社会開発協力部報告書

No. 2

THE REPUBLIC OF INDONESIA
FEASIBILITY STUDY
ON
IMPLEMENTATION
OF
INTRA-CITY DIGITAL MICROWAVE
SUBSCRIBER SYSTEM

SUMMARY

JANUARY 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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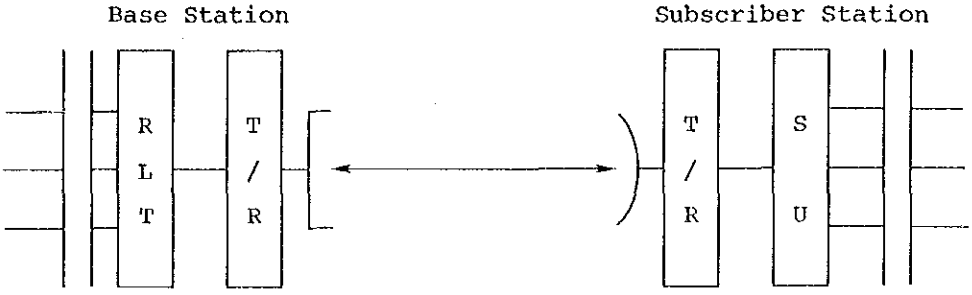
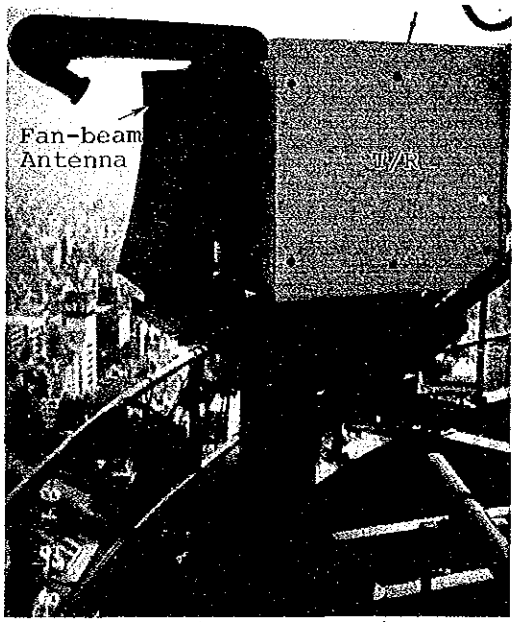
Applied System

. P-PM System



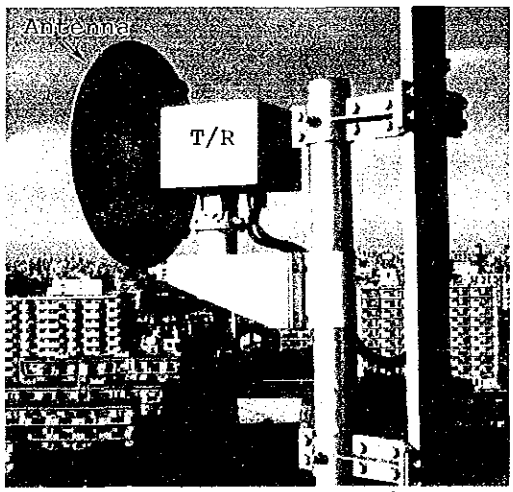


P-MP System in Base Station

Base Station Equipment

. T/R: T/R (Transmitter/Receiver) unit consists of the fan-beam antenna, transmitter, receiver and power supply block.

. RLT: RLT (Radio Link Terminal) unit consists of the T/R interface, TDMA block, line controller, switching equipment interface, and supervisory/ control interface.



P-MP System (Outdoor Type) in Subscriber Station

Subscriber Station Equipment

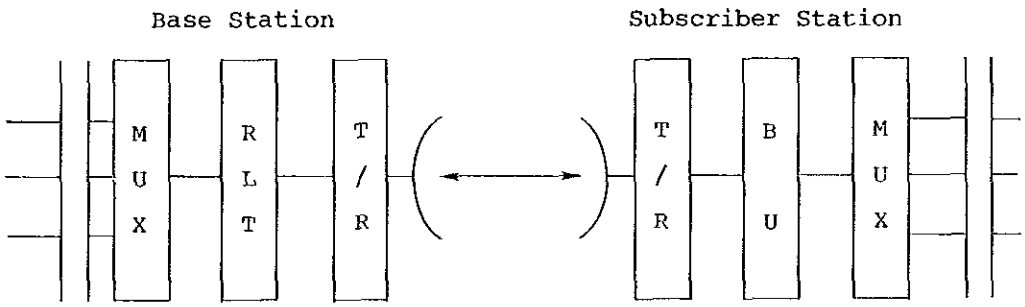
. T/R: T/R unit consists of the antenna, transmitter, receiver and power supply block.

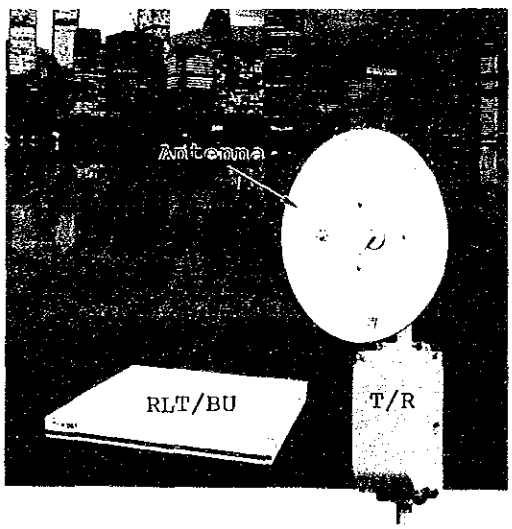
. SU : SU (Service Unit) consists of the transmitter/receiver interface, TDMA block, line controller, subscriber line interface, power supply block, and others.

* Photographs of P-MP System are those of a similar system.

P-MP System (Indoor Type)
in Subscriber Station

. P-P System



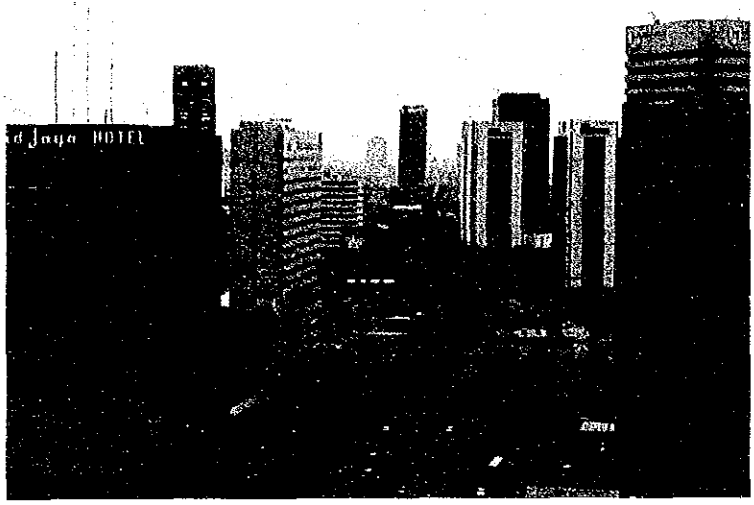


P-P System in Base Station/
Subscriber Station

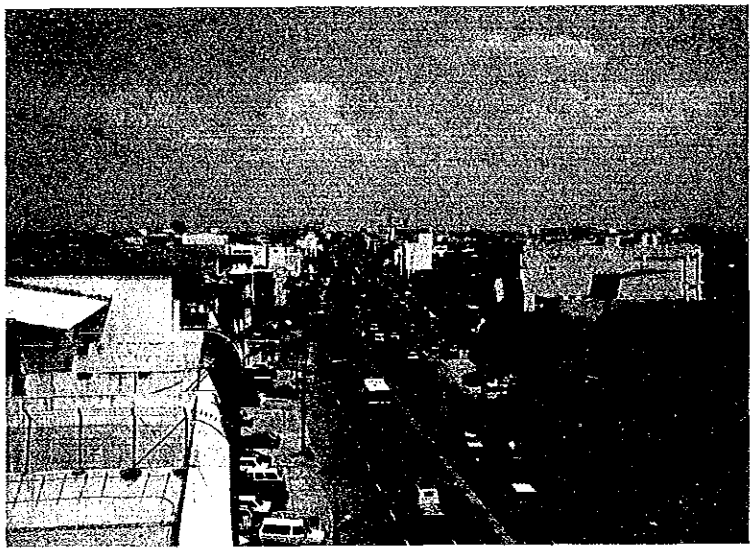
Base station equipment and Subscriber Station equipment are of almost the same configuration.

. T/R (Transmitter/Receiver) unit consists of the antenna, transmitter, receiver and power supply block.
. RLT/BU (Baseband Unit) consists of the T/R interface, code converter, MUX interface, and supervisory/control interface.

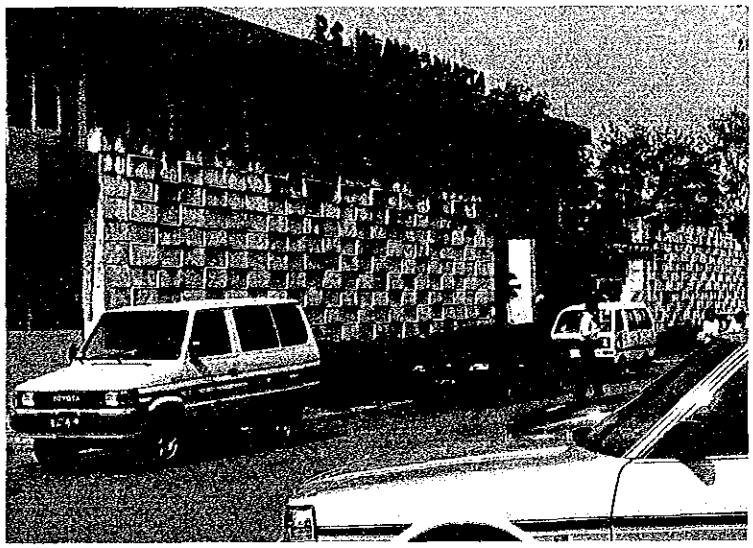
Subscriber Stations



Large Scale Subscriber Stations
(High-rise building along JL.M.H. THAMRIN in SM-1/SM-2 Areas)



Medium Scale Subscriber Stations in GB-2 Area



Important Subscriber Station in CPP Area.

CONTENTS

1. General

The purpose of this Study is to confirm the technical and economic feasibility of the application of a Digital Microwave System for a subscriber network in Jakarta.

From the results of the Study, it can generally be said that in Jakarta, the capacity of facilities in the Switching Center is relatively sufficient as compared with those of the outside plant and that existing subscriber lines have some problems as regards the quality of telecommunication services.
This means that most problems lie in the subscriber network rather than the other facilities.

The reason why the subscriber network has the problem is that installation of the subscriber network in Jakarta requires a great deal of difficult work such as forecasting of a rapidly increasing demand, cable construction in very complex areas with a high building density, acquisition of space, etc.

In view of the above situation, it is urgently necessary to provide a subscriber network for the purpose of meeting the telephone demand.

2. Technical Study

1) Establishment of criteria for basic approach of the Study

a) Study in harmonious coordination with PMC Option financed by World Bank Loan and PERUMTEL's own Finance

b) Subscriber Stations to be investigated;
- Subscriber Stations with five (5) or more floors or ten (10) or more line units
- Important Subscriber Stations (Hospitals, Communication Agencies, etc.)
- Subscriber Stations having poor quality

. Subscriber Stations with difficulties in construction of conventional Cable Subscriber System

c) Period of the Study is up to 1994

d) Specific characteristics of Jakarta
- Climate
- Future City Planning

2) Conduct of Field Survey concerning the following Subscriber Stations, Switching Centers and Outside Plant

. Subscriber Stations : 420
. Switching Centers : 32
. Outside Plant : Within subject area

3) Study Items

a) Demand forecasting up to 1994 taking into consideration future city planning, building construction planning and other factors

b) Comprehension of the existing situation and conditions for :
- Switching Center
  . Number of unoccupied terminals in switching equipment
  . Extra space for additional equipment
  . Traffic status
- Outside Plant
  . Lead-in Cable
  . Primary Cable
  . Cable Duct

c) Establishment of conditions regarding application of radio system
- Analysis of Weather Data
- Frequency Applicability

4) System Application

Based on the above Field Survey and Study, justification and selection of the applicable system was conducted for the introduction of a Microwave Subscriber System.

a) Features of Microwave Subscriber System

- Short period / Easy Installation and Easy Relocation
- Easy Maintenance and Operation
- Advantageous installation cost as compared with conventional Cable Subscriber System in case of long distance between the Base Station and Subscriber Station
  (However, the distance is limited by rainfall intensity and frequency.)
- Number of line units which can be used in this system is limited by:
  . Space for antenna installation
  . Capacity of the system
  . Interference between radio channels
- The application of this system is limited by visibility of line of sight between Base Station and Subscriber Station.

b) System to be used

i) P-MP System: For scattered Subscriber Stations having a small number of line units
   - Frequency: 14.5 ~ 15.35 GHz
   - Capacity : 158 ~ 179 channels/zone
     24 channels/set
   - Radius of Radio Zone: 4.1 km

ii) P-P System: For Subscriber Stations that require a medium number of line units and whose distribution is concentrated at one location
   - Frequency: 17.7 ~ 19.7 GHz
   - Capacity : 120 channels/set
   - Radius of Radio Zone: 4.2 km

The system configuration of each of the above is shown in Fig. 2-1.

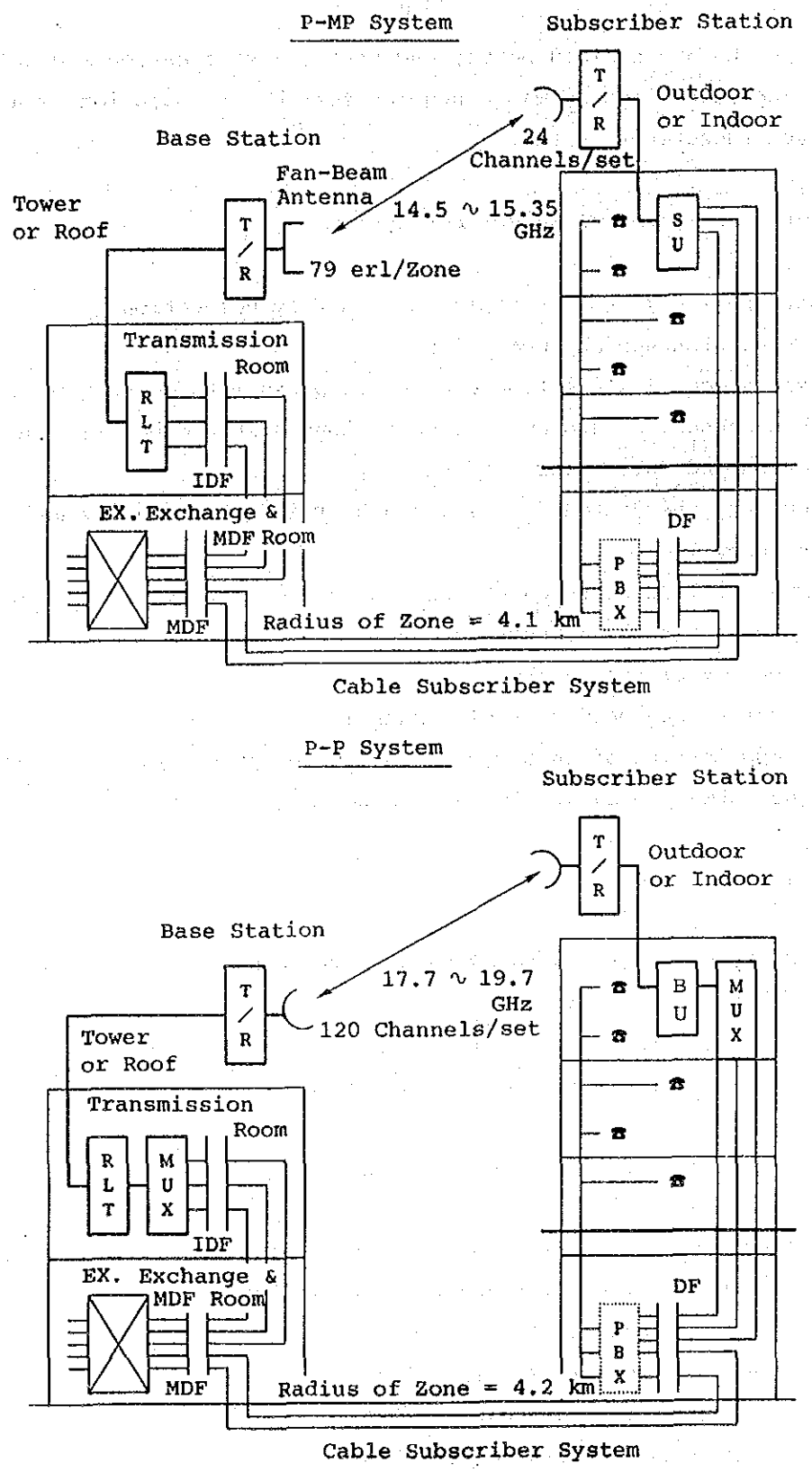


Fig. 2-1 System Configuration

c) Criteria for System Application

Efficient establishment of Areas and Base/Subscriber Stations was studied based on the following criteria:

i) Areas

. For P-MP System: Areas which include three (3) or more Subscriber Stations having an increase of 10 ~ 48 line units, and two (2) or more applicable Subscriber Stations with selection factors

. For P-P System: Areas which include at least one (1) applicable Subscriber Station having an increase of 49 ~ 600 line units

Subscriber Stations with selection factors defined by the following points:

- Important Subscriber Stations
- Subscriber Stations whose cost of Microwave Subsciber Station is cheaper than that of conventional Cable Subscriber System
- Subscriber Stations whose quality of existing subscriber lines is poor
- Subscriber Stations which present difficulties for the construction of a Cable Subscriber System

ii) Base Stations

. Existing Switching Centers are to be used as Base Stations.

. Maximum number of line units to be used in a Base Station is to be approx. 4800.

iii) Subscriber Stations

. Applicable Subscriber Stations are those indicated in para. i) above.

. The applied system is selected by the number of applied line units.

- For P-MP System: 48 or less line units
- For P-P System : 49 ~ 600 line units

3. Project Establishment

In accordance with the System and criteria established in the technical study, the concept of the project was studied to determine the scale, method and cost.

1) Scale of the project

a) Subject 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

The areas and applied systems are shown in Fig. 3-1.

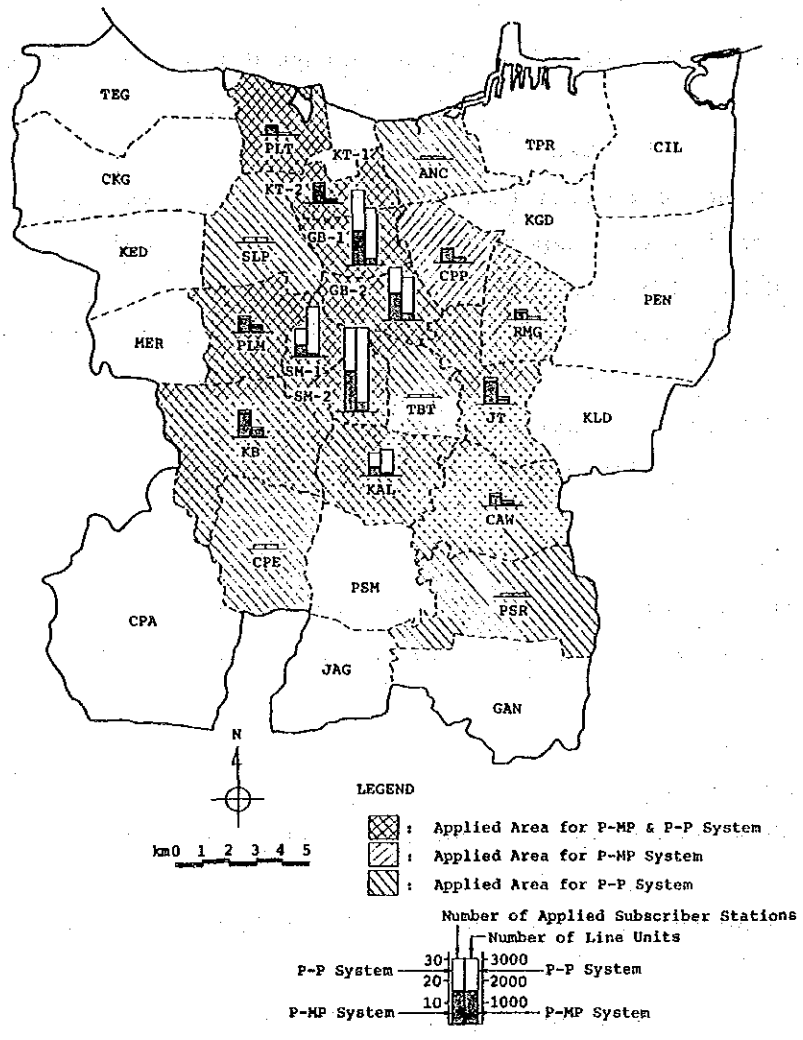


Fig. 3-1 Application Areas

b) Number of Subscriber Stations/Line Units

Subscriber Stations: 189 — P-MP System: 111
P-P System: 78

Line Units: 14,420 — P-MP System: 2,417
P-P System: 12,003

The number of Subscriber Stations and line units included in the subject areas was decided with due consideration of the system performance for each P-MP and P-P System. The annual trend of each is shown in Table 3-1.

Table 3-1 Annual Trend of Number of Subscriber Stations/Line Units

System	Number of	1989	1990	1991	1992	1993	1994
P-MP System	Subscribers	93	97	101	103	110	111
	Line Units	760	1,041	1,325	1,635	2,083	2,417
P-P System	Subscribers	49	57	62	67	71	78
	Line Units	4,466	5,981	6,970	8,672	10,111	12,003
Total	Subscribers	142	154	163	170	181	189
	Line Units	5,226	7,022	8,295	10,307	12,194	14,420

2) Implementation Schedule and Method

a) Implementation Schedule

The final target date for completion of all work is the end of 1994. However, work is to be divided into four (4) phases, because each phase should be conducted whenever actual demand arises as shown in Table 3-1 and 3-2. Meanwhile, the first phase of the work will include the following portions:

. Subscriber Stations: Both P-MP and P-P System will cope with demand up to 1991
. Base Stations : P-MP System will cope with demand up to 1994
P-P System will cope with demand up to 1991

The detailed implementation schedule is shown in Table 3-2.

Table 3-2 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 / SERVICE ITEMS				▲ CONTRACT FOR CONSULTING SERVICE	▲ CONTRACT OF PROJECT		▲ COMMENCEMENT OF INSTALLATION WORK	▲ COMPLETION OF WORK COMMENCEMENT OF SERVICE		▲ *2) BY PERUMTEL →			▲ *2) BY PERUMTEL →			▲ *2) BY PERUMTEL →		
P M C	I. PMC OPTION 1) DESIGN 2) TENDER/EVALUATION/AWARD 3) CONSTRUCTION				EXPECTED SCHEDULE				*1)									
PERUMTEL'S TASK	II. SELECTION OF CONSULTANT 1) PREPARATION/APPROVAL OF TOR, S/L, L/I 2) TENDER 3) EVALUATION/AWARD/APPROVAL																	
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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

b) 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 3-3.

Table 3-3 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

3) Total Project Cost

Total cost including contingency necessary for implementation of the Project is:

Rp. 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
(Exchange rate: ¥ 1 = Rp. 12.5)

Table 3-4 Total Project Cost

	PHASE I				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

4. Project Evaluation

The financial and economic feasibility of the Project is to be evaluated, including the effect of the system introduction in Jakarta.

1) Financial and Economic Analysis

The Project was evaluated by using the internal rate of return method for benefit and cost in order to confirm the feasibility of the Project from a financial and economic point of view.

As a result of the Study, the following data was obtained:

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

In addition, it was also identified that the additional revenue by this Project is expected to be about Rp. 7,500 million per year, and a high rate of return could be obtained whenever considering fluctuation factors such as an increase of average revenue per subscriber line and cost escalation due to inflation.

The result of analysis is shown in Table 4-1.

Table 4-1 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

2) Effect of System Introduction

When this System is introduced, the following benefits can be expected.

a) Reduced waiting: About 50% of total waiting of subject subscribers by the end of 1989

b) Improvement of poor quality lines: About 1,500 line units

c) Development of Telephone Utilization
   . Possibility of ensuring emergency communications especially for important Subscribers
   . Possibility of coping with the provision of temporary/emergency lines
   . Development of economic activity

3) Overall Evaluation

In consequence, it was demonstrated that this Project is feasible and will be highly beneficial due to the actual implementation.

5. Recommendations

Telecommunications, especially for subscriber lines are indispensable for modern economic and social development.

As seen from the results of technical study and the financial and economic analysis contained in the report, this Project is feasible as a public telecommunication service project. In a national economic sense also, its implementation is desirable.

The recommendation is hereby made that all selected Subscriber Stations (189 Subscriber Stations) in 18 Areas explained in para. 3 of this summary should be implemented as planned, and in strict accordance with the implementation schedule.

Followings are the main points of recommendations as regards the Project execution and technical aspects related to the implementation of this project.

1) Recommendations for Project Execution

a) Harmonious project execution with the other projects which are now being conducted by PERUMTEL in Jakarta

b) Direct management and supervision of the work by PERUMTEL concerning the work from the second to fourth phases which is explained in para. 3 of this summary

c) Acquisition of advance permission by PERUMTEL for the installation of equipment/material for the system in Subscriber Stations

d) Alternative Project Implementation Plan

It is also possible that the following three (3) cases will be adopted as an alternative project implementation plan with due consideration of various kinds of surrounding circumstances and conditions for the implementation of this Project.

① Alternative Case 1 .... only No. 1 group (SM-2, SM-1, GB-1, GB-2)
② Alternative Case 2 .... only No. 1 and No. 2 group (SM-2, SM-1, GB-1, GB-2, KAL, KB, SLP, CPP, PLM, JT)
③ Alternative Case 3 .... only SM-1, GB-1 and GB-2 of No. 1 group

The three kinds of project implementation schedule and total project cost are shown in Table AT1 to 3 and 4 to 6. The result of FIRR calculation for each case is shown in Table AT7.

2) Recommendations on Technical Aspects

a) Antenna Towers

Antennas to be used for this Project are to be installed on existing towers and/or towers now under construction in Subject Switching Centers.

If towers are not available for this Project, the areas for tower construction shall be considered.

b) System

i) Common Antenna

For the purpose of efficient application of the P-MP System, antennas are to be concentrated as much as possible for common use.

ii) Enlargement of System Capacity

To effectively accommodate a large number of line units in Subscriber Stations, a larger capacity system is to be considered and added during the actual implementation stage.

c) Countermeasures for Electric Power Failure

For the purpose of efficient operation of the system, an uninterruptible power supply system is considered for use in each Subscriber Station.

d) Public Telephone

In case that public telephones are connected to the Microwave Subscriber System, the public telephone signalling should be considered.

e) Details of the state of such facilities as switching equipment, MDFs, etc. will be investigated and confirmed in detail.

ATTACHMENT

Table AT-1 Project Implementation Schedule (Alternative Case 1)

	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 / SERVICE ITEMS				▲ CONTRACT FOR CONSULTING SERVICE		▲ CONTRACT OF PROJECT	▲ COMMENCEMENT OF INSTALLATION WORK		▲ COMPLETION OF WORK COMMENCEMENT OF SERVICE		*2) BY PERUMTEL			*2) BY PERUMTEL			*2) BY PERUMTEL	
PMC OPTION	I. PMC OPTION 1) DESIGN 2) TENDER/EVALUATION/AWARD 3) CONSTRUCTION						EXPECTED SCHEDULE *1)												
PERUMTEL'S TASK	II. SELECTION OF CONSULTANT 1) PREPARATION/APPROVAL OF TOR, S/L, L/I 2) TENDER 3) EVALUATION/AWARD/APPROVAL																		
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*2) PERUMTEL SHALL DIRECTLY CONDUCT THIS WORK AS OPTIONAL WORK TO THE CONTRACTOR'S CONCERNED
3) ——— : CONTINUOUSLY EXECUTED
---- : OCCASIONALLY EXECUTED

Table AT-2 Project Implementation Schedule (Alternative Case 2)

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																		
PMC OPTION	I. PMC OPTION 1) DESIGN 2) TENDER/EVALUATION/AWARD 3) CONSTRUCTION				EXPECTED SCHEDULE				*1)									
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*2) BY PERUMTEL

Note: *1) DEPEND ON SCHEDULE FOR CABLE MANUFACTURING, APPROVAL FOR EXCAVATION AND FINANCE ARRANGEMENT
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3) ——— : CONTINUOUSLY EXECUTED
---- : OCCASIONALLY EXECUTED

Table AT-3 Project Implementation Schedule (Alternative Case 3)

		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 / SERVICE ITEMS					▲ CONTRACT FOR CONSULTING SERVICE	▲ CONTRACT OF PROJECT		▲ COMMENCEMENT OF INSTALLATION WORK		▲ COMPLETION OF WORK COMMENCEMENT OF SERVICE									
PMC OPTION	I. PMC OPTION 1) DESIGN 2) TENDER/EVALUATION/AWARD 3) CONSTRUCTION						EXPECTED SCHEDULE				*1)									
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 b) SUBSCRIBER STATION 5) CABLE AND OTHER a) BASE STATION b) SUBSCRIBER STATION 6) TEST 7) TRAINING a) FACTORY (CLASS ROOM) b) LOCAL (CLASS ROOM) (ON THE JOB) 8) ONE YEAR MAINTENANCE ASSISTANCE																			

*2) BY PERUMTEL

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

Table AT-4 Total Project Cost (Alternative Case 1)

	PHASE I				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			217		7		11		6		242		3,019
P-P System			623		91		42		75		830		10,380
2. Design/Installation	24	275	76	1,367	11	148	12	115	13	152	137	2,057	3,766
3. Measuring Equipment			29								29		362
4. Training			20	23							20	23	277
5. Maintenance Assistance			16	66							16	66	262
6. Consultant	63	293	65	123							121	416	2,021
7. Subtotal (1.+2.+3.+4.+5.+6.)	88	567	1,047	1,580	110	148	64	115	93	152	1,402	2,562	20,085
8. Contingency	9	57	105	158	11	15	6	12	9	15	140	256	2,009
9. Total	96	624	1,151	1,738	121	163	71	127	103	167	1,542	2,819	-
10. Grand Total in Rp.	1,828		16,127		1,678		1,011		1,450		-		22,094

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

Table AT-5 Total Project Cost (Alternative Case 2)

	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			394		18		19		9		440		5,505
P-P System			689		91		100		108		988		12,352
2. Design/Installation	31	376	84	1,725	14	171	15	191	16	199	161	2,662	4,674
3. Measuring Equipment			29								29		362
4. Training			20	23							20	23	277
5. Maintenance Assistance			16	66							16	66	262
6. Consultant	70	331	74	151							145	482	2,290
7. Subtotal (1.+2.+3.+4.+5.+6.)	102	707	1,307	1,965	123	171	134	191	133	199	1,799	3,233	25,722
8. Contingency	10	71	131	197	12	17	13	19	13	20	180	323	2,572
9. Total	112	778	1,438	2,162	136	188	148	210	146	219	1,979	3,556	-
10. Grand Total in Rp.	2,175		20,132		1,885		2,054		2,049		-		28,295

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

Table AT-6 Total Project Cost (Alternative Case 3)

	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			138		3		7		3		152		1,895
P-P System			457		8		0		75		540		6,747
2. Design/Installation	20	182	67	1,043	3	25	4	34	12	142	106	1,425	2,746
3. Measuring Equipment			29								29		362
4. Training			20	23							20	23	277
5. Maintenance Assistance			16	66							16	66	262
6. Consultant	61	178	60	118							112	296	1,808
7. Subtotal (1.+2.+3.+4.+5.+6.)	81	360	787	1,250	14	25	11	34	90	142	983	1,810	14,096
8. Contingency	8	36	79	125	1	3	1	3	9	14	98	181	1,410
9. Total	89	396	866	1,375	16	28	12	37	99	156	1,081	1,991	-
10. Grand Total in Rp.	1,510		12,195		222		190		1,389		-		15,506

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

Table AT-7 Result of FIRR Calculation

Case	FIRR (%)	Share of line units (%)
Basic Case	24.9	100
Alternative Case 1	27.7	75
Alternative Case 2	26.6	92
Alternative Case 3	23.7	48