

2.2 Present State of Telecommunication Services in Thailand

2.2.1 State of Telecommunication Services in Some Countries

For the purpose of analyzing the current state of telecommunication services in Thailand, comparison among the status of some countries is tried.

Countries to be compared are sampled primarily from among the neighboring countries in higher sampling rate and secondarily from among other countries in lower sampling rate. On the other hand, services to be compared are telephone service, telegram service, telex service and data transmission service as based on the classification of ITU "Yearbook of Common Carrier Telecommunication Statistics".

1) Telephone Service

The present state of telephone service in sampled countries is shown in Table 2.2.1-1. The followings are pointed out.

- a) The state of Thailand stands at the medium position among the ASEAN countries in respect to the number of main lines, the telephone density and the ratio of waitings.
- b) The volume of GDP per capita is also middle position among the ASEAN countries.
- c) The number of main lines is generally below 2.0 per 100 persons in the countries whose GDP per capita is lower than about 1,000 US dollars.
- d) The ratio of waitings to main lines is generally higher in the countries whose GDP per capita is lower than about 5,000 US dollars.

2) Telegram Service

The current state of telegram service in sampled countries is shown in Table 2.2.1-2. The number of telegrams to be compared covers the domestic and international telegrams. The followings are pointed out.

- a) The state of Thailand stands at the higher position among the ASEAN countries in the number of telegrams per 100 persons.

- b) The state of telegram service is considerably affected by surrounding conditions such as Post service, Telephone service etc.
- c) In some of the countries such as U. Kingdom, Sweden and Canada etc., the number of telegrams per 100 persons is considerably low. That means the use of recorded communication may have shifted to the other media.

3) Telex Service

The current state of telex service in sampled countries is shown in Table 2.2.1-3. The followings are pointed out.

- a) The number of telex lines per 1000 telephone lines is generally higher in the Asian & African countries in comparison to those of the other countries. However, that of Thailand is rather lower among these countries.
- b) The number of telex lines per 1000 persons is generally lower in the Asian & African countries in comparison to those of the other countries.
- c) The service state keeps almost the constant level in the European and Oceanian countries, in respect to the number of telex lines per 1000 telephone lines as well as per 1000 persons.
- d) The service state is relatively lower in Japan and S. Korea where non-alphabetical characters are employed for native language.

4) Data Transmission Service

Data transmission can be carried out on the telephone network, telex network, leased circuit, packet data network etc. However, the networks to be compared are limited to the leased circuit and the packet data network. The reasons are that the service grade of the telephone and telex network is compared in their own paragraphs as described above, and some of the countries cannot obtain the number of data terminals on the telephone and telex network owing to the deregulation of terminal application.

The current state of data transmission service in sampled countries is shown in Table 2.2.1-4. The followings are pointed out.

- a) There are wide variation in the number of data lines, the number of data lines per 1000 persons and the number of data lines per 1000 telephone lines.
- b) It is considered that the data communication systems are constructed according to the customer's specific requirements which cannot be summarized in quantity.

2.2.2 Services Classified by Organizations

At present, the telecommunication services in Thailand are provided by TOT and CAT. The existing classification of each service is shown in Table 2.2.2-1. It can be noted that cellular mobile service is provided both of TOT and CAT. And paging service is presently offered by CAT, however, TOT seems to have a plan to commence this service.

Taking account of the future trends of telecommunication service and network, ISDN will surely be introduced in the near future and the service menu will become diverse according to the trend of demands.

The present state of telecommunication services offered by TOT and CAT are described in the following Table 2.2.2-1. This table describes just the present state and does not prescribe the future state of telecommunication services.

Table 2.2.1-1 Telephone Service State in 1987

Country	Number of Main Lines (Thousand)	Population (Thousand)	Main Lines per 100 Persons	Number of Waitings (Thousand)	Ratio of Waitings to Main Lines	GDP per Capita (US Dollar)
Thailand	902	53,873	1.67	289	0.320	784
Philippines	478	54,380	0.88	173	0.362	401
Indonesia	759	172,010	0.44	417	0.549	340
Malaysia	1,132	16,530	6.85	85	0.075	1,472
Singapore	876	2,631	33.30	1	0.001	7,320
Brunei	25	236	10.59	13	0.520	18,325
Australia	6,965	16,263	42.83	74	0.011	10,169
New Zealand	1,377	3,349	41.12	2	0.001	8,929
Papua New Guinea	31	3,423	0.91	3	0.097	658
Japan	48,014	122,264	39.27	No Data	-	18,538
S. Korea	8,625	42,080	20.50	No Data	-	2,034
India	3,488	776,337	0.45	1,125	0.323	261
Pakistan	584	100,553	0.58	437	0.748	347
Nepal	31	17,790	0.17	42	1.355	120
Sri Lanka	97	16,400	0.59	23	0.237	373
Iran	1,594	51,308	3.11	430	0.270	3,318
Saudi Arabia	1,149	10,800	10.64	76	0.066	No Data
Kuwait	257	1,825	14.08	3	0.012	9,959
Syria	466	11,147	4.18	1,170	2.511	2,278
Turkey	4,077	53,226	7.66	2,107	0.517	1,257
Greece	3,466	9,980	34.73	1,051	0.303	4,397
Italy	19,105	57,422	33.27	202	0.011	13,611
Spain	10,236	39,092	26.18	366	0.036	7,503
France	24,804	56,865	43.62	No Data	-	17,417
W. Germany	27,222	61,940	43.95	24	0.001	20,403
Sweden	5,481	8,414	65.14	No Data	-	16,511
U. Kingdom	22,137	56,763	39.00	No Data	-	9,546
Canada	13,206	25,796	51.19	No Data	-	16,404
Mexico	3,821	79,560	4.80	757	0.198	1,059
Brazil	7,892	141,452	5.58	No Data	-	1,175
Chile	581	12,529	4.64	233	0.401	1,266
Argentina	2,712	31,500	8.61	502	0.185	No Data
Algeria	635	23,500	2.70	457	0.720	2,527
Egypt	1,118	52,000	2.15	1,137	1.017	No Data
Kenya	145	22,030	0.66	55	0.379	314
Ghana	40	13,400	0.30	28	0.700	310
Zimbabwe	113	8,640	1.31	28	0.248	637

Source: ITU "Yearbook of Common Carrier Telecommunication Statistics", 1989

Table 2.2.1-2 Telegram Service State in 1987

Country	Number of Telegrams (Thousand)	Population (Thousand)	Telegrams per 100 Persons
Thailand	7,966	53,873	14.79
Philippines	13,457	54,380	24.75
Indonesia	11,147	172,010	6.48
Malaysia	963	16,530	5.83
Singapore	256	2,631	9.73
Brunei	23	236	9.75
Australia	1,986	16,263	12.21
New Zealand	569	3,349	16.99
Papua New Guinea	42	3,423	1.23
Japan	41,510	122,264	33.95
S. Korea	12,085	42,080	28.72
India	62,131	776,337	8.00
Pakistan	3,521	100,553	3.50
Nepal	1,204	17,790	6.77
Sri Lanka	111	16,400	0.68
Iran	5,768	51,308	11.24
Saudi Arabia	1,466	10,800	13.57
Kuwait	471	1,825	25.81
Syria	224	11,147	2.01
Turkey	6,661	53,226	12.51
Greece	2,848	9,980	28.54
Italy	24,336	57,422	42.38
Spain	5,590	39,092	14.30
France	11,708	56,865	20.59
W. Germany	5,328	61,940	8.60
Sweden	227	8,414	2.70
U. Kingdom	836	56,763	1.47
Canada	446	25,796	1.73
Mexico	25,142	79,560	31.60
Brazil	27,715	141,452	19.59
Chile	2,337	12,529	18.65
Argentina	12,587	31,500	39.96
Algeria	2,502	23,500	10.65
Egypt	17,350	52,000	33.37
Kenya	3,002	22,030	13.63
Ghana	1,249	13,400	9.32
Zimbabwe	542	8,640	6.27

Source : ITU "Yearbook of Common Carrier Telecommunication Statistics", 1989

Table 2.2.1-3 Telex Service State in 1987

Country	Number of Telex Lines	Population (Thousand)	Telex Lines per 1000 Persons	Number of Telephones (Thousand)	Telex Lines per 1000 Telephones
Thailand	6,164	53,873	0.11	902	6.83
Philippines	8,792	54,380	0.16	478	18.39
Indonesia	13,453	172,010	0.08	759	17.72
Malaysia	11,228	16,530	0.68	1,132	9.92
Singapore	17,949	2,631	6.82	876	20.49
Brunei	496	236	2.10	25	19.84
Australia	37,705	16,263	2.32	6,965	5.41
New Zealand	5,320	3,349	1.59	1,377	3.86
Papua New Guinea	1,360	3,423	0.40	31	43.87
Japan	42,000	122,264	0.34	48,014	0.87
S.Korea	10,304	42,080	0.24	8,625	1.19
India	34,044	776,337	0.04	3,488	9.76
Pakistan	7,180	100,553	0.07	584	12.29
Nepal	405	17,790	0.02	31	13.06
Sri Lanka	1,439	16,400	0.09	97	14.84
Iran	5,497	51,308	0.11	1,594	3.45
Saudi Arabia	14,962	10,800	1.39	1,149	13.02
Kuwait	3,192	1,825	1.75	257	12.42
Syria	2,402	11,147	0.22	466	5.15
Turkey	20,491	53,226	0.38	4,077	5.03
Greece	23,605	9,980	2.37	3,466	6.81
Italy	74,406	57,422	1.30	19,105	3.89
Spain	41,956	39,092	1.07	10,236	4.10
France	143,916	56,865	2.53	24,804	5.80
W. Germany	165,246	61,940	2.67	27,222	6.07
Sweden	19,660	8,414	2.34	5,481	3.59
U. Kingdom	111,505	56,763	1.96	22,137	5.04
Canada	43,900	25,796	1.70	13,206	3.32
Mexico	23,916	79,560	0.30	3,821	6.26
Brazil	98,300	141,452	0.69	7,892	12.46
Chile	7,923	12,529	0.63	581	13.64
Argentina	12,169	31,500	0.39	2,712	4.49
Algeria	8,244	23,500	0.35	635	12.98
Egypt	6,446	52,000	0.12	1,118	5.77
Kenya	2,531	22,030	0.11	145	17.46
Ghana	477	13,400	0.04	40	11.93
Zimbabwe	2,480	8,640	0.29	113	21.95

Source : ITU "Yearbook of Common Carrier Telecommunication Statistics", 1989

Table 2.2.1-4 Data Transmission Service State in 1987

(by Leased circuit & Data Network)

Country	Number of Data Lines	Population (Thousand)	Data Lines per 1000 Persons	Number of Telephones (Thousand)	Data Lines per 1000 Telephones
Thailand	4,700	53,873	0.087	902	5.21
Philippines	15,996	54,380	0.294	478	33.46
Indonesia	1,290	172,010	0.007	759	1.70
Malaysia	8,754	16,530	0.530	1,132	7.73
Singapore	30,498	2,631	11.592	876	34.82
Brunei	250	236	1.059	25	10.00
Australia	241,000	16,263	14.819	6,965	34.60
New Zealand	25,233	3,349	7.534	1,377	18.32
Papua New Guinea	435	3,423	0.127	31	14.03
Japan	200,676	122,264	1.641	48,014	4.18
S. Korea	26,705	42,080	0.635	8,625	3.10
India	1,268	776,337	0.002	3,488	0.36
Pakistan	No Data	100,553	-	584	-
Nepal	20	17,790	0.001	31	0.65
Sri Lanka	41	16,400	0.003	97	0.42
Iran	314	51,308	0.006	1,594	0.20
Saudi Arabia	3,650	10,800	0.338	1,149	3.18
Kuwait	614	1,825	0.336	257	2.39
Syria	No Data	11,147	-	466	-
Turkey	547	53,226	0.010	4,077	0.13
Greece	2,950	9,980	0.296	3,466	0.85
Italy	191,686	57,422	3.338	19,105	10.03
Spain	87,448	39,092	2.237	10,236	8.54
France	52,310	56,865	0.920	24,804	2.11
W. Germany	168,626	61,940	2.722	27,222	6.19
Sweden	28,035	8,414	3.332	5,481	5.11
U. Kingdom	No Data	56,763	-	22,137	-
Canada	No Data	25,796	-	13,206	-
Mexico	4,042	79,560	0.051	3,821	1.06
Brazil	16,509	141,452	0.117	7,892	2.09
Chile	997	12,529	0.080	581	1.72
Argentina	1,112	31,500	0.035	2,712	0.41
Algeria	256	23,500	0.011	635	0.40
Egypt	No Data	52,000	-	1,118	-
Kenya	2,835	22,030	0.129	145	19.55
Ghana	17	13,400	0.001	40	0.43
Zimbabwe	1,506	8,640	0.174	113	13.33

Source : ITU "Yearbook of Common Carrier Telecommunication Statistics", 1989

Table 2.2.2-1 Structure and Territory of Telecommunication Services in Aug.1989

Telecommunication Services			Domestic		International	
			TOT	CAT	TOT	CAT
Telephone (Voice) Communication	Ordinary Telephone	Call Service	S		S	S
		Network Service	S			
		Terminal Connection e.g. Facsimile Terminal, Data Terminal etc.	S			
	Public Telephone	Coin (Local)	S			
		Coin (STD)	S			
		Pre-paid Card	P			
	Radio & Mobile Telephone	Radio Telephone	S	S		
		Radio Mobile Telephone	S	S		
		Cellular Mobile Tel.	S	S		
		Train Telephone	P	S		
		Maritime Telephone	P	S		
		Airplane Telephone	P	P		
	Paging Station	P	S			
Leased Circuit	Voice Grade	S	S		S	
	Telex Access Line as Local Cable	S	S			
	Teletype & Telegraph	S	S		S	
	Broadcast Program Transmission	S	S		S	
	Data Transmission	S	S		S	
Data Communication	DATEL (Specified Data Transmission)				S	
	IDAR (International Database Access)				S	
	Packet Switched Data Network		S		S	
	MHS (Message Handling Systems)		S		S	
Recorded Communication	Telegram		S		S	
	Telex		S		S	
	Teletex (Super Telex)		S		S	
	Photo-Telegraph		S		S	
	Bureau Facsimile		S		S	
Video Communication	Videotex	P				
	Video Conference	P				

Legend: **S:** In service
P: Planning (Under study)

Note: This table describes the present state as of Aug. 1989 and does not prescribe the future state of telecommunication services.

2.2.3 Services Offered by TOT

The services presently offered by TOT are described in the followings.

1) Ordinary Telephone Service

The ordinary telephone service has been available for the domestic call and the international call to neighboring countries, i.e., Laos, Malaysia.

a) Subscription

At present, as a result of remarkable telephone expansion, the number of main telephones has rapidly become about two times as many as that of a few years ago. There is, however, still remarkable disparity in telephone density between the metropolitan area and provincial areas.

- i) About 70 percents of total number of main telephones have centralized in the metropolitan area corresponding to only one percent of the country area and about 13 percents of the population.
- ii) The telephone density is 1.67 through the whole country, however, Provincial's is merely 0.62 while Metropolitan's is 8.38 in the year of 1987.

The annual development of the ordinary telephone service is shown in Table 2.2.3-1 and Figure 2.2.3-1.

Table 2.2.3-1 Telephone Service Development

Year	1972	1975	1978	1981	1984	1987
Number of Main Telephones	156,839	208,851	295,631	389,238	519,491	901,622
Metropolitan	124,099	161,951	218,820	287,090	361,924	614,707
Provincial	32,740	46,900	76,811	102,148	157,567	286,915
Population (Thousand)	38,359	42,391	45,222	47,875	50,583	53,873
Metropolitan	4,740	5,417	6,030	6,625	6,660	7,338
Provincial	33,619	36,974	39,192	41,250	43,923	46,535
Main Telephones /100 Persons	0.41	0.49	0.65	0.81	1.03	1.67
Metropolitan	2.62	2.99	3.63	4.33	5.43	8.38
Provincial	0.10	0.13	0.20	0.25	0.36	0.62

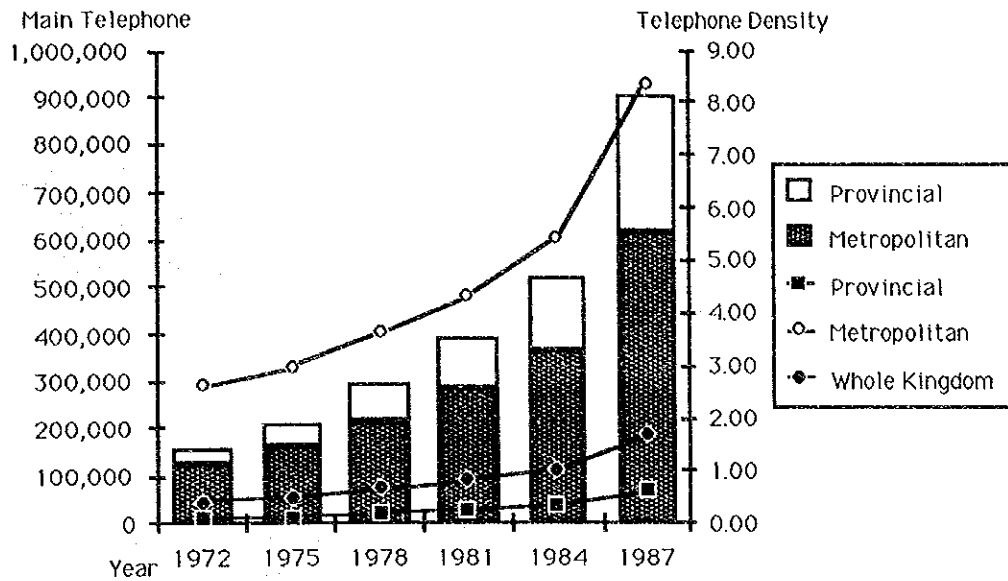


Figure 2.2.3-1 Telephone Service Development

b) Local and Trunk Service

The telephone call can be made for the whole domestic call and the international call to the neighboring countries. Table 2.2.3-2 shows the number of pulses and calls.

Table 2.2.3-2 Local and Trunk Service

(Unit: Thousand Calls)

Year	Local Service (1000 Metered Pulses)			Domestic Trunk Service (1000 Calls)			International Trunk Service (1000 Calls)		
	Metro.	Prov.	Total	Metro.	Prov.	Total	Metro.	Prov.	Total
1977	464,378	72,718	537,096	2,851	6,614	9,465	42	124	167
1978	531,812	88,217	620,030	3,008	7,421	10,429	45	137	182
1979	590,629	100,936	691,565	3,283	8,209	11,492	45	160	205
1980	630,014	118,897	748,911	3,703	10,011	13,714	41	162	202
1981	679,452	130,265	809,717	8,987	21,445	30,432	44	178	222
1982	762,498	154,578	917,075	12,133	29,003	41,136	57	213	270
1983	840,254	179,689	1,019,943	14,501	35,331	49,833	44	268	312
1984	904,817	211,438	1,116,255	16,365	39,675	56,040	158	400	558
1985	971,676	257,417	1,229,092	18,942	45,297	64,238	180	524	704
1986	1,178,590	397,563	1,576,153	22,618	52,391	75,009	205	520	725
1987	1,287,807	338,982	1,626,789	27,315	62,047	89,362	252	530	782
1988	1,463,935	396,616	1,860,551	34,762	77,741	112,503	367	643	1,010

2) Network Services on the Telephone Network

a) Hunting Service (Line Grouping Service)

In Thailand, hunting service is mostly utilized by the subscribers having PBX or PABX as line grouping service between the telephone exchange and PBX or PABX. The concept of line grouping is to hunt a free line belonging to a same subscriber in case of encountering line busy as shown in Figure 2.2.3-2.

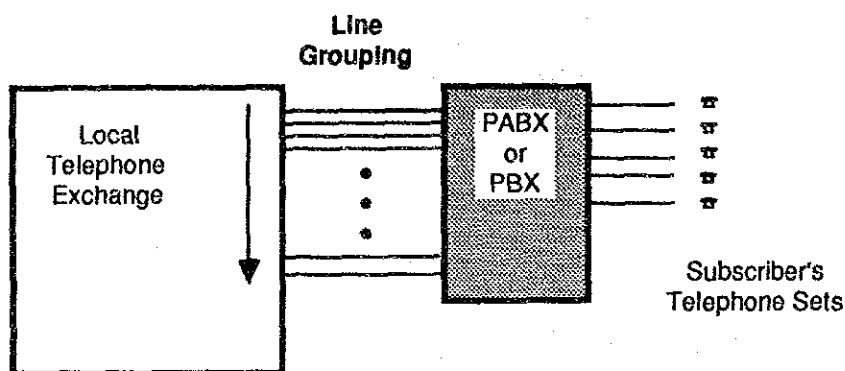


Figure 2.2.3-2 Concept of Line Grouping

This function can be available also for the subscribers having plural telephone line units in the same place. However, they don't tend to adopt the hunting service supposedly because of the following reasons:

- i) Branch telephone sets are connected sharing one line unit,
- ii) Enhanced Key telephone sets that can accommodate plural line units are not so popular.

b) Other Enhanced Services

For the purpose of better utilization of the telephone service, some of the enhanced services have been offered according to the request of subscribers. These services are available in the whole areas covered by the basic telephone service in the Kingdom, and at the present stage, additional fee is not charged aiming at the increase of the subscribers. However, TOT seems to intend to charge the additional fee in the near future.

Since the number of subscribers is a few in the provincial areas and its potentiality is low, the statistic data has been collected only for Bangkok Metropolitan area. Service menu and the number of subscribers and waiting applicants are shown in Table 2.2.3-3. The

number of telephone subscribers are 686,151 in Bangkok in Sep. 1988, and then the percentage of the subscribers for each network service is about 0.1 % of all the telephone subscribers.

Table 2.2.3-3 Network Service Subscribers in Bangkok

Service Menu	Aug. 1988		Mar. 1989	
	Subscribers	Waitings	Subscribers	Waitings
Automatic Call Repetition	587	54	962	39
Call Waiting	613	54	1,015	38
Abbreviated Dialling	572	40	905	23
Conference Call	575	51	934	34
Call Transfer	561	50	905	34
Hot Line	510	50	825	32
All Services (Above 6)	649	56	1,096	41

In addition to the above-mentioned services which have already been rendered, the following functions have been provided on the telephone exchanges as classified by SPC and Cross-bar. However, they have not been offered for the general public yet. The definite plan for introduction is under study.

- i) Subscriber private meter (SPC & Cross-bar)
- ii) Immediate charge information (SPC)
- iii) Malicious call trace (SPC & Cross-bar)
- iv) Outgoing call barring (SPC)

3) Terminal Connection Service to the Telephone Network

In Thailand, terminal application to the telephone network has already been deregulated by TOT. For the large scale of subscribers, PBX and PABX can be connected. And to cope with diversified non-voice services, various kinds of terminals for facsimile communication, data communication etc. can also be available by connecting specific equipments to the telephone network.

a) PBX and PABX

PBX and PABX are installed in the subscribers' facilities. The line units are grouped between the telephone exchange and PBX & PABX, and are distributed to the extension telephone sets.

As shown in Table 2.2.3-4, over 90 percents of PBXs are installed in the metropolitan area. Some of them are utilized also for residential use in order to share the limited line units. The number of extensions per PBX is considerably higher in provincial areas.

Table 2.2.3-4 State of PBX and PABX

Year	PBXs in Service			Line Units in Service			Extensions in Service		
	Whole	Metro.	Provin.	Whole	Metro.	Provin.	Whole	Metro.	Provin.
1976	2,908	2,689	219	10,162	9,756	406	82,804	68,947	13,857
1977	3,200	2,953	247	11,560	10,903	657	97,098	80,777	16,321
1978	3,473	3,189	284	12,903	12,140	763	105,391	87,430	17,961
1979	3,881	3,540	341	14,685	13,811	874	116,617	95,972	20,645
1980	4,399	4,006	393	16,569	15,568	1,001	129,647	106,802	22,845
1981	4,704	4,254	450	19,824	18,717	1,107	143,163	117,756	25,407
1982	5,313	4,781	532	22,835	20,922	1,913	171,397	139,053	32,344
1983	6,107	5,455	652	25,507	23,794	1,713	196,137	154,997	41,140
1984	6,957	6,242	715	28,741	26,804	1,937	218,475	172,634	45,841
1985	8,259	7,413	846	34,179	31,976	2,203	250,343	199,888	50,455
1986	9,592	8,557	1,035	41,397	38,418	2,979	292,466	232,139	60,327
1987	11,043	9,878	1,165	49,071	45,438	3,633	332,739	261,783	70,956
1988	N.A.	N.A.	1,216	N.A.	N.A.	3,962	N.A.	N.A.	84,988

Year	Line Units per PBX			Extensions per PBX			Extensions per Line Unit		
	Whole	Metro.	Provin.	Whole	Metro.	Provin.	Whole	Metro.	Provin.
1976	3.49	3.63	1.85	28.47	25.64	63.27	8.15	7.07	34.13
1977	3.61	3.69	2.66	30.34	27.35	66.08	8.40	7.41	24.84
1978	3.72	3.81	2.69	30.35	27.42	63.24	8.17	7.20	23.54
1979	3.78	3.90	2.56	30.05	27.11	60.54	7.94	6.95	23.62
1980	3.77	3.89	2.55	29.47	26.66	58.13	7.82	6.86	22.82
1981	4.21	4.40	2.46	30.43	27.68	56.46	7.22	6.29	22.95
1982	4.30	4.38	3.60	32.26	29.08	60.80	7.51	6.65	16.91
1983	4.18	4.36	2.63	32.12	28.41	63.10	7.69	6.51	24.02
1984	4.13	4.29	2.71	31.40	27.66	64.11	7.60	6.44	23.67
1985	4.14	4.31	2.60	30.31	26.96	59.64	7.32	6.25	22.90
1986	4.32	4.49	2.88	30.49	27.13	58.29	7.06	6.04	20.25
1987	4.44	4.60	3.12	30.13	26.50	60.91	6.78	5.76	19.53
1988	N.A.	N.A.	3.26	N.A.	N.A.	69.89	N.A.	N.A.	21.45

Among these PBXs, especially large scale of subscribers are shown in Table 2.2.3-5. Some of them may become major demand source for ISDN or High speed of digital leased circuit in the near future.

Table 2.2.3-5 Large Scale of PABX Subscribers

Subscribers Name	Exchange Code	Extensions
Rama Hospital	201	1,000
Bangkok Bank	230	1,000
Thai Red Cross	256	1,000
Siam Commercial Bank	256	1,000
Phloen Chit	257	1,000
Thai Farmers Bank	273	1,000
IBM	273	400
Mall Shopping	310	1,000
EGAT	436	2,500
Royal Thai Navy	442	2,000
Royal Thai Air Force	534	2,000
Airport Authority	535	1,000
Siam Cement	586	2,000

b) Facsimile Terminal

Facsimile communication service has been utilized in most areas on the telephone network. In order to use facsimile service, a customer has to purchase his terminal which has been already granted "Type approval" by TOT. And the customer can connect his terminal to the telephone network after obtaining permission by TOT.

G-1, G-2 and G-3 types are utilized at present, and G-4 type has not been authorized yet. However, it may become a forerunner of terminals of the ISDN services.

The number of facsimile terminals having been permitted by TOT has been increasing as shown in Table 2.2.3-6, comparing to the telephone development. Under the condition of deregulation for the terminal connection, more facsimile terminals seem to actually be utilized.

Table 2.2.3-6 Facsimile Terminal Development

Year	1985	1986	1987	1988
No. of Facsimiles	195	677	2,106	5,576
Growth Ratio (%)	-	347%	311%	265%
No. of Telephones	626,498	798,912	901,622	1,005,872
Percentage of Fax. to Tel.	0.03%	0.08%	0.23%	0.55%

c) Data Terminal

In a similar way to the facsimile terminal, data transmission lower than 2400 b/s can be available on the telephone network by means of Modulator-Demodulator (Modem), Acoustic coupler etc.

Provided that the facilities fulfill their functions in best condition, data transmission up to 9600 b/s can be available on the analog telephone network from the technical point of view, however, taking account of the present conditions, the bit rate is considered to be practically 2400 b/s at maximum. In most cases, data transmissions with higher bit rates than 2400 b/s employ leased circuits.

The number of data terminals connected to the telephone network is estimated as about 200.

4) Public Telephone Service

Public telephone sets are categorized by 3 types as follows:

- a) Local public telephone,
- b) Trunk public telephone,
- c) Rural long distance telephone.

The number of public telephone sets classified by each type is shown in Table 2.2.3-7.

Table 2.2.3-7 Public Telephone Service Development

Year	1982	1983	1984	1985	1986	1987	1988
Local Telephone	8,868	9,364	10,548	12,686	14,967	16,380	16,459
Metropolitan	7,645	8,076	9,070	10,855	12,607	13,666	13,697
Provincial	1,223	1,288	1,478	1,831	2,360	2,714	2,762
Trunk Telephone	0	710	977	1,632	1,949	2,352	2,791
Metropolitan	0	145	235	451	622	752	770
Provincial	0	565	742	1,181	1,327	1,600	2,021
Rural Telephone	184	225	322	135	892	1412	1418
Metropolitan	0	0	0	0	0	17	18
Provincial	184	225	322	135	892	1395	1400
Total	9,052	10,299	11,847	14,453	17,808	20,144	20,668
Metropolitan	7,645	8,221	9,305	11,306	13,229	14,435	14,485
Provincial	1,407	2,078	2,542	3,147	4,579	5,709	6,183
Population (Thousand)	48,846	49,564	50,583	51,795	52,969	53,873	54,961
Metropolitan	6,817	6,456	6,660	6,915	7,086	7,338	7,538
Provincial	42,029	43,108	43,923	44,880	45,883	46,535	47,423
Density / 1000 Persons	0.19	0.21	0.23	0.28	0.34	0.37	0.38
Metropolitan	1.12	1.27	1.40	1.63	1.87	1.97	1.92
Provincial	0.03	0.05	0.06	0.07	0.10	0.12	0.13

5) Cellular Mobile Telephone Service

Cellular mobile service is offered by TOT and CAT. As a result, they are now in competition with each other in the metropolitan and the surrounding areas.

a) Subscriptions and Traffic

TOT's cellular mobile service was put into operation in July 1986 in the Bangkok metropolitan area as an initial stage. In a short period after that, it was expanded to eastern and western sea board area within the year of 1986. Afterwards, available territory has been gradually expanded according to the demands. The number of subscribers has been increasing as shown in Table 2.2.3-8 and the number of calls & minutes are shown in Table 2.2.3-9.

Table 2.2.3-8 Annual Progress of Cellular Mobile Service

Year	Whole Kingdom	Metropolitan	Provincial
Sep. 1986	822	790	32
Mar. 1987	2,013	1,612	401
Sep. 1987	4,413	2,871	1,542
Mar. 1988	6,768	4,330	2,438
Sep. 1988	10,612	6,667	3,945

Table 2.2.3-9 Number of Calls & Minutes from Mobile Telephones

Year	Whole Kingdom			Metropolitan			Provincial		
	Calls	Minutes	Min./Call	Calls	Minutes	Min./Call	Calls	Minutes	Min./Call
1986	142	350	2.46	137	334	2.44	5	16	3.20
1987	3,457	9,534	2.76	2,033	5,407	2.66	1,424	4,127	2.90
1988	13,154	37,536	2.85	6,676	18,635	2.79	6,478	18,901	2.92

On the other hand, CAT have also provided cellular mobile radio service for the metropolitan area since February 1987. The number of subscribers utilizing CAT's service is estimated as about 10,000 in Aug.1989.

b) State of Call Service

The cellular mobile of TOT employs Nordic Mobile Telephone System (NMTS) standard whose radio frequency is 450 MHz. The calls can be made by dialling without through an operator. Wherever the Mobile Stations (MS) are located within the area covered by this system, the call can be originated regardless of their current location and this call can be kept continuing even if the Mobile Stations (MS) move to the areas controlled by other Radio Base Stations (RBS).

The enhanced services can be also available for cellular mobile service. The services are Abbreviated Dialling, Hot Line, Call Transfer, Conference Call, Call Waiting etc.

6) Leased Circuit Service

At present, all of the leased circuit service are provided by analog circuits. The usage classification is computer (data communication), teletype, telex, hot line, broadcast. The major usage is data communication by computers and telex communication as shown in Table 2.2.3-10.

Table 2.2.3-10 Leased Circuit Service

Usage	(Sep. 1988)							Total
	Computer	Teletype	Telex	Hot Line	Broadcast	Others		
Metropolitan	2,758	592	4,516	1,136	415	0	9,417	
Provincial	1,972	113	156	789	43	140	3,213	
Total	4,730	705	4,672	1,925	458	140	12,630	
Share	37.5%	5.6%	37.0%	15.2%	3.6%	1.1%	100.0%	

a) Data Transmission Use

Among data communication services, the most representative usage is banking account systems by computers which have prevailed through the whole country and are conveniently utilized by ordinary people. The percentage of the banking account systems is estimated by about 70 % of all the data communication services. That is, about 3,000 circuit units are for these systems.

b) Telex Service Access Line Use

As regards Telex communication, public switched telex service is offered by CAT, however, the subscriber lines between telex terminals and telex exchanges have to be leased from TOT. Since most of Telex terminals are installed in metropolitan area, the ratio of the number in metropolitan to provincial is about 30 to 1.

c) Broadcast Program Transmission Use

Broadcast is operated under the control of Public Relations Department (PRD). The circuits required for program transmissions are offered by TOT, CAT etc. The radio broadcasting services are operated by lots of sectors. Among them, the major sectors are National Broadcasting Service of Thailand and Army Broadcasting. The television broadcasting sectors are shown as follows:

- i) Sectors whose circuits are offered by TOT
 - National Broadcasting Service of Thailand (Channel 11)
 - Bangkok Entertainment Co., Ltd. (Channel 3)
 - Army Television (Channel 5)
- ii) Sectors whose circuits are offered by CAT
 - Mass Communication Organization of Thailand (Channel 9)
- iii) Sectors whose circuits are offered by PALAPA of Indonesia
 - Bangkok Broadcasting & TV Co., Ltd. (Channel 7)

2.2.4 Services Offered by CAT

The services presently offered by CAT are described in the followings. The service states are described on the basis of CAT's Telecommunication Services Report, CAT's Communications Services Statistical Report, CAT's Annual Report etc.

1) Telegram Service

Telegram service is the oldest telecommunication service and its number of handling cases has been gradually decreasing because of being replaced by other services in many countries. However, it is still indispensable telecommunication service for the general public where other means are unavailable. The number of telegrams and words for domestic and international calls is shown in Table 2.2.4-1 and 2.2.4-2.

Table 2.2.4-1 Domestic Telegram Service

(Unit: Thousand)

Year	Whole Kingdom		Metropolitan Area		Provincial Area	
	Telegrams	Words	Telegrams	Words	Telegrams	Words
1983	8,068	158,494	2,254	48,136	5,814	110,358
1984	8,308	165,741	2,269	48,991	6,039	116,750
1985	8,319	167,707	2,256	48,886	6,063	118,821
1986	7,320	138,143	1,938	39,518	5,382	98,625
1987	6,741	126,246	1,755	35,570	4,986	90,676
1988	6,625	121,183	1,678	34,426	4,947	86,757

Table 2.2.4-2 International Telegram Service

(Unit: Thousand)

Year	Total		Incoming		Outgoing	
	Telegrams	Words	Telegrams	Words	Telegrams	Words
1983	357	12,126	206	7,617	151	4,509
1984	290	10,152	163	6,281	127	3,871
1985	251	8,796	136	5,309	115	3,487
1986	209	7,296	110	4,259	99	3,037
1987	182	6,310	96	3,658	86	2,652
1988	169	5,804	89	3,322	80	2,482

2) Telex Service

Telex service enables the subscribers to receive and transmit messages by the use of telex terminal from one subscriber to another both within the Kingdom and to abroad. Telex is a kind of recorded communications and messages can be retained and used as documents

or source materials. Thai and Roman characters can be available as far as for the domestic call and only Roman characters are available for the international call.

Aiming at the subscribers who utilize personal computers for the general use, the telex network is capable of accommodating personal computers by means of "Code and Speed Converter" which is provided by CAT and storing messages in the memory. This enhanced service is named as "Super Telex".

The number of telex terminals, location of concentrators, calls and minutes is shown in Table 2.2.4-3 and 2.2.4-4.

Table 2.2.4-3 Telex Terminals and Concentrators

Year	Telex Terminals	Telex Concentrators
1983	3,885	35
1984	4,541	45
1985	5,146	60
1986	5,557	71
1987	5,921	62
1988	6,217	61

Table 2.2.4-4 Telex Calls and Minutes

Year	Domestic		International	
	Calls	Minutes	Calls	Minutes
1983	No Data	3,253,444	2,780,021	6,095,020
1984	No Data	3,952,091	3,287,886	7,186,838
1985	No Data	4,851,305	3,688,661	7,976,115
1986	1,875,569	4,911,278	3,731,236	7,650,130
1987	No Data	4,903,040	3,992,464	7,829,061
1988	No Data	4,343,688	3,814,595	7,407,110

3) Phototelegraph Service

This service is available for the general public to send photographs over telecommunication circuits within the Kingdom and to abroad. Not only photos but also diagrams, charts and other similar forms can be handled. This service is mainly utilized by press agencies, journalist offices, etc. The number of photos to be handled is shown in the Table 2.2.4-5.

Table 2.2.4-5 Phototelegraph Service

(Unit: Photos)

Year	Domestic	International	
		Received	Sent
1983	0	131	493
1984	115	123	358
1985	130	128	661
1986	41	193	440
1987	No Data	110	350
1988	No Data	40	184

4) Document Facsimile Service

This service enables the general public to transmit documents in any of the forms such as letters, diagrams, figures, layouts, foreign languages etc. There are two categories in this service, namely, Bureau facsimile service and Telefax service.

a) Bureau Facsimile Service

This service enables the general public to transmit documents by offering facsimile terminals of CAT. This service was commenced in 1983 for international call and in 1984 for domestic call. The number of pages handled is shown in Table.2.2.4-6.

Table 2.2.4-6 Pages Handled by Bureau Facsimile Service

Year	Domestic		International	
	Received	Sent	Received	Sent
1983	-	-	3,927	3,552
1984	173	173	8,367	6,436
1985	593	593	11,163	11,569
1986	1,897	1,940	10,185	13,411
1987	7,937	8,127	8,554	12,526
1988	10,998	11,525	6,267	15,933

b) Telefax Service

As described in the previous section of TOT's services, private facsimile terminals can be available as the terminal connection service. In addition to those private terminals, CAT's facsimile terminals are leased to subscribers for their private use. Normally, such facsimile terminals are to be coupled with telephone sets and link to the networks of both domestic and overseas telephone exchanges. The number of subscribers has rapidly been increasing as shown in Table 2.2.4-7.

Table 2.2.4-7 Telefax Service

Year	1983	1984	1985	1986	1987	1988
Telefax Services	1	50	286	928	2,231	4,451

5) International Telephone Service

This service is available for the general telephone subscribers. International telephone call can be made through Operator assistance, and Subscriber dialling provided the registration to CAT is made in advance. There has been rapid increase in the call number as shown in Table 2.2.4-8.

Table 2.2.4-8 International Telephone Service for Outgoing Call

(Unit: Thousand)

Year	Calls	Minutes	Minutes/call
1983	1,296	9,465	7.3
1984	1,419	10,619	7.5
1985	1,802	12,753	7.1
1986	3,436	19,439	5.7
1987	6,215	27,714	4.5
1988	11,089	42,451	3.8

6) Domestic Radio Telephone Service

This service is provided in only the locations where the domestic telephone service of TOT has not been accessed. It is offered to the general public in Bangkok metropolitan area and provincial areas. This service is, for the most part, utilized for the communication from provincial areas to Bangkok, and the number of calls and minutes has been decreasing year by year as shown in Table 2.2.4-9.

Table 2.2.4-9 Radio Telephone Service

Year	From Bangkok to Province		From Province to Bangkok	
	Calls	Minutes	Calls	Minutes
1983	207	631	46,533	154,133
1984	182	604	38,202	123,972
1985	153	536	31,479	105,816
1986	99	306	23,496	79,622
1987	N.A.	N.A.	N.A.	N.A.
1988	N.A.	N.A.	N.A.	N.A.

7) Radio Communication Service

This service is provided for the general public by adopting radio communication in various forms as follows.

a) Mobile Radio Telephone Service

This service is classified into various types, namely, Short-wave radio telephone adopting HF, Manual mobile radio telephone adopting VHF whose radio frequency is 130-160 MHz and Automatic mobile radio telephone adopting UHF whose radio frequency is 350 MHz.

HF system can be used for communication with a working range covering the whole country. VHF and UHF systems can be used with a working range of 50 kilometers for vehicle and 150 kilometers at maximum for stationary location. Adopting UHF system, public telephones have been provided on the trains for the routes between Bangkok to Phitsanulok, Bangkok to Surin and Bangkok to Khon Kaen.

In addition to the above-mentioned mobile radio telephone service, Cellular mobile service has begun into service in Feb. 1987. It adopts the radio frequency in 800 MHz by Advanced Mobile Phone System (AMPS) standard. Since the introduction of Cellular mobile service, as a result, other radio telephone services have been decreasing.

The number of subscribers for each service is shown in Table 2.2.4-10.

Table 2.2.4-10 Mobile Radio Telephone Service

Year	HF	VHF		UHF		Cellular
	Bangkok	Bangkok	Province	Bangkok	Province	Bangkok
1983	62	258	696	885	305	-
1984	55	279	886	1,077	421	-
1985	39	244	985	1,385	451	-
1986	29	206	933	1,579	584	-
1987	32		837		1,519	1,166
1988	29		1,119		1,432	3,113

b) Radio Paging Service

This service has gained wide popularity among business-men, organizations and the general public. The radio receiver can receive the radio signal in being carried to any places within the range of the radio control station. There are two kinds of this service.

i) Tone and Voice Paging System

This service started in 1980 adopting the radio frequency in 160-170 MHz band with a working range of about 20 kilometers from the radio station. This service is basically provided in manual mode. The caller has to phone the operator to send messages to the destination pager. The number of subscribers are decreasing because of being replaced by Digital Display Paging system as mentioned below.

ii) Digital Display Paging System

This service started in Jan. 1987 and has been operated by the private sector under the 10 years contract with CAT, adopting the radio frequency in 450 MHz band. The caller can send messages directly to the destination pager or make a call through the operator in manual mode. The sent messages are composed of numeric information and displayed on the terminals. The number of subscribers has been increasing significantly since the start of this service, as a result, more than 20,000 subscribers in March 1988.

c) Private Specialized Radio Communication Service

This service involves the provision of various radio communications for licensed operators in special cases. The licence is granted by individual cases, and the use and maintenance are under the supervision of CAT.

The number of subscribers relating to radio communication services is shown in Table 2.2.4-11.

Table 2.2.4-11 Radio Paging Service etc.

Year	Radio Paging			Private Radio		
	Digital Paging	Tone & Voice Paging		Tone only Paging	Handheld Transceiver	Private Network
	Kingdom	Bangkok	Province	Bangkok	Bangkok	Bangkok
1983	-	3,669	335	92	252	144
1984	-	5,850	383	146	367	164
1985	-	7,598	394	177	558	190
1986	-	7,501	452	300	672	363
1987	17,000	6,091		1,546		
1988	N.A.	6,791		2,192		

8) Maritime Mobile Radio Service

This service is another form of telegram and telephone service to make communication between the radio station and the sailing ships. The existing equipments have capability of covering the gulf of Thailand, the South China sea and the Indian ocean.

a) Maritime Telegram Service

This service is provided in two radio frequency ranges as follows:

- i) HF with a working range of about 2,000 kilometers,
- ii) MF with a working range of about 400 kilometers.

The number of sent telegrams are smaller than that of received, while the volume of sent words are generally larger than that of received until 1986. Accordingly, the volume of sent words per telegram is about 3 times as large as that of received.

b) Maritime Telephone Service

This service is provided in three radio frequency ranges as follows:

- i) HF with a working range of about 1,000 kilometers,
- ii) MF with a working range of about 300 kilometers,
- iii) VHF with a working range of about 90 kilometers.

The number of calls as well as the volume of minutes for outgoing are larger than those of received. They are about 10 times as large as that of received.

Table 2.2.4-12 Maritime Mobile Radio Service

Year	Telegram Service				Telephone Service			
	Received		Sent		Incoming		Outgoing	
	Telegrams	Words	Telegrams	Words	Calls	Minutes	Calls	Minutes
1983	17,446	302,882	7,982	375,444	3,010	22,960	19,683	94,967
1984	18,434	321,433	8,048	399,970	3,107	23,786	30,498	141,964
1985	18,129	308,872	8,685	425,849	3,347	23,289	40,199	194,289
1986	18,429	291,657	8,904	420,465	3,761	26,085	52,398	247,733
1987	17,605	282,816	7,274	240,943	4,364	24,768	52,890	231,300
1988	20,073	330,078	8,520	276,035	5,445	33,556	55,689	246,418

9) Leased Circuit Service

Service menu of CAT's leased circuit service is classified into domestic and international from a view point of areas, and telegraph grade and voice grade from a view point of application. Press Bulletin service is the specific telegraph grade circuit provided for only mass media agencies. The number of subscribers for each class is shown in Table 2.2.4-13.

Table 2.2.4-13 Number of Leased Circuits

Classification	1983	1984	1985	1986	1987	1988
Domestic Telegraph	153	155	158	131	141	135
International Telegraph	102	97	96	91	84	82
Telegraph (Press Bulletin)	13	17	16	13	12	8
Domestic Voice Grade	5	7	9	14	14	17
International Voice Grade	10	16	24	29	35	44

10) Data Transmission Service

In addition to the leased circuit service which can be available for data transmission, there are other specific data transmission services as mentioned below.

a) International DATEL Service

This service links the subscribers to those in other countries via overseas telephone network for various kinds of communications. It makes possible with a teleprinter at a speed faster than ordinary telex. It also handles data and facsimile transmission. The number of subscribers is shown in Table 2.2.4-14.

Table 2.2.4-14 DATEL Service

Year	Subscribers	Outgoing Calls	Outgoing Minutes
1983	3	N.A.	N.A.
1984	6	N.A.	N.A.
1985	7	N.A.	26,150
1986	11	660	12,501
1987	11	575	6,021
1988	11	768	9,101

b) International Database Access and Remote Computing Service (IDAR)

This service is an international data communication service between Thailand and USA, and allows subscribers in Thailand access to large database computer systems in USA. By way of the network in USA, the terminals accommodated on packet networks in foreign countries can be accessed. The number of subscribers is shown in Table 2.2.4-15.

Table 2.2.4-15 IDAR Service

Year	Subscribers	Minutes	Characters
1983	3	N.A.	N.A.
1984	18	N.A.	N.A.
1985	46	129,265	133,966
1986	83	275,904	377,496
1987	104	422,387	556,041
1988	154	576,637	811,558

11) Packet Switching Service

This service can provide the data transmission service as a form of permanent connection and dial-up access both within the Kingdom and to abroad. Some of the terminals can be accommodated directly on the packet exchange with X.25 and X.28 interface, and some of the terminals can be accommodated by way of the telephone network with X.28 interface. Otherwise, the terminals for abroad can be connected with X.75 interface.

In addition to the above-mentioned basic function, Message Handling Systems (MHS) on a basis of X.400 Rec. series by CCITT is also provided in this network. The configuration of packet network is shown in Figure 2.2.4-1.

This network named "TAIPAC" has begun into service in 1989. The switching nodes are installed in Bangkok, Chiang Mai and Hat Yai, and its concentrators are located in

Nakhon Sawan, Saraburi, Chon Buri, Rayong, Nakhon Ratchasima, Khon Kaen, Phitsanulok, Surat Thani and Phuket.

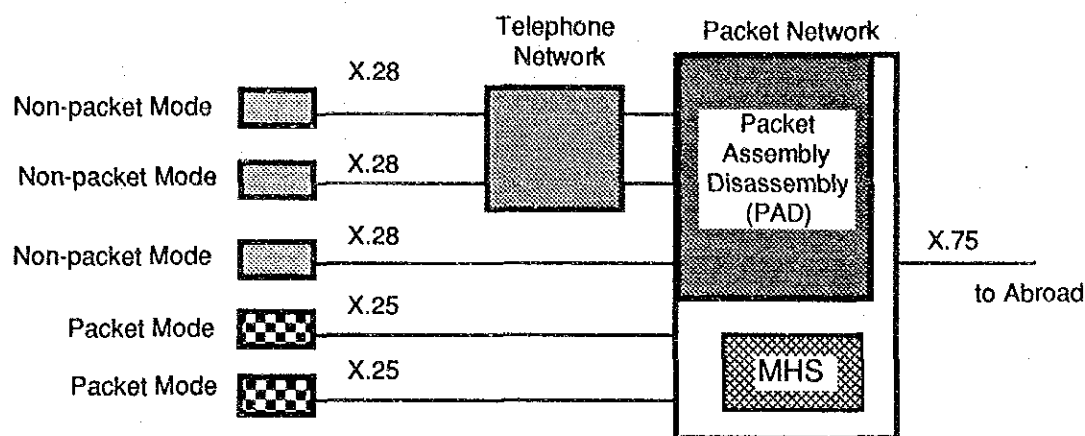


Figure 2.2.4-1 Configuration of Packet Network

12) International Broadcast Transmission Service

International broadcast transmission service is classified into two forms as follows. The number of programs and minutes for each form is shown in Table 2.2.4-16.

a) International Program Transmission Service

This service provides international transmission of programs such as reports of news, sports etc. through international telephone circuits.

b) International TV Transmission Service

This service is offered by transmitting TV pictures via communication satellites. TV pictures to and from abroad are sent and received through the Si Racha satellite center. This station links Thailand to the earth station in foreign countries through INTELSAT (International Telecommunication Satellite Organization) communication satellite.

Table 2.2.4-16 International Broadcast Transmission Service

Year	Program Transmission Service				TV Transmission Serv			
	Received		Sent		Received		Sent	
	Programs	Minutes	Programs	Minutes	Programs	Minutes	Programs	Minutes
1983	4	518	26	5,088	513	9,212	75	4,959
1984	5	623	52	5,465	747	10,102	68	1,870
1985	0	0	30	1,454	785	11,314	134	3,244
1986	9	2,123	11	923	907	15,916	145	4,974
1987	5	304	17	1,454	840	14,962	152	4,149
1988	1	103	25	10,925	1,393	25,204	641	14,806

2.3 Present State of Telecommunication Facilities

2.3.1 Switching Facilities

1) Signalling System (Inter Exchange Signalling System)

TOT adopts DC line signalling and E&M signalling for line signalling and MFC-R2 signalling for register signalling.

a) Line Signalling

i) DC line signalling uses DC loop signalling for supervisory.

ii) E&M line signalling uses out-band frequency(3825 Hz).

b) Register Signalling

MFC-R2 uses Multi-Frequency based on CCITT R-2 signalling system for inter register signalling.

2) Charging System

Charging system is divided into two categories. One is for local call and the other is for STD call.

a) Local Call

This is for calls within the metropolitan area or within a PC area in provincial areas of distance and time duration. Time zone system is going to be introduced for local call in the metropolitan area.

b) STD Call

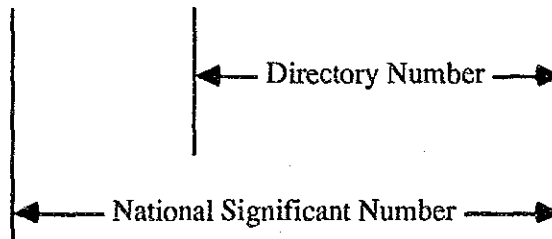
This is for calls between PC areas and is subdivided into three categories. One is between adjacent PC areas, another is between non-adjacent PC areas with same area code and the other is between non-adjacent PC areas with different area code.

3) Numbering Plan

The numbering plan, at present, is as follows:

- a) "0" is used for STD prefix
- b) "00" is used for ISD prefix
In case of the call to Malaysia, "09" is used
- c) The configuration of National Significant Number are:

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



- Metropolitan area A - BCD - EFGH
- Provincial area AB - CD - EFGH

- d) Two or three digits begun by "1" are used for Special call(1{X Y)

Table 2.3.1-1 and 2.3.1-2 show the present state of Numbering Plan.

Table 2.3.1-1 Numbering Plan for Ordinary Call

	1	2	3	4	5	6	7	8	9	0
1		METRO "2"	PROV. "3"	PROV. "4"	PROV. "5"		PROV. "7"			
	TOT Cellular Mobile Telephone									
2		Bangkok Metropolitan								
3		Phet- haburi		Nakhon Pathom	Ayutt- haya	Sarab- uri	Prach- inburi	Chon Buri	Chant- aburi	
4		Udon Thani	Khon Kaen	Nakhon Ratch- asima	Udon racha Thani					
5			Chiang Mai	Lam Pang	Phits- anulok	Nakhon Sawan				
6										
7			Yala	Songkla	Nakhon Si Thamm- arat	Phuket	Surat Thani			
8										
9	International Call to Malaysia									
0	International Call									

Table 2.3.1-2 Numbering Plan for Special Call

	1	2	3	4	5	6	7	8	9	0	
1			Line Man Test Set								
2			Police								
3	Directory Information (Local)										
4											
5											
6											
7	17 + ABC --- Complaints (Metropolitan Multi Exchange Area)										
	Complaints (Other Area)										
8	Stand - ard Time		Directory Information (Long Distance)		Inter- ception Service	Line Man Test Set	Two Party				
9	Police							Fire			
0	Trunk Operator (National)								Inter- national Trunk Operator		

4) Exchanges

TOT offers the telecommunication services through the network composed with the hierarchy as described in Chapter 7 and the number of them are as follows;

Tertiary Center	(TC)	7 Exchanges,
Secondary Center	(SC)	17 Exchanges,
Tandem Exchange	(TDM)	10 Exchanges,
Primary Center	(PC)	54 Exchanges,
Local Exchange	(LE)	285 Exchanges.

Note: The figures are at the end of 5th ESDP.

These are divided, in accordance with geographical areas of the country, into four areas, namely, one metropolitan area and three provincial areas. Each of those area have a TC and some SCs, PCs and LEs belong to each PC, SC and TC in provincial area.

PC corresponds to changwat except Nontaburi, Phatthumtani and Samutprakan where are suburban of metropolitan, Phangna and Ranong where are developing areas and Bangkok.

Metropolitan area, namely Bangkok, adopts different configuration of switching from that of provincial areas. It is divided into eight areas called Tandem area and, each Tandem has originating tandem function instead of SC and PC. Figure 2.3.1-1 shows the location of LE except RS(L)U in metropolitan areas and Figure 2.3.1-2 shows the location of primary center and above in whole country.

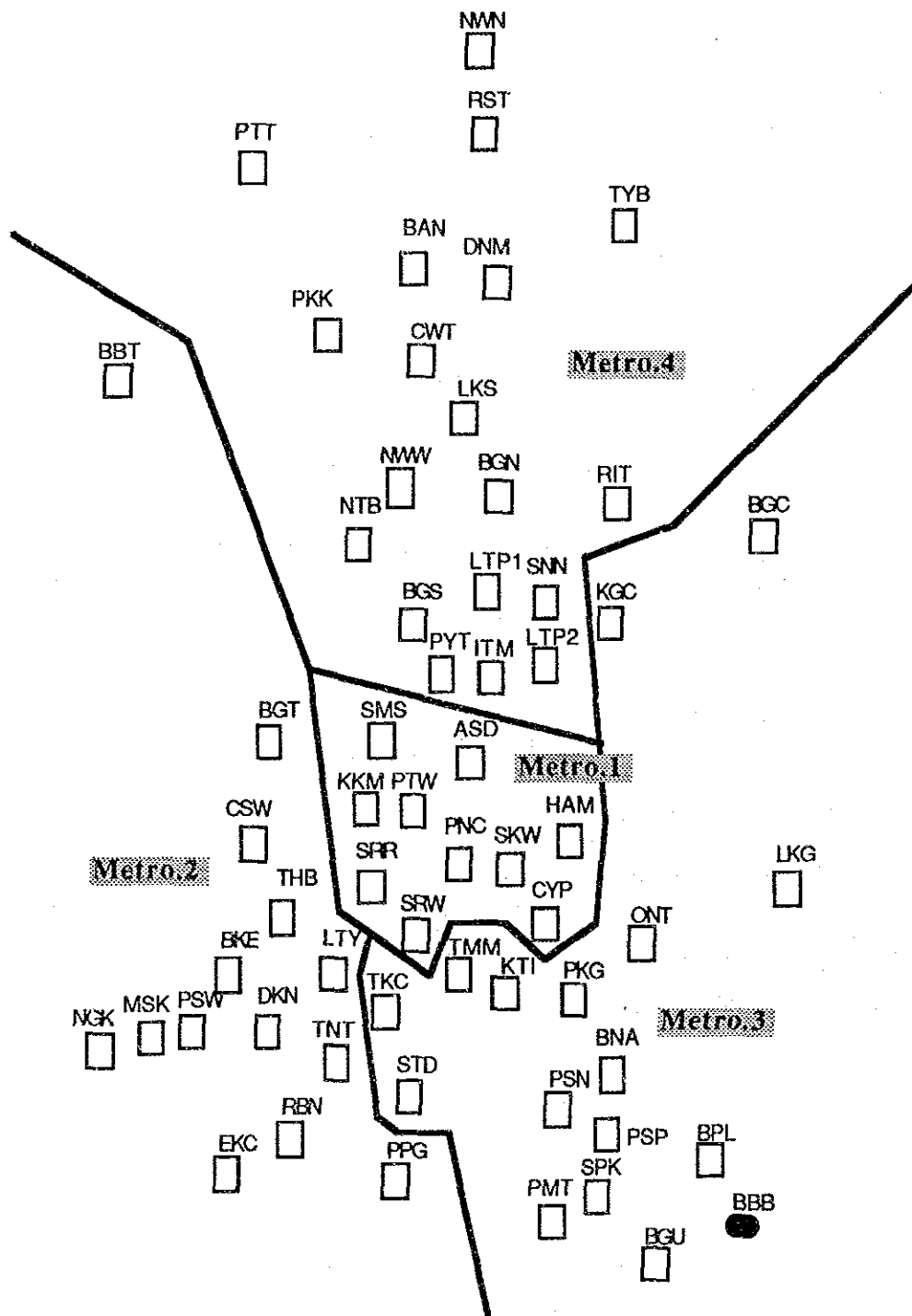


Figure 2.3.1-1 Location of LE in Metropolitan Area

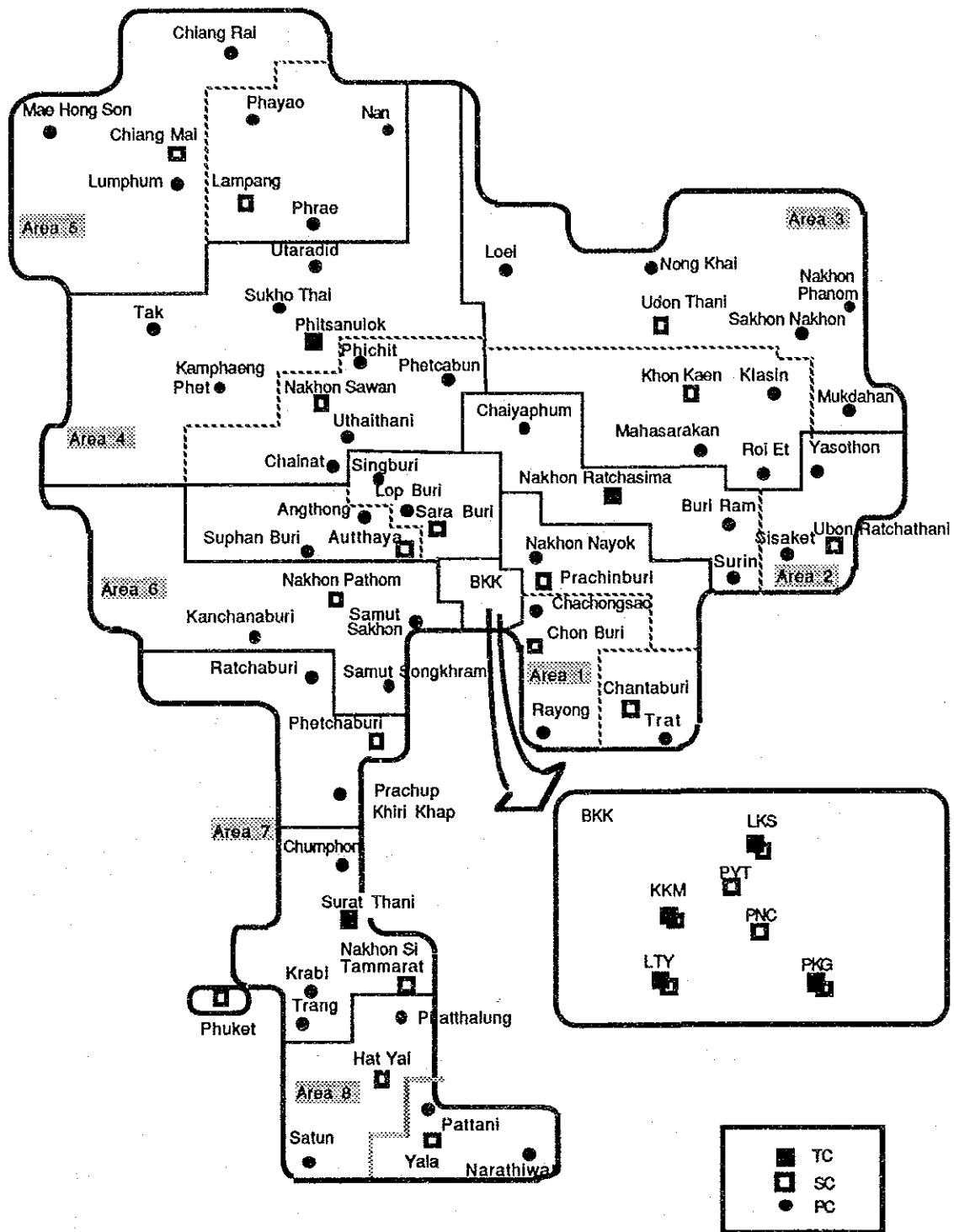


Figure 2.3.1-2 Location of PC Level and above

Table 2.3.1-3, Table 2.3.1-4, Figure 2.3.1-3 and Figure 2.3.1-4 present the development of exchanges for the past five years, and Figure 2.3.1-5 and Figure 2.3.1-6 show the present status of digitization.

Table 2.3.1-3 Annual Development of Number of Exchanges

Year	Location	1983	1984	1985	1986	1987
No. of Exchanges	Metro.	56	63	96	109	117
	Prov.	161	186	210	238	242
	Total	217	249	306	347	359
No. of Digital Exchanges	Metro.	12	13	52	73	74
	Prov.	8	37	74	137	150
	Total	20	50	126	210	224

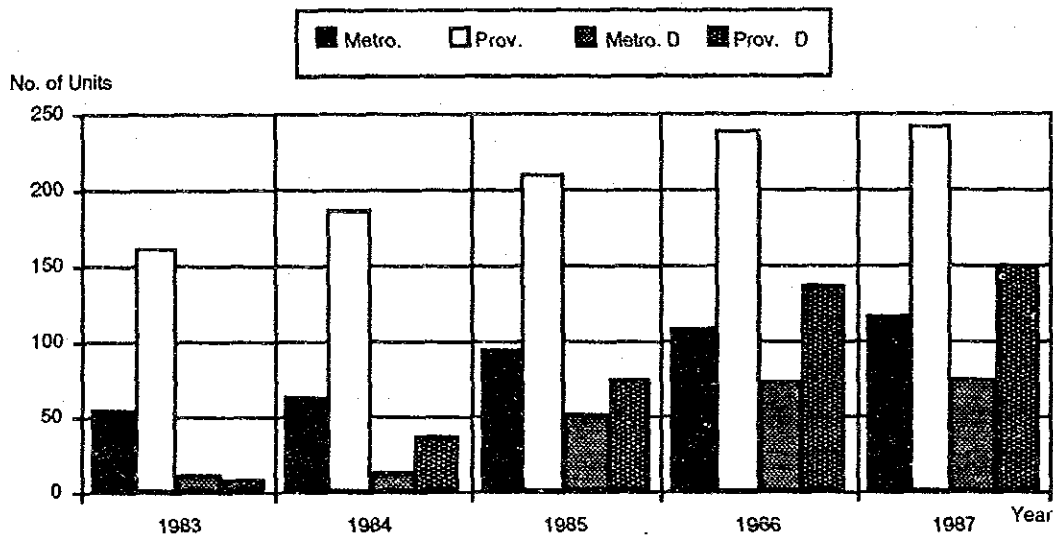


Figure 2.3.1-3 Annual Development of Number of Exchanges

It has been five years since TOT began to introduce digital exchanges, consequently the digitization ratio of exchange has become higher. All of the exchanges, however, cannot always provide ISDN service at present because these are basically only digital exchanges. Some exchanges have the function of ISDN services and others do not have. Therefore, when TOT tries to begin ISDN service, the condition of the exchanges should be examined.

Table 2.3.1-4 Annual Development of Number of Line Capacities
(Unit: 1000)

Year	Location	1983	1984	1985	1986	1987
Number of Line Capacities	Metro.	475	495	586	669	861
	Prov.	137	187	244	337	389
	Total	612	682	830	1006	1250
Number of Digital Line Capacities	Metro. D	10	12	221	306	497
	Prov. D	7	49	114	211	254
	Total	17	61	335	517	751

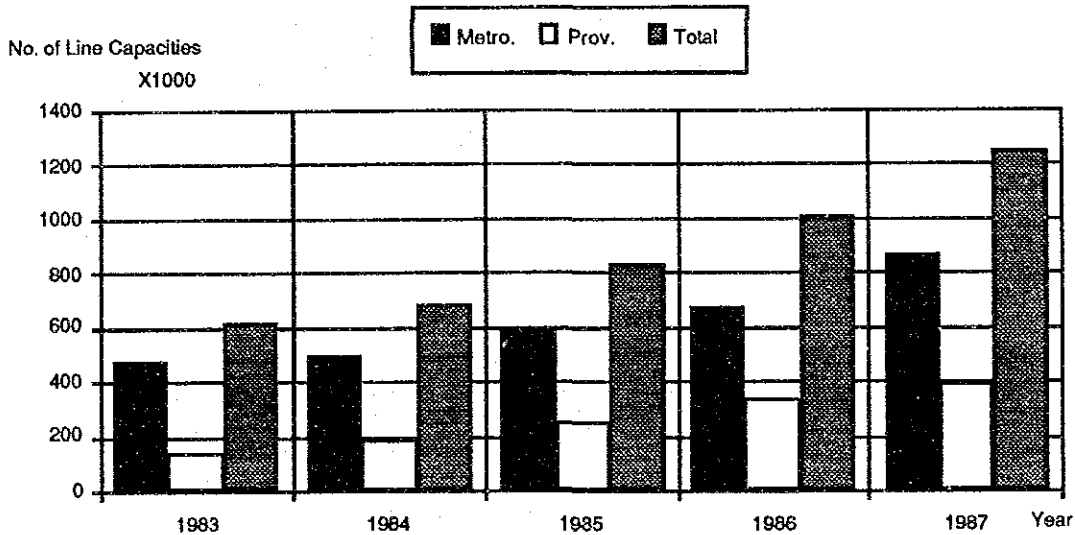


Figure 2.3.1-4 Annual Development of Number of Line Capacities

In general, the number of exchanges and line capacities provided by digital exchanges are larger than those of analog's and it is also the same for transmission circuits. It is, however, another matter whether it can provide ISDN service for a considerable area or not.

Especially, in metropolitan area 1 where is the center area of Bangkok, this is only one exchange for ISDN services at present. Therefore, when the expansion plan of exchanges is to be established, not only the expansion plan but also strategy on provision of ISDN service, reuse of existing digital exchange for it and economy evaluation should be considered. Table 2.3.1-5 shows the ratio of the number of digital lines which can offer IDN service. The detailed data on each exchanges are published in Appendix.

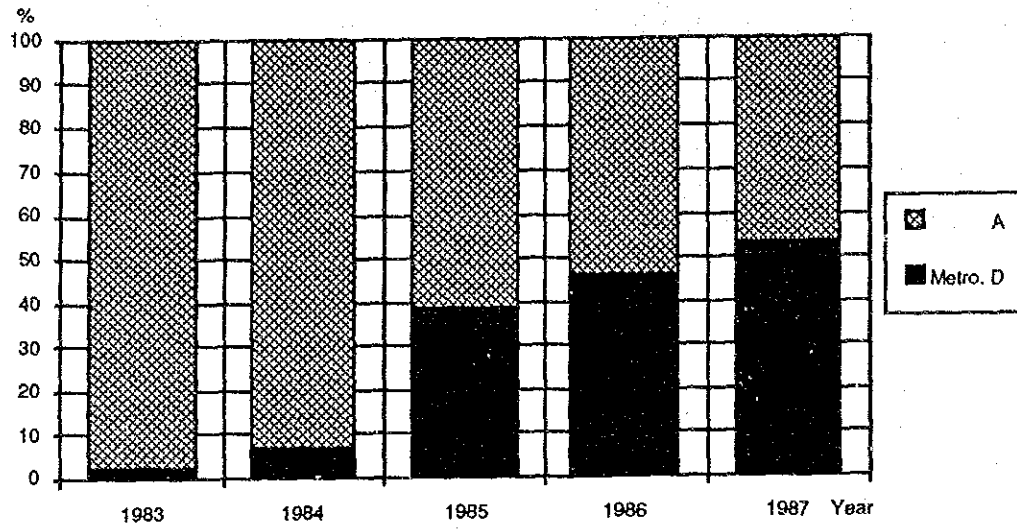


Figure 2.3.1-5 Ratio of Exchange Classified by Analog and Digital in Metropolitan Area

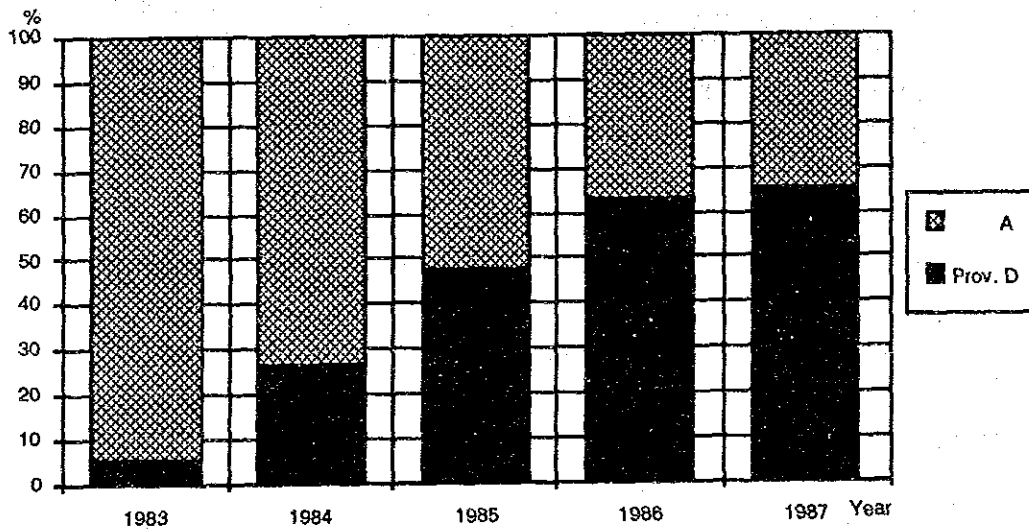


Figure 2.3.1-6 Ratio of Exchange Classified by Analog and Digital in Provincial Area

Table 2.3.1-5 Ratio of ISDN Lines

Area Name	Ratio	Area Name	Ratio
Metro.1	5%	Prov.1	76%
Metro.2	14%	Prov.2	49%
Metro.3	12%	Prov.3	64%
Metro.4	22%	Prov.4	86%
		Prov.5	70%
		Prov.6	53%
		Prov.7	72%
		Prov.8	42%
		Prov.9	51%
All Metro.	13%	All Prov.	64%

The end of 5th Project

2.3.2 Transmission Facilities

1) General

In this section, Long distance transmission system includes both the systems to link PC-PC, PC-SC, PC-TC, SC-SC, SC-TC, TC-TC and the system to link a switching facility to the other facilities in a PC area except Junction transmission systems. And junction transmission system means transmission systems which link a switching facility to the other switching facilities in Metropolitan area, Khon Kaen and Chiang Mai.

2) Long Distance Transmission

Long distance transmission network has been constructed through the five zones defined as follows:

- a) The first zone covering the central part including Bangkok, Ayutthaya, Supanburi, Saraburi, Nakhon Pathom, Rachaburi and Phetchaburi, etc.,
- b) The second zone covering the eastern part including Chon Buri, Rayong, Chanthaburi and Prachin Buri, etc.,
- c) The third zone covering the northeastern part including Nakhon Ratchasima, Khon Kaen, Udon Thani, Nong Khai, Buri Ram, Surin and Ubon Ratchathani, etc.,
- d) The fourth zone covering the north part including Lop Buri, Nakhon Sawan, Phichit, Phitsanulok, Uttaradit, Lampang and Chiang Mai, etc.,
- e) The fifth zone covering the south part including Prachuap Khiri Khan, Chunpon, Surat Thani, Nakhon Si Thammarat and Songkhla, etc.

Total route length and circuits of the long distance transmission network are given in Table 2.3.2-1. There are 721 systems and 42,337 kilometers of total route length at the end of July 1988. Table 2.3.2-2 shows the transmission network at the end of 5th project.

The rate of digitization in the transmission network has been rising, and it has reached about 75 percent of all transmission network by the end of FY 1988. Figure 2.3.2-1 shows the rate of each system in the transmission network. In this figure, it seems that TOT has mainly adopted microwave systems for long distance transmission.

Table 2.3.2-1 Existing Long Distance Transmission Network

(End of 1988)

Transmission System	Number of System	Route Length (km)	Channel End	
			Capacity	Working
Radio System				
Analog Microwave				
2700 CH System	1	4.30	2,700	0
1800 CH System	9	2,355.11	16,200	11,817
960 CH System	15	1,831.00	14,400	2,304
300 CH System	52	3,241.13	15,600	3,715
240 CH System	1	50.40	240	78
FDM Radio UHF	1	19.00	18	12
SUB TOTAL	79	7,500.94	49,158	17,926
Radio System				
Digital Microwave				
140 Mb/s System	7	2,124.34	13,440	6,180
68 Mb/s System	20	3,486.57	19,200	15,744
34 Mb/s System	121	14,087.59	58,080	26,324
17 Mb/s System	364	13,382.61	87,360	8,794
PCM Radio UHF	3	76.02	144	110
SUB TOTAL	515	33,157.13	178,224	57,152
Cable System				
Coaxial Cable System				
2700 CH System	1	5.99	2,700	3,008
960 CH System	8	30.56	7,680	5,052
300 CH System	3	14.96	900	538
FDM Cable System	7	206.66	336	266
VF Cable	6	23.68	0	0
SUB TOTAL	25	281.85	11,616	8,864
Cable System				
Optical Fiber Cable				
140 Mb/s System	12	27.76	23,040	3,120
68 Mb/s System	4	102.62	3,840	1,320
34 Mb/s System	8	233.65	3,840	1,860
PCM Cable System	75	880.47	2,250	
SUB TOTAL	99	1,244.50	32,970	6,300
TOTAL	718	42,184.42	271,968	90,242
International Transmission				
Microwave				
960 CH Capacity	2	152.60	1,920	92
Submarine Cable				
24 CH System	1	0.00	24	24
SUB TOTAL	3	152.60	1,944	116
GRAND TOTAL	721	42,337.02	273,912	90,358

Table 2.3.2-2 Transmission Network (End of 5th project)

Transmission System	Frequency Band (GHz)	Number of System	Distance (Km)	Remarks
Radio System				
Analog Microwave				
2700 CH System			4.3	
1800 CH System			2,914.5	
960 CH System			1,263.3	
300 CH System			2,663.8	
Sub Total			6,845.9	
Digital Microwave	4.7	1+1	111.0	
140 Mb/s System		2+1	326.8	
16 QAM		3+1	31.9	
	6.7	1+1	3,088.0	
		2+1	1,401.3	
		3+1	615.5	
	11.2	1+1	40.7	
		2+1	19.2	
		5+1	11.2	
Sub Total			5,645.6	
68 Mb/s System	7.5	1+1	1,103.0	
16 QAM		2+1	507.3	
		3+1	23.9	
Sub Total			1,634.2	
34 Mb/s System	2.0	1+0	2,846.7	
4 PSK		(1+0)2	114.9	
		1+1	186.0	
		(1+1)2	65.6	
		2+1	119.1	
	2.2	1+0	1,713.4	
		(1+0)2	29.8	
		1+1	461.5	
		(1+1)2	176.0	
		2+1	65.4	
	6.7	1+0	47.0	
	7.2	1+0	421.4	
		2+1	174.5	
	7.5	1+1	1,615.8	
		2+1	693.5	
Sub Total			8,730.6	
17 Mb/s System	2.0	1+0	5,301.0	
4 PSK		1+1	32.4	
	2.2	1+0	4,847.0	
		1+1	47.1	
	7.2	1+0	320.2	
Sub Total			10,547.7	
Digital Micro. Total			26,558.1	
Optical Fiber Cable				
565 Mb/s System			1,433.1	1,300 nm
140 Mb/s System			6.7	1,300 nm
			40.8	850 nm
34 Mb/s System			1,174.4	1,300 nm
			25.3	850 nm
Sub Total			2,680.3	
Grand Total			36,084.3	

Microwave system has been adopted by TOT to construct the transmission network. And it has become a large majority in the transmission network as shown in Figure 2.3.2-1.

Figure 2.3.2-2 (digital) and Figure 2.3.2-3 (analog) shows the layout of the long distance transmission network in the whole country at the end of 1992, and Figure 2.3.2-4 shows the layout of the long distance transmission network in Metropolitan area at the end of 1992.

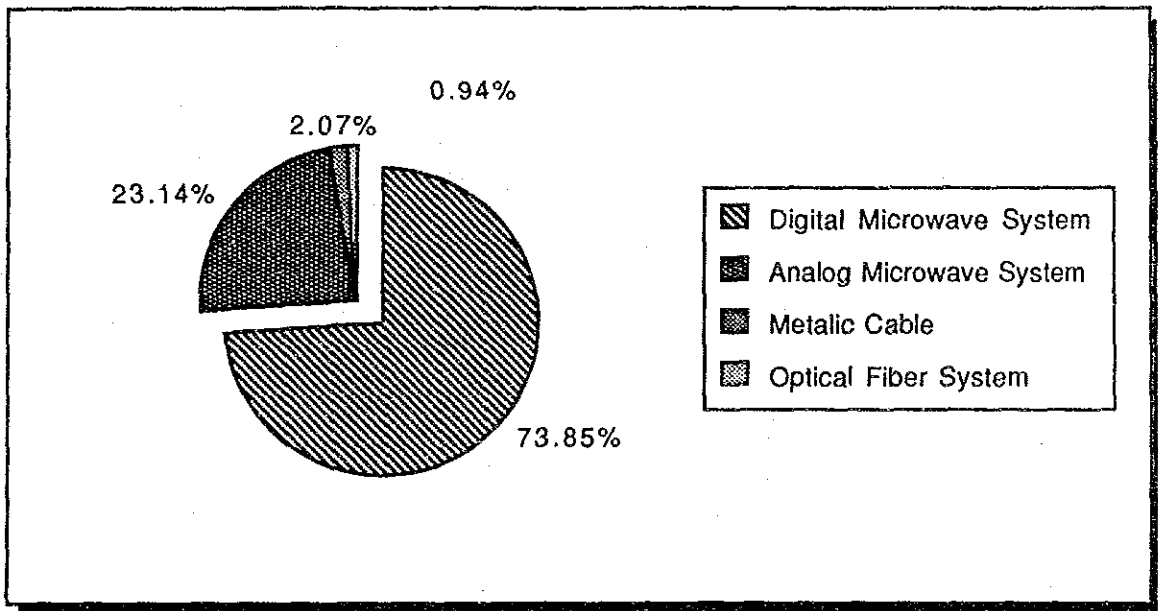


Figure 2.3.2-1 Constitution of Transmission System (End of 1988)

It is very important and necessary to enhance reliability of the telecommunication network to render the better telecommunication services.

At present, most of Transmission routes consist of tree-type, in other words, transmission routes consist of single transmission system. Introduction of looping and duplexing for transmission links was just started in the 5th ESDP project.

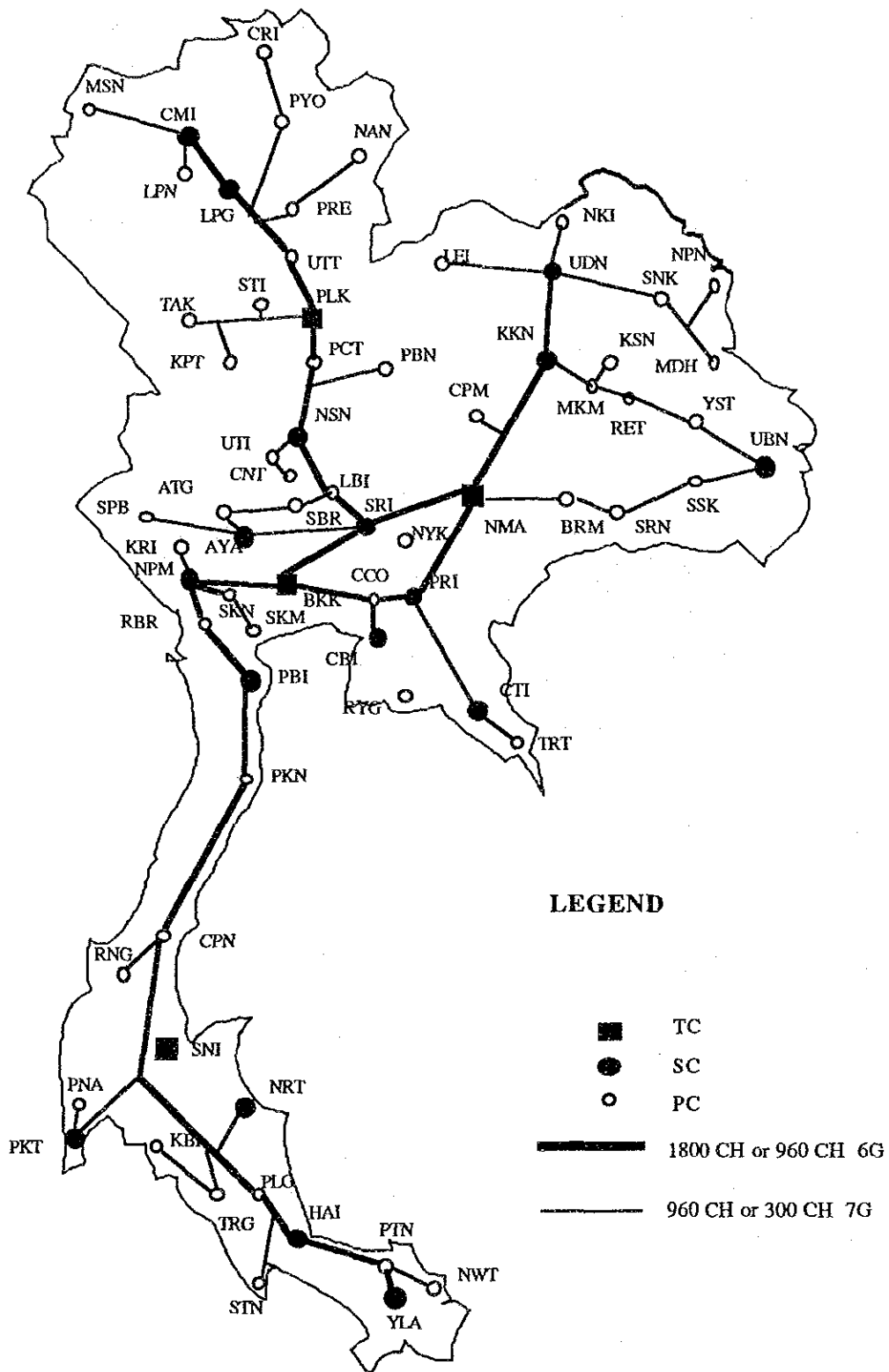


Figure 2.3.2-2 Long Distance Analog Transmission Layout (End of 1989)

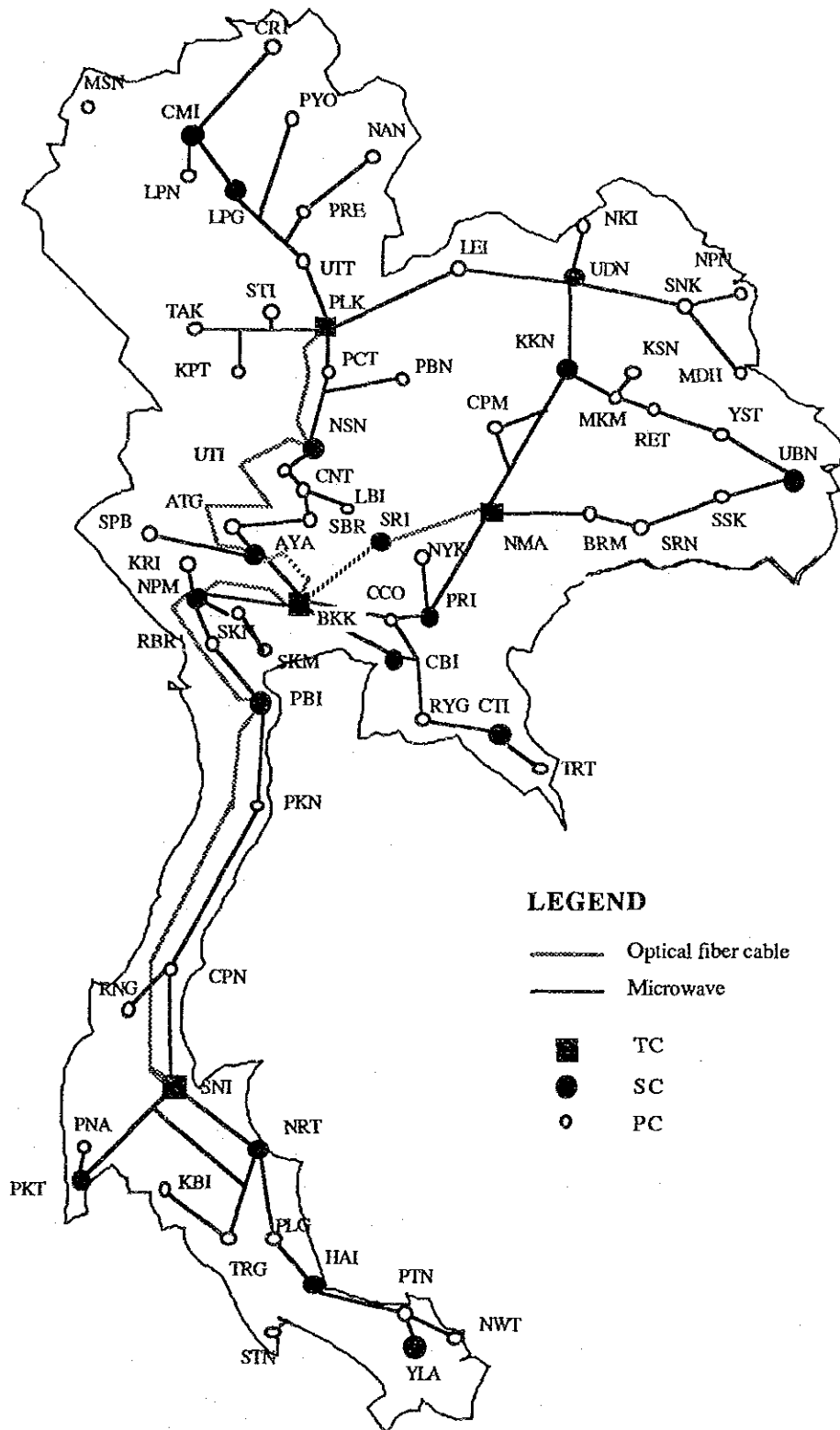


Figure 2.3.2-3 Long Distance Digital Transmission Layout (End of 1992)

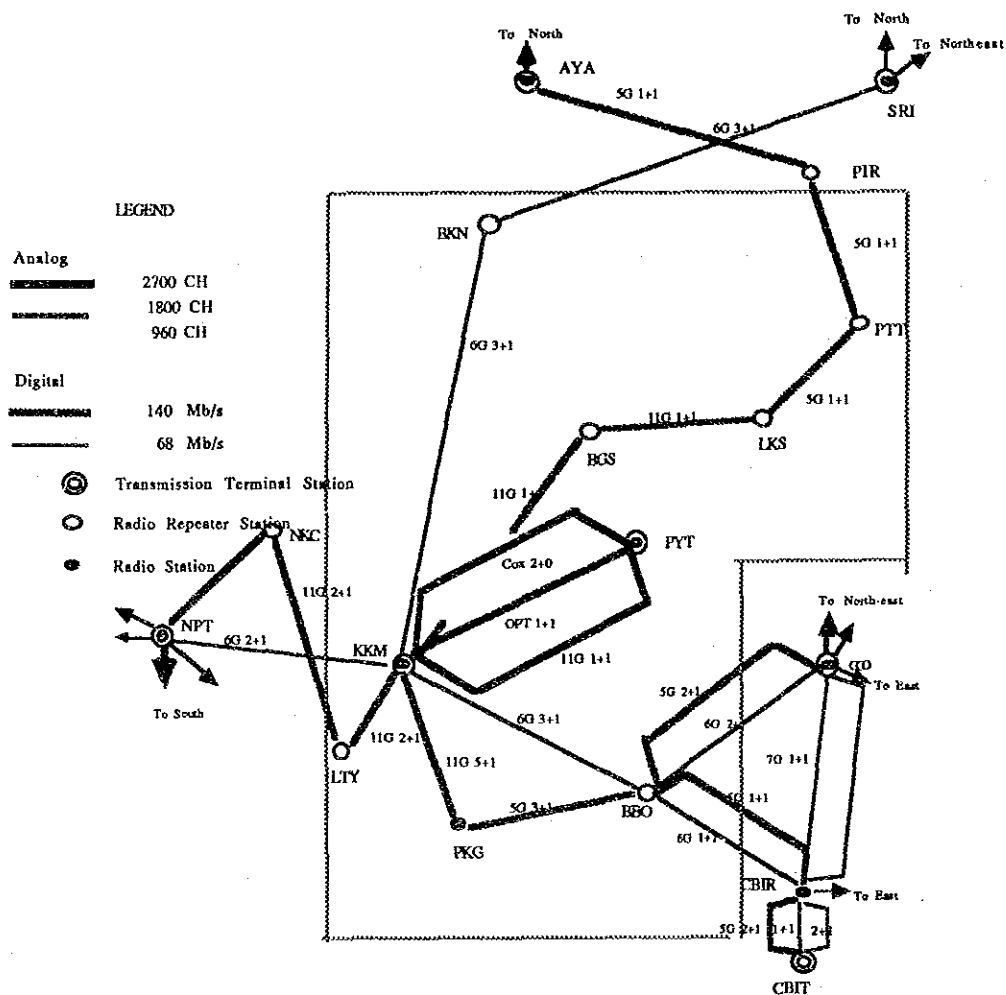


Figure 2.3.2-4 Long Distance Transmission Network (Metropolitan Area End of 1989)

2) Junction Transmission Network

Junction transmission networks exist in three areas, namely, Chiang Mai, Khon Kaen and Bangkok. In Chiang Mai area, the junction transmission connects Chiang Mai 1 and Chiang Mai 2 with the 34 Mb/s optical fiber system, and also connects Chiang Mai 2 and Chiang Mai 3 with the 140 Mb/s system. In Khon Kaen area, a junction connects Khon Kaen 1 and Khon Kaen 2 with the 140 Mb/s optical fiber system.

In Bangkok Metropolitan area, about 4,000 metallic PCM systems are working at the end of FY 1988, and some radio transmission systems are used as shown in Figure 2.3.2-5. They link SPC switching facilities with 2 Mb/s Digital Transmission Interface (DTI), and XB switching facilities with voice channel codec.

The optical fiber systems have been constructed in the 5th project, and the metallic PCM systems will almost have been replaced by the optical fiber systems by the end of 1992 as shown in Figure 2.3.2-5. And microwave routes of the junction network, which will be replaced by optical fiber systems, are shown in Figure 2.3.2-6.

According to the sampling data in 400 metallic PCM systems, the rate of working channels is more than 95 percent, which shows the efficient use of the facilities.

3) Television and Radio Program Transmission System

As shown in Figure 2.3.2-7, TOT is offering television program transmission for one user (National Broadcasting Services of Thailand: NBT). The television program is transmitted from Bangkok to Chiang Mai, Hat Yai and Khon Kaen by analog microwave transmission systems.

As shown in Figure 2.3.2-7, the user has already had a plan. Therefore, TOT should consider to provide the television program transmission network. And a proposed transmission system for television program is described in Chapter 8.

For radio broadcasting, most of the program transmission are offered for AM system (also it is offered for one user NBT). In future however, Frequency Modulation (FM) system will exceed AM system in the radio broadcasting. Figure 2.3.2-8 shows the plan of FM Radio Station. Therefore, it should be studied to provide the digital transmission system for carrying FM Stereo Program, also according to the requirement from radio broadcasting companies.

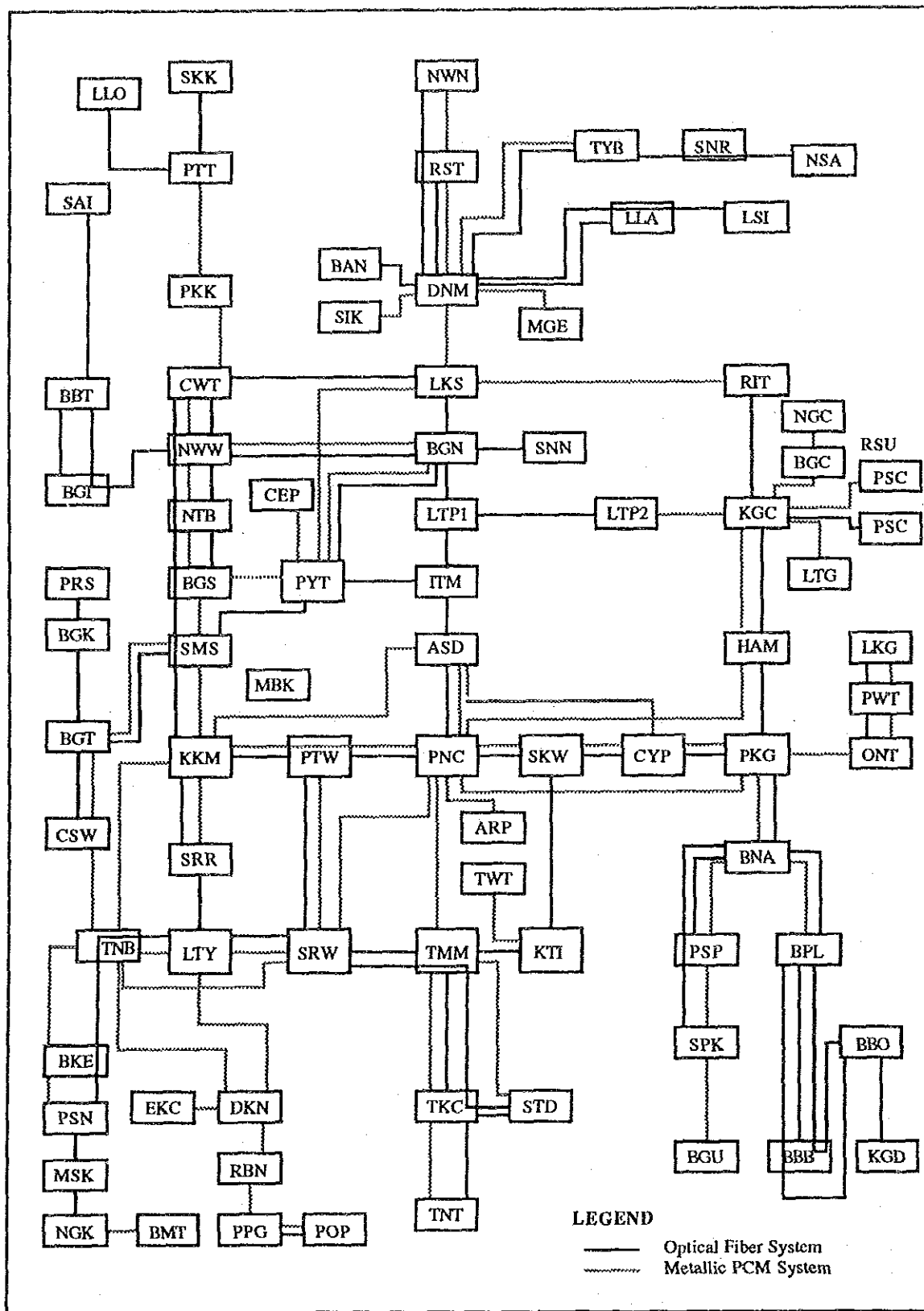


Figure 2.3.2-5 Metropolitan Junction Transmission Network Layout (End of 1992)

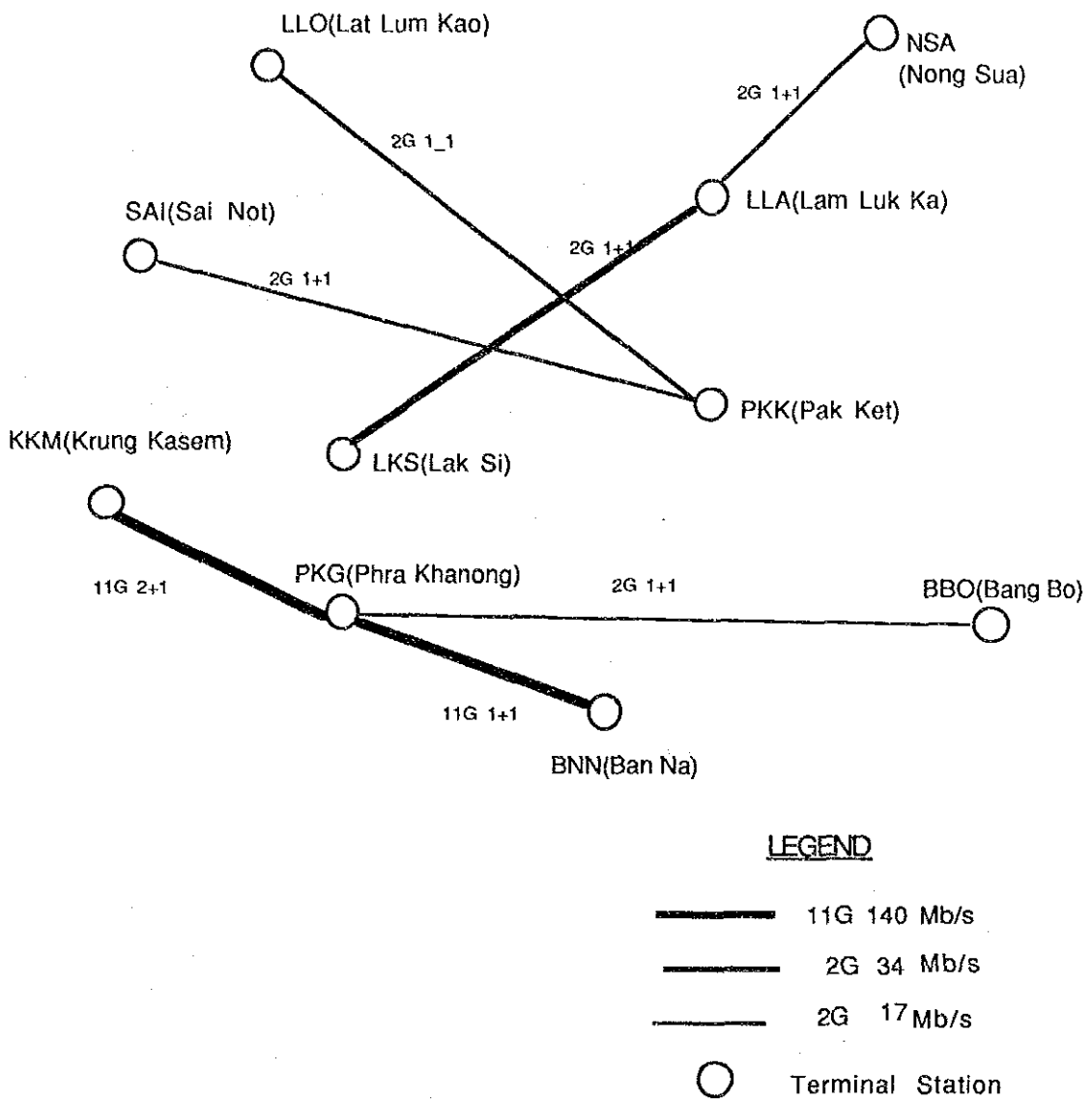
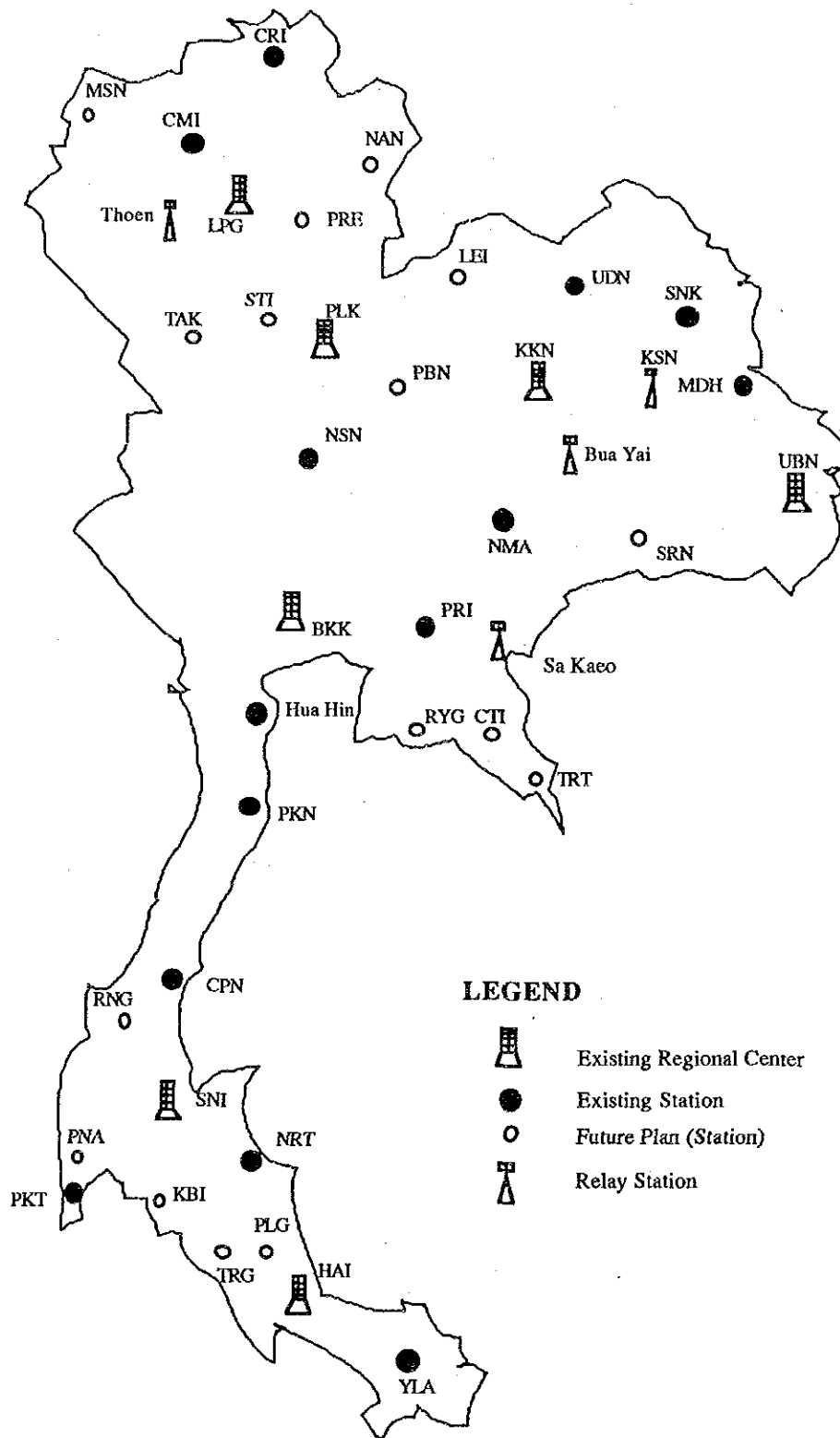
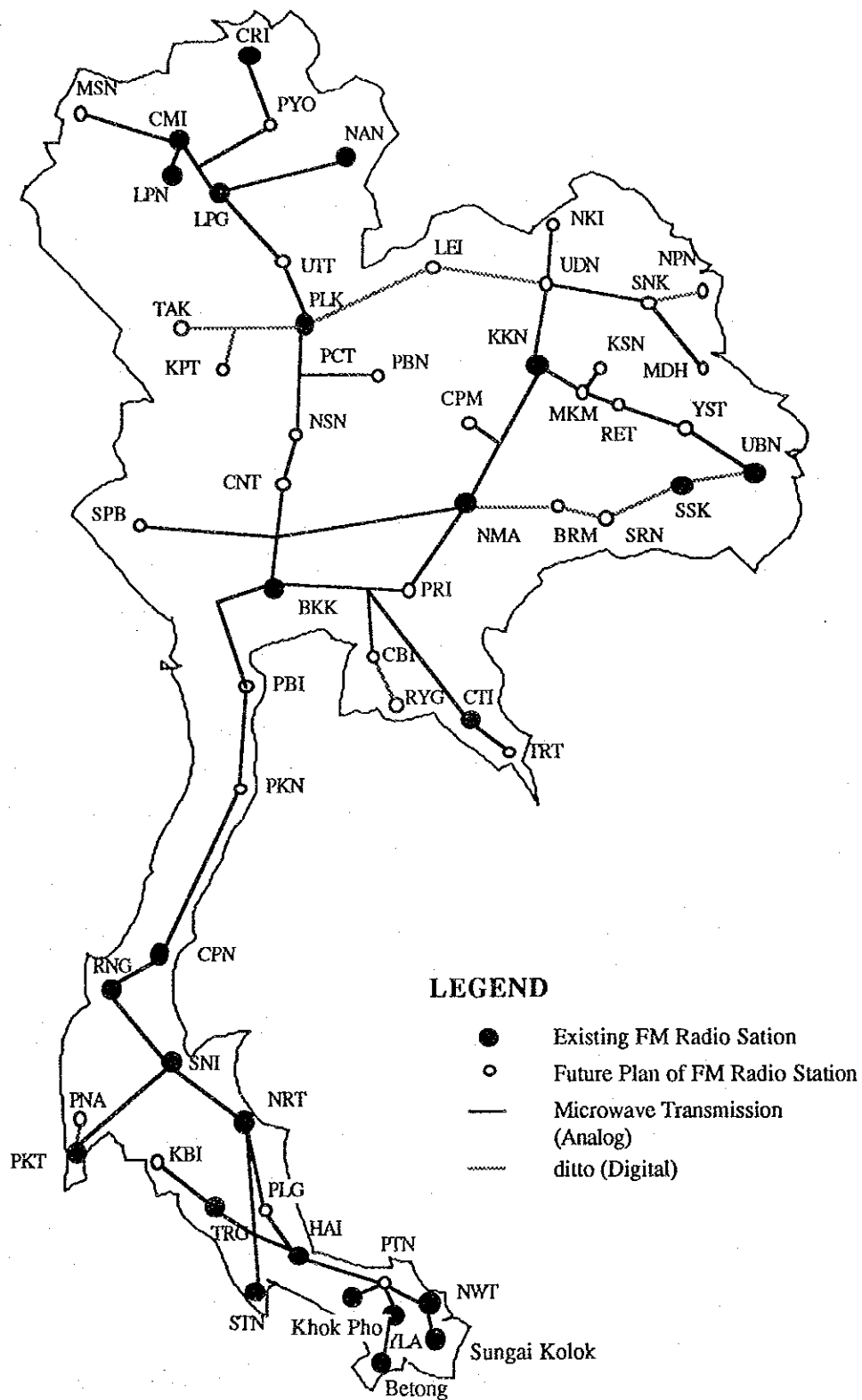


Figure 2.3.2-6 Metropolitan Junction Radio Transmission Network (End of 1988)



Source: PRD

Figure 2.3.2-7 Configuration of TV Broadcasting Station (End of 1988)



Source: PRD

Figure 2.3.2-8 Configuration of FM Radio Station (End of 1988)

2.3.3 Outside Plant Facilities

1) Facilities

TOT has been providing telecommunication services through local cable pairs, and UHF radio subscriber links with TDMA function system in local exchange areas. Radio subscriber links are generally used in the rural areas, and local cable pairs are mainly used in the metropolitan area and in the main cities of provincial areas. In addition, TOT has also been providing telecommunication services through subscriber carrier system in some urban areas for the lack of local cable pairs. However, this system has gradually been decreasing with expansion of local cables.

As of February 1989, TOT has about 1.56 million pairs of local cables in all over the country. The metropolitan area including telecommunication area 1 to 4 holds seventy percent of all local cable pairs. Among the total of local cable pairs in the whole country, about 70% of them have been connected to the customers for service. Especially in the metropolitan telecommunication area, the occupancy ratio is higher than 70 percent.

Figure 2.3.3-1 shows the present state of local cable pairs in each telecommunication area. And Figure 2.3.3-2 shows the present state of used cable pairs by changwat as of February 1989. In the central area of Bangkok and rapidly developing areas, aerial cables and drop wires are very densely installed, and underground facilities (conduits) lack space for additional cable installation. Therefore, there are some underground cables which are installed temporarily into telephone office without conduits. As a measure to cope with lack of space, sub-conduit method, inserting several pipes into a conduit, was introduced for installation of optical fiber cables as junctions in the metropolitan area. Almost all the aerial cables are installed with the poles belonging to electric enterprise. Gas pressuring system has been applied to the existing underground cables. However, new jelly-filled cables have been installed in recent years without gas pressuring system, making maintenance activities efficient.

Generally in other areas, however, underground facilities have enough room for cable to be constructed, and aerial facilities are rather in good condition.

TOT has introduced rigid distribution system for secondary cable network and primary cable pairs are connected with secondary cable pairs through the cable cabinet. Figure 2.3.3-3 shows the configuration of subscriber network.

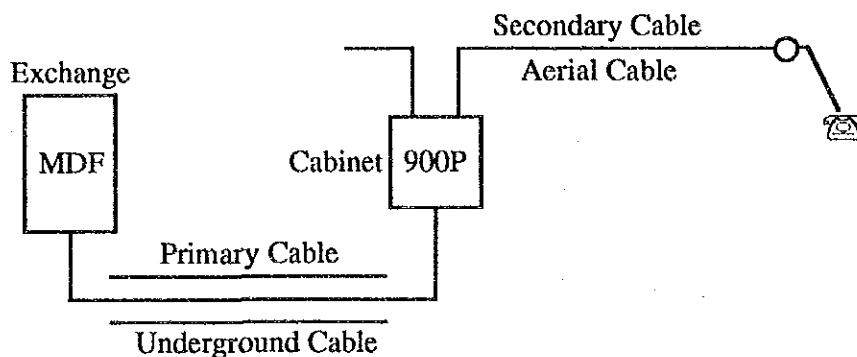


Figure 2.3.3-3 Configuration of Subscriber Network

2) Rural Telecommunications

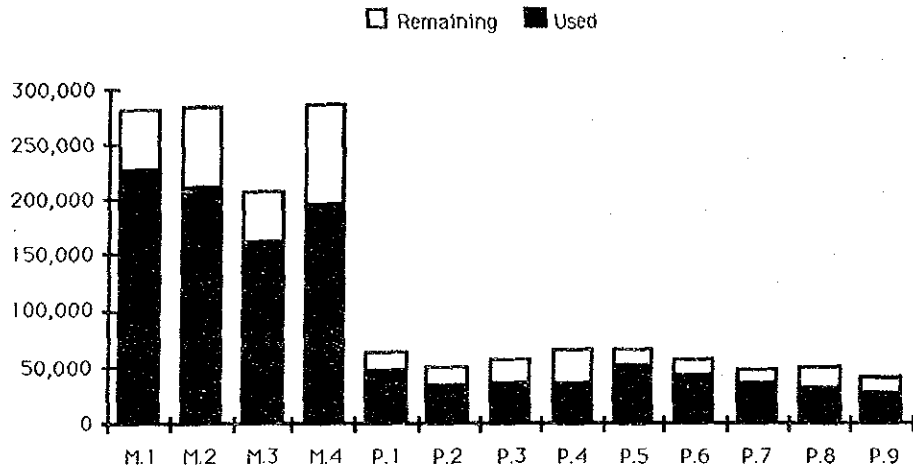
TOT has carried out Rural Long Distance Telephone Project, which consists of two projects, in order to alleviate the inconvenience of public and government sectors on the communications.

As the results of completion of these projects, it is expected to make more progress of agricultural, commercial and industrial activities in the rural areas. The main object of these projects are as follows.

- a) 1st Rural Telecommunication Project (1977~1986)
 - Public Telephone Service
 - Extend to Amphoe Level (amphoe, king amphoe)
 - No. of Location: 521
 - Average No. of sub./Local: 10
 - Point to Point Transmission

- b) 2nd Rural Telecommunication Project (1987~1989)
 - Public Telephone Service
 - Extend to Tambon Level
 - No. of Location: 1,813
 - Average No. of sub./Location: 3
 - Point to Multipoint Transmission

Figure 2.3.3-4 shows configuration for rural telecommunication system.



	M.1	M.2	M.3	M.4	P.1	P.2	P.3
Used	223,846	209,114	159,151	192,956	45,651	33,936	34,156
Remaining	59,026	75,743	47,802	92,326	17,312	16,802	21,782
Total	282,872	284,857	206,953	285,282	62,963	50,738	55,938

Area	P.4	P.5	P.6	P.7	P.8	P.9	Total
Used	35,215	49,217	41,517	34,409	29,813	26,669	1,115,650
Remaining	30,904	17,440	14,053	13,641	20,685	12,695	440,211
Total	66,119	66,657	55,570	46,239	50,498	37,648	1,555,861

Figure 2.3.3-1(1) Present State of Local Cable (Number of Pairs)

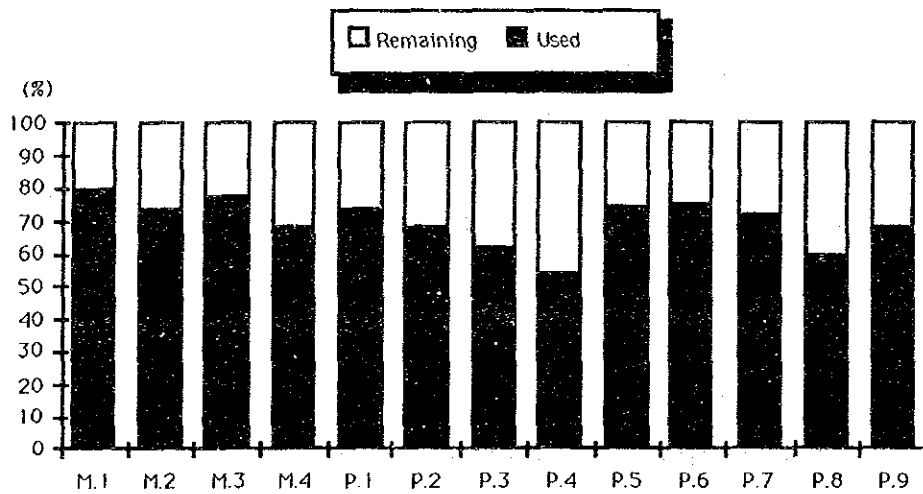


Figure 2.3.3-1(2) Present State of Local Cable (Used Ratio)

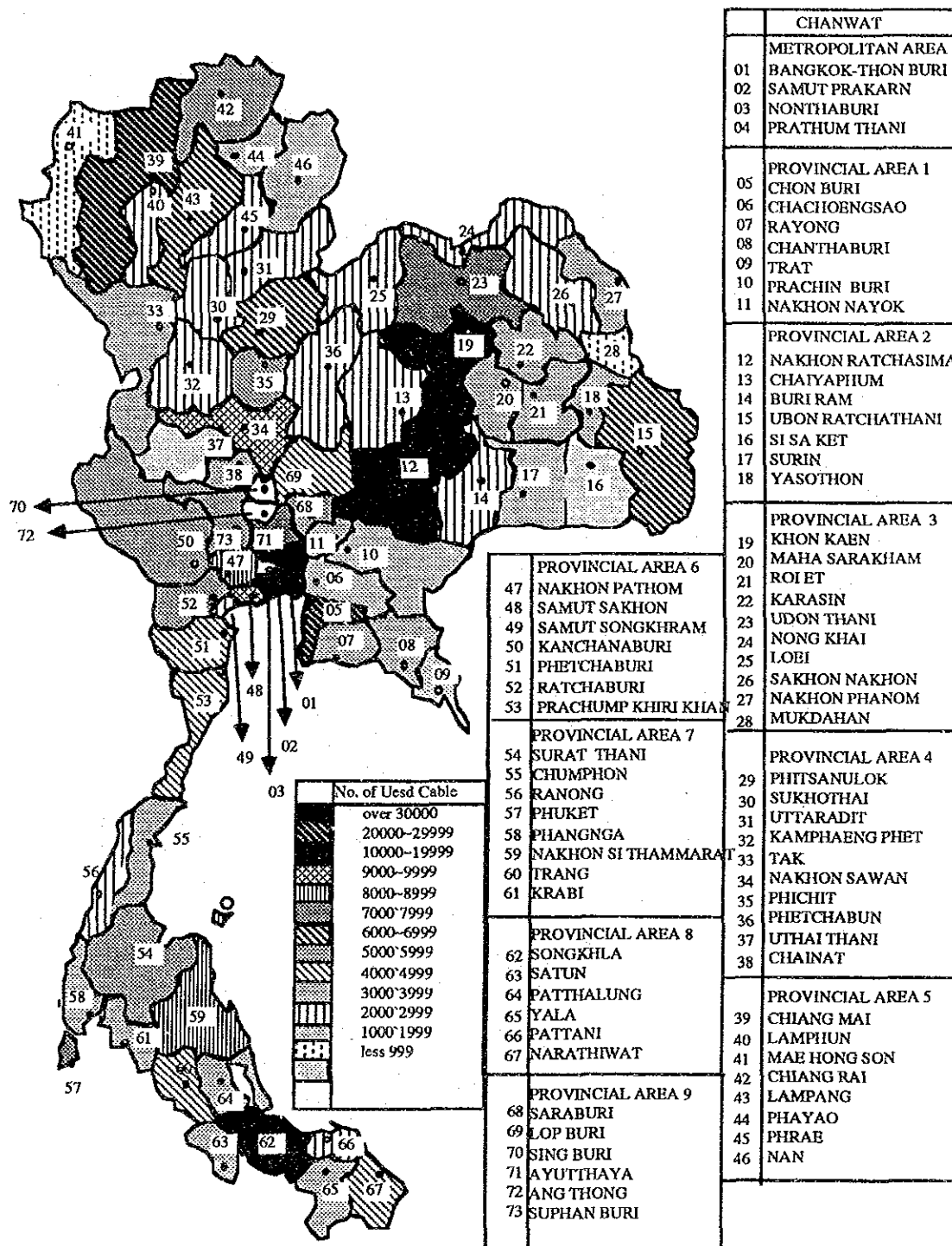


Figure 2.3.3-2 Used Cable Pairs

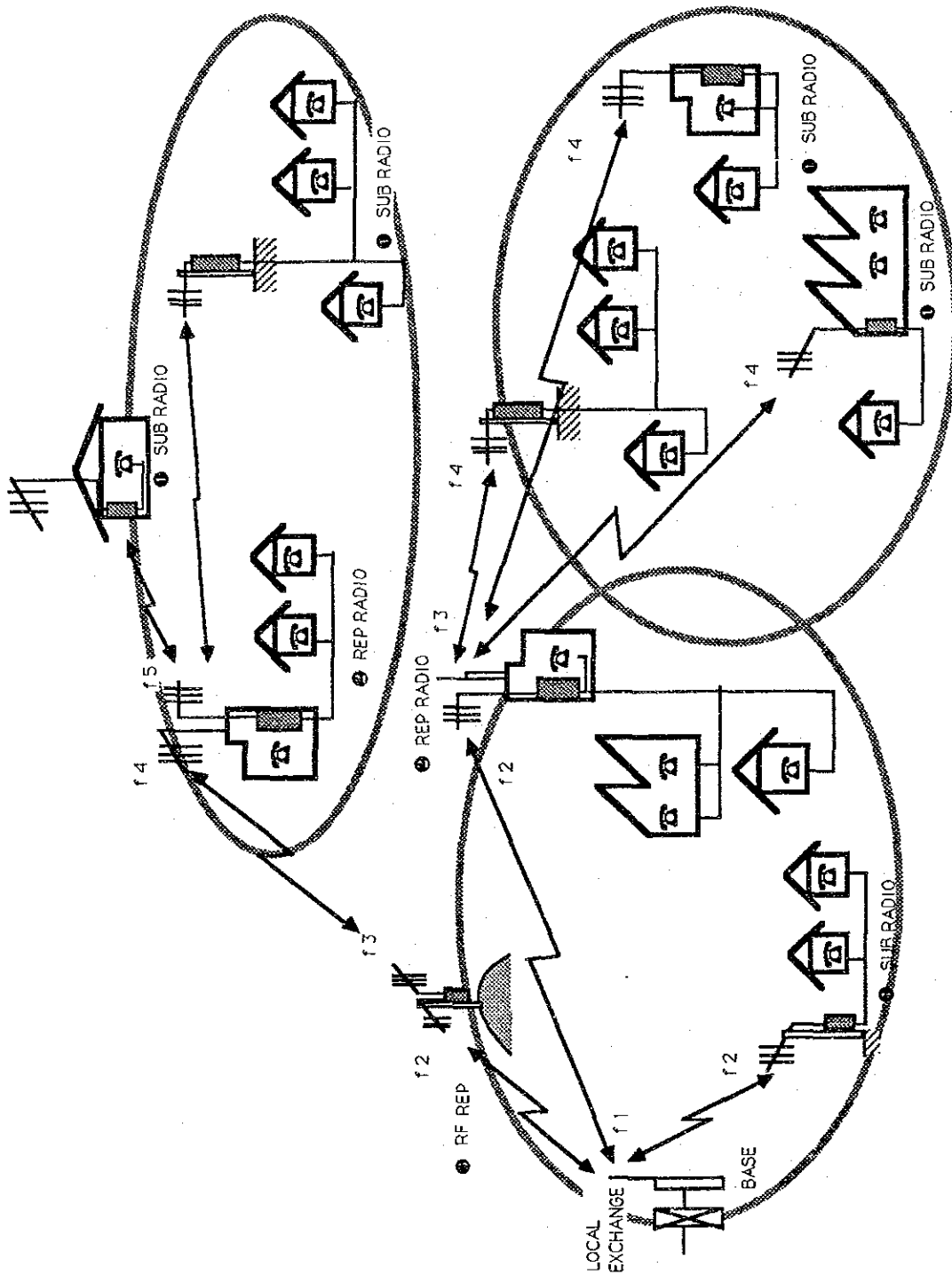


Figure 2.3.3-4 Configuration of Rural Telecommunication System (TDMA)

2.3.4 Cellular Mobile Facilities

1) Facilities for TOT's Cellular Mobile Service

a) Basic Facilities

The cellular mobile system is composed of 3 major facilities, namely,
Mobile Telephone Exchange (MTX),
Radio Base Station (RBS),
Mobile Station (MS).

A Mobile Telephone Exchange (MTX) is one type of SPC exchange. One MTX corresponds to one "Service area" and can cover 16 "Traffic area" at maximum. At present, traffic areas are divided into Bangkok metropolitan area, eastern seaboard area and western seaboard area. One traffic area is able to have 1 to 64 cells.

During the initial period, only one MTX has been employed and it was installed at the Krung Kasem telecommunication center in Bangkok. Within one MTX (Service area), 60,000 Mobile Stations (MS) can be accommodated. Until the year of 1991, additional MTXs will be set up at 4 locations, namely, Krung Kasem as the 2nd exchange, Nakhon Rachasima, Phitsanulok and Surat Thani. As a result of this expansion, the number of line capacities will reach 59,023 line units.

One Radio Base Station (RBS) has one cell, two cells or six cells depending on the density of Mobile Stations (MS). The working frequency adopts 479 to 483.5 MHz for the section from MS to RBS and 489 to 493.5 MHz for the section from RBS to MS with a channel spacing of 20 kHz band. Within one RBS, 225 traffic channels can be accommodated.

The map of location and territory covered by RBS is shown in Figure 2.3.4-1. The past introduction progress and the future expansion plan up to the year of 1991 are shown in Table 2.3.4-1.

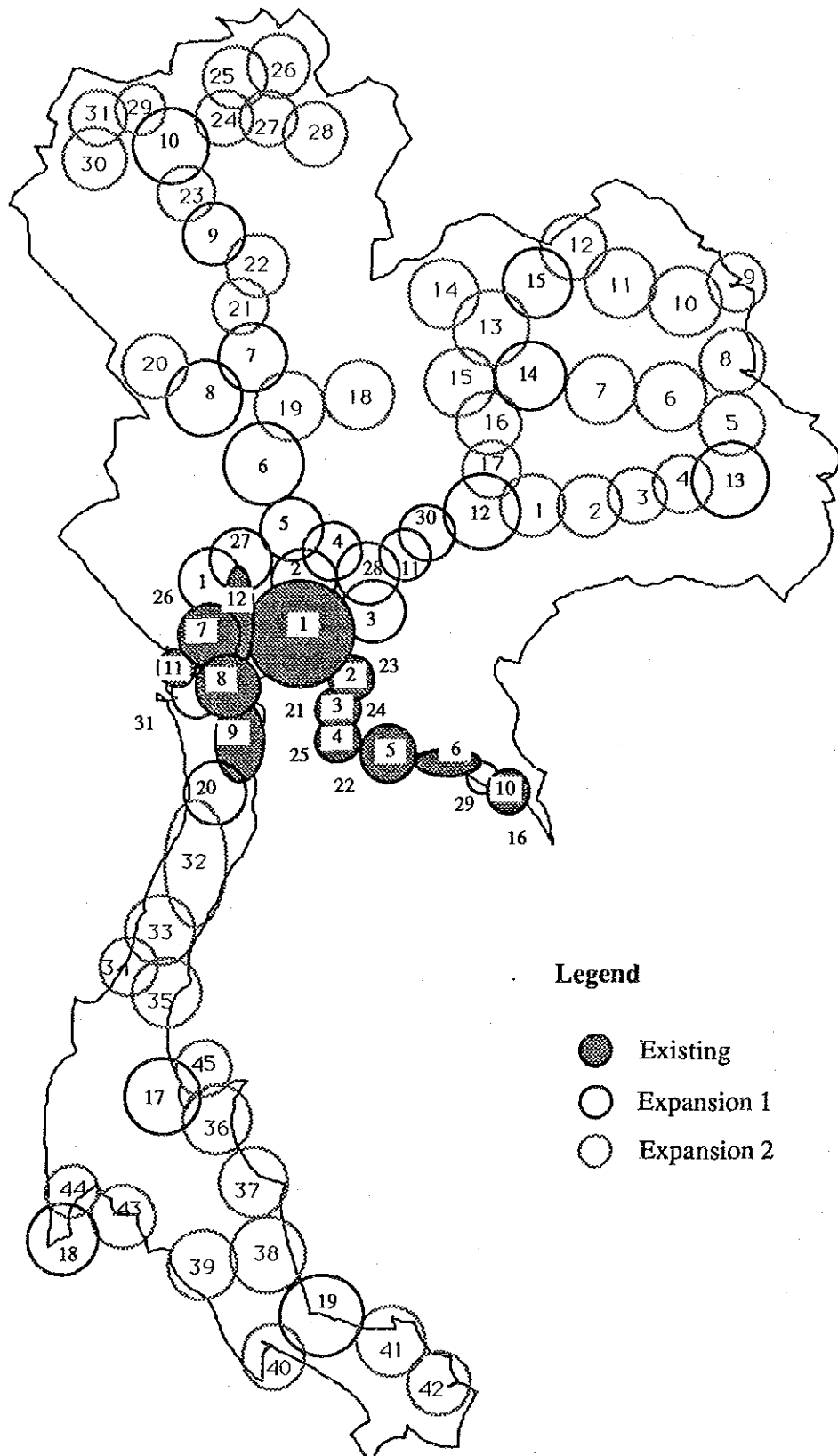


Figure 2.3.4-1 Location of Radio Base Station (1/2)

Existing

1. Bangkok
2. Bang Pakong
3. Si Racha
4. Ban Khanamrai
5. Khao Yaida
6. Chantha Buri
7. Nakhon Pathom
8. Phetchaburi
9. Hua Hin Radio
10. Trat
11. Ratchaburi
12. Suphan Buri

Expansion 1

1. Kanchanaburi
2. Ayutthaya
3. Nakhon Nayok
4. Lop Buri
5. Chai Nat
6. Nakhon Sawan Radio
7. Phitsanulok Radio
8. Kamphaeng Phet
9. Lampang Radio
10. Chiang Mai 3
11. Khao Pheng Ma
12. Nakhon Ratchasima
13. Ubon Ratchathani Radio
14. Khon Kaen 2
15. Udon Thani
16. Khao Wong Wian
17. Surat Thani
18. Phuket Radio
19. Hat Yai Radio
20. Prachuap Khiri Khan
21. Chon Buri Radio
22. Rayong
23. Bang Pakong
24. Si Racha
25. Khao Yaida
26. Nakhon Pathom
27. Suphan Buri
28. Saraburi
29. Khlung
30. Khao Yai Thiang
31. Rachaburi
32. Bangkok

Expansion 2

1. Huai Thalaeng
2. Buri Ram
3. Srikhoraphum
4. Si Sa Ket
5. Amnat Charoen
6. Selaphum
7. Maha Sarakham
8. Mukdahan
9. Nakhon Phanom
10. Sakon Nakhon
11. Sawang Daen Din
12. Nong Khai
13. Ban Huai Yang
14. Phuphasat
15. Chum Phat
16. Chaiyaphum
17. Khong
18. Phetchabun
19. Tapan Hin
20. Kho 1010
21. Sawankalok
22. Denchai Radio
23. Mae Tha Radio
24. Doi San Yao
25. Doi Mon Pa Koi
26. Chiang Rai 2
27. Phayao
28. Sa
29. Doi Inthanon
30. Mae La Noi
31. Mae Hong Son Radio
32. Khao Chairat
33. Chumphon
34. Ranong Radio
35. Lamae
36. Sichon
37. Nakhon Si Thammarat
38. Phatthalung
39. Trang
40. Satun
41. Yala Radio
42. Narathiwat
43. Krabi
44. Khao Ban Bang Duk
45. Ko Samui
46. Bangkok

Figure 2.3.4-1 Location of Radio Base Station (2/2)

Table 2.3.4-1 Existing Situation and Future Expansion Plan

Stage	Existing	1st.	2nd.	Total
Year	1986-88	1989	1990-91	
Number of MTXs	1	-	4	5
Number of Traffic Areas	3	7		10
Number of RBSs	22	31	54	107
Metropolitan Area	11	-1	9	19
Provincial Area	11	32	45	88
Number of MS Capacities	13,071	14,192	31,760	59,023
Metropolitan Area	8,990	2,400	16,800	28,190
Provincial Area	4,081	11,792	14,960	30,833
Number of Channels	517	632	1,352	2,501
Metropolitan Area	364	96	672	1,132
Provincial Area	153	536	680	1,369
Coverage Area (sq. km.)	59,390	150,985	271,969	482,344

b) Common Channel Signalling System

“Hand-off” and “Roaming” functions have been installed in this system for tracing the Mobile Stations (MS) and changing traffic channels. Hand-off function is to change a traffic channel among Radio Base Stations (RBS) within one Mobile Telephone Exchange (MTX), and Roaming function is to change a traffic channel among MTXs as shown in Figure 2.3.4-2.

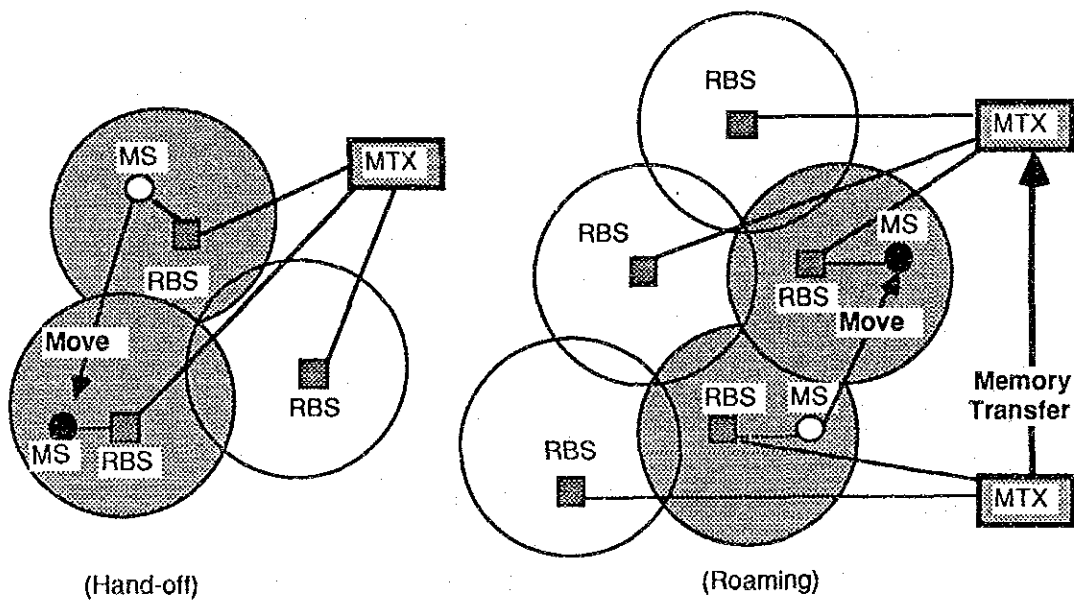


Figure 2.3.4-2 Channel Control Procedure

Coping with the increase of MTXs, it is necessary to change traffic channels to transfer the current memory between MTXs in case of Roaming. This Roaming functions are realized by adopting Common Channel Signalling System (CCS).

The advantages of CCS are described as follows:

- Capability of transferring the current memory smoothly between MTXs,
- Capability of gathering charging and traffic information,
- Capability of coping with further enhanced services in future,
- Foundation for the introduction of ISDN.

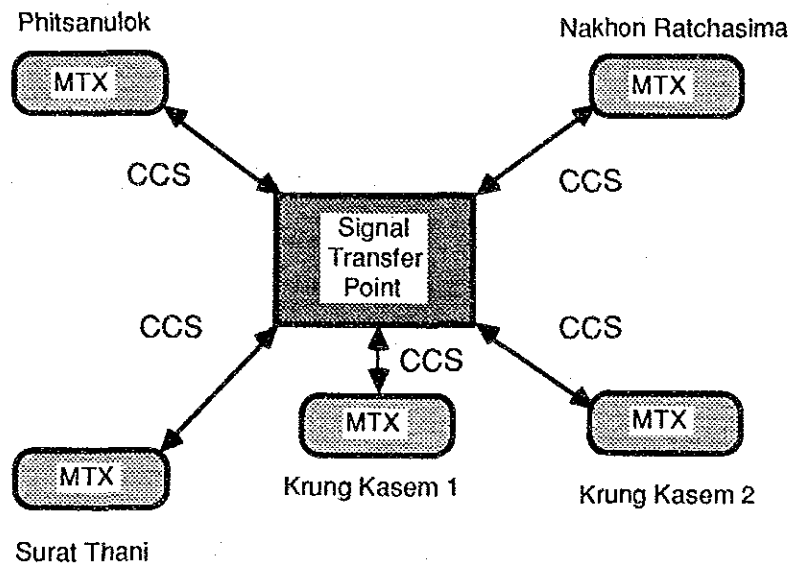
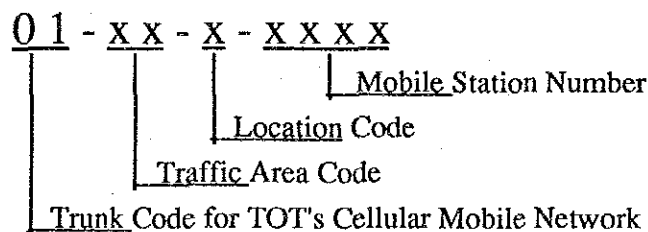


Figure 2.3.4-3 Common Channel Signalling for Cellular Mobile Network

c) Numbering Scheme

The trunk code of TOT's cellular mobile network is exclusively assigned as "01" among the whole numbering scheme for the telephone service. The numbering scheme for TOT's cellular mobile network is composed as follows:



The definite numbering plan covering the whole country is shown in Figure 2.3.4-4.

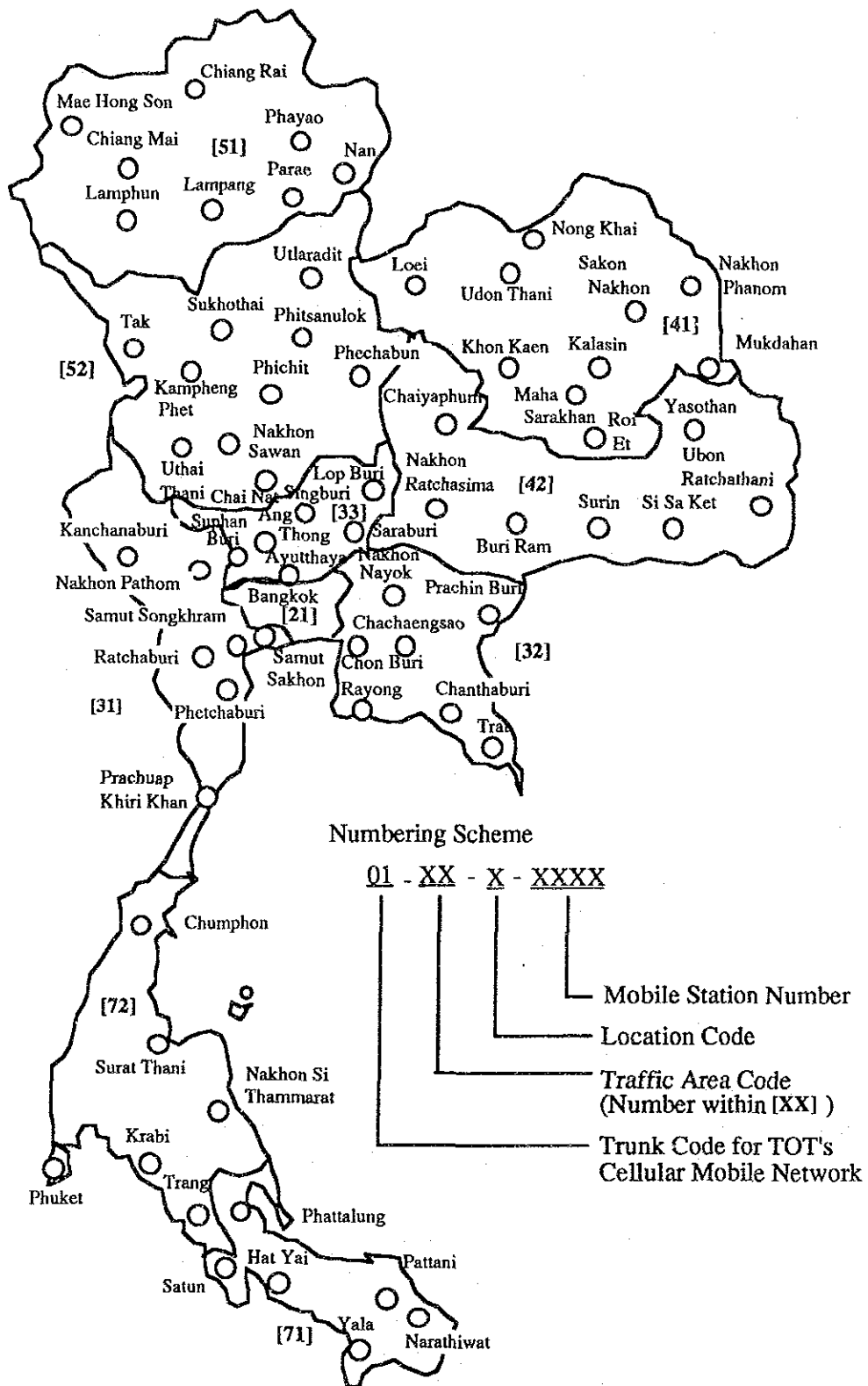


Figure 2.3.4-4 Numbering Plan for Cellular Mobile Network

For the CAT's cellular network, one unit of exchange code is exclusively assigned from among the numbering scheme. At the present stage, the exchange code "239" in Bangkok area is utilized, however its maximum capacities are 10,000 subscribers in one exchange code, successively, the exchange code "353" is scheduled to be introduced in the near future. With the expansion of CAT's cellular network, the exchange codes must be assigned one by one from among the ordinary telephone numbering scheme.

2) Inter-connection with Other Networks

TOT's cellular mobile network interworks with other networks such as TOT's telephone network and CAT's cellular mobile network. The network configuration and numbering system among them are shown in Figure 2.3.4-5 and Table 2.3.4-2.

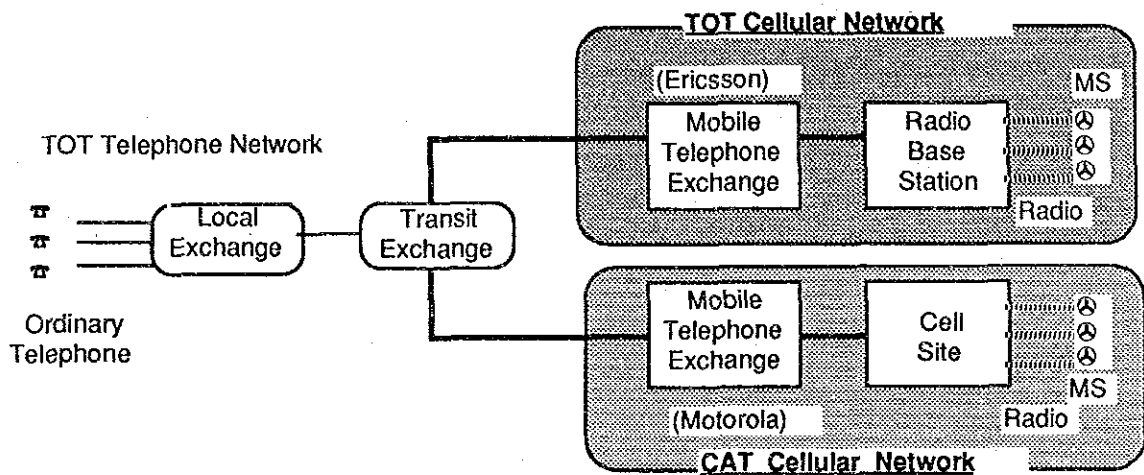


Figure 2.3.4-5 Network Configuration

Table 2.3.4-2 Numbering System Relating to Cellular Mobile Service

	Destination			
	TOT Telephone	TOT Cellular	CAT Cellular	International
Origination				
TOT Telephone	XXX-XXXX (0X)XXX-XXXX	(01)XX-X-XXXX	YYY-XXXX (02)YYY-XXXX	(001)XX-X.....X
TOT Cellular	(0X)XXX-XXXX	XX-X-XXXX	(02)YYY-XXXX	(001)XX-X.....X
CAT Cellular	XXX-XXXX (0X)XXX-XXXX	(01)XX-X-XXXX	YYY-XXXX (02)YYY-XXXX	(001)XX-X.....X
International	(66-X)XXX-XXXX	(66-1)XX-X-XXXX	(66-2)YYY-XXXX	-

Note : "YYY" means the exchange code for CAT's cellular mobile service. At the initial stage "239" and successively "353" are assigned.

2.3.5 Leased Circuit Facilities

At the present status, all of the leased circuit service are provided by analog circuits up to 9600 b/s. In order to offer the leased circuit service to subscribers, required circuit units are picked up from the telephone network facilities and connected in order throughout the whole sections from point to point.

Aiming at the high speed data transmission service, the digital leased circuit up to 64 kb/s will be available until 1991.

The scale of this project is 6,600 circuit units in the whole country, and they are distributed into 5,000 circuit units for metropolitan area at 62 nodes and 1,600 circuit units for provincial area at 73 nodes. The node locations for metropolitan area are Krung Kasem, Surawong, Phloen Chit, Paholyothin, Lak Si, Samran Rat, Lat Ya, Khlong Chan and Phra Khanong as shown in Figure 2.3.5-1. The node locations for provincial area are Nakhon Pathom, Chon Buri, Rayong, Ayutthaya, Nakhon Sawan, Phitsanulok, Chiang Mai, Nakhon Ratchasima, Khon Kaen, Udon Thani, Ubon Ratchathani, Surat Thani, Hat Yai and Phuket.

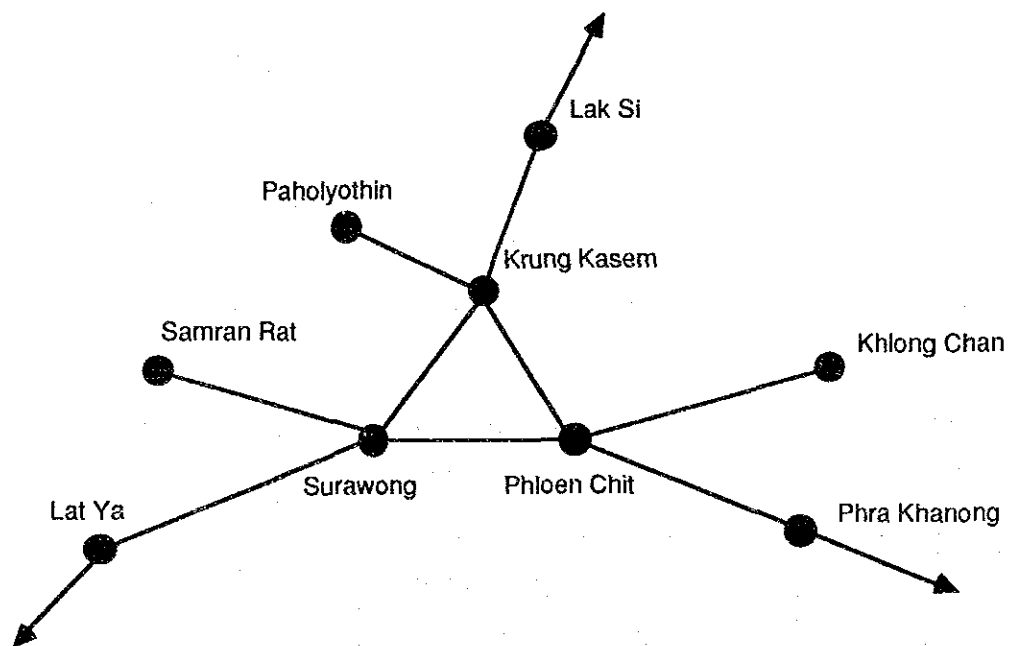


Figure 2.3.5-1 Major Nodes in Bangkok Metropolitan Area

2.3.6 Outline of Existing Expansion Projects

TOT has carried out its Economic and Social Development Plan (hereinafter referred to as "the ESDP") to improve the telecommunication services and extend the telecommunication facilities in order to cope with rapidly increasing demand and to keep security for public and the country, in conformity with the National Economic and Social Development Plans (hereinafter referred to as "NESDP"). The relation between NESDP and ESDP as their periods is shown in the following Table.

Table 2.3.6-1 Comparison of the ESDP and NESDP on Terms

Year	72	76	81	86	92
NESDP	72	3rd 76			
		77	4th 81		
			82	5th 86	87 6th 91
ESDP		77	4th	87	
				84	5th 92
					89 UETP 92

Source: The Sixth National Economic and Social Development Plan (1987~1991), NESDB, Office of the The Prime Minister.
1986 Annual Report, Telephone Organization of Thailand.

1) Outline of 4th ESDP (1977~1987)

The 4th ESDP was initially planned to be completed at the end of 1984, but the period was extended for three more years to 1987 mainly because of the introduction of digital stored program control switching equipment. As the result, the digitization of telecommunication network in Thailand has made rapid progress. One more feature of the 4th ESDP was the introduction of Rural Long Distance Public Telephone in ampoes and king ampoes. Therefore, communication service between metropolitan, urban area in the provinces and rural area was improved considerably.

Telephone density in 1987 became about three times as that of in 1977.

2) Present State of 5th ESDP (1984~1992)

The end of this Project was extended from 1988 to 1992 aiming at coordination of installation work.

The objectives of the 5th ESDP are the expansion of ordinary telephone service to 1,022,000 lines, new provision for telephone service to rural communities at tambon level and the introduction of new services like cellular mobile telephone, leased data service and videotex services, etc.

In the progress of this project, the domestic telephone lines in operation reached one million in September 1988. TOT is now making considerable effort to complete the 5th ESDP by the end of FY 1992.

The supply and installation of local cable network on this project have been carried out by 8 contractors, which are firms or joint ventures, in each area divided by 8 areas in the metropolitan areas and provincial areas respectively. These contractors have been executing the detailed survey for demand forecasting, basic design, detailed design, cost estimation and construction work under the TOT approval.

3) UETP (1989 ~ 1992)

TOT started next expansion project (Urgently Expanded Telephone Project), which is for 4 years from 1989 to 1992, to promote telephone service for the benefits of the government and the public. According to the concept of this plan, 207,300 subscriber lines will be installed in high demand such as Metropolitan area, Eastern Seaboard area, industrial estate and tourist attractions, and in order to improve the quality of telephone services, line maintenance center (LMC), operator consoles and test line units will be installed.

As the implementation results of these expansion projects, it will be expected that the telephone density will become 3.2 per 100 population.

The following table shows the summaries of the 4th ESDP, 5th ESDP and UETP.

Table 2.3.6-2 Summary of 4th ESDP (1977~1987)

Category	Object	Result by the end of FY 1986	Targets of FY 1987
Budget	19,894 m.Baht	18,018 m.Baht	1807.6 m.Baht
Switching	569,000 lines	542,176 lines	10,200 lines
Long distance			
Radio	50 routes	48 routes	2 routes
Optical fiber	20 routes	19 routes	1 routes
Rural long distance			
Radio	740 stations	691 stations	49 stations
Multiplex	652 stations	645 stations	7 stations
Rural long distance Telephone	468 amphoes	379 amphoes	142 amphoes

Table 2.3.6-3 Summary of 5th ESDP (1984~1992)

Category	Object	Result by the end of FY 1986	Targets of FY 1987
Budget	44,107 m.Baht	3,633 m.Baht	114 m.Baht
Land	165 plots	145 plots	
Building		15 locations	
Repeater station		21 locations	
RSU, RLU		4 locations	
Switching	1,160,754 lines	67,072 lines	197,672 lines
		(NEAX-61)	20,608 lines
		(AXE-10)	
Celluar mobile		10,447 lines	
Long distance			
1st phase	8 routes	6 routes	2 routes
Local network			44,300 pairs
Junction network	15 routes	12 routes	3 routes
Rural long distance Telephone	1,813 areas (5,439 lines)		

Source: Annual Report, TOT

Table 2.3.6-4 Summary of UETP (1989~1992)

Category	
Expenditure	8,955.5 Million Baht
Subscriber Line	207,300 lines
Long distance	8,000 circuits
Junction network	50,000 circuits (9 routes)
Local network	660,000 pairs/Km
Data service	6,600 terminals
Public telephones	6,000 sets
CMSC	1 LMC, 4 operator consoles 59 test line units

2.3.7 Present State of Maintenance Activities

1) Organization and Flow for Maintenance

The maintenance area is divided into 4 areas in metropolitan telecommunication area and 9 areas in provincial area, as shown in Figure 2.3.7-1. And also, these areas are respectively divided into small areas to cope with the volume of facilities, number of faults and geographical features.

These maintenance sections has some teams such as drop wire team, cable teams and construction team as well as PBX team and public telephone team. Figure 2.3.7-2 shows the organization of maintenance.

The Concept of work flow from fault occurrence to repair is as follows:

- a) Subscriber complains to "17xxx",
- b) Central Test Desk tries to locate the faults,
- c) Central Test Desk sends the kinds of fault to Dispatcher (Drop Wire),
- d) Dispatcher (Drop Wire) passes to Drop Wire Team,
- e) Drop Wire Team repairs and reports the result of repairing to Dispatcher (Drop Wire),
- f) If the location is switching or cable as well as PBX, public telephone and booth of public telephone, Dispatcher (Drop Wire) will pass to respective Dispatcher,
- g) The respective Dispatcher forwards repair team for fault repair,
- h) The Team reports the result of repairing to Dispatcher,
- i) The respective Dispatcher sends the result of fault repair to Dispatcher (Drop Wire),
- j) Dispatcher (Drop Wire) forwards the result to computer for collecting data.

Figure 2.3.7-3 shows work flow of fault repairing.

2) Present State of Maintenance Activities in TOT

Figures 2.3.7-4 and 2.3.7-5 shows the occurring condition of service breakdown. According to this data, until 1984, the ratio of faults per connected line had risen, up to about 0.8 faults occurred per year per connected line. However, from 1984 onwards, the ratio have been improved through the persevering efforts by TOT.

At the end of 1987, it's ratio was improved to 4.5 faults per month per 100 connected line.

Figures 2.3.7-6 and 2.3.7-7 show the contents of faults. According to this data, the number of faults caused by telephone sets, drop wires and cables account for about 80 percent of all faults. Although the ratio of drop wire and cable faults have been decreasing year by year, the ratio of telephone set have been remarkably increasing.

Figure 2.3.7-8 and 2.3.7-9 show the period of repair completions in Metropolitan area and Provincial area. According to this data, the repair period has been improved year by year. The standards and targets of maintenance work were established in 1987 as follows.

a) Fault ratio (per month per connected line) of subscriber lines should be within the following figures.

	<u>Metropolitan area</u>	<u>Provincial area</u>
Telephone set	1.0%	1.0%
Drop wire	2.8%	3.2%
Cable	1.6%	0.5%
Test of good condition	1.5%	0.1%
Others	0.1%	0.2%
Total	7.0%	5.0%

b) Percentage of repair completion should be exceed the following figures.

	<u>Metropolitan area</u>	<u>Provincial area</u>
Within 1 day	80%	95%
Within 2 days to 7 days	19%	4%
Over 7 days	1%	1%
Total	100%	100%

The above standards became satisfied in FY 1987 by making strenuous efforts of the organization. It is considered to be important to decrease the number of faults and to make shorter the period of repair as far as possible for providing the better telephone services and also smooth introduction of the new services in future.

3) Characteristic Case of Fault in Thailand

There are some special or typical cases of faults caused some typical environmental condition as follows.

- a) Induction trouble caused by commercial power induction.
- b) Destruction of aerial cable clamp bolt by high voltage induced from power Transmission.
- c) Deformation of underground cable closure by water pressure.
- d) Sinking and damage of underground facilities for soft ground.
- e) Damage of aerial cable caused by animal and insect.

In order to solve these various problems, it will be necessary to establish a new organization for research and development of outside plant technology.

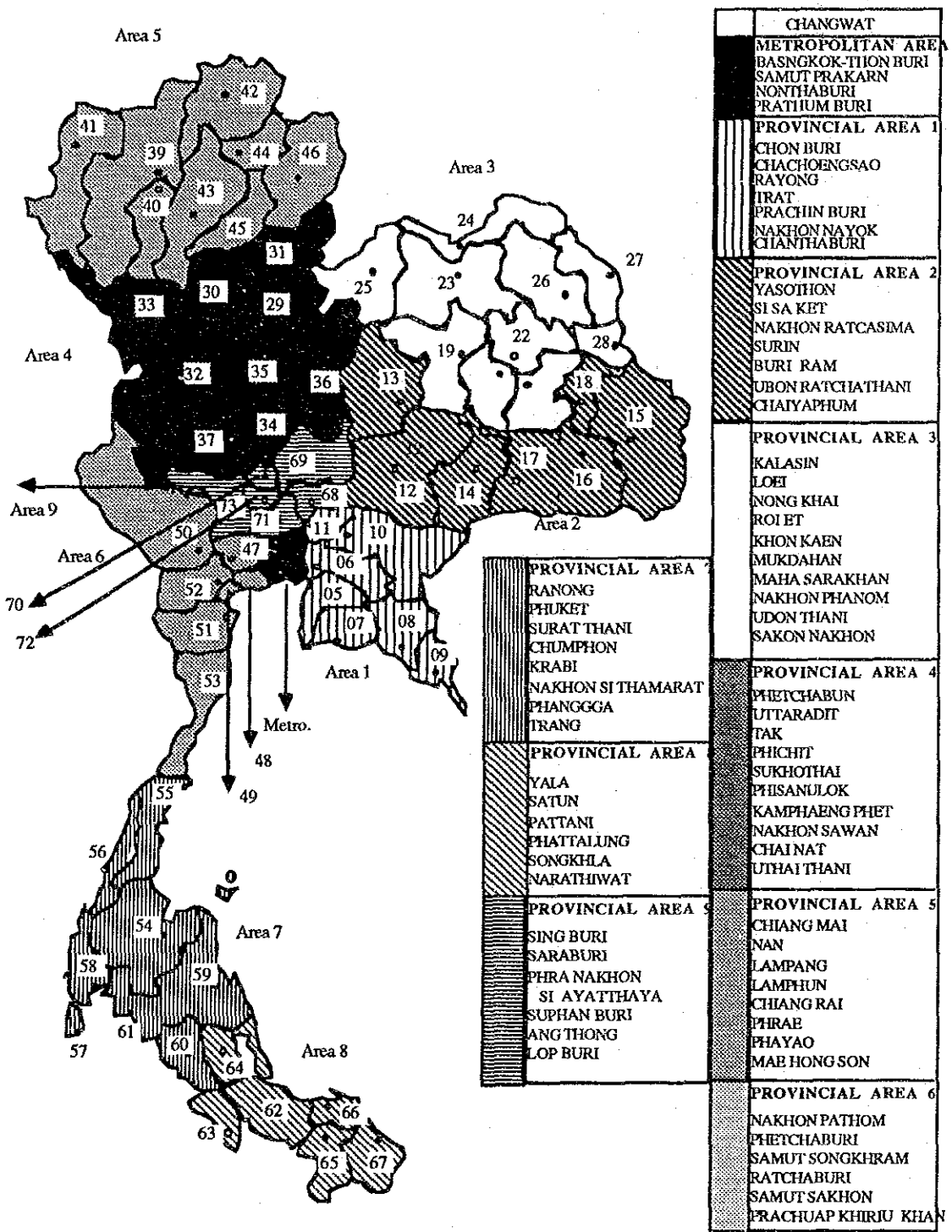


Figure 2.3.7-1 Maintenance Area in TOT

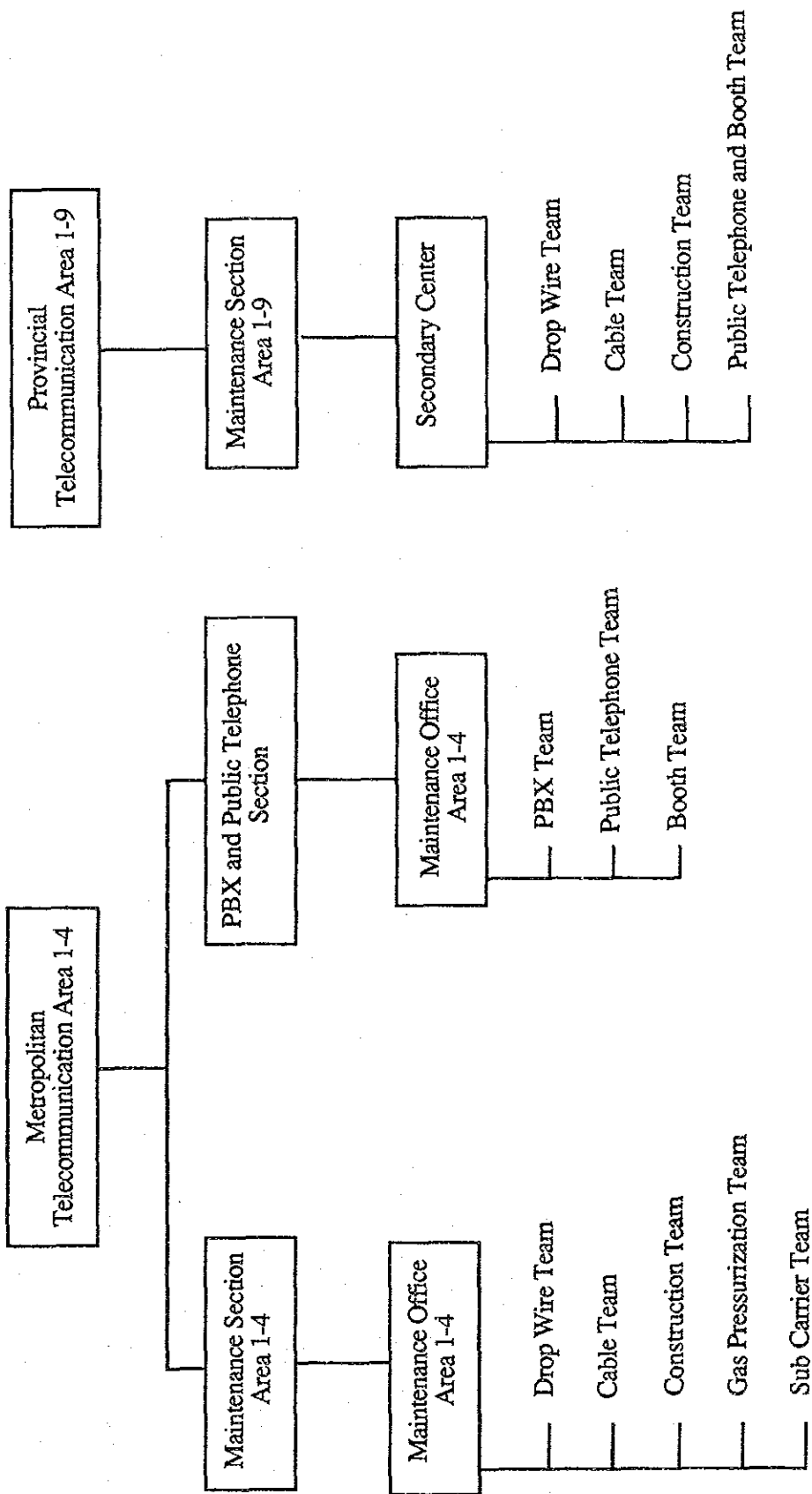


Figure 2.3 7-2 Organization for Maintenance

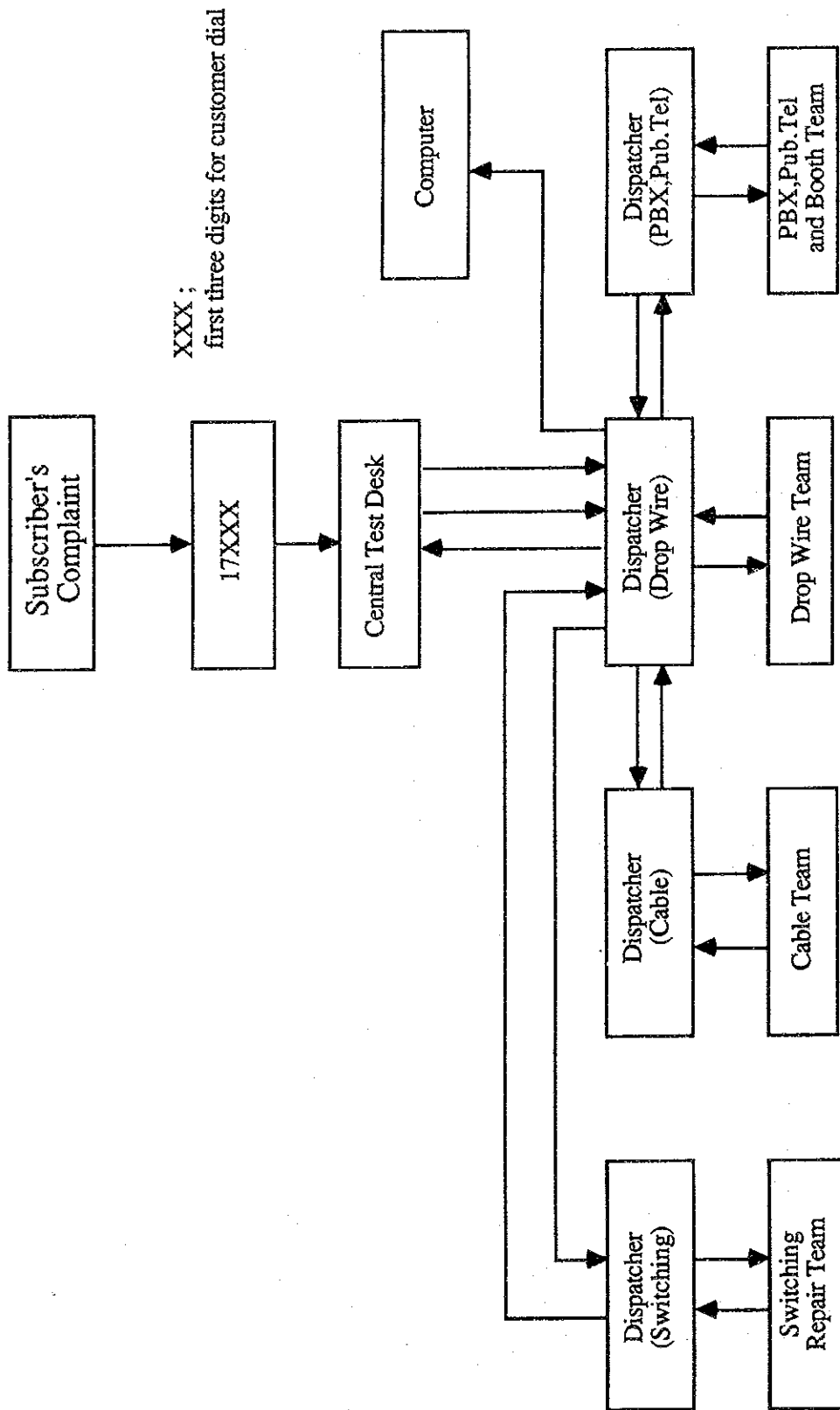
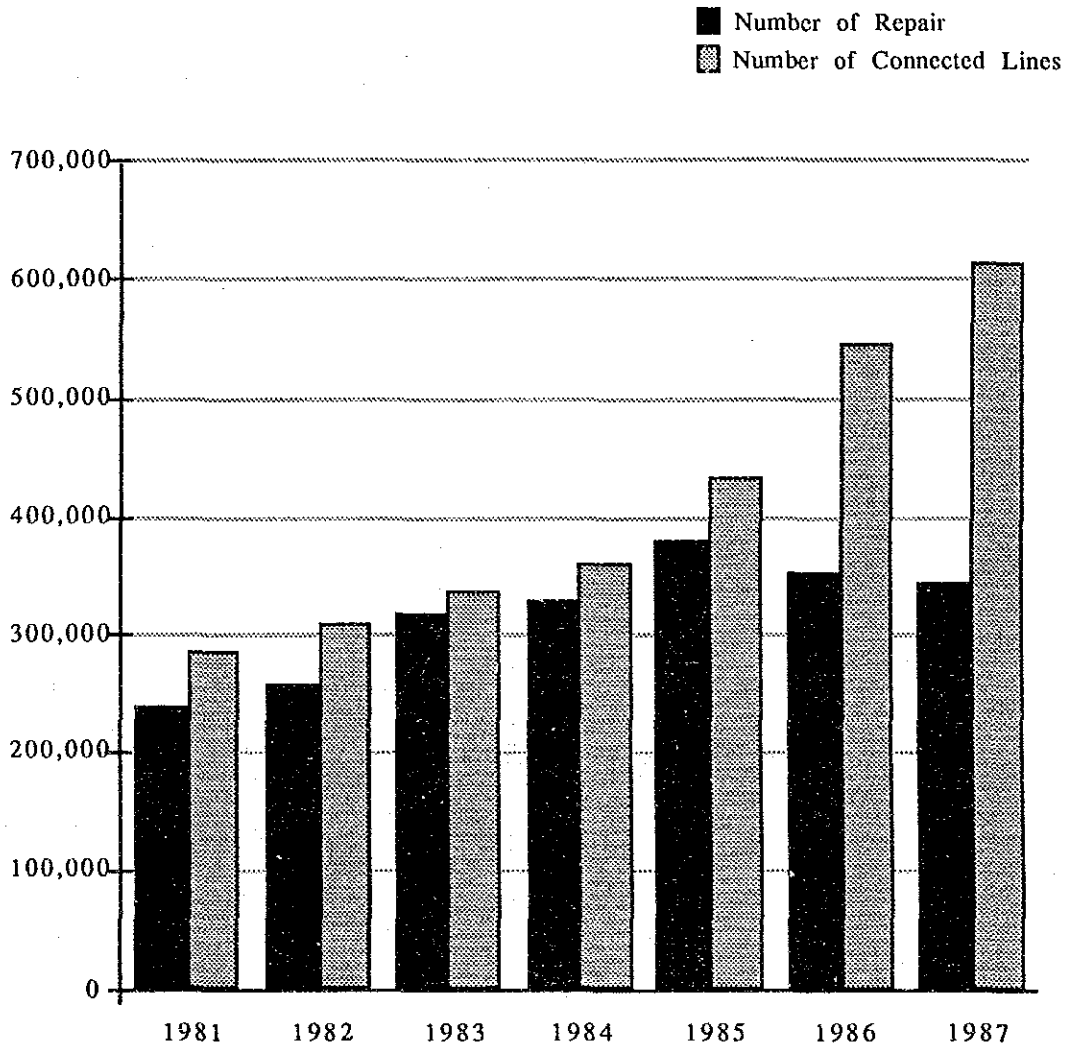
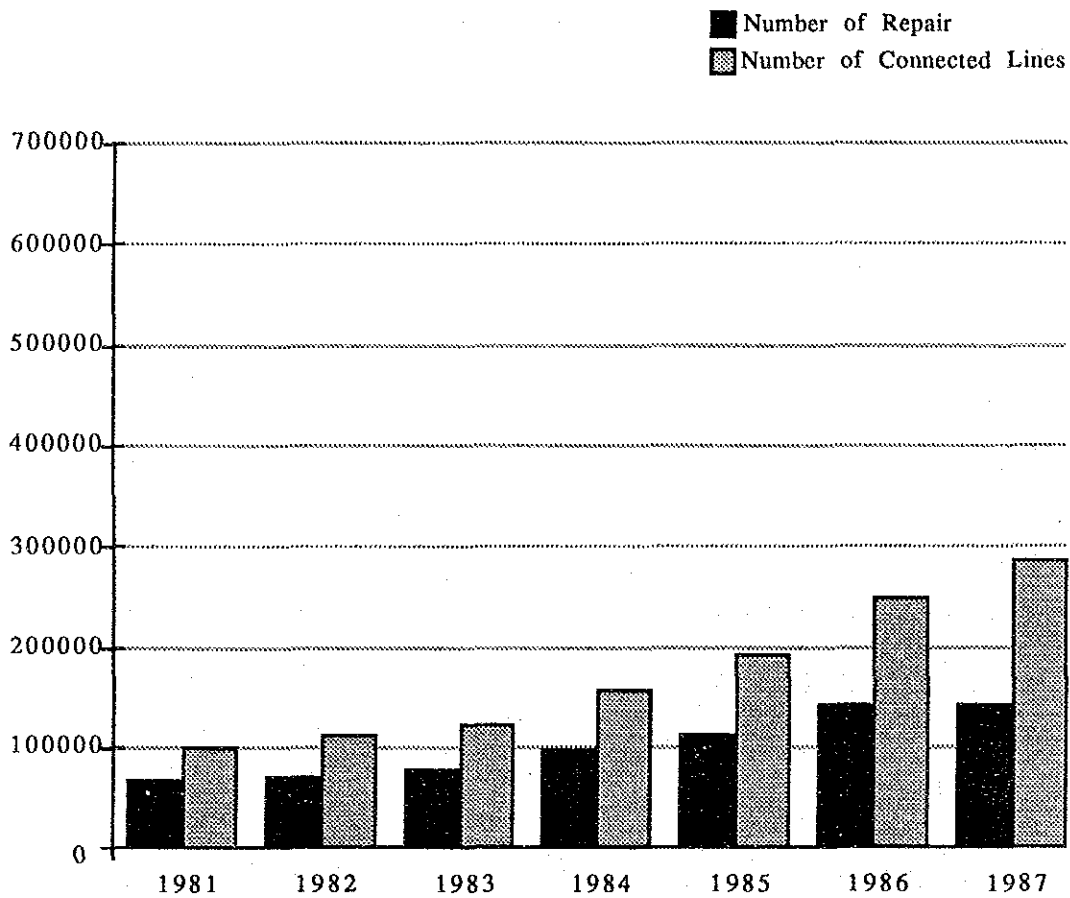


Figure 2.3.7-3 Flow Chart of Fault Repairing



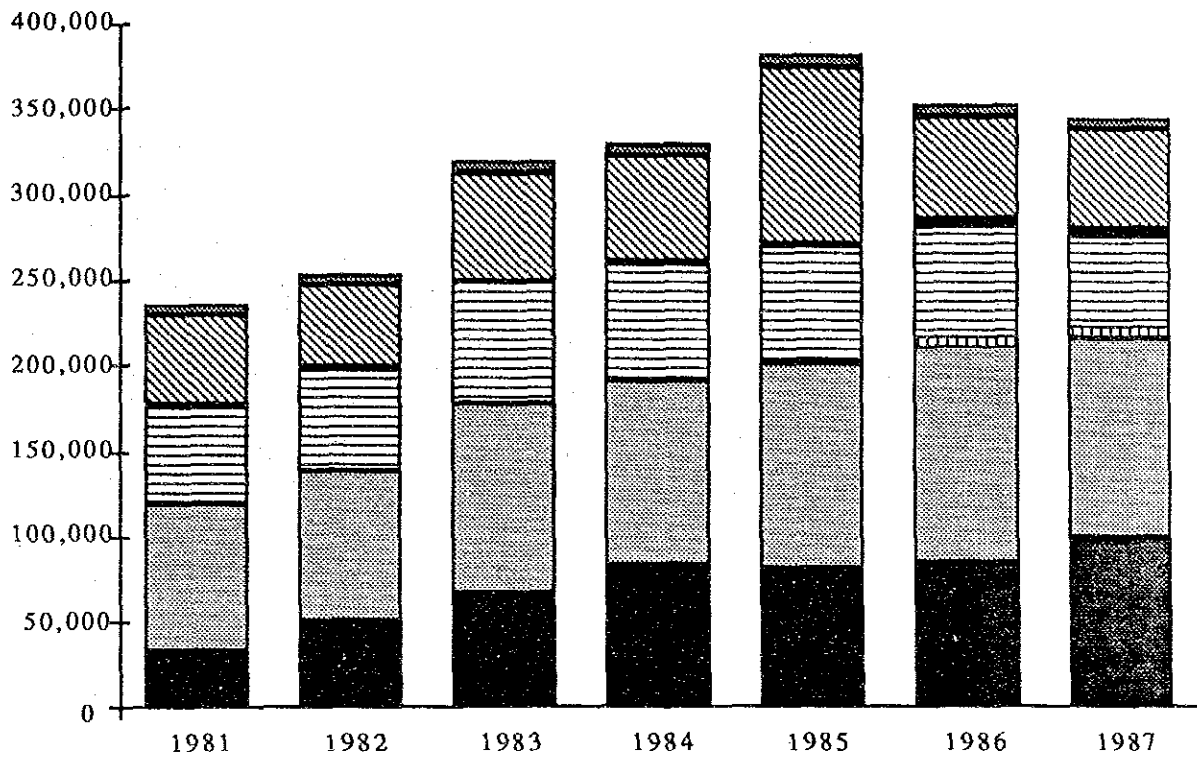
	1981	1982	1983	1984	1985	1986	1987
Repair	238,248	256,127	318,383	329,035	381,937	352,829	344,397
Lines	287,090	312,062	339,510	361,924	433,517	548,080	614,707

Figure 2.3.7-4 Number of Repairs - Metropolitan Area



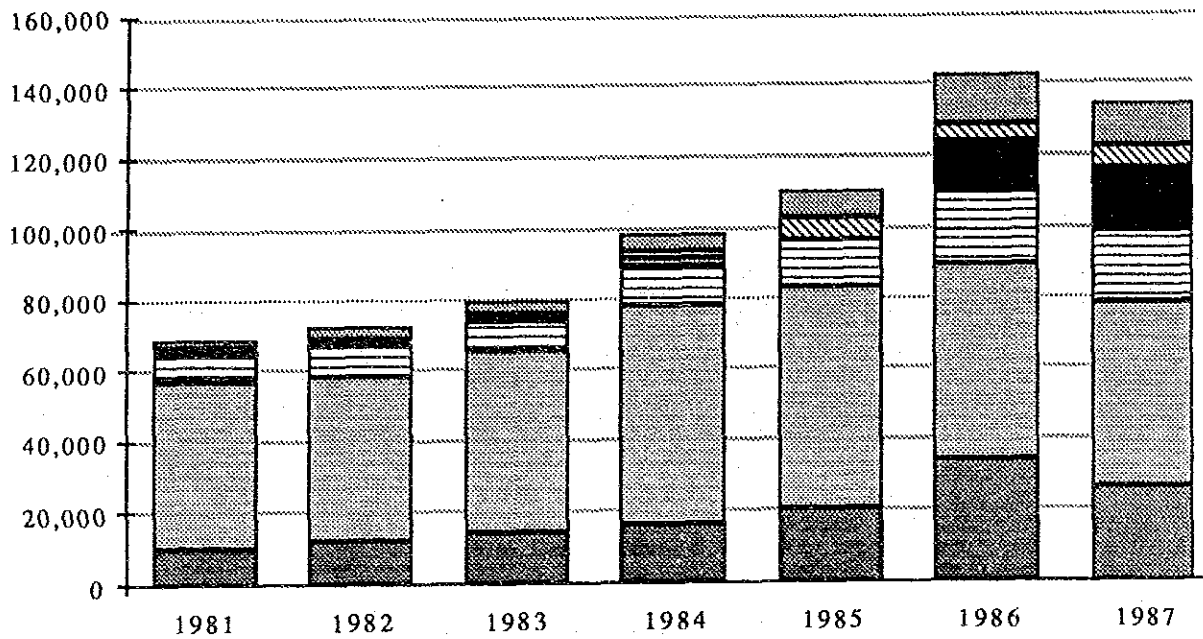
	1981	1982	1983	1984	1985	1986	1987
Repair	69,201	72,260	79,497	98,350	113,613	142,516	143,833
Lines	102,148	113,617	123,721	157,567	192,981	250,832	286,915

Figure 2.3.7-5 Number of Repairs - Provincial Area



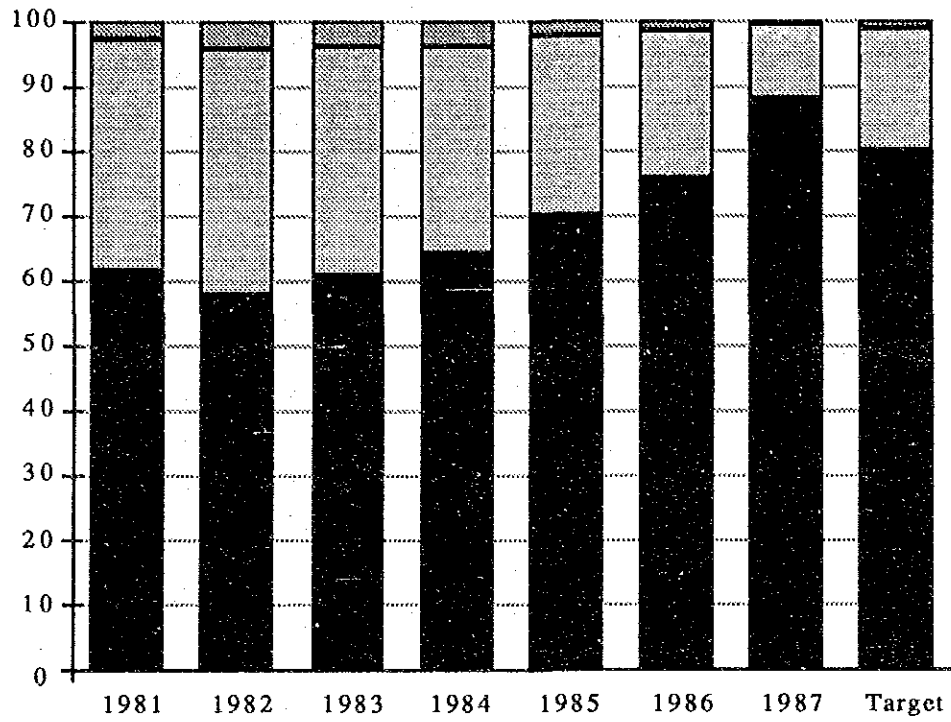
	1981	1982	1983	1984	1985	1986	1987
Telephone Set	35,265	50,671	66,232	83,202	80,877	84,652	99,196
Drop Wire	86,092	89,266	111,989	108,080	119,496	127,993	115,773
Sub.Carrier	-	-	-	-	-	3,862	4,538
Cable	57,990	60,318	70,165	67,497	69,122	65,205	56,328
Switching Equipment	667	724	1,330	1,320	2,174	4,415	4,167
Test of Good Condition	53,314	48,276	61,304	61,101	102,220	59,585	58,073
Others	4,920	6,872	7,363	7,835	8,048	7,117	6,322
Total	238,248	256,127	318,383	329,035	381,937	352,829	344,397

Figure 2.3.7-6 Contents of Faults - Metropolitan Area



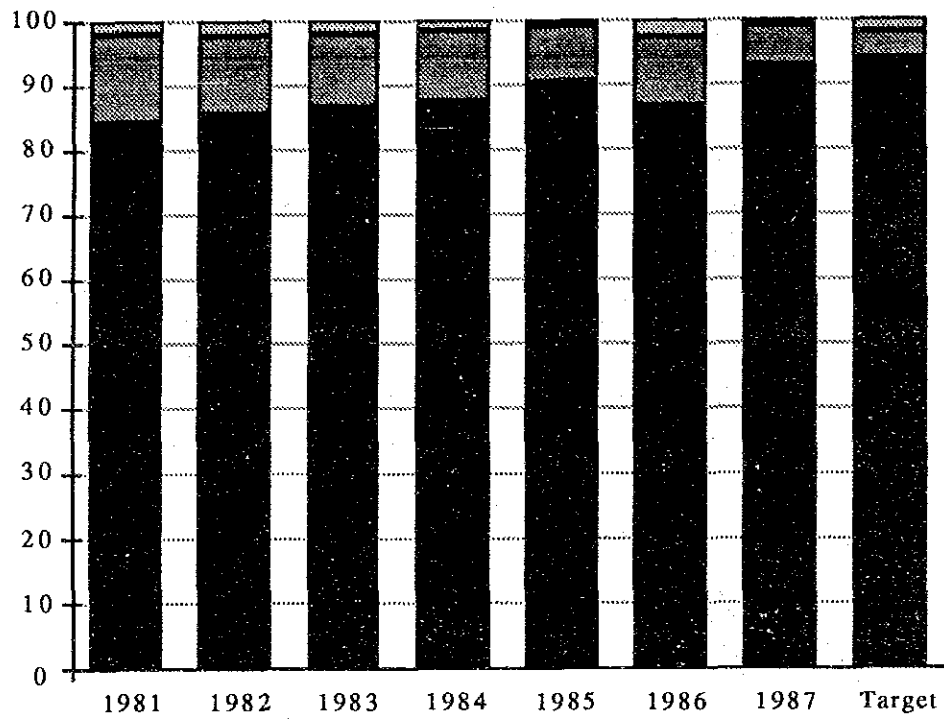
	1981	1982	1983	1984	1985	1986	1987
Telephone Set	10,182	12,188	14,740	16,460	20,449	33,942	36,562
Drop Wire	46,913	46,478	50,787	61,453	62,322	55,265	51,724
Sub Carrier	-	-	-	-	-	-	-
Cable	7,564	8,744	8,359	11,274	13,874	20,747	20,470
Switching Equipment	1,313	911	1,058	2,540	5,914	13,752	16,851
Test of Good Condition	1,030	611	1,348	1,812	2,921	4,827	6,313
Others	2,199	3,328	3,205	4,811	8,133	13,983	11,943
Total	69,201	72,260	79,497	98,350	113,613	142,516	143,863

Figure 2.3.7-7 Contents of Faults - Provincial Area



Category	1981	1982	1983	1984	1985	1986	1987	Target 1987
Within 1 day	61.79	57.94	60.78	64.44	70.01	75.84	88.05	80.00
Within 7 days	35.62	37.93	35.43	31.89	27.79	22.73	11.66	19.00
Over 7 days	2.59	4.13	3.79	3.67	2.20	1.43	0.29	1.00

Figure 2.3.7-8 Repair Period - Metropolitan Area



Category	1981	1982	1983	1984	1985	1986	1987	Target 1987
Within 1 day	84.45	85.54	86.48	87.28	90.36	87.63	92.60	95.00
Within 7 days	13.61	12.34	11.66	11.13	8.77	10.72	6.62	4.00
Over 7 days	1.94	2.12	1.86	1.59	0.87	1.65	0.78	1.00

Figure 2.3.7-9 Repair Period - Provincial Area

2.4 Existing Management Situation of the Operating Entity (TOT)

1) Financial Statement of TOT (1986 ~ 1988)

In FY 1986, Plant Under Construction & Works in Progress was almost the same size as existing Fixed Assets due to the delay of process from Work in Progress to Fixed Assets as shown in Table 2.4-1.

Table 2.4-1 Balance Sheet

(Unit: Million Baht)

<u>Assets</u>	1988	1987	1986
<u>Land Building & Equipment</u>			
Fixed Assets	27,374	23,139	15,660
<u>Less</u> Accumulated Depreciation	7,676	6,206	4,782
	19,698	16,933	10,878
Plant Under Construction & Works in Progress	12,210	11,663	15,276
	31,908	28,596	26,154
Right of the Submarine Cable <u>Investment</u>	314		
<u>Less</u> Reserve for Damages		3	3
		2	2
		5	5
<u>Other Assets</u>	2,652	1,713	1,383
<u>Current Assets</u>	5,202	4,226	5,158
<u>Total Assets</u>	40,157	34,536	32,696

<u>Liabilities & Equity</u>	1988	1987	1986
<u>Equity</u>	7,059	5,169	5,781
<u>Long-Term Liabilities</u>	25,315	23,015	20,728
<u>Customer, Employee, Contractor & Bidder Deposit</u>	2,675	2,320	2,013
<u>Other Liabilities</u>	1,777	1,381	1,073
<u>Current Liabilities</u>	3,332	2,651	3,102
<u>Total Liabilities & Equity</u>	40,157	34,536	32,696

Due to the tariff review in FY 1986, revenue had been improved remarkably as shown in Table 2.4-2.

Table 2.4-2 Income Statement

(Unit: Million Baht)

	1988	1987	1986
<u>Revenue from Telephone Service</u>			
Local Service	5,870	5,052	3,931
Trunk Service	4,490	3,565	2,834
Other Service	678	789	1,062
	11,038	9,407	7,828
<u>Operating Expenses</u>			
Expenses for Repair & Maintenance	363	358	349
Administrative Expenses	2,465	2,214	1,921
Bad Debt Expenses		19	9
Depreciation	1,670	1,714	971
	4,498	4,305	3,250
<u>Operating Income</u>	6,541	5,101	4,578
<u>Other Income</u>	252	147	277
	6,793	5,248	4,588
<u>Interest Expenses</u>	(1,971)	(1,812)	(1,426)
<u>Other Expenses</u>	(1,566)	(932)	(666)
<u>Last Year Adjusted Profit-Net</u>	(529)		
<u>Net Profit</u>	2,728	2,504	2,763

The amount of remittance to the Treasury jumped from 370 million Baht (FY 1986) to 1,105 million Baht (FY 1987) as shown in Table 2.4-3.

Table 2.4-3 Statement of Retained Earnings

(Unit: Million Baht)

	1988	1987	1986
<u>Unappropriated Retained Earnings</u>			
Balance at the Beginning of the Year	8,596	7,499	5,245
Plus <u>Net Profit for the Year</u>	2,728	2,504	2,763
	11,324	10,003	8,008
<u>Less</u> Last Year Appropriated			
Net profit			
Bonus to Directors and Employees	343	302	139
Remittance to the Treasury	820	1,105	370
	1,163	1,407	509
Total Unappropriated Retained Earnings	10,162	8,596	7,499
Appropriated Retained Earnings			
Reserve for Expansion	1,513	1,513	1,513
Capital Reserve	5	5	5
	1,518	1,518	1,518
Total Retained Earnings	11,680	10,114	9,017

2) Statistics of Personnel Figure

Table 2.4-4 Statistics of Personnel Figure

	1980	1981	1982	1983	1984	1985	1986	1987
1. Total Revenue(10 thousands Baht)	233,731	307,362	394,767	431,965	497,833	550,499	810,528	955,335
2. Total Expenses	154,892	246,899	207,505	285,781	297,695	459,532	534,209	704,906
3. Staff Remuneration	53,453	61,375	77,394	88,209	96,629	110,364	114,169	124,942
4. Welfare	8,793	9,931	12,024	13,602	14,535	16,105	17,702	21,005
* Other			2,494	5,090	7,298	7,686	6,743	4,951
5. Bonus	6,717	9,950	15,656	16,013	16,293	13,916	30,159	29,050
Expenses for Employee(3+4+5)	68,963	81,256	105,074	117,824	127,457	140,385	162,030	174,997
6. Number of Personnel	10,898	11,228	12,123	13,257	15,415	16,926	17,399	17,746
Regular Officials	7,452	7,563	7,862	8,577	11,380	13,095	14,088	14,234
Executive Engineer	63	62	79	72	73	72	68	60
Engineer	1,396	1,403	1,543	1,573	2,069	2,373	2,439	2,451
Craftsman	2,607	2,615	2,615	3,244	4,434	5,063	5,362	5,408
Total	4,066	4,080	4,237	4,889	6,576	7,508	7,869	7,919
Administrator	30	31	35	35	34	37	36	35
Assistant Administrator	714	722	841	859	1,218	1,497	1,539	1,568
Clerical Officials	2,642	2,730	2,749	2,794	3,552	4,053	4,644	4,712
Total	3,386	3,483	3,625	3,688	4,804	5,587	6,219	6,315
Special Officials	473	457	414	400	366	362	344	327
Worker	2,223	2,450	3,684	3,628	2,477	2,732	2,828	2,876
Worker on Probation	750	758	163	652	1,192	737	139	309
Engineer + Administrator	2,203	2,218	2,498	2,539	3,394	3,979	4,082	4,114
Craftsman + Clerical	5,249	5,345	5,364	6,038	7,986	9,116	10,006	10,120
Personnel Expenses per employee	6.33	7.24	8.67	8.89	8.27	8.29	9.31	9.86
Remuneration per employee	4.90	5.47	6.38	6.65	6.27	6.52	6.56	7.04
Ratio of Personnel Expenses to Revenue	26.63%	23.20%	22.65%	23.57%	22.33%	22.97%	16.27%	15.28%
7. Main Telephone Stations	365,894	389,238	425,679	463,231	519,491	626,498	798,912	901,622
8. Main Tel. Station/Employee(7/6)	33.57	34.67	35.11	34.94	33.70	37.01	45.92	50.81

Ratio of personnel expenses to revenue has been improving since FY 1986 because of the tariff review in FY 1986.

3) Organization Structure

While reorganization of TOT is still in the progress, a final reorganization chart is as follows.

ORGANIZATIONAL STRUCTURE IN 1988

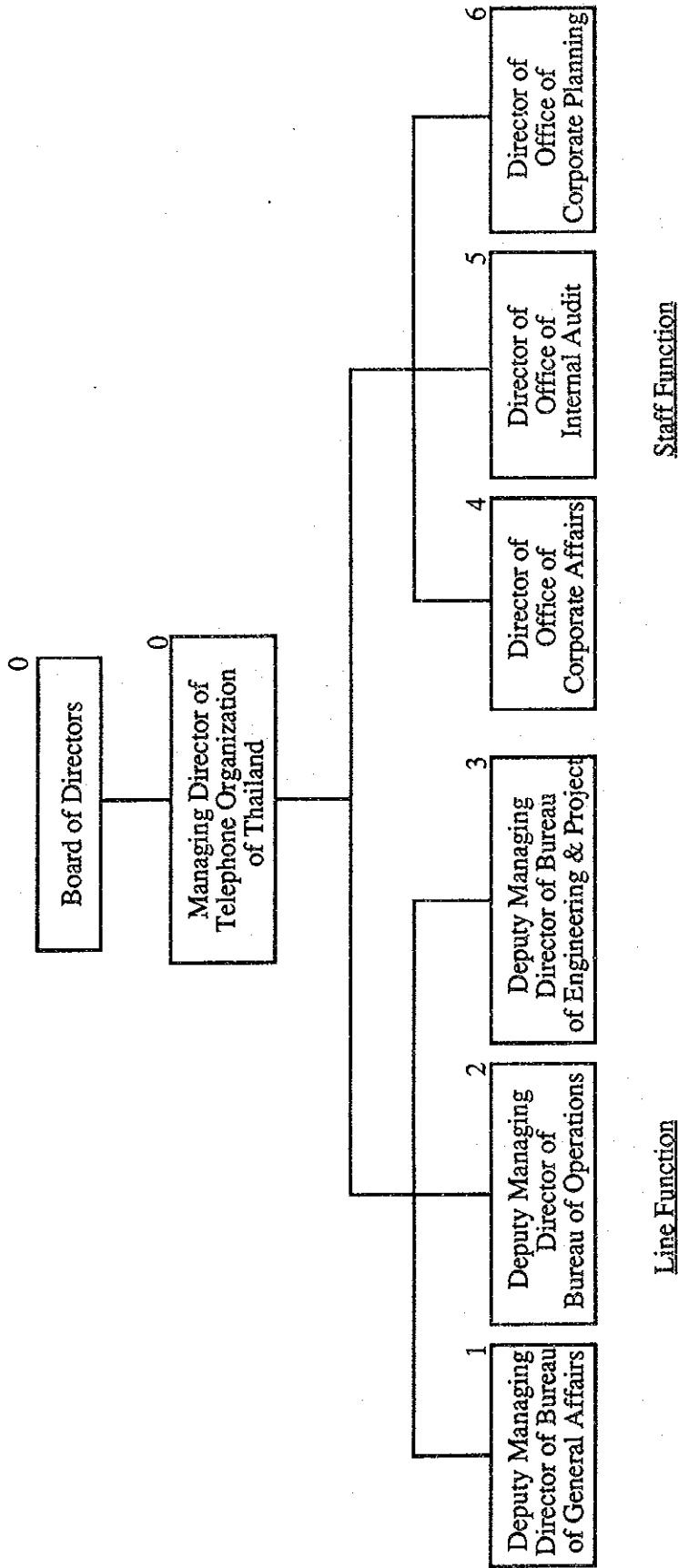


Figure 2.4-1 (1/7) Chart of Principle Organizational Structure (Bureau/Office) of Telephone Organization of Thailand

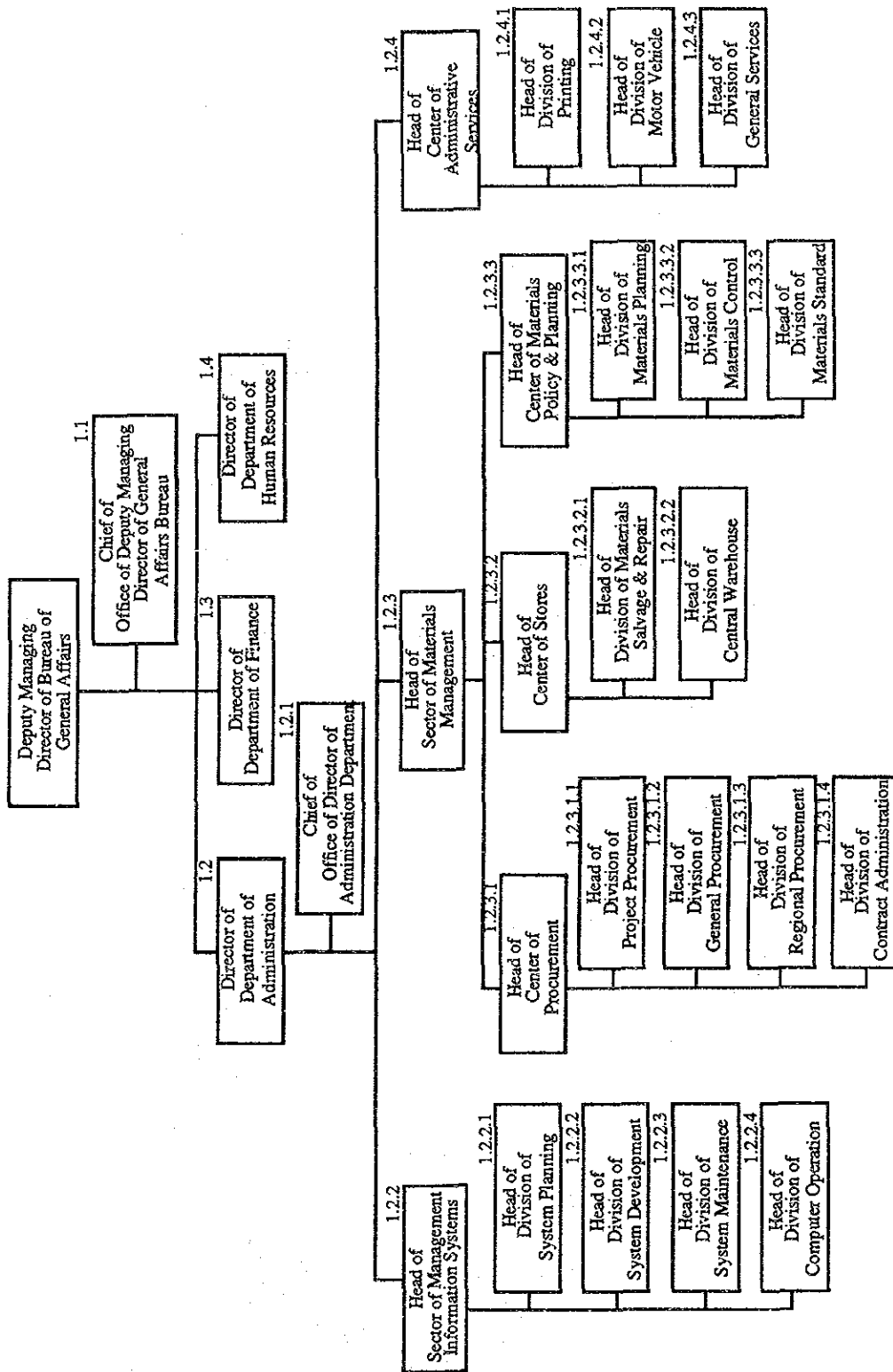


Figure 2.4-1 (2/7) Chart of Principle Organizational Structure of General Affairs Bureau

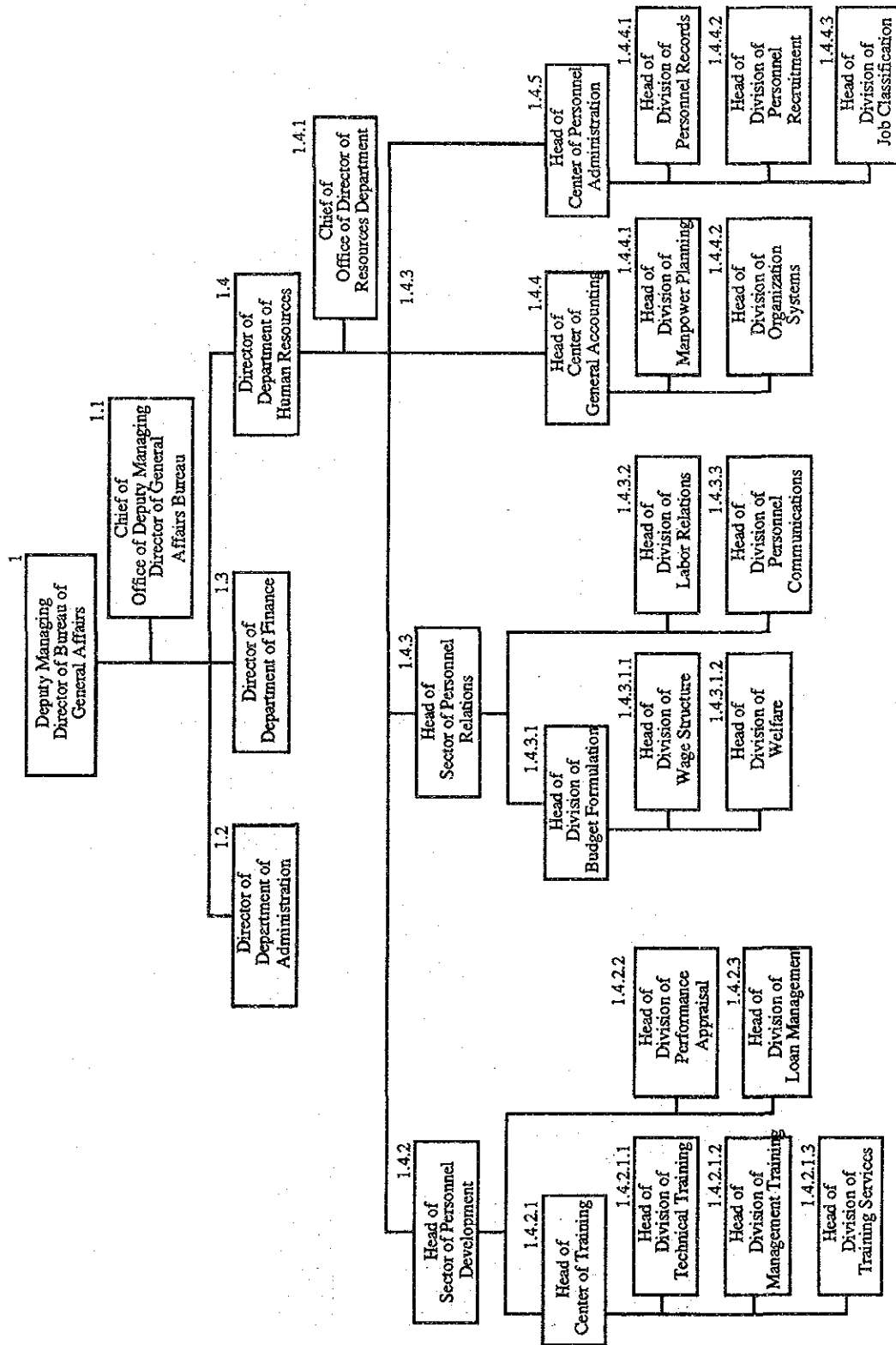


Figure 2.4-1 (4/7) Chart of Principle Organizational Structure of General Affairs Bureau (Human Resources Department)

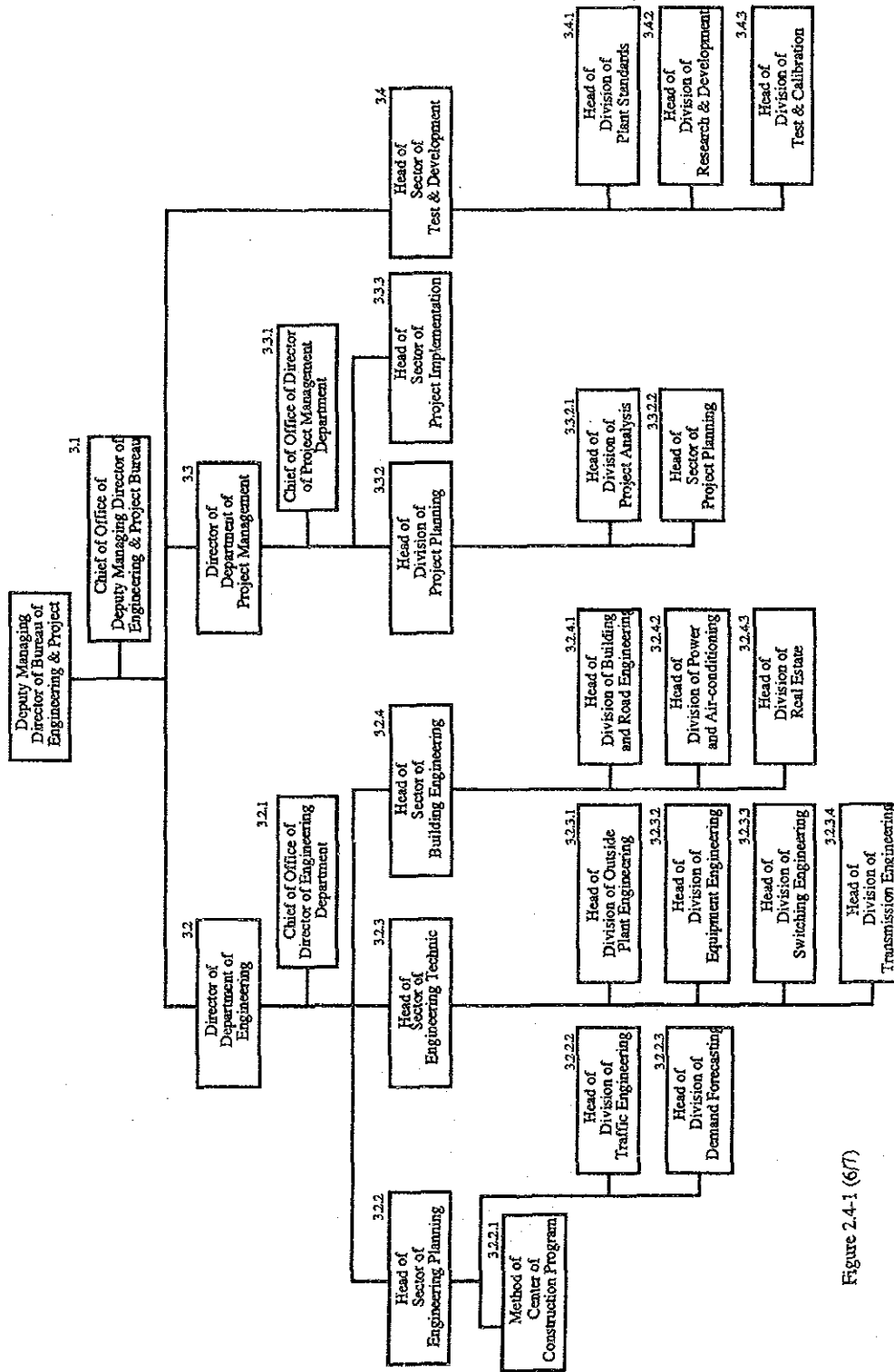


Figure 2.4-1 (6/7)

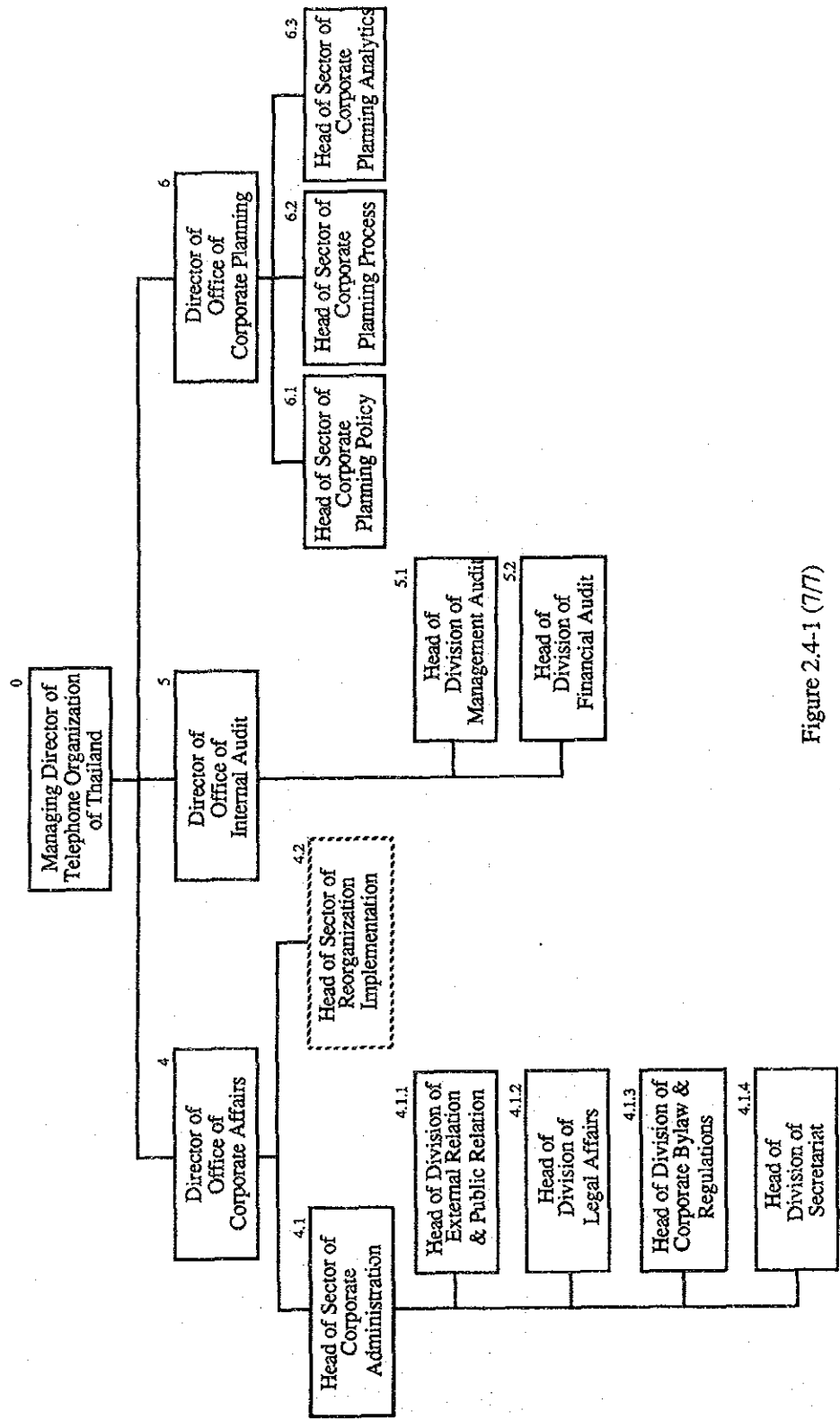


Figure 2.4-1 (7/7)

2.5 Present Situations of Each Telecommunication Area in TOT

2.5.1 Criteria of the Analysis

In this section, some analyses were attempted on telecommunication areas in TOT on the basis of the following figures.

- 1) Revenue was divided by 3 factors, which are local revenue, trunk revenue and total revenue respectively in 1988.
- 2) Switching and cable capacity margins were calculated as the ratio of remaining capacity to total capacity on the basis of TOT's Data on February in 1989.
- 3) Fault ratio was applied as one of the criteria, taking the number of faults per 1000 subscriber per month in 1988, as the unit value.
- 4) As for waiting applicants, the unit value was calculated as the ratio of waiting applicants to expressed demand on the basis of the Data on February in 1989.

Table 2.5-1 and 2.5-2 are the source of data for this analyses.

Table 2.5-1 Main Telephone and Revenue

Area	Main Tele.	Local Revenue	Trunk Revenue	Total Revenue
Metro.1	196,777	1,691,637,168	476,443,165	2,168,080,333
Metro.2	190,530	996,113,401	269,812,402	1,265,925,803
Metro.3	185,207	633,273,841	150,283,216	783,557,057
Metro.4	167,192	849,044,623	283,737,954	1,132,782,577
Province. 1	44,340	179,653,964	286,027,610	465,681,574
Province. 2	32,676	148,251,510	263,031,101	411,282,611
Province. 3	33,430	159,245,439	291,643,819	450,889,258
Province. 4	33,369	143,727,302	278,474,938	422,202,240
Province. 5	46,254	216,149,288	381,823,982	597,973,270
Province. 6	41,149	153,633,779	265,519,965	419,153,744
Province. 7	33,074	149,699,773	357,915,895	507,615,668
Province. 8	29,939	144,467,040	302,619,207	447,086,247
Province. 9	25,490	83,141,449	180,558,514	263,699,963

Note Main telephone is the number as of February 1989.
Revenue are total in FY1988.

Table 2.5-2 Switching and Cable Capacity, and Waiting Applicant as of Feb. 1989

Area	Line Capacity	Remain Line	Cable Capacity	Remain Cable	Waiting List
Metro.1	301,616	93,569	282,872	59,026	64,196
Metro.2	264,222	61,578	284,857	75,743	107,479
Metro.3	201,341	56,385	206,953	47,802	96,042
Metro.4	224,549	44,644	285,282	92,326	104,236
Province. 1	64,008	17,409	62,063	17,312	23,237
Province. 2	49,416	15,022	50,738	16,802	2,381
Province. 3	49,348	14,629	55,938	21,782	1,881
Province. 4	57,020	21,433	66,119	30,904	1,882
Province. 5	62,552	14,353	66,657	17,440	8,039
Province. 6	59,936	16,746	55,570	14,053	16,254
Province. 7	47,362	12,549	48,050	13,461	12,476
Province. 8	38,096	6,888	50,498	20,685	8,085
Province. 9	34,004	6,986	39,364	12,695	4,875

Table 2.5-3 shows the unit value, which was calculated as the procedure above mentioned.

Table 2.5-3 Unit Value

Area	Local	Trunk	Total	Switching	Cable	Fault Ratio	Waiting
Metro.1	8,597	2,421	11,018	31	21	42.41	25
Metro.2	5,228	1,416	6,644	23	27	37.71	36
Metro.3	3,419	811	4,231	28	23	74.69	34
Metro.4	5,078	1,697	6,775	20	32	50.48	38
Province. 1	4,052	6,451	10,503	27	28	83.47	34
Province. 2	4,537	8,050	12,587	30	33	46.25	7
Province. 3	4,764	8,724	13,488	30	39	33.87	5
Province. 4	4,307	8,345	12,653	38	47	47.01	5
Province. 5	4,673	8,255	12,928	23	26	48.09	15
Province. 6	3,734	6,453	10,186	28	25	64.67	28
Province. 7	4,526	10,822	15,348	26	28	98.70	27
Province. 8	4,825	10,108	14,933	18	41	62.02	21
Province. 9	3,262	7,084	10,345	21	32	72.97	16

Note Revenue; per main telephone.
 Switching and Cable; Remain / Total
 Fault; per month per 1000 sub
 Waiting; Waiting / Express Demand

2.5.2 Result of the Analyses

The unit values of telecommunication areas obtained as described before are evaluated with 10 points scale, in which full point means the best condition in TOT. As for fault ratio and waiting applicants, reciprocals of the above values are applied for the relative evaluation.

Table 2.5-4 shows the evaluation of those matters in telecommunication areas respectively.

Table 2.5-4 Value of Point for Each Criterion

Area	Local	Trunk	Total	Switching	Cable	Waiting	Fault
Metro.1	10.0	2.2	7.2	8.3	4.5	2.2	8.0
Metro.2	6.1	1.3	4.3	6.2	5.7	1.5	9.0
Metro.3	4.0	0.7	2.8	7.5	4.9	1.6	4.5
Metro.4	5.9	1.6	4.4	5.3	6.9	1.4	6.7
Province. 1	4.7	6.0	6.8	7.2	6.0	1.5	4.1
Province. 2	5.3	7.4	8.2	8.1	7.1	7.8	7.3
Province. 3	5.5	8.1	8.8	7.9	8.3	10.0	10.0
Province. 4	5.0	7.7	8.2	10.0	10.0	10.0	7.2
Province. 5	5.4	7.6	8.4	6.1	5.6	3.6	7.0
Province. 6	4.3	6.0	6.6	7.4	5.4	1.9	5.2
Province. 7	5.3	10.0	10.0	7.0	6.0	1.9	3.4
Province. 8	5.6	9.3	9.7	4.8	8.8	2.5	5.5
Province. 9	3.8	6.5	6.7	5.5	6.9	3.3	4.6

Figure 2.5-1 to 2.5-7, drawn in radar chart form, show the values of all the telecommunication areas on each criterion. And Figure 2.5-8 to 2.5-20 show the values of all the criteria on each telecommunication area. The latter figures show that if the dotted area in the chart of a telecommunication area is larger, the telecommunication area is considered to be the better condition. As the results of this analysis, the characters and weak points of each area can be found out, as described in the following.

- 1) According to analysis from the view point of revenue:
 - a) The local call revenue of Metropolitan Areas are higher than those of provincial areas.
 - b) The trunk call revenue of Metropolitan areas are lower than those of provincial areas.

As the result, total revenue in provincial areas per subscriber is higher than in metropolitan area. In particular, the area including tourist resorts and far from metropolitan area such as telecommunication area 7 or 8, mark high revenue.

2) According to analysis from the view point of facilities:

Both switching and cable capacity margins mark approximately the similar values in the same area except a few areas as shown in Figure 2.5-4 and 2.5-5. This shows the area of high used lines, is also the area of high used cables.

3) According to maintenance activities:

In some areas, where are high ratio of fault occurrence, appropriate measures should be taken according to the major causes of faults.

4) According to analysis by telecommunication area:

Provincial telecommunication areas are represented by rather balanced forms except a few areas, but the form of metropolitan areas are quite reformed.

It is signified that local revenue in metropolitan areas is higher than trunk revenue and there are many waiting applicants in every metropolitan area.

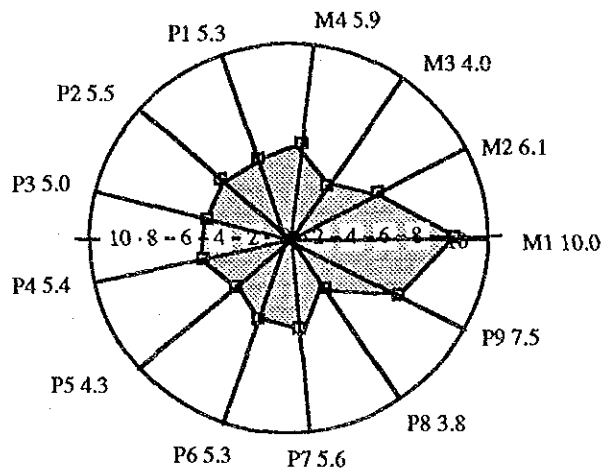


Figure 2.5-1 Local Revenue

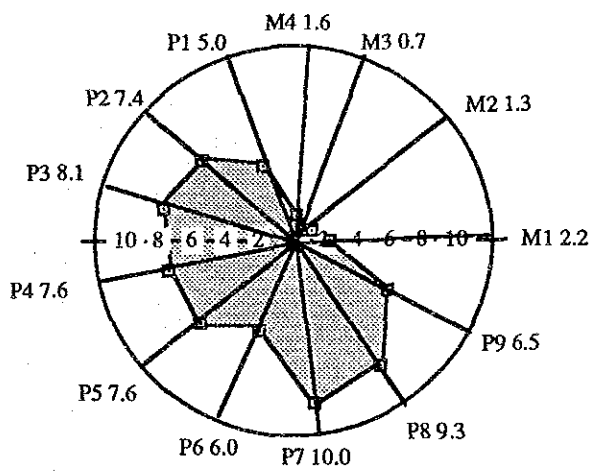


Figure 2.5-2 Trunk Revenue

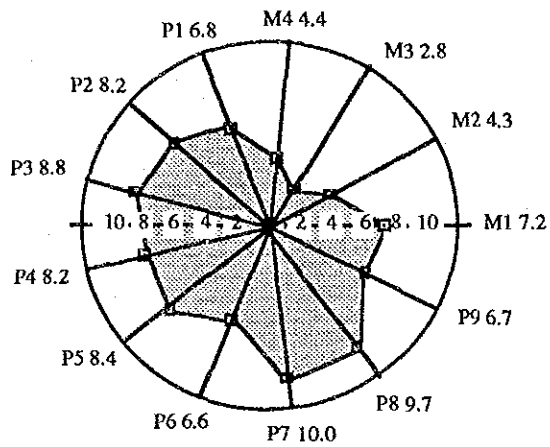


Figure 2.5-3 Total Revenue

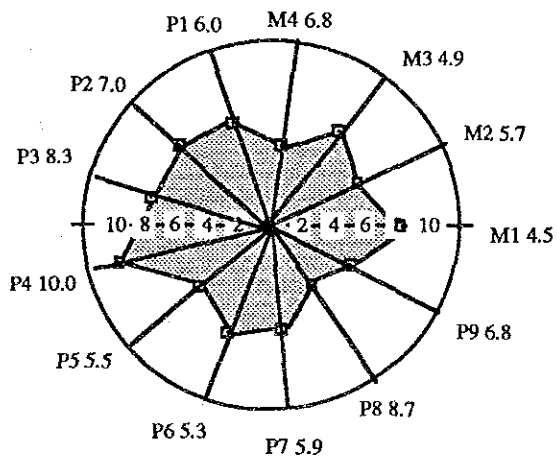


Figure 2.5-4 Cable Capacity Margin

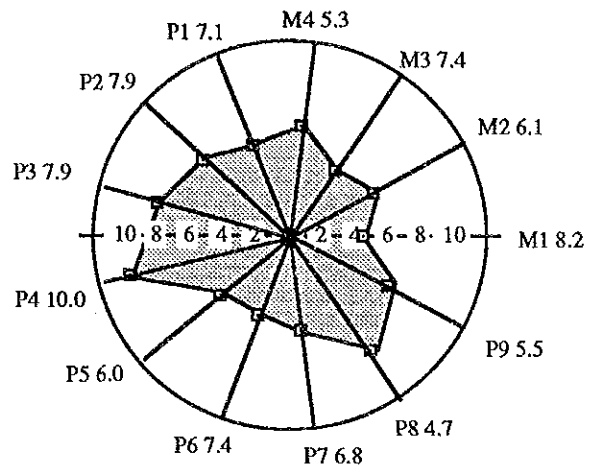


Figure 2.5-5 Switching Capacity Margin

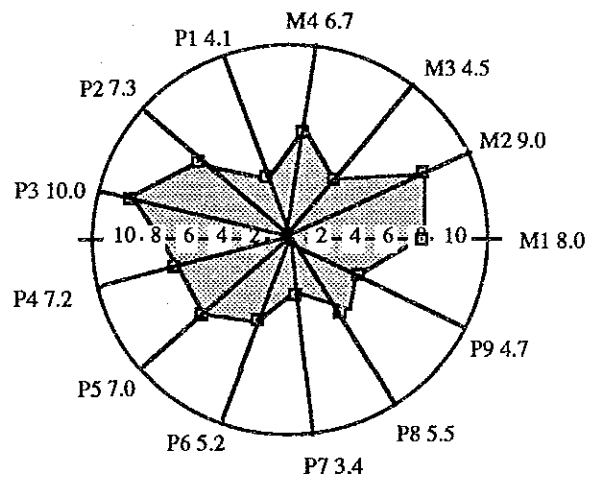


Figure 2.5-6 Fault Ratio

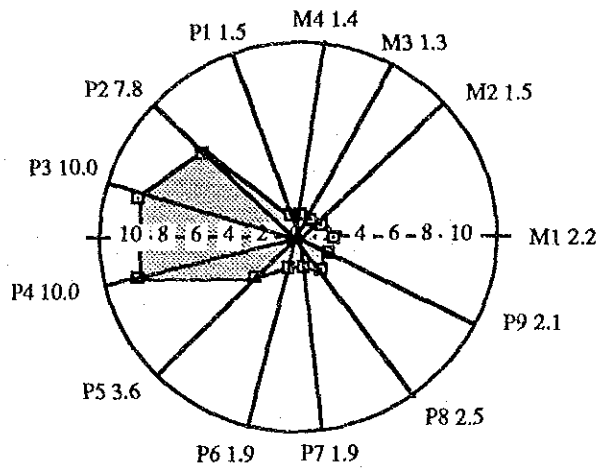


Figure 2.5-7 Waiting Applicant

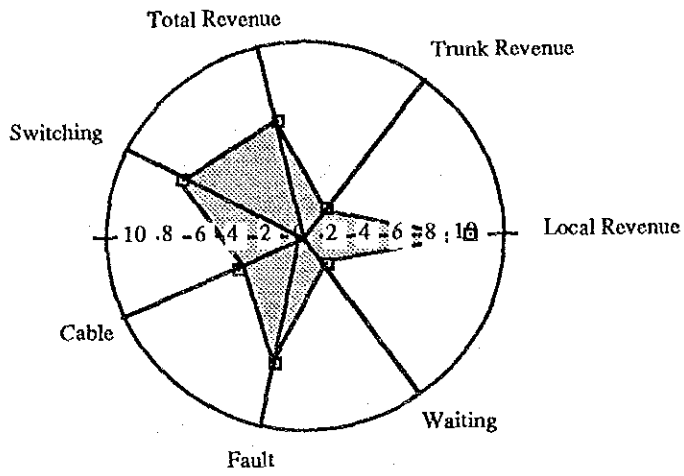


Figure 2.5-8 Metropolitan Area-1

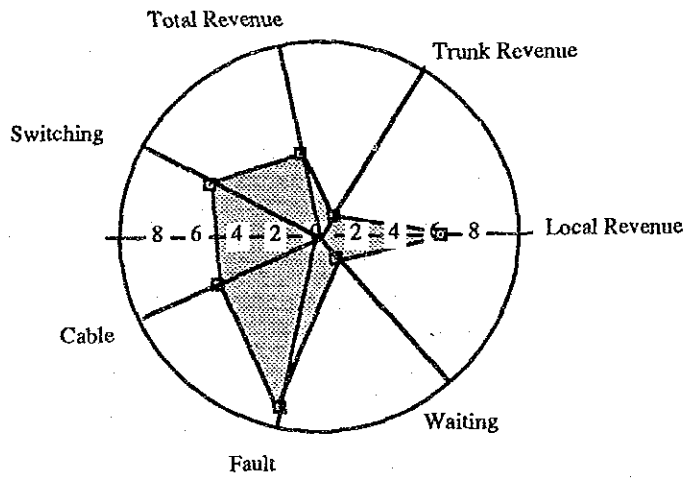


Figure 2.5-9 Metropolitan Area-2

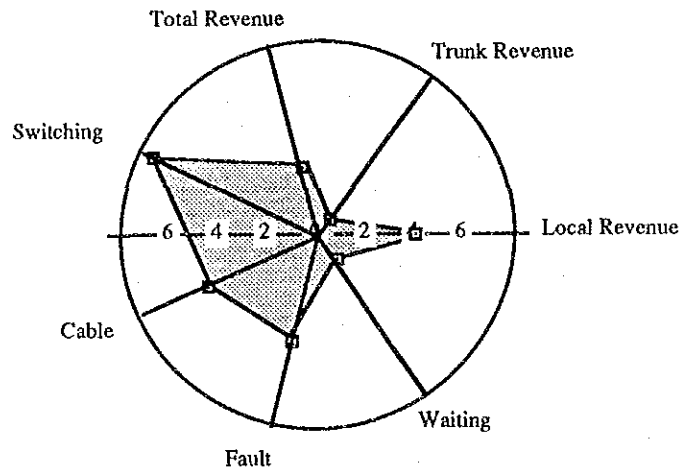


Figure 2.5-10 Metropolitan Area-3

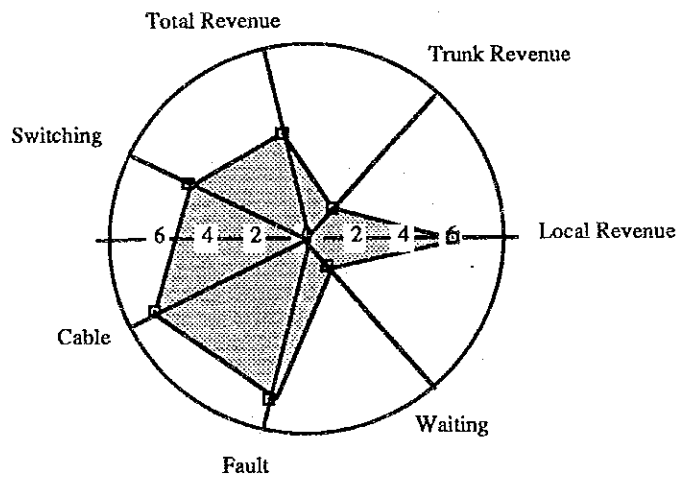


Figure 2.5-11 Metropolitan Area-4

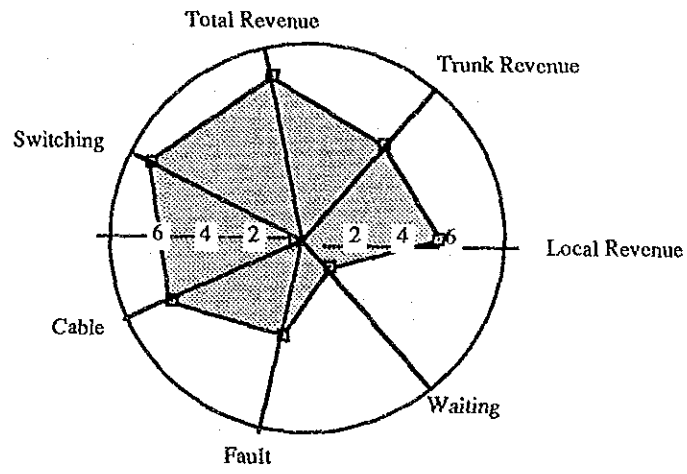


Figure 2.5-12 Provincial Area-1

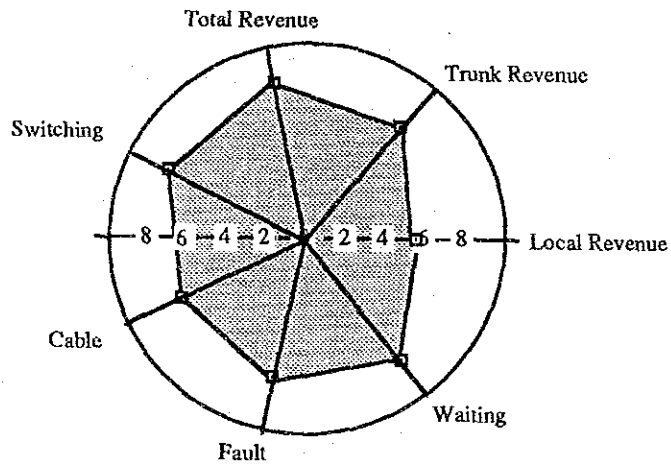


Figure 2.5-13 Provincial Area-2

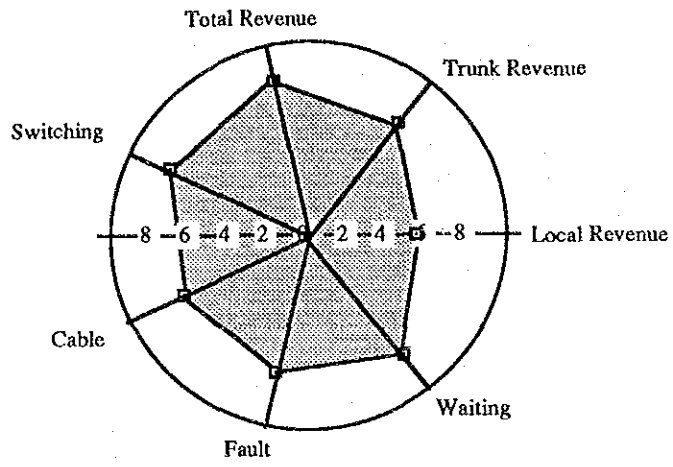


Figure 2.5-14 Provincial Area-3

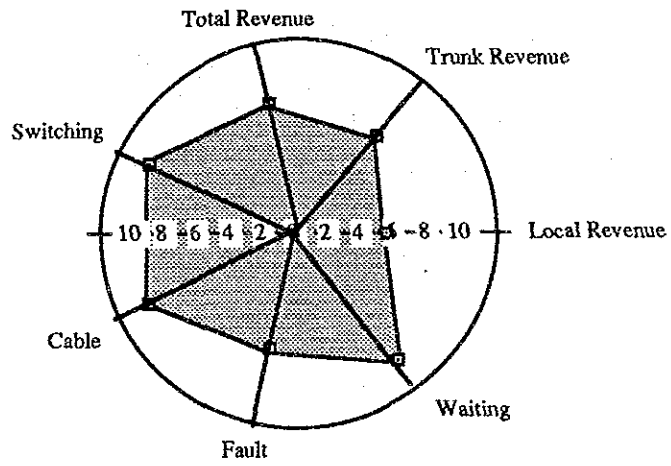


Figure 2.5-15 Provincial Area-4

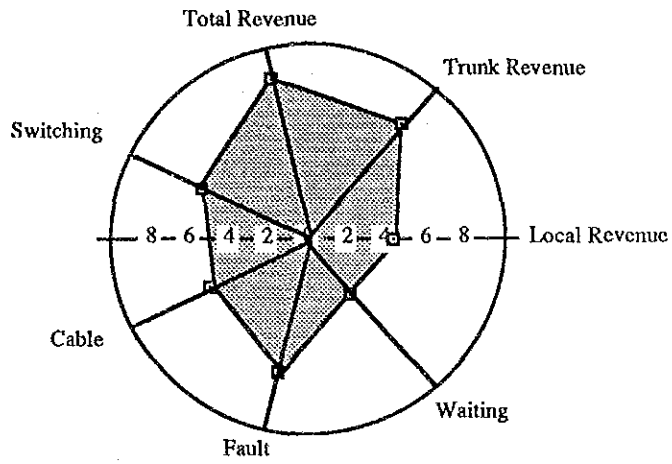


Figure 2.5-16 Provincial Area-5

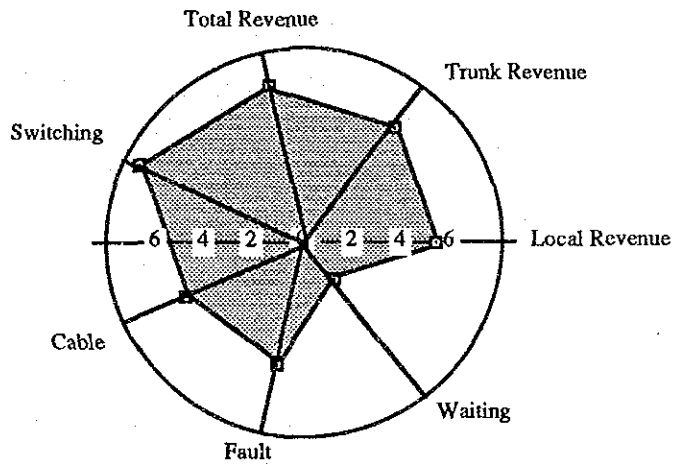


Figure 2.5-17 Provincial Area-6

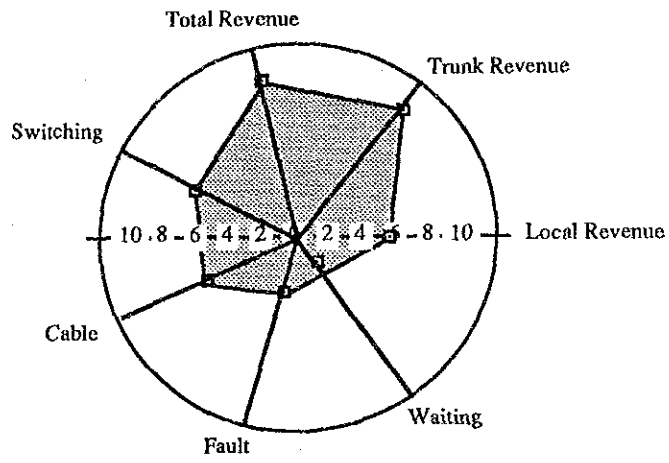


Figure 2.5-18 Provincial Area-7

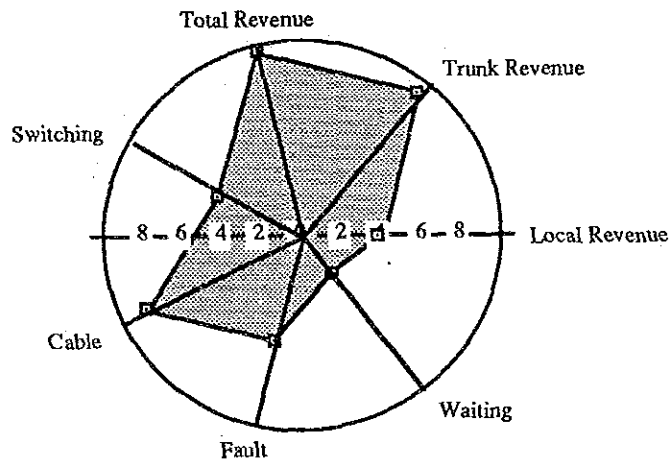


Figure 2.5-19 Provincial Area-8

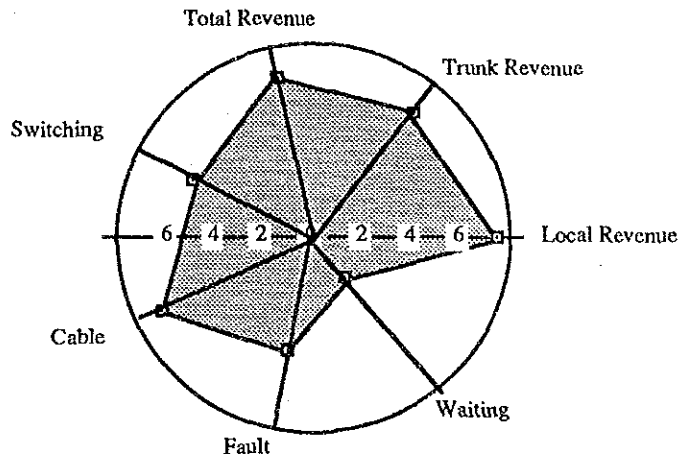


Figure 2.5-20 Provincial Area-9

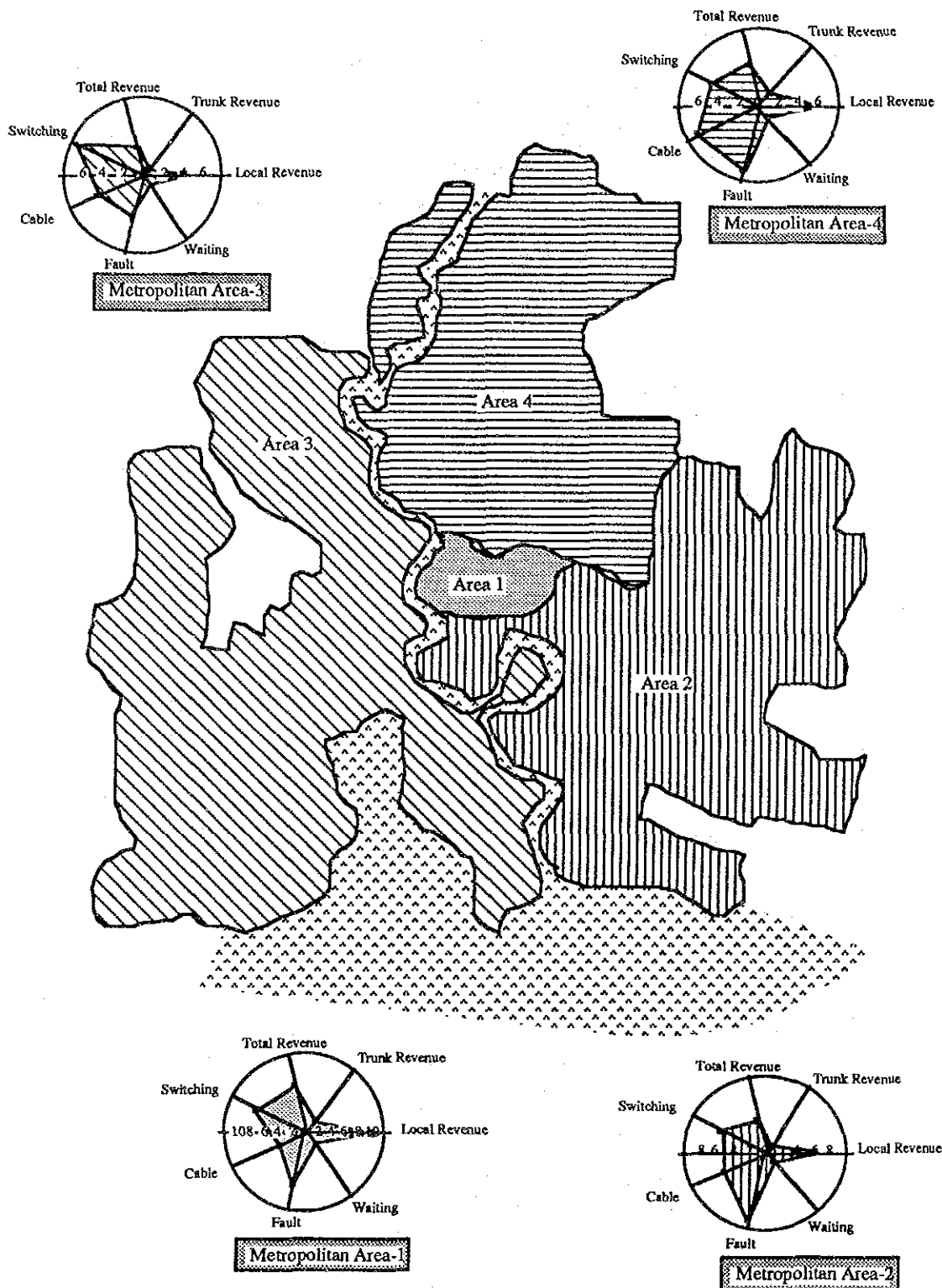


Figure 2.5-21 Present Situation in Metropolitan Areas

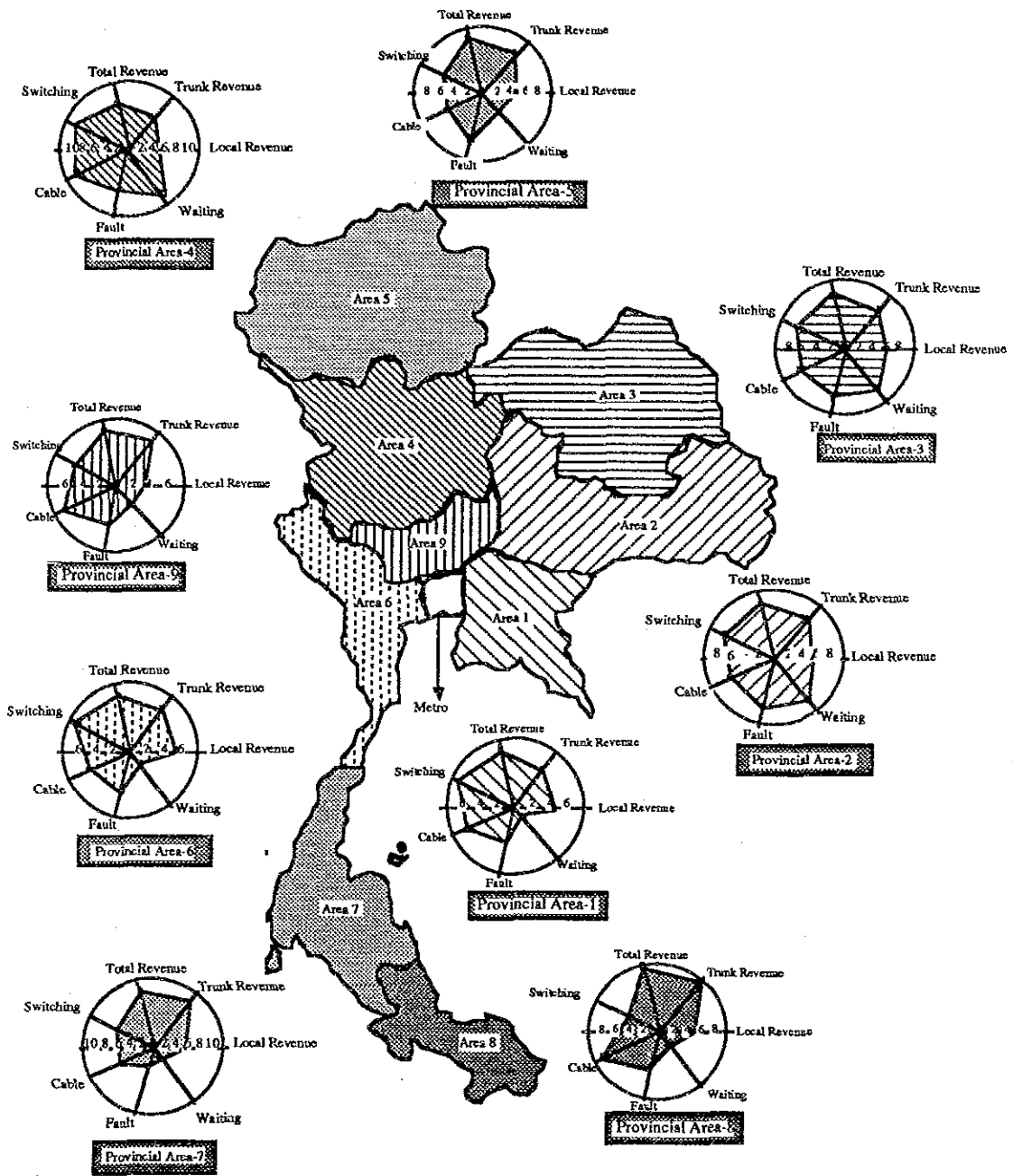


Figure 2.5-22 Present Situation in Provincial Areas

