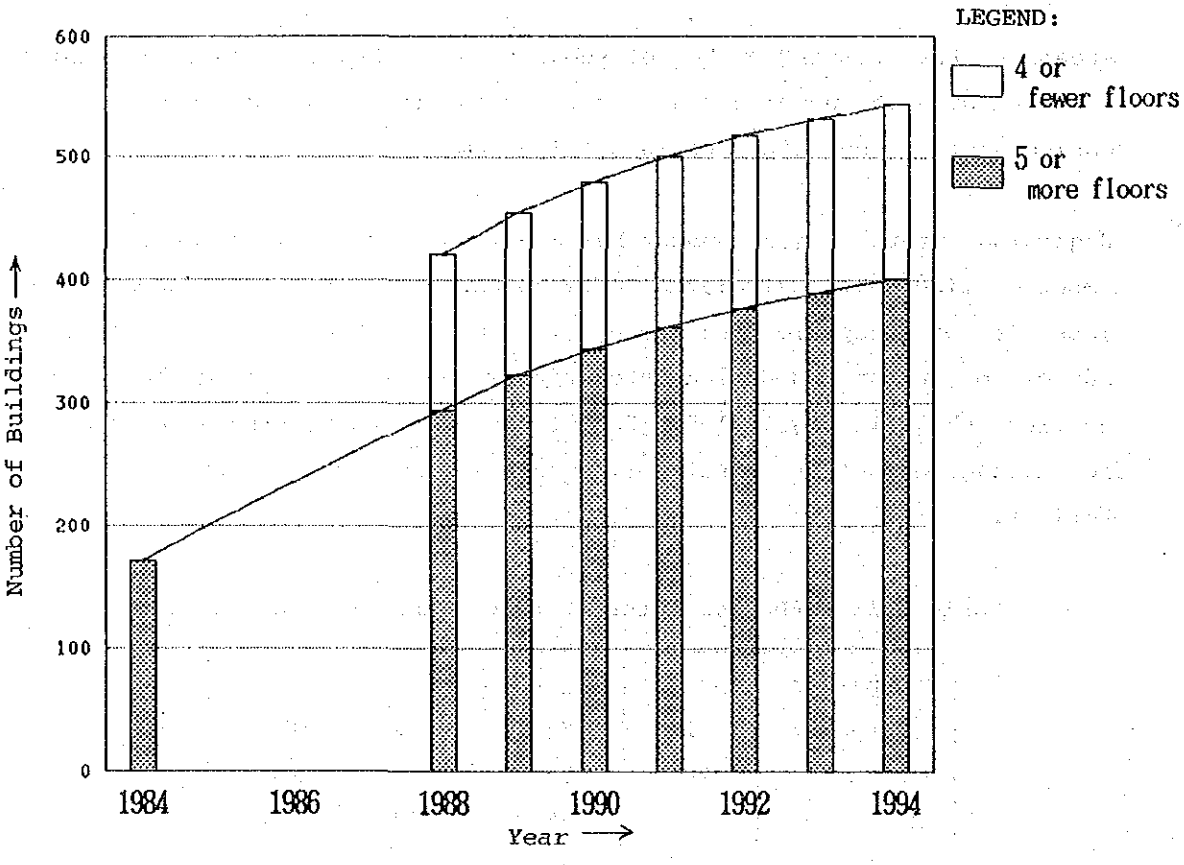
5.2 Number of Subscriber Stations

1) The number of additional buildings up to 1994 was estimated to be 123, comprising 87 buildings forecast and 36 buildings under construction.

2) The trend in the number of buildings is shown in Fig. 5-2-1. After the vacant space for building construction land is filled in the center of DKI Jakarta owing to new buildings, the number of additional high-rise buildings will decrease from year to year. The Annual trend in the number of Subscriber Stations up to 1994 in each area is shown in Table 5-2-1. As can be seen in Table 5-2-1, the subject Subscriber Stations are distributed in 22 areas per 32 areas of Jakarta, and the total number of Subscriber Stations will be amounted to 544 as of 1994.



Source: DKI Jakarta Office, Data in 1984

Fig. 5-2-1 Annual Trend in Number of Buildings

Table 5-2-1 Annual Trend in Number of Subscriber Stations in each Area

STO	1988	1989	1990	1991	1992	1993	1994
ANC	1	1	2	3	4	4	4
CAW	11	11	12	13	14	15	16
CPP	19	20	21	22	23	23	23
CPE	6	6	7	7	8	9	10
GB-1	75	77	80	82	82	85	86
GB-2	66	75	76	77	78	79	81
CAN	1	1	2	2	2	2	2
JT	15	16	18	20	22	23	23
KAL	10	11	12	13	14	17	19
KB	26	26	27	28	28	29	29
KT-1	6	6	6	6	6	6	6
KT-2	27	28	29	30	31	32	33
PLM	14	15	16	16	16	17	17
PSM	2	2	3	3	3	3	3
PSR	2	3	3	3	3	3	4
PLT	6	6	6	6	6	6	6
RMG	8	8	9	9	9	9	9
SM-1	24	33	34	34	34	34	34
SM-2	69	74	79	87	94	94	95
SLP	22	23	24	25	26	27	28
TPR	5	5	5	5	5	5	5
TBT	6	8	9	10	10	10	11
Total	421	455	480	501	518	532	544

5.3 Number of Line Units

1) Using the above procedure and based on the above data, the number of line units in 1988 is estimated as about 29,600 and demand as of 1994 is forecasted to be about 61,800 then the number of additional line units up to 1994 is to be 32,200.

The number of line units for existing subject Subscriber Stations will increase by 20,600 up to 1994, and new subject Subscriber Stations will have 11,600 line units in 1994.

2) The number of additional line units up to 1994 are concentrated in the area of GB-1, GB-2, SM-1 and SM-2, they account for 67% of the total.

3) The number of requested line units in existing subject Subscriber Stations is estimated to be about 9,900 based on the results of interviews and investigation, and thus the demand in 1988 is assumed to be about 39,500 including existing line units.

4) The annual trend in the number of line units up to 1994 is shown in Fig. 5-3-1 and Table 5-3-1, and Fig. 5-3-2 shows the distribution of subject Subscriber Stations and the number of their additional line units up to 1994 in each area. The situation regarding each subject Subscriber Station is shown in Attachment-5.

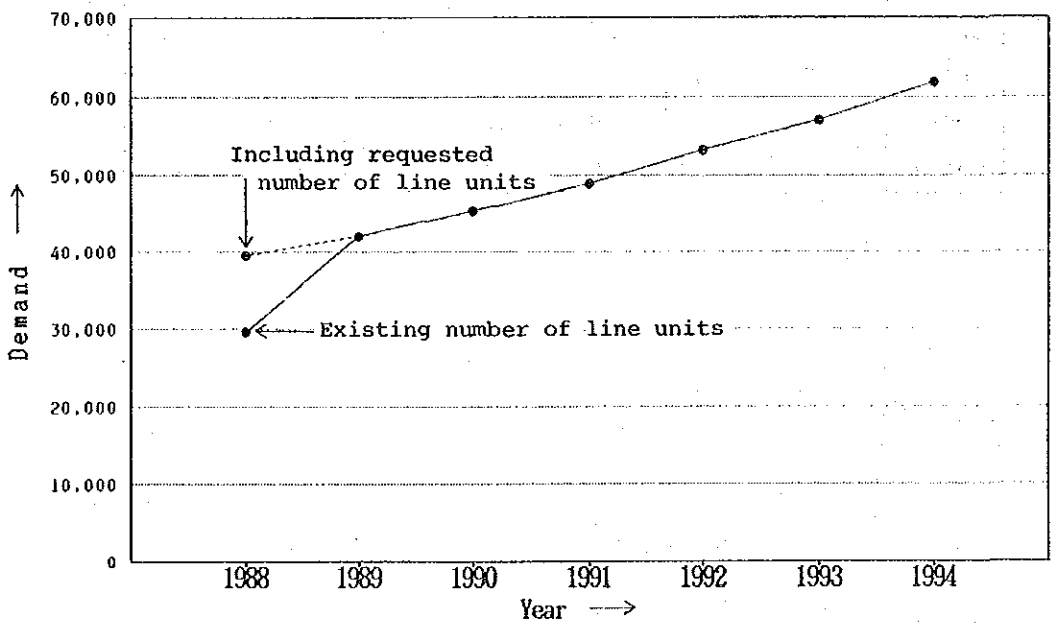


Fig. 5-3-1 Annual Trend in Number of Line Units

Table 5-3-1 Annual Trend in Number of Line Units in each Area

STO	1988	1989	1990	1991	1992	1993	1994	'94-'88
ANC	42	45	59	90	187	196	206	164
CAW	410	691	737	825	900	981	1,143	733
CPP	436	707	754	818	953	1,001	1,088	652
CPE	227	297	323	338	408	458	588	361
GB-1	6,522	9,143	9,755	10,337	10,851	11,747	12,445	5,923
GB-2	5,176	7,129	7,498	7,918	8,350	8,809	9,595	4,419
GAN	7	13	26	27	28	29	31	24
JT	424	474	604	738	818	896	948	524
KAL	798	975	1,075	1,180	1,370	1,992	2,455	1,657
KB	1,341	2,933	3,088	3,296	3,460	3,666	3,859	2,518
KT-1	380	435	458	481	504	529	559	179
KT-2	1,688	1,916	2,062	2,220	2,363	2,520	2,789	1,101
PLM	450	533	588	614	647	777	823	373
PSM	64	75	91	95	100	104	110	46
PSR	28	140	148	155	163	171	276	248
PLT	230	322	337	355	372	390	412	182
RMG	201	247	272	285	300	314	333	132
SM-1	2,957	4,962	5,308	5,573	5,854	6,145	6,518	3,561
SM-2	7,215	8,928	10,119	11,406	13,203	13,865	14,764	7,549
SLP	446	1,254	1,327	1,445	1,554	1,666	1,849	1,403
TPR	247	308	322	339	355	372	393	146
TBT	303	367	399	446	470	492	629	326
Total	29,592	41,894	45,350	48,981	53,210	57,117	61,813	32,221

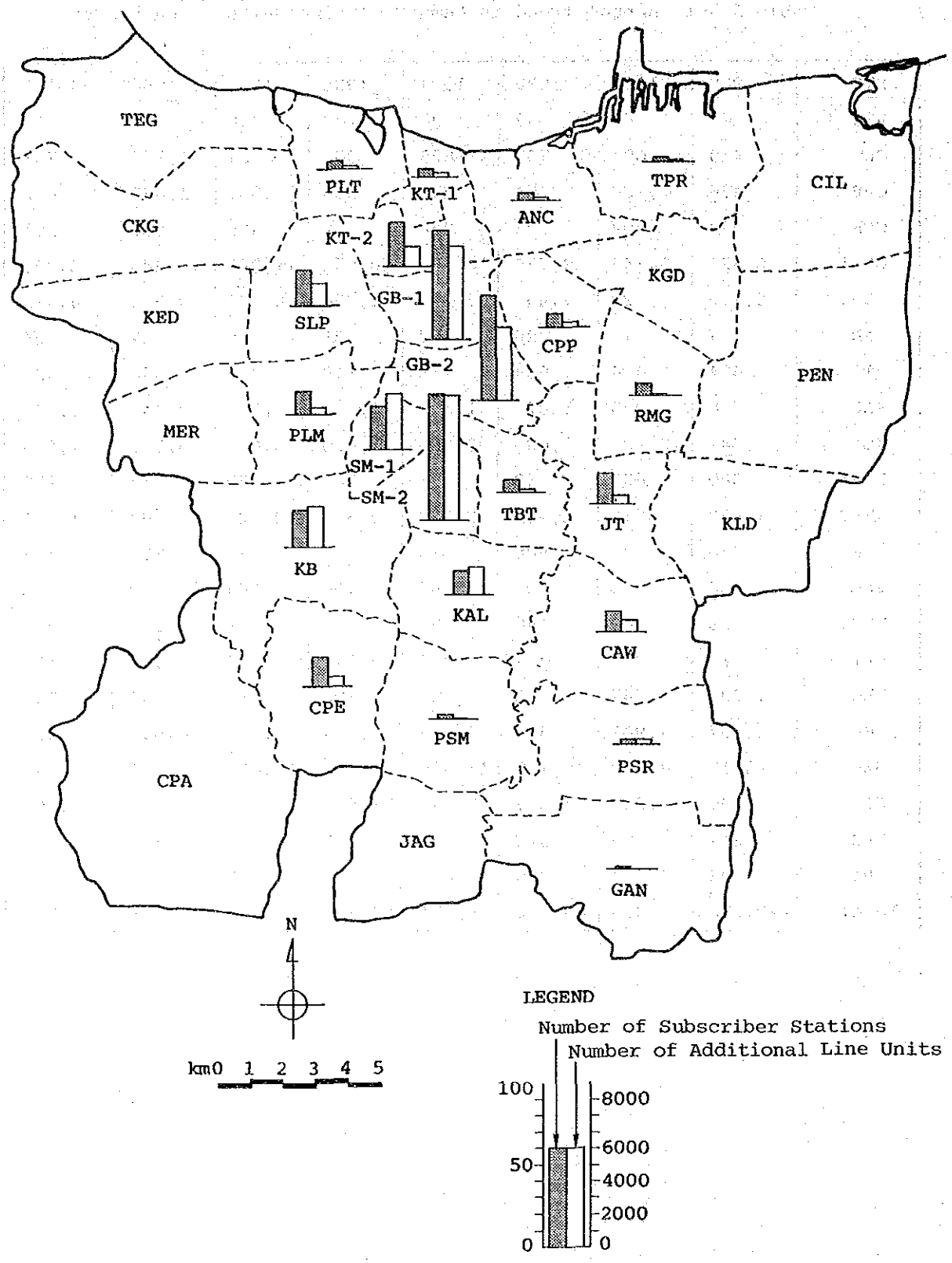


Fig. 5-3-2 Distribution of Subject Subscriber Stations and their Additional Line Units up to 1994

5.4 Classification of Forecasted Demand

1) The situation in 1994, subject Subscriber Stations classified in accordance with the definition stipulated in para. 3.2, is shown in Table 5-4-1.

Table 5-4-1 Classification with the Definition

Item / STO	I		I + P		P + L		L		Total	
	S	C	S	C	S	C	S	C	S	C
ANC							4	164	4	164
CAW							16	733	16	733
CPP	1	10			6	176	16	466	23	652
CPE	2	17					8	344	10	361
GB-1	7	91					79	5,832	86	5,923
GB-2	7	150					74	4,269	81	4,419
GAN							2	24	2	24
JT							23	524	23	524
KAL							19	1,657	19	1,657
KB	6	40			4	1,051	19	1,427	29	2,518
KT-1							6	179	6	179
KT-2	3	17			1	27	29	1,057	33	1,101
PLM	1	5	1	5	5	76	10	287	17	373
PSM							3	46	3	46
PSR							4	248	4	248
PLT	1	2					5	180	6	182
RMG							9	132	9	132
SM-1	1	25			16	1,555	17	1,981	34	3,561
SM-2	1	5	1	12	23	1,392	70	6,140	95	7,549
SLP	6	110			1	5	21	1,288	28	1,403
TPR							5	146	5	146
TBT							11	326	11	326
Total	36	472	2	17	56	4,282	450	27,450	544	32,221

Note:

I : Important Subscriber Station
I + P : Important Subscriber Station with Poor Quality
P + L : Poor Line Units and Large Subscriber Station
L : Large Subscriber Station
S : Number of Subscriber Stations
C : Number of Additional Line Units

2) Figs. 5-4-1 and 5-4-2 indicate the distribution of the number of subject Subscriber Stations classified by the number of additional line units up to 1994.

The number of subject Subscriber Stations which will have more than 10 and fewer than 600 additional line units is 435, and the number of their additional line units is accounts for 88% of the total.

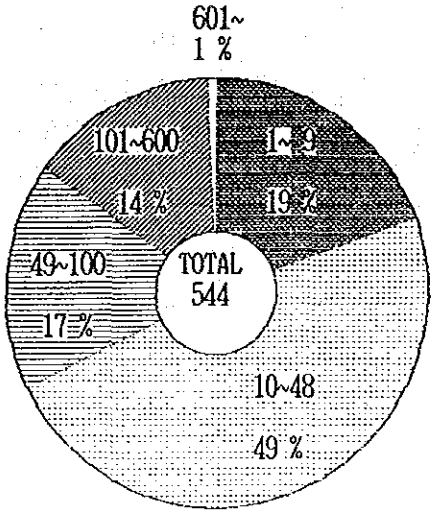


Fig. 5-4-1 Classification of Subscriber Stations with Number of Additional Line Units

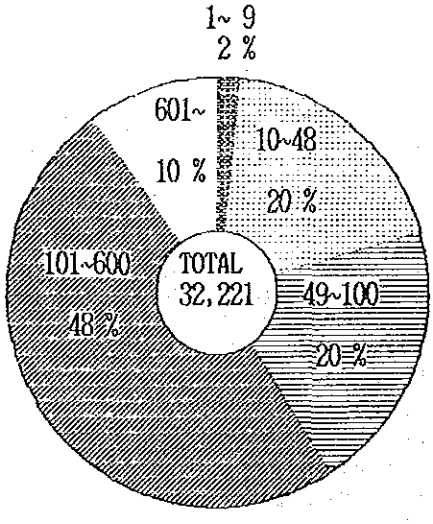


Fig. 5-4-2 Classification of Line Units with Additional Number

CHAPTER 6

TECHNICAL STUDY

CHAPTER 6 TECHNICAL STUDY

For the purpose of effective application of a Microwave Subscriber System, the technical study was carried out in this Chapter 6 with due consideration given to the present situation in Jakarta and the "Fundamental Technical Plan".

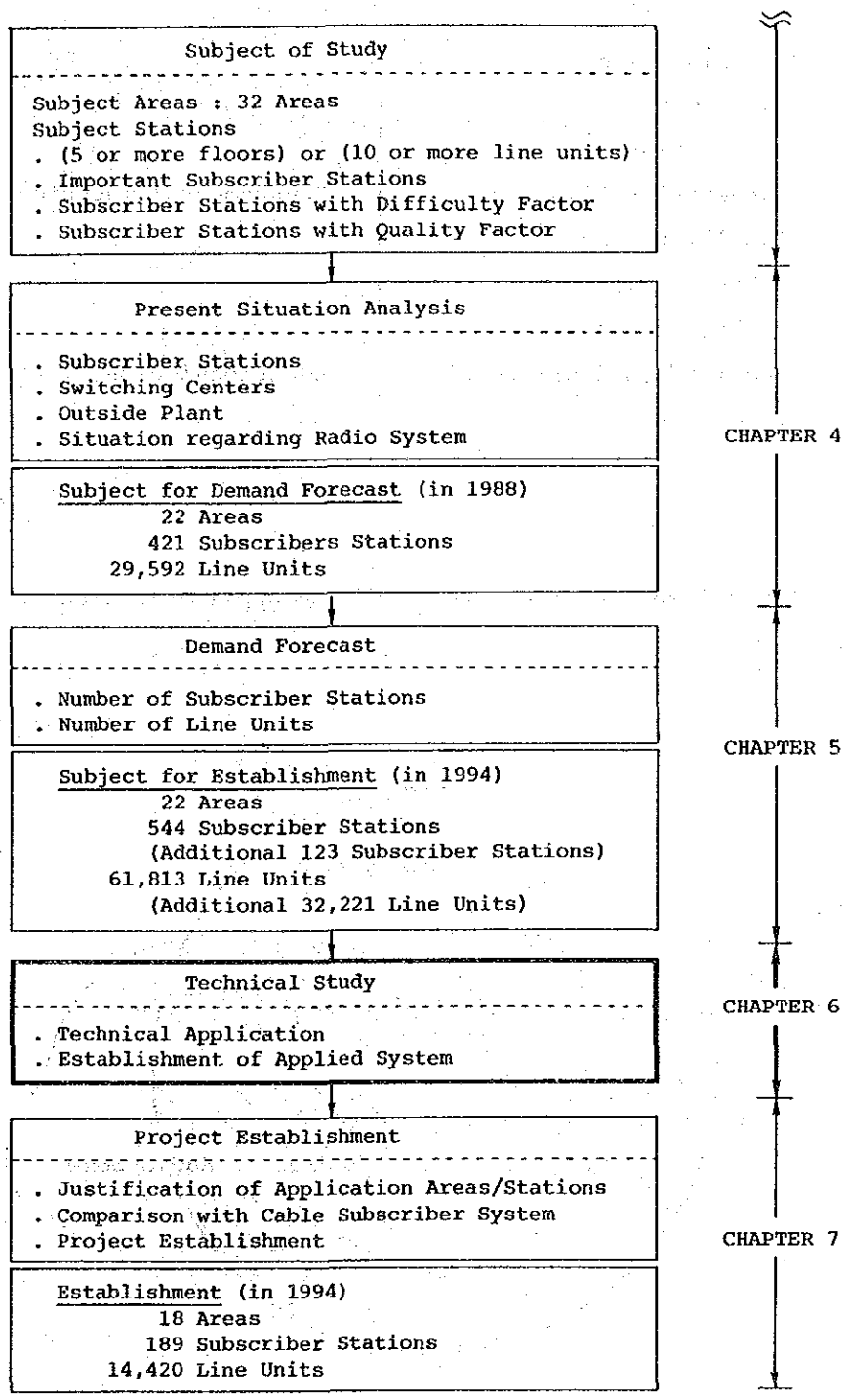


Fig. 6-1 Project Establishment Flow

6.1 Technical Application

The "Fundamental Technical Plan" which contains the seven (7) plans, and additional two (2) plans were taken into consideration for the establishment of the applied system.

- Numbering Plan
- Charging Plan
- Routing Plan
- Transmission Plan
- Signalling Plan
- Switching Plan
- Synchronization Plan

— "Fundamental Technical Plan"

- Security/Availability Plan
- System Plan

— Additional Plan

1) Numbering Plan

The relation between the radio zone and the applicable area is shown in Fig. 6-1-1.

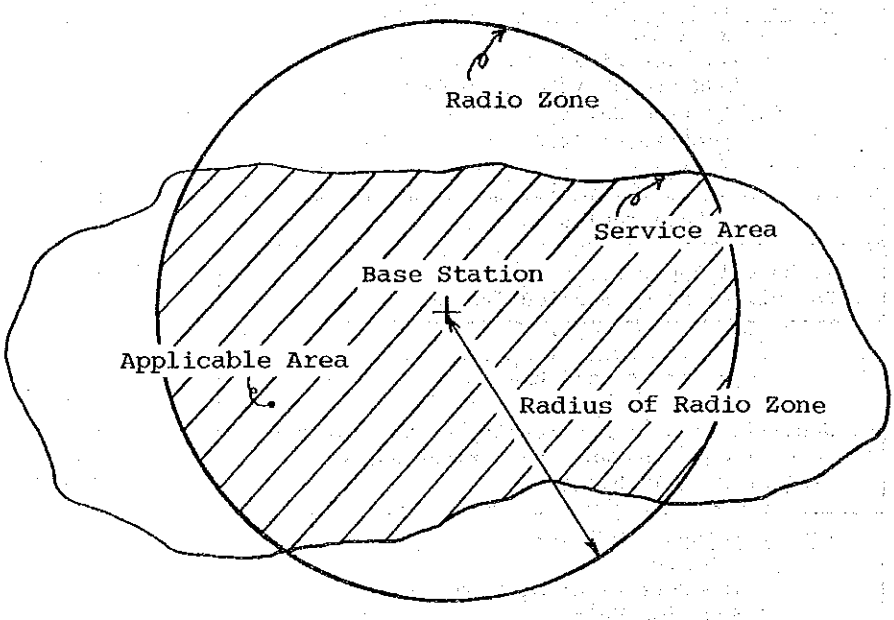


Fig. 6-1-1 Applicable Area

The applicable area is defined by the area where the radio zone overlaps the service area.

Therefore, the numbering of Subscriber Stations by the Microwave Subscriber System is same as the conventional Cable Subscriber System, and subscriber numbers are unique in the applicable area.

2) Charging Plan

The charging system applied in the Microwave Subscriber System follows that of the "Fundamental Technical Plan".

The following three kinds of charges are applied:

- Installation Fee
- Periodic Subscription Fee
- Usage Charge

Details of them are given in para. 9.1 of Chapter 9.

3) Routing Plan

The Microwave Subscriber System has a 2-wire analogue interface as shown in Fig. 6-1-2. As this is the same as the conventional Cable Subscriber System, this system has no direct relation with the Routing Plan.

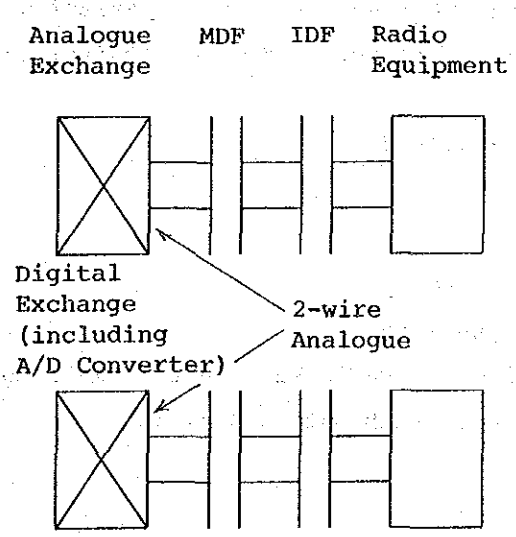


Fig. 6-1-2 Interface to Exchange

4) Transmission Plan

The Microwave Subscriber System is connected as follows:

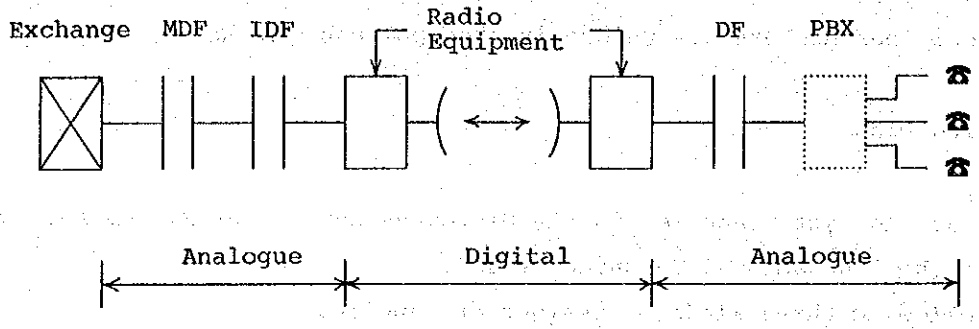


Fig. 6-1-3 Connection of Microwave Subscriber System

The transmission loss is divided into two sections: in the digital section is nearly 0 dB; and the other in the analogue sections (i.e. the sections in Base/Subscriber Stations) is limited by cable loss in building/PBX loss etc., and is smaller than in the conventional Cable Subscriber System.

5) Signalling Plan

The signalling of the Microwave Subscriber System is decided according to the signalling plan on subscriber lines in the "Fundamental Technical Plan", and the signalling interface matches the existing systems (main stations, PBX without DID facility, PABX with DID facility).

- Supervisory Signalling
  - . Outgoing Call
  - . Clear Forward
  - . Incoming Calling
- Information Signalling
  - . Rotary Dialling/Decadic Push Button Dialling
  - . Multi Frequency Push Button Dialling

6) Switching / Synchronization Plan

The Microwave Subscriber System is applied to the analogue subscriber lines, so the Switching/Synchronization Plan are outside the scope of the Study.

7) Security / Availability Plan

The performance by the Microwave Subscriber System is established with due consideration given to the specific characteristics in Jakarta, and such that satisfies the performance objectives.

In addition, the Microwave Subscriber System employs TDMA (Time Division Multiple Access) and ID (Identification) Codes in the radio section, so that it is possible to provide protection from radio channel interference and radio bootlegging.

8) System Plan

The application of the Microwave Subscriber System is established according to certain criteria (in para. 7.1 of Chapter 7) and the System Plan is covered in Chapters 8 and 9.

6.2 Establishment of Applied System

1) System Outline

The following two types of radio system are currently used for subscriber lines:

- Point to Multi-point System
  (hereinafter referred to as "P-MP System")

- Point to Point System
  (hereinafter referred to as "P-P System")

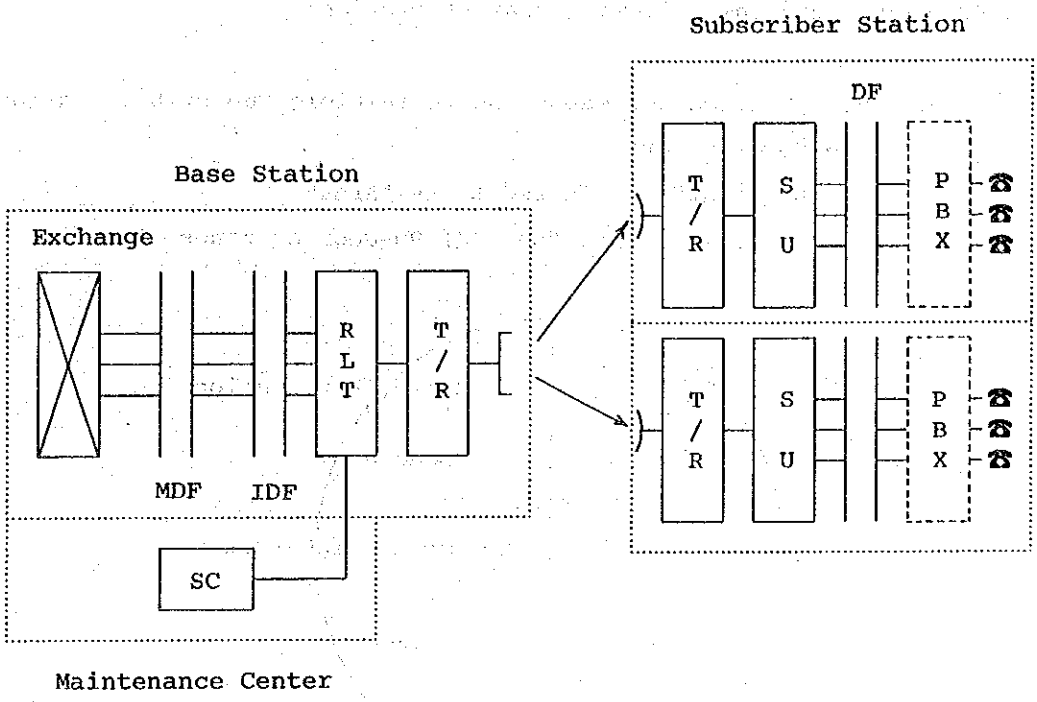
a) P-MP System

i) System Configuration

A P-MP System is similar to a mobile radio system, miniaturized for Subscriber use.

This system is suitable for scattered Subscriber Stations having a relatively small number of line units.

The conceptual system configuration is shown in Fig. 6-2-1.



T/R : Transmitter/Receiver

RLT : Radio Link Terminal

SU : Service Unit

SC : Supervisory/Control Equipment

PBX : Private Branch Exchange

Fig. 6-2-1 Configuration of P-MP System

ii) Characteristics

P-MP System has the following characteristics:

- One Base Station corresponding to multiple Subscriber Stations
  → Coverage area
  (hereinafter referred to as "Area")
  : divided into four (4) 90-degrees zones

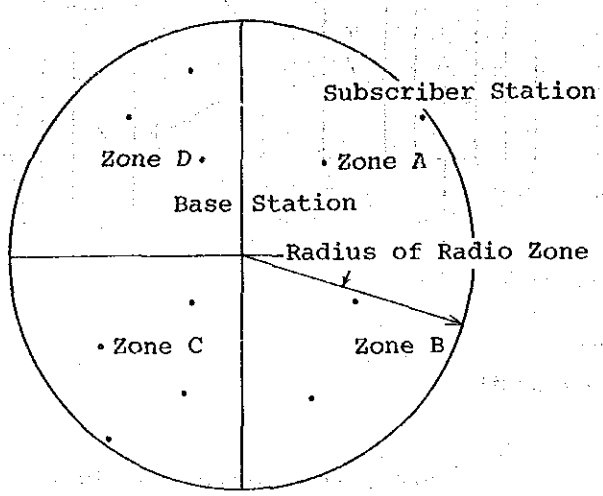


Fig. 6-2-2 Area / Zone of P-MP System

One of these zones (hereinafter referred to as "Zone") corresponds to one unit of the radio system. In practice, Zones should be set up according to the geographical distribution of demand in the subject area.

- Demand-Assigned-Method
  → Coping with increasing capacity

- Effect of Concentration
  → Capacity depending on calling rate

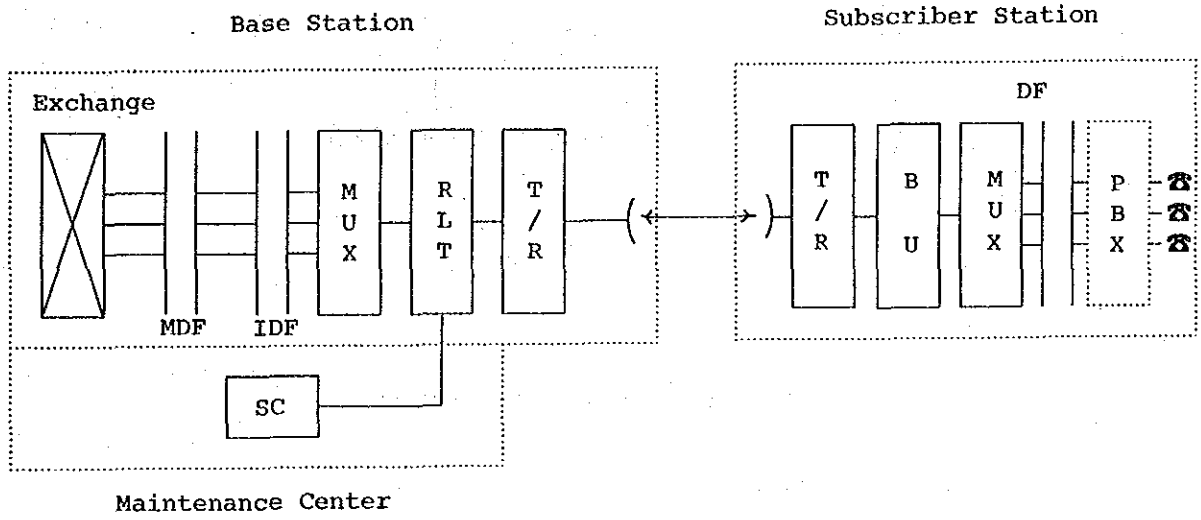
b) P-P System

i) System Configuration

A P-P System is similar to a digital microwave relay system, miniaturized for subscriber line application.

This system is suitable for subscribers who require a medium number of line units and who are concentrated at one location.

The conceptual system configuration is shown in Fig. 6-2-3.



T/R : Transmitter/Receiver
RLT : Radio Link Terminal
BU : Base Band Unit
MUX : Multiplexer
SC : Supervisory/Control Equipment
PBX : Private Branch Exchange

Fig. 6-2-3 Configuration of P-P System

ii) Characteristics

A P-P System has the following characteristics:

- One Base Station corresponding to one Subscriber Station as shown below:

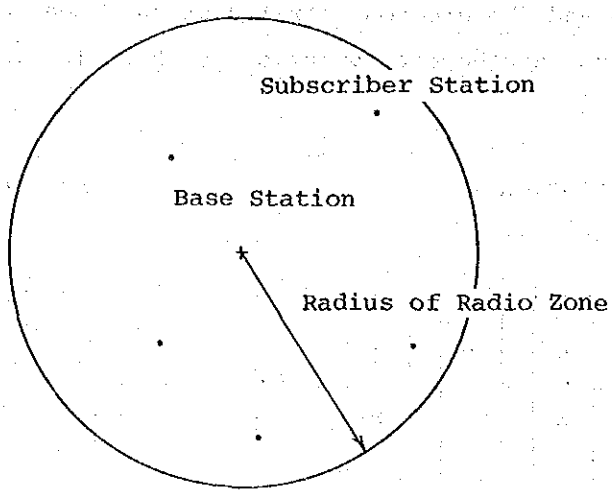


Fig. 6-2-4 Area of P-P System

- Pre-Assigned-Method
  - → No effect of concentration
  - → Independence of calling rate

2) Capacity

When establishing the capacity, the following two (2) major items should be taken into consideration:

- Distribution of number of subject line units including;
  . Subscriber Stations with poor quality subscriber lines to be improved in number of line units and additional line units.
  . Other Subscriber Stations in number of additional line units

- Capacity of existing similar system

a) P-MP System

The capacity of a P-MP System is to be decided by that of the Subscriber Station and that of the system (= unit of Base Station).

i) Capacity of Subscriber Station

Actually in Jakarta, the distribution of the number of additional line units shows that the cumulative percentage of Subscriber Stations with fewer than 48 additional line units was more than 68% in Fig. 5-4-1.

Judging from the tendency of the distribution of demand in Jakarta, the capacity of the P-MP System to be applied for the Study is set at 24 channels per set in the case of an existing similar system and the upper limit per Subscriber Station is to be set at 48 line units per two (2) sets with due consideration given to the distribution of subject demand.

That is to say:

- 24 channels per set
- 48 line units (2 sets) per Subscriber Station

ii) Capacity of Base Station

The capacity of the Base Station (= System Capacity) is to be stipulated by traffic density and this also to be determined with due consideration given to similar existing system.

- 316 erl. per Area (79 erl. per Zone)

On the other hand, where system capacity is stipulated by the number of channels, it depends on the Subscriber Station calling rate as shown in the following equation:

$$\text{Capacity of P-MP System (in number of channels)} = \frac{\text{System Capacity in Traffic Density (erl.)}}{\text{Calling Rate of Subject Area (erl.)}} \quad \cdots (1)$$

The calling rate of subject area depends on the availability of terminal equipment such as PBX, KT, etc. in the subject Subscriber Stations in the same area.

As can be seen in Fig. 4-1-10, the ratio of the availability of terminal equipment is relatively high at 83.0%. Taking account of the above existing situation, the worst case including margin of the calling rate as shown in Fig. 4-2-3 will be applied on the condition that most Subscriber Stations are using terminal equipment.

Then, the equation (1) will be substituted to the following:

$$\text{Capacity of P-MP System (in number of channels)} = \frac{\text{System Capacity in Traffic Density (erl.)}}{\text{Calling Rate with PBX, KT, etc. of Subject Area (erl.)}} \quad \cdots (2)$$

As a result of the calculation, Table 6-2-1 was obtained:

Table 6-2-1 Capacity of P-MP System

Calling Rate of Area	Capacity of P-MP System
0.40 erl.	197 channels per Zone
0.44 erl.	179 channels per Zone
0.50 erl.	158 channels per Zone

b) P-P System

The capacity of the similar existing system was adopted in the range of the following capacity in the Study.

- P-P System: 120 channels per set

3) Radio Frequency

The radio frequency applied to this Study was established with due consideration given to following factors:

- Frequency Allocation Situation in Jakarta
- Condition of Rainfall Intensity in Jakarta
- Geographical Distribution of Subject Demand

a) Radio Zone

The radio zone corresponding to each frequency was established by considering the rainfall intensity in Jakarta.

i) Rainfall Attenuation

The rainfall attenuation due to changes in rainfall was calculated from the following equation:

$$Zp = 60 \cdot \gamma \cdot R1 \cdot D \cdot \Gamma p \cdot \exp(-fp \cdot D^{1/2}) \quad (dB)$$

where : P = 0.02%

Γ p= 0.57150

fp = 0.10387

Then :

$$Zp = 0.16132 \cdot f^{1.475} \cdot D \cdot \exp(-0.10387 \cdot D^{1/2}) \quad (dB)$$

ii) Rainfall Margin

The rainfall margin for each system was calculated from the following equation:

$$Zm = Pr - NO - [C/NO] \quad (dB)$$

where : Pr : Receiving Level (dBm)

NO : Thermal Noise of Receiver (dB)

[C/NO] : Required Thermal Noise (dB)

Then :

P-MP System

$$Zm = 66.9 - 20 \cdot \log f - 20 \cdot \log D \quad (dB)$$

P-P System

$$Zm = 82.6 - 20 \cdot \log f - 20 \cdot \log D \quad (dB)$$

iii) Radio Zone

The radio zone is defined by the distance covered by the radio system on the condition that the value of rainfall attenuation is to be equal to the value of the rainfall margin.

As a result of the above, the relation between the radio frequency for each system and radius of radio zone is as shown below:

- P-MP System

Due to above, Zp = Zm

Then :

$$0.1613 \cdot f^{1.475} \cdot D \cdot \exp(-0.10387 \cdot D^{1/2})$$
$$= 66.9 - 20 \cdot \log f - 20 \cdot \log D$$

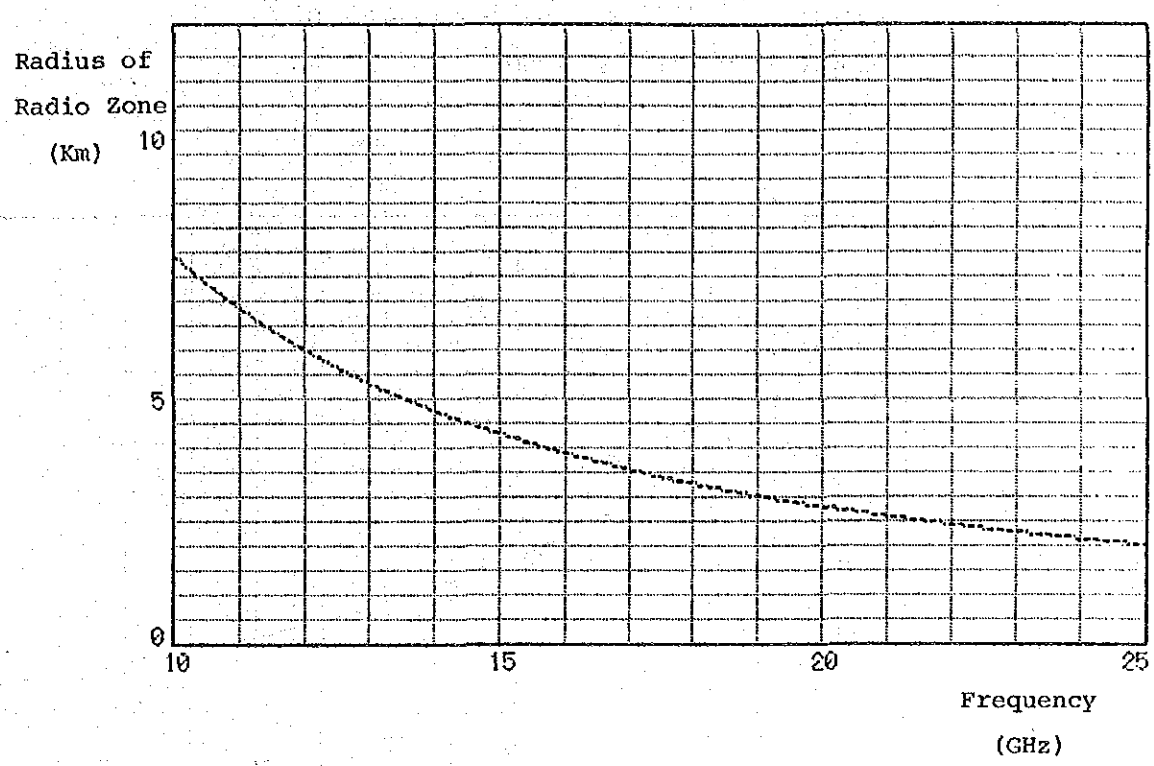


Fig. 6-2-5 Relation between Radio Frequency and Radius of Radio Zone for P-MP System

- P-P System

Due to above, $Zp = Zm$

Then :

$$0.1613 \cdot f^{1.475} \cdot D \cdot \exp(-0.10387 \cdot D^{1/2}) = 82.6 - 20 \cdot \log f - 20 \cdot \log D$$

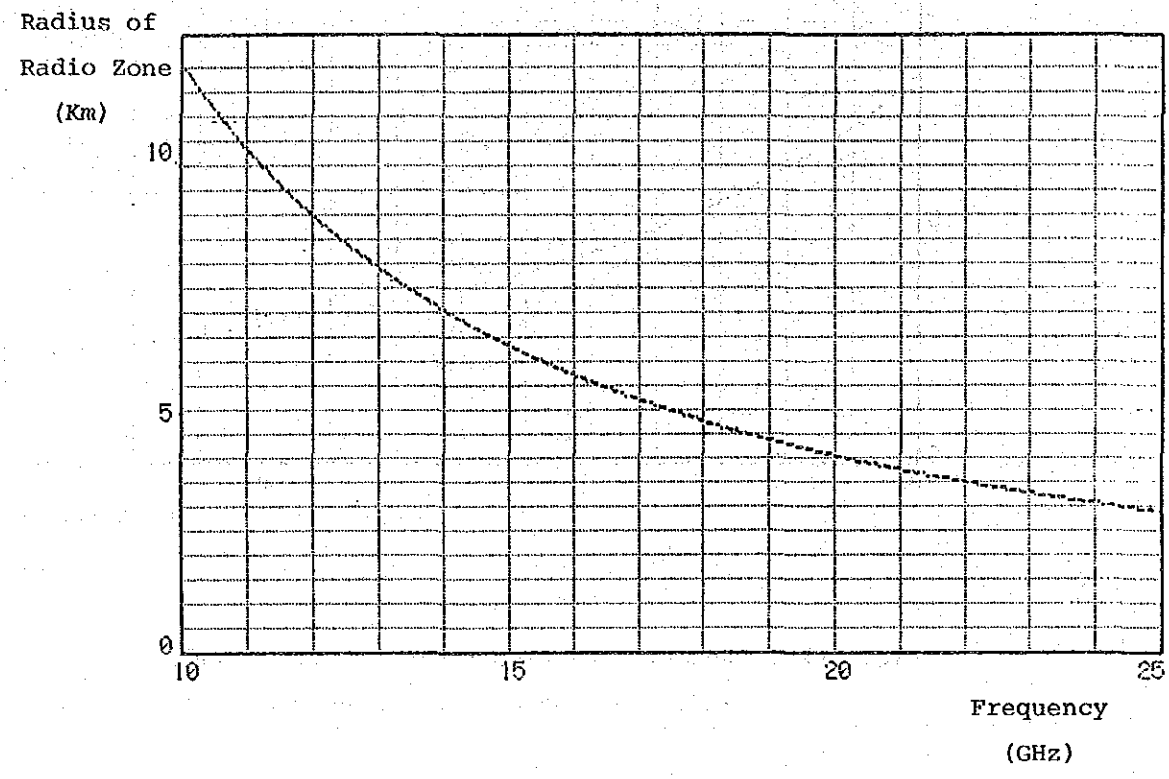


Fig. 6-2-6 Relation between Radio Frequency and Radius of Radio Zone for P-P System

b) Selection of Radio Frequency

In accordance with the relation between radio frequency and radius of radio zone, and frequency information especially regarding usable frequency allocation, the radius of the radio zone is expected to be as shown below.

Table 6-2-2 Expected Radius of Radio Zone

Radio Frequency	P-MP System	P-P System
10.5 ∿ 10.68 GHz	7.2 Km	10.9 Km
12.75 ∿ 13.25 GHz	5.2 Km	7.7 Km
14.5 ∿ 15.35 GHz	4.1 Km	6.1 Km
17.7 ∿ 19.7 GHz	2.8 Km	4.2 Km
21.2 ∿ 22.5 GHz	2.3 Km	3.4 Km

Meanwhile, Fig. 6-2-7 below shows the geographical distribution (distance between Base Station and Subscriber Station) for Subscriber Stations in the subject areas.

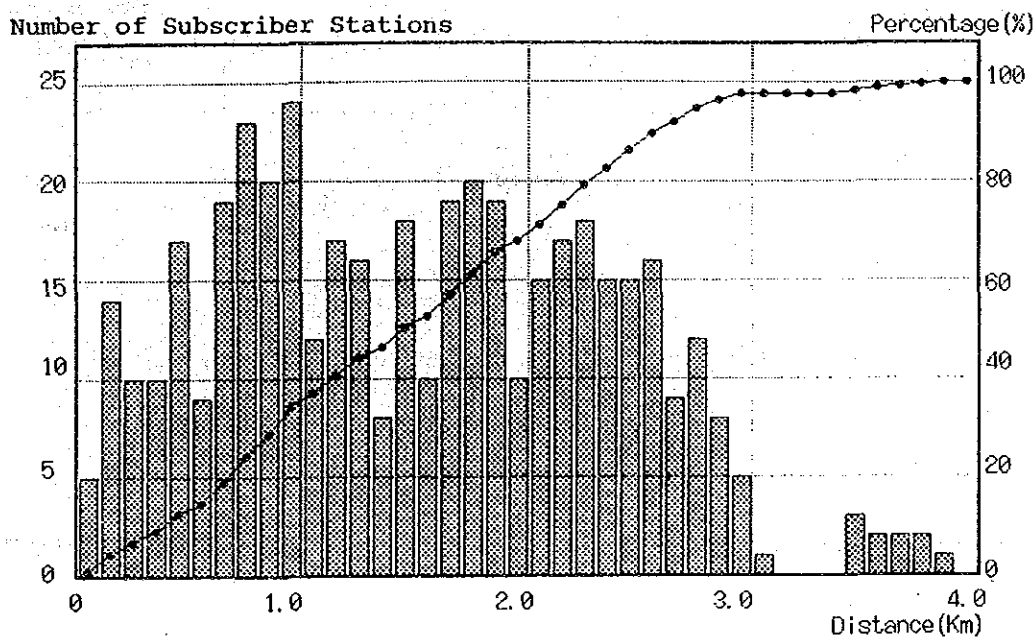


Fig. 6-2-7 Geographical Distribution of Subject Subscriber Stations

It was established that subject Subscriber Stations are located within 4 Km from the subject Switching Center.

Therefore, the radius of the radio zone from the subject Switching Center should be kept to about 4 Km to cover most Subscriber Stations and the following frequencies were selected for each system.

- P-MP System : 14.5 ∿ 15.35 GHz
- P-P System : 17.7 ∿ 19.7 GHz

c) Channel Arrangement

The radio frequency channel arrangement for each system is established with due consideration given to CCIR recommendation.

i) P-MP System

The channel arrangement of the P-MP System adopts the interleaved-channel-arrangement.

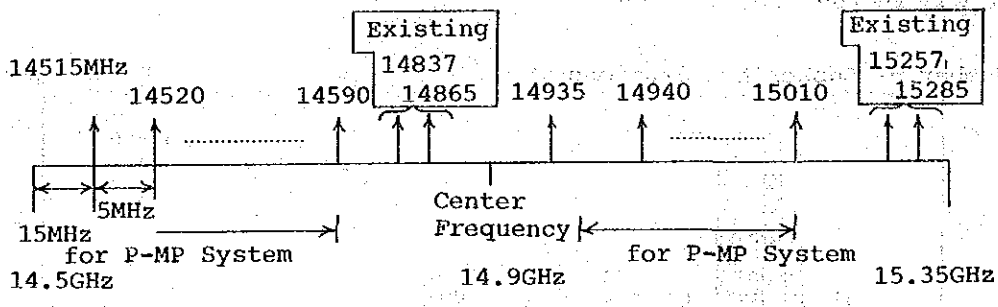


Fig. 6-2-8 Channel Arrangement of P-MP System

ii) P-P System

This channel arrangement is based on the similar existing system.

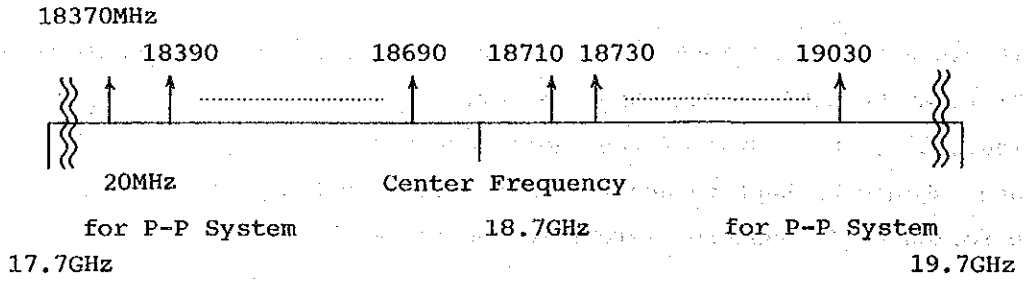


Fig. 6-2-9 Channel Arrangement of P-P System

4) System Performance

The system performance for each system is established with due consideration given to efficiency and the similar existing system.

a) P-MP System

Table 6-2-3 System Performance of P-MP System

Items	Base Station	Subscriber Station
Frequency	14.5 ∿ 15.35 GHz	
Channel Separation	10 MHz (5MHz Interleave)	
Modulation Scheme	2FSK	
Access Scheme	Demand-Assigned TDMA	
Capacity	79erl. / Zone	24 channels / set
Transmitter Power	20.0dBm	
Noise Figure	4.0dB	
Antenna	20dBi(Fan-Beam)	30dBi (60cmD)
Interface	Analogue 2W	
Power Supply	DC-48V about 300W / Zone	AC220V about 40W
Shape (W,D,H) m	T/R: 0.4, 0.4, 0.5 RLT: 0.5, 0.5, 1.5 / Zone	T/R: 0.3, 0.3, 0.3 SU : 0.4, 0.4, 0.3

b) P-P System

Table 6-2-4 System Performance of P-P System

Items	Base Station	Subscriber Station
Frequency	17.7 ∿ 19.7 GHz	
Channel Separation	20 MHz	
Modulation Scheme	4PSK	
Access Scheme	Pre-Assigned TDMA	
Capacity	2.048Mb/s x 4 (120 channels)	
Transmitter Power	23.0dBm	
Noise Figure	13.0dB	
Antenna	38dBi (60cmD)	
Interface	Analogue 2W	
Power Supply	DC-48V about 160W	DC-48V (AC220V) about 180W
Shape (W,D,H) m	T/R: 0.3, 0.4, 0.2 RLT: 0.6, 0.6, 0.2 MUX: 0.3, 0.2, 2.8	T/R: 0.3, 0.4, 0.2 RLT: 0.6, 0.6, 0.2 MUX: 0.3, 0.2, 2.8

5) Noise Allocation

Based on the above system performance, the noise allocation is established as follows:

a) P-MP System

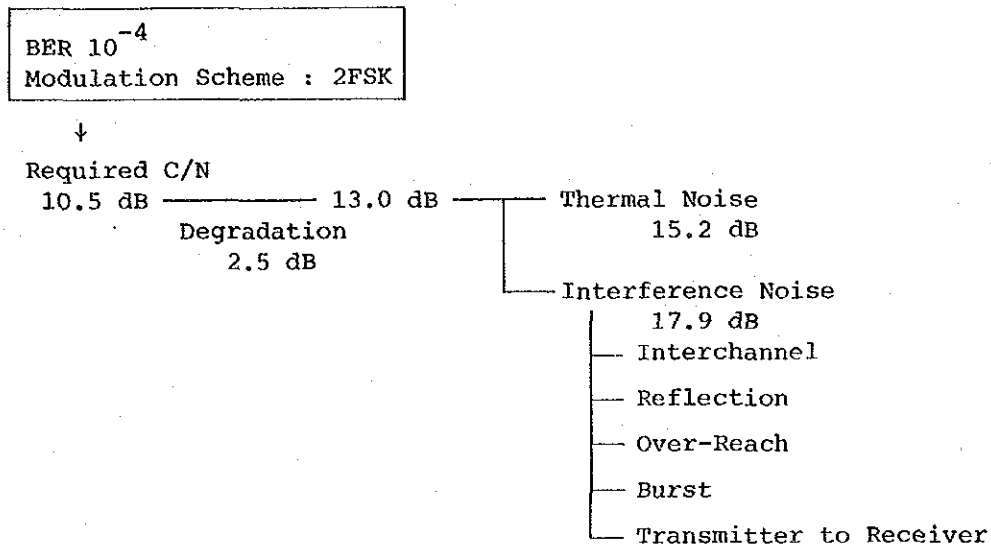


Fig. 6-2-10 Noise Allocation of P-MP System

b) P-P System

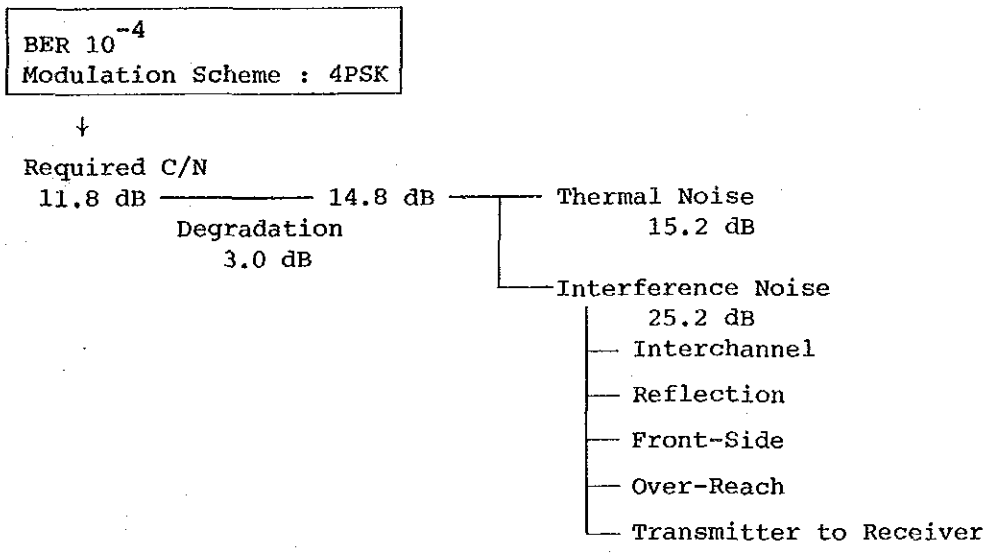


Fig. 6-2-11 Noise Allocation of P-P System

CHAPTER 7

PROJECT ESTABLISHMENT

CHAPTER 7 PROJECT ESTABLISHMENT

Based on the demand forecast in Chapter 5 and the technical study in Chapter 6, this project was established through the justification of the application and comparison with a Cable Subscriber System.

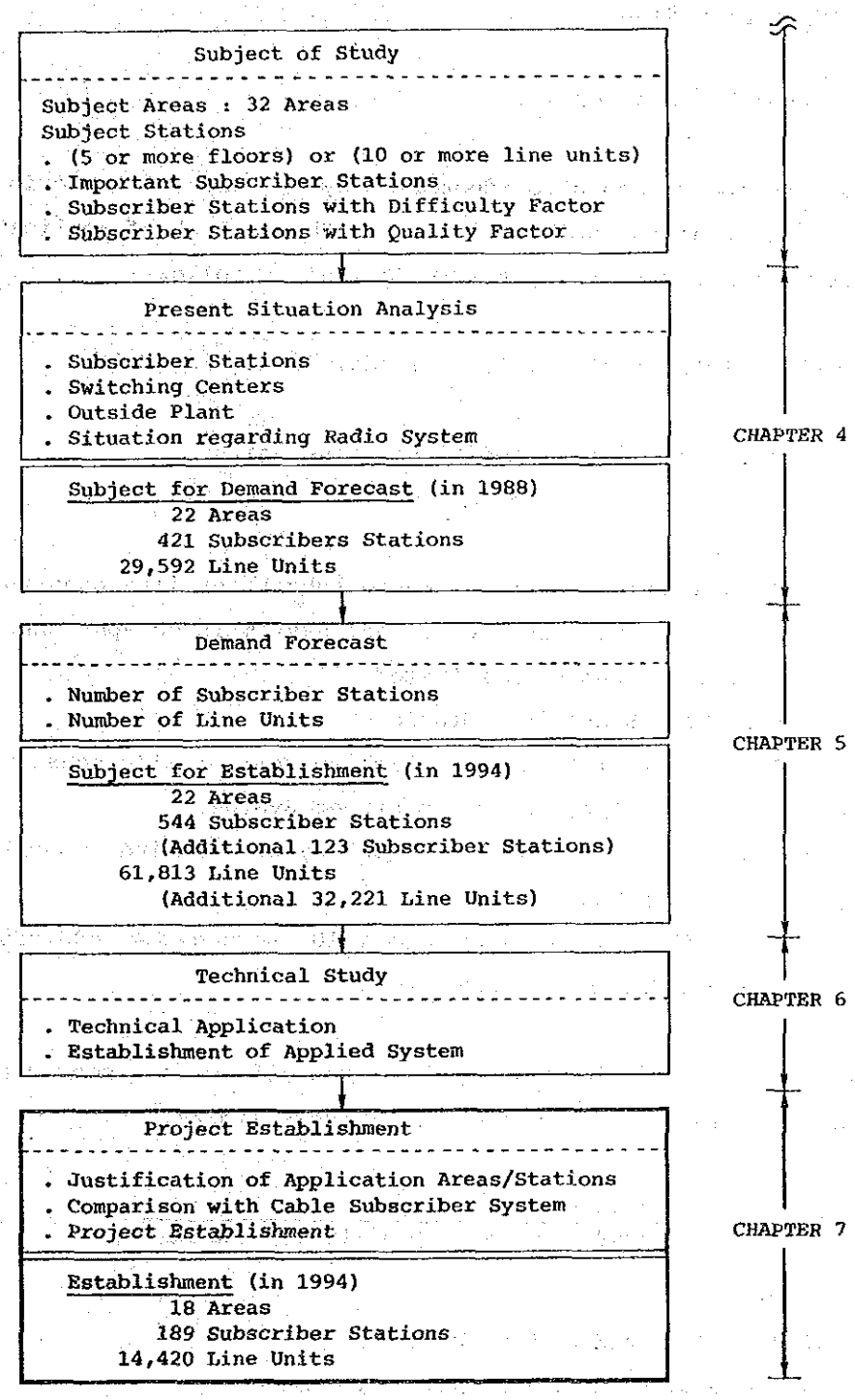


Fig. 7-1 Project Establishment Flow

7.1 Justification of Application Areas/Stations

For the purpose of justification of application Areas/Stations, the following criteria/priorities of application are established.

1) Criteria for Application

a) Subject Subscriber Stations

Subject subscribers should be identified by the unit of Subscriber Station (nearly equal to one building), and the subject of application for the Microwave Subscriber System is defined as follows:

- Subscriber Stations (C, I, D, O) : Additional Line Units

- Subscriber Stations (Q) : Additional Line Units
  + Improvable Line Units

where C : The Subscriber Stations whose subscriber line construction cost by a Microwave Subscriber System is cheaper than that by a Cable Subscriber System.

I : Important Subscriber Stations

D : Subscriber Stations for which subscriber line construction is difficult by Cable Subscriber System.

Q : Subscriber Stations whose quality of existing subscriber lines is poor.

O : Subscriber Stations with over 10 and under 48 additional line units, except the above.

Improvable rate should be kept to more than 50%, or the poor quality subscriber lines should be improved within some limits.

$$\text{Improvable Rate} = \frac{\text{Number of Improvable Line Units}}{\text{Number of Poor Quality Line Units}}$$

. P-MP System

Number of Improvable Line Units

= 48 - (Number of Additional Line Units)

$\sim$ 120 - (Number of Additional Line Units)

. P-P System

Number of Improvable Line Units

= 120 x (Number of Applied P-P System Sets) -
(Number of Additional Line Units)

120 x { (Number of Applied P-P System Sets) + 1 } -
(Number of Additional Line Units)

The applicable Subscriber Stations should be selected within the following limits:

- Lower Limit

It is necessary to establish the lower limit of the subject Subscriber Stations by number of line units from the viewpoint of cost performance, except for important Subscriber Stations. The lower limit of application is to be defined by the P-MP System.

The relative cost per line unit for each range of application, calculated based on the demand conditions in Jakarta, is shown in Fig. 7-1-1.

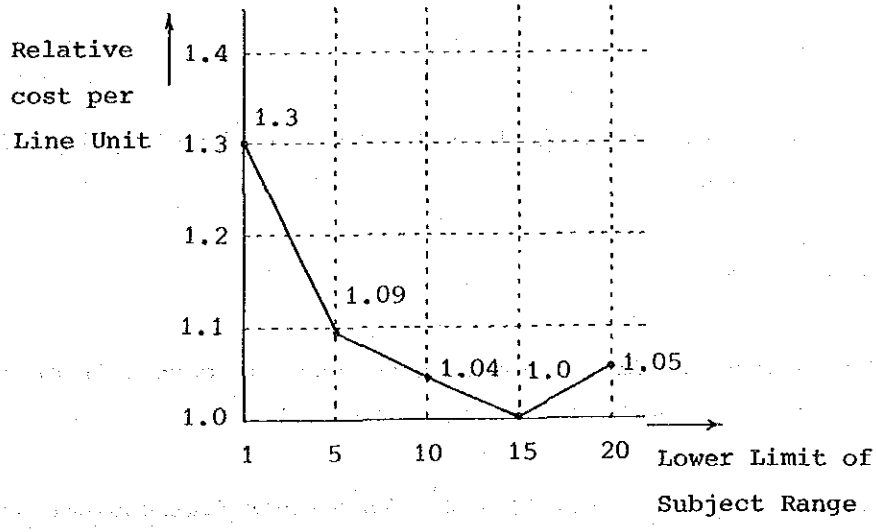


Fig. 7-1-1 Relative Cost per Line Unit by Range

The subject lower limit of application is shown to be 10 ∿ 15 line units in case of the P-MP System. In this Study, a lower limit of 10 line units will be applied except in the case of important Subscriber Stations.

- Upper Limit

The upper limit of application is to be defined by the P-P System. This is limited by the interference between radio systems and installation space for P-P System in Subscriber Stations.

An upper limit of 600 line units (5 P-P System sets) is to be applied in this Study.

- Applied System

Based on the establishment of the applied system, the system to be applied for the each Subscriber Station in the Study is used in the following line unit range:

. P-MP System

Number of Applied Line Units $\leqq$ 48 line units
per Subscriber Station (2 sets)

. P-P System

49 $\leqq$ Number of Applied Line Units $\leqq$ 600 line units
line units per Subscriber Station (5 sets)

b) Subject Area

The application Area should be selected from the viewpoint of effective application of each system.

i) P-MP System

The application Areas should be selected in each unit of a radio Zone according to the following criteria:

Number of (C + I + D + Q) $\geqq 2^{*1}$ Subscriber Stations per Zone
and
Number of (C + I + D + Q + O) $\geqq 3^{*2}$ Subscriber Stations per Zone

Note:

*1 : This number is defined by the number of P-MP System Subscriber Stations which is more economical than that of a P-P System in a same Zone.

*2 : The number is defined such that the ratio of Subscriber Stations which belong to (C, I, D, Q) should be more than 50% in a Zone.

ii) P-P System

The application Areas should be selected in each unit of a Subscriber Station within the following limit:

Number of P-P Systems ≦ 35 sets per Base Station

2) Priority of Application

a) P-MP System

The applicable Subscriber Stations including "O" are to be selected within radio Zone capacity according to the following priority order of application.

Priority

← high low →

C > I > D > Q > O

b) P-P System

The applicable Subscriber Stations are to be selected according to the following priority order of application.

In addition to the above, the applicability of each Subscriber Station is to be judged from the viewpoint of interference between each Subscriber Station, and installation space.

Priority

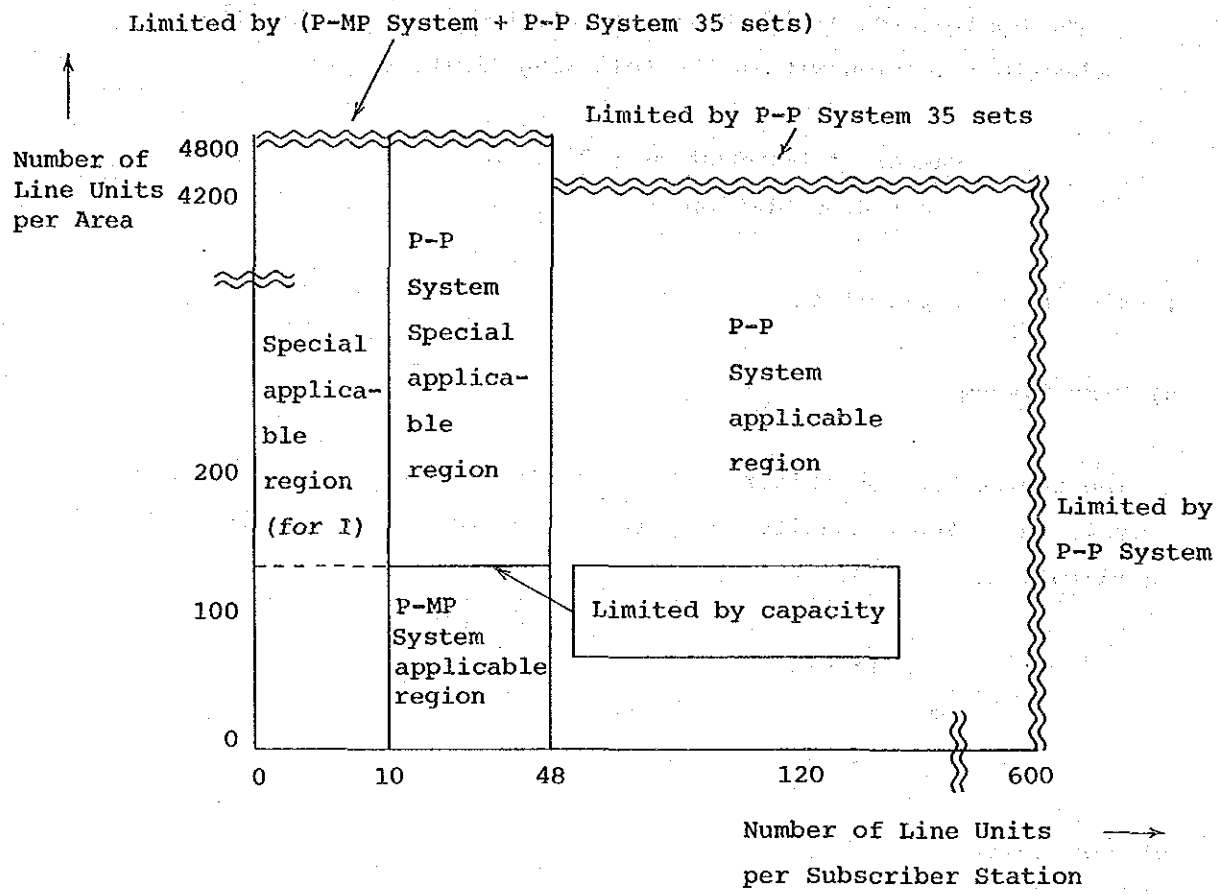
← high low →

C > I > D > Q

3) Justification

The application of the Microwave Subscriber System is justified by the critera/priorities mentioned above.

The method of application is summarized as follows:



Priority : C > I > D > Q > O

Fig. 7-1-2 Application Region

Maximum number of line units to be used in a Base Station is to be approx. 4,800 (P-MP System: approx. 600, P-P System: 4,200).

7.2 Comparison

1) General

The comparison between Microwave/Cable Subscriber System was carried out in accordance with the following procedure.

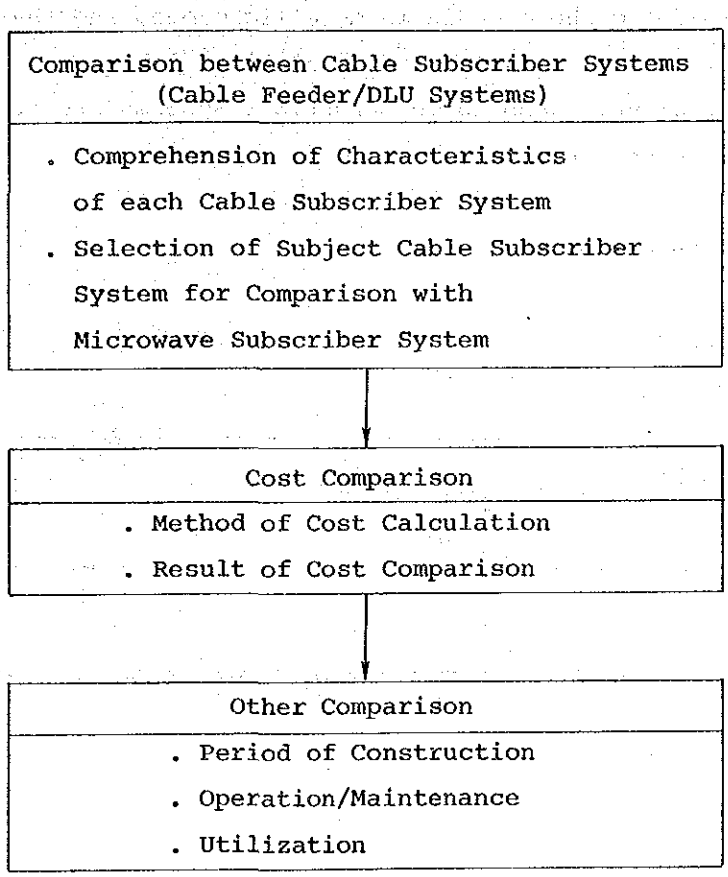


Fig. 7-2-1 Comparison Flow

2) Comparison between Cable Subscriber Systems

a) Cable Subscriber Systems

Cable Subscriber Systems which are the subject of comparison with the Microwave Subscriber System are mainly classified into two types: the Cable Feeder System whose media is metallic cable, and the DLU System whose media is metallic cable or optical-fiber cable.

In this paragraph, these Cable Subscriber Systems are studied and compared with each other.

- Cable Feeder System

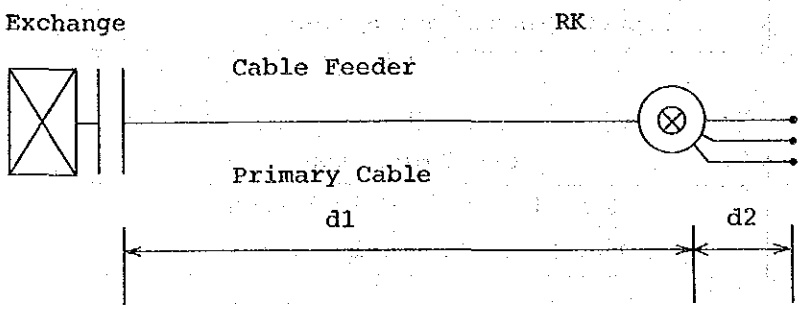


Fig. 7-2-2 Configuration of Cable Feeder System

- DLU System

. PCM-30 System

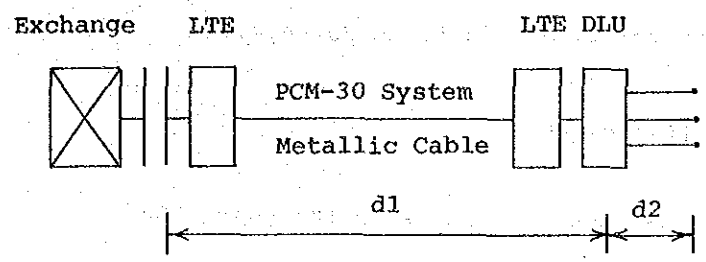


Fig. 7-2-3 Configuration of PCM-30 System

. Optical-Fiber System

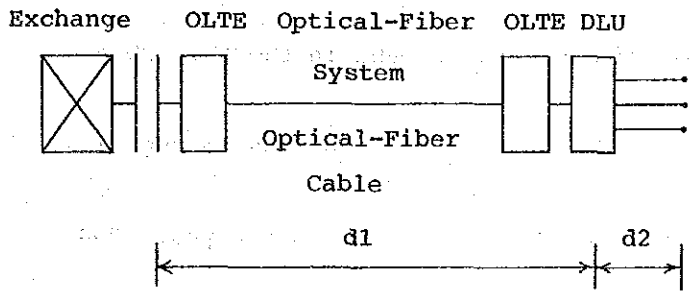


Fig. 7-2-4 Configuration of Optical-Fiber System

b) Design Standard

The design standard of Cable Subscriber System is established in accordance with the following data obtained from PERUMTEL.

. "GUIDELINE OF LOCAL TELEPHONE CABLE NETWORK PLANNING"

. "EWSD DIGITAL ELECTRONIC SWITCHING SYSTEM, DIGITAL LINE UNIT"

i) Demand in "DFA" and "RK"

- Subject Years for Demand Forecast : 1988, 1994, 1999, 2004, 2009

- Demand Forecast

  . RK Area : based on Plant Record (General Map)
  and Macro-Demand by PMC Option Report (1988.3)

  . DFA : Interview Data in Field Survey-1,2

ii) Criteria of Application

- RK Area : less than 900 pairs in the year 2004

- DFA : more than 100 pairs in the year 1999

iii) Number of Facilities

- Situation of existing Facilities : based on Plant Record

- Capacity of RK Cabinet : demand in the year 2004

- Capacity of DLU System : 500 ∿ 6000 ss (6 types)

- Volume of Primary Cable : demand in the year 1994

iv) Others

- Subject of Improvement
  : Old primary Cable (Installed before 1975)
  : Poor Quality Pairs

- Primary Cable Route : refer to existing duct route

- Applied Calling Rate : 0.4 ∿ 0.5 erl

c) Comparison between Cable Subscriber Systems

i) Preconditions

- Cable Route : assuming that the cable route / length of both systems are same (d1, d2).

- Facilities (equipment, cable, duct, M.H. etc.) and Land
  : assuming that these are newly installed.

- Diameter of copper and number of cable pairs
  Copper Diameter : 0.4mm, 0.6mm, 0.8mm
  Number of Cable Pairs : 400, 800, 1000, 1200 pairs
  (0.4mm, 0.6mm)
  400 pairs (0.8mm)

- Limit of Application : Cable Feeder System
  . 0.4mm cable : 3.0 Km
  . 0.6mm cable : 5.7 Km
  . 0.8mm cable : 8.4 Km
  . Cables of different diameter should not be connected together.

- EWSD
  : DLU System is applied only in EWSD service area.
  Switching Centers where EWSD is already installed or EWSD installation is planned are shown in Table 7-2-1.

Table 7-2-1 Current or planned EWSD Installation

SW Center	Existing	Plan
CPP	9,411	-
CPE	4,668	6,000 (1991)
GB-1	148	-
GB-2	-	10,000 (1991)
JT	10,094	7,000 (1989)
KAL	-	4,000 (1991)
KB	1,730	3,000 (1988)
KT-1	8,590	9,000 (1991)
KT-2	746	14,000 (1989)
PLM	4,000	7,000 (1991)
PSR	2,059	2,000 (1988)
PLT	-	10,000 (1990, 1)
RMG	666	4,000 (1989)
SM-1	4,706	7,000 (1991)
SM-2	2,678	5,000 (1991)
SLP	721	10,000 (1988)
TBT	-	5,000 (1989)

Note: Number of terminals

( ) : Year to be installed

In the GB-1 Switching Center, the capacity of the EWSD is insufficient, and it is excluded from the subject Switching Centers where the application of a DLU System is considered.

ii) Comparison between Cable Subscriber Systems

Comparative costs for Cable Feeder and DLU Systems (PCM-30, Fiber-Optical) are shown in Fig. 7-2-5 and 7-2-6.

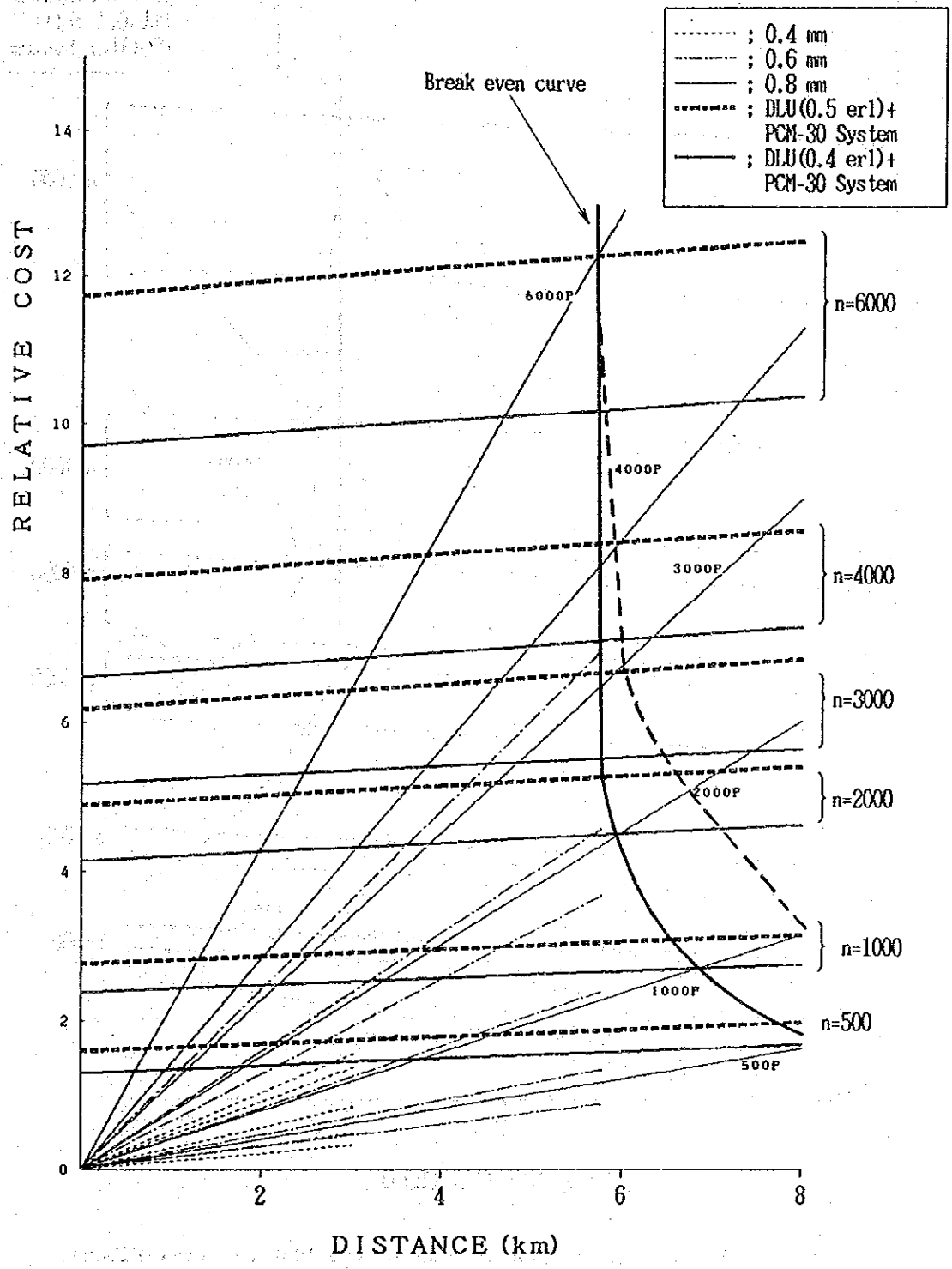


Fig. 7-2-5 Cost Curve [Cable Feeder vs. DLU (PCM-30)]

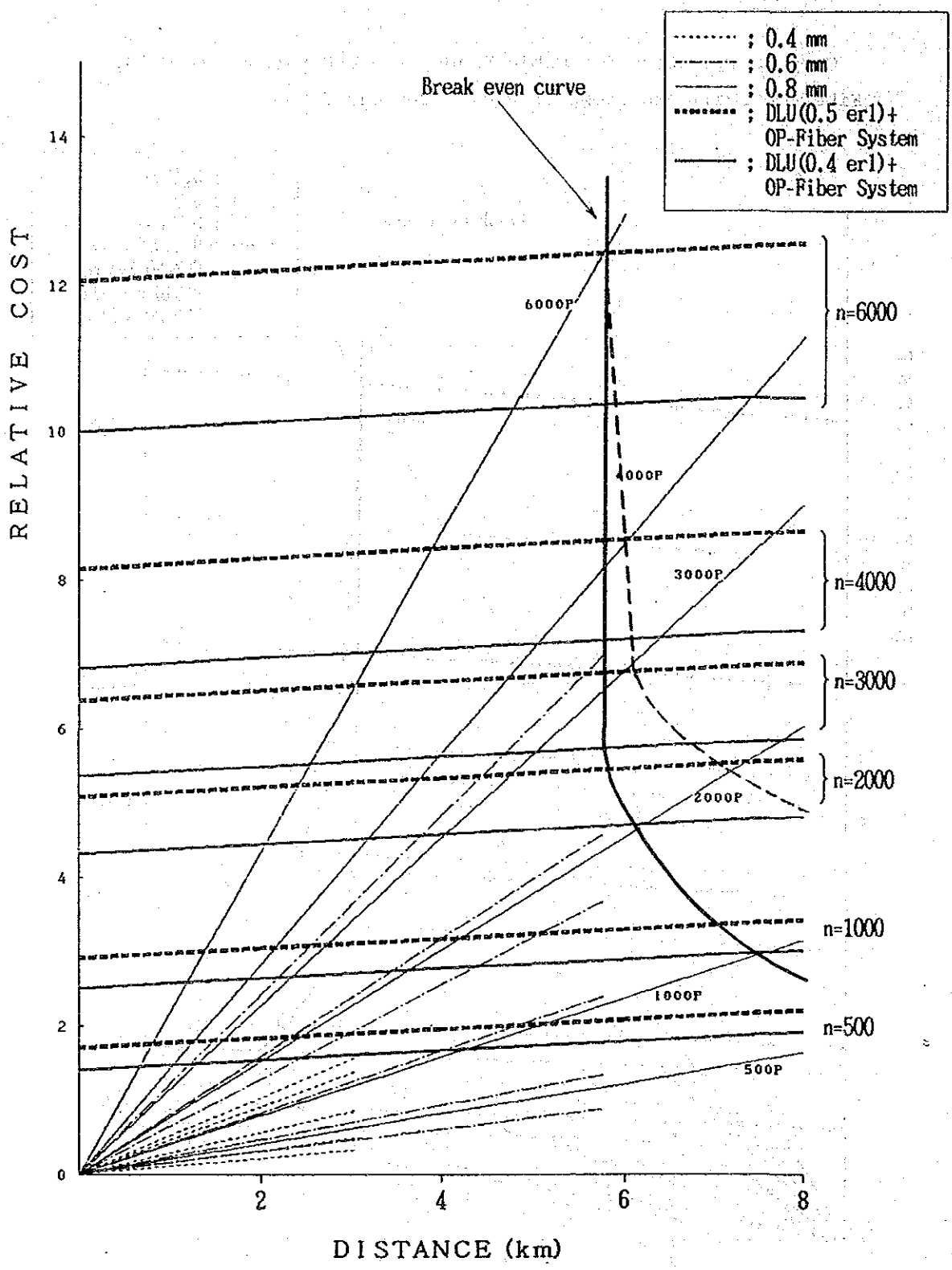


Fig. 7-2-6 Cost Curve [Cable Feeder vs. DLU (Optical-Fiber)]

iii) Result of Comparison

The result of comparison show the application area for each system from the technical and economical view point Fig. 7-2-7 and 8.

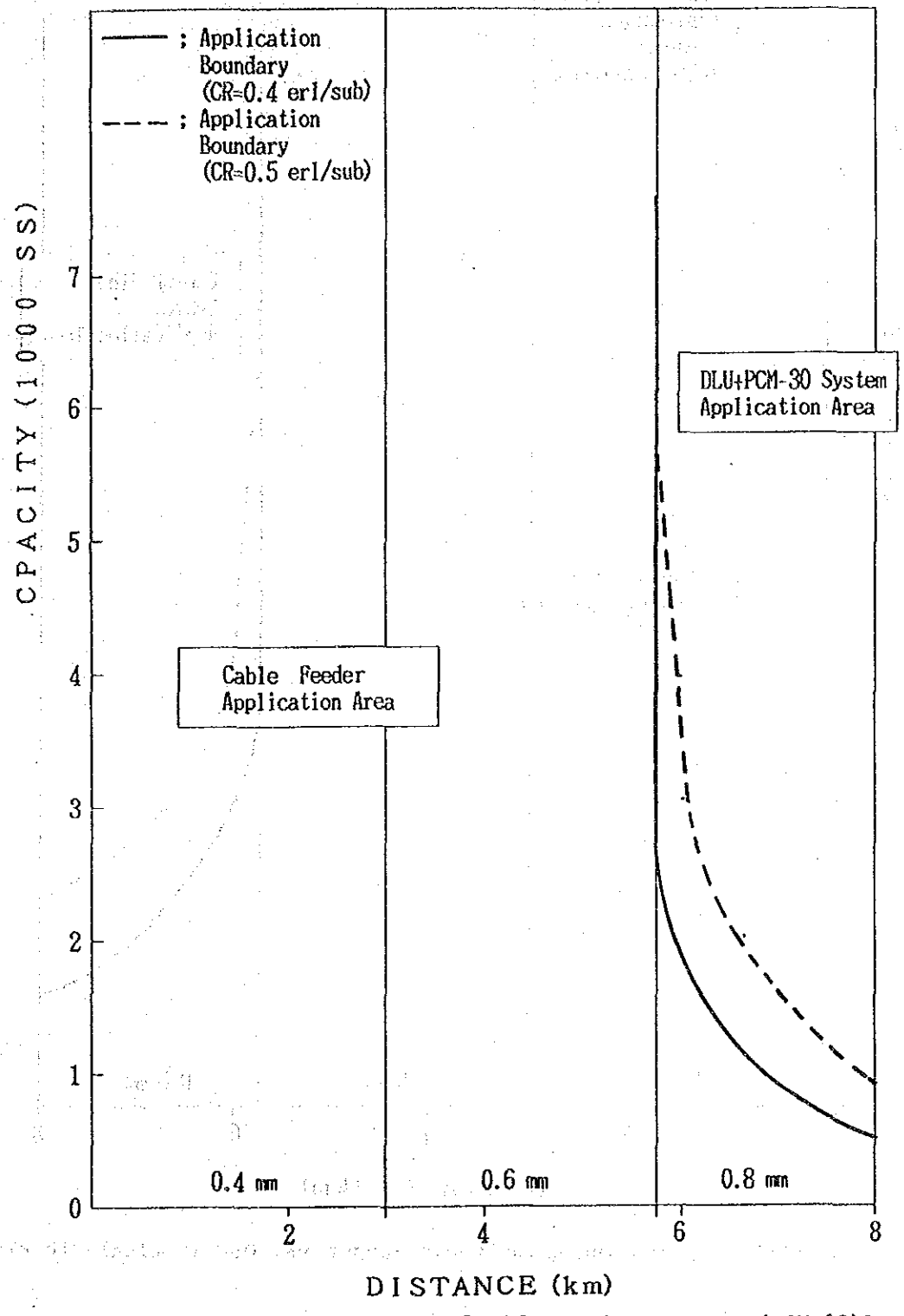


Fig. 7-2-7 Application Area [Cable Feeder vs. DLU (PCM-30)]

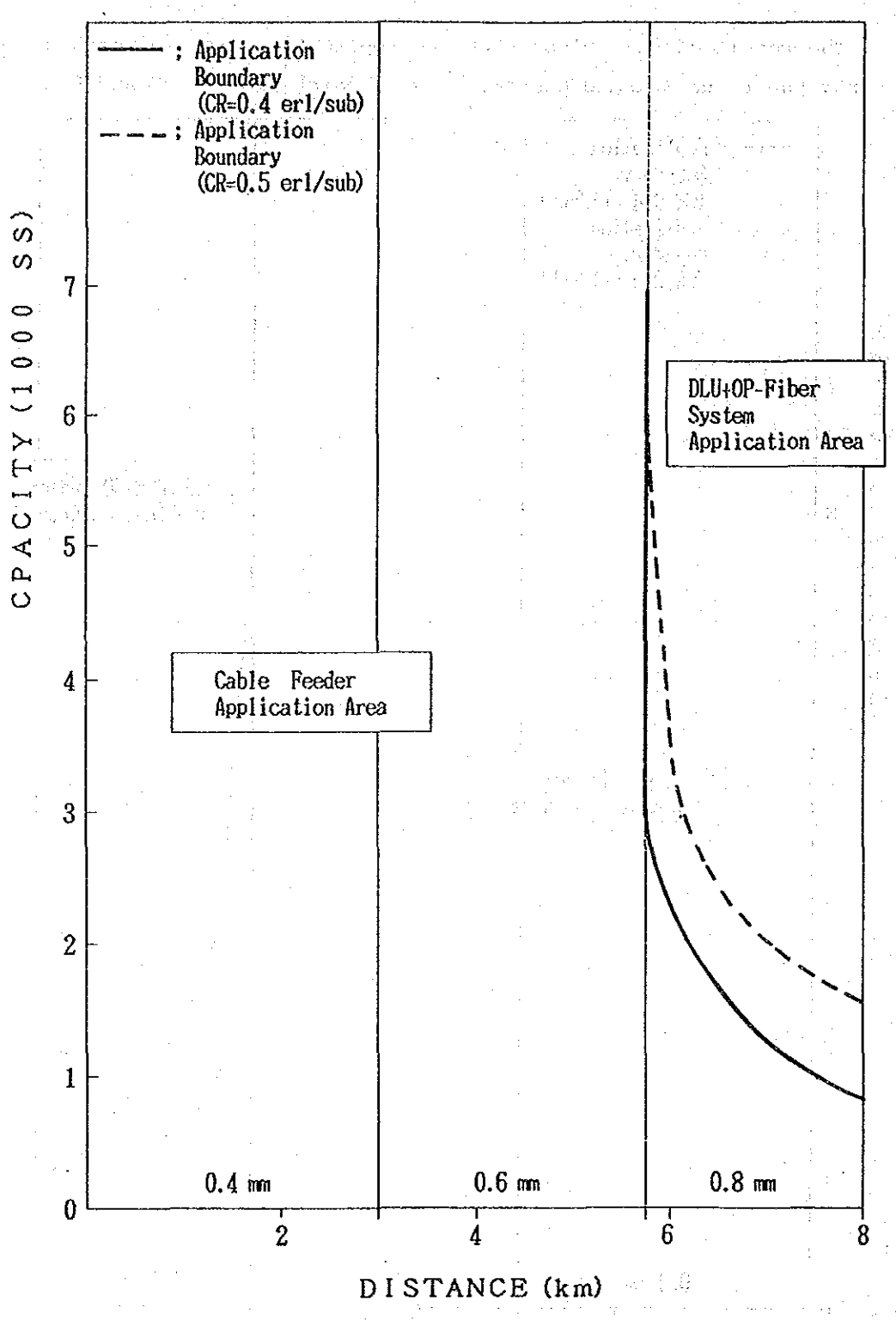


Fig. 7-2-8 Application Area [Cable Feeder vs. DLU (Optical-Fiber)]

The areas where the application of a DLU System is advantageous are limited to the following:

- Switching Center areas where an EWSD exchange has been / will be introduced (16 Switching Centers)

- Areas where the subscriber calling rate is low:
  residential areas, for example

- Areas which are far from the associated Switching Center (more than about 4 Km)

- Areas where demand is concentrated

- Areas where installation space (land and building) for the DLU System can be secured.
  (It is difficult to obtain installation space in central of Jakarta.)

Considering the geographical distribution of the subject Subscriber Stations (Fig. 6-2-7) and the characteristics of the Cable Feeder/DLU System, in this Study, the Cable Feeder System (hereinafter referred to as "Cable Subscriber System") is selected for comparison between a Microwave Subscriber System and Cable Subscriber System.

3) Cost Comparison

The costs of Microwave / Cable Subscriber Systems are to be compared, base on a study of each technical point.

a) Method of Cost Calculation

i) Microwave Subscriber System

The cost of the Microwave Subscriber System is decided taking into consideration the cost of similar radio systems.

① P-MP System

The cost of the P-MP System is calculated as follows:

$$\text{Cost of P-MP System in No. j Area} = \frac{Bj}{\sum_{i=1}^{N} Ci} \times Ci + Si$$

Where : Ci : Number of Line Units in No.i Subscriber Station

Bj : Cost of Base Station in j Area

= Bi + Bz + In

Bi : Cost of Base Station Equipment independent of Number of Zones (including tax, transportation charges, etc.)

Bz : Cost of Base Station Equipment dependent on Number of Zones (including tax, transportation charges, etc.)

In : Installation Cost

Si : Cost of No.i Subscriber Station

= Se + In

Se : Cost of Subscriber Station Equipment (including tax, transportation charges, etc.)

In : Installation Cost

② P-P System

The cost of the P-P System is calculated as follows:

Cost of P-P System = Bi + Si

Where : Bi : Cost of Base Station for No.i Subscriber Station
= Be + In
Be : Cost of Base Station Equipment (including tax, transportation charges etc.)
In : Installation Cost
Si : Cost of No.i Subscriber Station
= Se + In
Se : Cost of Subscriber Station Equipment (including tax, transportation charges etc.)
In : Installation Cost

ii) Cable Subscriber System

The cost of the Cable Subscriber System is calculated as follows:

Cost of Cable Subscriber System = Pc + Dc + Cc + Sc

Where :
Pc : Cost of Primary Cable per Subscriber Station (including "RK" Cabinet Cost etc.)
Dc : Cost of Duct per Subscriber Station
Cc : Commission Fee per Subscriber Station
Sc : Cost of Secondary Cable per Subscriber Station

On the other hand, the cost of the Cable Subscriber System is calculated in accordance with the following procedure:

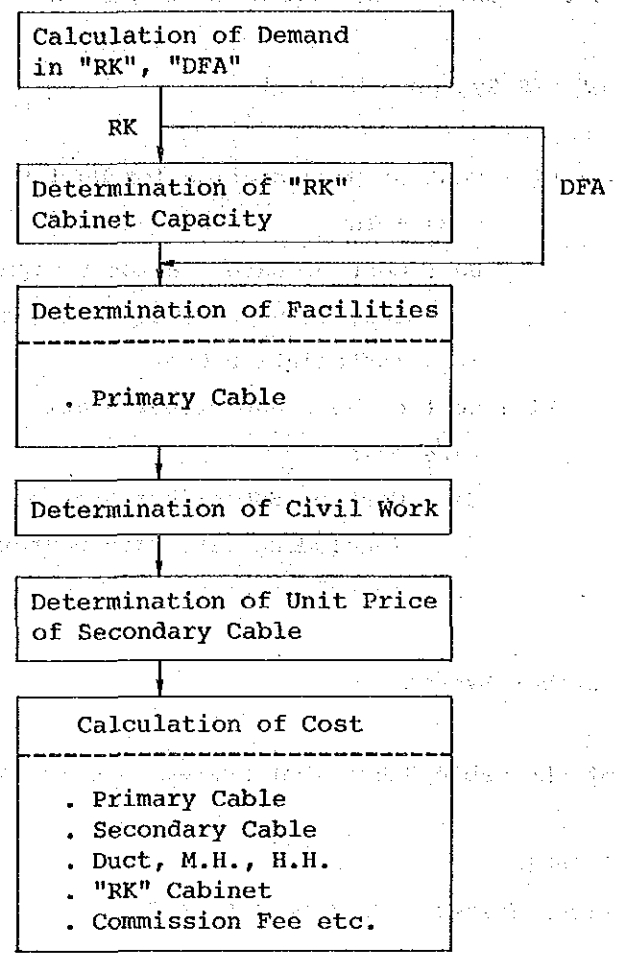


Fig. 7-2-9 Cost Calculation Flow of Cable Subscriber System

① Primary Cable Cost

The number of pairs to be installed in "RK" corresponding to the subject Subscriber Stations is shown as follows:

$$P = D \times 1.25 - C + E$$

Where

P : Number of Addition Terminals in "RK",
(unit : 100 terminals)

D : Demand at 1994

C : Number of Existing Primary Cable Pairs in "RK"

E : Number of Poor Quality Pairs in Existing Primary Cable

② Duct Cost

The number of new ducts to be installed is determined as follows:

- Number of New Ducts = Number of Cables for the subject demand in the year 1994 (in case when (A-B) < 0)

where

A : Number of unoccupied ducts at present

B : Number of all cables in the year of 1994

- Spare Duct:

One spare duct to be reserved per section

- Broken Duct:

The cost for repair of the broken duct is 3 times the ordinary unit price.

③ Commission Fee

The commission fee for construction should be paid equal to 6% of the duct construction cost to the DKI office.

④ Secondary Cable

. Standard Cost of Secondary Cable = K x C x (D1 - D0)

D1 : Demand in 1994

D0 : Demand in 1988

K : Standard cost of installation for secondary cable pair terminal in "RK"

C : Correction coefficient

b) Result of Cost Comparison

The result of the cost comparison between the Microwave Subscriber System and the Cable Subscriber System is shown in Fig. 7-2-10.

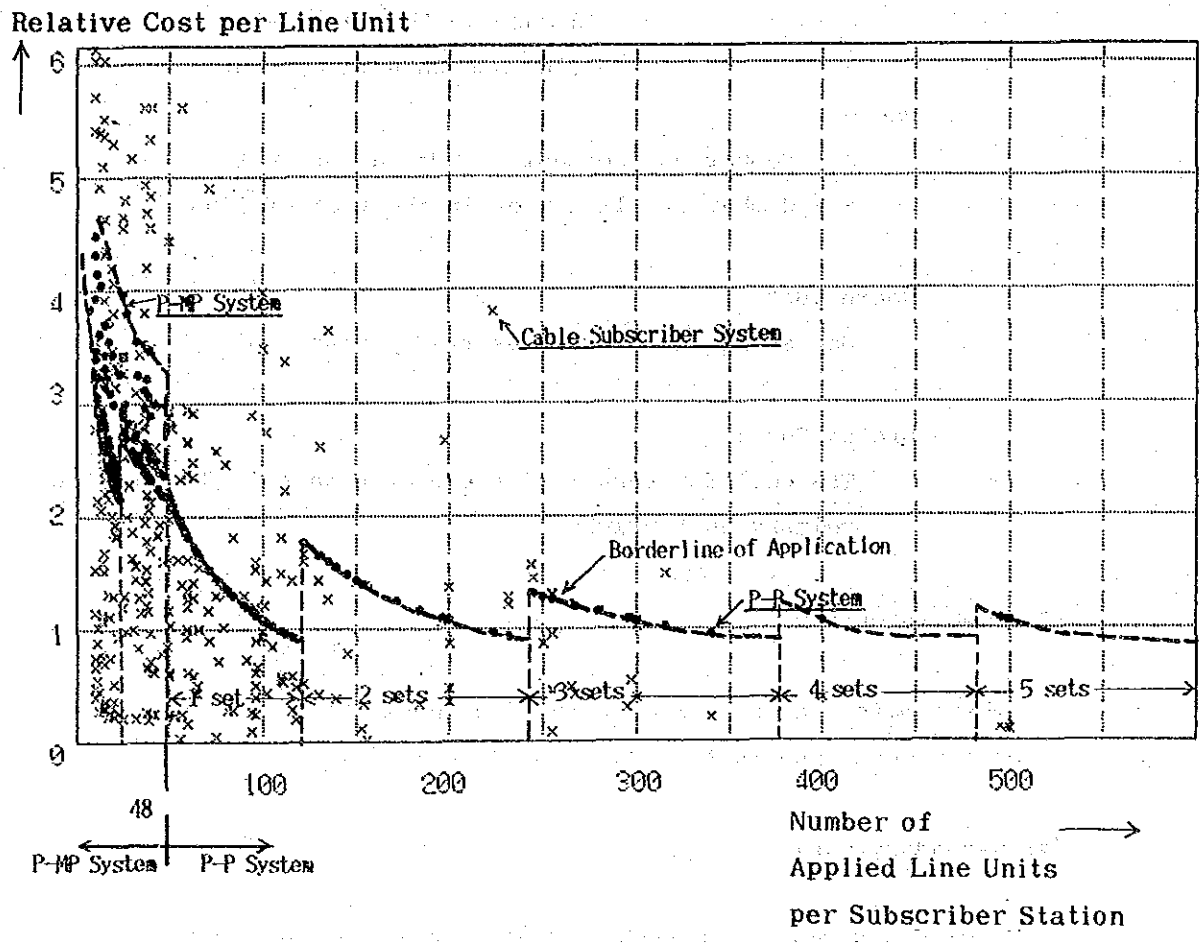


Fig. 7-2-10 Result of Cost Comparison

The upper region in Fig. 7-2-10 is that of application of the Microwave Subscriber System, and the bottom region is that for the Cable Subscriber System.

The Subscriber Stations which are plotted above the borderline are economically advantageous to the Microwave Subscriber System; this applies to 125 Subscriber Stations (23.0% of the total number of subject Subscriber Stations) as shown in Attachment-5.

Finally, the applicable Subscriber Stations are selected according to the criteria/priority order in para. 7.1 of this Chapter.

From the cost comparison, the following tendencies can be identified.

- P-MP System

  The relative costs per line unit are relatively higher than those of a P-P System / Cable Subscriber System.

  These are affected by the number of Subscriber Stations per Zone and the number of applied line units per system.

- P-P System

  The relative costs per line unit are unique to the number of a applied line units, and these are relatively lower than those of P-MP System.

- Cable Subscriber System

  The relative costs per line unit are variable with the number of applied line units and are affected by the following factors:

  . Necessity of Civil Work
  . Distance between Switching Center and Subscriber Stations
  . Number of Applied Line Units etc.

4) Other Comparison

a) Period of Construction

The system design and construction of a Microwave Subscriber System is limited to two points (Base/Subscriber Station) and involves little civil work, so that the construction period is shorter than for a Cable Subscriber System.

b) Utilization

A Microwave Subscriber System can be installed easily and can be removed easily, so that this system is suitable for temporary utilization.

In contrast, a Cable Subscriber System cannot be used again.

c) Maintenance and Operation

A Microwave Subscriber System is limited to two points, so a failure point can be easily identified and quickly repaired.

However, this system needs to maintain visibility between the Base Station and Subscriber Stations, requiring maintenance and preservation of the propagation path.

7.3 Project Establishment

1) Applicable Areas / Stations

The result of the comparison between a Microwave Subscriber System and Cable Subscriber System is shown below (refer to Attachment-5, 6, 7).

a) General

The total number of applicable Subscriber Stations/line units and the application Areas are shown below:

- P-MP System

  13 Areas, 19 Zones, 111 Subscriber Stations, 2417 Line Units (in 1994)

- P-P System

  17 Areas, 78 Subscriber Stations, 12003 Line Units (in 1994)

- Total

  18 Areas, 189 Subscriber Stations, 14420 Line Units (in 1994)

  The number of applicable line units is about half of that of waiting in 1989.

  The application Areas which geographically concentrate in a middle of Jakarta for the Microwave Subscriber System are shown in Fig. 7-3-2.

The relationship between application and subject is shown in Fig. 7-3-1.

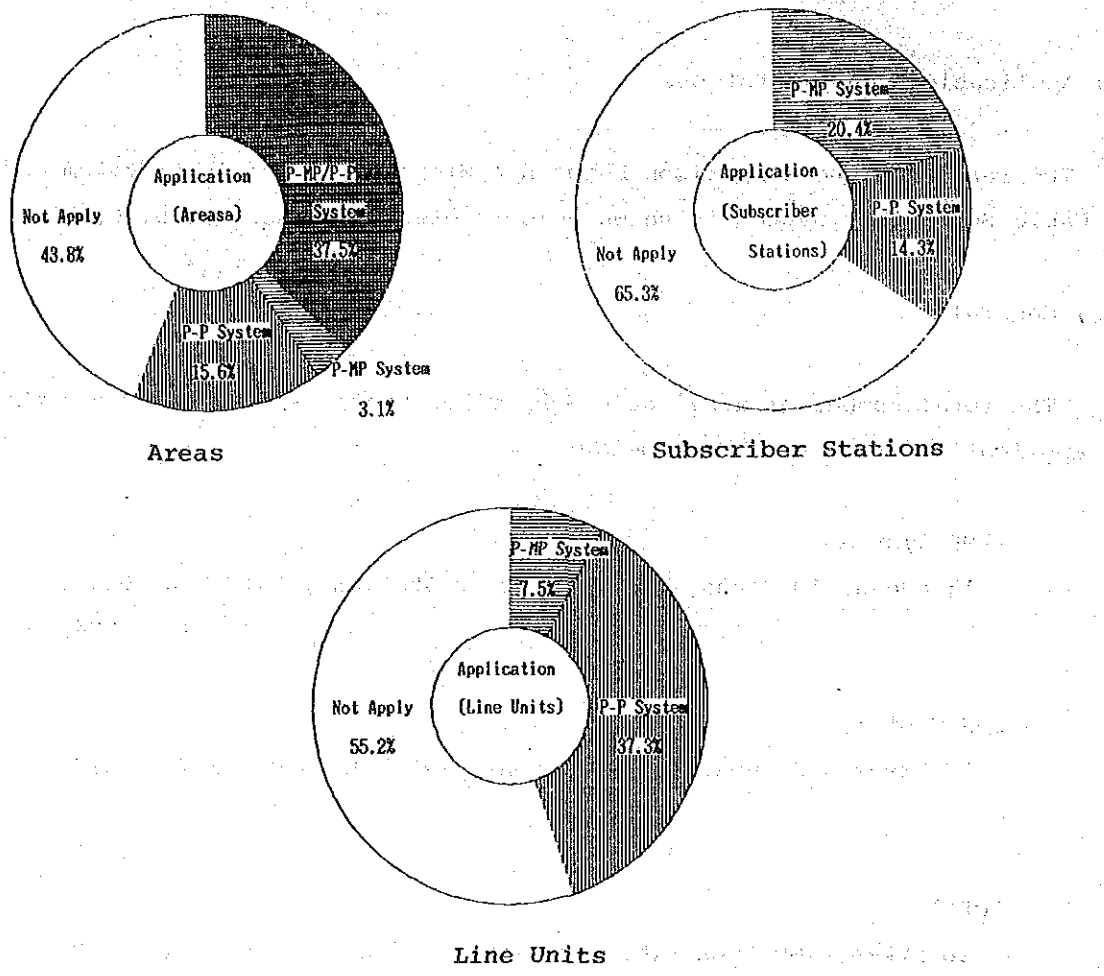


Fig. 7-3-1 Relationship between Application/Subject in 1994

The application for the Microwave Subscriber System concentrates in the five (5) Areas (GB-1, GB-2, SM-1, SM-2, KAL), and the number of applicable line units in these Areas is 83.1% of the total number.

Details of the above are shown in Table 7-3-1.

Table 7-3-1 Applicable Subscriber/Base Stations in 1994

	P-MP System			P-P System		Total	
	Zone	Sub.	Line Units	Sub.	Line Units	Sub.	Line Units
ANC	-	-	-	1	102	1	102
CAW	1	5	144	1	96	6	240
CPP	1	6	158	-	-	6	158
CPE	-	-	-	2	196	2	196
GB-1	2	16	310	18	2,265	34	2,575
GB-2	2	13	307	11	1,655	24	1,962
JT	2	10	206	2	123	12	329
KAL	1	4	116	6	1,099	10	1,215
KB	2	12	256	1	120	13	376
KT-2	1	8	97	1	63	9	160
PLM	1	7	158	1	101	8	259
PSR	-	-	-	1	102	1	102
PLT	1	3	41	1	100	4	141
RMG	1	3	40	1	50	4	90
SM-1	1	5	118	8	2,226	13	2,344
SM-2	3	19	466	20	3,424	39	3,890
SLP	-	-	-	2	185	2	185
TBT	-	-	-	1	96	1	96
Total	19	111	2,417	78	12,003	189	14,420

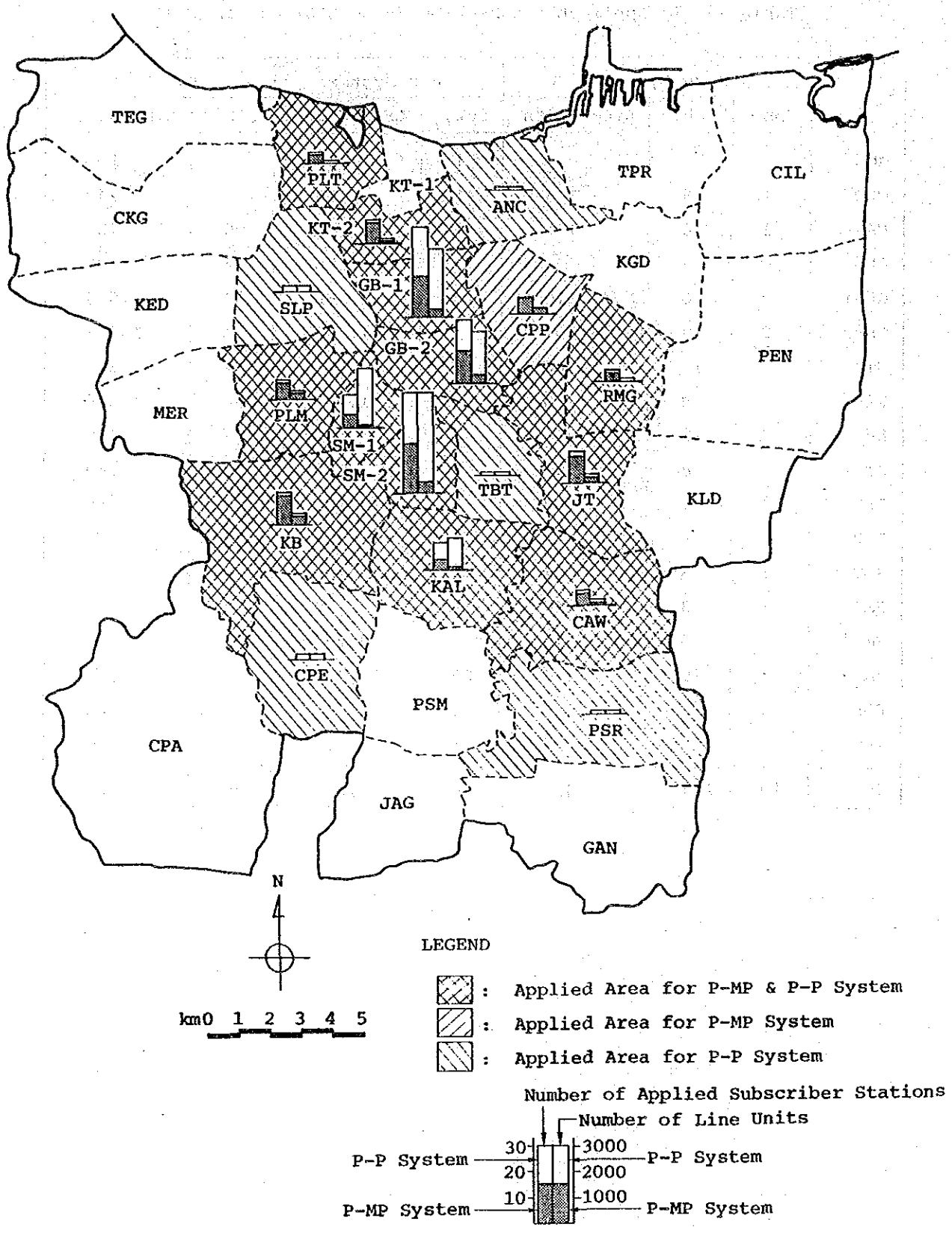


Fig. 7-3-2 Application Areas

b) Annual Trend of Application

The annual trend of applicable Subscriber/Base Stations and number of line units are shown in Fig. 7-3-3, 4 and Table 7-3-2, 3.

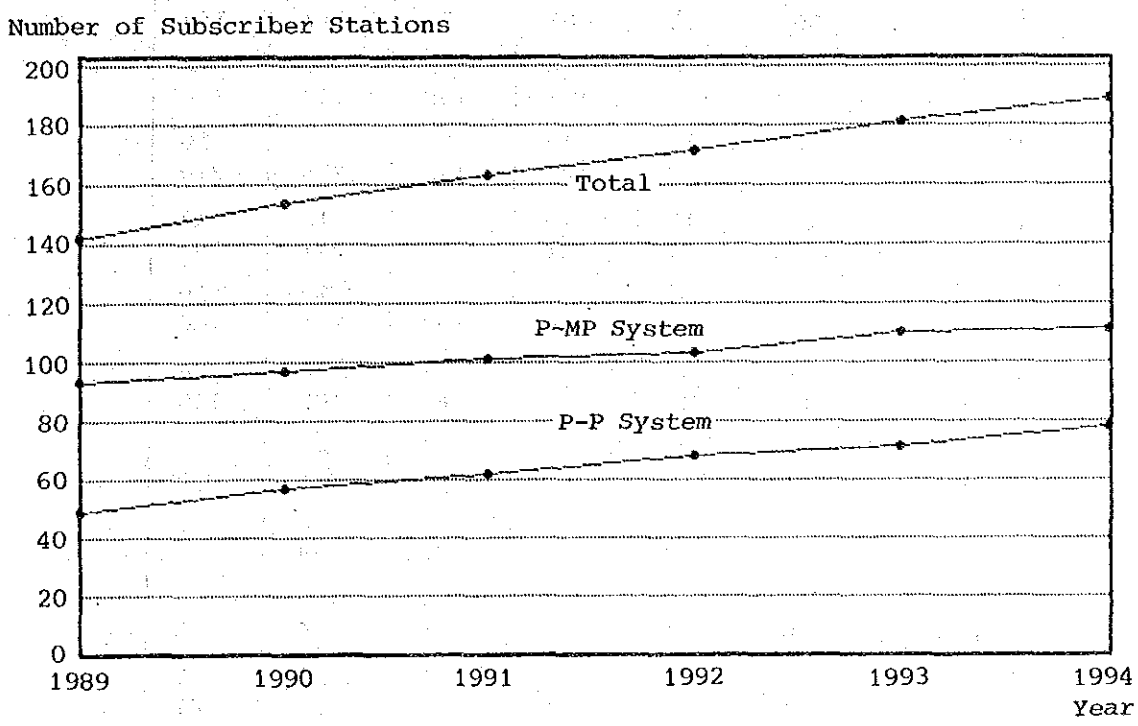


Fig. 7-3-3 Annual Trend of Applicable Subscriber Stations

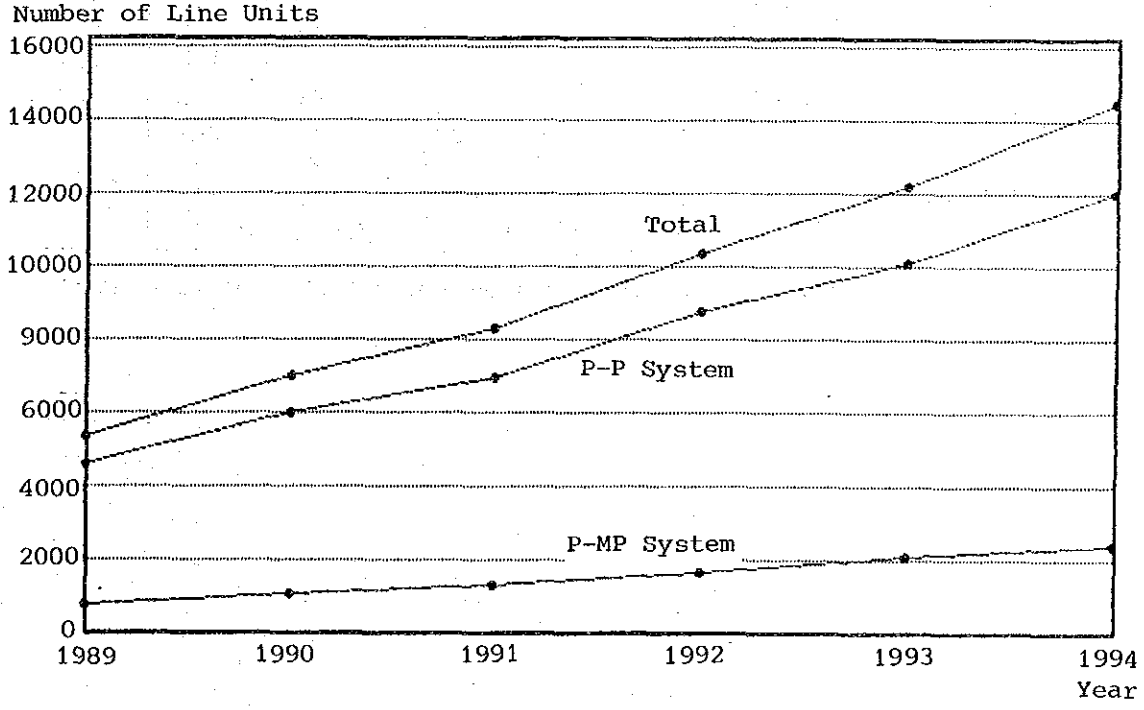


Fig. 7-3-4 Annual Trend of Applicable Subscriber Lines

Table 7-3-2 Annual Trend of Application for P-MP System

Area	1989	1990	1991	1992	1993	1994
	3	4	4	4	5	5
CAW	30	50	61	72	117	144
	6	6	6	6	6	6
CPP	111	119	129	139	148	158
	10	11	13	13	16	16
GB-1	49	78	143	175	278	310
	13	13	13	13	13	13
GB-2	149	177	204	237	271	307
	7	7	7	9	10	10
JT	36	50	66	127	181	206
	3	3	3	3	4	4
KAL	43	49	56	62	105	116
	9	10	11	11	11	12
KB	77	116	147	181	215	256
	7	7	7	7	8	8
KT-2	20	33	45	60	74	97
	6	7	7	7	7	7
PLM	46	88	101	119	136	158
	2	2	3	3	3	3
PLT	8	13	20	26	32	41
	3	3	3	3	3	3
RMG	11	16	22	27	33	40
	5	5	5	5	5	5
SM-1	56	66	77	90	102	118
	19	19	19	19	19	19
SM-2	124	186	254	320	391	466
P-MP	93	97	101	103	110	111
Total	760	1,041	1,325	1,635	2,083	2,417

*remarks: Number of Subscriber Stations / Number of Line Units

Table 7-3-3 Annual Trend of Application for P-P System

Area	1989	1990	1991	1992	1993	1994
ANC	-	-	-	1 92	1 97	1 102
CAW	-	-	-	-	-	1 96
CPE	1 56	1 64	1 72	1 81	1 90	2 196
GB-1	14 1,171	16 1,452	17 1,658	17 1,820	17 1,988	18 2,265
GB-2	9 585	9 719	9 859	9 1,008	9 1,162	11 1,655
JT	-	1 52	2 106	2 111	2 117	2 123
KAL	1 34	2 110	3 190	3 221	5 773	6 1,099
KB	1 88	1 94	1 100	1 106	1 113	1 120
KT-2	-	1 52	1 54	1 57	1 60	1 63
PLM	-	-	-	-	1 96	1 101
PSR	1 76	1 81	1 86	1 91	1 96	1 102
PLT	1 57	1 65	1 73	1 81	1 90	1 100
RMG	1 28	1 32	1 36	1 41	1 45	1 50
SM-1	8 1,545	8 1,658	8 1,776	8 1,900	8 2,031	8 2,226
SM-2	10 686	13 1,454	15 1,803	19 2,897	20 3,177	20 3,424
SLP	2 140	2 148	2 157	2 166	2 176	2 185
TBT	-	-	-	-	-	1 96
P-P Total	49 4,466	57 5,981	62 6,970	67 8,672	71 10,111	78 12,003
Total	142 5,226	154 7,022	163 8,295	170 10,307	181 12,194	189 14,420

*remarks: Number of Subscriber Stations / Number of Line Units

2) Modification

Based on the determination of the application Areas / Subscriber Stations, modifications in each Base Station should be carried out.

a) Precondition of Modification

i) Priority

The selection of Base Stations is performed according to the following priority:

high ① Utilizes existing Facilities in Switching Center
↑
Priority ② Modification of existing Facilities in Switching Center
↓
low ③ Consideration of other Building instead of Switching Center as Base Station

The modification in each Base Station will be carried out according to the following conditions required for introduction of the Microwave Subscriber System.

ii) Power

- P-MP System : 7 amperes per Zone
- P-P System : 4 amperes per set

iii) Installation Space

- P-MP System
  - Outdoor Equipment : 1 Antenna per Zone
  - Indoor Equipment : 0.3 m^2 per Zone
- P-P System
  - Outdoor Equipment : 1 Antenna per set
  - Indoor Equipment : 0.1 m^2 per set

b) Study of Modification

Existing Base Station conditions and required modifications were established to study the data obtained from Switching Centers based on precondition stipulated in previous paragraph and the result is shown in Table 7-3-4.

Table 7-3-4 Investigation of Modifications

	Existing				Require		Installation		Modification
	To	EX	MD	Po	Po	I.S	Out	In	
				20	0	0			
ANC	—	o	o	200	4	0.1	Roof	1F:P	
				5	7	0.3	New		Tower G25m
CAW	—	o	o	400	11	0.4	Tower	1F:P	
				0	7	0.3			
CPP	—	o	o	600	7	0.3	Roof	1F:P	
				5	4	0.1			
CPE	G60	o	o	200	8	0.2	Tower	1F:P	
				400	90	2.5			Power Supply
GB-1	R10	o	o	400	122	3.3	Roof	6F:T	
				106	54	1.6	Roof		MDF
GB-2	G43	o	x	400	86	2.4	Tower	1F:P	
				0	14	0.6			
JT	G72	o	o	600	22	0.8	Tower	4F:R	
				55	11	0.4			
KAL	G120	o	o	400	55	1.5	Tower	1F:P	
				135	18	0.7	Roof		
KB	R12	o	o	400	18	0.7	Tower	2F:P	
				33	7	0.3	Roof		
KT-2	R40	o	o	200	11	0.4	Tower	4F:P	
				50	7	0.3			
PLM	G72	o	o	600	11	0.4	Tower	1F:R	
				1	4	0.1			
PSR	G24	o	o	200	4	0.1	Tower	1F:P	
				55	11	0.4			Exchange
PLT	G45	x	o	400	11	0.4	Tower	2F:R	

Table 7-3-4 Investigation of Modifications (Cont'd)

	Existing				Require		Installation		Modification
	To	EX	MD	Po	Po	I.S	Out	In	
				32	11	0.4			
RMG	G43	o	o	200	11	0.4	Tower	1F:P	
				55	79	2.1	High-rise		Entrance
SM-1	—	o	o	200	87	2.3	Building		
				272	65	2.0	New WITEL-IV		Entrance
SM-2	G90	o	o	500	161	4.4			
				2	8	0.2			
SLP	G72	o	o	600	12	0.3	Tower	1F:P	
				2	0	0			
TBT	—	o	o	400	4	0.1	Roof	1F:P	

Note:

To(Tower), EX(Exchange), MD(MDF), Po(Power), I.S. (Installation Space)

Out(Outdoor Equipment), In(Indoor Equipment)

Tower . CPE, KT-2 : planed for 1988

. KAL : planed for 1989

Power . The power supply system conditions refer to the rectifier (DC-48V) for transmission system.

. Used value (1988.8) / capacity

. Capacity : including that of rectifiers constructed by PCM phase-2 Project

Require : upper value : in 1989, lower value : in 1994

Installation Space . P : PCM / Transmission Room, R : Radio Room

i) Selection of Base Stations

Most Base Stations were selected in the existing Switching Centers except for the following Base Stations as shown in Fig. 7-3-5.

- SM-1 :

A high-rise building should be used for the Base Station instead of the SM-1 Switching Center in order to ensure visibility between the Base Station and Subscriber Stations.

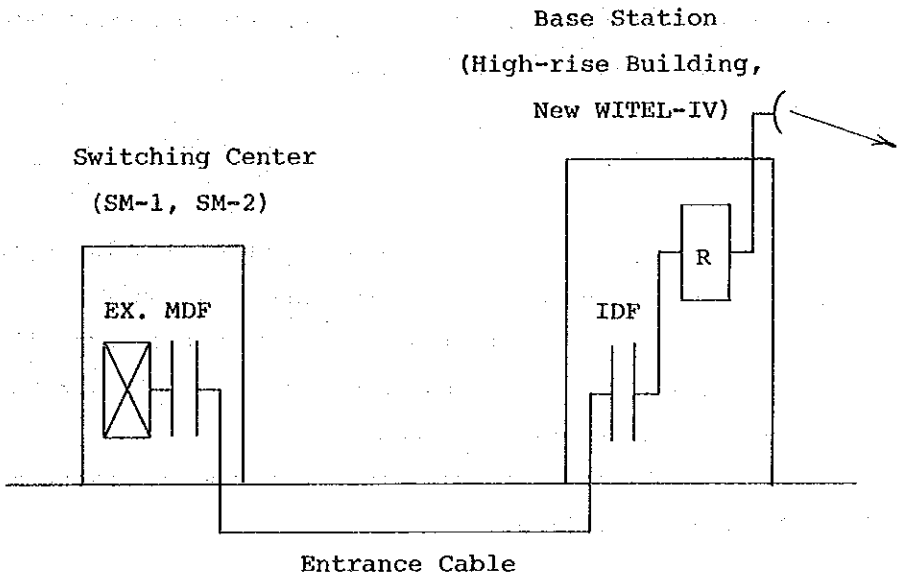
In this Study, No.34 ("Dharmala Sakti", List in Attachment-4) Subscriber Station where visibility is good and unoccupied primary cable is available was established as the Base Station.

- SM-2 :

The new WITEL-IV building which is under construction should be used as the Base Station instead of the SM-2 Switching Center from the viewpoint of installation space for Microwave Subscriber System.

As the room for indoor equipment, it is planned to use the 2nd or 3rd floor which is used as the radio room, and outdoor equipment will be installed on the roof.

The Base Station in SM-2 will be used as the maintenance center.



Ex. : Exchange

R : Microwave Subscriber System

Fig. 7-3-5 Base Station separate from Switching Center

ii) Tower

- CAW :

A new tower will be constructed in the Base Station considering the visibility (refer to Attachment-1, 4) between the Base Station and Subscriber Stations.

iii) Exchange / MDF

The number of line units used for the Microwave Subscriber System is shown in Fig. 7-3-2 and Table 7-3-1.

As expansion plans for the switching equipment are not yet fixed, a comparison is made with the number of existing unoccupied terminals in this Study.

The MDF situation for the Microwave Subscriber System is shown in Table 7-3-4.

In GB-2, it is necessary to install MDFs for the Microwave Subscriber System in a separate room from the existing MDF room where it is impossible to install them.

iv) Power Supply System

The applicability of power supply system should be judged taking the used value and capacity into consideration.

Utilization / installation plan could not be established exactly, so in this Study, only the required power (DC-48V) for the Microwave Subscriber System is mentioned.

In GB-1, the power supply system for the Microwave Subscriber System needs to be installed.

3) Classification of Applicable Subscriber Stations

a) Selection Factors

The applicable Subscriber Stations are classified by selection factor as follows:

i) P-MP System

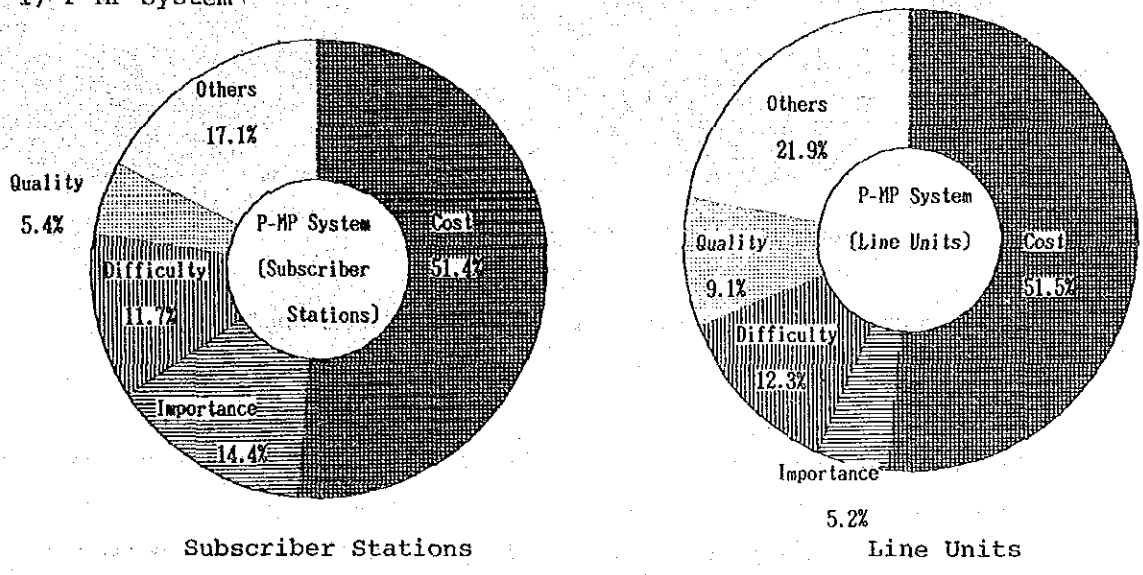


Fig. 7-3-6 Classification of P-MP System Application by Selection Factor

ii) P-P System

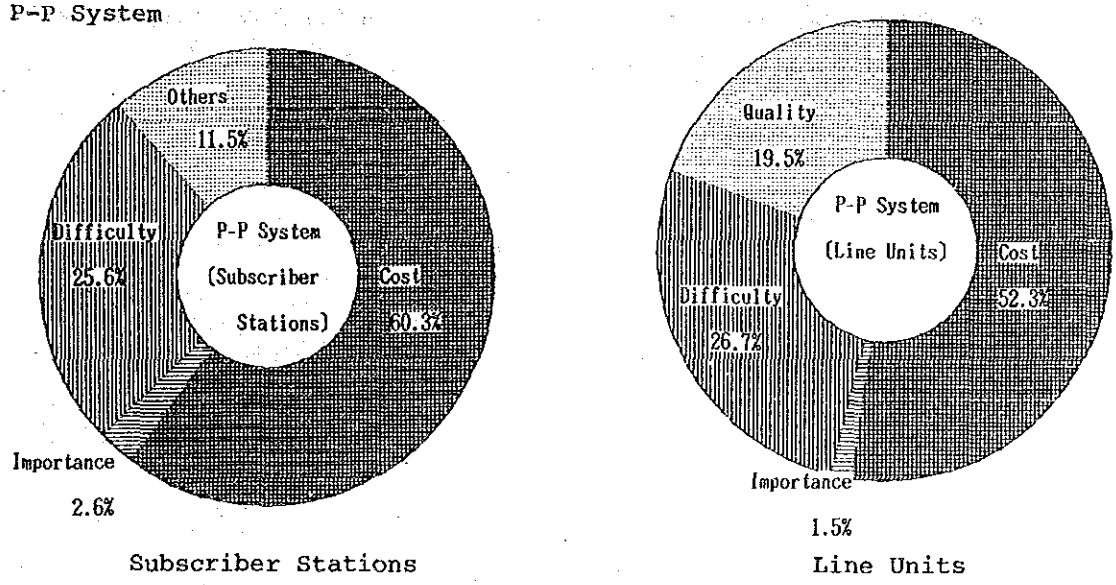


Fig. 7-3-7 Classification of P-P System Application by Selection Factor

iii) Total

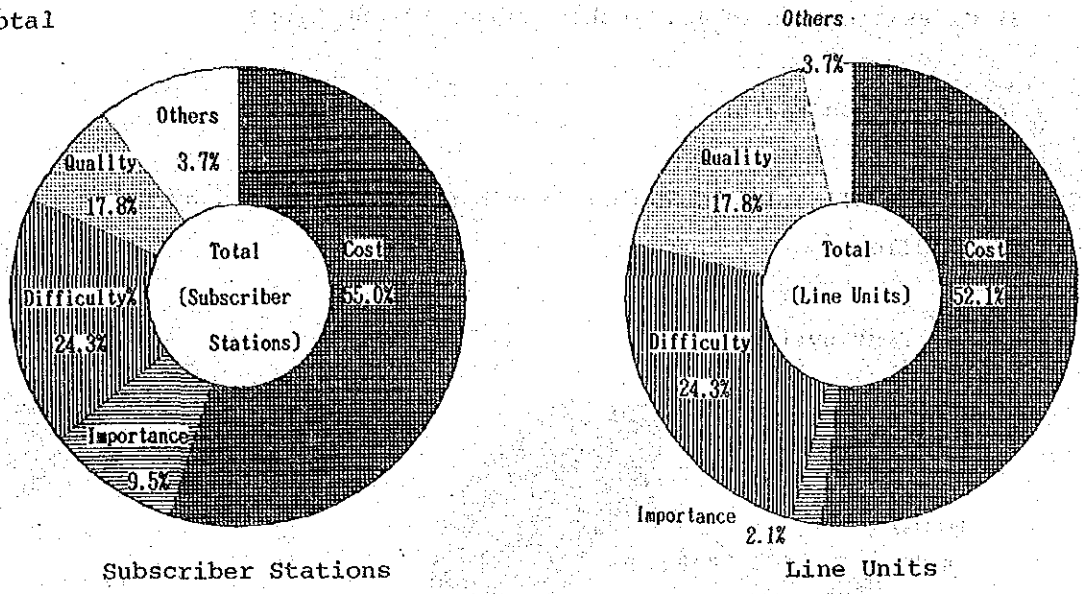


Fig. 7-3-8 Classification of P-MP & P-P System Application by Selection Factor

The half of the applicable Subscriber Stations are selected from the economic view point.

The numbers of applicable line units with quality and importance factor are not proportional to those of the applicable Subscriber Stations, because the Subscriber Stations with quality factor are applied to the additional line units and improvable line units, and the Subscriber Stations with importance factor have only a small number of additional line units.

iv) Area

Figs. 7-3-9, 10 indicate the following characteristics :

- SM-1, CPP : Areas where many poor quality subscriber lines exist

- GB-1, 2, KB, KT-2 : Areas where many important Subscriber Stations exist

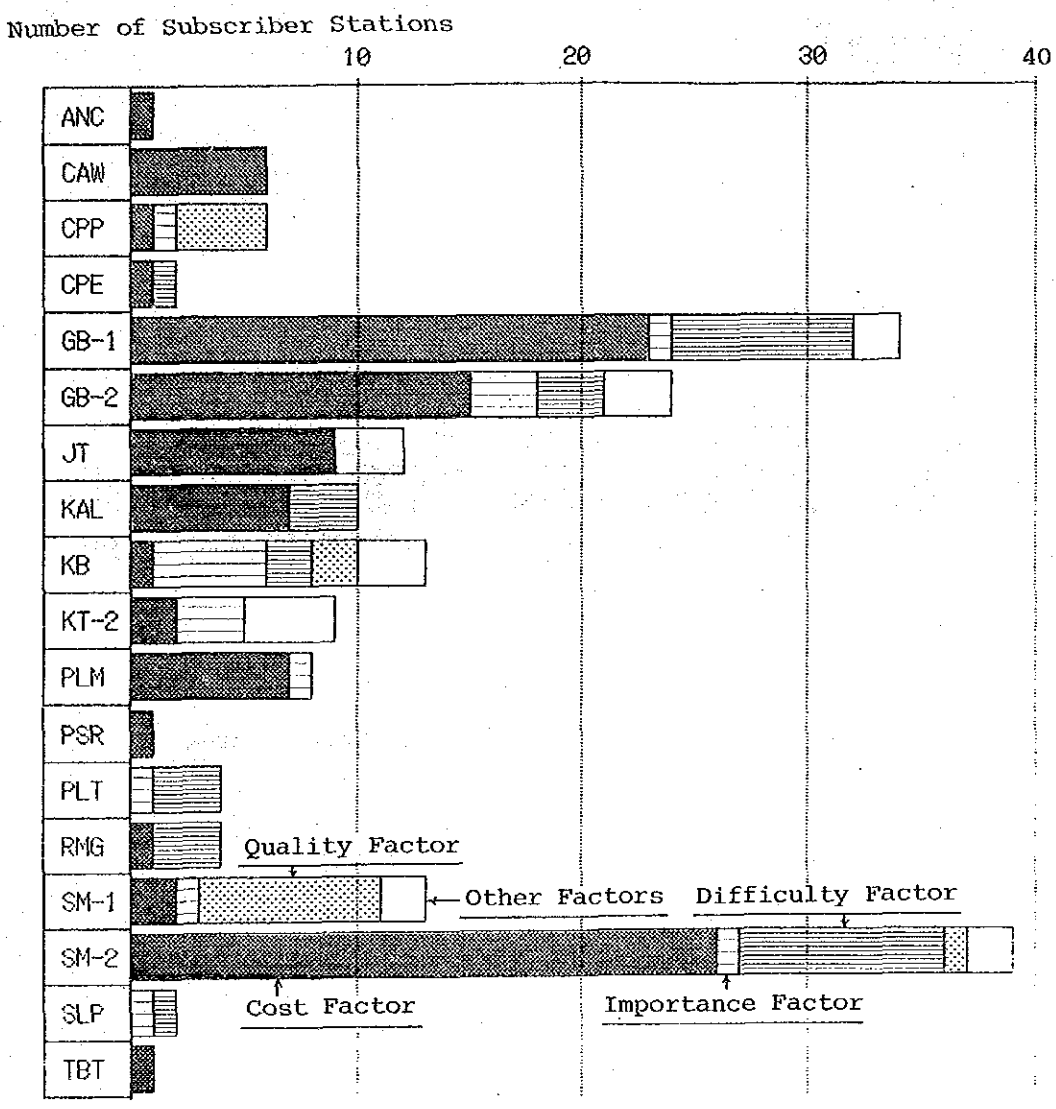


Fig. 7-3-9 Classification by Subscriber Station in Area

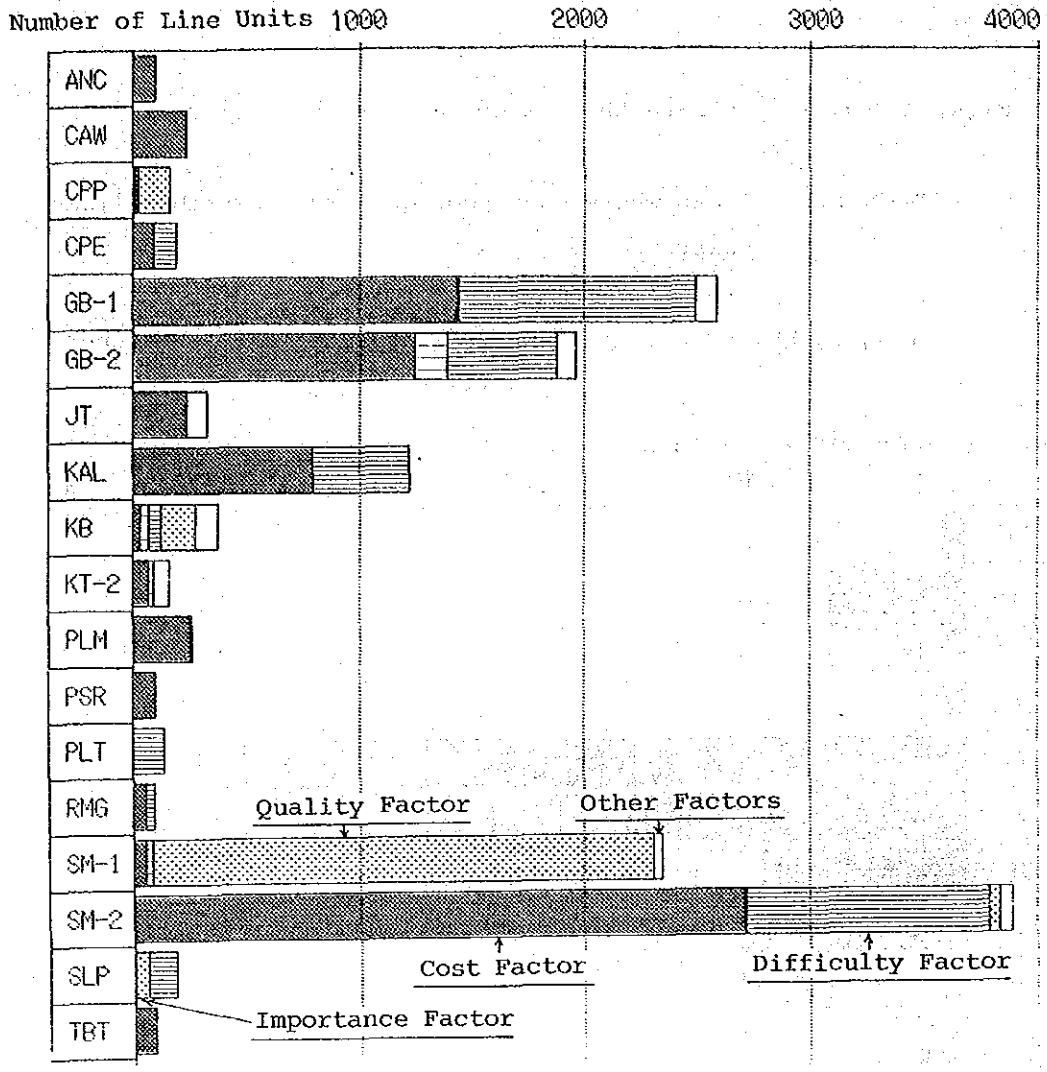
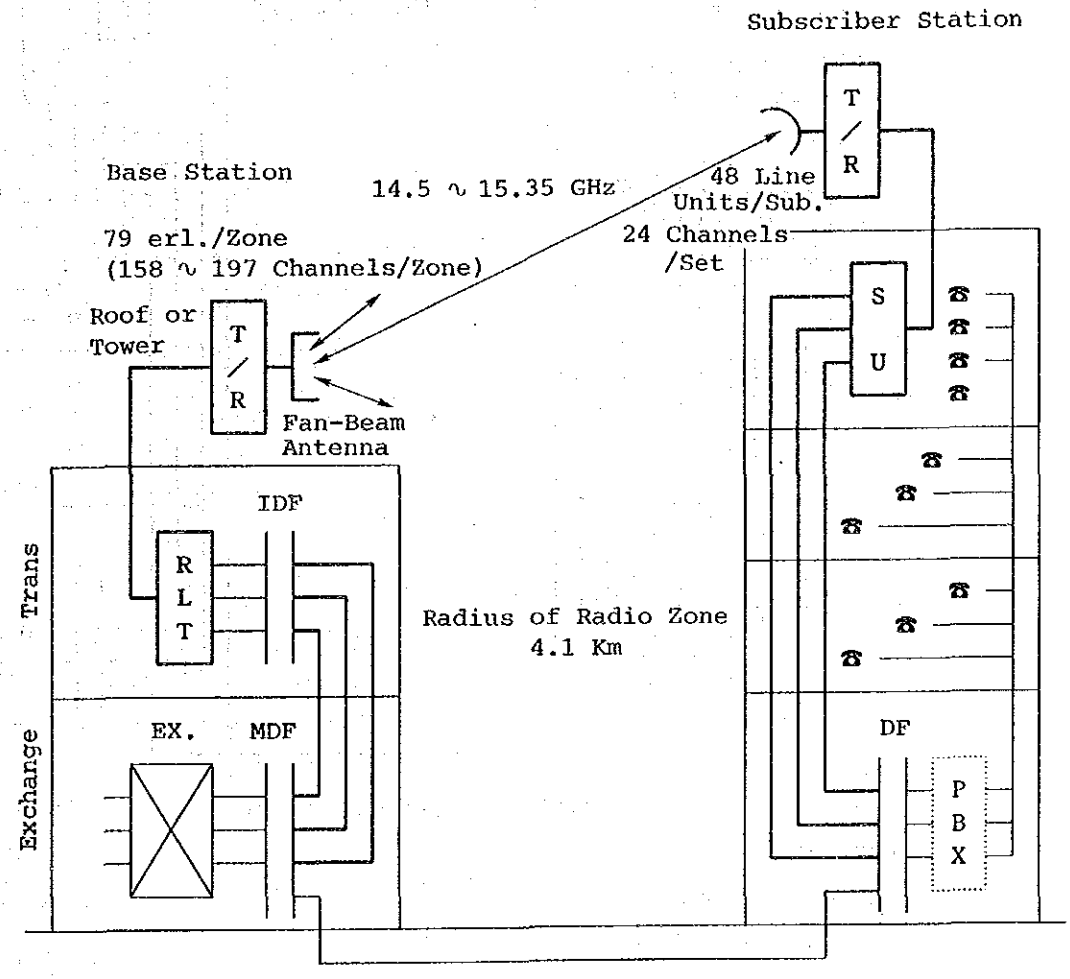


Fig. 7-3-10 Classification by Line Unit in Area

5) Summary

A summary of Chapter 7 is shown in Figs. 7-3-11 and 7-3-12.

a) P-MP System



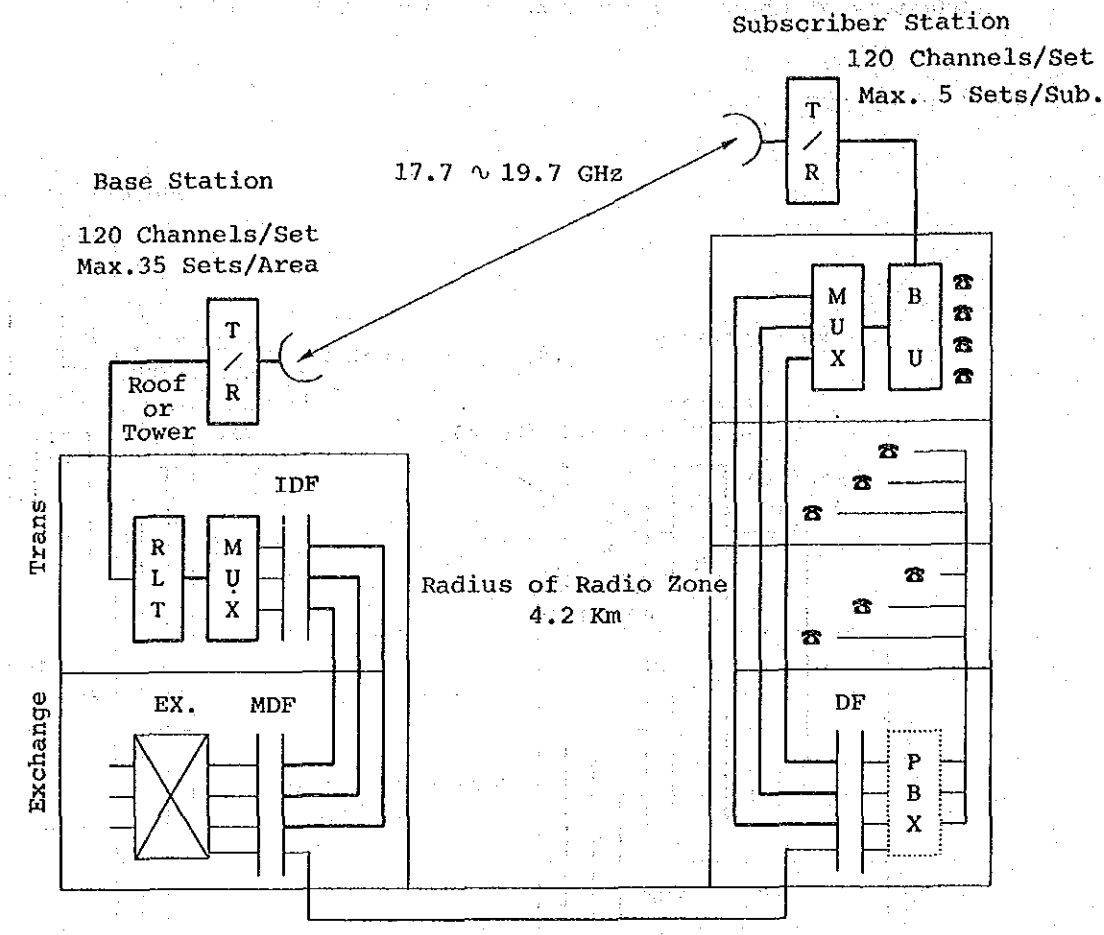
13 Areas
19 Zones
(11 SW Centers
1 High-rise Buil.
1 New WITEL-4
1 Tower Const.)

Cable Subscriber System

111 Subscriber Stations
2,417 Line Units

Fig. 7-3-11 Summary of P-MP System Application

b) P-P System



17 Areas

(15 SW. Center
1 High-rise Buil.
1 New WITEL-4
1 Tower Const.)

Cable Subscriber System

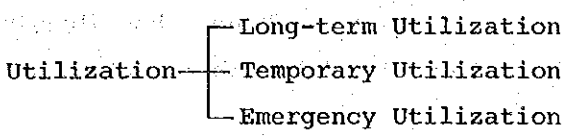
78 Subscriber Stations

12,003 Line Units

Fig. 7-3-12 Summary of P-P System Application

4) Utilization

Utilization is considered under the following classifications:



a) Long-term Utilization

Subscriber Stations which are selected from the viewpoint of economy should be utilized for a long period.

b) Temporary Utilization

Subscriber Stations which are selected from the viewpoint of difficulty of Cable Subscriber System construction, quality of existing subscriber lines, importance and other factors should be utilized temporarily.

In addition to the above, the P-P System should be available for temporary utilization in service areas where the frequency of exhibitions etc. is high.

The period of temporary utilization depends on the individual situation.

c) Emergency Utilization

The Microwave Subscriber System should be available for emergency utilization (in case of disaster, urgent demand etc.), because these systems can be installed rapidly.

For this purpose, these systems should be provided in advance as follows:

- P-MP System

  A Subscriber Station set should be provided in each tandem area.

- P-P System

  A P-P System (for Base Station and Subscriber Station) should be provided in each tandem area.

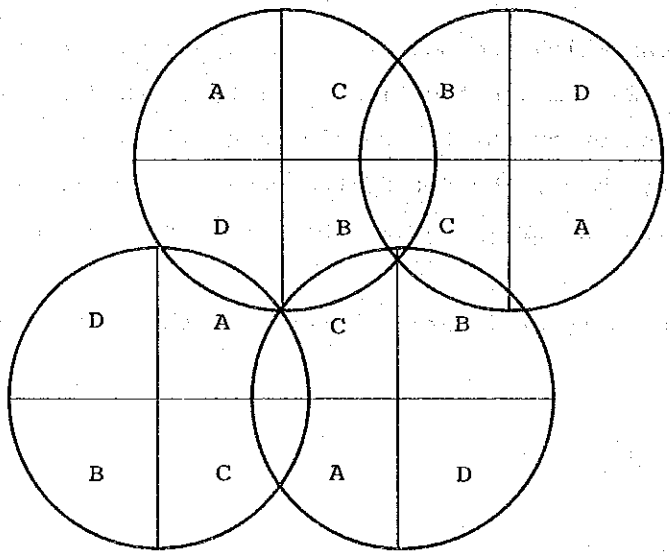
7.4 Verification

1) Technical Confirmation

Based on the establishment of application Areas, and Subscriber/Base Stations, the applicability of the Microwave Subscriber System is confirmed as follows:

a) P-MP System

The method of radio frequency channel assignment is shown in Fig. 7-4-1. According to this method, P-MP Systems can be used without over-reach interference in Jakarta.



A, B, C, D : Groups of Radio Frequency Channels

Fig. 7-4-1 Method of Radio Frequency Channel Assignment for P-MP System

b) P-P System

Interference should be studied in the worst case, which is defined as Front-Side Interference between channels of the same radio frequency.

The most severe Area is identified to be the SM-2 Area where 17 radio frequency channels exist within about 10 degrees.

Desired-to-Undesired Signal Ratio ([D/U]) is defined as follows:

$$[D/U] = Dd + Nd \quad (dB)$$

Where Dd : Attenuation by Antenna Directivity

Nd : Attenuation by Cross Polarization

Then

$$[D/U]_{d=10degrees} = 40 \text{ dB}$$

This value satisfies noise requirement, and thus it is possible to use the P-P System in Jakarta.

Taking into consideration demand after 1995 and emergent/temporary use, it is better to keep the number of radio frequency channels within the selected frequency band (17.7 ∿ 19.7 GHz)

2) Geographical Distribution

The geographical distribution of the applicable Subscriber Station is shown in Fig. 7-4-2.

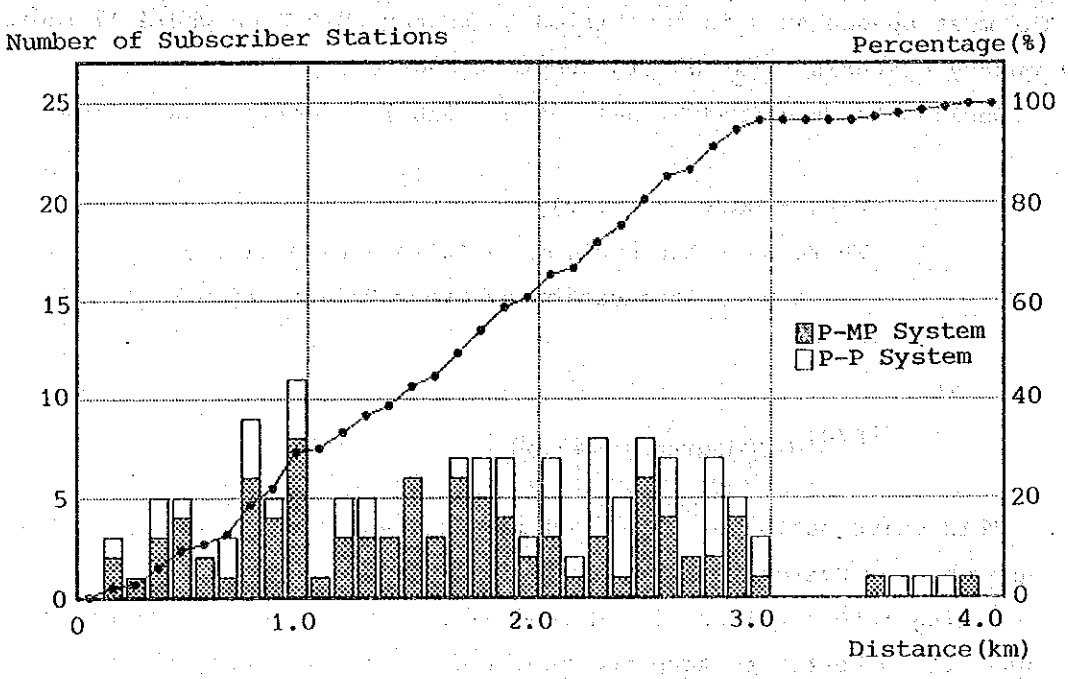
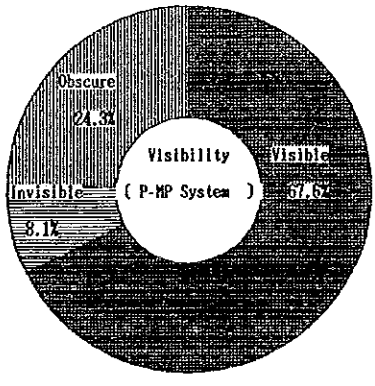


Fig. 7-4-2 Geographical Distribution of Applied Subscriber Stations

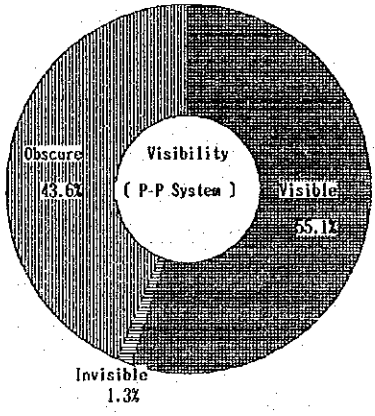
All of the applicable Subscriber Stations were established as being located within the radio Zones of P-MP / P-P System.

3) Visibility

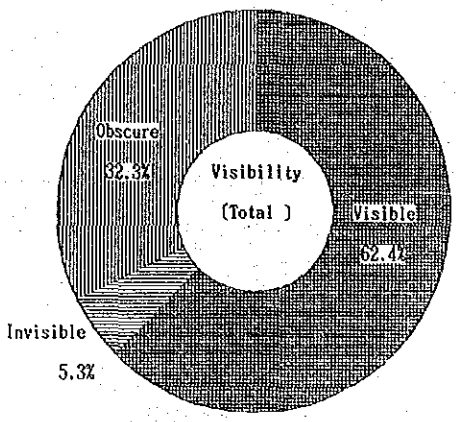
Visibility conditions for applicable Subscriber Stations are shown in Fig. 7-4-3.



P-MP System



P-P System



Total

Fig. 7-4-3 Visibility of Applicable Subscriber Stations

Most invisible / obscure Subscriber Stations will be made visible by the installation of antennas on the towers which are under construction or are planned to be constructed in the near future.

4) Terminal Equipment Situation

The utilization of terminal equipment (PBX, KT etc.) at the P-MP System Subscriber Stations is shown in Fig. 7-4-4.

The ratio of utilization is 83.1% of the number of applicable Subscriber Stations, so it can be judged that the application of the calling rate is reasonable.

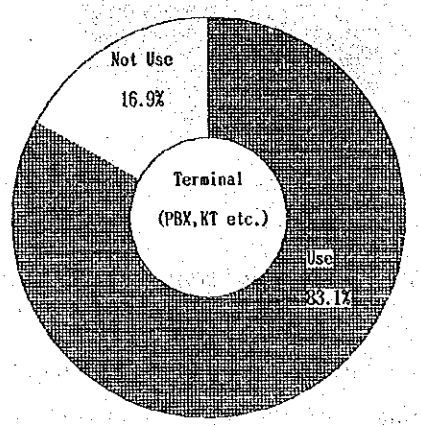


Fig. 7-4-4 Terminal Equipment Situation (PBX, KT etc.) of Applied Subscriber Stations

On the other hand, the ratio of utilization of other terminal equipment (Telex, Facsimile) which are used by the Microwave Subscriber System is indicated in Fig. 7-4-5.

The Microwave Subscriber System can handle telex, facsimile, low speed digital communication etc., and in particular, the P-P System can be used for high speed digital services (digital PBX, digital Facsimile, other data communications etc.) by changing the MUX to Multi-Media-MUX.

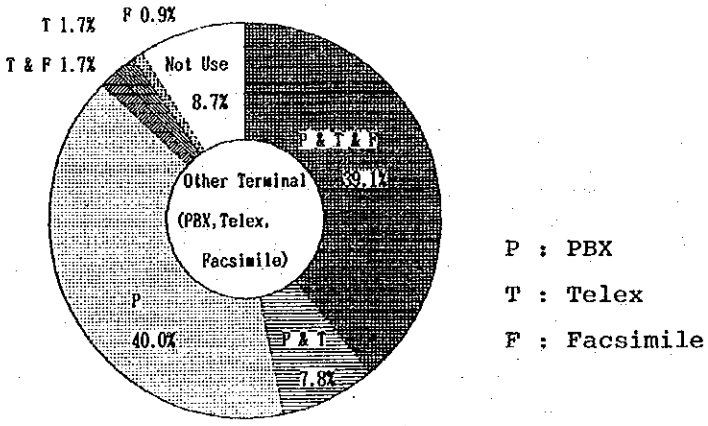


Fig. 7-4-5 Situation regarding Other Terminal Equipment of Applied Subscriber Stations

5) Improvement of Poor Quality Subscriber Lines

Poor quality subscriber lines will be improved by introduction of the Microwave Subscriber System.

The number of improvable Subscriber Stations / line units and the improvable rate are shown in Table 7-4-1.

Table 7-4-1 Improvement of Poor Quality Subscriber Lines

Item	No. of Subject		No. of Impr.		Impr. Rate	
	Sub.	Line Units	Sub.	Line Units	Sub.	Line Units
P-MP System	15	598	4	92	26.7%	15.4%
P-P System	17	3,279	17	1,422	100%	43.3%
Total	32	3,877	21	1,514	65.6%	39.1%

The improvable rate was less than 50%, because the application of the Microwave Subscriber System was limited by capacity and installation space.

CHAPTER 8

PROJECT IMPLEMENTATION

CHAPTER 8 PROJECT IMPLEMENTATION

8.1 General

1) Execution of Work

This Project comprises various kind of work such as implementation design, procurement of equipment/materials from several manufacturers and installation of cables, towers and equipment over a wide area in Jakarta.

In order to effectively complete this project within a short period, major items of work will be undertaken by the contractor nominated as the successful bidder in international competitive bidding and will be executed on a full turn-key basis including design, procurement and/or manufacturing, transportation, installation, testing/inspection, one year maintenance assistance, technology transfer and project management etc.

2) Coordination with Other Projects

In order to ensure that this Project makes good progress and is completed by the target date, coordination is to be made with the progress of other projects such as installation of the Cable Subscriber System and its related facilities.

3) Training

Training for technical staff to manage and maintain the system is to be prepared by the contractor within his Scope of Work.

This training is for PERUMTEL staffs who manage project execution and maintain facilities for the Microwave Subscriber System.

4) Maintenance Assistance

Maintenance assistance for this new Microwave Subscriber System is to be undertaken by the contractor for a period of one (1) year after completion of the work.

5) Employment of Consultant

To ensure the smooth execution of the work, a consultant who knows the situation regarding demand and telecommunications in Jakarta is to be employed, and is to conduct coordination, protect planning, bid document preparation/evaluation, basic design, screening detail design, witnessing of factory inspection, work supervision, final workmanship assessment and coordination with other projects.

8.2 Project Implementation Plan

1) Implementation Schedule

The target date for completion of all work is the end of 1994.

The implementation of the work is to be conducted in four (4) phases in accordance with a project implementation schedule as shown in Table 8-2-1.

a) The details of each phase of work are as follows :

① First phase :

- Selection and determination of consultant by PERUMTEL
- Engineering design and supervisory work up to witnessing of acceptance test by consultant
- Implementation design, equipment/material procurement and installation work of system including training and one year maintenance assistance by contractor

Implementation work in this stage includes the following facilities :

- Subscriber Stations : P-MP/P-P System coping with demand up to 1991
- Base Stations : P-MP System coping with demand up to 1994
  : P-P System coping with demand Up to 1991

② Second to Fourth Phases :

: Each phase of implementation work is to be conducted by PERUMTEL itself on an optional basis.

- Supervisory work up to witnessing of acceptance test by PERUMTEL
- Implementation design, equipment/material procurement and installation work by contractor

Implementation work in each stage includes the following facilities :

. Subscriber Stations	:	P-MP/P-P System coping with demand up to end of each year (1992, 1993, and 1994)
. Base Stations	:	P-P System coping with demand up to end of each year (1992, 1993 and 1994)

b) The period of each kind of work is estimated as follows :

i) Selection and determination of consultant	:	6 Months
ii) Consultancy work		
. Survey, engineering design and permission for use of Subscribers' buildings	:	3 Months
. Selection of contractor	:	2 Months
. Supervision of contractor's work	:	15 Months
iii) Contractor's work		
. Implementation design	:	3 Months
. Manufacturing/transportation	:	7 - 14 Months
. Installation work including test	:	7 Months
. Maintenance assistance	:	12 Months

Each of the above is for the first phase of implementation work. Each subsequent phase of implementation work is to be completed within ten (10) months.

Table 8-2-1 Project Implementation Schedule

MONTH NUMBER	-14 -13 -12 -11	-10 -9 -8 -7	-6 -5 -4 -3	-2 -1 1 2	3 4 5 6	7 8 9 10	11 12 13 14	15 16 17 18	19 20 21 22	23 24 25 26	27 28 29 30	31 32 33 34	35 36 37 38	39 40 41 42	43 44 45 46	47 48 49 50	51 52 53 54	55 56 57 58
CALENDAR YEAR	1989			1990			1991			1992			1993			1994		
MONTH	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4	5 6 7 8	9 10 11 12
EVENT				CONTRACT FOR CONSULTING SERVICE	CONTRACT OF PROJECT		COMMENCEMENT OF INSTALLATION WORK	COMPLETION OF WORK COMMENCEMENT OF SERVICE										
SERVICE ITEMS																		
P M C	I. PMC OPTION 1) DESIGN 2) TENDER/EVALUATION/AWARD 3) CONSTRUCTION				EXPECTED SCHEDULE				*1)			*2) BY PERUMTEL			*2) BY PERUMTEL			*2) BY PERUMTEL
PERUMTEL'S TASK	II. SELECTION OF CONSULTANT 1) PREPARATION/APPROVAL OF TOR, S/L, L/I 2) TENDER 3) EVALUATION/AWARD/APPROVAL																	
CONSULTANT'S TASK	III. 1) SURVEY, ENGINEERING DESIGN AND RECEIVING PERMISSION 2) SELECTION OF CONTRACTOR 3) SUPERVISION OF DETAILD DESIGN 4) WITNESSING FACTORY TEST 5) SUPERVISION OF INSTALLATION WORK 6) WITNESS ACCEPTANCE TEST																	
CONTRACTOR'S TASK	IV. 1) IMPLEMENTATION DESIGN 2) MANUFACTURING 3) TRANSPORTATION 4) EQUIPMENT INSTALLATION a) BASE STATION NO. 1 GROUP NO. 2 GROUP NO. 3 GROUP b) SUBSCRIBER STATION NO. 1 GROUP NO. 2 GROUP NO. 3 GROUP 5) CABLE AND OTHER a) BASE STATION NO. 1 GROUP NO. 2 GROUP NO. 3 GROUP b) SUBSCRIBER STATION NO. 1 GROUP NO. 2 GROUP NO. 3 GROUP 6) TEST 7) TRAINING a) FACTORY (CLASS ROOM) b) LOCAL (CLASS ROOM) (ON THE JOB) 8) ONE YEAR MAINTENANCE ASSISTANCE																		

Note: *1) DEPEND ON SCHEDULE FOR CABLE MANUFACTURING, APPROVAL FOR EXCAVATION AND FINANCE ARRANGEMENT
*2) PERUMTEL SHALL DIRECTLY CONDUCT THIS WORK AS OPTIONAL WORK TO THE CONTRACTOR'S CONCERNED
3) ——— : CONTINUOUSLY EXECUTED
---- : OCCASIONALLY EXECUTED

2) Installation Work

Installation work of equipment and other associated materials in each phase is to be conducted in accordance with a priority order due to the importance of Subscriber Stations to be relieved by this system as shown in Table 8-2-2.

Table 8-2-2 Priority Order of the Area

Priority Order	Name of Area
No. 1 group	SM-2, SM-1, GB-1, GB-2
No. 2 group	KAL, KB, SLP, CPP, PLM, JT
No. 3 group	PLT, CPE, PSR, RMG, KT-2, CAW, ANC, TBT

A priority order in each area was established according to the following procedure :

Step 1 Criteria for priority order

The priority order for relief by this system is to be selected in proportion to the number of line units of the following Subscriber Stations included in the area.

① Additional Subscriber Stations up to 1994
② Waiting Subscriber Stations as of 1988
③ Important Subscriber Stations
④ Subscriber Stations which are difficult in the construction of Cable Subscriber System
⑤ Subscriber Stations with poor quality

Step 2 In accordance with criteria stipulated in step 1, areas are classified into three (3) kinds according to the following factors;

◎ : more than 1,000 Line Units

o : 100 ∿ 1,000 Line Units

Δ : less than 100 Line Units

The above result is indicated in Table 8-2-3.

Step 3 Each area classified by step 2 is grouped in accordance with the following procedure;

I : Areas in which ◎ are one or more

II : Areas in which o are one or more

III : Only Δ and -

The above result is indicated in Table 8-2-3.

Table 8-2-3 Classification of Areas and Area Grouping

	Criteria					
Area Name	1	2	3	4	5	
ANC	-	-	-	-	-	III
CAW	Δ	Δ	-	-	-	III
CPP	o	Δ	Δ	-	o	II
CPE	Δ	Δ	-	Δ	-	III
GB-1	◎	◎	Δ	o	-	I
GB-2	◎	o	o	o	-	I
JT	o	Δ	-	-	-	II
KAL	o	Δ	-	o	-	II
KB	o	Δ	Δ	Δ	Δ	II
KT-2	Δ	Δ	Δ	-	-	III
PLM	o	Δ	Δ	Δ	Δ	II
PSR	Δ	Δ	-	-	-	III
PLT	Δ	Δ	Δ	Δ	-	III
RMG	Δ	Δ	-	Δ	-	III
SM-1	◎	o	Δ	-	◎	I
SM-2	◎	o	o	◎	o	I
SLP	o	Δ	Δ	o	-	II
TBT	-	-	-	-	-	III

Step 4 Priority order in each group is subject to that of the total number of line units in each area. This order is shown in Table 8-2-4.

Table 8-2-4 Priority Order in Each Group

Group	Priority order							
	1	2	3	4	5	6	7	8
I	SM-2	SM-1	GB-1	GB-2				
II	KAL	KB	SLP	CPP	PLM	JT		
III	PLT	CPE	PSR	RMG	KT-2	CAW	ANC	TBT

3) System to be installed

The number of sets to be installed in each area within each phase of the work is shown in Table 8-2-5.

Table 8-2-5 Number of Sets to be installed

Priority		Area Name	Sys. Name	1991		1992		1993		1994		Total	
				B	S	B	S	B	S	B	S	B	S
I	1	SM-2	P-MP	3	20	0	3	0	3	0	2	3	28
			P-P	20	20	10	10	5	5	0	0	35	35
	2	SM-1	P-MP	1	6	0	0	0	0	0	1	1	7
			P-P	20	20	0	0	0	0	0	0	20	20
	3	GB-1	P-MP	2	14	0	2	0	5	0	0	2	21
			P-P	23	23	0	0	0	0	4	4	27	27
	4	GB-2	P-MP	2	17	0	0	0	0	0	2	2	19
			P-P	12	12	1	1	0	0	5	5	18	18
SUB TOTAL			P-MP	8	57	0	5	0	8	0	5	8	75
			P-P	75	75	11	11	5	5	9	9	100	100
II	1	KAL	P-MP	1	4	0	0	0	2	0	0	1	6
			P-P	3	3	0	0	6	6	3	3	12	12
	2	KB	P-MP	2	12	0	3	0	1	0	1	2	17
			P-P	1	1	0	0	0	0	0	0	1	1
	3	SLP	P-MP	0	0	0	0	0	0	0	0	0	0
			P-P	2	2	0	0	0	0	1	1	3	3
	4	CPP	P-MP	1	8	0	0	0	0	0	1	1	9
			P-P	0	0	0	0	0	0	0	0	0	0
	5	PLM	P-MP	1	8	0	0	0	1	0	1	1	10
			P-P	0	0	0	0	1	1	0	0	1	1
	6	JT	P-MP	2	7	0	4	0	2	0	0	2	13
			P-P	2	2	0	0	0	0	0	0	2	2
SUB TOTAL			P-MP	7	39	0	7	0	6	0	3	7	55
			P-P	8	8	0	0	7	7	4	4	19	19
III	1	PLT	P-MP	1	3	0	0	0	0	0	1	1	4
			P-P	1	1	0	0	0	0	0	0	1	1
	2	CPE	P-MP	0	0	0	0	0	0	0	0	0	0
			P-P	1	1	0	0	2	2	1	1	4	4
	3	PSR	P-MP	0	0	0	0	0	0	0	0	0	0
			P-P	1	1	0	0	0	0	0	0	1	1
	4	RMG	P-MP	1	3	0	0	0	0	0	0	1	3
			P-P	1	1	0	0	0	0	0	0	1	1
	5	KT-2	P-MP	1	7	0	0	0	1	0	0	1	8
			P-P	1	1	0	0	0	0	0	0	1	1
	6	CAW	P-MP	1	4	0	1	0	2	0	1	1	8
			P-P	0	0	0	0	0	0	1	1	1	1
	7	ANC	P-MP	0	0	0	0	0	0	0	0	0	0
			P-P	0	0	1	1	0	0	0	0	1	1
	8	TBT	P-MP	0	0	0	0	0	0	0	0	0	0
			P-P	0	0	0	0	0	0	1	1	1	1
SUB TOTAL			P-MP	4	17	0	1	0	3	0	2	14	23
			P-P	5	5	1	1	2	2	3	3	11	11
TOTAL			P-MP	19	113	0	13	0	17	0	10	19	153
			P-P	88	88	12	12	14	14	16	16	130	130

Note : B ... Number of Sets in Base Station

S ... Number of Sets in Subscriber Station

8.3 Alternative Project Implementation Plan

In the execution of this Project, the following three (3) kinds of alternative implementation plan can be considered according to the characteristics of each group in Table 8-2-2.

1) Alternative Case 1 (Implementation of No. 1 group only)

This group includes Subscriber Stations which have the most high priority line units to be urgently relieved by this system and present the most difficulties in construction by means of the Cable Subscriber System.

2) Alternative Case 2 (Implementation of No. 1 and No. 2 group only)

These groups and the areas excluding No. 3 group with a smaller level number of demand initially.

3) Alternative Case 3 (Implementation of SM-1, GB-1 and GB-2 in No. 1 group)

These areas are those having no plan for installation of subscriber lines to meet current and future demand.

The results of the Study for each of the above alternative cases are given in Attachment-9.

8.4 Operation and Maintenance

1) Concept

Telecommunication facilities depend a great deal upon whether the system is operated and maintained rationally and efficiently.

In addition, this system is the first introduction of a subscriber system by means of a Digital Microwave System in the Republic of Indonesia and a large number of Subscriber Stations will be included in this system over a wide area in Jakarta.

For these reasons, it is necessary to establish an operation and maintenance organization for this system.

2) Operation and Maintenance Organization

In principle, the organization for operation and maintenance for this system should be established in WITEL-IV of PERUMTEL where control of all telecommunication facilities in the Jakarta Area is handled.

The present organization concerning operation and maintenance for radio systems is illustrated in Fig. 8-4-1.

Taking into consideration the following characteristics of radio system operation and maintenance, it is not necessary to provide maintenance and operation staff at every Switching Center.

i) Transmission equipment, which is installed in every Base Station and Subscriber Station, is designed and produced to a high level of reliability.

ii) Through the use of supervisory equipment, it is possible to monitor the operational status of this new system from a station which is staffed with full-time maintenance personnel (hereinafter referred to as the "Maintenance Center")

a) Maintenance Staffing

At present, the radio equipment maintenance division is sufficiently staffed with full-time maintenance personnel mainly for microwave radio systems.

Taking into consideration the above situation and the increased amount of equipment to be maintained, maintenance staffing in conformity with this system is shown below; these staff members are to be incorporated into the present organization of the radio equipment maintenance division in the SM-2 Switching Center as shown by the thick line in Fig. 8-4-1.

Engineer : 1

Technicians : 3

In addition, measuring equipment, spare parts, tools, etc. necessary for maintenance of this system are to be provided as explained below.

i) Measuring equipment for maintenance which is used frequently should be distributed to each Base Station, and measuring equipment which is not used frequently should be held in stock at the Maintenance Center.

ii) Spare panels and spare parts should be held in stock at the Maintenance Center. As for maintenance tools and consumables, a minimum number should be distributed to each Base Station.

iii) Periodical tests, inspections and trouble shooting are to be carried out by the maintenance staff of the Maintenance Center.

b) Operational Staffing

The function of the operation staff for this system is only supervision of alarm indications when a fault occurs in this system.

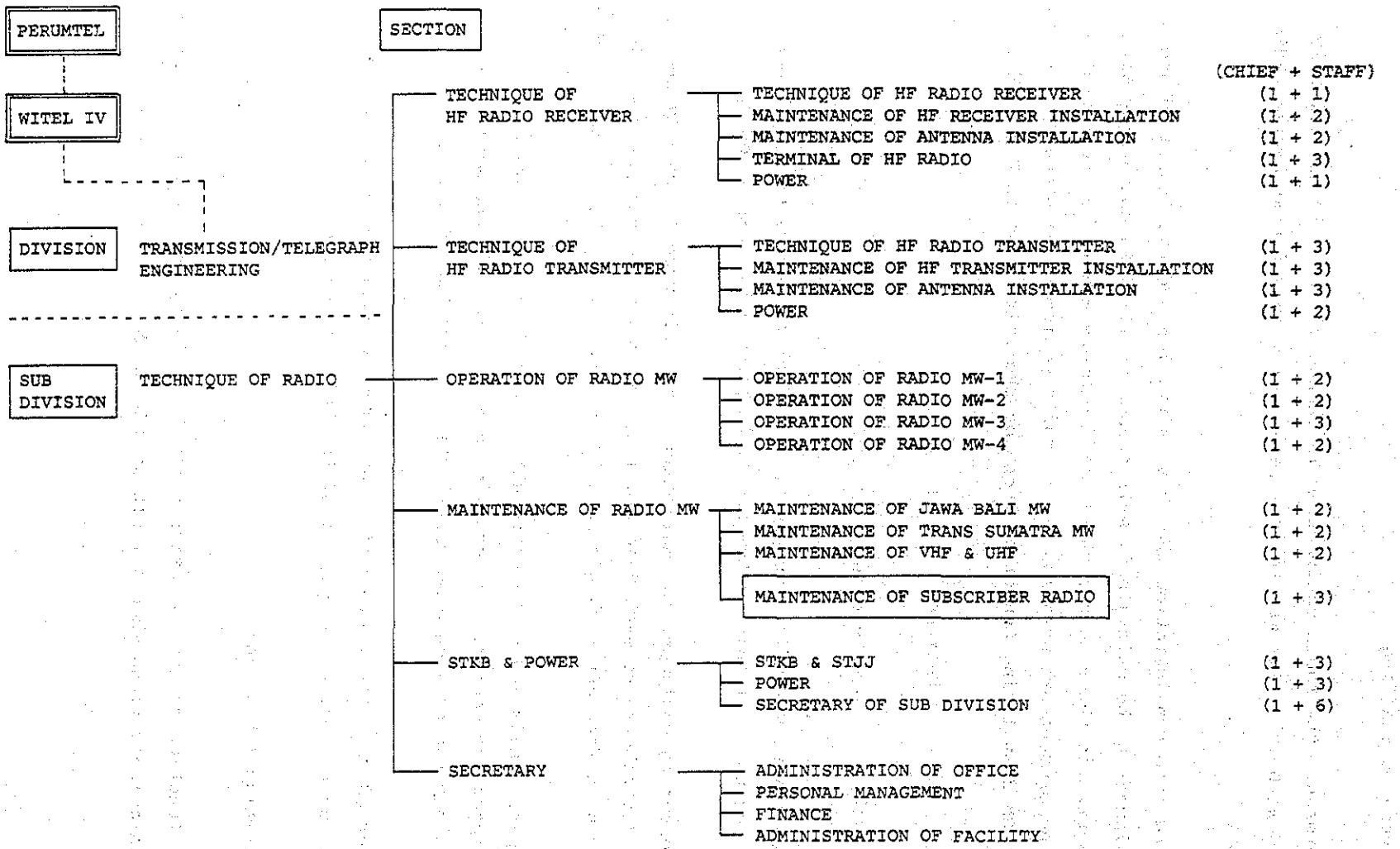


Fig. 8-4-1 Maintenance Organization

The operation staff then inform the maintenance staff who carry out trouble-shooting.

Therefore, the function of operation staff is very simple and it is possible for the present staff to supervise this system.

For this reason, there is no need to increase the operation staff with the addition of this new system.

3) Training

Training for maintenance and project management staff of PERUMTEL is to be carried out by the contractor in the following manner :

a) Categories

Training comprises two (2) categories. One is in-factory training in the contractor's country for the engineer class by classroom lectures.

The other is domestic training for technicians in Indonesia by classroom lectures and on-the-job-training.

b) Number of Trainees

Engineers to be trained in the contractor's country are two (2), and technicians to be trained are six (6) for lectures and six (6) for on-the-job-training.

c) Period

The training period in the contractor's factory is one (1) month, and domestic training is one (1) month for classroom lectures and two (2) months for on-the-job-training respectively.

8.5 Project Cost Estimation

1) Preconditions

Preconditions for project cost estimation are as described below.

i) This Project is implemented in accordance with the implementation schedule given in Table 8-2-1 Project Implementation Schedule.

ii) Installation work is executed as a full turn-key base contract awarded to the successful bidder in international tender.

iii) A consultant is employed to expedite smooth progress of project implementation including engineering design, examination, bid evaluation, work supervision and acceptance inspection.

iv) Cost of training for operation and maintenance of the facilities installed by this Project is included in the project cost.

v) The exchange rate to be used in cost calculation is
US$1 = ¥130
¥1 = Rp. 12.5

vi) Costs necessary for system installation in each subscriber's building, such as permission and hiring charges, are not included in this cost estimation.

vii) The ratio of staffs (but except for the labours for construction) belonging to consultant and contractor for the implementation of the Project is:
Local/Foreign = more than one (1) in the ratio of total Man-Month

2) Material and Equipment Procurement

For main materials and equipment to be used in this Project, classification of the procurement method is to be as follows :

a) Procurement by Foreign Currency

i) Radio system (P-P and P-MP system)

- Antennas
- Transmitters and receivers
- Radio link terminals, subscriber units and base band units
- Multiplexers (only for P-P system)
- Spare parts and manuals

ii) Measuring equipment

- Measuring equipment necessary for this Project
- Special tools

b) Procurement by Local Currency

i) Cables and wires

ii) Steel structures and foundation materials

iii) Other miscellaneous materials for construction such as PVC pipes, metal and tools.

3) Project Cost Estimation

The unit price for calculation of this Project cost is based on the standard price adopted by PERUMTEL and the unit price used in recent projects of the same kind.

In addition, the under-mentioned points are also taken into consideration:

- The both of foreign and local engineers are expected to participate in the engineering/implementation design and supervision of installation work.

- After completion of work by the contractor handling demand up to 1991, subsequent actual work in 1992, 1993 and 1994 should be directly carried out by PERUMTEL on an optional basis with the contractors concerned.

- Witnessing of factory inspection and acceptance testing is to be included in the consultancy service fee.

a) Equipment and Material Cost for Radio System (P-P and P-MP system)

Rp. 20,942 Million
(Foreign Currency portion ¥1,675 Million)
(Local Currency portion -)

b) Installation Cost including Materials, and Tools during Installation Work.

Rp. 5,171 Million
(Foreign Currency portion ¥176 Million)
(Local Currency portion Rp. 2,971 Million)

c) Measuring Equipment necessary for Project Implementation and Maintenance Work.

Rp. 362 Million
(Foreign Currency portion ¥29 Million)
(Local Currency Portion -)

d) Training

Numbers and cost of maintenance and installation personnel to receive training during this Project are shown below:

i) Training Items and Number of Trainees

Training Item	In Indonesia	Overseas	Total
Radio/Transmission (lectures)	6 x 1 month	2 x 1 month	8 man-months
On-The-Job-Training	6 x 2 months		12 man-months

ii) Training Cost

Rp. 277 Million
(Foreign Current portion ¥20 Million)
(Local Currency portion Rp. 23 Million)

e) Maintenance Assistance (One year)

After project completion, the contractor will provide maintenance assistance for one year.

Rp. 262 Million
(Foreign Currency portion ¥16 Million)
(Local Currency portion Rp. 66 Million)

f) Consultancy Service

Work items to be consigned to the consultant employed for project implementation and the cost of the consultancy service to be provided by the consultant are listed below:

i) Consignment Work Items

- Survey and receiving permission for Subscriber Stations
- Preparation of engineering design drawing
- Preparation tender of documents and bid evaluation
- Review/check of detailed design drawings
- Review/check of equipment/materials supplied as well as installation practices.
- Review/check of work progress and cost
- Witnessing of to factory inspection of equipment and material to be supplied
- Supervision of installation work
- Witnessing of to interim inspection and final acceptance test

i) Consultancy Service Cost

Rp. 2,412 Millon
(Foreign Currency portion ¥146 Million)
(Local Currency portion Rp. 584 Million)

4) Total Project Cost

As a result of above each cost estimation, total project cost including contingency is indicated below:

Rp. 32,369 Million
(Foreign Currency portion ¥2,269 Million)
(Local Currency portion Rp. 4,009 Million)

The exchange rate is applied as ¥1 = Rp. 12.5.

Breakdown of the above is shown in Table 8-5-1 and 8-5-2.

Table 8-5-1 Equipment/Installation Cost in each Area

Unit: Million

	1991			1992			1993			1994			P-MP Total	P-P Total	Grand Total	Total in Rp.
	P-MP	P-P	Total	P-MP	P-P	Total	P-MP	P-P	Total	P-MP	P-P	Total				
ANC					8.3	8.3								8.3	8.3	
					8.4	8.4								8.4	8.4	112.2
CAW	23.4		23.4	1.5		1.5	2.9		2.9	1.0	8.3	9.4	28.9	8.3	37.2	
	19.0		19.0	1.3		1.3	3.4		3.4	1.1	8.4	9.6	24.7	8.4	33.1	498.0
CPE		8.3	8.3								8.3	8.3		16.6	16.6	
		8.4	8.4								8.4	8.4		16.9	16.9	224.5
CPF	29.3		29.3							1.0		1.0	30.4		30.4	
	25.7		25.7							1.1		1.1	26.8		26.8	406.3
GB1	53.7	191.0	244.7	2.9		2.9	6.9		6.9		33.2	33.2	63.6	224.2	287.8	
	46.9	178.7	225.6	2.6		2.6	8.6		8.6		26.0	26.0	58.1	204.7	262.8	3,860.0
GB2	58.3	99.6	158.0		8.3	8.3				2.3	41.5	43.8	60.6	149.5	210.1	
	50.8	93.6	144.4		5.8	5.8				2.3	34.4	36.7	53.1	133.9	187.0	2,813.3
JT	44.0	16.6	60.6	5.9		5.9	2.9		2.9				52.8	16.6	69.4	
	33.4	16.9	50.3	6.7		6.7	3.4		3.4				43.5	16.9	60.4	928.5
KAL	23.4	24.9	48.3				2.9	49.8	52.8		24.9	24.9	26.4	99.6	126.0	
	18.2	25.3	43.5				3.4	40.3	43.6		20.1	20.1	21.5	85.8	107.3	1,682.5
KB	50.7	8.3	59.0	4.4		4.4	1.3		1.3	1.1		1.1	57.5	8.3	65.8	
	42.7	8.4	51.2	3.8		3.8	1.2		1.2	1.9		1.9	49.7	8.4	58.1	880.5
KT2	27.6	8.3	35.9				1.1		1.1				28.7	8.3	37.0	
	25.1	8.4	33.6				1.9		1.9				27.0	8.4	35.5	497.9
PLM	29.1		29.1				1.5	8.3	9.8	1.3		1.3	31.8	8.3	40.2	
	26.4		26.4				1.3	8.4	9.7	1.2		1.2	28.9	8.4	37.3	539.2
PSR		8.3	8.3											8.3	8.3	
		8.4	8.4											8.4	8.4	112.2
PLT	21.7	8.3	30.0							1.3		1.3	23.0	8.3	31.3	
	16.8	8.4	25.3							1.2		1.2	18.0	8.4	26.4	417.9
RMG	22.0	8.3	30.3										22.0	8.3	30.3	
	16.9	8.4	25.3										16.9	8.4	25.3	403.5
SM1	26.4	166.1	192.4							1.0		1.0	27.4	166.1	193.5	
	22.3	137.8	160.1							1.1		1.1	23.4	137.8	161.2	2,579.9
SM2	79.1	166.1	245.2	4.4	83.0	87.5	3.8	41.5	45.3	2.5		2.5	89.9	290.6	380.5	
	67.6	156.0	223.6	3.8	68.9	72.7	3.6	31.8	35.4	2.4		2.4	77.5	256.7	334.1	5,090.7
SLP		16.6	16.6								8.3	8.3		24.9	24.9	
		16.9	16.9								5.8	5.8		22.7	22.7	334.1
TBT											8.3	8.3		8.3	8.3	
											8.4	8.4		8.4	8.4	112.2
Preinstal-	28.0	41.5	69.5										28.0	41.5	69.5	
lation	10.9	16.2	27.2										10.9	16.2	27.2	895.8
Foreign	516.8	772.3	1,289.1	19.1	99.6	118.8	23.4	99.6	123.0	11.6	132.9	144.5	570.9	1,104.4	1,675.4	
Local	422.7	692.1	1,114.8	18.2	83.2	101.4	26.6	80.6	107.2	12.3	111.8	124.1	479.9	967.6	1,447.5	
Total in Rp.	6,882.5	10,345.5	17,228.0	257.4	1,328.8	1,586.2	319.0	1,326.2	1,645.2	157.4	1,772.6	1,930.0	7,616.4	14,773.0	22,389.4	22,389.4

Note 1: The upper rows show equipment and material costs in terms of foreign currency (¥).
Note 2: The lower rows show installation related costs in terms of local currency (Rp.)
Note 3: Common expenses such as the consultant fee and engineering fee are not included.

Table 8-5-2 Total Project Cost

	PHASE 1				PHASE II		PHASE III		PHASE IV		Total		Grand Total in Rp.
	1990		1991		1992		1993		1994				
	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	
1. Equipment/Material													
P-MP System			517		19		23		12		571		7,137
P-P System			772		100		100		133		1,104		13,805
2. Design/Installation	35	417	90	1,920	16	189	17	206	18	238	176	2,971	5,171
3. Measuring Equipment			29								29		362
4. Training			20	23							20	23	277
5. Maintenance Assistance			16	66							16	66	262
6. Consultant	71	408	75	176							146	584	2,412
7. Subtotal (1.+2.+3.+4.+5.+6.)	107	825	1,519	2,185	135	189	140	206	162	238	2,063	3,644	29,426
8. Contingency	11	83	152	219	13	19	14	21	16	24	206	364	2,943
9. Total	117	908	1,671	2,404	148	208	154	226	178	262	2,269	4,008	
10. Grand Total in Rp.	2,373		23,295		2,061		2,148		2,491		-		32,369

Note 1: Foreign Currency: Million ¥
: Local Currency : Million Rp.
Note 2: ¥1 = Rp.12.5

CHAPTER 9

FINANCIAL AND ECONOMIC ANALYSIS

CHAPTER 9 FINANCIAL AND ECONOMIC ANALYSIS

9.1 General

This chapter examines the financial and economic feasibility of this Project, using the internal rate of return (referred to as IRR) method for benefit / cost analysis. In addition to this analysis, influence and significance of the Project are also evaluated from a socioeconomic standpoint. This chapter is composed of the following analyses.

1) Financial Benefit / Cost Analysis

The financial IRR (FIRR) is calculated on all equity to examine the benefit of the Project.

2) Sensitivity Analysis

The amount of the FIRR is calculated when benefit and cost vary during project life.

3) Socioeconomic Analysis

The socioeconomic significance and contribution to society of the Project are evaluated from the viewpoint of national welfare.

4) Overall Evaluation

Considering the results of the above analyses, the feasibility and social benefit of the Project are evaluated.

9.2 Premise of Financial and Economic Analysis

1) Project Life

Although PERUMTEL assumes the life time of radio equipment to be 15 years, as far as this evaluation is concerned, the project life is assumed to be 20 years which has been agreed with the Indonesian side. In making the project life assumption, it is also taken account of the design standards/present quality conditions of radio equipment and the ordinary project life of a telecommunication feasibility study.

The project life begins in 1991 when system operation is started and expires in 2010.

2) Salvage Value

The salvage value of equipment after the end of its life time is assumed to be the same as the equipment removal cost. Therefore the salvage value is regarded to be zero.

3) Sunk Cost

The cost is not included in the project cost. Only additional cost originated from the Project is evaluated. Costs already incurred are not considered.

4) Inflation Rate

The effect of inflation is not considered basically, because it requires forecasting of uncertain future economic situations. But this effect is examined in the sensitivity analysis.

5) Currency Exchange Rate

All benefits and costs are calculated in Rupiah and are based on the average annual exchange rate in recent years. The following exchange rate is used for the estimation.

US$1 = ¥130

¥ 1 = Rp. 12.5

6) Cost and Benefit Estimation

The present charging system and average call charge revenue are used to estimate telephone revenue. Traffic incoming revenue from outside the Jakarta area might be an additional revenue for PERUMTEL, but it is not included in revenue items, for the purpose of measuring the benefit of the Project itself. In addition, the estimation of traffic incoming revenue involves difficulties in collecting the related data and determining traffic originating locations.

For maintenance and operation cost estimation, PERUMTEL's financial practice is taken into consideration.

7) Financial Loan

Financial loan is not included in revenue items, because the FIRR calculation on all equity is based on the amount of cash on hand. For the same reason, interest and repayment are excluded from cost items.

9.3 Revenue and Cost Estimation

1) Revenue Estimation

A telecommunication facility cannot generate a sufficient revenue until each facility is harmonized with the other related facilities. The revenue accrued to this Project is generated by compensating for the deficiencies of subscriber lines for which implementation of the expansion program is behind schedule.

As the subscriber lines installed under the Project can be utilized for telephones (including facsimile and low speed data telecommunication use, etc.), only telephone revenue is estimated. The revenue of the Project is composed of the following items:

Installation Fee	:	Rp. 500,000
Periodic Subscription Fee:		Rp. 3,500
(Monthly Rental Fee)		
Usage Charge	:	Average revenue per line unit

The installation fee is classified into seven charging ranks and the WITEL-IV belongs to the highest rank. The monthly rental fee is classified into Rp. 3,500 and Rp. 2,000, which reflect the concept of equity among regions.

Usage charge revenue consists of automatic calls, operator assisted calls and access charge for international calls. The average usage revenue per line unit is estimated based on the pulses for a month in the subject Area.

a) Procedure for Estimation of Average Revenue

Annual usage charge revenue per line unit is calculated according to the following equation:

$$R(A) = PS \times WD \times Rp.75$$

R(A) : Automatic Call Revenue per Line Unit

PS : Number of Pulses per Line Unit per Day

WD : Working Days of Equipment a Year (300 days)

Rp.75: Unit Price for One Pulse

Average revenue per line unit is calculated according to the following equation:

$$RA = R(A) + R(O) + R(I)$$

AR : Average Revenue per Subscriber

R(O) : Operator Assisted Call Charge Revenue

R(I) : Access Charge for International Call

Note 1 : PS, R(O) and R(I) is calculated according to PMC, REPELITA-V INVESTMENT PROGRAM ANNEX, FEB. 1988.

Note 2 : The working days are calculated by subtracting Sundays and national holidays in Indonesia from 365 days.

The transition of telephone usage charge revenue per line unit is shown in Table 9-3-1. The revenue has been increasing steadily in recent years in spite of some fluctuation. Based on the above equation and the table, the average revenue per line unit is estimated to be Rp.920,000 in 1988. This average revenue is assumed to continue during the project life.

Table 9-3-1 Transition of Telephone Usage Charge Revenue

Unit: Rp.

Year	International access charge	Automatic call	Operator assisted call	Total
1982	31,991	588,001	17,460	637,452
1983	45,215	758,823	19,459	823,497
1984	42,635	753,375	20,945	816,955
1985	74,294	817,238	22,532	914,064
1986	77,418	812,765	20,258	910,441

Source: PMC, REPELITA-V INVESTMENT PROGRAM ANNEX, FEB. 1988

b) Procedure for Total Revenue

The total revenue is calculated according to following equation:

Total revenue = (Installation Fee x No. of New Lines)
+ (Periodic Subscription Fee + Usage Charge)
x Accumulated No. of New Lines

c) Estimation of Removal Ratio

The removal ratio is assumed, because a part of the Microwave Subscriber System is expected to be substituted by a Cable Subscriber System in a future. To assume this ratio the following subscriber conditions are considered.

C : Cost advantage
I : Important Subscriber Station
D : Difficult cable construction
Q : Quality improvement
O : Others: consideration of the effectiveness of line accommodation (only applied to P-MP System)

Applicable Subscriber Stations are selected in accordance with the following priority justification as explained previously in Chapter 7.1.

P-MP System: C > I > D > Q > O
P-P System : C > I > D > Q

It is determined to remove the Subscriber Stations in lower priority order and that the Subscriber Station who has two or more than two conditions is excluded from the object of removal. The removal ratio is assumed as shown in the following table.

Table 9-3-2 Assumption of Removal Ratio

Subscriber's condition	Removal ratio	Remarks
C	0%	High cable cost
I	5%	Necessity of duplicated lines
D	10%	High cable cost
Q	50%	Cable cost holds lower level.
O	90%	Low cable cost

The removal schedule of equipment is assumed as shown in Table 9-3-3. Taking account of the priority and the removal ratio, the total number of removed line units is estimated to be 2,122. The removal work is supposed to be started from 1998, because the capacity of cable facilities is predicted to catch up with the real demand for telephones in 1997 as explained in Chapter 5.1. It is assumed that removal work is continued until 2002, eliminating 530 or 532 line units a year and relocating half of this number the next year, since the Microwave Subscriber System has the advantage that it can be diverted from one Subscriber Station to another Subscriber Station. Then the final number of relocated lines is estimated to be 1,061.

Table 9-3-3 Removal Schedule of Line Unit

Year	1998	1999	2000	2001	2002	Total
Eliminated line units	530	530	530	532		2,122
Relocated line units		265	265	265	266	1,061

Revenue estimation is shown in Table 9-3-4 based on the above assumption.

Table 9-3-4 Revenue Estimation

Unit: Million Rp.

Year	Non-call Revenue		Call Revenue	Total Revenue
	Installation Fee	Monthly Fee	Usage Charge	
1990	0	0	0	0
1991	4,148	58	1,272	5,477
1992	1,006	348	7,631	8,986
1993	944	433	9,482	10,859
1994	1,113	512	11,218	12,844
1995	0	606	13,266	13,872
1996	0	606	13,266	13,872
1997	0	606	13,266	13,872
1998	0	606	12,779	13,384
1999	133	583	12,535	13,251
2000	133	572	12,291	12,996
2001	133	561	12,046	12,739
2002	133	550	12,290	12,973
2003	0	561	12,290	12,851
2004	0	561	12,290	12,851
2005	0	561	12,290	12,851
2006	0	561	12,290	12,851
2007	0	561	12,290	12,851
2008	0	561	12,290	12,851
2009	0	561	12,290	12,851
2010	0	561	12,290	12,851
2011	0	561	12,290	12,851
Total	7,741	11,090	241,957	260,788

2) Cost Estimation

The cost of the Project consists of the following items:

Capital Cost : construction cost, consultant fee, and contingency, etc.
Working Capital: cash / bank deposit and accounts receivable
Operation Cost : maintenance / operation cost and reinstallation cost
Tax : income tax

a) Capital Cost (Project Cost)

Design fee, equipment cost, labor cost and consultant fee are estimated as construction costs. The break down of capital cost and currency portion are shown in Table 8-5-2.

b) Working Capital

Working capital is the fund prepared for business operation. As the cost related to stock items is already included in construction cost, cash /bank deposit and accounts receivable are considered.

The amount of cash / bank deposit is estimated according to the actual cash and deposit ratio to the total business revenue of PERUMTEL. This ratio is determined to be 18.2% taking an average of the last 3 years.

The amount of accounts receivable is estimated according to the actual accounts receivable ratio to the operation revenue of PERUMTEL. This ratio is determined to be 19% taking an average of the last 3 years.

c) Operating Cost

The operating cost consists of i) maintenance cost, ii) operating expenses and iii) relocation cost.

i) Maintenance Cost (Personnel and Supplies Expenses)

Maintenance work is necessary from the first year of operation. The Microwave Subscriber System requires only 4 maintenance staff members and there is no need to maintain the transmission span between Base Station and Subscriber Stations, unlike the case of the Cable Subscriber System. Taking account of these characteristics, maintenance ratio to the equipment cost is determined to be 3%.

ii) Operating Expenses (Office Overhead)

As for operating expenses, personnel expenses for operation staff are not estimated, because an operation staff is not necessary for the system. Only office overhead is estimated.

iii) Relocation Cost

This cost is estimated to be 0.32 million Rp. per line on the basis of the investment cost estimation excluding equipment cost, measuring equipment cost and training cost, etc. As described in the premise of analysis, the equipment removal cost is regarded to be equal to salvage value of equipment and only the relocation cost is considered for the equipment removal and transference.

d) Income Tax

A tax ratio of 35% of the taxable profit is applied conforming to the corporate income tax law (established in 1983). Besides the income tax, PERUMTEL pays a social development contribution to the national treasury after subtraction of the income tax. However, this payment is excluded from the project costs, as it is just a profit disposal.

Cost estimation is shown in Table 9-3-5 based on the above assumption.

Table 9-3-5 Cost Estimation

Unit: Million Rp.

Year	Capital Cost	Working Capital	Operation Cost	Tax	Total Cost
1990	2,373	0	0	0	2,373
1991	23,295	997	509	0	24,800
1992	2,061	1,635	903	1,535	6,135
1993	2,148	1,707	1,096	2,068	7,019
1994	2,491	2,063	1,295	2,448	8,297
1995		2,440	1,413	3,506	7,360
1996	0	0	1,413	4,361	5,774
1997	0	0	1,413	4,361	5,774
1998	0	0	1,369	4,205	5,575
1999	0	0	1,357	4,163	5,520
2000	0	0	1,417	4,053	5,469
2001	0	0	1,393	3,971	5,364
2002	0	0	1,415	4,045	5,460
2003	0	0	1,321	4,035	5,357
2004	0	0	1,321	4,035	5,357
2005	0	0	1,321	4,035	5,357
2006	0	0	1,321	4,035	5,357
2007	0	0	1,321	4,035	5,357
2008	0	0	1,321	4,035	5,357
2009	0	0	1,321	4,035	5,357
2010	0	0	1,321	4,035	5,357
2011	0	-8,843	1,321	7,131	-391
Total	32,369	0	26,888	78,130	137,386

3) Principal and Interest Repayment

The foreign portion of capital cost is funded by foreign loan and for financing to PERUMTEL, Indonesian government loan conditions are applied. Repayment of the principal is started from the 6th year at an equal rate for the remaining years. The repayment schedule is shown in Table 9-3-6 on the basis of cost estimation and repayment conditions.

Interest Rate : 12%
Repayment Period : 15 years
Forbearance Period : 5 years

Table 9-3-6 Repayment Schedule

Unit: Million Rp.

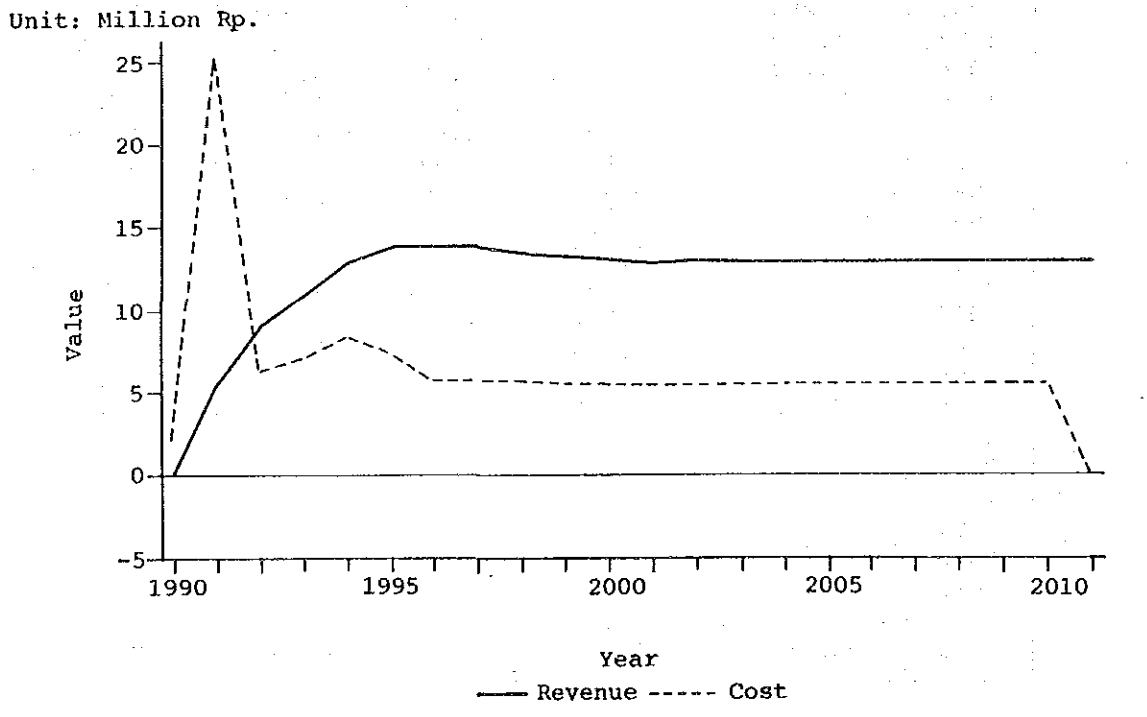
Year	Borrowing	Repayment	Balance	Interest Rate 12%	Total Repayment
1990	1,465		1,465		
1991	20,891		22,356	176	176
1992	1,853		24,209	2,683	2,683
1993	1,922		26,132	2,905	2,905
1994	2,229		28,360	3,136	3,136
1995			28,360	3,403	3,403
1996		2,836	25,524	3,403	6,239
1997		2,836	22,688	3,063	5,899
1998		2,836	19,852	2,723	5,559
1999		2,836	17,016	2,382	5,218
2000		2,836	14,180	2,042	4,878
2001		2,836	11,344	1,702	4,538
2002		2,836	8,508	1,361	4,197
2003		2,836	5,672	1,021	3,857
2004		2,836	2,836	681	3,517
2005		2,836		340	3,176
2006					
2007					
2008					
2009					
2010					
2011					
Total	28,360	28,360	-	31,021	59,381

9.4 Project Evaluation

1) Result of Financial Analysis

A cash flow table is shown in Table 9-4-1 which is drawn up according to the above assumption and revenue/cost estimation. It is recognized that the system generates approximately Rp.7,500 million profit per year. The FIRR comes to 24.9% which justifies the Project as financially feasible, because this value exceeds the domestic market interest rate (time deposit) of 15% ∿ 18% and also exceeds interest rate on loan of 18% ∿ 20%. Generally speaking, a project is identified to be feasible if the IRR is 8% or more.

Fig. 9-4-1 shows the transition of revenue and cost during the project life, indicated in nominal price. It is recognized that revenue maintains a higher level than cost on a one year comparison basis beginning from 1992.



Note: Values are indicated in nominal price.

Fig. 9-4-1 Transition of Revenue and Cost

Table 9-4-1 Cash Flow Table (Basic Case)

Unit: Million Rp.

Year	Inflow				Outflow					In-Out
	Installation Fee	Monthly Fee	Usage Charge	Total Revenue	Capital Cost	Working Capital	Operation Cost	Tax	Total Cost	
1990	0	0	0	0	2,373	0	0	0	2,378	-2,373
1991	4,148	58	1,272	5,477	23,295	997	509	0	24,800	-19,323
1992	1,006	348	7,631	8,986	2,061	1,635	903	1,535	6,135	2,851
1993	944	433	9,482	10,859	2,148	1,707	1,096	2,068	7,019	3,840
1994	1,113	512	11,218	12,844	2,491	2,063	1,295	2,448	8,297	4,546
1995	0	606	13,266	13,872		2,440	1,413	3,506	7,360	6,512
1996	0	606	13,266	13,872		0	1,413	4,361	5,774	8,098
1997	0	606	13,266	13,872		0	1,413	4,361	5,774	8,098
1998	0	606	12,779	13,384		0	1,369	4,205	5,575	7,810
1999	133	583	12,535	13,251		0	1,357	4,163	5,520	7,731
2000	133	572	12,291	12,996		0	1,417	4,053	5,469	7,527
2001	133	561	12,046	12,739		0	1,393	3,971	5,364	7,375
2002	133	550	12,290	12,973		0	1,415	4,045	5,460	7,513
2003	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2004	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2005	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2006	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2007	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2008	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2009	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2010	0	561	12,290	12,851		0	1,321	4,035	5,357	7,494
2011	0	561	12,290	12,851		-8,843	1,321	7,131	-391	13,242
Total	7,741	11,090	241,957	260,788	32,369	0	26,888	78,130	137,386	123,402

FIRR= 24.9%

2) Sensitivity Analysis

If the Project is executed under the conditions assumed above and revenue/cost estimation is not changed, the FIRR comes to 24.9%, which shows sufficient feasibility from a financial perspective.

But it would be better to take account of fluctuation factors such as increased average revenue per line unit and cost escalation due to inflation. Therefore the sensitivity analysis is carried out to examine the influence of revenue/cost variations. The result of this analysis is shown in Table 9-4-2, and cash flow tables for various cases are shown in Tables AT10-1 to AT10-3 of Attachment 10.

Table 9-4-2 Change of RIFF by Sensitivity Analysis

	Condition	FIRR (%)
Basic case	Where no variation of revenue/cost	24.9
Revised case	Where revenue increases at 3% a year	27.7
	Where total cost increases by 10%	21.9
	Where inflation escalates at 7.5% a year	21.9

By sensitivity analysis this Project is proved to be feasible, even if the inflation escalates at 7.5% every year or the total cost increases by 10%. The reasons are considered to be that the need only for only 4 maintenance staff members save on personnel cost, rapid installation makes it possible to secure telephone revenue at an earlier stage, and the subject Areas have a highly intensive demand for telephones, which produces a large amount of traffic revenue.

3) Socioeconomic Analysis

a) Purpose of the Analysis

The purpose of the socioeconomic analysis is to evaluate the social profit and significance after considering the result of financial analysis from the viewpoint of the overall national economy. That is to say, the repercussion of the Project upon society and the economy is evaluated without respect to the composition of investor and beneficiary.

b) Method

i) Price Adjustment

Generally in order to calculate the degree of social profit, the EIRR (Economic Internal Rate of Return) calculation is carried out in terms of the prices for Indonesian economy, indicated in terms of the economic prices. Although the numeral of the domestic currency is used for the financial analysis, in the economic analysis the foreign currency portion of input goods is adjusted to the economic prices. Because it is supposed that the domestic market price is often distorted by the import substitution policy or government price control.

Then the costs of foreign currency portion are converted into the proper domestic prices by means of the SER (Shadow Exchange Rate). The SER is obtained through the ratio of a trade amount including trade tariffs and an actual trade amount excluding trade tariffs. In this analysis the SER is calculated as 1.07 which means the local currency is devaluated by 7%. The equation of SER is shown in AT-10.

Shadow wage rate (SWR) is not considered in this analysis. In case of a large scale project implementation, a great many unskilled laborers are hired at below the market wage, which induces depression of the income level and saving ratio. In such a project evaluation SWR is calculated to measure the impact upon the macro economy.

On the other hand, this Project does not require much unskilled laborer and is carried out in a limited area; therefore there is no need to calculate the SWR.

ii) Benefit and Cost

Traffic incoming revenue from outside the Jakarta area could be an additional benefit of project implementation, but this benefit is not included in the revenue items, as it is hard to estimate the actual revenue accurately. By advancing th year of revenue aquisition, it is possible to save a portion of opportunity cost which would have been forgone by inflation without the Project implementation. This portion is regarded as an economic benefit which is added to the revenue.

Although tax is an expenditure for PERUMTEL, it is regarded as simply a money transfer within the country. Tax is eliminated from the cost items.

c) Economic Internal Rate of Return (EIRR)

Based on the above assumption, the cash flow table (Table 9-4-6) is drawn up by eliminating the tax from the cost items. As the result of this analysis, the EIRR comes to 36.4%, which achieves a high level of IRR.

4) Qualitative Analysis

It can be said that the impact of the Project upon public administration and the economy is prominent, because it is expected to improve the lack of telephone line supply and poor quality in the Jakarta metropolitan area.

Owing to the introduction of this Microwave Subscriber System, the needed telephone lines are obtained and it is considered that public administration service will improve in effectiveness by making use of these lines.

It is also considered that the possibility of emergency calls to public organizations will be expanded. In hospitals the obtained lines can be utilized for emergency call connections. These effects will contribute to the improvement of the security level in Jakarta.

At present the big enterprises and foreign capital investors are concentrated in the Jakarta area and simultaneously the demand for telecommunication is increasing year by year among them. It is required to modify and expand the telecommunication facilities as soon as possible. As many of the Subscriber Stations are installed on high rise buildings, this system assists in promoting their economic activity.

Because of the lack of telephone lines, people are forced to use ground transportation as a means of communication. By introducing this system, it is possible to reduce the transportation costs to exchang information.

5) Overall Evaluation

This project can be justified as feasible since the FIRR is at a high level even when fluctuation factors are taken into account. This Project is also expected to play an important role in supporting the public administration services and economic activity with regard to telecommunications.

CHAPTER 10

RECOMMENDATION

CHAPTER 10 RECOMMENDATION

10.1 Conclusion

The results of the Study are briefly summarized as follows:

1) Selected Areas and Subscriber Stations

As a results of justification of application Areas/Stations, Areas/Subscriber Stations subject to be relieved by this system are;

a) Areas: 18 Areas
ANC, CAW, CPP, CPE, GB-1, GB-2, JT, KAL, KB, KT-2, PLM PSR, PLT, RMG, SM-1, SM-2, SLP, TBT

b) Subscriber: 189 Stations

2) Project Cost

Total project cost including contingency is:

Pr. 32,369 million

Meanwhile, the breakdown of foreign/Local Currency of the above total cost is;

Foreign Currency Portion: ¥2,269 million
Local Currency Portion : Rp. 4,009 million

(Conversion rate: ¥1 = Rp. 12.5)

3) Financial/Economic Evaluation

Internal rate of return of this project is:

Financial Internal Rate of Return: 24.9%
Economic Internal Rate of Return : 36.9%

4) Effect

Effects due to Implementation of this Project are:

a) Additional revenue : Rp. 7,500 million/year

b) Reduced waiting Subscribers : About 50% of Total waiting Subject Subscribers by the end 1989

c) Improvement of Poor Quality Lines : Around 1,500 line units

d) Possibility of ensuring emergency communications especially for important Subscribers

e) Possibility of coping with the provision of temporary/emergency lines

5) Overall Evaluation

This Project is judged to be feasible from the viewpoint of finance/economics and the effects when considering the situation in Jakarta compared to the features of this system.

From the above points of view, this Project is expected to be proceeded as soon as possible for the improvement of telecommunication situation in Jakarta.