hunting system. There is no capacity limitation in the SPC switching system to provide the hunting system.

Table 3.5.2-6 shows an actual example of the subscriber class and the telephone numbers allocation in the NEAX-61 SPC switching system.

Table 3.5.2-6 Actual Example of Subscriber Class and Telephone Number Allocation in NEAX-61 Switching System

Exchange Name / Categories	0137 INTHAMARA		0137 Homing INTHAMARA RSU 1	0137 Homing INTHAMARA RSU 2	0137 Homing INTHAMARA RSU 5
Number of Extension Lines	15,360		1,000	1,000	1,000
Office Code	275	276	274	274	274
Directory Number	0000 - 9999 (10,000)	0000 - 5359 (5,360)	0000 - 0999 (1,000)	1000 - 1999 (1,000)	4000 - 4999 (1,000)
PABX (All Pilot Lines)	0020 - 0349 (330)	1020 - 1069 (50)	0020 - 0119 (100)	1020 - 1119 (100)	4020 - 4119 (100)
Coin Box					
Local (Line Reverse)	0350 - 0629 (280)	1070 - 1089 (20)	0120 - 0139 (20)	1120 - 1139 (20)	4120 - 4139 (20)
STD and with Local	0630 - 1679 (1,050)	1090 - 1099 (10)	0140 - 0209 (70)	1140 - 1209 (70)	4140 - 4209 (70)
Ordinary Subscriber	1895 - 9999 (8,105)	0010 - 1019 1115 - 5359 (4,255)	0008 - 0019 0225 - 0999 (787)	1008 - 1019 1225 - 1999 (787)	4008 - 4019 4225 - 4999 (787)
Sub. Private Meter	1680 - 1894 (215)	1100 - 1114 (15)	0210 - 0224 (15)	1210 - 1224 (15)	4210 - 4224 (15)
Test Line Number	(20)		(8)	(8)	(8)
FLT (LTC)	0000 - 0004		-------	-------	-------
OTL (SPC)	0005 - 0010		0000	1000	4000
AAT TTL	0012 0013		0001 0002	1001 1002	4001 4002
MTL ESE	0014 0015		0003 0004	1003 1004	4003 4004
SUBLT ACTTTL	0016 0017		0005 0006	1005 1006	4005 4006
RTT CPT	0018 0019		0007 -------	1007 -------	4007 -------
TST-R	0011		-------	-------	-------

Source: TOT

3.5.3 Various Services to Alleviate B-sub Busy

Various network services such as call waiting (C/W) service and direct inward dialing (DID) service for private automatic branch exchanges (PABX) are also effective to improve the call completion ratio, especially for high B-sub busy subscribers. The followings are the present status of these services provided by TOT.

1) SPC Special Services

a) The present SPC switches can provide its subscribers with various services such as:

i) call transfer (C/T),
ii) automatic call repetition (A/C/R),
iii) abbreviated dialing (A/D),
iv) conference call (C/C),
v) hot line (H/L),
vi) call waiting (C/W),
vii) outgoing call barring (O/C/B)
viii) immediate charge information (I/C/I) service.

b) In order to improve the call completion ratio, automatic call repetition (A/C/R) and call waiting (C/W) services are effective. The followings are the services features.

i) Automatic Call Repetition (A/C/R):

When a telephone caller reaches a busy line, he may set his phone to automatically dial to the desired line when it becomes free. When the phone rings, he will have the desired party on the line.

ii) Call Waiting (C/W):

Another (the third) party is calling a subscriber while talking with one party , the subscriber will hear an interrupted signal twice in a two second interval. He can choose to speak to either party.

c) Table 3.5.3-1 shows the switching capacity for the C/W service, the number of the C/W users (lines), and the total number of the main telephone lines accommodated to the SPC switches in the BMA. The switching capacity for the C/W and C/W users have been increasing over the last 4 years; however, only 1.12% of the total

main telephone lines are using the C/W service in FY 1990 in the area as shown in Table 1.3.1-1. Furthermore the automatic call repetition (A/C/R) service is not popular as shown in Figure 3.5.3-1.

Table 3.5.3-1 Call Waiting (C/W) Service Development in the Bangkok Metropolitan Area

Fiscal Year	1988	1989	1990	1991
1. C/W Capacity	35,664	38,857	41,319	44,518
2. C/W Users	2,050	3,667	6,426	7,756
3. Main Telephone Lines (SPC)	348,011	462,339	573,805	
4. Occupancy Rate (=2/1)	5.75%	9.44%	15.55%	17.42%
5. Users Rate (=2/3)	0.59%	0.79%	1.12%	

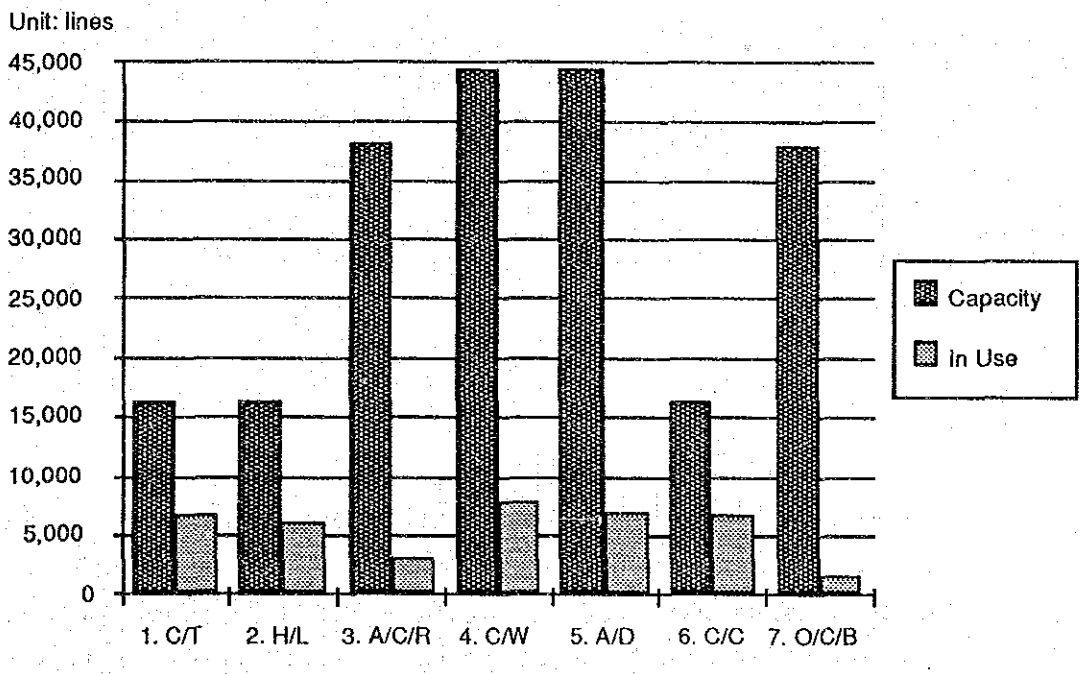


Figure 3.5.3-1 Capacity and Number in Use for Special SPC Service at FY 1991 (as at Sep. 30, 1991)

d) In case of Japan, the usage of the C/W service has increased for the last five years. Approximately 13% of the total subscriber lines are using the C/W service at the end of FY 1990.

Table 3.5.3-2 Number of C/W Users and Subscribers in Japan

FY	1986	1987	1988	1989	1990
1. C/W User	2,129,769	2,891,067	3,850,906	5,195,970	7,048,842
2. Subscribers	46,771,746	48,419,104	50,337,093	52,407,863	54,480,029
3. User Rate (1/2)	4.55	5.97	7.65	9.91	12.94

Source: NTT, "Major Statistics", August 1991

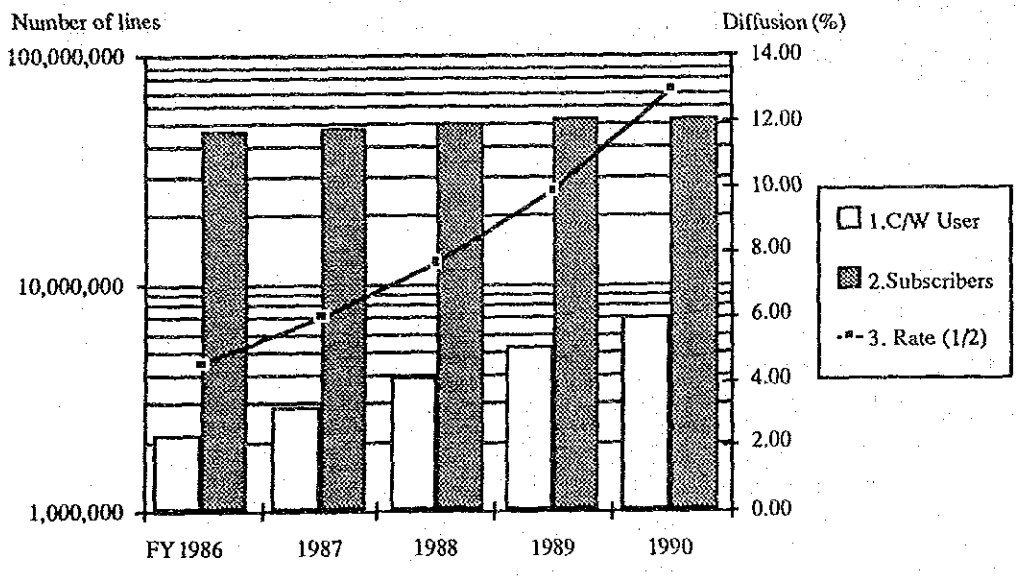


Figure 3.5.3-2 The Development of C/W Service in Japan

e) The reason of the unpopularity for the C/W and A/C/R services is partly because the usage directions are rather complex. There are also the subscribers who do not find any merit for using these services. However, the C/W service is one of the most effective ways for those high B-sub busy subscribers who can not afford to install additional telephone lines. It is, therefore, highly recommended for TOT to promote the C/W service for reducing single-line B-sub busy subscribers who can not install additional main telephone lines.

2) Direct Inward Dialing (DID) Service for PABX

a) Merit of DID Service

The SPC switches offer the Direct Inward Dialing (DID) service for the PABX users. The DID service provides PABX extensions with normal subscriber

numbers. The SPC switching systems send the number signal which controls PABXs and select the preset extension; therefore, incoming calls can be directly connected to extensions without operators of PABXs.

Figure 3.5.3-3 shows the system configuration of the DID service.

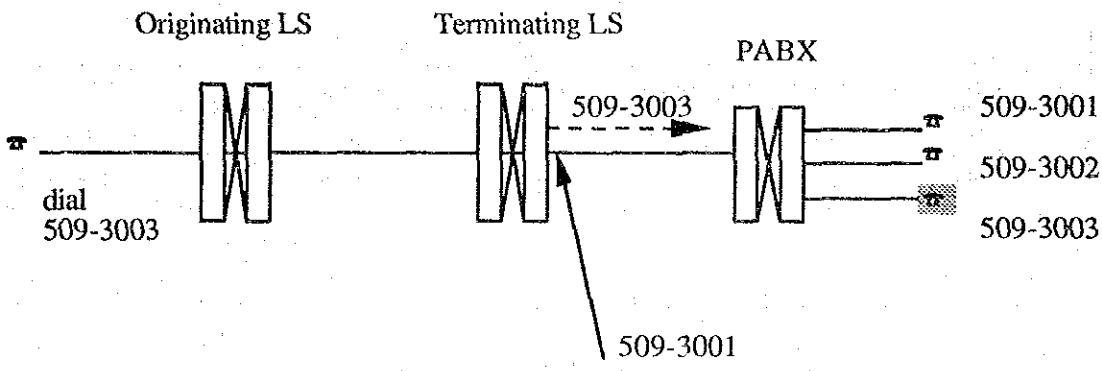


Figure 3.5.3-3 Direct Inward Dialing System for PABX

Merits of the DID service are as follows:

i) When the extension is busy, the busy tone can be sent to the caller,
ii) The number of main telephone line can be economized,
iii) Waiting time for operator connection is not necessary because of direct connection to extensions,
iv) It is not necessary for operators to receive and connect incoming calls; therefore, operators' workload can be reduced and manpower cost can be saved.

In the case that there are relatively many incoming calls to one PABX user compared with the call handling capability of its operators, the telephone callers from outside have to wait for operator responses. This also makes each holding time longer and increases B-sub busy as a result. Hence, the DID service is preferable for high B-sub busy PABX users.

b) The Present Service Provision by TOT

TOT provides the DID service using the PCM-30 transmission system as the link between a PABX and its host exchange. The minimum requirement of the DID service for a PABX subscriber is 4 PCM-30 systems with 120 (30ch X 4 sys.) circuits (main telephone lines) and 400 (100 line X 4 sys.) extension lines. For an

increase of DID numbers, the required PCM system steps up by one system with 30 circuits and 100 extensions.

Table 3.5.3-3 shows the line capacity for DID service provided by TOT.

Table 3.5.3-3 The Line Capacity for DID Service by TOT

	Basic Unit	Additional Unit
1. The Number of Main Telephone Line	120 lines	30 lines
2. The Number of Assigned Telephone Numbers (the number of extensions)	400 lines	100 lines

c) Recommendation for Improvement

According to the data from TOT, there exist approximately 113 subscribers who use more than 100 telephone lines (see Table 3.5.2-3); however, the number of PABXs with more than 100 main telephone lines counts only 43 (see Table 3.5.2-2). Most of these 43 large PABXs are supposed to be the DID service users.

If there is no limitation on the number of main lines to apply for the DID service, the DID service can prevail more widely to the medium and small size PABX users. Then it can contribute to reduce B-sub busy. Therefore, it is recommended for TOT to consider the provision of the DID service for small- and medium-sized PABX subscribers.

3.5.4 Special Activities to Reduce High B-sub Busy

TOT has just begun the special traffic sales promotion activity to monitor high-B-sub busy traffic subscribers and recommend them to solve their telephone usage problems.

The Network Management Sector of the Telecommunications Network Department in the Operations Bureau of TOT monitors high B-sub busy subscribers, lists them up, and sends these subscribers' telephone numbers to the Commercial Services Center. Special sales promotion units at commercial divisions sometimes visit the subscribers offices or shops, try to find out solutions to improve their incoming call traffic performance, and make recommendations.

This activity to focus on those high B-sub busy subscribers is most effective to ease the traffic congestion of subscribers. The following procedure is useful.

1) Collecting the Information of High B-sub Busy Subscribers

The traffic congestion on the subscribers line is usually caused by subscribers such as travel agencies, hotels, and trading companies, that rely largely on the telephone for their business activities.

The procedure starts from listing up those high B-sub busy subscribers. The reliable information sources for finding high B-sub busy subscribers are:

a) the complaint center,
b) the telephone billing center, and
c) special traffic survey.

TOT has two network management and control centers; NCOM and AOM. These fully computerized centers can monitor the traffic of all SPC switches in the whole Kingdom. They can monitor B-sub busy occurrences for each SPC switching unit and print out B-sub busy subscribers' telephone numbers. These subscribers list is quite useful to find out high B-sub busy subscribers.

2) Subscriber's Traffic Monitoring

In addition to the listed telephone number, the following subscriber's information is necessary:

a) the subscriber's name, address, and the number of staff who use telephone,
b) the number of main telephone lines and their telephone numbers which belong to the subscriber,
c) the subscriber's telephone system type (PABX, Key Telephone system, or ordinary telephone set) and the number of extensions,
d) already using hunting system or not yet using.

Almost all information listed above are available in the commercial section; however, there may be some information which is to be collected from the subscriber through interviews.

The listed subscriber's traffic must be monitored and measured in the second step.

3) Finding the Solution: Calculation of the Required Number of Main Telephone Lines

In the case that the subscriber has more than one main telephone line but not yet using the hunting system, it is highly recommended for TOT to let the subscriber apply for and use the hunting system.

In most cases, those high B-sub busy subscribers need additional main telephone lines in order to ease their traffic congestion problem. The appropriate number of main telephone lines for the subscriber is estimated by the Erlang theory based on the measured traffic during the busy (peak) hours. It should be noted that the busy or peak hours of every subscriber are different. It is recommended, therefore, to monitor the subscribers traffic for 24 hours if possible. If it is not practical, 12 hours measuring is the second alternative way.

4) Consultation and Negotiations with High B-sub Busy Subscribers

Subscribers usually do not know about their telephone traffic condition and the efficient way to improve their traffic problem. Normal subscribers sometimes are not aware that their telephone lines are often busy and therefore many people complain about it.

It is, therefore, indispensable for TOT to send the staff to those high B-sub busy subscribers to show the evidence of their traffic congestion problem and recommend them to take certain actions. In order to do this activity, setting up the special teams is important. Each team has staffs from the commercial section and traffic section.

5) Improvement Progress Monitoring and Control

In order to ease the subscribers traffic congestion problem through the special activity mentioned above, it is essential to check the improvement by monitoring traffic congestion problem regularly. If one subscriber can successfully use the hunting system and/or install additional required main telephone lines, it is a good chance to collect actual traffic improvement data. It will be also quite useful to persuade other high-B-sub busy subscribers to accept solutions for easing traffic congestion problems.

The progress of the special activity should be reported to the Service Quality Improvement Committee that one of top executives chairs. The role of the committee is to monitor the achievement of the teams, analyze bottlenecks, and instruct any departments concerned to take necessary improvement measures to ease traffic congestion problems.

3.5.5 Special High B-sub Busy Subscriber Survey

The study team has conducted the high B-sub busy subscriber survey with great cooperation from the staffs of the NCOM Center, the Network Management Sector, and the Center of Commercial Services of TOT.

It is expected that there are many subscribers who have more than one telephone line but do not use the hunting system. This can be the main cause and reason of the high B-sub busy. The hunting system is effective to reduce B-Sub busy when a subscriber uses more than one main telephone line in one location. In order to clarify the reason of not using the system and find out the solutions, the special survey was conducted.

The objective of this survey is to find out the actual situation of high B-sub busy subscribers, clarify the causes of high B-sub busy, and find out solutions to reduce traffic congestion of the subscriber.

1) Survey Procedure and Methodology

The survey was conducted through the following five steps:

a) list up High B-sub busy subscribers,
b) preparation of the questionnaire,
c) address a telephone questionnaire, and
d) collect, summarize and analyze answers,
e) extraction of recommendations and suggestions.

The survey period was two months from April to May, 1992; therefore, the study team has selected only two exchange areas to list up high B-sub busy subscribers. In order to list up the B-sub busy subscribers, the NCOM center has done the special observation for three days. The sampling method is as follows:

a)	Required number of samples:	approximately 100 subscribers per exchange
b)	Selected Exchanges	Two (2) Exchange Offices: Khlong Toei and Bang Phli
c)	Sampling method:	Sampling from NCOM list of B-sub busy subscriber tel. number
d)	Sampling Period:	During the busy hours from April 7 to 9, 1992
e)	Questioner:	Staff in TOT commercial center (commercial divisions)
f)	Interview Survey Period:	from April to May, 1992 (2535).

2) High B-sub Busy List Up Survey

The NCOM Center at Lat Ya has conducted special traffic observations for two local SPC exchanges, Khlong Toei (KTI) and Bang Phli (BPL), for three days from April 7 to 9, 1992 during the busy hour (about 10 to 11 am).

According to the sorting and selection of the B-sub busy telephone numbers on the printout list from the NCOM center, 65 telephone numbers in KTI and 86 in BPL were selected as high B-sub busy telephone numbers.

Observation results, sorting, and selection procedures and results are as follows.

a) Khlong Toei area

Table 3.5.5-1 High B-Sub Busy Observation Result at KTI from April 7 to 9, 1992

Exchange & Code	Date	Tel. Number	B-sub B Count
KTI	7-Apr.	431	749
(240, 249)	8-Apr.	381	730
	9-Apr.	453	1,000
935	Total	1,265	2,479
	B-sub Busy Count	Frequency	
	1	831	
	2	245	
	3	79	
	4	31	
	5	24	
	6	12	
	7	6	
	8	12	
	9	4	
	>= 10	21	
	Max.	51	
	Min.	1	
	Average	1.96	
	STD	3.14	

Sorting Condition			
	A	2 times more	434
	B	3 times more	189
	C	2 days more	330
	D	3 days	76
	E	A & C	129
	F	B & C	62
	G	A & D	65

Table 3.5.5-1 indicates the followings:

i) Total 2,479 telephone calls have met B-sub busy for three days during the busy hour. The number of B-sub busy subscriber lines was 1,265 in total, which accommodated in the NEAX-61 switching units with "240" and "249" exchange code in Khlong Toei switching office.

ii) There were 831 telephone numbers which counted only one time B-sub busy for one day, 245 telephone numbers counted two time B-sub busy, 21 telephone numbers counted more than and equal to 10 time B-sub busy, and one telephone number counted 51 time B-sub busy for one day (approximately one hour observation period).

iii) There are 330 telephone numbers that counted B-sub busy more than and equal to two days. 76 telephone numbers counted B-sub busy every day.

iv) Within the 76 telephone numbers, which encountered B-sub busy every day, 65 telephone numbers got more than and equal to 2 time B-sub busy.

The Study Team has picked up these 65 telephone numbers as the high B-sub busy numbers and investigated further in detail.

b) Bang Phli area

Table 3.5.5-2 High B-Sub Busy Observation Result at BPL from April 7 to 9, 1992

Exchange & Code	Date	Tel. Number	B-sub B Count
BPL	7-Apr	415	930
(312, 315, 316)	8-Apr	343	707
	9-Apr	409	919
	Total	1,167	2,556

B-sub Busy Count	Frequency
1	657
2	225
3	124
4	55
5	41
6	17
7	14
8	7
9	4
>= 10	23
Max.	43
Min.	1
Average	2.19
STD	2.67

Sorting Condition			
	A	2 times more	510
	B	3 times more	285
	C	2 days more	364
	D	3 days	94
	E	A & C	206
	F	B & C	133
	G	A & D	86

Table 3.5.5-2 indicates the followings:

i) Total 2,556 telephone calls have met B-sub busy for three days during the busy hour. The number of B-sub busy subscriber lines was 1,167 in total, which accommodated in the NEAX-61 switching units with "312", "315", and "316" exchange codes in the Bang Phli (BPL) switching office.

ii) There were 657 telephone numbers which counted only one time B-sub busy for one day, 225 telephone numbers counted two time B-sub busy, 23 telephone numbers counted more than and equal to 10 time B-sub busy, and one telephone number counted 43 time B-sub busy for one day (approximately one hour observation period).

iii) There are 364 telephone numbers that counted B-sub busy more than and equal to two days. 94 telephone numbers counted B-sub busy every day.

iv) Within the 94 telephone numbers, which encountered B-sub busy every day, 86 telephone numbers got more than and equal to 2 time B-sub busy.

The Study Team has picked up these 86 telephone numbers as high B-sub busy numbers and investigated further in detail.

65 subscriber numbers in Khlong Toei and 86 subscriber numbers in Bang Phli, which are in case G, i.e., the subscriber number which has more than two B-sub busy counts in approximately one hour and are listed up every day, are selected for the interview survey.

3) Attribute of the Selected High B-sub Busy telephone Lines

Some of those telephone numbers selected as high B-sub busy lines belong to the same subscriber. Those 65 high B-sub busy lines belong to 34 subscribers in KTI. Those 86 high B-sub busy lines belong to 41 subscribers in BPL.

The following tables show the attribute of the selected high B-sub busy telephone lines.

a) Khlong Toei area: 65 telephone lines

Table 3.5.5-3 The Attribute of the Selected 65 High B-sub Busy Telephone Lines in KTI

Dial Type	Hunting	Pilot or Non Pilot	Slip or Non Slip
1) Tone: 61	1) Not Using:26		
2) Rotary: 4	2) Using: 39	1) Pilot: 12	
		2) Non Pilot:27	1) Slip: 3
			2) Non Slip: 24

Table 3.5.5-4 The Number of High B-sub Busy Subscriber in KTI

Exchange Code	Number of Subscribers
"240-"	1
"249-"	34
Total	35

b) Bang Phli area: 86 telephone lines

Table 3.5.5-5 The Attribute of the Selected 65 High B-sub Busy Telephone Lines in BPL

Dial Type	Hunting	Pilot or Non Pilot	Slip or Non Slip
1) Tone: 81	1) Not Using:61		
2) Rotary: 5	2) Using: 25	1) Pilot: 10	
		2) Non Pilot: 15	1) Slip: 13
			2) Non Slip: 2

Table 3.5.5-6 The Number of High B-sub Busy Subscriber in BPL

Exchange Code	Number of Subscribers
"312-"	1
"315-"	7
"316-"	30
"317-"	3
Total	41

4) Findings from the Interview Survey for High B-sub Busy Subscriber

In order to find out whether these subscribers have more than one telephone line and whether they are using the hunting system or not, an interview survey was planned. If they have two or more than two telephone lines and are not using the hunting system yet, there is a high possibility to reduce B-sub busy when they introduce the system.

A questionnaire was prepared for the telephone interview survey to high B-sub busy subscribers, which is attached in ANNEX- . Staff in the Commercial Section has made telephone interviews to these high B-sub busy subscribers. Findings from the interview are as follows.

a) Khlong Toei area: 35 subscribers

Table 3.5.5-7 Telephone System for High B-sub Busy Subscriber in KTI

The Number of Main Telephone Lines		The Number of Main Telephone Lines
1) One: Single Line User: 5		
2) Multi-line User: 30	1) Using Hunting: 16	Max.: 19
		Min.: 4
		Ave.: 13.1
	2) Not Using Hunting: 14	Max.: 12
		Min.: 2
		Ave.: 4.9

As Table 3.5.5-7 indicates, 35 high B-sub subscribers consist of 5 single-line and 30 multi-line subscribers. In these 30 multi-line subscribers, only 16 subscribers are using the hunting system and the remaining 14 are not using the hunting system.

19 is the maximum number of telephone lines per subscriber. 4 is the minimum. The average is 13.1 lines within these 16 hunting system using multi-line users.

12 is the maximum number of telephone lines per subscriber. 2 is the minimum. The average is 4.9 lines within these 14 non hunting system multi-line subscribers.

12% (305 B-sub busy) of the total 2,479 B-sub busy observed within three days busy hours in KTI occurred by these 14 subscribers, who are multi-line users but not using the hunting system.

53.3% is the usage rate of the hunting system for the high B-sub busy subscribers in KTI.

b) Bang Phli area: 41 subscribers

Table 3.5.5-8 Telephone System for High B-sub Busy Subscriber in KTI

The Number of Main Telephone Lines				The Number of Main Telephone Lines
1) Single-Line User:	3			
2) Multi-line User:	38	1) Using Hunting:	12	Max.: 19
				Min.: 4
				Ave.: 9.8
		2) Not Using Hunting:	26	Max.: 19
				Min.: 2
				Ave.: 7.2

As Table 3.5.5-8 indicates, 41 high B-sub subscribers consist of 3 single-line and 38 multi-line subscribers. In these 38 multi-line subscribers, only 12 subscribers are using the hunting system and the remaining 26 are not using the hunting system.

19 is the maximum number of telephone lines per subscriber. 4 is the minimum. The average is 9.8 lines within these 12 hunting system using multi-line users.

19 is the maximum number of telephone lines per subscriber. 2 is the minimum. The average is 7.2 lines within these 26 non hunting system multi-line subscribers.

31% (797 B-sub busy) of the total 2,556 B-sub busy observed within three days busy hours in BPL occurred by these 26 subscribers, who are multi-line users but not using the hunting system.

31.6% is the usage rate of the hunting system for the high B-sub busy subscribers in BPL.

c) Customers' Requests and Complaints to TOT

During the interviews to those 65 high B-sub busy subscribers, the following requests and complaints were gathered.

Table 3.5.5-9 Requests and Complaints from 65 High B-sub Busy Subscribers

Requests and Complaints to TOT	Number of Answers
1. Our telephone lines are always busy and it is very difficult to make an incoming call from outside to our office and also difficult to make an outgoing call from our office.	62
2. Already has applied for additional telephones installation but not hear when the installation is available.	60
3. Many faults occurs often.	22
4. It takes long period to get repair and maintenance service from TOT.	17
5. It is difficult to hear clearly the voice from telephone receivers.	13
6. There are some interrupting noise while talking through telephone.	13
7. We want to apply for and use the hunting system. (want to combine separated hunting groups into one hunting group).	7 (1)
8. TOT provides good maintenance service.	6
9. The service grade is very poor.	2
10. There are often wrong number incoming calls.	2
11. Complaints on Billing: (want to receive telephone bills regularly; there is always "balance brought foreword" even though the payment is done before the due date).	2
12. Can not make an outgoing call from one telephone line.	1
13. Can not make an trunk call from one telephone line.	1
14. Want TOT to install more public telephones	1
15. Our telephone lines are always busy so we want to install queuing system for our customers.	1
16. Telephone terminal set (system) breaks down often.	1
17. CDAS center is always busy.	1

This survey has clarified the following points:

a) As there are many multi-line subscribers who have not yet used the hunting system but are ready to install it, their traffic congestion can be greatly improved by introducing the hunting system. It is highly recommended for TOT to find those subscribers and promote using the hunting system for them.

b) Almost all high B-sub busy subscribers are aware of their telephone traffic congestion problem and have strong demand for additional telephone line installation. Therefore, it is recommended for TOT to supply main telephone lines for those high traffic subscribers when additional telephone lines in the same switching unit are available to install; and make the additional lines included within their same hunting group.

5) Solution and Recommendation

In order to improve incoming call completion ratio to those high B-sub busy telephone subscribers, the following measures are effective:

a) introducing the hunting system when they have more than one telephone line in a place, changing their telephone number if they are not in a same exchange code to introduce the hunting system,

b) installing additional main telephone lines into their hunting system if they already use the hunting system but they have still frequent B-sub busy,

c) installing additional main telephone lines and introducing the hunting system if they are using only one main telephone line, and

d) installing the C/W service if they have only one main telephone line and if they can not install additional telephone lines.

If there is any subscriber who agrees to take one of these measures, it is a good chance for TOT to assess the B-sub busy improvement before and after taking measures.

In addition to the measures listed above, there are other measures to improve telephone usage efficiency in the subscriber telephone set system. For example, the key telephone system can also improve the call completion ratio when used with the hunting system. Even though TOT is not providing its customers with any telephone terminal set at the present, it is better for TOT to promote telephone systems such as the key telephone among those high B-sub busy subscribers.

Because it is rare for TOT to introduce the key telephone system as well as the hunting system even in the TOT commercial office at the present, very few staff knows the merits of the hunting system. It is highly recommended for TOT to start using these systems in TOT offices at first to let the staff understand the merits, and then promote them among subscribers in order to ease traffic congestion and improve the call completion ratio.

3.6 Traffic Congestion in the Network

Purpose

Although only a small percentage of attempted calls (5.5%) ware not completed because of congestion, it is worth investigating because the method and procedure to improve the problem is well established.

The present working and usage situation of the switches and trunk lines in the BMA was studied to identify the problems caused by congestion and to propose measures and policies for call completion ratio improvement.

Study

The study is conducted to understand the present working situation of the SPC switches (NEAX61), trunk line usage situation between the LEs(XB and SPC) and the SPC TDMs, between the SPC TDMs and the TCs, between the PSTN and the MTXs, and between the MTXs and the Base stations, to identify problems and to propose measures and policies to eliminate the problems.

1) Working situation of the SPC switches

   On the congestion problem of the switches a study is conducted to understand the present situation of (1) system over-load, (2) concentrator over-load, and (3) junction over-load on the basis of traffic reports and to identify reasons why dial-tone cannot be sent and which switch units cause the problem.

2) Trunk line usage situation

   On the congestion problem of the trunk lines, a study is conducted to understand the present situation of the trunk lines between the LEs and the SPC TDMs and between the SPC TDMs and the TCs on the basis of the traffic reports and to compute the necessary number of trunk lines for the final routes between the switch units.

3) MTX line usage situation (between the PSTN and MTXs and between MTXs and Base stations)

   On the cellular mobile telephone congestion problem, a study is conducted to understand the present situation of the trunk lines between the PSTN and the MTXs and between the MTX and the Base stations on the basis of the traffic data of the KKM switch units and to compute the necessary number of lines.

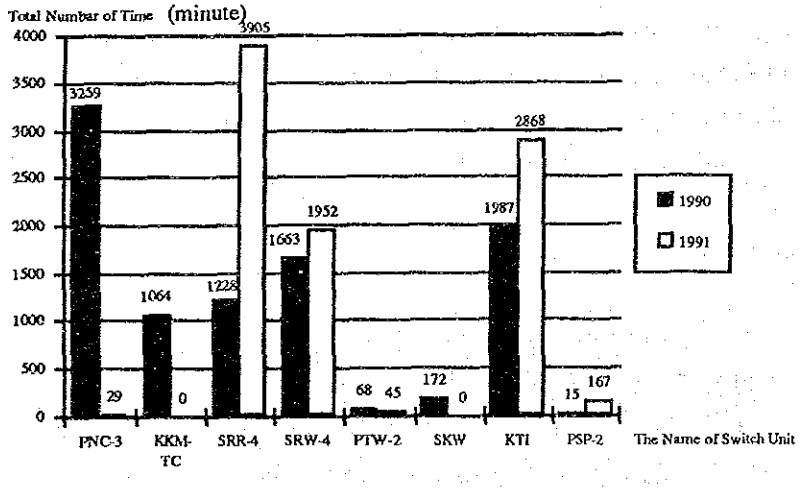
3.6.1 Switching congestion

1) System Over-load

The system over-load is the state in which an actual call control condition exceeds the central control unit (here after CC) capacity of a switch. The NEAX 61 Switch automatically restricts out-going calls (in-coming calls) when the actual call control condition exceeds 90% (95%) of the CC. These restrictions will continue until the actual call control condition becomes less than 80% of the CC.

The out-going call restriction means that a switch does not send dial-tone back to the calling party when the receiver is lifted.

The system over-load condition of the last two years is reported to be 9456 minutes in 8 switches in the BMA in 1990 and 8966 minutes in 6 switches in 1991. The main causes of the system over-load in 1990 most likely trunk line congestion and switch congestion due to high out-going call traffic. Figure 3.6.1-1 shows the number and the total amount of time of the system over-load of the last two years in the BMA.

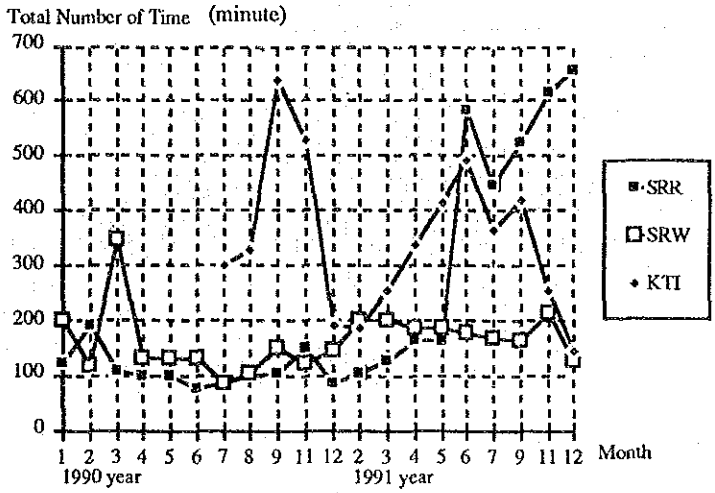


Source: Monthly Report from the Center of Metropolitan Switching Office

Figure 3.6.1-1 Total Number and Account of Time of System Over load in the BMA

Figure 3.6.1-2 shows the total amount of time (minute) for the out-going call restriction in each month, compiled from the Monthly Fault Statistics Report of the past 2 years. The

system over-load problem occurred only in three switch units of SRR-4, SRW-4 and KTI in the BMA.



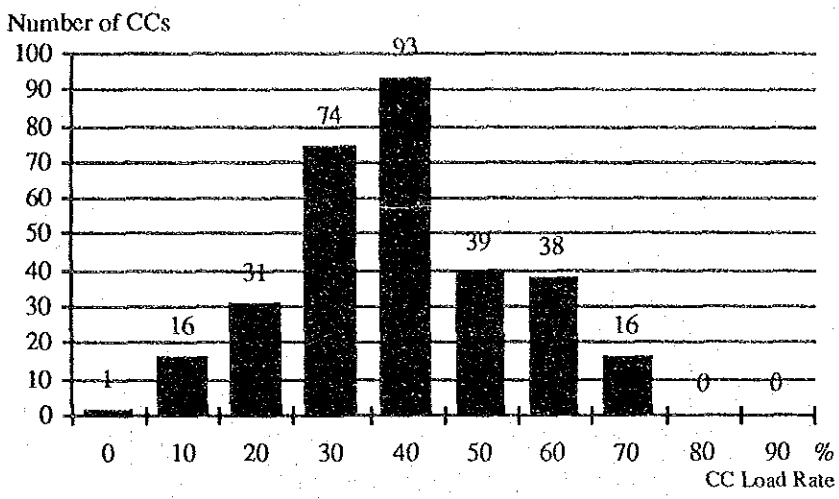
Source: Monthly Report from the Center of Metropolitan Switching Office

Figure 3.6.1-2 Total Amount of Time of System Over Load in Each Month in the BMA

Of the 308 central control units of the NEAX 61 switches studied in the BMA, the monthly average CC load rate of 215 units (70%) is below 50% in 1991 according to the Monthly Fault Report.

On the other hand, there are 16 central control units of which the monthly average CC load save rate is more than 76%. They are installed in the SRW-4, KTI and SRR-4 switch units which are identified as the switch units that experienced the system over-load.

The central control units of which the average monthly CC load rate exceeds 76% (called CP unit) may be utilized more than 90% of their CC capacity during the traffic peak period. Hence, they will easily move to the out-going call restriction condition. Figure 3.6.1-3 shows how CC is loaded for the NEAX 61 switches in the BMA.

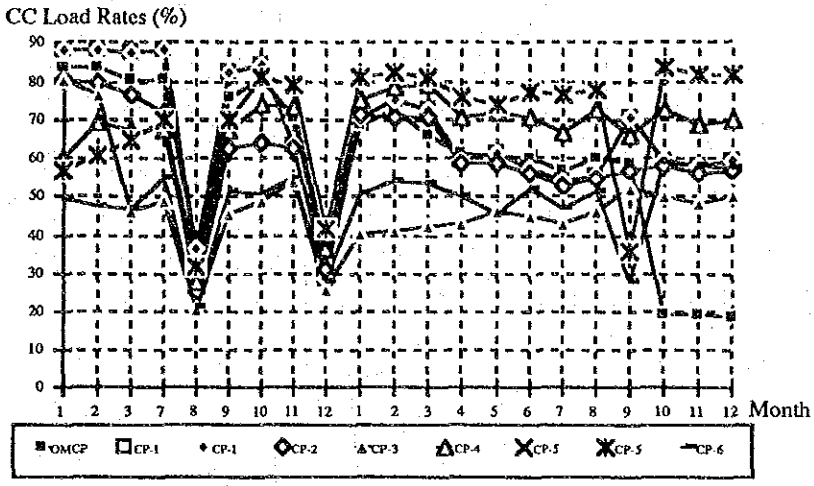


Source: Traffic Data from the Sector of Network Management

Figure 3.6.1-3 Central Control Load Rate of SPC Switch Unit in the BMA

The SRW-4, KTI and SRR-4 switch units experienced high CC load rates. For example, the average monthly CC load rate of the SRW-4 switch unit has been decreasing over the past two years; however, some central control units use more than 80% of the CC. They will easily operate under the out-going call restriction condition.

On the other hand, since there are two units of which their central CC load rates are below 50%, there are differences in the load rates of central control units in one switch. This implies that high usage subscribers should be connected to central control units with low load rates. Figure 3.6.1-4 shows the CC load rate of each central control unit in the SRW-4 switch unit. Table 3.6.1-1 list of the units with more than 76% of the CC load rates in the NEAX 61 switches in the BMA. ANNEX shows the CC load rates of the past three years.



Source: Traffic Data from the Sector of Network Management

Figure 3.6.1-4 The CC Load Rate of each Central Control Unit in the SRW-4 Switch Unit

Table 3.6.1-1 List of the CP Units with more than 76% of the CC Load Rates in the NEAX 61 Switches in the BMA

Rank-ing	Unit name	CP unit numbar	CC occu-pancy %	Rank-ing	Unit name	CP unit numbar	CC occu pancy %	Rank-ing	Unit name	CP unit numbar	CC occu-pancy %
1	SRW 4	5	79	3	KTI	0	78	5	SRR 4	OMCP	76
2	SRW 4	5	79	4	KTI	0	78	6	SRR 4	OMCP	76

2) Concentrator and Juncture

In addition to the system over-load, concentrator and juncture congestion causes the switch congestion problem. Since these congestion problems are associated with high traffic into switches, subscribers either hear no dial tone or obtain no connection. Figure 3.6.1-5 shows a configuration of a switching unit.

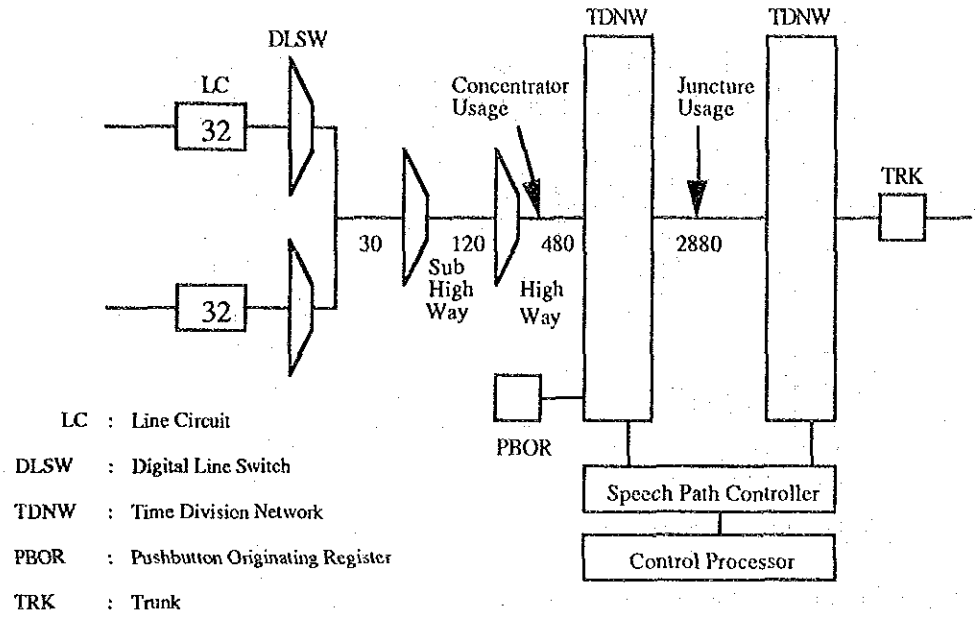
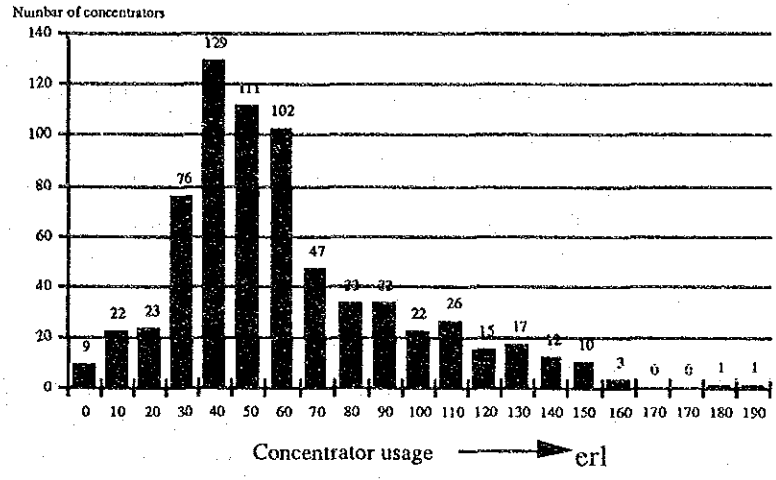


Figure 3.6.1-5 Configuration of Switching Unit

a) Concentrator Usage

Concentrator usage shows traffic volume on high way which has 480 channels for forward and backward speech path. Figure 3.6.1-6 shows the status of concentrator usage of the 692 sampled high ways in the BMA according to monthly average traffic volume.



Source: Traffic Data from the Sector of Network Management

Figure 3.6.1-6 Distribution of Concentrators in the BMA According to Traffic Volume

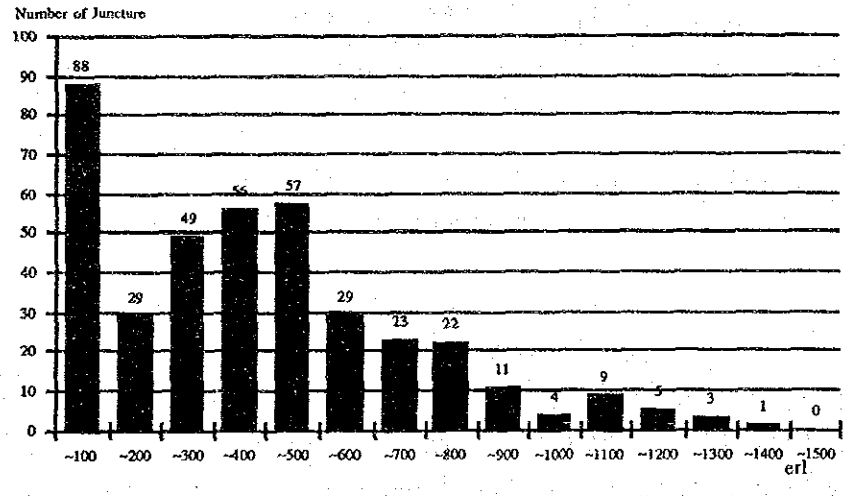
Of the 692 sampled units, the traffic volume of 22 units exceeded 144 earl (threshold figure set by TOT) and are concentrated in the PLT T-3, SRW-4, PTW-2, TKC,-2 KTI and PYT T-2 switch units. They, however, vary in their working conditions. Table 3.6.1-2 lists up the high traffic volume high ways. ANNEX shows the traffic data of the past 3 years.

Table 3.6.1-2 List of the High Traffic Volume on High Ways in the BMA

Rank-ing	Unit Name	CP No.	HW No.	erl	Rank-ing	Unit Name	CP No.	HW No.	erl	Rank-ing	Unit Name	CP No.	HW No.	erl
1	PL T-3	5	0	280	9	SRW 4	OMCP	1	156	17	PYT T-2	12	3	148
2	ptw2	2	4	188	10	PL T-3	1	1	155	18	PL T-3	3	0	146
3	SRW 4	OMCP	0	165	11	PL T-3	3	1	154	19	PL T-3	4	0	146
4	PL T-3	2	0	162	12	SRW 4	2	0	153	20	SRW 4	4	0	146
5	SRW 4	2	1	161	13	KTI	1	1	152	21	SRW 4	1	2	146
6	SRW 4	2	2	159	14	SRW 4	4	2	151	22	PL T-3	1	0	144
7	PL T-3	2	1	156	15	TKC-2	1	1	151					
8	PL T-3	4	1	156	16	PL T-3	7	0	149					

b) Juncture Usage

A juncture is located next to a highway in a SPC switch. The function of the juncture is to set a speech path to a called party in the switch. Figure 3.6.1-7 shows the working conditions of the sampled junctures in each switch units (Total 316 units) in the BMA according to their average monthly traffic volume.



Source: Traffic Data from the Sector of Network Management

Figure 3.6.1-7 Working Conditions of the Sampled Junctures in each Switch Units in the BMA

There is no juncture which has handled more than 1,500 erl (threshold figure set by TOT) for its traffic volume. Of the 386 sampled units, the traffic volume of 18 units exceeded 1,000 erl and are installed in the tandem switches in the LKS T-4, PKG T-6, PTY T-2 and PNC T-3 switch units. Table 3.6.1-3 lists up these units in the BMA. ANNEX shows the traffic data of the past 3 years.

Table 3.6.1-3 List of the Units with more than 1,000 erl of Traffics in the BMA

Ran-	name	Junctor		Ran-	Unit	Junctor		Ran-	Unit	Junctor	
king	name	number	erl	king	name	number	erl	king	name	number	erl
1	PL-T3	9	1333	7	PL-T3	2	1114	13	PL-T3	1	1033
2	PL-T3	8	1288	8	PKG T-6	1	1114	14	PL-T3	5	1029
3	PL-T3	6	1239	9	PYT T-2	1	1109	15	LKS T-4	3	1017
4	PL-T3	4	1212	10	PYT T-2	3	1099	16	LKS T-4	4	1012
5	PL-T3	3	1185	11	PKG T-6	4	1077	17	PKG T-6	6	1006
6	LKS T-4	1	1157	12	PL-T3	10	1033	18	PYT T-2	2	1002

c) No Dial Tone

Since many reports had been made on hearing no dial tone for call attempts, the Study Team conducted traffic measurement of the NEAX 61 switches in the BMA through the NCOM center to investigate how many calls the PBOR (Push-button Originating Register) in these switches received.

The traffic study was conducted for 5 days from April 20 in 1990. As a result, the Study Team found that 12 switch units sent out no dial tone. Table 3.6.1-4 list of the names of the switch units and the number of complete and incomplete calls in the study.

Table 3.6.1-4 List of the Names of the Switch Units and Number of Complete and Incomplete Calls in the Study

Unit Name	Working PBOR		April				
			20	21	22	23	24
LKS 4	570	TGP.OK	44,879	40,045		35,288	36,386
		TGP.NG	1,333	456		172	270
LTP1	210	TGP.OK		75,046		62,599	66,092
		TGP.NG		44		33	20
KKM	176	TGP.OK	80,857	71,927			
		TGP.NG	154	21			
PNC 3	660	TGP.OK		160,589		159,642	
		TGP.NG		22		1	
PPG 2	210	TGP.OK	46,989	43,007		43,655	
		TGP.NG	58	1		1	
SMS 2	90	TGP.OK	30,629				25,004
		TGP.NG	2				3
SRW 4	405	TGP.OK		127,660		126,956	114,354
		TGP.NG		14		9	4
SRR 4	360	TGP.OK				124,965	
		TGP.NG				1	
PTW 2	240	TGP.OK					60,963
		TGP.NG					5
ASD 2	330	TGP.OK	120,252				
		TGP.NG	6				
BGS 2	150	TGP.OK	51,244				
		TGP.NG	2				
DNM 2	300	TGP.OK		64,930			
		TGP.NG		13			

Note : TGP OK: Trunk Group Hunt OK
TGP NG: Trunk Group Hunt No Good

Although Table 3.6.1-4 shows how many calls the PBORs did not connect, it does not show which TSCPF (Time Switch and Central Processor Frame) group sent out no dial tone. Hence, it needs a further study for the switch units which sent out no dial tone.

3) Recommendation

As shown in Table 3.6.1-1, the SRR-4 SRW-4 and KTI switch units have been experiencing the system over load quite often.

The engineering specification of the NEAX 61 switch says:

The processor capacity at any size of switches shall meet the following requirements.

a) A 20% of the call processing capacity shall be reserved in addition to the required capacity to cover peak traffic, and as a safety margin (see Figure 3.6.1-8).

b) The total loading of the processor (required load +20% reserved) shall not exceed 70% of its full load capacity. This is to provide reserve capacity for operation and maintenance functions, administrative functions, etc. (see Figure 3.6.1-8).

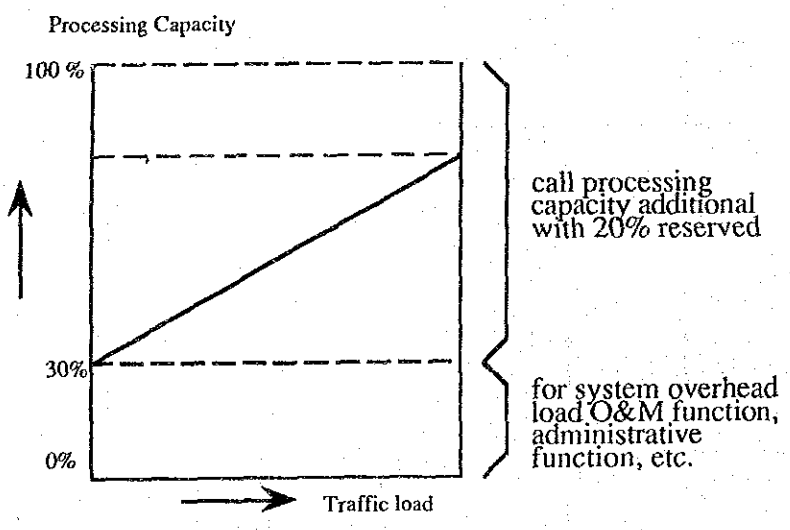


Figure 3.6.1-8 Capacity of Call Processing

It is, therefore, necessary to relocate high usage subscribers connected to the CP units (units with more than 70% of call control capacity loading) to less loaded units.

The sector of metropolitan switching offices conducted its own study on the system over-load problem in switch units. As a result, they relocated high usage subscribers in April of 1992 and succeeded in reducing the call control capacity loading rate from 81% to 66%. Hence, as for switch units experiencing many system over-load problems and CP units with more than 70% loading rates it is necessary to even out the loading rates of CP units in the same switch by traffic investigations.

As for high ways accommodating high usage subscribers, it is also necessary to take the same action.

3.6.2 Traffic Congestion of Circuit

1) Outgoing Route from LE (XB) to SPC tandem

A study was conducted on the usage condition of trunk lines on the basis of the traffic reports issued by the Department of Network Management to investigate the trunk line congestion problems. The traffic reports provide the data on traffic volume between two switch units of the previous year, the necessary number of trunk lines to meet that traffic volume, the projected traffic volume for the coming two years, and the necessary number of trunk lines to meet that projected traffic volume.

a) XB Switches

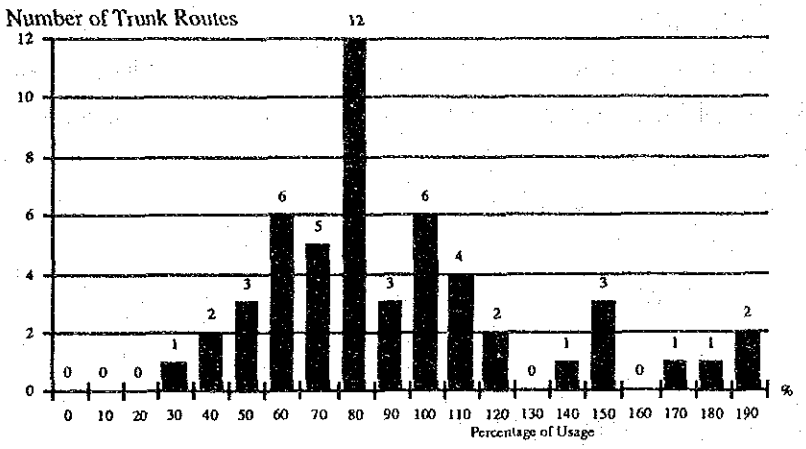
The usage conditions of trunk lines between each XB switch unit and SPC tandem switch unit in the BMA were studied by using the monthly traffic reports (October of 1989 to September of 1990).

The studied routes were 47 for out-going final routes and 66 for in-coming final routes. The following formula provides the trunk line usage rate.

Necessary Number of Trunk Lines / Present Number of Trunk Lines x 100 = The Usage Rate (%)

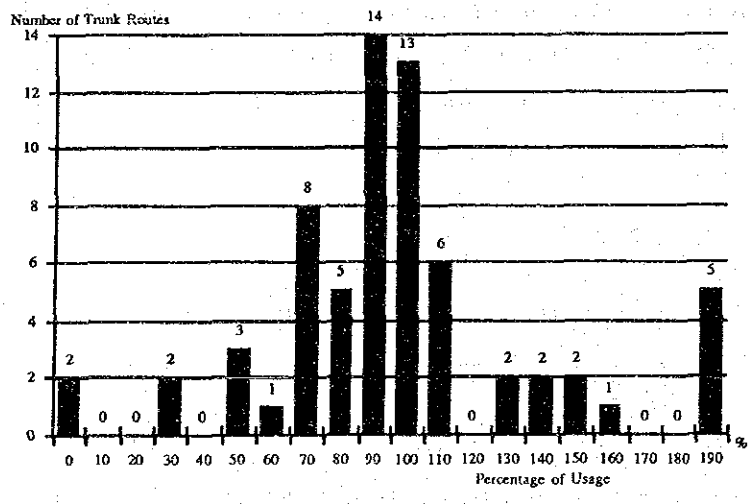
Where
The necessary number of trunk lines corresponds to those in the traffic report .

Figures 3.6.2-1 and 3.6.2-2 show how the usage rates vary for the out-going and incoming final routes in the BMA, respectively.



Source: Traffic Data from the Sector of Network Management

Figure 3.6.2-1 Distribution of Trunk Usage of Outgoing Final Routes in the BMA

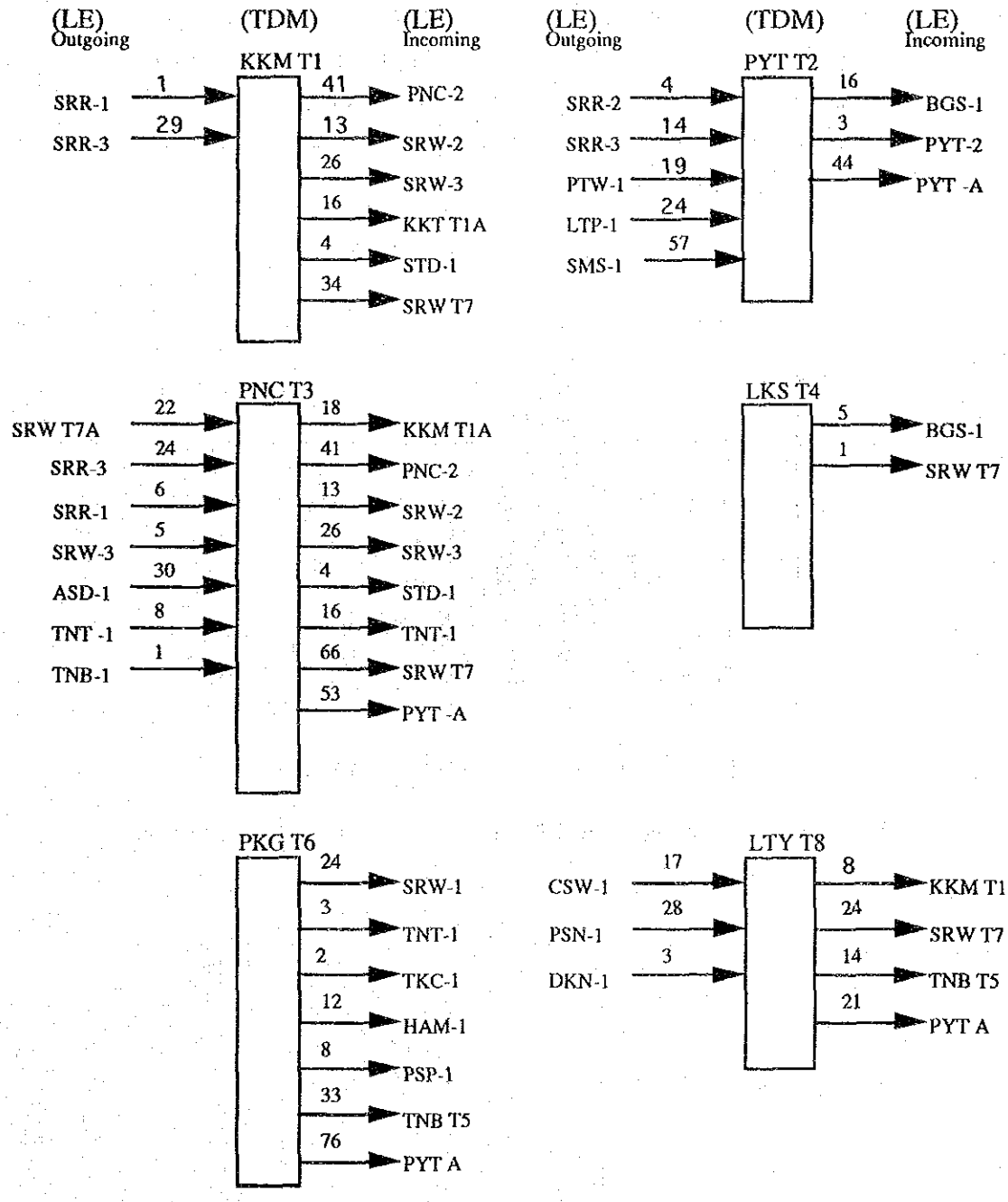


Source: Traffic Data from the Sector of Network Management

Figure 3.6.2-2 Distribution of Trunk Usage of Incoming Final Routes in the BMA

From those two figures, it can be found that there are 20 out-going final routes (out of 52 routes) and 31 in-coming final routes (out of 66 routes) of which the usage rates exceed 100%.

Figure 3.6.2-3 shows the differences between the necessary and present number of trunk lines for each SPC tandem switch units. From the figure, it is clear that the present number of trunk lines to PNC T-3 switching offices is far too few compared with the necessary number. ANNEX shows the traffic data.

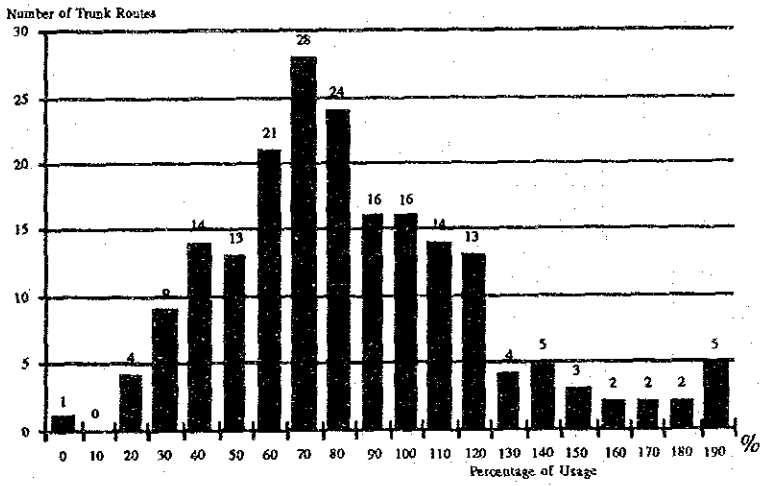


Note : TDM = Tandem Center
LE = Local Exchanges

Figure 3.6.2-3 Number of Shortage Circuits Between XB (LE) and SPC Tandem in the BMA

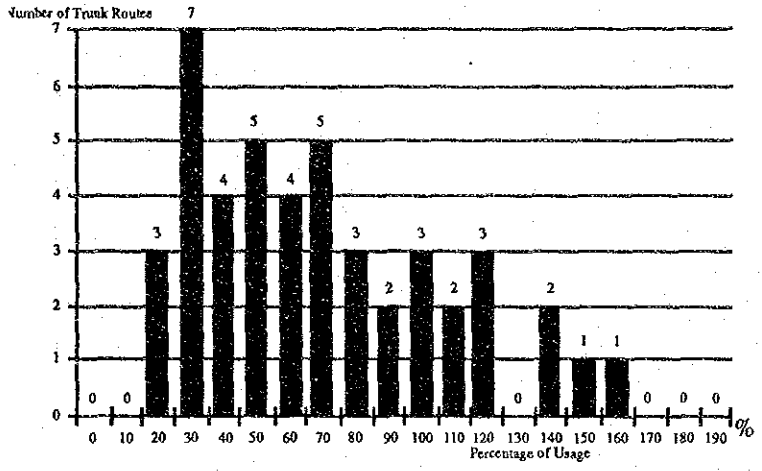
b) SPC switches (NEAX 61)

The usage conditions of trunk lines between each SPC (LE) switch unit and SPC tandem switch unit in the BMA were studied on the basis of the monthly traffic reports (January of 1991 to December of 1991). The studied routes were 196 for out-going final routes and 45 for in-coming final routes. The usage rates were computed in the same way as those of the XB switch case. Figure 3.6.2-4 and 3.6.2-5 show how the usage rates vary for the out-going and in-coming final routes in the BMA, respectively.



Source: Traffic Data from the Sector of Network Management

Figure 3.6.2-4 Distribution of Trunk Usage of Outgoing Final Routes in the BMA



Source: Traffic Data from the Sector of Network Management

Figure 3.6.2-5 Distribution of Trunk Usage of Incoming Final Routes in the BMA

From those Figures, it can be found that there are 66 out-going final routes (out of 196 routes) and 12 in-coming final routes (out of 45 routes) of which the usage routes exceed 100%. Figure 3.6.2-6 shows the differences between the necessary and present number of trunk lines in the BMA. The total number of circuits in shortage is 1,828 for out-going and 778 for in-coming. ANNEX shows the traffic data.

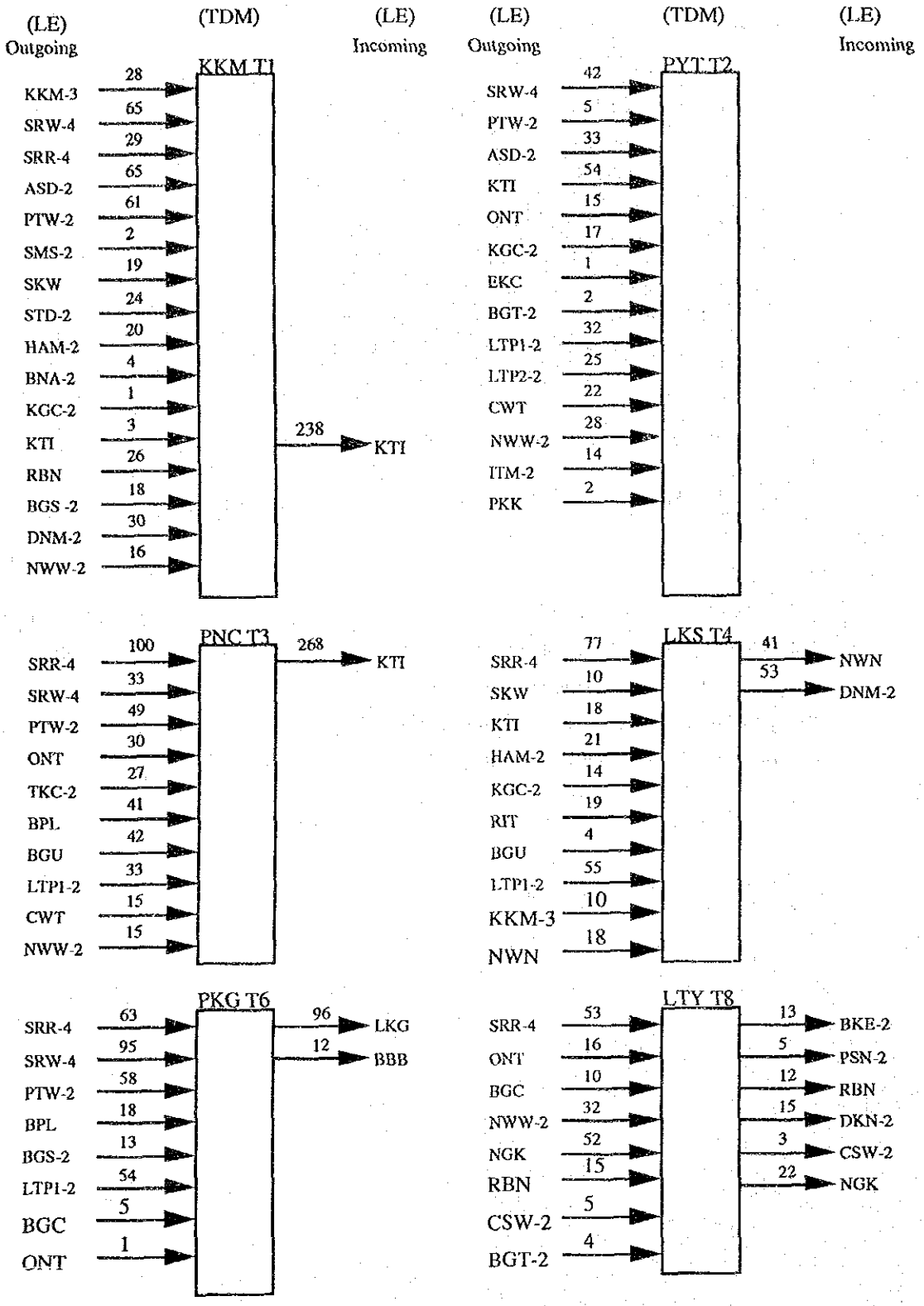
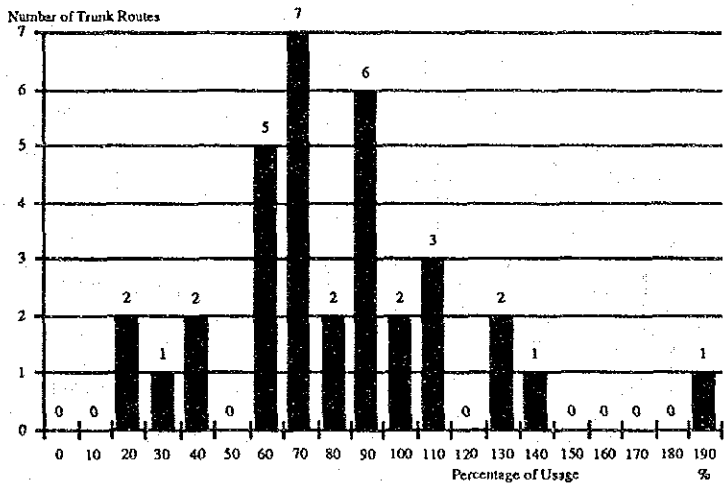


Figure 3.6.2-6 Number of Circuits in shortage Between SPC (LE) and SPC Tandem in the BMA

c) SPC tandem and TC to TC

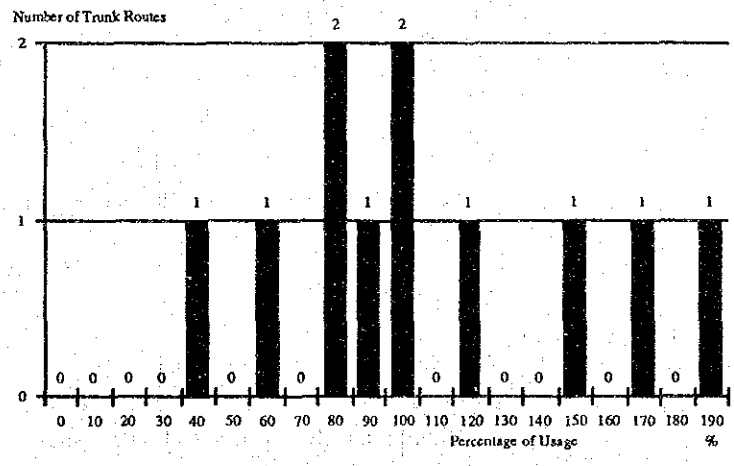
The usage conditions of trunk lines between each SPC tandem switch unit and TC switch unit in the BMA were studied by using the monthly traffic reports (January of 1991 to December of 1991).

The studied routes were 34 for out-going final routes and 11 for incoming final routes. The usage rates were computed in the same way as those of the XB switch case. Figures 3.6.2-7 and 3.6.2-8 show how the usage rates vary for the out-going and in-coming final routes in the BMA, respectively.



Source: Traffic Data from the Sector of Network Management

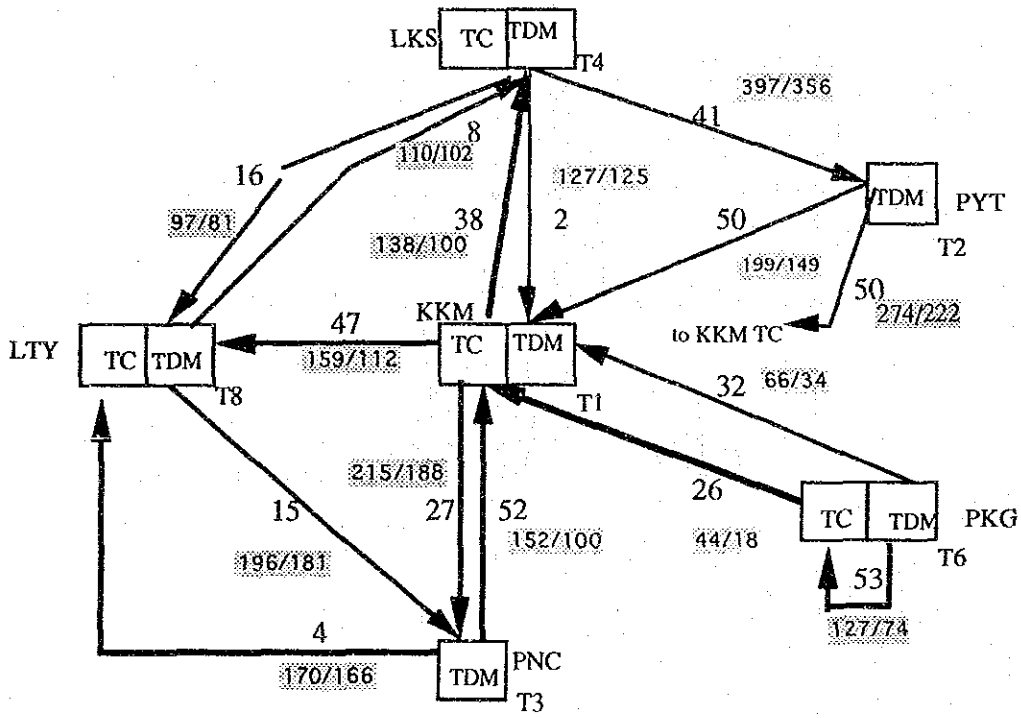
Figure 3.6.2-7 Distribution of Trunk Usage of Outgoing Final Routes in the BMA



Source: Traffic Data from the Sector of Network Management

Figure 3.6.2-8 Distribution of Trunk Usage of Incoming Final Routes in the BMA

From those two Figures, it can be found that there are 9 out-going final routes (out of 34 routes) and 6 in-coming final routes (out of 11 routes) of which the usage rates exceed 100%. Figure 3.6.2-9 shows the differences between the necessary and present numbers of trunk lines in the BMA. From the Figure, it is clear that the present number of trunk lines to KKM TC switch unit is far too few compared with the necessary number. The total number of circuits in shortage is 274 for TDM to TDM and 187 for TDM to TC in the BMA. ANNEX shows the traffic data.



Legend

——— = TDM ~ TDM Circuit ——— = TDM ~ TC Circuit

53 = Number of Required Circuits

Excange office name

KKM : Krung Kasem	LKS : Lak SI
PYT : Phahonyothin	PKG : Phara Khanong
PNC : Phloen Chit	LTY : Lat Ya

Note : TC = Tertiary Center
Number of Required Circuits = Number of Shortage of Circuits

Figure 3.6.2-9 Number of Circuits in Shortage Between SPC Tandem and TC in the BMA

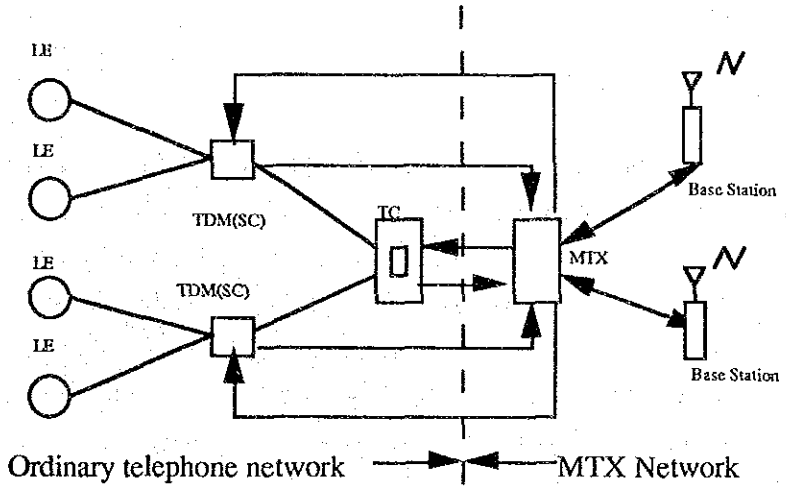
3.6.3 Traffic Congestion of Mobile Telephone Circuits

1) Traffic between PSTN and MTX

A study was conducted on the traffic volume to compute the necessary number of lines since traffic congestion problems had been also eminent for the mobile telephone service (470 MHz)

The traffic study on the cellular mobile telephone service provided by KKM switch unit was conducted for 4 days, starting from April 21 of 1992.

A traffic study was also conducted to obtain the traffic volume in busy hours between the PSTN and MTXs, i.e., between each TDM(SC) switch unit and MTX switch unit and between each TC switch unit and MTX switch unit. The necessary number of trunk lines would be computed and compared with the present number of trunk lines. Figure 3.6.3-1 shows the network configuration of the cellular mobile telephone service.



Note : MTX = Mobile Telephone Exchange
PSTN = Public Switched Telephone Network

Figure 3.6.3-1 Network Configuration of Cellar Mobile Telephone

Figure 3.6.3-2 shows the 470 MHz MTX network configuration.

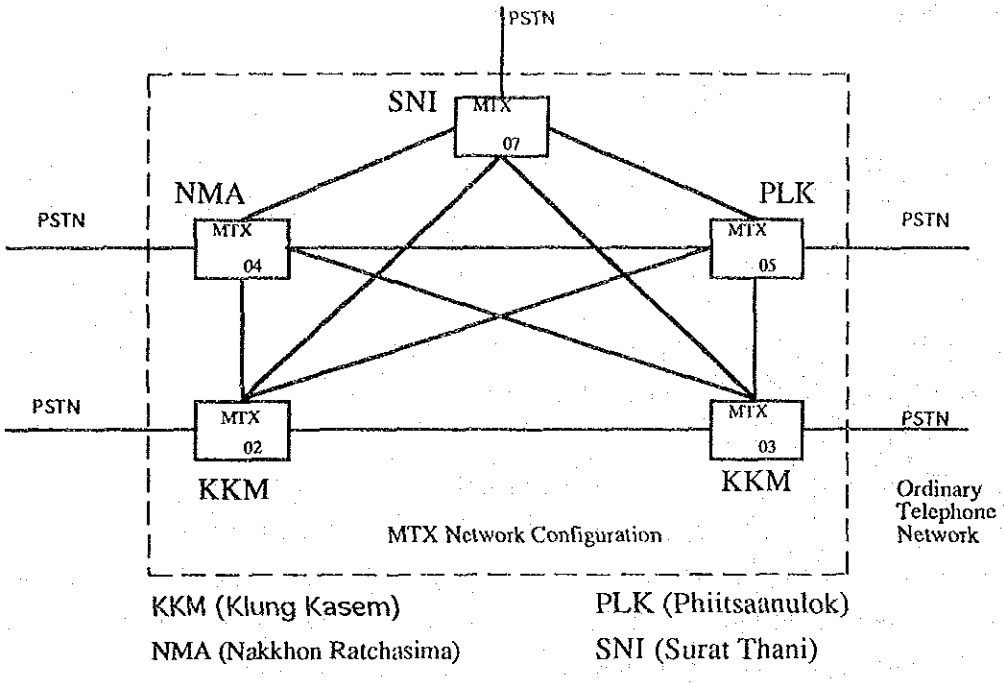


Figure 3.6.3-2 470 MHz MTX Network Configuration

Computation Method

The average traffic volume in the busy hour (10:00 to 11:00) was computed from the traffic study result. The necessary number of trunk lines was estimated by using the Erlang B method with the probability loss of 1% on the basis of the above average traffic volume multiplied by 1.2. The average traffic volume was multiplied by 1.2 to make the adjustment. Because the necessary number of trunk lines is usually computed on the basis of the average traffic volume of 30 highest traffic day data; however, the traffic study was conducted for 4 days and the average traffic volume obtained was smaller than usual cases.

The number of the studied routes between the PSTN and MTXs are 30 for MTX 02, 14 for MTX 03, 2 for MTX 04, 14 for MTX 05 and 2 for MTX 07. Figure 3.6.3-3 shows the differences between the necessary and present number of trunk lines for each route. It is clear from the figure that more trunk lines to MTX 02 and MTX 03 only are needed. 11 routes in MTX 02 and 5 routes in MTX 03 need more lines. The total number of circuits in shortage is 165 for MTX to PSTN,. ANNEX shows the traffic data.

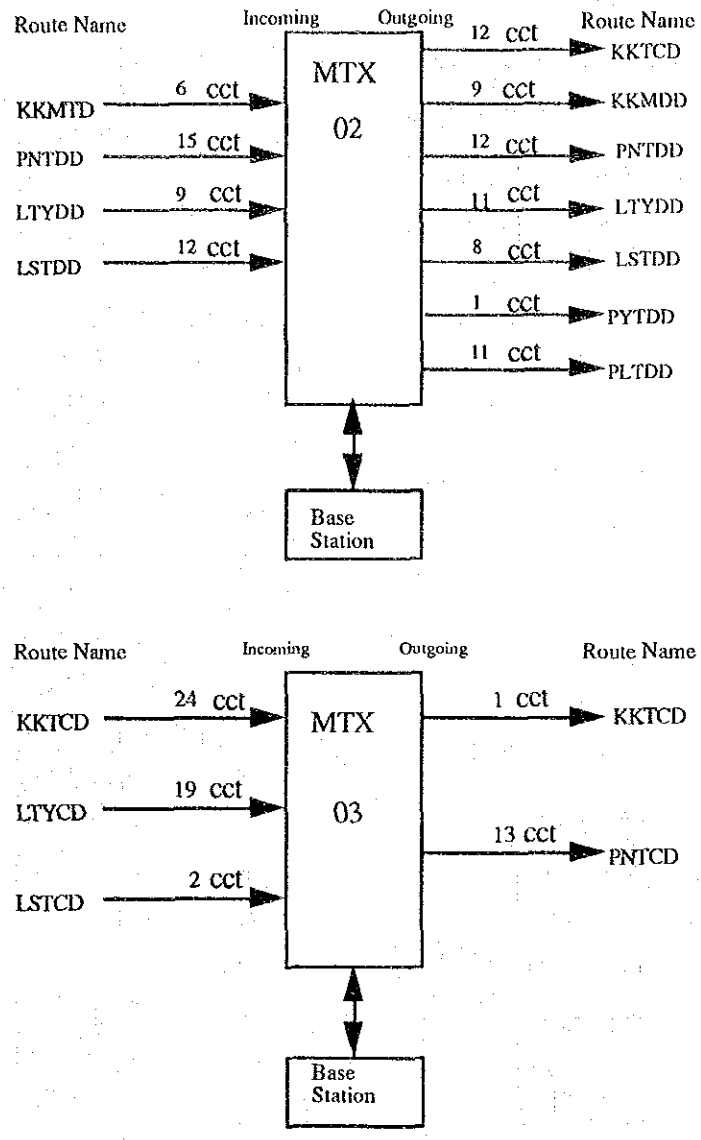


Figure 3.6.3-3 Total Number of Circuits in shortage Between PSTN and MTX

2) Traffic between MTXs and Base Stations

A traffic study was conducted in the same way as that a) between each MTX and Base station. The study was conducted for 56 links (1 link is 1 DTI) on 27 routes in MTX 02, 41 links on 31 routs in MTX 03, 28 links for 27 routes in MTX 04 , 32 links on 27 routes in MTX 05, and 26 links on 26 routes in MTX 07. Figure 3.6.3-4 shows the differences between the necessary and present number of trunk lines for each routes. It is clear from the figure that 2 links in MTX 02, 26 links in MTX 03, 2 links in MTX 04, 7 links in MTX 05, and 3 links in MTX 07 need more lines. The total number of circuits in shortage is 89 for MTX to Base Station. ANNEX shows the traffic data.

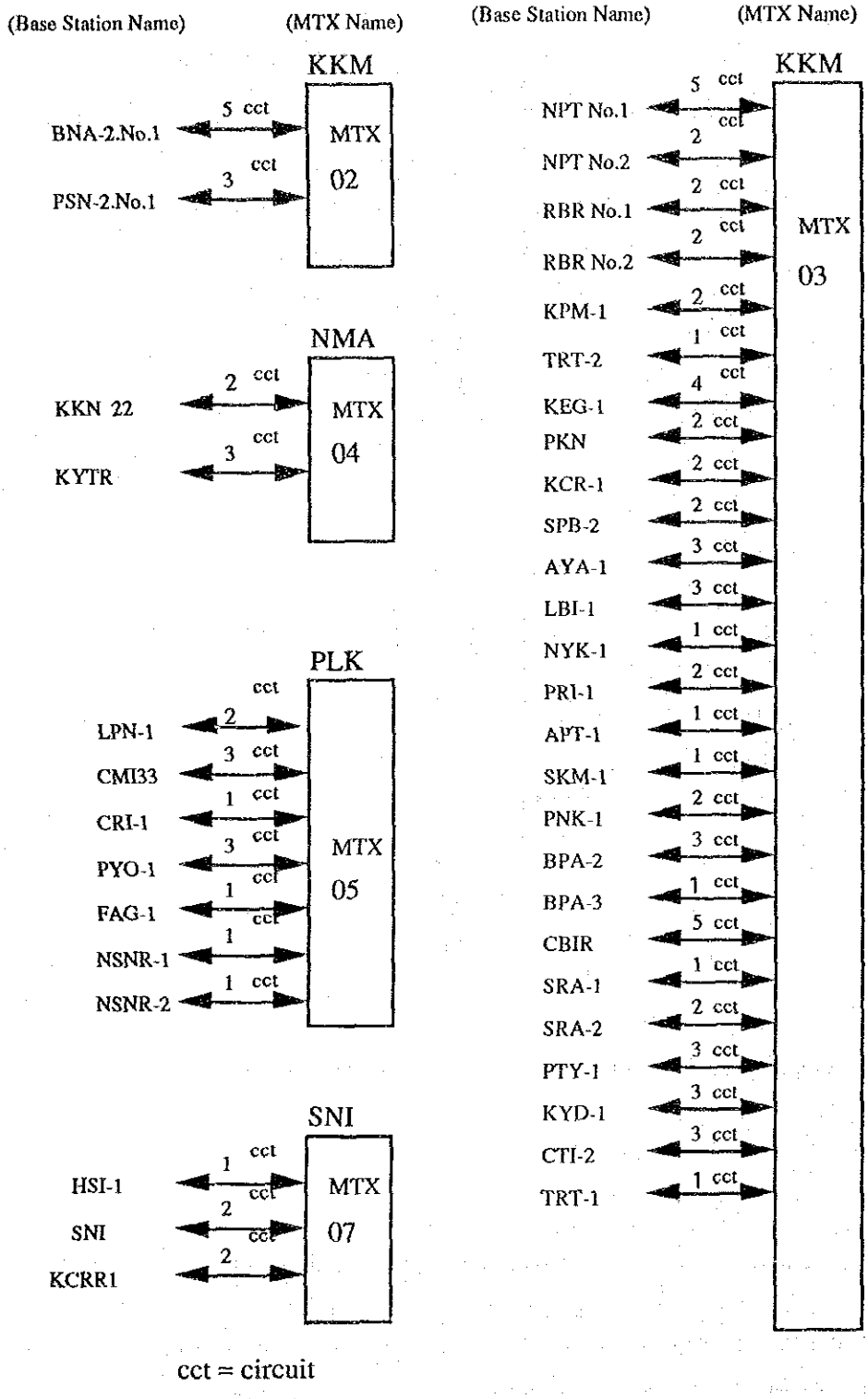


Figure 3.6.3-4 Number of Circuits in Shortage Between MTX and Base Station

3.7 Other Issues

3.7.1 P.D.Abandon

It is estimated that most of P.D.Abandon calls are caused by users. For example, a user stops to dial because of having forgotten the destination number or misses dialing. So, a subscriber campaign that reminds users to check numbers before lifting receivers and to dial by looking at memos. It is estimated that the other P.D.Abandon calls are originated from intermittent short circuit of subscriber lines. After actions to reduce P.S.Abandon calls and the rehabilitation work of deteriorated subscriber lines, P.D.Abandon calls will be reduced.

3.7.2 B-sub-no-answer

B-sub-no-answer is a call attempt which does not receive any answer from a called party. In this category, calls which can not receive any answer within 90 seconds are also included.

Table 3.7.2-1 and Figure 3.7.2-1 show terminating subscriber categories and their percentage shares of the occurrences which were observed from originating calls from the Phra Kanong-T6 switch on 21st of April, 1992. Ordinary subscribers occupy 60% of B-sub-no answers. A further study is needed to understand the detail of ordinary subscribers but generally we can presume that it is caused by people not being around when a call comes. In this case it is effective to recommend users who tend to be out, to use automatic answer telephones.

Table 3.7.2-1 B-sub-no-answer Terminating Subscriber Category

Category	Call	%
Vacant number	45	18.1
Changed number	4	1.6
Mobile telephone	20	8.1
Ordinary subscriber	153	61.7
1XY(100,125,152)	4	1.6
ISD	7	2.8
Over digit	15	6.0
Total	248	100

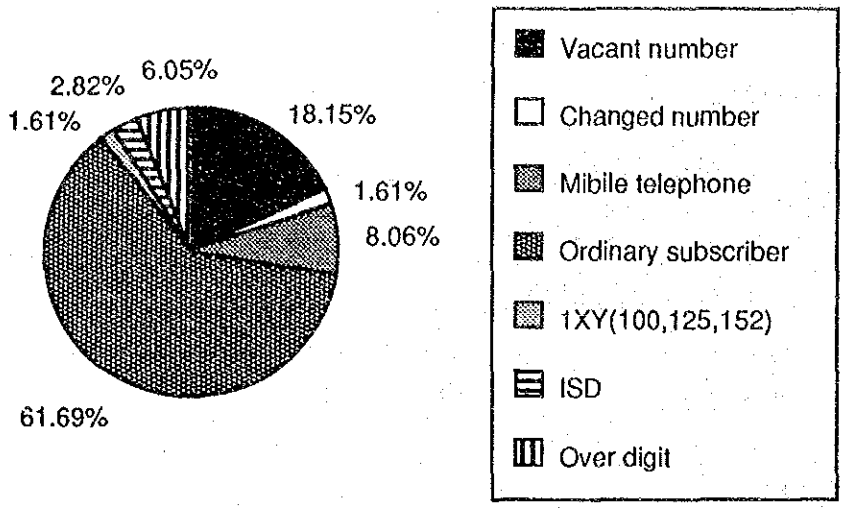


Figure 3.7.2-1 Distribution to subscriber categories of B-sub-no-answer

The next category which causes high B-sub-no-answers is vacant numbers and changed numbers. The category occupies 20% of B-sub-no-answers. From the limitation of backward signal codes in the R-2 signal system of TOT, B-5 Code is assigned for vacant and changed numbers. (The assignment of the code on backward signals is shown in Table 3.7.2-2.) So a caller who dials a vacant or changed number will be connected to a terminating point in a switch just like a normal call line but will not be able to receive any answer. This is why the call becomes B-sub-no-answer.

To solve the problem, the Study Team recommends TOT to assign B-3 code, which is not used now, for changed numbers. The function of B-3 code is that a call which has received B-3 can be reconnected to another route. By the function, a caller who has dialed a changed number can be connected to the reception desk where a operator can tell new telephone number or to a computer center which will provide information of new telephone number automatically. The routing of calls for changed numbers is shown in Figure 3.7.2-2.

Table 3.7.2-2 Assignment of R-2 Backward Signal

Signal Number	TOT's Meanings	CCITT R-2
B-1	Called subscriber's line free, charge	Spare for national use
B-2	Called subscriber's line busy	Send special information tone
B-3	Called subscriber's line intercepted	Subscriber's line busy
B-4	Congestion	Congestion
B-5	Called subscriber's line free, non-charge	Unallocated number
B-6	Last party release	Subscriber's line free, charge
B-7	Not equipped	Subscriber's line free, non-charge
B-8	ditto	Subscriber's line out of order
B-9	ditto	Spare for national use
B-10	ditto	ditto
B-11	ditto	Spare for international use
B-12	ditto	ditto
B-13	ditto	ditto
B-14	ditto	ditto
B-15	ditto	ditto

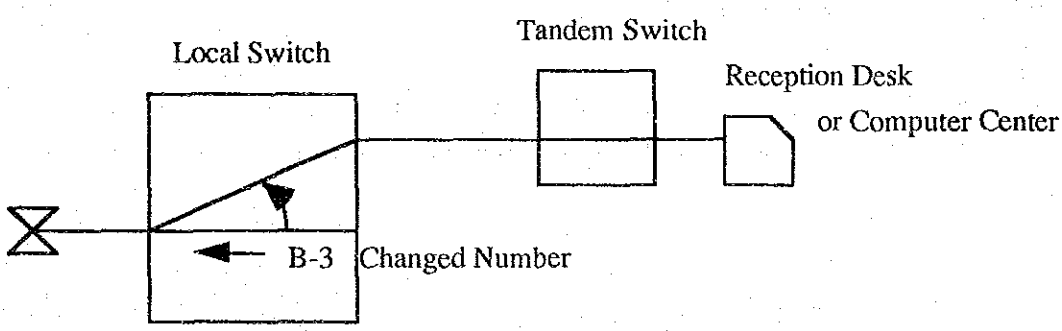


Figure 3.7.2-2 The routing of calls for changed numbers

Regarding the calls to vacant numbers, the Study Team recommends to install recorded announcement machines to inform no subscriber being assigned to these numbers.

It is also important for TOT to improve operator answer delay even though the percentage of the operator B-sub-no-answer is not high. The Study Team recommends TOT to take necessary actions to improve the operator answer delay time. For example, the target answer delay time of NTT is that 85% of operator answers must be made within 11 seconds.

3.7.3 Fault

Faults are classified into P.S.Time-out, P.D.Time-out and other technical faults categories in the network.

1) P.S.Time-out

P.S.Time-out is originated from subscriber lines which are left in off-hook status by line fault (short circuit) or users who does not dial after off-hook. Reducing P.S.Abandon calls, there are basically two measures. One is reducing faulty subscriber lines and the other is to ask users to use telephone equipment correctly.

In the connection process of P.S.Time-out, after the subscriber line has become P.S.Time-out, the line receives a busy tone for a specific period and then the line will be locked out. During the time when the line is in lock-out status, if the terminating call comes, it will become a B-sub-busy call. So, to reduce B-sub-busy calls, the Study Team recommends to introduce the SPC switch automatic howler-tone sending equipment which has a function of sending a howling tone out to a subscriber line when the line has been left off-hook. Hopefully, the customer hears the tone and puts the telephone set back on-hook.

The block diagram of the equipment in a switch is shown in Figure 3.7.3-1 and the process of connection status of a P.S.Time-out call is shown in Figure 3.7.3-2.

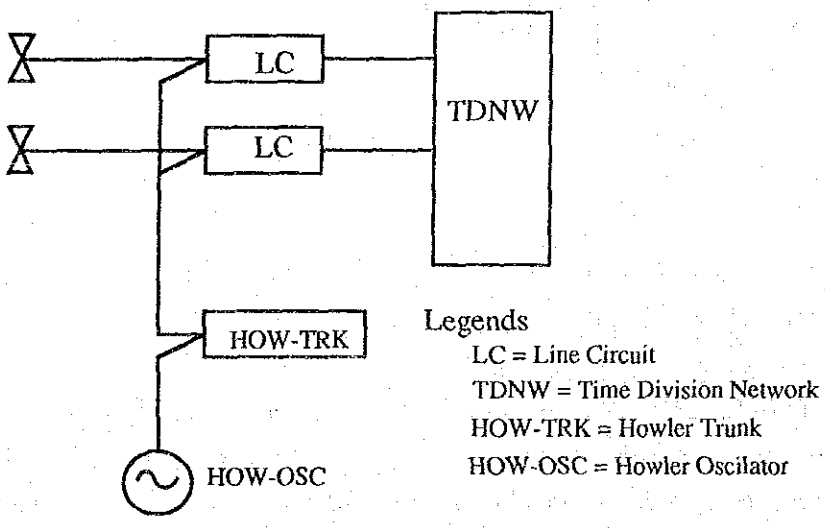
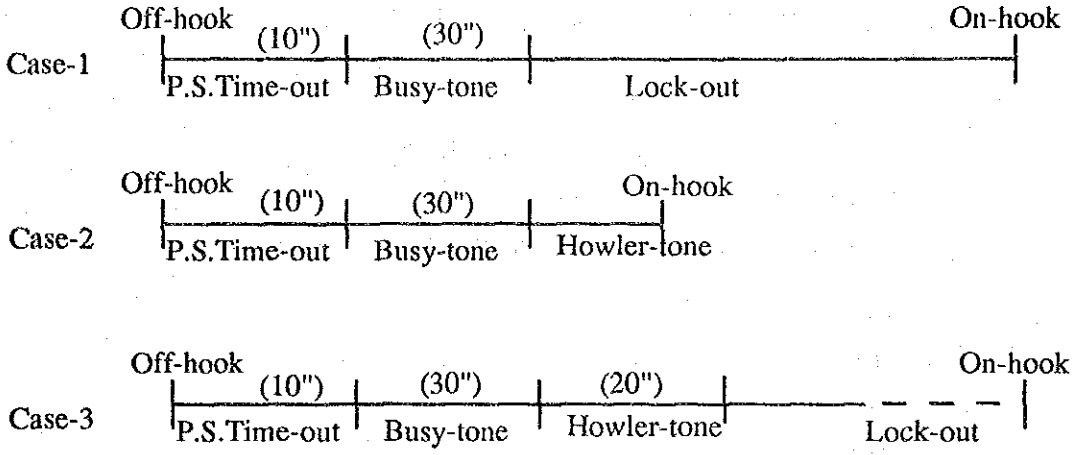


Figure 3.7.3-1 Block Diagram of Automatic Howler Tone Sending Equipment



Case-1 = Present Sequence

Case-2 = After introduction of howler-tone (in the case that the subscriber hook ons when hearing a howling tone

Case-3 = After introduction of howler-tone (in the case that the subscriber does not hook on

( ) shows an sample of specified time periods

Figure 3.7.3-2 The Process of Howler Tone Connection

2) P.D.Time-out

At present, the timing of P.D.Time-out (limit time interval between dial digits being set on register) is set at 4 seconds. It seems the time is too short. For example, the time in Japan is 20 seconds and in Malaysia 8 seconds. The Study Team estimates the time can be extended from 4 seconds to 8 seconds. Because, at present, 30 P.B.Receivers are installed in a network unit of the NEAX-61 switches.

(Notes)

a) This reallocation of the timing is recommended only to the SPC switches because most of the XB switches do not have enough ORs.

b) Estimation of traffic increase of P.B.Receivers by extending the P.D.Time

Present P.B.Receiver traffic per network unit (by TOT specifications)

= (Mean P.B.Receiver holding time of a call) x
(The number of calls per network unit)

$$= 6.6^{sec} \times \frac{514.4^{erl.}}{90^{sec}} = 22.53^{erl.}$$

Required number of P.B.Receivers
= 29

Traffic increase by extension of P.D.Time by 4 seconds
= (The number of calls per network unit) x
(The proportion of P.D.Time-out calls to the number of total calls) x (4^{sec})
= $(\frac{514.4^{erl.}}{90^{sec}})$ x (0.08) x (4^{sec})
= $1.09^{erl.}$

Total traffic of P.B.Receivers
= $22.53^{erl.}$ + $1.09^{erl.}$
= $23.62^{erl.}$

Required number of P.B.Receivers after extension of P.D.Time
= 30

3) Technical Faults in the Network

Technical faults mainly consist of code errors in MFCS and MFCR. Most of the causes are estimated to come from problems in MFCSs in the XB switches and unstable status of transmission lines. The situation will be improved by reinforcing of periodic maintenance.

3.7.4 Paging Service

As described in Section 3.3.1, some paging service carriers do not have enough circuits between local switches and paging switches. Table 3.7.4 and Figure 3.7.4 show the results of calculation on the number of required circuits, but we have to know that the number of required circuits is calculated according to the present traffic and the traffic will change mainly by the number of subscribers of paging phones. So, when TOT implements the expansion work of the circuits, TOT has to estimate the traffic increase up to the target year.

Table 3.7.4 The Number of Required Circuits

	Measured Traffic	Existing CCT	Block Rate	Offered Tra	Basic Tra	Required CCT
151(KK)	47.42	80	0.000	47.43	56.91	66
151(PKG)	7.07	15	0.000	7.07	8.48	14
152	65.92	80	0.012	66.33	79.60	89
153	0.71	15	0.000	0.71	0.85	3
161	9.82	60	0.000	9.82	11.78	18
162	20.72	50	0.009	20.81	24.98	31
253-2233	7.25	10	0.251	8.47	10.16	16
253-7766	14.64	20	0.232	16.86	20.23	27
253-7788	28.57	37	0.500	42.84	51.41	60
254-7788	2.65	5	0.370	3.43	4.12	9
255-7788	9.84	15	0.273	11.68	14.02	20

Notes

1. Offered traffic is calculated by the following equation considering the effects of repeat calls.
   Offered traffic = (Measured traffic) x (1- 0.5 x (Blocking rate)) / (1- (Blocking rate))
2. Basic traffic is calculated by the following equation.
   Basic traffic = 1.2 x (Offered traffic)
3. The number of required circuits is calculated by Erlang B Formula in the case that the blocking rate is 0.03.

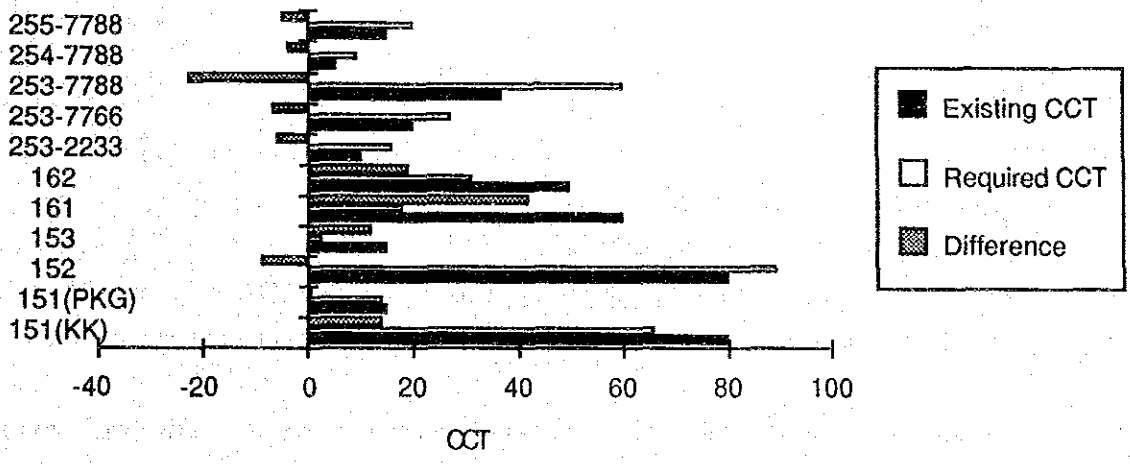


Figure 3.7.4 The Number of Required Circuits of Paging Service

3.7.5 Telephone Directory Assistance Service

Telephone directory assistance service is useful to improve call completion ratio since this service provides telephone users with correct subscribers' telephone numbers. It is indispensable for telephone companies to provide accurate, updated; and speedy telephone directory assistance service to their customers. This subsection focuses on the present directory assistance service provided by TOT, which is called "13 service" or "Computerized Directory Assistance Service (CDAS)", illustrates its issues, and recommends the installation of Automatic Information Service (AIS).

1) Telephone Directory

Both telephone directory and directory assistance service are provided by TOT with free of charge for subscribers and telephone users. The present conditions for listing subscriber names and their telephone numbers are as follows:

a) It is possible for a subscriber to put a different name (commonly used name, not his own name) on the telephone directory.

b) It is also possible for a subscriber to put another name besides his own name on the directory. The fee for adding another name in the telephone directory is 20 Baht per name per month.

c) The telephone directory revised and is published once a year regularly.

2) Present Status of Directory Assistance Service

a) The Present Automatic Information Service by TOT

There is no universal automatic information service (AIS) by the computerized voice generator device at the present for ordinary telephone users. Therefore, when one makes a telephone call to the telephone number which subscription was stopped, or which line was cut off by TOT, or which number was changed by relocation, one can hear only dead number tone from the TOT telephone network. There is no automatic voice message telling about the status and the new number.

Automatic changed number information announcement service is only available for large users by means of a voice recorded announce machine. When the telephone numbers of a large users are changed, TOT provides, for a certain period of time with free of charge, the automatic announcement service telling calling parities that

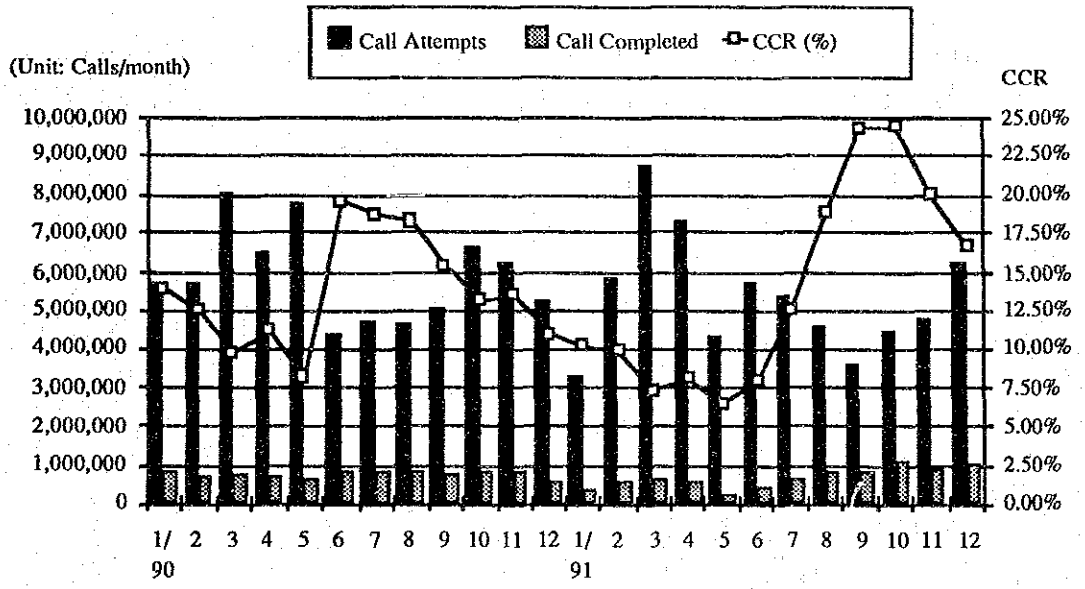
the called telephone number was changed and is not used at the present, and to call for TOT's Computer Directory Assistance System (CDAS: "13" & "183") service for further information.

Everyone who wants to know the changed telephone numbers, therefore, checks them in the telephone directory or calls "13 service", which is the operator assisted directory service provided by the CDAS center of TOT.

b) Call Completion Ratio to CDAS Service

Every telephone user, who wants to know new or changed telephone numbers, calls the CDAS center; however, in the lines CDAS center are always busy. It is very difficult for users to make successful calls and get information without re-dialing many times.

Figure 3.7.5-1 shows the numbers of call attempts, calls completed, and call completion ratio (CCR) to the CDAS of two (2) years from January 1990. The lowest CCR is 6.43% on May 1991. The highest is 24.31% on October 1991. The average is 13.11% in two years.



(Source: CDAS Center, TOT)

Figure 3.7.5-1 Call Attempts and Calls Completed at the CDAS Center

c) Present Capacity of the CDAS Center

The Computer Directory Assistance System (CDAS) center of TOT located at the Surawong exchange office has at present 20 remote centers in the provincial area and provides operator directory assistance service for telephone users in the whole Kingdom. Each remote center connects with the Bangkok CDAS center through leased circuits of 14.4 kb/s speed.

The CDAS center has 183 operators terminals (work stations) for the BMA, in which 167 terminals are provided for directory information services ("13" & "183") at the present. 20 remote centers in the provincial area have 35 terminals in total.

Table 3.7.5 shows the statistical data of the services in the Bangkok CDAS center from October 1990 to December 1991. The average number of calls per working day has been in the range from 35,000 to 65,000 with 143 terminals from October 1990 to July 1991. After increasing 10 terminals from September 1991, the average number of calls per working day has increased to be in the range between 74,000 and 80,000.

However, there were more than 6 million call attempts in December 1991 while the number of completed calls was only 1 million as shown in Figure 3.7.5-1.

This large gap between the rapidly increasing calls for the directory assistance service and the relatively small number of operator terminals of the CDAS Center is the main cause of the low CCR of the CDAS center.

Table 3.7.5 Service Statistics of the CDAS Center in the BMA

year/ month	Number of Terminals	Total Number of Calls Completed for the CDAS Center (per month)	Number of average calls per day		Number of Subscribers			
			Working Day	Day Off	Metro.	Province.	Cellular Mobile	Total
90/10	143	1,320,102	50,617	22,947	919,692	426,428	31,238	1,377,358
11	143	1,283,577	48,929	25,890	929,225	431,010	33,138	1,393,373
12	143	1,104,877	44,101	23,926	934,749	434,958	34,124	1,403,831
91/1	143	1,133,281	58,328	22,552	942,940	439,877	36,115	1,418,932
2	143	912,590	37,551	22,124	951,920	444,794	40,823	1,437,537
3	143	965,010	34,927	23,152	962,477	451,890	43,949	1,458,316
4	143	980,418	40,386	21,121	969,760	457,959	46,305	1,474,024
5	143	925,678	35,010	20,496	980,315	463,992	49,612	1,493,919
6	143	1,122,581	45,272	21,713	1,011,734	472,070	53,511	1,537,315
7	143	1,696,340	65,127	32,865	1,023,698	479,306	58,921	1,561,925
8	143	1,803,421	67,370	38,864	1,034,775	485,576	61,972	1,582,323
9	153	2,084,976	80,590	43,618	1,052,829	492,729	66,331	1,611,889
10	153	2,180,302	80,343	45,861	1,074,094	502,002	67,569	1,643,665
11	153	2,041,086	78,001	44,782	1,087,615	508,471	71,510	1,667,596
12	153	1,918,396	74,185	42,405	1,094,572	514,487	74,231	1,683,290

Source: CDAS center, TOT

d) Systems Expansion Procedure

In order to improve the CCR for the CDAS Center and provide better directory assistance service for the customers, TOT already made a system expansion plan to increase its operator terminals. However, it took one and half year for TOT to get an approval of the National Computer Committee to increase the terminals.

The National Computer Committee is a governmental committee to coordinate and approve every plan to install, expand, modify computerized systems used by the government organizations and the state enterprises. The quick and appropriate approvals are essential for TOT to expand their operation systems to cope with growing subscribers and the telecommunications network.

e) Update of CDAS Database

According to the TOT staff in a commercial division, necessary period to update the CDAS center's directory data base is approximately one week without outside plant work and two weeks with outside plant work such as relocation. According to the staff in the CDAS center on the other hand, it takes approximately one week to

update the directory data base after receiving service orders from the commercial section; however, sometimes it takes more than three months to receive service orders from the commercial section; Service orders are occasionally lost .

In order to provide accurate directory services, the service order procedure has to be monitored and checked strictly.

f) Actual Case of Telephone Number Change

In Thailand, it is not possible at present for a subscriber to change the subscriber telephone location beyond the local exchange boundary. Changing telephone numbers by requests of subscribers does not occur so frequently as Japan.

However, TOT sometimes changes the host exchange accommodation of the RSUs; therefore, there are some cases in which many subscribers have to change their telephone numbers at the same time. The following is an actual example of this case.

i) There is a Japanese restaurant at Asoke Tower named as AKAMON. One of the AKAMON staff told that their telephone number with 252 exchange number was suddenly changed by TOT on August 1991. They were provided with a different exchange number and subscriber numbers. Their present telephone numbers are as follows:

Tel) 260-0235~6 258-3886
Fax) 258-3875

ii) In addition to the above telephone numbers, they have the following numbers for their staff use only, not for their customers to make reservations.

261-6432~4 and 261-6438~9

iii) The AKAMON restaurant recently distributed sales promotion bills in which they list these staff-use telephone numbers for their customers to make calls for reservation. They tell that their telephone lines (260-0235~6, 258-3886) often become out of service and that their customers complain these line always being busy. They, therefore, decided to let their customers call other telephone numbers.

iv) However, the Telephone Directory "Greater Bangkok 1992" shows the telephone numbers of AKAMON restaurant, as follows:

252-5969 or call 252-5986, 260-0235~6

The April 1992 edition of "Out & About", a free travel guide magazine for tourists in Bangkok, has a small article.

Attention: At present the Telephone Organization of Thailand is changing the telephone numbers in many parts of the city. We shall be grateful, if your establishment's number is wrongly listed, to be advised of the new number.

3) The Service Improvement Measures for Directory Assistance Service

a) Merit of AIS Introduction

The Automatic Information Service (AIS) announces the changed telephone number information to telephone users. AIS automatically provides a calling party with an announcement telling to call a new telephone number since the called telephone number has been changed already .

If TOT installs the AIS, the large number of telephone users, who do not know changed numbers, can be informed new telephone numbers automatically. This service contributes to reduce the number of B-sub no answer, to ease the traffic congestion to the CDAS center, and to increase successful calls. The following section describes the system configuration of the AIS.

b) Features and System Configuration of the AIS

The AIS provides announcements automatically when telephone users make telephone calls to those telephone numbers that are not connected to with the following messages:

i) the called telephone number (or telephone line) is not used by any subscriber. Please check the correct telephone number or call for the directory assistance service,
ii) the called telephone number has been changed and the new telephone number is xxxx-xxx-xxxx,
iii) the called telephone number is stopped for subscription.

Figure 3.7.5-2 shows the system configuration of the AIS.

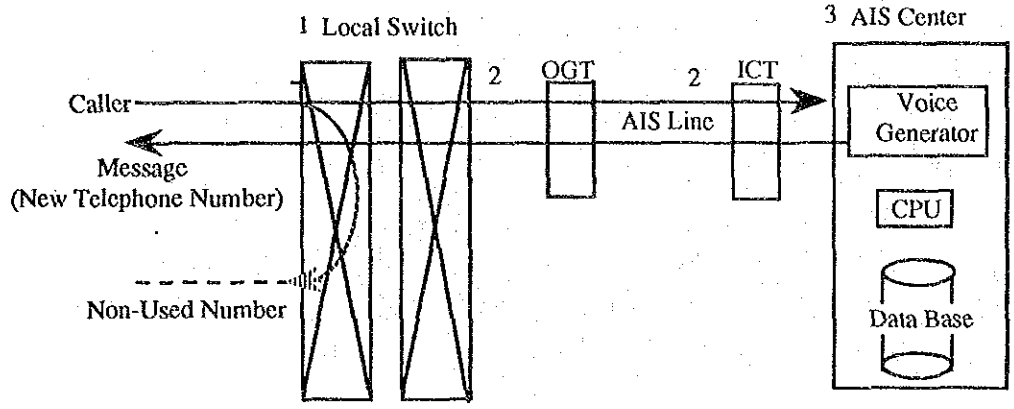


Figure 3.7.5-2 System Configuration of the AIS

The AIS provides these messages according to the following steps:

i) when a caller makes a dialing to a non-used telephone number, a terminating local switch (LS) can chock if the called number is used or not,

ii) If not, then the LS connects the calling party with the AIS center,

iii) The AIS center receives the called telephone number, searches the database, and sends the voice message (with the new telephone number information in the case of a changed number) back to the caller.

c) The Recommended Location and Capacity of AIS

i) Location of AIS center

It is recommended to install the AIS center in the SRW exchange office utilizing a vacant room after the existing XB switches are replaced in 1993.

ii) Capacity of the AIS

100 AIS service class per 10,000 local switching capacity (1% of the switch line capacity) is applied as capacity estimation for the AIS at the initial stage. Although the switching capacity in the BMA becomes approximately 1.5 million lines at the end of the sixth ESDP plan period, the SPC switching unit with 10,000 lines capacity is planned to be installed and utilized as the AIS center equipment.

The capacity of the AIS center equipment will be increased according to usage of the AIS service after the service provision.

In addition to the AIS center equipment, the two OGT circuits are required for each local switch in the BMA.

It is appropriate to keep providing the AIS message service for about three (3) months to one changed (and non-used) telephone number.

3.7.6 Measure for Rush Call

On occasion, rush call breaks out at a burst triggered by advertisement, disaster accidents, etc., and as a result, the whole telephone network becomes incapable of offering the service as in normal condition. These rush calls can be classified into two types, namely, one is a type of anticipated in advance while the other is a type of non-anticipated.

1) Anticipated Type

Anticipated type of rush call is mostly caused by the reservation, order entry etc. by way of a telephone call. Some of happenings can be anticipated in respect to the destination telephone number, the day & time etc. and the suitable measures can be taken in advance. The consulting should be carried out for the rush call subscribers from a viewpoint of advertisement method, number identification method, acceptance method of request etc.

2) Non-Anticipated Type

Non-anticipated type of rush call is mostly caused by disasters. Rush calls concentrate on the specified region where disaster breaks out. The measure should be studied on the whole network basis. Even if under encountering these condition, the essential communication should be secured for the benefits of society.

As an instance of this measure, subscriber class is divided into two classes. One is an urgent class and the other is a general class. In the case of meeting with the urgent condition, the calls from general class are restricted for the rush call area at the originating exchange by identifying the subscriber class and the destination code.

The urgent class of subscribers is composed of the government offices, police & fire stations, public corporations, newspaper companies, TV Broadcasting, etc. By classifying the subscribers the essential communication could be secured as shown in Figure 3.7.6.

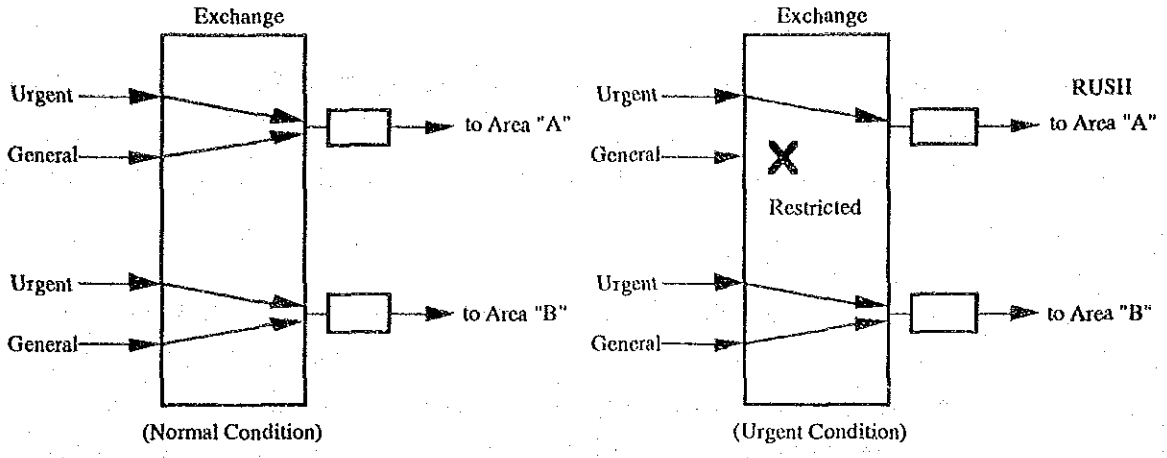


Figure 3.7.6 Call Restriction for Rush Call Area

3.7.7 Study on Call Period

Telephone users calling behavior has great influence on traffic. The call period or duration, i.e., how long one call takes, differs from call to call and person to person. However, the longer the average call period becomes, the greater the probability of traffic congestion becomes.

TOT applies an unit call rate system for its local call tariff. One local call is 3 Baht no matter how long one call lasts. As for trunk calls or long-distance calls, TOT applies a distance and time metering rate system. The trunk call charge per minute is structured in 6 steps from 3 Baht to 18 Baht according to the distance during day time (7:00 to 18:00). The long-distance call charge is 50% discounted in the evening time during 18:00 and 22:00 compared with that in the day time. It is further discounted for one third (1/3) in the night time during 22:00 and 7:00 compared with that in the day time.

The call period or the holding time of local calls may be longer than that of trunk calls because its fare is not time sensitive.

This section examines the above mentioned hypothesis by examining the holding time of the local and trunk calls.

1) Sampling Method

A call period (Call Duration) survey was conducted to investigate subscribers' (telephone users') calling behavior. The Study Team has selected the following nine (9) switching units for the survey as representatives of the business, residential, and combination areas. Table 3.7.7-1 shows the selected 9 switching units.

Table 3.7.7-1 Selected 9 Switching Units for the Call Period Survey

1)	Business Area	a)	Phloen Chit (PNC)
		b)	Surawong (SRW4)
		c)	Pathum Wan (PTW)
2)	Residential Area	a)	Pak Kret (PKK)
		b)	Charan Sanitwong (CSW)
		c)	Bang Khae (BKE)
3)	Business and Residential Area (Combination)	a)	Hua Mak (HAM)
		b)	Samran Rat (SRR)
		c)	Lat Phra (LTP)

The NCOM Center has observed completed calls originating from the above 9 SPC switching units and collected the calling period data according to the following conditions:

a) Observation date: May 12, 1992

b) Observation time: i) Morning starting from 8:00 o'clock and ending until the number of calls reached 1,000 calls per switch
ii) Evening starting from 20:00 o'clock and ending until the number of calls reached 500 calls per switch

c) Number of Samples: i) Morning 1,000 calls per switch 9,000 calls in total
ii) Evening 500 calls per switch 4,432 calls in total

d) Observed Call Type:

All PSTN calls: international calls, trunk (Long Distance) calls, special calls ("13", "183", "17" services, etc.), and local calls originating from the nine (9) switching units during the observation time.

2) Result of the Observation

a) Difference in Calling Behavior : Morning and Evening

Table 3.7.7-2 shows the total number and its percentage share of the observed morning and evening calls from the 9 switching units classified by call destinations (local call, special call, trunk call, and international call).

Table 3.7.7-2 Observed Total Calls from the 9 Switching Units Classified by Destinations

	Morning Time		Evening Time	
Observed Number of Calls and Percentage Share	9,000	100.00%	4,432	100.00%
1) International Call	151	1.68%	62	1.40%
2) Trunk Call	384	4.27%	344	7.76%
3) Special Call	299	3.32%	179	4.04%
4) Local Call	8,166	90.73%	3,847	86.80%

The percentage share of the trunk call is 4.27% in the morning time; however, it becomes 7.76% in the evening time.

Table 3.7.7-3 and Figure 3.7.7-1 and Figure 3.7.7-2 show the number of calls from each switching unit classified by call destinations.

Table 3.7.7-3 Observed Calls Classified by Destination from Each 9 Switching Units

	SRR4	HAM2	SRW4	BKE	CSW2	PKK	PNC	PTW2	LTP1
Morning Time									
Starting	09:00:09	09:00:34	08:59:13	09:00:05	08:59:04	09:00:09	08:56:52	08:59:52	09:00:29
Ending	11:53:25	13:13:30	10:52:37	10:53:57	14:45:08	12:20:47	16:07:01	09:57:03	09:57:58
Number of Calls	1000	1000	1000	1000	1000	1000	1000	1000	1000
International	10	9	41	8	4	20	35	11	13
Trunk	60	41	44	41	41	33	39	52	33
Special	26	35	21	44	36	31	40	28	38
Local Call	904	915	894	907	919	916	886	909	916
Call Share(%)									
International	1.00%	0.90%	4.10%	0.80%	0.40%	2.00%	3.50%	1.10%	1.30%
Trunk	6.00%	4.10%	4.40%	4.10%	4.10%	3.30%	3.90%	5.20%	3.30%
Special	2.60%	3.50%	2.10%	4.40%	3.60%	3.10%	4.00%	2.80%	3.80%
Local Call	90.40%	91.50%	89.40%	90.70%	91.90%	91.60%	88.60%	90.90%	91.60%
Evening Time									
Starting	19:59:49	20:00:40	19:58:50	20:00:03	20:07:08	20:00:07	19:57:07	19:59:52	20:00:50
Ending	20:47:48	20:55:29	20:49:28	22:04:41	20:55:53	21:36:15	23:55:59	21:01:48	21:08:02
Number of Calls	500	500	500	500	500	500	432	500	500
International	5	2	21	12	0	5	12	2	3
Trunk	53	48	21	27	50	49	27	28	41
Special	34	14	23	14	14	19	14	26	21
Local Call	408	436	435	447	436	427	379	444	435
Call Share(%)									
International	1.00%	0.40%	4.20%	2.40%	0.00%	1.00%	2.78%	0.40%	0.60%
Trunk	10.60%	9.60%	4.20%	5.40%	10.00%	9.80%	6.25%	5.60%	8.20%
Special	6.80%	2.80%	4.60%	2.80%	2.80%	3.80%	3.24%	5.20%	4.20%
Local Call	81.60%	87.20%	87.00%	89.40%	87.20%	85.40%	87.73%	88.80%	87.00%

Table 3.7.7-3 shows that SRW4 and PNC have comparatively larger international calls. This indicates that international business users are concentrated in these areas.

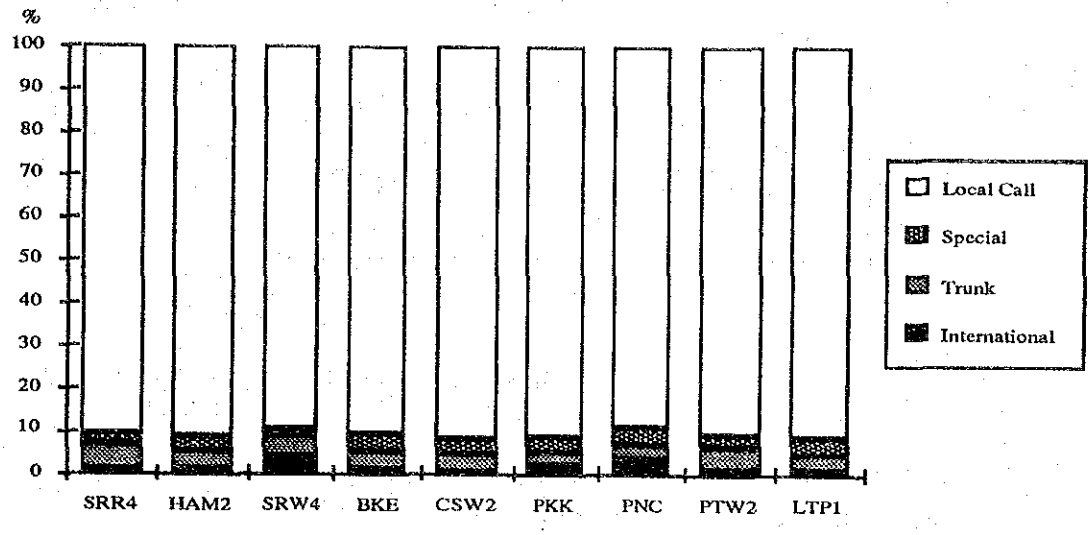


Figure 3.7.7-1 Percentage Share of Outgoing Calls in the Morning of May 12, 1992

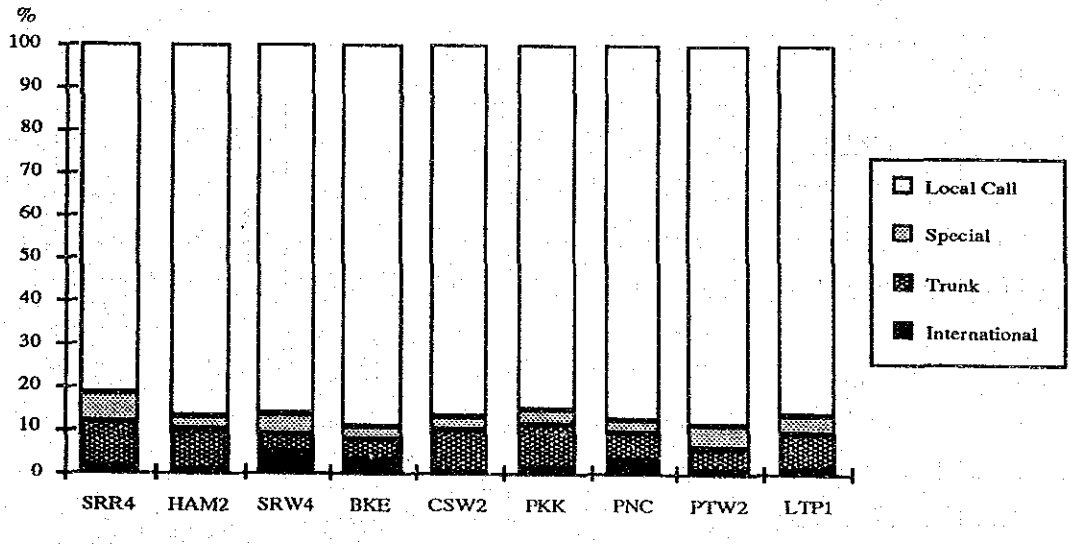


Figure 3.7.7-2 Percentage Share of Outgoing Calls in the Evening of May 12, 1992

b) Calling Period Difference: Local Call and Trunk Call

Table 3.7.7-4 shows the average call period for trunk and local calls. In the morning, the average call period of the trunk call is 2 minutes and 23 seconds. It is 26 seconds shorter than that of the local call. On the other hand, the average trunk call period is 15 seconds longer than that of the local call in the evening.

Table 3.7.7-4 Average Call Period for Trunk and Local Calls for the Total Samples from the 9 Switching Units

	Morning Time	Evening Time
1 Trunk Call	2:23	4:06
2 Local Call	2:49	3:51
3. Difference (=1-2)	- 0:26	0:15

Table 3.7.7-5 and Table 3.7.7-6 show the statistic data of the local and trunk calls from each switching unit in the morning and in the evening, respectively. The average period of the local call is longer than that of the trunk call for seven (7) switching units in the morning time; however, for four (4) switching units in the evening.

Table 3.7.7-5 Call Period Statistics of the 9 Switching Units in the Morning on May 12, 1992

Call Period	SRR4	HAM2	SRW4	BKE	CSW2	PKK	PNC	PTW2	LTP1
1. Trunk Call									
1) Max.	00:12:32	00:17:22	00:08:01	00:21:31	00:19:51	00:09:52	00:30:07	00:15:30	00:07:45
2) Min.	00:00:11	00:00:25	00:00:14	00:00:16	00:00:23	00:00:23	00:00:26	00:00:11	00:00:28
3) Average	00:02:04	00:02:28	00:01:42	00:02:46	00:02:21	00:02:04	00:03:34	00:02:15	00:02:29
4) STDEV	00:02:05	00:03:23	00:01:42	00:03:39	00:03:10	00:02:01	00:06:06	00:02:23	00:01:44
2. Local Call									
1) Max.	01:22:59	01:10:26	00:22:02	00:37:20	03:12:31	02:00:30	01:22:54	00:27:47	00:33:57
2) Min.	00:00:07	00:00:07	00:00:04	00:00:07	00:00:07	00:00:04	00:00:06	00:00:08	00:00:02
3) Average	00:02:36	00:03:03	00:02:41	00:02:40	00:03:08	00:02:51	00:02:59	00:02:29	00:02:52
4) STDEV	00:04:31	00:05:02	00:03:08	00:03:26	00:07:47	00:05:15	00:04:48	00:02:54	00:03:40

Table 3.7.7-6 Call Period Statistics of the 9 Switching Units in the Evening on May 12, 1992

	SRR4	HAM2	SRW4	BKE	CSW2	PKK	PNC	PTW2	LTP1
1. Trunk Call									
1) Max.	00:27:47	00:11:14	00:12:19	00:31:14	00:21:40	00:43:58	00:33:07	00:11:59	00:24:00
2) Min.	00:00:22	00:00:19	00:00:31	00:00:40	00:00:24	00:00:16	00:00:59	00:00:33	00:00:36
3) Average	00:03:31	00:02:32	00:02:52	00:05:36	00:04:22	00:04:39	00:06:02	00:02:55	00:04:51
4) STDEV	00:05:15	00:02:45	00:03:08	00:06:59	00:04:48	00:08:48	00:07:08	00:02:37	00:05:01
2. Local Call									
1) Max.	00:36:52	00:31:44	00:30:47	00:57:58	00:52:16	00:58:59	00:47:39	00:40:02	00:44:30
2) Min.	00:00:08	00:00:02	00:00:11	00:00:07	00:00:09	00:00:03	00:00:07	00:00:05	00:00:03
3) Average	00:02:49	00:03:05	00:02:27	00:04:38	00:04:36	00:04:45	00:04:45	00:03:20	00:04:14
4) STDEV	00:04:19	00:04:05	00:03:25	00:07:10	00:07:26	00:06:58	00:08:21	00:05:04	00:05:50

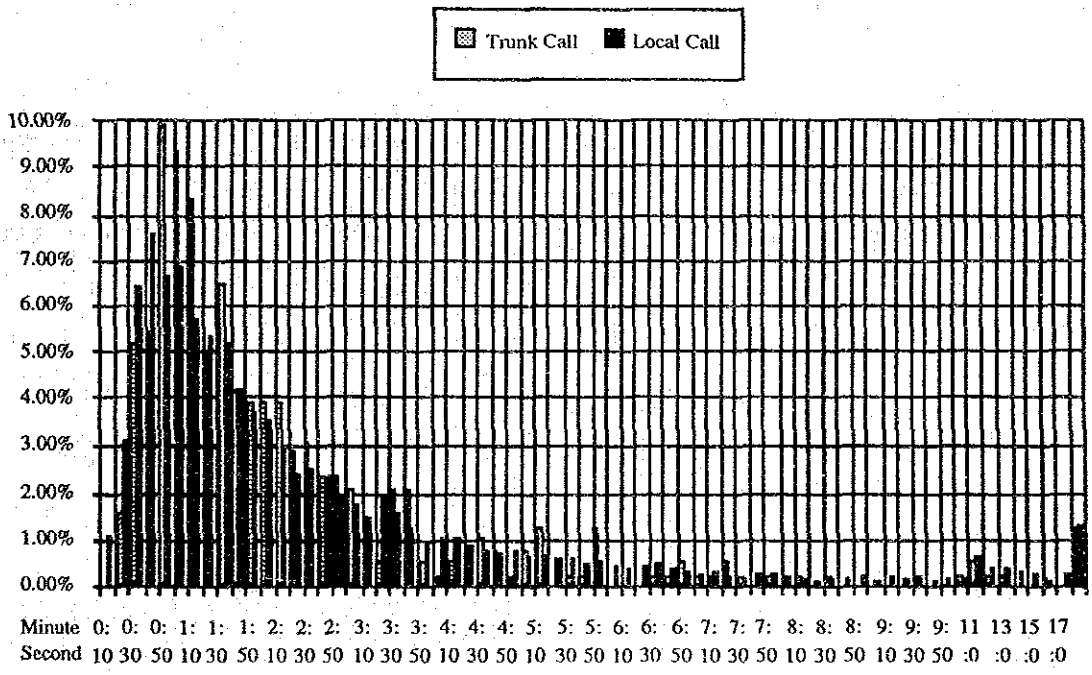


Figure 3.7.7-3 Frequency Distribution of Trunk and Local Call Period in the Morning

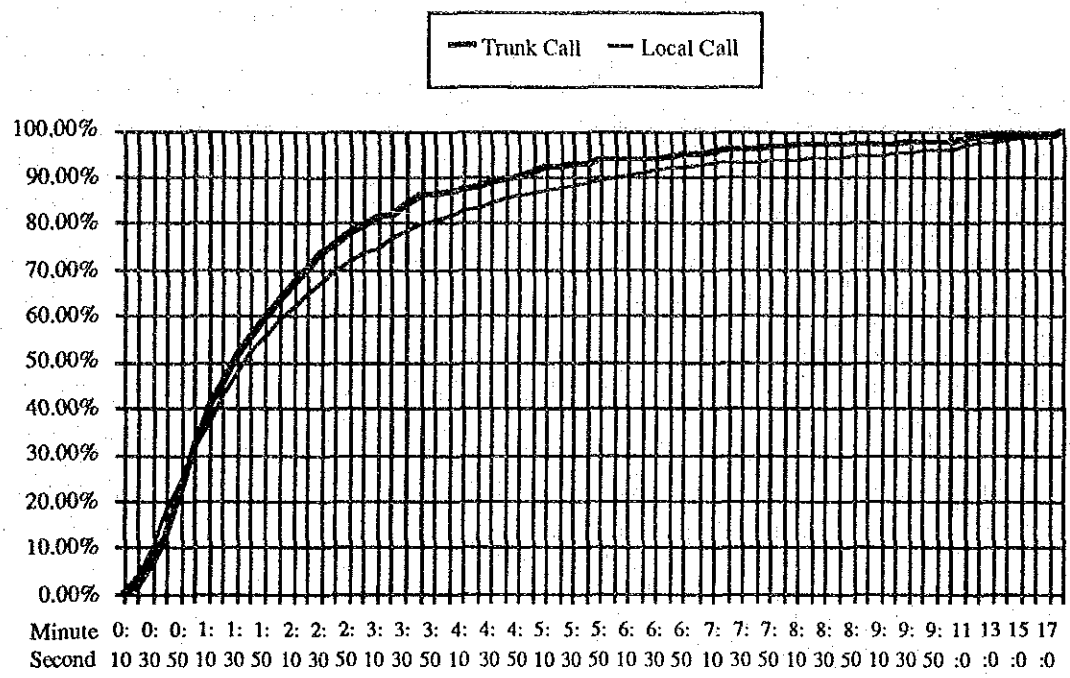


Figure 3.7.7-4 Cumulative Frequency Distribution of Trunk and Local Call Period in the Morning

Table 3.7.7-7 shows the frequency distribution and the cumulative frequency distribution of all sample calls from the 9 switching units both in the morning and the evening time. The table indicates that the most frequent call period lasts from 31 seconds to 40 seconds both in the morning and the evening.

Table 3.7.7-7 Frequency Distribution of the All Calls from the 9 Switching Units

Period	Morning Time			Evening Time		
	Frequency		Cumulative Frequency (%)	Frequency		Cumulative Frequency (%)
~00:10 sec	93	1.03%	1.03%	37	0.83%	0.83%
~00:20	279	3.10%	4.13%	141	3.18%	4.02%
~00:30	625	6.94%	11.08%	360	8.12%	12.14%
~00:40	716	7.96%	19.03%	424	9.57%	21.71%
~00:50	624	6.93%	25.97%	298	6.72%	28.43%
~01:00 min.	633	7.03%	33.00%	301	6.79%	35.22%
~01:10	524	5.82%	38.82%	234	5.28%	40.50%
~01:20	481	5.34%	44.17%	186	4.20%	44.70%
~01:30	466	5.18%	49.34%	157	3.54%	48.24%
~01:40	372	4.13%	53.48%	131	2.96%	51.20%
~01:50	335	3.72%	57.20%	129	2.91%	54.11%
~02:00	315	3.50%	60.70%	114	2.57%	56.68%
~02:10	260	2.89%	63.59%	106	2.39%	59.07%
~02:20	217	2.41%	66.00%	76	1.71%	60.79%
~02:30	227	2.52%	68.52%	60	1.35%	62.14%
~02:40	207	2.30%	70.82%	99	2.23%	64.37%
~02:50	172	1.91%	72.73%	76	1.71%	66.09%
~03:00	151	1.68%	74.41%	58	1.31%	67.40%
~03:30	433	4.81%	79.22%	201	4.54%	71.93%
~04:00	285	3.17%	82.39%	125	2.82%	74.75%
~04:30	235	2.61%	85.00%	116	2.62%	77.37%
~05:00	186	2.07%	87.07%	92	2.08%	79.44%
~05:30	160	1.78%	88.84%	80	1.81%	81.25%
~06:00	126	1.40%	90.24%	79	1.78%	83.03%
~07:00	206	2.29%	92.53%	143	3.23%	86.26%
~08:00	132	1.47%	94.00%	94	2.12%	88.38%
~09:00	87	0.97%	94.97%	75	1.69%	90.07%
~10:00	101	1.12%	96.09%	75	1.69%	91.76%
over 10:00	352	3.91%	100.00%	365	8.24%	100.00%
Total	9000	100.00%		4432	100.00%	

The average call period in the evening time tends to become longer than that in the day time. 80% of calls end within 4 minutes in the morning, but 5 minutes and 30 seconds in the evening. 90% of calls end within 6 minutes in the morning, but 9 minutes in the evening.

Table 3.7.7-8 shows the cumulative frequency distribution of call periods for the trunk and local calls in the morning.

This table indicates the followings:

i) 63.28% of the trunk call and 59.53% of the local call end within 2 minutes,

ii) 79.95% of the trunk call and 73.45% of the local call end within 3 minutes,

iii) 90.63% of the trunk call and 86.57% of the local call end within 5 minutes.

Table 3.7.7-8 Frequency Distribution and Cumulative Frequency Distribution of Trunk and Local Call Periods in the Morning

Period	Trunk Call				Local Call			
	Frequency Distribution		Cumulative Freq. Distribution		Frequency Distribution		Cumulative Freq. Distribution	
~00:10 sec	0	0.00%	0	0.00%	88	1.08%	88	1.08%
~00:20	6	1.56%	6	1.56%	254	3.11%	342	4.19%
~00:30	20	5.21%	26	6.77%	527	6.45%	869	10.64%
~00:40	21	5.47%	47	12.24%	619	7.58%	1,488	18.22%
~00:50	38	9.90%	85	22.14%	542	6.64%	2,030	24.86%
~01:00	36	9.38%	121	31.51%	561	6.87%	2,591	31.73%
~01:10	32	8.33%	153	39.84%	468	5.73%	3,059	37.46%
~01:20	19	4.95%	172	44.79%	437	5.35%	3,496	42.81%
~01:30	25	6.51%	197	51.30%	426	5.22%	3,922	48.03%
~01:40	16	4.17%	213	55.47%	343	4.20%	4,265	52.23%
~01:50	15	3.91%	228	59.38%	305	3.73%	4,570	55.96%
~02:00	15	3.91%	243	63.28%	291	3.56%	4,861	59.53%
~02:10	15	3.91%	258	67.19%	242	2.96%	5,103	62.49%
~02:20	11	2.86%	269	70.05%	198	2.42%	5,301	64.92%
~02:30	12	3.13%	281	73.18%	207	2.53%	5,508	67.45%
~02:40	9	2.34%	290	75.52%	192	2.35%	5,700	69.80%
~02:50	9	2.34%	299	77.86%	157	1.92%	5,857	71.72%
~03:00	8	2.08%	307	79.95%	141	1.73%	5,998	73.45%
~03:30	15	3.91%	322	83.85%	408	5.00%	6,406	78.45%
~04:00	11	2.86%	333	86.72%	263	3.22%	6,669	81.67%
~04:30	8	2.08%	341	88.80%	223	2.73%	6,892	84.40%
~05:00	7	1.82%	348	90.63%	177	2.17%	7,069	86.57%
~05:30	6	1.56%	354	92.19%	154	1.89%	7,223	88.45%
~06:00	6	1.56%	360	93.75%	123	1.51%	7,346	89.96%
~07:00	5	1.30%	365	95.05%	191	2.34%	7,537	92.30%
~08:00	5	1.30%	370	96.35%	126	1.54%	7,663	93.84%
~09:00	2	0.52%	372	96.88%	84	1.03%	7,747	94.87%
~10:00	2	0.52%	374	97.40%	96	1.18%	7,843	96.04%
over 10:00	10	2.60%	384	100.00%	323	3.96%	8,166	100.00%
Total	384	100.00%			8,166	100.00%		

c) The Fluctuation of Calls during 24 Hours

The following two figures show the call load curves during 24 hours at Bang Khae (BKE) and Phloen Chit (PNC) switching units observed for 4 days on April 20, 21, 23, and 24, 1992.

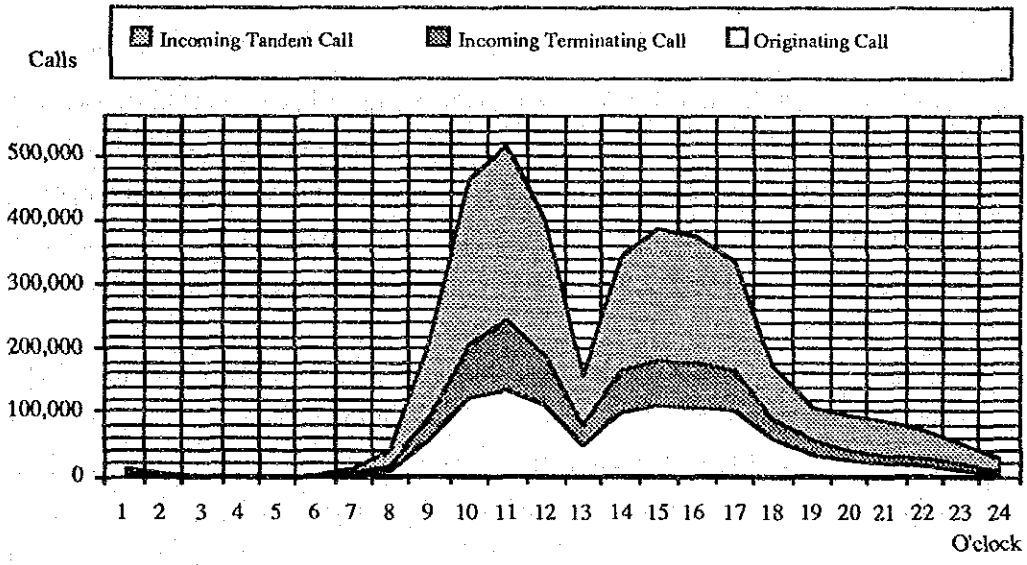


Figure 3.7.7-5 Fluctuation of the Calls at PNC during the 24 Hours
(the average of 4 days: April 20, 21, 23, and 24, 1992)

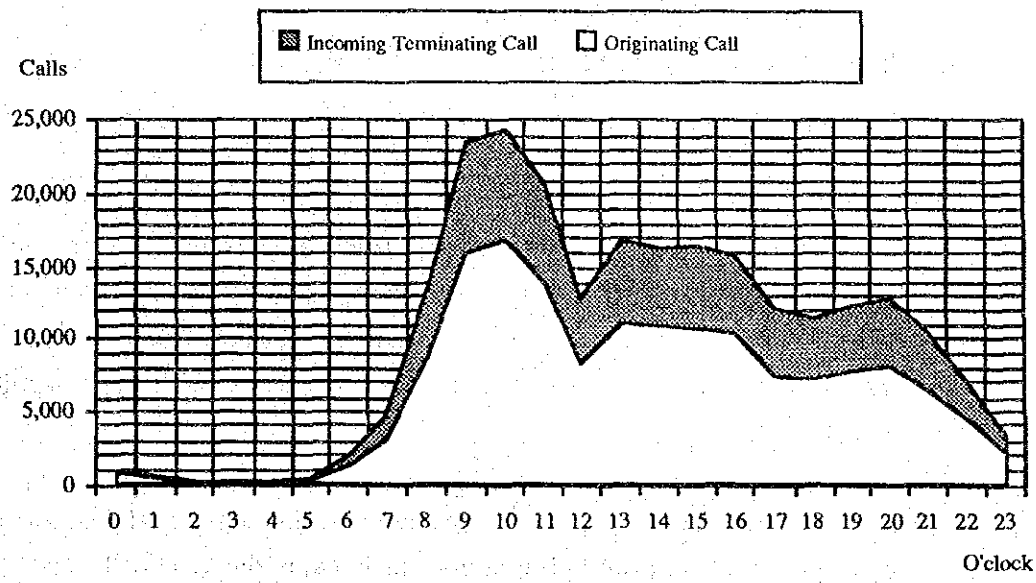


Figure 3.7.7-6 Fluctuation of the Calls at BKE during the 24 Hours
(the average of 4 days: April 20, 21, 23, and 24, 1992)

The peak arises during 11 o'clock at BKE and 10 o'clock at PNC.

3) Results from the Analysis

The call period (or holding time) survey collected 13,432 originating calls in total from the 9 switching units in the BMA in the morning and the evening on May 12, 1992. Though the observed data is limited, the following conclusions can be derived from this survey.

a) As Figure 3.7.7-4 and Table 3.7.7-8 clearly indicate that the period of the local calls is evidently longer than that of the trunk call in the morning time. This is probably because of the unit call rate system for the local call tariff. The local call charge for one call is the same no matter how long one call lasts. Hence, the customer may tend to keep the holding period of one local call as long as possible.

b) The traffic congestion is the most serious during the morning time between 9 o'clock and 12 o'clock. Approximately 90% of the calls in the morning time is the local call in the BMA. Hence, if the local call period becomes shorter than that in the present, it may contribute to ease the traffic congestion in the BMA.

c) In order to ease the traffic congestion in the BMA, it is essential for TOT to
   i) increase the network capacity, particularly to install sufficient main telephone lines as well as to promote the introduction of the hunting system for those high B-sub busy subscribers, and
   ii) keep the network in the better operational condition.

d) In addition to the above measures, introduction of the time-metering system for the local call tariff in the BMA may be effective to ease the traffic congestion by reducing local call periods. TOT could not introduce the time metering system in the BMA several years before because of the rejection by the Government even though the necessary equipment had been installed to the network to measure local call period. However, it is worth considering again from the viewpoint of improving the CCR.

e) Because the trunk call rate increases according to the holding period, i.e., minute by minute, the period of the trunk call is shorter than that of the local call. The longest call period for the observed trunk call is 43 minutes and 58 seconds in the evening time from PKK, but that for the local call is 3 hours 12 minutes and 31 seconds in the morning time from CSW2, the others longer than one hour are 2:00:30 (PKK), 1:22:59 (SRR4), 1:22:54 (PNC), 1:10:26 (HAM2).

f) Computer communications become increasingly popular in these days. Banking systems, the trading companies global networks, transportation management systems of sipping industry, reservation systems for traveling agencies, and point of sales systems (POS) for retailers and wholesalers are relying on computer communications networks. These are also developing in the BMA.

g) Those customers with relatively large traffic volume tend to use leased circuits for their communications among terminals and computers when the tariff system is time sensitive. If the call charge does not increase for the length of the calling period, they may hold lines throughout their business hours when their communications partners are the fixed ones.

h) If it is still difficult for TOT to introduce the time-metering system for the local call tariff in the BMA, the traffic load management measures are to be considered in order to ease the traffic congestion in the morning busy hours in the BMA. The time-of-day local call pricing, for example, may be one of the effective measures. When the local call charge is lower in the early morning and the evening times compared with that in the busy hours during day time, some portion of the calls will shift to the discount hours and the peak level of the busy hour may become lower.

3.8 Traffic and Network Management

In this section, a primary focus will be on improvement methods of traffic and network management in the "Sector of Network Management" and "NCOM" center.

3.8.1 Present Organization for Traffic and Network Management

1) Organization

Figure 3.8.1-1 shows the organization structure of traffic and network management concerned.

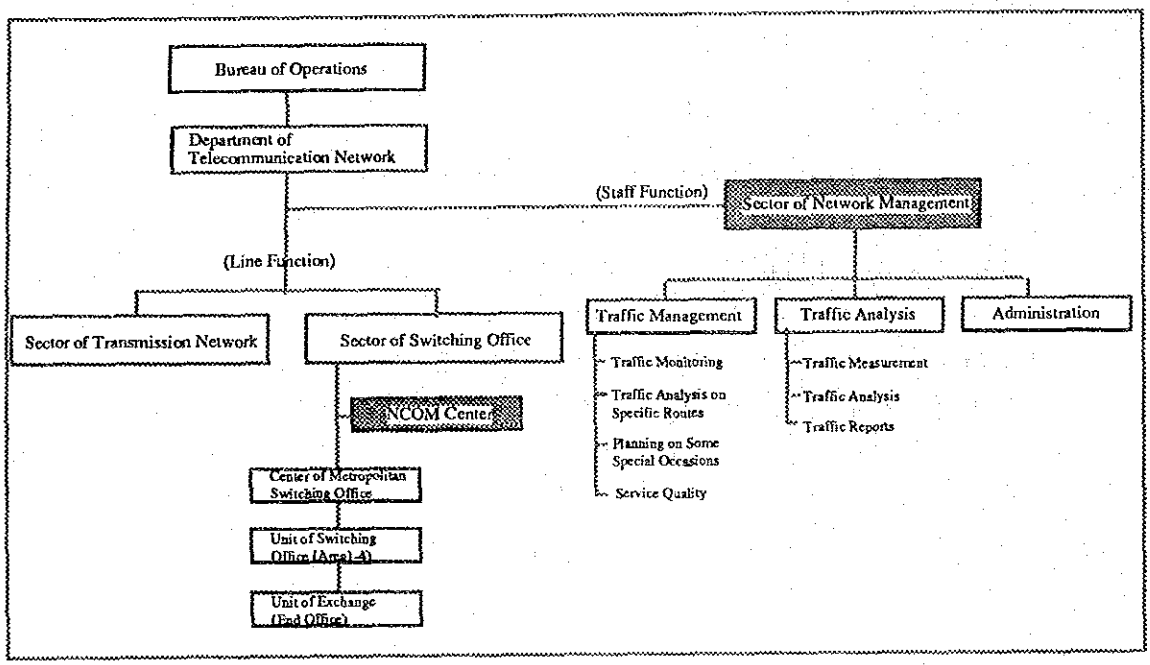


Figure 3.8.1-1 Organization Structure of Traffic and Network Management Concerned

2) Job Description of Sector of Network Management

The Sector of Network Management in the Department of Telecommunications Network is staff function. The sector jobs are concretely as follows:

a) Collect and analyze network management data,
b) Determines what action can be taken by network personnel to improve the network performance,
c) In coordination with traffic engineers, schedule data to collect traffic data,
d) Follow up on data collection and provide data to traffic engineer timely,

e) In emergencies such as trunk route failures, instruct network personnel to take appropriate temporary actions that will ease traffic congestion,

f) Issue orders to rearrange facilities to optimize the utilization of switching and trunk facilities,

g) Request actions from traffic engineers when data indicate that additional equipment will be required to maintain good service quality,

h) Determine what equipment is required for the collection of traffic and switching data to measure performance and make formal requests for additional and replacement equipment,

i) Reviews equipment by service data and initiate actions to minimize the duration and frequency of out-of-service switching and trunk equipment,

j) Monitors installation schedules and issue progress reports,

k) Coordinates the installation of special services.

As mentioned above, the main job of the sector is to analyze traffic data and to propose the required number of circuits to plant planning sections (transmission, switching and engineering sections). However, the required number of circuit proposed from this sector may not be always reflected into a circuit installation plan of each section. The reasons can be presumed as follows.

a) Because a construction plan pried of TOT is 5 years, it takes long time to install the required number of circuits. If the present required number of circuits will have been constructed in the future, then, a new situation different from the present one may occur.

b) Especially, it takes longer for constructing intertoll trunk and local trunk line.

c) The system is short for enforcing the small-scale construction plan which can cover the rough long term construction plan. And, adjustment and arrangement little carry out among the sections concerned (outside plant, switching and transmission etc.).

3) NCOM Center

The NCOM center belongs to the sector of switching office at present. The NCOM center (Lat ya) performs many functions for network management. such as monitoring network status and network control. The main functions of network management are shown in Figure 3.8.1-2.

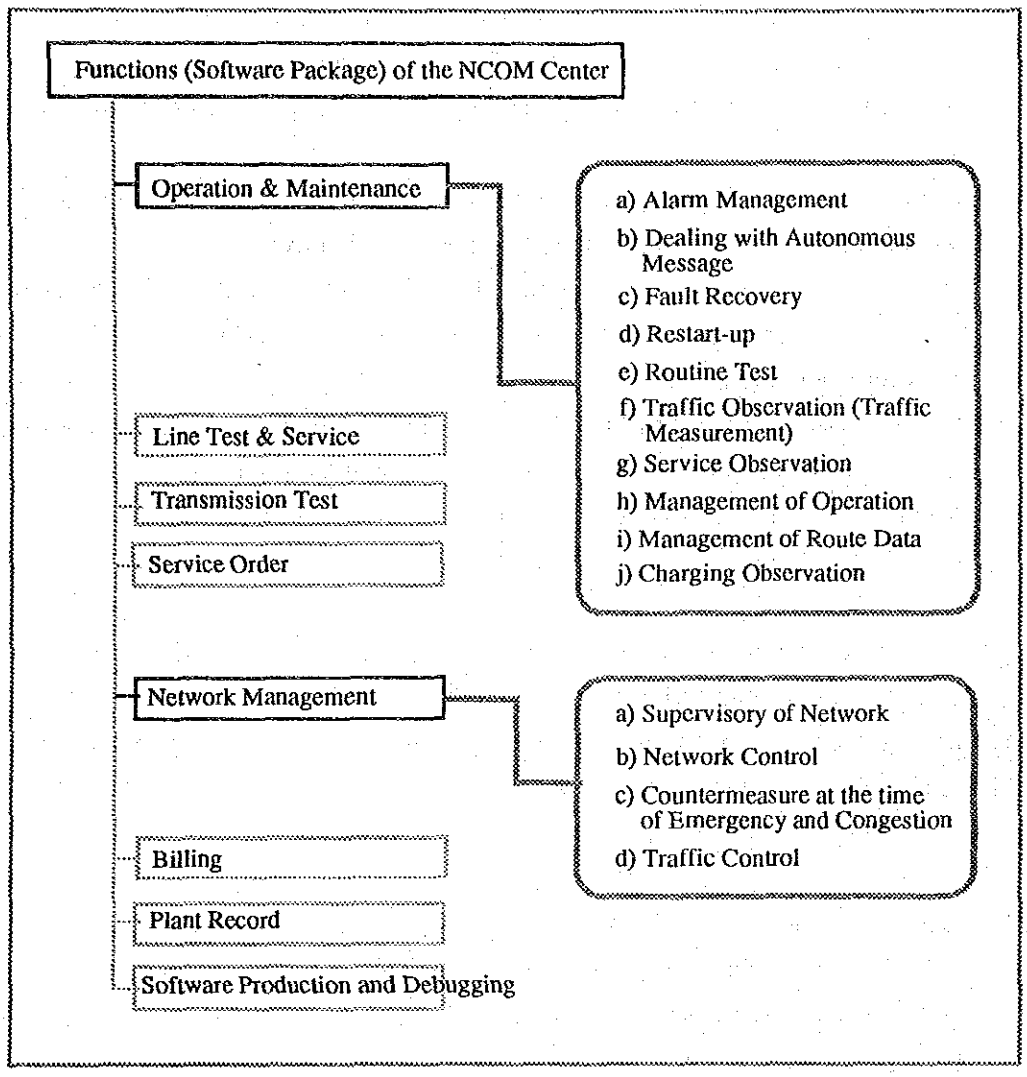


Figure 3.8.1-2 Functions of Network Management Concerned in NCOM Center

4) Work Flow for Traffic and Network Management

The work flow of traffic and network management of TOT is shown in Figure 3.8.1-3. In general, the work consists of two functions. One is the "Traffic Management" function as a part of facility management. The other is the "Network Management" function to carry out traffic monitoring and traffic control for maintaining a suitable network condition.

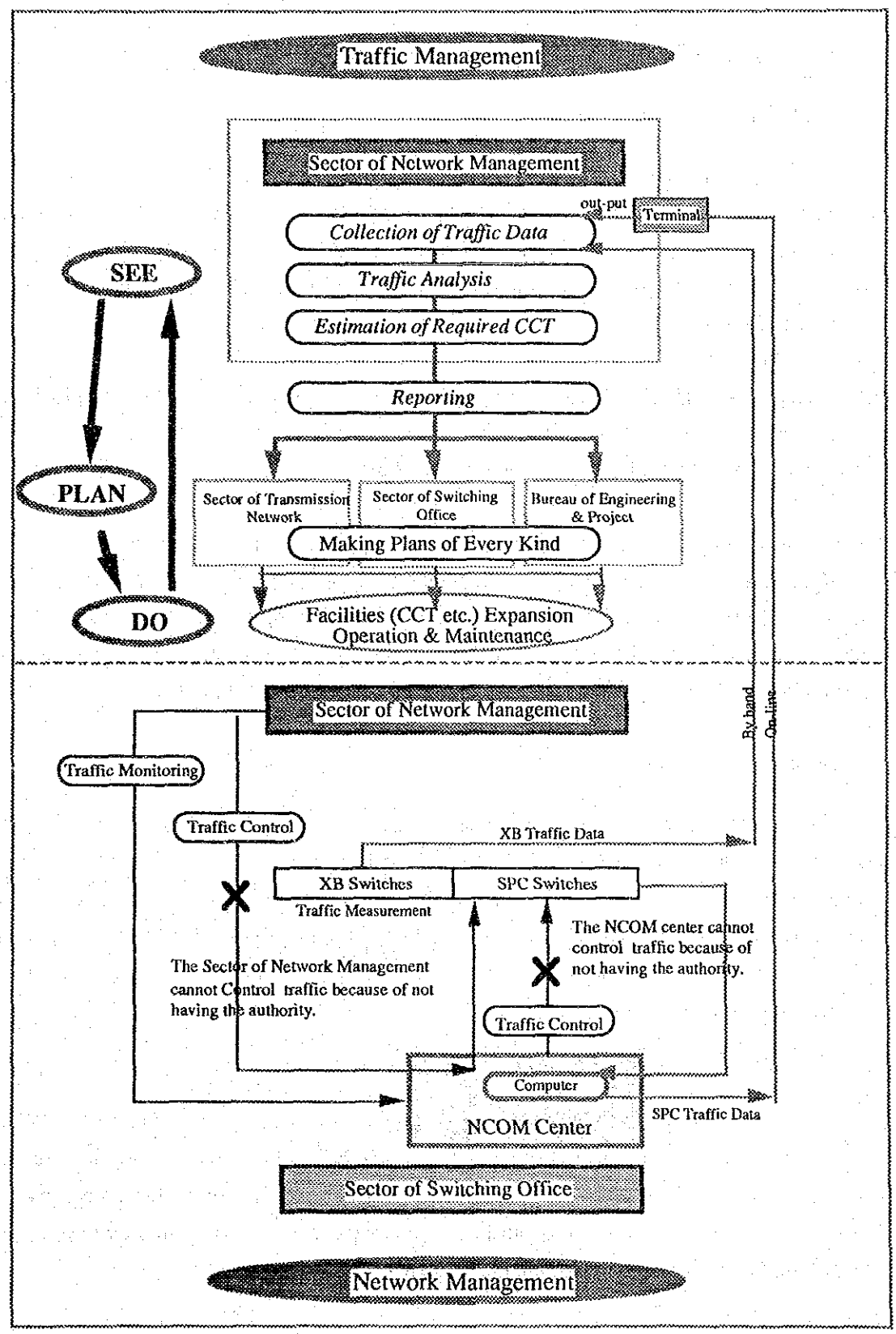


Figure 3.8.1-3 Present Network Management in TOT

3.8.2 Present State of Traffic and Network Management

1) State of Traffic Management

At present, the periodical traffic measurement is carried out by the Sector of Network Management. Regarding how to obtain the traffic data in the SPC switches, the sector uses an on-line system between the NCOM center and this sector. After analyzing the data, the sector proposes the required number of circuits to the plant planning section by quarterly reports.

Recently, TOT has established a new NCOM center which has enhanced functions for traffic management such as a data base function; however, the functions had not been used yet. when the study team observed the center.

In the mean time, in order to improve the call completion ratio, the sector has started to analyze and study measures on P.S.Abandon, B-sub-busy calls. The Study Team highly recommends that the sector starts more practical works to improve the customer service and to make the activities more forcible by stronger supports from the top executives of TOT. Closer cooperation form other sectors concerned are also required.

2) State of Network Management

The sector of network management monitors traffic status of each SPC exchange by using the work stations of the NCOM center. Besides the sector undertakes preparation works against abnormal traffic if that is foreseeable, for example, announcement of university entrance examination results. However, if some fault or congestion occurs in the telecommunications network, this sector hardly gives appropriate instructions to other offices concerned. Because this sector does not have enough authority to supervise the network and instruct the staff of the exchange offices.

On the other hand, the NCOM center has many network management functions. When some congestion or fault occurs in the network, the NCOM center does not take enough actions to exchange offices for improving the situation. Because the center has not been also given any authority and responsibility for network management. As mentioned above, the network management functions are not used enough.

3.8.3 Improvement measures

1) Improvement Measures of Traffic Management

a) Active Cooperation and Adjustment between Line and Staff Function

TOT needs cooperation and adjustment of the line and staff to further improve the call completion ratio. For example, it is not clear whether the required number of circuits reported from this sector (Staff) is well reflected to circuit installation plans in the plant planning sections (Line). Therefore, it is necessary to take a prior consultation between the line and staff. If the call completion ratio is decreasing because of lower quality in subscriber lines, the sector needs a cooperation in the rehabilitating and replacing plans with sections concerned. From these situations, this sector may need more authority and responsibility).

At present, TOT is reorganizing itself to shift authority from the upper part to the lower part. The main purpose of reorganization is to improve the customer service quality. Figure 3.8.3-1 shows a draft of new organization structure. In the draft, it is not clear how the organization of traffic management will change; however, the Study Team considers that each of the "Department of Subscriber Services (refer to Figure 3.8.3-1)"should have a function to analyze the traffic of its own telecommunication network area.

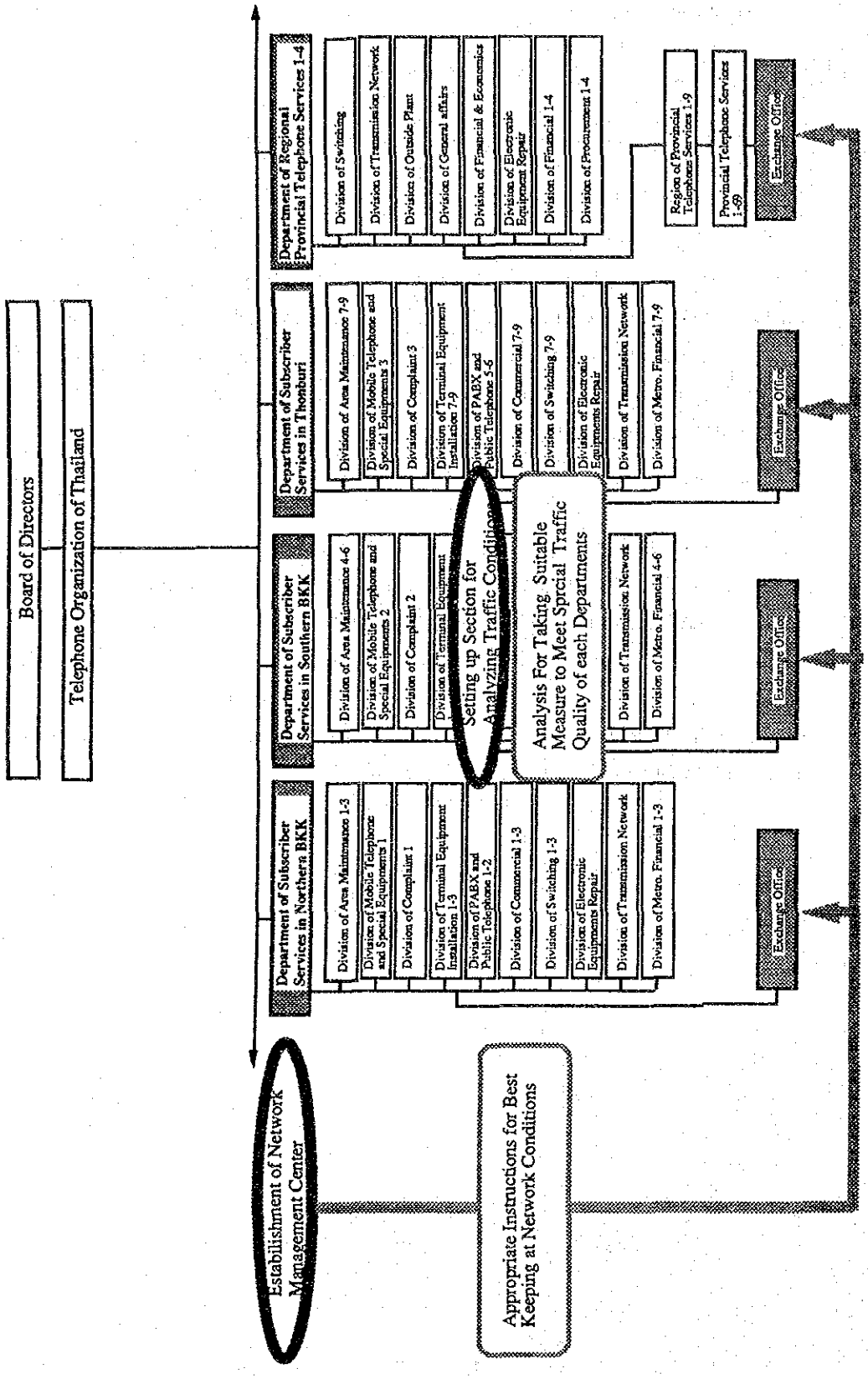


Figure 3.8.3-1 Draft of New Organization Structure of TOT and Establishment of Traffic Analysis Section and Network Management Center

b) Technical Skill Advancement

Real counter-measure activities to improve the call completion ratio in TOT have been just started.

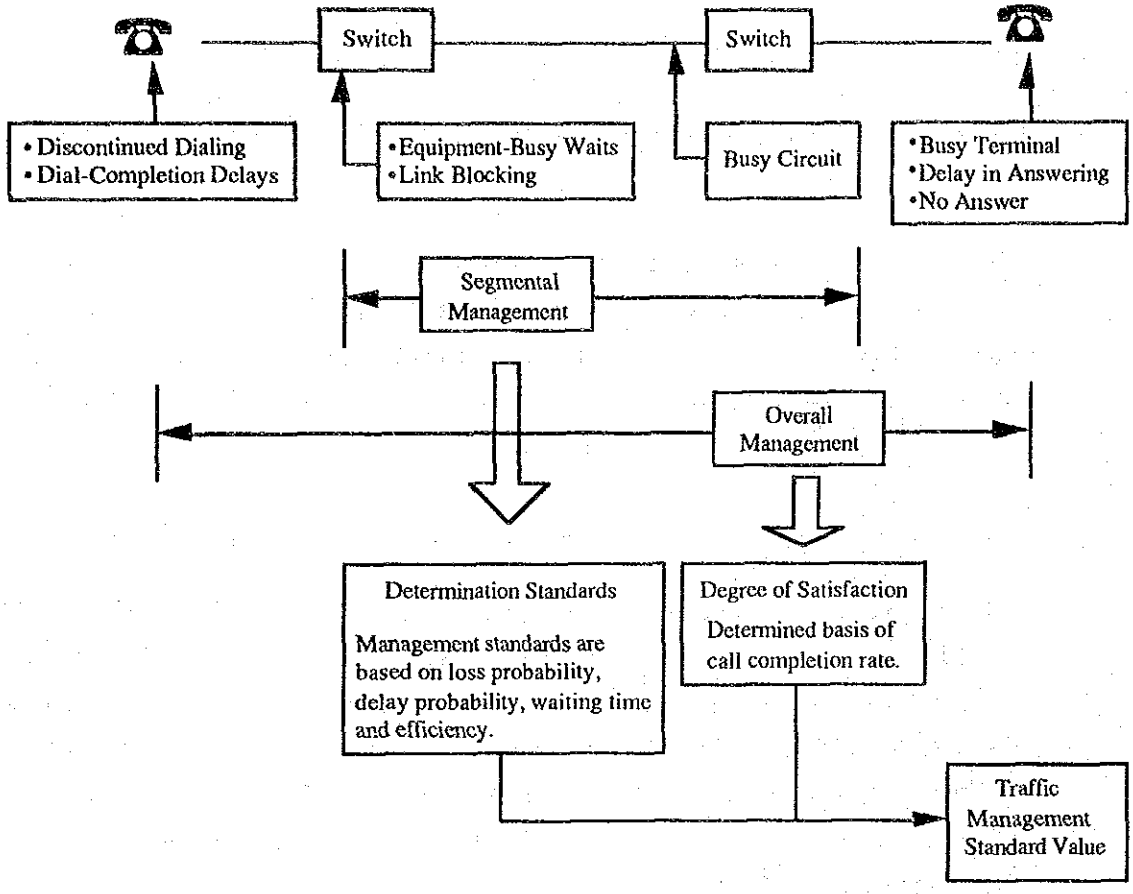
Therefore, TOT is in short of experts in this field. It is necessary for them to acquire some methodology to improve the call completion ratio. It means, for example, what traffic materials in the NCOM center uses, how to analyze traffic data etc. In order to cultivate to many experts, it is indispensable to adopt an On-the-Job-Training system for the junior staff.

c) Setting up Study Team and Committee for Improving Call Completion Ratio

Without strong cooperation from sections concerned, improvement of the call completion ratio cannot be made. In order to improve the call completion ratio, as described in "Transition of Improvement Call Completion Ratio in Japan" of this Supporting, TOT should set up a study team for investigating actual traffic status in TOT. and also establish a committee with strong authority. The committee will give appropriate counter-measures to the sections concerned on the basis of the report from the study team.

d) Creating Control Value for Network Management

In order to improve the call completion ratio, it is required to create a control value for carrying out network management actually. The method is described in Figure 3.8.3-2.



Overall Management

From the standpoint of guaranteeing service quality, overall management comprehensively manages the entire connection system from dialing by a user to being connected to the destination party, and cover all traffic-related elements -- even including user phone habits. (Comprehensive evaluation is carried out by using the call completion rate.)

Segmental Management

Segmental management deals with the service quality of switches and circuits as determined by MPT ordinance. Management is effected through management standards based on loss probability, delay probability, waiting time and efficiency.

Figure 3.8.3-2 Concept of Traffic Management Standards

2) Improvement measures of Network Management

In order to manage the telecommunications network effectively and economically, centralization of telecommunication network management is required. It has mainly two merits. One is to grip the actual situation of traffic and troubles in the whole network. Other is to be able to allocate experts efficiently.

Because of telecommunications facility faults or extraordinary social and natural problems, telecommunications networks and services may be disturbed. To prepare

fore these situations, it is necessary to obtain the collect information and to instruct proper actions to sections concerned. In order to prevent the telecommunications services from deteriorating, a centralized network monitoring system will become essential.

a) Establishment of Centralized System for Network Management

TOT should establish a network management operation center (See Figure 3.8.3-1). In order to establish the system, TOT needs to use the network monitoring system in the NCOM center. If some faults or congestion occur in the telecommunications facilities of TOT, the network management center will give appropriate instructions to offices concerned in order to improve the situation. The telecommunications networks will be maintained at their best.

3.8.4 Transition of Improving Call Completion Ratio in Japan

Figure 3.8.4 shows the transition of improving the call completion ratio in Japan.
A detailed explanation is given in APPENDIX.

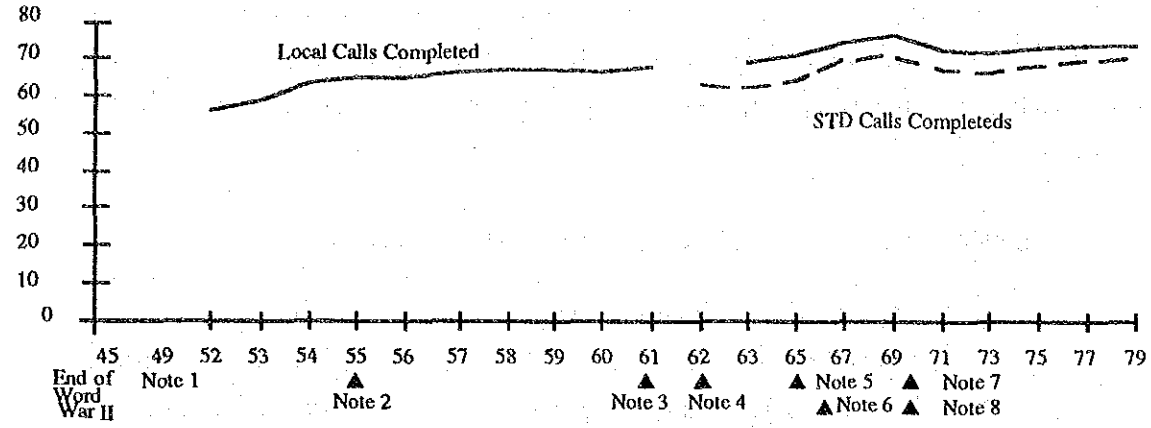


Figure 3.8.4 The Call Completion Ratio in Japan

Note 1 Foundation of Study Group

(1) Establishment of Study Group Subscriber Priority of Telephone which enacted the further request of the subscriber, who has a congested telephone line, as 2nd priority of telephone installation to relieve congestion.
(2) Introduction of extensive use of hunting facilities, and increase of PBX
(3) Development of new type of PBX and the wiring plan system (WPS)**

Note 2

(1) Incoming only service* was put into operation
(2) Development of auxiliary telephone
(3) Introduction of Automatic Intercept Service

Note 3 Foundation of Sub-Committee

(1) Target value of call completion rate should be 75%.
(2) The active counter-measures for subscriber congestion should be carried out.
(3) The special traffic survey with the introduction of long-distance STD service should be arranged.

Note 4 Establishment of Advisory Committee

(1) The target value of call completion rate should be 75%.
(2) The focus of the counter-measures was placed on the improvement of called subscriber busy. (Extensive introduction of pilot number hunting service)

Note 5 Administration of STD Call Completion Rate

(1) More systematic and better management of
(2) individual congested subscriber lines. Management of circuits in each stage of trunk line as well as the overall trunk line was introduced.

Note 6 Counter-measure for subscriber dialing failure

(1) Guidance as to proper telephone use

(2) Distribution of the materials, such as pocket-books for telephone numbers

Note 7 Establishment of Long-Term Targets

(1) Local calls 75%
(2) STD calls 70%

Note 8

The automatic observation system was developed

3.9 Target and Implementation Schedule

The Study Team has set the target value of the call completion ratio at 55% at the end of 1997 referring the target being set by TOT which is 50% at the end of 1996. To achieve the target, TOT has to eliminate many obstacles which have been described above. Table 3.9.1-1 shows target value of each incomplete call category.

Table 3.9.1-1 Target of Call Completion Ratio

Category	CCR in TOT as of March 1992	Target in 1997	Difference
Complete Call	23.5(%)	55 (%)	+31.5 (%)
P.S.Abandon	26.8	16	-10.8
P.D.Abandon	7.7	5	-2.7
Congestion	5.4	2.4	-3
B-sub-busy	24.4	13.6	-10.8
Ringing Abandon	5.8	3.5	-2.3
Fault	5.2	2.5	-2.7
Others	1.2	2	+0.8
Total	100	100	0

The following is the explanation of target value of each category and the methods of reducing in complete calls.

P.S.Abandon

a) In the field trial at Phra Khanong-T6, the percentage share of P.S.Abandon calls to total originating calls reduced to 20% from 44% by repairing faulty subscriber lines. At the end of the field trial, there still were some faulty subscriber lines. It is estimated that lower percentage than 20% can be obtained if we continued the activities. [-6.8%]

b) By replacement of deteriorated public telephones, drop wires and protectors, P.S.Abandon calls from public telephones will be reduced. [-1%]

c) Replacement of deteriorated cables, drop wires and in-house wires. [-2%]
TOT will undertake a campaign to ask users to use telephones correctly. [-1%]

P.D.Abandon

a) TOT will undertake a campaign to ask users to use telephones correctly. [-1.7%]

b) Replacement of deteriorated cables, drop wires and in-house wires. [-1.0%]

Congestion

a) Expansion of the number of circuits. [-2.4%]
b) Introduction of a recorded announcement service for irregular congestions. [-0.5%]
c) Subscriber line accommodation adjustment. [-0.1%]

B-sub busy

a) Promotion of the multi-hunting-system to the users who have more than one telephone line. [-4.4%]

b) Expansion of subscriber lines for the users whose lines are already congested. [-5.2%]
c) Promotion of the call-waiting-service to the users who have single line and do not have so heavy traffic. [-1%]
d) Replacement of deteriorated cables, drop wires and in-house wires. [-0.1%]
e) Introduction of the Automatic Howling Tone Sender. [-0.1%]

B-sub no answer

a) Offer of an announcement service for changed numbers and unassigned numbers. [-1%]
b) Recommend to use automatic answer telephones to the users who tend not to be at home [-0.6%]
c) Promotion of the call transfer service [0.2%]
d) Introduction of the management on operator answer delay time [-0.2%]
e) Replacement of deteriorated cables, drop wires and in-house wires [-0.3%]

Fault

a) At present, the timing of P.D.Time-out (limit time interval between dial digits being set on register) is set at 4 seconds. It seems the time is too short. For example, the time in Japan is 20 seconds and in Malaysia 8 seconds. So the Team recommends to set longer time (at least the same value as Malaysia). [-1.7%]
b) Undertaking periodic maintenance on trunk circuits and signaling equipment [-1%]

An implementation schedule of the measures described above is shown in Table 3.9.1-2.

Table 3.9.1-2 Measures and Implementation Plan

Categories	Present %	Causes	Measures	Effects	'93	'94	'95	'96	'97	Cost
P.S. Abandon	26.8	Subscriber line faults Users behavior	Repair of faulty subscriber lines	-6.8%						Unit : Million Baht
			Replacement of public telephone & protecter	-1.0%						(*)
			Subscriber line rehabilitaion work	-2.0%						(*)
			User campaign (correct use of telephone)	-1.0%						(-)
B-sub-busy	24.4	Not enough introduction of hunting systems Shortage of main telephone lines Not enough introduction of call-waiting service Faulty subscriber lines	Promotion of multi-hunting-system	-4.4%						(-)
			Expansion of subscriber lines	-5.2%						(-)
			Promotion of call-waiting service	-1.0%						(-)
			Subscriber line rehabilitation work	-0.1%						(*)
			Installation of Automatic Howling Tone Sender	-0.1%						(6)
P.D. Abandon	7.7	Subscriber line faults Users behavior	Subscriber line rehabilitaion work	-1.0%						(*)
			Dial consulting activity	-1.7%						(-)
B-sub no answer	5.8	No information of changed telephone numbers except telephone directory service No person to answer Subscriber line faults (line disconnection) Operator's answer delay	Introduction of information service for changed number	-1.0%						(70)
			Promotion of automatic answer telephone	-0.6%						(-)
			Promotion of call transfer service	-0.2%						(-)
			Subscriber line rehabilitation	-0.3%						(*)
			Management on operator's answer delay time	-0.2%						(-)
Congestion	5.4	Shortage of trunk circuits CC over-load Repeat calls	Increasing number of circuits	-2.4%						(56)
			Subscriber line accommodation adjustment	-0.1%						(-)
			Introduction of recorded announcement	-0.5%						(1)
Fault	5.2	Shortage of P.D.Timing Multi-frequency code error	Changing P.D.Timing	-1.7%						(-)
			Improvement of periodic maintenance	-1.0%						(-)

Note (*) shows that the cost of the item is counted in improvement work of fault ratio.

CHAPTER 4

IMPLEMENTATION PLAN

CHAPTER 4 IMPLEMENTATION PLAN

The causes of the high fault ratio and the low call completion ratio of the present telecommunications services in the Study Area are analyzed in Chapter 2 and Chapter 3. Both chapters propose various measures to reduce the fault occurrences and to increase the complete calls in the Study Area.

This chapter selects 26 projects to be implemented in the Phase-1, i.e., the next 5 years, and groups those projects into the following three fields at first:

1) the outside plant field,
2) the switching and transmission fields, and
3) the other fields.

Secondly this chapter arranges those selected projects in priority order and classifies them into the three priority classes by taking the improvement effects and the cost of each project into consideration. Then, an implementation schedule is formulated for every project.

4.1 Formulation of Implementation Plan

4.1.1 Selection of Implementation Project

The Study Team selects the 26 projects from those measures to formulate the implementation plan, i.e., the action plan in other words by taking the following viewpoints into consideration:

a) Those measures which are expected to contribute to the improvement of the fault ratio and the CCR directly,
b) Those measures which are able to be carried out smoothly within the Phase-1 period.

All the projects are indispensable for TOT to achieve the service targets of the fault ratio and the CCR within the Phase-1 period.

Other improvement measures that are not listed in the 26 projects are also expected to promote and support upgrading the telecommunications service quality. They are proposed as the other measures in Section 4.5 of this chapter.

4.1.2 Priority Order

The selected projects can be divided into two groups. One group brings the effects of improving the fault ratio; and the other group brings the effects of improving the CCR. The rehabilitation projects of subscriber lines bring the both effects.