5.2 Switching Network

There is no question that Indonesia's international telecommunication networks will develop significantly by the expansion of existing service networks and through introduction of new service networks. Firm guidelines and rational techniques are needed to map out equipment plans to execute effective equipment investments when networks are on their way to maturity.

This section describes telecommunication equipment plans for gateway offices broken down by services.

Gateway office equipment plans for existing services (telephone and telex) are mapped out based on the following guidelines.

1) In Indonesia, P.T. Indosat operates international networks, and PERUMTEL, domestic networks.

2) At present P.T. Indosat does not have its own subscribers which are accommodated directly by international exchanges therefore international traffic is always routed through domestic networks.

3) Gateway offices are connected to the highest hierarchical offices in domestic networks.

4) Several gateway offices will be built to enhance the network flexibility.

5) When there are several gateway offices, the domestic handling area of one gateway office is allocated by dividing the domestic network by the number of gateway offices making WITEL the minimum unit. The areas handled by gateway offices are not duplicated.

6) One gateway office is connected to several adjoining highest hierarchical offices in the domestic network. One highest hierarchical office in the domestic network is connected to only one gateway office.

7) Other gateway offices back up international traffic that should be handled by a gateway office when one gateway office is no longer able to function. The ratio of traffic to be backed up should be optimal after considering cost, transmission route and other conditions. The gateway offices will be mainly responsible for back-up steps. For more effective back up, if possible, the domestic networks will also take steps to transfer the international traffic from an area handled by a gateway office whose function has stopped to other gateway offices.

8) Gateway offices receiving calls from the domestic networks will first be responsible for charging international calls.

9) In telephone service, the signaling system, numbering plan, and other plans for tie lines between gateway offices and offices in the domestic networks are based on the Fundamental Plan of PERUMTEL.

10) Equipment expansion of Indonesian international telecommunication networks will be based on digital technology. Existing analog equipment will be replaced by digital equipment when it reaches its life. Analog/digital conversion equipment will be installed during the transition period in which analog and digital technologies operate in parallel. Such conversion equipment will be installed in optimal locations considering the investment efficiency.

5.2.1 Telephone Switching

(1) International Telephone Switching Network

Based on the foregoing guidelines for equipment plans, Indonesian international telephone switching network is expected to grow as described in the following.

(a) The Medan Gateway Office will start operating in 1983 and will be handling all international telephone traffic for Sumatra. In the beginning, the gateway office will accommodate international circuits with eight Asian countries. Traffic with other countries will be routed through the Jakarta Gateway Office. The Medan Gateway Office should preferably be connected to the Palembang Tertiary Trunk Centre (TTC) as well.

Fig. 5.2.1.1 shows the configuration of Indonesian international telephone network in 1984.

(b) In operating Indonesian international telephone service, there are a number of subjects that require prompt action to effectively meet the rapidly-increasing traffic, such as an improved semiautomatic operation system, introduction of a common channel signalling system, and introduction of network control techniques. International telecommunication carriers are required to be able to flexibly meet the world-wide service demands and technological trends. Based on this, P.T. Indosat is required to have its own gateway office equipment.

The Jakarta Gateway Office handling the bulk of Indonesian international traffic should be separated from METACONTA 10C operated by PERUMTEL as soon as is practical, and operate using its own switching systems.

To meet foregoing requirement and growing telephone demand, new digital SPC exchange should be installed in 1985. The new exchange should not only be connected to Jakarta TTC, but also to Surabaya TTC. When required, it should be able to effectively handle traffic by having direct circuits with the secondary trunk centre (STC) of the Jakarta area (WITEL IV).

Fig. 5.2.1.2 shows the network configuration planned for 1985.

(c) Development of the eastern regions of Indonesia is forecasted for the future. Expansion plans are being made for the domestic telecommunication networks in these regions based on digital technology. Considering these factors, the international telephone traffic in the eastern regions of Indonesia is expected to grow to a considerable level in the future (21st Centrury).

For this reason, the feasibility of building a third gateway office should be studied weighing the factors of economy and countermeasures for emergencies in order to efficiently handle international telephone traffic in the eastern regions. Studies in this respect are described in Section 5.4.

Fig. 5.2.1.3 shows the network configuration in case a third gateway office is installed in Surabaya.

(2) Capacity of Telephone Exchange

The capacity of an exchange is expressed by the number of terminations and processing capacity. The processing capacity is a factor that specifies how much traffic congestion an SPC exchange can handle and is generally shown by the Call Handling Capacity (CHC).

(a) Required Number of Terminations in Telephone Exchange

The required number of terminations in an exchange is the number of terminations which a switching system must have at the end of each fiscal year. The required number of terminations is calculated by classifying the terminations into the following groups. The number of terminations for individual groups is the same as the number of circuits calculated based on the demand forecast. The number of terminations required for a switchboard differs depending on the design of a switching system and will be discussed separately.

- Number of terminations for international circuits (Refer Table 4.1)
- Number of terminations for inter-gateway tie lines (Refer Table 4.4)
- Number of terminations for tie lines to domestic networks (see Tables 4.5 and 4.6)
- 10% of total of the foregoing for testing and other purposes

Tables 5.2.1.1 and 5.2.1.2 show the required number of terminations between 1984 and 2000 for the Jakarta and Medan Gateway Offices.

(b) Required Processing Capacity

The required call handling capacity (CHC) is calculated based on the number of busy hour calls.

Table 5.2.1.3 shows the required CHCs of telephone exchanges in the Jakarta and Medan Gateway Offices.

CHCs have been calculated using the following methods.

$$BHC_i = \frac{C_1}{C_2} \cdot A_i$$

$$CHC = \frac{\Sigma BHC_i}{1 - MR} \quad \text{(BHCA)}$$

where BHC_i: Busy hour calls broken down by call types (See Appendix 5-2-1-1)

c_1: Concentration Ratio (0.1)

c_2: Number of working days per year (300)

A_i: Number of calls per year broken down by call types (including incomplete calls)

(See Appendix 5-2-1-2)
CHC: Call Handling Capacity
MR: Marginal Ratio of CHC (0.3)

(c) Required Number of Switchboards

The required number of switchboards for the Medan and Jakarta Gateway Offices are described in 7.2.1.

(d) Operational Life of Telephone Exchange

The mechanical life of switching equipment is estimated to be 20 years. However, in many instances, spare parts will hardly be obtainable 10 years after the start of operations, and the functions of the switching equipment no longer meet new services. Therefore, the master plan is based on a premise that the next generation of exchange will be built 10 years after installing the exchange.

(3) Construction and Expansion Plans

Figs. 5.1.2.4 and 5.1.2.5 show the required switching system capacities for the Jakarta and Medan Gateway Offices, respectively. The construction and expansion plans based on such capacities are described in the following.

(a) Construction Plan

① Construction Plan for Jakarta Gateway Office

Digital SPC telephone exchange having the following capacities will be built in 1985.

Number of Terminations	Initial Capacity	Final Capacity
International Circuits	1,800	5,000
Tie Lines to domestic network	2,000	6,000
Inter-gateway tie Lines, etc.	500	1,500
Switchboards	200	350
Call Handling Capacity	100×10^3 (BHCA)	

By 1996, telephone demand will reach the final capacity of the exchange, requiring the next generation of exchange to be installed. The initial capacities of the next generation exchange can be calculated using the required capacity in 1999 based on Fig. 5.1.2.4. However, there are many uncertain factors to estimate the final capacity at present. IDN or ISDN will be introduced, and exchange will have to conform to compound services aside from a mere telephone function. Therefore, installation plans for exchange to be used after 2000 are required to incorporate future technological trends.

② Construction Plan for Medan Gateway Office

It is expected that the call handling capacity of the digital SPC telephone exchange scheduled to be installed in 1983 will no longer be able to meet the required CHC of the Medan Gateway Office in 1994. Therefore, second-generation digital SPC telephone exchange will be installed in 1993. Until around 1998, both the first and second generations of exchanges will process the international telephone traffic load of Sumatra in an appropriate proportion.

The first-generation exchange is expected to be operating until 1998 at 80% of its capacity. The remaining load will be processed by second-generation exchange. The initial capacities of second-generation exchange will be met the circuit capacity required in 1996 shown in Fig. 5.2.1.5. The call handling capacity will be 50×10^3 (BHCA) as far as the telephone load is concerned. An application of 100×10^3 (BHCA) will be desirable considering the requirements of the IDN age. In any event, the capacities of second-generation exchange should be carefully studied while watching the trends in IDN and ISDN.

(b) Expansion Plans

① Switching System Capacity Expansion Plan

Figs. 5.1.2.4 and 5.1.2.5 are updated based on revised demand forecasts. The capacity expansion plan shall span 2 to 3 years. The future required capacities for the years corresponding to spans are calculated based on Figs. 5.1.2.4 and 5.1.2.5 to determine suitable expansion quantities.

② Switchboard Expansion Plan

Expansion quantities shall be decided based on the required number described in Section 7.2.1 as is the case with expansions of switching system capacities.

③ Introduction of New Signalling Systems

The CCITT No.6 signalling system will be introduced for international circuits in Medan and Jakarta Gateways in 1983.

This signalling system will be started to use in inter-gateway tie lines when the new telephone digital SPC exchange starts operation in Jakarta Gateway in 1985.

The CCITT No.7 signalling system will be introduced in conjunction with utilization trends of PERUMTEL and foreign countries.

④ Introduction of Network Control System

A network control system shall be introduced soon after two-gateway offices in Jakarta and Medan start operating in 1985. The network control system has the following functions.

- International circuit group busy information is exchanged between two gateway offices. Suitable overflow operations are performed to maintain effective utilization of international circuits and to decrease ineffective traffic of inter-Gateway tie lines.
- Commands are issued to switching systems in each gateway office based on transmission line failure information detected by the international gateway for appropriate traffic control.
- Failure information of telephone switching machine is exchanged between gateways for traffic control.

(4) Additional Services

(a) INMARSAT

The requirements of the INMARSAT service for telephone exchanges will be described in Paragraph 5.3.2.

(b) Promotion of ISD Service

The following measures will be implemented to carry out ISD service.

① Hotel ISD Service

Beginning in 1984, an ISD charging function will be added to PBX's in hotels to permit direct ISD from hotel rooms. When viewed from gateway offices, these ISD calls are handled as the same as ordinary ISD calls, and no installation of additional equipment is needed. A technical standard to add a charging function to PABX's will be needed for guidance to hotels.

② Installation of International Public Telephones

Public telephones for international calls will be installed in public places where international telephone calls are frequently made such as airports, ports, and international conference halls. These telephones will offer ISD and semi-automatic services. Gateway offices will send charge information such as charging pulses, and public telephones will collect coins or deduct deposit card amounts.

International public telephone systems can be divided into two systems - a system for direct connecting of a gateway office and public telephones, and a system for accessing of a gateway office via the domestic network.

In the former system, the public telephone arrangement will be developed by P.T. Indosat, and transit lines will be leased by PERUMTEL. Considering the cost of transit lines, public telephones can be installed only near gateway offices. International exchanges will be required to match interface conditions with public telephones.

In the latter system, the public telephone arrangement will be developed jointly with PERUMTEL. The numbering plan for the domestic network related to international public telephones will require a review and some technical studies. In the latter system, telephones can be installed in areas far wider than those of the former system. As is the case with the former system, additional functions are required for international exchanges.

This service will start in 1984.

(c) Automation of Charge Notice Service

The demand for charge notices is increasing. In general, 15% of completed outgoing calls are said to require charge notices. If PT INDOSAT is to continuously offer the charge notice service, the service should be promptly automated. In the automatic charge notice system, charge information is received from switching equipment online, a subscriber is automatically called, speech is automatically reproduced, and the charge is given without requiring any personnel. The service is scheduled to start in Jakarta in 1985 and in Medan in 1984.

(d) Abbreviated Dialing Service

In ISD, subscribers have to dial long numbers. In this connection, invalid traffic increases as calls as connected to wrong parties as subscribers dial incorrectly and as subscribers redial after realizing halfway through that they have dialed a wrong number. To prevent these problems and to offer subscribers a pleasant ISD service, the abbreviated dialing service will be used. The function to translate dialing should most preferably be installed with local switch (LS) of the domestic network. It can also be installed in international gateway offices. To implement this service, functions should be added to exchanges, and abbreviated dial numbers have to be added to the domestic numbering plan, requiring consultation with PERUMTEL.

The service is planned for 1985 when the new Jakarta Gateway Office is scheduled to start operations.

(e) Efficient Information Service

Inquiries from subscribers regarding international charges, rates, etc. increase parallel with an increase in demand. Therefore, to offer this service efficiently has two advantages - it does not require personnel increases and it quickly offers needed information to subscribers. Therefore, the use of this service should be actively encouraged. To realize this service, the following steps need to be taken in terms of equipment:

① Introduction of an automatic charge information processing system.

② Provision of displays and keyboards on switchboards and information desks for online access to the automatic processing system to permit retrieval or correction of needed information.

③ Introduction of a number filing system covering international numbers, as well as area numbers of various countries. (It can be used not only with telephone, but also with all other services.) Automation of this service will start in 1985.

(f) Promotion of CLR Operation

CLR operation has such excellent advantages as lowering the operation work load, enhancing the utilization efficiency of domestic tie lines, and offering subscribers pleasant services. The service should be promoted. The following functions are needed to introduce CLR operation in terms of equipment.

① When the domestic networks have a verification network, gateway offices must have a function to access such a network from switchboards, to dial applicable subscriber numbers, to form a loop between speech and verification paths, and to send a loop back tone.

② A function to automatically display subscriber Nos. on gateway office switchboards when subscriber Nos. can be sent from the domestic network (use of SPC in LS's, introduction of Super 10, and other steps).

To start this service at the earliest opportunity, Jakarta will start system ① using a verification network system in 1984 and system ② in 1985 when the new Jakarta gateway office will start service. The CLR operation proportion will be increased by these two systems.

In Medan, CLR operation will be started by system ② simultaneous with the start of operation in 1983.

Digitization of the domestic networks and the use of SPCs and Super 10 will become premises in System ②, and strong maneuvering with PERUMTEL will be required.

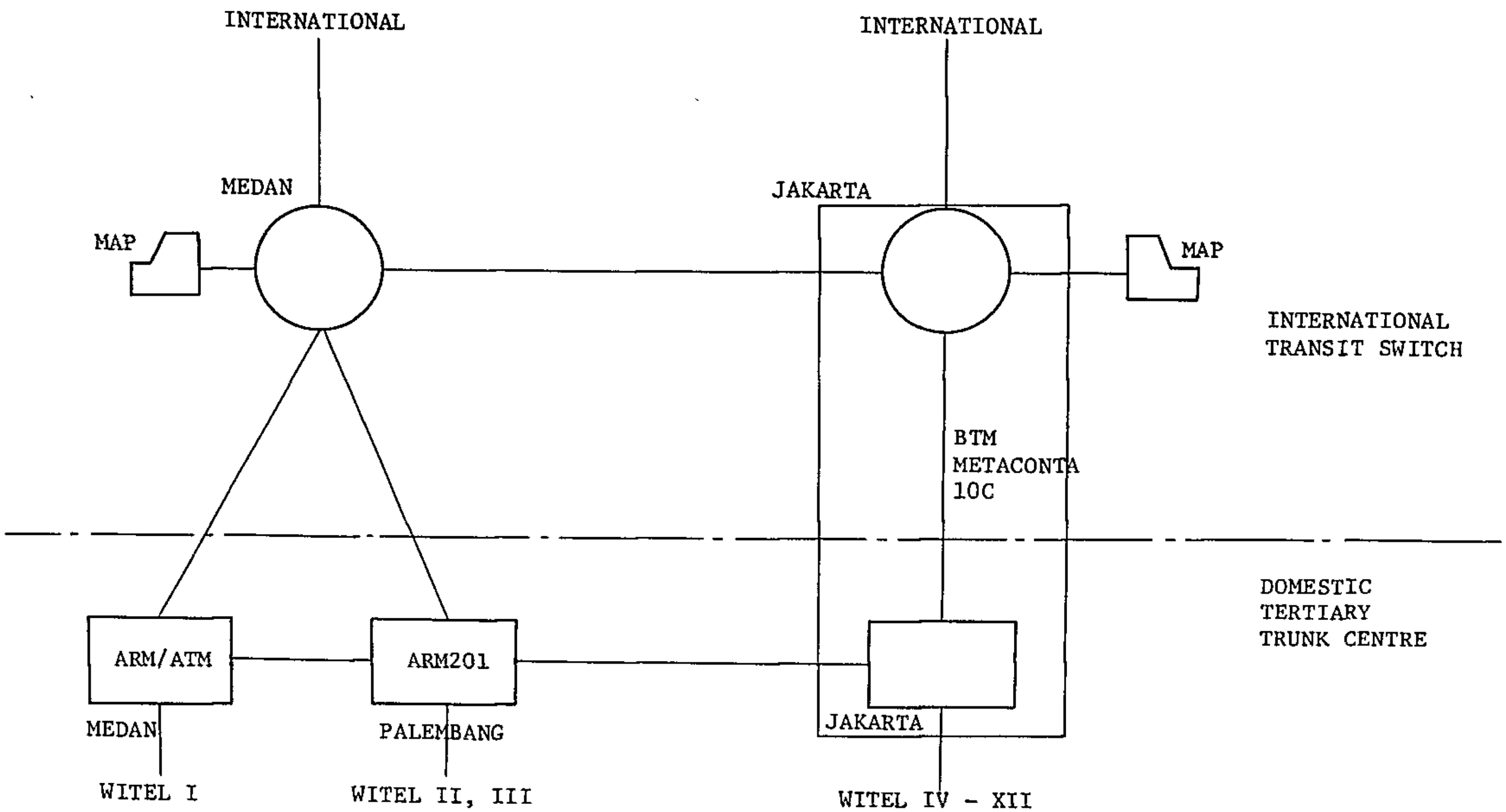


Fig. 5.2.1.1 International Telephone Network of Indonesia in 1984

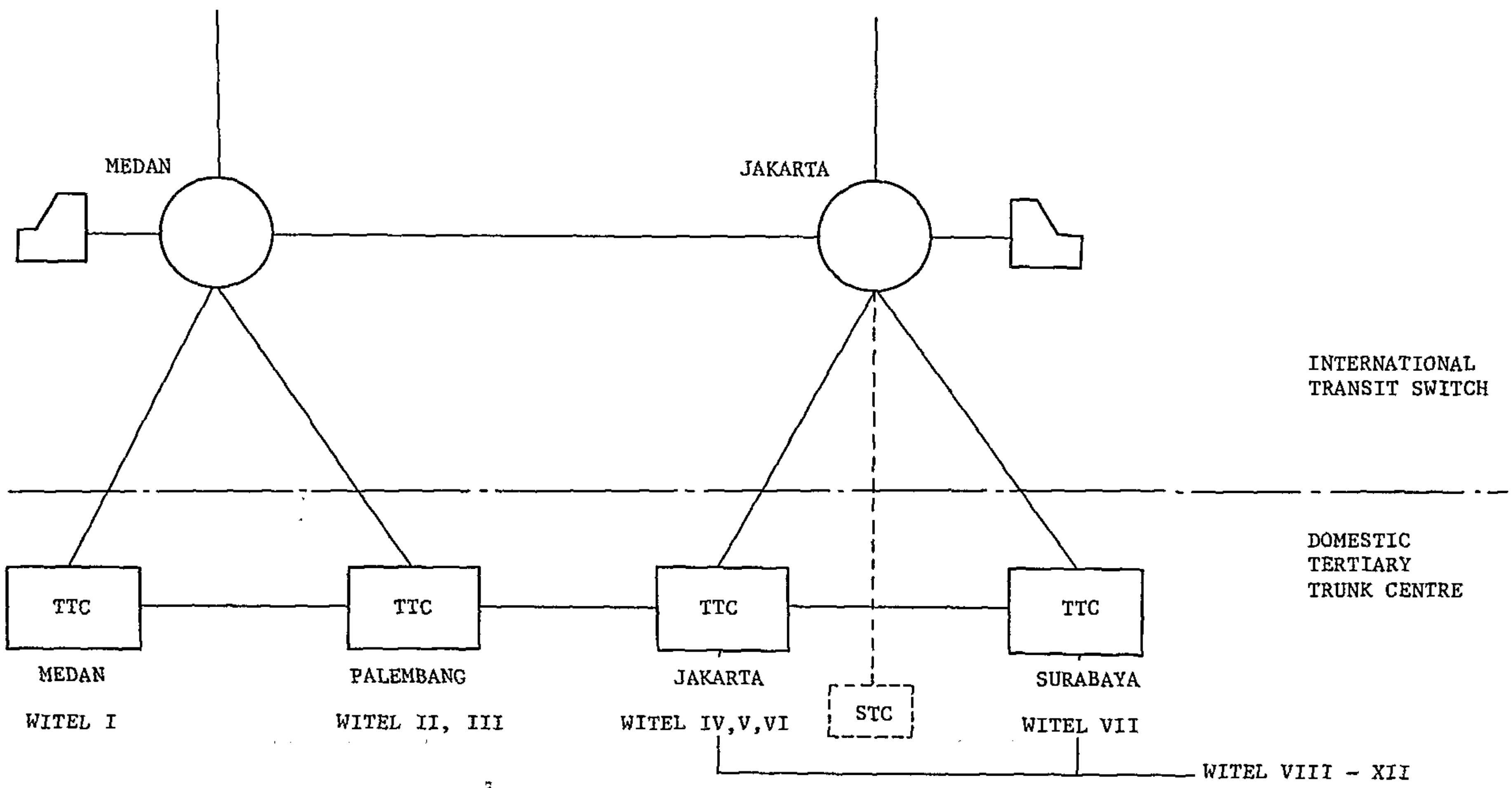


Fig. 5.2.1.2 International Telephone Network of Indonesia in 1985

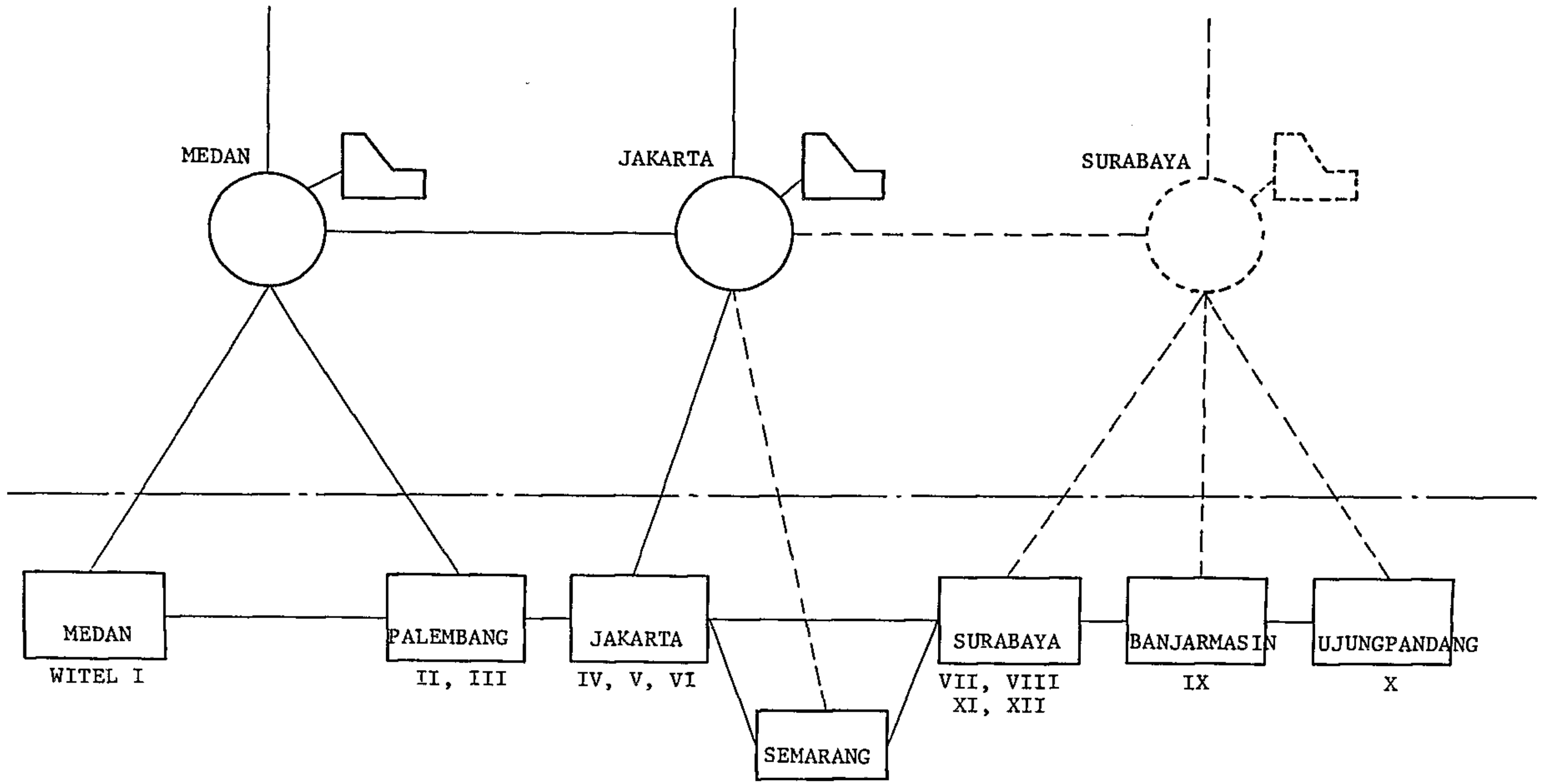


Fig. 5.2.1.3 International Telephone Network of Indonesia in the Future

Table 5.2.1.1 Required Number of Terminations of Telephone Exchanges - Jakarta Gateway

(Termination)

Year	International Circuits	Inter-Gateway Tie Lines	Domestic Tie Lines	Tests & Others	Required Number of Terminations
1984	830	50	930	180	2,000
1985	1,030	50	1,140	230	2,500
1986	1,240	50	1,390	270	3,000
1987	1,500	50	1,680	330	3,600
1988	1,780	60	2,020	390	4,300
1989	2,100	70	2,410	460	5,100
1990	2,450	90	2,800	540	5,900
1994	3,850	160	4,400	840	9,300
1999	5,850	290	6,800	1,300	14,300
2000	6,250	330	7,200	1,380	15,200

Table 5.2.1.2 Required Number of Terminations of Telephone Exchanges - Medan Gateway

(Termination)

Year	International Circuits	Inter-Gateway Tie Lines	Domestic Tie Lines	Tests & Others	Required Number of Terminations
1984	80	50	120	30	300
1985	150	50	150	40	400
1986	180	50	200	50	500
1987	240	50	240	60	600
1988	300	60	300	70	800
1989	360	70	400	90	1,000
1990	430	90	490	100	1,200
1994	740	160	900	180	2,000
1999	1,260	290	1,660	320	3,600
2000	1,370	330	1,790	350	3,900

Table 5.2.1.3 Required Call Handling Capacity of Telephone Exchanges

Year	Jakarta Gateway		Medan Gateway	
	Total BHC (Σ BHC)	Required CHC	TOTAL BHC (Σ BHC)	Required CHC
1984	8,989	12,900	1,130	1,700
1985	11,269	16,100	1,512	2,200
1986	14,042	20,100	2,003	2,900
1987	17,367	24,900	2,665	3,800
1988	21,352	30,500	3,568	5,100
1989	25,877	37,000	4,683	6,700
1990	30,534	43,700	5,746	8,200
1994	51,638	73,800	11,062	15,800
1999	82,501	117,900	21,351	30,500
2000	89,465	127,800	23,601	33,800

(BHCA)

Fig. 5.2.1.4 Required Telephone Switching Capacity of Jakarta Gateway

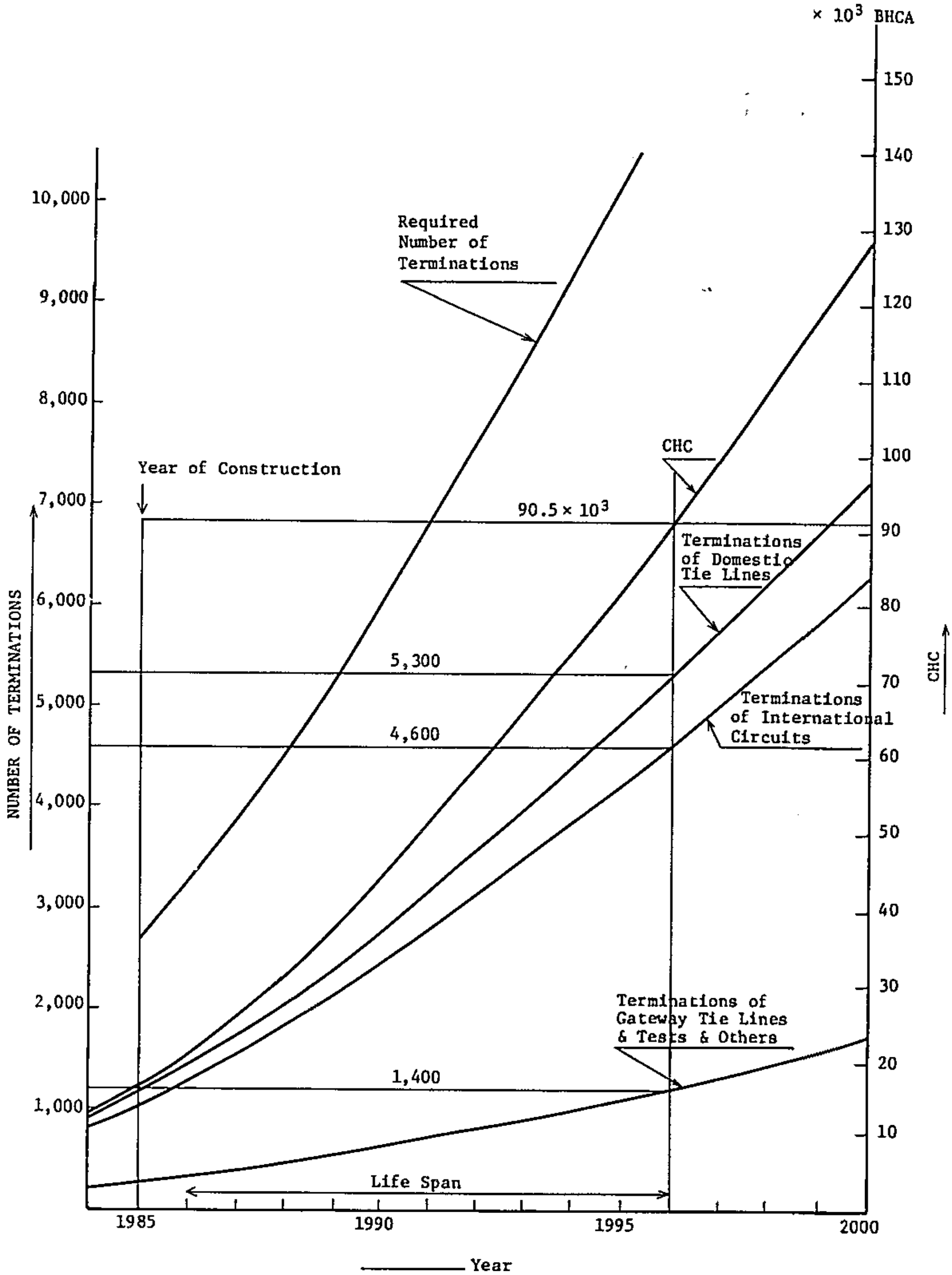
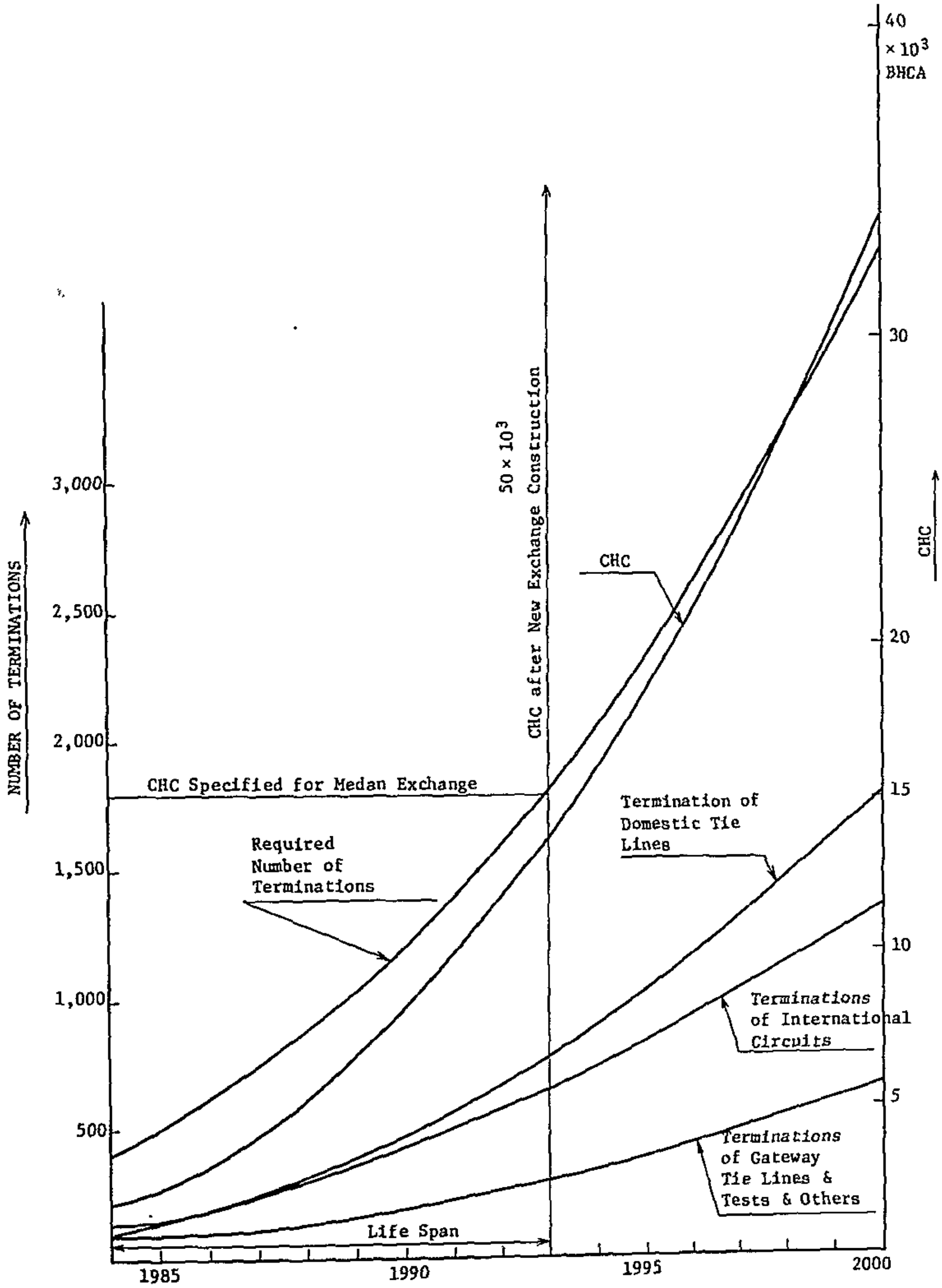


Fig. 5.2.1.5 Required Telephone Switching Capacity of Medan Gateway



(5) International Telephone Traffic Backup Plan

Even when an exchange of Jakarta or Medan gateway would suspend its functions, a gateway could back up the other gateway and secure traffic in an optical ratio by making use of dual gateways.

(a) In case of failure of Medan Exchange

In case of failure of Medan exchange, international circuits and Medan TTC tie lines accommodated with Medan gateway are to be transferred into Jakarta exchange using inter-gateway tie lines. Through this backup means, slightly more than 20% of traffic originated in Sumatra could be secured. (See Fig. 5.2.1.6).

The routing, by which traffic originating from Jakarta gateway to subscriber in Sumatra via domestic network could be handled, should preferably be secured at all times.

The routing could make it possible that the traffic on inter-gateway tie line is handled by the domestic network under normal conditions, and the traffic of far exceeding the foregoing 20% is secured in an emergency at the Medan gateway.

Fig. 5.2.1.7 shows the traffic flow in this case.

(b) In case of failure of Jakarta Exchange

1) Backup using Metaconta 10C

The failure of Jakarta gateway means the suspension of WITEL IV TTC functions. The measure as that inter-gateway tie line is deverted to backup by Medan exchange could not be taken. Therefore, the ASK exchange will be utilized as backup to secure more than 20% normally handled by Jakarta gateway untill completion of New Jakarta gateway. (See Fig. 5.2.1.8)

2) Backup plan after New Jakarta Gateway

The traffic handled by Jakarta exchange could be backed up by Medan exchange by utilizing inter-gateway tie line after New Jakarta gateway in 1985.

The difference of exchange capacity between Jakarta and Medan, Jakarta exchange has more than 5 times as large as Medan exchange, would need inter-gateway tie line with large capacity and spare facility for emergency and a large number of operators in Medan in order to handle traffic efficiently. (See Fig. 5.2.1.9) By utilizing Metaconta 10C to back up the New Jakarta exchange, more than 50% of traffic could be secure. (See Fig. 5.2.1.10)

(c) General Consideration for Backup Plan

1) Backup plan should be modified to be efficient according as diversity of demand, international/domestic network, advance of telecommunication technology.

2) Backup would cause congestion. Ask subscribers to refrain from call repetition by introducing an announcement service.

3) In order to lower the probability of complete suspension of gateway function, the exchange should be composed of several units.

4) Determination of backup procedure, promotion of automatic operation, and periodic training should be made to proceed the backup procedure quickly and accurately.

5) The exchange should have a surplus capacity to meet the needs in the case of suspension of the other gateway.

6) The gateway should have special booking number of subscriber class in addition to booking numbers that are normally used. It would allow the special subscribers to use circuit and it would secure the important communication even when congestion is caused by the failure of gateway.

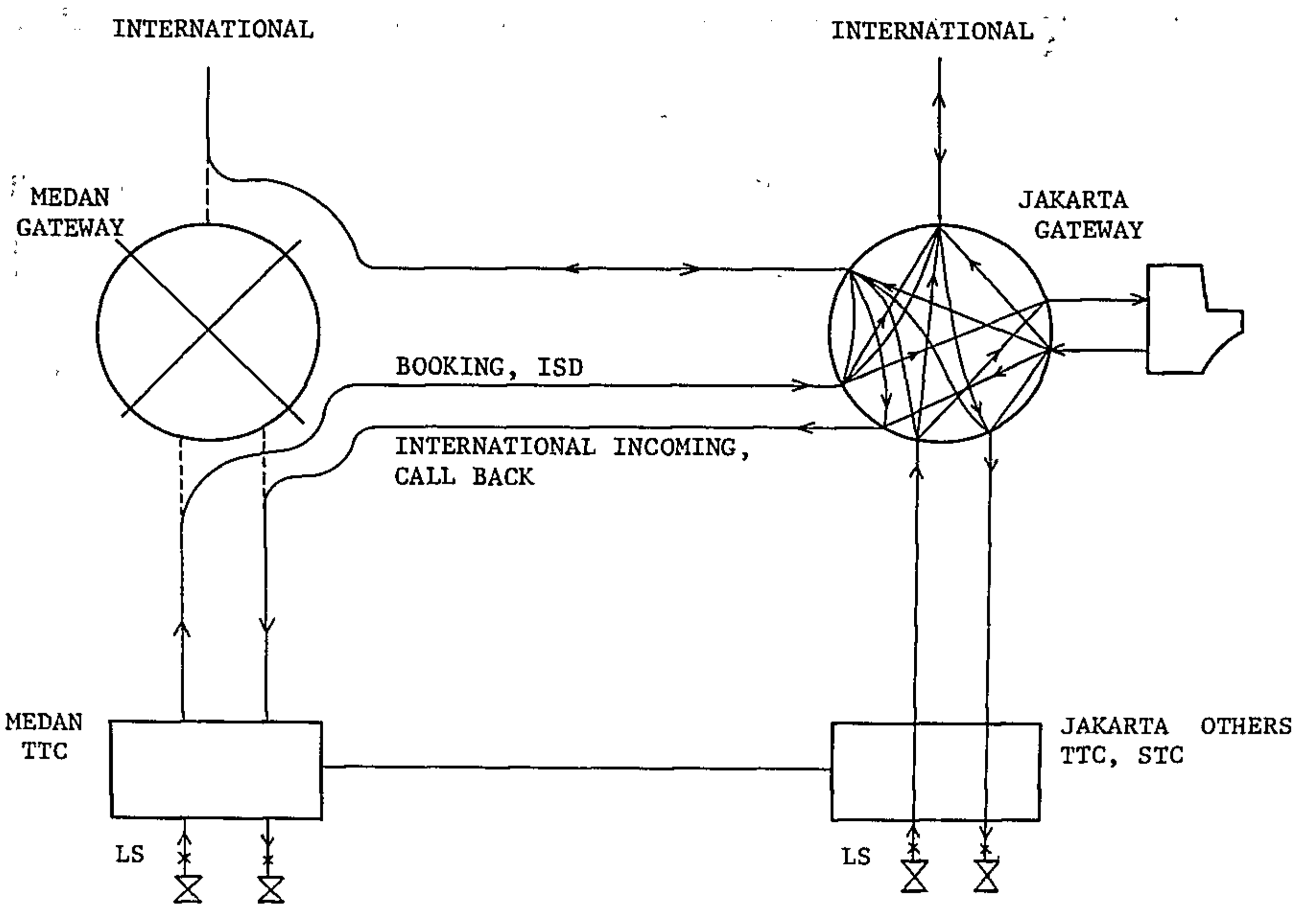


Fig. 5.2.1.6 Back Up Routing by Tie Line (Medan Gateway Fail)

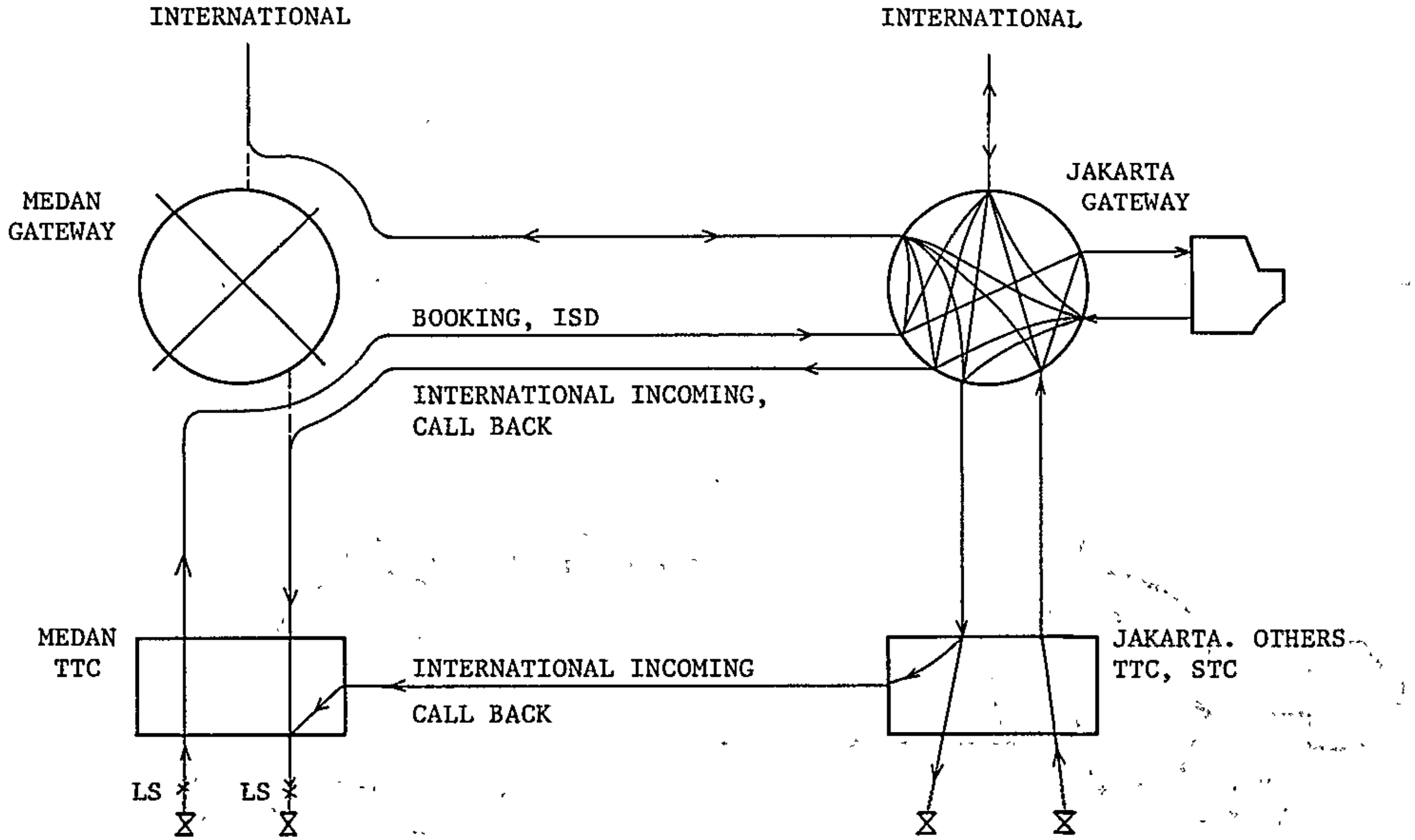


Fig. 5.2.1.7 Back up Routing by Tie Line and National Network (Medan Gateway Fail)

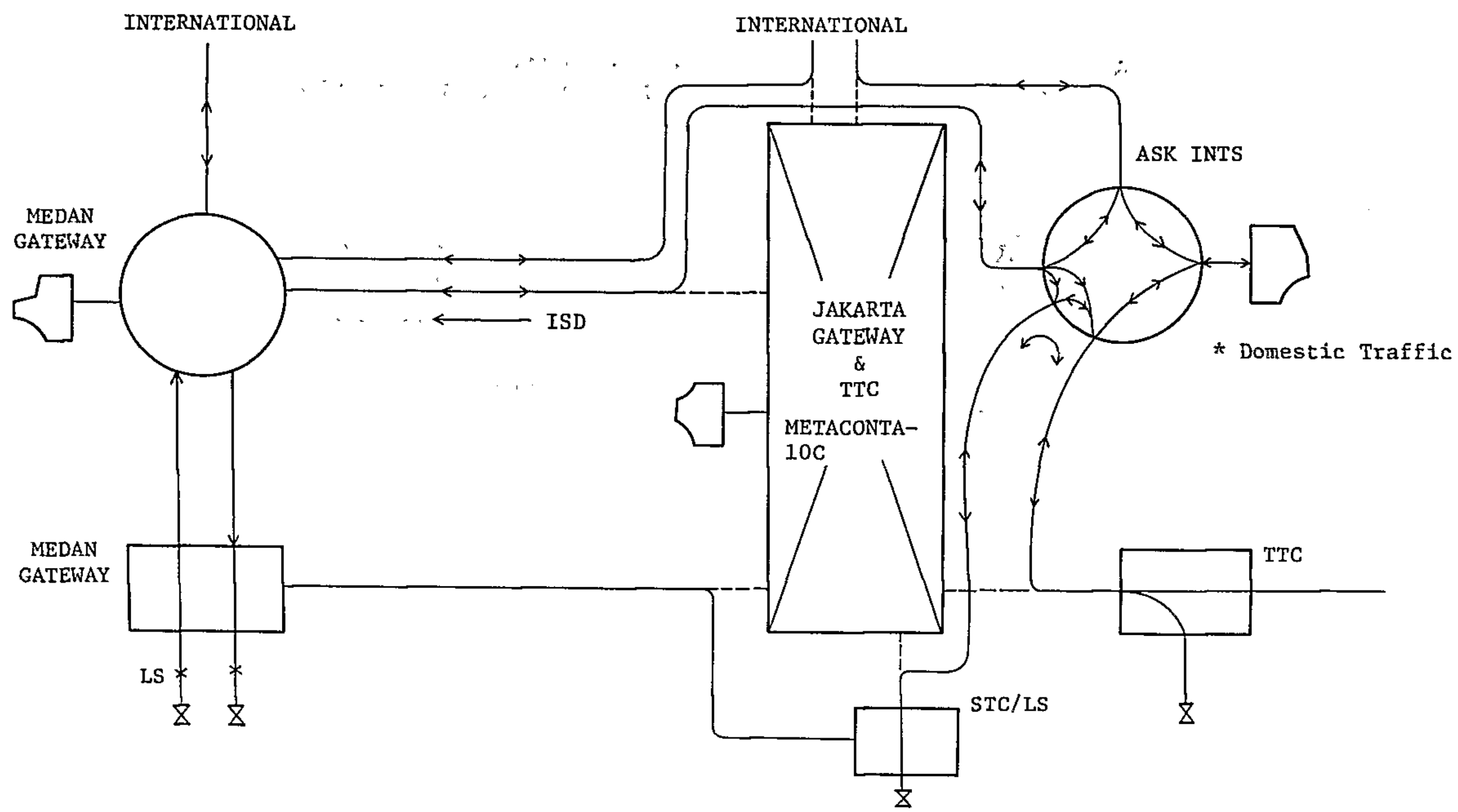


Fig. 5.2.1.8 Back Up Routing by ASK (METACONTA-10C Failure)

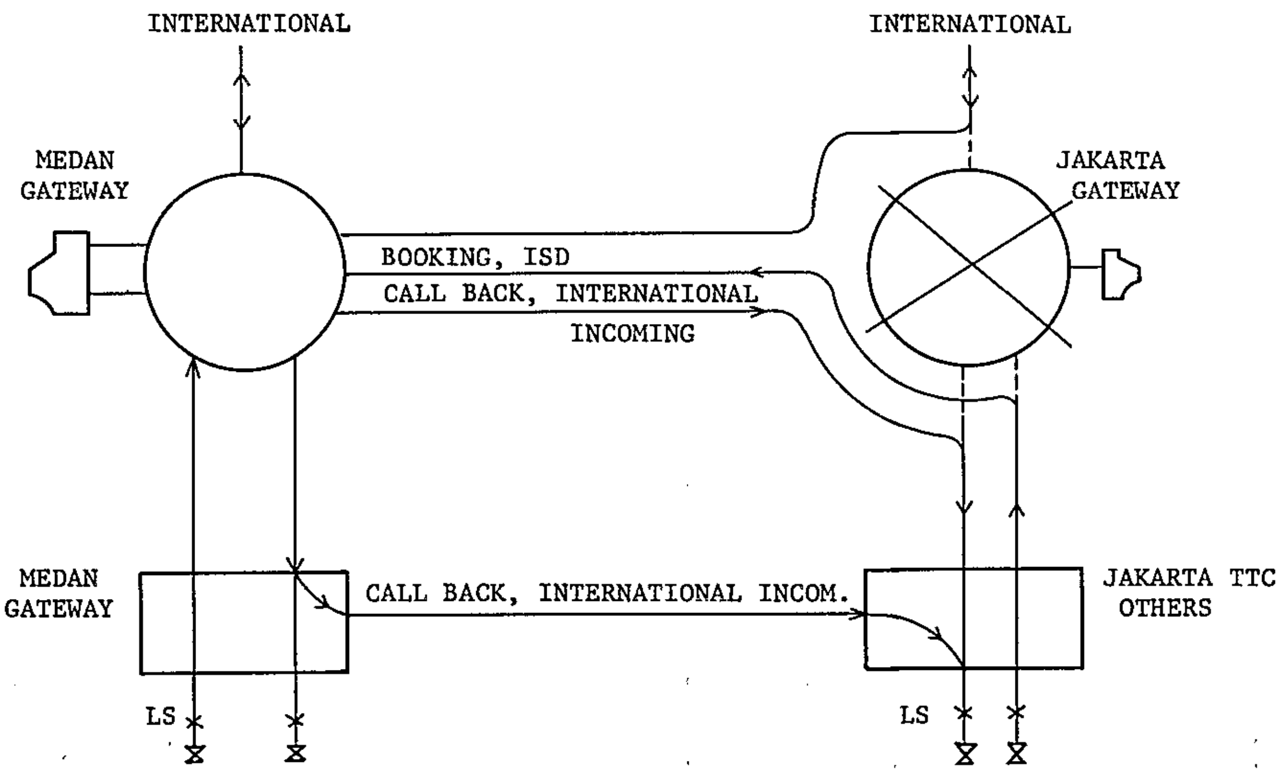


Fig. 5.2.1.9 Back Up Routing by Tie Line and National Network
(Jakarta Gateway Failure) 1985

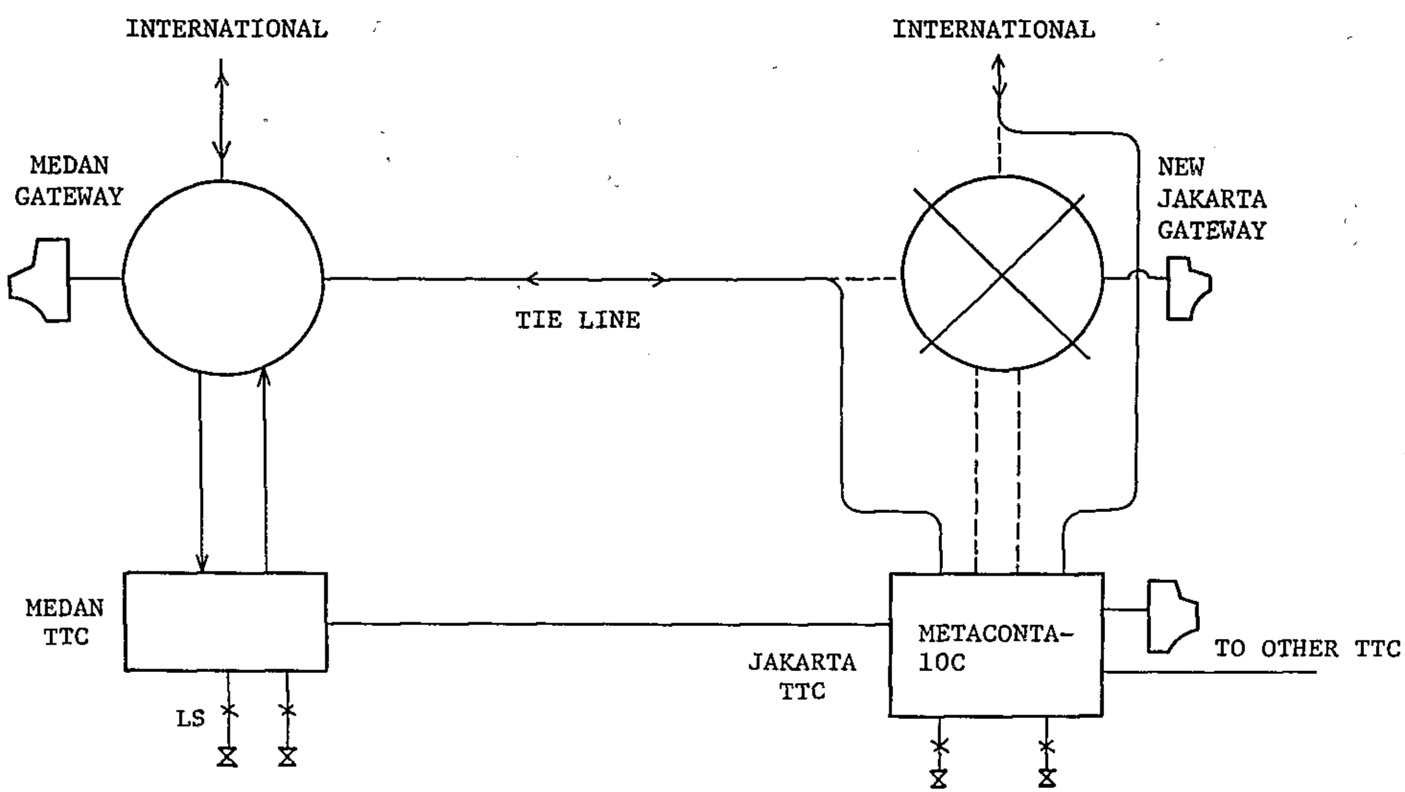


Fig. 5.2.1.10 Back Up Routing by Metaconta 10C (New Jakarta Gateway Failure) 1985

5.2.2 Telex Switching

(1) International Switching Network

The international telex network of Indonesia which is independent from, but interconnected with, the PERUMTEL domestic network should be established, operated and maintenanced by P.T. Indosat as early as possible. The main steps in the process of network development are foreseen as follows:

(a) 1st Quarter of 1984: Introduction of Medan SPC exchange (Fig. 5.2.2.1)

Introduction of Medan SPC exchange is to be completed. The transition of international telex trunks from Jakarta TWK D2B to the new Medan exchange begins.

(b) End of 1984: Transition of international trunks (Fig. 5.2.2.2)

Transition of approximately 40 to 50 international trunks for eight Asian countries is to be completed. In normal traffic, the direct interconnection between TWK D2B and the PERUMTEL Medan Tandem Exchange should be kept as small as possible.

(c) 1985: Introduction of new Jakarta SPC Exchange (Fig. 5.2.2.3)

A new SPC exchange is to be introduced in the new INDOSAT Building in Jakarta. This is the replacement of TWK D2B and the establishment of an independent P.T. Indosat international network.
TWK D2B is maintained and operated as a stand-by in case of an unexpected system failure or emergency.

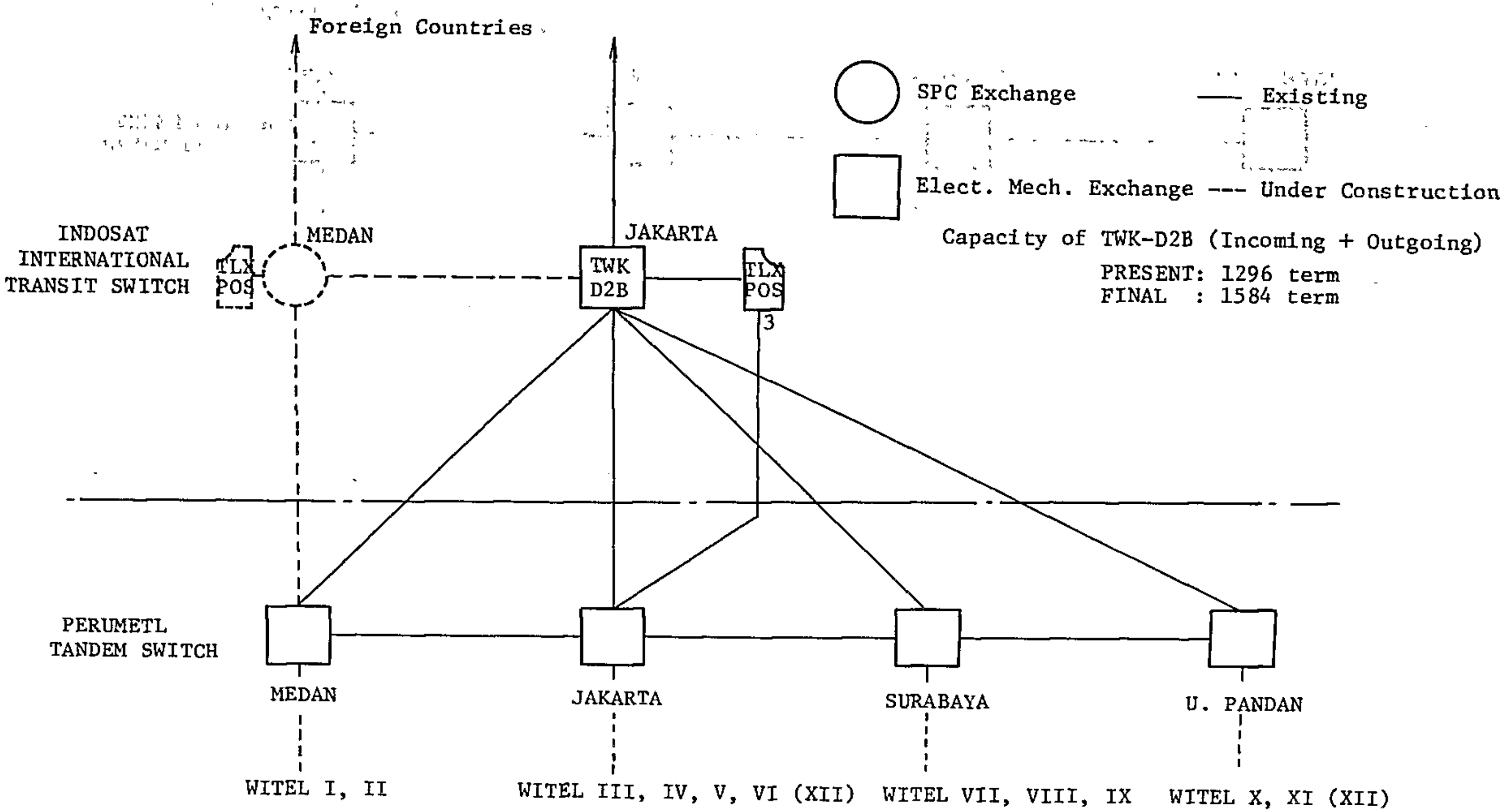


Fig. 5.2.2.1 Indonesian International Telex Network at Beginning of 1984

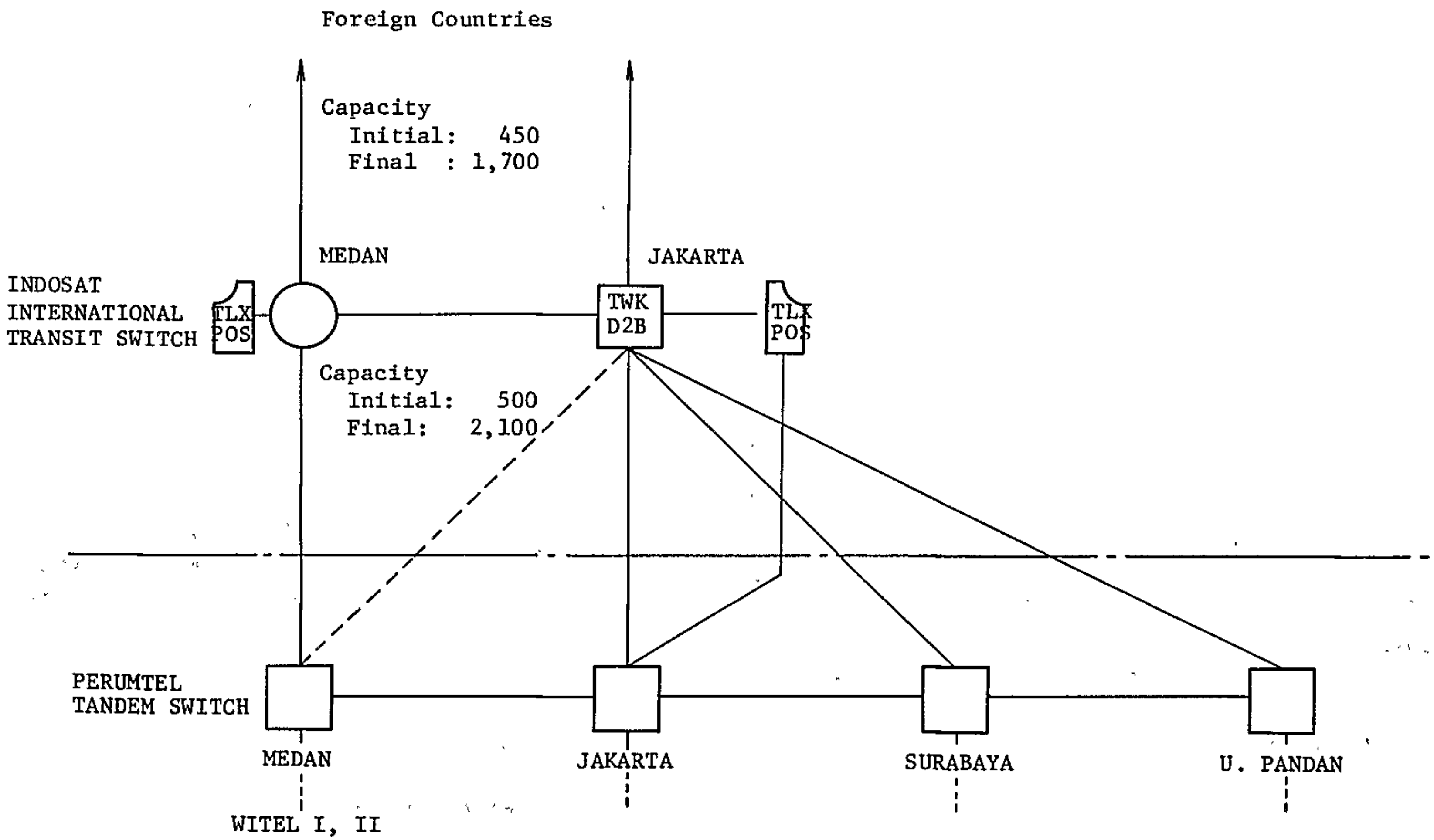


Fig. 5.2.2.2 Indonesian International Telex Network at the End of 1984

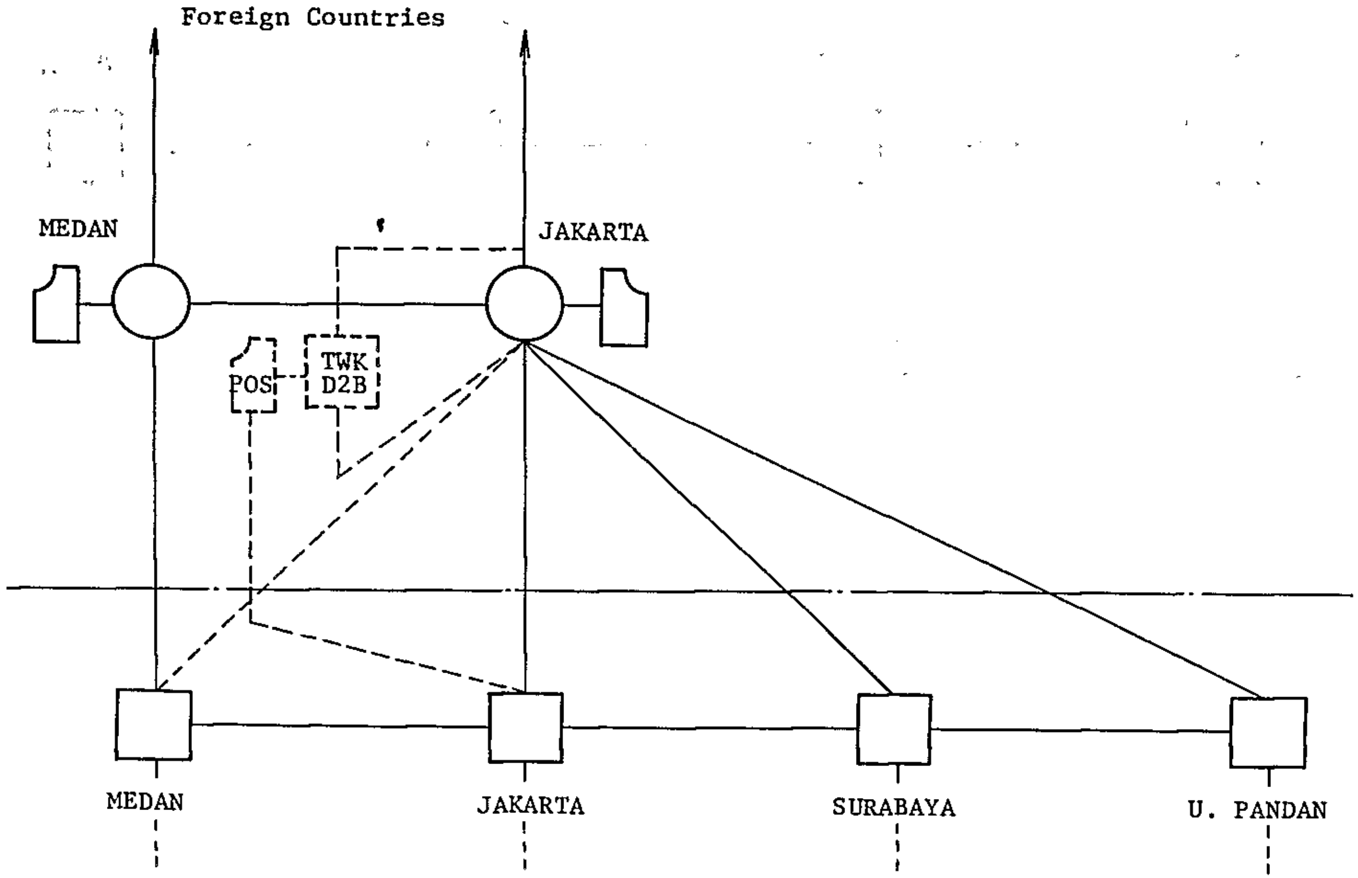


Fig. 5.2.2.3 Indonesian International Telex Network in 1985

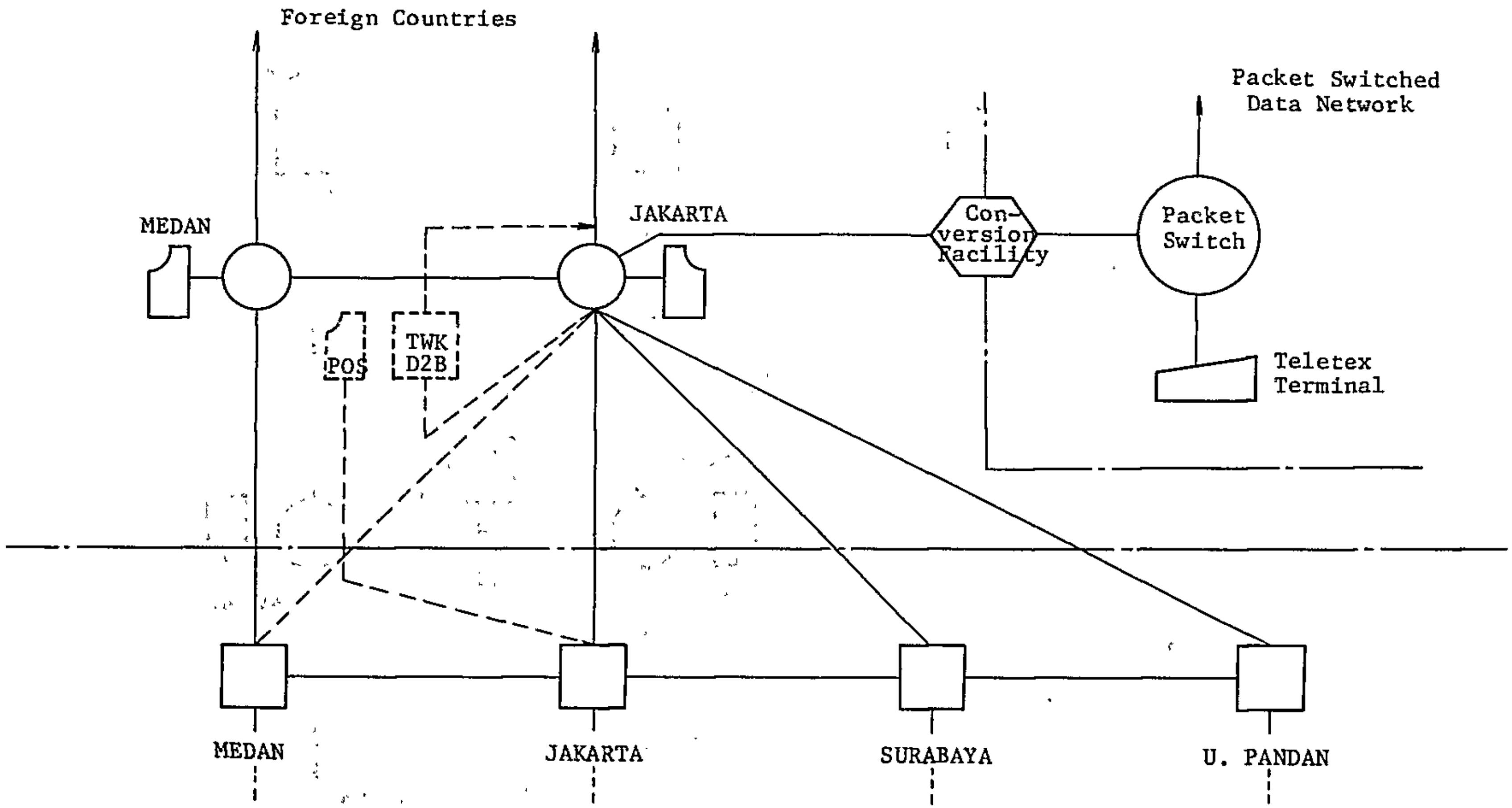


Fig. 5.2.2.4 Indonesian International Telex Network in 1986

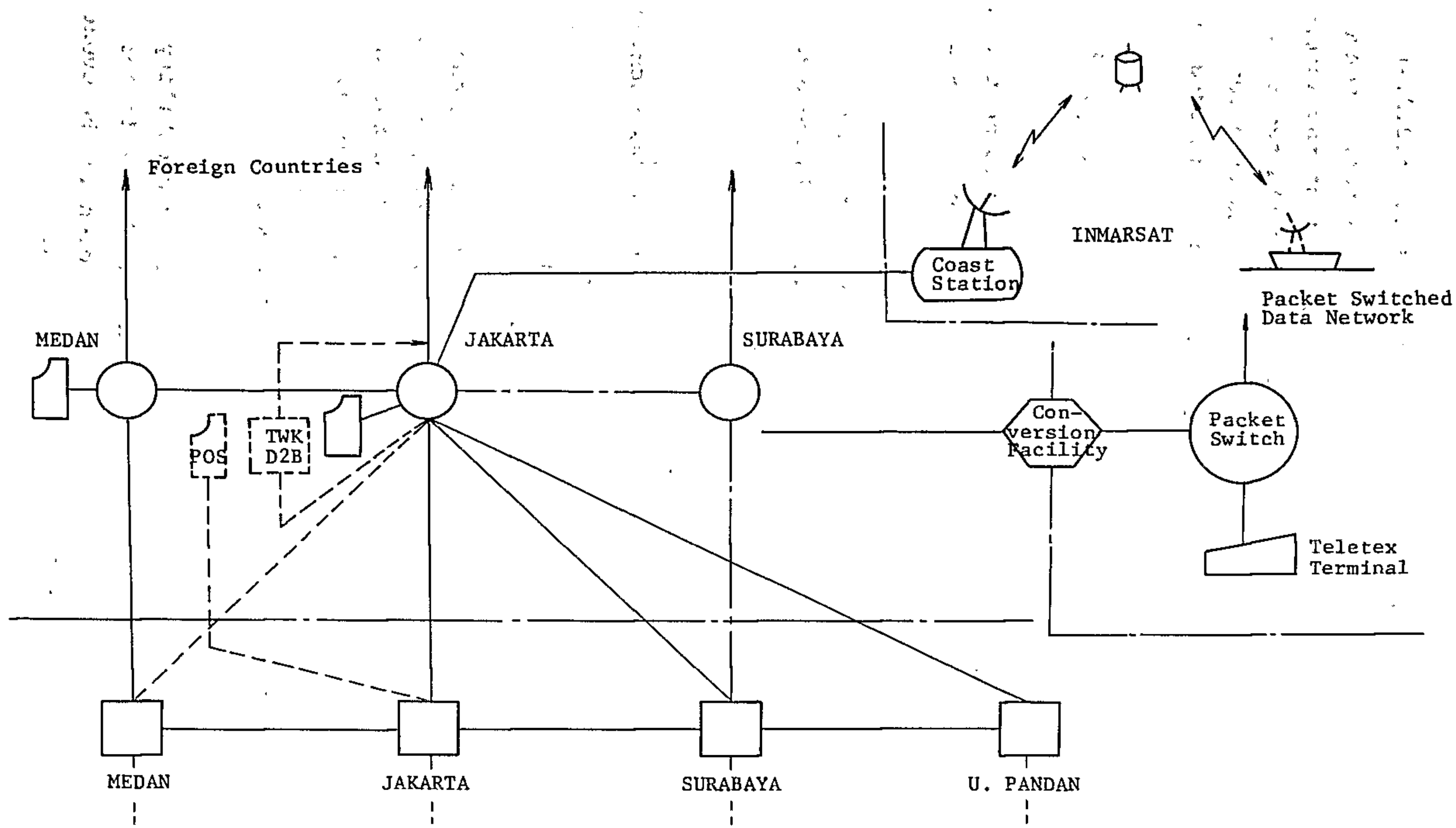


Fig. 5.2.2.5 Indonesian International Telex Network from 1990 to 2000

(d) 1986: Interworking with Teletex (Fig. 5.2.2.4)

With the introduction of a packet switch, a conversion facility (C.F.) is to be implemented so that the interworking between telex and Teletex can be started from the first stage of the Teletex service inauguration. The C.F. can be an independent system or be integrated into the packet switch.

(e) Study on the Possibility of the Third Gateway Exchange (Fig. 5.2.2.5)

The next possible step of network development will be the establishment of the third exchange. The study is covered in Section 5.4.

Assumption: In this plan, the network interface between PERUMTEL and INDOSAT is assumed to remain unchanged.

(2) Capacity of Exchange

In modern SPC systems, the capacity of a telex exchange is specified mainly by these two factors:

i) Call Handling Capability (C.H.C)
ii) Number of Terminations or Line Units

These factors are decided by the traffic growth and life span of the switching systems. The criteria and the relationship between the above parameters applied for the estimation of capacity are described in the following.

(a) Parameters related to traffic growth

i) Number of Calls

This factor specifies call handling capability in which a system should have a 30% margin for stable operation of the system even in the event of abnormal operating conditions.

ii) Number of International and National Circuits

This is the main factor which specifies the number of terminations. The following loss probability is applied to the estimated traffic volume in Erlang.

International: 1/50 (Recommendation F.64)
National : 1/100

In order to obtain the total number of terminations, a 10% margin is further added for the purpose of testing and maintenance.

iii) Ratio of Manual Calls

From this factor the number of positions is decided and is added to the number of terminations. Since automatic operation is penetrating so widely throughout the world as described in Section 7.2.1 (2), this factor can be regarded as negligible compared to the total terminations in this planning.

(b) Life Span

The life span of a switching system may be considered as 20 years* from the viewpoint of hardware. For the international telex switch, however, the features of the system are being considerably revised according to developments in recent technology. Consequently the life span is getting shorter. A life span of 10 years is suitable for use in planning international communications. This life span is the factor which determines the final capacity of an exchange in terms of call handling capacity and termination.

* In the Japanese domestic telephone SPC, this figure is publicized to be 19 years. The fundamental parts of International Telex SPC Exchange in Japan is based on the same hardware of domestic Telephone SPC Exchange.

(c) Initial Capacity and Expansion Schedule

Initial capacity is determined by circuit demands when the first expansion is scheduled. The time span before the first system expansion should be set to prevent an increase in manpower, repetitive operations or initial investment cost. A realistic figure for this is between three and five years and the longer value is adopted for this planning.

(d) Estimation of Required Call Handling Capability (CHC)

The CHC which will be required until the year 2000 in exchanges in Medan and Jakarta is estimated by applying the above stated criteria and the routing plan shown in Fig. 5.2.2.6 to the demand growth for each related WITEL shown in Table 4.7.2. The estimated results are shown in Table 5.2.2.1 (Medan), Table 5.2.2.2 (Jakarta) and Table 5,2,2,7. The calculation has been made using the procedures and formula below for each year.

Table 5.2.2.1 Estimation of Required Call Handling Capacity of Medan Exchange

Year		1984	1985	1986	1987	1988	1989	1990	1994	2000
MIN ($\times 10^3$)	WITEL I	1639	2210	2853	3654	4518	5550	6643	9796	14346
	WITEL II	306	390	526	645	826	979	1208	1774	2532
	Total	1945	2600	3379	4299	5344	6529	7851	11570	16878
	I.G. B	98	202	264	355	447	546	656	985	1443
	MINy	2043	2802	3643	4654	5791	7075	8507	12555	18321
Av. C.T.		2.8	2.67	2.56	2.45	2.35	2.26	2.18	1.89	1.58
Cy		730	1049	1423	1900	2464	3131	3902	6643	11596
BHC		405	583	791	1055	1369	1739	2168	3690	6442
CHC		1205	1735	2354	3140	4074	5176	6452	10982	19173

Table 5.2.2.2 Estimation of Required Call Handling Capacity of New Jakarta Exchange

Year		1984	1985	1986	1987	1988	1989	1990	1994	2000
MIN ($x10^3$)	Total Indonesia	27784	32507	37546	42990	48579	54408	60393	77133	93762
	WITEL I, II	1945	2600	3379	4299	5344	6529	7851	11570	16878
	WITEL III-XII	25839	29907	34167	38691	43235	47879	52542	65563	76884
	I.G. A	965	584	740	751	875	1074	1290	1725	2451
	MINy	26804	30491	34907	39442	44110	48953	53832	67288	79335
Ac. C.T.		2.8	2.67	2.56	2.45	2.35	2.26	2.18	1.89	1.58
Cy		9573	11420	13636	16099	18770	21661	24694	35602	50212
BHC		5318	6344	7575	8944	10428	12034	13719	19779	27896
CHC		15827	18881	22545	26619	31036	35815	40830	58866	83024

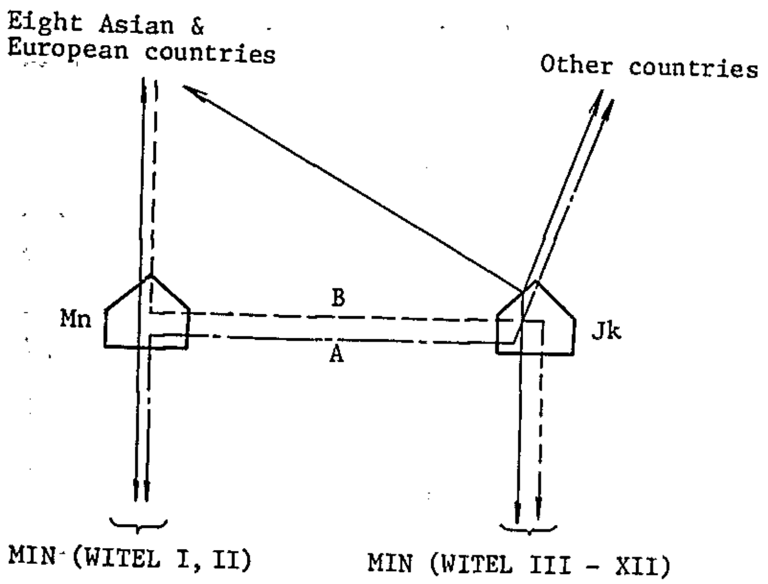


Fig. 5.2.2.6 Routing Plan for Telex Traffic

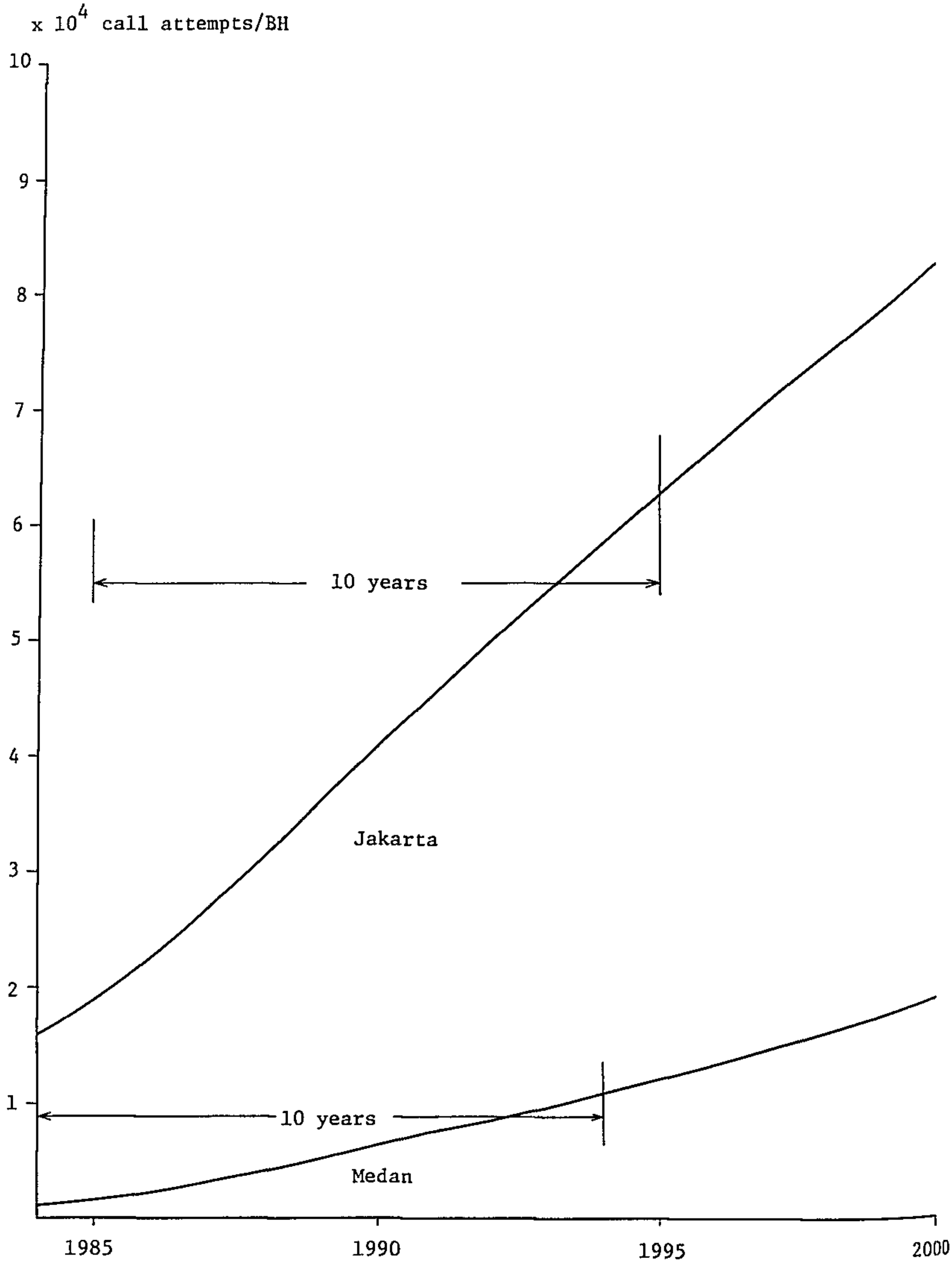


Fig. 5.2.2.7 Required Call Handling Capability

MINy = MIN(WITEL) + MIN(I.G.)

Cy = MINy/Av.C.T.

BHC = FC x Cy/EDy

CHC = BHC/(1-MR)/R.EF

where

MINy: Traffic handled in minutes per year through each exchange

MIN(WITEL): Traffic handled in minutes per year originating from and coming into corresponding WITEL

MIN(WITEL I + II) for Medan

MIN(Total Indonesia) - MIN(WITEL I + II) for Jakarta

MIN(I.G.): Traffic handled (in minutes) through intergateway trunks per year

Flow A for Jakarta Exchange estimation

Flow B for Medan Exchange estimation

Cy: Number of calls handled at each exchange per year

Av.C.T.: Average chargeable time of each call per year

BHC: Busy Hour Calls (effective)

FC: Factor of Concentration (15%)

EDy: Effective number of days per year

CHC: Call Handling Capability

MR: Marginal ratio of CHC (30%)

R.EF: Ratio of effective calls (48%)

Conclusion:

As is seen from Fig. 5.2.2.7, the required call handling capability for Medan and the new Jakarta Exchange is as follows:

Medan Exchange: 12,000 Busy Hour Call Attempts for traffic from 1984 to 1995*

New Jakarta Exchange: 65,000 Busy Hour Call Attempts for traffic from 1985 to 1996*

* One year is added to the 10 year span in order to cover the capacity at the end of one year.

(e) Estimation of Required Number of Terminations

The number of terminations which will be required until the year 2000 is calculated in principle by applying the criteria in Section (2) (a) to the traffic growth. The terminations are used for international and national circuits. The national circuits consist of intergateway circuits and tie lines with domestic networks. The number of circuits for these three groups are already estimated in Table 4.3.2, 4.8.1 and 4.8.2 respectively. The total number of terminations is obtained by adding a 10% margin to the total of these three groups. The results for Medan and Jakarta are shown Table 5.2.2.4, .5 and Fig. 5.2.2.8, .9 respectively.

Table 5.2.2.4 Required Number of Trunks in Medan Exchange

			1984	1985	1986	1987	1988	1989	1990	1994	2000
National	Tie Line	WITEL I, II	41	52	65	80	96	115	140	195	277
	Inter-Gateway	MDN-JKT	24	19	23	24	28	33	38	50	68
		Total	65	71	88	104	124	148	178	245	345
International			40	88	103	126	152	174	189	258	350
Total			105	159	191	230	276	322	367	503	695
10% Margin			10.5	15.9	19.1	23.0	27.6	32.2	36.7	50.3	69.5
Grand Total			116	175	211	253	304	355	404	554	765

Table 5.2.2.5 Required Number of Trunks in Jakarta Exchange

Trunk Group			1984	1985	1986	1987	1988	1989	1990	1994	2000
National	Tie Line	WITEL III-VI	384	442	501	565	629	693	758	941	1098
		WITEL V-IX	37	41	46	51	56	61	67	79	90
		WITEL X-XII	8	9	10	11	11	12	13	16	18
	Inter-Gateway	JKT-MDN	24	19	23	24	28	33	38	50	68
		Total	453	511	580	651	724	799	876	1086	1274
International			565	694	768	841	933	1012	1080	1292	1471
Total			1018	1205	1348	1492	1657	1811	1956	2378	2745
10% Margin			101.8	120.5	134.8	149.2	165.7	181.1	195.6	237.8	274.5
Grand Total			1120	1326	1483	1642	1823	1993	2152	2616	3020

Note: Estimation based on Erlang B Formula
Loss Probability 1/50 for international
1/100 for national

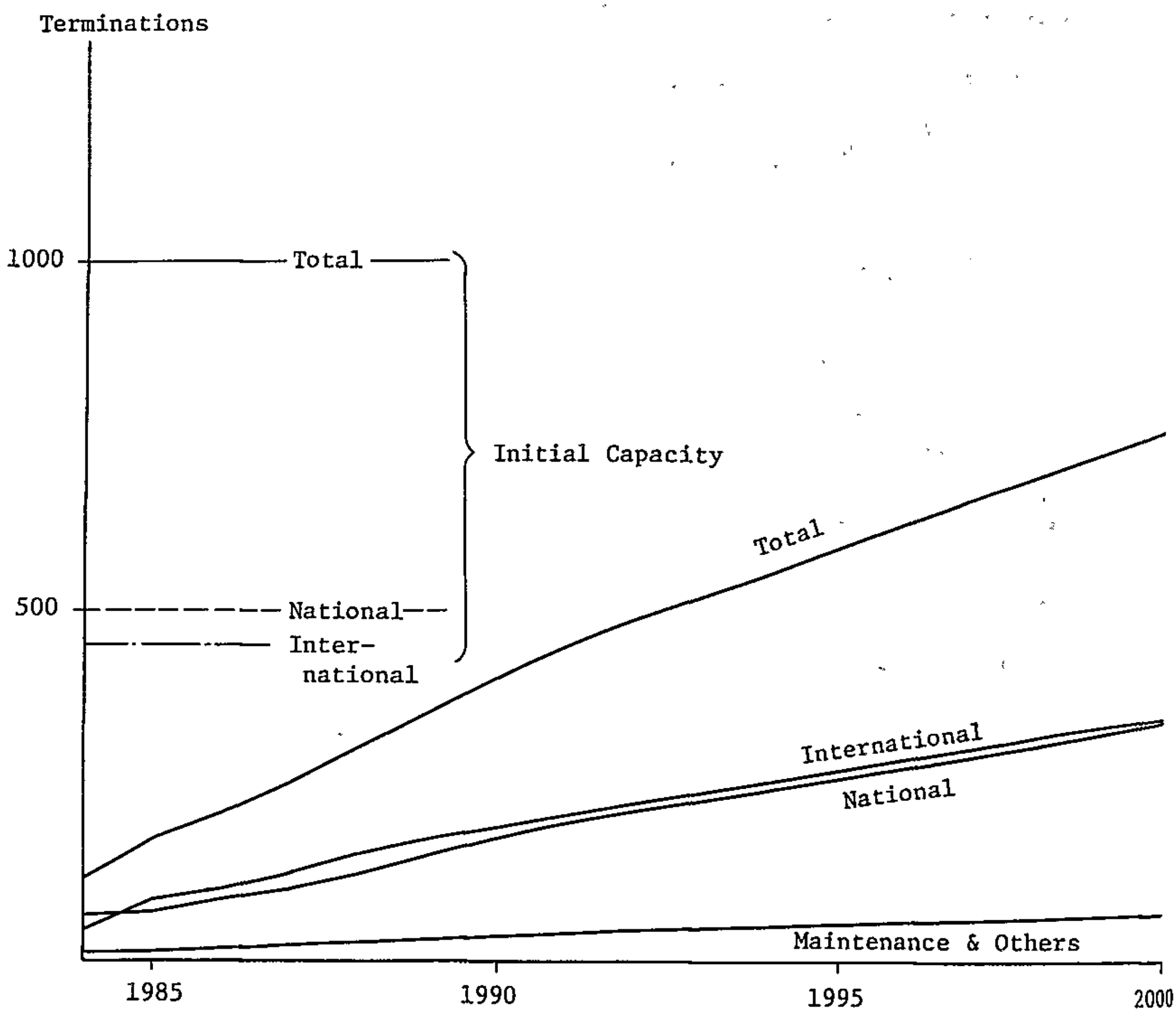


Fig. 5.2.2.8 Estimated Number of Terminations for Medàn

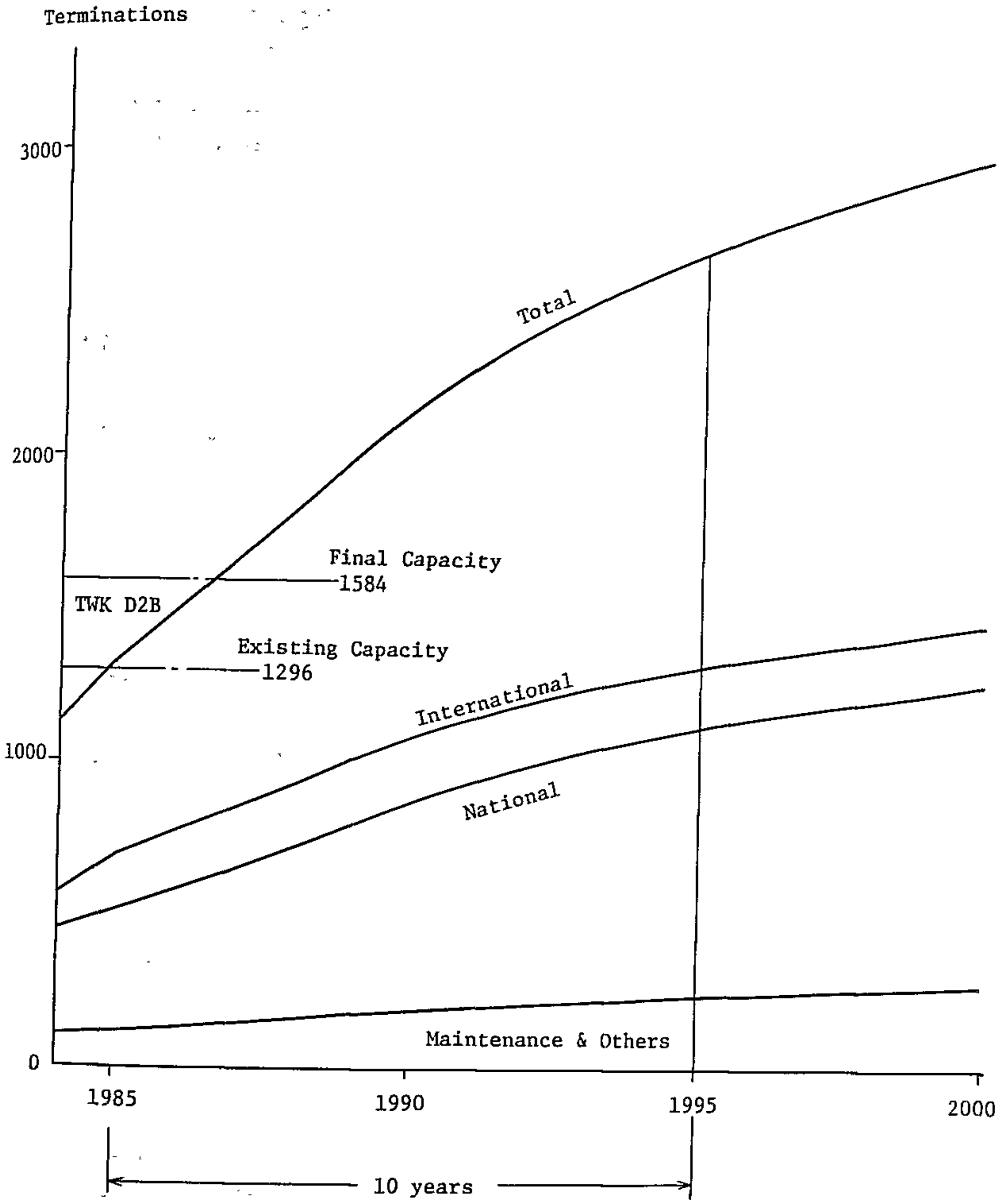


Fig. 5.2.2.9 Estimated Number of Terminations for Jakarta

(3) Scheduling of System Introduction and Expansion

Examining the results shown in Fig. 5.2.2.8 and .9, the scheduling of the expansion of the Medan exchange and the introduction of the new Jakarta exchange is planned as follows:

Medan Exchange:

The initial capacity of terminations for the Medan SPC exchange is already specified as follows:

International Terminations:	450
National Terminations:	500

These figures will cover the demands for future normal traffic until the year 2000.

Jakarta Exchange:

TWK D2B will require expansion in 1984. The expanded part should be put into service in the beginning of 1985. In order to cope with successive demand growth, a new SPC is to be introduced in 1985 in a new international telecommunications center in Jakarta. The initial capacity of the new exchange for 1986 to 1990 traffic will be:

International Terminations:	1,200
National Terminations :	1,000

This conclusion has been directly obtained from the demand forecast shown in Section 4.5. Since the number of international terminations include a number of new direct connections, the amount can be suppressed considerably if the prospective direct connections can be postponed. Then the expansion of TWK D2B can also be postponed. The TWK D2B should be used as a stand-by after the introduction of SPC in Jakarta. The new system should be arranged so that it does not influence commercial traffic even in the initial troubles sometimes associated with a new installation. The first expansion will be in 1990.

At that time, the system will be expanded to:

International Terminations: 1,400

National Terminations: 1,300

As is seen in Fig. 5.2.2.8, since the final capacity of the Medan exchange covers the demands of terminations up to the year 2,000, it is preferable to introduce the same type of system in Jakarta from the viewpoint of efficiency in installation and maintenance, especially the maintenance of software. Ten years after the initial installation, the introduction of new versions of both systems for expansion or replacement in both cities should be considered from the viewpoint of system maintenance and operation, taking into account the progress of computer and switching technology. The required scale of new systems can be easily estimated by the method and figures described above. The features of the system, however, will be significantly changed in the next generation, for the following reasons.

i) Telex traffic might have been considerably affected by the introduction of data or Teletex services.

ii) The worldwide trend toward service integration will be envisioned more clearly at that time.

The system features of the next generation should be studied with these points in consideration.

(4) Introduction of Advanced Services

Associated with the introduction of SPC exchanges, various additional services can be implemented and provided to customers. Here, some of those considered appropriate for introduction in INDOSAT have been chosen from the facilities mentioned in Section 5.1.3 (3), with some comments added. Since, among those services mentioned previously, (b), (e), (f) are services which should be implemented in terminal exchanges, they are exempted here.

1) Facilities Provided in Real Time

(a) Abbreviated Dialing

This is a method to decrease the number of digits in a selection code which a customer has to transmit when he makes a call attempt. Two choices in implementation can be envisioned:

i) Access by a special number followed by abbreviated dialing. In this method a special number has to be assigned in a special numbering plan. The number of digits in this method is not remarkably decreased, if, for example, the special number consists of three digits and the abbreviated dialing of two digits.

ii) Selection Code Consists of Less Digits than a Special Number

One to three digits in numerals or alphabets can be used in this method. Alphabets are sometimes more useful than numerals due to the ease of memorization. This method is referred to as "character dialing" and is considered a more recommendable version than choice i).

Abbreviated dialing can be suitably implemented by preparing a predetermined amount of memory and access protocols to this memory for each subscriber and by entrusting its use to the subscriber's operation. Accordingly, a system has to be equipped with external memory devices, such as magnetic disks, for abbreviated dialing files.
See Appendix 5.2.2 (4)(a) for reference.

(b) Camp-On

The average rate of effective and ineffective calls in international telex service is approximately 50%. Subscribers tend to repeat call attempts after receiving a service code.
Camp-on is a service in which a switching system takes the place of the customer's operation and automatically repeats the call set-up action with a predetermined number of repetitions and intervals. At the same time, this service aims to prevent excessive repetition of call attempts. This is effective for service code "NC" and, in some conditions, for "OCC". This service should be able to be activated for each destination. It is important to select parameters carefully so that this automatic retrial does not increase the load to the processor. See Appendix 5.2.2 (4)(b) for reference.

(c) Announcement

This is a service which takes advantage of the computer memory where useful information is written in and read out in response to access from subscribers. There are some variations envisioned. Here, two typical schemes are presented.

i) Access by Special Number

News or informative announcements on telex services can be accessed by subscribers by typing a special number. Special numbering planning has to be taken into account.

ii) Automatic Routing to Announcement

In the case of circuit failure on an aggregate level, accesses to the route should be abandoned but terminated with some printout on subscribers' typewriters.

(d) Chargeable Time Information

This is the indication by an exchange to the terminal of the chargeable time of a call prior to the release of the terminal. Instead of the normal clearing of some combinations of I.A., No. 2 can request this information.

2) Facilities Provided on a Store and Forward Basis

(a) Store and Forward (Single address)

Storing messages in a switching system is quite a new feature in circuit switching. In busy hours, however, subscribers want to be released from transmitting their messages as soon as possible. On the network side, messages can be deposited in a system and transmitted when busy hours are over or when international circuits are less congested. This will give a good traffic control scheme. From these viewpoints, this facility has benefits for both customers and carriers. This facility is a feature for outgoing calls. If this service is applied for incoming calls in circumstances where no other countries have this facility, it will go into effect to draw in the traffic to this switching node. This is the reason why this service has been offered for over ten years in the U.S. where competition is the basis of social activity.
Recently, a number of administrations have been implementing this facility, which has a possibility towards international interworking. For this reason CCITT SG IX has selected it as a topic of study. In the introduction of this service, since it is difficult to estimate demands, the initial system should not be large, but rather small and easily expandable. See Appendix 5.2.2 (4) for reference. From the viewpoint of operation and maintenance, it is advisable that the system be independent from the main switching system and interconnected with trunk lines.

(b) Multi-Address Call

Telex messages often have the same contents but multiple recipients. This service can be implemented by the network and provides customers with the facility to receive a message with multiple addresses. Since this facility inherently needs a message storing function, it is advisable to implement it together with the store-and-forward facility.

Among the above-mentioned services, the store-and-forward and multi-address call should be started from the time of the Jakarta exchange. Then if demands increase sufficiently, a study should be done for Medan. Abbreviated dialing can be started from the Medan exchange on an experimental basis if regional provision of a new service is permitted.

(5) Telegraph Terminal Equipment

When telegraph channels are set up on the wide-band transmission link of the present, one typical method is to apply the FMVFT (Voice Frequency Telegraph) system (CCITT Recommendation R.35) on one analog voice-band (4KHz) circuit. Recent digital technology has enabled the application of a new system, R.101 TDM, for the same purpose. The TDM system can provide nearly twice as many channels as VFT systems with a slight cost increase (10% to 20%). The worldwide trend is leaning toward the adoption of TDM.

The comparison between the two systems is as follows.

	Number of Channels	Modulation Rate	Others
VFT	24 ch	50 Bauds	
TDM	46 ch (at 50 Bauds)	50-300 Bauds	Aggregate bit rate 2400 bit/s Operated in combination with MODEM

It is recommended that TDM systems be used for circuits with a number larger than the capacity of VFT. The required number of telegraph terminal equipment is shown below for each gateway from 1984 to 1989 corresponding to the traffic forecast for telex and telegraph leased circuits.

		1984	1985	1986	1987	1988	1989
Jakarta	VFT		40*	+2	+1	+2	+1
	TDM		23*	+2	+1		+1
Medan	VFT	6			+5		
	TDM	4			+3		

* Purchase assumed in the New Jakarta Telex Exchange project. TDM/VFT to be installed before 1985 are included in these numbers.

(6) Countermeasures for a system failure in an SPC exchange

General considerations described in the Telephone Section 5.2.1 (5) (c) are also applicable for the planning in the telex except the last item 6). Since the telex traffic is handled almost in fully automatic operation, the back up planning is much more easily envisaged than the case of telephone.

1) In case of failure in Medan (Fig. 5.2.2.6.1)

An efficient and effective means is to take advantage of inter-gateway trunk lines between Medan and Jakarta, and to switch them over to the tie lines with PERUMTEL tandem exchange and/or international trunk lines so that the Jakarta exchange could take the place of Medan exchange. Following arrangements are necessary for this purpose.

i) The interface of trunk lines which are switched over should be the same as the other end in signalling and in electrical characteristics.

ii) The routing function and the capacity of Jakarta exchange be prepared and adaptable for this switch over. The capacity increase is estimated approximately 20% if the complete back up is required.

iii) The number of intergateway trunk lines should have a capacity to carry traffic in accordance with a required back up ratio. In plan B, applying TDM's on two voice grade channels in the place of VFT, the dominant traffic will be covered in 1984 and the back up ratio in 1990 will be approximately 30%.

2) In case of failure in Jakarta (Fig. 5.2.2.6.2)

One of the countermeasures, Plan A, is to take advantage of the existing TWK D2B. The plan A has an attractive feature that it does not require increase in the number of intergateway trunk lines and that TWK D2B has enough experience on operation.

In the future, however, due to the increase in maintenance cost of TWK D2B, the Plan A will be taken the place of by the Plan B. Since the traffic handled in Jakarata is five to six times as large as that of Medan and there is a long distance between Medan and Jakarta, which leads to a high operation cost of intergateway trunk lines, a complete back up is considered not suitable.

Unless there is not a particular criteria for back up ratio, an objective might be laid down at a point where the operation cost of a certain number of trunk lines becomes comparative with the maintenance cost of TWK D2B. Since the Medan exchange has a larger capacity than what is required for normal traffic, the exchange will be an effective tool for the back up purpose.

The necessary arrangements described in the previous paragraph 1) are also applicable to this case except figures about the capacity increase and the back up ratio. By means of the use of TDM's, a back up ratio 5% can be implemented at the initial stage of Jakarta new exchange.

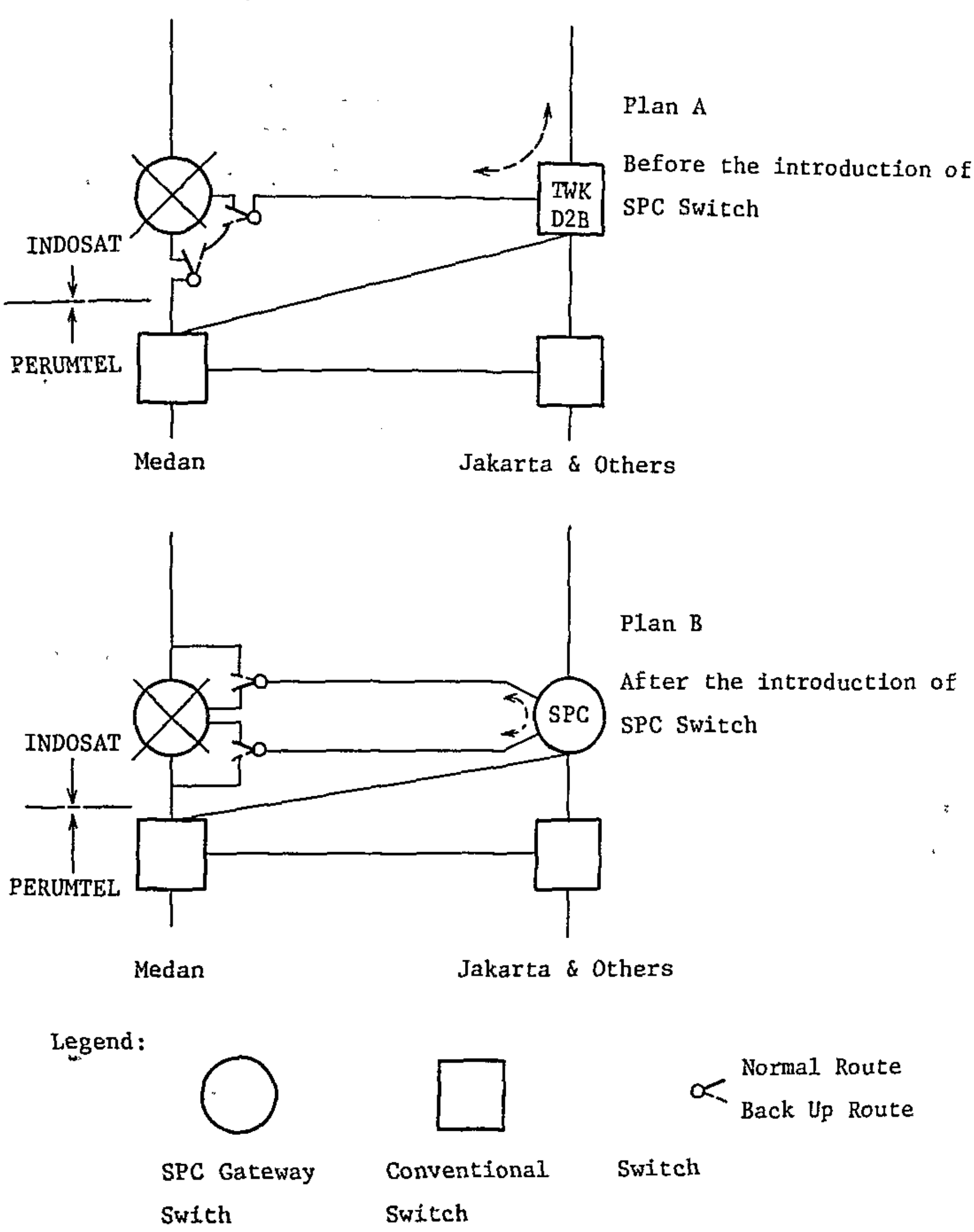


Fig. 5.2.2.6.1 Back Up Concept in case of
Medan Exchange Failure

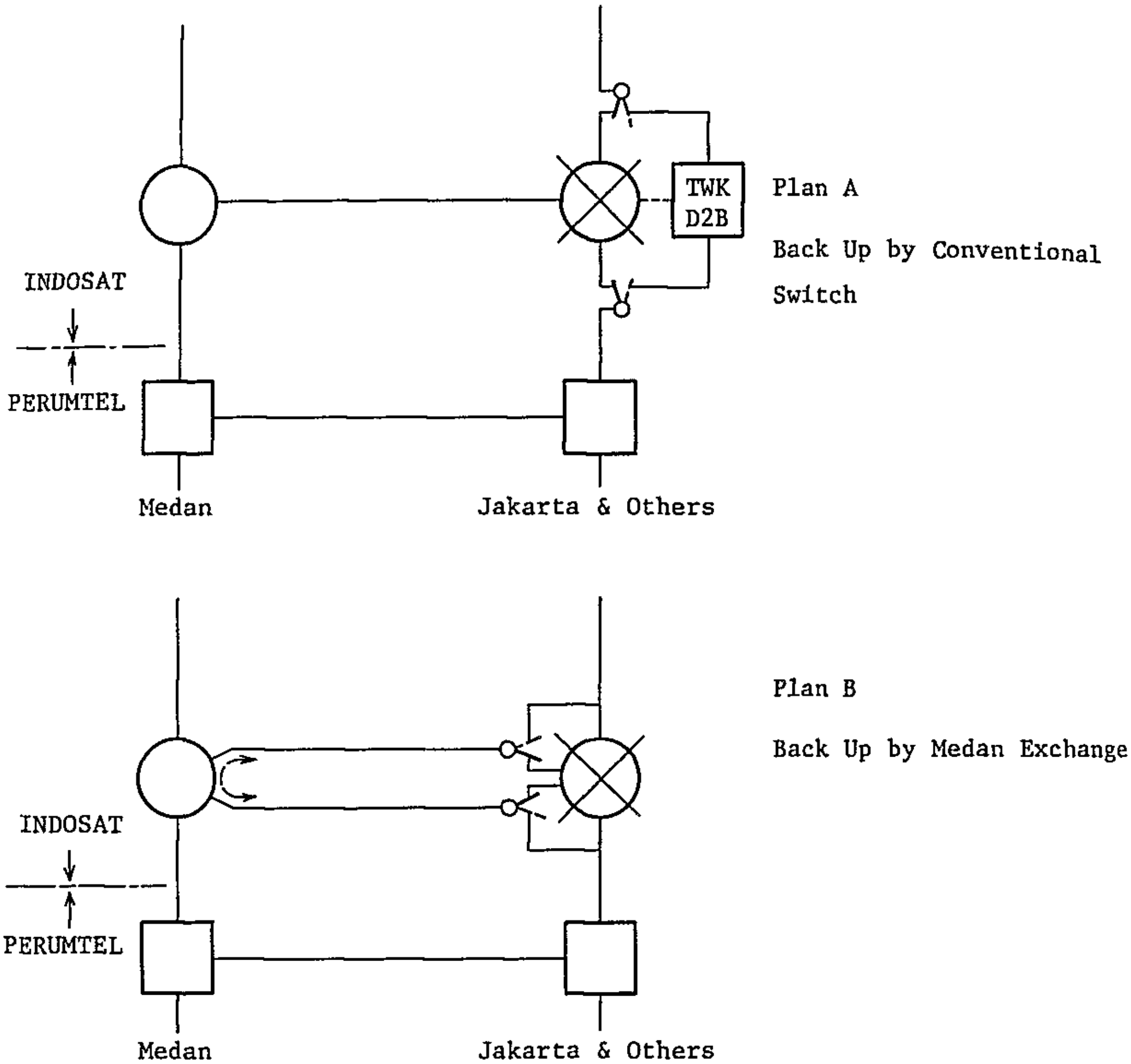


Fig. 5.2.2.6.2 Back Up Concept in case of Jakarta Exchange Failure

5.2.3 Data Switching

In response to the world trend to establish a public switched data network, an international packet switching system should be introduced in Indonesia. As for the introduction of a circuit switched data network, since further observation is necessary for future planning, the description here focuses on a packet switched network. In this plan the network is referred to as IPSDN (Indonesian International Packet Switched Network).

The schedule is as shown in Table 1.3 and the location should be in the center of major international telecommunication demand, i.e.,

Year : 1985

Location : New International Telecommunication Center in Jakarta

In this section some basic elements for planning the introduction of a new data network are described.

(1) Network Organization and Expansion

A possible network structure in 1985 is shown in Fig. 5.2.3. Here P.T. Indosat is supposed to have its own subscribers by leasing subscriber lines from PERUMTEL.

In Fig. 5.2.3 the first network/subscriber (DCE/DTE*) interfaces are supposed to be CCITT Recommendation X.25 and ISO BASIC.

* DCE : Data Circuit Terminating Equipment
  DTE : Data Terminal Equipment

In the following years, the network expansion shown below can be considered in accordance with demand growth, the situation in the domestic network and the worldwide trend together with international standardization.

i) Interworking with the domestic data network, which depends on PERUMTEL's planning.

ii) Introduction of Telex in 1986
This is associated with the introduction of a Conversion Facility and the start of interworking with the telex network.

iii) Introduction of facsimile with G3 machine in the future.

iv) Introduction of data facsimile (G4) machine in the future.

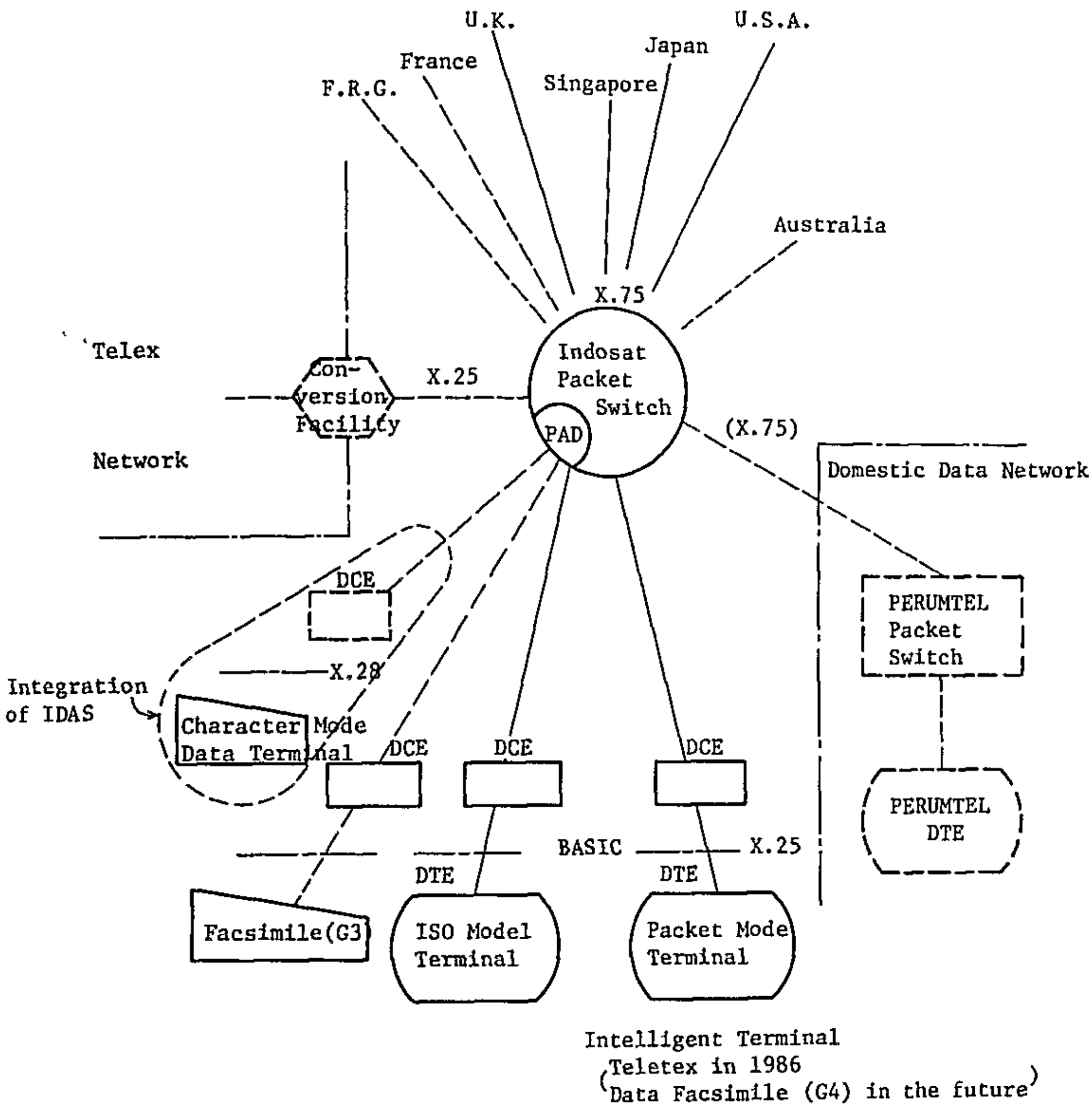


Fig. 5.2.3 Indonesian International Public Data Network in 1985

Note: ----- indicates possibilities for the future

(2) System Capacity and Structure

In studying a system for a new service for which the demand is still ambiguous, it is advisable that its capacity not be too large in the initial stage, but small and easily expandable. Also its life span should be set shorter than conventional service systems, e.g. five years.

The number of circuits are calculated on a delayed basis since packet switching is based on a stored-and-forward technique. This study heavily depends, however, on the structure and the characteristics of the system, and it is hard to show a general method.

As distributed control is one of the major trends and PSDN can be a service with integrated features as shown in Fig. 5.2.3.1, a new system can be a complex of small processing units. For example, see Appendix 5.2.3.2.

(3) Protocols

Protocols to be adopted in the INDOSAT Packet Switched Network are classified into two: (a) Terminal-Network protocol and (b) Inter-network protocol. Tentative choices are as follows.

(a) Terminal/Network (DTE/DCE) Interface

i) X.25 protocol

This is the most basic protocol in packet switching and is applied to packet mode terminals. Although this has become a CCITT Recommendation, there are some versions and variations in interpretations. A careful choice should be made to select a new and adaptable version.
For example, there are three categories stipulated in this recommendation as the communication mode:

i) Virtual Call
ii) Permanent Virtual Call
iii) Datagram

Of these three, ii) and iii) are not recommendable because protocols and operations for international use have not been established yet.

ii) ISO BASIC

This is a protocol applied for non-packet mode terminals and corresponds to IBM BSC (Binary Synchronous Communications) protocol.
As this has no facility to format a message into packets, the network has to prepare PAD*.
This is not a CCITT standardized protocol, however, since this type of terminal is widely used all over the world, it is recommended that it be supported also in Indonesia.

iii) X.28 protocol

This is for start-stop mode data terminals which are popularly used for data base access. The introduction of this protocol enables into this network the integration of simple data terminals without protocols which are most popularly used and the largest in number.

b) Inter-network Interface

i) X.75 protocol

The international gateway to gateway interface should be implemented by this protocol.
As well as X.25, only the virtual call should be adopted. When a domestic packet switched network is established, interfacing will be necessary between two networks, and will be arranged by bilateral agreement between P.T. Indosat and PERUMTEL.
A possible choice could be also X.75.

* PAD : Packet Assembly Disassembly

ii) X.25

When the Teletex service is introduced by using a packet switched network, an interfacing of the data and telex network will be essential and a conversion facility which converts protocols of both networks should be introduced. In this case, X.25 can be adopted as an interface between the C.F. and the packet switch. The C.F. will play the role of a DTE in the packet switched network.

(4) Numbering Plan

The numbering plan for IPSDN should be based on CCITT Rec. X.121 as described in Section 5.1.4.(3). The DCC of DNIC assigned for Indonesia is 510 and the network digit should be applied in conjunction with PERUMTEL planning.

The NTN should be configured by the following principles.

i) to be operational for a long period of time
ii) to have a systematic structure
iii) to have flexibility for future expansion

The first one or two digits can be assigned as an area code. The existing Indonesian telex numbering plan might be a good reference for this plan.
An example is shown below.

```
      DNIC             Max. 10 digits
510  +  X     +     A B C D .....
DCC     Network     Area Code
        Digit
                    NTN: Network Terminal Number
```

(5) Charge Method

A minute recording method should be adopted in a packet network like other SPC networks where charge records are automatically put out on magnetic tapes. A recording should be made for all calls both effective and ineffective.

What is new and peculiar to packet switching is that a recording of an effective call includes two elements:

i) Transmitted number of segments (1 segment = 64 octets)
ii) Holding time in seconds

Since the majority of DTE's are computers or similar devices which have the capability of recording by themselves, the chargeable time indication and online call data information retrieval are not essential.

(6) Additional Facilities

There are a lot of additional facilities defined for PSDN. In a new network, however, additional facilities should not be versatile from the beginning but be appropriately expanded in accordance with the growth in customer demand.

Some examples which could be offered in the initial stage of IPSDN are as follows.

(a) Reverse Charges

A facility to permit the called party to pay the charges.

(b) Abbreviated Address Calling

This facility is similar to telex and is intended for manually operated terminals. (e.g. BSC terminals)

(c) Direct Call

This is a facility which enables the establishment of a call without the need to transmit address signals to the network. This facility is also intended only for manually operated terminals and cannot be offered in combination with abbreviated address calling.

(d) Packet Multiplexing

This is not an additional facility but an inherent characteristic of PSDN. However, from a service viewpoint this can be a service menu. By setting the charge for each logical channel, a customer can enjoy this service if he pays for multiple logical channels. This is a facility in which a DTE can simultaneously communicate with several parties by sharing one physical connection on a time-division packet-multiplexed basis.

(7) Transmission Line

(a) Subscriber Line

While the domestic network consists of analog transmission lines, subscriber lines should be set up by leasing voice-grade circuits from PERUMTEL and applying MODEM's for DCEs corresponding to service speeds. In principle, DCEs which are installed on subscribers' premises should be provided by P.T. Indosat and interfaced with the corresponding DCEs in the P.T. Indosat Communication Center. Possible selection can be made from user service classes 8 to 10 (2400 to 9600 bps.) in CCITT Recommendation X.1.

(b) International Link

In the beginning, analog voice-grade channels with data MODEM's will satisfy the traffic demand. When the demand increases, 48 kbps or 56 kbps will be provided by the SCPC system via a satellite link or by the group band MODEM via a submarine cable.

5.3 Transmission

5.3.1 Satellite Communications and Submarine Cable Systems

Communication media based on satellite communications and submarine cable systems are witnessing tendencies for wider bandwidths, higher performance, and a lower price that are progressing at a rapid rate.

Each of these media requires investments of huge sums of money ranging from several tens of millions of dollars to several hundred million dollars to start it. Careful consideration is needed in promoting the construction plan, such as selection of media, investment priority, construction timing, etc. An economical comparison will be needed.

These two media have an essential difference in their characteristics. A cable system is a circuit that connects two points. A satellite system is a circuit that connects a large number of points. Therefore, a comparison of the two for the following items alone is not sufficient:

- ° Capital expenditure
- ° Investments in space sector
- ° Additional expenditure to offer circuits

Therefore, in order to correctly evaluate a cable and satellite circuit, an annual use charge charged on a half circuit to both communication carriers is used. Calculations of the annual rent per half circuit for a cable circuit are extremely easy.

In satellite communications, the annual rent is the total of the earth station operating expenditure and satellite rents payable to INTELSAT.

Utilizing a technique developed by B.M. Dawidziuk and H.F.Preston of Standard Telephones & Cables (STC), annual charges per half circuit via a cable and satellite circuits are calculated.

(a) Submarine Cable System

The definition for an annual charge for a cable system has been decided through many years at experience. This charge is considered Ac, and initial start-up cost, Cc.

To calculate the annual charge Ac, three elements are considered in the cost.

ⓐ	Depreciation cost (durable years, 25)	4%
ⓑ	Interest on capital	10
ⓒ	Repair, maintenance, and operation cost	1
	Total	15%

The annual charge Ac per half circuit will be

$$Ac = \frac{0.15\ Cc}{2NF} \quad \text{provided}$$

$$F = \frac{n_1+n_2+\ldots\ldots+n_{25}}{25N}$$

(n_1, n_2, ... n_{25} are the number of circuits which comprise traffic in the 1st, 2nd, ... and 25th years. F is N that normally becomes 0.7 to 0.8)

when the initial cost is made Cc, cable circuit capacity, N, and utilization efficiency, F.

Based on previous data, the subtriplicate law can be utilized in calculations of approximate values for the initial cost. The STC-14 M system (for 1840 Chs), for example, is estimated at approximately $50,000 per system nautical mile at 1980 prices. Based on it, the initial start-up cost Cc will be:

$$Cc = 50{,}000\sqrt[3]{\frac{f_n}{f_o}}$$

f_n: System design bandwidth
f_o: 14 MHz

(b) Satellite Communications System

The annual expenditure As of a satellite consists of two factors:

- ° Annual expenditure of earth stations Ae
- ° Satellite rent S

The principal factors for the annual expenditure Ae of a satellite earth station are as follows:

° Depreciation cost (durable years, 10)	10%
° Interest on capital	10
° Repair, maintenance, and operation cost	10
Total	30%

In this instance, the annual expenditure Ae of a satellite earth station per half circuit will be:

$$Ae = \frac{0.30\ Cs}{N} \quad \text{provided}$$

Cc: initial start-up cost of a satellite earth station. $5 to 6 million on average even though it changes depending on the circuit capacity N.

The satellite rent is reduced annually and was $5,120 in 1980.

Therefore, the total amount for annual satellite cost As can be expressed by As = Ae + S and is greatly affected by the number of circuits operated N of a satellite earth station in particular. Fig. 5.3.1.1 shows annual expenditure of a satellite earth station with respect to the number of circuits in operation (half circuits).

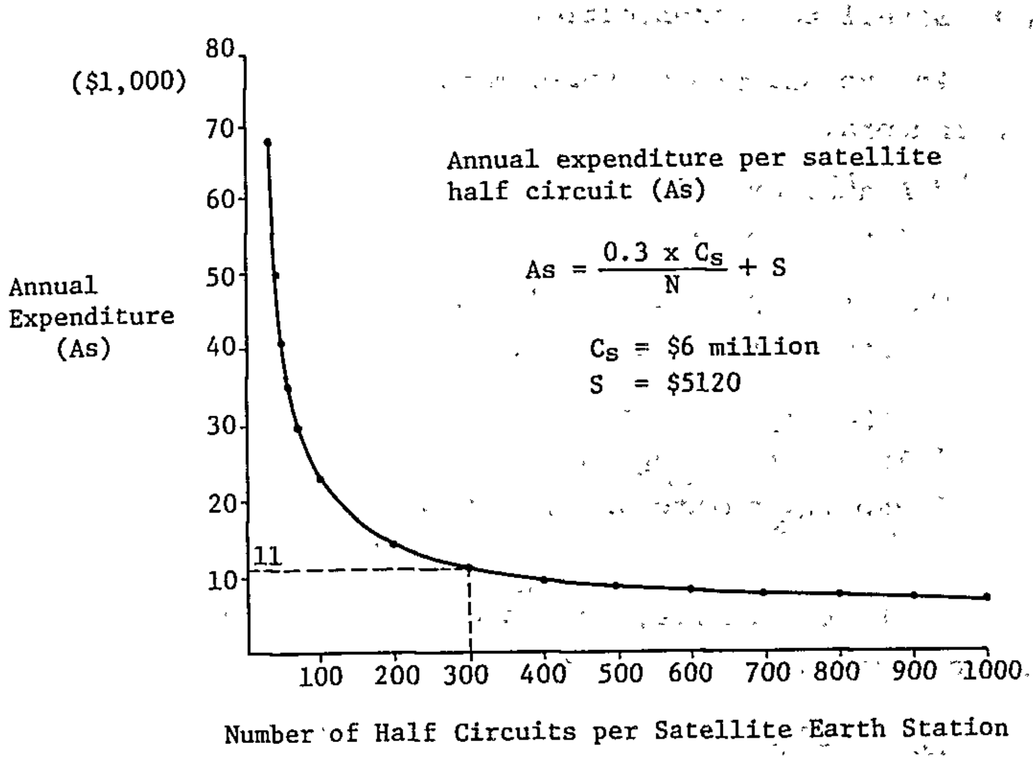


Fig. 5.3.1.1

(c) Comparison of Annual Expenditure between Submarine Cable System and Satellite Communications

As an example, a comparison of annual expenditure when installing a submarine cable from Indonesia is made assuming the number of half circuits of the Jatiluhur Earth Station to be 300 channels.

The annual expenditure of satellite communications will be $11,000 in accordance with Fig. 5.3.1.1 The annual cable expenditure is calculated after making installation distances of cable systems to be variables. The results are shown in Fig. 5.3.1.2. The cable utilization efficiency F is made to be 0.7.

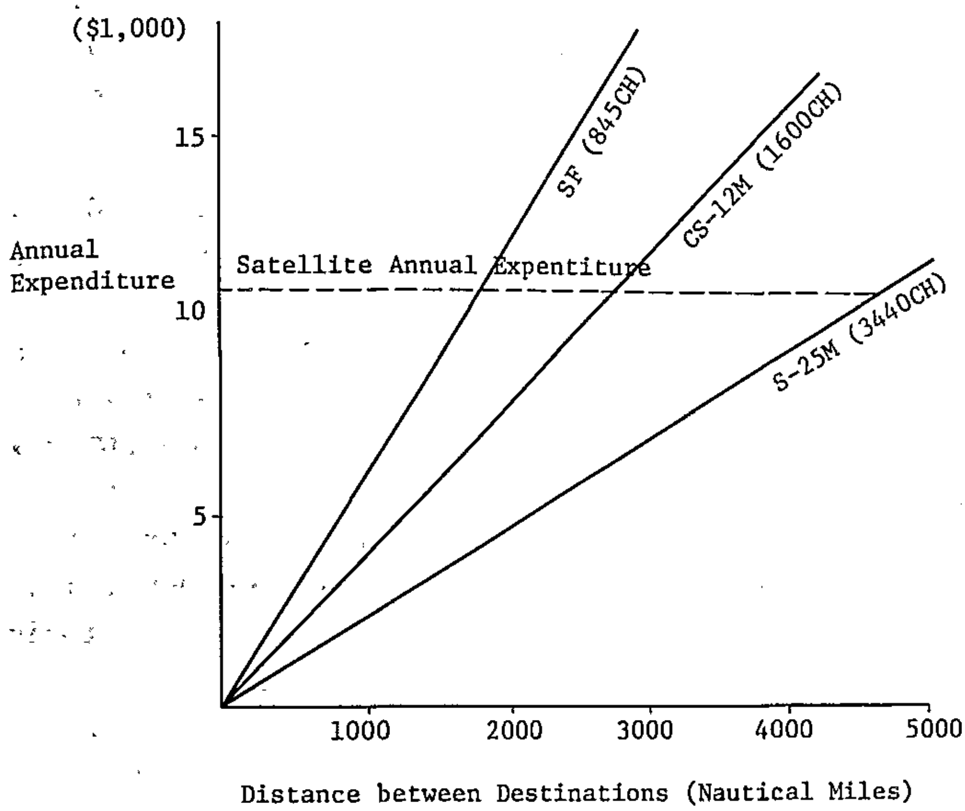

($1,000)
15
Annual
Expenditure
10
5
Satellite Annual Expentiture
SF (845CH)
CS-12M (1600CH)
S-25M (3440CH)
1000
2000
3000
4000
5000
Distance between Destinations (Nautical Miles)

Fig. 5.3.1.2

5.3.2 Satellite Communications

(1) INTELSAT

As more opportunities present themselves for Indonesia to take part in the international community, the demand in Indonesia for international communications will increase further. As a trend throughout the world, the demand for international communications continues to increase year after year. To meet the increase in demand, INTELSAT will introduce TDMA beginning in 1984.

P.T. Indosat too is required to introduce TDMA and consolidate and expand the existing equipment and facilities parallel with these trends in order to offer communications paths that are always stable and high in quality.

(a) Outline of the Plan

i) Introduction of TDMA/DSI in the Indian Ocean region (1984)

ii) Construction and operation of TDM reference station (1984)

iii) Introduction of TDMA/DSI in the Pacific Ocean region (1986)

INTELSAT is scheduled to introduce TDMA/DSI in the Pacific Ocean region in 1986. In line with this introduction, PT INDOSAT will consider introducing TDMA/DSI in that region.

iv) The number of TDMA circuits is expected to increase every year after 1985. The introduction of SS/TDMA with the INTELSAT-VI satellite is scheduled for around 1989. P.T. Indosat is required to expand its TDM circuits parallel with these developments. For the moment, however, a duplex configuration with FDM is desirable.

v) FDM circuits will continue to be used, and their maintenance has to be considered. The depreciation of equipment and facilities more than 10 years old will become visible, and replacements will have to be made. (Installation of equipment that also considers effective and efficient maintenance and operations shall be planned.)

vi) A forecast of increases in destinations and circuits is shown in the table below. After 1989, more conventional FDM circuits are expected to be changed to TDM circuits. The capacity of the FDM equipment will become surplus, and the surplus capacity should be utilized to meet increases in FDM destinations. The introduction of SCPC shall be considered for destinations with a low volume of traffic. (High-speed data transmission at 56 kbps is possible with SCPC.)

Number of Destinations

	1984	1985	1986	1987	1988	1989	1990	1994	2000
IOR	12	21	21	23	26	26	26	29	31
POR	10	12	12	12	12	12	12	14	14
Total	22	33	33	35	38	38	38	43	45

Number of Circuits/Number of Countries (Voice Grade)

	1984	1985	1986	1987	1988	1989	1990	1994	2000
IOR	333/16	407/28	470/28	567/31	672/36	778/36	894/36	1393/39	2238/42
POR	235/10	294/12	335/12	418/12	484/13	564/13	644/13	991/16	1591/16
Total	568/26	701/40	805/40	985/43	1156/49	1342/49	1538/49	2384/55	3829/58

(2) Maritime Satellite Communications (INMARSAT)

As described in III-1-3, the maritime satellite communications service will be offered as a new service.

(a) 1st stage: in the beginning, ship earth stations will be installed on ocean-going ships of Indonesian registry over 5,000 tons for communications via coast earth stations of other countries.

PT INDOSAT is required to offer information regarding ship earth station equipment to these shipowners and to act on their behalf in submitting utilization applications to INMARSAT.

PT INDOSAT shall offer the following services.

1) Commissioning Procedures*

i) Purpose of Commissioning

Any shipowner, interested person, or organization which desires to operate a Standard A ship earth station within the INMARSAT system must have the ship earth station approved by INMARSAT for access to the system. This approval is termed "Commissioning"; in order to obtain this approval certain information must be supplied to INMARSAT, and the ship earth station must undergo a simple series of tests after installation on board the ship to verify that it functions properly.

Only ship earth stations of models which have been type approved for use in the INMARSAT system will be considered for commissioning.

ii) Submission of Application

The application for approval for access to the INMARSAT system shall be submitted to INMARSAT in the English language via the routing organization (usually Signatory).

Normally, a fully completed application for commissioning should be received by INMARSAT (via the routing organization concerned) at least 14 days in advance of the desired commissioning time. To expedite the handling of messages within the Directorate, applicants are invited to forward informal copies of the application by letter or telex directly to INMARSAT subject to confirmation by the relevant routing organization before the actual commissioning date.

iii) Types of Tests

The commissioning tests are functional tests designed to demonstrate that the particular ship earth station installation functions properly and is fully responsive to network control signals. The sequence of tests shall include:

(*) Excerpt from INMARSAT Commissioning Procedure Document

- ° Ship-to-shore duplex telegraph call including character error rate test (Classes 1 and 3)
- ° Shore-to-ship duplex telegraph call including character error rate test (Classes 1 and 3)
- ° Ship-to-shore distress priority telegraph test (Classes 1 and 3)
- ° Ship-to-shore distress priority test with duplex voice with compandors (Classes 1 and 2)
- ° Shore-to-ship duplex voice with compandors (Classes 1 and 2) including:
  - Deviation and subjective quality both to and from the ship
  - Return loss for ship earth stations interfacing with 2 wire ship board extensions.

iv) Approval for Access

Upon successful completion of all the commissioning tests, the coast earth station shall notify the ship earth station operator and the INMARSAT OCC of the successful completion of the tests. The coast earth station will grant to the ship earth station temporary authorization for access to the INMARSAT space segment for all modes of communication applicable to the class of ship earth station. The coast earth station will also advise the ship earth station operator that within the first 24 hours he should only place calls through the coast earth station that performed the commissioning tests in order to allow time for the ship station identity to be passed to other coast earth stations and to allow them to enter the ship station identity in their list of authorized ship earth stations. After 24 hours, the ship earth station operator would be free to place calls through other coast earth stations.

The formal approval for access to the INMARSAT system will be granted by the INMARSAT OCC and notification will be forwarded as soon as possible to all coast earth stations, and in due course to the applicant, the licensee, the routing organization, all Signatories, and other appropriate authorities.

v) Duration

INMARSAT approval of a particular ship earth station installation for access to the INMARSAT system will remain valid until and one of the following occurs:

- Removal of the complete ship earth station equipment
- Any change in the information contained in the commissioning application which would require a change in ship station identity

- Significant modification or change to the ship earth station

- Persistent malfunction or any operation of the ship earth station that degrades the performance of the system.

2) The construction of a ship earth station is given in the following for reference.

i) Configuration of SES Equipment

Typical ship earth station eqipment consists of the following. (See Fig. 5.3.2.(4))

Above Deck Equipment (ADE)

Antenna & Radome
Antenna pointing control mechanism
Power amplifier (transmitter)
Low-noise amplifier (receiver)

Below Deck Equipment (BDE)

Up-converter
Down-converter
Local oscillator
Modulator
Demodulator
Channel control unit
Antenna control unit
Operation board
Power supply unit
Peripheral equipment

The peripheral equipment includes the following, as necessary.

Teleprinter
Telephone handset (or full set)
Voice-band data modem
Facsimile unit
High-speed data unit

Main features of existing and newly developed SES equipment are summarized in Table 5.3.2.1.

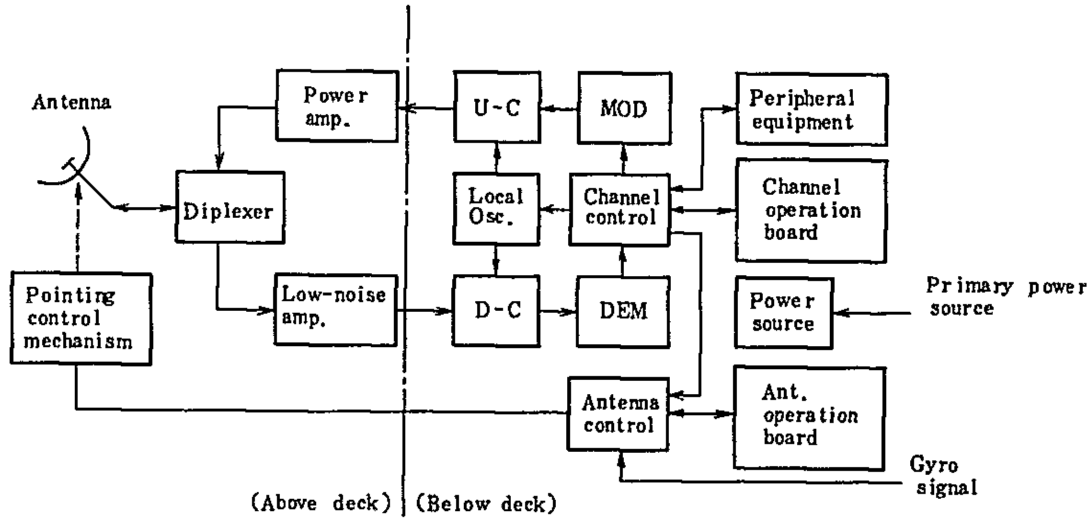


Fig. 5.3.2.1 Block Diagram of Ship Earth Station Equipment

Table 5.3.2.1 Main Features of Existing and Newly Developed SES Equipment

Item	Existing SES	Newly developed SES
- Antenna	1.2 mø parabola (gain = 23.9 dBi)	0.85 mø parabola (gain = 20.7 dBi)
- Power amplifier	40 W (2 transistors in parallel)	70 W (4 transistors in parallel)
- Low-noise amplifier	210 K (bipolar transistors)	65 K (GaAs FET)
- Antenna mount system	4-axis (X, Y, Az, El)	4-axis (X, Y, Az, El)
- Angular sensor for antenna control	High speed gyro (12000 rpm) installed on X-Y plane	Low speed gyro (3000 rpm) installed on radome base
- FM demodulator	PLD*	ERPLD**
- Channel control	Micro-processor	Micro-processor with enhanced capability
	(*) Phase-locked discriminator	(**) Extended-range phase-locked discriminator

ii) Communication Functions of Ship Earth Stations

Communication functions of ship earth stations are as follows:

° Class of Ship Earth Station (INMARSAT Spec.)

Class 1 - Standard A ship earth station, usable for both telegraph and telephone-type traffic.

Class 2 - Standard A ship earth station, usable only for telephone-type traffic.

Class 3 - Standard A ship earth station, usable only for telegraph traffic.

° Channel Type

Duplex telegraphy (Telex)

Duplex telephony (Telephone)

Duplex telephony without compandors (Voice-band data and Facsimile)

Ship-to-shore high speed data (56 kbps data, optional)

Shore-to-ship one-way telegraphy

Shore-to-ship one-way telephony without compandors

Shore-to-ship one-way telephony with compandors

° Priority of Services

Distress - Highest priority (for a message indicating that a ship is threatened by grave and imminent danger and requests immediate assistance)

Urgency - Priority subsequent to Distress (for a message concerning the safety of a ship or the safety of a person)

Safety - Priority subsequent to Urgency (for a message to transmit an important navigational or important meteorological warning)

Routine - Lowest priority (for ordinary calls)

° Capability for Simultaneous Processing of Calls

A Standard A ship earth station can transmit only one carrier at a time. It can receive only one carrier at a time except the case of a telephone call where a telegraph group call over the common TDM channel can also be received at the same time.

These features are summarized in Table 5.3.2.2.

	Duplex telegraphy	Duplex telephony	Telegraph group call over the common TDM ch
Duplex telegraphy	--	x	x
Duplex telephony	x	--	o
Telegraph group call over the common TDM ch	x	o	--

iii) Typical Characteristics of INMARSAT Ship Earth Stations

Typical characteristics of INMARSAT ship earth stations are summarized below.

° Communication Characteristics

. Telephone

Subjective equivalent S/N (weighted): $\geq$ 26 dB
Frequency bandwidth: 300 - 3000 Hz

. Telegraphy (50-baud start - stop)

Character error rate: $\leq 6 \times 10^{-5}$

. Voice-band data (up to 2400 bps)

Bit error rate: $\leq 10^{-5}$

. Ship-to-shore high speed data (56 kbps, optional)

Bit error rate: $\leq 10^{-6}$

° Environmental Conditions

. Vessel motion

Roll : ±30°
Pitch: ±10°
Yaw : ±8°

iv) Outline of INMARSAT SES Specifications

An outline of INMARSAT SES Specifications is given below.

° Frequency

Receive from satellite:	1535.0 - 1543.5 MHz
Transmit to satellite:	1636.5 - 1645.0 MHz
Request frequencies (to be alternately transmitted):	1638.600 MHz 1642.950 MHz
Tuning capability:	Automatic tuning to any one of 339 frequencies in 25 KHz increments starting at 1535.025 MHz and ending at 1543.475 MHz.
Tuning in the idle state:	1537.750 MHz (common TDM carrier) 1538.475 MHz (alternate common TDM carrier*) (*) to be changed manually from common TDM carrier when required.
Transmit RF frequency:	101.5 MHz above receive RF frequency (paired with a receive frequency)

° G/T

$\geq$ 4 dBK, under the following conditions.

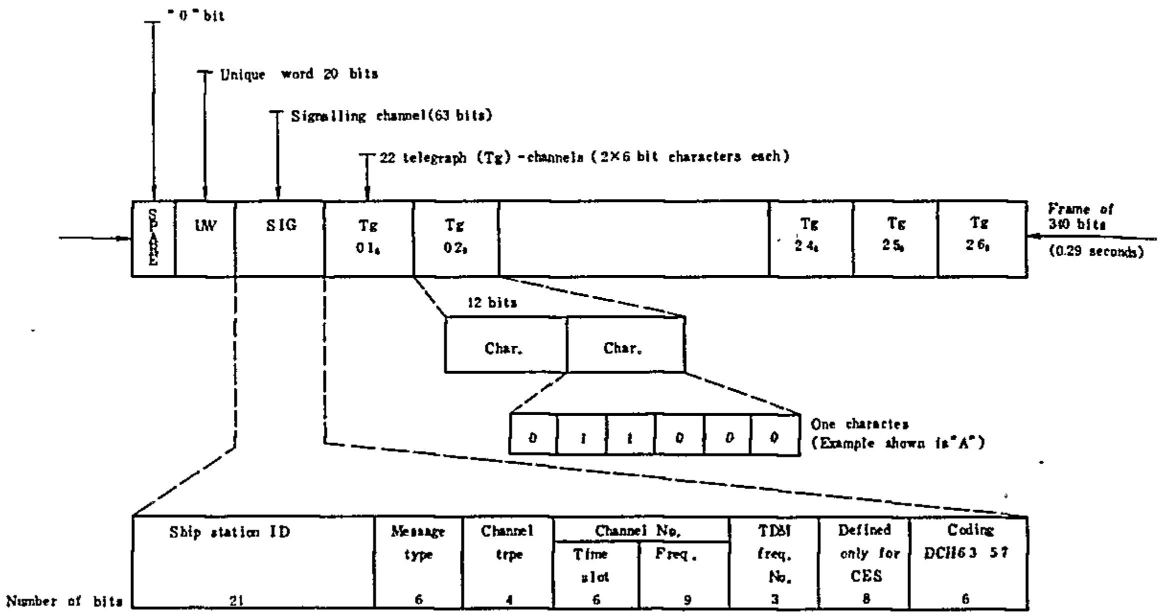
- Clear sky climatic conditions
- Antenna elevation angles greater than or equal to 5°
- With residual antenna pointing errors, including those due to imperfect stabilization system performance
- Including the noise contribution of the receiver low-noise amplifier at an ambient temperature of 25°
- With the transmitter power amplifier at a specified output level
- Including the loss introduced by a dry radome, where a radome is fitted.

° EIRP

Request carrier TDMA carrier FM carrier	:	36 dBW $^{+1\ dB}_{-2\ dB}$
High speed data carrier	:	38 dBW $^{+1\ dB}_{-2\ dB}$

° Modulation and Baseband Characteristics

. TDM channel		
Modulation	:	constant envelope 2 ϕ PSK
Data rate	:	1200 bps
Frame length	:	0.29 s (348 bits)
Unique word	:	20 bits (complementary unique word every six frames)
Coding	:	57 bits plus 6 parity bits encoded with BCH (63, 57) code
Channel format	:	See Fig. 5.3.2 (2).
. Telephone channel		
Modulation	:	FM
Peak frequency deviation	:	12 kHz
r.m.s. speech deviation	:	3.8 kHz for average talker
Baseband reference level	:	0 dBr is defined as the level causing 12 kHz peak deviation
Baseband	:	300 - 3000 Hz
Companding	:	2:1 syllabic (CCITT Rec. G. 162)
Peak clipping level	:	0 dBr



NOTES: 1. The first bit transmitted is written to the left (see the telegraph character "A" above). In the signaling channel this corresponds to the least significant bit.

2. In the telegraph channel the first bit transmitted indicates the type of character field. When the first bit is "0", the subsequent 5-bit character field represents an ITA No. 2 character; When it is "1", the subsequent 5 bits represent line conditions for signaling.

3. Error detection coding shall be Bose-Chaudhuri-Hocquenghem (BCH) 63, 57.

4. The spare bit preceding the unique word shall be "0". All other spare bits shall be "1's".

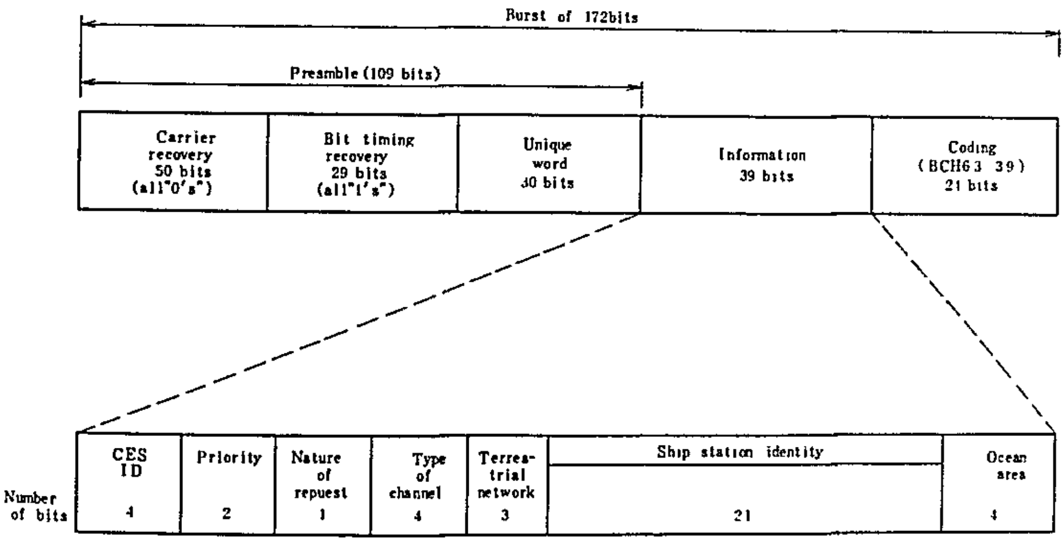
Fig. 5.3.2.2 TDM Channel Format (Shore-to-Ship)

. Request channel

Modulation	:	Constant envelope 2ϕ CPSK
Data rate	:	4800 bps
Burst duration	:	35.83 ms (172 bits)
Preamble	:	109 bits (carrier recovery field; 50 bits, bit timing field; 29 bits, unique word; 30 bits)
Channel format	:	See Fig. 5.3.2.3.

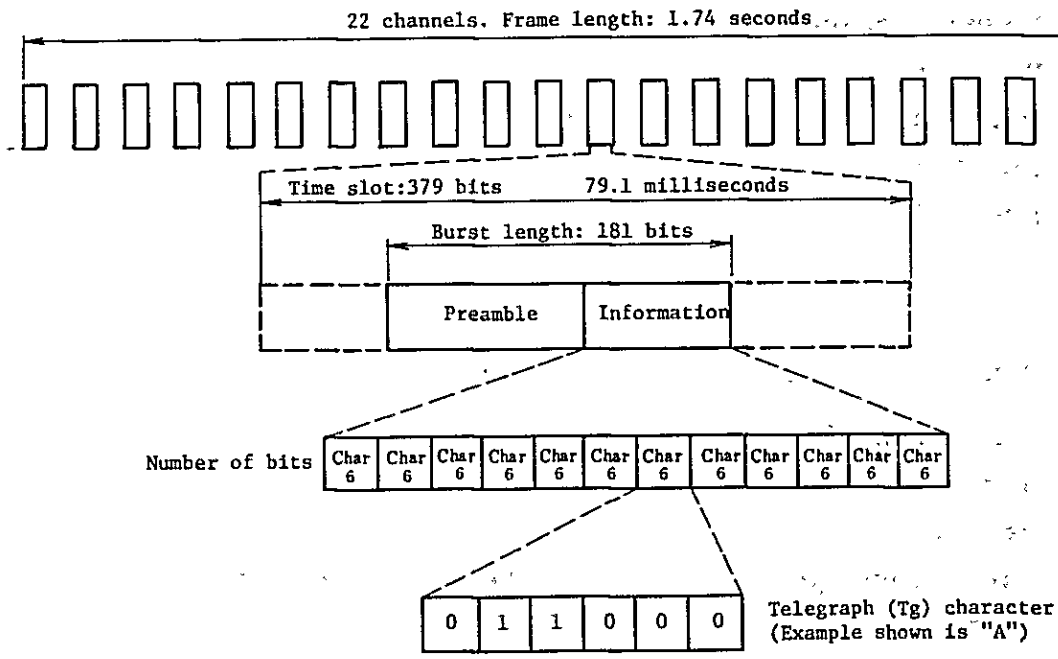
. TDMA channel

Modulation	:	Constant envelope 2ϕ CPSK
Data rate	:	4800 bps
Burst duration	:	37.7 ms (191 bits)
Frame length	:	1.74 s
Preamble	:	Same as request channel
Channel format	:	See Fig. 5.3.2.4.



1. The first bit transmitted is written to the left. This corresponds to the least significant bit.
2. Error detection shall be Bose-Chaudhuri-Hocquenghem (BCH) 63, 39.

Fig. 5.3.2.3 Ship Earth Station Request Carrier Format (Ship-to-Shore)



NOTES:

1. The first bit transmitted is written to the left (see the telegraph character "A" above). In the telegraph channel this corresponds to the least significant bit.

2. In the telegraph channel, the first bit transmitted indicates the type of character field. When the first bit is a "0", the subsequent 5-bit character field represents an ITA No. 2 character. When it is a "1" the subsequent 5 bits represent line conditions for signaling.

   Number of bits - Preamble (Ship-to-Shore):
   109 bits (Carrier recovery, bit timing recovery and the unique word; same as for request burst)

   Number of bits - Message (Ship-to-Shore):
   72 bits (12 characters of 6 bits each)

Fig. 5.3.2.4 TDMA Telegraph Channel Format (Ship-to-Shore)

° Antenna Characteristics

. Sidelobes

$G = 8$ dBi (16° $\leq \theta \leq$ 21°)

$G = 41 - 25 \log \theta$ dBi (21° $< \theta \leq$ 57°)

$G = -3$ dBi ($\theta >$ 57°)

. Axial ratio

2 dB (on-axis)

. Polarization

RHCP for both receive and transmit

° Ship Station Identification (ID)

. Ship station ID

$N_1N_2N_3N_4N_5N_6N_7$ (each Ni represents a 3-bit code)

. Mandatory address recognition capability

- unique ship station ID recognition
- area group call recognition

  $00000N_6N_7$ (N_6N_7 = 0 0 is reserved for calls to all ship earth stations in the network)

. Optional address recognition capability

- fleet group call recognition
- national group call recognition

  0 $N_2N_3N_4N_5N_6N_7$ (a 2nd or 3rd 21-bit identification code which is associated with the group call)

(b) 2nd Stage: P.T. Indosat will build a coast earth station around 1990 near the sea regions in which traffic is heavy, after becoming a member of INMARSAT. Equipment and facilities to offer services shall be added to the Jakarta office. The suitable location for this additional equipment and facilities will be Jatiluhur because of personnel and other considerations.

3rd Stage: When demands for marine satellite services are realized and it is considered feasible to have two coast earth stations, an earth station will be erected facing an ocean other than that of the existing coast earth station.

The general description of a coast earth station is given in the following.

1) The Coast Earth Station and Network Coordination Station

i) Introduction

The INMARSAT system comprises multiple coast earth stations in each ocean region as well as a number of ship earth stations. To control the communications network, a centralized control scheme in which one of the multiple coast earth stations plays the role of network coordination is adopted. This station is referred to as a Network Coordination Station (NCS) and is collocated with a coast earth station (CES). In the following the fundamental requirements for CES and NCS are described.

ii) INMARSAT Requirements for CES and NCS

ⓐ Requirements for CES

The fundamental requirements for each INMARSAT CES are defined in the document "Technical Requirements for INMARSAT Coast Earth Stations" (TRD) Issue 2, approved by INMARSAT Council on July 1, 1981.

The required basic functions and capabilities of the CES are as follows:

° TDM carrier transmission

Each CES shall transmit at least one TDM (Time Division Multiplexed) carrier at a frequency which is uniquely associated with the station. The TDM carrier is used to transmit signaling messages to the NCS and telegraph messages to the ship earth station (SES). This TDM carrier is referred to as a Local TDM (LOC TDM) carrier. The TDM channel format is shown in Figure 5.3.2.5. The signaling message and twenty-two telegraph channels are time division multiplexed in each TDM frame and PSK modulated at 1,200 bps. The duration of each TDM frame is 0.29 sec.

° Common TDM carrier reception

Each CES shall receive Common TDM (COM TDM) carrier for reception of signaling messages from NCS.

The signaling channel format of Common TDM carrier is the same as that of Local TDM carrier.

° Request carrier reception

Each CES shall monitor the two ship-to-shore request carriers and process those requests addressed to the CES.

Request channel format is shown in Figure 5.3.2.6. The request carrier is PSK modulated at 4,800 bps and transmitted at burst mode on the basis of random access. The duration of a request carrier burst is approximately 36 msec.

° Transmission and reception of communication carriers

Each CES transmits and receives the SCPC-FM carriers for voice grade channel service and serves the following types of channels for SESs.

- Duplex Telephone (with compandor)
- Duplex Telephony (without compandor)
- Shore-to-Ship Simplex Telephony (with compandor)
- Shore-to-Ship Simplex Telephony (without compandor)

Each CES also transmits telegraph messages on the telegraph channel in its own Local TDM carrier and receives telegraph messages from SESs on the TDMA (Time Division Multiple Access) carrier at a frequency which is 2,225 MHz below its own Local TDM carrier.

TDMA channel format is shown in Figure 5.3.2.7. The repetition rate of the TDMA bursts is once each 1.74 sec. and the duration is approximately 38 msec. Each burst is PSK modulated at 4,800 bps and contains up to 12 characters of message text.

The following types of telegraphy services are provided.

- Duplex Telegraphy (Telex)
- Shore-to-Ship Simplex Telegraphy

In addition to the above types of channels, CES may have a capability of handling a ship-to-shore High Speeed Data (56 Kbps) channel.

° Automatic frequency compensation (AFC)

Each CES shall have the capability for automatic frequency compensation of C-to-L link (shore-to-ship) and L-to-C link (ship-to-shore).

From an efficient spectrum utilization point of view, the shared AFC pilot scheme will be adopted in the INMARSAT system, reducing the number of pilots to three in each ocean region. All CESs will be assigned to an AFC geographical grouping: northern hemisphere, equatorial region and southern hemisphere. Within each group, a particular CES will be designated as the AFC reference station. Only this station transmits the AFC pilot carrier pair. All the other CESs within the group receive the AFC pilot carrier pair.

° Ship earth station list

Each CES shall maintain a list of SESs authorized or barred by INMARSAT to access the system.

ⓑ Access and Control

° Signaling channels

NCS transmits Common TDM carrier (common signaling channel) which is received by all CESs and SESs. Each CES transmits its own Local TDM carrier which includes the signaling channel and is received by NCS.

Each SES transmits the request carrier (request channel) on a basis of random access when the ship operator originates a call. Two frequency slots are designated for the request channel for ships. NCS also receives request carriers to collect the statistical data and to respond to a request message with non-existing CES ID. Signaling carriers are shown in Figure 5.3.2.8.

° Communications channels

SCPC-FM (Single Channel Per Carrier-Frequency Modulated) channels are used for transmission of voice, data or facsimile signals. For voice transmission, the compandor (compressor and expander) is applied to the SCPC-FM channel. This is effective to improve the subjective channel quality by reducing the background noise when no signal is transmitted.

Twenty-two 50-baud telex channels and a signaling channel are time division multiplexed in a Local TDM carrier for the shore-to-ship direction. The corresponding twenty-two 50-baud ship-to-shore channels are transmitted on a TDMA carrier in a single channel per burst mode.

A push-to-talk voice orderwire channel is provided among CESs in each satellite network. Communication carriers between CES and SES are shown in Figure 5.3.2.9.

° Channel assignment procedure

Each CES handles requests for a call received from ships on the request carrier or from shoreside parties on the terrestrial channel. Each service request is checked to ensure that the calling or called ship earth station is authorized to have access to the INMARSAT system.

In Figures 5.3.2.10 and 5.3.2.11, telex and telephone channel assignment procedures are shown. The request carrier is not used for the calls originating from the shoreside parties.

After the channel assignment has been completed, the subsequent signaling (in-band signalling) procedure is performed in the assigned communication channel. The typical in-band signaling procedures are shown in Figures 5.3.2.12 and 5.3.2.13.

. Telex channel assignment

For the telex call request, the addressed CES searches an idle channel at first. If a channel is available the CES sends an "assignment message 10_8" on the Local TDM carrier which will be received by NCS. NCS repeats the "assignment message 10_8" on the common signaling channel of the Common TDM carrier.

On reception of the repeated "assignment message 10_8" from NCS, the addressed CES and SES start transmission of telex in-band signaling messages on the TDM carrier and the corresponding TDMA burst carrier, respectively. NCS is not involved in the subsequent in-band signaling in the working channel.

The telex calls via the NCS collocated CES are handled by NCS in the same manner as for calls from another CES since no internal link for message transmission is permitted between NCS and the collocated CES.

NCS maintains a Busy Ship List and determines if an addressed SES is busy with another call. If the addressed SES is busy on the Busy Ship List, NCS does not repeat the "assignment message 10_8" from the CES, but transmits a "ship busy message 26_8" on the common signaling channel.

. Telephone channel assignment

For telephone call requests, the addressed CES transmits a "request-for-assignment message 20_8" to NCS on the Local TDM carrier if a voice channel trunk (including SCPC-FM Modems) is available.

On reception of the "request-for-assignment message 20_8", NCS selects an idle telephone channel from the common pool of assignable telephone channels in the network and transmits an "assignment message". Then the addressed SES is marked as busy in the Busy Ship List of NCS.

The corresponding CES and SES tune to the assigned telephone channel in response to the "assignment message 10_8". NCS is not involved in the subsequent in-band signaling in the SCPC-FM channel. If no telephone channel is available for assignment, NCS transmits a "congestion message 25_8". The telephone calls via the NCS collocated CES are handled by NCS in the same manner as for another CES.

. Clearing procedure

On completion of the normal in-band clearing sequence in the working channel, the CES transmits "notification of ship clearing message 21_8" to NCS as is shown in Figure 4.3.2.14. NCS removes the SES from the Busy Ship List in order to accept the following calls to/from that SES and makes the telephone channel status as idle in the case of a telephone call.

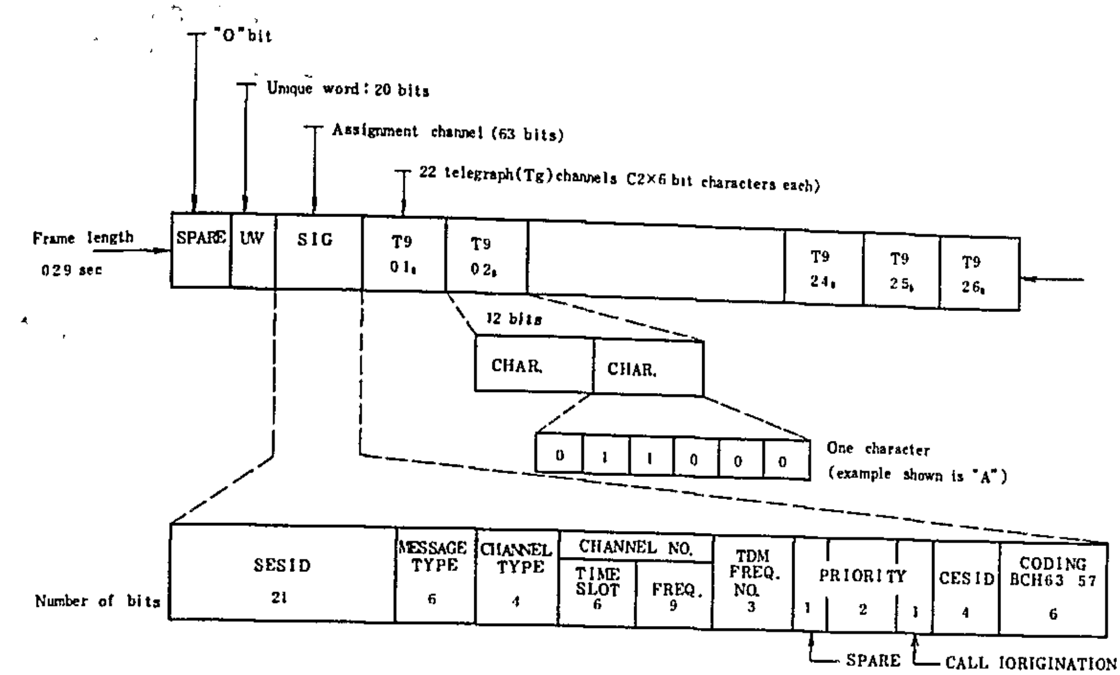


Fig. 5.3.2.5 TDM Channel Format

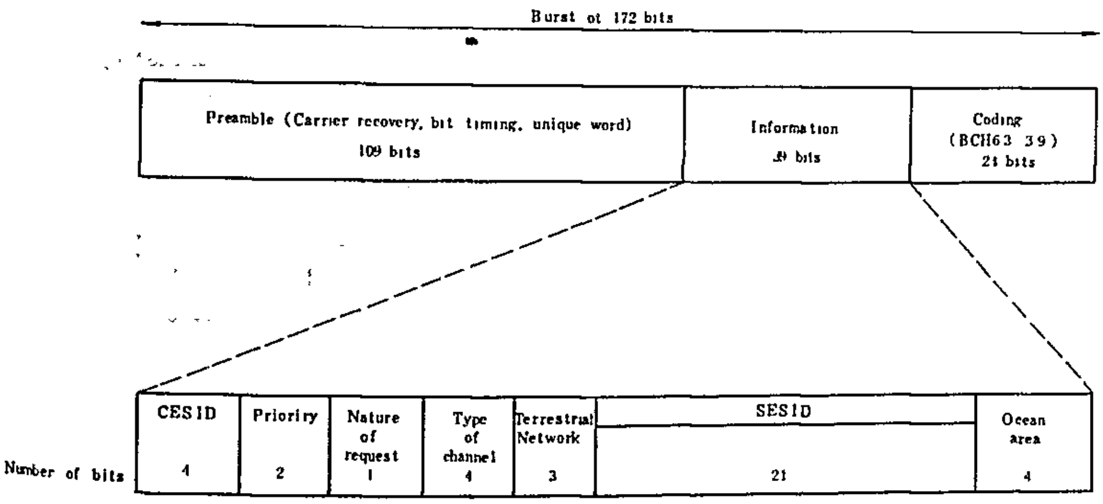


Fig. 5.3.2.6 Request Channel Format

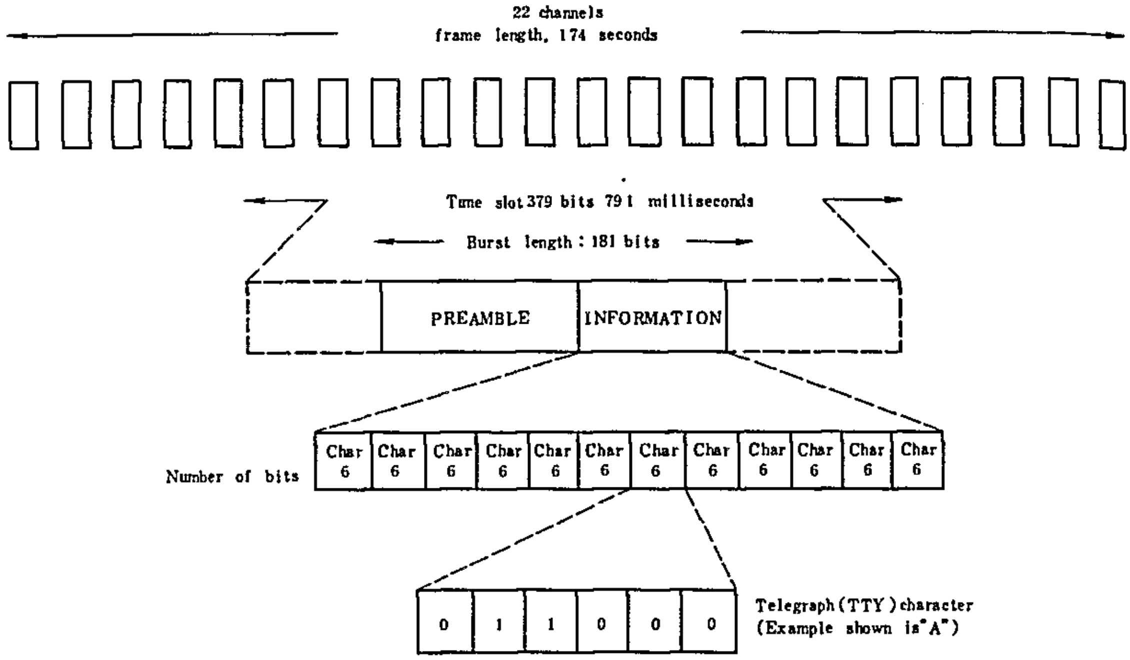
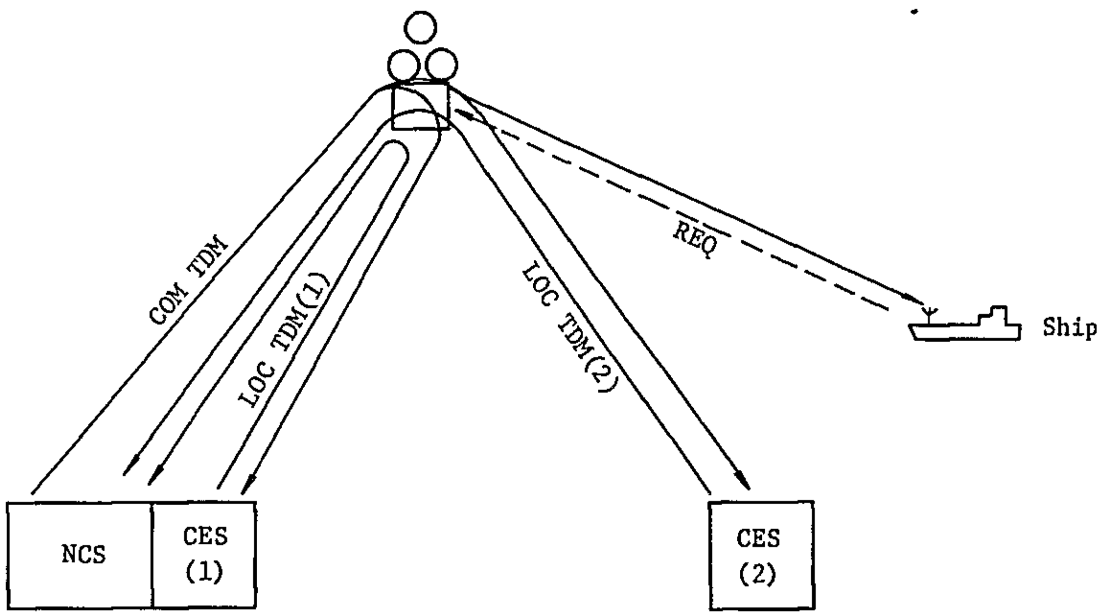
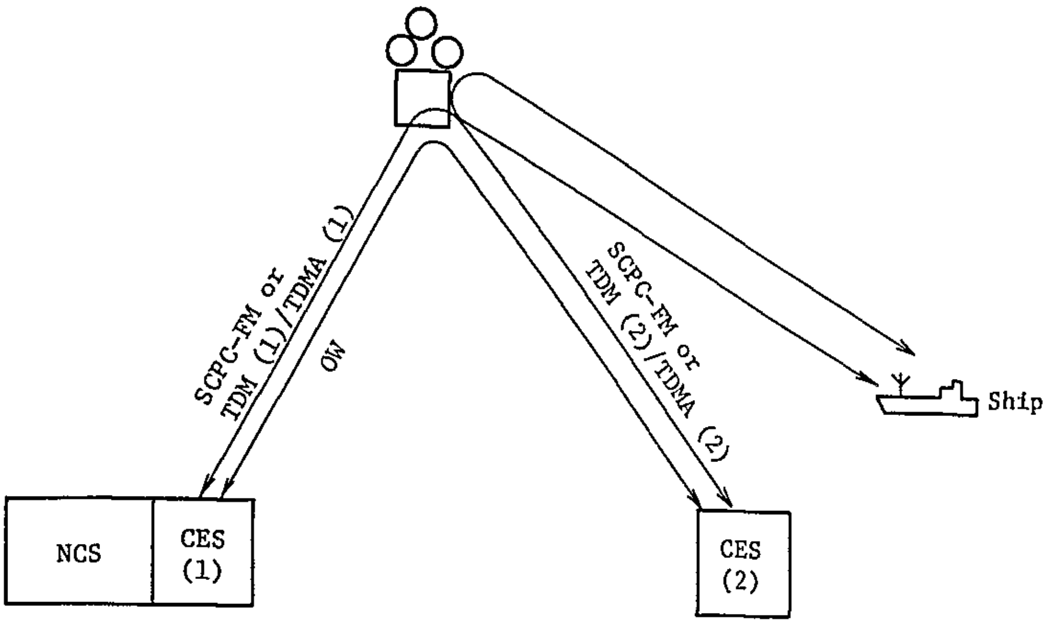


Fig. 5.3.2.7 TDMA Channel Format



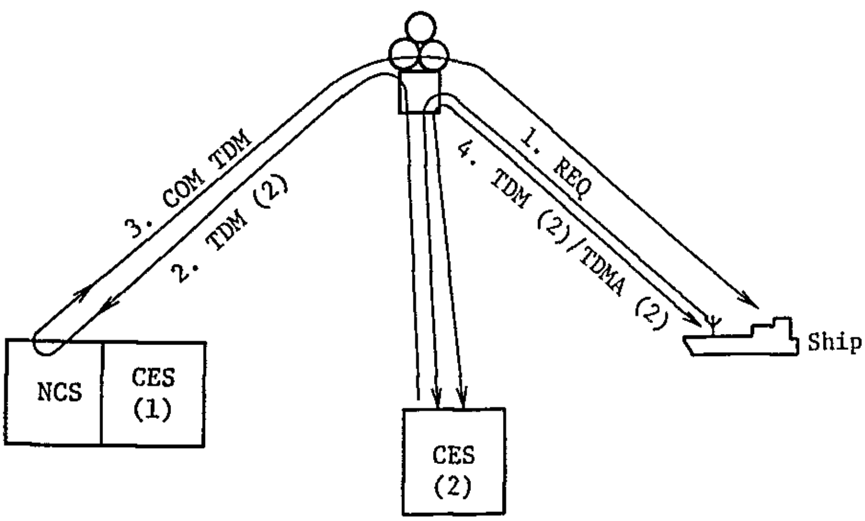
NCS: Network Coordination Station
CES: Coast Earth Station
COM TDM: Common TDM Carrier
LOC TDM: Local TDM Carrier
REQ: Request Carrier

Fig. 5.3.2.8 Signalling Carriers



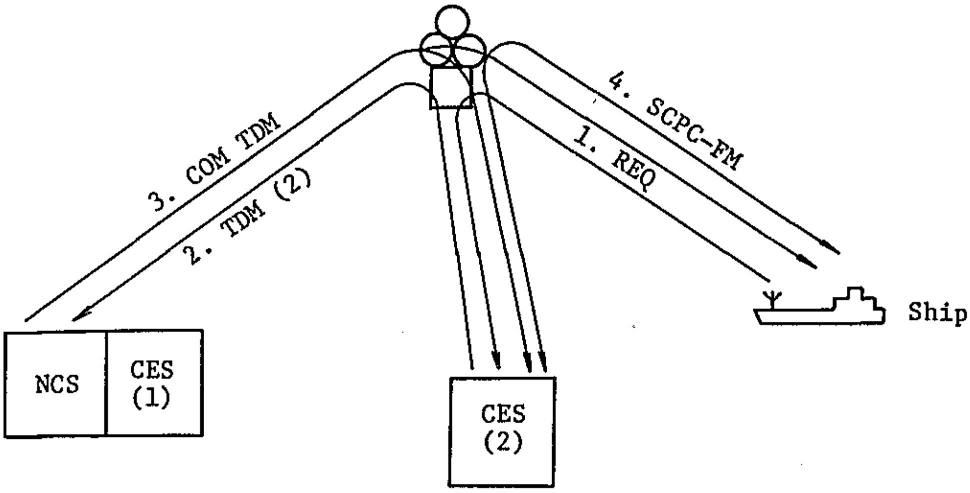
SCPC-FM: Telephone or Data Carrier
TDM, TDMA: Telex Carrier
OW: Voice Orderwire Carrier

Fig. 5.3.2.9 Communication Carriers



NCS repeats the telex channel assignment message from CES and controls the busy-ship list.

Fig. 5.3.2.10 Telex Call Set-up Procedure



NCS assigns a telephone channel in response to the request for assignment from CES and controls the busy-ship list and telephone channel list.

Fig. 5.3.2.11 Telephone Call Set-up Procedure

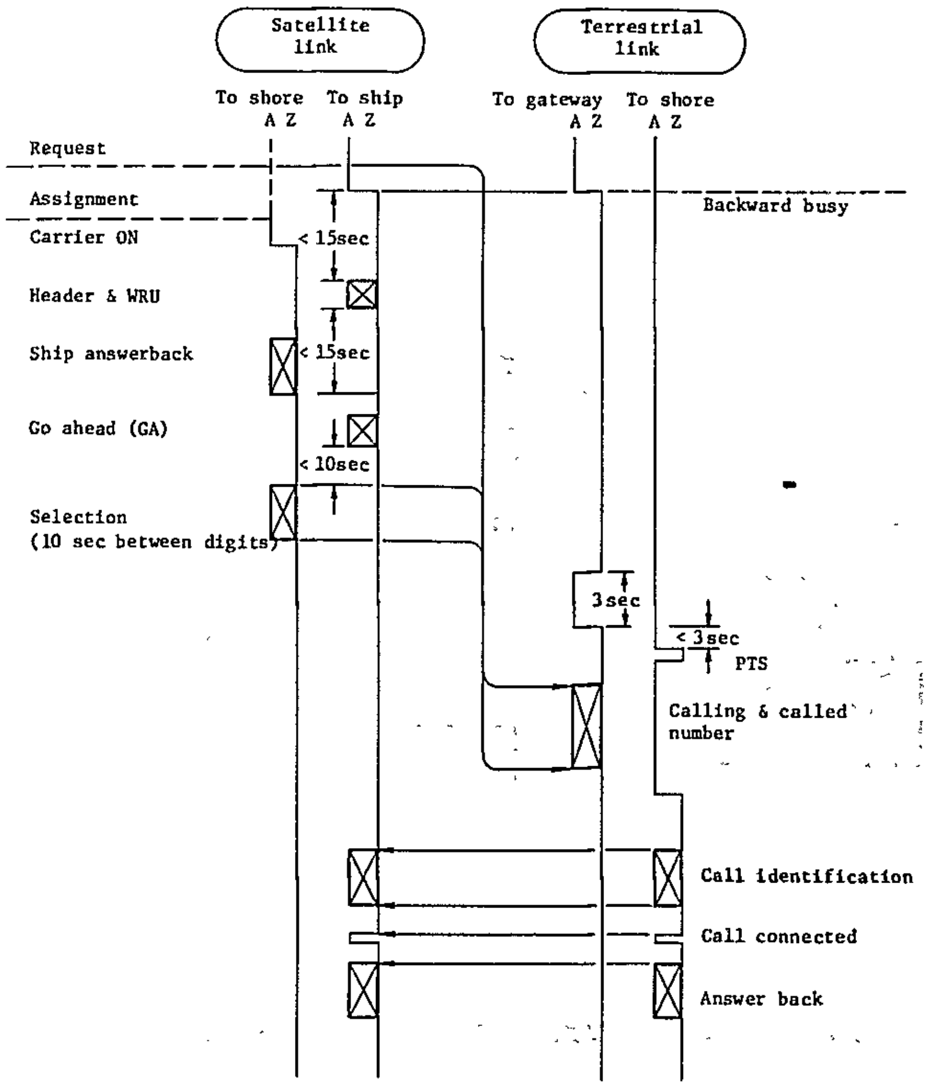


Fig. 5.3.2.12 In-band Telex Signalling (Ship-to-Shore)

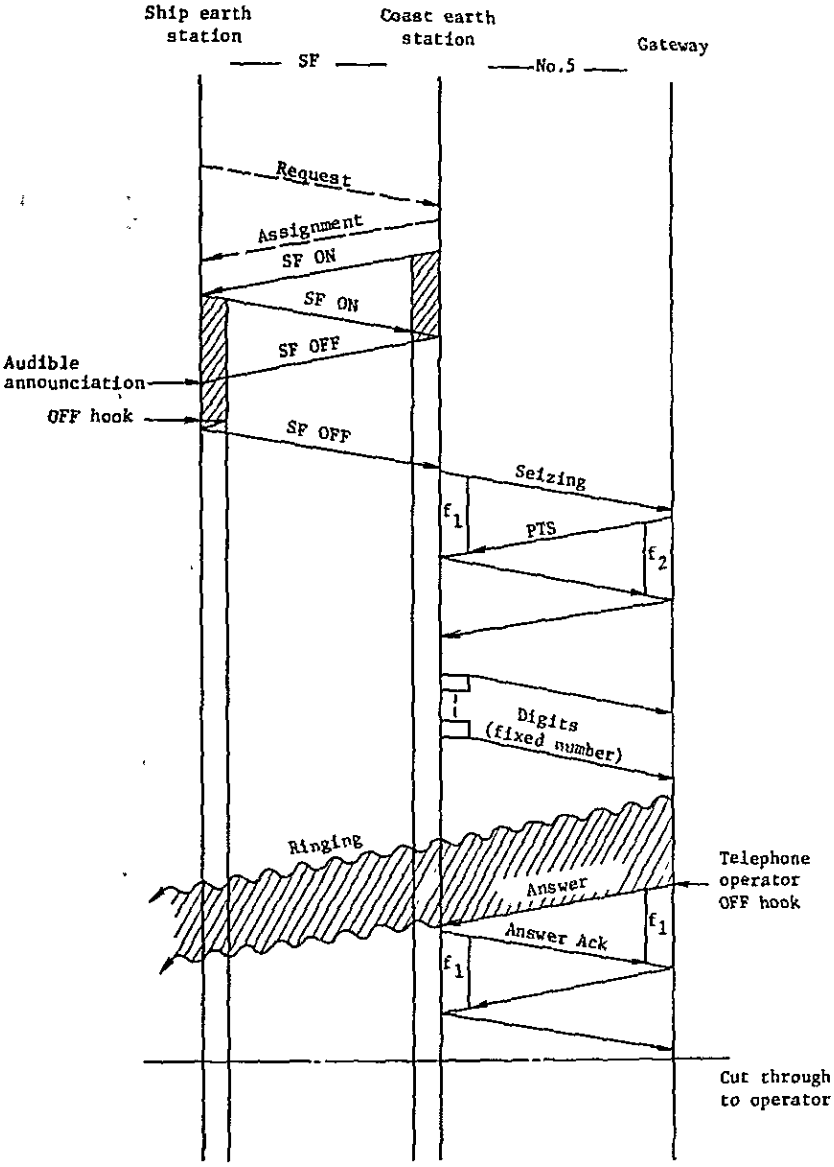
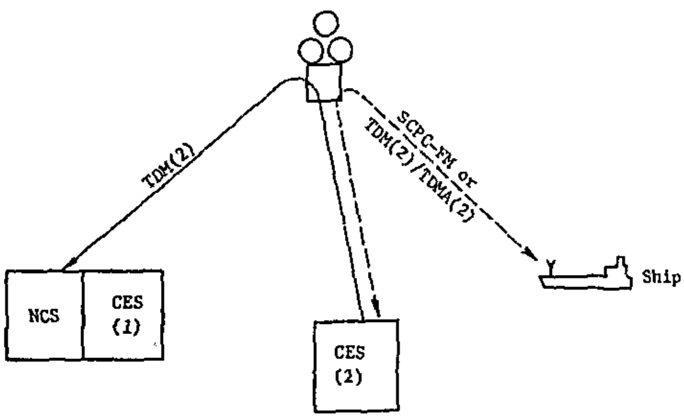


Fig. 5.3.2.13 In-band Telephone Signalling (Ship-to-Shore)



After clearing the communication channel CES sends "Notification of ship clearing" message to NCS. NCS controls busy-ship list and telephone channel list.

Fig. 5.3.2.14 Clearing Procedure

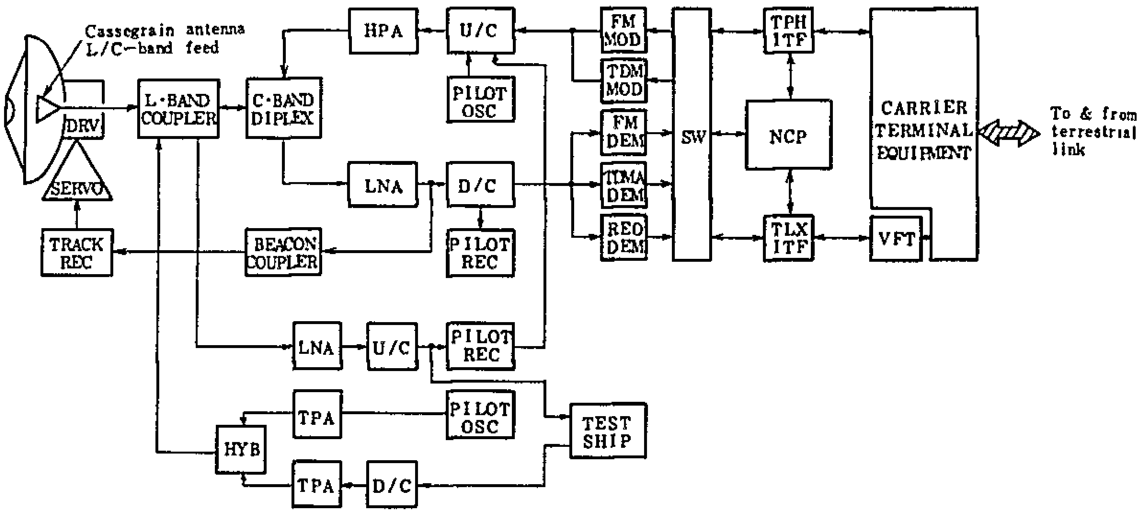


Fig. 5.3.2.15 Block Diagram of Coast Earth Station

Table 5.3.2.3 Radio Frequency Characteristics of Earth Stations

		Coast Earth Station				Ship Earth Station	
		C-Band		L-Band		L-Band	
		Transmit	Receive	Transmit	Receive	Transmit	Receive
Frequency (MHz)	From	(6410.0)* 6417.5	(4180.0)* 4192.5	(1626.5)* 1636.5	(1530.0)* 1535.5	1636.5	1535.0
	To	6425.5	4200.0	1644.0 (1646.5)*	1542.5 (1545.0)*	1645.0	1543.5
Polarization		RHCP	LHCP	RHCP		RHCP	
Axial Ratio		1.06	(1.06)*	1.3	(1.3)*	2 dB	
Antenna Gain (dBi)		54.0	50.0	29.5	29.0	-	
G/T (dBK)		32.0		2.0		-4.0	
EIRP (dBW)	Request TDM/TDMA	67.0 max.		36.0		36.0	
	Telephone	70.0 max.					
	High Speed Data			38.0		38.0	
	AFC Pilot	59.0 max.		27.0			

( )* --- Recommended value

Table 5.3.2.4 Modulation and Multiple Access Method

Channel	Modulation and multiple access	Remarks
Telephone	SCPC-FM	Max. Freqeuncy Deviation: 12 kHz 2:1 syllabic compandor used.
Telegraphy (Ship-to-Shore)	2ø PSK-TDMA	22 bursts per frame: 4,800 bps
(Shore-to-Ship)	2ø PSK-TDM	22 ch multiplexed: 1,200 bps
High Speed Data (Ship-to-Shore)	4ø PSK	Data rate: 56 kbps; 1/2 convolution code
Request	2ø PSK random access	Burst signal (172 bits): 4,800 bps
Assignment	2ø PSK-TDM	Pre-fixed to telex signal: 1,200 bps

Table 5.3.2.5 Major Performance Characteristics of INMARSAT Satellites

Satellite	Direction	G/T (dBK)	EIRP (dBW)	Shore-to-Ship Capacity (ch)
INTELSAT V MCS	Ship-to-Shore	-16	17.5 (Saturation)	30 (35)*
	Shore-to-Ship	-21	31.8	
MARECS	Ship-to-Shore	-15	14 (Effective)	40 (50)*
	Shore-to-Ship	-19	33.2	
MARISAT	Ship-to-Shore	-17.5	18 (Saturation)	4 (8)*
	Shore-to-Ship	-22	23	

Note: Listed values in least contract: Expected values are marked as ( )*.

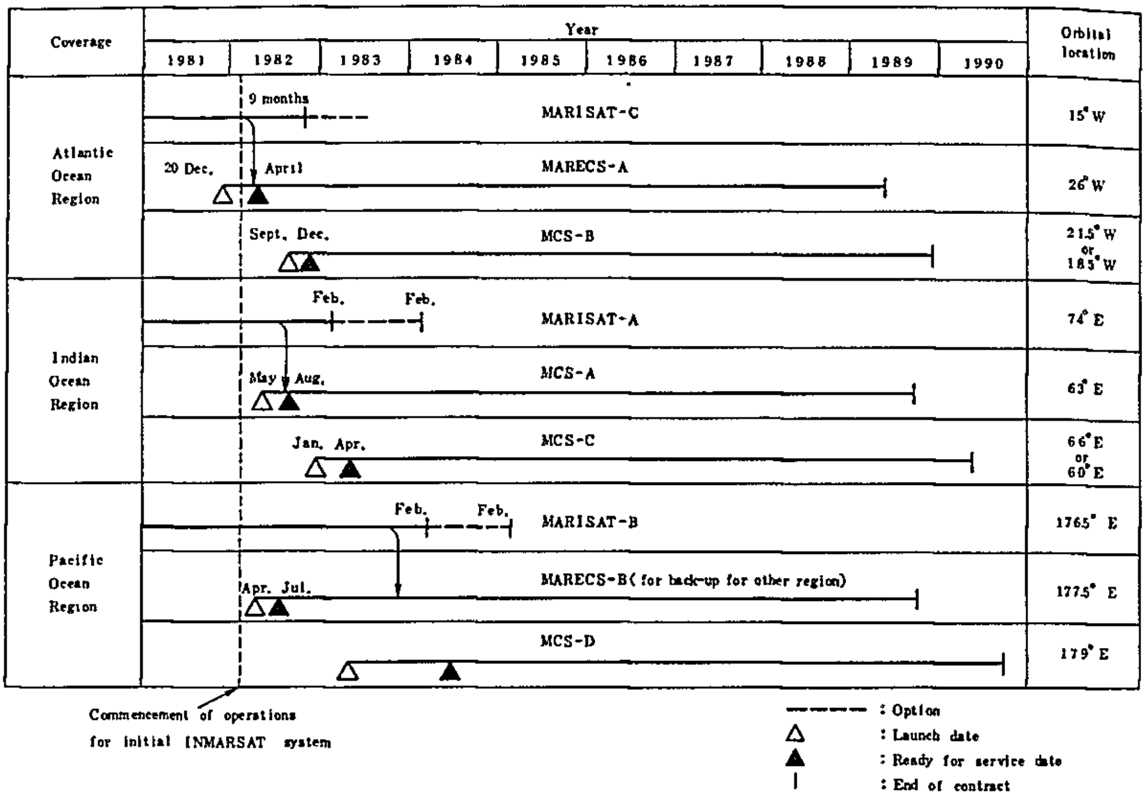


Fig. 5.3.2.16 Operational Plan of INMARSAT System

5.3.3 Submarine Cable Systems

As international submarine cable systems, Indonesia owns the Indonesia-Singapore Cable (I-S Cable) opened in 1980 and will own the Medan-Penang Cable when it is placed in service in 1983, and the Medan-Singapore Cable scheduled to be opened in 1984.

The submarine cable systems that require Indonesia to promote their installations are:

① Australia-Indonesia-Singapore Cable is to replace SEACOM (whose cable life is expected to end around 1987) and is planned to be opened in 1986.

② Medan-Colombo-Djibouti-Jeddah-France Cable is planned to be opened in 1985.

The demand forecast used in the master plan is for traffic to and from Indonesia and cannot be used to calculate cable capacities for the foregoing cables. Therefore, data at the Indian Ocean Data Gathering Meeting held in Sydney in 1982 has been used.

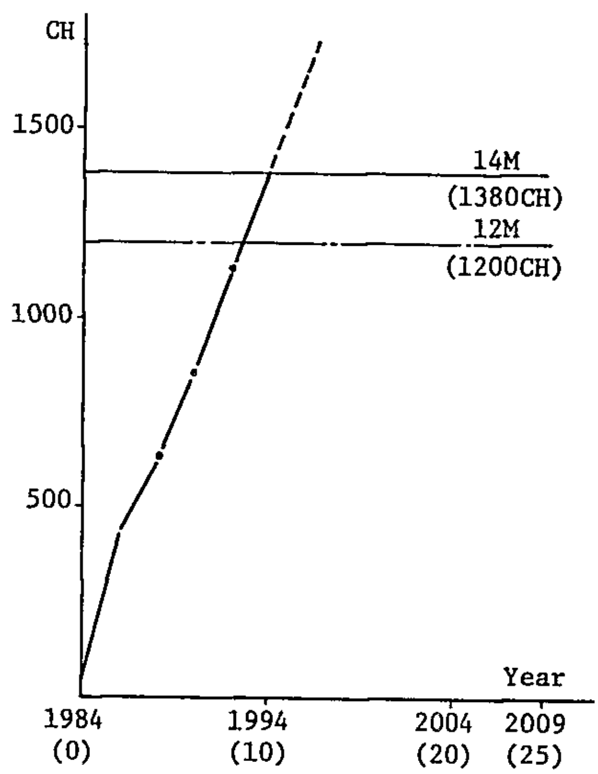
(1) Cable Capacities

The cable capacities have been decided based on the fill factor method (see Appendix 5.3.3-1).

① Australia-Indonesia Cable

The demand forecast at the Sydney meeting was as shown below.

Year / Channels	1984	1986	1988	1990	1992	1994
CH	43	423	616	856	1134	1385



Assuming the cable life to be 25 years, the fill factors when the individual cable systems were used were calculated.

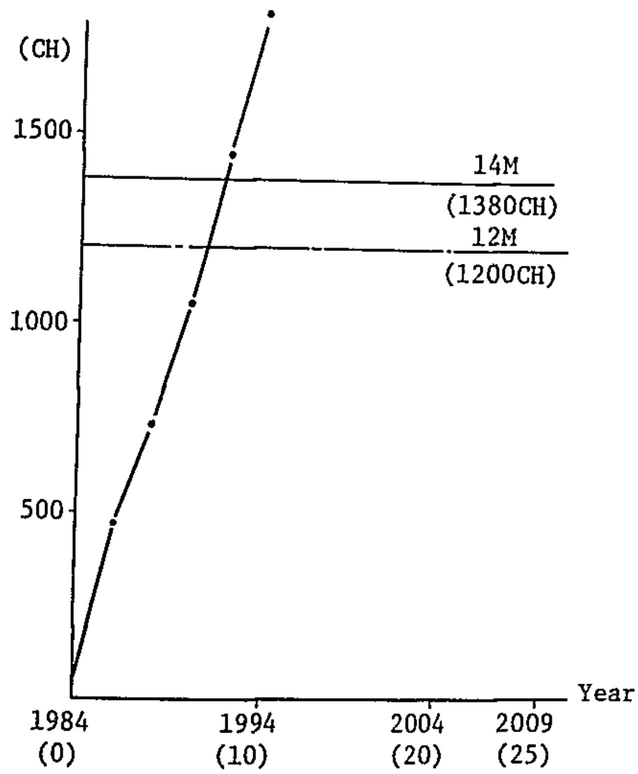
Cable System	Fill Factor	Circuit Capacity
CS-12M	0.82	1200 CH
NE (14M)	0.79	1380 CH
S-25	0.58	2580 CH

Normally, the fill factor at approximately 0.7 or 0.8 is desirable. Therefore, a 12 ∿ 14 M system is appropriate for the Australia-Jakarta cable.

② Jakarta-Singapore Cable

The demand forecast is shown in the following.

Channels \ Year	1984	1986	1988	1990	1992	1994
CH	41	465	728	1052	1441	1822



The fill factors when the individual cable systems were used would be as follows:

Cable System	Fill Factor	Circuit Capacity
CS-12M	0.85	1200 CH
NE (14M)	0.83	1380 CH
S-25	0.70	2580 CH

The 25 M system is slightly too large in capacity, and the 12 to 14 M system seems appropriate.

③ Medan-Colombo Cable

The cable is a section of the cable that will extend from Singapore to Medan, Colombo, Djibouti, Jeddah, and France via Arab countries. Circuit forecast data for the Medan-Colombo cable was submitted at the Sydney Meeting. However, the demand forecast is expected to change due to the MEDARABTEL plan. Under the circumstances, it has been assumed that this cable would open in 1987, and data at the Sydney Meeting has been used as a circuit forecast.

Year	1987	1989	1991	1993	1995	1997
CH	16	579	795	1038	1299	1483

The fill factors for the individual cable systems are shown in the following:

Cable System	Fill Factor	Circuit Capacity
CS-12M	0.83	1200 CH
NE (14M)	0.81	1380 CH
S-25	0.65	2580 CH

The 12 to 14 M system seems to be appropriate.

(2) Route Lengths

A cable route has to be selected referring to ocean survey data of previous ocean surveys, marine charts, and ocean data. Due to a lack of sufficient data, the cable routes have been selected using marine charts for this master plan.

① Australia-Indonesia Cable

Two cable routes can be considered for this cable. One route is the west route to be installed from Jakarta to Perth through the Sunda Strait. The other is the east route to be installed from Jakarta to Perth through the Java and Flores Seas. In connection with the east route, the Java Sea is shallow with a water depth of approximately 50 m and has a continental shelf. The sea is known for active shrimp fishing, and this sea region should be avoided from the standpoint also of protecting the cable against fishing activities.

The problems with the west route are the Sunda Strait and Java Trench. The Sunda Strait is located between the Indian Ocean and Java Sea. Seawater flows at a speed of about 3.5 kts affected by tidal currents. Because the water depth is shallow, seawater is estimated to flow on the sea bottoms also at about the same speed. The cable on a sea bottom is to be abraded by seawater, and cable faults caused by wear can also be considered. The cable in this section has to be armored to protect it against abrasion.

The Java Trench is where the Australian plate (see Appendix 5.3.3-2) sinks under the Eurasian plate, and its sea-bottom topographical feature is believed to be complex. In this sea region, the cable route should be selected perpendicular to the sea bottom contour. A sufficient survey of this sea region will be required during an ocean survey.

The sea region in Western Australia extending from the Java Trench to Perth abounds with sea mountains. The route has been selected after choosing sections of these sea mountains which are as flat as possible.

Based on the foregoing, an alternate course (A/C point) for the possible route is shown in Table 5.3.3.1. The calculation formula shown in Appendix 5.3.3-3 has been used to calculate the route distances.

Position	Latitude	Longitude	Distance (n.m)
JAKARTA	6°07.28'	106°50.40'	
			15.72
A/C-1	5°52.00'	106°46.40'	
			26.97
A/C-2	5°43.50'	106°20.70'	
			18.81
A/C-3	5°49.50'	106°02.80'	
			95.31
A/C-4	6°48.00'	104°47.00'	
			153.88
A/C-5	9°11.00'	103°48.00'	
			108.65
A/C-6	11°00.00'	103°42.00'	
			242.75
A/C-7	15°00.00'	104°26.00'	
			359.90
A/C-8	20°50.00'	106°00.00'	
			234.56
A/C-9	24°40.00'	106°54.00'	
			426.80
A/C-10	30°36.00'	111°21.00'	
			240.21
PERTH	31°57.00'	115°45.00'	
		Total	1923.56

(1 n.m = 1,852 m)

Table 5.3.3.1 Australia-Indonesia Cable

② Jakarta-Singapore Cable

The sea region between Jakarta and Singapore is shallow, its maximum water depth being approximately 50 m. The sea region contains a large number of islands and shoals. The question in selecting the 2nd I-S Cable will be where the landing site for Singapore is to be.

The landing site in Singapore for the 1st I-S Cable already has the 1st I-S, MST, and SEACOM Cables. The question is whether or not there is a enough space to install the 2nd I-S Cable. When selecting the landing site for the 2nd I-S Cable on the Singapore side to be the landing station for the Medan-Singapore Cable (west of the Singapore Island), the 2nd I-S Cable has to be a route that passes through the islands near the Bintan and Batam Islands. There are straits around these islands for ship navigation, and a cable can be installed. However, if dredging is to be undertaken in that area to deepen the straits, it may cause cable damage.

These questions should be fully studied. In this plan, the two proposals will be studied.

The first plan is for a route parallel to the 1st I-S Cable. The 2nd proposal is a cable route that passes along the Durian, Berhala, and Banka Straits. The cable routes under these proposals are shown in Tables 5.3.3.2 and 5.3.3.3.

Table 5.3.3.2 2nd Jakarta-Singapore Cable (Plan-1)

Position	Latitude	Longitude	Distance (n.m)
JAKARTA	6°07.28'	106°50.40'	
			7.31
A/C-1	6°00.00' (S)	106°49.40' (E)	
			60.78
A/C-2	5°00.00'	107°00.80'	
			71.71
A/C-3	3°51.90'	107°24.30'	
			24.49
A/C-4	3°27.30'	107°25.00'	
			15.60
A/C-5	3°14.50'	107°16.00'	
			22.50
A/C-6	2°52.50'	107°10.80'	
			49.38
A/C-7	2°11.50'	106°43.00'	
			11.49
A/C-8	2°00.00'	106°42.00'	
			73.03
A/C-9	1°00.00'	106°00.00'	
			109.41
A/C-10	0°39.50' (N)	105°13.50'	
			33.72
A/C-11	1°06.30'	104°52.90'	
			21.83
A/C-12	1°16.30'	104°33.50'	
			7.12
A/C-13	1°16.00'	104°26.40'	
			4.30
A/C-14	1°13.80'	104°22.70'	
			25.65
A/C-15	1°13.00'	103°57.10'	
			5.68
SINGAPORE	1°17.75'	103°53.95'	
		Total	544.0

Table 5.3.3.3   2nd Jakarta-Singapore Cable (Plan-2)

Position	Latitude	Longitude	Distance (n.m)
JAKARTA	6°07.28' (S)	106°50.40' (E)	
			16.86
A/C-1	5°50.55'	106°47.70'	
			110.03
A/C-2	4°00.00'	106°45.60'	
			53.29
A/C-3	3°10.40'	106°25.50'	
			38.07
A/C-4	2°50.50'	105°53.00'	
			32.74
A/C-5	2°20.20'	105°40.25'	
			24.24
A/C-6	2°16.60'	105°16.30'	
			15.03
A/C-7	2°08.70'	105°03.50'	
			54.87
A/C-8	1°15.10	104°50.60'	
			50.16
A/C-9	0°48.60'	104°08.00'	
			16.24
A/C-10	0°34.40'	104°00.00'	
			50.89
A/C-11	0°16.50' (N)	103°55.00'	
			13.41
A/C-12	0°27.30' (N)	103°47.00'	
			11.57
A/C-13	0°38.50'	103°43.90'	
			8.54
A/C-14	0°43.40'	103°36.90'	
			24.46
A/C-15	1°07.60'	103°32.60'	
			13.47
SINGAPORE	1°20.00'	103°38.00'	
		Total	533.87

③ Medan-Colombo Cable

The route for this cable reaches Colombo from Medan after passing through the Straits of Malacca, between Sumatra and Nicobar Islands, and through the Indian Ocean.

The problem with this route is offshore oil fields north of Sumatra. Oil field and pipēline positions, as well as the pipeline installation method, have to be studied in advance. The A/C points selected as a possible cable route are shown in Table 5.3.3.4.

Table 5.3.3.4 Medan-Colombo Cable

Position	Latitude	Longitude	Distance (n.m)
MEDAN	3°48.00'	98°45.00'	
			38.65
A/C-1	4°26.00'	98°53.00'	
			127.12
A/C-2	5°50.00'	97°17.00'	
			134.08
A/C-3	6°21.00'	95°06.00'	
			888.97
A/C-4	5°20.00'	80°16.00'	
			77.88
A/C-5	6°26.00	79°34.00'	
			32.96
COLOMBO	6°55.00'	79°50.00'	
		Total	1299.66

(3) Cable Lengths

After deciding a cable route, a bottom profile along the cable route is made, and sea-bottom incline angles at various locations are calculated. In order for the submarine cable to be not suspended in the sea, extra cable lengths, namely, cable slack, are calculated in excess of the route length where there are inclinations, and the total cable length is calculated.

There are two cable installation methods. One method is to install cables in the usual way. The other method is to bury them. During normal cable laying, cable slack is controlled to match the sea-bottom inclination angles. In the burying method, cable control is not possible, and cable slack in this laying method differs fundamentally with that of the normal installation method. A large factor in determining cable slack in burying a cable is the route deviation showing how much the cable has deviated from the planned cable route during actual laying work.

A cable slack of 1% is needed with respect to the cable route when a precision positionning system is equipped on board a cable ship. A cable slack of within 1.5% is needed even with a cable ship having a standard positionning system.

(1) Australia-Indonesia Cable

Due to lack of cable route information, only approximate values could be obtained. The water depth from Jakarta to A/C-3 point is shallow, and the cable slack has been calculated to be 1.5% considering the burying of the cable.

The sea region from A/C-3 to Perth has an average sea-bottom inclination angle of 3°, and a cable slack of 3% has been calculated.

Allowing for course deviation by the cable ship as well as the cable length (twice the water depth) needed at the final cable junction point, etc., 1% is added to the cable length. Totaling them, a cable length of 1998.96 n.m will be required.

$$1{,}015 \times 61.5 \text{ n.m} + 1.04 \times 1862.06 \text{ n.m} = 1998.96 \text{ n.m}$$

(2) Jakarta-Singapore Cable

A cable slack of 1.5% has to be allowed for this cable which will be buried in the sea bottom for its entire length.

Therefore, in the first proposal, the total cable length will be 1.015 x 544 n.m = 552.16 n.m, and in the second proposal, 1.015 x 533.87 n.m = 541.88 n.m.

③ Medan-Colombo Cable

The cable slack for the cable from Medan to sea regions up to 200 m in water depth should be 1.5% considering that the cable will be buried in those sections. However, the cable will not be buried at points where the cable crosses pipelines. Cable slack for deep-sea sections is uniformly 3%. Therefore, the total cable length will be:

1.015 x 60 n.m + 1.03 x 1239.66 n.m = 1337.75 n.m

(4) Installation Cost

When making an estimate for installation of a submarine cable, a detailed survey of cable installation costs in cable projects in the past broken down by individual expense is made. Such factors as wholesale price indices of all industrial products, wage and statistics indexes, wage increase ratios, and foreign exchange rates should be considered each year.

In the case of an existing submarine coaxial cable, an empirical subtriplicate law based on experience can be utilized for calculation of approximate values of cost. Assuming an f_o MHz cable system with an installation cost of A_o, the installation cost A_n when newly installing an f_n MHz system can be expressed by the following mathematical formula:

$$A_n = A_o \sqrt[3]{\frac{f_n}{f_o}}$$

However, the installation cost (A_o) can be divided roughly into the following three categories.

(i) Variable cost which differs depending on the cable size, length, and type.

Variable cost = (cost per unit length using 100% lightweight cable) x (total cable length) x (cost penalty factor for using armoured cable)

The variable cost includes the submerged plant, surveying, and laying.

(ii) The terminal equipment and land cable costs are not related to the submarine cable length and are estimated to be approximately US$5 million for a 12 ∿ 14 MHz system.

(iii) The cable station cost (land, station building, and electric power equipment) differs depending on the situation in each country and is assumed to be approximately US$5 million (for two stations). The relative cost ratio for a cable station is shown in the following.

No. of cable segments terminated in the station	1	2	3
Relative cost	1	1.5	2.0

① Australia-Indonesia Cable

The cable types and lengths to be used in this cable are shown in the following:

Type of cable	Length n.m	Relative cost per n.m
Lightweight (1.5")	1,774.06	1.0
Simple Armoured	129	1.7
Double Armoured	18.5	3.5
Double Armoured (Screened)	2.0	5.0
	1,923.56	

Data of previous cable systems (as recent as possible) may be used as the variable cost. The plan has used data of the ANZCAN Cable, the variable cost of which has been reported to be approximately US$45,000 per nautical mile.

Therefore, the installation cost of the Australia-Indonesia Cable based on the mathematical formula contained in Appendix 5.3.3-4 will be:

° Variable cost = 0.55 x 45,000 x 1,998.96 + 0.45 x 45,000 x 1,998.96 x (1,849.46 + 1.7 x 129 + 3.5 x 18.5 + 5.0 x 2.0)/1,998.96
= US$92.9M

° Terminal equipment + land cable cost = US$5M

° Cable station cost = US$5M

Total cable system cost = US$102.9M (1984 prices)

(2) Jakarta-Singapore Cable

The cable types and lengths to be used in this cable system are described in the following:

(Proposal 1)

Type of cable	Length n.m	Relative cost per n.m
Single Armoured	537.16	2.3
Double Armoured	12.0	3.5
Double Armoured (Screened)	3.0	5.0
	552.16	

(Proposal 2)

Type of cable	Length n.m	Relative cost per n.m
Single Armoured	289.88	2.3
Double Armoured	249.0	3.5
Double Armoured (Screened)	3.0	5.0
	541.88	

The cable installation costs for the two proposals are:

Proposal 1 US$49.8 million
Proposal 2 US$54.9 million

Comparing the two proposals, Proposal 1 is better in terms of both technology and economy, even though it involves the problem of finding a suitable landing station in Singapore.

③ Medan-Colombo Plan

The cable types and lengths to be used in this system are described in the following:

Type of cable	Length n.m	Relative cost per n.m
Lightweight	1,275.75	1.0
Single Armoured	20	2.3
Double Armoured	40	3.5
Double Armoured	2	5.0
(Screened	1,337.75	

The cable installation cost is estimated to be US$94.5 million.

5.3.4 Transmission Path Between Boundary Station and Gateway

To smoothly handle Indonesia's increasing international traffic, P.T. Indosat has planned the following projects.

① 1984 Introduction of TDMA/DSI for the Indian Ocean Satellite

② 1985 Construction of the New Jakarta Gateway

③ 1986 Submarine cable linking Australia ∿ Indonesia ∿ Singapore

The existing transmission path between the boundary station and gateway has to be reviewed to accomplish these projects.

The Jakarta international switching equipment is accommodated in the Gambir office. To handle the increasing international traffic, a new gateway has to be built in the location where the new digital switching system will be installed. Indonesia has the Australia ∿ Indonesia ∿ Singapore submarine cable plan. However, there is no space in the existing Ancol landing station to accommodate the required terminal equipment, and a new landing station will have to be built.

Regarding satellite communications, TDMA/DSI will be introduced with the Indian Ocean satellite during the second half of 1984, and the existing microwave tie-line between the Jatiluhur Earth Station and the Jakarta Gateway requires consideration. The tie-line between the gateway and boundary station has been studied as described in the following.

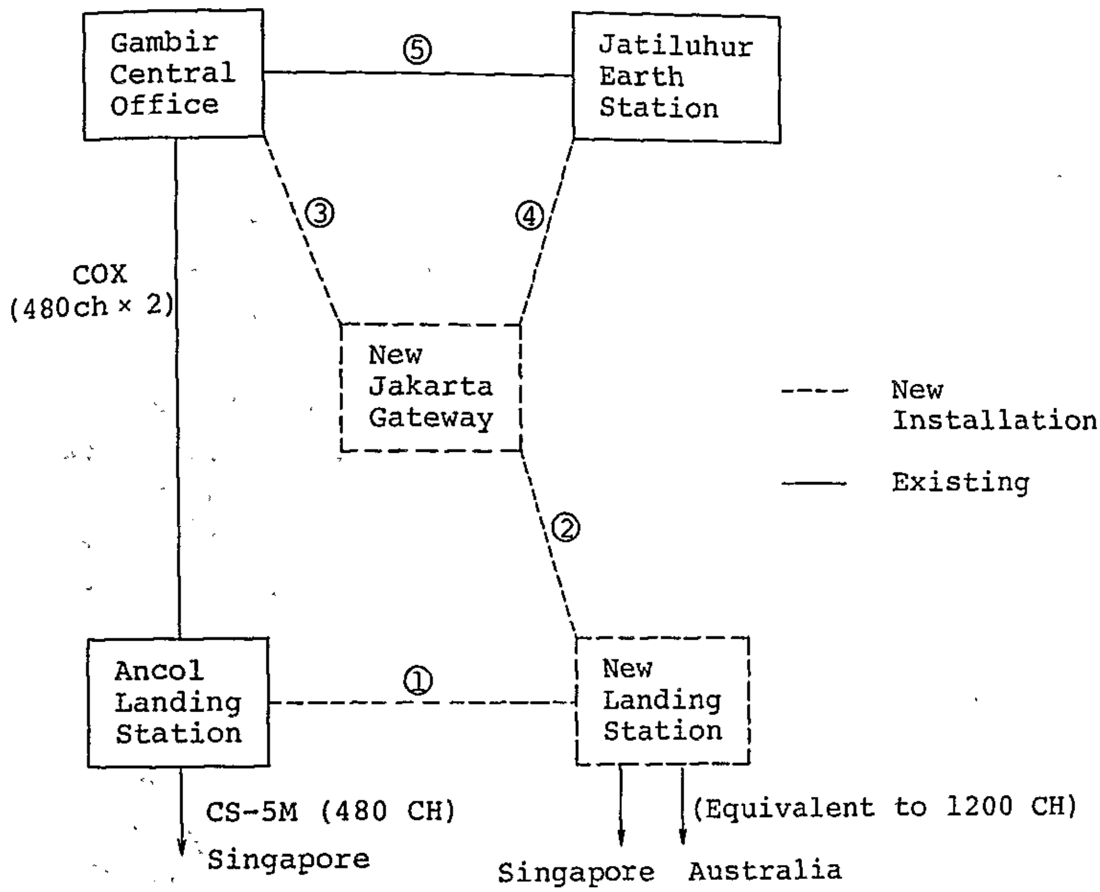
(1) Conditions

a. The switching system for the New Jakarta Gateway will be digital.

b. After constructing the New Jakarta Gateway, the switching equipment in the Gambir Office will back up the new Jakarta switching system.

c. A new landing station will be built for the Australia ∿ Indonesia and second Indonesia ∿ Singapore submarine cables.

(2) Transmission Path and System



i) Transmission Path ①

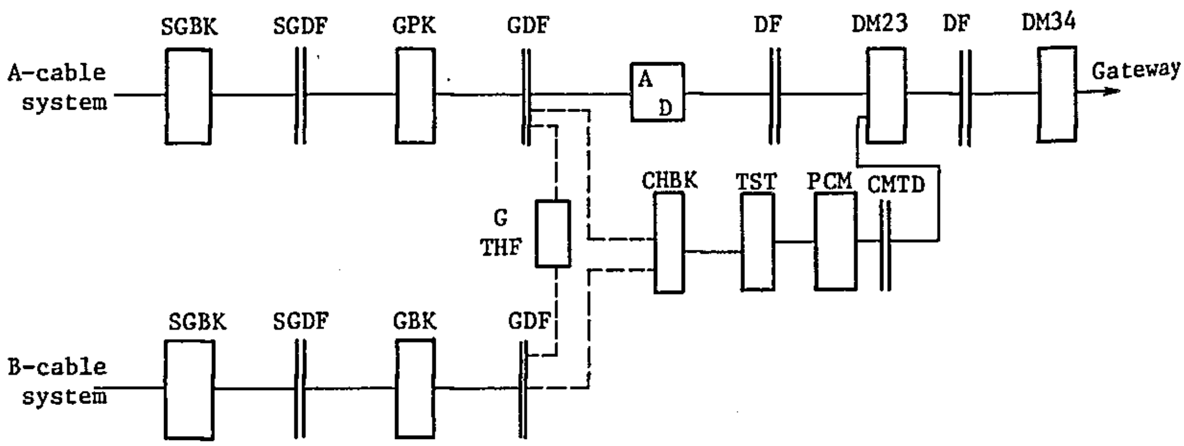
The link between the existing Ancol Landing Office and the new landing station will be connected by analog microwave or coaxial cable channels.

ii) Transmission Path ②

A digital switching system will be installed in the New Jakarta Gateway. As the cable system is analog, an A/D conversion facility will have to be installed in the landing station or gateway.

The location for an A/D conversion facility depends on whether the transmission path ② is analog or digital. The A/D conversion facility will be installed in the landing station when the transmission path ② is digital while it will be installed in the gateway when the path is analog. Regardless of whether the transmission path is digital or analog, the structure of the A/D conversion facility in the gateway or landing station will not differ greatly. Consideration is required here on what portion of traffic (of the Australia ∿ Indonesia ∿ Singapore cable) will have group or channel connection in Indonesia, and the maintenance and operation mode. The scale of the A/D conversion facility should be decided depending on this, and the maintenance and operation mode will differ.

When A/D conversion is performed at the group level after making group or channel connection in the landing station (see the diagram in the following), for example, the gateway will not be able to perform tests between gateways at SG and G levels.



Therefore, intergateway tests that have been performed by the gateways in the past will be performed by the landing station.

On the other hand, intergateway tests can continuously be performed when A/D conversion at the G level is performed by the gateways.

In this light, the problem with the installation of an A/D conversion facility will be one of maintenance and operation. Therefore, unless there are maintenance and operational problems, the transmission path should be digitized.

iii) Transmission Path (3)

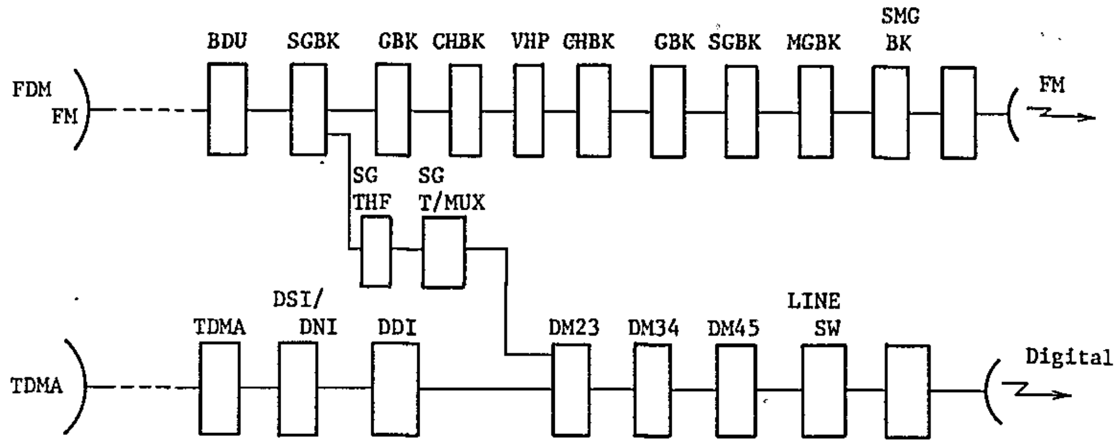
This requires consultation with PERUMTEL. If PERUMTEL plans to install digital switching systems in the near future, a digital tansmission path should be installed. However, if analog switching equipment will remain over a long period of time, an A/D conversion facility should be installed on the PERUMTEL side.

iv) Transmission Path (4)

Transmission path (4) shows a digital microwave tie-line between the Jatiluhur Earth Station and the New Jakarta Gateway, and transmission path (5) shows the existing analog microwave tie-line.

TDMA/DSI will be introduced with the Indian Ocean satellite beginning with the third Quarter (preoperation) of 1984. However, both FDM and TDMA will be used for the present.

Therefore, an FDM/TDM conversion facility will be needed in the earth station. One example is shown in the diagram appearing in the following. Utilizing this system configuration, the existing FM microwave channels can also be used to back up digital microwave channels.



FDM
FM
BDU
SGBK
GBK
CHBK
VHP
GHBK
GBK
SGBK
MGBK
SMG
BK
FM
SG
THF
SG
T/MUX
TDMA
TDMA
DSI/
DNI
DDI
DM23
DM34
DM45
LINE
SW
Digital

5.4 Study on the Third Gateway

According to the planning described in the former sections, two gateways are scheduled to exist in the Indonesian International network in 1985. As the next step, the third gateway should be taken into consideration in the planning until the year 2,000. The following is a case study on this subject.

5.4.1 General Requirements for an International Gateway

The establishment of a new gateway should be planned so as to economize the communication cost by utlizing communication resources efficiently and finally to produce benefits to users. For this purpose following points should be studied.

(1) Traffic demands

When a new gateway is established, it should cover a region where we can have a good prospect for considerable amount of traffic and revenue. If the international telecommunication facilities in the region is not sufficiently developed and potential demands are expected due to prosperous trading and industrial activities, the establishment of a new gateway sometimes can motivate an increase in customers' demands.

(2) Link with domestic network

If P.T. Indosat exchanges are not to accommodate directly subscriber lines of telephone nor telex, they do not have to be strictly situated in the center of customer distribution. Rather, it should be located close to the main route of domestic communication.

(3) Provision of international circuits and terrestrial links

A gateway is generally supposed to have multiple international connections which go through a submarine cable landing station and/or a satellite station via terrestrial links.

Accordingly it should be situated in a geographically suitable location from this viewpoint, that is:

i) to have multiple international connections
ii) to be not far from boundary stations

(4) Enhancement of network dependability

The addition of a new gateway is sometimes aimed at the enhancement of network dependability or countermeasures for some emergency, e.g. earthquake, etc. In this case, the new gateway should be geographically distant enough from other gateways, so as not to be affected by the same cause of disturbance.

(5) Effect on marketing strategy and service enhancement

In regard to marketing, effects of the establishment of the third gateway should be studied on the following possibilities:

i) if a new exchange brings to P.T. Indosat a tight relation with customers in its new service area.
ii) if the establishment of a new exchange activates marketing activity for international services in the service area.
iii) if the activated marketing activity associates increased profits.
iv) if the third gateway leads to a prosperous estimation in profits and expenses.

Even if iv) cannot be met, the establishment of a new gateway may be taken into consideration for the sake of social and economical development of the service area.

(6) Financial analysis

From the viewpoint of management, the cost of a new gateway should be well balanced in the following items:

a) Revenue from
   i) Major services : Telephone and telex
   ii) Others

b) Investment cost

i) Transmission systems such as submarine cables, satellite station, terrestrial links.

ii) Switching systems and associated equipments

iii) Building, land, etc.

c) Operating cost

i) Payment for domestic communication charges

ii) Cost increase due to the division of international communication links into plural groups

iii) Operational cost

iv) Maintenance cost

5.4.2 Case Study on Surabaya Gateway

Since two gateways are to be established in two major cities, Jakarta and Medan, the next possibility will be found in the third largest city, Surabaya. This city is considered to meet the requirements described in the previous section. In this section a study is made by following each point of Section 5.4.1

(1) Traffic demands

Since Surabaya has geographical advantages and is a city historically active in commerce, it is considered to have sufficient potential demands for international communication. The introduction of the third gateway in this area will give a keen impact and newly awake the potential demands. The basis of estimated demand increase for telephone and telex will be as follows.

	Telephone	Telex
First five years	3 times increase (30%/year)	2.5 times increase (20%/year)
Second five years	2.5 times increase (20%/year)	Twice increase (15%/year)

Actual values are illustrated in Fig. 5.4.2.1. Third gateway is scheduled to be established in 1990 due to the environmental condition described in Paragraph (2).

(2) Link with domestic network

As the PERUMTEL network is well established, e.g. tandem exchanges of telephone and telex are already installed, no serious difficulty is foreseen in setting up tie lines between a new exchange and PERUMTEL exchanges.

In addition to this, a plan on the telecommunications network development in the eastern part of Indonesia has been studied (See Reference (5)). According to this plan, the first step of modernization for the network in this region will be completed in 1990, and the main route of the network of this region will be all linked with Surabaya.

Therefore, Surabaya is evaluated to a suitable location for the third gateway to be linked with domestic network.

(3) Provision of international circuits and terrestrial links

Since no international connection has not been visualized in this region, some transmission system should be introduced. Without international connections it will be difficult to justify the establishment of a new gateway in this city.

Regarding this point, there are two possible cases in envisaging the type of gateway. (See Fig. 5.4.2.2)

Case A : Concentrator type exchanges are installed without international circuits.

Case B : International transit switches are installed with moderate number of international circuits and charging function.

Since Indonesia is a large country and a long distance exists between Jakarta and Surabaya, direct interconnections with foreign countries are more efficient and Case B is more recommendable.

In order to avoid the cost increase caused by splitting international circuits, only major routes with a large number of circuits should be fractioned and accommodated in Surabaya. According to the information obtained so far, a submarine cable will be difficult to be landed on Surabaya. The satellite is only one choice to realize the setting-up of international connections.

Satellite links should be set up for POR and IOR, considering accesses to major countries. The network configuration is shown in Fig. 5.4.2.3. The increase in the number of circuits for telephone and telex is illustrated in Fig. 5.4.2.4 and Fig. 5.4.2.5 respectively.

(4) Enhancement of network dependability

Since Surabaya is approximately 670 km east to Jakarta, and can remain undisturbed even in case of emergency in other two cities, it will meet this requirement (3).

Presently the international telecommunications traffic is excessively concentrated in Jakarta. The establishment of Surabaya exchange enables the distribution of international traffic in a balanced manner among three gateways. An objective ratio of traffic distribution to be aimed at over Medan : Jakarta : Surabaya will be 2 : 6 : 2. This arrangement will not only secure the network dependability but also contribute the regional development of eastern part of Indonesian society.

(5) Effect on marketing strategy and service enhancement

Surabaya is quite away from the center of international telecommunication, Jakarta. The inauguration of marketing activity together with the installation of exchanges will lead to a good public relations of P.T. Indosat, then to the whipping-up of latent demands and finally to service enhancement.

(6) Financial analysis

Corresponding to the revenue estimated from the increased telephone and telex traffic demands described in Paragraph (1), a financial analysis has been made for investment and

operation costs in Chapter 11.
Investments covers following major items:

a) Land
b) Building with Air Conditioning
c) Power Supply
d) Transmission Systems
   i) Satellite earth station for POR
   ii) Satellite earth station for IOR
   iii) Terrestrial lines and domestic lines
e) Switching systems
   i) Telephone exchange (including switchboard)
   ii) Telex exchange
   iii) Maintenance facilities

Operating costs consist of following items:

a) International (Satellite) circuit lease
b) Domestic circuit (intergateway and tie line with PERUMTEL) lease
c) Compensation for PERUMTEL
d) Operator
e) Maintenance
f) General administration

The results of financial analysis as is described in Chapter 11 shows that the introduction of the third gateway is quite feasible and will yield a proper profit.

(7) Conclusion

A case study made here concludes that the third gateway in Surabaya is a feasible and recommendable project. It will not only lead to a properous development of international telecommunication in Indonesia but also contribute to a regional development and further total development of the country.

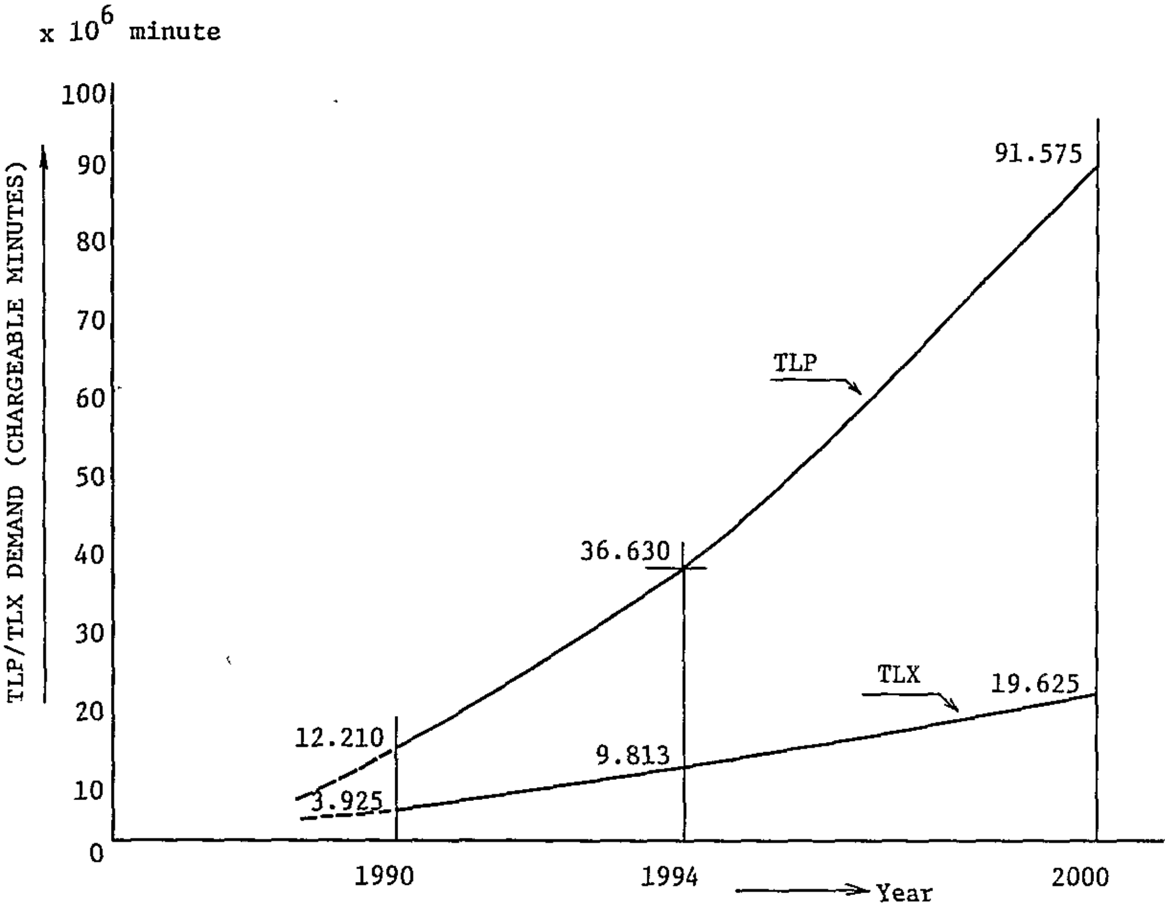
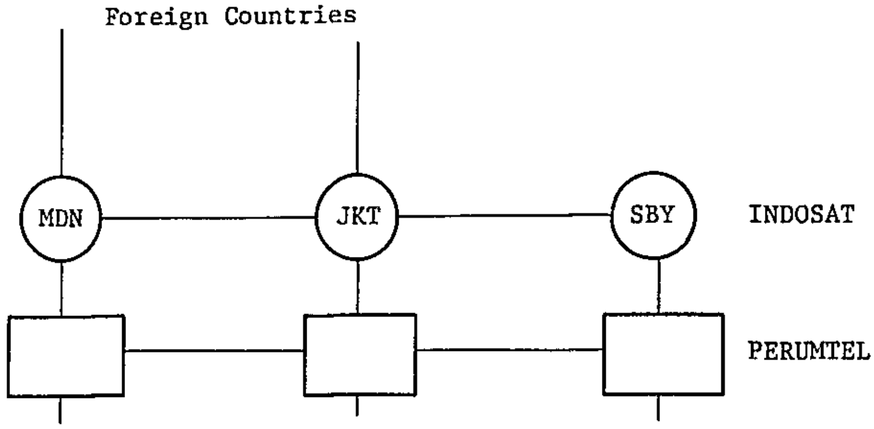
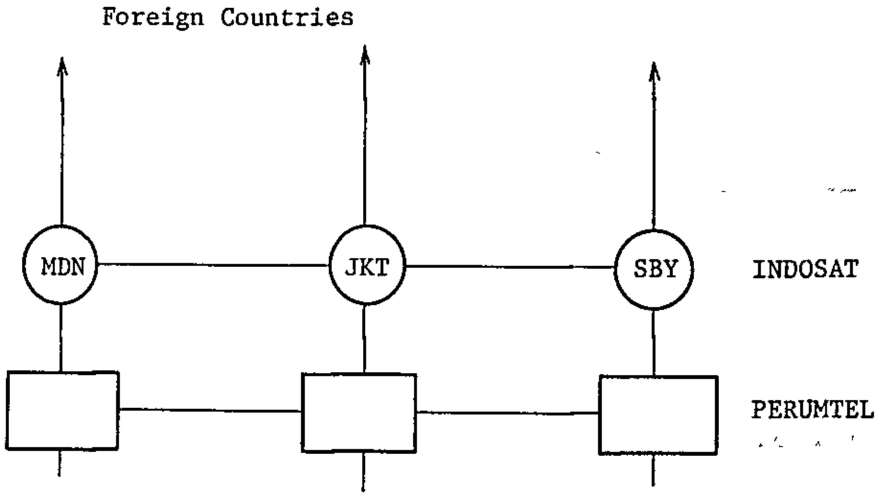


Fig. 5.4.2.1 Estimated demands for Telephone and Telex handled by Surabaya Gateway



Case A



Case B

Fig. 5.4.2.2 Possible Configuration of Surabaya Gateway

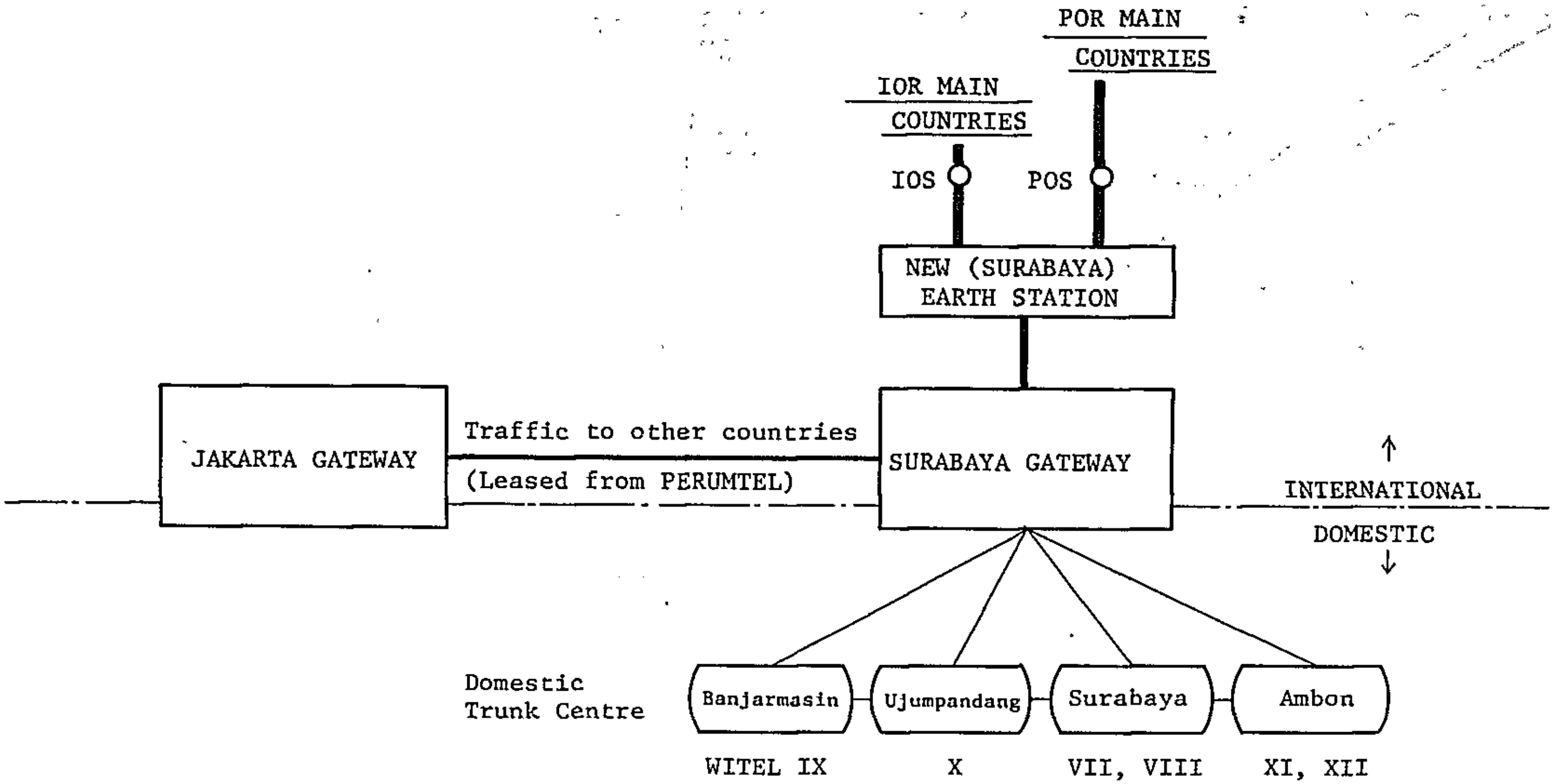


Fig. 5.4.2.3 Network (Transmission) Configuration of Surabaya 3rd. Gateway

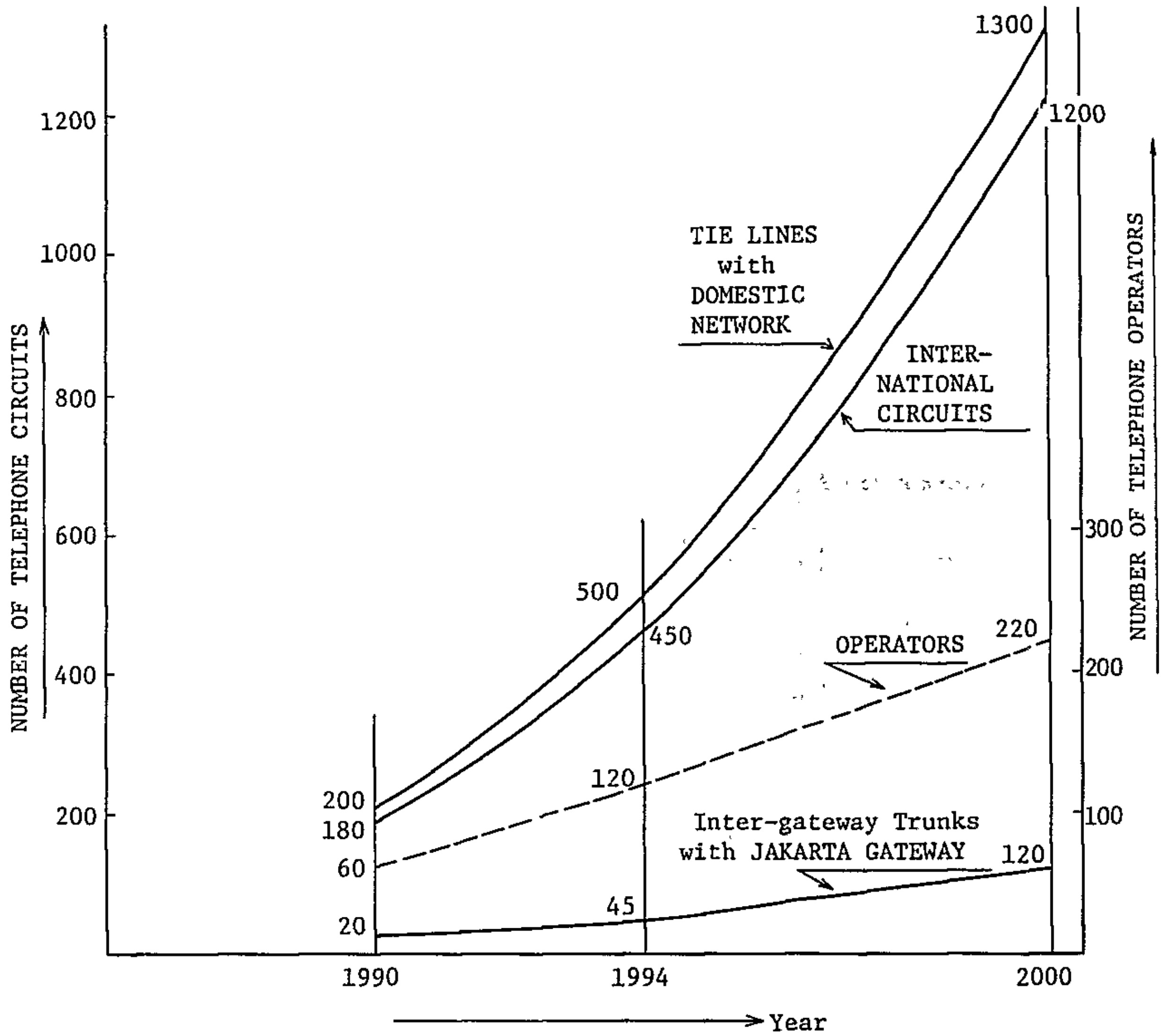


Fig. 5.4.2.4 Telephone Circuit Increase

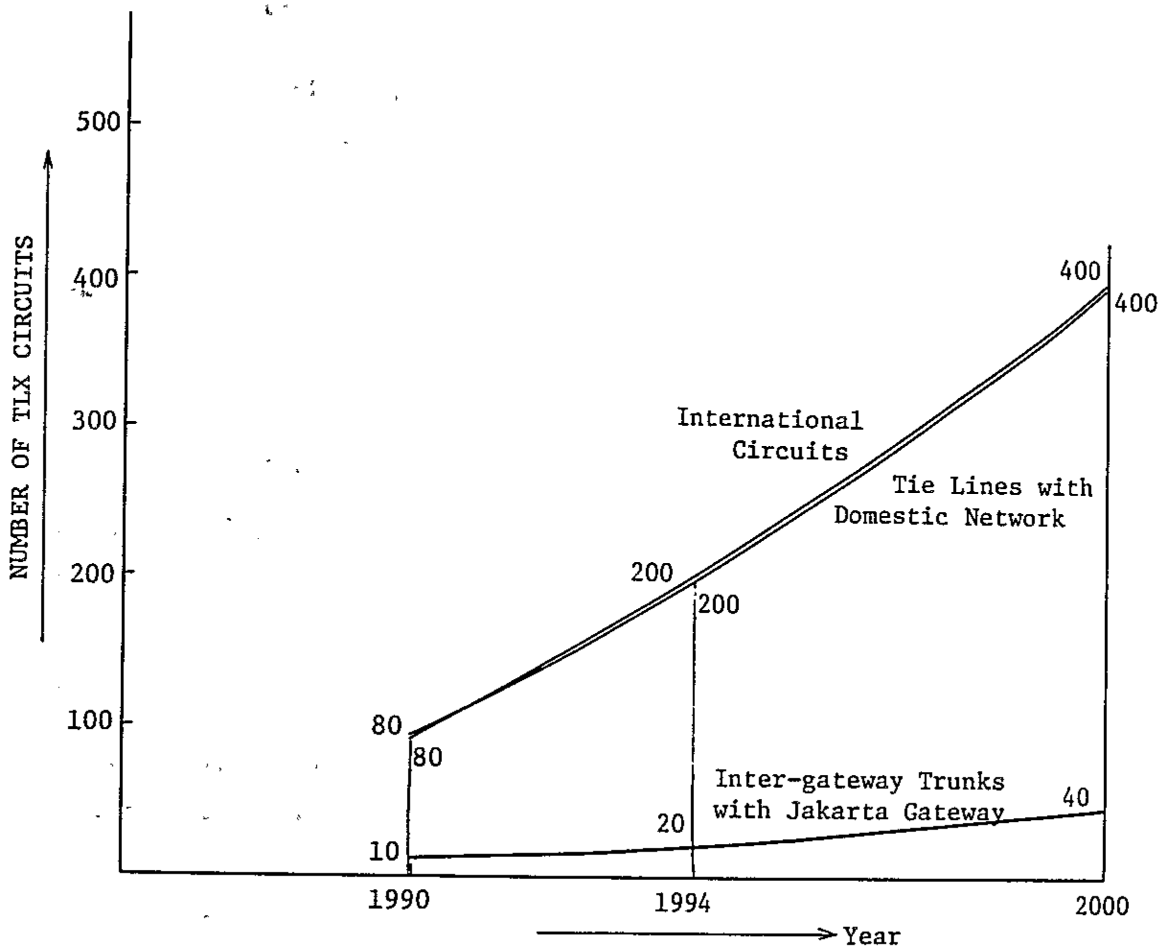


Fig. 5.4.2.5 Telex Circuit Increase

5.5 ISDN and Digitalization

5.5.1 An Approach and Steps Towards ISDN

General trends towards ISDN are as described in Section 5.1.6. Although major developed countries are planning to establish ISDNs within each domestic region, in the field of international telecommunications no country has launched a clear image on the ISDN yet. In this section a tentative image for an approach and steps to be taken by P.T. Indosat in the progress toward ISDN is shown based on Fig. 5.2.5.

(1) First Step - Digitalization of Telephone Network

The first step should be the digitalization of the telephone network, which will carry the major amount of information bits, i.e. basically 64 kbit/s in digitalized form in the era of digital telephony. Each step is as follows:

i) In accordance with worldwide technological trends, the telephone exchanges for the future, e.g. Medan and Jakarta, are to be digital systems.

ii) Associated with digital exchanges, tie lines with the domestic network should be digital types from the very beginning as far as possible. In order to avoid the degradation of transmission quality, analog/digital conversion should not be repeated through the end-to-end connection. This arrangement should be in accordance with the digitalization of the PERUMTEL network. Efforts by PERUMTEL are expected to result in the digitalization of exchanges and inter-office trunk lines in parallel. The completion of IDN will be accomplished by the digitalization of subscriber lines.

iii) Most important is the digitalization of international circuits. The possibility of this can lead to the realization of an international ISDN. The satellite link will be the first digitalized international link implemented by the introduction of PCM/TDMA. The application of fiber optics to submarine cables will make digitalization possible in the future. These processes cannot be implemented at one time but will take a long time and must be carried out in stages. Detailed planning principles on digitalization are described in the following Section 5.5.2.

(2) Second Step - Establishment of a Data Network and the First Stage of Integration

In order to cope with the demands for new and advanced communications, e.g., data communications and telematic services, a plan to introduce IPSDN is described in Section 5.2.3. In the future a circuit switched data network (CSDN) will be necessary if such service traffic develops and the need reaches a point at which a large amount of information for facsimile and high-speed data transfer must be transmitted.

Since IDN itself is a circuit switched network, future integration of data networks will be more feasible with CSDN although the major trend is moving towards the establishment of PSDN at present. Although the main service in the present type of record communication is telex, its low speed of 50 bauds is not efficiently adaptable to the 64 kbits used in a digital telephone channel. The second step for integration will be taken only when this type of data network has developed and matured enough to carry large amounts of traffic as well as replacing telex and being accommodated into IDN.

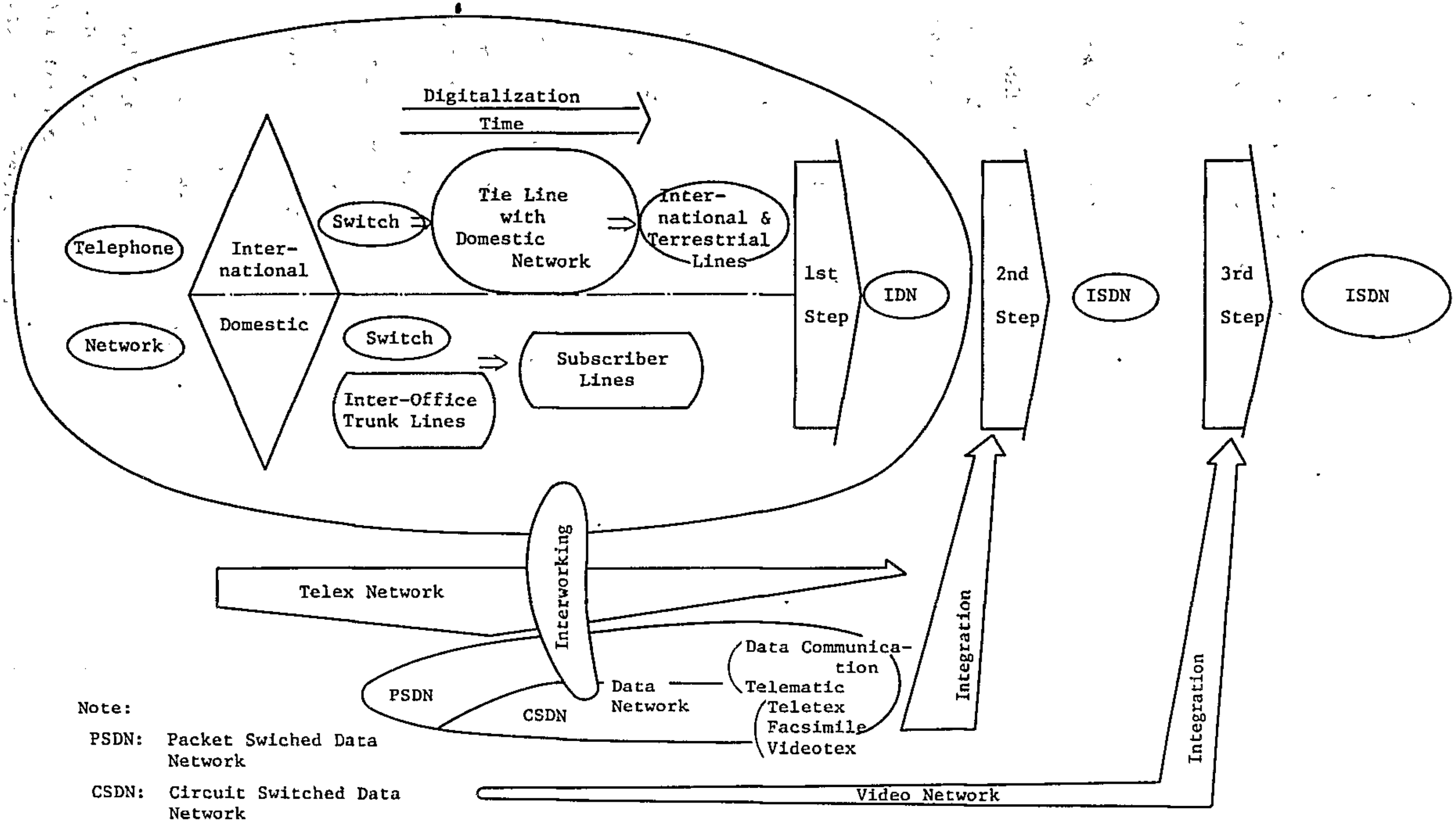
In order to promote the development of new data networks, the interworking between networks will be very important. In conclusion, efforts are required of P.T. Indosat to develop new data networks.

(3) Third Step - Integration of a Video Network

Video class services such as video conference and visual telephone will be offered on a leased circuit basis further in the future. When it is possible to install equipment featuring fiber optics at user locations and/or international traffic reaches a sufficiently high level, a video network can be integrated into ISDN. However, this will take a long time and cannot be realized in the near future.

(4) Other Considerations

The above is an approach from a technological point of view. For the realization of international ISDN it is necessary to conclude international agreements on many important points, such as tariffs, numbering plans, routing plans, etc.



Note:

PSDN: Packet Swiched Data Network

CSDN: Circuit Switched Data Network

Fig. 5.2.5 An Approach and Steps Towards ISDN

5.5.2 Steps Towards Network Digitalization

(1) Development of Network Digitalization

Digitalization of international transmission lines is carried out by introducing the following communication systems:

- INTELSAT digital SCPC (1979 ∿)
- " TDMA (1984)
- Optical-fiber submarine cables (1990 ∿)

In the domestic network, PERUMTEL will carry out the digitalization of these networks step by step, and analog and digital systems will continue to be mixed in the network for a considerably long period of time.

(2) P.T. Indosat's Policy Towards Digitalization

P.T. Indosat will positively respond to the general trends for network digitalization. Digitalization of international and domestic networks shall be positively undertaken with a long-range perspective paying full consideration to rational equipment investments.

(a) Digitalization of own Equipment and Networks

The new installation of gateway facilities transmission lines, and other equipment for P.T. Indosat shall incorporate digital technology to efficiently meet future trends for digitalized networks. Appropriate digital/analog (A/D) conversion will be provided during the transition period in which both digital and analog systems coexist.

(b) Digitalization of International Networks

Digitalization of international networks shall be carried out based on international consensus. P.T. Indosat is required to promote digitalization and to be positive in introducing INTELSAT TDMA and optical-fiber submarine cables. PT INDOSAT is also required to participate in and cooperate with international research activities regarding the development of these systems.

(c) Cooperation towards Digitalization of Domestic Networks

International telecommunications in one country can provide high quality services depending on the well balanced development of international and domestic networks. P.T. Indosat is required to build its own networks using high-quality digital equipment and to positively cooperate with the digitalization of domestic networks. Digitalization plans on both sides have to be exchanged, and final plans have to be decided after thorough consultation to implement digitalization with efficient equipment investments.

P.T. Indosat will decide technical interface conditions for international and domestic networks together with PERUMTEL.

(3) Technical Conditions for Digitalization

P.T. Indosat shall carry out digitalization of its own networks under the following technical conditions:

(a) Digital Hierarchy and Coding System

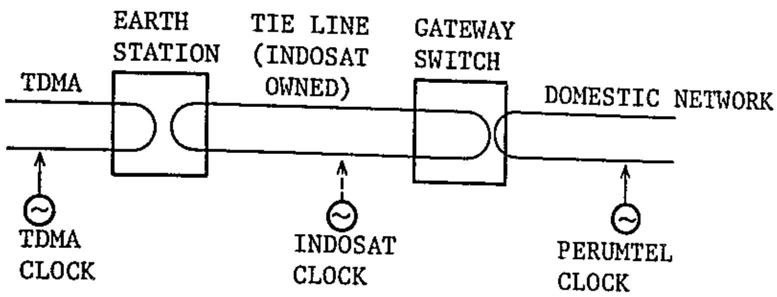
There are two digital hierarchy systems - the CEPT system and the Japan-USA system. A hybrid hierarchy approach can also be considered for matching between different systems. The CEPT system is becoming dominant internationally. The TDMA hierarchy is based on the CEPT system. In Indonesia, PERUMTEL is supporting the CEPT system and is promoting digitalization of the domestic networks based on the CEPT system. P.T. Indosat too, will build its networks based on the CEPT system. Through the use of the CEPT system, the coding system will be the A rule. Judging from its geographical conditions, there will be no possibility of Indonesia having direct digital transmission lines with μ-rule destinations, and there will be no need for μ/A conversion.

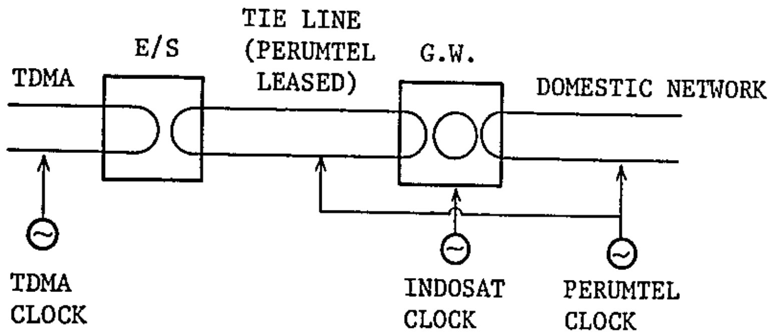
(b) Network Synchronization

International gateway offices accommodating digital circuits will have two digital interfaces - domestic and international systems. The domestic digital network will have a slaved synchronization system using PERUMTEL's master clock. In principle, the international digital network will have a plesiochronous synchronization system, and P.T. Indosat will have its own clock. When the clocks of P.T. Indosat and PERUMTEL can be unified, the PERUMTEL's clock will be used as the master.

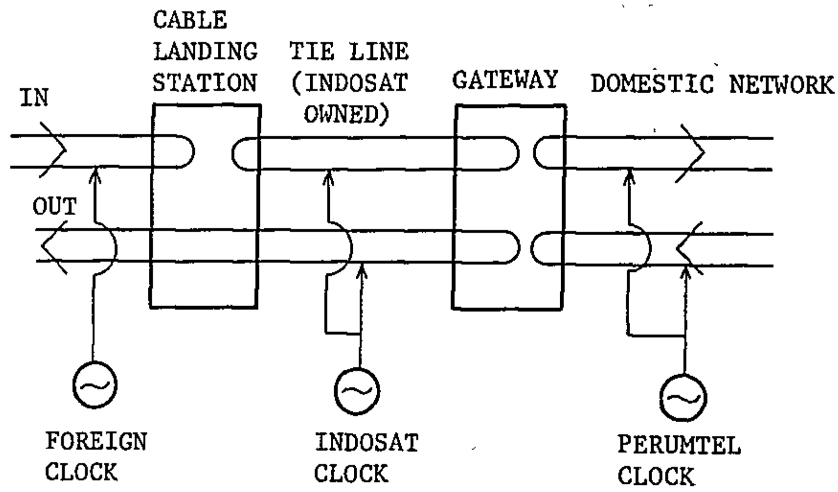
Network synchronization systems in concrete terms are shown in the following.

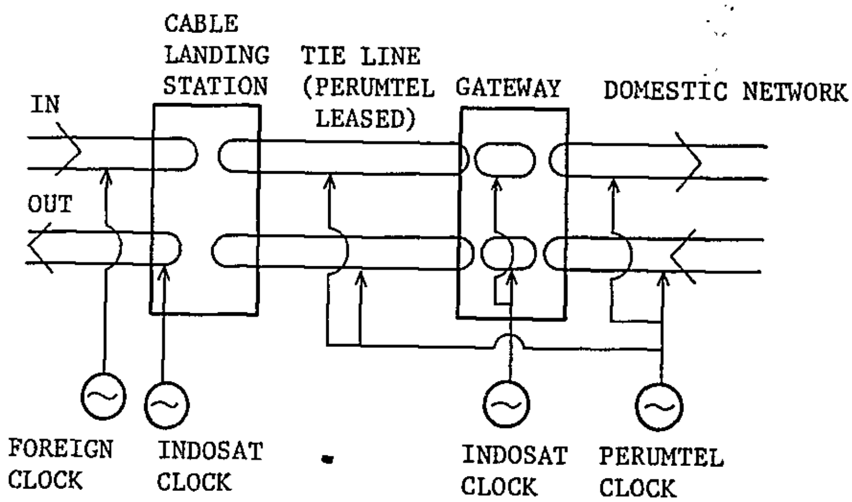
① TDMA - Terrestrial Network



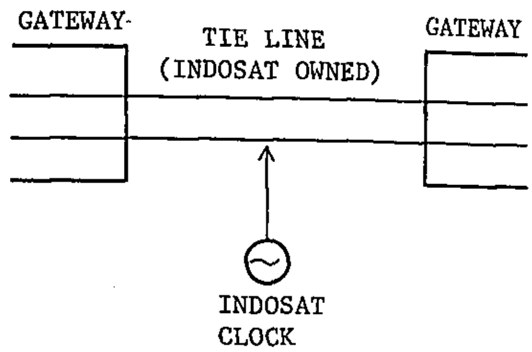


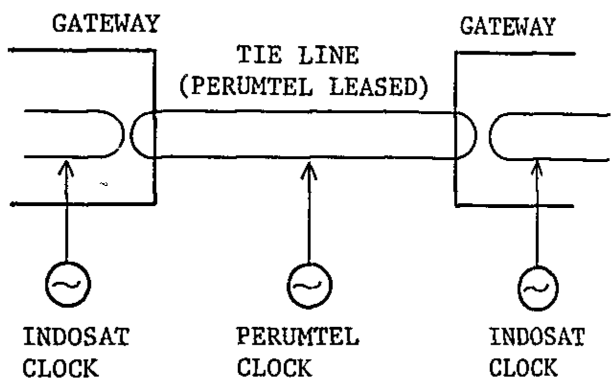
② Submarine Cable - Terrestrial Network





③ Inter-gateway Tie Line



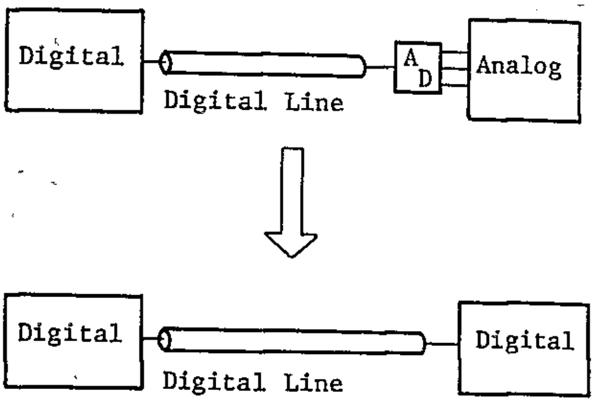


(4) Digital-Analog Interface with Domestic Network

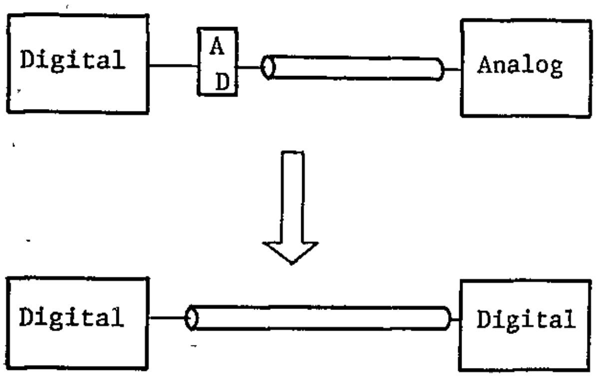
PERUMTEL is promoting network digitalization based on its own plan. P.T. Indosat's digitalization will be implemented at a faster rate than that of PERUMTEL. For this reason, it is reasonable to assume that the network interface between the two will initially experience a digitalized international system and an analog domestic system. Then the domestic system will be digitalized after a certain period of time. As a matter of course, a process reversal of this sequence or simultaneous digitalization of both systems can be considered for some equipment.

Analog/digital (A/D) conversion has to be performed on either side when one side is digital and the other is analog. The location for the installation of the A/D converter shall be selected from the standpoint of minimizing investment costs until both sides are digitalized. The site for installation of the A/D converter shall be studied based on the following diagram.

Case A



Case B



In Case A, lines are also digitalized when one side is digitalized, installing the A/D converter on the analog side. Thus, the lines can be used as they are.

In Case B, the A/D converter is installed on the digital side. When the other side is digitalized, lines also require digital replacement.

Based on the foregoing, the following conclusions can be derived.

i) When P.T. Indosat installs new digital equipment and tie lines with PERUMTEL, the tie lines should also be digital, and the A/D converter shall be installed on the PERUMTEL side with analog equipment (Case A). This is because the analog transmission lines will be wasted when the PERUMTEL side is digitalized in the future when the A/D converter is installed on the digitalized side of P.T. Indosat.

ii) When digitalizing the P.T. Indosat side in the circumstance that P.T. Indosat and PERUMTEL have already been linked by analog equipment:

- The A/D converter is installed on the P.T. Indosat side when the final capacity of the existing analog transmission lines can meet the traffic volume until digitalization of the other side is completed. (Case B)
- The A/D converter is installed on the PERUMTEL side and transmission lines are also digitalized when the final capacity of the existing analog transmission lines cannot meet the traffic volume forecasted. (Case A)

The above cases i) and ii) are considerations assuming that P.T. Indosat's digitalization plan is implemented first, When PERUMTEL's plan is implemented first, simply change "P.T. Indosat" to "PERUMTEL" and vice versa.

(5) Own Possession and Digitalization of Tie Lines Between Gateway Office and Border Stations (Cable Landing Stations, Earth Station)

P.T. Indosat will build new gateway offices and border stations. Tie lines connecting them should preferably be owned by P.T. Indosat and digitalized, for the following reasons:

① PERUMTEL has been undertaking digitalization of telecommunication networks. However, it will require a long time until the entire Indonesian region, which is vast, can be digitalized. Digitalization will first be implemented in rural areas, ahead of in urban areas which already have developed analog networks. Therefore, P.T. Indosat's digitalization plan will be implemented first ahead of PERUMTEL in these applicable areas.

② Synchronization of TDMA and digital submarine cable systems require a high accuracy and flexible operations and should be placed under the network synchronization control of P.T. Indosat.

③ Circuit expansions can be decided based on individual planning, and it will be no more efficient to conduct circuit operation and maintenance.

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CHAPTER III

6

6. ORGANIZATION

6.1 Introduction

P.T. Indosat is a company of considerable national importance, which exclusively responsible for Indonesia's international telecommunications, contributes to the economic, social and cultural development of Indonesia and serves the interests of its people.

As mentioned in the preceding chapters looking at future international telecommunications, Indonesia's international telecommunications are expected to develop rapidly. Especially the following item development would be expected.

- ° Increasing traffic of telecommunications by such conventional means as international telephone and telex
- ° The introduction of teleconferences, maritime satellite communications, data communications and other new services
- ° The development and introductions of new technologies for electronic switch, optical fiber and ISDN
- ° Efficient operation and maintenance of more advanced and sophisticated communications facilities
- ° An associated international telecommunications cooperation

These developments and the need to grow to satisfy both national and customer requirements in a well-balanced way must also be matched with amicable relationships with international carriers.

The national undertaking of an international telecommunications business is strongly dependent on its organization and personnel.

As P.T. Indosat which is authorized to exclusively undertake international telecommunications, a highly specialized business, it is extremely important to train excellent personnel.

Therefore, P.T. Indosat is required to train appropriate personnel to provide international telecommunications service via an effective and efficient organization, so that it can contribute to the national development of Indonesia and the well-being of its people.

6.2 Organization

To cope with the increasing demands for international telecommunications and traffic, realize the introduction of new service and promote the active development of new technology, it is necessary for P.T. Indosat to solidify the foundation of its organization.

6.2.1 Effective and Efficient Organization

(1) Implementation of Business Aims

For P.T. Indosat to implement its aims, it is important to allocate its personnel to appropriate duties with authority duly shared to enable them to act effectively and efficiently.

Structuring the organization of a company is indispensable for the management of its business. If the organization of a company does not function effectively and efficiently, not only its business activities will be impaired but its future as a whole will be hampered. Therefore, it is necessary to structure the organization of a company by analyzing its business and necessary activities from a managerial viewpoint.

(2) Allocation of Duties

The structuring of a business organization generally starts with a decision on how to divide its business or what sections to create. It is then desirable to organize a line of instructions which can have the divided sections carry out coordinated activities under a single directive.

To achieve a rational business division, it is necessary to define business duties and ranges for the resulting sections. It is also important to avoid any overlap in duties or responsibilities between sections, or situations where a lack of connection with others causes a business gap.

These may be prevented by analyzing business responsibilities allocated for each section.

(3) Analysis of Business Responsibilities

An analysis of business responsibilities is necessary for rational business management.

An analysis of business responsibilities makes possible a full, precise grasp of the real situation of business sections to which they are allocated. By studying desirable business relationships between the created sections, it can be determined of their structure is best suited for various conditions to implement business aims.

According to Dr. P.F. Drucker, even a good company with excellent business results may be found through this analysis of business responsibilities to have various defective points as listed below:

1) Important duties are left unattended

2) Important duties are attended only when needs arise

3) Once important but now meaningless duties are still considered important

4) An obsolete business structure is carried forward

5) An apparently unnecessary job is done without any review

These are important elements to review in every business organization.

6.2.2 Concrete Organization

(1) Strategic Organization

The basis of P.T. Indosat's business is the expansion of its conventional service and the active introduction of new service.

To realize this, P.T. Indosat needs to consider the creation of an organization well equipped with strong marketing strategy and capable of promoting the development and introduction of new technology.

(2) Simple Organization

The success of a business organization is determined largely by its structure and management. If it has too many small divisions, the development of its personnel tends to be hampered.

This problem also causes a business organization to suffer delayed decision-making. With their authority restricted, its employees find it difficult to exercise their ability. Moreover, such divisiveness tends to create sectionalism and petty empire-building. It is therefore desirable to prevent such situations.

(3) Appropriate Division of Authority

In a private company, all important matters are usually decided only by its top management or key personnel. However, an organization capable of making such important decisions at a relatively low level and translating them into action is quick in decision-making and flexible to changes.

Having many things decided only at a higher level and thus leaving decision-making to its top management, a business organization cannot enhance the morale of its personnel and wastes their capabilities.

(4) Mobile Organization

To implement 'imminent projects, it is desirable to structure an adequate mobile structure, such as a project team organized for the construction of the Medan Central Station and related facilities. To carry out major projects such as the Medan project and the construction of the new central station in Jakarta, it is important to gather personnel from all the related sections and make their abilities work collectively.

6.2.3 Future Estimated Organization of P.T. Indosat

From organizationally important points as explained above, it is desirable for P.T. Indosat to reorganize itself to:

1. Establish a managerially solid foundation
2. Promote strategic market exploration always matching the social needs
3. Promote the active introduction of new technologies and cope with the increasing use of more advanced and sophisticated communications facilities
4. Cope with the introduction of new services (data communications, integrated services digital network, etc.) to supplement telex and telephone services.
5. Strengthen cooperation with international carries in other countries and such international organizations as ITU and INTELSAT
6. Raise excellent personnel
7. Make low-level business sections effective by avoiding many and unnecessarily tight divisions

From these points, it is considered appropriate for P.T. Indosat to have as shown Table 6.2.2.1 to 6.2.2.3

(1) Organization to 1985
(2) Organization to be added to 1990
(3) Organization to be added to 2000

From these points, P.T. Indosat's estimated future organization is showned in Fig. 6.2.3.1. to Fig. 6.2.3.3.

Table 6.2.2.1 Organization to 1985

	Main business responsibility
Financial Department	Strengthens business foundation and secures healthy financial state
Personnel Department	Promotes office automation to manage general personnel administration, staffing programs, employment plans, organizational plans, personnel and staff training, personal information and pay data
Medan Project Team	Formed to implement the Medan Project, engages itself in the management and operation of Sumatra after the completion of the central station and cable-landing station
Sales Department	Serves to keep good relationship with POSTEL and PERUMTEL Serves central managerial roles and carries out strategic activities, such as expansion of existing service, introduction of new service, market exploration, public relations activities, management of service quality and demand forecasting
Technical Department	Serves as main technical force which plans and implements realistic expansion of facilities, introduction of facilities needed by new services and other communications and transmission facilities
Operations Department	Administers operations sections at telephone and telegraph stations, ITMC, cable stations and satellite stations linked to Jakarta Prepares operations and maintenance procedures

Table 6.2.2.2 Organization to be added 1990

	Main business responsibility
Management Analysis Department	Generalizes traffic data on conventional telegraph, telephone, telex and leased circuit services and various data on international telecommunications and statistical and analytical data to help future demand forecast, circuit and facility expansion program and financial programs as well as management as a whole
Data Communications Department	Prepares for the development and introduction of international computer access service, message switching and other forms of data communications as the third generation of telecommunications by studying technical matters as well as service charges and conditions and watching international trends
International Relations Department	Participates in international organizations (ITU, INTELSAT and IMMARSAT) and strengthens and promotes operational cooperation and joint actions with other countries as required by increased traffic of international communications
Maintenance Department	Strengthens maintenance and management of facilities to secure reliability and stability of international telecommunications provided through satellites, submarine cables and switchboards

- to be continued -

Network Control Department	Administers operating stations and gives them instructions as well as coordinates with other countries in setting up transmission paths and opening and closing telex and telephone circuits Works on the staffing of operation and maintenance personnel
Education and Training Department	Administers P.T. Indosat's training center, plans and implements education and training programs by procuring and providing training facilities and has responsibility for education and training of personnel engaged in international telecommunications business as a whole

Table 6.2.2.3 Organization to be added 2000

	Main business responsibility
Operations Planning Department	Serves as the management force of P.T. Indosat by working out long-term programs for Telecommunications service, demand forecasts, service charges and conditions development and operation of new services, and assessing economic and financial situation as guidelines for business management
Technical Planning Department	Serves as the technical force of P.T. Indosat by working out programs for the introduction of new facilities, matching demands, construction of new central stations (such as third channel stations) and digital transmission routes and introduction of satellite-related & other new technologies.
Laboratory	Serves as the research force of P.T. Indosat which, set up to promote the development of Indonesia's telecommunications, conducts research in cooperation with PERUMTEL and universities to realize ISDN and develop satellite communications, submarine cable, and switchboard technologies, among others

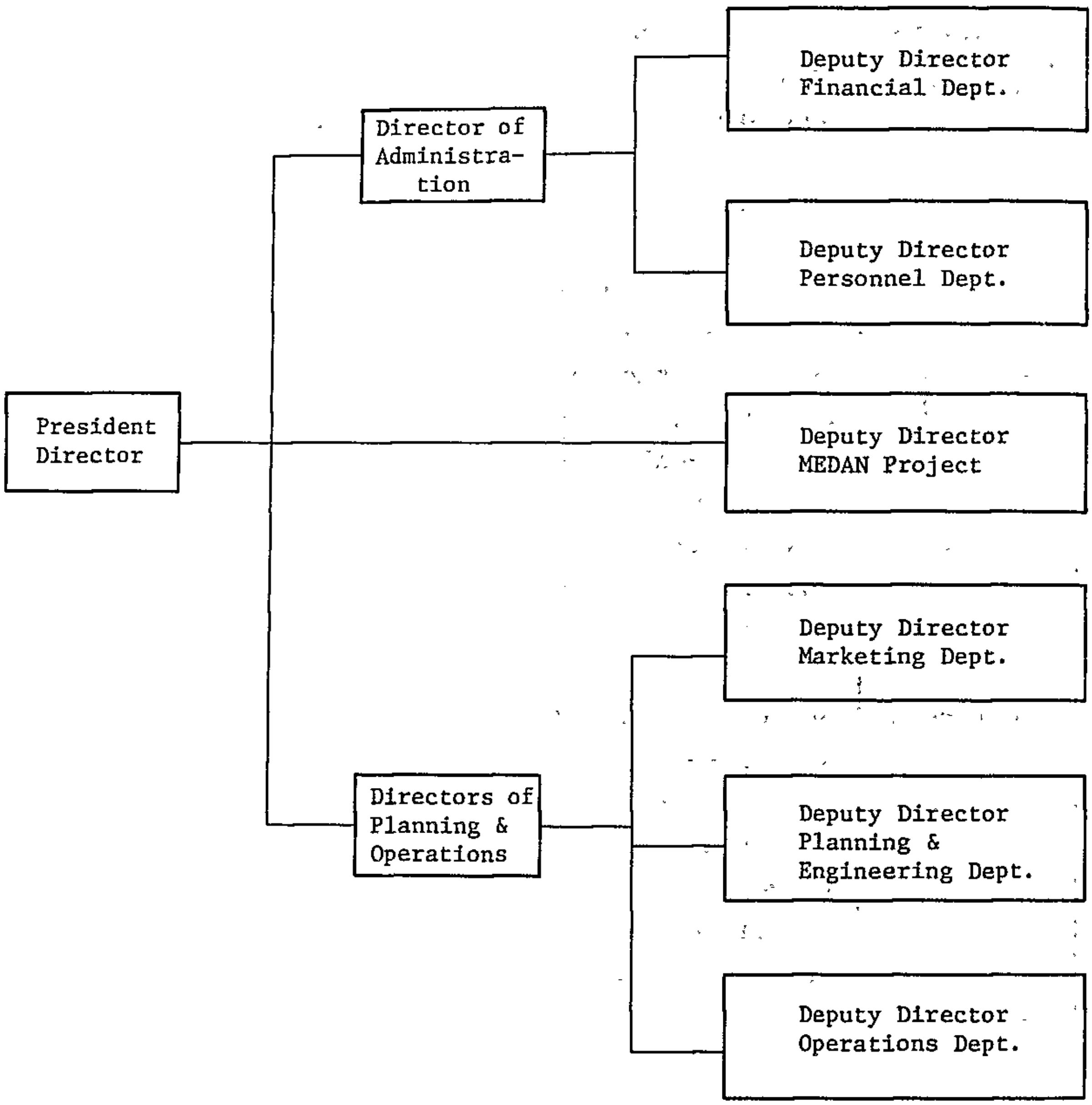

Fig. 6.2.3.1 Estimated Organization to 1985

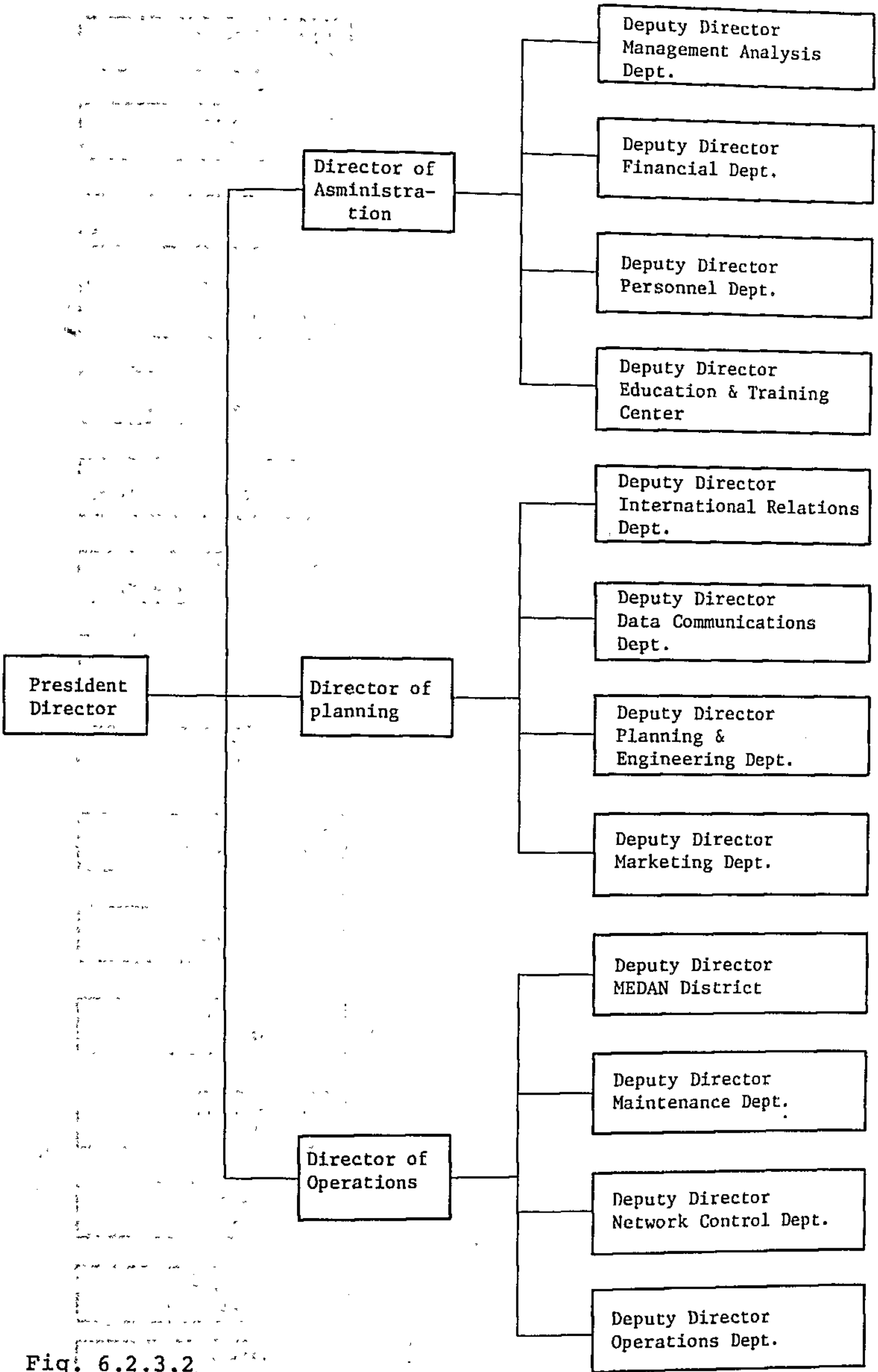

Fig. 6.2.3.2

Estimated Organization to 1990

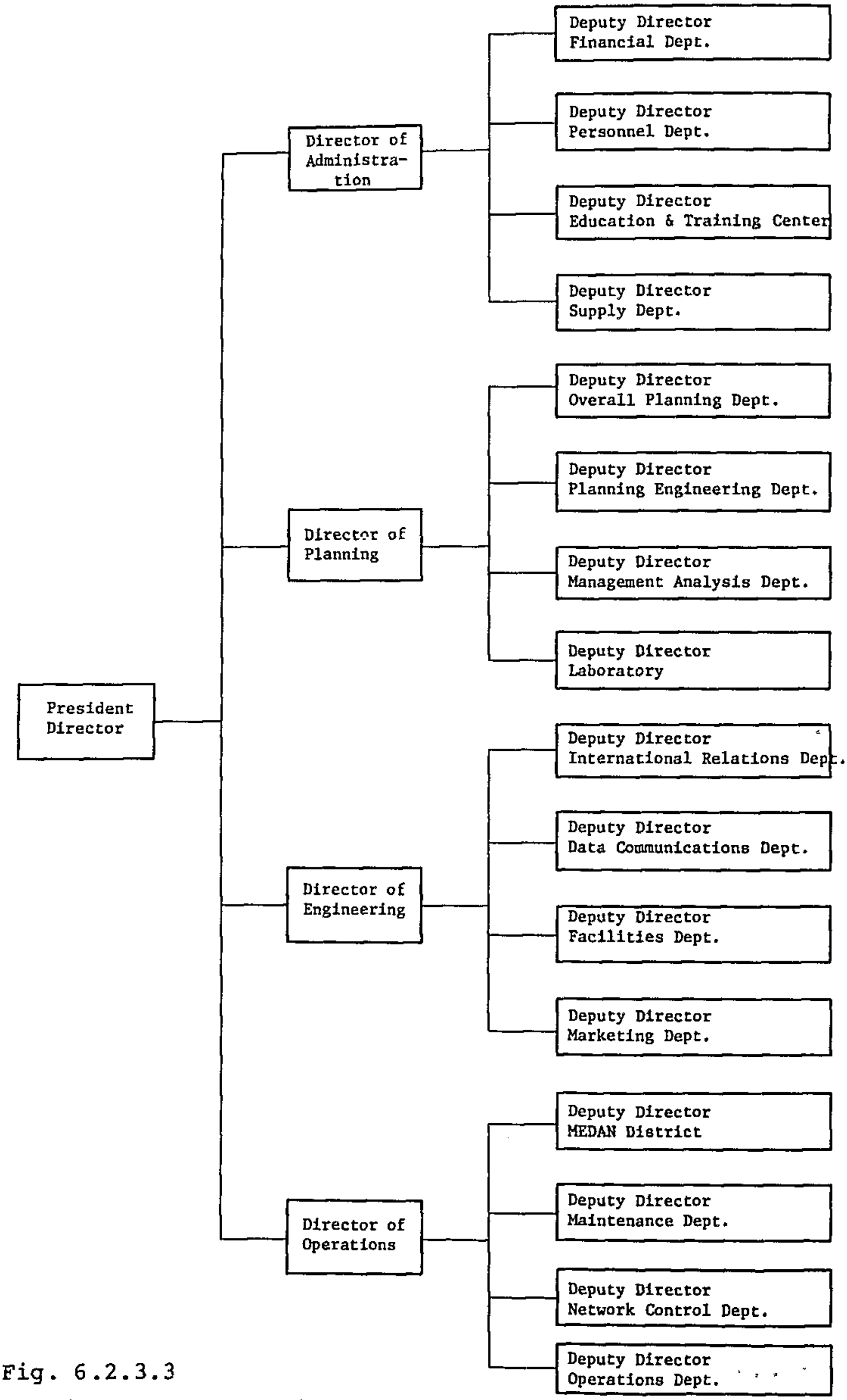

Fig. 6.2.3.3

Estimated Organization to 2000

6.3 Manpower Plan

To maintain and develop the business of P.T. Indosat, it is important to employ excellent personnel and train them from long-term aspects. To motivate them to improve is also necessary.

6.3.1 Personnel Development

(1) Basic Personnel Development Policy

Irrespective of job type and title, it is important to train personnel to:

a) Recognize the social role of P.T. Indosat and positively carry out their duties with high morals and a strong sense of responsibility to match its business policy

b) Equip themselves with knowledge and ability necessary to carry out their duties effectively and make constant efforts toward further improvement

c) Keep a sharp eye, ability of precise judgement and high creativity to cope with changes in domestic and international situations concerning the company

d) Develop maturity and a deep sense of responsibility, as persons wide in vision, perception, breadth of viewpoint, an international sense, and rich in humanity

(2) Personnel Development Method

Personnel development as explained above should be based on self-motivation stemming from an individual's will to improve. Preferably, various staffing, educational and training measures should be taken up in an organic and generalized way. To develop the good personality of personnel, it is recommended to:

a) Encourage self-motivation

b) Give daily advice and training in the company

c) Provide varied education and training inside and outside the company

(3) Staffing Policy

A staffing policy which can achieve the efficient management of a business organization by utilizing its personnel optionally is the most important element for personnel development.

To determine a staffing policy, it is recommended that:

a) Personnel assignments be based on ability and achievements. This requires a fairly operated merit system

b) Actively promote personnel changes, which can activate the company and enhance a sense of unity among its business sections

c) Introduce a job rotation system to give younger personnel experience in a range of jobs and to assess their capabilities as a future specialist or generalist, and consider future reallocation of personnel from telephone stations, where the retirement percentage is extremely low at 1%, to other sections

6.3.2 Manpower Plan

(1) Conceptual Idea of Manpower Plan

Personnel supporting the telecommunications business (and staff to operate the conventional services) will be increased to match the increasing volume of work, and to handle telecommunications traffic the major force of the company.

The personnel of the company tends to increase. But it is not easy to control the number like production adjustment. Therefore, its planning needs full and careful consideration.

Unlike traffic volume or the number of circuits, it is not appropriate to increase personnel; an increase in personnel makes it difficult for the company to cope flexibly with its managerial changes resulting from changing international and domestic economic conditions.

To work out P.T. Indosat's personnel plan, it is recommended that:

a) Personnel be divided broadly into clerk personnel (in management and administration departments and including clerks), technical personnel, maintenance personnel and operation personnel (telephone, telex and telegraph service personnel) and work out the number of personnel necessary for each department

b) Rationalization and automation of office clerical work be done to restrict the number of personnel in such management departments as finance and personnel

c) Sufficient personnel be allocated to such management departments as those for technical planning and design, through consideration of the development of Indonesia's telecommunication and relationship with other countries and reallocate them from one development project to another to fully utilize such personnel

d) The increase of facility maintenance personnel be restricted as much as possible through the rationalization of maintenance methods and simplication of supervisory and test procedures, although some increase will be needed to match increases in the installation of facilities and circuits

e) The increase of telephone station operators be reduced (these accounts for about 60% of P.T. Indosat's total personnel (as of July, 1982)), because the number of manually-operated calls will level out as ISD traffic increases, although telephone demand overall will show a healthy growth.

An appropriate level of telephone station personnel can be calculated from a traffic profile. However, it is more important to lower its composition ratio against the company's total personnel.

The percentage of telephone station operators leaving the company before the mandatory retirement is extremely low at about 1% of the total personnel and work force in this field is quite stable. However, it is important to consider making up for retirees so as not to hamper the smooth operation of the telephone station.

It is important to reallocate telephone station operators to other sections for optinum utilization of personnel.

(2) Estimated Number of Personnel

To implement the various plans of P.T. Indosat, a suitable personnel assignment plan commensurate with the planned schedule is needed together with the foregoing basic approach on personnel plans.

Table 6.3.2.1 shows a long-term estimate of personnel requirements up to the year 2000.

1984	1985	1986	1987	1988	1989	1990	1994	1999	2000
1,226	1,371	1,330	1,405	1,511	1,647	1,727	2,065	2,238	2,310

Table 6.3.2.1 Estimate of Personnel Requirements

6.3.3 Employment Plan

A company should take into account such factors as the introduction of new service, technological development and its managerial strategy when working out its employment plan.
To decide the employment of personnel to support the future business of P.T. Indosat, it is necessary to:

(1) Determine job sections requiring employment and the number of personnel needed

(2) Set rational criteria for employment screening

(3) Stage rational employment activities based on the set employment criteria

Figure 6.3.3.1 explains a flow of jobs to work out an employment program.

(1) Number of Required Personnel

Desirably, the number of newly-employed personnel should be decided with consideration given to the number of necessary personnel based on long-term manpower plan, the year's business projects and the number of retirees.

If an employment plan is worked out with too much emphasis placed on the necessity of personnel, personnel figure as a whole inevitably becomes bloated. Therefore, it is necessary to review the number that can be reduced, and subtract these from the planned intake, to restrict new employee recrutment as much as possible.

(2) Employment Criteria

An employment examination is one of employment criteria recommended for P.T. Indosat. It is desirable to employ personnel equipped with ability and suitability as explained in personnel development policy 6.3.1.1. Because the company employs an ability-based merit system, employing necessary personnel for necessary posts as the needs arise may be a good means to upgrade its operation.

(3) Future-Based Employment Program

The most important element for working out an employment program is the number of newly-required personnel and existing personnel. The number of newly-employed personnel changes from year to year, depending on the traffic of international telecommunications, long-term and short-term demand forecasts and facility expansion programs. It is also affected greatly by economic conditions at home and abroad, which changes the company's financial situation. Although the number of new employments is generally changed to cope with economic fluctuations, it is desirable to employ the fixed number of new personnel constantly.

(4) Employment Activities

After the number of new personnel is decided, Indonesia's educational environment and employment activities by other companies should be analyzed to as a guide toward the development of employment activities.

① Educational Environment and Labor Market

The situation of any labor market is determined by the balance between job offerers and job seekers. Because of Indonesia's economic development and an increase in the number of private companies, it will become increasingly difficult to secure suitable employees. Concentrating on graduates from schools teaching electric and electronic engineering, and English - particularly needed in the international telecommunications business - their availability is further limited.

Meanwhile, although the employment rate in Indonesia has been increasing year after year, the number of desirable potential employes will also rise, thanks to increasing emphasis on education. From this educational environment, it is recommended to set the number of new recruits based on educational levels, such as university, college and high school.

Management department personnel	University or recruit from outside the company
Technical department personnel	University or college
Telephone station operators	College or high school
Engineers	Technical school

② Employment Activities

To secure excellent personnel, it is important to enhance the reputation of P.T. Indosat and publicize the socially important role of international communications, to draw as many applicants as possible.

As recruitment methods, P.T. Indosat should:

a) Keep constant contact with universities, technical schools and high schools which educate people needed by P.T. Indosat

b) Propagate the activities of P.T. Indosat through school visits

c) Publish newspaper employment advertisements - which also serve to enhance the public image of P.T. Indosat

d) Utilize the government's manpower office

e) Seek suitable recruits from others private companies

By making these efforts constantly, it becomes possible to recruit top-grade personnel.

(5) Regular Employment and Extraordinary Employment

Regular employment is aimed at new graduates, season when the largest number of job applicants can be expected. Therefore, it is desirable to employ the planned number of new personnel at this time of year as regular recruits. Because the planned number of new personnel may not be recruited, however, depending on economic conditions and educational environment, it is also advisable to recruit particularly suitable personnel at any time, when the necessity and opportunity arise.

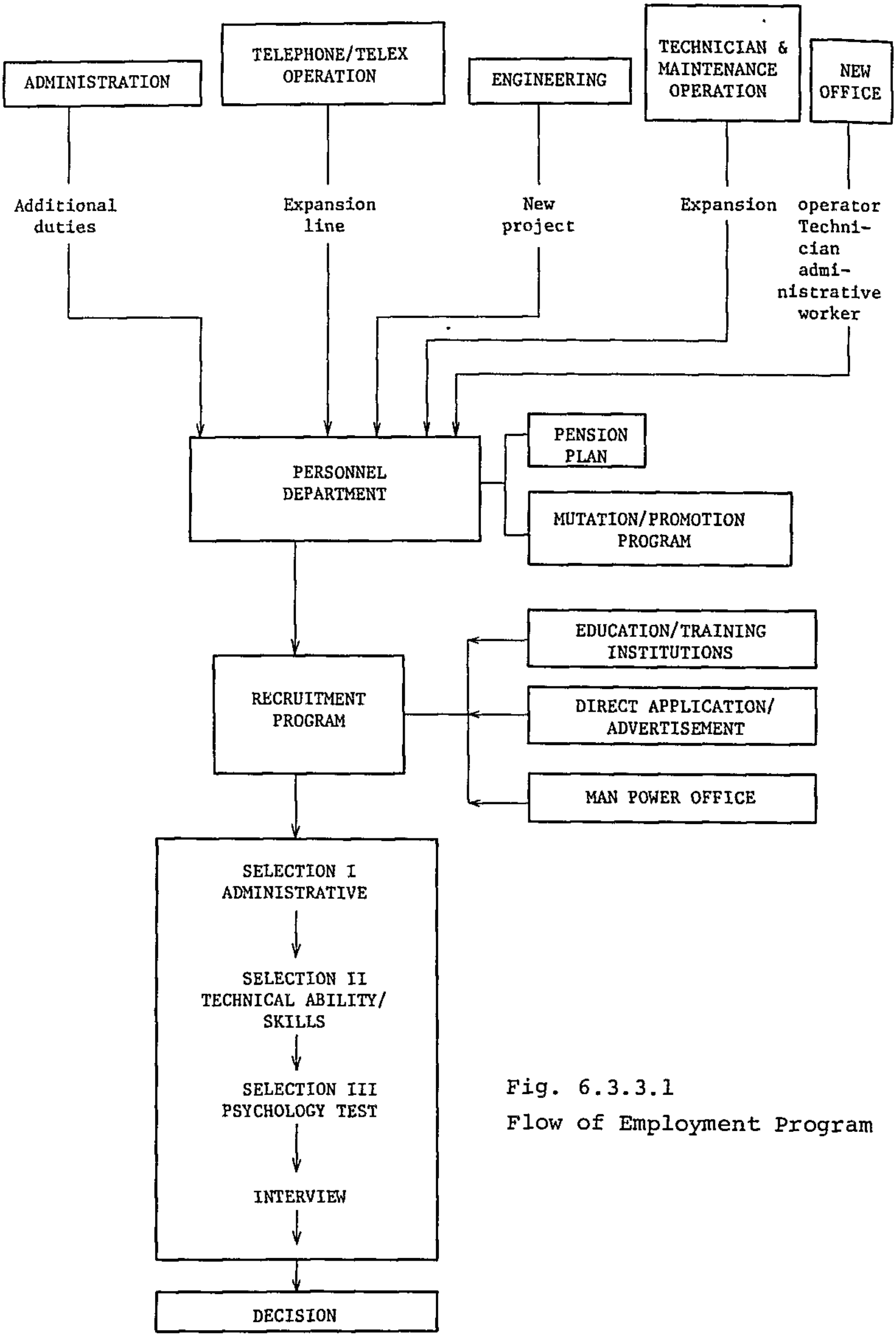

Fig. 6.3.3.1

Flow of Employment Program

6.3.4 Employees Motivation Systems

In a private company, employees hold the key to the development of its business. Over the long period of their service, employees provide their ability fully to the company; this is the result of the loyalty of the employees to their company. Resultantly, in one way or another, the company needs to thank its employees.

For a company to motivate its employees and stimulate their willingness to improve and further its development as a result, it is necessary to set up various systems serving these purposes.

(1) Appreciation

It is important to appreciate employees for their remarkable achievements in international telecommunications business to give them further motivation. Inventions and new ideas, exemplary job achievements, the prevention of major accidents and other remarkable matters should be appreciated with commendations from the President Director. Presenting these appreciations on the anniversary of the company's foundation may be effective to make its employees determined renewedly to make efforts for the further development of their company.

The recommended commendations are for:

(1) inventions and new ideas
(2) excellent achievement
(3) good job performance

(2) Appreciation for Long Term

This is to appreciate a long period of service provided by employees to international telecommunications business.

The acknowledgement of 10 years, 20 years and 30 years of service should be presented from the President Director to thank the relevant employees for their long-time contribution to the company. This is important to renew the willingness of employees to work.

(3) Overseas Study

This system is to enable employees to study at overseas universities and research institutes. So they can master knowledge and technology necessary for international telecommunications. At the same time, employees can gain an international sense backed up with education. This will greatly help train young employees who will support Indonesia's international telecommunications in the future.

(4) Domestic Study

This system is to enable employees to study at universities and educational or training institutes so that can increase their knowledge and technological capabilities. According to this experience, employees reflect their achievements in the business of the company.

(5) Suggestion Activity

All employees should not only have the opportunity to propose new methods and ideas to improve the company's business and reflect their will on the management of the company but be actively encouraged to do so. Excellent ideas and proposals should be taken up for their implementation with due appreciation.

It is desirable to hold a gathering of employees from all the operating offices once or twice a year to let them present their proposals and ideas. This kind of event not only activates the operating offices but also promotes the self-motivation of their staffs to work and improve.