Sources of external funds are listed in Table 1-4-10. Bilateral foreign loan occupied 83% of the total fund in 1991. Meanwhile, annual arrangement for foreign loans such as Bilateral and World Bank is planned to be approximately 50%.

According to accounting data shown in Annex 3, PT. TELKOM could afford 10% of capital investment from its internal fund after application of the other items than capital investment in FY 1991.

Table 1-4-10

Sources of External Funds in PT TELKOM
Disbursed long-term liabilities

RP. '000.000	1989		1990		1991		1992 Estimate	
A. Foreign Funds								
Foreign loans								
- Holland	19,038	7.7%	30,556	7.6%	24,038	3.4%	83,716	4.9%
- Germany	34,285	13.8%	47,011	11.7%	203,979	28.7%	156,580	9.1%
- France	20,857	8.4%	14,447	3.6%	52,879	7.4%	70,798	4.1%
- Japan	16,507	6.6%	17,716	4.4%	56,518	8.0%	130,524	7.6%
- USA	39,601	15.9%	45,112	11.2%	210,505	29.6%	289,846	16.8%
- Spain	0	0.0%	36,799	9.2%	4,726	0.7%	36,799	2.1%
- Belgium	0	0.0%	15,455	3.9%	36,501	5.1%	19,999	1.2%
- World Bank	10,434	4.2%	7,671	1.9%	87,980	12.4%	28,906	1.7%
	140,723	56.6%	214,768	53.5%	677,126	95.4%	817,168	47.5%
Foreign bonds	0	0.0%	0	0.0%	0	0.0%	0	0.0%
A	140,723	56.6%	214,768	53.5%	677,126	95.4%	817,168	47.5%
B. Domestic funds								
Domestic loans		0.0%		0.0%		0.0%		0.0%
- R.D.I	22,436	9.0%	59,644	14.9%	0	0.0%	142,620	8.3%
- BNI	0	0.0%	0	0.0%	0	0.0%	222,223	12.9%
- BEII	7,667	3.1%	9,656	2.4%	78	0.0%	79,214	4.6%
- Consortium	78,000	31.3%	117,000	29.2%	32,900	4.6%	460,001	26.7%
	108,103	43.4%	186,300	46.5%	32,978	4.6%	904,057	52.5%
Domestic bonds	0	0.0%	0	0.0%	0	0.0%	0	0.0%
B	108,103	43.4%	186,300	46.5%	32,978	4.6%	904,057	52.5%
A + B	248,825	100.0%	401,068	100.0%	710,104	100.0%	1,721,225	100.0%

5. CONDITIONS ON ESTABLISHING REPELITA-VI

5.1 PELITA-V Program and Its Progress

5.1.1 Original Program

PELITA-V, the fifth and final phase of the First 25-year Long-Term Development was established by BAPPENAS in 1988. PELITA-V determined policies, programs and targets of development for the five year period commencing April 1, 1989.

For the domestic telecommunications sector, the aim and target of PELITA-V were originally as follows:

(1) to increase scope and quality of services through

   a) the expansion of networks; and
   b) increased efficiency of operation;

(2) to increase public telecommunications facilities over wider areas at prices the public can afford;

(3) to increase 1.4 million telephone line units;

(4) to increase 15,200 telex units;

(5) to increase 5,000 rural telephone connection; and

(6) to increase 27,000 public telephone booths.

(source: BAPPENAS - PELITA-V)

5.1.2 Revised Program

The first edition of PELITA-V Program was set up as 1.4 million telephone connection by PERUMTEL on January 18, 1990.

It is indispensable to review and revise the Program due to the changing financial projections, development activities and the allocation of development funds, etc.

The recent rapid economy growth in Indonesia required a large telecommunications infrastructure. In response to such big demand for telecommunications, PT.TELKOM revised the Program as the second edition of which the target aims at 2.1 million telephone connections on May 1, 1991.

The second edition of PELITA-V Program is shown in Table 1-4-11 below.

Table 1-4-11 Summary of PELITA-V Program (2nd Edition)

Category	Capacity	Locations
<Switching system>(LU)	2,591,992	689
KOTAMADYA	1,861,000	273
IKK	392,000	228
IKC	337,000	188
<Outside Plant>(pairs)	3,524,000	
<Transmission>(CHs)	112,746	

The detail program is shown on Table 1-4-14 "Annual Expansion Program for Switch and Outside Plant by WITEL".

5.1.3 Progress of PELITA-V Program

(1) Progress of PELITA-V up to 1991

The progress of the PELITA-V Program as of December 1991 is estimated as follows;

Table 1-4-12 Progress of PELITA-V Program as of Dec. 1991

Category	Program	Progress
Switching System	2,591,992	641,662 (25.2%)
Outside Plant	3,524,720	967,390 (32.9%)

Overall progress is estimated about 30% of the target. The detail is shown in Table 1-4-15 "PELITA-V Implementation Program by sub-system".

(2) Estimated Progress of PELITA-V up to 1993

On the assumption of smooth implementation and firm financing, the progress of PELITA-V program in sub-system at the end of 1993 is estimated as follows:

Table 1-4-13 Estimated Progress at the End of PELITA-V

Category	Program	Progress
Switching system	2,591,992	2,177,000 (84.0%)
Outside Plant	3,524,720	2,985,620 (84.7%)

Overall progress is estimated about 84% of the target.

Table 1-4-14 PELITA-V : ANNUAL EXPANSION PROGRAM FOR SWITCH AND OUTSIDE PLANT BY WITEL

WITEL	SUB-SYSTE	EXIST1988	1989	1990	1991	1992	1993	1994	EXPAND	REMOVE	TOTAL
I	SWITCH	70,548	3,300	10,206	10,942	83,328	75,000		182,776	(28,304)	225,020
	OSP	89,407	33,260	44,070	27,850	120,000	57,900	24,600	307,680	(2,260)	394,827
II	SWITCH	30,712		10,428	20,186	50,390	41,010	8,000	130,014	(19,656)	141,070
	OSP	40,774	10,500	23,220	41,850	64,900	42,100	11,750	194,320	(1,784)	233,310
III	SWITCH	41,256		5,700	22,282	29,776	66,000	3,000	126,758	(12,630)	155,384
	OSP	68,446	21,000	22,750	29,290	27,300	59,930	49,300	209,570	(2,000)	276,016
IV	SWITCH	436,974	13,000	70,060	130,000	385,500	439,000	67,000	1,104,560	(268,097)	1,273,437
	OSP	527,036	61,600	77,200	173,900	371,100	482,950	221,500	1,388,250	0	1,915,286
V	SWITCH	91,948		42,378	37,740	43,232	67,358	27,000	217,708	(36,544)	273,112
	OSP	109,627	18,140	40,080	77,240	108,950	58,600	27,600	330,610	(22,617)	417,620
VI	SWITCH	78,490	8,000	17,444	29,690	81,680	62,000	16,000	214,814	(37,598)	255,706
	OSP	106,000	15,100	29,800	60,930	89,550	58,800	20,100	274,280	(42,621)	337,659
VII	SWITCH	121,174	9,200	21,932	37,784	119,722	98,500	14,000	301,138	(72,069)	350,243
	OSP	185,750	32,700	54,900	44,400	121,950	108,990	7,700	370,640	(10,718)	545,672
VIII	SWITCH	39,277	500	8,264	22,570	19,640	15,000	29,000	94,974	(11,285)	122,966
	OSP	37,165	22,600	7,700	27,820	14,300	44,650	46,400	163,470	(7,205)	193,430
IX	SWITCH	27,906	4,200	11,700	28,236	17,388	6,790	30,000	98,314	(14,856)	111,364
	OSP	46,643	9,300	13,700	33,100	29,500	7,500	33,750	126,850	(8,340)	165,153
X	SWITCH	41,676	21,000	2,200	36,930	10,098	8,000	15,000	93,228	(24,470)	110,434
	OSP	66,164	30,730	15,300	39,650	19,900	5,900	11,100	122,580	(6,784)	181,960
XI	SWITCH	6,522	400	6,600	3,688	776		7,000	18,464	(3,130)	21,856
	OSP	11,016	600	7,200	6,820		500	9,600	24,720	(1,000)	34,736
XII	SWITCH	8,660		3,400	3,844		1,000	1,000	9,244	(2,660)	15,244
	OSP	13,830		1,900	3,550	1,900	3,400	1,000	11,750	(410)	25,170
TOTAL	SWITCH	995,143	59,600	210,312	383,892	841,530	879,658	217,000	2,591,992	(531,299)	3,055,836
	OSP	1,301,858	255,530	337,820	566,400	969,350	931,220	464,400	3,524,720	(105,739)	4,720,839
					25.2%			100.0%			
					32.9%			100.0%			
ACCUMU-	SWITCH	995,143	1,054,743	1,265,055	1,648,947	2,490,477	3,370,135	3,587,135		(531,299)	3,055,836
LATION	OSP	1,301,858	1,557,388	1,895,208	2,461,608	3,430,958	4,362,178	4,826,578		(105,739)	4,720,839

SOURCE: PROGRAM PEMBANGUNAN PELITA V, EDISI 1 MEI 1991 by DIRECTORAT PEMBANGUNAN

Table 1-4-15 PELITA-V : IMPLEMENTATION PROGRAM AND PROGRESS BY SUB-SYSTEM

NO.	SOURCE	SUB-SYS SST/SSP	EXISTING CAPASITY	IMPLEMENTATION SCHEDULE BY YEAR 1989	1990	1991	1992	1993	1994	TOTAL EXPANSION	REMOVAL	AT THE END OF PELITA-V
1	TELKOM	SWITCH								0		
		OSP		255,530	208,620	60,890	272,310	390,000	82,500	1,269,850		
2	BILATERAL	SWITCH		59,600	233,320	161,742	12,494	118,536		585,692		
		OSP								0		
3	TELECOM 3	SWITCH				87,000	194,000	146,000	5,500	432,500		
		OSP			72,250	328,900	407,050	108,490	22,480	939,170		
4	TELECOM 4	SWITCH					319,000	300,000	50,000	669,000		
		OSP					5,200	150,000	62,000	217,200		
5	ADB TEL 1	SWITCH								0		
		OSP						83,000	50,000	133,000		
6	PBH	SWITCH				100,000		275,000	115,000	490,000		
		OSP				41,200	11,200	260,000	114,000	426,400		
	TOTAL	SWITCH	995,143	59,600	233,320	348,742	525,494	839,536	170,500	2,177,192		
		OSP	1,301,858	255,530	280,870	430,990	695,760	991,490	330,980	2,985,620		
	PELITA-V PROGRAM	SWITCH	995,143	59,600	210,312	383,892	841,530	879,658	217,000	2,591,992	531,299	3,055,836
		OSP	1,301,858	255,530	337,820	566,400	969,350	931,220	464,400	3,524,720	105,739	4,720,839
	ACCUMULATIVE PROGRESS	SWITCH		100.0%	108.5%	98.1%	78.1%	84.5%	84.0%	84.0%		
		OSP		100.0%	90.4%	83.4%	78.1%	86.7%	84.7%	84.7%		

(SOURCE: PROGRAM PEMBANGNAN PELITA-V DAN VI, 21 Nov.,1991 by DITPEM)

5.1.4 Evaluation of PELITA-V Achievement

Based on the RENCANA JANGKA PANJANG (CORPORATE PLAN) PT.TELKOM 1993 - 1997 and other sources concerned, volume of achievement in 1992 and 1993 are estimated. Amount of volume achieved in PELITA-IV and PELITA-V are shown in Table 1-4-16.

Table 1-4-16 Achieved Volume in PELITA-IV and V

Category	PELITA-IV	PELITA-V
Switching system (LU)	329,010	2,022,808
Outside Plant (pairs)	1,301,858	2,981,015
subscriber Connections	312,137	1,526,520
Public telephones	3,373	43,827

An expected achievement of PELITA-V is considerably large compared with that of PELITA-IV. It takes a leap forward up to about 6 times in switching system, 3 times in outside plant and 5 times in subscriber connection of PELITA-IV.

Table 1-4-17 shows Statistical telecommunications data on PELITA-IV and PELITA-V. Figure 1-4-11 shows historical development of switching system, outside plant and subscriber connection.

5.2 The Status at the End of PELITA-V

Telecommunications facilities at the end of PELITA-V estimated are shown in Table 1-4-18.

Table 1-4-18 The status at the End of PELITA-V

Category	Volume (x1,000)
Switching capacity (LU)	3,000
Outside Plant (pairs)	4,283
Subscriber Connections	2,391
Public Telephones	50
Telephone Density/100Pop	1.3

It is concluded that REPELITA-VI program is to be established in accordance with the above figures.

Table 1-4-17 STATISTICAL TELECOMMUNICTIONS DATA FROM PELITA-IV AND PELITA-V

PELITA-III	PELITA - IV							PELITA - V			
YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1. TEL OFFICE	666	683	693	704	714	719	745	811	829		
2. SWITCH CAP. (L.U.)	666,133	697,816	779,378	838,555	912,022	995,143	1,105,185	1,349,973	1,564,451	2,299,951	3,017,951
3. OSP ENTRANCE (SSP)						1,301,858	1,557,388	1,895,208	2,435,173	3,378,088	4,282,873
4. SUBS	503,253	536,102	602,356	675,204	756,572	815,390	877,397	1,043,959	1,246,910	1,734,910	2,341,910
5. PUBLIC TEL	2,363	3,171	3,739	4,106	4,363	5,736	6,748	13,669	24,563	45,563	49,563
6. SUBS + PUB (4. + 5.)	505,616	539,273	606,095	679,310	760,935	821,126	884,145	1,057,628	1,271,473	1,780,473	2,391,473
7. WAITING APP	251,696	326,444	380,906	413,556	445,899	549,084	498,079	458,096	354,710	304,710	254,710
8. SUB+PUB+WAIT (6. + 7.)	757,312	865,717	987,001	1,092,866	1,206,834	1,370,210	1,382,224	1,515,724	1,626,183	2,085,183	2,646,183
9. POPULATION (x1,000)	158,083	161,580	164,630	168,348	172,010	175,589	179,136	179,322	182,279	185,285	188,341
10.TEL.DENSITY (6./100 p)	0.32	0.33	0.37	0.40	0.44	0.46	0.49	0.58	0.68	0.94	1.24
11.DMND DENSITY (8./100 P)	0.48	0.54	0.60	0.65	0.70	0.78	0.77	0.85	0.89	1.13	1.40

INCREASED VOLUME IN PELITA-IV & PELITA-V		
SWITCH EXPANSION	329,010	2,022,808
OSP EXPANSION	1,301,858	2,981,015
SUBS INCREMENT	312,137	1,526,520
PUBLIC TEL INCR	3,373	43,827

(SOURCE : Volume in 1992 and 1993 are estimated by RENCANA JANGKA PANJANG (CORPORATE PLAN) PT. TELEKOM 1993 - 1997, EDISI JANUARI 1992)

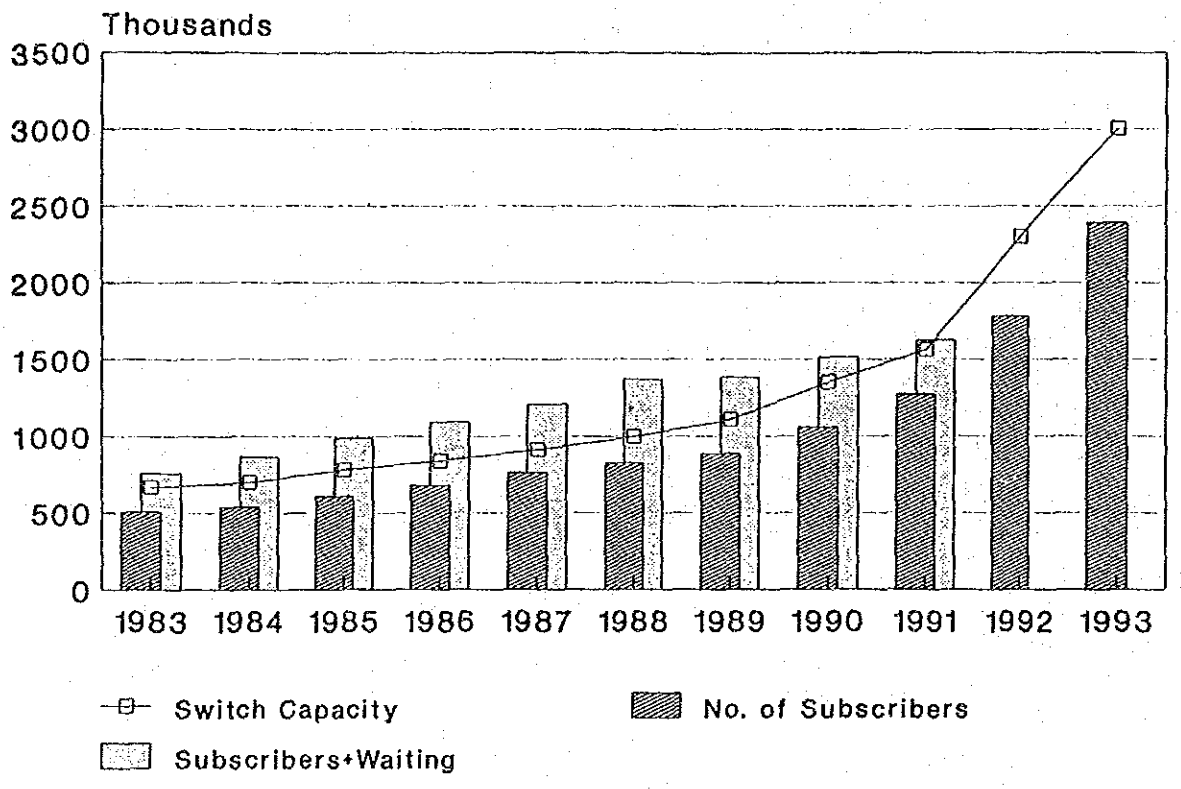


Figure 1-4-11 Statistical Data of PELITA-IV and PELITA-V

SECTION 5
SERVICE PROVISION POLICY

SECTION 5 SERVICE PROVISION POLICY

In order to decide the service provision policy for REPELITA-VI, the policy and strategy of the long-term development are studied.

The policy and strategy of telecommunications long-term development have been presented by "Pokok-Pokok Pikiran Pembangunan Jangka Panjang Tahap-II Sector Pariwisata, POS dan Telekomunikasi", by Department of Tourism, Posts and Telecommunications (hereinafter called as TELKOM 2020).

Service provision policy for REPELITA-VI is established taking the TELKOM 2020 into consideration.

1. DEVELOPMENT TARGET OF TELECOMMUNICATIONS SERVICES

From the viewpoints of technological, services and human resources development, the future services development target is established as follows:

The long-term target of the telecommunications services in Indonesia is to realize "Telecommunications for everyone concerned and by every one concerned". Especially, objectives of "for every one concerned" are as follows:

(1) Everyone concerned enjoys telecommunication services with one's own personal number;
(Personal Communications)

(2) Everyone concerned enjoys telecommunications services to and from everywhere; and
(Wireless Communications)

(3) Everyone concerned enjoys diversified telecommunications services.
(Multi-purpose Communications)

The above targets of the telecommunications services are supported by the reliable telecommunications network which is established as a result of technological development.

2. SERVICE DEVELOPMENT

At present, the following telecommunications services are operated through the analog and digital mixed network:

a) Telephone service;
b) Telegram service;
c) Telex service;
d) Packet-data service;
e) Mobile communications services; and
f) Leased circuit service.

The telecommunications services mentioned above are to be enhanced and/or transferred to other advanced new services with technological innovation toward ISDN and IN services.

A goal of long-term service development up to Year 2020 is to provide the nation-wide Broadband ISDN (B-ISDN) and IN services. It must integrate all the services above and the advanced supplemental services.

The summary of service provision policies in each decade is shown in Table 1-5-1.

3. DEVELOPMENT POLICIES IN EACH DECADE

The service development to reach a goal by the year 2020 is described below.

3.1 Acceleration Decade

(1) Improvement of service quality mainly in telephone service over the country by digitalization of the facilities and network.

(2) Introduction of the Narrowband ISDN to the major big cities such as Jakarta, Bandung, Surabaya and Medan.

(3) Introduction of the advanced new services to be realized not only by N-ISDN but also by the end terminals.

The advanced new services to be realized by the above development scenario are listed as follows:

a) Services to be realized by the network

- G4 telefax service;
- Teletex service;
- Voice conference service;
- Video conferences Service;
- Still picture transmission; and
- Paging service.

b) Services to be realized by the end terminals

- Leased circuit service;
- Call transfer service;
- Call waiting service; and
- Message recording.

(4) The existing telecommunications services consisting of telephone service, telex service, packet data service and mobile communications services are to be continued to provide.

3.2 Enhancement Decade

During this decade, Narrowband ISDN is spread to all Ibu Kota Kabupaten (IKK). At the same time, Broadband ISDN (B-ISDN) is introduced to the major big cities, such as Jakarta, Surabaya, Bandung, Medan, Semarang, Ujung Pandang. Narrowband ISDN is replaced to Broadband ISDN.

Through B-ISDN, the other advanced new services such as various video services and high speed data transmission services are available in the above areas.

At the beginning of this decade, packet data service and telex service will be integrated into Narrowband ISDN.

Digital Satellite System (PALAPA-D) is ready to operate during this decade and also to operate as back-up network for ISDN.

3.3 Autonomy Decade

B-ISDN covers most of cities over the country and everyone concerned is able to utilize the advanced services to and from everywhere.

During this decade, the advanced mobile communications services are developed and the mobile communications network takes also a kind of subscriber network for ISDN as well as optic fiber subscriber network. Wireless and portable telephone sets are generally used not for the limited service (to/from mobile terminals) but for wireless ordinary personal communication.

Table 1-5-1 Summary of Development Policies in each Decade

Categories	up to 2000	up to 2010	up to 2020
<Telephone density>	2.6 - 3.2	5.5 - 6.0	9.0 - 10.0
<Telephone service coverage>	up to IKC	up to Desa	to every individuals
<ISDN services>	N-ISDN limited areas	N-ISDN to IKK B-ISDN limited areas	B-ISDN Nationwide
<Quality of services>			
Digitalization	100%	100%	100%
PELITA-V :	70%		
PELITA-VI :	100%		
Year 2000 :	100%		
Automatization	100%	100%	100%
PELITA-V : IKK	100%		
IKC	30%		
REPELITA-VI: IKC	100%		
Successful call ratio	45-50%	50-70%	>70%

SECTION 6
DEMAND FORECAST

SECTION 6 DEMAND FORECAST

1. TELEPHONE SERVICES

Telephone demand is forecasted in both macroscopic and microscopic approaches. Macroscopic demand forecast is conducted by CCITT regression formula between the expressed demand density and GDP per capita, while microscopic demand forecast is conducted by PT. TELKOM in association with 17 national universities, based on the data collection through field survey in the sampling areas of Kecamatans.

Macroscopic demand forecast is used for an estimate of national demand in whole Indonesia and establishing a target of REPELITA-VI. The result of microscopic demand forecast by PT. TELKOM is utilized for a distribution of the macroscopic demand to all the Kecamatan.

Kecamatan basis demands distributed are arranged into exchange area basis demand.

1.1 Process of Demand Forecast

The telephone demand for REPELITA-VI is estimated in accordance with the following procedure;

(1) Macroscopic demand forecast by CCITT regression model;

(2) Review of microscopic demand forecast conducted by PT. TELKOM;

(3) Bridge demand between the estimated expressed demand in 1993 and the macroscopic demand in 1998;

(4) Demand distribution from nation-wide demand to WITEL areas;

(5) Demand distribution from WITEL demand distributed to Kotamadya, Kabupaten and Kecamatan; and

(6) Aggregation of Kecamatan demands to each exchange area demand.

1.2 Macroscopic Demand Forecast

For macroscopic demand forecast, a forecast model was developed by a regression analysis. The analysis was made in correlation between the expressed demand density and GDP per capita using statistical data (1985-1989) of 42 countries over the world.

As a result of the analysis, the following regression model was obtained:

$$\ln((MLt+WAt)/POPt*100) = -6.5582+1.12992*\ln(GDPt/POPt)$$

where,

ln : natural logarithmic operator
MLt : the number of main lines in period t
WAt : the number of waiting applicants in period t
POPt: population in period t
GDPt: real GDP in period t (1985 US$ constant price)

The regression curve expressing a correlation between demand density and GDP/capita is shown in the Figure 1-6-1. A result of demand forecast by the regression model is shown in the Table 1-6-1.

Table 1-6-1 Macroscopic Demand Forecast in Indonesia

Item	PELITA-V 1993	REPELITA-VI 1998	REPELITA-VII 2003
<Plan 1 : 7% GDP growth>			
GDP/capita (US$)	768	999	1,314
Demand density/100	2.6	3.5	4.8
Demand (x 1,000)	4,865	7,060	10,261
<Plan 2 : 5.5% GDP growth>			
GDP/capita (US$)	726	880	1,078
Demand density/100	2.4	3.0	3.8
Demand (x 1,000)	4,564	6,116	8,208
<Plan 3 : 8% GDP growth>			
GDP/capita (US$)	797	1,086	1,496
Demand density/100	2.7	3.8	5.5
Demand (x 1,000)	5,074	7,761	11,888
Population (Mil.)	188.3	203.1	216.6

The data used to develop the model for the above macroscopic demand forecast consist of existing main lines and waiting applicants registered. Accordingly, the demand estimated does not include potential demand. However, potential demand is motivated by supply and is changed to real demand.

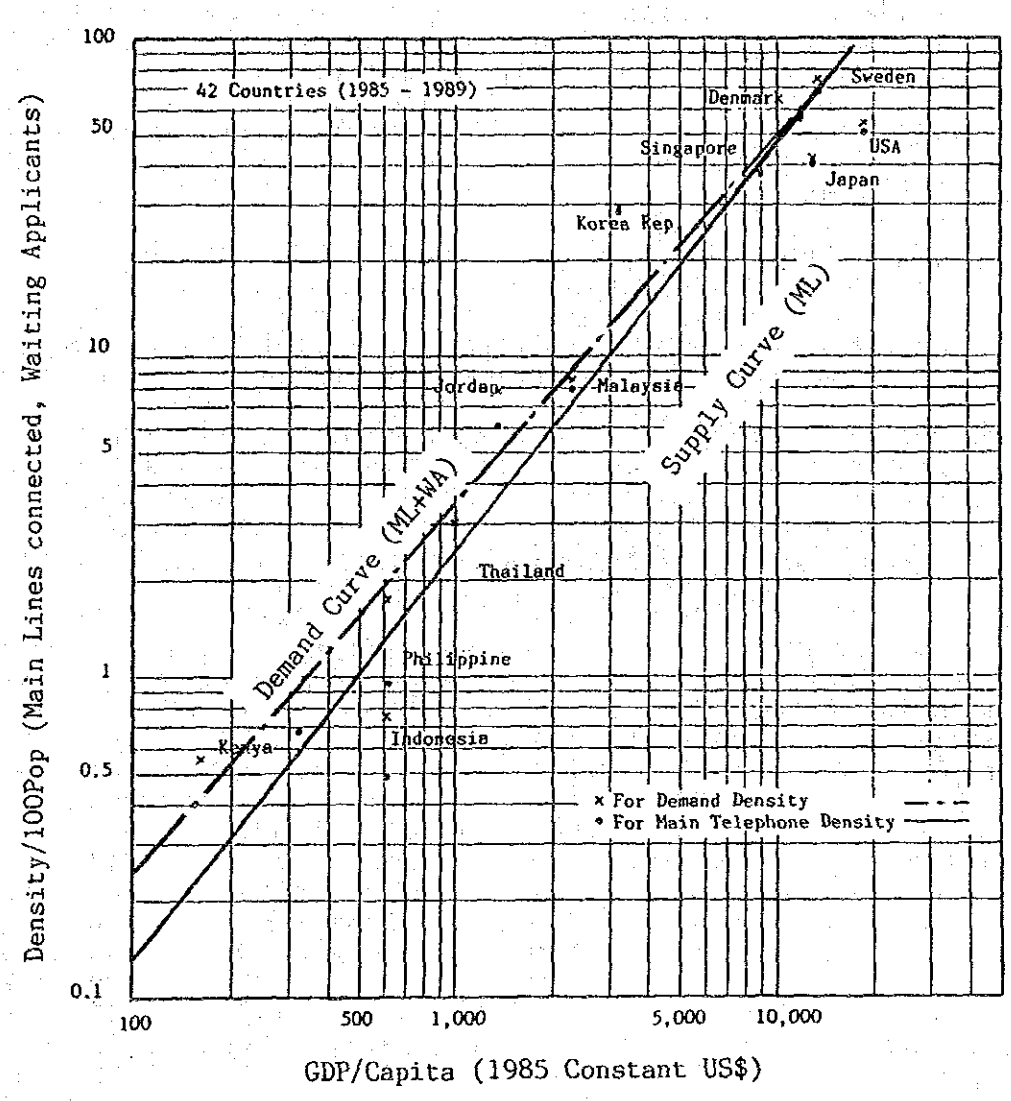


Figure 1-6-1 The Regression Curve expressing correlations between demand and supply densities and GDP per Capita

1.3 Review of Microscopic Demand Forecast by PT. TELKOM

1.3.1 Process of the Forecast and the Results

Microscopic demand forecast on Kecamatan basis throughout Indonesia (1994 - 2000) was conducted by PUSRENLITBANG, PT. TELKOM in association with all the WITEL and 17 national universities during the period from January 1990 to April 1992. The microscopic demand forecast was made in accordance with the following procedure;

(1) Microscopic demand forecast by Kecamatan based on field survey on sampling basis (sampled area is 10% in average);

(2) Macroscopic demand forecast by Kabupaten by using various regression model; and

(3) Determination of microscopic demand by Kecamatan by comparative examination between (1) and (2) above.

A result of the demand forecast by PUSRENLITBANG is summarized by WITEL in the Table 1-6-2.

Table 1-6-2 Microscopic Demand Forecast by WITEL

Year / WITEL	1994	1995	1996	1997	1998
I	164	182	201	227	263
II	100	114	125	139	161
III	189	209	231	257	288
IV	1,572	1,647	1,732	1,827	1,930
V	646	712	775	844	913
VI	210	232	256	282	315
VII	489	579	567	593	636
VIII	132	139	163	179	200
IX	99	110	124	135	150
X	114	124	136	147	159
XI	16	18	20	22	25
XII	32	43	57	75	99
TOTAL	3,763	4,108	4,385	4,727	5,140

Unit: thousand

The microscopic demand by Kecamatan forecasted and determined through the process above is utilized for a distribution of WITEL demand to all the Kotamadya, Kabupaten and Kecamatan.

The demand is also indispensable for preparing installation plans of telecommunications facilities, such as exchange location plan and outside plant design.

1.3.2 Comments on Microscopic Demand Forecast

(1) The data for microscopic demand forecast should be maintained by WITELs. It should be always up-dated and utilized for various plannings.

(2) The forecasted demand would be classified by at least the following demand category for more accurate revenue forecast:

a) Residential demand; and
b) Industrial demand.

(3) The forecast method and model is to be standardized and simplified so that the forecast and update of the data will be continuously and easily made.

(4) The nation-wide demand forecast should be annually conducted not only for planning but also for improvement of an accuracy of the demand forecast.

1.4 Bridge Demand between the Estimated Expressed Demand in 1993 and the Macroscopic Demand in 1998

Difference between the estimated expressed demand and estimated demand by the regression model in 1993 is very large. The difference is supposed to be potential demand. The potential demand is being transformed to the expressed demand and decreases as a supply revel approaches to an international average.

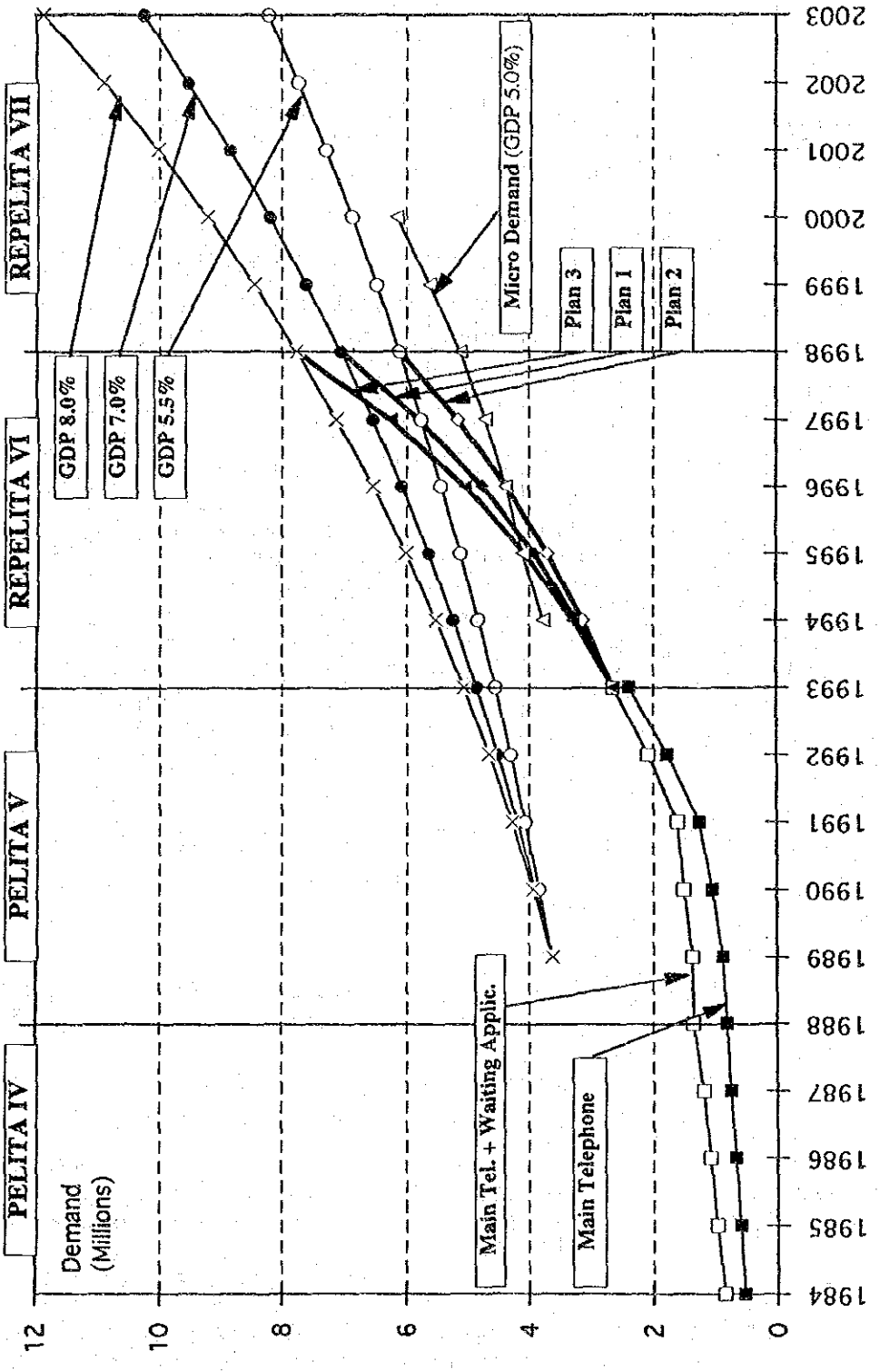
In consequence of the above, the macroscopic demand to be proposed is estimated on an assumption that the expressed demand will increase along the "Bridge Line" toward an international average demand. It is also same situation as in the supply.

The bridge demand estimated along "Bridge Line" is shown in the Table 1-6-3. The relation between results of each demand forecast including historical demand is shown in the Figures 1-6-2 and 1-6-3.

Table 1-6-3 Bridge Demand Estimated

Item \ Year	1994	1995	1996	1997	1998
<Plan 1 : 7% GDP growth>					
GDP/capita (US$)	809	851	898	947	999
Demand density	1.8	2.2	2.6	3.0	3.5
Demand (x 1,000)	3,386	4,179	5,074	6,030	7,060
<Plan 2 : 5.5% GDP growth>					
GDP/capita (US$)	753	782	813	846	880
Demand density	1.7	2.0	2.3	2.7	3.0
Demand (x 1,000)	3,220	3,864	4,559	5,314	6,116
<Plan 3 : 8% GDP growth>					
GDP/capita (US$)	847	900	958	1,020	1,086
Demand density	1.8	2.3	2.8	3.3	3.8
Demand (x 1,000)	3,481	4,403	5,425	6,541	7,761
Population (Mil.)	191.4	194.6	197.4	200.2	230.1

Figure 1-6-2 The Each Result of Demand Forecast



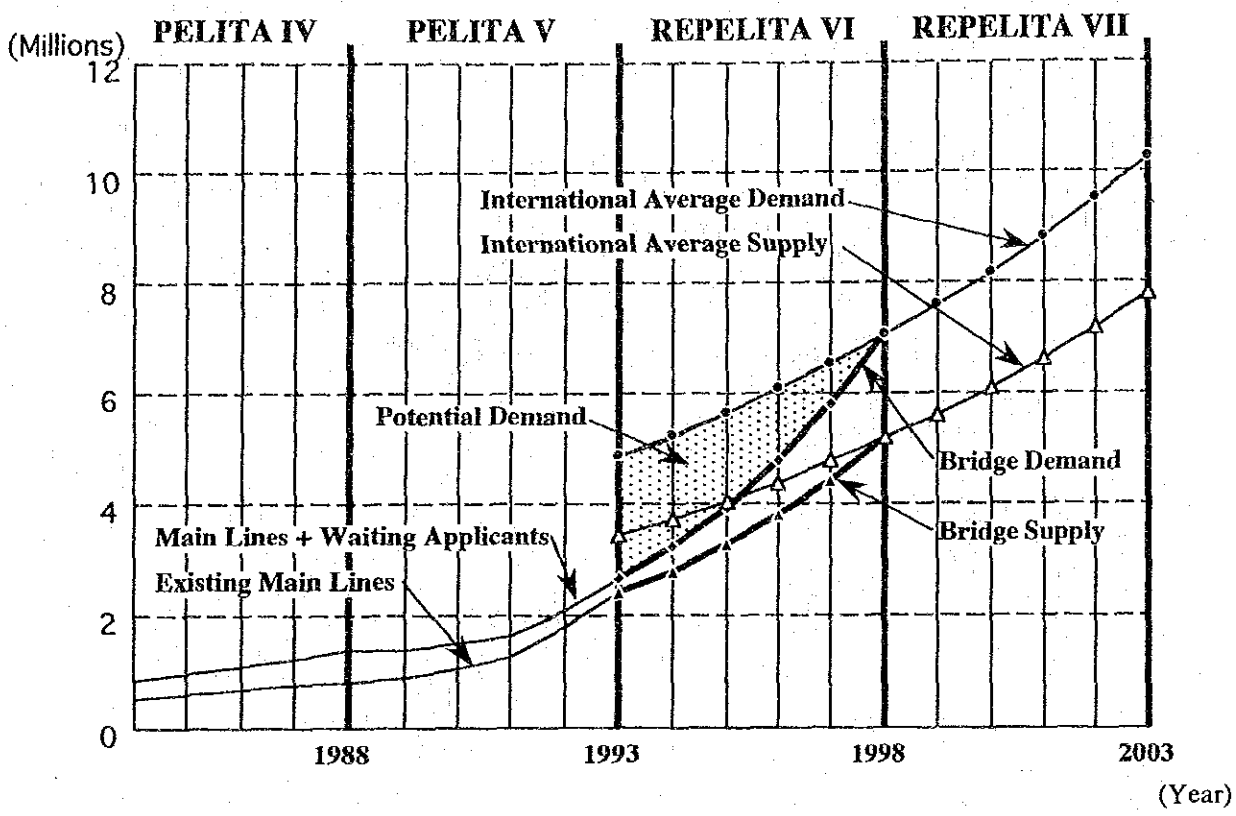


Figure 1-6-3 Bridge Demand and Bridge Supply

1.5 Macroscopic Demand Estimate to 8.0 Million Line Units

In relation between telecommunications demand and supply, an increase of the supply is one of major factors which induce an increase of demand.

As a result of analysis, the following facts was made clear in JICA Rural Telecommunications Study 1985. More and more telephones are supplied, more demands are motivated.

In other words, as the convenience of telephone is widely recognized through demonstrative effect, its intensive prevalence will enhance function as a telephone network as well as intensifying dependency on the telephone. However, as the supply reaches to a certain degree of saturation, growth of demand begins to stagnate, then both demand and supply reach a saturation point, which is estimated approximately 70 per 100 inhabitants in main line density.

Based on the above theoretical study, the macroscopic demand to total 8.0 million line units including basic and additional components at the end of REPELITA-VI is estimated by the regression models consisting of demand and supply models described in the previous paragraph and SECTION 7. The calculation is made based on figures at the end of REPELITA-VI as follows:

(1) By Supply Model

The relation between input and output on the calculation by the supply model is as follows:

<Input>		<Output>
8.0 MLU (capacity)	-->	6.4 MLU (80% connected)
6.4 MLU (connected)	-->	3.2 (line density by model)
3.2 (line density)	-->	US$1,182 (GDP/Pop by model)

(2) By Demand Model

The relation between input and output on the calculation by the demand model is as follows:

<Input>		<Output>
US$1,182 (GDP/Pop)	-->	4.2 (demand density by model)
4.2 (demand density)	-->	8.53 (demand in million)

(3) Conclusion on Calculation

In consequence of the total supply of 8.0 MLU capacity by the end of REPELITA-VI, approximately 8.5 million demand will be expected. However, the total 8.0 MLU supply will not satisfy even approximately 7.0 million

demand on 3.5 MLU basis, as only 80% of the total capacity will be connected. A result of the calculation is summarized as follows:

* Accumulated capacity : 8.0 MLU
* Main lines to be connected : 6.4 MLU (80% of 8.0MLU)
* Main line density : 3.2/100Pop
* Demand density : 4.2/100Pop
* Demand estimate to 8.0MLU : 8.53 million

1.6 Demand Distribution to WITEL Areas

The macroscopic demand (Bridge Demand) is distributed to WITEL areas by a distribution ratio. As a result of distribution analysis of current and forecasted microscopic demands, and socio-economic indexes among islands and WITELs, the distribution ratio of macroscopic demand is adjusted by the microscopic demand factors above, population and Regional Gross Domestic Products (GRDP). The distribution ratio to WITEL and distributed demands to WITEL are shown in the Table 1-6-4 and Table 1-6-5 respectively.

Table 1-6-4 Demand Distribution Ratio to WITEL

Item	WITEL 1	WITEL 2	WITEL 3	WITEL 4
GRDP w/o P&G	6,948	3,244	6,584	11,791
Population(x1,000)	13,900	7,403	15,736	8,362
Micro Demand	263,027	160,959	288,003	1,930,650
Current Demand	105,616	55,718	71,961	515,860
Distribution Ratio	6.49%	3.46%	5.90%	31.00%

Item	WITEL 5	WITEL 6	WITEL 7	WITEL 8
GRDP w/o P&G	14,276	11,334	15,483	3,036
Population(x1,000)	35,980	31,964	33,040	10,334
Micro Demand	913,438	315,263	635,753	200,328
Current Demand	206,681	165,199	252,325	82,960
Distribution Ratio	15.44%	8.74%	13.75%	4.03%

Item	WITEL 9	WITEL 10	WITEL 11	WITEL 12
GRDP w/o P&G	5,641	4,025	767	779
Population(x1,000)	9,258	12,724	1,882	1,656
Micro Demand	149,935	158,821	25,066	98,550
Current Demand	82,283	72,425	11,315	15,721
Distribution Ratio	4.70%	4.20%	1.01%	1.28%

Note: GRDP in Million Rp.

Table 1-6-5 Distributed Demands to WITEL by Year

WITEL \ Year	1994	1995	1996	1997	1998
I	220,000	271,000	329,000	391,000	458,000
II	117,000	145,000	176,000	209,000	244,000
III	200,000	247,000	299,000	356,000	417,000
IV	1,050,000	1,296,000	1,573,000	1,870,000	2,189,000
V	523,000	645,000	783,000	931,000	1,090,000
VI	296,000	365,000	444,000	527,000	617,000
VII	466,000	575,000	698,000	829,000	971,000
VIII	136,000	168,000	205,000	243,000	285,000
IX	159,000	196,000	238,000	283,000	332,000
X	142,000	176,000	213,000	253,000	296,000
XI	34,000	42,000	51,000	61,000	71,000
XII	43,000	53,000	65,000	77,000	90,000
TTL	3,386,000	4,179,000	5,074,000	6,030,000	7,060,000

1.7 Distribution of Macroscopic WITEL Demand to Kecamatan

Macroscopic demands distributed to WITEL is divided into all the Kecamatans in accordance with the distribution of microscopic demand forecasted on Kecamatan basis by PUSRENLITBANG, PT. TELKOM. Results of the demand distribution to all the Kecamatans are shown in Data Book.

2. MOBILE COMMUNICATIONS SERVICES

2.1 Needs to Mobile Communications Services

When people want to communicate with anyone, anytime and anywhere, telecommunications services are most convenient means to realize such requirements.

Up to the present, conventional telecommunications services have been developed by using fixed terminals. Consequently, enhancement of accessibility to the telecommunications terminals is a major objective of telecommunications network development.

However, as socio-economic activities supported by telecommunications services permeate, conventional telecommunications services realized by fixed terminals are not sufficient to satisfy the above communication needs. To overcome inconvenience on communication by fixed terminals, convenience of mobile communications services is widely being recognized. Needs to the mobile

communications services are not only to enhance accessibility to communication means. In developing countries, the mobile communications services are great remedy to accelerate telecommunications network development which is often delayed due to difficulty of subscriber network improvement. In consequence, demand to the mobile communications services is rapidly increasing in the world.

2.2 Definition and Use of Mobile Communications Services

In Indonesia, mobile communications services consist of mobile telephone service and radio paging service, while it is defined that mobile telecommunications systems are land mobile systems for public costumers via radio stations connected to the public switched telephone network (PSTN). These systems are extension parts of PSTN to moving end terminals and most often applied in urban areas where the fixed telephone network is highly developed. However, they are also effective for providing "fixed" telephone service to areas where it is difficult to be reached by wired line or due to technical reasons cable installations have not yet been implemented. They offer superior portability and enable rapid, flexible construction of telephone network, even though it might be more expensive than installing metallic lines or multi-access subscribers radio systems.

2.3 Mobile Telephone Service

2.3.1 Demand Forecast by Conventional Mean

Mobile telephone service demand is estimated by regression model built in relation between main lines and mobile telephone densities in 27 countries from which the data are available. The regression model obtained is as follows:

$$\ln(MTt/POPt*1000) = -1.843 + 1.837*\ln(MLt/POPt*100)$$
$$(R=0.911)$$

where,

ln : natural logarithmic operator
MTt : the number of mobile telephones in period t
POPt: population in period t
MLt : the number of main lines in period t

A result of demand forecast for mobile telephone service up to the end of REPELITA-VIII is shown in the following Table 1-6-6:

Table 1-6-6 Forecasted Mobile Telephone Demand

Year	1998	2003	2008
3.5 MLU Basis	186,100	360,800	834,300
5.0 MLU Basis	272,500	479,000	1009,000

The data used for the regression analysis for the demand estimate to mobile telephone service are referred to in Annex 4.

2.3.2 Supplementary Examination

As described in SECTION 3, mobile communications services are still on introductory stage. As convenience of the services is recognized, the demand to the mobile services are rapidly increasing. In general, it could be said that mobile telephone service has a large potential demand even though trend of development has not been fixed in the world. The following items are to be taken into consideration to forecast the potential demand:

(1) Scrutiny of international data (Where, Who, etc.);

(2) Market survey in the country; and

(3) Establishment of legal and tariff structure based on the detailed survey and study.

From the above view points, execution of Master Plan Study on Mobile Communications Service including market survey is recommended.

To estimate the potential demand, data in the neighbor countries could be referred. Current status of mobile and other telecommunications services in those countries are as follows:

Table 1-6-7 Current Status of Mobile and Other Services in the Neighbor Countries

Items \ Countries	INDONESIA	MALAYSIA	THAILAND
Population (x1000)	182,000	17,000	55,000
Main Lines	1,500,000	1,500,000	1,200,000
Main Lines/100Pop	0.82	8.82	2.18
Mobile Subscribers	25,000	170,000	180,000
Mobile Subs/1000Pop	0.14	11.3	3.27
Mobile Subs/100ML	1.67	10.0	15.0

ML : main lines
Source: Asian Communications

The mobile telephone density in Indonesia is very low comparing with those in other ASEAN countries. The low penetration seems to be caused by the following reasons:

(1) Up-Front Charge, which has high price elasticity, is very high.

(2) The present price structure is not suitable with customers' needs.

The demand for mobile telephone, therefore, will be increased rapidly up to the same level as other neighbor countries on conditions that the price structure is changed radically and capability of service provision by not only PT. TELKOM but also other operating companies are enhanced. Consequently, it is expected from the above data that the mobile telephone demand will be in 10% - 15% of the number of main telephone lines.

2.4 Radio Paging Service

The demand forecast for radio paging service is made by regression model built in relation between main line and radio paging subscriber densities in 31 countries. The regression model developed is as follows:

$$\ln(PGSt/POPt*1000)=-1.042+1.509*\ln(MLt/POPt*100)$$
$$(R=0.873)$$

where,

ln : natural logarithmic operator
PGSt: the number of paging subscribers in period t
POPt: population in period t
MLt : the number of main lines in period t

A result of demand forecast for radio paging service up to the end of REPELITA-VIII is shown in the following Table 1-6-8:

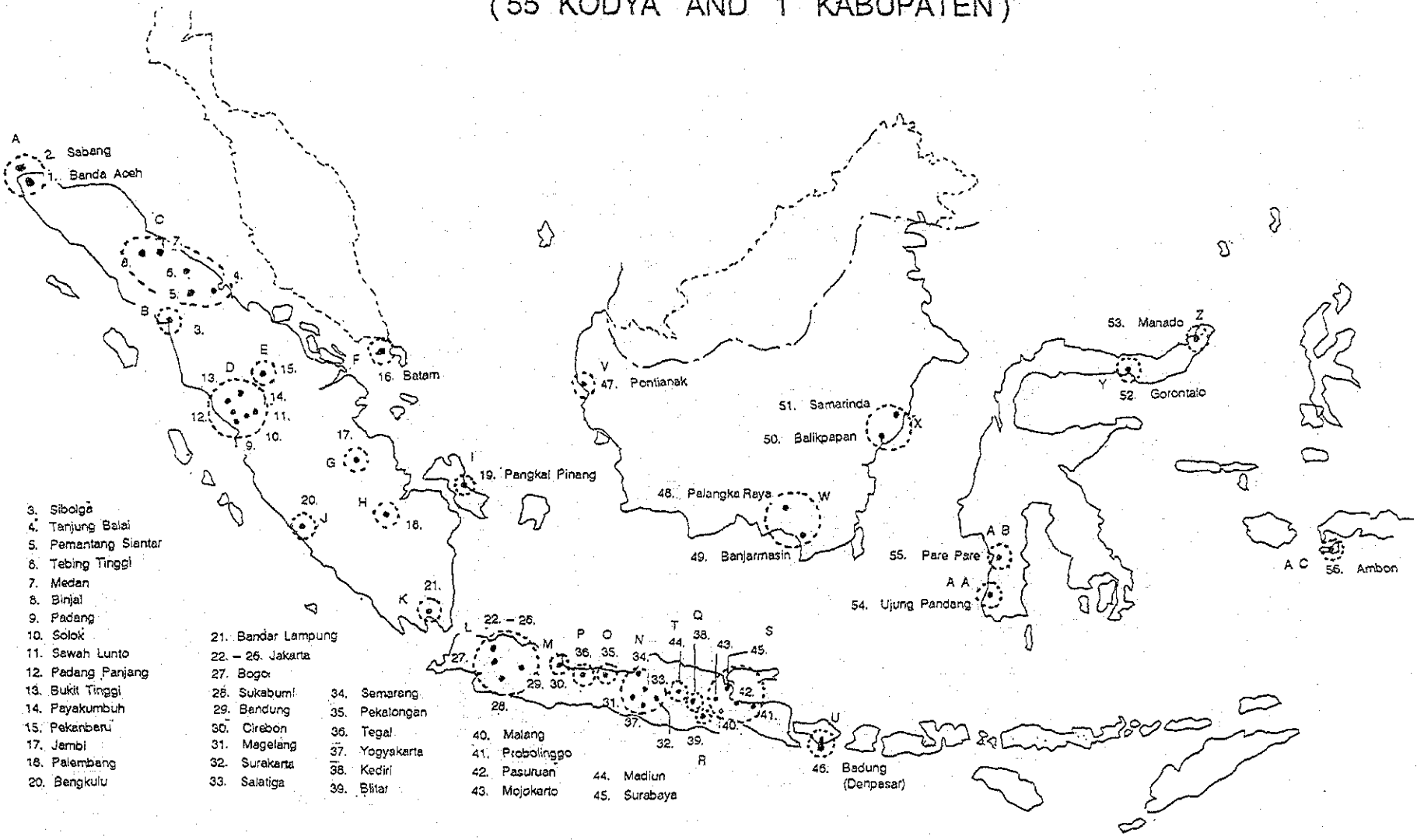
Table 1-6-8 Forecasted Radio Paging Demand

Year	1998	2003	2008
3.5 MLU Basis	303,000	528,100	1,062,500
5.0 MLU Basis	414,500	666,400	1,242,200

The data used for the regression analysis for the demand estimate to paging service are referred to in Annex 4.

As a result of analysis of socio-economic and telecommunications indexes, potential mobile communications service areas including existing service areas, which consist of 55 Kotamadya and 1 Kabupaten are proposed in the Figure 1-6-4.

Figure 1-6-4 MOBILE COMMUNICATION SERVICE AREA
(55 KODYA AND 1 KABUPATEN)



3. NON-TELEPHONE SERVICES

3.1 Telex and Telegram Services

Historical demand growth of telex and telegram services are expressed in the number of telex and gentex terminals in this study.

According to the past trend, the highest growth of telex and telegram service demands were seen in year 1987, with annual growth rate of 17.0% and afterwards it has been gradually slowing down as follows:

Table 1-6-9 Past Trend on the Number of Telex Terminals

Year	No. of Terminals	Annual growth rates (%)
1985	10.407	-
1986	11.738	12.8
1987	13.733	17.0
1988	15.441	12.4
1989	16.830 *	9.0
1990	18.117 *	8.0
1991	19.529	8.0

Note: * estimated

Although higher demand growth was seen until the year 1991, the further demand growth is pessimistic because the rapid reduction of demand growth is forecasted according to the recent service trend seen in other countries that the telex service demand is being transferred to other service media, i.e., facsimile, data communications, etc. Telegram service is at present used as a substitute media of the telephone service. Especially in rural area where telephone service is not provided yet, the telegram service will also be absorbed in telephone service, as suitable rural telephone system will be introduced. Considering the above, the result of forecast is shown below:

Table 1-6-10 Forecasted Telex Terminal Demand

Year	1993	1988	2003
No. of terminals	21,500	23,500	25,000
Annual growth rates	4%	2%	1%

3.2 Data Communication Services

The following two (2) types of data communications services are at present provided:

- leased circuits; and
- packet data communication service (SKDP).

3.2.1 Leased Circuits used for Data Communications

According to the past data (from 1976 to 1988), rapid growth has been observed as 20%-50% per annum. Approximately 80% of leased circuits are used within Jakarta area. The sharp up-trend is not applicable to estimate the future demand, because it is considered the peculiar records. For an estimate of the future demand, the following regression model is developed in relation between main line and leased circuit densities in 21 countries:

$$\ln(LCt/POPt*1000)=-3.389+1.425*\ln(MLt/POPt*100)$$
$$(R=0.908)$$

where,

ln : natural logarithmic operator
LCt : the number of leased circuits in period t
POPt: population in period t
MLt : the number of main lines in period t

A result of demand forecast for leased circuits up to the end of REPELITA-VIII is as follows:

Table 1-6-11 Forecasted Leased Circuit Demand

Year	1998	2003	2008
3.5 MLU Basis	26,900	45,300	88,100
5.0 MLU Basis	36,000	56,600	102,100

The data used for the regression analysis for the demand

estimate for leased circuit service are referred to in Annex 4.

3.2.2 Packet Data Communications Service (SKDP)

The data terminals are connected on public telephone network (PSTN) and dedicated public data network (SKDP). In Indonesia, more than 90% of SKDP traffic is for international connection according to the past records. Regarding the number of SKDP subscribers, the past trend during 1987 - 1991 is observed as follows:

Table 1-6-12 Past Trend of SKDP Demand

Year	No. of SKDP subscribers	Annual growth rates (%)
1987	146	-
1988	269	84.2
1989	396	47.2
1990	777	96.2
1991	913	17.5
Average Growth Rate		58.0

ITU defines the category of data terminal equipment in the Yearbook of Common Carrier Telecommunication Statistics as follows:

(1) Number of data terminal equipment on the public telephone and telex networks; and

(2) Number of data terminal equipment connected to dedicated public data networks.

According to an international trend from a viewpoint of service utilization on data communication services including telex service, those services have been changing to data communication on dedicated data network toward ISDN. Finally all the services will be realized by ISDN. In consequence, all the data terminal equipment including telex terminal equipment will become potential demand to ISDN services. For an estimate of the future demand in the number of data terminal equipment, the following

regression model is developed in relation between main line and data terminal equipment densities in 21 countries:

$$\ln(DTt/POPt*1000)=-2.224+1.042*\ln(MLt/POPt*100)$$
$$(R=0.899)$$

where,

ln : natural logarithmic operator
LCt : the number of data terminal equipment on PSTN, telex network and dedicated data network in period t
POPt: population in period t
MLt : the number of main lines in period t

A result of demand forecast in the number of data terminal equipment up to the end of REPELITA-VIII is as follows:

Table 1-6-13 Forecasted Data Terminal Demand

Year	1998	2003	2008
3.5 MLU Basis	59,600	89,100	147,000
5.0 MLU Basis	73,800	104,700	163,800

The data used for the regression analysis for the demand estimate of data terminal equipment are referred to in Annex 4.

4. ISDN SERVICES

ISDN Services are generally classified into the following categories:

(1) Bearer Services;
(2) Teleservices; and
(3) Supplementary Services.

By the end of the year 1998, regarding the services of (1) and (2) above, potential users are banks, airline companies and other big business / companies which require

advanced telecommunications services for nationwide and worldwide communication. Those services are to be mainly used for modernization of their own communication network for such potential users. Potentiality of the demand for the services (1) and (2) above is fully depending on the service provider's efforts at marketing and technical consulting to users. The demand to such advanced services is depending on an degree of maturity toward information society.

At present, approximately 10 users consisting of foreign banks, airline companies, national electric power cooperation, and PT. TELKOM have plans to improve their communication networks for their business by means of ISDN services in near future. In addition to the above, SKDP subscribers are expected to use ISDN bearer services.

In the service category of (3) above, call transfer and call waiting services are mainly used by business telephone subscribers as additional advanced services to the ordinary telephone service.

The demand of data terminal equipment described in the previous paragraph will become a portion of the demand to ISDN services. In consequence, much potential demand to ISDN services is expected.

Here, the following are the provision target of ISDN services for REPELITA-VI and VII.

REPELITA-VI	70% of major business users in major cities where N-ISDN is available.
	20% of business users in other areas where ISDN is available.
REPELITA-VII	80% of business users in major Ibu Kota Propinsi (IKP).

SECTION 7
SUPPLY PLAN

SECTION 7 SUPPLY PLAN

1. LONG-TERM SUPPLY SCENARIO

1.1 Basic Policy on Establishing the Supply Scenario

A Long-Term Supply Scenario up to the year 2019 including REPELITA-VI Program on Telecommunications Development is established considering the policies and strategies in The Second 25-Year Telecommunications Development during the period of the years 1994-2019, from REPELITA-VI to X. In the 25-Year Long-Term Development Plan, it is emphasized that the telecommunications is "a Social Gap Bridge" in National Development. The policies and strategies in the Plan are as follows:

(1) to eliminate the gap that occurs currently between various different social groups;

(2) to induce participation of the private sector in telecommunications development, management and operation/ undertaking; and

(3) to develop the management system on a hierarchic organization towards a matrix organization and ultimately reaching an organization characterized by "human networking" and "information based organization".

1.2 Development Programs in the 25-year Long-Term Plan

(1) First Stage: Acceleration Decade (1990 - 2000)

All the existing weaknesses on the scope and quality of services are improved so that they reach the satisfactory level for the users.

With a total of around 11 million telephone lines, it is expected that all the existing demand could be served while through restructurization and digitalization, the quality of network services could be enhanced.

(2) Second Stage: Enhancement Decade (2000 - 2010)

The capacity of the network is expanded so that it reaches around 15 million telephone lines with scope that is more equitable between the urban and rural areas, and between Western Indonesia and Eastern Indonesia.

(3) Third Stage: Autonomy Decade (2010 - 2020)

The telecommunications industry is induced to also grow so that Indonesia establishes autonomy in the supply of telecommunications equipment and technology.

On the other hand, with a total of 18 to 20 million telephone lines and the rate of economic growth of the country currently, the implementation of telecommunications can already be self-financed in its development.

1.3 Telephone Service

1.3.1 Telephone Service Coverage

(1) Service Coverage in Acceleration Decade (1990-2000)

The penetration of automatic telephone service reaches all district capitals (Ibu kota Kabupaten) and sub-district capitals (Ibu kota Kecamatan) and even some villages (Desas) which are located in the capitals.

(2) Service Coverage in Enhancement Decade (2000-2010)

The target of expanding the scope is to cover the villages (Desas) and other remote areas, both the individual service and the mass service mode (coin boxes, public call offices).

(3) Service Coverage in Autonomy Decade (2010-2020)

During two previous decades the development is for an overall scope and is supported by every individual as well as institutional activity for everyone.

1.3.2 Telephone Supply Volume

(1) Supply Volume in Acceleration Decade (1990-2000)

Attempts to strengthen various sub-systems making telecommunications network are more and more approaching the fulfillment of the demands. The total capacity of the telephone connection will reach to 6-8 million line units.

(2) Supply Volume in Enhancement Decade (2000-2010)

During this decade, the capacity of telephone connection which has been supplied completely in the previous decade is further extended to meet the demand of the public. The total capacity of the telephone connection will reach to 12-14 million line units.

(3) Supply Volume in Autonomy Decade (2010-2020)

During this decade, the total capacity of the telephone connection will reach to 20-25 million line units. The figure of density at this supply level means the demand of the people.

1.3.3 Target Supply Volume Estimated by CCITT Model

A Supply Model (CCITT model) was built in the study to establish targets of supply volume at each development stage. The following Supply Model has been built as a result of regression analysis in a relation between GDP per capita and main telephone line density per 100 inhabitants in 42 countries during the period of the years 1985-1989:

$$\ln((MTt/POPt)*100) = -7.8018 + 1.2649*\ln(GDPt/POPt)$$

where,

ln : natural logarithmic operator
MTt : the number of main lines in period t
GDPt: real GDP in period t (U.S$ 1985 constant price)
POPt: population in period t

The supply volumes which are calculated from international average telephone density corresponding to the economic level (GDP/capita) are shown in the following Table 1-7-1, comparing with the telephone demands estimated by using CCITT model in the relation between GDP per capita and demand density in SECTION 6:

Table 1-7-1 Supply Volume Estimated by CCITT Model

Year	1993	1998	2003
<Supply Volume in main lines>			
* Plan 1 (7.0%)	3,440,000	5,172,000	7,800,000
	(4,300,000)	(6,465,000)	(9,750,000)
* Plan 2 (5.5%)	3,203,000	4,404,000	6,074,000
	(4,004,000)	(5,505,000)	(7,593,000)
* Plan 3 (8.0%)	3,606,000	5,750,000	9,196,000
	(4,508,000)	(7,188,000)	(11,495,000)
<Demand in main lines>			
* Plan 1 (7.0%)	4,865,000	7,060,000	10,261,000
* Plan 2 (5.5%)	4,564,000	6,116,000	8,208,000
* Plan 3 (8.0%)	5,074,000	7,761,000	11,888,000

Note: % shows annual growth rate of GDP.
Figures in ( ) show capacity (main lines / 0.8)

1.3.4 Target Supply Volume to be Proposed

In consequence of the estimate, the Plan 1 shown in the following Table 1-7-2 is most recommendable as a development target from a view of possible investment scale estimated from past investment, project achievement and recent economic growth in Indonesia:

Table 1-7-2 Telephone Supply Volume to be Proposed

Year	1993	1998	2003
<Supply Volume in Capacity>			
Plan 1 (7.0%)	3,000,000	6,500,000	9,800,000
Plan 2 (5.5%)	3,000,000	5,500,000	7,600,000
Plan 3 (8.0%)	3,000,000	7,200,000	11,500,000
<Supply Volume in Main Lines>			
Plan 1 (7.0%)	2,391,000	5,172,000	7,800,000
Plan 2 (5.5%)	2,391,000	4,404,000	6,074,000
Plan 3 (8.0%)	2,391,000	5,750,000	9,196,000
<Telephone Density in Main Lines>			
Plan 1 (7.0%)	1.3	2.6	3.6
Plan 2 (5.5%)	1.3	2.2	2.8
Plan 3 (8.0%)	1.3	2.8	4.3
<Bridge Demand in Main Lines>			
Plan 1 (7.0%)	2,475,000	7,060,000	10,261,000
Plan 2 (5.5%)	2,375,000	6,116,000	8,208,000
Plan 3 (8.0%)	2,542,000	7,761,000	11,888,000

Note: % shows annual growth rate of GDP,
Capacity to be installed: main lines / 0.8,
Telephone Density: main lines / 100 inhabitants,
The supply volume in 1993 is TELKOM's estimate,
Main Lines mean connecting lines for subscribers.

The telephone supply volumes proposed in the Table 1-7-2 above are based on a scenario that the supply level in Indonesia will reach an international supply level in commensurate with the economic level in GDP per capita.

1.4 Non-Telephone Services

1.4.1 Telex and Telegraph Services

As mentioned in SECTION 4, telex and telegraph services will be gradually replaced to tele-facsimile service and telephone service.

On the other hand, in order to integrate the existing networks for telex and telegraph services into ISDN in the near future, it is necessary to transfer telex service users into tele-facsimile or data communications services. The demand for telex service mentioned in SECTION 6 is estimated as follows:

Table 1-7-3 Telex Terminal Demand

Year	1993	1998	2003
Telex Terminals	21,500	23,500	25,000

At the end of PELITA-V, the number of telex terminal exchanges is 35 and the total telex line capacity is 28,550, which is enough to cover the demand up to the year 2003.

Considering the above circumstances on strategy and existing sufficient capacity, it is not recommended to expand the existing telex network.

The telegram service which is provided by telex network is also not recommended to expand during REPELITA-VI period, because no increase of telegram service demand is expected. Generally the telegram service is mainly a substitute for telephone service to/from the areas where no telephone service is provided.

1.4.2 Data Communications Services

Data communications services are provided by packet switched public data network (SKDP) and leased circuit network. Those networks have been improved and enhanced to provide the services on nation-wide basis. However, the data communications network will be integrated into the ISDN. As the first step toward ISDN, existing networks to provide data communications services will be interconnected by the "SPINTEL".

1.5 ISDN Services

The development of ISDN services depends entirely on the strategic marketing and the technological development for the introduction of IDN/ISDN. These services to be provided by IDN/ISDN bring evolution not only in business activities but also in social activities, for both users and service providers.

As mentioned in SECTION 4, all the existing telecommunications services, i.e. telephone service, non-

telephone services including packet data and leased circuits, will be integrated into ISDN services. The services to be provided by ISDN will penetrate from Jakarta and major large cities to small cities as follows:

(1) By the Year 1999

Through IDN and narrowband ISDN, a part of bearer services (64 kbit/s, Speech, 3.1 kHz audio), teleservices (group 4 telefax, teletex) and supplementary services (call transfer, call waiting) are introduced in the limited areas.

Packet data network and telex network are to be integrated into narrowband ISDN.

(2) By the Year 2010

Through narrowband ISDN, the above service coverage is to be expanded. The telephone network is to be integrated into narrowband ISDN, while broadband ISDN services are commenced in major cities.

(3) By the Year 2020

Broadband ISDN is to be expanded all over the country and becomes the national telecommunications network in full scale.

2. SUPPLY PLAN FOR REPELITA-VI

A supply plan for REPELITA-VI is established in accordance with the policy and strategy of the long-term development.

2.1 Service Provision Policy

A service provision policy for REPELITA-VI is established in consideration of the Policy and Strategy of Telecommunications Long-Term Development which have been presented by "Pokok-Pokok Pikiran Pembangunan Jangka Panjang Tahap-II Sector Pariwisata, POS dan Telekomunikasi" by Department of Tourism, Posts and Telecommunications.

The services provision policy for REPELITA-VI is summarized as follows:

Table 1-7-4 Summary of Services Provision Policy for REPELITA-VI

Capacity (basic component)	: 3.5 MLU (a)
Capacity (additional component)	: 1.5 MLU (b)
Telephone density	: 2.6 (a) / 3.2 (a)+(b)
Service coverage	: up to all the Kecamatan
Narrowband ISDN services	: JKT, SBY, BDG, MDN
Digitalization	: 100%
Automatization	: 100%
Successful call ratio	: 45%-50%

Details of the service provision policy are described in the later paragraphs.

2.1.1 The Target of Telecommunications Services

A target of telecommunications services for REPELITA-VI is to be established from the following long-term viewpoint.

A target of the telecommunications services is decided in realizing "telecommunications services for everyone concerned and by every one concerned". Especially, the services "for every one concerned" are to be provided as follows:

(1) Every one concerned enjoys telecommunications services with one's own personal number;
(Personal Communications)

(2) Every one concerned enjoys telecommunications services to and from everywhere; and
(Wireless Communications)

(3) Every one concerned enjoys diversified telecommunications services.
(Multi-purpose Communications).

2.1.2 Services Development

At present, the following telecommunications services are provided through the analog and digital mixed network:

a) Telephone service;
b) Telegram service;
c) Telex service;
d) Packet data service (SKDP);
e) Mobile communications service; and
f) Leased Circuit service.

The telecommunications services mentioned above are to be developed adding new services with technological innovation toward ISDN (Integrated Services Digital

Network) and IN (Intelligent Network). In consequence, provision of new services depends on telecommunications network development.

A goal of long-term services development up to the year 2020 is to provide the nation-wide Broadband ISDN and IN services. It must integrate all the services above and the advanced supplemental services. The REPELITA-VI is the first step toward the goal at the end of Second Long-Term Telecommunications Development. A scenario of services development continuing the existing services by the end of REPELITA-VI is as follows:

(1) Improvement of service quality mainly for telephone service by digitalization of the facilities and the network;

(2) Introduction of Narrowband ISDN to major cities; and (Jakarta, Surabaya, Bandung and Medan)

(3) Introduction of the following new services to be realized by network and end terminals:

a) Services realized by network

- G4 telefax service;
- Teletex service;
- Voice conference service;
- Video Conference service;
- Still picture transmission; and
- Paging service.

b) Services realized by end terminals

- Circuit lease service;
- Call transfer service;
- Call waiting service; and
- Message recording.

2.2 Yearly Supply Plan

Yearly supply plan is to be established from viewpoints of project implementation and its finance. At a financial viewpoint, an internal rate of return (IRR) of the program will become higher, when more projects are implemented in the later stage of the program period.

In a trend of the past program implementation, the actual implementation was also delayed and concentrated in the later stage of the program due to the following major reasons:

(1) A delay of the previous program (carry-over); and

(2) A delay of contractual procedure.

Considering the above, the yearly supply plan of REPELITA-VI is prepared taking the following into account:

(3) Coordination with the projects to be carried over from PELITA-V;

(4) Balanced supply volume in a WITEL area through the program period;

(5) Three (3) year implementation period for a project package consisting of the following:

a) One (1) year for preparatory work on design, tendering and contractual procedure; and
b) Two (2) years for actual implementation.

2.3 Regional Supply Plan

As stated in SECTION 3, the supply plan is established as follows:

* 3.5 MLU on exchange by exchange basis
* 1.5 MLU on profitable area by area basis

The details of the capacity distribution to the regions and exchanges are described below.

2.3.1 3.5 MLU on Exchange by Exchange Basis

Total 3.5 million line unit capacity is distributed in accordance with the demand distribution ratios described in SECTION 6. The capacity is distributed by the distribution ratio to all the Kecamatan. Then the supply volume by Kecamatan is aggregated into each exchange area. For Jakarta area, the supply plan established in accordance with the above procedure is adjusted considering current facilities condition and on-going projects.

2.3.2 1.5 MLU on Profitable Area by Area Basis

The installation of 1.5 million telephone line unit capacity will be realized by private participation. In consequence, the capacity is distributed only to profitable areas (cities). Areas (cities) to be distributed the capacity are selected in accordance with the following criteria:

(1) More profitable by less investment cost;
(2) More demand and higher demand density; and

(3) Higher traffic intensity per subscriber.

As a result of analysis based on the criteria above, the following three (3) cities exceeding two (2) million in 1990 population census are selected as suitable areas for private participation. In addition, the capacities to be assigned to the cities are established based on insufficient capacities comparing with the demands at the end of REPELITA-VI. Considering the above, suitable areas and provision for private participation are proposed as follows:

Table 1-7-5 Suitable Areas for Private Participation

Jakarta	:	0.7 million line unit capacity
Surabaya	:	0.4 million line unit capacity
Bandung	:	0.4 million line unit capacity

The data used for comparative analysis among major cities exceeding one (1) million in 1990 population census are referred to in the following Table 1-7-6:

Table 1-7-6 The Data for Comparative Analysis

Cities	Pop (x1,000)	Pop/area (/km2)	Demand (1998)	Total Pulses	Pulses /line
Jakarta	8,223	12,788	2,189	47.6%	10,103
Surabaya	2,473	8,677	425	9.9%	11,781
Bandung	2,057	5,130	575	5.6%	10,972
Medan	1,730	5,340	201	4.9%	10,767
Semarang	1,249	3,663	233	2.9%	9,670
Palembang	1,141	3,370	115	2.0%	13,279

Sources: population in 1990 (BPS)
: pulses in 1991 (TELKOM)
: demand (x1,000) in 1998 estimated by JICA study team

SECTION 8

NETWORK DEVELOPMENT AND INSTALLATION PLAN

SECTION 8 NETWORK DEVELOPMENT AND INSTALLATION PLAN

1. LONG-TERM NETWORK DEVELOPMENT SCENARIO

1.1 Technological Development

1.1.1 Background

The technology is one of dominant factors in the supply of telecommunications services. The significant parts in the telecommunications technology are terminal technology, transmission technology and switching technology which are engineered by the application of digital techniques. These three technologies have been and will be constantly developed rapidly, so that in relation to the development of telecommunications in the perspective of the global network it needs to be standardized at an international scale.

In the First Long-Term Development Period, the telecommunications technology has been provided by the government as one of the strategic means for the transformation of the nation toward an industrial community.

By the end of the Second Long-Term Development Period, the information technology which also covers the telecommunications technology will reach some characteristics which are entirely different from their present form. In consequence of the development of information technology consisting of telecommunications technology and data processing technology, various kinds of advanced services are realized.

1.1.2 Technological Development Policy and Strategy

(1) Technological Development Policy

Attempt to accelerate the national development and the development of the national telecommunications industry can be made by utilizing the opportunities which are offered by the progress in science and technology. In the selection of technology, attention must be paid to the following criteria:

a) The technology is aimed at providing advantages to all aspects of life, with the objectives of increasing productivity, efficiency and to increase the added value.

b) The application of satellite technology, optical fiber and mobile communications technology which are all based on digital technique are utilized and

developed for the establishment of the Integrated Services Digital Network (ISDN).

(2) Technological Development Strategy

To accelerate telecommunications development supporting national development and, to realize advanced telecommunications services to be provided for various needs in socio-economic activities, the following technological development is indispensable:

a) Satellite communications technology;
b) Submarine cable technology;
c) Large capacity microwave technology;
d) Digital radio telecommunications technology; (Subscriber radio system)
e) Broadband switching technology;
f) Computer based advanced technology;
g) Mobile communications technology; and (to realize universal personal telecommunications)
h) Software technology.

1.2 Long-Term Network Development

Based on telecommunications service provision policy aiming at the establishment of services which are oriented at the satisfaction of the people and fulfillment of the demand, for both in quality as well as in quantity, long-term telecommunications network development is planned in the Second 25-Year Telecommunications Development. The network development will be carried out in the following three phases.

1.2.1 Network Development in Acceleration Decade (1990-2000)

During this decade, a target of the national telecommunications network is the digitalization with the intermediate objective in the form of the establishment of the Integrated Digital Network (IDN) as the base in order to reach the final target in the form of the Integrated Services Digital Network (ISDN). At this decade it is planned to realize IDN 100% so that the narrow band ISDN is realized in major cities.

The following the completion of submarine optical fiber cable system between Surabaya and Banjarmasin, the development continues in the following routes:

(1) Jakarta - Surabaya;
(2) Kalimantan - Sulawesi; and
(3) Sumatra - Jawa.

1.2.2 Network Development in Development Decade (2000-2010)

In this decade, the narrowband ISDN is available in district capitals.

The development of submarine optical fiber cable network is extended to cover all the large islands up to Irian Jaya.

The option of a satellite at low orbit and L-band gives the opportunity for the development of the advanced mobile communications system.

1.2.3 Network Development in Independence Decade (2010-2020)

The broadband ISDN with the ability to distribute not only voice, data and text but also image is opened the opportunity to image communications which is utilized by the community.

Mobile communications service network covers whole country and gives the opportunity to increase efficiency in the national transportation system for cargo and passengers.

The submarine optical fiber cable network forms the backbone network together with the terrestrial microwave transmission network.

1.3 Service-Wise Network Development Scenario

The public telecommunications services in Indonesia are currently provided by the following four (4) public networks:

1) Telephone network;
2) Telex network;
3) Packet switched data network (SKDP); and
4) Non-switched network (Leased circuits).

When the favorable impacts of the rapid technological development and innovation in the telecommunications are taken into consideration for the telecommunications network development in Indonesia, the public telecommunications networks above can be integrated into ISDN in the following steps:

STEP 1 : Digitalization of the network;
STEP 2 : Integration of the network (IDN);
STEP 3 : Integration of the services (ISDN); and
STEP 4 : Intelligent network (IN).

1.3.1 Telephone Service

(1) Ordinary Telephone Service

A development scenario of telephone network realizing telephone service which is most dominant service in the telecommunications services is as follows:

a) to expand network coverage to sub-districts (Kecamatan) and villages (Desa);
b) to expand supply volume meeting the demand;
c) to automatize the existing manual boards; and
d) to digitalize the existing network toward ISDN and IN.

A target of the telephone network development during REPELITA-VI is to cover all the sub-district capitals with automatic telephone service.

(1) Mobile Telephone Service

In addition to the ordinary telephone service, land mobile telephone service by analog system has been provided in Jakarta, Surabaya and Jakarta-Bandung. A network development scenario for land mobile telephone service is as follows:

a) to expand network coverage to major cities and major roads; and
b) to expand supply volume meeting the demand.

In near future, digital cellular mobile telephone system with sub-microwave bands will be introduced.

In CCIR, development of Future Public Land Mobile Telecommunications System (FPLMTS) is under study in cooperation with CCITT. FPLMTS will be established as an international standard for mobile communications.

1.3.2 Non-Telephone Services

Non-telephone services such as telex, leased circuits and packet data communications are provided by the respective independent network. In near future those networks will be integrated into ISDN. However, up to the completion of ISDN the following advanced services will be provided by the telephone network or data network:

a) Teletex;
b) Videotex;
c) Information services;
d) Booking services;
e) MHS (message handling service); and
f) Others.

For development of data communications, existing networks such as SKDP and leased circuits will be improved and enhanced until establishment of an integrated network for ISDN. To expand SKDP network, P.T. TELKOM has been carrying out to install additional SKDP equipment in Jakarta and major cities. During PELITA-V, six (6) ANP are newly installed and additional six(6) ANP will be installed in major cities.

As the first step toward ISDN, P.T. TELKOM is aiming at interconnecting with existing systems by "SPINTEL".

1.3.3 Approach to ISDN

The implementation steps toward ISDN will vary depending on various circumstances such as demand variation, quality and condition of existing network, financial capability of operating entity, etc. In any case, however, evolution toward ISDN will be divided into the following three steps:

STEP 1 : Digitalization of existing telephone network to establish IDN for ISDN;
STEP 2 : Provision of narrowband ISDN; and
STEP 3 : Provision of broadband ISDN.

(1) Digitalization of existing telephone network

The existing analog telephone network is digitalized up to the line concentration portion through the adoption of digital switching and transmission technologies. This will form an Integrated Digital Network (IDN) with 64 kbit/s bearer channels among users of concentrator through the switching systems.

An ISDN interface and the common channel signalling are provided to enable the user to access to the service capabilities and/or network facilities of ISDN.

Different dedicated networks such as telephone network and data communications network are integrated into an ultimate form of ISDN. This single network will then possess the capabilities for data switching at speeds higher than 144 kbit/s and provide video transmission switching services.

(2) Provision of narrowband ISDN

At the previous step, all preparatory work necessary to provide narrowband ISDN services is completed. By using narrowband ISDN the following services are available:

a) Teletex;
b) Group IV facsimile;
c) Audiographic conference;
d) Video conference;
e) Still picture transmission; and
f) National/regional paging and other mono-directional services.

(3) Provision of broadband ISDN

The broadband ISDN service will be realized as a result of technological development of broadband switching and high speed transmission system including subscriber network.

2. Planning Principles for REPELITA-VI

This Paragraph describes planning principles for network development and provision criteria for preparing installation plan by facility category.

From a technological point of view principles for network planning and facility planning are based on the Fundamental Technical Plan (FTP) and Strategic Development Plan (SDP).

As stated regarding a development scale in SECTION 3, an optimistic development target of REPELITA-VI is 5.0 million telephone line unit capacity of new installation in addition to the total capacity (3.0 million line unit capacity) at the end of PELITA-V. In this study, the network and facility planning are made on the following basis:

* 3.5 MLU: on exchange by exchange basis
* 1.5 MLU: on profitable area by area basis
* Backbone transmission covering 5.0 MLU

At a viewpoint of telephone network development, a development scenario by the end of REPELITA-VI is as follows:

(1) to expand the network coverage to all the Kecamatan;
(2) to automatize all the existing manual boards; and
(3) to digitalize the existing network toward ISDN and IN.

The planning principles by sub-system for REPELITA-VI are described in the following paragraphs.

3. SWITCHING NETWORK

3.1 Switching Network Development

The existing SLDD network consists of seven (7) tertiary centers (TC), thirty three (33) secondary centers (SC) and many primary centers. It is conventional four (4) hierarchy network.

As the network scale becomes larger and larger, the existing four (4) hierarchy network causes a reduction of successful calls due to concentration of destined and transit traffic through more switching nodes to a specific SLJJ exchange like Jakarta TC. In consequence of heavy traffic concentration including heavy transit traffic to a specific exchange, the exchange capacity becomes extremely large. The overgrown exchange can not be covered by one unit of system. Inevitably, the exchange is composed with multiple units. It is against network simplification and is not economical. Considering the above and division of operation company, the existing SLJJ network is to be reorganized as follows:

(1) Reduction of hierarchies (4 to 3) by abolition of all the tertiary centers and establishment of SC-SC mesh network (40x40) except Ternate and Merauke which have no terrestrial transmission links

(2) Establishment of the following three gateways to/from the international switches

Table 1-8-1 Domestic Gateways and International Switches

Domestic gateways	International Switches
Jakarta	Jakarta
Medan	Medan
Surabaya	Surabaya (in future)

(3) Separated trunk switches from local switch for both SC and the domestic gateway above

Typical connections considering the above are as follows:

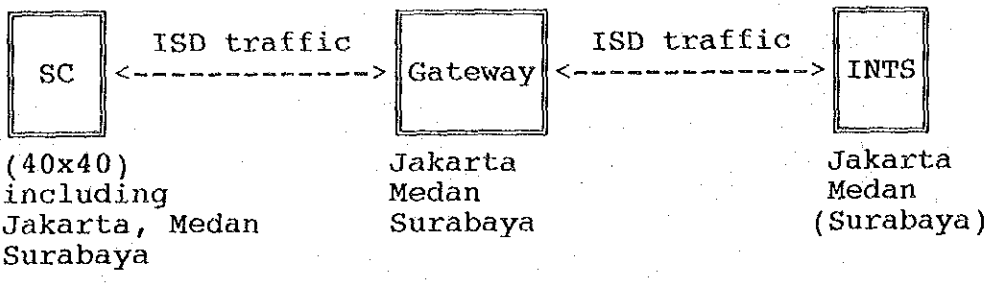


Figure 1-8-1 A Typical ISD Connection

With respect to the item (1) above, connections among SCs except Ternate and Merauke are on mesh network. Because Ternate and Merauke have only satellite links and are not planned to install terrestrial transmission links by the end of REPELITA-VI. Accordingly, those two cities are connected with other SCs by only satellite links. However, it is not advisable at a reason why extremely large capacity of satellite links is required.

To cope with the situation, it is recommendable that Ternate and Merauke are temporarily connected to Surabaya SC (to be changed to SC on SC-SC mesh network) as PCs to avoid confusion on traffic routing, until terrestrial transmission system is installed to the cities.

3.2 Switch Provision Criteria

3.2.1 Ultimate Switch Capacity

An economical life time of switching system is generally assumed 18-20 years after the initial provision. However, a provision capacity to be required at the end of 2003 is applied as an ultimate capacity based on the following reasons:

(1) After the year 2004, an expansion of N-ISDN and B-ISDN will become main objectives. Accordingly, most existing telephone switches will be changed and replaced to ISDN switches.

(2) Some of existing switch types can not be changed to ISDN switch. Such switches will be replaced to ISDN switches.

3.2.2 Initial Provision

An initial provision of equipment possible to be expanded covers the capacity to be required at the end of 1998. However, an initial provision of common and power equipment, etc. which can not be easily expanded covers

the ultimate capacity at the year 2003.

3.2.3 Suitable Capacity of a Local Switching Unit

(1) Kotamadya Area

A suitable capacity of a local switching unit in Kotamadya area is assumed 30,000 line units, considering subscriber density in an exchange area and cost per line unit. For big cities like Jakarta, Surabaya, etc., however, 50,000 line units in maximum capacity for a local switching unit may be applied to reduce the number of switching units in view of network simplification.

(2) Ibu Kota Kabupaten (IKK)

For Ibu Kota Kabupaten (district capital), switching system combined with trunk and subscriber connection functions with less than 30,000 line units capacity is applied considering less transit traffic intensity.

(3) Surrounding Area of Ibu Kota Kabupaten

In surrounding area of district capital (IKK), a suitable capacity of a local switching unit is assumed approximately 1,000 line units, considering subscriber density in an exchange area and cost per line unit.

3.2.4 Criteria of switching System Selection

(1) Local Exchange Type in Urban Area

Local exchange type in urban area including multi-exchange area is defined depending on initial and ultimate line unit capacities as shown in the following Table 1-8-2:

Table 1-8-2 Local Exchange Type in Urban Area

Category	Initial Line Capacity (IC)	
	10,000 > IC	IC ≥ 10,000
<Ultimate Capacity (UC)>		
30,000 > UC	Type U-R	Type U-I
UC ≥ 30,000	Type U-R+	Type U-I

Note 1: Type U-I : Independent exchange
Type U-R : RLC/RSU
Type U-R+ : RLC/RSU --> Type U-I in future
Note 2: 50,000 instead of 30,000 may be applied for big cities.

(2) Trunk/Tandem Exchange Type

Trunk/Tandem exchange type is defined depending on an ultimate transit traffic in Erl as shown in Table 1-8-3.

Table 1-8-3 Trunk/Tandem Exchange Type

Category	Trunk Ex.	Tandem Ex.
<Transit Traffic (TT)>		
TT < 800 Erl.	Type T-C	Type T-C
800 Erl. ≤ TT	Type T-S	Type T-S

Note: Type T-C: Combined type with local exchange
Type T-S: Separated type from local exchange

On the other hand, the secondary centers are basically of separated type from local switching function.

(3) Local Exchange Type in Rural Area (Kabupaten Area)

Local exchange type in rural area (Kabupaten area) is defined depending on an ultimate line unit capacity as shown in the following Table 1-8-4:

Table 1-8-4 Local Exchange Type in Rural Area

Category	Local Exchange Type
<Ultimate Capacity (UC)>	
1,000 > UC	Type R-I (stand alone type)
UC ≥ 1,000	Type R-R

Note: Type R-I : Small independent exchange
Type R-R : RLC/RSU

3.2.5 Applicable System Capacity by Existing Switch Type

(1) STDI (EWSD)

Applicable system capacity of EWSD per unit is as follows:

Table 1-8-5 Applicable System Capacities of EWSD

Type	System Capacity (LU)
EWSD	up to 30,000 (stand alone)
STDI-K	up to 1,000 (stand alone)
DLU	up to 10,000 (digital LU)

Note: DLU: expansion unit: 8 line units.
Capacity of DLU is a portion of that of control exchange.

(2) STDI-II CITRA (AT&T No.5 ESS)

Applicable system capacity of No.5 ESS per unit is as follows:

Table 1-8-6 Applicable System Capacities of STDI-II CITRA

Type	System Capacity (LU)
No.5 ESS	up to 50,000 (stand alone)
RSU	up to 10,000

RSU: Remote Switching Unit

(3) STDI-II NUSA (NEC NEAX-61)

Applicable system capacity of NEAX-61 per unit is as follows:

Table 1-8-7 Applicable System Capacities of NEAX-61

Type	System Capacity (LU)
NEAX-61	up to 50,000 (stand alone)
RSU	up to 10,000

RSU: Remote Switching Unit

3.2.6 Area Priority on New Installation of Telephone Exchange

New installation of exchange facility during REPELITA-VI is done in accordance with the following priorities:

Priority 1

Demand fulfillment in Kotamadya & IKK

Priority 2

Automatization of existing manual exchanges

Note: In case the demand in the objective area at the year 2003 is less than 800, automatization is realized by radio subscriber system without installing a new exchange.

Priority 3

Expansion of network coverage to all the Kecamatan

Priority 4

Digitalization of the existing analogue exchanges in Jakarta for an improvement of SCR and toward ISDN

Priority 5

Replacement of the existing analogue exchanges outside JKT.

3.2.7 Provision Strategy on Type of Switching System

By the end of PELITA-V, N-ISDN services will be commenced. In addition to the above cities N-ISDN services will be provided also in Medan. Considering a difficulty on

providing N-ISDN services with existing EWSD, no installation of new EWSD unit is required in the above four cities. However, the total number of line units to be installed for REPELITA-VI is to be equally supplied by three types of switching systems i.e. EWSD, No.5 ESS and NEAX-61.

To simplify OA&M for the switching system, the following switch provision policy in accordance with "FTP 92" is basically applied:

a) One type of switching system for one WITEL;
b) One type of switching system in one building; and
c) A type of switching system already installed is not changed.

3.2.8 Quantitatively Balanced Implementation

In order to achieve REPELITA-VI Program, the Program during five years should be divided into each year by WITEL as equally as possible. An average achievement per year is estimated 0.86 MLU for 3.5 MLU target and 1.16 MLU for 5.0 MLU target including digitalization of existing analogue exchange.

3.3 Traffic and Circuit Calculation

In order to calculate traffic and circuits to be required for extremely large scale network, the calculation is made dividing the network into three portions as follows:

(1) Sections Between Secondary Areas (SA)

SC-SC

(2) Within Each Secondary Area

SC-PC, PC-LE

(3) Within Multi-Exchange Areas

3.3.1 Calculation Condition for Sections between Secondary Areas

Traffic and circuit calculation for the exchange sections between Secondary Areas are made by using the regression model built by JICA Long Term Plan Study. The details are stated below.

(1) Traffic Distribution

Distributed traffic matrix between 40 Secondary Areas (40 X 40 matrix) is obtained by the following regression model:

$$\ln(Xij) = -4.095 + 0.510*\ln(Si) + 0.570*\ln(Sj) - 1.653*\ln(Pij) + 0.185*D*\ln(Pij)$$

where,

ln : natural logarithmic operator
Xij: traffic in Erl. from SAi to SAj
Si : the number of main lines in SAi
Sj : the number of main lines in SAj
Pij: the number of pulses for a minute from SAi to SAj
D : dummy, to/from Jakarta: D=1, to/from others: D=0

(2) The Number of Circuits between Secondary Areas

The number of circuits between Secondary Areas is calculated from the following factors:

a) Distributed traffic matrix;
b) Traffic routing condition; and
c) Cost ratio.

Note: SC-SC network is of mesh configuration.

3.3.2 Calculation Condition for Sections within Secondary Area

Traffic and circuit calculation for the exchange sections within each Secondary Area i.e. SC-PC, PC-LE, are made based on traffic distribution ratios from a subscriber:

Table 1-8-8 Traffic Distribution Ratio from a Subscriber

Exchange Sections	Distribution Ratio (%)
Sub - LE	100.0
Sub - Sub within own LE	67.0
LE - own PC	33.0
PC - own SC	16.0

Note: Sub: Subscribers
LE : Local Exchange
PC : Primary Center
SC : Secondary Center

3.3.3 Calculation Condition for Multi-Exchange Areas

Traffic and circuit calculation for the exchange section in a multi-exchange area is made by using a method recommended by CCITT in "Local Network Planning".

(1) Traffic Distribution

Traffic distribution between exchanges in a multi-exchange area is made by using a gravity model with the following calculation conditions:

a) Outgoing traffic by exchange;
b) Crow flight distance between exchanges; and
c) Community factor.

(2) The Number of Circuits between Exchanges

The number of circuits between exchanges in a multi-exchange area is calculated based on the following factors:

a) Distributed traffic matrix;
b) Cost ratio; and
c) traffic routing condition.

3.3.4 Traffic per Subscriber for Planning

For the purpose of planning, the following originating traffic per subscriber are applied by area category:

a) 60 mErl. for Kotamadya areas; and
b) 48 mErl. for Kabupaten areas

3.4 Synchronization Plan

The present network in Indonesia is operated under the presiochronous synchronization. N-ISDN services are provided in the later stage of PELITA-V, which most of SCs are planned to be linked by digital transmission systems during REPELITA-VI.

Taking spread of ISDN services into consideration, synchronous network is to be established in the period of REPELITA-VI. The Pre-selected Alternate Master Slave (PAMS) synchronization network, which follows FTP 92 (Fundamental Technical Plan 1992), will be established. To assure the network security, two (2) master clocks for domestic network are requested to install.

From the viewpoint of geographic condition in Indonesia, the master clocks are to be installed in Jakarta and Surabaya in 1995 corresponding with an introduction of second optic fiber transmission system by SDH (Synchronous Digital Hierarchy).

Jakarta master clock covers the western part of Indonesia (WITEL I to VI) and Surabaya master clock covers the eastern part of Indonesia (WITEL VII to XII). Both master clock are operated under a mutual synchronization. Other

exchanges excluding Jakarta and Surabaya are operated as slave stations of Jakarta and Surabaya corresponding to the completion of digital transmission link. Transmission of clock signal is according to the network hierarchy through the clock path of 2Mbit/s. At least two (2) clock paths for main and alternate are basically prepared.

Sub-master clock will be installed at the central exchanges of the regions when the regional companies will be established. In case that high speed data transmission services will be introduced, the sub-master clock in the related regions will be mutually synchronized with master clock to improve the clock stability against transmission delay and degradation of clock accuracy due to environmental condition.

3.5 Signalling Plan

Signalling plan is a facility to arrange utilizing / application of signalling system at telecommunications network. The main objective of signalling plan is to avoid irregularity of telecommunications network caused by various applications of signalling system which are not in mutual accord. Toward ISDN, introduction of Common Channel Signalling No. 7 is indispensable. The introduction of CCS No. 7 must be paid attention to the network type to be served and evolution plan of network for a certain area considering demand of signalling system for ISDN network. By the end of REPELITA-VI, ISDN services are to be introduced in Jakarta, Surabaya, Bandung and Medan. In consequence, CCS No. 7 is also to be introduced in the above areas.

4. TRANSMISSION NETWORK

As a result of traffic estimate and circuit calculation, approximate 76,000 trunk circuits among the SCs are required at the end of REPELITA-VI. To satisfy this requirement, large capacity transmission systems have to be newly installed throughout the country. Accordingly, construction of terrestrial transmission links are to be accelerated during REPELITA-VI. In this connection, fiber optic transmission system is desirable because of its expandability on system capacity.

The priority is given to connect most of SCs by terrestrial transmission systems resulting to complete terrestrial links among the provincial capitals. Only two (2) SCs, namely Ternate and Merauke, are planned to be served by satellite system considering the geographic condition and the volume of circuits required.

4.1 Network Configuration

4.1.1 Circuit Requirement

According to the circuits requirement for SCs, the numbers of 2Mbit/s streams required for the terrestrial routes among the major islands are shown in Table 1-8-9.

Table 1-8-9 Inter-Island Circuit Requirement for Terrestrial Links

Area	JAW.	N.T.	SUL.	KAL.	SUM.	M&I
Jawa	1,194	150	184	166	625	71
N.Tenggara	150	6	21	20	47	12
Sulawesi	184	21	10	25	57	15
Kalimantan	166	20	25	10	57	15
Sumatera	625	47	57	57	65	33
Maluku&Irian	71	12	15	15	33	3
Total	2,390	256	312	293	884	149

Unit: the number of 2Mbps

4.1.2 Inter-island Links

As a result of consideration on circuits requirement, geographical location of islands and the existing routes including on-going projects, the following four (4) inter-island links are requested to be newly installed:

a) Jawa - Sulawesi
b) Jawa - Sumatera
c) Sumatera - Kalimantan
d) Sulawesi - Maluku/Irian Jaya

(1) Jawa - Sulawesi

The captioned link is required to be completed urgently since the Trans-Sulawesi project is planned to be completed in the year 1994. Three (3) routes are applicable for the objective link. The first route is direct link, the second one is via Nusa Tenggara and the third one is via Kalimantan.

Since the digital transmission system is available between Jawa and Sumatera, the direct route has advantage on the accessibility to Sumatera. In addition, construction period is expected to be short, because it is possible to utilize the existing back-haul link in Jawa island.

As for the second route, distance of the submarine cable section is shorter than the first one.

Meanwhile, the capacity of the on-going Trans-Nusa Tenggara is insufficient to carry the large traffic to/from Sulawesi, Maluku and Irian Jaya. Therefore, construction of new system to link Jawa and Nusa Tenggara is requested. In this connection, repeater less submarine cable system along the islands in Nusa Tenggara would be applicable.

In connection with the third route, it has less advantage because of limitation on capacity of the existing submarine cable between Surabaya and Kalimantan. Meanwhile, the diversity route is necessary in future to carry the traffic for Sumatera and the west Jawa from Sulawesi, Maluku and Irian Jaya. For this purpose, the submarine cable between Sulawesi and Kalimantan is to be installed in future.

From the above view points, the captioned inter-island route is proposed to complete by the following steps:

1st step : Surabaya - Ujung Pandang
(Surabaya - Denpasar - Reo - Ujung Pandang as an alternative)

2nd step : Kalimantan - Ujung Pandang
(in early stage of REPELITA-VII)

(2) Jawa - Sumatera

As for the captioned section, it is recommended to link Jakarta and Palembang considering traffic volume. Taking the inter-island link for Sumatera - Kalimantan into consideration, it is recommended to make one access point in Sumatera to utilize back-haul system. Considering accessibility to Palembang, Pangkal Pinang is recommended as landing station in Sumatera. In addition, it will be required to extend the submarine cable system up to Sekupang (Batam Island) in the next development stage to satisfy the rapid growing demand in the area together with international connection for Singapore.

As an alternative route, on the other hand, fiber optic system for Jakarta - Tanjung Karang - Palembang is applicable including submarine cable for the section Jakarta and Tanjung Karang on condition that high-way between Tanjung Karang and Palembang would be completed by the year 1996.

In connection with the captioned inter-island link, the further survey and study such as sea bed and road condition is required to finalize the route and system.

4.1.3 Intra-Island System

As a result of consideration on the circuits requirement, network reliability and geographic condition, at least three (3) routes in Jawa and two (2) routes in Sumatera are required, respectively. Optical fiber cable system is desirable on the expandability of system capacity to satisfy future demand.

(1) Jawa Island

Two (2) digital transmission systems will be available until the end of PELITA-V. The one is Jawa - Bali digital microwave and the other is Jakarta - Surabaya fiber optic cable system.

In addition, the third system is to be constructed to fulfill the circuit requirement. To satisfy large demand for the section, second fiber optic transmission system is proposed in northern part of the island to realize the route diversity. It is proposed to lay the cable along the existing railway or main commercial power line aiming at shorter construction period and construction easiness.

(2) Sumatera Island

As for construction of terrestrial fiber optic cable system, permanent road (railway) structure is indispensable to maintain the system in good condition for long time. Taking the present road condition in the eastern part of Sumatera into consideration, digital microwave system is proposed for 2nd backbone route between Medan and Palembang.

Meanwhile, optic fiber cable system for Medan - Palembang - Tanjung Karang is also desirable on condition of existence of permanent road, which is well-paved along the objective section. Therefore, further study on route and system selection is requested before the implementation of the captioned link.

4.2 Summary of New Backbone Transmission System

As mentioned in SECTION 3, it is assumed that the following on-going backbone projects are completed at the early REPELITA-VI:

a) Cross Kalimantan (Phase-II): [Microwave]
b) Trans Sulawesi (Phase-II) : [Microwave]
c) Nusa Tenggara : [Microwave]

During REPELITA-VI, meanwhile, the below-mentioned terrestrial backbone systems are planned to be newly constructed:

a)	2nd Jakarta-Surabaya	: [Optical fiber]
b)	Surabaya-Ujung Pandang	: [Submarine cable]
c)	Medan-Banda Aceh (Digitalization)	: [Microwave]
d)	Ujung Pandang-Ambon-Biak	: [Submarine cable]
e)	Jakarta-Pangkal Pinang (Note 1)	: [Submarine cable]
f)	Pangkal Pinang-Pontianak	: [Submarine cable]
g)	2nd Trans Sumatra (Note 2)	: [Microwave]
h)	Jakarta-Padang (Note 3)	: [Microwave]
i)	Surabaya-Malang (Note 4)	: [Microwave]
j)	Biak-Jayapura	: [Submarine cable]

Note 1 : Alternative is submarine cable for Jakarta-Tanjung Karang and optical fiber cable for Tanjung Karang - Palembang.

Note 2 : Alternative is optical fiber cable for Medan-Palembang.

Note 3 : One alternative is optical fiber cable for Jakarta-Tanjung Karang-Padang including submarine cable.
Second alternative is combination of systems mentioned in the above notes 1 and 2.

Note 4 : Alternative is optical fiber cable.

The ability of traffic processing will be up graded through the completion of the above systems, especially in Jawa and Sumatra. The telecommunications circumstances of north-west and south-east Sumatra, Nusa Tenggara, Maluku and northern part of Irian Jaya (i.e, Sorong, Biak & Jayapura) are remarkably improved.

As mentioned in the previous paragraph, Banjarmasin - Ujung Pandang [Submarine cable] system is proposed to be completed in the early REPELITA-VII. A ring configuration among Sumatra, Jawa, Kalimantan and Sulawesi will be completely established and the reliability of the transmission network will be improved.

On the other hand, it is scheduled that the digitalization of backbone systems is completed by the end of 1995 after the construction of Medan - Banda Aceh route, consequently N-ISDN services are ready for operation at any SC areas.

Nationwide terrestrial transmission routes at the end of REPELITA-VI are shown in Figure 8-1 including the alternative routes.

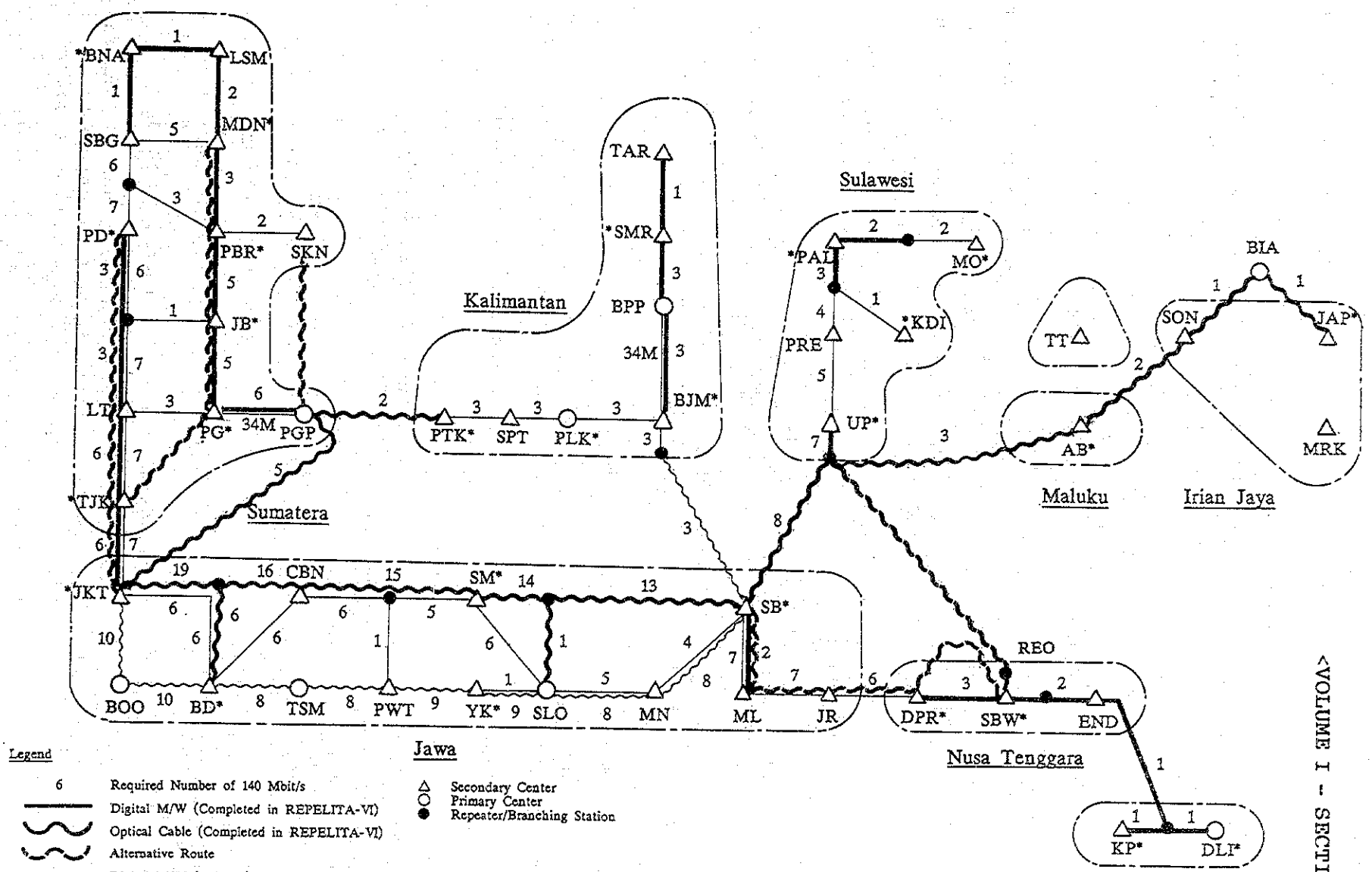


Figure 1-8-2 Backbone Terrestrial Route at the end of REPELITA-VI

4.3 Provision Standard

The transmission network structure is determined by the development target, the circuits requirement and the geographical condition of the area concerned.

4.3.1 Terrestrial Backbone System

The provision standard for backbone terrestrial transmission systems are as follows:

(1) As for the high traffic links, plural terrestrial routes are to be provided by geographically different route or by different transmission media.

(2) In connection with the above (1), ring configuration is planned to be structured.

(3) In case of SC where no alternative terrestrial route is established, the satellite system is applied as back up system.

(4) Toward the ISDN era, SDH (Synchronous Digital Hierarchy) system is applied to new route basically.

(5) Capacity of new submarine cable system is proposed taking twice of the circuits requirement in 1998 into account.

4.3.2 Terrestrial Spur System

Terrestrial system is given the priority for spur system. The following criteria is applied to system selection:

Table 1-8-10 The Criteria of Transmission System Selection

Application	Distance from main network
<Terrestrial>	
Optical Fiber:	0 - 30 km
Digital Microwave:	20 - 100 km (Note)
<Satellite>	More than 100 km

Note: It will be composed of 2 or 3 radio hops.

Selection of spur system is determined by not only distance but also geographical condition of the hop. But if there is less deference between fiber and microwave systems both in economical and technical aspects, microwave system is preferable since station's tower

facility can be utilized for subscriber's radio and mobile communications systems as a function of base station.

4.3.3 Satellite System

The service area of PALAPA domestic satellite is being extended up to around ASEAN countries. Meanwhile, PALAPA system enters the C-generation and introduction of new telecommunications services, such as video tele-conference and message handling, has been planned.

Strategy on its service application is under study by the preparatory committee for new PALAPA company, which will be established as a subsidiary of PT. TELKOM in 1992.

The details of PALAPA satellite system available for the domestic public network is not clear at the moment, however, the following provision criteria of satellite circuit are presumed for the planning of REPELITA-VI:

(1) TDMA system is basically applied to SC and major PC where are located in provincial capital and important place, to provide backbone circuits in cases:

- that any terrestrial link is not available. (100% of the required circuits are installed.)

- that one (1) terrestrial link is available, but no alternative route is provided. (10% of the required circuits are installed as back-up circuits.)

Beside the above, at least one (1) SC in one (1) WITEL has TDMA system as back-up circuits.

(2) PA-SCPC system is basically applied to PC where no terrestrial link is available during REPELITA-VI.

(3) DA-SCPC system is applied to all the exchanges, where no terrestrial link is provided, and to handle the over-flow traffic of pre-assigned circuits.

5. LOCAL NETWORK

For expansion of local network, the expansion of conventional cable network in urban areas and subscriber network in the rural areas is planned to cover all the Kecamatan.

In other words, one of major targets of REPELITA-VI is to expand the network to all the Kecamatan. The local network to cover all the Kecamatan consists of local cable network and radio subscriber system. To connect subscribers in Kecamatan areas, an new exchange is established in an urbanized Kecamatan in Kabupaten to cover surrounding several Kecamatans.

As a result of the study, the expansion of local subscriber networks are planned in 1200 exchange areas including the existing exchange areas, the installation program by exchange area is summarized in the VOLUME II, "Implementation Program for REPERITA-VI".

The implementation program is represented in the net number of lines or the number of subscribers installed which amount to 4,370,000 lines and 56,000 subscribers to be connected by the radio subscriber system by 1998. The installation consists of the following works:

(1) Installation of primary and secondary cable pairs;

(2) Construction of cable ducts, manholes and other supporting facilities; and

(3) Installation of radio subscriber system (RSS).

The criteria of system selection are established from the following points of view:

(1) Distance between subscribers to be connected and exchanges (more than 10 Km);

(2) The number of subscribers in a limited area far from the exchange; and

(3) Distribution of subscribers to be connected.

Based on a result of the study above, the installation plan consisting of the number of SSP (cable pairs) and radio subscriber system is prepared. The criteria established for planning are as follows:

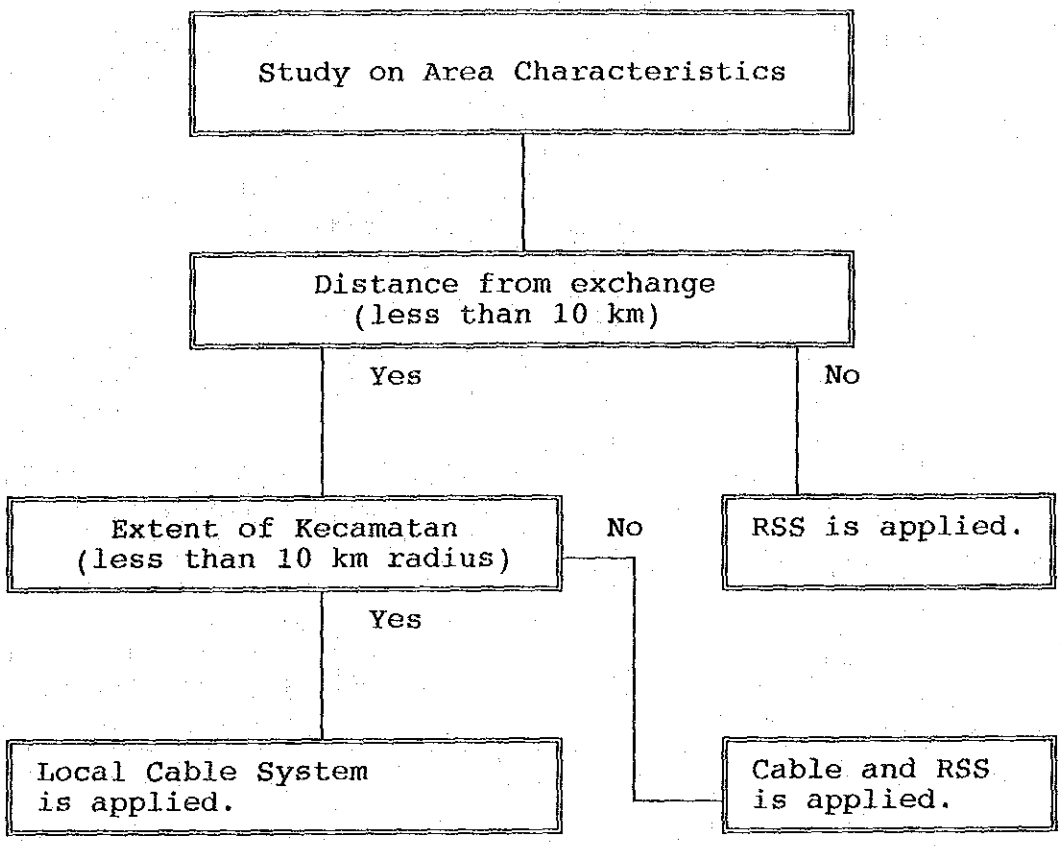


Figure 1-8-3 System Application Criteria

6. SUPPORTING FACILITIES

6.1 Design Policy for REPELITA-VI

The supporting facilities to form a part of the telecommunications system should satisfy the variety of conditions required for the telecommunications services which will become more sophisticated and more diversified.

Accordingly, the supporting facilities required for REPELITA-VI should be planned under the following policies below.

(1) Planning and construction of the telecommunications network as an infrastructure in the information-oriented society is to be made linking with the national and the urban development programs;

(2) Buildings are to be planned to accommodate without generating any problem to the telecommunications equipment which may be replaced in a considerably short interval;

(3) Preventive and protective measures are to be introduced against calamity caused by fires, storm, flood, earthquake and also man-made calamity;

(4) Security of the privacy of the public, the companies, etc. is to be reflected in the building design;

(5) Economical but efficient maintenance and management of buildings and towers are to be pursued. Measures are to be taken to preserve a good environment, and to save natural resources and energy; and

(6) Environment within which PT. TELKOM staff works and welfare of the staff are to be improved.

6.1.1 Exchange Building

Planning principles for the exchange building are as follows:

(1) TELKOM's prototype as a standard is basically applied for new exchanges;

(2) A prototype for the exchange with less than 1,000 LU capacity (DLU) is newly established;
(dimension: building area: 60m2, site area: 240m2)

(3) A high-rise building for new Jakarta trunk center is planned considering land acquisition, antenna for microwave link, etc.;

(4) Proposed building capacity covers that at the end of REPELITA-VI considering initial investment cost; and

(5) In case the existing exchange building has no sufficient space for new installation of equipment, the building is to be expanded and modified.

6.1.2 Tower

The planning principles for antenna towers are as follows:

(1) The existing tower is to be used for installation of additional antenna as much as possible, considering a life and strength of the tower.

(2) In planning of new tower construction, K-truss structure is applied from a viewpoint of ease of construction and economical advantage.

6.1.3 Access Roads

Access road is to be of 3.0 meters in width meeting TELKOM's standard and asphalted.