

**A STUDY ON A REGIONAL DEVELOPMENT PLAN
FOR TELECOMMUNICATIONS NETWORKS
IN THE BANGKOK METROPOLITAN AREA
IN THE KINGDOM OF THAILAND**

FINAL REPORT

**FOR
A LONG-TERM DEVELOPMENT PLAN
ON
THE TELECOMMUNICATIONS NETWORKS**

MAIN REPORT

October 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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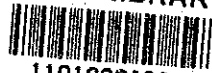
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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on a Regional Development Plan for Telecommunications Networks in the Bangkok Metropolitan Area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Mr. Satoshi Akaike, NTT International Corporation, twice between July 1991 and August 1992.

The team held discussions with the officials concerned of the Government of Thailand, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

October 1992



Kensuke Yanagiya
President
Japan International Cooperation Agency

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List of Abbreviations for Local Exchange Areas in BMA

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1	Phloen Chit	PNC	1	30	Dao Khanong	DKN	3
2	Samran Rat	SRR	1	31	Bang Phlat	BGT	3
3	Krung Kasem	KKM	1	32	Phasi Charoen	PSN	3
4	Surawong	SRW	1	33	Charan Sanitwong	CSW	3
5	Samsen	SMS	1	34	Rat Burana	RBN	3
6	Asok Din Daeng	ASD	1	35	Lat Ya	LTY	3
7	Pathum Wan	PTW	1	36	Muban Setthakit	MSK	3
8	Sukhumwit	SKW	1	37	Ekkachai	EKC	3
9	Chaiyaphruk	CYP	2	38	Nong Khaem	NGK	3
10	Bang Na	BNA	2	39	Phra Pradaeng	PPG	3
11	Khlong Chan	KGC	2	40	Bang Bue Thong	BBT	3
12	Thung Mahamek	TMM	2	41	Phahonyothin	PYT	4
13	Sathupradit	STD	2	42	Inthamara	ITM	4
14	Thanon Tok	TNT	2	43	Bang Khen	BGN	4
15	Bang Chan	BGC	2	44	Bang Su	BGS	4
16	Phra Khanong	PKG	2	45	Don Muang	DNM	4
17	Hua Mak	HAM	2	46	Lak Si	LKS	4
18	Trok Chan	TKC	2	47	Ram Inthra	RIT	4
19	Lat Krabang	LKG	2	48	Lat Phrao 1	LTP1	4
20	Khlong Toei	KTI	2	49	Lat Phrao 2	LTP2	4
21	On Nut	ONT	2	50	Chaeng Watthana	CWT	4
22	Ramkamhaeng	RKN	2	51	Nonthaburi	NTB	4
23	Samut Prakan	SPK	2	52	Ngam Wong Wan	NWW	4
24	Pu Chao Saming Phrai	PSP	2	53	Pak Kret	PKK	4
25	Bang Phli	BPL	2	54	Pathum Thani	PTT	4
26	Bang Pu	BGU	2	55	Rangsit	RST	4
27	Bang Phli Bang Bo	BBB	2	56	Thanyaburi	TYB	4
28	Thon Buri	TNB	3	57	Nawa Nakhon	NWN	4
29	Bang Khae	BKE	3	58	Bang Phun	BAN	4

List of Abbreviations for the Other Offices and Stations (1/2)

NO.	OFFICES AND STATIONS	ABBR	Remarks	NO.	OFFICES AND STATIONS	ABBR	Remarks
1	Bangkok	BKK		30	Lampang	LPG	
2	Chon Buri	CBI		31	Phayao	PYO	
3	Chachoengsao	CCO		32	Nan	NAN	
4	Rayong	RYG		33	Phitsanulok	PLK	
5	Chanthaburi	CTI		34	Sukhothai	STI	
6	Trat	TRT		35	Uttaradit	UTT	
7	Prachin Buri	PRI		36	Kamphaeng Phet	KPT	
8	Nakhon Nayok	NYK		37	Tak	TAK	
9	Nakhon Ratchasima	NMA		38	Nakhon Sawan	NSN	
10	Chaiyaphun	CPM		39	Phichit	PCT	
11	Buri Ram	BRM		40	Pechabun	PBN	
12	Ubon Rachathani	UBN		41	Uthai Thani	UTI	
13	Si Sa Ket	SSK		42	Chai Nat	CNT	
14	Surin	SRN		43	Saraburi	SRI	
15	Yasothon	YST		44	Lop Buri	LBI	
16	Khon Kaen	KKN		45	Sing Buri	SBR	
17	Maha Sarakham	MKM		46	Ayuthaya	AYA	
18	Roi Et	RET		47	Ang Thong	ATG	
19	Kalasin	KSN		48	Suphan Buri	SPB	
20	Udon Thani	UDN		49	Nakhon Pathom	NPT	
21	Nong Khai	NKI		50	Sumut Sakhon	SKN	
22	Loei	LEI		51	Samut Songkhram	SKM	
23	Sakon Nakhon	SNK		52	Kanchanaburi	KRI	
24	Nakhon Phanom	NPN		53	Pechaburi	PBI	
25	Mukdahan	MDH		54	Ratchaburi	RBR	
26	Chiang Mai	CMI		55	Prachuap Khiri Khan	PKN	
27	Lamphun	LPN		56	Surat Thani	SNI	
28	Mae Hong Son	MSN		57	Chunmphon	CPN	
29	Chiang Rai	CRI		58	Ranong	RNG	

List of Abbreviations for the Other Offices and Stations (2/2)

NO.	OFFICES AND STATIONS	ABBR	Remarks	NO.	OFFICES AND STATIONS	ABBR	Remarks
59	Phuket	PKT		67	Yala	YLA	
60	Phangnga	PNA		68	Pattani	PTN	
61	Nakhon Si Thamarat	NRT		69	Narathiwat	NWT	
62	Trang	TRG		70	Hat Yai	HYI	
63	Krabi	KBI		71	Phra Intharacha	PIR	Repeater
64	Songkhla	SKA		72	Nakhon Chaisi	NKC	Repeater
65	Satun	STN		73	Chon Buri Repeater	CBIR	
66	Phatthalung	PTN		74	Chon Buri Terminal	CBIT	

SUMMARY

SUMMARY

1. Introduction

The Study Team on "A Regional Development Plan for Telecommunications Networks in the Bangkok Metropolitan Area in the Kingdom of Thailand" (hereinafter referred to as "the Study Team"), dispatched by Japan International Cooperation Agency (hereinafter referred to as "JICA") carried out the study during Work in Thailand-I, Work in Japan-I, and Work in Thailand-II from July 1991 to January 1992 as for the first phase; and Work in Thailand-III, Work in Japan-II, Work in Thailand-IV, and Work in Japan-III during the period from March to September 1992 as for the second phase with the counterparts of Telephone Organization of Thailand (hereinafter referred to as "TOT").

This Final Report presents the long-term plan study performed by the Study Team during the above period.

1) Scope of the Study

The Bangkok Metropolitan Area (BMA: Bangkok, Pathom Thani, Samut Prakan, Nonthaburi) and the Surrounding Area (Nakhon Pathom, Sumut Sakhon, Ayutthaya) are the areas for the study (The Study Area).

The term of the plan studied is fifteen (15) years starting from the fiscal year of 1993 to 2007, and after the selection of a top priority project, its feasibility study is carried out.

2) Objectives of the Study

This study has two main goals. One is to formulate a long-term telecommunications development plan which contributes overall development of the Study Area. The other is to carry out a feasibility study for a top priority project which is selected from high priority projects in the long-term plan.

2. Regional Development Framework

1) Structure of BMR

Major socioeconomic activities in the Bangkok Metropolitan Region (BMR: 36 districts of the Bangkok Metropolitan Area and the five surrounding provinces: Pathm Thani, Nonthaburi, Samut Prakan, Sumut Sakhon and Nakhon Pathom) have been

predominantly taking place in areas along with main roads which are relatively well equipped with basic infrastructure. Since the basic infrastructure shortage problem of will not be solved in the near future, the development will take place along with main roads connecting outer commercial, residential centers and industrial estates.

2) Regional Development Framework from 1992 to 2007

a) Strategic Target Areas in the 6th National Development Plan

According to the 6th National Development Plan, the BMR is divided into four strategic target areas to promote overall spatial development as follows:

- i) Central business area (area: 147 Km², population: 3.3 million in 1990),
- ii) Rapidly growing suburban area (area: 1,65 Km², population: 3.3 million in 1990),
- iii) Industrial area (area: 75 Km², population: 1.3 million in 1990),
- iv) Outer BMR area (area: 6,352 Km², population: 1.4 million in 1990).

b) Socioeconomic Outlook

Three scenarios on the socioeconomic outlook of Thailand are as follows:

i) Optimistic scenario (high case)

The Thai economy can generate real average annual GDP growth rate of 10% for the next 20 years. The government will increase public sector investment to 8% in 1992 and maintain that level thereafter.

ii) The most likely scenario (base case)

The Thai economy can generate real average annual GDP growth rate of 8% for the next 20 years. The government will increase public sector investment to 7% in 1992 and maintain that level thereafter.

iii) Pessimistic scenario (low case)

The Thai economy can generate real average annual GDP growth rate of 5% for the next 20 years. The government will increase public sector investment to 4% in 1992 and maintain that level thereafter.

3. Trend of Telecommunications Technologies and Services

In the coming years, telecommunications network digitization toward services integration so-called ISDN (Integrated Services Digital Network) and telecommunications network intellectualization will be vigorously pursued by network operators to offer new services economically and efficiently. Furthermore, PCN (Personal Communications Network) will be introduced to realize personal communications by radio phones.

Optical fiber communication systems, microwave radio transmission systems, and satellite communication systems progress aiming at high-speed and broad band digital transmission systems to realize B-ISDN (Broad-band ISDN) from N-ISDN (Narrow-band ISDN). Optical fiber lines are to be introduced in entire subscriber loops, i.e. "FTTH (Fiber to the Home)".

One of the most promising approaches for B-ISDN is ATM (Asynchronous Transfer Mode) in the flow of packet switching. The ATM can be characterized by its very high-speed and large capacity transmission links and simple, hard-wired protocols within a network. Research and development of optical switches on STM (Synchronous Transfer Mode) in the flow of circuit, switching aiming at establishment of integrated communications and broadcasting networks has been making a good progress, too.

4. Present State of Telecommunications Services

1) Ordinary Telecommunications Services

The number of main telephones in the whole Kingdom has reached one million three hundred and twenty five thousands (1,325,000) as of the end of FY 1990 and become 2.5 times larger compared with that of FY 1984. Telephone density in the whole Kingdom has reached 2.35 main telephone lines per 100 inhabitants and become 2.3 times larger than that of FY 1984.

2) Other Services

a) Mobile Telecommunications Services

The number of cellular mobile telephones (Nordic Mobile Telephone System adopting 470 MHz and 900 MHz) offered by TOT is approximately seventy-nine thousand and two hundreds (79,200) as of September, 1991. The Advanced Mobile Phone System adopting 800 MHz is also offered by CAT with forty-four thousand three hundred (44,300) subscribers as of September, 1991.

The number of TOT paging service subscribers including the concession basis is approximately eighty-eight thousand and nine hundreds (88,900) and that by CAT is approximately fifty-nine thousand and three hundreds (59,300) as of September, 1991.

b) **Leased Circuit Services**

The number of leased lines offered by TOT in the BMA is approximately ten thousand and six hundred (10,600) as of September, 1991. Forty-seven percent of that is used for computer communications.

c) **Data Transmission Services**

i) **DATA NET Service**

DATA NET service is a data transmission service that uses the subscriber lines. The number of subscribers in the whole Kingdom is approximately two hundreds (200) as of August, 1990.

ii) **Digital Data Network (DDN) Service**

DDN service is a data transmission service ranging from 2,400 bit/s to 64 kb/s that uses dedicated lines. The number of 9,600 b/s circuits is two hundred and thirty-nine (239) and that of 64 Kb/s circuits is sixty-nine (69).

5. **Present State of Telecommunications Network**

1) **Network Configuration**

The telephone network is established with three office ranks; that is, TC (Tertiary Center), TDM (Tandem Exchange) and LE (Local Exchange) in the BMA, and four office ranks; that is, TC, SC (Secondary Center), PC (Primary Center) and LE in the other areas.

2) **Numbering Plan**

An open numbering system is adopted using "0" for the trunk prefix. The configuration of national significant number is as follows:

Trunk Prefix "0" + Trunk Code + Exchange Code + Station Number

a) BMA: A-BCD-EFGH A is 2.

b) Other areas: AB-CD-EFGH for instance A is 3, B is 5 for Ayutthaya.

"00" is used for ISD (International Subscriber Dial) prefix; however "09" is used for Malaysia.

3) Signaling System

DC signaling and E&M signaling systems are used for line signaling and MFC-R2 signaling system is used for register signaling.

6. Present State of Telecommunications Facilities

1) Outline of Existing Expansion Projects

TOT carried out the 4th ESDP (Economic and Social Development Plan) from 1977 to 1987 for five hundred and sixty-nine thousand (569,000) telephone line expansion to cope with rapidly increasing telephone demand, within the framework of the NESDP (National economic and social development Plan). In addition, TOT has been carrying out the 5th ESDP (1984 ~ 1992) for one million and one hundred and sixty-one thousand (1,161,000) telephone line expansion. TOT started UTEP (Urgent Telephone Expansion Project) (1989 ~ 1992) for two hundred and seven thousand (207,000) telephone line expansion.

2) TOT Seventh ESDP

TOT is about to carry out the seventh ESDP (1992 ~ 1996) for three million (3,000,000) telephone line expansion by a BTO (Build Transfer and Operation) scheme.

3) Outside Plant

TOT has approximately 1.47 million pairs of primary cables in the Study Area as of May 1991. Approximately 96% of them, about 1.42 million pairs, have been installed in the BMA. The average usage rate of the local cable pairs in the Study Area is 73%. At some exchanges (about 20%) in the Study Area, it has exceeded 90% level.

The number of faults per 1,000 connected lines in the BMA is approximately 48 in 1990. It has steadily decreased from 1985. However, the number of faults per 1,000 connected lines in other areas is approximately 58 in 1990. It has not decreased since 1984.

The number of faults caused by telephone sets, drop wires and cables account for approximately 81% of all faults in the BMA and 64% in other areas in 1990.

4) Switching Facilities

The number of line capacities in the BMA is approximately one million and one hundred and twenty-six thousands (1,126,000) at the end of FY 1990. They take 66.8% share of the whole Kingdom. The number of digital switch line capacities in the BMA is approximately seven hundred and eighty-one thousands (781,000) in 1990. They consist of 69.4% of the number of line capacities in the BMA.

The number of line capacities in other areas is approximately five hundred and fifty-nine thousands (559,000) in FY 1990. The number of digital switch line capacities in other areas is approximately four hundred and twenty-four thousands (424,000) in FY 1990. They consist of 75.7% of the number of line capacities in other areas.

The number of the connected lines in the BMA is approximately nine hundred and one thousands (901,000) at the end of FY 1990. They consist of 80.0% of the number of line capacities in the BMA. The number of connected lines in other areas is approximately four hundred and twenty-four thousands (424,000) at the end of FY 1990. They consist of 75.7% of the number of line capacities in other areas.

5) Transmission Facilities

Optical fiber communications systems such as 140 Mb/s and 565 Mb/s, and microwave communications systems such as 34 Kb/s, 68 Kb/s and 140 Mb/s of digital systems, and 960 CH, 1,800 CH and 2,700 CH of analog systems will be introduced as long-distance transmission systems. Total number of DTI (Digital Trunk Interface: 1 DTI has 30 channels) for the long-distance transmission systems in the Study Area is expected to reach 130 at the end of the 6th project.

Optical fiber communications systems such as 140 Mb/s and 565 Mb/s are used as tandem trunk link transmission systems. Total number of DTIs in the Study Area is expected to become 2,154 at the end of the 6th project.

Optical fiber communications systems such as 34 Mb/s, 140 Mb/s and 565 Mb/s , and PCM (Pulse Code Modulation) -30 systems are used as local trunk link transmission systems. Total number of DTIs in the Study Area will be 3,102 at the end of 6th project.

7. Present Organization and Management

1) Present Organization of TOT

Organization structure of TOT consists of three (3) bureaus and four (4) offices under the Board of Director and Managing Director as of May, 1992. The three (3) bureaus are General Affairs, Operations and Engineering and Project. The four (4) offices are Corporate Affairs, Internal Audit, Corporate Planning and ISDN promotion. The number of employees is 18,885 as of May, 1992.

2) Training

TOT has one training center in Bangkok at present. The training center has been providing necessary training opportunities and courses for the TOT staff. TOT has a plan to establish three provincial training centers in order to provide more training chances for the staff in the provincial areas.

3) Financial Situation of TOT

The fiscal year 1990, generated total income of 17,036 million Baht, total expense of 8,995 million Baht, and net profit of 8,041 million Baht.

8. Demand Forecast

1) Telephone Service Subscription Demand

In this study, future demand is forecasted through two steps. The first step is a macro level forecast for the BMA and the surrounding area, which is called the macro forecast. The second step is a micro level forecast for each telephone service area, which is called the micro forecast. The following table shows the result of the demand forecast.

		1992 (2535)	1997 (2540)	2002 (2545)	2007 (2550)
Telephone Demand	BMA	2,103,989	3,511,014	4,961,677	5,955,994
	Nakhon Pathom	55,055	91,883	150,299	220,360
	Samut Sakhon	69,616	103,992	144,425	185,847
	Ayutthaya	41,621	57,133	76,618	100,511
Telephone Demand per 100 persons	BMA	25.21	38.28	49.80	55.44
	Nakhon Pathom	8.54	13.07	19.75	26.87
	Samut Sakhon	19.83	26.60	33.43	39.21
	Ayutthaya	5.61	7.11	8.85	10.87

2) Other Telecommunications Services

In this study, services which have not yet been provided by TOT are called New Services such as ISDN services. Services which have been already provided by TOT are called Existing Services such as cellular mobile telephone and paging phone services.

a) Existing Services

The demand forecasts for existing services are as follows:
(whole Kingdom)

	1992	1997	2002	2007
Cellular Mobile Telephone	234,000	1,091,000	1,311,000	1,383,000
Paging Phone	286,000	1,108,000	1,307,000	1,320,000
Leased Circuit	21,000	74,000	132,000	193,000
Facsimile	104,000	405,000	661,000	872,000

b) New Services

The demand forecast for new services is as follows:
(whole Kingdom)

		1992	1997	2002	2007
Videotex		2,000	53,000	114,000	155,000
High Speed Leased Circuit		--	58,900	93,000	105,000
ISDN Services	Basic Rate Interface (BRI)	670	26,000	506,000	1,507,000
	Primary Rate Interface (PRI)	30	3,000	14,000	22,000

The demand forecast of ISDN services is made by applying a logistic curve model to the market research data.

The number of calls for the message service and free dial service is estimated on taking the development of those in Japan into consideration.

9. Objectives and Strategies in the Long-term Plan

1) Long-term Development Objectives

Long-term development objectives are as follows:

- a) Fulfillment of telephone demand,
- b) Upgrade of service quality,
- c) Diversification of services,
- d) Improvement of management.

The long-term plan period is divided into the following three phases.

Phase-1: From FY 1993 to FY 1997

Phase-2: From FY 1998 to FY 2002

Phase-3: From FY 2003 to FY 2007

2) Development Strategies and Targets

Development strategies and targets are shown as follows.

a) Reduction of Waiting Applicants

Target: Elimination of Waiting Applicants	
BMA	By the End of Phase-1
Surrounding Area	By the End of Phase-2

b) Public Telephone

Target: Public Telephone Density per 1,000 Inhabitants			
	By the end of Phase-1	By the End of Phase-2	By the End of Phase-3
BMA	4	6	8
Surrounding Area	2	3	4

c) Completion of Network Digitization

Switching Systems

Target: 100% Digitization	
BMA	By the End of Phase-2
Surrounding Area	By the End of Phase-1

d) Decrease the Outside Plant Faults

Target: Fault Ratio per 1,000 Lines per Month			
	By the end of Phase-1	By the End of Phase-2	By the End of Phase-3
BMA	25	20	15
Surrounding Area	30	20	15

3) Priority Ranking of the Strategic Target Areas in the Study Area

Areas are ranked according to the following classification as a result of analysis made in Chapter 2.

The Highest Priority Area (P-1 Area)	Central Business Area
The Second Highest Priority Area (P-2 Area)	Rapidly Growing Suburban Area
The Third Highest Priority Area (P-3)	Industrial Area
The Fourth Highest Priority Area (P-4)	Outer Area

Therefore, implementation of the long-term plan must be executed by the targets and the area ranking.

10. Traffic Forecast

1) Methodology

In this study, future traffic volume is forecasted by two steps. The first step is macro level forecast, which forecasts whole traffic volume of each message area in the Study Area. The second step is micro level forecast, which forecasts traffic volume each switch unit in the message area.

2) Macro Forecast

The forecasting equations in this study are decided, after trial of least squares method applying the historical data to several calculation models, for forecasting traffic growth in study period.

3) Micro Forecast

The future volume of originating traffic in each switch unit is estimated in this study, based on calling rate in 1987 of each switch unit and adjusted by macro traffic. The volume of terminating traffic to a switch unit is calculated by using terminating to originating ratio measured in 1987.

11. New Service Introduction Plan

Marketing research on telecommunications services was executed to grasp customers needs in the study period.

The five seminars were held to carry out the marketing research smoothly. 228 representatives from 131 companies and governmental organizations attended the seminars.

The questionnaires were distributed to three hundred (300) companies and the collected questionnaires were two hundred and twenty-three (223).

The exchange offices were classified to implement new telecommunications services efficiently by considering revenue per line, growth rate of revenue per line, the number of leased circuits, the number of facsimile terminal sets and the number of companies. The ranking of the exchange offices which consists of four priority areas is determined for the introduction of the new services.

12. Telecommunications Network Plan

1) Network Structure

In this study the same network structure as the existing one is applied. Because the network will accommodate six million subscribers by the end of the study period, the existing two level network is suitable.

2) Signaling System No. 7

The CCS No. 7 should be introduced not only for ISDN services but as a part of the infrastructure of intelligent telecommunications network services. At present, applications for ISDN technologies have not been developed enough for providing practical services; therefore, for the time being, it is better for TOT to modernize the existing network rather than to expand ISDN services in the near future until new promising services come up. The targets to complete the signaling network for smooth and effective introduction of new services are as follows:

- a) Every new switch unit which is to be installed during and after the seventh TOT ESDP expansion project plan period is equipped with CCS No. 7. A network with CCS No. 7 is established by an overlay structure on the present public switched telephone network (PSTN) with an R-2 signaling system.
- b) Signaling Transfer Areas (STA areas in which Signaling Transfer Points (STP) have responsibility for signal transfer) are assigned to the same areas as the Tertiary Center Areas of the present PSTN.
- c) Two (2) STPs are installed in one STA. One STP in every STA forms one plane (called A plane) connected by a mesh structure and another STP in every STA establishes another plane (called B plane) with the same mesh structure.
- d) From the viewpoint of the present network structure and transmission routes, STPs are assigned to the Tertiary or Secondary Centers listed below:

Krung Kasem and Lak Si for "02" Area

Phra Kanong and Lat Ya for "03" Area

Nakhon Ratchasima and Khon Ken for "04" Area.

Phisanulok and Nakhon Sawan for "05" Area and

Sura Thani and Hat Yai for "07" Area

3) Numbering Plan

- a) Changing the digits in the Metropolitan Area

At present, the BMA numbering system uses 7 digits (exchange code: 3 digits, station number: 4 digits). Changing the numbering system such as changing exchange code from 3 digits to 4 digits in the BMA is examined by taking into consideration of not only ordinary telephone numbering capacity but also new

services such as mobile telephone and ISDN, PBX dial-in services and network management easiness.

b) New Numbering Plan for Cellular Mobile Telephone Service

It is better to give an identification code to the cellular mobile telephone service for identifying the network in order to simplify the numbering style.

4) Network Management Development Plan

a) Issues at Present and in the Future

Regarding the TOT's network management system, the issue is that the supervisory and management systems are not established as one system. They are working independently. In the switching field, the different O & M systems are established by each manufacturer in different offices even though each system has its own national center. In the transmission field, a national center which is able to monitor both the long-distance and the junction transmission networks has been established. However, it is required to establish a national center which can monitor both the transmission network and switching network.

It is decided that the TOT seventh telecommunications expansion project in the BMA is implemented by a private firm. TOT will adopt the same scheme for the provincial areas. However, it is necessary that TOT should monitor the overall network performance throughout the country because TOT has responsibility for all network users as a government enterprise. As the size and complexity of a telephone network expands, a need evolves for larger quantity of more accurate information of the network.

b) Proposal of Establishment of Integrated Network Management System

It is essential for TOT to establish an integrated network management system. The system will consolidate the existing systems and bring more benefits on utilization of the existing facilities.

5) Reliability Development Plan of Telecommunications Network

The long-distance microwave and optical fiber transmission systems are used to connect most SCs (Secondary Centers) and TCs (Tertiary Centers) with looped or doubled routes.

The restoration plan against disasters has not been completely executed yet. The restoration plan against disasters should be implemented as soon as possible. Because interruption of communications will give big social and economic losses to the society. The following items are recommended to be incorporated in the plan.

- i) Improvement, diversification and grade up of power supply systems
- ii) Provision of mobile satellite earth stations
- iii) Establishment of a portable radio transmission system
- iv) Establishment of an emergency telecommunications system (ETS)

13. Telecommunications Facility Plan

1) Installation Schedule of Main Telephone Line (Sales Plan)

The number of main telephone lines to be connected in each area in the Study Area for the three phases is as follows.

	BMA	Nakhon Pathom	Samut Sakhon	Ayutthaya	Total Study Area	Share
Phase-1 (1993-1997)	2,371,100	49,100	56,600	31,600	2,508,400	47%
Phase-2 (1998-2002)	1,499,600	75,600	56,200	34,800	1,666,100	31%
Phase-3 (2003-2007)	1,040,600	64,900	34,800	25,000	1,165,300	22%
Total	4,911,300	189,600	147,600	91,400	5,339,800	100%

Note: The above figures include:
 1) subscriber main telephone lines to be connected, and
 2) public telephone lines.

2) Outline of the Expansion Plan

The outline of the expansion plan is as follows.

Main Work	Phase-1	Phase-2	Phase-3	Total
Main Telephone	2,486	1,641	1,139	5,266

Note Unit: Thousand
 The above figures exclude public telephone lines.

Item	Phase-1	Phase-2	Phase-3	Total
Investment Cost	91.9	59.1	47.2	198.2

Note Unit: Billion Baht

14. Operation and Maintenance

1) Operation and Maintenance Work

a) Transmission

Centralization of the supervisory systems will be completed by FY 1992. All the transmission systems will be integrated in Phase-2. The transmission networks will be also expanded in the future. The O & M system to increase work efficiency will be enormously improved by using this centralized operation system.

b) Switching

All the existing XB switches by SPC switches will be replaced before FY 2000. Centralization of night-time and holiday maintenance jobs is completed; therefore, centralization of day-time maintenance jobs will be also completed.

c) Outside Plant

In the near future, outside plant facilities will increase by enormous scale. Therefore, it is necessary for TOT to establish a more effective maintenance system. Telephone installation work will jump up until the target year of eliminating waiting applicants. The telephone installation work should be carried out under contract. Quick repair work is very important to keep trust of the customers on TOT. However, temporary repairs must be avoided because they are one of the major causes of the frequent faults. It is very important to reduce the fault rate by executing preventive maintenance activities on the basis of the present conditions.

2) Manpower Policy Guideline

A manpower policy guideline in the future is proposed in this Section. The guideline is estimated by using the number of subscribers in each year and the past growth rate of the subscriber lines per employee, that is, MEI (Annual Manpower Efficiency Index Increase Rate). This guideline is certainly challenging. It can be observed that the target MEI tends to decrease after FY2000.

3) Necessary Number of Employees by Microscopic Estimation

The necessary number of employees of two cases is estimated in this Section. The two cases are the efficient O & M work scheme and the ordinary O & M work scheme. If

TOT employs the efficient O & M work scheme, it can cut about 5,000 employees at the end of FY2007.

4) Human Resource development

It is expected that jobs and tasks in the Study Area will become larger and more complicated in order to improve the telecommunications networks and to provide new telecommunications services; therefore, TOT must develop skills and abilities of its employees up to a sufficient level so that they can operate complex, massive and sophisticated facilities.

15. Implementation of the Long-term Plan

According to the objectives and strategies, the long-term project implementation program in the BMA and the Surrounding Area for each phase are discussed in this Section.

16. Financial Analysis

1) Basic Assumptions of Financial Analysis

The BTO scheme is not taken in to consideration at this phase of the study. The whole expansion and development of the telecommunications network and facilities in the Study Area is assumed to be implemented by one operating entity. The project life is set to be 35 years from FY 1993.

2) Result of Financial Analysis

The Financial Internal Rate of Return (FIRR) of the long-term plan is estimated as 10.05%. The sensitivity analyses are made for the following cases: 1) the demand decrease cases (10% decrease and 20% decrease), 2) the telephone call revenue decrease cases (10% decrease and 20% decrease), and 3) the capital expenditure increase cases (10% increase and 20% increase). The project FIRRs fall down to the range between 8.72% and 5.48%.

The total capital expenditure for the long-term plan during the 15 years is estimated as 202,343 million Baht. The long-term plan can be implemented with 42,000 million Baht of own fund, 73,100 million Baht of loan financing, and the rest from the internal cash generation of the project.

17. High Priority Projects

1) Selection of the high Priority Projects

Three high priority projects are selected by the Study Team on the condition that they are to be selected from projects excluding those already decided to be carried out with the BTO scheme. They are as follows:

- a) Replacement of deteriorated facilities
- b) Establishment of Outside Plant Technical & Research Supporting Centers (OTRSC)
- c) Reinforcement of Outside Plant Maintenance Centers (OPMC)

In any telecommunications development plan, it is indispensable to consider a telecommunications network plan with expansion, replacement, rehabilitation, and modernization, operation and maintenance of telecommunications facilities because telecommunications services can not be provided without reliable and efficient telecommunications networks and facilities.

Since the next telephone expansion project will be executed by the BTO scheme during the seventh TOT ESDP project period, TOT can and must utilize most of their resources to modernize their networks and facilities to establish better network and facility management systems, and to develop future cores of engineers, professionals and management personnels during the seventh TOT ESDP period.

Therefore, replacement of deteriorated and out-of-date facilities is to be selected as the top priority project. The replacement and rehabilitation of deteriorated subscriber cables and wires will contribute greatly to reduce outside plant faults and to improve telecommunications services quality.

2) Replacement of Deteriorated Facilities

a) Outline of Replacement Plan

i) Outside Plant

Paper insulated cables installed more than 20 years ago are replaced in Phase-1 by taking account of the strategic target areas.

ii) Switching System

XB switches are replaced in Phase-1 by taking the following conditions into consideration: space requirement for facility expansion, staff relocation from XB switching system operation and maintenance, new services introduction and operation starting years of XB switches.

iii) Transmission System

Out-of-date PCM-30 systems are to be replaced in Phase-1 in accordance with the XB switching system replacement plan.

b) Investment Cost

The investment cost of the replacement projects is five thousand three hundred and seventy-four (5,374) million Baht.

18. Evaluation of the Long-term Plan

1) Significance of the Long-term Plan

Considering geographical, economical, and political surroundings of Thailand, its significance will increase as a gateway to Laos, Kampuchea, and Viet Nam. Thailand will play a leading role for assisting the economic recoveries of the Indochina countries. Thailand becomes a production base for what they need for their economic recoveries. The Bath based trading zone will penetrate into the Indochina countries. The Bangkok Metropolitan Region is expected to become an telecommunications and information communications hub of the Indochina region if it is benefited from sufficient and efficient telecommunications services.

In order to achieve the objectives and targets of the long-term plan, the Study Team proposes the telecommunications network and facility expansion projects as well as replacement, renewal, rehabilitation, reformation, and modernization of the existing networks and facilities as high priority projects.

2) Benefits and Effects of the Long-term Plan

a) Financial Benefit of the Long-term Plan

The investment cost for the long-term plan is estimated to be approximately 198,000 million Baht in total: 92,000 million Baht for Phase-1, 59,000 million Baht for Phase-2, and 47,000 million Baht for Phase-3. The investment program of the long-term plan includes not only the network and facility expansion projects to meet the increasing demand for the telecommunications services, but also projects for rehabilitation, replacement, renewal, reformation, and modernization of the existing telecommunications networks and facilities, which are essential to provide better service quality.

The financial internal rate of return (FIRR) of the long-term plan is estimated as 10.05% in the financial analysis on the assumption that the plan is carried out by one operating entity, i.e., TOT.

The estimated FIRR indicates that the plan is feasible from the financial viewpoint of the state-owned operating entity when the required amount of investment is financed according to certain financing assumptions.

b) Socioeconomic Effect of the Long-Term Plan

i) Realization of ISDN Era

Providing sufficient level of POTS (Plain Old Telephone Service) is the first objective of the long-term plan. With the implementation of the long-term plan, the telephone demand is expected to be fulfilled during Phase-1 and the waiting applicants in the Study Area will be eliminated. Thailand is able to participate in the ISDN era in earnest after the completion of an expanded and efficient POTS network. The long-term plan contributes to the society which needs enhanced info-communications methods. Therefore, the implementation of the proposed projects in the BMA during Phase-1 has the key to enter into the ISDN era.

ii) Realization of Information Society

Telecommunications systems can become strategic resources in every business practice to increase competitive advantages in market places, to improve managerial efficiency, and to discover innovations. Telecommunications

systems will become critical strategic management resources in every industry.

In the implementation course of the long-term telecommunications generating development plan, the telecommunications sector is expected to change from "Plain Simple Voice Messages Transmission Business" to more complex and valuable "Information Carrier Business" and to value-added "Coordination Supporting Business" to support the above mentioned business practices and industries.

c) Effect on Socioeconomic Development

Industrial and regional development will progress in a moderate speed. The Thai economy can expect real average annual GDP growth rate of 8% for the next 20 years. The government will increase public sector investment to 7% in 1992 and maintain that level thereafter. The real effective exchange rate will be kept unchanged.

However, if the proposed long-term plan and projects are not carried out respectively, the scenario will become quite different from the expectation. It also will not be able for Thailand to support the economic recoveries of the neighboring Indochina counties such as Laos, Kampuchea, and Viet Nam.

3) Issues to be Considered for the Implementation of the Long-term Plan

a) Outlook of Project Implementation

The telephone line expansion project in the TOT ESDP is carried out with the BTO scheme. However, it should be required for TOT to carry out overall integrating management of domestic telecommunications networks including those operated by the private firms. TOT is expected to carry out the network planning, traffic management, numbering planning, signaling system planning, etc. as a leading government enterprise in the telecommunications field. Therefore, the Study Team expects that these projects will be entirely coordinated and managed by TOT during the long-term plan period.

b) Financial Capability

It is pointed out that one reason for TOT to adopt this method is the limitation of foreign loan availability as a governmental enterprise. In order to circumvent the

tight fund availability, TOT may consider again to apply BTO schemes in the future projects as long as TOT operates its business as a state-owned enterprise.

There are already many private telecommunications service providers under the concession basis in Thailand. They provide paging and cellular mobile services, satellite communications services, data communications services, and various value added network services (VAN).

There is no guarantee for TOT to be able to maintain its position as a state enterprise monopolizing the domestic telecommunications networks and services in the future. Therefore, it is essential for TOT to improve its financial capability to compete with private operators and provide better quality and more efficient services for its customers with competitive prices.

c) Construction and Installation Capacity

For efficient and smooth implementation of the long-term plan and its large-scale installation projects, the following construction and installation proposes should be considered.

- i) Active applications of new technologies and techniques for construction and installation,
- ii) Normalization and leveling of construction and installation work volume,
- iii) Total project management,
- iv) Promotion of contractors for telecommunications systems and facilities construction and manufacturing,
- v) Simplification of various permission and approval procedures.

d) Follow-up the Project Implementation (Operation & Maintenance)

i) Operation & Maintenance Systems and Structure

In this study, the Study Team proposed the establishment of an integrated network management system in the switching and transmission section and reinforcement of the out side plant maintenance center (OPMC), which are expected to improve its performance of maintenance and operation activities and increase efficiency.

ii) Human Resources Management and Development

The human resources development is required not only for implementing the long-term plan and projects but also for following up and enhancing the performances of implemented projects. Both human resources management and human resources development are key factors for successful implementation of the long-term plan.

e) Consideration on Project Implementation

The proposed projects can be classified into several technical and administrative fields. To implement these projects, the following matters should be taken into consideration.

i) Effective Implementation

Telecommunications services and networks should be expanded efficiently from the viewpoints of rendering better services and also effective investment.

For this reason, projects aiming at the same purpose in the same area should be coordinated to be carried out in the same period. For example, the implementation period of a switching facility expansion project and an outside plant facility expansion project should be adjusted to the same time as much as possible.

Both expansion projects and rehabilitation projects should be well coordinated to avoid redundant construction works and shorten the construction period and save the investment costs.

ii) Coordination with National Development Policies

Will timed and coordinated reinforcement of telecommunications service provision will bring a major impact for sound socio-economic development. Therefore, implementation of the projects should be carried out not only in the developed areas but also the developing areas in accordance with the National Economic and Social Development Plan.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Final Report consists of the following two parts and each part also consists of three volumes:

- 1) Part 1: The Long-term Plan Study
 - a) Summary
 - b) Main Report
 - c) ANNEX

- 2) Part 2: The Feasibility Study on the Top Priority Project
 - a) Summary
 - b) Main Report
 - c) ANNEX

The Study Team on "A Regional Development Plan for Telecommunications Networks in the Bangkok Metropolitan Area in the Kingdom of Thailand" (hereinafter referred to as "the Study Team"), dispatched by Japan International Cooperation Agency (hereinafter referred to as "JICA") carried out the study during Work in Thailand-I, Work in Japan-I, and Work in Thailand-II from July 1991 to January 1992 as for the first phase; and Work in Thailand-III, Work in Japan-II, Work in Thailand-IV, and Work in Japan-III during the period from March to September 1992 as for the second phase with the counterparts of Telephone Organization of Thailand (hereinafter referred to as "TOT").

This Final Report presents the long-term plan study performed by the Study Team during the above period.

1.1 Background of the Study

JICA conducted "a Master Plan Study on Telecommunications Development in the Kingdom of Thailand" (hereinafter referred to as "the Master Plan Study") in response to the request of the Government of the Kingdom of Thailand from September 1988 to December 1989. The Master Plan Study has revealed several issues on telecommunications in the Bangkok Metropolitan Area and urged the necessity for a further development study in the area.

In response to a request of the Government of the Kingdom of Thailand, the Government of Japan decided to implement a Study on A Regional Development Plan for Telecommunications

Networks in the Bangkok Metropolitan Area in the Kingdom of Thailand (hereinafter referred to as "the Study"). JICA and TOT agreed upon the scope of work for the Study in October 1990.

The Study Team headed by Mr. Satoshi Akaike, a senior manager of Planning Administration Department of Telecommunications Consulting Division in NTT International Corporation, began the Study from July 1991.

The Study consists of the following two phases:

- 1) the first phase of the Study aims to formulate a long-term telecommunications development plan in the Bangkok Metropolitan Area and its surrounding three prefectures, i.e., Nakhon Pathom, Samut Sakhon, and Ayutthaya.
- 2) the second phase of the Study aims to conduct a feasibility study on the top priority project which should be selected from high priority projects in the long-term plan.

A study on "the Long-term Development Plan on the Telecommunications Network" is the first phase of the Study. This final report presents the study results of the long-term plan and proposes the top priority project to be studied further for the feasibility in the second phase.

The study results of the feasibility study for the top priority project is described in the other report titled as "Final Report for a Feasibility Study on an Implementation Plan to Upgrade the Telecommunications Services Quality".

1.2 Scope of the Study

The area to be covered in this study is the Bangkok Metropolitan Area (Bangkok, Pathom Thani, Samut Prakarn, Nonthaburi: hereinafter referred to as "BMA") and the surrounding area (Nakhon Pathom, Samut Sakhon, and Ayutthaya). Figure 1.2 shows the study area.

The term of the long-term plan is fifteen (15) years from the fiscal year of 1993 to 2007, and after the selection of the top priority project, a feasibility study will be carried out for the project.

Study Area

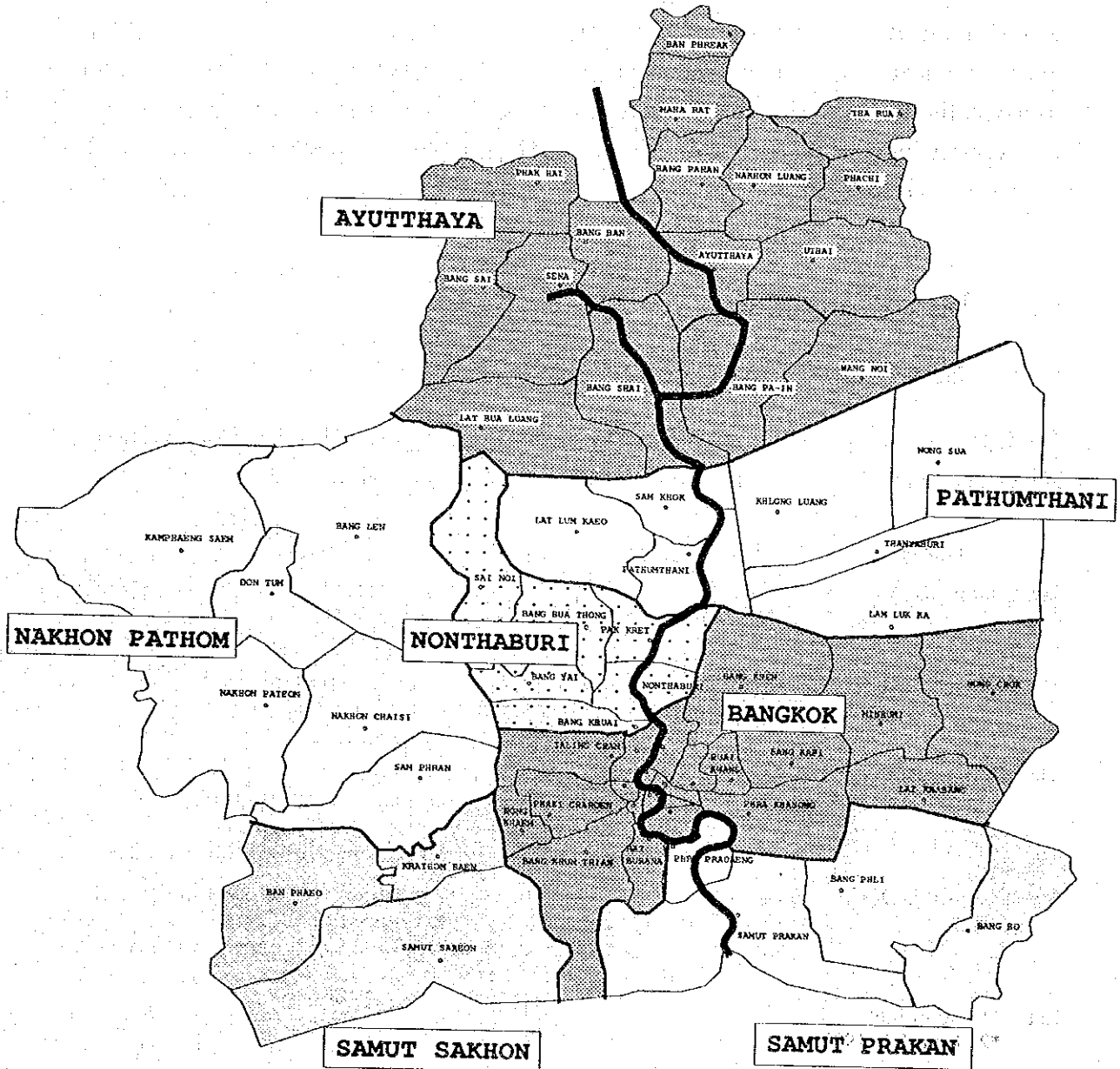
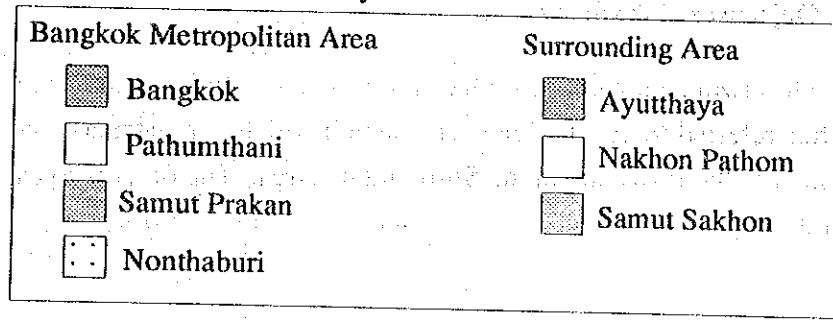


Figure 1.2 The Study Area

1.3 Objectives of the Study

The study has two main purposes. One is to formulate a long-term telecommunications plan (hereinafter referred to as "the long-term plan") which is expected to contribute to overall development in the BMA and in the Surrounding Area. The other is to carry out a feasibility study for a top priority project which is selected from high priority projects in this long-term plan.

The long-term plan study includes studies on long-range marketing perspectives of telecommunications services, a telecommunications network development plan, a telecommunications facilities expansion plan, network management, maintenance and operation, finance, and human resources development. The long-term plan study also covers a new services introduction plan and development plan of ISDN (Integrated Services Digital Network) in the Study Area.

1.4 Organization of the Study

1.4.1 Japanese Advisory Committee

The Japanese Advisory Committee provides the Study Team with advice and supervision for implementing the Study. The members of the committee are as follows:

<u>Name</u>	<u>Duty in Charge</u>	<u>Affiliated to</u>
Mr. Osamu KOYAMA*1	Chairman (New Services)	Senior Advisor for International Cooperation Communications Policy Bureau, Ministry of Posts and Telecommunications
Mr. Kaoru SUZUKI*2	Chairman (New Services)	Senior Advisor for International Cooperation International Affairs Department Ministry of Posts and Telecommunications
Mr. Kiyoshi KONO	Member (Network Planning)	Assistant Director Telecommunications Systems Division, Telecommunications Bureau, Ministry of Posts and Telecommunications
Mr. Nozomu GODA	Member (Switching System Planning)	Info-communications Development Specialist Institute for International Cooperation, Japan International Cooperation Agency (JICA)

Note: *1 up to July 1992.

*2 from July 1992.

1.4.2 Study Team

The names and duties in charge of the Study Team members are shown in the following list:

Name	Duty in Charge
Mr. Satoshi AKAIKE	Team Leader / Development Planning
Mr. Katsumi MURAKAMI	Assistant Team Leader / Transmission Systems Planning
Mr. Junji IHARA *	Demand Forecast
Mr. Kiyoshi MUSHU	Network Planning
Mr. Hiroshi NAKAI *	New Services
Mr. Tomiatsu TSUJIMURA	Switching Systems Planning
Mr. Tomoyoshi ASO	Outside Plant Systems Planning
Mr. Kiyoshi WASHIZAWA	Operation and Maintenance Planning
Mr. Hiroyuki KANO	Financial and Economic Analyses

Note: * up to December 1991.

1.4.3 Counterparts from TOT

In order to achieve both technical transfer to TOT and an effective study, TOT provided its counterparts from Corporate Planning Office (CPO) and other departments concerned. The names and duties in charge of TOT counterparts are shown in the following list:

Name	Duty in Charge	Department
Mr. Sanan PHIROMSWAD	Director	Corporate Planning Office
Mr. Deacha MONGKOLRAT	Head of Corporate Planning Process Sector	ditto
Mr. Chakree SUBPRAWONG	Counterpart Team Leader	ditto
Mr. Sawat CHAIYEN	Development Planning and Economy	ditto
Mr. Amnuay THONGDEETARE	ditto	ditto
Ms. Vilaiporn BOONYASURAKUL	ditto	ditto
Ms. Issra FONGNRUN	ditto	ditto
Mr. Seree CHINTARATANA	Switching System	ditto
Mr. Suwat NACAPUNCHAI	ditto	ditto
Ms. Jintana PRASERTSOM	Transmission System	ditto
Mr. Arkom KRACHANGMOL	ditto	ditto
Mr. Kamron TEINTHONGDEE	Outside Plant and O&M	ditto

Name	Duty in Charge	Department
Mr. Pichet LEEPITAKWATANA	Outside Plant and O&M	Corporate Planning Office
Mr. Tinnakorn ITSRANGKUL NA AYUTHAYA	Telecommunications Network and Traffic Forecast	ditto
Mr. Somchai VICMUKTANON	ditto	ditto
Ms. Atchada RUAMMAHASAP	Demand Forecast	ditto
Mr. Taksin HENGTRAKUL	ditto	ditto
Mr. Suwit TRCHAROENVIWAT	New Services	ditto
Ms. Chothip SUTHONTHUNYAKORN	ditto	ditto
Mr. Prateep THIRATI	Marketing Research	ditto
Ms. Somsri NGOWROONGRUENG	ditto	ditto
Mr. Chanathib VIJAKKHANA	ditto	ditto
Ms. Jaitip SIN-AKORN	ditto	ditto
Ms. Apinya KLINFUNG	ditto	ditto
Mr. Kavich MANUNAPICHU	ditto	ditto
Mr. Supree BHIROMSAWAT	ditto	ditto
Ms. Chanida SUKHAVIRAJ	Financial and Economic Analyses	ditto
Ms. Chadaporn KUNUDOM	ditto	ditto
Ms. Yupa LEEWONGCHAROEN	ditto	ditto
Ms. Valaikul SATTHARPHORN	Human Resources	ditto
Ms. Ratee MALAISIRIRAT	ditto	ditto
Ms. Kanungnid RATTANASEREEWONG	ditto	ditto
Mr. Nimit WATTANUTCHARIYA	Switching System	Bureau of Engineering & Project
Mr. Presert MANPIBOON	ditto	Bureau of Operation
Mr. Charoen WILAIHONG	Transmission System	Bureau of Operation
Mr. Thawisak KITTIJARURAK	ditto	Bureau of Engineering & Projects
Mr. Sopchoke SOMCHAIWONG	Outside Plant and O&M	Bureau of Engineering & Projects
Mr. Thamrong PHOOLPHAN	ditto	Bureau of Operation

<u>Name</u>	<u>Duty in Charge</u>	<u>Department</u>
Mr. Somsak RUNGHRUNWIROT	Outside Plant and O&M	Bureau of Operation
Mr. Sukij CHANSIAORASMEE	ditto	ditto
Mr. Sorrasak SOOKTHAI	Demand Forecast	Bureau of Engineering & Projects
Mr. Pattharin PATTHARASIKARIN	Traffic Forecast	ditto
Ms. Wannaporn LILAHAJIVA	Financial and Economic Analysis	Bureau of General Affairs
Ms Rungporn CHUANCHAISIT	ditto	ditto
Ms. Sanipong HONGSPANJI	Human Resource	ditto

1.5 Study Work Schedule

The study is divided into the following seven works:

Study Phase	Main Study Items	Period
Work in Thailand -I	Explanation and discussion of Inception Report, Data collection, Field surveys, Demand forecast, Preparation and explanation of Progress Report.	Jul. - Oct. 1991.
Work in Japan -I	Demand forecast, Traffic forecast, Long-term facility expansion plan, O & M plan, Human resource development plan, Financial analysis, Selecting priority projects.	Oct. - Dec. 1991
Work in Thailand -II	Explanation and discussion of Interim Report, Selection of the top priority project.	Jan. 1992
Work in Thailand -III	Supplementary Survey of a feasibility study for the top priority project.	Feb. Mar. 1992.
Work in Japan - II	Facility plan , O & M plan, and Implementation plan for the top priority project, Estimation of investment cost, Management plan, Financial analysis, Preparation of Draft Final Report.	May - July. 1992.
Work in Thailand -IV	Explanation and discussion of Draft Final Report.	Aug. 1992
Work in Japan - III	Preparation and submission of Final Report	Aug.- Sep. 1992

Figure 1.5 illustrates the work schedule of the Study .

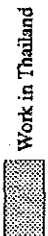
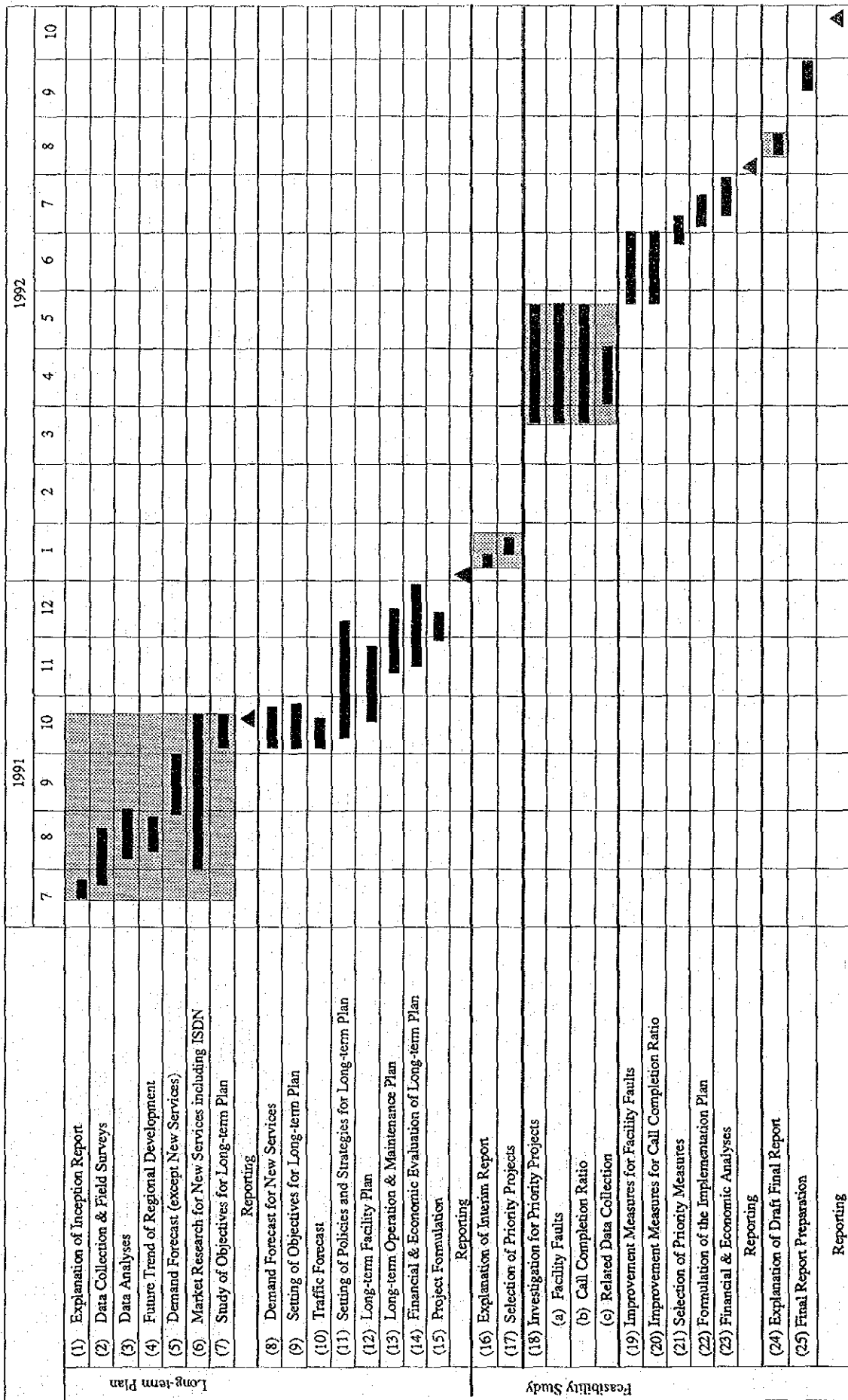


Figure 1.5 Work Schedule

CHAPTER 2

REGIONAL DEVELOPMENT FRAMEWORK

CHAPTER 2 REGIONAL DEVELOPMENT FRAMEWORK

2.1 Significance of the Study

The purpose of this section is to examine opportunities and threats of the telecommunications sector of Thailand in general and the Bangkok Metropolitan Region (BMR) in particular by analyzing prospects of socio-economic development of Thailand and the BMR. Missions, strategies and goals of the telecommunications development in the BMR will be formulated on the basis of the examination results.

2.2 National Development Policy and Target

2.2.1 Conceptual Framework of the Seventh National Economic and Social Development Plan (NESDP)

1) Objectives

- i) To maintain a sustainable growth path of the Thai economy beyond the next decade,
- ii) To achieve a better income distribution of target groups and to raise up the quality of life of the Thai people,
- iii) To maintain the economic stability and modernize the financial systems of private and public sectors.

2) World Economy

The world economy has rapidly changed during the last NESDP period (1986-1991). The pace of the changes may be accelerated during the 7th Plan period (1992-1996). The changes have created economic opportunities and promoted transfer of technologies. Reforms in eastern European countries and USSR have given new opportunities while Thailand may have to prepare for any disturbance caused by the world crises such as the Gulf War.

3) Opportunity

- i) The reconstruction of some middle east countries such as Saudi Arabia and Kuwait may induce positive effects to the economies of the developed countries and accelerate the recovery of the world economy.
- ii) The re-location of industries from Japan and Asian NIEs to the ASEAN countries will make the Asia and Pacific countries become another world trade and industrial center. Thai exports and industries benefit from this structural change.

- ii) The development of Indochina countries may turn Thailand into an economic center of this region.

4) Uncertainty

- i) There are uncertainties in the price of crude oil, world commodity price, exchange rate fluctuation and interest rates.
- ii) The European integration in 1992 and political changes in Eastern Europe may change the direction of capital flows among donors and recipients in the world. The free trade zone created by U.S. and Canada, the twin deficit of the U.S. may produce uncertainty in foreign exchange and world money market.
- iii) There is an increasing trend of trade conflicts. Trade negotiations either bilateral or multilateral may produce adverse effects on trade and industrial development.

5) Socioeconomic Structure Changes during the Seventh Plan Period

- i) Trade and production structure changes under the 7th plan consist of three major reforms. First, production may have to turn away from intensively utilizing natural resources and labor and rely more on their efficient use and technology to increase productivity. Second, business management style will turn away from the traditional family management style to more professional style which separates owners from management. Third, production and supply may have to rely more on foreign markets and foreign direct investment.
- ii) The population structure and the labor market have entered into a structural transformation in such a way that the population of age group 0-5 year has declined substantially where as the working age and aging population have increased. That is to say, the population of age group 15-59 and 60 and over will increase to 63.7 and 7 percent the levels in 1995 as compared with 58 and 5.6 percent level in 1985. In the year 2000, they are 65.6 and 8 percent respectively. In other words, working population (age group 15-59 year) will increase from 30 million persons in 1985 to 38 and 42 million persons in the year 1995 and 2000, respectively.

The comparative advantages of Thailand owing to the labor quality, quantity and wages are declining. The expansion of the manufacturing sector, services and modern agriculture needs higher qualified human resources such as technicians, engineers, and professional personnels.

In the 7th Plan, there will be surplus labor in the agricultural sector. They are not well educated and can not adjust themselves to conform with new waves of industrial development. Thus, while there is excess demand on one hand, there is also excess supply on the other hand.

iii) Thailand definitely needs to invest in R & D and engineering and science education to increase its technical autonomy

iv) Population, human resettlement and expansion of urban communities owing to the expansion of trade, industry and services will have the following features.

- In the 7th Plan, there will be changes in family structures. Family formation will tend toward "single head" and/or "one-person" households more while "intact" or extended households where a few generations are living together will decline.

In the rural area, the production scheme changes from simple rice or cash crop farming to mass production such as shrimp farming. This will change household structure as well.

- Migration in to cities which are production bases and commercial centers will increase, especially, the BMR, the cities in the eastern seaboard and southern seaboard as well as main cities in each region.

Migration of traditional to modern agricultural areas is expected. City growth will lessen the proportion of rural agricultural land areas. Land price is affected by speculation demand in cities and makes more difficult for people to own their estates. Low income communities will emerge in the cities. Their quality of life and environment degradation is an ill result of urbanization.

v) Macro-economic impacts to the rural areas during the 6th Plan have been seen as decrease of rural income after the commodity price has been low. In the 7th Plan, the commodity price is predicted to be moderately increased. Thus, poverty is still a problem. As the younger generation has moved out from the rural areas to the cities, those who are left behind will find that they lack strong economic supports from young family members.

Although the poverty line decreased from 39.0 percent in 1969 to 25.2 percent in 1987, the top income class (20 percent) still had the income share of 55.6 percent in 1986 as compared with 49.3 percent in 1975/76. On the contrary, the lowest income

class (20 percent) had the income share of 4.6 percent as compared with 6.1 percent in the same period mentioned before.

- vi) In the 7th Plan, it is necessary to lessen the investment-saving gap as well as dependency on foreign savings in both private and public sectors. The money market needs to liberalize the foreign exchange and interest rates. Internationalization of the money and capital markets is planned. In addition, various monetary instruments are planned to be introduced in 7th Plan period. It is also necessary to restructure the administrative institutions and legal aspects such that the market can flexibly function. The introduction of VAT (value added tax) in 1992 aims to abolish the cascading effects of the business tax. Local public finance is also one way to decentralize fiscal responsibility to provinces.

2.2.2 Assumptions

1) World Economic Growth

As an impetus to export demand of Thailand, it is assumed that the world economy, its growth performance of 3.4 percent on average during 1987-1990, will adjust downward to the growth rate of 2.6 percent on average during 1992-1996. This is owing to the regional growth performance assumed as follows:

Industrialized countries grow by 2.6 percent per year on average. The U.S. economy is assumed to recover after the Gulf war and grows by 2.5 percent on average. The Japanese economy is assumed to grow by 3-3.5 percent for the next 5 years.

	Growth Scenarios (%)	
	1987 - 1990	1992 - 1996
OECD	3.4	2.6
- US	3.0	2.5
- Japan	5.2	3 - 3.5
Asian NIEs	8.8	7.0
ASIAN	7.4	7.0
West Pacific	5.4	6.0
EC	3.1	2.7

The other Asian countries have their average growth rates of 7.0 percent during 1992-1996 as compared with 7.4 percent during 1987-1990.

2) World Inflation

	1989	1990	1991	1992 - 96
OECD CPI (%)	4.4	4.8	5.6	+4.6%
Oil price (\$ / barrel)	18.5	23.5	23.6	+25.0%
- Crude Oil	16.6	21.4	19.8	+7.0%
- Petroleum Products	22.1	26.4	29.0	+7.0%

3) Commodity Prices (\$/Ton)

	1986	1990	1991	1992 - 96
- Rice	320	287	318	+4.8%
- Maize	112	109	121	+4.4%
- Sugar	282	277	367	-4.7%
- Rubber	112	103	151	+7.2%

4) Interest Rate and Foreign Exchange Rate

	1988	1989	1990
- Interest rate(US's Discount rate)	6.2	6.93	6.98
- Index of US \$	87.9	91.29	86.5
- Foreign Exchange			
Baht / US \$	25.29	25.71	26.0
Yen / US \$	128.17	138.00	144.8
German Mark / US \$	1.76	1.88	1.62
British Pound / US \$	0.56	0.61	0.56

2.2.3 Economic Forecast of 1992 - 1996

1) Overall Economic Performances

The Thai economy is able to achieve a rather satisfactory growth performance during the 7th Plan period. The average growth rate is 8.8 percent per year. Nonetheless, the rate

is somewhat lower than the growth rate in the 6th plan which was 10.8 percent on average.

The manufacturing sector, the construction sector and the service sector expand with the rates of 9-10 percent on average. The agriculture sector behaves, however, more or less the same as in the 6th Plan. Its growth rate is 3.4 percent per year owing to constraints on the supply side, land, water supply, labor force and unfavorable commodity prices on the demand side. The unfavorable supply conditions of the agriculture sector may drive up food supply prices.

Domestic demand on the part of private consumption is still an impetus to the growth. In addition, large scale public infrastructure projects will induce investment during the 7th Plan period and put pressures on the widening of investment-saving gap and inflation. The external demand for the Thai export is forecasted to expand by 14 percent (in terms of value).

The GDP of Thailand increases from the level of 2,051 thousand million Baht in 1990 to 4,700 thousand million Baht in 1996. The per-capita income increases from merely 41,000 Baht in 1991 to be 77,000 million Baht by the end of 1996. In other words, real income increases by 7 percent per year during the 7th Plan period.

2) Production and Supply

- i) The agriculture sector annually expands by 3.4 percent in the base case scenario. During the period, there are slow downs in the production and supply of rice, sugar cane, cassava, maize and rubber which are main cash crops of Thailand, owing to the sluggish demand reflected in their commodity prices. On the supply side, there are also constraints such as water supply, labor shortages, and low productivity in the sector. The fishery and livestock sector annually expands at the rate of 5.0 percent on average owing to high export demand.
- ii) The manufacturing sector still annually expands at rate of 10 percent on average. Leading industries are, for example, electronics, electrical appliances, toys, sports equipment, textile and apparel as well as housing textiles. It is found that domestic demand for construction materials, household appliances, furniture and cars are still high.

- iii) The construction sector is still annually expanding with a rather high rate in double digit figures. This is owing to the fact that large investment of public infrastructure projects and housing demand by private households are quite high.
- iv) The service sector annually expands at the rate of 8 percent with tourists increase by 7.5 percent per year during the 7th Plan period.

	Forecast in Base Case (% / baht)
1. Economic Performances (%)	8.8
- Agriculture	3.4
- Manufacture	9.9
- Construction	8.9
2. Inflation (%)	6.6
3. Private Investment	9.6
4. Balance of Trade (Average per year in '000 million baht)	371.2
5. Current Account (in '000 million baht)	232
Current AC / GDP (%)	-6.6

3) Foreign Trade and External Balance

- i) The trade deficit forecasted in the 7th Plan will be 370 thousand million Baht on average. This is as high as 10.5 percent of the GDP as compared with 8.4 percent during the 6th Plan period.

The export is assumed to expand by 14 percent per year on average in the 7th Plan period while as it was 24.5 percent per year in the 6th Plan period. This is owing to the sluggish world demand as the world GDP is supposed to expand by 2.6 percent per year.

The import demand expands at the rate of 12.5 percent or 1,415.5 thousand million Baht per year as compared with 658 thousand million Baht per year in the 6th Plan period. The source of import growth is import of capital goods by private sectors and public enterprises. The import of oil and petroleum products are 210-240 thousand million Baht by 1996.

- ii) The current account deficit deteriorates during the 7th Plan period. The size of the deficit which is 232 thousand million Baht or 6.6 percent of the GDP as compared with 91

thousand million Baht and being 4.5 percent of the GDP during the 6th Plan period. This is due to the fact that tourism revenue will expand at a slower pace than that in the 6th plan period. The adverse effect is also caused by the decline in net factor income from abroad, especially labor income from the middle east.

	External Balance	
	1990	1996
1. Export ('000 million baht)	590.0	1,321.8
2. Import ('000 million baht)	830.0	1,743.3
3. Trade Balance ('000 million baht)	-240.0	-421.4
4. Trade Balance / GDP (%)	-11.7	-8.9
5. Current Account ('000 million baht)	-156.0	-247.6
6. Current Account / GDP (%)	-7.5	-5.3

4) Inflation

The average inflation rate during the 7th Plan period is 6.7 percent per year as compared with the world inflation rate of 4.5 percent per year. This is due to the adjustment of wage level of civil servants and public enterprises as well as the minimum wage. The price level is also pressured by the increase of land price owing to the high demand for housing.

5) Domestic Saving and Investment

	1989	1990	1991
1. Private sector	-6.6	-12.2	-8.5
Saving	19.2	16.9	18.9
- Households	10.2	7.3	10.3
- Business	9.0	9.6	8.6
Investment	25.8	29.1	27.4
2. Public sector	3.2	4.9	3.2
Saving	8.4	11.3	10.8
- Government	6.5	9.3	5.3
- Public Enterprises	2.0	2.0	5.5
Investment	5.2	6.4	7.6
3. Saving Gap	-3.6	-7.3	-5.3