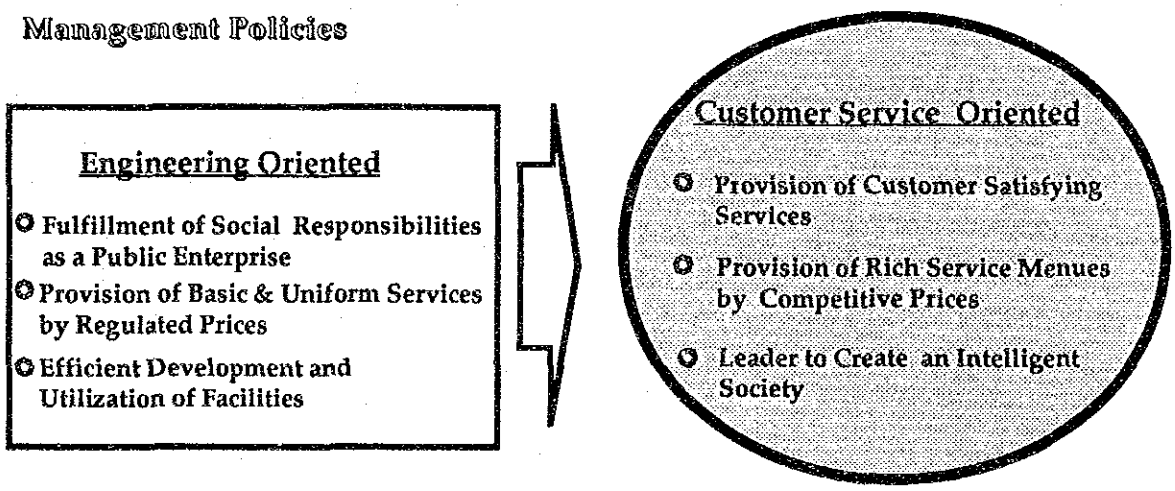


Figure 3.2.1-1 Social Development Stages and the Roles of Telecommunications (3/3)

3.2.2 Telecommunications Services in an Information Society and Prospects of Thailand

What more specific contributions can telecommunications development make for the development of Thailand during the next twenty years?

For Thailand to be able to develop a modern financial sector which can compete with those in Singapore and Hongkong in Southeast Asia, telecommunications will play a crucial role. Both international and domestic financial dealings depend heavily on good, reliable, and efficient telecommunications networks which can offer diversified and sophisticated services for reasonable prices. If telecommunications services can not satisfy customers demands, financial sector reformation and development will be severely stifled.

One of the essential factors for rural industry development is to establish a network of production-distribution-marketing systems which can link rural resources to urban markets and give better accessibility of public services to entrepreneurs in the rural areas. Rural industries must be able to absorb immense reservoir of under-employed labor workers in the agricultural sector and to realize economies of scale through quantitative expansion. Marketing connections with urban and international markets where mass demands exist are hence essential. Without a nation-wide telecommunications network, establishment of the nation-wide production-distribution-marketing systems cannot be realized.

When Thailand aims to develop its own export oriented industries and to make itself an attractive place for production bases of foreign firms, development of efficient and reliable integrated domestic and international telecommunications systems is also essential to develop nation-wide systems of subcontractors and supporting industries. Establishment of teleports in the BMR, the Eastern Seaboard area, the Southern Seaboard area, and the Northern Region and linking them by a network will provide export oriented industries and firms with high-powered information communications resources.

Under the current situation of the shortage of quality workers, telecommunications will also provide efficient and effective tele-education resources for providing nationwide secondary level education services to unskilled labor workers scattered in the provincial areas.

3.2.3 An Econometric Analysis of Telecommunications Investment Effects in Thailand

The previous section qualitatively discussed what contributions telecommunications development can be expected to make for the socio-economic development in Thailand. This

section examines how much contribution the past telecommunications investment made for the past socio-economic development. Chapter 10 estimates the amount of economic contribution that the Master Plan is expected to make by utilizing the method developed in this section.

For these purposes, an econometric approach is employed. Production functions of three sectors, i.e., the agricultural, manufacturing and other remaining sectors, are estimated on the basis of statistical and economic theories. A production function is a theoretical tool often employed in economics to analyze technical relationships between physical primary inputs, such as labor, capital and land, and outputs. Theoretically they can be formulated as

$$Y = f(X_1, X_2, ..., X_n) \qquad \text{(Eq.1)}$$

where Y is the output, Xis are production inputs. Y and Xis are assumed to be positively related; that is, Y increases as Xis increase.

The functional form employed in this study is called the Cobb-Douglas type which is the most widely used functional form in econometric studies. It is formulated as

$$Y = AX_1^{a1} X_2^{a2} ... X_n^{an} \qquad \text{(Eq.2)}$$

where A and ais are parameters of the Cobb-Douglas production function. ai is called the output elasticity parameter of the i-th input. This means that one percent increase of the input X_i is supposed to increase the output Y by ai percent; that is, ai represents how much contribution the input X_i makes for producing Y in percentage.

The aim of the econometric analysis is to statistically estimate the values of the output elasticities of the telecommunications investment in producing agricultural, manufacturing, and other remaining sectors GDP. Knowing these values make it possible to calculate how much sectoral and national income the telecommunications investment will yield.

The estimated result of Eq.2 by the Ordinary Least Square Method is given as follows:

$$\ln(Y_{it}) = -1.03113Da + 0.884021Dm + 0.836915Ds$$
$$(-4.578) \qquad (4.955) \qquad (4.613)$$

$$+ 0.264929 \ln (ELCK_t) + 0.027923 (TRANK_t/K_{it}) \ln(K_{it})$$
$$(5.932) \qquad (3.971)$$
$$+ 0.954091 \ln(E_{it}) \qquad \text{(Eq.3)}$$
$$(16.44)$$

for i = agriculture, manufacturing, and service sectors,
and t = 1976,....,1986.

$R^2 = 0.99817$, $\overline{R^2} = 0.99783$, S.E. = 0.01487, D.F. = 27

where

- the values in parentheses are t-values of the estimated parameter values,
- Y_{it} is the 1972 price real sectoral GDP in the i-th sector at the t-th period,
- Da, Dm, and Ds are 0-1 dummy variables for the agricultural, manufacturing, and service sectors, respectively; i.e., for example, Da = 1 for the agricultural sector and otherwise Da = 0,
- $ELECK_t$ is capital sock of the electricity and water utility sector at the t-th period,
- $TRANK_t$ is capital stock of the transportation and communications sector at the t-th period,
- K_{it} is capital stock of the i-th sector at the t-th period,
- E_{it} is the number of employed persons in the i-th sector at the t-th period,
- R^2 and $\overline{R^2}$ are the coefficient of determination and adjusted coefficient of determination, respectively,
- S.E. is the standard error of the equation and D.F. is the degree of freedom.

Eq.3 is formulated in the log-linear form for estimation. Explanatory variables chosen for Eq.3 are the sectoral capital stock, K, the sectoral employment, E, the electricity and water sector capital stock, ELECK, the transportation and communications sector capital sock, TRANK, and three sectoral dummies, Da, Dm, and Ds. Eq.3 treats two capital stock variables, ELECK and TRANK, as public goods; hence, they commonly appear in all three sectors. In Eq.3, TRANK is formulated as a variable which improves the productivity of K, while ELECK is formulated as a variable which improves the over-all sector output productivity.

The original data used for the above estimation result are listed in Tables 3.2.3-1, 3.2.3-2, and 3.2.3-3. While the original data consist of ten sectoral observations, ten sectors were aggregated into the five sectors;

- Agriculture Sector = Agriculture Sector + Mining & Quarrying Sector,
- Manufacturing Sector = Manufacturing Sector,
- Other Remaining Sector = Construction Sector + Wholesale & Retail Trade Sector + Banking, Insurance & Real Estate Sector + Public Administration & Defense Sector + Services Sector,
- Electricity & Water Sector = Electricity & Water Sector,
-Transportation & Communications Sector = Transportation & Communications Sector.

Estimated parameters are significantly different from zero at the 5% level and have all expected theoretically justifiable signs. The output elasticity of the most concerned variable, TRANK, is calculated as 0.027923(TRANK/K)ln(K). Table 3.2.3-4, 3.2.3-5, and 3.2.3-6 show the data used for estimation, the estimated sectoral GDP, the estimation error rate, and the output elasticity of TRANK. According to the results, the fitness of the model to the data is fairly well as the estimation error rates indicate. The average output elasticities during the sample period are 0.29, 0.16, and 0.10 for the agricultural, manufacturing, and service sectors, respectively. This implies that one percent increase of the transportation & communications capital stock contributed to increase three sectoral GDP by 0.29, 0.16, and 0.1 percent.

It has been estimated that the investment in the transportation and communications sector between 1976 and 1986 contributed to increase the output of the agricultural sector by 0.86%, the output of the manufacturing sector by 0.49%, and the output of the remaining sectors by 0.31% on the average.

Table 3.2.3-1 Sectoral Capital Stock

(Million Baht, 1972 Prices)

Year	Agri.K.	Min.K.	Mfg.K.	Con.K.	Elec.K.	Tran.K.	Trade.K.	Bank. K.	Pub.K.	Serv.K.	Econo-my K
1970	27,201	4,490	91,414	11,943	16,802	42,481	26,107	2,195	11,970	62,319	296,922
1971	30,989	5,575	98,006	13,573	18,183	44,881	27,303	2,608	12,041	69,627	322,785
1972	34,776	6,660	104,598	15,204	19,564	47,281	28,499	3,021	12,111	76,935	348,649
1973	38,564	7,744	111,191	16,834	20,945	49,680	29,695	3,433	12,182	84,244	374,512
1974	42,351	8,829	117,783	18,465	22,326	52,080	30,891	3,846	12,252	91,552	400,376
1975	46,139	9,914	124,375	20,095	23,707	54,480	32,087	4,259	12,323	98,860	426,239
1976	51,398	9,689	131,090	20,518	25,733	59,766	35,118	4,804	13,173	114,172	465,460
1977	56,657	9,464	137,805	20,940	27,759	65,053	38,148	5,348	14,023	129,484	504,681
1978	61,916	9,238	144,520	21,363	29,786	70,339	41,179	5,893	14,873	144,796	543,903
1979	67,175	9,013	151,235	21,785	31,812	75,626	44,209	6,437	15,723	160,108	583,124
1980	72,434	8,788	157,950	22,208	33,838	80,912	47,240	6,982	16,573	175,420	622,345
1981	77,645	11,380	165,812	27,019	35,956	85,174	49,943	7,151	17,112	192,283	669,474
1982	82,856	13,972	173,674	31,829	38,074	89,436	52,646	7,320	17,651	209,145	716,603
1983	88,068	16,564	181,537	36,640	40,192	93,698	55,349	7,490	18,191	226,008	763,733
1984	93,279	19,155	189,399	41,450	42,309	97,960	58,051	7,659	18,730	242,870	810,862
1985	98,490	21,747	197,261	46,261	44,427	102,222	60,754	7,828	19,269	259,733	857,991
1986	103,702	24,339	205,123	51,071	46,545	106,484	63,457	7,997	19,808	276,595	905,121

Source : Kitti LIMSKUL, The Sectoral Capital Stock, Employment and Source of Economic Growth in Thailand 1960 ~ 1986, Chulalongkorn University, Thailand, 1988.

Table 3.2.3-2 Sectoral Employment

(Thousand Persons)

Year	Agri.E.	Min.E.	Mfg.E.	Con.E.	Elec.E.	Tran.E.	Trade. E.	Bank. E.	Pub.E.	Serv.E.	Econo my E
1970	13,202	87	683	181	25	268	753	123	459	725	16,506
1971	13,359	86	824	187	29	293	837	145	478	781	17,019
1972	13,517	85	964	193	32	317	922	168	497	837	17,532
1973	13,675	84	1,105	199	35	341	1,006	190	517	893	18,045
1974	13,832	84	1,246	205	38	366	1,090	213	536	948	18,558
1975	13,990	83	1,387	210	41	390	1,174	235	555	1,004	19,071
1976	14,481	87	1,478	258	45	406	1,260	262	581	1,056	19,915
1977	14,973	91	1,569	306	49	422	1,346	289	607	1,108	20,759
1978	15,464	95	1,659	354	53	438	1,431	316	633	1,160	21,603
1979	15,956	99	1,750	402	56	454	1,517	343	658	1,211	22,448
1980	16,448	103	1,841	450	60	471	1,603	370	684	1,263	23,292
1981	16,738	96	1,925	470	64	482	1,679	403	743	1,353	23,954
1982	17,029	90	2,008	490	68	494	1,755	437	801	1,443	24,615
1983	17,319	83	2,092	510	72	506	1,831	470	860	1,533	25,277
1984	17,610	77	2,176	530	76	518	1,908	503	919	1,623	25,938
1985	17,900	70	2,260	550	80	530	1,984	536	978	1,712	26,600
1986	18,190	63	2,344	570	84	542	2,060	570	1,036	1,802	27,262

Source : Labor Force Survey, National Statistical Office

Table 3.2.3-3 Gross National Product by Industrial Origin

(Million Baht, 1972 Prices)

Year	Agri.Y.	Min.Y.	Mfg.Y.	Con.Y.	Elec.Y.	Tran.Y.	Trade.Y.	Bank.Y.	Pub.Y.	Serv.Y.	Economy Y
1970	47,465	2,846	21,728	7,222	1,526	8,574	24,863	5,829	6,613	17,585	144,252
1971	50,537	2,856	25,203	7,689	1,879	9,373	27,189	6,559	6,993	18,811	157,089
1972	53,609	2,866	28,678	8,156	2,232	10,172	29,515	7,289	7,373	20,037	169,926
1973	56,681	2,876	32,153	8,622	2,584	10,970	31,841	8,019	7,753	21,263	182,763
1974	59,754	2,886	35,629	9,089	2,937	11,769	34,168	8,748	8,133	22,488	195,600
1975	62,826	2,896	39,104	9,555	3,289	12,567	36,494	9,478	8,513	23,714	208,437
1976	65,898	2,906	42,579	10,022	3,642	13,366	38,820	10,208	8,893	24,940	221,274
1977	68,259	3,249	46,961	11,118	4,180	14,735	41,277	12,007	9,753	27,737	239,275
1978	70,619	3,593	51,343	12,213	4,717	16,103	43,733	13,807	10,613	30,534	257,275
1979	72,980	3,936	55,725	13,309	5,255	17,472	46,190	15,606	11,472	33,331	275,276
1980	75,340	4,280	60,107	14,404	5,792	18,840	48,646	17,406	12,332	36,128	293,276
1981	77,701	4,623	64,489	15,500	6,330	20,209	51,103	19,205	13,192	38,925	311,277
1982	79,986	4,968	67,723	16,072	6,975	21,614	53,107	21,349	13,618	41,514	326,925
1983	82,270	5,312	70,957	16,643	7,620	23,019	55,112	23,493	14,045	44,104	342,573
1984	84,555	5,657	74,191	17,215	8,265	24,424	57,116	25,636	14,471	46,693	358,221
1985	86,839	6,001	77,425	17,786	8,910	25,829	59,120	27,780	14,897	49,282	373,869
1986	89,124	6,346	80,659	18,358	9,555	27,234	61,124	29,924	15,323	51,871	389,517

Source : National Income Statistics of Thailand, NESDB

Table 3.2.3-4 Agricultural Sector

(Million Baht, 1972 Prices)

TIME	K	E	ELECK	TRANK	Y	Yest	e	Outela	Contribution to GNP (%)
1976	61,087	14,568	25,733	59,766	68804	66,630	-3.16%	0.29437	0.79
1977	66,121	15,064	27,759	65,053	71508	70,457	-1.47%	0.29824	0.79
1978	71,154	15,559	29,786	70,339	74212	74,294	0.11%	0.30172	0.79
1979	76,188	16,055	31,812	75,626	76916	78,144	1.60%	0.30370	0.93
1980	81,222	16,550	33,838	80,912	79620	82,008	3.00%	0.30543	1.07
1981	89,025	16,834	35,956	85,174	82324	83,858	1.86%	0.29645	0.95
1982	96,828	17,118	38,074	89,436	84953	85,788	0.98%	0.28888	0.85
1983	104,631	17,402	40,192	93,698	87582	87,780	0.23%	0.28255	0.76
1984	112,434	17,686	42,309	97,960	90211	89,819	-0.43%	0.27686	0.71
1985	120,238	17,970	44,427	102,222	92840	91,898	-1.01%	0.27046	0.84
1986	128,041	18,254	46,545	106,484	95469	94,008	-1.53%	0.26402	1.05
								0.29	0.86

Yest : Estimated Y

e : Estimation Error Rate = (Yest - Y) / Y

Outela : Output elasticity of TRANK = (ΔY / Y) / (ΔTRANK /TRANK)

Table 3.2.3-5 Manufacturing Sector

(Million Baht, 1972 Prices)

TIME	K	E	ELECK	TRANK	Y	Yest	e	Outela	Contribution to GNP (%)
1976	131,090	1,478	25,733	59,766	42579	43,820	2.92%	0.14639	0.39
1977	137,805	1,569	27,759	65,053	46961	47,608	1.38%	0.15227	0.40
1978	144,520	1,659	29,786	70,339	51343	51,459	0.23%	0.15768	0.41
1979	151,235	1,750	31,812	75,626	55725	55,372	-0.63%	0.16198	0.50
1980	157,950	1,841	33,838	80,912	60107	59,343	-1.27%	0.16590	0.58
1981	165,812	1,925	35,956	85,174	64489	62,997	-2.31%	0.16751	0.53
1982	173,674	2,008	38,074	89,436	67723	66,688	-1.53%	0.16896	0.50
1983	181,537	2,092	40,192	93,698	70957	70,416	-0.76%	0.17036	0.46
1984	189,399	2,176	42,309	97,960	74191	74,179	-0.02%	0.17150	0.44
1985	197,261	2,260	44,427	102,222	77425	77,977	0.71%	0.17157	0.53
1986	205,123	2,344	46,545	106,484	80659	81,808	1.43%	0.17110	0.68
								0.16	0.49

Table 3.2.3-6 Other Remaining Sectors

(Million Baht, 1972 Prices)

TIME	K	E	ELECK	TRANK	Y	Yest	e	Out ela	Contribution to GNP (%)
1976	174,611	2,836	25,733	59,766	83990	75,210	-10.45%	0.11252	0.30
1977	193,921	3,049	27,759	65,053	92139	82,103	-10.89%	0.11127	0.29
1978	213,230	3,261	29,786	70,339	100287	89,112	-11.14%	0.11030	0.29
1979	232,540	3,474	31,812	75,626	108436	96,231	-11.26%	0.10905	0.33
1980	251,850	3,686	33,838	80,912	116584	103,452	-11.26%	0.10799	0.38
1981	276,395	3,906	35,956	85,174	124733	110,671	-11.27%	0.10466	0.33
1982	300,940	4,125	38,074	89,436	132042	118,002	-10.63%	0.10185	0.30
1983	325,485	4,344	40,192	93,698	139351	125,437	-9.98%	0.09950	0.27
1984	350,030	4,563	42,309	97,960	146659	132,969	-9.34%	0.09739	0.25
1985	374,575	4,782	44,427	102,222	153968	140,592	-8.69%	0.09499	0.29
1986	399,120	5,002	46,545	106,484	161277	148,302	-8.05%	0.09257	0.37
								0.10	0.31

3.3 Future Trend of Telecommunication Technologies and Services

Recently, telecommunication services in every country have become more and more diversified and sophisticated to cope with the ever-advancing demands from every governmental and private sectors for promoting national prosperity and people's welfare. Needless to say, such diversification has been supported by related telecommunication technologies having been evolved remarkably in many countries. Telecommunication networks have evolved from the simple telephone system into a combination of individual networks for different media such as voice, text and images, and finally into the Integrated Services Digital Network (ISDN).

In this section, a contemplation on future trend of telecommunication technologies and services is tried by extrapolating current trends in the supporting technologies and in user requirements. The key features of the future services will be multi-media presentation, higher-speed, and increased intelligence.

3.3.1 Evolution of Telecommunication Network

1) The Telephone Network Era

The primary goals of telecommunications administrations were to expand network coverage so as to be able to meet customer needs whenever and wherever they might arise, and to establish a completely automatized network. In Thailand, TOT achieved completion of nationwide direct dialing, one of the goals mentioned above, in 1981, and has been making every effort to achieve the other goal, general state of non-waiting telephone installation, by about the end of 1997.

2) Separate Networks for Separate Services

Demand for diversified and sophisticated telecommunication services had been intensifying by the late 1970's in many countries. The conventional methods of using modems to send text, graphics, and data were no longer able to satisfy requirements for speed, quality, and lower expenses. Many administrations concerned established new networks that were optimal in design for each individual medium. In Japan, a packet switched public data network and a facsimile communication network were established in 1981, and a videotex communication network was put into operation in 1984.

3) The ISDN Era

Further diversification of media in the near future will make separate networks for separate services infeasible for reasons of function or economy. Thus, an ISDN, that is based on the latest digital technology and compatible with all media, has been studied in many countries. In Japan, on the basis of first hand experiences obtained through the trial service of INS Model system, the 2B+D basic interface service was started in April 1988 conforming to international standards, and recently in June 1989, the primary rate interface service (23B+D, H0, H1) was commenced. Figure 3.3.1-1 shows evolutional transition of telecommunication networks described above.

3.3.2 Technological Progress

1) Network Architecture

To deal with diversified and sophisticated services, a telecommunication network must have the following features;

a) To be able to respond to the customers' needs with speed and flexibility,
b) To have a clear configuration of functions and a plan for harmonious development, and
c) To be easy to maintain and operate.

A two-layer system as shown in Figure 3.3.2-1 is considered to meet the above requirement. One layer is the transport layer for connections and transmission of user information, and the other is the intelligent layer for highly sophisticated service control such as calling number conversion, specification of communication partners, and network operation.

Based on this concept, the study has been continued to establish a new configuration that would exactly satisfy the requirements mentioned above by standardizing the interfaces between the layers and between the nodes within the layer.

2) Customer Premises Equipment

Recent rapid advances in LSI and microprocessor technologies have resulted in highly sophisticated customer premises equipment, ranging from telephone terminals to computer work stations. Under ISDN, functions can be appropriately divided between the network and the sophisticated customer premises equipment. Thus the network need not to be equipped

with functions to provide services as is done in pre-ISDN stages. This is made possible by a separate control signal channel provided along with the information channel. Control signals can be transmitted freely through this signal channel between different customer premises equipment as well as between network and customer premises equipment.

To encourage customers to use these sophisticated services, customer premises equipment must be made available at low cost. Efforts have presently been concentrated on development of low-cost ISDN equipment, particularly digital telephones, G4 facsimiles, and 64 kb/s videoconferencing equipment.

3) Optical Transmission System

As a new type of transmission system, many optical cable transmission systems have been introduced in every country. In Japan, small and medium capacity optical transmission systems, with transmission speeds of 32 Mb/s and 100 Mb/s respectively, were introduced in 1981. Commercialization of equipment having a speed of 1.6 Gb/s (the capacity of 23,000 telephone signals) was achieved in 1987. Now an ultra-high-speed (2.4 Gb/s) optical fiber transmission system is being developed intensively. Coherent optical techniques which would allow the terabit order (10^{12} b/s) over distances of more than 100 km without repeaters are also under research.

Economical optical subscriber transmission systems are being developed to offer subscriber broad-band services at reasonable expenses, aiming at making optical subscriber services available to ordinary households as well as to large institutional users.

4) Switching System

Achieving intelligence in telecommunication services requires stratification of the network as described above. At the same time, switching system functions must be modularized as much as possible to facilitate addition of new services. Division of software for switching system control into operating system (OS) and application software is being studied to achieve functional separation of application software from hardware in the same way as for information processing software.

The asynchronous transfer mode (ATM) is being vigorously researched in various countries for broad-band ISDN switching as a means to provide multi-media services, including moving pictures. In Japan, too, the organizations concerned are contributing to ATM standardization at international forums such as CCITT. Also, a leading enterprise in

Japan is proceeding with ATM development, expecting to offer ATM public network services in several years.

5) Mobile Communications

Mobile communications, now centered on automobile telephones, is being developed to achieve portable equipment that would allow communication with anyone, anywhere, and anytime. Effort is forecasted on digital systems, efficient use of frequencies by employing sub-microwave bands and minimal zones, and expansion of service areas through use of satellite communication system.

Also, the size of mobile terminals is being reduced. The volume of portable telephone units is expected to shrink from the current 400 cc to less than 300 cc within the next few years.

6) Information Technology

Artificial Intelligence (AI), databases, and software technology are important to the achievement of intelligent telecommunication services. Research on such AI technology as voice recognition, machine translation, handwritten character recognition, and expert systems is being emphasized. At present, relational databases are in general use. In the future, multi-media database technology applying automatic key word extraction and image recognition and synthesis will assume increased importance.

7) Human Interface Technology

The interface between equipment and human beings will become even more important under the pressure for more diversified and sophisticated services. Assuming that humans are subject to stress and certain to make errors, it is vital that the system be designed to relieve and support the people that operate it. Thus, not only the development of AI and knowledge base technology, but also research into human thought processes and actions are essential. It is believed that inter-disciplinary research in cognitive science, psychology, and other areas of human engineering deserve priority.

3.3.3 Future Services

In this paragraph, an extrapolation of future telecommunication services in terms of multiple media, higher speed, and increased intelligence is described.

1) Multiple Media

Telecommunication services began with the telephone, but have recently been expanding into non-telephone media such as text and images. With the change of the times from the present ISDN towards the next generation broad-band ISDN, which will use ATM, the transmission of information ranging from low bit rate data to higher-speed moving image information in a uniform manner will become possible. The teleconferencing system, which combines moving pictures and voice, is one example. Addition of other media such as text and pictures will carry this service one step further to multi-media teleconferencing.

2) Higher-Speed

ISDN will realize higher-speed telecommunication services. Improvement in the quality of different media, including voice, text, and images, is planned. It will be possible to listen to a music concert in high fidelity stereo sound presented through public telecommunication network. Facsimile will turn to color, high precision, and more detail. Images will be transmitted with no degradation of the original quality. High Definition Television (HDTV) will become a reality, and broadcast and CATV services will be offered through telecommunication circuits.

3) Increased Intelligence

Multi-point communication and time-designated call services are among the intelligent telephone services offered by the administrations. By use of ISDN and the common channel signaling (CCS) system, more diversified and sophisticated services will be realized. Telemarketing provides an example of such a service. Instead of calling again and again by a customer in a mail order case, ISDN can automatically send the calling customer ID to the telemarketing office, and the reception operator can call back the customer when he is unoccupied.

The individual networks built to cope with facsimile, videotex, and other specific media will gradually be integrated by ISDN into multi-media services. It is foreseen that media conversion services such as conversion from facsimile data into text format, and storage services, in which voice is temporarily recorded in the network and sent out at designated times or when desired by the receiver, will be commenced one after another.

Personalized services may be another form of intelligent telecommunications. In conventional services, calls are received through universal numbers allocated to subscriber

lines. However, virtual private network service, will allow each user to select a private numbering system and use it freely over the public networks. Such services used in conjunction with advanced databases will make it possible to call Mr. X, and the system will search for him until he is reached and make the connection, no matter where he is, as shown in Figure 3.3.3-1.

Further, more sophisticated services applied with AI technology has been studied and will be developed in the near future. Operation of a conventional computer involves keyboards and requires knowledge of special input and output procedures. However, advances in natural language processing technologies such as handwritten character and voice recognition, and going beyond that, understanding of spoken conversation, will allow interactive manipulation of computers in a manner similar to human conversation. Speech recognition combined with machine translation could also be applied to provide automatic simultaneous translation for international phone calls.

Thus, advances in telecommunication and information technologies may bring about many forms of intelligent telecommunication services. Full understanding of user desires and requirements is important for making such services available. As for telecommunication terminals, assuring portability (toward "wrist-phones" as the ultimate goal) and connectability (being able to hook up any terminal at any location) will become more important among the requirements.

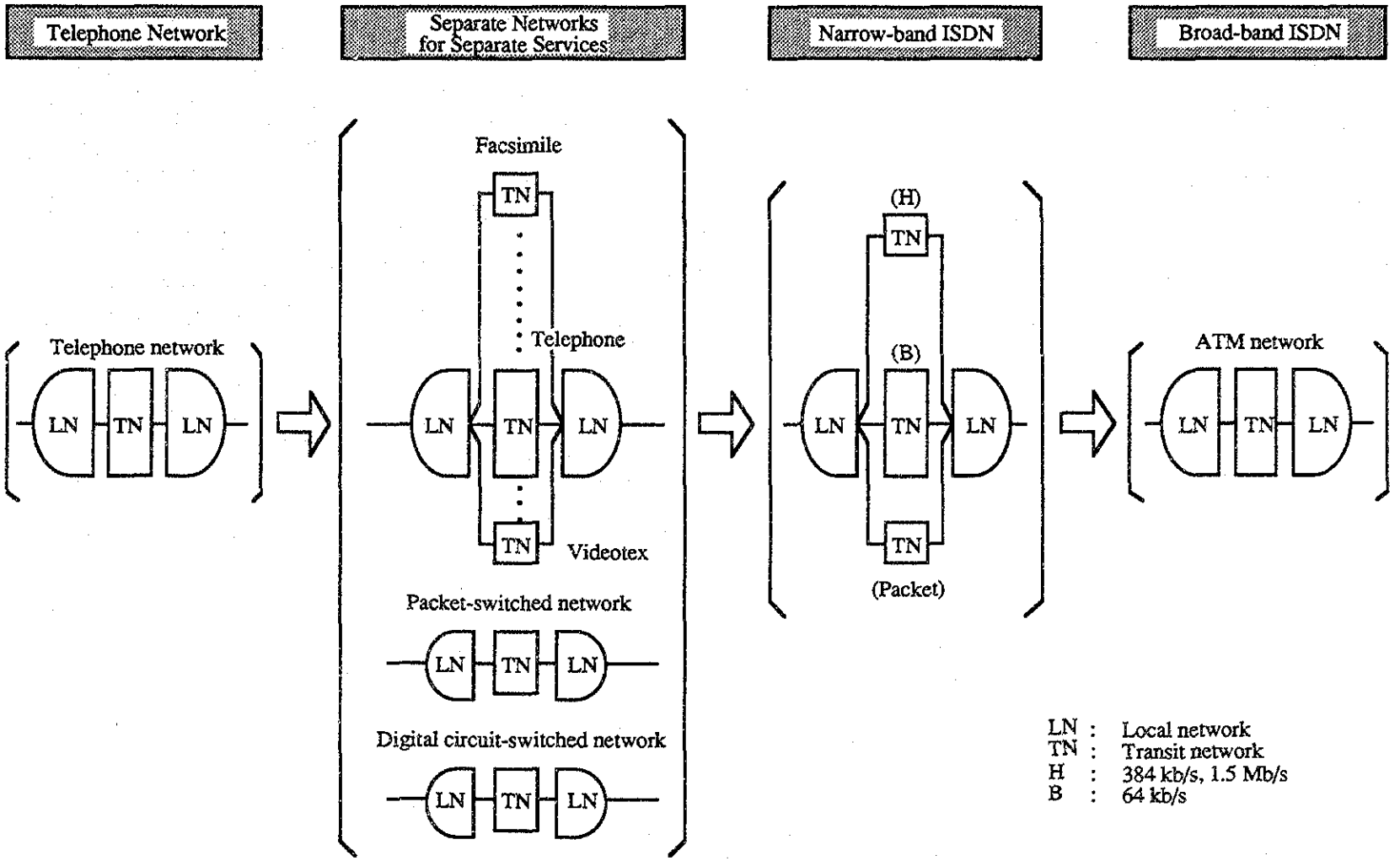


Figure 3.3.1-1 Transition of Telecommunication Network

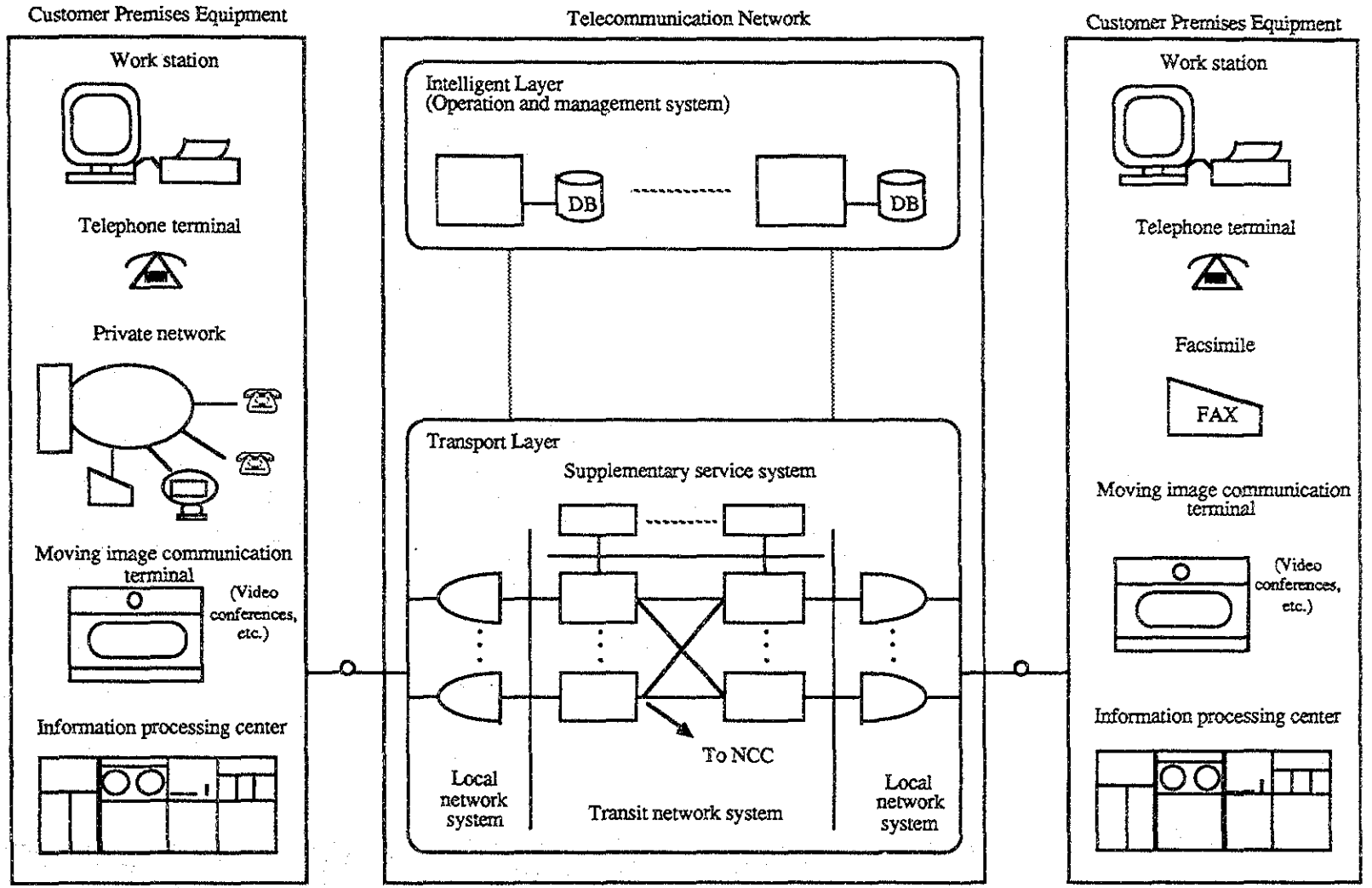


Figure 3.3.2-1 Two-layer Network Architecture

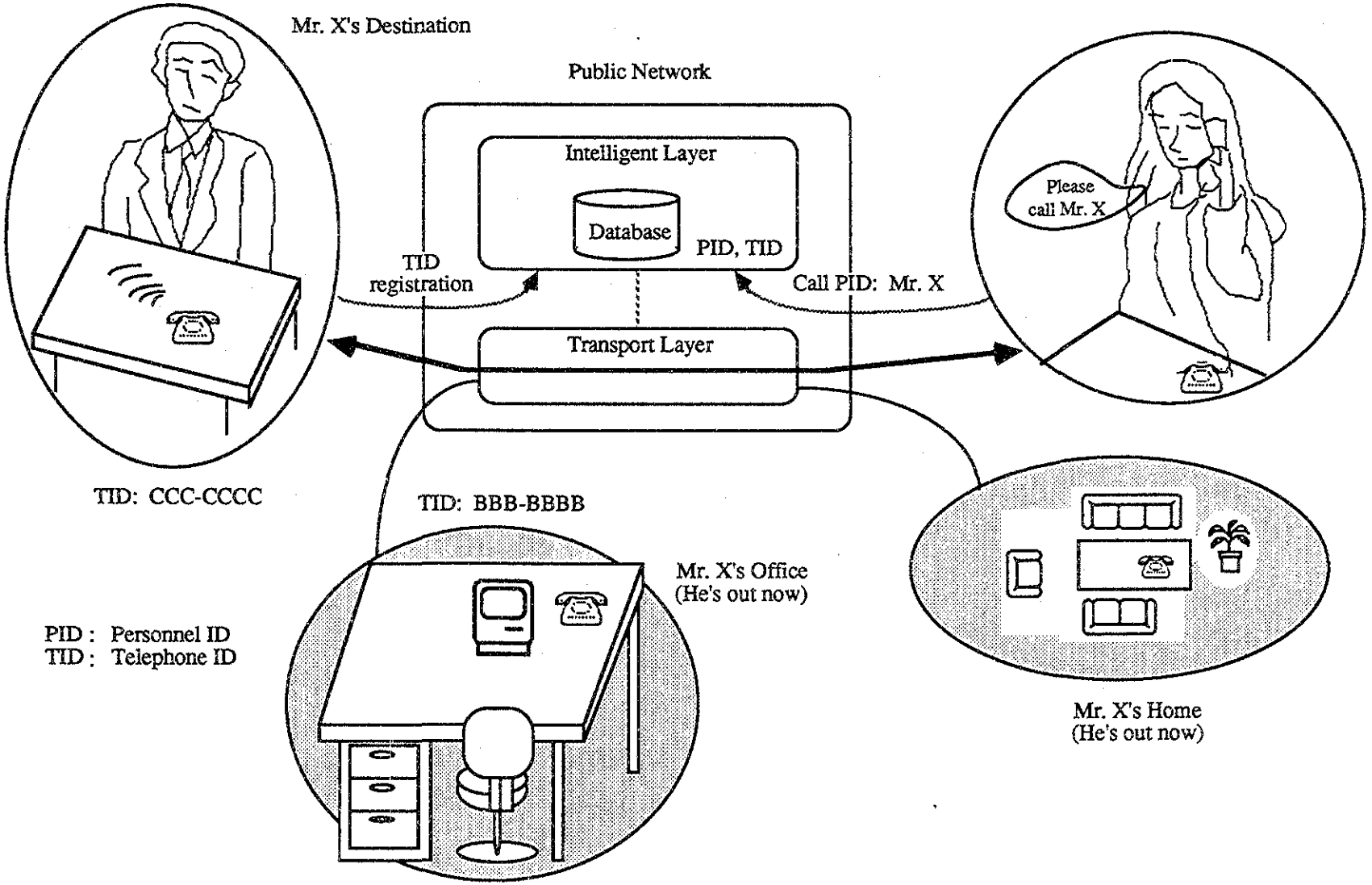


Figure 3.3.3-1 Personnel Dialling Service

CHAPTER 4

DEMAND FORECAST

CHAPTER 4. DEMAND FORECAST

4.1 Telephone Service

4.1.1 Telephone Service Subscription Demand

1) Methodology

Future demands were forecasted by two methods. One method is based on potential demands, called potential demand approach and the other is based on expressed demand, called expressed demand approach. The results by the two methods are cross-examined.

Figure 4.1.1-1 shows the forecast procedure for subscription demand.

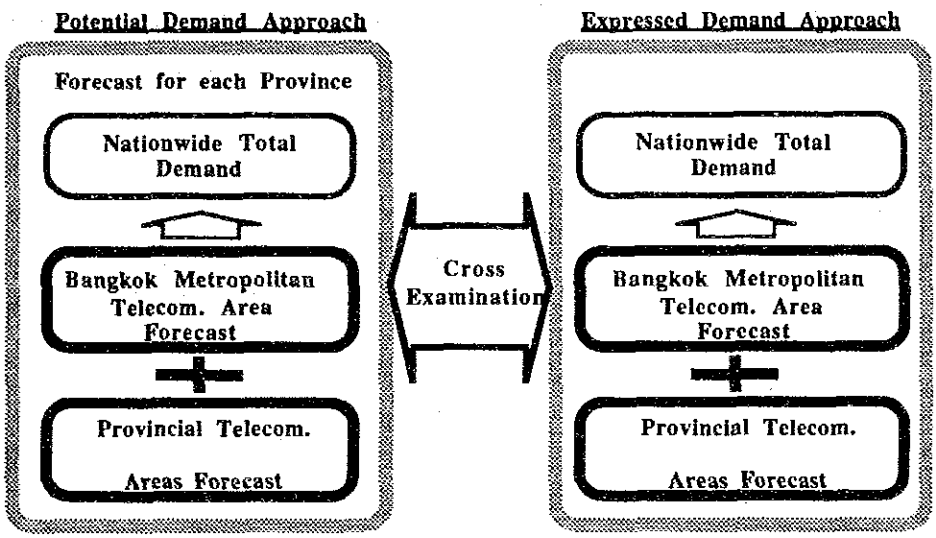


Figure 4.1.1-1 Telephone Subscription Demand Forecast Procedure

2) Potential Demand Approach

The concept of potential demand is explained in Figure 4.1.1-2.

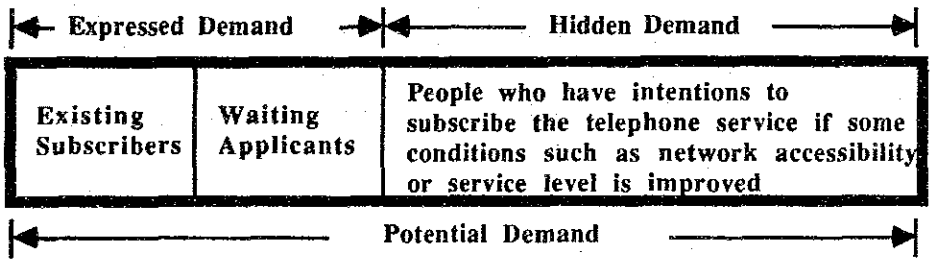


Figure 4.1.1-2 The Concept of Potential Demand

Figure 4.1.1-2 explains the concepts of expressed demand and potential demand. The expressed demand consists of the existing subscribers and the waiting applicants. The potential demand consists of the expressed demand and people who are not included in the expressed demand but who have desires and financial capabilities of subscribing the telephone service.

The potential demand is forecasted by estimating the number of potential residential subscribers and the number of potential business subscribers for each province.

The estimating procedures of the two groups of the subscribers are explained in the following two sections.

a) Potential Residential Subscribers

A socio-economic model which is conceptually similar to the model explained in GAS 9 Handbook B is formulated on the basis of a household monthly income distribution to forecast the number of potential residential subscribers. The number of potential residential subscribers will be obtained in three steps:

i) Estimation of household monthly income distribution,
ii) Prediction of the number of households,
iii) Calculation of the number of potential residential subscribers.

i) Estimation of Household Monthly Income Distribution

Future household monthly income distributions are estimated by formulating the following model.

$$F(X_{it}) = \frac{100}{1+\exp(a+b \cdot Y_{it}) \cdot X_{it}^{C}} \qquad (4.1)$$

where

X_{it} : Monthly income level of province i in period t

$F(X_{it})$: Accumulated percentage of households whose income levels are not more than X in province i in period t

Y_{it} : Per capita 1972 price real gross provincial product in province i in period t

a,b.c : Coefficients

Figure 4.1.1-3 shows a typical accumulated household monthly income distribution curve.

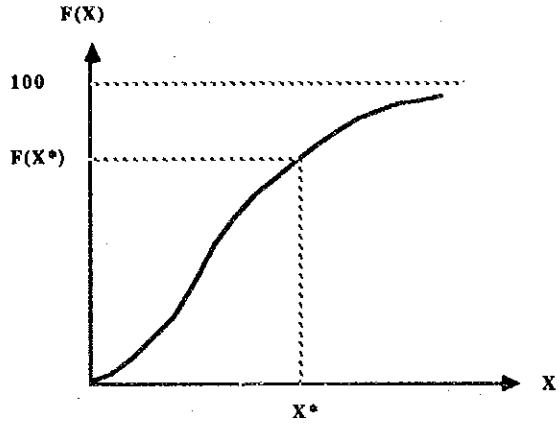


Figure 4.1.1-3 Household Monthly Income Distribution Curve

The model is rearranged in the following log-linear form for estimation.

$$\ln\left(\frac{100}{F(X_{it})} - 1\right) = a + b \cdot Y_{it} + c \ln(X_{it}) \qquad (4.2)$$

The coefficients were estimated by using the household income data in "Household Socio-Economic Survey in 1986" by National Statistical Office of Thailand, and the other socio-economic data by NESDB. The results are shown as follows:

$$\ln\left(\frac{100}{F(X_{it})} - 1\right) = 16.45386908 + 0.00011050 \cdot Y_{it} - 2.50729444 \ln(X_{it}) \qquad (4.3)$$

In this calculation, the following statistical tests of significance were obtained:

T-value(a)	= 60.192,
T-value(b)	= 20.545,
T-value(c)	= 65.291,
Coefficient of Determination (R^2)	= 0.9809,
Adjusted Coefficient ($\overline{R^2}$)	= 0.9805,
Standard Error of Estimate	= 0.3817,
Degree of Freedom	= 91,
Probability of T-value(a)	= 0.000,
Probability of T-value(b)	= 0.000,

Probability of T-value(c) = 0.000.

In this study, households whose income levels are more than 7000 baht a month in 1986 are assumed as potential residential subscribers. Hence, the percentage of potential residential subscribers, P(7000 baht), is

$$P(7000\ \text{baht}) = 100\text{-}F(7000\ \text{baht}) \quad (4.4)$$

The threshold value of 7000 baht is the average figure of the opinions from the experts concerned.

ii) Prediction of the Number of Households

The number of households in the future are estimated by projected future population size and average number of household members. Namely,

$$\text{Predicted Number of Households } (H_{it}) = \frac{\text{Projected Future Population Size}}{\text{Average Number of Household Members}} \quad (4.5)$$

Average number of household members is assumed to decrease from the 1987 figure by, namely,

0.103 person per year in the Bangkok Metropolitan Telecommunication Area,

0.074 person per year in the Provincial Telecommunication Areas.

The above rates were calculated from the household size data between 1972 and 1987.

iii) The Number of Potential Residential Subscribers

The number of potential residential subscribers in province i in period t is calculated as follows;

$$RD_{it} = P(7000\ \text{baht})_{it} * H_{it}, \quad (4.6)$$

where

RD_{it} : The number of potential residential subscribers in i province in period t,

$P(7000)_{it}$: The percentage of potential residential subscribers in province i in period,

H_{it} : The number of households in province i in period t.

b) Potential Business Subscribers

A model is formulated on the basis of the number of employees, who have no less than upper secondary school education level, to forecast the number of potential business subscribers. The forecast procedure is divided into the following three steps:

i) Estimation of the number of employees who have educational levels no less than upper secondary school level,
ii) Estimation of the number of main telephone stations per employee of the defined category,
iii) Calculation of the number of potential business subscribers.

i) Estimation of the Number of Employees Who Have Educational Levels No Less Than Upper Secondary School Level.

The number of employees of the defined category is estimated by the following formula;

$$E_{it} = N_{it} \cdot R(Y_{it}), \quad (4.7)$$

where
E_{it} : The number of employees of the defined category in province i in period t,
N_{it} : Projected population size in province i in period t,
$R(Y_{it})$: The number of employees of the defined category per population in province i in period t,
Y_{it} : Per capita 1972 price real gross provincial product in province i in period t.

$R(Y_{it})$ is specified as follows;

$$R(Y_{it}) = a + \beta \cdot Y_{it} + b \cdot D, \quad (4.8)$$

where
a, b, ß : Coefficient,
D : Dummy variable for the Bangkok metropolitan area.

The coefficients were estimated by the data from " * REPORT OF THE LABOR FORCE SURVEY." (1982, 1985,1986), published by National Statistical Office of Thailand. The estimated results are shown in the following model.

$$R(Y_{it}) = 0.01500213 + 0.00000235\ Y_{it} + 0.04599516\ D \qquad (4.9)$$

In this calculation, the following statistical tests of significance were obtained:

T-value(a)	= 2.800,
T-value(β)	= 2.732,
T-value(b)	= 3.231,
Coefficient of Determination (R^2)	= 0.9603,
Adjusted Coefficient ($\overline{R^2}$)	= 0.9537,
Standard Error of Estimate	= 0.0076,
Degree of Freedom	= 12,
Probability of T-value(a)	= 0.015,
Probability of T-value(β)	= 0.017,
Probability of T-value(b)	= 0.007.

ii) Estimation of the Number of Main Telephone Stations per Employee of The Defined Category.

The number of main telephone stations per employee of the defined category is estimated by formulating the following model.

$$G(Z_{it}) = a + ß \cdot Z_{it} + b \cdot D, \qquad (4.10)$$

where

$G(Z_{it})$: The number of business main telephone stations per employee of the defined category in province i in period t,

Z_{it} : Per capita nominal GPP in province i in period t,

a, ß : Coefficient,

D : Dummy variable for Japan.

The coefficients were estimated by the data of USA, the UK, Canada, Sweden, and Japan. The estimated results are shown in the following model.

$$G(Z_{it}) = 0.10125025 + 0.00000431\ Z_{it} + 0.11289334\ D \qquad (4.11)$$

In this calculation, the following statistical tests of significance were obtained:

T-value(a)	= 11.275,
T-value(β)	= 3.0923,
T-value(b)	= 13.218,
Coefficient of Determination (R^2)	= 0.7707,
Adjusted Coefficient ($\overline{R^2}$)	= 0.7619,
Standard Error of Estimate	= 0.3113,
Degree of Freedom	= 52,
Probability of T-value(a)	= 0.000,
Probability of T-value(β)	= 0.003,
Probability of T-value(b)	= 0.000.

iii) Calculation of Number of Potential Business Subscribers.

The number of potential business subscribers in province i in period t is calculated as follows:

$$BD_{it} = G(Z_{it}) \cdot E_{it}, \qquad (4.12)$$

where

BD_{it} : The number of potential business subscribers in province i in period t,

$G(Z_{it})$: The number of main telephone stations per employee of the defined category in province i in period t,

E_{it} : The number of employees of the defined category in province i in period t.

3) Expressed Demand Approach

Expressed demand approach is estimated by two models on the basis of the data of existing subscribers and waiting applicants. The first model forecasts the number of subscribers in the Bangkok metropolitan telecommunication area. The second model forecasts the number of subscribers in the provincial telecommunication areas.

a) Expressed Demand in The Bangkok Metropolitan Telecommunication Area

In forecasting telephone penetration in a developed area where demand is expected to saturate in the foreseeable future, such as the metropolitan telecommunication area of the country, a logistic curve model is generally the most appropriate [1]. Therefore, for the Bangkok metropolitan telecommunication area, a logistic curve was fitted to the number of people who actually expressed their desires to subscribe the telephone service (they are current telephone subscribers plus waiting applicants). The model is expressed as follows;

$$\frac{D_t}{N_t} = \frac{K}{1+M \cdot EXP(-\alpha t)}, \qquad (4.13)$$

where

D_t : The number of people who actually expressed their desires to subscribe the telephone service in period t,

N_t : Population size in period t,

K : Saturation level (number of telephone per person),

M, α : Constant.

In this study, the following parameters were used:

M : 1.8708 ($= \frac{KN_t - D_t}{D_t \cdot EXP(-\alpha t)}$, using Eq. 4.13 with base year (t = 0) data results),

α : 0.12 (Estimated from historical data),

K : 0.35 (Data of several other countries used).

b) Expressed Demand in The Provincial Telecommunication Areas

For the provincial telecommunication areas, an income elasticity model was formulated on the number of people who actually expressed their desires to subscribe the telephone service. The model used is presented as follows;

$$\frac{D_{it}}{N_{it}} = a \left(\frac{GPP_{it}}{N_{it}}\right)^{\beta} \cdot \exp(b \cdot D), \qquad (4.14)$$

[1] GAS 9 Handbook B, P. 65, CCITT, 1988

where

D_{it} : The number of people who actually expressed their desires to subscribe the telephone service in province i in period t,

N_{it} : Population size in province i in period t,

GPP_{it} : Gross provincial product in province i in period t,

ß, a, b : Income elasticity coefficient,

D : Dummy variable for the Bangkok metropolitan area.

The model is rearranged in the following log-linear form for estimation.

$$\ln(\frac{D_{it}}{N_{it}}) = A + \beta \ln(\frac{GPP_{it}}{N_{it}}) + b \bullet D \qquad (4.15)$$

The results are shown in the following model.

$$\ln(\frac{D_{it}}{N_{it}}) = -12.2224 + 1.3819 \ln(\frac{GPP_{it}}{N_{it}}) + 0.5802 \bullet D \qquad (4.16)$$

In this calculation, the following statistical tests of significance were obtained:

T-value(A)	= 16.015,
T-value(β)	= 15.421,
T-value(b)	= 3.5597,
Coefficient of Determination (R^2)	= 0.9329,
Adjusted Coefficient ($\overline{R^2}$)	= 0.9309,
Standard Error of Estimate	= 0.2464,
Degree of Freedom	= 67,
Probability of T-value (A)	= 0.000,
Probability of T-value (β)	= 0.001,
Probability of T-value (b)	= 3.5597.

4) The Results of Demand Forecast

The results of demand forecast are shown in Figure 4.1.1-4.

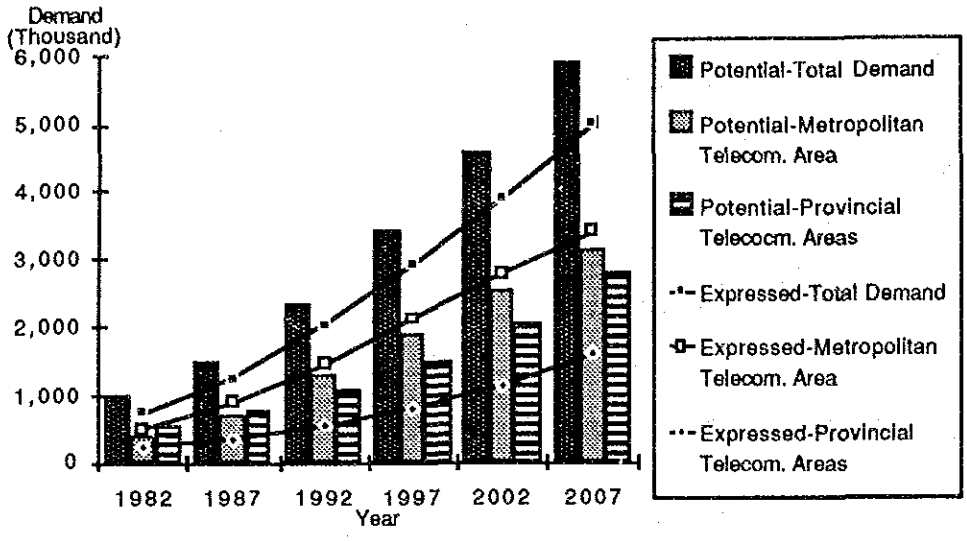


Figure 4.1.1-4 Result of Forecast

5) Examination of the Results

i) The forecasted potential demand is larger than the forecasted expressed demand in the provincial telecommunication areas. The reason may be that a large part of potential demand has been discouraged and has not been registered as waiting applicants because of long waiting time in the provincial areas in the past. Therefore, the forecasted potential demand can be considered more appropriate for the study because discouraged demand will very likely show up once network accessibility is improved.

ii) The forecasted potential demand is, on the other hand, smaller than the forecasted expressed demand in the Bangkok metropolitan telecommunication area. The reason can be that potential demand by business subscribers in the Bangkok metropolitan area may be higher than the forecasted figure by the model. More study is needed for this problem.

iii) Hence, this report employs the forecast results of the potential demand approach for the provincial telecommunication areas and the forecast results of the expressed demand approach for the Bangkok metropolitan area.

Thus, the demand figures for this report are shown in the following.

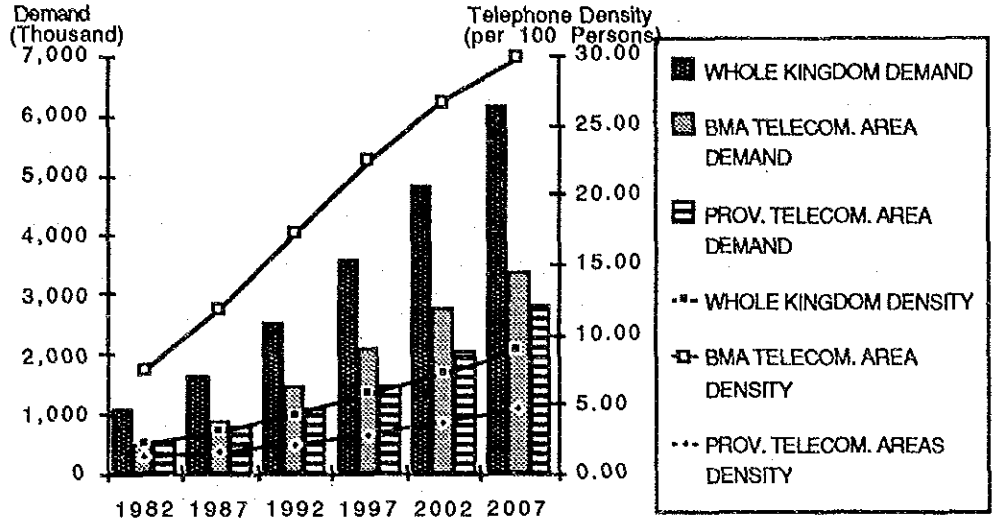


Figure 4.1.1-5 Telephone Subscription Demand and Density

Table 4.1.1-1 Forecasted Telephone Demand and Density

(Thousand)

	Telecom. Area	1992	1997	2002	2007
Telephone Demand	Bangkok Metro. Area	1,467	2,120	2,769	3,376
	Provincial Area	1,060	1,494	2,037	2,791
	Whole Kingdom	2,527	3,614	4,806	6,167
Telephone Density	Bangkok Metro. Area	17.27	22.39	26.73	29.92
	Provincial Area	2.14	2.84	3.67	4.82
	Whole Kingdom	4.35	5.82	7.30	8.92

Note: Telephone density is the figure when all the people having intentions to subscribe will be offered telephone service.

4.1.2 Network Services on the Telephone Network

1) Hunting Service (Line Grouping Service)

With the expansion of telephone network, the number of subscribers having plural line units will be increasing. On the other hand, the functions of telephone sets will more and more be enhanced under the condition of deregulation of terminal application. Enhanced key telephone sets will usually be utilized by the ordinary business subscribers and some of the residential subscribers.

At present, hunting service is mostly utilized by PBX or PABX subscribers. Hunting service can easily promote the customer's benefit effectively. It can also upgrade the successful call ratio and, consequently, contribute the increase of revenue to the telecommunication carriers. Incidentally, the inquiry and memorandum of telephone number and dialling operation may become brief.

Therefore, in accordance with the future trends and the benefits for subscribers and the telecommunication carriers, its application area should be extended for all the subscribers having plural lines. It is more effective to promote hunting service along with key telephone sets.

The ratio of hunting line units will be upgrading about 20 % in the metropolitan area and 10 % in the provincial area for the whole line units.

2) Other Enhanced Services

Some of other enhanced network services have been provided on the telephone network with free of additional fee in Thailand. The services are Automatic Call Repetition, Call Waiting, Abbreviated Dialling, Conference Call, Call Transfer and Hot Line. In the near future, their additional fees will likely to be charged. Accordingly, the volume of demands will be varying in accordance with the future tariff structure.

Taking the case of Japan for reference, some of the similar services have been already provided to the society with some additional monthly fee. That is, the monthly fee for ordinary telephone service is 2,350 Yen for the business use in Tokyo. The fee ratio to ordinary telephone service is varied according to the functions. Under this tariff structure, the percentage of each service to the total number of main telephones is shown in Table 4.1.2-1.

It is expected that their demands will be increasing up to several percents of the ordinary telephone service in Thailand, depending on the conditions of the tariff structure.

Table 4.1.2-1 Network Services in Japan

(As of March 1989)

Service Menu	Monthly Fee (Yen)	Ratio to Monthly Basic Fee	Number of Subscribers	Percent to Main Tel.	Status in Thailand
Ordinary Service	2,350	-	49,904,000	-	In Service
Push Tele. Lines	450	0.19	10,002,000	20.04%	In Service
Abbreviated Dial	600	0.26	No Data	-	In Service
Call Waiting	350	0.15	3,851,000	7.72%	In Service
Voice Mail Store	500	0.21	120,000	0.24%	Not yet
Conference Call	500	0.21	6,115	0.01%	In Service
Call Transfer	2,400	1.02	142,000	0.28%	In Service
Destination Charge	3,500	1.49	80,000	0.16%	Not yet
Credit Call	150	0.06	277,000	0.56%	Not yet

Source : Annual Report of Nippon Telegraph and Telephone Corporation

As regards the introduction plan for enhanced services, it is a matter of policy rather than demand forecast. It should be established based on the requirements of general public. Coping with the diversification of the requirements and capability of providing various services by ISDN, the customer oriented organization should be fortified for the purpose of collecting requirements and reflecting them for the introduction plan.

Relating to the services not introduced in Thailand yet, the following network services are considered to be feasible for introduction in future. However, the volume of demand will be a little for the time being, and some of them can more easily be offered by ISDN in cooperation with Common Channel Signalling (CCS) system. Therefore, it should be better to introduce them as the supplementary service on the ISDN network.

- Subscriber private meter,
- Advice of charge,
- Malicious call trace,
- Outgoing call barring,
- Destination charge (Free dial call),
- Voice mail storage,
- Calling line identification,
- Notice of detailed charge information,
- Closed user group connection,
- Credit card call,

- User-to-user signalling,
- etc.

4.1.3 Terminal Connection Service to the Telephone Network

The various kinds of facilities can be connected to the telephone network under the permission of TOT. In prospect of the future trend, they are generally classified into analog interface and digital interface. The typical terminals are shown in Table 4.1.3-1.

Table 4.1.3-1 Typical Terminals on the Telephone Network

Service	Analog Interface	Digital Interface
Voice Communication	Analog Telephone Analog PBX & PABX	Digital Telephone Digital PABX
	Voice Mail System	
Recorded Communication	G-1, G-2 & G-3 Facsimile	G-4 Facsimile
	Facsimile Store & Forward System	
Data Communication	Modulator-Demodulator (MODEM) Acoustic Coupler	Digital Service Unit (DSU)
	Message Handling Systems (MHS)	
Video Communication	Videotex (Still)	Videotex (Still & Moving) Video Conference Video Phone

1) Digital Telephone

At the present stage, analog telephone sets are available on the telephone network in Thailand. In the near future, with the commencement of ISDN, digital telephone sets will be introduced. Some of the existing analog telephone subscriptions will transfer to the digital subscriptions, depending on the tariff level of ISDN and the price of digital terminals. The whole view of forecast is described in the section 4.6, in relation to other terminals such as G-4 facsimile, Data terminal etc.

2) PBX & PABX and LAN

As mentioned in the section 2.2.3, PBX & PABX are presently connected to the telephone network with analog interface. In prospect of the development of data communication systems and the construction of Intelligent Buildings, some of them will be replaced by Digital PBX or LAN (Local Area Network), in parallel with adopting Broad Band ISDN. The comparison between analog PBX and LAN is shown in Table 4.1.3-2.

Table 4.1.3-2 Comparison between Analog PBX and LAN

Item	Analog PBX	LAN
Connected Terminals	Telephone	Telephone Data & Video Terminal Computer Main Frame
Network Configuration	Star	Star Ring (Loop) Bus (Branch)
Cable Material	Pair Cable	Pair Cable (Low Speed) Coaxial Cable Optical Fiber (High Speed)
Access Method	Mechanical Connection	Channel Division Dynamic Access
Transmission Speed	Low Speed (below 64 kb/s)	High Speed (10 kb/s - 100 Mb/s)

It is considered that the demand source of LAN is based on the subscribers having PBX & PABX with over 50 line units. With the introduction of LAN or Digital PBX, Broad Band ISDN or High speed digital leased circuit will be adopted for communicating with other sectors.

3) Facsimile Terminal

The demand forecast for facsimile terminals is carried out as one of the portion of the ordinary telephone sets, on the basis of the ratio of facsimile terminals to main telephone demand.

Making reference to the case of Japan, the number of facsimile terminals is considered to reach around 3,000,000. The percentage of facsimile terminals to telephone line units has been becoming higher year by year, and has reached to about 6 % in March 1989 as shown in Table 4.1.3-3.

Table 4.1.3-3 Facsimile Terminal Development in Japan

FY Year	No. of Telephones (Thousand)	No. of Facsimiles (Thousand)	Percentage of Fax.
1974	28,868	6	0.02%
1975	31,702	12	0.04%
1976	33,721	22	0.07%
1977	35,066	40	0.11%
1978	36,403	65	0.18%
1979	37,761	99	0.26%
1980	39,052	139	0.36%
1981	40,276	204	0.51%
1982	41,501	312	0.75%
1983	42,879	487	1.14%
1984	43,959	731	1.66%
1985	45,300	1,030	2.27%
1986	46,772	1,400	2.99%
1987	48,419	2,200	4.54%
1988	49,904	3,000	6.01%

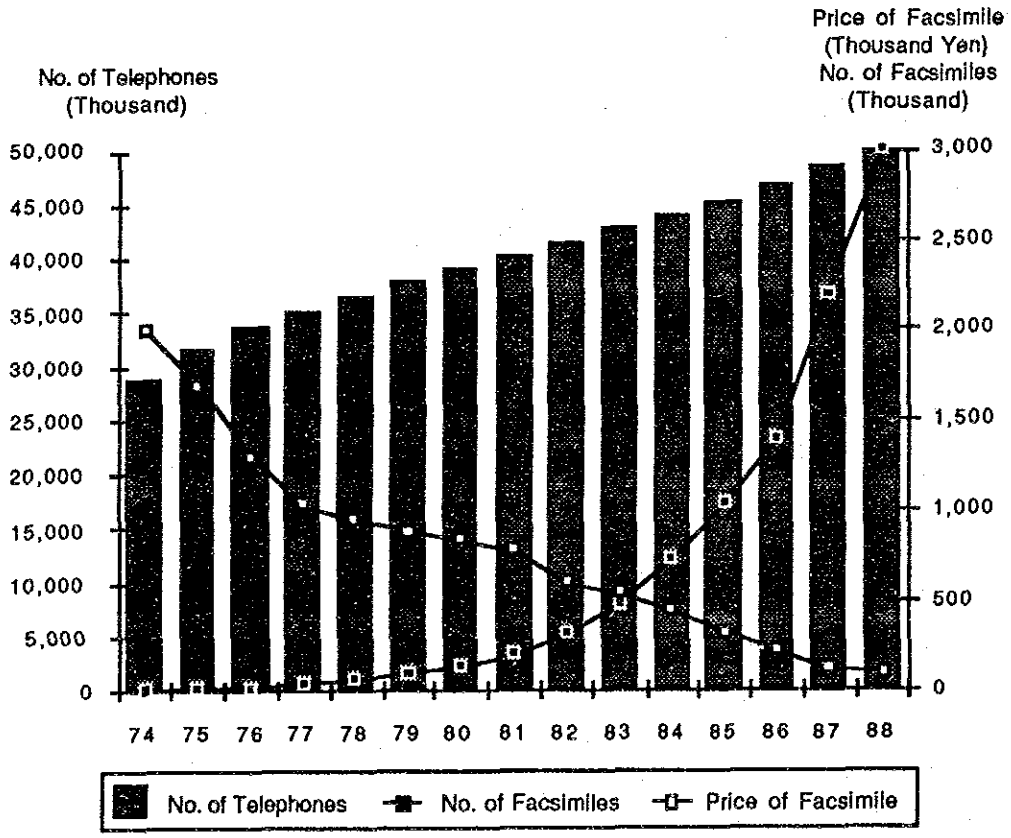


Figure 4.1.3-1 Facsimile Terminal Development in Japan

This rapid development in Japan consists in the following features:

- Suitable for transmitting complicated characters such as Kanji, Kana,
- Suitable for transmitting drawing, table, hand-written draft,
- Easy operation because of non-key board operation,
- Lower of terminal cost year by year as shown in Figure 4.1.3-1,
- Easy application for terminal connection to telephone network without installation fee and monthly fee.

Thai language employs also complicated characters and the terminal application has been already deregulated. The conditions are almost the same to Japan. Most of the above-mentioned features can be applied in Thailand. From now on, the cost of terminal will continue to be lower and lower and the intelligence of terminal will continue to be higher and higher year by year. Facsimile will become popular terminal for ordinary people. It can be expected that facsimile communication will be developing rapidly in Thailand.

At the present stage, G-1, G-2 and G-3 terminals are granted by TOT. As regards G-4 terminal, its final specification has been just standardized in 1988. In the near future, it will surely be increasing in number in accordance with the lower of G-4 terminal cost, the network digitization and ISDN introduction.

The demand of facsimile terminals is considered to develop about the rate from 1 % to 10 % of main telephone demand up to the year of 2007 as shown in Table 4.1.3-4.

Table 4.1.3-4 Forecast of Facsimile Terminals

Year		Actual	Forecast			
		1987	1992	1997	2002	2007
No. of Telephone Demand (x1000)		902				
	Metropolitan Area	615	1,467	2,120	2,769	3,376
	Provincial Area	287	1,060	1,494	2,037	2,791
Percentage of Facsimile (%)		0.23%				
	Metropolitan Area		2%	4%	7%	10%
	Provincial Area		1%	2%	3%	5%
Number of Facsimiles (x1000)		2	40	115	255	478
	Metropolitan Area		29	85	194	338
	Provincial Area		11	30	61	140

2) Data Terminal

The telephone network can transmit the low speed of data up to 9600 b/s by way of modem, acoustic coupler etc. The typical usage is personal computer communications. While the number of personal computers is estimated at about 40,000 in 1988, the number of data terminals (Modems) on the telephone network is about 200. The percent of on-line data terminals to personal computers is about 0.5 %. With the increase of personal computers and the development of telephone network, this percents will be rising and Digital Service Unit (DSU) will be adopted as interface facility in future.

The demand for this service is described in the paragraph of demand forecast of leased circuit as a part for data terminals accommodated on the telephone network. (Table 4.3.1-4)

3) Other Enhanced Terminals

The following terminal facilities are considered to be feasible for connecting to telephone network in future, especially in the field of Video communication:

- Videotex Terminal,
- Video Phone,
- Video Conference,
- etc.

They are highly enhanced terminals. For the time being, the demand is considered to be limited to specific subscribers, namely, not serious for the general public. Some of the terminals require high bit rate transmission, therefore, these services are realized on digital leased circuits or ISDN. In conclusion, they should be introduced as private network at the initial stage, and gradually expanded to the general public in accordance with the digitization of network.

4.2 Mobile Communication Service

In the field of mobile communication service, the communication types are variable in order to offer the convenience individually during the movement. Some of the services are compared in respect to their specifications as shown in Table 4.2-1.

Table 4.2-1 Mobile Communication Services

Service	Direction of Communication	Radio Base Control Radius (km)	Measure for Radio Interference	Type of Terminal
Public Service				
Voice Communication				
Cellular Mobile	Both Way	3 - 10	Good	E, P
Radio Phone	Both Way	30	Good	E
Marinet Phone	Both Way	50	Good	E
Data Signal Transmission				
Paging	One Way	10 - 15	Good	P
Tele Terminal	Both Way	3	Good	P
Private Service				
Voice Communication				
Exclusive Radio	One Way	5 - 10	Poor	E, P
Multi Connection Access	One Way	20 - 30	Good	E
Personal Radio	One Way	5 - 10	Poor	E
Tranceiver Radio	One Way	1	Poor	P

Note : Type of Terminal **E** : Equipped Type
P : Portable Type

4.2.1 Cellular Mobile Service

1) Present Status

As mentioned in the section 2.2 and 2.3, the cellular mobile service is offered under the competitive condition between TOT and CAT. The target of this service is originally for passenger cars. However, the application territory by this service is very flexible, and the surrounding conditions are not so simple in Thailand. The following matters should be taken into account before the demand forecast.

- Cellular mobile service is offered by TOT and CAT. The volume of demands will be enhanced largely under the competitive condition between TOT and CAT.

- Cellular mobile service is utilized as an alternative method of the ordinary telephone service for the areas where local cable pairs are poor in quality and in quantity. In such cases, subscriber stations are usually kept at the fixed points and are not utilized as land mobile stations for its original usage. The ratio of this usage is supposed to be about several to 10 % of the cellular mobiles.

- As the background of the above-mentioned alternative method, the tariff level of cellular service is not so higher than that of ordinary telephone service, making allowance for its convenience. The tariff structure between them is compared in Table 4.2.1-1 and 4.2.1-2.

Table 4.2.1-1 Comparison of Tariff Structure

Item	Ordinary Telephone	Cellular Mobile Telephone
Installation Charge	5,000/3,700/3,500 B	Under User's Responsibility
Registration Fee	-	1,000 B
Deposit	3,000 B	3,000 B
Monthly Charge		
Push Line	100 B	500 B
Rotary Line	50 B	-
Call Charge (7:00 - 18:00)		
Classification	6 Classes	3 Classes
1 Minute Call Charge	3 B / 6 B / 9 B / 12 B / 15 B / 18 B	3 B / 8 B / 12 B
Definite call charge structure is compared in Table 4.2.1-2.		

- Similar service has been available especially for provincial area by TOT, adopting radio transmission system for the subscriber carrier portion, namely, between the end of telephone network and land mobiles. Based on the existing service classification, it is included in the ordinary telephone service as "Rural Communication". Its application areas cover another territory and are considered to be not competitive with cellular mobile service.

- Similar mobile service has been available, apart from the cellular mobile service by CAT, adopting HF, VHF and UHF radio transmission system. Based on the existing service classification, it is categorized as another type of mobile telephone service by CAT. The total number of these subscribers is about 3,300 in 1986 and 2,500 in 1988. Since the introduction of cellular mobile services by TOT and CAT, the number of these subscribers has been decreasing.

- Cellular mobile service has the capability of expanding the application territory. It can be applied to "Portable phone", "Coastal phone", "Train phone" etc. Judging from the view of the present stage, the portable phone is covered by this network.

Table 4.2.1-2 Comparison of Tariff Structure for Call Charge

(Baht / 1 Minute)

Trunk Code											Location Name
121	**131**	**132**	**141**	**142**	**151**	**152**	**171**	**172**	Cellular Mobile		
2	32 - 36	37 - 39	42 - 43	44 - 45	53 - 54	55 - 56	73 - 74	75 - 77	Ordinary		
3 3	**3** 6 - 12	**3** 6 - 12	**12** 15 - 18	**8** 12 - 15	**12** 15 - 18	**8** 9 - 15	**12** 18	**8** 15 - 18	2	**121**	Bangkok
	3 3 - 12	**3** 6 - 12	**12** 12 - 18	**8** 6 - 18	**12** 15 - 18	**8** 6 - 18	**12** 15 - 18	**8** 6 - 18	32 : 36	**131**	Phetchaburi Nakhon Pathom Ayutthaya, Saraburi
		3 3 - 12	**12** 12 - 18	**8** 6 - 15	**12** 18	**8** 9 - 18	**12** 18	**8** 12 - 18	37 : 39	**132**	Nakhon Nayok Chon Buri Chanthaburi
			3 3 - 12	**8** 6 - 12	**12** 9 - 18	**8** 6 - 18	**12** 18	**12** 18	42 : 43	**141**	Udon Thani Nakhon Phanom Khon Kaen, Kalasin
				3 3 - 12	**12** 12 - 18	**8** 12 - 18	**12** 18	**12** 18	44 : 45	**142**	Nakhon Ratchasima Buri Ram Yasothon, Surin
					3 3 - 12	**8** 6 - 18	**12** 18	**12** 18	53 : 54	**151**	Chiang Mai Chiang Rai Lampang, Nan
						3 3 - 12	**12** 18	**12** 18	55 : 56	**152**	Phitsanulok Sukhothai, Tak Nakhon Sawan
							3 3 - 12	**8** 9 - 18	73 : 74	**171**	Yala, Pattani Narathiwat Songkhla, Satun
								3 3 - 12	75 : 77	**172**	Nakhon Si Tammarat Krabi, Phuket Surat Thani, Ranong

Call Charge (Baht) for 1 Minute (7:00 - 18:00)

Cellular Mobile Telephone
Ordinary Telephone

The above-mentioned conditions are summarized in Figure 4.2.1-1.

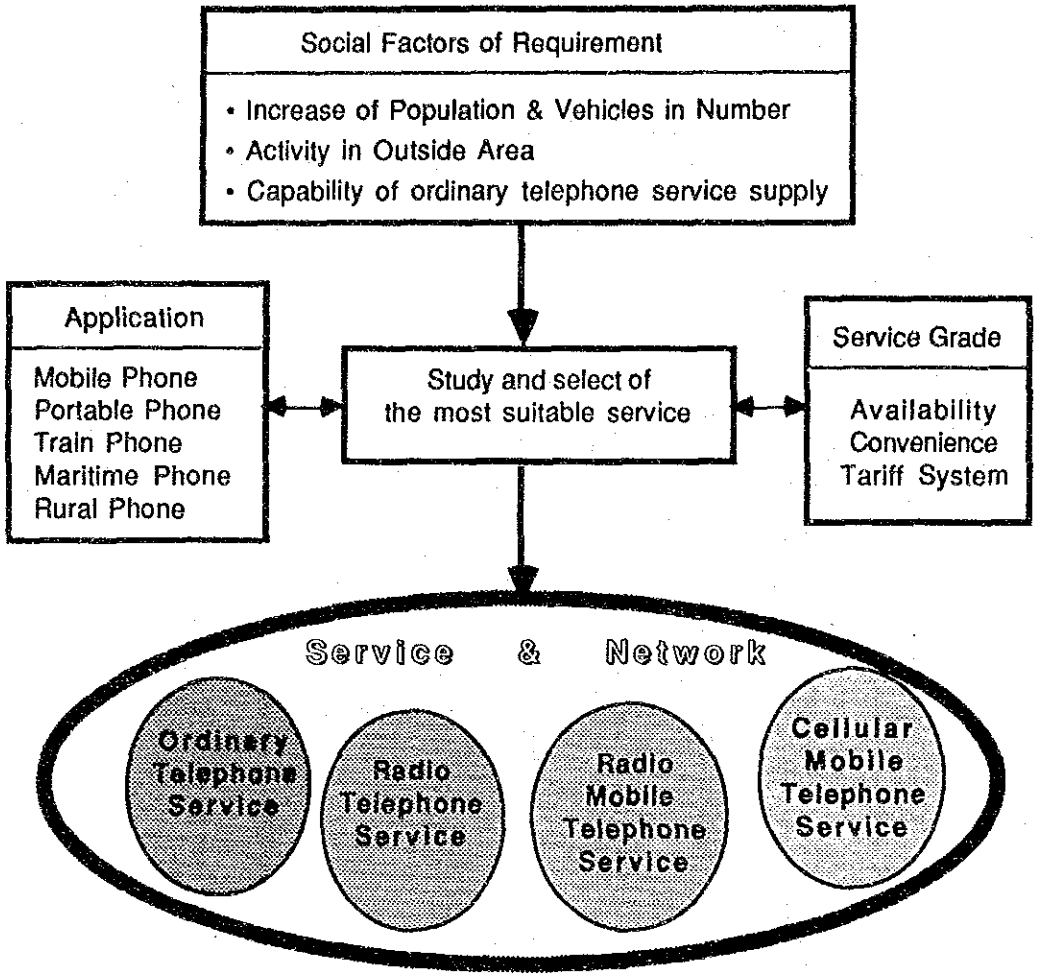


Figure 4.2.1-1 Relations between Demand and Service

2) Precondition for Forecast

As mentioned above, the surrounding conditions are complicated in Thailand. The cellular mobile service has been commenced in the last several years, and the past trend data is not enough for the future demand forecast. Therefore, the demand forecast is tried on a macroscopic basis by the following methodology.

- The service state in foreign countries is referred to in comparison with the population and the main telephones, for the purpose of studying the appropriate service level.

Table 4.2.1-3 shows that the present state of service level varies with the country in a wide range. Among others, the states in Australia and Scandinavian countries are superior in respect to the ratio of mobile telephone to population as well as main telephone. This means that this service is suitable for covering the wide area where the population density is lower.

Table 4.2.1-3 Mobile Telephone Service State in Some Countries

Country	Number of Mobile Tel. in 1988	Population (Thousand) in 1987	Mobile Tel. per 1000 Persons	Number of Main Tel. (Thousand) in 1987	Mobile Tel. per 1000 Main Tel.
Thailand	13,000	53,873	0.24	902	14.41
Philippines	3,000	54,380	0.06	478	6.28
Indonesia	3,400	172,010	0.02	759	4.48
Malaysia	17,400	16,530	1.05	1,132	15.37
Hong Kong	30,000	5,659	5.30	1,989	15.08
Australia	295,000	16,263	18.14	6,965	42.35
Japan	150,000	122,264	1.23	48,014	3.12
Austria	36,904	7,573	4.87	2,907	12.69
Belgium	19,163	9,864	1.94	3,402	5.63
Denmark	101,660	5,129	19.82	2,711	37.50
Finland	109,010	4,941	22.06	2,365	46.09
France	104,817	56,865	1.84	24,804	4.23
Iceland	6,519	247	26.39	113	57.69
Ireland	5,729	3,543	1.62	796	7.20
Italy	31,000	57,422	0.54	19,105	1.62
Luxembourg	372	370	1.01	162	2.30
Netherlands	35,000	14,714	2.38	9,410	3.72
Norway	152,193	4,199	36.25	1,949	78.09
Portugal	1,000	10,266	0.10	1,655	0.60
Spain	12,746	39,092	0.33	10,236	1.25
Sweden	244,126	8,414	29.01	5,481	44.54
Switzerland	33,902	6,573	5.16	3,381	10.03
U. Kingdom	530,000	56,763	9.34	22,137	23.94
W. Germany	103,583	61,940	1.67	27,222	3.81

Source : Overseas Telecommunication Journal
ITU "Yearbook of Common Carrier Telecommunication Statistics"

- Taking account of the important role of cellular mobile network utilized as ordinary telephone for the areas where the local cable pairs are poor for the benefits of society, it is considered that the target should basically be set up on the basis of population.

- The radio telephones by HF, VHF and UHF radio systems will gradually be integrated into the cellular mobile network or the ordinary telephone network. These subscribers can be regarded as one of the demands of cellular mobile service.

- Some of the cellular mobile stations adopted as alternative method will continue to be utilized after the ordinary telephone service is sufficiently available, because the tariff level of cellular mobile network is not so higher in comparison with that of ordinary telephone.

- The application territory by the cellular mobile network is for the land mobile phone and portable phone. The sharing ratio of portable phone is supposed to be set up as 20 percent in 1992, 30 percent in 1997, 40 percent in 2002 and 50 percent in 2007 for the metropolitan area, and set up somewhat lower for the provincial area.

3) Forecast

As one of the guideline for estimating demands, it is considered to be reasonable that the methodology is adopted on the basis of population because of the above-mentioned reasons. Making reference to the future demand of ordinary telephone service, the installation density is forecasted as 29.92 in the metropolitan area and 4.82 in the provincial area per 100 persons in the year of 2007.

Taking account of the service states in Scandinavian countries in comparison to the future state of these telephone services in Thailand, it is adjustable that the installation density of cellular mobile service is forecasted as 30 in the metropolitan area and 6 in the provincial area per 1000 persons in the year of 2007. Namely, this density is equivalent to about one tenth (1/10) of the ordinary telephone service.

Based on this installation density, the demand forecast is tried by classifying into metropolitan & provincial area, and mobile phone & portable phone as shown in Table 4.2.1-4.

Table 4.2.1-4 Forecast of Cellular Mobile Service

Year		1992	1997	2002	2007
Population (Thousand)		58,041	62,102	65,865	69,165
	Metropolitan	8,496	9,467	10,357	11,284
	Provincial	49,545	52,635	55,508	57,881
Mobile Tel./1000 Persons					
	Metropolitan	5	10	20	30
	Provincial	1	2	4	6
No. of Cellular Service		92,025	199,940	429,172	685,806
	Metropolitan	42,480	94,670	207,140	338,520
	Provincial	49,545	105,270	222,032	347,286
	Share of Portable Phone				
	Metropolitan	20%	30%	40%	50%
	Provincial	10%	20%	30%	40%
	No. of Mobile Tel.				
	Metropolitan	33,984	66,269	124,284	169,260
	Provincial	44,591	84,216	155,422	208,372
	No. of Portable Phones				
	Metropolitan	8,496	28,401	82,856	169,260
	Provincial	4,955	21,054	66,610	138,914

4.2.2 Paging Service

1) Service Menu

There are various types of paging services in the world. In general, they are classified as follows:

a) One tone paging,
b) One tone and voice message paging,
c) Two tone paging,
d) Vibration paging,
e) Digital display paging,
f) etc.

In Thailand, as mentioned in the section 2.2.4, paging service is presently offered by CAT. The service menu is Tone & Voice paging system and Digital display paging system. Digital display paging system was introduced in 1987 and the subscriber has been increasing rapidly.

2) Future Prospects

At present, the paging service is mostly utilized as one of the supporting services of telephony. However, in the near future, the application territory may be extended. Since the digital display paging station is capable of identifying the Roman characters, it can accept the character signal and may also be utilized as data communication station. This concept is shown in Figure 4.2.2-1.

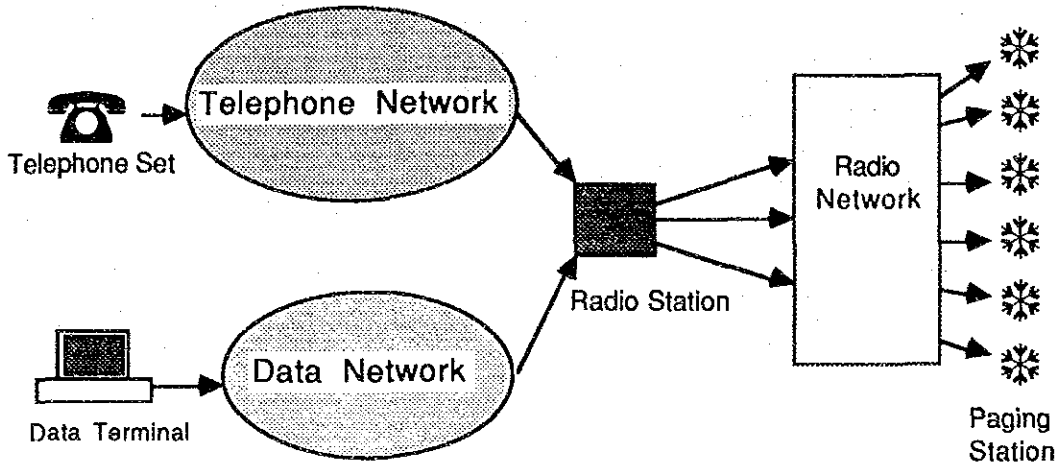


Figure 4.2.2-1 Paging System Interworking with Data Network

3) Forecast

The paging system is mostly connected to the telephone network as the end station with one way communication. Accordingly, the demand is considered to closely relate to the ordinary telephone service. Therefore, the demand forecast is basically carried out by multiplying some ratio to the number of main telephones.

Comparing the paging subscribers to the main telephones in number, the ratio has been increasing in Thailand considering as a whole. Especially, since the commencement of digital display paging system, its development is significant as shown in Table 4.2.2-1.

Table 4.2.2-1 Comparison of Paging Station to Main Line in Thailand

Year	Number of Paging Stations		Number of Main Lines	Ratio of Paging to Main Lines
	Tone & Voice	Digital Display		
1983	4,004	-	463,231	0.009
1984	6,233	-	519,491	0.012
1985	7,992	-	626,498	0.013
1986	7,953	-	798,912	0.010
1987	6,091	17,000	901,622	0.026

Source : CAT's Communications Services Statistical Report
TOT's Statistical Report

Making reference to the case of Japan, the number of paging subscribers is 2,834 thousand while the number of main telephones is 49,904 thousand in FY 1988. As a result, the ratio of paging stations is about 0.057. In comparison to the case of Japan, the ratio is relatively lower in European countries as shown in Table 4.2.2-2.

Table 4.2.2-2 Comparison of Paging Station to Main Line in Europe

Country	Number of Stations	Number of Main Lines	Ratio of Paging to Main Lines
Austria	63,804	2,907	0.022
Belgium	40,000	3,402	0.012
Denmark	34,363	2,711	0.013
Finland	27,469	2,365	0.012
France	135,177	24,804	0.005
Ireland	2,013	796	0.003
Italy	22,700	19,105	0.001
Luxembourg	2,174	162	0.013
Netherlands	179,000	6,234	0.029
Norway	57,442	1,949	0.029
Spain	33,000	10,236	0.003
Sweden	100,000	5,481	0.018
Switzerland	22,677	3,381	0.007
U. Kingdom	585,000	22,137	0.026
W. Germany	175,120	27,222	0.006

Source : Overseas Telecommunications Journal
ITU "Yearbook of Common Carrier Telecommunications Statistics

Note : The number of Paging Stations is as of Jan. 1989
The number of Main Lines is as of FY. 1987

On the basis of the cases in Japan and European countries, the suitable index should be established for the paging service demand forecast in Thailand. Taking account of the significant development of digital display paging and the future prospects of capability of

interworking with data network, the index should be set up higher than those of European countries.

After setting up this index as the target for each 5 year plan, the demand forecast in the whole Kingdom is tried in proportion to the demand of main telephones. Then, the total demands are distributed into metropolitan & provincial area and the type of terminals. About 90 % of stations are considered to be utilized in the metropolitan area, and the tone & voice paging may be replaced by the digital paging up to the year around 1997. The result is shown in Table 4.2.2-3.

Table 4.2.2-3 Forecast of Paging Service

Year		Actual	Forecast			
		1987	1992	1997	2002	2007
Number of Telephone Demand (x1000)		902	2,527	3,614	4,806	6,167
Ratio of Paging Station		0.025	0.035	0.044	0.052	0.060
Number of Paging Stations (x1000)		23	88	159	250	370
Area	Metropolitan	20	75	140	220	330
	Provincial	3	13	19	30	40
Terminal Type	Tone & Voice	6	4			
	Digital Display	17	84	159	250	370

4.3 Leased Circuit Service & Data Communication Service

At present, leased circuits are utilized for data communication, telex access line, hot line, broadcasting etc. As regards data transmission use, the application territory of leased circuit closely relates to that of packet switched data network. Accordingly, data communication service is covered in this section.

4.3.1 Basic Transmission Service

1) Data Transmission Use

Leased circuits for data transmission use will take an important role in future. The demand will become stronger in quantity and higher in quality in proportion to the development of on-line computer systems. The recent international trends of data transmission are high-speed data transmission and packet switched data network.

a) Trends and Prospects

As regards high-speed data transmission, digital leased circuit of 6,600 circuit units are scheduled to be introduced by TOT in 1991. Data transmission by digital circuit up to 64 kb/s can be available and, it enables to provide not only point-to-point connection but also multi-point connection and cross connection. The quality of service is upgraded. Furthermore, in accordance with the development of ISDN, data transmission over 64 kb/s will surely be provided adopting optical fiber cable and satellite communication systems.

As regards packet switched network, "TAIPAC" has been in service by CAT in 1989. Packet switching nodes are installed in Bangkok, Chiang Mai and Hat Yai, and Packet concentrators are located in Nakhon Sawan, Saraburi, Chon Buri, Rayong, Nakhon Ratchasima, Khon Kaen, Phitsanulok, Surat Thani and Phuket. In these areas, Packet mode terminal up to 9600 b/s and Non-packet mode terminal can directly be accommodated on this network. In other areas, Non-packet mode terminal can be accommodated by way of the telephone network.

With the enhancement of network functions, the leased circuit is capable of being shared with the public network. Namely, the facilities are physically shared while the circuits are logically separated through the functions of Closed User Group (CUG) and Virtual Private Network (VPN). As a result, the leased circuit can physically be integrated into ISDN in future.

b) Suitable Network

Owing to these development of networks, the users of data communication can select the most suitable network from among telephone network, low speed of analog leased circuit, high speed of digital leased circuit, packet data network etc., according to their requirements.

In general, leased circuit is suitable for large amount of data transmission, telephone network is suitable for small amount of data transmission with low speed transmission and packet network is suitable for large/small amount of data transmission. The suitable application for each network is shown in Figure 4.3.1-1 and the general specifications are compared in Table 4.3.1-1.

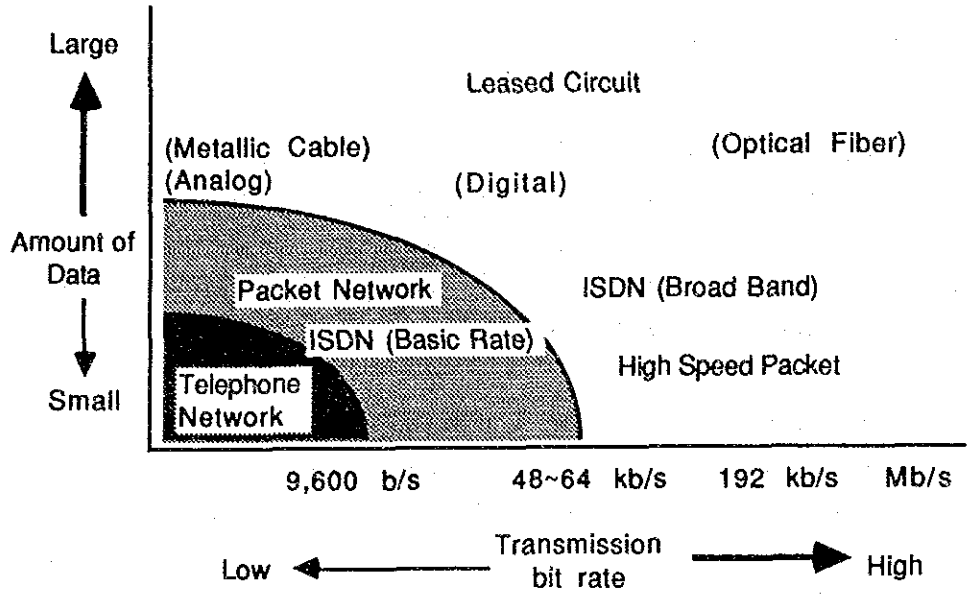


Figure 4.3.1-1 Suitable Network for Data Transmission

Table 4.3.1-1 General Specifications for Data Transmission Use

Item	Telephone Net.	Leased Circuit	Packet Network	ISDN Network
Bit Rate	below 9600 b/s	Variable	below 48 kb/s	64 kb/s (2 B) 16 kb/s (1 D)
Bit Error Ratio	10^{-5}	Variable	10^{-11}	10^{-11}
Dialling Procedure	Necessary	Not Necessary	Selective (Necessary or Not Necessary)	Selective (Necessary or Not Necessary)
Call Setting Up Time	15 sec. at maximum	No Time Period	1 sec. at maximum	1 sec. at maximum
Tariff Structure				
Monthly Charge	Lower: On the basis of the number of local subscribers	Higher: On the basis of Bit Rate, Distance etc.	Medium: On the basis of Bit Rate	(Under Study) In accordance with the tariff of other networks
Call Charge	On the basis of Call Duration, Distance etc.	Not Charged	On the basis of Transmitted Data, Distance etc.	

As described in Figure 4.3.1-2, the competitive relations among various network services are taken into account and the demands for data transmission will be distributed into each network in proportion to the appropriate ratio.

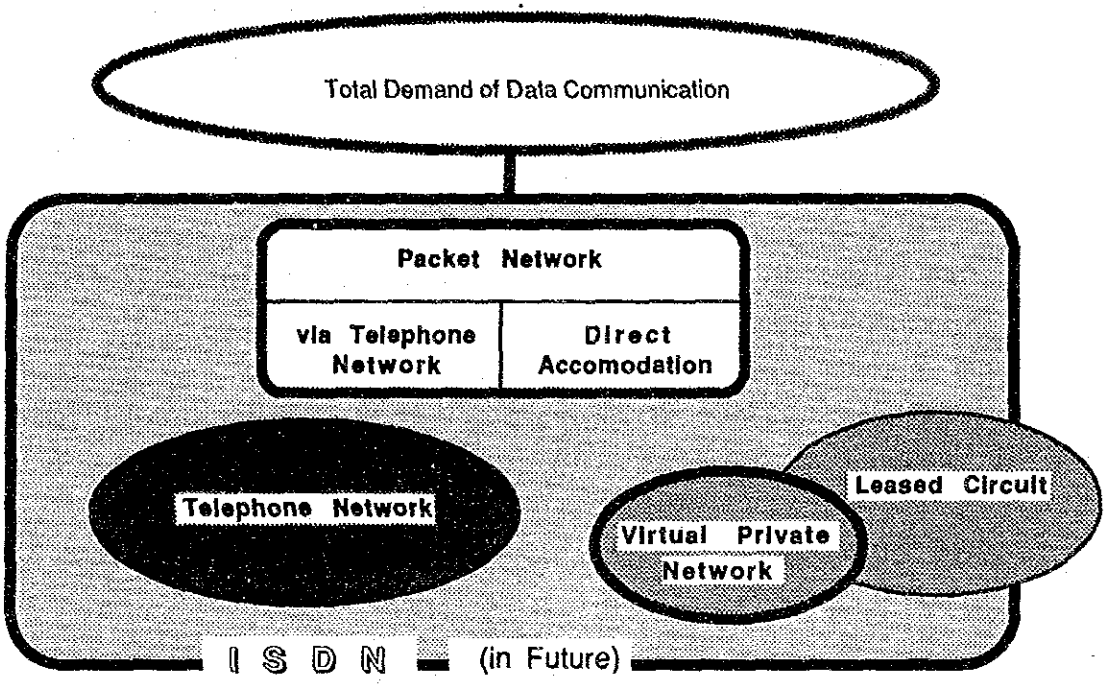


Figure 4.3.1-2 Distribution of Demands

c) Appropriate Ratio among Networks

There is no base data for estimating this appropriate ratio because the status after the introduction of new networks cannot be foreseen in any countries. Although the data in other countries cannot always be suitable in Thailand, taking the case of Japan as a reference, the number of data communication circuits classified by each network are shown in Table 4.3.1-2.

It should be noted that the following activities have taken place during the last 10 years in Japan.

- The circuit switched public data network (CSPDN) has already been in service since Dec. 1979. Successively, the packet switched public data network (PSPDN) has been in service since July 1980.

- The high speed digital leased circuit service has begun in Nov. 1984. The number of circuits has remarkably been increasing.

- The number of data transmission circuits accommodated on the telephone and telex network has become unavailable since the year of 1985, because of the deregulation of terminal application that has been effective since April 1985.

- Interworking between telephone network and packet data network has begun in April 1985.

- The commercial ISDN service with the basic access rate interface (2B+D) has begun in April 1988.

- The commercial ISDN service with the primary access rate interface (23B+D) etc. has just begun in June 1989.

Table 4.3.1-2 On-line Circuits for Each Network in Japan

Service Menu	Mar. 1984	Mar. 1985	Mar. 1986	Mar. 1987	Mar. 1988
Leased Circuit					
50 b/s	126,659	133,994	143,391	154,582	166,338
100 b/s	601	546	489	366	344
200 b/s	8,323	7,726	7,610	6,626	6,018
300 b/s	10	9	45	60	84
1,200 b/s	10,375	9,761	8,978	8,699	8,218
2,400 b/s	8,669	8,946	9,033	8,471	8,629
4,800 b/s	3,317	3,764	4,557	4,292	4,490
9,600 b/s	1,569	2,717	4,358	6,764	9,698
Others	156	183	192	145	55
Sub Total	159,679	167,646	178,653	190,005	203,874
Leased Circuit (High Speed Digital)					
64 kb/s	-	0	21	382	620
192 kb/s	-	0	140	323	700
384 kb/s	-	7	124	466	998
768 kb/s	-	2	135	413	995
1.5 Mb/s	-	9	151	421	827
3 Mb/s	-	-	-	-	39
6 Mb/s	-	9	69	120	228
Sub Total	-	27	640	2,125	4,407
Circuit Switched Public Data Network (CSPDN)					
200-300 b/s	5	4	6	8	16
1,200 b/s	26	11	8	18	12
2,400 b/s	158	174	182	170	165
4,800 b/s	369	783	1,042	964	1,144
9,600 b/s	914	1,535	2,468	3,517	4,447
48 kb/s	123	170	285	544	1,298
Sub Total	1,595	2,677	3,991	5,221	7,082
Packet Switched Public Data Network (PSPDN)					
200-300 b/s	11	17	75	83	77
1,200 b/s	113	192	298	400	493
2,400 b/s	1,107	2,267	3,825	4,555	5,700
4,800 b/s	810	1,926	4,484	5,965	8,531
9,600 b/s	867	2,028	4,189	6,955	10,332
48 kb/s	99	196	385	633	912
Sub Total	3,007	6,626	13,256	18,591	26,045
Packet via Telephone Network					
200-300 b/s	-	-	727	5,654	12,507
1,200 b/s	-	-	175	3,550	14,544
2,400 b/s	-	-	0	7	240
Sub Total	-	-	902	9,211	27,291
Telephone Network	72,895	95,656	No Data	No Data	No Data
Telex Network (50 b/s)	3,651	4,610	No Data	No Data	No Data
Sub Total	76,546	100,266	A	B	C
Grand Total	240,827	277,242	197,442 +A	225,153 +B	268,699 +C

Source : Annual Report of Ministry of Posts and Telecommunications in Japan

As mentioned above, the actual data for utilizing telephone and telex network as data transmission lines are not available. Supposing that A is 120,000, B is 140,000 and C is 160,000 as noted below, the shared percentage for each network and the percentage of data lines to main telephone lines is calculated as shown in Table 4.3.1-3.

According to this supposition, the share of leased circuits up to 48 kb/s has been declining, while those of other networks have been rising. Then, the ratio of data lines to main telephone lines has steadily been rising.

Table 4.3.1-3 Share of Each Network for Data Lines in Japan

Service Menu	Mar. 1984	Mar. 1985	Mar. 1986	Mar. 1987	Mar. 1988
Leased Circuit up to 48 kb/s 1)	159,679	167,646	178,653	190,005	203,874
2)	66.3%	60.5%	56.3%	52.0%	47.6%
Leased Circuit over 48 kb/s	-	27	640	2,125	4,407
	-	0.0%	0.2%	0.6%	1.0%
Circuit Switched Data Network	1,595	2,677	3,991	5,221	7,082
	0.7%	1.0%	1.3%	1.4%	1.7%
Packet Switched Data Network	3,007	6,626	13,256	18,591	26,045
	1.2%	2.4%	4.2%	5.1%	6.1%
Packet via Telephone Network	-	-	902	9,211	27,291
	-	-	0.3%	2.5%	6.4%
Telephone & Telex Network 3)	76,546	100,266	A	B	C
	31.8%	36.2%	37.8%	38.3%	37.3%
Total	240,827	277,242	197,442 +A	225,153 +B	268,699 +C
	100.0%	100.0%	100.0%	100.0%	100.0%
Number of Main Telephones (Thousand)	42,879	43,959	45,300	46,772	48,419
Comparison of Data Lines to Main Tel.	0.56%	0.63%	0.70%	0.78%	0.89%

Note: 1) Upper row indicates number of circuit units.
2) Lower row indicates percentage of circuit units.
3) Under conditions : A = 120,000 B = 140,000 C = 160,000

d) Forecast

In this section, the demand is primarily classified into data lines on telephone network, leased circuit and packet data network. In the near future, ISDN is scheduled to be introduced and as a result some of the data lines will transfer to the ISDN service subscription. The ISDN service can be available not only for data communication but also for voice communication, recorded communication etc. Therefore, the transition to ISDN should be studied in the section 4.6, in relation to voice communication, recorded communication etc.

The forecast is carried out in proportion to the future demand of telephone network on the basis of the following methodology.

- Referring to the future demand of main telephone lines,
- Estimating the ratio of data lines to main telephone lines as 1% to 4%,
- Multiplying the above-mentioned ratio to the main telephone lines, then calculating the total number of data lines,
- Distributing the total number of data lines into each network in proportion to the share ratio.

The definite process and results are summarized in Table 4.3.1-4.

Table 4.3.1-4 Forecast of Data Transmission Use

Service Menu		1992	1997	2002	2007
Number of Telephone Demand (x1000)		2,527	3,614	4,806	6,167
Estimated Share of Data Lines to Tele.		1%	2%	3%	4%
Estimated Number of Data Lines		25,270	72,280	144,180	246,680
	Leased Circuit up to 48 kb/s 1)	20,216	46,982	72,090	74,004
	2)	80%	65%	50%	30%
	Leased Circuit over 48 kb/s	505	4,337	14,418	37,002
		2%	6%	10%	15%
	Packet Switched Data Network	1,011	5,060	14,418	37,002
		4%	7%	10%	15%
	Packet via Telephone Network	1,011	7,228	21,627	49,336
		4%	10%	15%	20%
	Telephone Network	2,527	8,674	21,627	49,336
		10%	12%	15%	20%

Note: 1) Upper row indicates number of circuit units.
2) Lower row indicates percentage of circuit units.

2) Telex (Packet Data) Network Access Line Use

The leased circuits for telex service are utilized for the access lines to the telex exchanges of CAT. They should virtually be classified as local cables rather than leased circuits from the overall point of view.

The demand source of this telex service is almost the same with that of the packet data service. That is, demand for the telex service will gradually be shifting to the packet data service. While the number of telex subscribers will be decreasing in future, the number of

packet data service will surely be increasing covering the number of decreasing circuit units for the telex service.

The number of leased circuits for the access line to telex exchange can be referred to as the demand of telex service as shown in Table 4.4.2-2. On the other hand, the number of leased circuits for the access line to packet exchange can be referred to as the number of data lines by packet switched network as shown in Table 4.3.1-4.

3) Voice Transmission (Hot Line) Use

For the purpose of transmitting voice information between the regular points, the leased circuit can be available as Hot line service. It can be adopted not only for voice communication but also for facsimile communication, low bit rate of data transmission etc.

Taking reference to the present state in Thailand as described in the section 2.2.3, the number of leased circuits for hot line use is about one second (1/2) of data transmission (computer) use. On the contrary, in the case of Japan, that number is somewhat higher than that of data transmission use.

It is considered to be appropriate that the demand is estimated at about two third (2/3) to four fifth (4/5) of data transmission use. Under this supposition, the result is summarized in Table 4.3.1-5.

Table 4.3.1-5 Forecast of Voice Transmission Use

Service Menu	1992	1997	2002	2007
Leased Circuit for Data Transmission Use	20,721	51,319	86,508	111,006
Ratio of Voice Transmission Use	66%	70%	75%	80%
Leased Circuit for Voice Transmission Use	13,676	35,923	64,881	88,805

4) Video Transmission Use

At present, leased circuits are rare for video transmission use in Thailand. However, in future, they will surely be employed for some specified users. Taking reference to the case in Japan, application fields of leased circuits for video transmission use are shown in Table 4.3.1-6.

Table 4.3.1-6 Application Fields for Video Transmission Use in Japan

(March 1986)

Application Field	Number	Ratio	Description
Observasion of Land Traffic Jam	586	76.6%	Observation of land traffic jam at intersections by police station
Transmission of Horse Race	48	6.3%	On-the-spot race transmission for betting ticket spots in remote areas
Guard and Security	44	5.8%	Security service for VIP
Observation of Water Level	26	3.4%	Observation of water level at water supplying stations
Observation of Waiting Passengers	24	3.1%	Observation of the number of waiting passengers at Taxi stand
TV Broadcasting	17	2.2%	Distribution of information between headquater and branch offices
Observation of ATM	6	0.8%	Observation of Automatic Teller Machine at banks
CATV Broadcasting	4	0.5%	Distribution of CATV Programs to customers
Others	10	1.3%	TV Conference etc.
Total	765	100.0%	

Source : Data provided by Nippon Telegraph and Telephone Corporation

Taking account of the frequent land traffic jam and the wide popularization of ATM (Automatic Teller Machine) systems in Thailand, the video transmission is considered to be applicable in the fields of land traffic observation use and ATM observation use.

5) Broadcast Program Transmission Use

The sectors of broadcasting are specified, therefore, the demand and expansion plan should be formulated individually according to their requirements.

The future trends of broadcasting are considered to be as follows:

- FM stereo program broadcasting,
- Satellite broadcasting,
- High quality television,
- etc.

6) Summary

As forecasted above, the results for leased circuits and data network are summarized in Table 4.3.1-7.

Table 4.3.1-7 Forecast of Leased Circuits & Packet Network

Service Menu		1992	1997	2002	2007
Leased Circuit					
	Data Transmission up to 48 kb/s	20,216	46,982	72,090	74,004
	Data Transmission over 48 kb/s	505	4,337	14,418	37,002
	Telex Network Access	10,000	7,200	4,800	0
	Packet Data Network Access	1,011	5,060	14,418	37,002
	Voice Transmission	13,676	35,923	64,881	88,805
	Video Transmission	500	1,000	2,000	3,000
	Broadcast Program Transmission	200	500	1,000	1,500
Packet Switched Data Network					
	Packet as Direct Accommodation	1,011	5,060	14,418	37,002
	Packet via Telephone Network	1,011	7,228	21,627	49,336

4.3.2 Message Handling Systems (MHS)

1) General

This service provides the capability of transferring and distributing messages by way of the message storage function (Mail Box) inside or outside the network. This service can be realized regardless of the kind of networks as the function of Bearer service. The enhanced services such as confidential call, multi-address call, time-delivery call, media conversion call, inquiry call by Bulletin Board Service (BBS) can be available in addition to the basic service as shown in Figure 4.3.2-1.

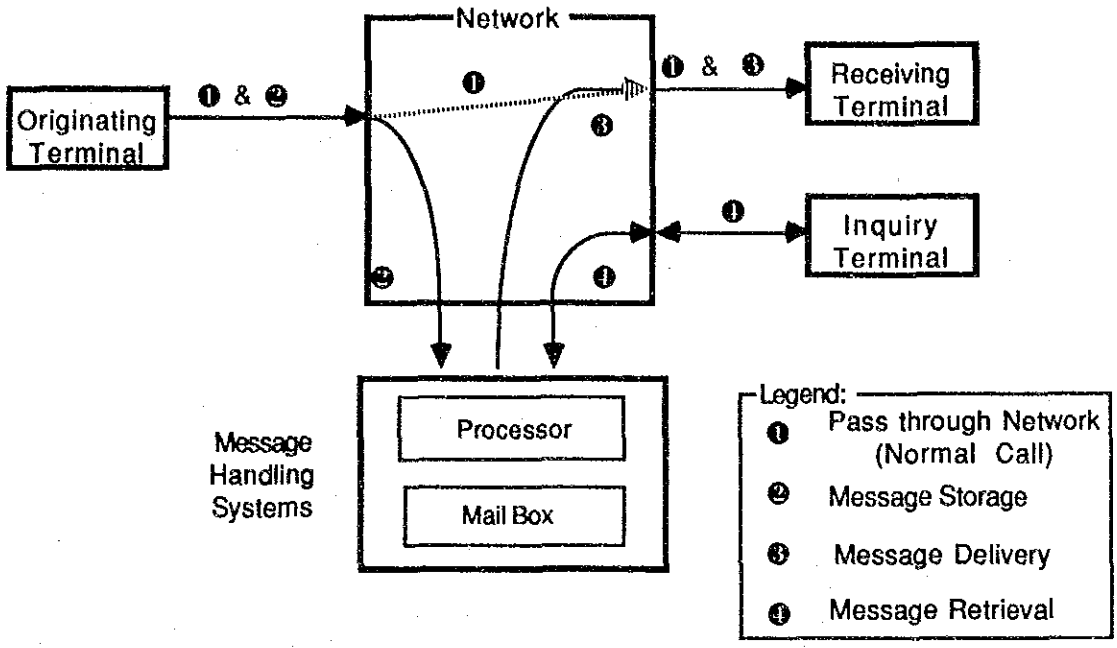


Figure 4.3.2-1 Concept of Message Handling Systems (MHS)

For the purpose of providing the international standard, an elaborate study has been carried out as Message Handling Systems (MHS) for Rec. X.400 series by CCITT. In some of the countries, this service has been already launched on various networks. In Thailand by CAT, similar service has been launched as "Telebox" service in the telex network and the regular service on the basis of the CCITT Rec. is also offered as "Electronic Mail System" in cooperation with the packet data network.

2) Demand Forecast

As mentioned above, this service can be realized regardless of the kind of networks. The personal computers accommodated on the telephone network by means of Modem may become feasible markets. In most cases, high bit rate of data transmission is unnecessary for the personal computer communications. Accordingly, the telephone network is also suitable for this purpose, because it has large capacities and covers large areas. It is more effective to promote MHS service in accordance with Videotex service aiming at the share of personal computers as terminals for both services.

a) Demand Forecast on the basis of Data Lines

Since this service can be regarded as one type of network services in the field of recorded communications, the volume of demand is estimated by multiplying some ratio to the number of data lines. On the basis of the estimated data lines except by leased circuits as described in Table 4.3.1-4, the demand of MHS is forecasted as shown in Table 4.3.2-1.

Table 4.3.2-1 MHS's Forecast Based on Data Lines

Year	1992	1997	2002	2007
Estimated Number of Data Lines (Source: Table 4.3.1-4)	4,549	20,962	57,672	135,734
Packet Network	1,011	5,060	14,418	37,002
Packet via Tel. Network	1,011	7,228	21,627	49,366
Telephone Network	2,527	8,674	21,627	49,366
Estimated Ratio for MHS	15%	15%	20%	20%
Number of MHS's Subscribers	700	3,100	11,500	27,100

b) Demand Forecast on the basis of Personal Computers

The number of personal computers is estimated at 13,000 facilities in 1984 and 40,000 facilities in 1988 in Thailand. During that four years, the growth ratio is more than 30 % per year. According to the prospect of International Data Corporation in Asia (IDC), it is forecasted that the growth ratio of computer unit sales is about 15 to 25 % during the next 5 years in Thailand. It is very difficult to forecast the growth ratio for the long-range periods. The estimation is tried by varying the growth ratio 15 to 25 % for each 5 years.

Most of personal computers will be utilized in stand-alone mode. The number of MHS's subscribers is estimated at about 2 to 5 % of the total number of personal computers.

Table 4.3.2-2 MHS's Forecast Based on Personal Computers

Year	1992	1997	2002	2007
Estimated Personal Computer	97,650	243,000	604,700	1,216,300
Estimated Growth Ratio	25%	20%	20%	15%
Estimated Ratio for MHS	2%	3%	4%	5%
No. of MHS's Subscribers in the Whole Kingdom	1,953	7,290	24,188	60,815

c) Demand Prospect from an Overall Point of View

Based on the results of above-mentioned two methodologies, the demand of MHS service will reach at approximately 6,000 in 1997, 20,000 in 2002, and 40,000 in 2007 on the macroscopic basis.

4.4 Recorded Communication Service

4.4.1 Recorded Communication Service for Public Use

1) Service Menu

a) Telegram Service

Telegram service is offered at the post offices etc. by CAT. As shown in Table 2.2.4-1 and 2.2.4-2, the number of telegrams and words have been decreasing year by year since 1986. Comparing the data between the metropolitan area and provincial areas, the number for domestic telegram in provincial areas is about 2.5 times as large as that of metropolitan area. It is considered that this service is being replaced by other media such as facsimile communication in proportion to the development of telephone network.

b) Bureau Facsimile Service

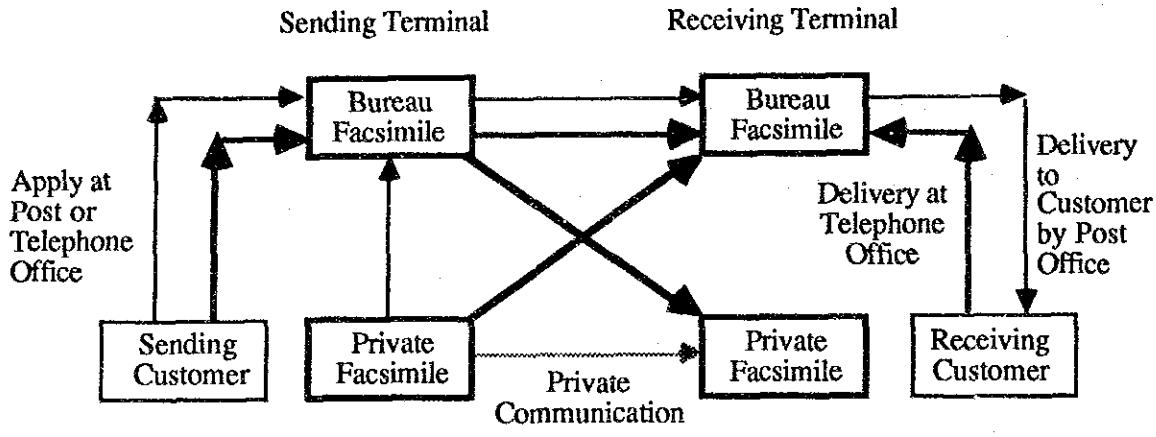
Aiming at the general public having no facsimile terminal of their own, Bureau facsimile service has been offered by CAT. The handling cases have rapidly been increasing since its commencement of service as shown in Table 2.2.4-6. This service is presently available at the major post offices (about 50 offices) while the telegram service is available at the whole post offices (about 2,000 offices). If this service is offered at the whole post offices, the number of handling cases by bureau facsimiles will remarkably be increasing while the number of telegrams may gradually be decreasing.

2) Case in Japan

Taking the case of Japan as a reference, Bureau facsimile service is offered under the competitive condition between telephone offices and post offices. The operation form is different between telephone offices and post offices as shown in Figure 4.4.1-1.

The bureau facsimile service of post offices is operated among the terminals at major post offices, and the messages are delivered to the destinations. On the other hand, that of telephone offices is operated among the terminals at telephone offices and private offices,

residences etc., and the messages received at telephone offices are not permitted to deliver to the destination by the regulation, and the receiver must get the facsimile messages at the telephone offices.



Legend

Bureau Facsimile (Telephone Office) Communication
Bureau Facsimile (Post Office) Communication
Private Facsimile Communication

Figure 4.4.1-1 Operation Form of Bureau Facsimile in Japan

The number of telegrams has been keeping almost the same level as a whole, however, examining the data in detail, greeting messages for celebration and condolence are increasing while urgent messages are decreasing year by year. On the other hand, the number of pages or cases offered by bureau facsimile service has been increasing rapidly as shown in Table 4.4.1-1. The data offered by telephone offices has been unavailable since 1985, however, this service is considered to be penetrated to the society.

Table 4.4.1-1 Comparison among Competitive Services in Japan

FY Year	Number of Telegrams (1,000 Cases)					No. of Bureau Facsimile Service	
	Urgency	%	Greeting	%	Total	Telephone Office (1,000 Pages)	Post Office (1,000 Cases)
1979	11,190	27	29,860	73	41,050	-	-
1980	11,040	27	30,000	73	41,040	1	-
1981	11,030	26	30,930	74	41,960	9	5
1982	10,613	24	32,693	76	43,306	59	44
1983	10,411	23	34,118	77	44,529	253	64
1984	7,647	18	34,037	82	41,684	675	629
1985	5,273	13	35,383	87	40,656	No Data	2,877
1986	4,334	11	35,716	89	40,050	No Data	5,022
1987	3,827	9	37,211	91	41,038	No Data	7,945
1988	3,660	9	37,811	91	41,471	No Data	10,597

Source : Annual Report of Ministry of Posts and Telecommunications
Annual Report of Nippon Telegraph and Telephone Corporation

3) Forecast

Taking the above-mentioned trends into account, the demand forecast for telegram service and bureau facsimile service is carried out. However, these services are now operated by CAT, and it is rather difficult to reflect the principles for offering these services under the competitive condition on this forecast. Therefore, taking reference to the international trends, the future demand is prospected on the macroscopic basis.

As shown in Table 2.2.1-2, the service state relating to telegram service is compared among some countries. According to this table, there are wide variation in the number of telegrams per 100 persons. It is considered that the state is affected by the surrounding conditions such as Post service, Facsimile service etc. and the service menu covered by telegram is different among the sampled countries. For example, the data of Japan is relatively higher, because the greeting messages for non-urgent use are included as reach about 90 percents.

The telegram service and bureau facsimile service are offered for the benefits of general public, accordingly, their future trends should be forecasted on the basis of population. The demands of both services are forecasted in Table 4.4.1-2.

Table 4.4.1-2 Forecast of Telegram & Bureau Facsimile Service

Year		Actual	Forecast			
		1987	1992	1997	2002	2007
Population	(x1,000)	53,873	58,041	62,102	65,865	69,165
Telegram Service	Cases per 100 Persons	14	11	8	5	2
	Total Cases (x1,000)	7,966	6,385	4,968	3,293	1,383
Bureau Facsimile Service	Cases per 100 Persons	0.0	5	10	15	20
	Total Cases (x1,000)	21	2,902	6,210	9,880	13,833

4.4.2 Recorded Communication Service for Private Use

1) Service Menu

a) Telex Service

According to the statistics of telex service by CAT as shown in Table 2.2.4-3 and 2.2.4-4, the increasing ratio for terminals is considered to be still high, namely about 5 to 6% per year in recent years. However, from the viewpoints of calls and minutes, the number of calls as well as minutes has begun to decrease since the year of 1987 or 1988 for domestic and international services. The demand for the telex service will be becoming lower in future.

Although the telex network can transmit the Thai character within the Kingdom, it is considered that operation of facsimile terminal is less troublesome than that of telex terminal, and facsimile communication is more suitable to transmit Thai character messages. It is considered that the telex service is being replaced by facsimile communication as mentioned below in proportion to the development of telephone network.

b) Private Facsimile

The number of facsimile terminals is forecasted in the section 4.1.3 as one of the terminal connection services to the telephone network. In future, facsimile terminals will be popularized into the residential subscribers.

2) Forecast

Taking the above-mentioned trends into account, the demand for telex service is forecasted. However, the telex service is now operated by CAT, and it is rather difficult to reflect the principle for offering this service under the competitive condition on this forecast. Therefore, taking reference to the international trends, the future demand is prospected on the macroscopic basis.

As shown in Table 2.2.1-3, the service state relating to telex service is compared among some countries. According to this table, the number of telex lines per population and per main telephone keeps almost the constant level in the European and Oceanian countries under the circumstance of telephone service development. It is considered that this constant level can be adopted as one of the guidelines. However, even in some of these countries, the number of telex terminals has begun to decrease recently. Therefore, the forecast level should be set up somewhat lower.

The demand of telex service is considered to basically relate to the telephone service, because the competitive service of facsimile terminals are accommodated on the telephone network. Accordingly, the future trends should be forecasted on the basis of ordinary telephone subscriptions. The demand is forecasted in Table 4.4.2-1.

According to this forecast, the number of telex subscriptions is estimated as about 10,000 at maximum, and is supposed to be decreasing year by year after that. The telex service may gradually be replaced by other services and finally, the facilities will be integrated into other networks.

Table 4.4.2-1 Forecast of Telex Service

Year	Actual	Forecast			
	1987	1992	1997	2002	2007
Telephone Demand (x1,000)	902	2,527	3,614	4,806	6,167
Telexs per 1,000 Telephones	6.8	4	2	1	-
Total Number of Telex Terminals	6,164	10,000	7,200	4,800	-

4.4.3 Facsimile Store & Forward System

For the purpose of making use of facsimile communication more efficiently, the facsimile store & forward system is studied as in the following.

1) Advantages

A facsimile message is transmitted to the receiving terminal synchronously with the originating terminal by sending and receiving the control signals. There is no time lag between them. In addition to this transparent transmission, if the memory storage is installed in the network and the store and forward capability is provided for facsimile communication, more convenient communication will be realized. That is, facsimile messages are initially stored in the system and forwarded to the intended facsimile terminals in accordance with the system specification.

The store and forward capability can provide the following benefits, among others:

- The retry call function automatically redials the number and forwards the stored messages in the system, in case of encountering the called party busy. In 1987, the successful call ratio is about 30% in metropolitan area. This function enables to save the worries, time and labor of the calling party.

- The multi-address call function delivers same messages to plural called parties, according to the instruction of calling party at one operation. This enables to save the time and labor of the calling party.

- The confidential call function prevents to open the stored messages, unless the identification number for delivery request coincides with the secret number registered in the system. The operation of facsimile terminal is very easy, however, the messages are put into print without regard to the conditions at the receiving terminal. This function enables to enhance the secrecy of facsimile communication.

2) Case in Japan

In Japan, the facsimile store & forward service was commenced in Sep. 1981. The definite service functions are multi-address call, retry call, time delivery call, confidential call etc. In order to get this service, another contract is required for each terminal.

According to the recent data, the percent of subscription for this service has reached 10 % of the total number of facsimile terminals as shown in Table 4.4.3-1. In appreciating the precedent case in Japan, this store & forward system has gradually been introduced in other countries, namely, in USA, in Republic of China etc.

Table 4.4.3-1 Facsimile Store & Forward Service in Japan

FY Year	Number of Terminals (x 1,000)	Number of Store & Forward Subscriptions	Percentage of Subscription
1981	204	790	0.5 %
1982	312	2,603	1.0 %
1983	487	9,551	2.1 %
1984	731	18,214	2.6 %
1985	1,030	46,271	4.6 %
1986	1,400	85,234	6.1 %
1987	2,200	201,058	9.1 %
1988	3,000	298,000	9.9 %

3) Forecast

On the basis of the forecasted result for facsimile terminals as described in the section 4.1.3, the forecast of store & forward function is described in Table 4.4.3-2. It is considered to be feasible that this service is commenced by about the year of 2000, taking the development of facsimile communication into account.

Table 4.4.3-2 Forecast of Facsimile Store & Forward Service

Year	1992	1997	2002	2007
Number of Facsimiles (x1,000)	40	115	255	478
Percent for Subscriptions	2 %	5 %	10 %	20 %
Number of Subscriptions (x1,000)	1	6	26	96

4.5 Video Communication Service

4.5.1 Videotex Service

This service provides the timely information in response to the inquiry from subscribers. It is composed of various sectors in addition to the basic network service. In order to launch this service, these sectors should interwork systematically as shown in Figure 4.5.1-1.

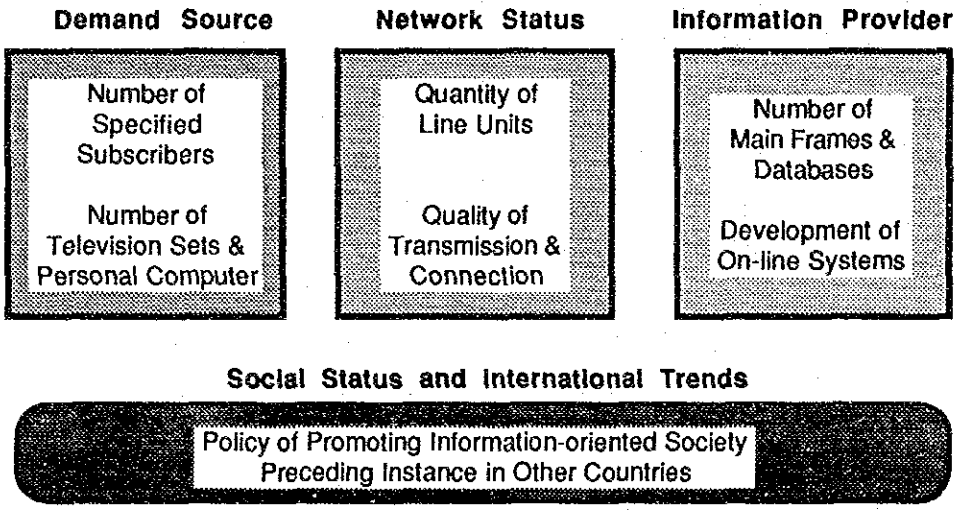


Figure 4.5.1-1 Sectors Relating to Videotex Service

1) Demand Source

It is considered that the facilities and the networks to be required for this service are shared with those employed by other services, because the inquiry duration is at most 10 minutes per subscriber in one day and this inquiry call is always originated by the subscriber side at any time when he wants to retrieve the information.

The demand source of this service basically relates to the number of television sets & personal computers as terminal equipments and the number of line units as access method. The number of television sets classified by population and household in detail is shown in Table 4.5.1-1. In addition, the number of personal computers is estimated as 40,000 equipments.

Table 4.5.1-1 Number of TV Sets in Thailand

(Year 1984)

Region	Number of TV Sets	Population	TV Sets per 100 people	Number of Households	TV Sets per 1000 Households
Bangkok	1,007,960	5,174,682	195	1,053,380	957
Central	978,060	11,189,297	87	2,074,250	472
North	547,740	10,281,206	53	2,010,260	272
Northeast	531,070	17,638,044	30	3,008,220	177
South	314,390	6,299,876	50	1,179,540	267
Whole Kingdom	3,379,220	50,583,105	67	9,325,650	362

Source : Report of Radio and Television Survey, National Statistical Office

According to the above-mentioned Table, the number of television sets are somewhat small for launching this service from a general point of view. However, from the other point of view, the applicants for this service are considered to belong to the advanced class of society and they have already set up television sets, personal computers, main telephones etc. The conditions have been satisfied for this specified class.

It is considered that the demand population for this service is classified into two classes. In accordance with this classification, during the initial stage, the target should be aimed at the specified class. After offering this service to forerunners, the target should be expanded to the general public.

2) Network Status

The existing telephone network is available to access to the database for providing with still pictures. However, when moving pictures are to be provided in future, wide range of frequency bands or high bit rates will be necessary. It will be realized by digital leased circuits or ISDN.

It is considered that the present status of telephone network is somewhat short in supply quantity and somewhat poor in transmission quality. The continuous improvement and development of telephone network should be given for the smooth access to the information providers aiming at the nationwide expansion of this service in future.

3) Information Provider

The feasible application fields of information providers are news, game, quiz, stocks, seat reservation, guide for events, shopping, sight seeing, telephone directory etc. These

database cannot be built up in a short period and the large amount of budgets are required in case of the exclusive development. Practically, the existing database should positively be applied for the information providers.

The data communication systems to be in service at present are bank account systems, seat reservation system for Thai air, Siam cement system, telephone directory system by TOT etc. They are conveniently utilized by the society, and may become information providers in future. Furthermore, new more systems should be developed as the back ground for launching this service.

This service should be launched in cooperation with the existing systems as the trial service. During that periods, new more systems will be in service, and the feasible information providers will be increasing in number.

4) International Trends

Generally, Videotex systems are operated in three types in the world. Their specifications are compared in Table 4.5.1-2.

Table 4.5.1-2 Comparison of Videotex Systems

System	CAPTAIN	NAPLPS	CEPT
Available Graphic Indication	Geometric Mosaic Photographic	Geometric Mosaic	Geometric Mosaic Photographic
Original Indication	Alpha-Photographic	Alpha-Geometric	Alpha-Mosaic
Character Repertory	Alphabet & Numeric Simbols Kanji & Kana	Alphabet & Numeric Simbols	Alphabet & Numeric Simbols
Character Block Size			
Alphabet & Numeric	31 C x 16 L	40 C x 24 L	40 C x 24 L
Kanji & Kana	15 C x 8 L	-	-
Simple Animation	Provided	Not Provided	Not Provided
Voice Output	Provided (Synthetic Melody)	Not Provided	Not Provided
Transmission Speed	4800 b/s	1200 b/s	1200 b/s
Applied Countries	Japan	North America	European Countries

Note : **CAPTAIN** Character And Pattern Telephone Access Information Network
NAPLPS North American Presentation Level Protocol Syntax
CEPT Conférence Européene des Postes et Télécommunications

a) European Countries

At the present stage, the status of this service is less fruitful than expected in most of the countries except France. The major factor for fruitfulness in France consists in, before anything else, the large number of terminal supply with free of charge. As a result of this measure based on the nationwide telecommunication policy for promoting this service, the number of terminals are enormously larger in comparison to those of other European countries as shown in Table 4.5.1-3. If this measure has not been taken, it is doubtful that France can be fruitful in this service.

Table 4.5.1-3 Videotex Terminals in European Countries

Country	Dec. 1987	Dec. 1988
France	3,000,000	4,228,000
W. Germany	96,000	147,000
U. Kingdom	80,000	95,000
Netherlands	30,000	30,000
Sweden	30,000	30,000
Austria	8,340	9,000
Switzerland	6,800	10,000
Italy	5,000	8,000
Finland	4,500	5,000
Belgium	2,500	No Data
Norway	1,500	No Data
Denmark	1,400	No Data
Ireland	900	No Data
Spain	300	No Data
Luxembourg	200	No Data

Source : "World Telecom News" issued in Japan
Data provided by CAPTAIN Service Ltd,.

b) Japan

In Japan, Videotex service is operated by three groups. The first is CAPTAIN system for the public use covering the whole country, the second is Local CAPTAIN system covering the restricted areas and the third is Private CAPTAIN system within specified sectors as one of the inside information systems. Some of the Local CAPTAIN systems interwork with CAPTAIN system and provide their information to CAPTAIN system as one of the information providers. Their relations are shown in Figure 4.5.1-2.

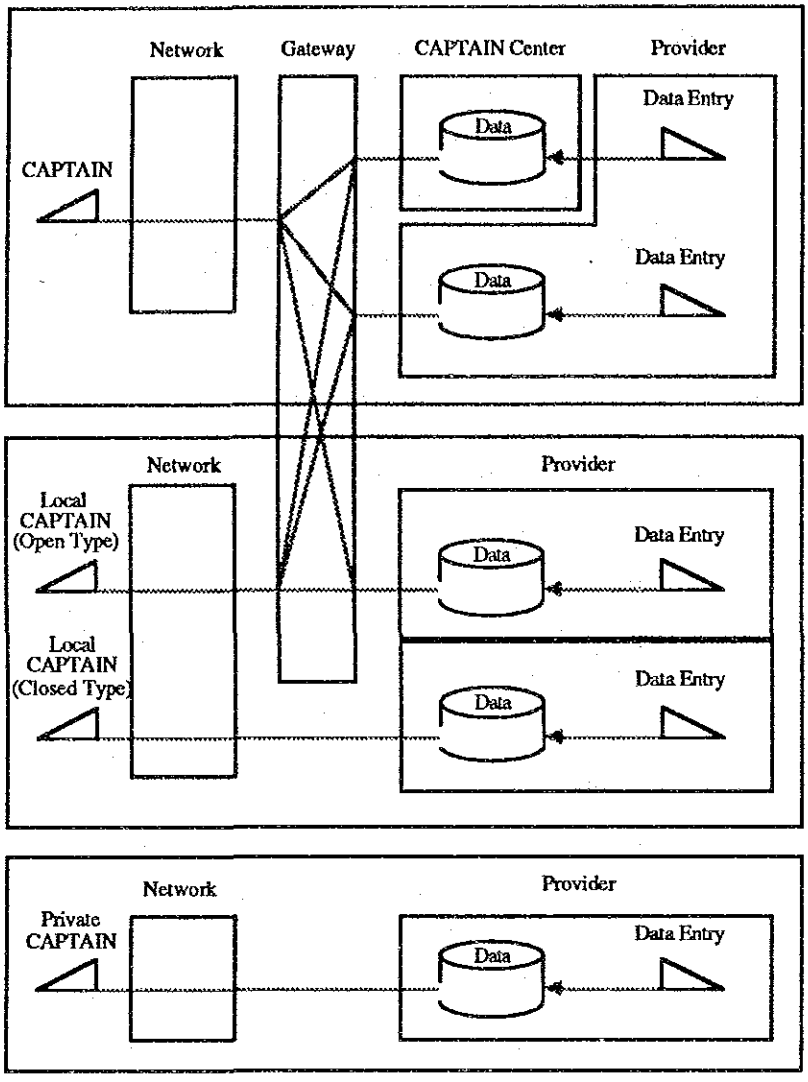


Figure 4.5.1-2 Relations among Various Videotex Systems in Japan

As regards the CAPTAIN system, the commercial service was commenced in Nov. 1984 after five years field trials. The number of subscribers and information providers has gradually been increasing as shown in Table 4.5.1-4. The application fields to be frequently retrieved are Game, Mail Box, Stock quotations, News, Fortune-telling, Horse race etc. Recently, the growth ratio for the residential use is remarkable, especially for the purpose of referring to the up-to-date information for stock quotations. It takes five years since the start of commercial service until sign of becoming popular to the general public has come out. However, greater efforts are still necessary to increase the number of subscribers.

Table 4.5.1-4 Past Trend of CAPTAIN Service in Japan

Year	Number of Subscribers			Price of TV Adapter (Yen)	Information Providers		Number of Stored Pictures (Thousand)
	Whole Number	Residential			CAPTAIN Center	Provider's Center	
		Number	%				
Mar. 1985	5,320	565	11%	200,000	428	10	105
Sep. 1985	8,023	944	12%		527	18	154
Mar. 1986	11,706	1,836	16%	80,000	576	25	183
Sep. 1986	19,990	3,925	20%		631	49	179
Mar. 1987	30,345	8,076	27%	67,000	639	48	199
Sep. 1987	38,952	11,894	31%		639	49	198
Mar. 1988	62,352	25,264	41%		618	64	206
Sep. 1988	72,630	31,085	43%	45,000	609	79	213
Mar. 1989	89,333	39,970	45%		585	103	223

Source : Annual Report by Ministry of Posts and Telecommunications
Data provided by CAPTAIN Service Ltd,.

5) Demand Forecast and Development Plan

Based on the above-mentioned descriptions, the demand depends on the surrounding conditions much and the following plans are practical for developing this service.

- The volume of demand is considered to be low, below 100 subscribers for the initial stage,
- The number of feasible information providers is considered to be low for the initial stage,
- The demand and information providers should positively be aroused by adopting promotion measures,
- Aiming at this specified class and the existing computerized systems, the preparation study should be carried out,
- The information providers should be cooperated by the telecommunication service providers,
- The field trials should be carried out at least for three to five years with feasibility study,
- The commercial service should be commenced after an elaborate study of the results of field trial.

4.5.2 Other Video Communication Services

In the field of Video communication service, Video Phone service, Video Conference service Video observation service etc. will be feasible in future. However, the demand will not be serious for the general public for the time being, and will be limited to specified subscribers. Practically, the demand trend should individually be estimated on the basis of market survey for the specified subscribers.