2. Telegraph Demand Forecast (Telegram and Telex)

2-1 Telegram

2-1-1 Trends in Overseas Countries

The number of telegrams during the past ten years in some countries are shown in Fig. V.2.1-1. It is understood, from the figure, that the number of telegrams has decreased at an annual rate of about 9% in the majority of these countries excluding some developing countries. In the developing countries, the number of domestic telegrams only is increasing continuously as shown in Fig. V.2.1-2 and the number of overseas telegrams is also decreasing with few exceptions (as shown in Fig. V.2.1-3).

2-1-2 Telegram Demand in Indonesia

In the past ten years the total number of telegrams in Indonesia has continnuously increased at an annual rate of 9%. However, the breakdown of these telegrams shows that only the number of domestic telegrams is increasing (at an annual rate of 10%) and the number of overseas telegrams has been decreasing at an annual rate of 13% since its peak reached in 1974 (Fig. V.2.1-4).

It may be considered that telegram demands in Indonesia also may tend to decrease in a long range as in many other countries because of the development of telephone, telex and other convenient communication means.
Assuming that the number of telegrams

continues to increase at the current increase ratio until 1985 and assuming that there are three such different patterns of increase as shown in Table V.2.1-1, we can have a demand forecast for the year 2005 as shown in Fig. V.2.1-4.

Table V.2.1-1 Telegram Demand Forecast Patterns

Pattern	Saturation Point	Decreasing Point	Remarks
①	1995	After 2005	Optimistic trend
②	1990	After 2000	Intermediate trend
③	1985	After 1995	Pessimistic trend

The number of telegram demands obtained for individual reference years from Fig. V.2.1-4 are given in Table V.2.1-2.

Table V.2.1-2 Telegram Demand Forecast in Indonesia (Unit: 10^6 telegrams)

Pattern	1985	1990	1995	2000	2005	Number of Telegrams per Person
①	10	13	$16.^3$	$16.^3$	$16.^3$	0.071
②	10	13	13	13	$7.^7$	0.033
③	10	10	10	6	$3.^5$	0.015

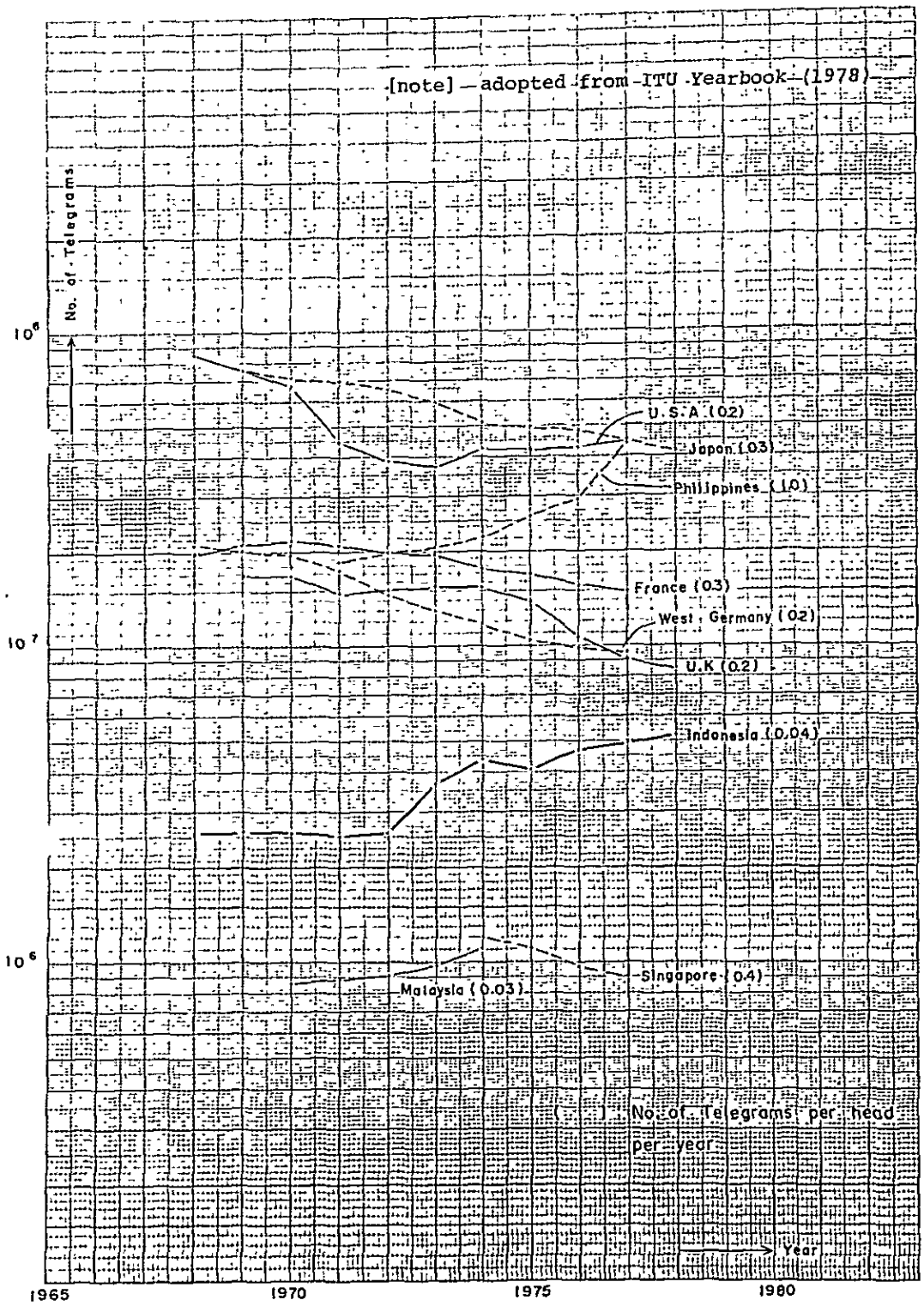


Fig. V.2.1-1 Telegram in Some Countries (Total)

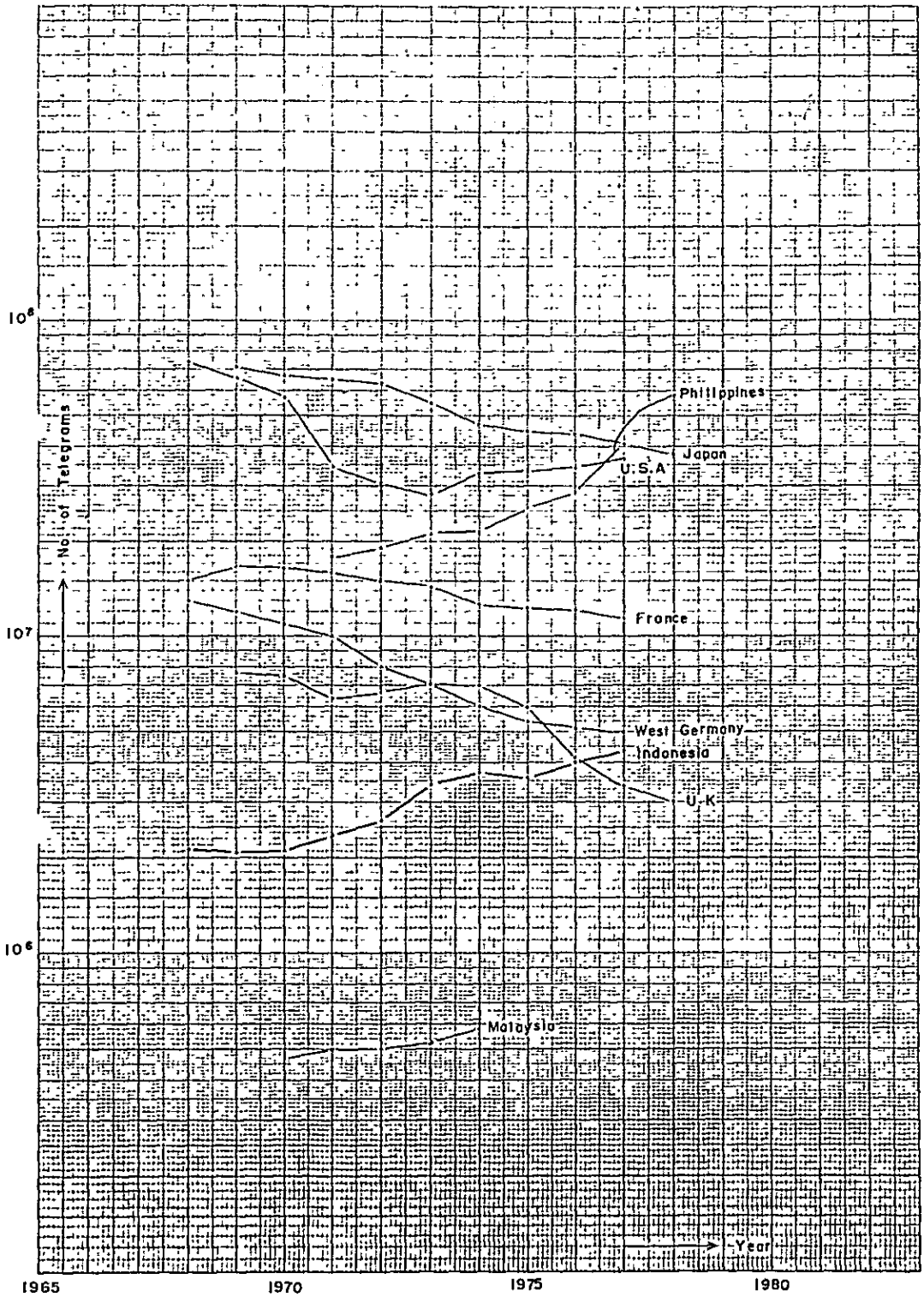


Fig. V.2.1-2 Telegram Trends in Some Countries (Domestic)

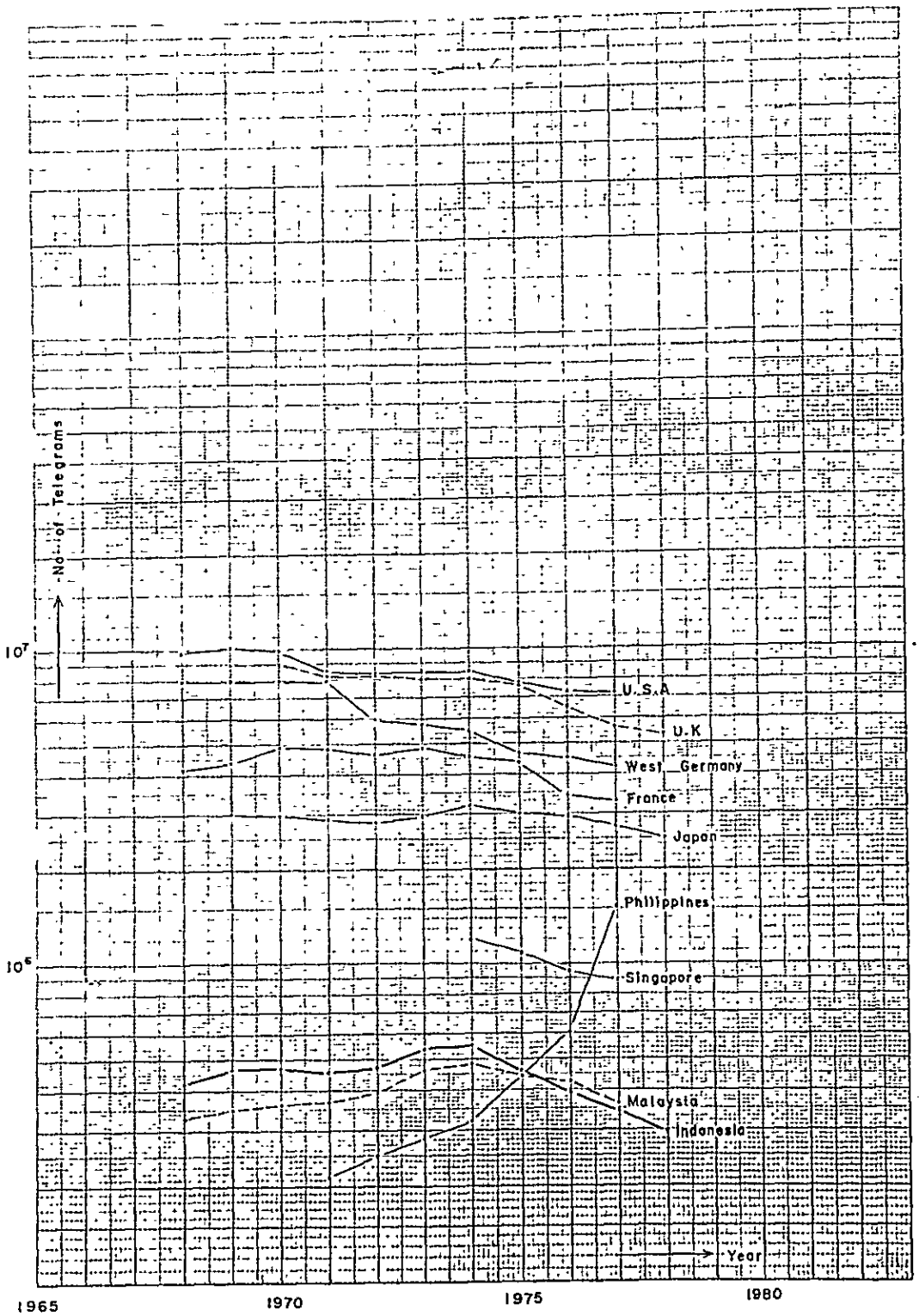


Fig. V.2.1-3 Telegram Trends in Some Countries (Overseas)

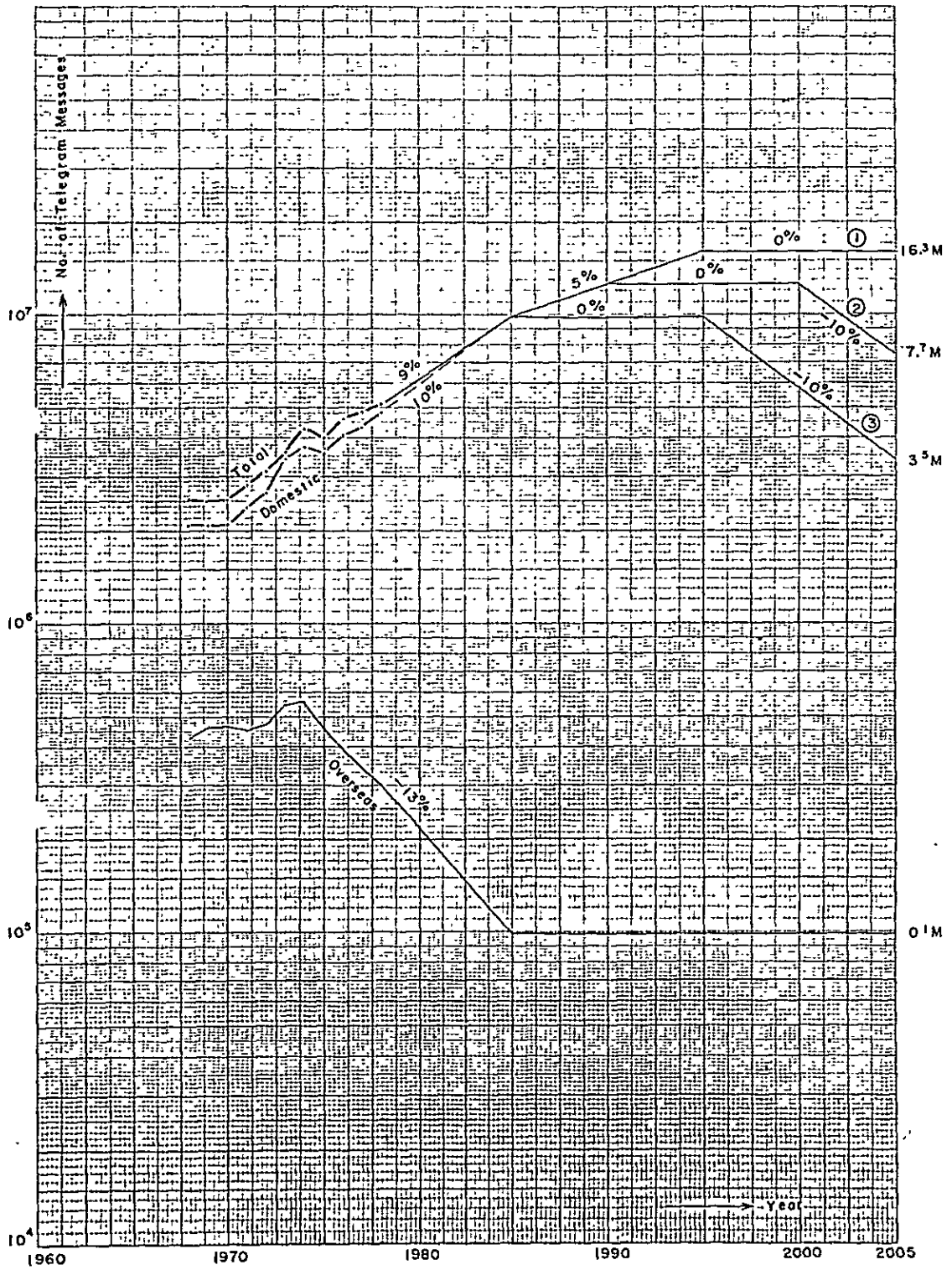


Fig. V.2.1-4 Telegrams in Indonesia

2-1-3 Check of Telegram Demand Forecast from the Standpoint of Income

The telegram income of PERUMTEL has been constantly Rp. 3 billion every year since several years ago. Most telegrams in 2005 can be estimated to be domestic telegrams, so that if the income to be gained by one domestic telegram in 2005 is supposed to be Rp. 400 (although it is Rp. 347 in 1978), the number of telegrams in 2005 is to amount to

$$\text{Rp. 3 billion/Rp. 400} = 7.5 \times 10^6 \text{ (telegrams)}$$

This corresponds to nearly to the case of pattern ②.

2-1-4 Distribution of Telegrams to Areas

By dividing the total number of telegram demands, which is given in Table V.2.1-2, to Sumatera Utara and Slawesi Selatan depending on the population ratio*, we can obtain such results as given in Table V.2.1-3.

* Population ratio (as of 1977) from "Statistik Indonesia," 1977-1978 Table III.1.10

	Whole Country	Sumatera Utara	Sulawesi Selatan
Population (10^6)	133.9	7.75	5.82
Population Ratio (%)	(100.0)	(5.8)	(4.4)

Table V.2.1-3 Telegram Demands

(Unit: 10^3 telegrams)

Area	Pattern	(1980)	1985	1990	1995	2000	2005
Sumatera Utara*	①	360	580	750	950	950	950
	②	360	580	750	750	750	450
	③	360	580	580	580	350	200
Sulawesi Selatan	①	300	440	570	720	720	720
	②	300	440	570	570	570	340
	③	300	440	440	440	260	150

* The area to be served by this project covers about 33% of the entire area of the Propinsi and about 64% of the entire population of the Propinsi. Accordingly, the number of demands in the area to be served by this project can be obtained by the population ratio as given in Table V.2.1-4.

Table V.2.1-4 Telegram Demands in Medan Area

(Unit: 10^3 telegrams)

Area	Pattern	(1980)	1985	1990	1995	2000	2005
Medan Area*	①	230	480	610	610	610	610
	②	230	480	480	480	480	290
	③	230	370	370	370	220	130

* Including Medan Kotamadya.

2-2 Telex

2-2-1 Trends in the World

The number of telex subscribers throughout the world amounted to about one million as of 1978. However, the growth rate is somehow decelerating down to about 8%. Future telex demands can be forecast by assuming various growth rates, as shown in Fig. V.2.2-1. The cause for the deceleration of the growth rate is the change of telex traffic to data communication, facsimile, electronic mail, etc., which are expected to see rapid growth in future. This tendency is becoming conspicuous in some countries. (Fig. V.2.2-2)

2-2-2 Telex Demands in Indonesia

During the past ten years the number of telex demands has increased at as high an everage annual ratio as 20%. It is difficult, however, to consider that this tendency will continue until year 2005. Accordingly, demand forecast is made by assuming three patterns ranging from a comparatively optimistic prospect to such a prospect that the increase ratio in 2005 is assumed to be zero, and the results of the telex forecast are shown in Fig. V.2.2-3.

In the most optimistic case (curve ①), the number of demands in 2005 is about 70,000 and the number of telex subscribers is to become 3 out of 10,000 inhibitants. In the most pessimistic case (curve ③), the number of demands in 2005

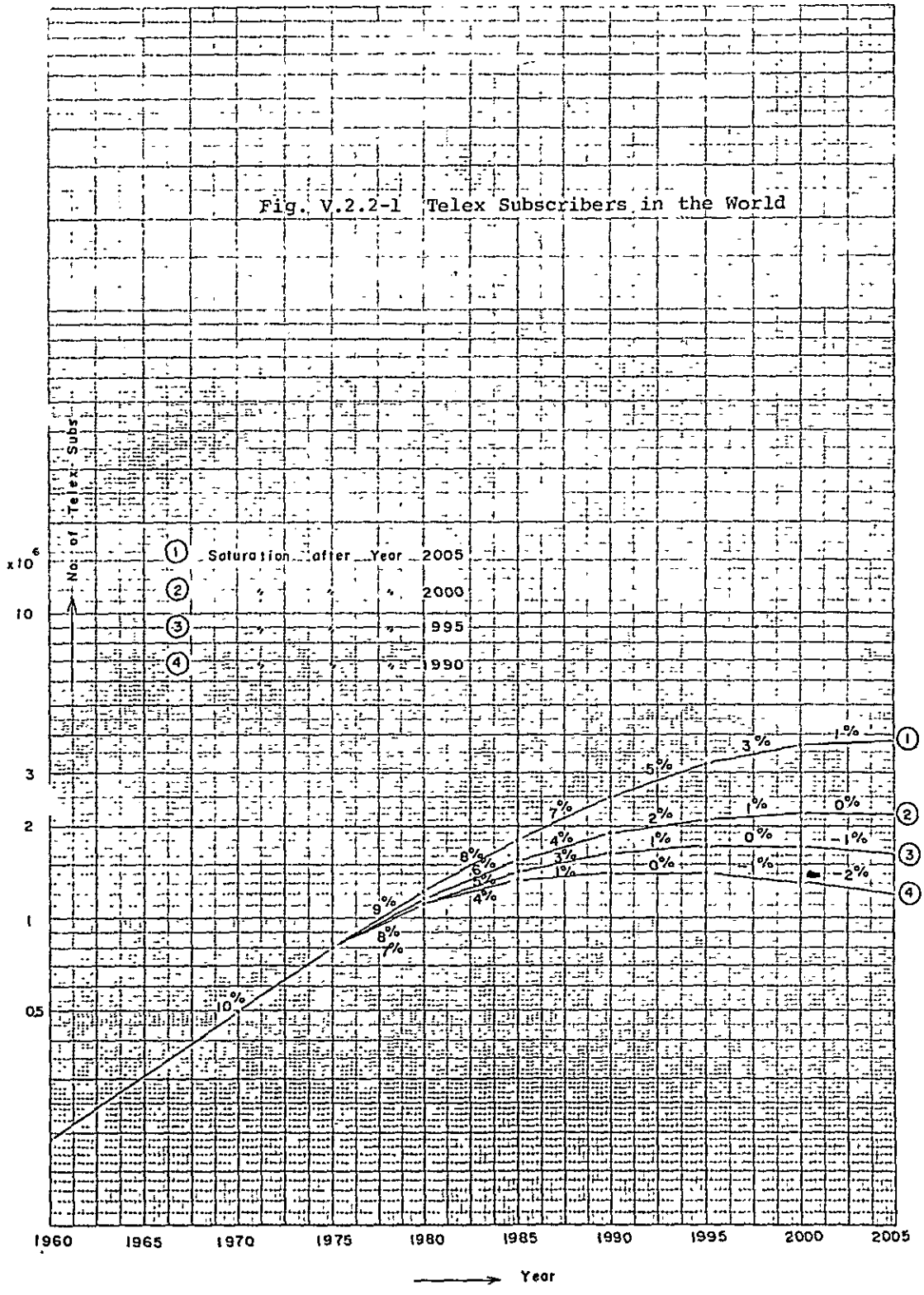
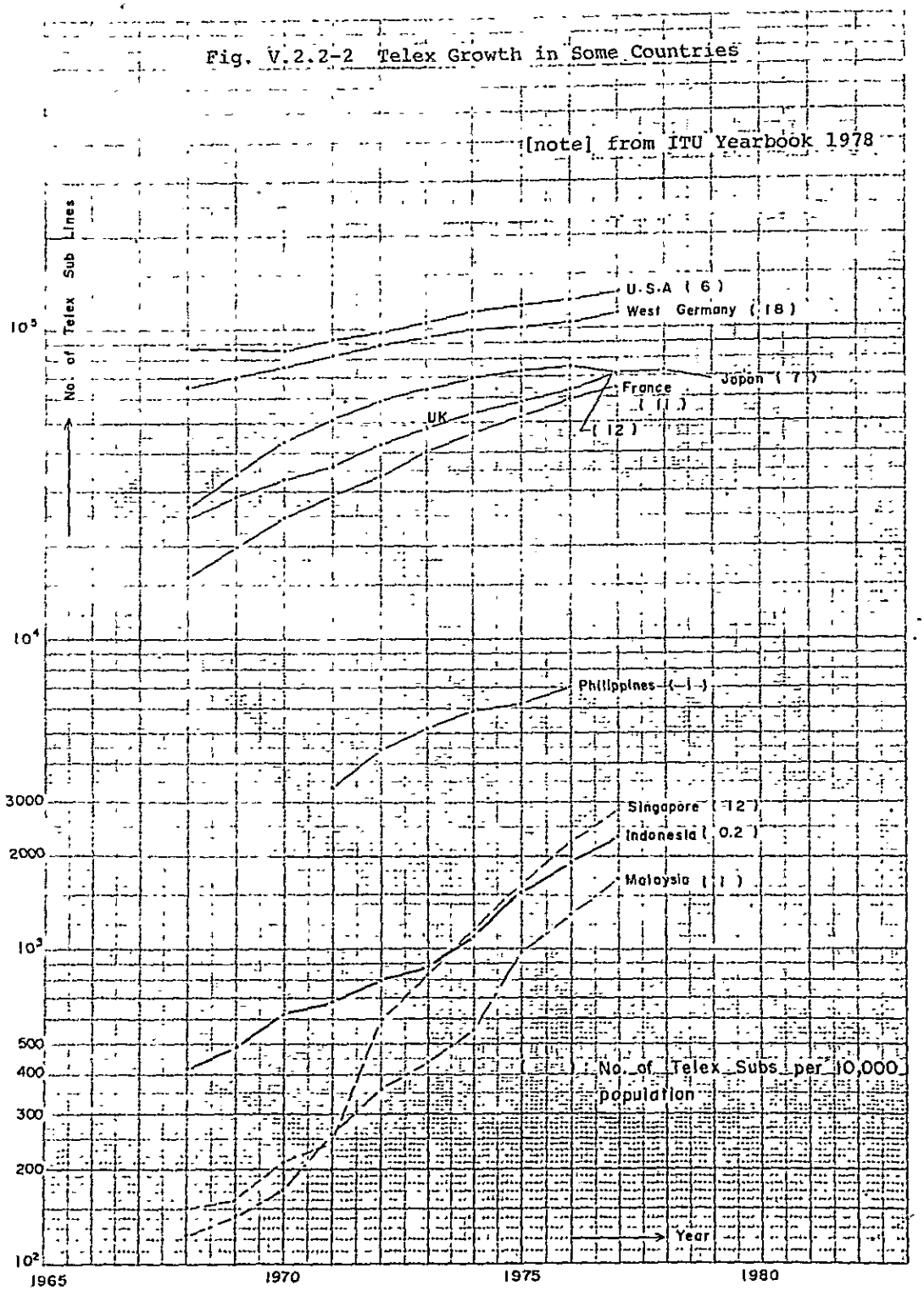


Fig. V.2.2-1 Telex Subscribers in the World

Fig. V.2.2-2 Telex Growth in Some Countries



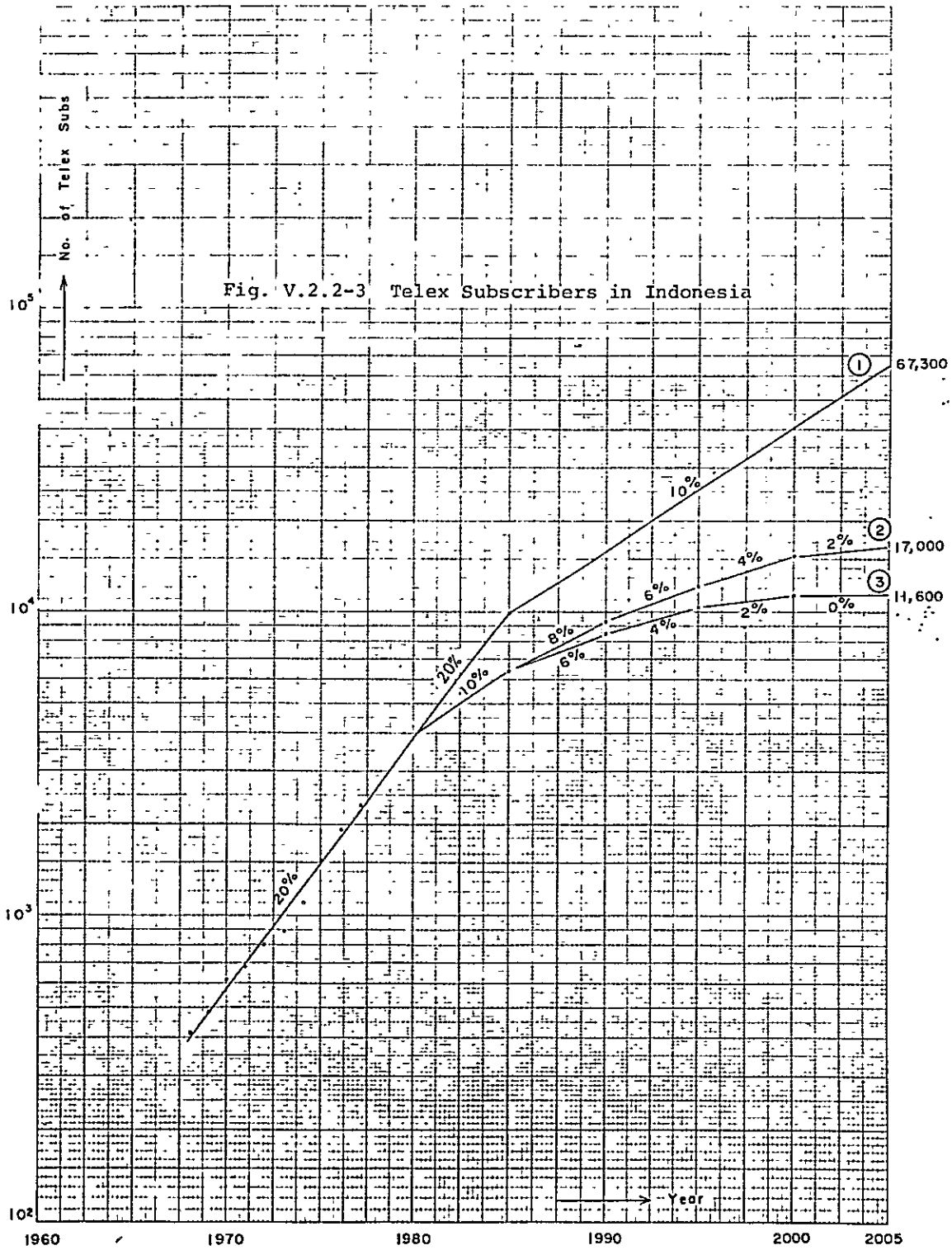


Fig. V.2.2-3 Telex Subscribers in Indonesia

is about 12,000 and the number of telex subscribers per 10,000 inhabitants is to be 0.5. It may be proper that the actual case will come intermediate (curve ② or nearly) between these two extreme cases.

2-2-3 Demand Distribution to Areas

By distributing the total number of demands in the whole country, which is given in Fig. V.2.2-3, to Sumatera Utara and Sulawesi Selatan depending on the population ratio*, we have such a telex demand forecast as given in Table V.2.2-1.

Table V.2.2-1 Telex Demand Forecast

Area	Pattern	(1980)**	1985	1990	1995	2000	2005
(Note) Sumatera Utara	①	(307)	580	930	1510	2440	3900
	②	(307)	380	550	730	900	990
	③	(307)	380	500	610	670	670
Sulawesi Selatan	①	(136)	440	700	1150	1850	2960
	②	(136)	290	420	550	690	750
	③	(136)	290	380	460	510	510

* See SECTION V, paragraph 2-1-4 of this report.

** Indicates the existing channel capacities of Medan and Ujung Pandang Offices.

Note: The number of telex demands forecast for the area to be served by this project is given in Table V.2.2-2.

Table V.2.2-2 Number of Telex Demands in Medan Area

Area	Pattern	(1980)	1985	1990	1995	2000	2005
Medan Area*	①	(307)	370	600	970	1560	2500
	②	(307)	240	350	470	580	630
	③	(307)	240	320	390	430	430

* Including Medan Kotamadya.

3. Standards

Transmission Standard

In this project the telecommunication network has been designed on the basis of the FUNDAMENTAL PLAN, 1972, PERUMTEL. For the rural telecommunication network and digital transmission lines using the MAS and SMA (subscriber loop multiplexer analog) equipment, which are not set out in the FUNDAMENTAL PLAN have been designed on the basis of the following standards in consideration of the recent trends of the CCITT and the CCIR.

(1) Reference (R.E.)

distribution of a transmission
the MAS and SMA is to be
in Fig. V.3.1.

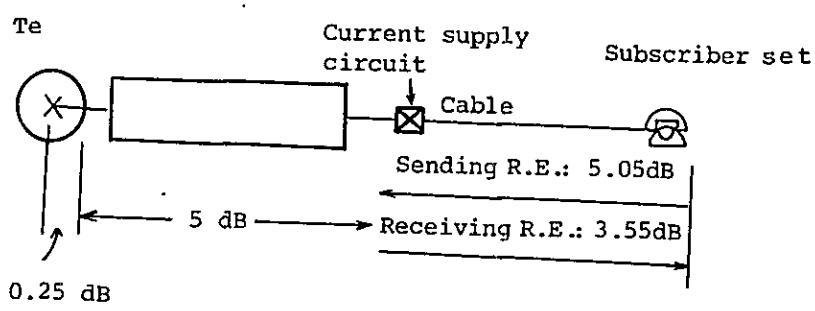


Fig. V.3.1

(2) Noise and bit error rate

1) Noise

The objective for the circuit noise of the MAS and SMA are to be equally 10,000pWOp.

2) Bit error rate

a) PCM radio relay equipment

The bit error rate per kilometer is not to exceed 10^{-10} for more than 80% of time.

b) PCM-30 equipment on cable

The bit error rate per kilometer is not to exceed 4×10^{-9} for any time.

3) Amplitude frequency response

For the MAS and SMA, the amplitude frequency response characteristics are to be 3/5 of that specified in Figure 1/G. 132, Orange Book, CCITT. For PCM systems, the amplitude frequency response characteristics are to meet Figure 1/G.712, Orange Book, CCITT.

3-2 Application Standards of Transmission Equipment

(1) Transmission equipment for subscribers

To be applied to demands in such Kecamatan that have demands less than those determined in the first year telephone setup standard.

1) SMA equipment

This equipment is to be applied to cases where

demands are comparatively concentrated to limited areas and line-of-sight condition is not achieved in radio wave propagation. The maximum applicable distance is about 24 kilometers in the case of 0.6 mm polyethelene insulated pair screened cable.

2) MAS equipment

This equipment is to be employed in cases where demands are spread in one plane and line-of-sight condition in radio wave propagation is achievable.

(2) Transmission equipment for toll circuits

1) PCM transmission on cable

This type of PCM transmission equipment is to be employed in such sections where the required number of channels is comparatively small and the line-of-sight condition can not be secured. The PCM-30 is to be employed, since this transmission equipment is to be connected with digital exchange. Polyethylene insulated pair screened cable is to be employed as the cable.

2) PCM transmission by radio

This method is to be employed in such sections where the line-of-sight condition in radio wave propagation can be achieved and the required number of channels is comparatively large.

4. Financial Analysis in the Case of Manual Switchboard Service

4-1 Sumatera Utara Project

The results of financial analysis for the implementation of the Sumatera Utara project by manual switchboard service supposed to be an employment opportunity producing type are as follows.

For the manual switchboard service to be employed, the estimated telephone demand is considerably small as compared in the case of automatic switching service and the total number of demands to be made in 1995 is to be about 8,700 subscribers. Suppose these demands are to be fulfilled each year uniformly for the period of 10 years and the total capacity corresponding to the intial investment is supposed to be 8,700 subscribers in ten years, the costs and earnings of this project can be estimated as follows.

Initial investment:	8355 (million Rp.)
Exchange (manual):	132 (million Rp.)
Trunk lines:	5220 (million Rp.)
Subscriber's lines and telephone sets:	2742 (million Rp.)
Buildings and power plants:	261 (million Rp.)
Maintenance cost (annual):	175 (million Rp.)
Operating cost (per subscriber):	60 (thousand Rp.)
Working capital cost:	30% of earnings
Earnings	
Subscription fee (per subscriber):	25 (thousand Rp.)
Basic rates (per subscriber, annual):	18 (thousand Rp.)
Toll call rates (per subscriber, annual):	100 (thousand Rp.)

The estimated cash flow statement of this project is as follows.

	Earnings				Costs				
	Subscript. Fee	Basic Rate	Toll call	Total	Initial Invest.	Maint. Cost	Operat. Cost	Working Capital Cost	Total
1					8355	175			8530
2	22	16	87	125	0	175	52	38	265
3	22	32	174	229		175	104	31	300
4	22	48	261	331		175	156	30	361
5	22	64	348	434		175	208	31	414
6	22	80	435	573		175	260	30	465
7	22	96	533	640		175	312	31	518
8	22	112	609	743		175	364	30	569
9	22	128	696	846		175	416	31	622
10	22	144	783	949		175	468	30	673
11	22	160	870	1052		175	520	31	726
12	0	160	870	1030		175	520	Δ4	691
								0	695
21	0	160	870	1030		175	520	Δ309	386

The estimated internal rate of return of this project is 0.05%.

The employment opportunities are to be provided to about 92 persons in the second year and to about 420 persons in the eleventh year on condition that the average annual wage per person is Rp.1,000 thousand and 32% of the maintenance cost and 70% of the operating cost correspond to the personnel cost. This increase in employment opportunities is considerably small when compared with that in the case of automatic switching service and corresponds to less than 1/2,

in the total sum, of the personnel cost, so that it may be concluded that this project of introducing manual switchboard service is not suitable as an employment enhancing project also.

4-2 Sulawesi Selatan Project

The results of financial analysis for the adoption of manual switchboard service for the Sulawesi Selatan are as follows. In this project investment for meeting demands by 1995 is to be made in 1983 and 1984 and investment for the expansion of facilities for meeting demands in 2005 is to be made in 1995. First, as many waiting demands as 3000 applicants are to be fulfilled by 1985 and the annual demands of 392 applicants are to be fulfilled until the total number of demands become 6920 by 2005. If the capacity is not sufficient, it is made up for by the investment for the expansion of facilities in 1995.

The estimated amounts of investment to be made in the initial phase and 1995 are as follows.

		1983	1984	1995
Breakdown	Total Investment	11,493	11,493	6,540
	Exchange	112	112	990
	Toll Lines	3,484	3,484	3,516
	Intra-Kecamatan Lines	7,691	7,691	0
	Local Lines and Telephone Sets	207	207	2,034

The estimated maintenance cost is 1.32% of the total investment and the estimated operating cost is 30% of gross annual earnings. The estimated earnings are as follows.

Subscription fee (per subscriber): 25 (thousand Rp.)
Basic rate (per subscriber): 18 (thousand Rp.)
Toll call charge (per subscriber): 71 (thousand Rp.)

The estimated balance of the project is as follows.

	Subscrpit. Fee	Basic Rate	Toll Call	Total	Initial Invest.	Maint. Cost	Operat. Cost	Working Capital Cost	Total
1					11,493				11,493
2					11,493				11,493
3	75	61	213	349		303	105	105	513
4	2	68	241	311		303	93	Δ12	384
5	2	75	269	346		303	105	12	420
6	2	82	297	381		303	115	10	428
7	2	89	325	416		303	125	10	438
8	2	96	353	451		303	135	10	448
9	2	103	381	486		303	145	10	458
10	2	110	409	521		303	155	10	468
11	2	117	437	556		303	165	10	478
12	2	124	465	591		303	175	10	488
13	2	131	493	626	6,540	390	185	10	7,125
14	2	138	521	661		390	195	10	595
15	2	145	549	696		390	205	10	605
16	2	152	577	731		390	215	10	615
17	2	159	605	766		390	225	10	525
18	2	166	633	801		390	235	10	535
19	2	173	661	836		390	245	10	545
20	2	180	689	871		390	255	10	555
21	2	187	717	906		390	265	10	565
22	2	194	745	941	Δ3,270	390	275	Δ265	Δ2,870

The total amount of costs is to be Rp.36,604 million whereas the total amount of earnings is to be Rp.12,243 million in this project, so that the total amount of costs is to be about three times as large as the total amount of earnings even if the discount rate is made zero. Accordingly, the implementation of this project will cause a great loss from the financial standpoint.

The employment opportunities to be provided by this project are for about 170 persons at the initial phase and about 320 persons in the final year of the project on condition that the annual average wage of a person is Rp.1,000 thousand, which is not so large when compared with the annual average employment opportunities of the automatic switching project (320 persons). Although requiring a small amount of investment at the initial phase, this project will cause a great loss and can not be determined to be feasible.

4-3 Evaluation of Manual Switchboard Service Project

The implementation of such a project as based on an employment enhancing type manual switchboard service in the Sumatera Utara and Sulawesi Selatan areas is not feasible at least from the financial standpoint. Moreover, the manual service project will not necessarily provide more employment opportunities than those to be provided bv the automatic switching project but may be less effective in giving employment opportunities as estimated in the case of Sumatera Utara. It may be concluded, therefore, that the manual switchboard service project is not recommendable even for the purpose of providing employment opportunities.

5. Recommendations

5-1 Future Plan for Kotamadya Medan

5-1-1 Telephone Demand Forecast

The telephone demand forecast for Sumatera Utara and distribution of forecast demands to Kabupaten and Kecamatan are described in SECTION III, paragraph 1. The distribution of the forecast demands to individual Kecamatan in Kotamadya Medan has been made in the same method and the results obtained are given in Table V.5-1.

Table V.5-1 Demand Forecast for Kotamadya Medan

Office Name (Kecamatan Name)	Forecast Demand Value		
	1985	1995	2005
Kota, Timur, Barat, Baru	16300	39100	93300
Belawan	1600	3800	9000
Labuhan	1400	3200	7700
Deli	1200	3000	7100
Sunggal	2200	5400	12800
Denai	3200	7700	18300
Johar	1300	3000	7300
Tuntungan	400	1100	2500
Total	27600	66300	158000

5-1-2 Demand Supply Program

Of the Kotamadya Medan, the old Kotamadya Medan (Kota, Timur, Barat, and Baru) is the political and economic center having Propinsi Office of Sumatera Utara and Kotamadya Office and Belawan is one of the major Indonesian trade ports, each of which has large telephone demands and is expected to provide a high income from telephone.

As explained in SECTION III, paragraph 3, the country is expected to afford an average telecommunication service level meeting its economic activities by fulfilling demands 100%, so that facility planning is to be made in consideration of the 100% fulfilment of demands in principle in both above-mentioned Kecamatan and other Kecamatan which are, being the satellite cities of the above-mentioned Kecamatan, experiencing a great increase in population.

5-1-3 Outline of Facility Planning

At present, Medan and Belawan Offices are located in the Kotamadya Medan.

Medan Office is an automatic exchange office having a capacity of 38 thousand subscriber's line units and serving the four Kecamatan of Kota, Tinur, Barat, and Baru which formerly formed the Kotamadya Old Medan (as of 1951) and which contain about 60% of the population of the Kotamadya.
Belawan Office is a manual switchboard office with a capacity of 360 subscriber's line units at present

and is expected to be automatized in near future to have a capacity of 1000 line units.
Including the largest trade port in Indonesia in its service area, Belawan Office presently serves about 6% of the total population of the Kotamadya. The Kotamadya Medan consists of eleven Kacamatan of which six Kecamatan scarcely offers telephone service at present. However, these Kecamatan of Medan have several industrialization plans, are experiencing remarkable population increase, and desire to set up telephone service as soon as possible. Described below are the outlines of the recommended office setup plan and junction network plan.

(1) Office setup plan

The names of Kecamatan where telephone offices are to be set up, the scales of these telephone offices to be set up, and the scales of expansion of the existing offices are given in Table V.5-2. Since the present capacity of Medan Office will be able to fulfil demands to be made by 1990, it is recommended to make a modification plan in which expansion should not be initiated in the first year and the existing offices are to be provided with the tandem function for those offices to be set up newly.
It is desirable to adopt digital exchange and provide the function of remote control of line concentrators to be installed outside the office.

Table V.5-2 Office Setup Plan and Capacity of Facilities

	Initial Capacity		Ultimate Capacity No of L.U	Office Building	Remarks
	Exchange Type	No. of L. U.			
Medan V	-	-	60,000^{T}	Standard Building	With tandem function
Belawan II	Digital Exchange	2,800^{T}	8,000^{T}	Same as above	
Labuhan	Same as above	3,200^{T}	7,700^{T}	Same as above	
Deli	Same as above	3,000^{T}	7,100^{T}	Same as above	
Sunggal	Same as above	5,400^{T}	12,800^{T}	Same as above	
Denai	Same as above	7,700^{T}	18,300^{T}	Same as above	
Johar	Same as above	3,000^{T}	7,300^{T}	Same as above	
Tuntungan	Same as above	1,100^{T}	2,500^{T}	Same as above	

(2) Junction network plan

By setting Medan Office as the Tandem Office, the number of channels of each junction line to be established between Medan Office and each office to be set up newly (as given in Table V.5-2) has been obtained under the following calculation conditions and the results of calculation are given in Table V.5-3.

Calculation conditions

Total traffic including intra-office calls: 0.1 erlang
Ratio of intraoffice connection: 30%
Trunk efficiency: 70%

Table V.5-3 Number of Channels between Tandem Office and Each Office to be set up Newly

Destination	Number of Channels		
	1985	1995	2005
Belawan	60	280	800
Labuhan	140	320	770
Deli	120	300	710
Sunggal	220	540	1280
Denai	320	770	1830
Johar	130	300	730
Tuntungan	40	110	250

The PCM-24 or PCM-30 system using metalic line is to be adopted in principle for the transmission line. For the Medan - Deli - Labuhan - Belawan link,

Medan - Denai link and Medan - Sunggal link of which the channel capacities are to be considerably large, the adoption of optical fiber transmission system may be recommendable. The locations of offices to be set up newly, an outline of the junction lines to be established, the number of demands forecast for each year, and the channel capacity of each route are shown in Fig. V.5-1.

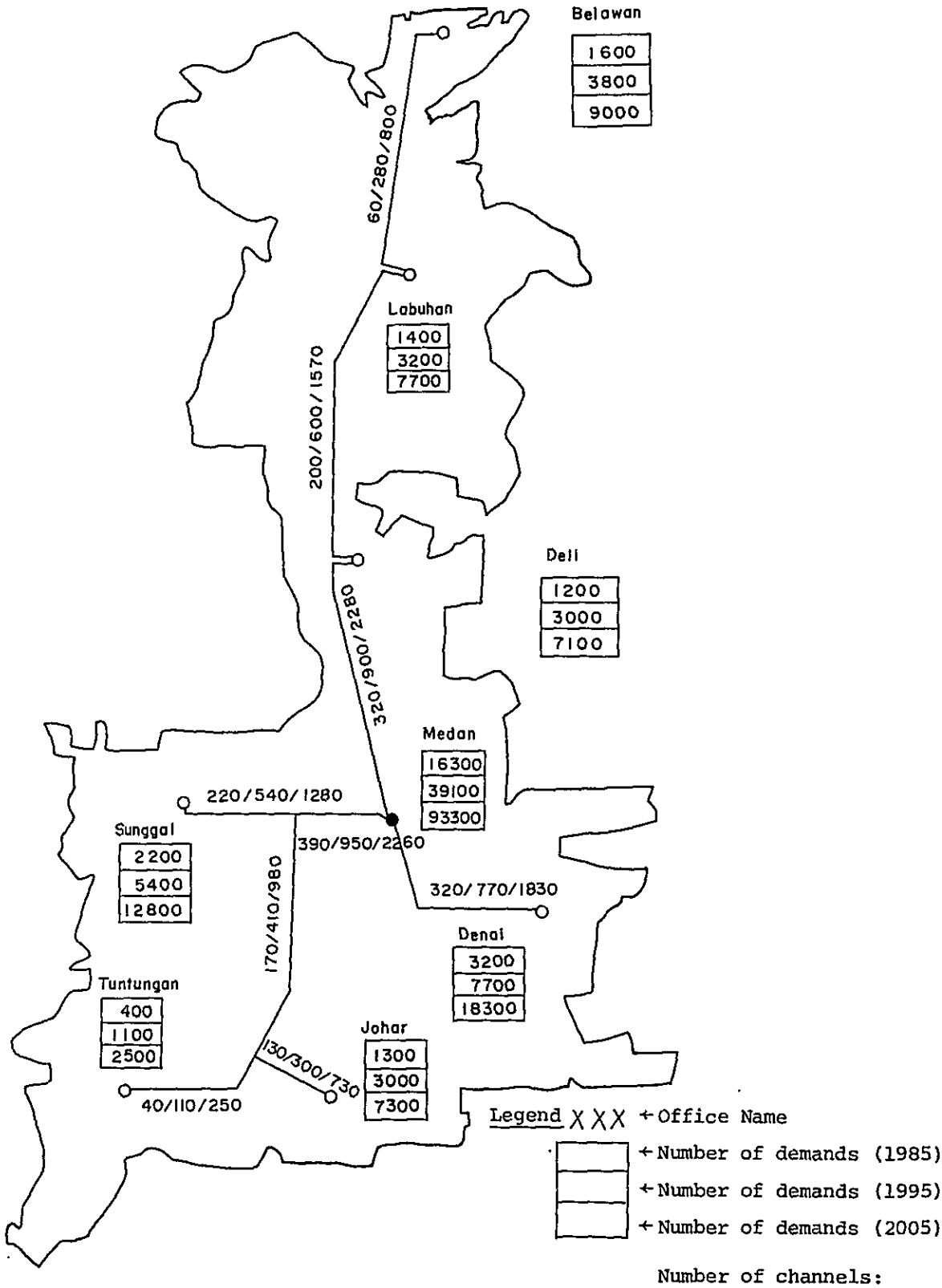


Fig. V.5-1 Medan Local Telecommunication Network Plan

5-2 Future Plan of Ujung Pandang and Pare Pare Cotamadya

5-2-1 Telephone Demand Forecast

Telephone demand forecast in areas other than Ujung Pandang and Pare Pare Kotamadya is described in the preceding SECTION IV "SULAWESI SELATAN." This paragraph describes the telephone demand forecast of Ujung Pandang and Pare Pare Kotamadya for the purpose of conducing to the future plan of these two Kotamadya.

The preceding SECTION IV shows that the total telephone demand forecast in Sulawesi Selatan excluding these two Kotamadya is as follows.

1985:	10,309 sets
1995:	13,606 sets
2005:	18,188 sets

On the other hand, it is generally known that a close relationship exists between the GDP per capita and the number of telephones per 100 inhabitants. Since GDP data for individual Kabupaten in Sulawesi Selatan was not available, we have used the income of the Propinsi instead. The income ratio of

Ujung Pandang and Pare Pare Kotamadya to other Kabupaten is calculated to be 78:22 by the 1978 statiscal data of Sulawesi Selatan. From this, we can estimate the telephone demand of the entire Propinsi for different years as follows.

Year	Total Telephone Demand Forecast for Propinsi	Telephone Demand Forecast for 2 Kotamadya
1985	46,859 sets	36,550 sets
1995	63,718 sets	50,112 sets
2005	82,673 sets	64,485 sets

Distribution to Ujung Pandang and Pare Pare Kotamadya is to be determined from the non-agricultural laborer population ratio of 88:12 (from 1978 statistic data) as follows.

Year	Ujung Pandang	Pare Pare
1985	32,164 sets	4,386 sets
1995	43,736 sets	5,964 sets
2005	56,747 sets	7,738 sets

5-2-2 Demand Fulfilment Plan

At present the demand fulfilment percentages of Ujung Pandang and Pare Pare telephone offices are equally 80%. In order to achieve a demand fulfilment percentage of 80% by 1985 and 100% by 2005 against demands increasing year after year, the following number of telephone sets will be required for these offices.

Year	Ujung Pandang	Pare Pare
1985	25,731 sets	3,509 sets
1995	39,362 sets	5,368 sets
2005	56,747 sets	7,738 sets

5-2-3 Future Plan

(1) Ujung Pandang Kotamadya

At present, Ujung Pandang-I Office (capacity: 10,000 line units – HKS) covers five Kecamatan within its service area and 49% of the total population of the Kotamadya is included in the service area. Ujung Pandang-II Office (capacity: 4,000 – BTM) covers two Kecamatan within its service area and at present 19% of the total population of the Kotamadya is contained in the service area. The remaining four Kecamatan including 32% of the total population of the Kotamadya have no telephone office at all. Suppose the telephone demand increases with the population, the telephone demand forecast of these two telephone offices and other area is as follows.

Year	UP I	UP II	Others
1985	12,608 sets	4,888 sets	8,235 sets
1995	19,287 sets	7,479 sets	12,596 sets
2005	27,806 sets	10,782 sets	18,159 sets

Accordingly, we recommend the following future plan.

A. The HKS Exchange (installed in 1967) currently used at Ujung Pandang-I Office has as small a

capacity as 10,000 line units, and it is necessary to change the exchange to an electronic exchange with an ultimate capacity of 30,000 line units.

B. The BTM Exchange used currently at Ujung Pandang-II Office is to be expanded to have a capacity of 11,000 line units in conformity with the demand fulfilment plan.

C. In order to provide service over the current non-telephone areas, at least two new offices are to be set up in the suburbs of Ujung Pandang.

In consideration of the future introduction of digital communication network, the new Ujung Pandang-I Office is to be of digital type and, at the same time, is to be furnished with toll transit facilities.

(2) Pare Pare Kotamadya

The ultimate capacity of the currently used PENTACONTA Exchange is 3,000 line units. A new electronic exchange with an ultimate capacity of 4,000 line units is to be set up by 1985. This exchange is to be of digital type and have toll transit facilities in preparation for the introduction of digital communication network as in the case of Ujung Pandang.

5-3 Radio Frequency Channel Assignment

(1) A radio transmission line between an end office and a primary center

Table V.5.3-1 gives the number of required telephone channels for transmission between an end office and a primary center. The number of required channels for each radio section is given in attached Fig. III.2.4-2-2~-5. From these data, a transmission capacity of 60 telephone channels per radio channel is recommended.

Fig. V.5.3-2 shows the distribution of a radio section distance. For radio sections of less than 20 km, transmission by cable is generally recommendable. In consideration of the transmission distance of about 35 km maximum and the above-mentioned transmission capacity per radio channel, the adoption of 800 MHz band is recommended.
When the transmission capacity per radio channel is 60 telephone channels, and when 4-phase shift keying modulation (4PSK) is employed, the transmission capacity is to be 4M bits/sec and the transmission speed 2M bauds. In this case, the method of radio frequency allocation to be employed is the problem. That is, one method is to obtain two radio channels from one radio frequency by using two oppositely polarized waves. The second method is to allocate frequency channels at intervals of a certain value and alternately change their polarization planes. Of course, the first method is much more advantageous from the standpoint of effective use of the radio frequency band.

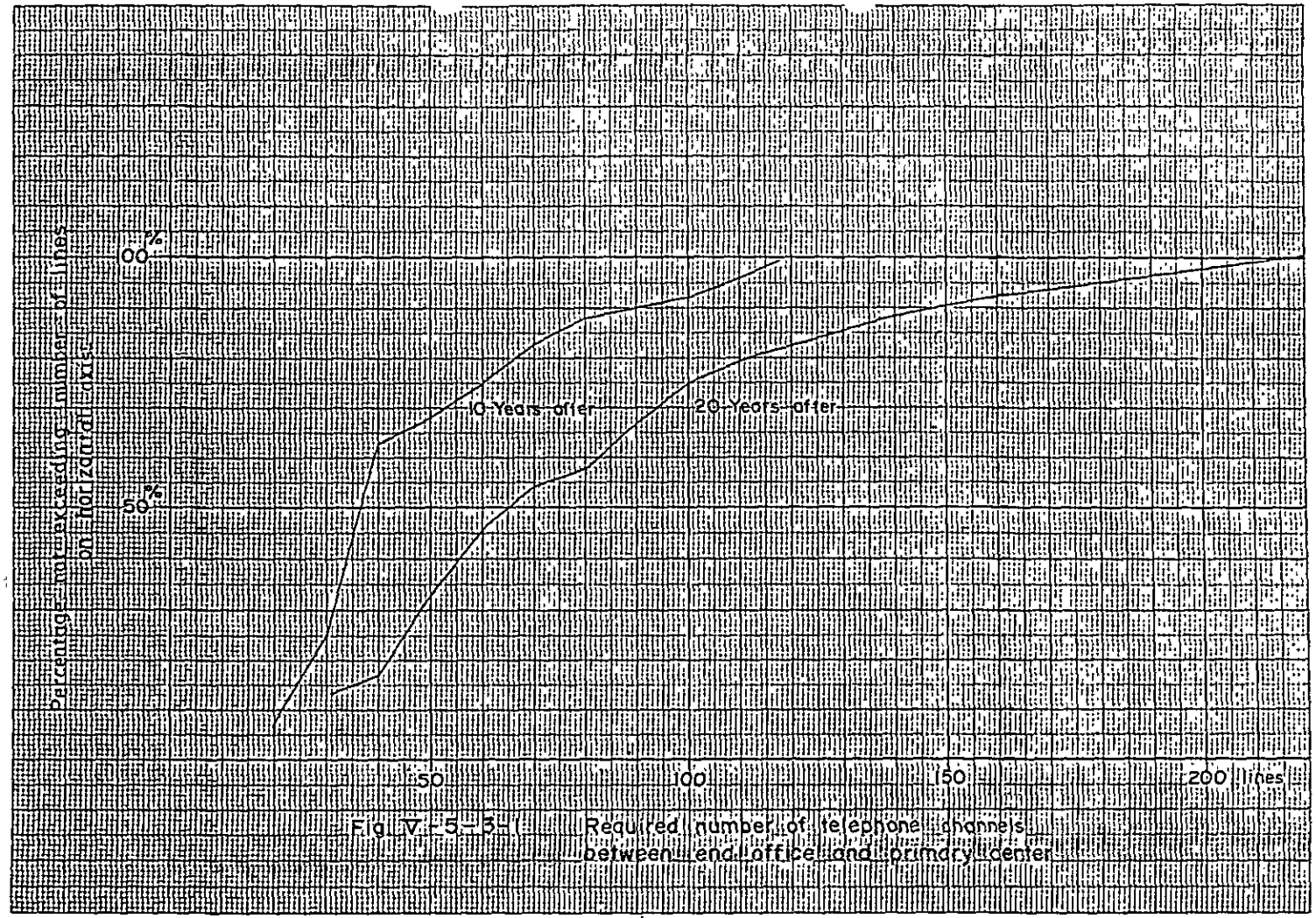

Percentage not exceeding number of lines on horizontal axis
100%
50%
10 Years after
20 Years after
50
100
150
200 lines
Required number of telephone channels between end office and primary center

Fig. V-5-3-1

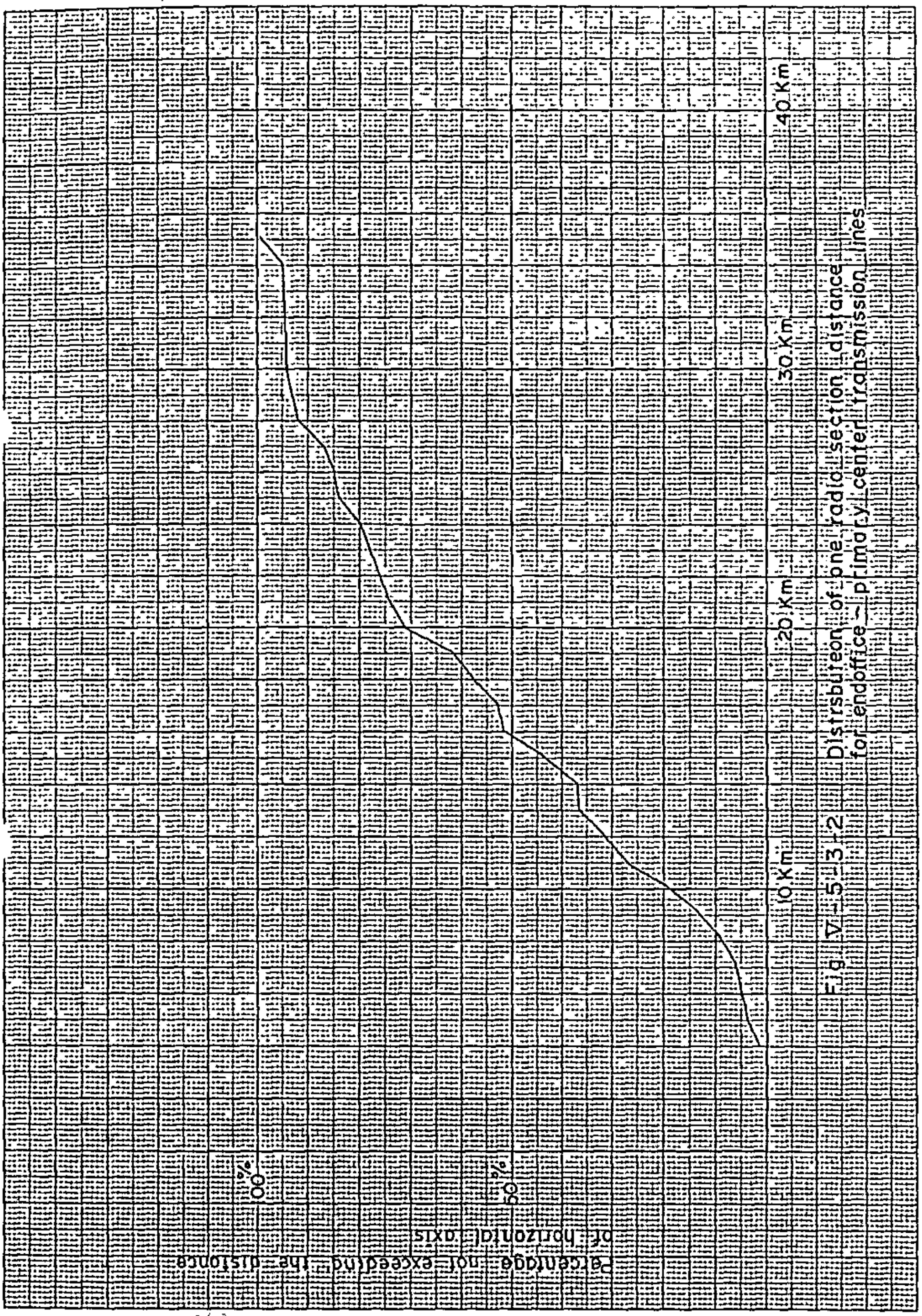


Fig. V-5-3-2 Distrsbuteon of one radio section distance
for endoffice – primary center transmission lines

The first method is disadvantageous for use when opposite polarization discrimination degrades upon occurrence of fading or rainfall. Accordingly, the first method is not suitable for comparatively high radio frequencies subject to fading or rainfall attenuation. The 800MHz band recommended for use between an end office and a primary center in this project is scarcely subject to fading and rainfall attenuation and, in addition, the distance of one radio seciton is about 35 km at the maximum, so that such a frequency allocation that uses two radio channels each with two orthogonally polarized waves is recommended. If this type of frequency allocation is employed, all that is required is to provide an adjacent radio frequency spacing of 1.5 x clock frequency, the minimum transmitting and receiving frequency separation of 3.5 x clock frequency, and the guard band of 0.8 x frequency separation between the upper and lower frequency edges.
In the case of the PCM-800MHz 60CH system, orthogonally modulated signals of 2M bits/sec are used in the 4PSK method and the transmission speed becomes 2M bauds. Accordingly, we have

Adjacent frequency spacing = 1.5 x 2 MHz = 3 MHz

Minimum transmitting and receiving frequency separation = 3.5 x 2 MHz = 7 MHz

Guard band between upper and lower edges = 0.8 x 2MHz = 1.6MHz

When such radio frequency allocation as above is employed, the problem is how many radio channels secured at maximum.
As per as Sumatera Utara is concerned, it may be

understood from Fig. V.5.3-1 that four channels plus one protective radio channel, that is a total of 5 radio channels (go and back), sufficient.
However, since the radio frequency allocation standard should be determined on a national scale, it may be better to set forth the radio frequency allocation standard after preparing a nationwide edition of Fig. V.5.3-1. Anyway, the allocation of the radio frequency of 800MHz as above is recommended as far as Sumatera Utara is concerned.

(2) Radio transmission line between primary and secondary centers

There are ten primary center ~ secondary center radio sections to be set up in this project. Of these radio sections,

- three radio sections are to be established by using existing coaxial cables,
- four radio sections are to be established by radio channel expansion to the Existing Trans-Sumatera Microwave System,
- one radio section is to be set up by radio channel expansion of the Band Ache Microwave System, and
- the remaining two sections are to be set up newly in this project.

The required numbers of channels for these radio sections are given in Table V.5.3-1 which indicates radio wave distances from Medan. From the data on the required channel capacity, distance from the secondary center, etc., given in this table, the 480-channels system using a 2GHz band may be most suitable.

Table V.5.3-1 Required Transmission Capacities for Transmission between Primary and Secondary Centers

Radio Section	No. of Channels (1985)	No. of Channels (1990)	No. of Channels (1995)	No. of Channels (2005)
To Binjai (20 km)	230	320	560	800
To Kabanjahe (56 km)	60	80	130	190
To Tebing Tinggi (60 km)	180	280	470	660
To Pematang Siantar (60 ,m + 42 km)	380	560	740	980
To Kisaran (60 km + 65 km)	160	230	380	530

Range that can be fulfilled by one radio frequency channel consisting of 480 telephone channels. ← → Range which requires more than 2 radio frequency channels for fulfilment

The baseband signal of 480 telephone channels has a capacity of 34M bits/sec and if the 4-phase shift keying modulation (4PSK) is adopted as in the case of the 800MHz system, the clock frequency becomes 17MHz. Accordingly, the adjacent frequency channel spacing obtained by the method described in the preceding paragraph is 17MHz x 1.5 = 25.5MHz. Then, the minimum transmitting and receiving frequency separation becomes 17MHz x 3.5 = 59.5MHz.

According to the frequency allocation set out in CCIR Recommendation 382-2, the recommended adjacent frequency channel spacing is 29MHz and the recommended minimum transmitting and receiving frequency separation is 68MHz.

It may be advantageous to apply these values as they are to this case. In this case also, the use of one radio frequency with two radio channels by orthogonally polarized waves may be employed, since the probability of the occurrence of fading and rainfall attenuation are small thanks to the frequency characteristics of the 2GHz band and the degradation of opposite polarization discrimination is small under the worst condition.

Fig. V.5.3-3 shows the relationship between the hierarchy of the time division multiplex telephone signal used at the carrier repeater station and the required pulse train for the radio circuit.

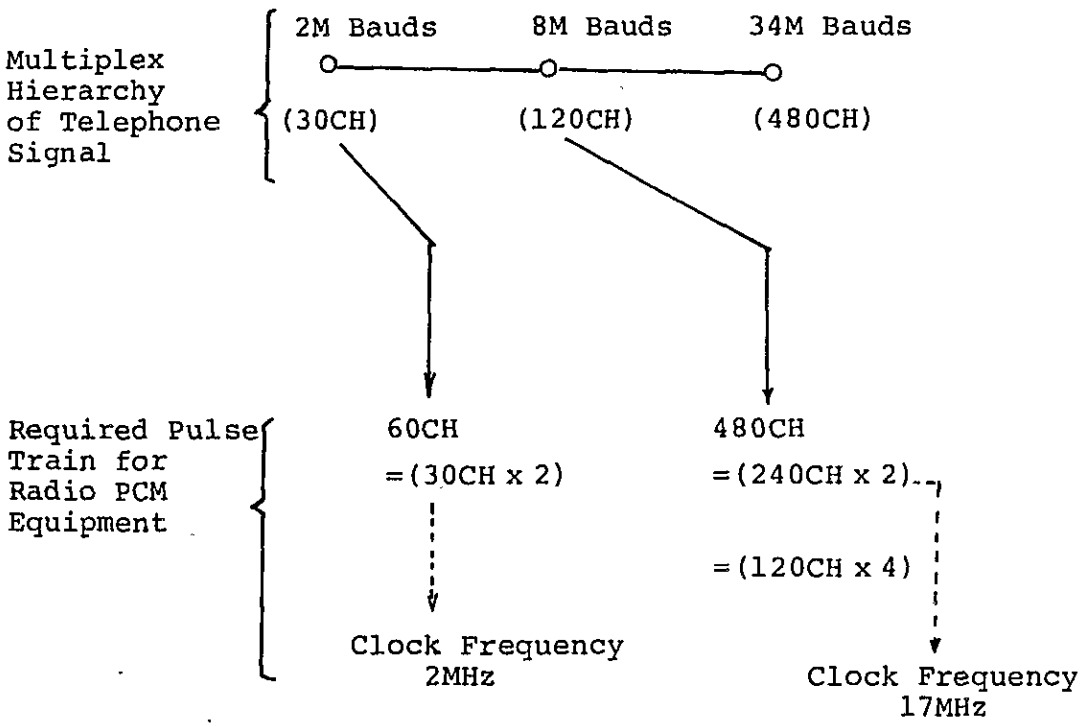


Fig. V.5.3-3 Relationship between Time Division Multiplex Telephone Signal Hierarchy and Required Pulse Train for Radio Circuit

(3) Frequency allocation necessary for MAS system

The scales of MAS systems planned for five Kabupaten of Sumatera Utara are given in Table V.5.3-2.

Table V.5.3-2 Scales of MAS Systems Planned in 5 Kabupaten in Sumatera Utara

Kabupaten	No. of Base Stations	No. of Kecamatan	No. of Systems	No. of Subscriber's Equipment (sets)
Langkat	3	10	6	200
Karo	2	6	3	86
D. Serdang	6	17	10	323
Simalungun	4	9	5	163
Asahan	3	8	4	126
Total	18	50	28	898

As shown in the table, a total of 18 base stations are to be set up over five Kabupaten and a frequency band to cover 28 systems (each to consist 8 radio channels) is to be employed. By this 50 Kecamatan are to be served and 898 sets of subscriber's equipment are to be set up. When MAS is introduced on such a large scale as this, it is important to achieve a rational frequency allocation.
A plan for frequency allocation made by frequency repetition on condition that the D/U against interference is to be more than 30 dB is shown in Table V.5.3-3.

In this plan, the required number of systems is 16 for the required frequency band of 28 systems.
For the frequency band to be used, the 400MHz or 800MHz band may be suitable. A frequency band of 18MHz width is necessary if one system is supposed to use 8 radio channels and 20 systems are accommodated in the band (up and down) as shown in Fig. V.5.3-4.
For introducing the MAS system on a nationwide scale, it is very rational to secure two groups of 18MHz bandwidth and use threse groups alternately for adjacent provinces.

Table V.5.3-3 A Frequency Band Assignment Plan for MAS System

Kabupaten	Base Station	Required No. of Systems	Assigned System No.
Langkat	Pangkaran Susu	1	1
	Tanjung Pura	2	2, 3
	Binjai	3	4, 5, 6
Karo	Tigabinanga	2	2, 3
	Kabanjahe	1	1
Deli Surdang	Belawan	1	7
	Delitua	2	8, 9
	Birubiru	2	10, 11
	Galang	1	13
	Lubuk pakam	1	12
	Tebing Tinggi	3	14, 15, 16
Simalungun	Serberawan	1	11
	Pematang Siantar	1	10
	Samosir	1	4
	Simarijarunjung	2	5, 6
Asahan	Kisaran	1	1
	Tanjung Balai	1	2
	Air Batu	2	3, 4
Total		28	

Note: One system is supposed to consist of 16 radio channels and can accommodate 8 telephone circuits.

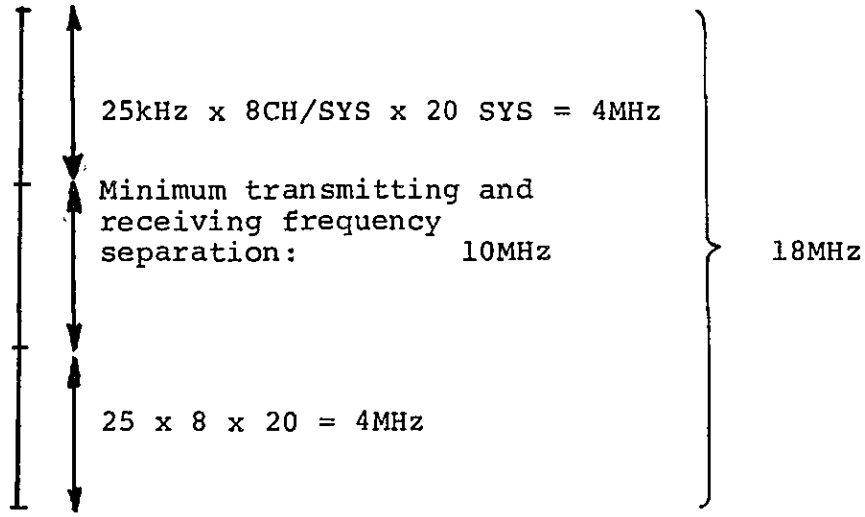


Fig. V.5.3-4

As shown in Table V.5.3-3, radio equipment of a maximum of 3 systems (24 radio channels or 48 radio frequencies) per MAS base station will be accommodated so that in making the detail design of base station, it is necessary to take due care for arrangement and composition of the transmitters and use transmitting and receiving antennas separately so as to sufficiently suppressing interference due to intermodulation.

5-4 TDM-PCM Multiple Access Radio Equipment, Digital MAS and Others

Let us first consider the TDM-PCM multiple access radio equipment. Radio transmission lines of 19 radio sections and a total distance of about 390 km are to be set up in the first year of this project over five Kabupaten in Sumatera Utara, as mentioned earlier. These transmission lines are to be used as interlocal lines to connect 26 telephone offices (end offices) to be set up in 1985. The number of telephone offices to be set up in 1995 is to be 41 and that to be set up in 2005 is to be 56. Those Kecamatan not to fall within the ordinary telephone service area are connected to adjacent telephone offices by means of the MAS equipment.

When telephone offices are to be constructed in such areas where subscriber telephone service is currently given by the MAS equipment, the MAS subscriber lines may be replaced by conventional PCM radio equipment as a transmission lines of an end office ~ a primary centre in future. Because the number of the MAS telephone service due to increasing the subscribers. And because the new transmission line connected to a primary centre from the end office is needed in place of a radio section of the MAS. The matter mentioned above may bring increasing a radio trunk line. This is one of the special feature of the five Kabupatens in Sumatera Utara, which means that Kecamatan where telephoen offices are to be constructed in future are spread in a two-dimensional way (on a plane). That is, the society is expected to develop uniformly on a plane. How interlocal call transmission lines are to be set up for telephone offices to commence service after 1985 is a very important problem from the economical standpoint. As already stated, if these telephone offices to be constructed newly after 1985 are to be connected by radio, one radio section length is to be approx. 15 km and the number of required telephone channels at 75% is estimated

to be about 60.
On the other hand, at the time of constructing these telephone offices the time division multiplex method will probably be the most dominant system.
Under these conditions, the time division multiplex multiple access radio transmission by using PCM is recommended. In this system, the time division multiplex multiple access radio equipment is to be set up at a geographical center so as to emit radio waves uniformly from the master station to be located at the geographical center to dotted telephone offices or receive radio waves from slave stations. By assigning specific time slots to telephone offices in individual directions, multiplex telephone signals are to be transmitted to/from individual slave telephone offices depending on the time slot sequence. Possible specifications may be roughly as follows.

- Time slots are to be assignable in blocks of 30 channels in individual directions.
- As many time slots as for maximum 4 ~ 5 directions are to be provided.
- The total channel capacity is to be about 480 channels.
- The BER is to be about 10^{-8}.

That is, a total capacity of 34M bits/sec is to be assigned to or collected from predetermined time slots.

In the case of the FDM-FM transmission system also, interference, frequency assignment, etc., may become problems when radio wave emission is made from one point to the groundings. In addition, when a compara-

tively wide frequency band is necessary as in the case of a digital system, the economy of working frequencies becomes a more important program. One of the special features of the time division multiplex PCM multiple access radio is a distinguished efficiency in frequency assignment. In addition, it is not necessary to install radio transmitter-receiver equipment for every directions at the master station, which is very advantageous for the economy of floor space in the building.
For the time being, equipment with a total transmission capacity of 3M bits/sec are being developed for commercial use and manufacturers are making efforts to raise the transmission capacity of the equipment. Such equipment that provides a transmission capacity of 34M bits/sec or so will be manufactured in near future if there are demands.

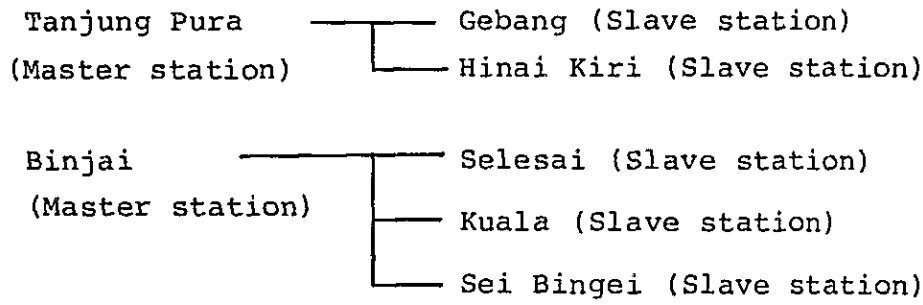
Table V.5 4-1 shows the trends of the numbers of Kecamatan which telephone service by the MAS system is to be given in each Kabupaten.

Table V.5.4-1 Trends of Telephone Service by MAS Equipment

Kabupaten	Number of Kabupaten in MAS Service in 1985	Number of Kabupaten in MAS Service in 2005
Langkat	10	4
Karo	6	5
Deli Sardang	17	6
Simalungun	9	6
Asahan	8	3
Total	50	24

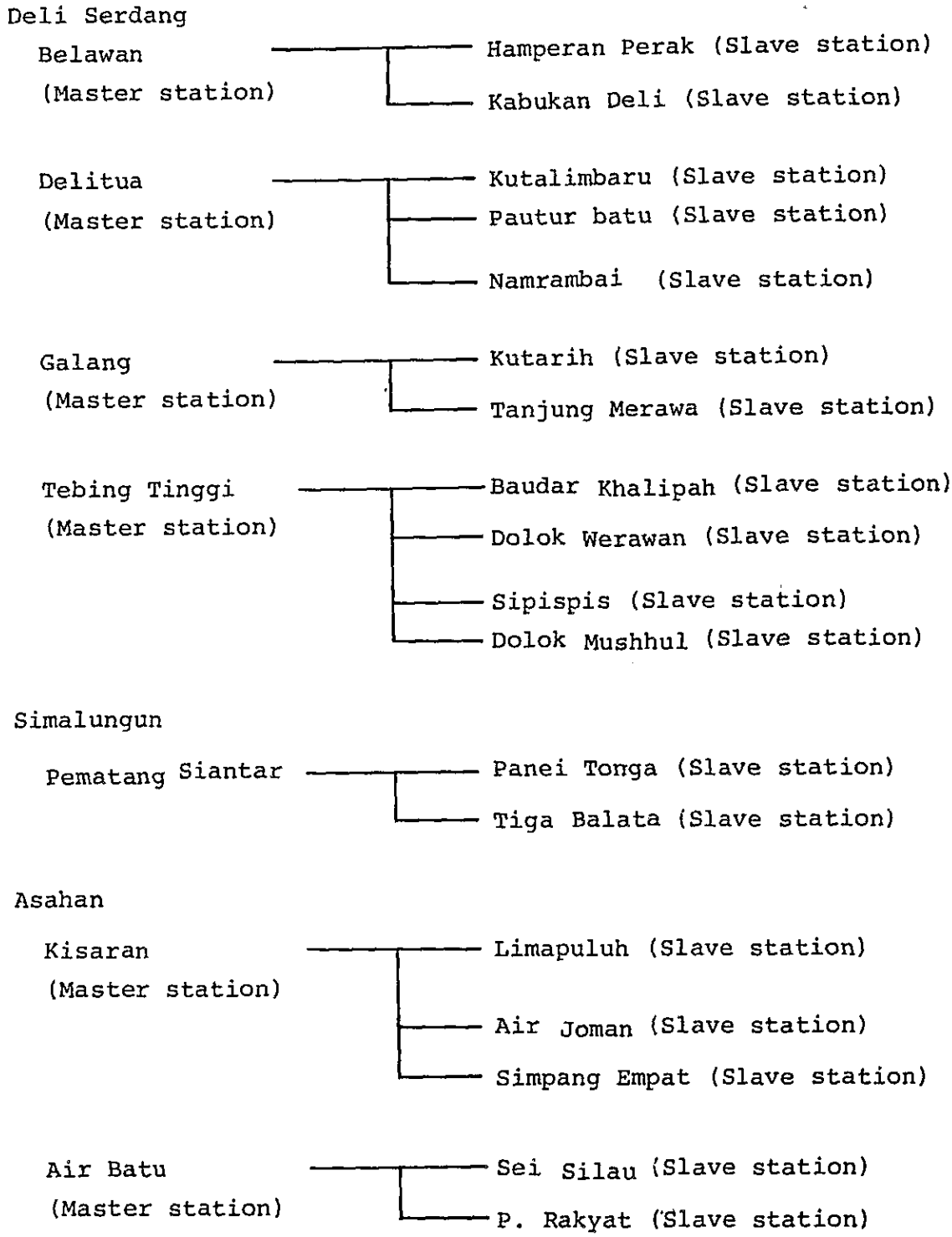
As shown in the table, 50 Kecamatan are to recieve telephone service by MAS method in the first year of the project and in 20 years later new telephone offices are to be set up but 24 Kecamatan are to still receive telephone service by the MAS.
By this, the number of base stations are to be decreased. In the first year of 1985, 18 base stations are to be set up but 20 years later three MAS base stations in Dele Surdang, three MAS base stations in Simalungun, and one MAS base station in Asahan are to disappear, that is, a total of seven base stations are to disappear.
Instead of these MAS base stations expected to to replaced by as many new telephone offices as already mentioned are to be set up newly.
The end office ~ primary center transmission line conditions to be presented after 1985 are shown below for cases where PCM time division type multiple access multiplex equipment using the digital system may be applicable.

Langkat



Karo

Not applicable


Deli Serdang
Belawan
(Master station)
Hamperan Perak (Slave station)
Kabukan Deli (Slave station)
Delitua
(Master station)
Kutalimbaru (Slave station)
Pautur batu (Slave station)
Namrambai (Slave station)
Galang
(Master station)
Kutarih (Slave station)
Tanjung Merawa (Slave station)
Tebing Tinggi
(Master station)
Baudar Khalipah (Slave station)
Dolok Werawan (Slave station)
Sipispis (Slave station)
Dolok Mushhul (Slave station)
Simalungun
Pematang Siantar
Panei Tonga (Slave station)
Tiga Balata (Slave station)
Asahan
Kisaran
(Master station)
Limapuluh (Slave station)
Air Joman (Slave station)
Simpang Empat (Slave station)
Air Batu
(Master station)
Sei Silau (Slave station)
P. Rakyat (Slave station)

Let us now consider digital MAS equipment.
Some digital type MAS equipment have been already put into commercial use. Since sufficient data of digital type MAS equipment has not been obtained this time, this project has been planned on the assumption of adopting analog type MAS equipment. However, the adoption of digital MAS equipment is more advantageous from the standpoints of compatibility with other digital equipment, service versatility and compatibility with subscriber's lines using cable. From the standpoints of economy and operation, digital MAS equipment are essentially reasonable in price and tend to perform stable operation.

Digital MAS equipment will generally be used extensitively from now on as PCM multi access multiplex equipment, so that if the adoption of digital MAS equipment is achievable upon implementing this project, digital MAS equipment should be employed.

Now let us consider an outline of digital MAS equipment applicable to this project for reference's sake.
A radio frequency having been phase modulated with a signal of approx. 1M bits/sec which has 15 time slots is to be emitted from the radio base station, which corresponds to a radio base station having 15 radio channels. That is, the maximum number of subscribers allowed to use telephone at a time is 15. One time slot is assigned to one subscriber, the second time slot to another subscriber,.... Of course, these time slots employ the demand assignment method and the correspondence between subscribers and time slots is

determined depending on the originating and terminating conditions of telephone calls.
The subscriber's equipment at the receiving side picks up only the signal on the assigned time slots to form a telephone signal.

Let us now consider the telephone signal from the subscriber's equipment to the radio base station (up link). In this case, all subscriber's equipment belonging to a certain radio base station are synchronized with each other and signal emission from a certain subscriber's equipment is made only at a certain time slot and the next time slot is assigned to another subscriber's equipment. As the result, signals on assigned time slots are sequentially sent from individual subscriber's equipment to the receiver of the radio base station.
It is to be noted, however, that some difficulties are encountered in the technique of the up link in manufacturing equipment and thus the radio base station capacity is restricted by these difficulties accordingly.

Described so far is an outline of digital MAS radio equipment. The adoption of digital MAS equipment assures, in addition to the advantages of digitalization, extremely effective use of radio frequencies as already mentioned.
That is, 15 channels can be secured per one radio frequency at a time. This is one of the major feature of digital MAS radio equipment. Accordingly, MAS repeater equipment (mentioned later) can be easily realized because of the reuse of less radio frequencies and

thus the application of the MAS system is greatly extended. For the channel quality, it is easy to obtain a BER of 10^{-8} normally (between radio base station and subscriber's equipment).

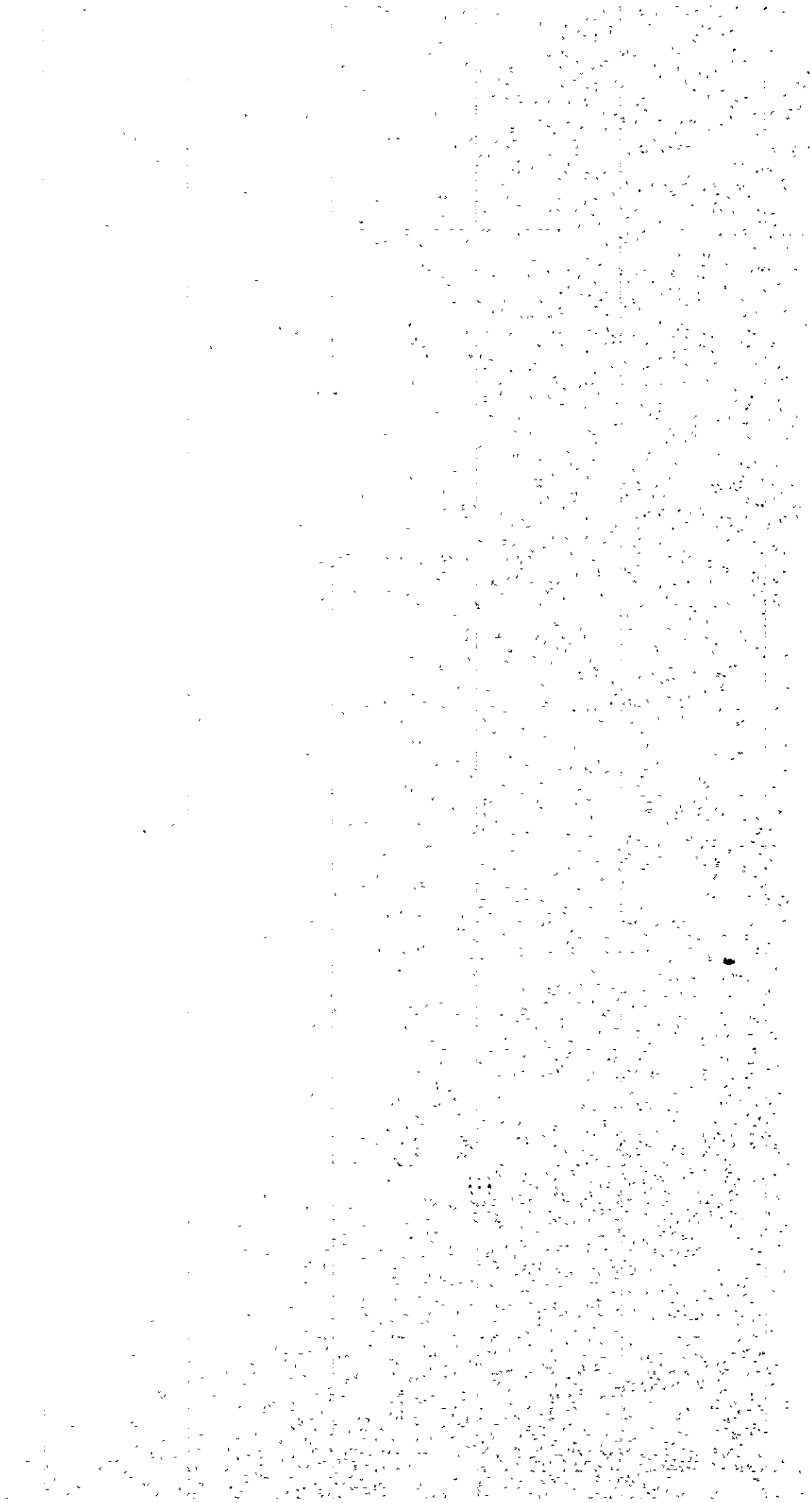
The price of a subscriber's equipment is almost equal to that of an analog equipment and the price of a radio base station is 2.5 ~ 3 times as large as the price of an analog radio base station. Although an analog type radio base station can accommodate 44 subscriber's equipment by 8 radio frequencies (at 0.071 erl/subscriber and 1% calling less rate), a digital radio base station can accommodate 114 subscriber's equipment by 15 time slots (at the same calling rate and calling less rate). Accordingly, the price of analog radio base station per subscriber's equipment and that of digital radio base station per subscriber's equipment are nearly equal to each other.
Digital type MAS equipment are now good enough to cope with analog MAS equipment from the standpoint of economy also, as stated above. Accordingly, it is recommended to determine whether to adopt or not digital MAS equipment by thoroughly examining the supply record of digital MAS equipment manufacturers and equipment maintenability and reliability (against trouble) at the time of detailed design.

Now let us consider MAS repeaters.
When the subscriber's equipment is located beyond the reach of the radio wave from the base station

in the MAS, it was recommended to place the subscriber's equipment at the repeating point of the radio wave and set up a fixed radio link by VHF from the repeating point to the subscriber's house. However, this requires a radio frequency to be assigned to each channel for the fixed radio link by VHF, which is not desirable for many subscribers from the standpoint of radio frequency assignment. Therefore, by using an active converter at the repeating point and amplifying and converting the radio wave from the base station or the radio wave from the subscriber's equipment, the MAS subscriber's equipment and repeater equipment can be set up quite rationally and economically.
At present, it seems that the demand for the MAS itself is not large and manufacturers are hesitating to actually produce MAS equipment. However, if MAS equipment are to be introduced in a great scale as in this project, there may be such manufacturers that will deliver equipment while meeting these requirements sufficiently. Accordingly, it is recommended to set out the use of such active converter type repeaters as mentioned above in the specification.

As mentioned in the paragraph on digital MAS equipment, MAS repeaters exhibit their merits sufficiently when used in a digital system. From this standpoint also, the adoption of the digital type MAS is recommended.

V-6 Attached Drawings and Tables



Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (1/10)

(Langkat - 1/2)

Kecamatan (Office Name) \ Year	Type of Planned Equipment (No. of line units) / No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
① Gebang (Gebang)	MAS → Office Setup (500T)					MAS to be accommodated at ⑨.
	18	36	199		453	
② Besitang	MAS					MAS to be accommodated at ②.
	18		41		44	
③ Pk. Susu (Pk. Susu)	Existing Ex. (Manual) → Automatization (400T)					
	46		105		239	
④ Babalan (Pk. Brandon)	Existing Ex. (Auto) (400T) + MAS → (Expansion) (+200T)					Automatization to be accomplished in 1981. Accommodated at ②. Numbers in ( ) indicate the number of fulfilled demands.
	174 (18)*		400 (41)*		920 (44)*	
⑤ Stabat (Stabat)	Office Setup (800T) → (Expansion) (+800T)					Regional merger with ⑦. * indicates the number of fulfilled demands.
	154 (135)*		352 (310)*		800 (705)*	
⑥ Padang Tualang	MAS					To be accommodated at ⑨.
	5	8	43		44	
⑦ Hinai	Regional merger					Regional merger with ⑤.
	153		310		705	
⑧ Sicanggang (Hinai Kiri)	MAS → Office Setup (400T) → (Expansion)					MAS to be accommodated at ⑨.
	21		247		562	
⑨ Tanjung Pura (Tj. Pura)	Automatization (400T) + MAS → (Expansion) (400T)					①, ⑥ and ⑧ to be accommodated by MAS. * indicates the number of fulfilled demands.
	138 (44)*		316 (44)*		719 (44)*	
⑩ Sei Bingei (Sei Bingei)	MAS → Office Setup (600T)					MAS to be accommodated at ⑪.
	40	40	40		252	

Note: All numbers of fulfilled demands are accumulated ones and the numbers of line units to be increased by expansion are not accumulated ones.

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (2/10)

Kecamatan (Office Name) \ Years	Type of Planned Equipment (No. of line units) / No. of Fulfilled Demands					Remarks
	1985	1990	1995	2000	2005	
⑪ Binjai (Binjai)	Existing Ex. (Auto) (+3600T) + MAS → (Expansion) (+5900T) →					⑩ ⑫ ⑭ and ⑲ to be accommodated by MAS. Figures in ( ) indicate the No. of fulfilled demands. No. of existing line units: 1000
	1860 (88)		4469 (88)		10337 (88)	
⑫ Salapian	MAS → Office Setup ( ) →					MAS to be accommodated at ⑪.
	17	35	35	35	215	
⑬ Kuala (Kuala)	Existing Ex. (Manual) (30T) → Automatization (400T) → (Expansion) (400T) →					
	30		186		423	
⑭ Selesai (Selesai)	MAS → Office Setup (400T) → (Expansion) (400T) →					MAS to be accommodated at ⑪.
	44		242		551	
⑮ Bohorok	MAS →					To be accommodated at ⑪.
	7	13	13	13	23	
Langkat Total No. of Fulfilled Demands	2725		6998		16287	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (3/10)

(Karo - 1/1)

Kecamatan (Office Name) \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
① Kabanjahe (Kabanjahe)	Existing Ex. (Manual) + MAS: 393 (37)		(Expansion) (+1400T): 645 (44)		1932 (44)	To be automatized by 1985 (800). Regional merger of ③ and ⑤. MAS to be accommodated at ④.
①' Berastagi (Berastagi)	Automatization (400T): 231		(Expansion) (+800T): 379		1136	
② Payung (Tiganderket)	MAS: 46		Office Setup (400T): 46		240	MAS to be accommodated at ⑥.
③ Simpang Empat	(Regional Merger): 36		76		176	Regional merger with ①.
④ Barus Jahe	MAS: 37		44		44	To be accommodated at ①.
⑤ Tiga Panah	(Regional Merger): 25		52		120	Regional merger with ①.
⑥ Tiga Binanga (Tiga Binanga)	Automatization (200T) + MAS: 30 (132)		(Expansion) (+200T): 64 (132)		149 (132)	Figures in ( ) indicate No. of fulfilled demands of ⑦, ⑧, ⑨, and ⑩ to be accommodated by MAS.
⑦ Mardinding	MAS: 10		10	12	12	To be accommodated at ⑥.
⑧ Munte	MAS: 31		31	43	43	To be accommodated at ⑥.
⑨ Juhar	MAS: 21		21	25	25	To be accommodated at ⑥.
⑩ Kota Buluh	MAS: 16		16	19	19	To be accommodated at ⑥.
Karo Total No. of Fulfilled Demands	876		1384		3896	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (4/10)

(Deli Serdang - I/3, Medan Area)

Kecamatan (Office Name) \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
① Hamparan Perak (Hamparan Perak)	MAS → Office Setup (600T) → Expansion (T) →	33		377	861	MAS is to be accommodated at Belawan.
② Labuhan Deli (Labuhan Deli)	MAS → Office Setup (600T) →	11	44	44	327	Same as above.
③ Sunggal (Sunggal)	Office Setup (600T) → (Expansion) (+600T) →	225		514	1174	
④ Delitua (Delitua)	Office Setup (1000T) → Expansion (+800T) →	126 (327)*		287 (521)*	656 (964)*	Regional merger with ⑤. ⑦~⑪ to be accommodated by MAS. * indicates the No. of fulfilled demands.
⑤ Patumbak	(Regional Merger)	151		345	788	Regional merger with ④.
⑥ Percut Sei Tuan (Tembung)	New Office (1000T) R → Expansion (+1000T) →	359		819	1871	Remote control of ⑬ office. R: Remote Control
⑦ Biru-Biru (Biru-Biru)	MAS → Office Setup (T) →	23	23	23	45	219	MAS is to be accommodated at ④.
⑧ Kuta Limbaru (Kuta Limbaru)	MAS → Office Setup (T) →	23	23	23	43	213	Same as above.
⑨ Namorambai (Namorambai)	MAS → Office Setup (600T) →	39	39	39		365	Same as above.
⑩ Pancur Batu (Pancur Batu)	MAS → Office Setup (800T) →	44	44	44		408	Same as above.
⑪ Sibolangit	MAS →	19	19	19	36	36	Same as above.

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (5/10)

(Deli Serdang - 2/3, Medan Area)

Kecamatan (office Name) \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
⑫ Galang (Galang)	Automatization ——→ (Existing) ——→ (400T) + MAS (+400T)					⑲ and ⑳ to be accommodated (MAS)., *indicates No. of fulfilled demands at ⑲ and ⑳ .
	130		296		677	
	(88)*		(88)*		(88)*	
⑬ Batang Kuwis (Batang Kuwis)	Office Setup (R) (400T)					⑥ to be control station.
	134		306		700	
⑭ Pantai Cermin	Regional Merger					To be accommodated at ⑰ (Regional merger).
	112		255		583	
⑮ Tanjung Morawa (Tanjung Morawa)	MAS ——→ Office Setup ——→ (Expansion) ——→ (600T) (+600T)					MAS to be accommodated at Medan.
	44		345		788	
⑯ Lubuk Pakam (Lubuk Pakam)	Automatization ——→ (Expansion) ——→ (800T) (+800T)					
	273		624		1425	
⑰ Perbaungan (Perbaungan)	Office Setup ——→ (Expansion) ——→ (800T) (+800T)					⑭ to be accommodated (regional merger). * indicates No. of fulfilled demands at ⑭ .
	165		377		863	
	(112)*		(255)*		(583)*	
⑱ Gunung Meriah	MAS ——→					To be accommodated at ④ (MAS).
	5	5	5	10	10	
⑲ Kota Rih (Kota Rih)	MAS ——→ Office Setup ——→ (800T)					To be accommodated at ⑫ (MAS)
	54	54	54		379	
⑳ Bangun Purba	MAS ——→					To be accommodated at ⑰ (MAS)
	34	34	34	88	88	
㉑ Senembah Tanjung Mude Hilir	MAS ——→					To be accommodated at ④ (MAS).
	15	15	15	29	29	
㉒ Senembah Tanjung Mude Hulu	MAS					To be accommodated at ④ (MAS).
	6	6	6	12	12	
Total No. of fulfilled demands by Medan Secondary Center	2025		4851		12472	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (6/10)

(Deli Serdang - 3/3, T. Tinggi Area)

Year / Kecamatan (Office Name)	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
(23) Dolok Merawan (Dolok Merawan)	MAS → Office Setup (400T) → (Expansion) (+600T) →					MAS to be accommodated at (26).
	11		287		656	
(24) Bandar Khalifah (Bandar Khalifah)	MAS → Office Setup (400T) → (Expansion) (+600T) →					MAS to be accommodated at (26).
	12		297		679	
(25) Sipispis (Sipispis)	MAS → Office Setup (600T) → (Expansion)					MAS to be accommodated at (26).
	8	20	226		517	
(26) Tebing Tinggi	Existing Ex.(Auto) (+3600) → (Expansion) (+5600T) →					No. of existing line units: 1000 (23)~(25), (29) and (30) to be accommodated by MAS. * indicates No. of fulfilled demands.
	2072 (44)*		4537 (44)*		10175 (44)*	
(27) Sei Rampah (Sei Rampah)	(Automatization) (800T) → (Expansion) (+1000T) →					
	186 (150)		424 (364)		969 (831)	
(28) Tanjung Beringin	(Regional Merger) →					To be accommodated at (27) (regional merger).
	150		364		831	
(29) Dolok Masihul (Dolok Masihul)	MAS → Office Setup (600T) → (Expansion) →					MAS to be accommodated at (26).
	9	20	236		540	
(30) Teluk Mengkudu	MAS →					MAS to be accommodated at (26).
	4	4	44	44	44	
Total No. of fulfilled demands in T. Tinggi Area.	2452		6415		14411	(Automatization) (Automatization)
Total No. of fulfilled demands in Deli Serdang Area.	4477		11266		26883	area area

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (7/10)

(Simalungun - 1/2)

Kecamatan \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
① Siantar (P. Siantar)	Existing Ex. (Auto) (+5000T) +MAS → Expansion (+7500T)					No. of existing line units: 4000 (②-⑤, ⑦-⑨ to be accommodated by MAS. * indicates No. of fulfilled demands.
	4279 (176)*		8292 (176)*		15878 (176)*	
② Jorlang Hataran	MAS → Regional Merger →					MAS to be accommodated at ①. Regional merger to be accommodated at ⑫.
	27		139		303	
③ Sidamanik (Sarimatondang)	MAS → Office Setup (Auto) (600T) → Expansion (+600T) →					MAS to be accommodated at ①.
	59		307		669	
④ Dolok Pardamean	MAS →					To be accommodated at ①.
	8	23	23	23	23	
⑤ Raya	MAS →					To be accommodated at ①.
	14	41	41	41	41	
⑥ Panei (Panei Tonga)	SMA → Office Setup (Auto) (600T) → (Expansion)					SMA to be accommodated at ①.
	20	20	242		527	
⑦ Silima Kuta	MAS →					To be accommodated at ①.
	15	42	42	42	42	
⑧ Dolok Silau	MAS →					To be accommodated at ①.
	7	20	20	20	20	
⑨ Purba (Tigarunggu)	MAS → Office Setup (Auto) (T)					MAS to be accommodated at ①.
	18	50	50	50	201	
⑩ Simpang Solon (Parapat)	Existing Ex. (Auto) (1000T) →					No. of existing line units: 1000
	123		223		400	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (8/10)

(Simalungun – 2/2)

Kecamatan \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands					Remarks
	1985	1990	1995	2000	2005	
⑪ Bosar Maligas (Bosar Baru)	SMA → Office Setup (Auto) (600T) →					SMA to be accommodated at ⑰ .
	20		20		325	
⑫ Dolok Pangaribuan (Tiga Dolok)	MAS → Office Setup (Auto) (400T) → (Expansion) (+600T) →					MAS to be accommodated at ①. Regional merger with ② after setting up the office. * indicates No. of fulfilled demands.
	27		146 (139)*		316 (303)*	
⑬ Tanah Jawa (Tanah Jawa)	Office Setup (Auto) (400T) → Expansion (+400T) →					
	160		360		796	
⑭ Raya Kahean	MAS →					To be accommodated at ⑯ .
	24	24	44	44	44	
⑮ Silau Kahean	MAS →					Same as above.
	24	24	44	44	44	
⑯ Dolok Batu Nyanggar (Serbelawan)	Automatization (400T) → (Expansion) (+400T) →					⑭ and ⑮ to be accommodated by MAS. * indicates No. of fulfilled demands.
	111 (44)*		253 (88)*		551 (88)*	
⑰ Bandar (Perdagangan)	Automatization (400T) → (Expansion) (+400T) →					⑪ to be accommodated by SMA. * indicates No. of fulfilled demands at ⑪ .
	124 (65)*		283 (90)*/10	(0)	617 (0)	
Simalungun Total No. of Fulfilled Demands	5060		10529		20797	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for Individual Kecamatan (9/10)

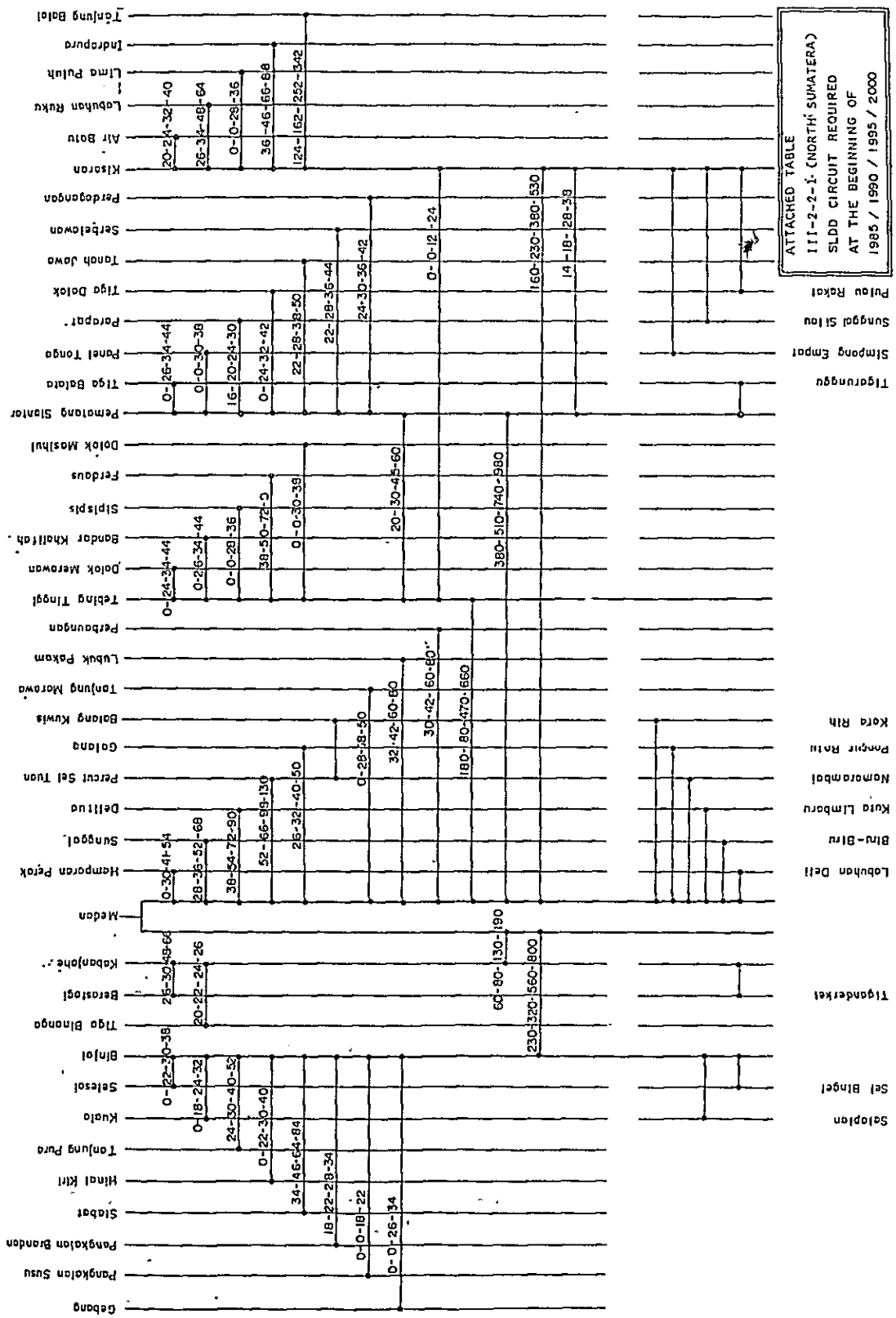
(Asahan - 1/2)

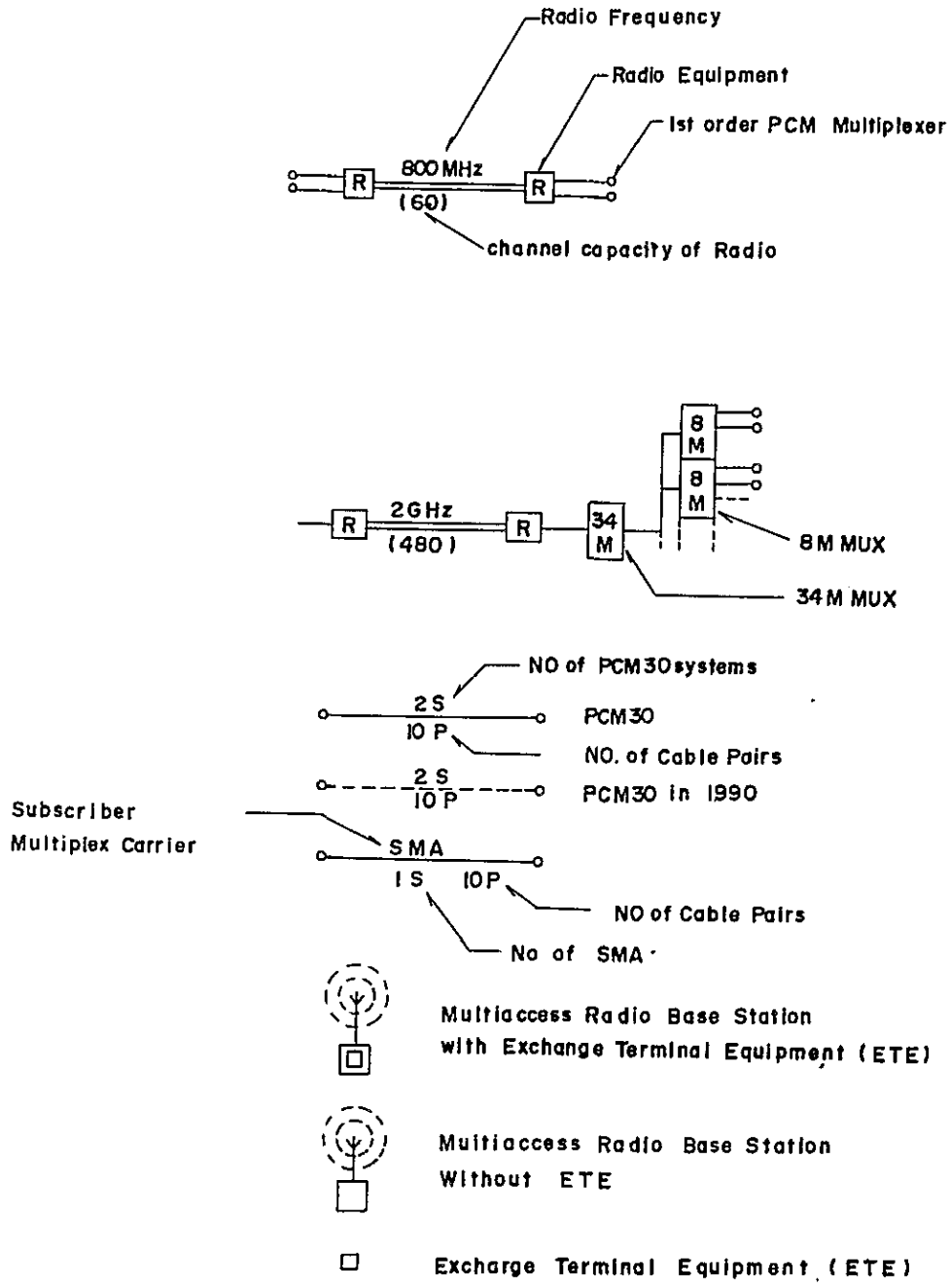
Kecamatan \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
① Sungei Kepayang	MAS					MAS to be accommodated at ⑮.
	17	17	17	17	17	
② Air Joman (Air Joman)	MAS			Office Setup (600T)		MAS to be accommodated at ④.
	33	33	60		408	
③ Simpang Empat (Simpang Empat)	MAS				Office Setup	MAS to be accommodated at ⑮.
	27	27	27	27	200	
④ Kisaran (Kisaran)	Existing Ex. (Auto) (+200T) + MAS		(Expansion) (+1200T) + MAS			No. of existing line units: 1000 ②,⑥, and ⑪ to be accommodated by MAS. * indicates No. of fulfilled demands.
	442 (88)*		1007 (88)*		2280 (88)*	
⑤ Air Batu (Air Batu)	Office Setup (400T)		(Expansion) (+200T)			⑦,⑧, and ⑨ to be accommodated by MAS. * indicates No. of fulfilled demands.
	101 (44)*		230 (44)*		522 (44)*	
⑥ Buntu Pane (Sungai Silau)	MAS				Office Setup	MAS to be accommodated at ④.
	15	15	28	88	198	
⑦ Pulau Rakat (Pulau Rakat)	MAS				Office Setup	MAS to be accommodated at ⑤.
	30	30	30	30	212	
⑧ Bandar Pulau	MAS					Same as above.
	11	11	11	11	36	
⑨ Bandar Pasir Mandoge	MAS					Same as above.
	3	3	3	3	8	
⑩ Talawi (Labuhan Ruku)	Automatization (600T)		(Expansion) (+600T)			Regional merger with ⑪. * indicates No. of fulfilled demands at ⑪.
	125 (95)*		286 (217)*		647 (492)*	

Attached Table III.2.1-2 Demand Fulfilment and Office Setup Plan for individual Kecamatan (10/10).

(Asahan - 2/2)

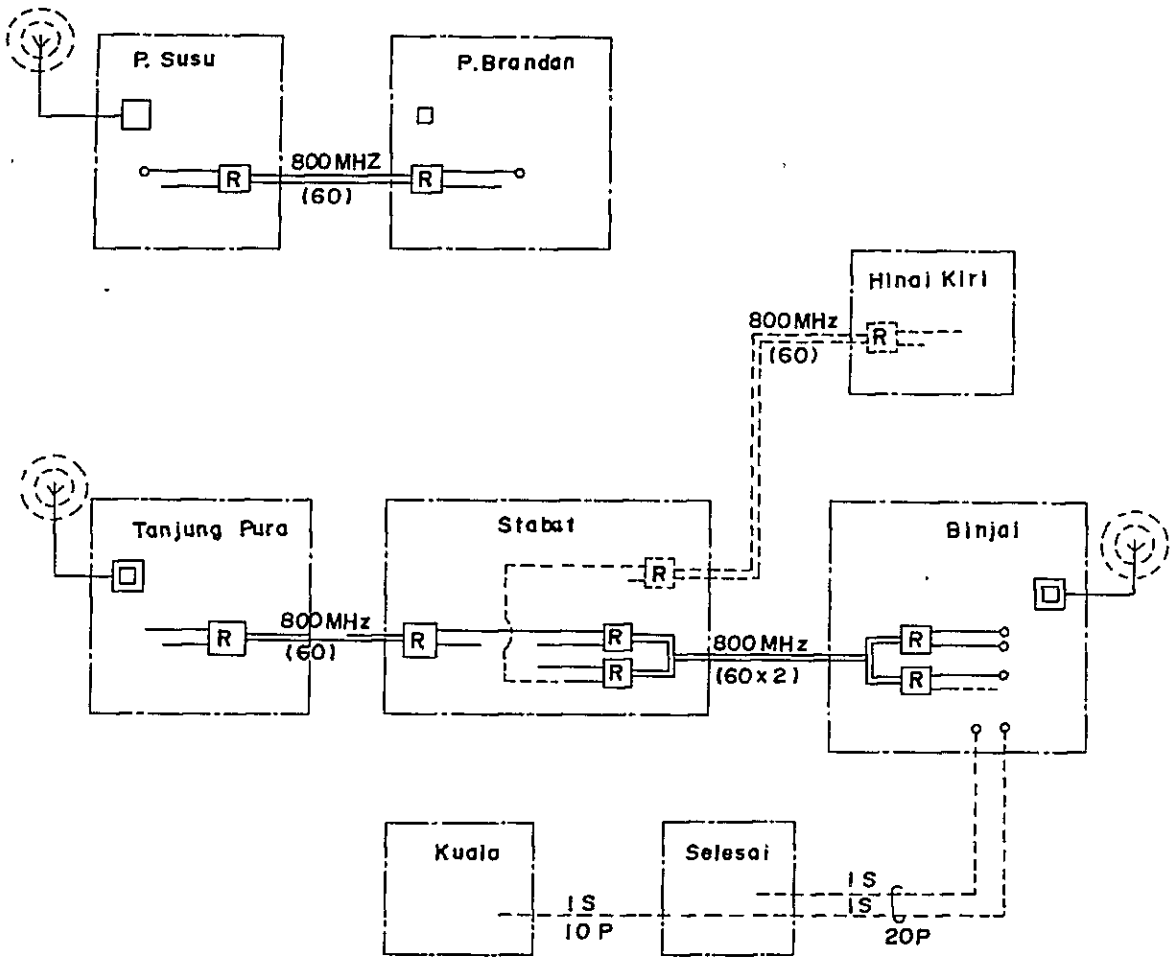
Kecamatan \ Year	Type of Planned Equipment (No. of line units) No. of Fulfilled Demands 1985	1990	1995	2000	2005	Remarks
⑪ Lima Puluh (Lima Puluh)	MAS → Office Setup (600T)					MAS to be accommodated at ④.
	40	40	217		492	
⑫ Tanjung Tiram	(Regional Merger)					Regional merger with ⑩.
	86		195		442	
⑬ Air Putih (New Town)	Office Setup (800T) → (Expansion) (+800T)					Regional merger with ⑭. * indicates No. of fulfilled demands at ⑭.
	207 (102)*		471 (232)*		1066 (526)*	
⑭ Medang Deras	(Regional Merger)					Regional merger with ⑬.
	102		232		526	
⑮ Tanjung Balai (Tj. Balai)	Automatization (2100T) +MAS → (Expansion) (+2700T) +MAS					①and③ to be accommodated by MAS. * indicates No. of fulfilled demands at ①and③
	942 (44)*		2049 (44)*		4733 (44)*	
Asahan Total No. of Fulfilled Demands	2181		4863		11787	


ATTACHED TABLE
III-2-2-1: (NORTH SUMATERA)
SLDD CIRCUIT REQUIRED
AT THE BEGINNING OF
1985 / 1990 / 1995 / 2000
Gebang
Pangkalan Susu
Pangkalan Brandan
Stabat
Hinai Kiri
Tanjung Pura
Kuala
Selesai
Binjai
Tiga Binanga
Berastagi
Kabanjahe
Medan
Hamparan Perak
Sunggal
Delitua
Percut Sei Tuan
Galang
Bolang Kuwia
Tanjung Morawa
Lubuk Pakam
Perbaungan
Teblng Tinggi
Dolok Merawan
Bandar Khalifah
Siplspis
Perdous
Dolok Masihul
Pematang Siantar
Tiga Balata
Panei Tonga
Parapat
Tiga Dolok
Tanah Jawa
Serbelawan
Perdagangan
Kisaran
Air Bolu
Labuhan Ruku
Lima Puluh
Indrapura
Tanjung Balai
Sei Bingei
Tiganderket
Belawan Deli
Binjai-Stabat
Kuta Limbaru
Namorambai
Pangkir Raiu
Kota Rih
Pulau Rakat
Tigarunggu
Simpang Empat
Sunggal Silou

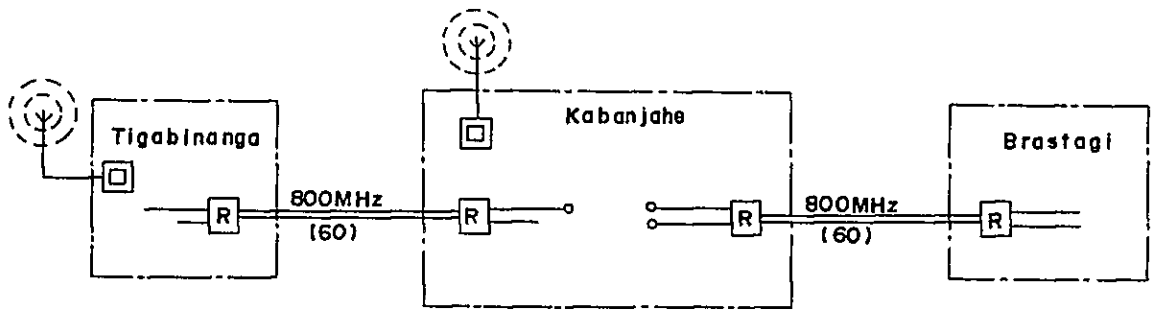


Symbols usedin figures of multiplex configuration

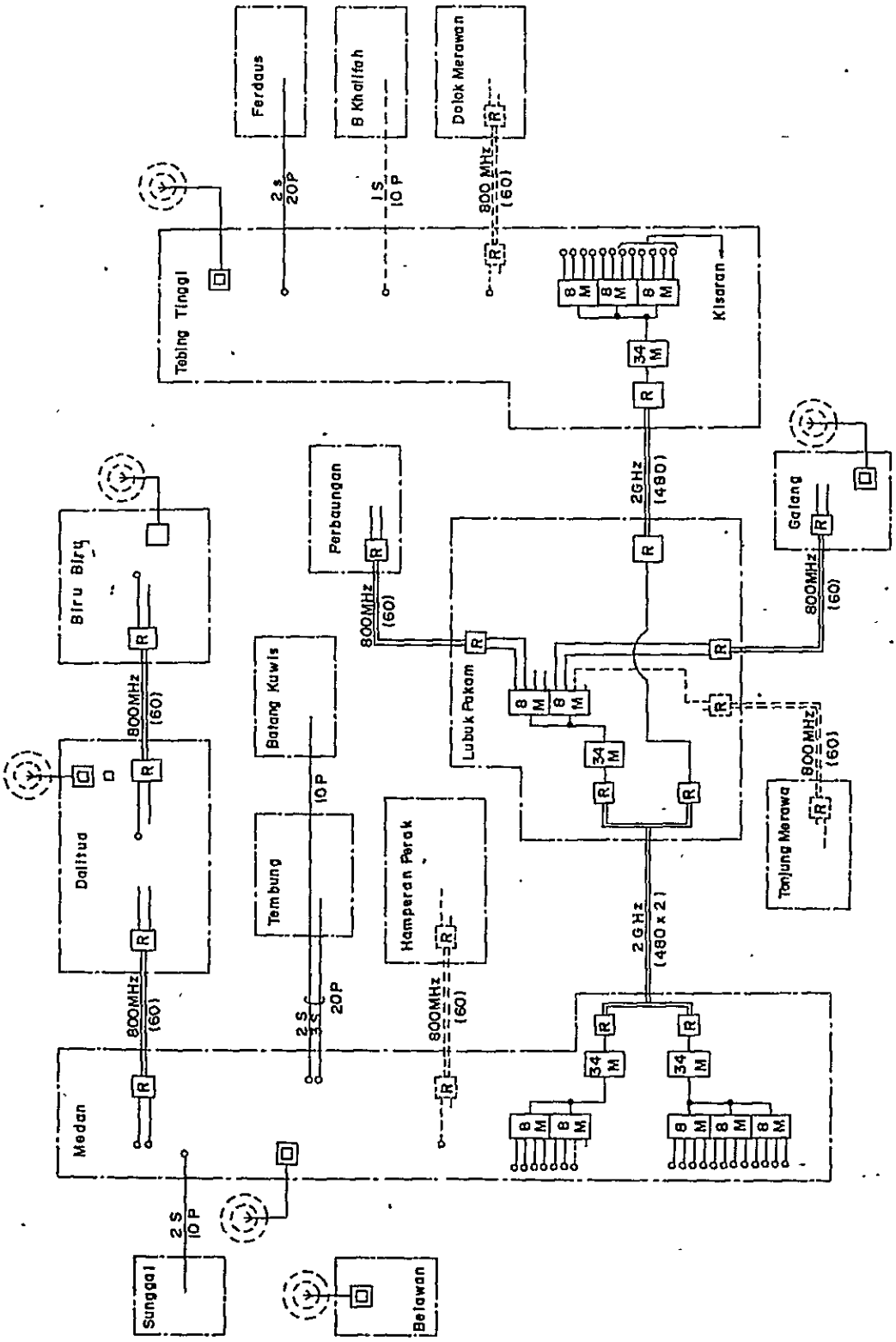
Attached Fig. III-2-4-1-1



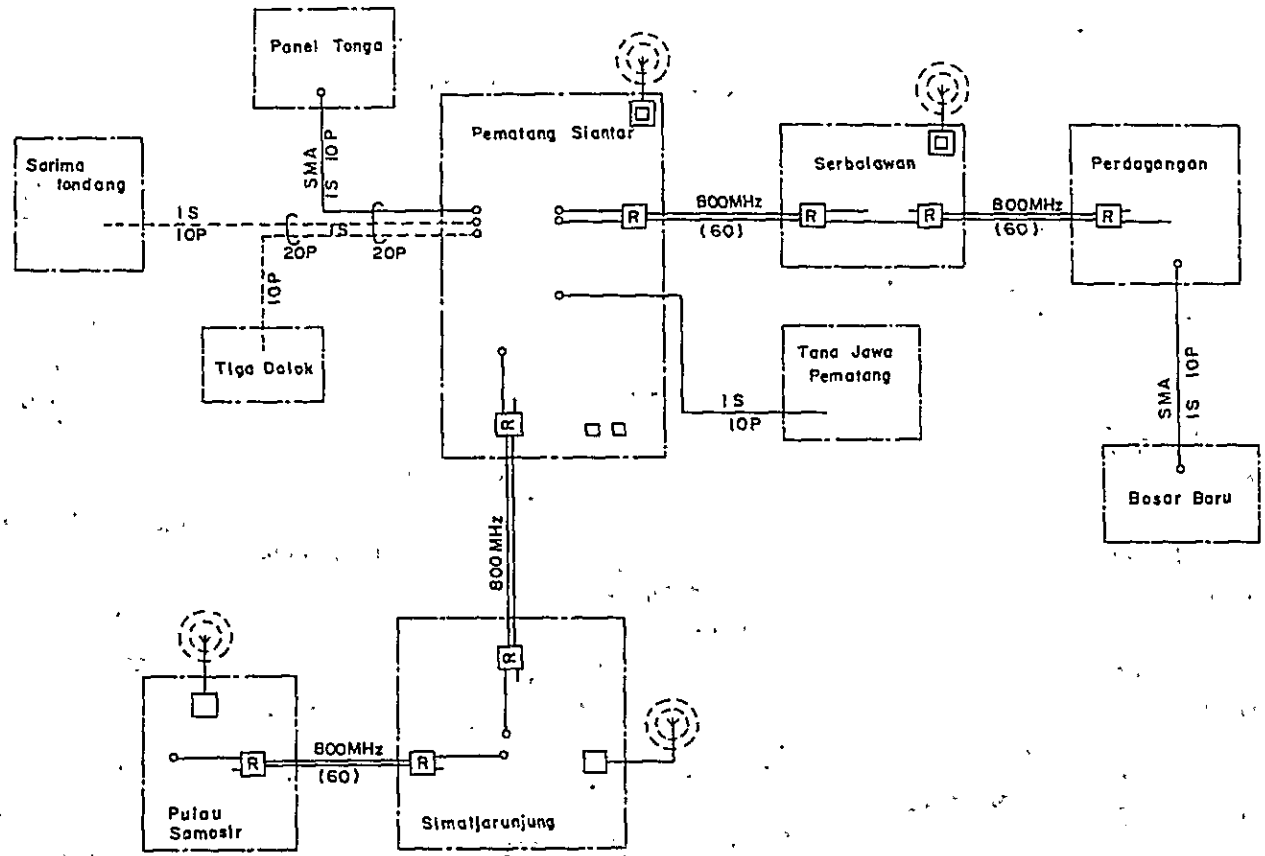
Attached Fig. III-2-4-1-2 Multiplex configuration in LANGKAT



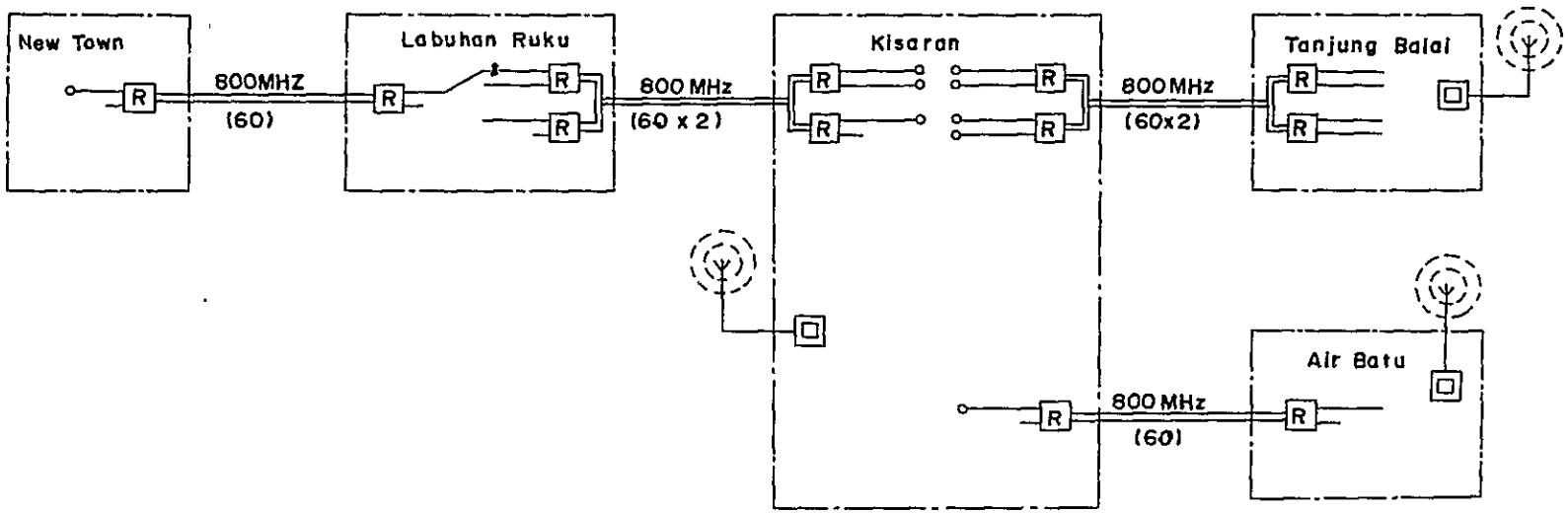
Attached Fig. III-2-4-1-3 Multiplex configuration in KARO



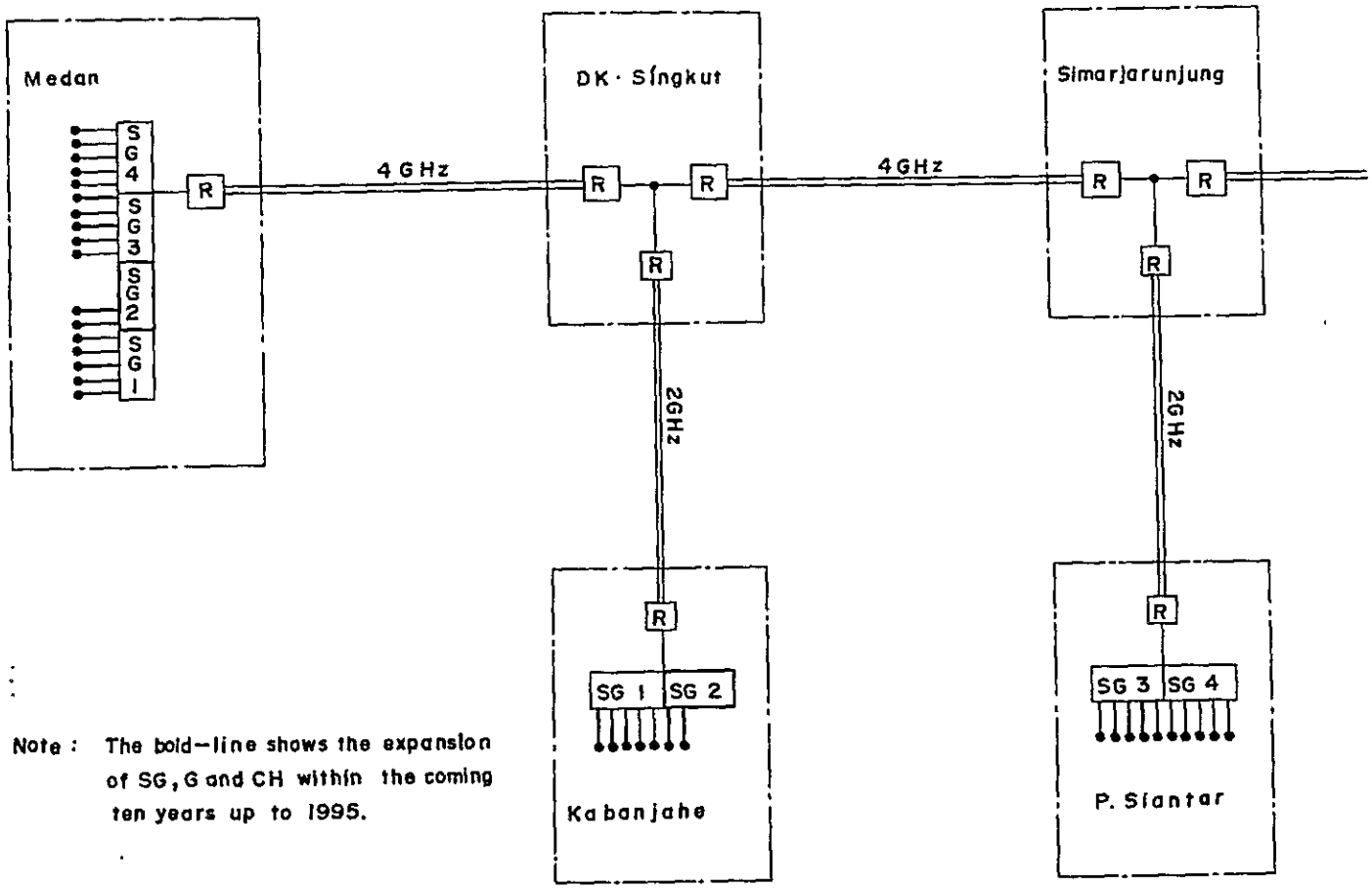
Attached Fig. III-2-4-1-4 Multiplex configuration in DELI SERDANG



Attached Fig. III-2-4-1-5 : Multiplex Configuration in SIMALUNGUN

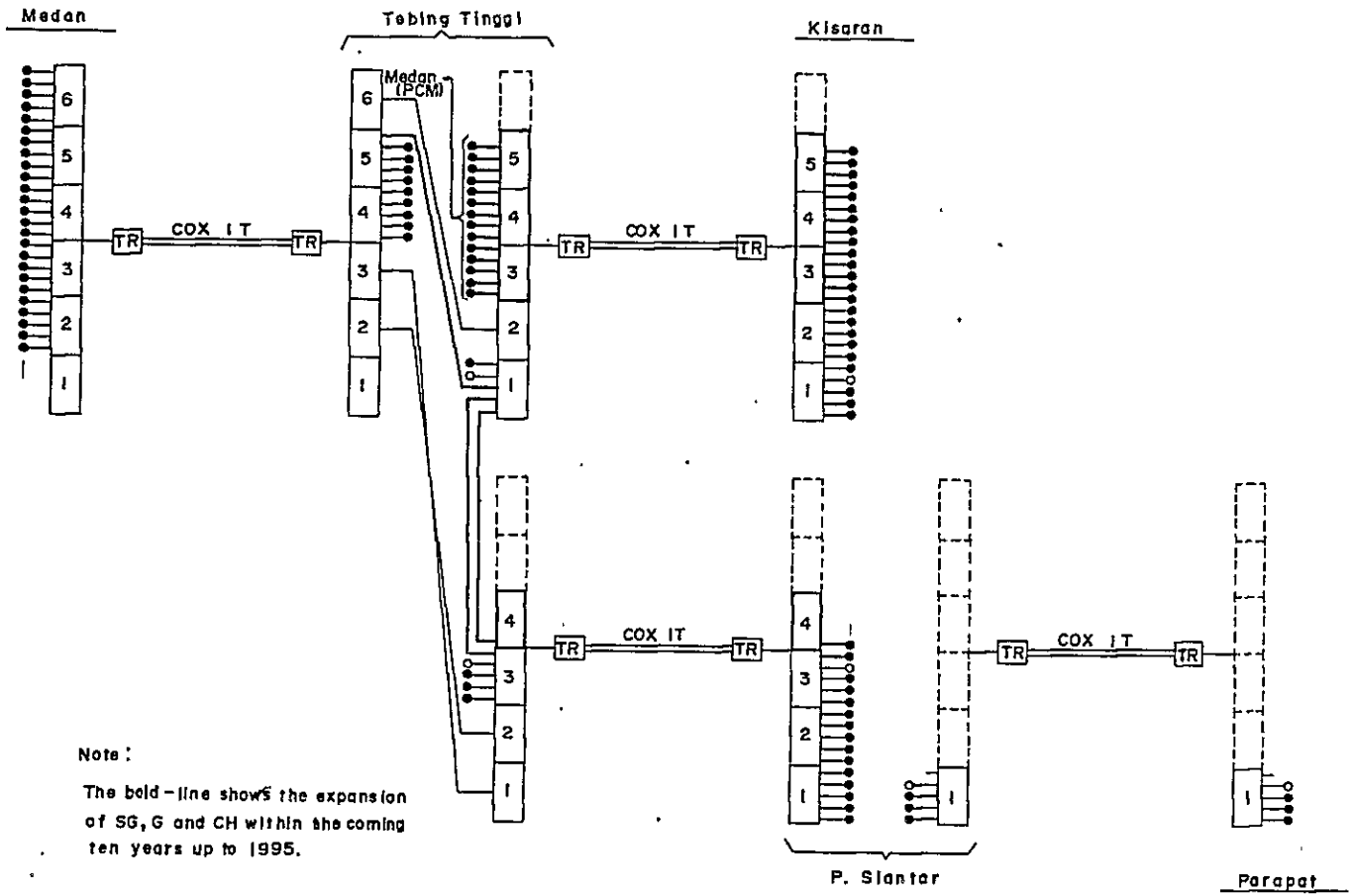


Attached Fig. III-2-4-1-6 Multiplex configuration in ASAHAN



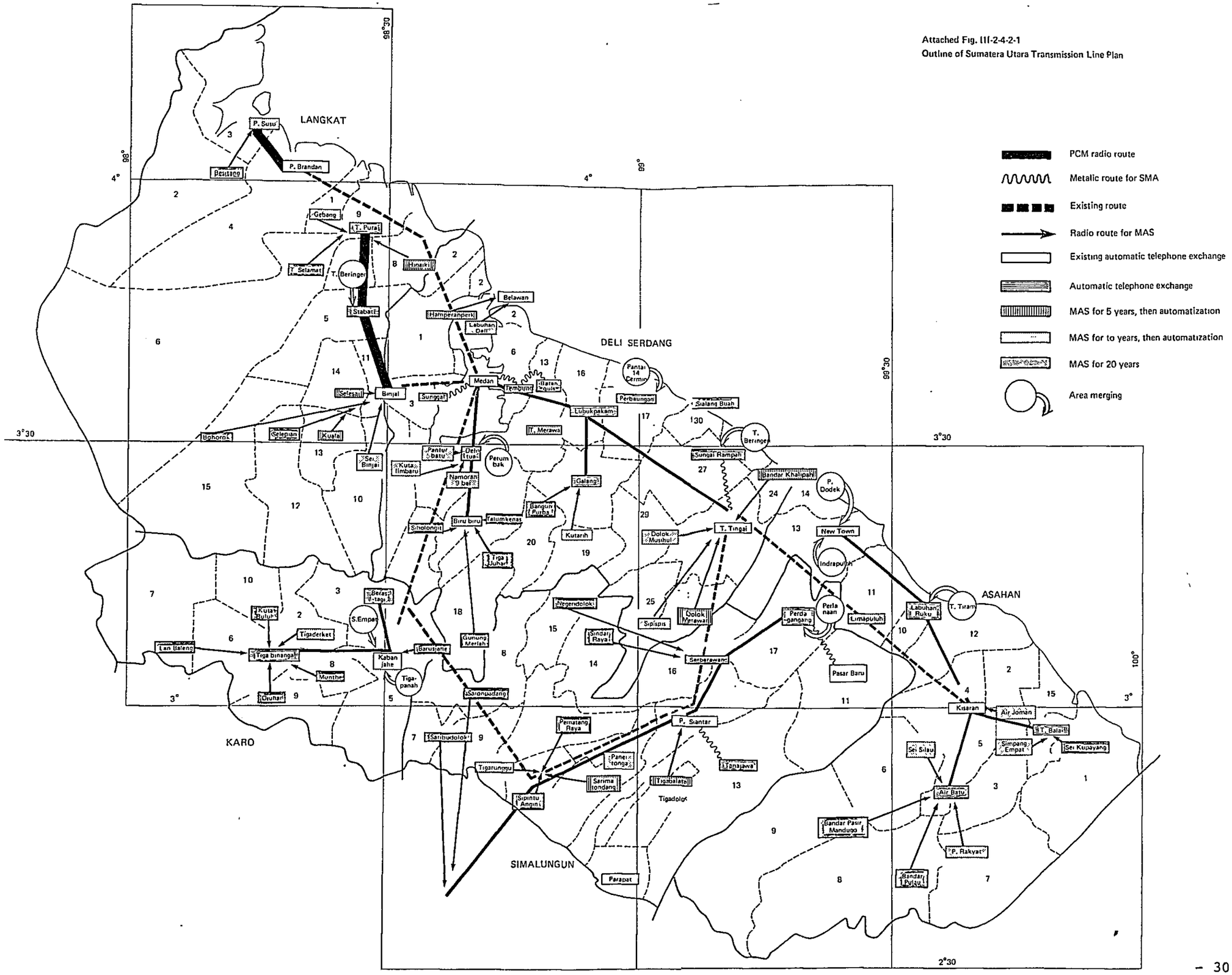
Note : The bold-line shows the expansion of SG, G and CH within the coming ten years up to 1995.

Attached Fig. III-2-4-1-7 Multiplex configuration between kabupaten (the existing Trans-Sumatra Microwave System)



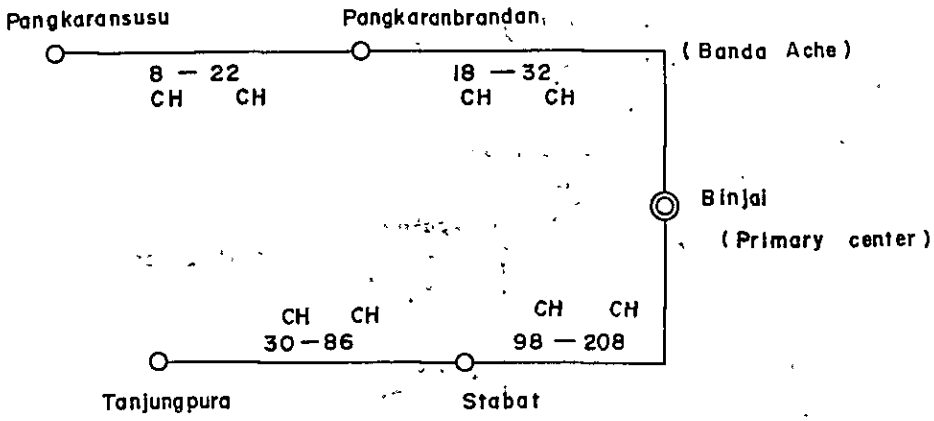
Attached Fig. III-2-4-1-8 . Multiplex configuration between Kabupaten (the existing coaxial cable system)

Attached Fig. III-2-4-2-1
Outline of Sumatera Utara Transmission Line Plan

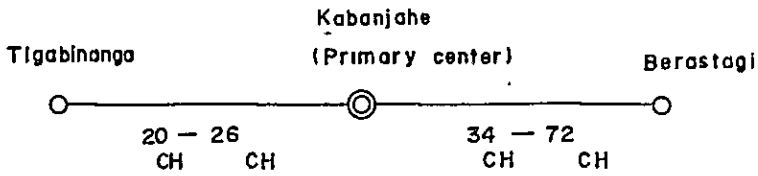


PCM radio route
Metalic route for SMA
Existing route
Radio route for MAS
Existing automatic telephone exchange
Automatic telephone exchange
MAS for 5 years, then automatization
MAS for to years, then automatization
MAS for 20 years
Area merging

Langket



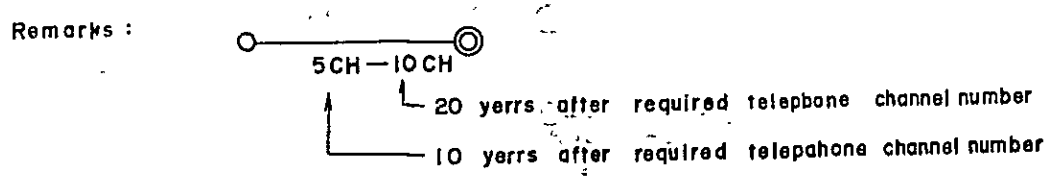
Karo



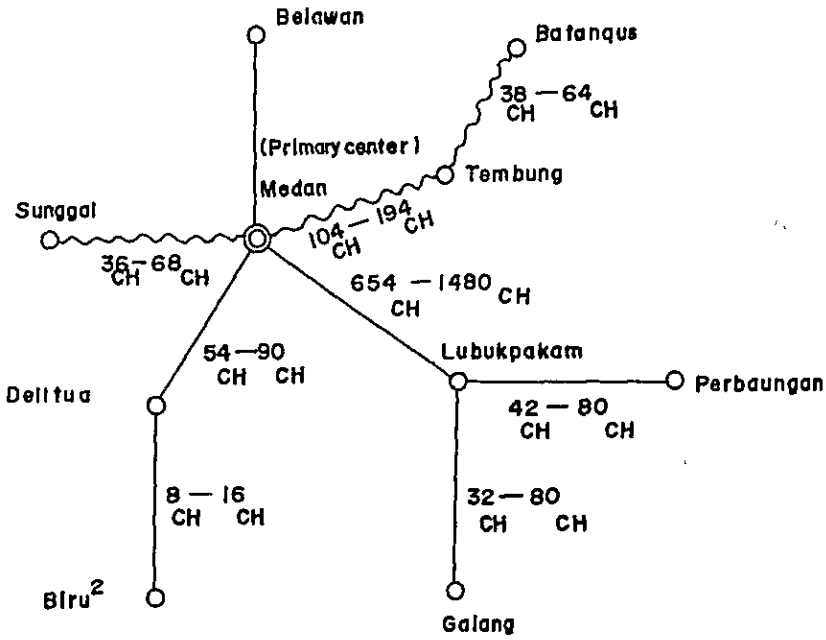
Attached fig. Ⅲ－2－4－2－2

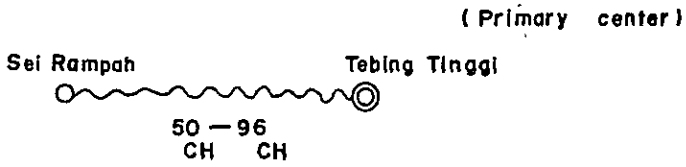
Required channel capacity for each radio section

(Langkat and Karo)



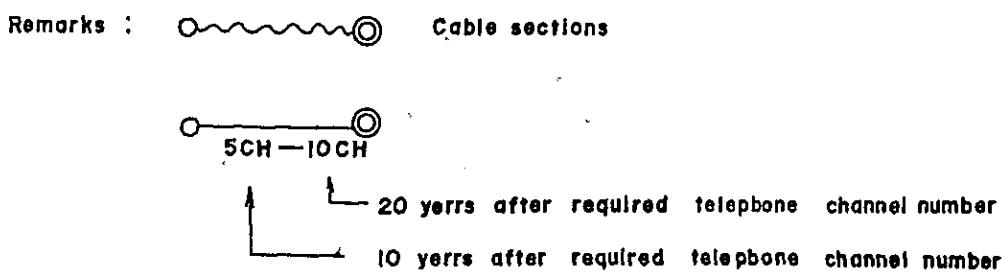
Deli Serdang



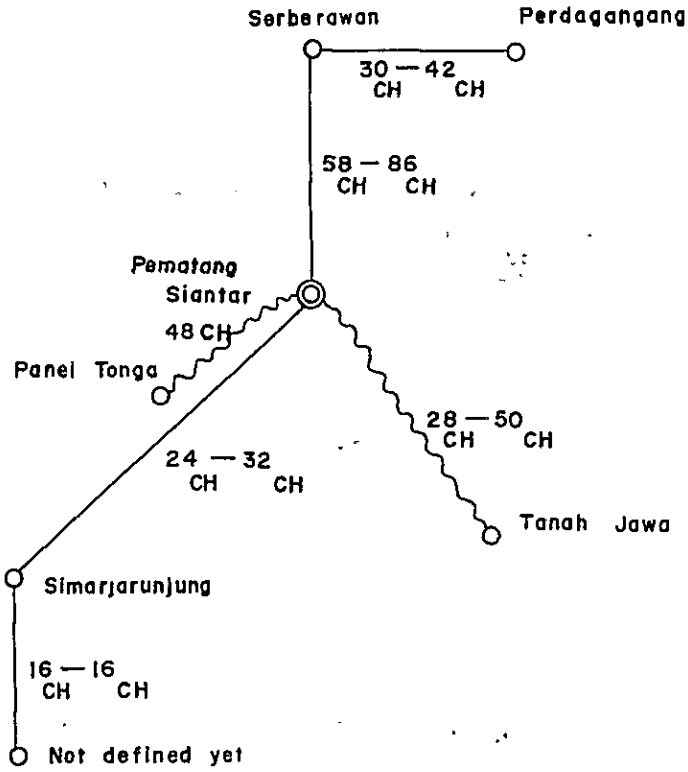


Attached fig. Ⅲ－2 － 4 －2－3

Required channel capacity for each radio section

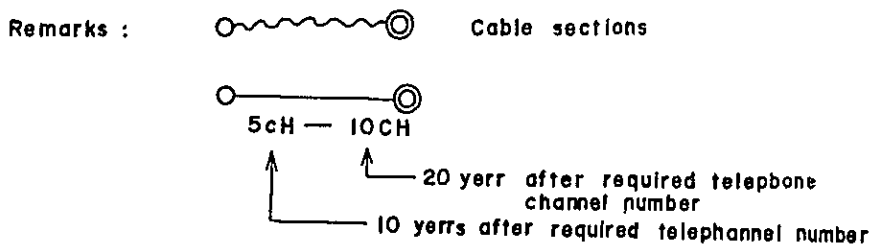


Simalungun

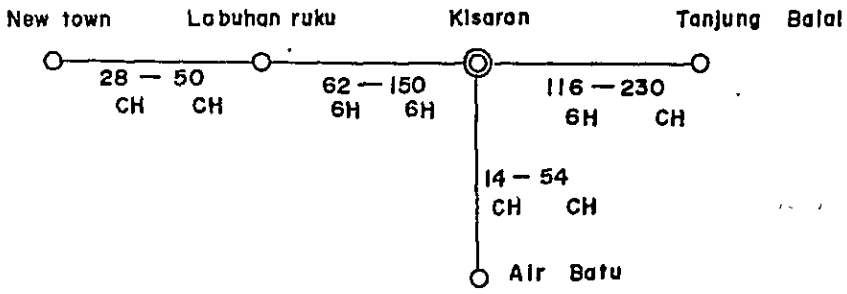


Attached fig. Ⅲ - 2 - 4 - 2 - 4

Required channel capacity for each radio section

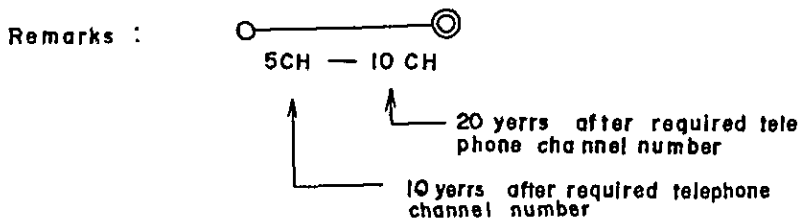


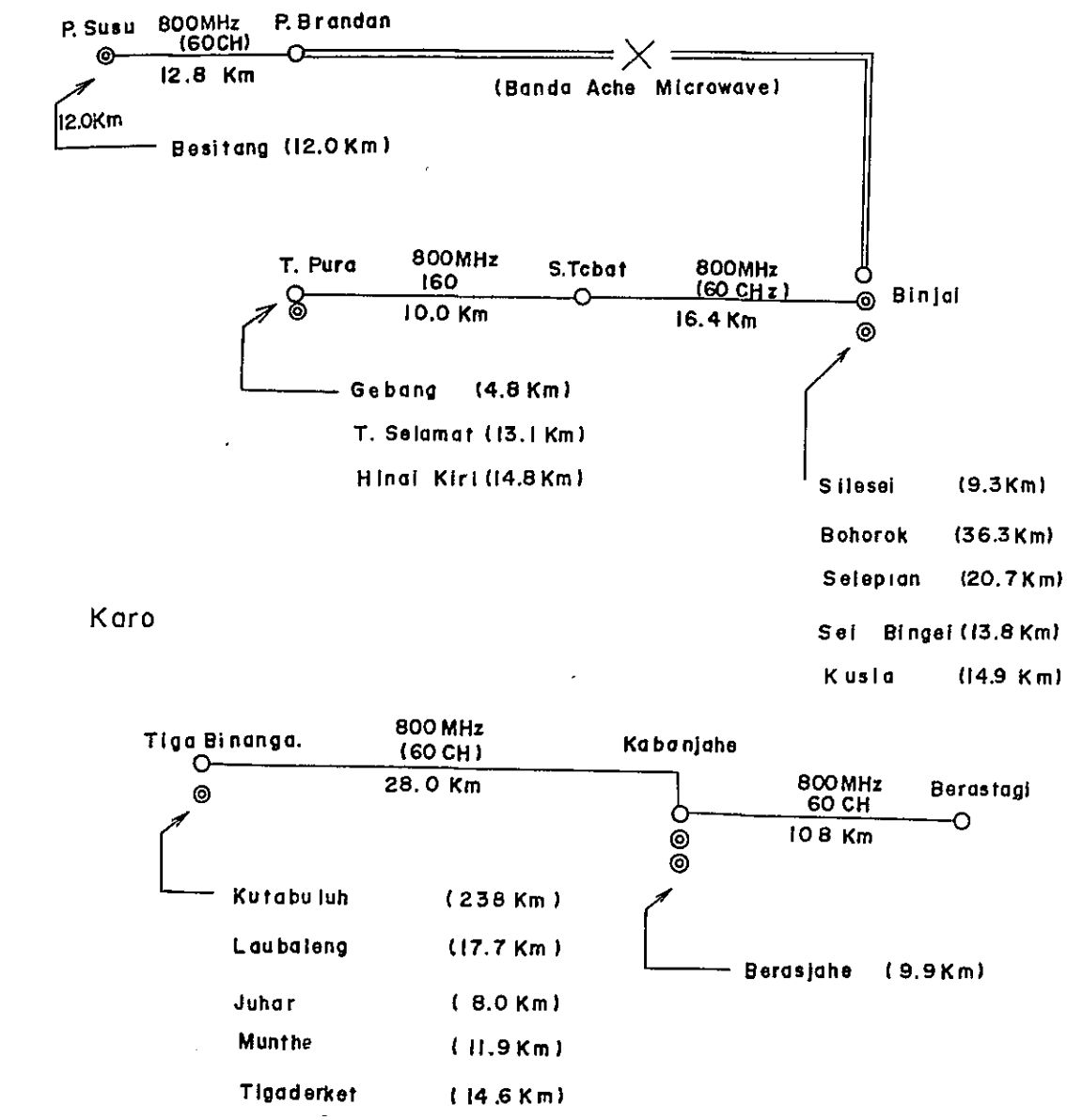
Asahan



Attached fig. Ⅲ-2-4-2-5

Required channel capacity for each rodio section

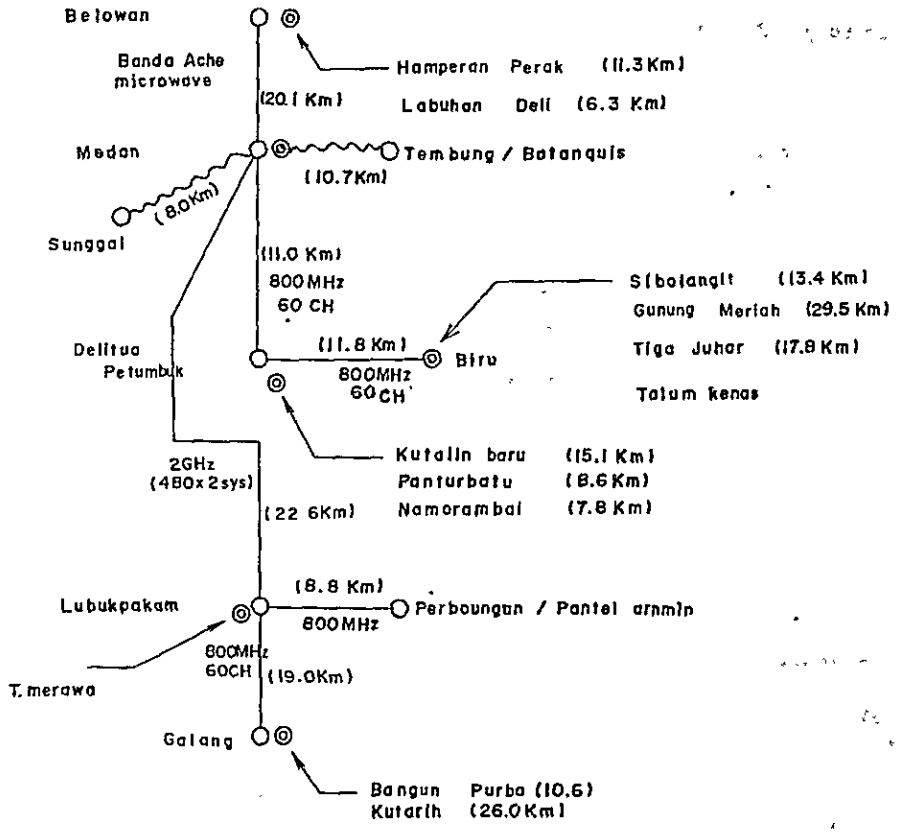




Attached fig. Ⅲ - 2 - 4 - 2 - 8

Configuration of radio transmission line

Deli Serdang I



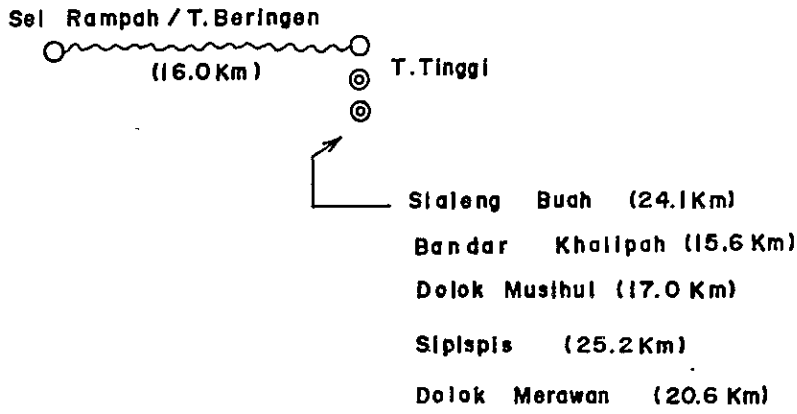
Attached fig. III 2-4-2-9

Configuration of radio transmission line

Remarks :

- End office
- Primary center
- MAS Basestation
- Radio PCM transmission line
- MAS subscribers line ant its basestation
- Existing transmission line

Deli Serdang II

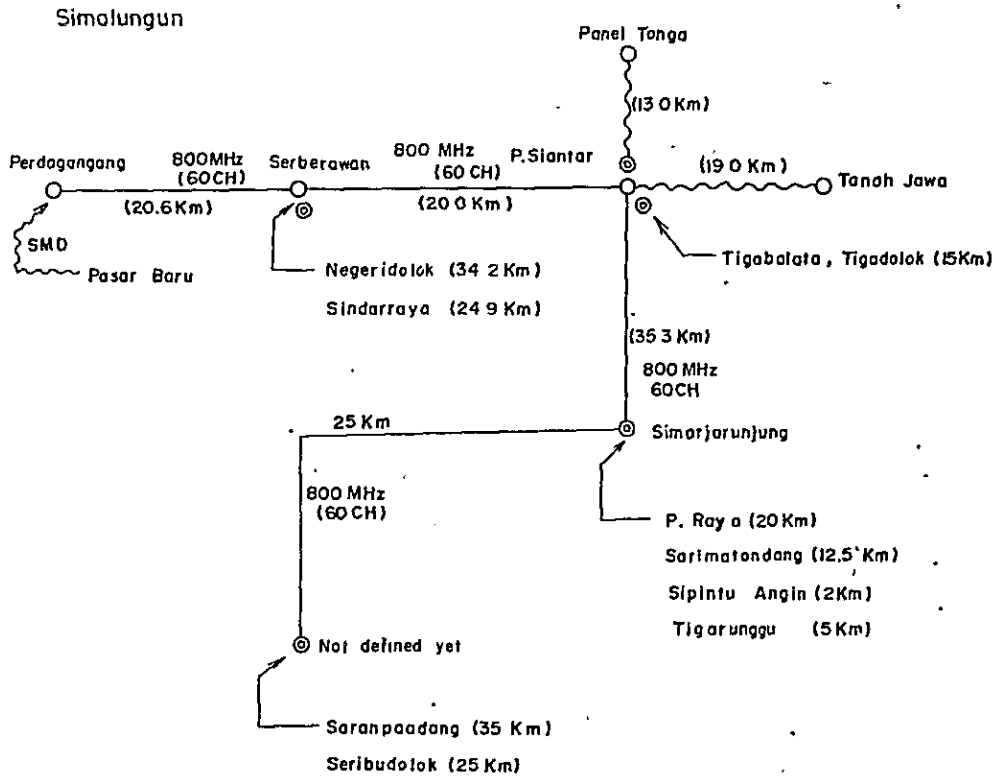


Attached fig. III - 2 - 4 - 2 - 10

Configuration of radio transmission line

Remarks :

- End office
- Primary center
- MAS Basestation
- Redio PCM transmission line
- MAS subscribers line basestation
- Existing transmission line



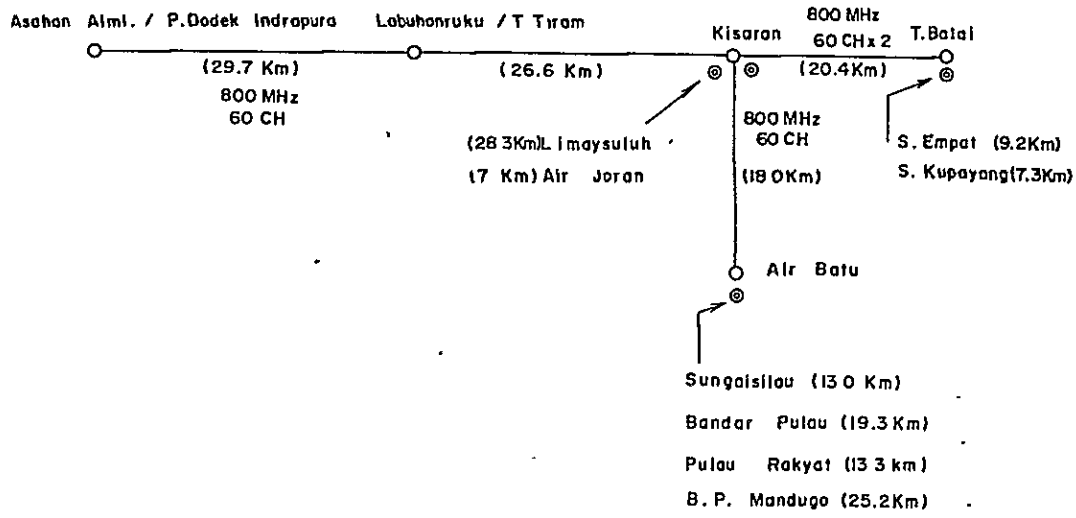
Attached fig. Ⅲ-2-4-2-11

Configuration of radio transmission line

Remarks :

- End office
- Primary center
- MAS Base station
- Radio PCM transmission line
- MAS subscriber line and its basestation
- Existing tranmission line

Asahan

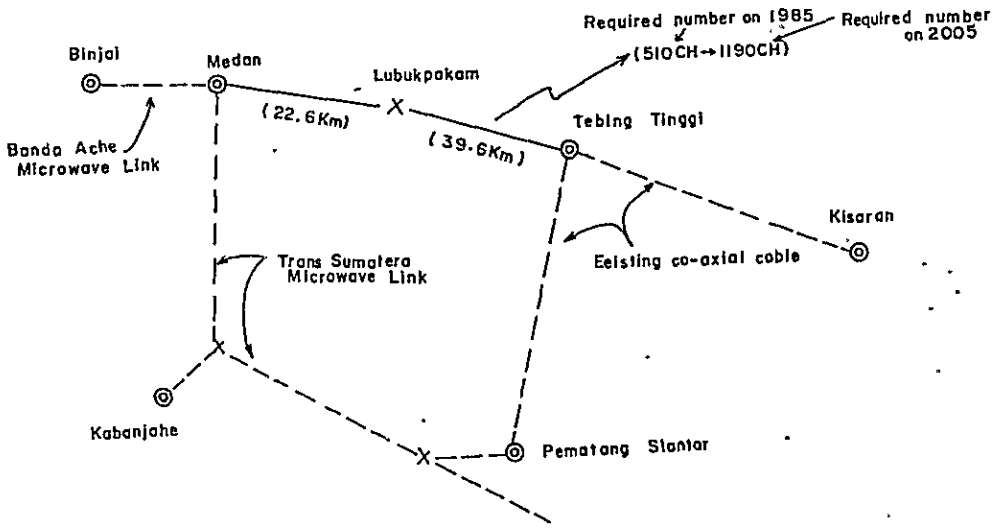


Atlached fig. Ⅲ－2－4－2－12

Configuration of radio transmission line

Remarks :

- End office
- Primary center
- MAS Basestation
- Radio PCM transmission line
- MAS subscribers line and its basestation
- Existing transmission line



Attached fig. Ⅲ-2-4-2-13

Primary ～ Secondary center radio transmission line