III. STANDARDS

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1. Traffic Engineering Standards

Traffic engineering standards are intended to stipulate telephone switching performance or the degree of satisfactoriness of users and secure such stipulated switching performance. That is, traffic engineering standards form the foundation for the establishment, operation and maintenance of telephone networks.

In the case of the Philippines, some values of performance standard are used but they are not sufficient and examination will be made in near future for the systematization of traffic engineering standards.

The traffic engineerting standards which form the foundation of this project are outlined hereunder.

1-1 Configuration of Traffic Engineerting Standards

Traffic engineering standards comprise performance standard, which stipulates the most basic foundation in telephone switching, and quality allotment standard and facilities provision standard, which are formed on the basis of the quality standard.

1-2 Nature and Treatment of Traffic

In discussing the telephone switching performance it is necessary to make some difinitions on the treatment of traffic to be discussed.

In general, the traffic varies with time with a certain tendency reflecting the peculiarities of the social and economical conditions. It is also known expirically that the traffic varies with the day, week, season, and year. In general, the traffic is considered by the traffic of the busy hour (i.e., continued one hour in the day during which the traffic becomes maximum) and should be treated in consideration of variation from day to day in the year.

1-3 Switching Performance Standard

Switching performance is the quality in telephone switching or the degree of service extended in the switching process when both operating condition of the facilities and traffic condition are normal.

Switching performance can be divided into connection loss and connection delay from the standpoint of the csuses of its degradation.

(1) Connection loss is such that the call originated by a calling party

is lost by encountering trunk busy, switching equipment busy, called party busy, or no answer by the called subscriber on the way the call is connected. In the event of connection loss, the calling is required to originating a call again.

(2) Connection delay

Connection delay appears as a time interval ranging from the time when the calling party originates a call to the time when dialing is achievable or a time interval from the time after the calling party dials to the time when the called party answers. In this case, the calling party can accomplish his purpose by waiting.

Causes of connection loss and switching delay are enumerated in Table III-1-3-1.

In setting forth switching performance standard, not only the satisfactoriness of users but also the economy of facilities should be taken into consideration. Future examination in the Philippines is anticipated. In this project, the following major values are used to represent switching performance standard.

(1) Call congestion in switching stage (loss probability)

10.0% for toll calls
4.0% for local calls
3.0% for special code calls

(2) Answering time of operator

15% for rate of waiting over 11 seconds

Table III-1-3-1 Classification of Switching Performance Deterioration Factors

Classification		Explication	Main Effective Factors
Connection Loss	Loss caused by originating stage busy	Call loss owing to all busy of originating stage equipment when a call is originated.	Traffic volume in the stage.
	Loss caused by connecting stage busy	Call loss owing to all busy of equipment or junction lines in the process of connection to the called party after dialing or in the way of dialing by subscribers or operators	Traffic volume in the stage or route.
	Loss caused by called party busy	Call loss owing to called party busy after dialing by subscribers or operators	Total volume of originating and terminating traffic of the called party
	Loss caused by no response of called party	Call loss owing to no response of called party after connection from a subscriber or an operator	Subscriber's habit
Connection Delay	Dial tone delay	The time from beginning of a call until dial tone is heard.	Traffic volume in originating stage
	Dialing delay by calling party	Necessary time for dialing	Number of digits, dial speed, subscriber's habit
	Post-dialing delay in automatic connection	The time after finish of dialing by subscriber until beginning of ring tone emission.	Traffic volume, signaling system

(Continued)

Classification		Explication	Main Effective Factors
Connection Delay	Operator response delay	The time after the indication of arrival of a call until the response of operator.	Operators load volume
	Manual connection delay in non-delay manual toll call	The time after the response of operator until beginning of ring tone in non-delay manual toll call service.	Traffic volume of the stage or route, handling time, automatic connection delay
	Connection delay of a call of manual toll call on delay basis	The time from application of a call until connection to called party	Traffic volume of the stage or the route
	Delay of called party's response	The time after emission of ring tone until called party responses	Subscriber's habits

Remarks:

1. The following subscriber's intentions or responsabilities are not included in the switching performance.
   (1) Dialing suspension
   (2) Suspension before response of called party and suspension right after response of called party
   (3) Wrong number dialing

2. In the switching performance, take no account of misconnection and wrong number connection due to equipment fault.

1-4 Switching Quality Allotment Standard

Performance standard is an overall standard which stipulates the quality of service to be given to users. In the design practice as telephone networks, however, a standard for allotting performance standard to switching processes in respective switching stages is required.

This standard for allotting performance standard to respective switching stages is called switching quality allotment standard. Switching quality allotment standard consists of loss probability allotment standard and delay time allotment stadard.

The major quality allotment standards used as foundations in this project are as follows.

(1) Loss probability allotment standard

(a) Allotment standard for toll calls

The loss probability of the basic route will be made 0.01 per switching stage. (Fig. III-1-1.)

(b) Allotment standard for intra-office connection

The loss probability of intra-office trunk will be made 0.02.

(2) Delay time allotment standard

(a) Delay time allotment in automatic service

Delay time in automatic switching depend on factors determined by the type of switching, signaling method, and the number of switching stages and such factors determined by the traffice as waiting time of common equipment. The former factors depend greatly on the system selection, equipment design and switching system configuration. In the Philippines, this standard must be studied in future.

(b) Allotment of non-delay manual service

Waiting probability for outgoing trunk for local connection 0.01

Waiting probability for outgoing trunk for toll connection

Non delay service 0.05

delay service 0.1

1-5 Facilities Provision Standard

This standard stipulates the method of calculation of facilities for meeting the quality standard. This standard should, of course, be set forth in consideration of ease of design and economic allotment of quality standard as well.

In the Philippines, this standard has not yet been established and consistency in calculation may sometimes be lacked. Future study is anticipated.

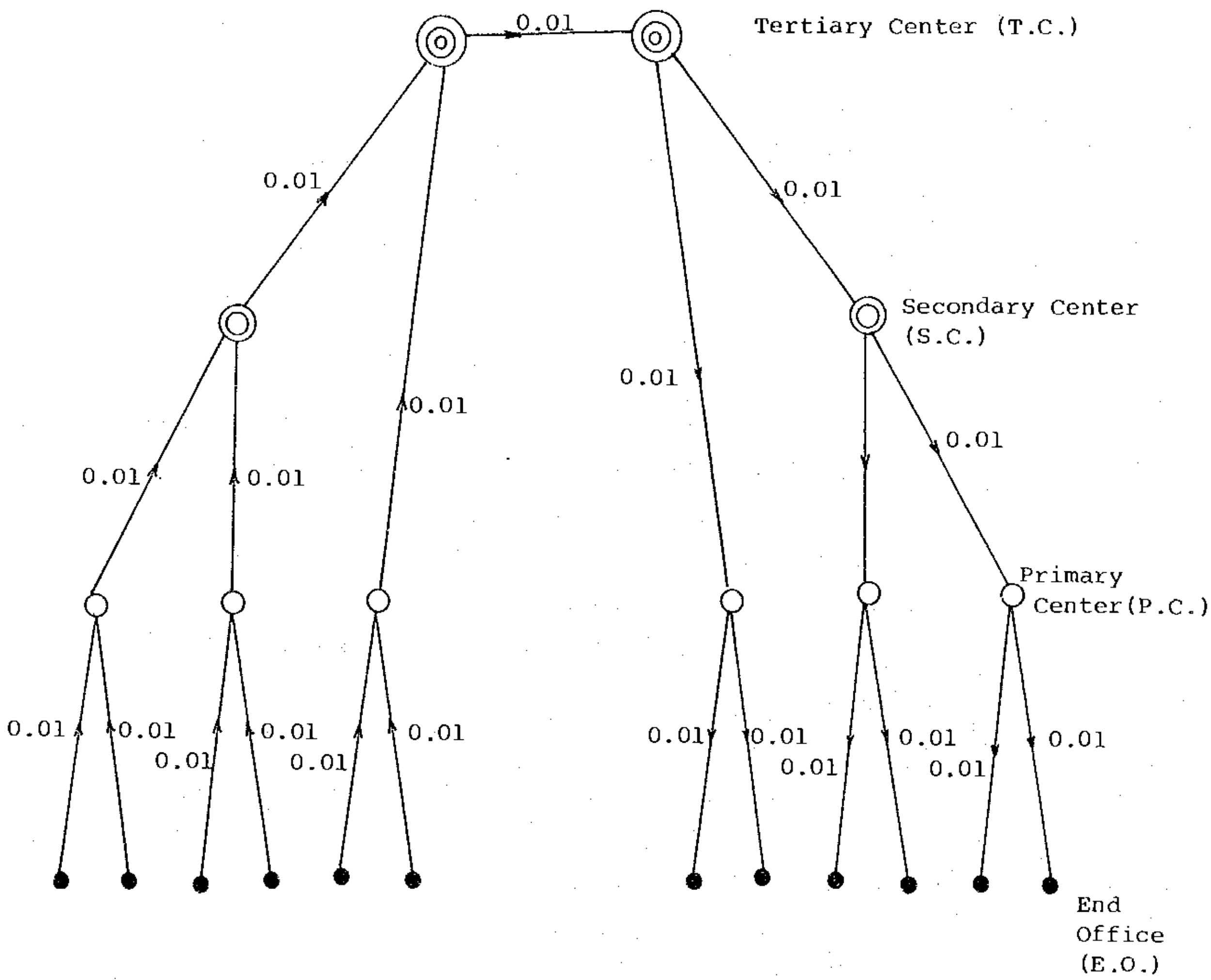


Fig. III-1-1 Loss Probability Allotment at Toll Connection

2. Transmission Standards

2-1 Circuit Loss Allotment

BUTEL is going to employ reference equivalent for circuit loss measurement in accordance with the recommendation of CCITT. That is, the following requirements will be met for international connections for 97% of all originating and terminating calls in countries of an average scale (in which the distances between the international exchange and subscribers exceed 1000km but do not exceed 2500km and to which the Philippines belongs).

(1) The nominal reference equivalent of the sending system between subscribers and first international links should not exceed 21dB.

(2) The nominal reference equivalents of the receiving system between subscribers and first international links should not exceed 12dB.

However, circuit loss allotment of the above-mentioned reference equivalents of 21dB and 12dB in the Philippines has not yet been determined.

In general, larger loss allotment is given to loses in subscriber systems and smaller loss allotment to loses in upper-ranking sections. However, this requires:

(1) provision of high-quality transmission lines,

(2) larger cable conductor diameters, and

(3) 4-wire toll exchanges,

and involves considerable expenses for facilities.

This must be compensated for by using thinner subscriber cables.

Considering all above synthetically, the survey team recommends as follows. (See Fig. III-2-1-1.)

	Loss allotment
International Exchange - National Center:	0dB
National Center - Secondary Center:	0dB
Secondary Center - Primary Center:	3.5dB
Primary Center - End Office:	6dB
End Office - Subscriber:	11.5dB (Sending system)
	1.5dB (Receiving system)

By this, circuit loss from a subscriber to the international exchange will be 20db on the sending system and 11dB on the receiving system, affording a margin of 1dB when compared with the CCITT recommendation (G121) of 21dB and 12dB. The circuit loss for long-distance calls will become 31dB, which

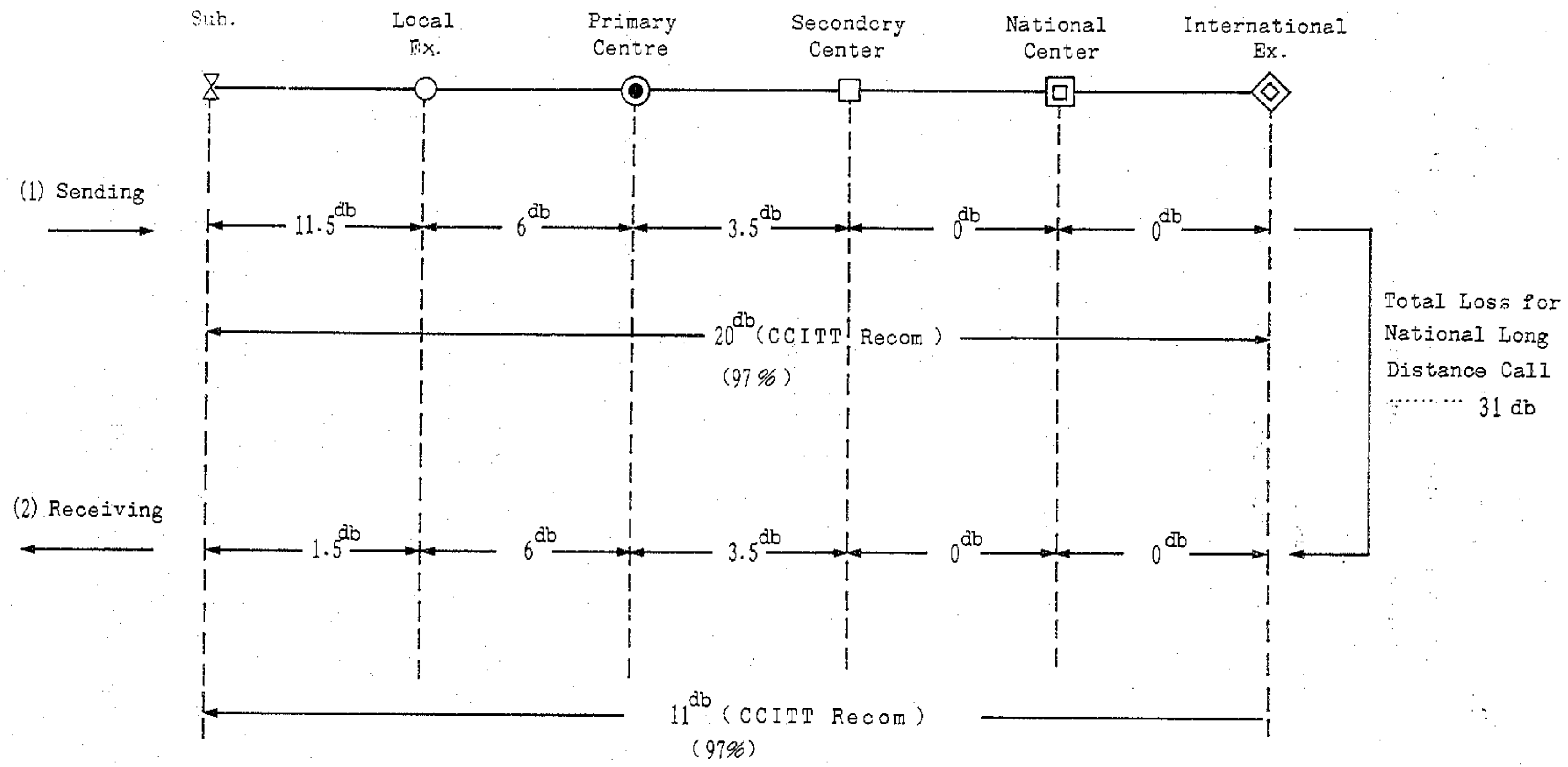
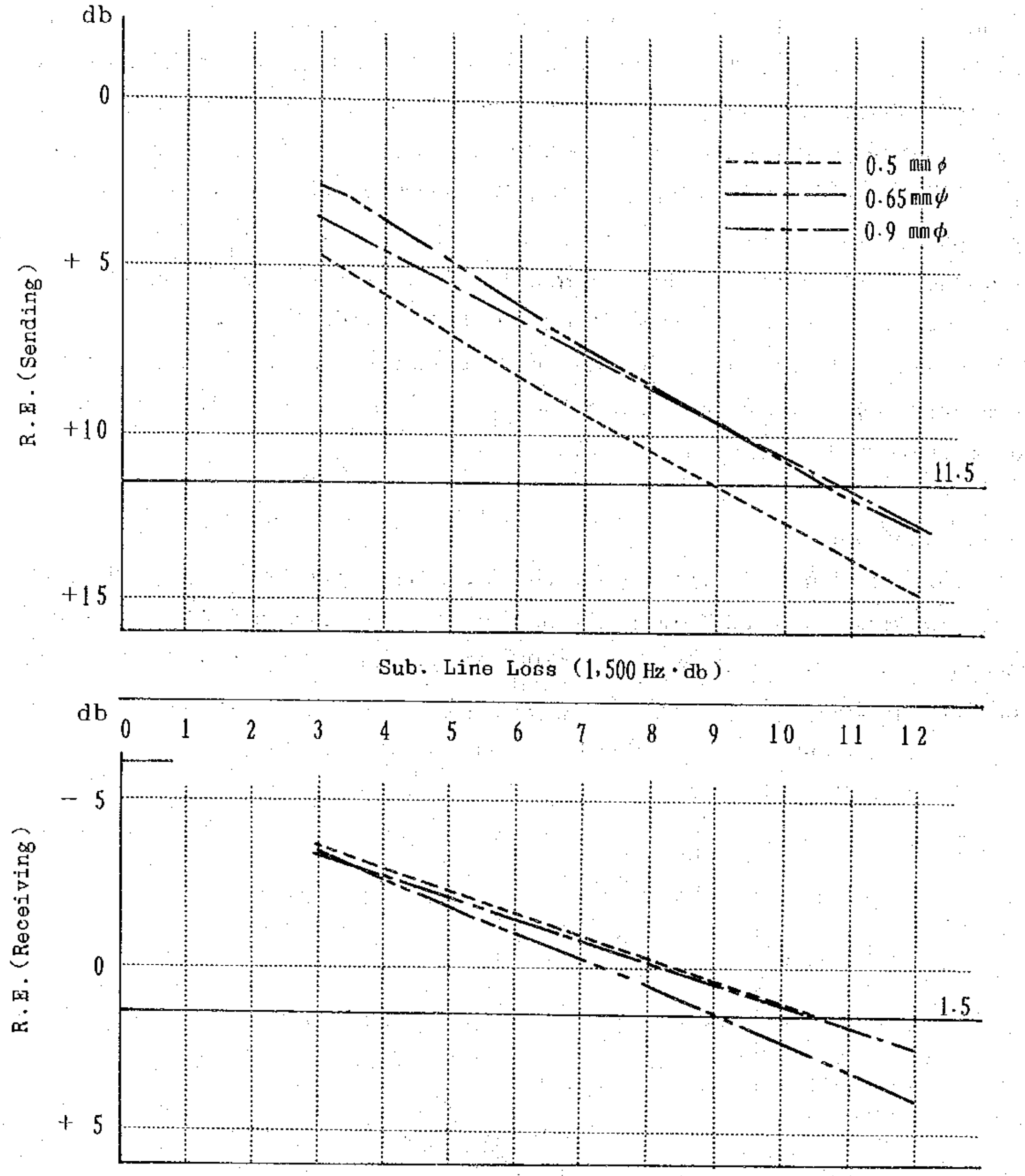


Fig. III −2−1−1 Transmission Loss Allotment (Reference Eqivalent)



Reference Equivalent(Sub.Line System) for Japanese Type 600 Telephone

Fig. III−2−1−2

is 5dB less than the maximum allowable loss recommended by CCITT (36dB). The loss of a subscriber system depends on the type of the telephone set in use and subscriber cable conductor diameter, so that circuit loss values can not be determined simply by the subscriber cable loss. The relation between the reference equivalent and cable loss (at 1500Hz) in the case of Type 600 Telephone used in Japan is shown in Fig. III-2-1-2 where 11.5dB in RE (sending side) corresponds to 9dB in cable loss of a 0.5mm conductor diameter and 1.5dB in RE (receiving side) to 10.4dB in cable loss of the same conductor diameter. That is, the allowable line loss is 9dB, which is nearly equal to the BOTEL's allowable design standard (100% value) of subscriber line maximum loss, 10dB.

2-2 Noise Allotment

For telephone circuit noise, the CCITT Recommendation sets out that the noise power passed from a national to an international line should exceed neither (4000+4L)pWop nor (7000+2L)pWop at a 0dB relative level on the international line (where L is the total length of the long distance FDM system composing the national system). (See Fig. III-2-2-1.)

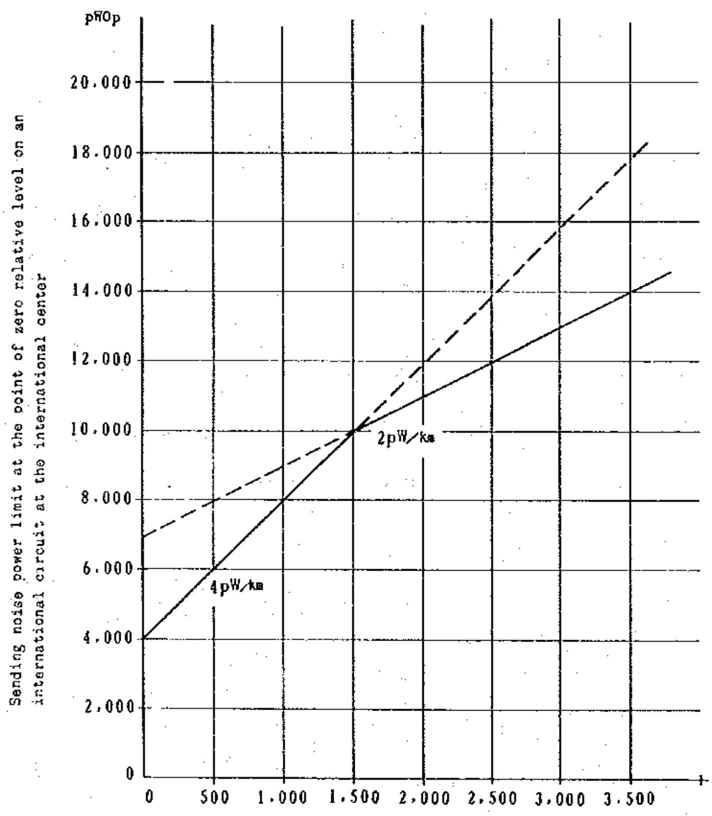


Fig.III-2-2-1 Total length of national long-distance FDM carrier system

An allotment model is shown in the figure in the Recommendation by assuming a hypotherical reference circuit. Noise alloment should be made as per the model. In more concrete, noise allotment should be as follows.

National Center-Secondary Center:

As per CCITT Recommendation(G222) for noise of 2500km transmission lines

Secondary Center - Primary Center:

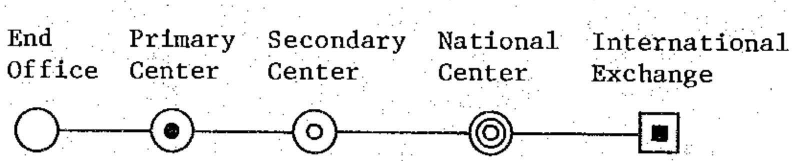
2000pWop

Primary Center - End Office

2000pWop

Exchange noise is 200pWop

The noise power at the connecting point between the national system passed from Region I and II and the internation system then becomes about 3100pW, sufficiently meeting the above-mentiones CCITT Recommendation. This value is obtained from the following calculation.



Exchange noise	200pW		200pW		200pW		200pW
Section noise		2000pW		2000pW		1460pW	
Net loss		6dB		3.5dB		0dB	

Now, let us calculate these noise values in terms of noises at the reference point of the international line.

Exchange noise:

$$200\text{pW} \times 10^{-\frac{6+3.5}{10}} + 200\text{pW} \times 10^{-\frac{3.5}{10}} + 200\text{pW} \times 2 = 512\text{pW}$$

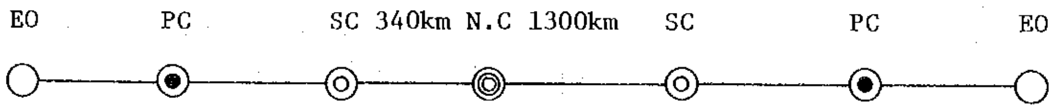
Transmission noise:

$$2000pW \times 10^{-\frac{6+3.5}{10}} + 2000pW \times 10^{-\frac{3.5}{10}} + 1460pW = 2578pW$$

Total: $3082pW < 4000 + 4L\ pW$

$< 7000 + 2L\ pW$

When the transmission line is established so far to Mindanao Island in the south by the standard set out for this project, the circuit noise of the section between Region I or II and Mindanao will become 1980pW at the exchange point (end office) on the receiving side, which corresponds to 1.09mV in voltage. This value is better than the Japanese standard (1,1mV). (See Fig. III-2-2-2.)



Exchange noise	200pW		200pW		200pW		200pW		200pW		200pW		200pW
Section noise		2000pW		2000pW		1460pW		5650pW		2000pW		2000pW	
Net Loss		6dB		3.5dB		0dB		0dB		3.5dB		6.0dB	

Exchange noise

Exchange noise: $$200pW \times 10^{-\frac{19}{10}} + 200pW \times 10^{-\frac{13}{10}} + (200pW \times 3) \times 10^{-\frac{9.5}{10}} + 200pW \times 10^{-\frac{6}{10}}$$

$$+ 200pW = 330pW$$

Transmission noise: $$2000pW \times 10^{-\frac{19}{10}} + 2000pW \times 10^{-\frac{13}{10}} + (1460pW + 5650pW + 2000pW) \times 10^{-\frac{9.5}{10}} +$$

$$2000pW \times 10^{-\frac{6}{10}} = 1650pW$$

Total 1980pW → 1.09mV

FIG. III-2-2-2

2-3 Allotment of Mean-Time Noise in Radio Section

2-3-1 Main Routes

For mean-time noise of main routes formed with microwave links, CCIR Recommendation (393-1) is set out which recommends that the weighted mean-time noise of a main route should be 7500pW/2500km for any hour. For actual circuits, however, it should be such as given by

$$(3L + 200)pW$$

where L is the radio transmission distencl in km.

2-3-2 Spur Routes

A weighted value of 2000pW will be alloted to four spur routes in the primary center ~ end office for a hypothetical reference circuit including carrier mutliplex equipment. Baseband repeating will be employed for less than 60 channels and heterodyne repeating for 300 channels.

2-4 Short-Time Breakdown Ratio in Radio Section

According to the CCIR Recommendation for the short-time breakdown ratio of a radio link in a propagation course, the time ratio of exceeding 10^6pW in unweighted value should be less than 0.01% for a radio link length of 2500km. This CCIR Recommendation will be applied to the short-time breakdown ratio of the main microwave system to be established in the project. The value of 10^6pW corresponds to 30dB in signal-to-noise ratio at the OdB relative level of a toll board. CCIR has set out recommendations not only for such large noises but also for smaller noises.

These recommendations are: the time ratio of exceeding 47500pW in weighted value should be 0.1% and that of exceeding 7500pW should be 20%. It is empirically verified that if the unweighted value of 10^6pW is met for variable factors of a propagation course, unweighted values in other cases are met consequently.

Accordingly, short-time breakdown standard for 2500km and 10^6pW is set not to exceed 0.01% in this project as well. On the other hand, a short-time breakdown ratio objective value of 0.001% is picked up in the field of data communication.

To what extent this objective can be reached in the microwave system is discussed.

For the short-time breakdown ratio (nonavailability) of the radio link which is ascribable to the propagation course, the time ratio of exceeding 10^6pW unweighted value is made 0.01%/2500km. Also, a value of 0.001%/2500 km is given for reference's sake.

In addition to the propagation courses radio equipments group and power plants group incorporated in a radio link also contribute to the short-time breakdown ratio (or nonavailability). There is no established standard for the time being, and it is recommended, as a considerably rational means, to allot 0.01%/2500km to each of the factors ascribable to the propagation course, the factor ascribable to the radio equipments, and the factor ascribable to the power plant equipments so as to achieve overall reliability (including the three factors) of 0.03%/2500km. The radio and power equipment are detailed in VIII "SYSTEM DESIGN."

2-5 Color TV Signal Transmission Standard

For the color TV signal transmission standard, it is recommended to set the amplitude to frequency response characteristic in the video band to be within ±1dB up to 4MHz and the differential gain and differential phase to be less than 10% and 5°, respectively.

2-6 Minimum Net loss

In Telephone circuits containing repeaters, reflection may be caused in the two-wire sections as shown in Fig.III-2-6-1, which may cause disturbance in calls.

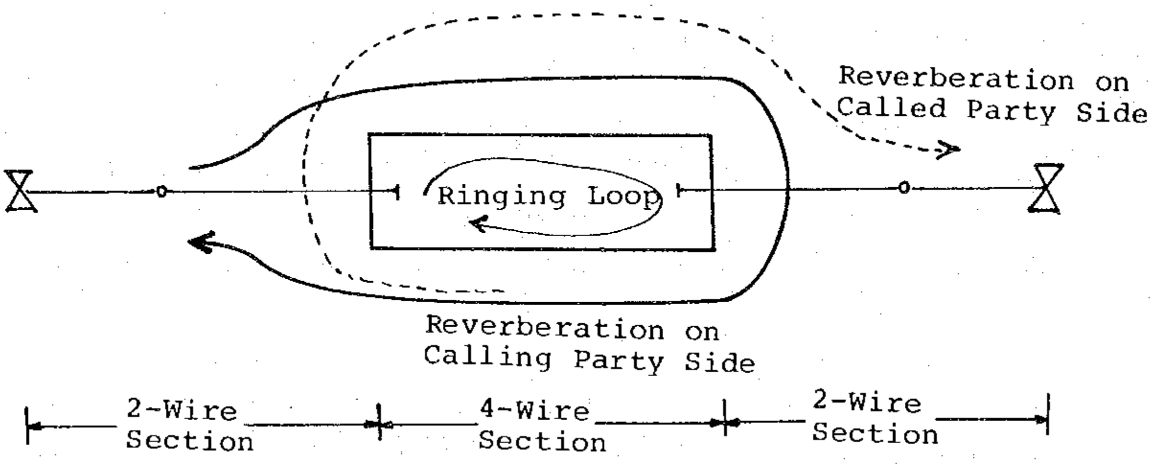


Fig. III-2-6-1 Reverberation Path

When the sum of the gains in the loop of the 4-wire section including repeaters exceeds the sum of losses in the loop an oscillation condition is caused, which is called "ringing." When "ringing" is caused, communication is not achievable on the channel and, in addition, disturbance may be given to other channels in the multiplex transmission line to cause a great number of circuits to become faulty all together.

Even if oscillation of loops is not caused, attenuation distortion or phase distortion may be caused in the telephone circuit and such a phenomenon as talking into an empty barrel may be caused to make it difficult to listen to talking. This condition is called "near ringing" and is caused in a state nearly causing oscillation of loop.

Furthermore, when the speech current from the talking party is reflected on the associate party side and returns to the talking party with a time delay, communication may be disturbed. However, it is known that this disturbance is not so bothersome when the transmission line contains a considerable loss.

In order to prevent these types of phenomina, it is necessary to design so that the total gain of the loop should not exceed the total loss of the loop and, at the same time, that a proper margin should be provided in considerable transmission loss, so that reduction in the transmission loss of the circuit is limited.

That is, there is such a minimum value of transmissiou loss that will not cause ringing, near ringing, nor reverberation. This minimum value of tranmission loss is called the minimum transmission loss. In general, the requirement for near ringing is most severe, so that when this requirement for near ringing is met, requirements for reverberation and ringing will be met.

Thus it is generally necessary to consider only the requirement for near ringing upon discussing the transmission loss in circuit design.

When, in Fig.Ⅲ-2-6-2, the reverberation attenuations of the hybrid coils (H) on the ends are E1 and E2 and the amplifier gains are G1 and G2, then the difference between the losss and gain in the loop circuit is given by

$$(E1 + E2) - (g1 + g2) = 2K \quad \ldots\ldots\ldots\ldots (1)$$

When $K<0$, the circuit causes ringing. When $K>0$, the circuit does not cause ringing. When $K>0$ but K is nearly 0, near ringing is caused. Accordingly, in order to make proper circuit design, it is necessary to provide a margin for preventing near ringing. This margin of 2K is called near ringing margin. The results of subjectiv test show that in the range of $2K = 7 \sim 10$dB, the communication condition degradation due to decrease of 2K is rather small and that in the range of $2K = 4 \sim 7$dB the communication condition degradation becomes remarkable. Accordingly, the near ringing margin is usually made 7dB. In actual transmission lines, loss variation, gain variation, and attenuation distortion variation are also caused. If the sum of these variations is $2\Delta\alpha$, the requirement for obtaining a stable circuit is

$$(E1 + E2) - (g1 + g2) \geqq 2(K + \Delta\alpha) \quad \ldots\ldots (2)$$

If, in Fig.Ⅲ-2-6-2, return losses at P1 and P2 are X1 and X2 and the amplification degrees are G1 and G2, we have

$$E1 = X1 + \beta 1 + \beta 2 \qquad E2 = X2 + \beta 1 + \beta 2$$

$$G1 = g1 - \beta 1 - \beta 2 \qquad G2 = g2 - \beta 1 - \beta 2$$

Then Equation (2) can be written as follows

$$(G_1 + G_2) + 2(k + \Delta\alpha) \leqq X_1 + X_2 \quad \cdots\cdots\cdots\cdots \quad (3)$$

If, in Fig.III-2-6-2, the line losses of the two-wire section are L1 and L2 and the intra-office loss of offices A1 and A2 are L0 and G1 = G2 = G, then the transmission loss between A1 and A2, N, is

$$N = L1 + L2 + 2L0 - G \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (4)$$

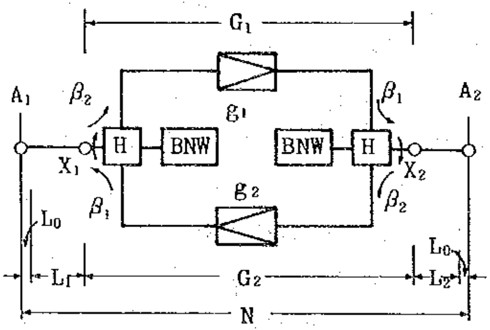


Fig. III-2-6-2

By obtaining G from Equation (3) and substituting it into Equation (4), we have

$$N \geqq L1 + L2 + 2L0 + K + \Delta\alpha - \frac{1}{2}(X1 + X2) \quad \cdots\cdots\cdots\cdots \quad (5)$$

which allows obtaining the minimum transmission loss.

In order for the circuit to be constructed in this project to be stable, it is necessary that the loss obtained from Equation (5) should be lower than the specified loss.

Equation (5) varies with the circuit condition. That is, the minimum transmission loss varies with the magnitude of the level variation, terminal return loss, the cable length in the 2-wire section, and the structual return loss of the cable.

When these values are set as follows, the relationship between the line loss in the 2-wire section (including the loss of repeating coil) and the minimum transmission loss is shown in Figs.III-2-6-3 ~ III-2-6-5.

Premises

1) Standard deviation of loss variation per section of carrier system: 1.0dB

2) Standard deviation of gain variation of negative impedance converter: 1.0dB

3) Standard deviation of loss variation per section of PCM circuit: 0.3dB

4) Structural return loss of toll cable: 23dB

5) Terminal return loss: 3dB
(Standard deviation: 1dB)

6) The number of 4-wire sections is made 3 in consideration of future condition for considering circuits between SC (Secondary Centers) and PC (primary Centers).

7) Rate of risk of near ringing: 1%

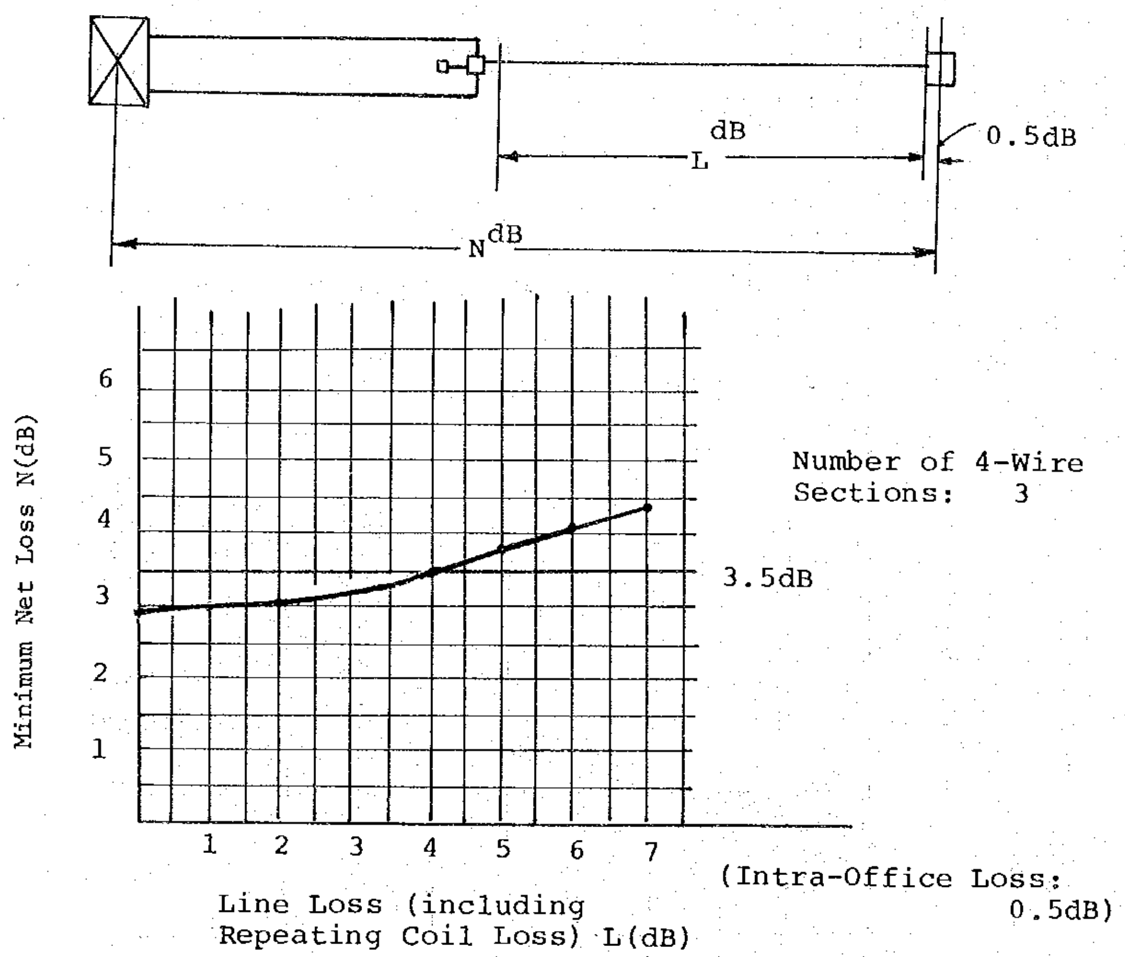


Fig.III-2-6-3 4W-2W Circuit Minimum Net Loss

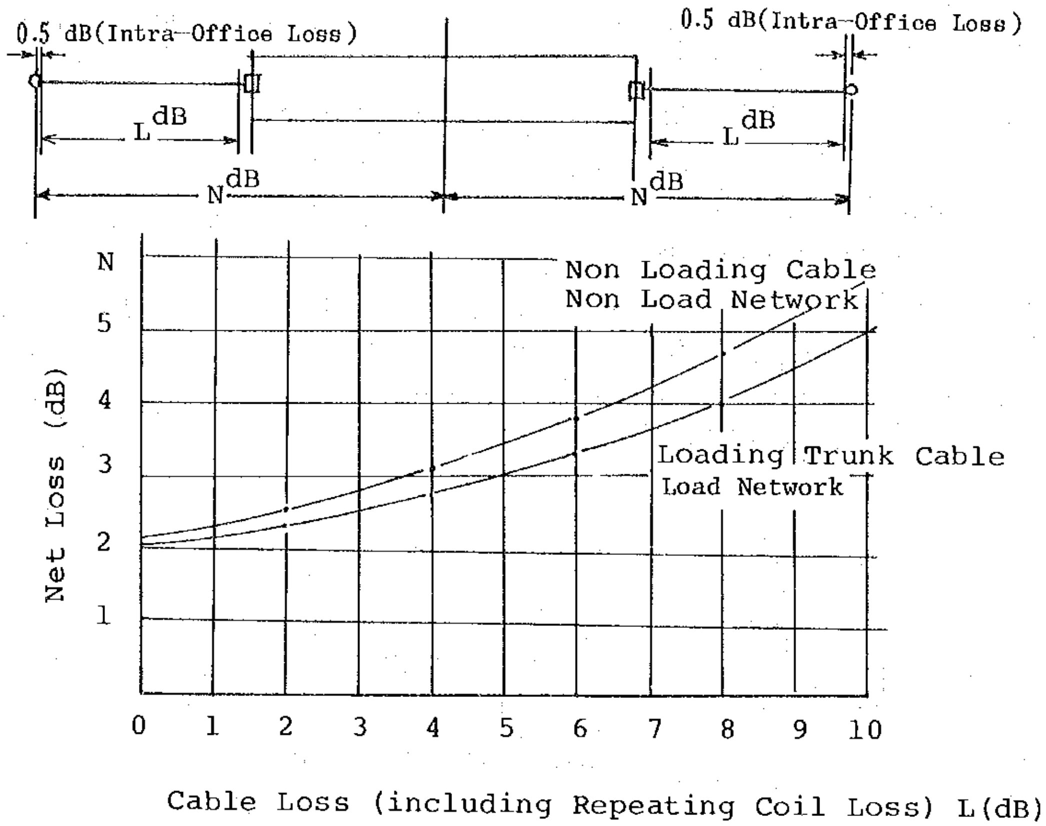


Fig. III-2-6-4 2W Circuit Minimum Net Loss (Carrier)

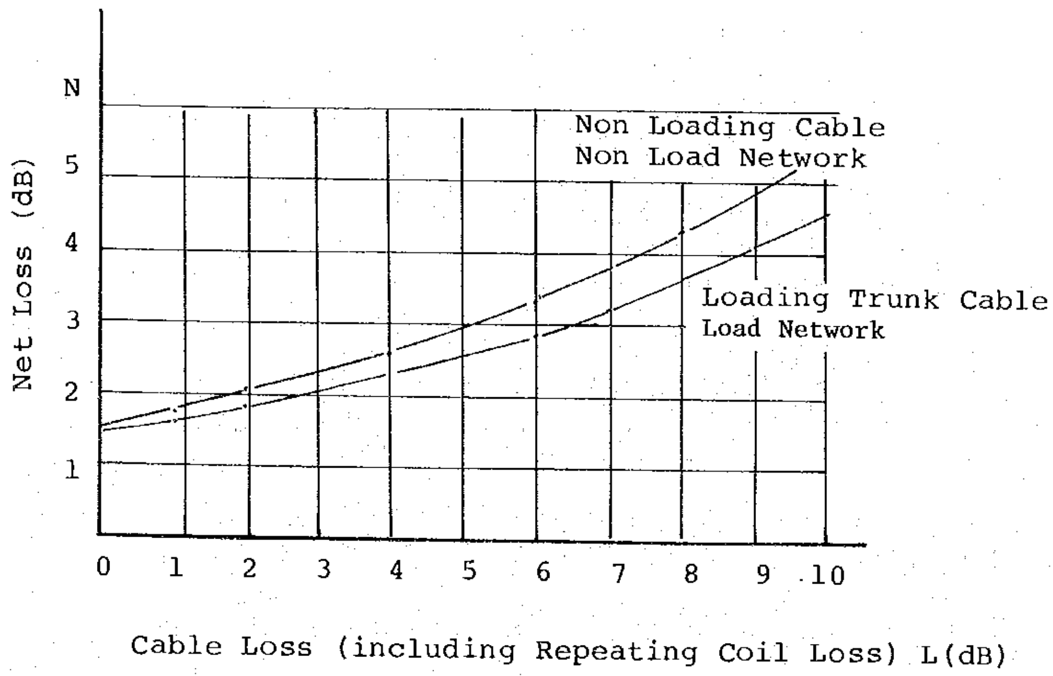


Fig. III-2-6-5 2W Circuit Minimum Net Loss (PCM)

3. NETWORK PLAN

3-1 Telephone

3-1-1 Present Situation of Toll Network

Toll call connections by BUTEL are conducted not by the STD but by the waiting method via toll switch boards.

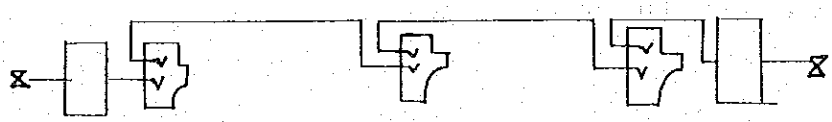
(1) Configuration of toll network

BUTEL's toll network has an NSC in Manila, a DSC in Baguio to cover the Northern Part of Luzon, a DSC in Cebu to cover the Visayas area, and a DSC in Cagayan de Oro to cover the Mindanao (Fig. III-3-1-1).

In the Northern Part of Luzon, a DSC is located in Baguio and direct trunks are passed from some offices to the NSC in Manila. (Fig.III-3-1-2).

(2) Routing

Connection of toll calls in the Northern Part of Luzon are made via the switchboard of the DSC in Baguio except when direct trunks to Manila are used. Let us consider, for example, connection from Bangued to Candon are connected via Baguio as shown below.



The existing toll network is in a "star" form and connections between end offices require detouring through a remotely-located DSC.
This network configuration is ascribable to many smallscale exchange and the concentration of toll calls to or from Manila.

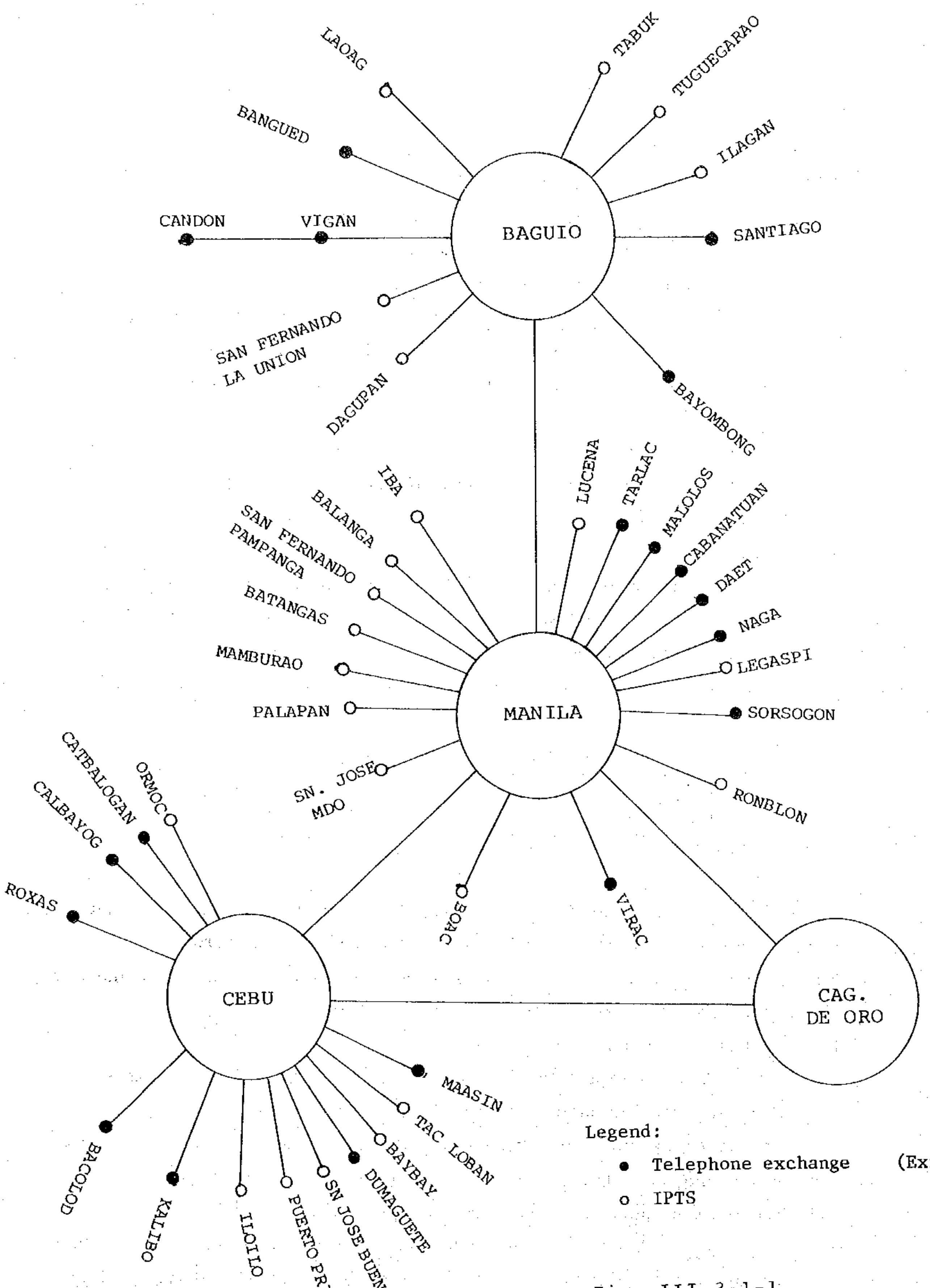
3-1-2 Network Plan Proposed by BUTEL

The toll network plan proposed by BUTEL in the "10-Year Telecom Expansion Program" is shown in Fig. III-3-1-3 as is as follows.

(1) To establish two TS in Baguio and Laoag in Region 1 and two TS in Bayombond and Tuguegaroa in Region II.

(2) Two office ranks are end office and primary centers.

(3) A "composite" network configuration is formed where primary center to local office connection is achieved by a "star" network and primary center to primary center connection (including connection with



Legend:
- ● Telephone exchange (Existing)
- o IPTS

Fig. III-3-1-1

BUTEL Telephone Routing Diagram (Existing)

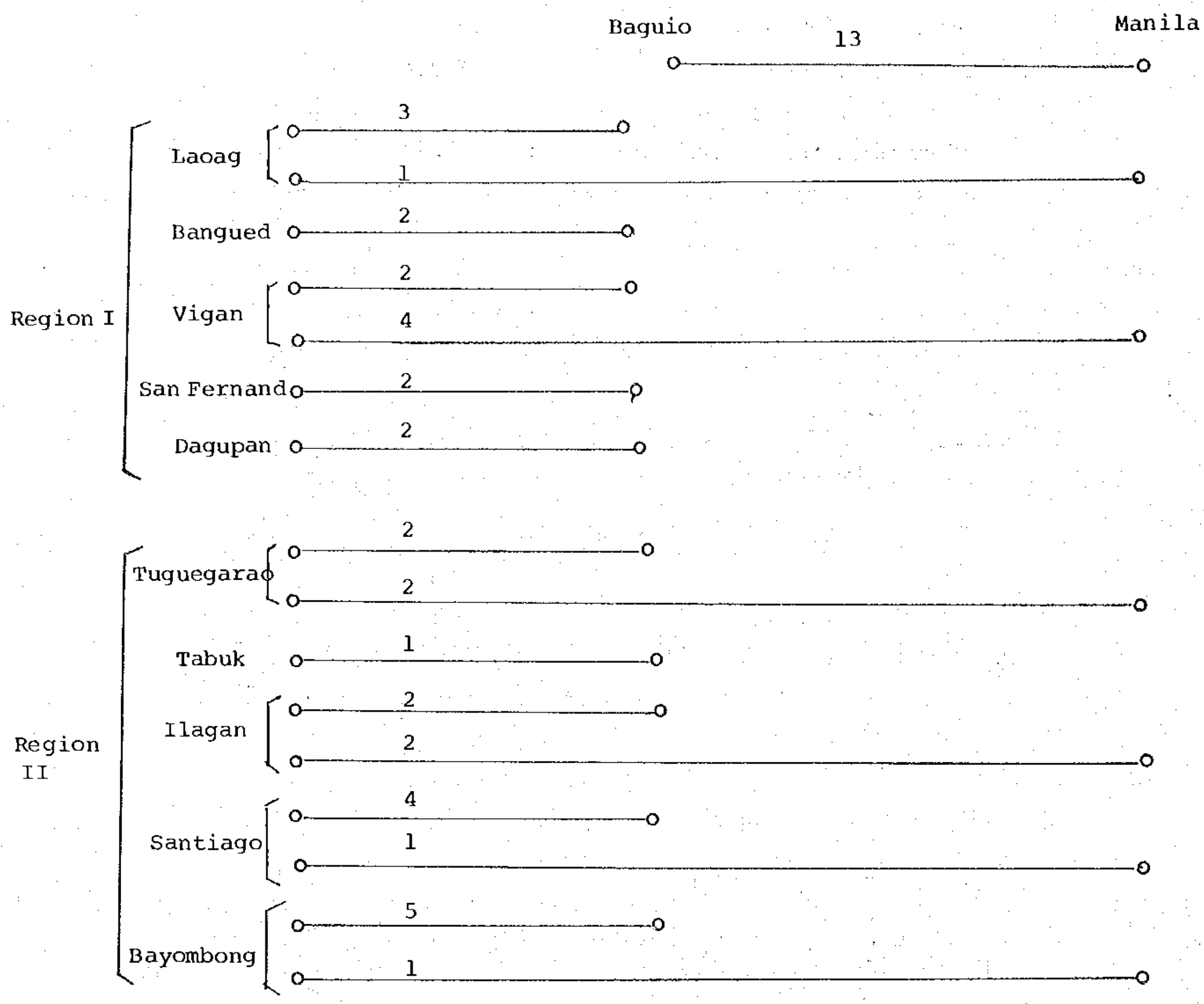


Fig. III-3-1-2 BUTEL Long Distance Telephone Circuits in Regions I and II (Existing) the NSC in Manila) by a "mesh" network.

(4) At Laoag TC and Tuguegarao TC a few DOMSAT (Domestic Satellite) circuits are furnished. This is intended to secure the irreducible minumum of telecommunications service and prevent isolation in communications in case the main route should fail due to a fault or trouble.

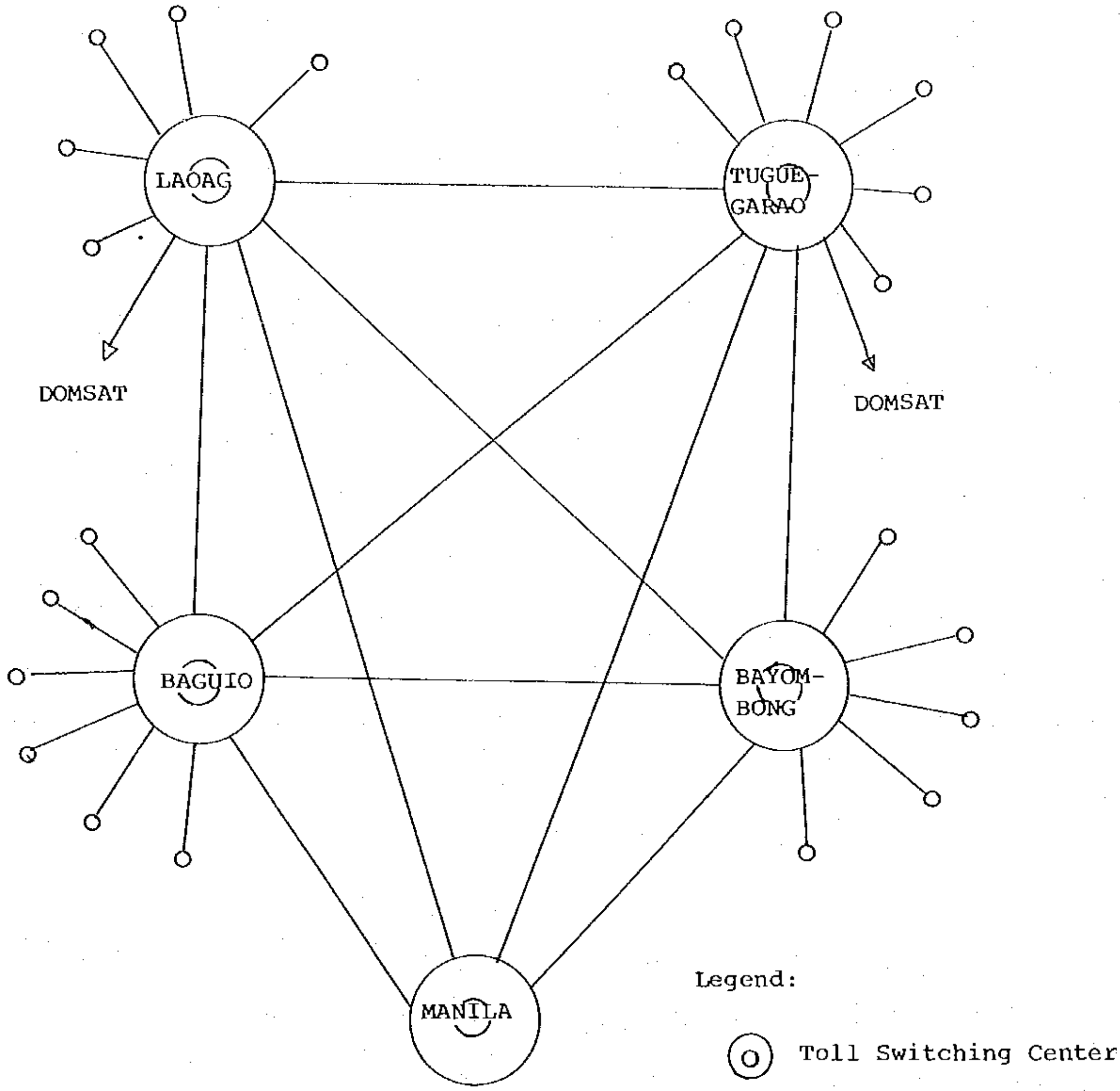


Fig. III-3-1-3 Network Plan Proposed by BUTEL

3-1-3 Fundamentals of Network Configuration

3-1-3-1 Basic Network Forms

Basically, network forms can be divided into "mesh" and "star" types. In addition to them, "composite" type formed by using them in combination is also used.

(1) "Mesh" network

In this type of network, circuits are established between all offices and the network thus constructed has a "mesh" form. This type of network provides advantages of simplicity and economy when adopted for a comparatively small number of offices which deal with comparatively heavy traffic. When used for a comparatively large great number of offices with less traffic, this type of network yields such disdvantages as increase in the number of lines and degradation in line occupation efficiency.

(2) "Star" network

A "star" network is a systematically organized network and compensates for the disadvantages of a "mesh" network. In this type of network, all calls are connected via a specific exchange. When the number of offices is much larger, it is rather uneconomical to connect a specific exchange with all offices and it is more recommendable to form "Star" networks in different areas and pile these "star" networks cubically so as to form a "multi-stage star" network. A "star" network provides the advantages of simplicity in network configuration, developed line efficiency, and rational allotment of transmission line loss but it also provides the following disadvantages.

a) Sections involving considerable amounts of traffic are connected via higher-ranking office so that the number of transit calls increases and an increased number of switching equipnent is required.

b) Increase in the number of transit calls requires increased number of connection links and then requires high-quality lines, resulting in increasing circuit cost.

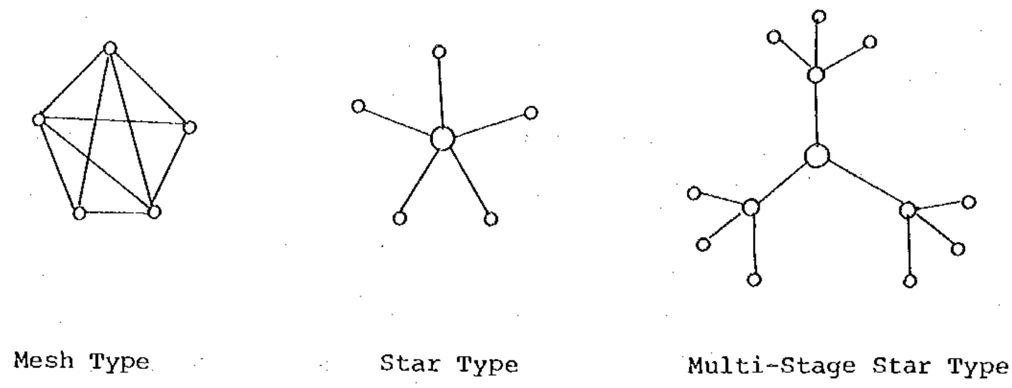


Fig. III-3-1-4 Shapes of Networks

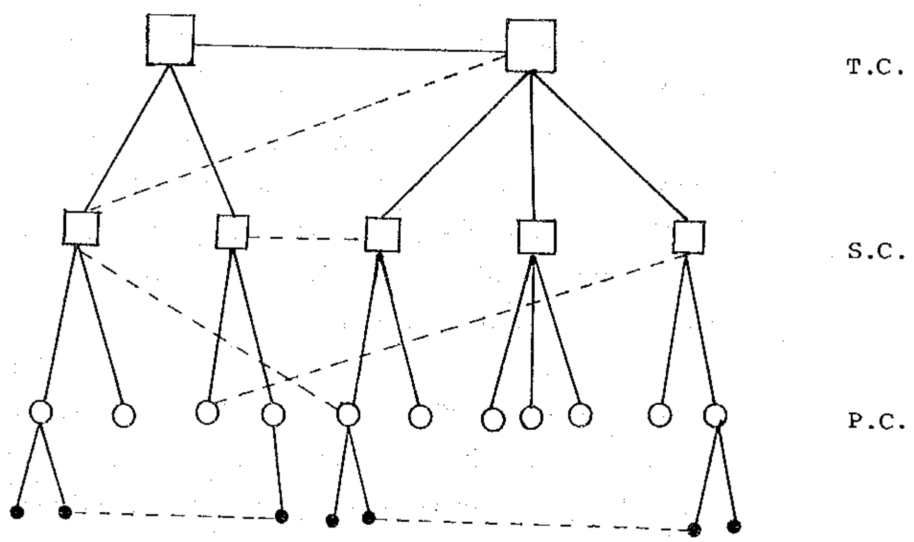


Fig. III-3-1-5 General Telephone Network

3-1-3-2 Configuration of Toll Networks

Toll networks extend to all areas in the country and not only networks become large in scale but some sentions with heavy trffic and those with small traffic are mixed up complicately.

"Mesh" and "star" networks, which are the basic forms of networks, provide both advantages and disadvantages.

"Mesh" network is advantageous for a comparatively small number of offices with a comparatively heavy traffic, whereas "star" network is advantageous for a comparatively large number of offices with comparatively small traffic.

In forming toll network configuration, consideration should be given to charging system and numbering plan as well as to efficiency usefulness of line and economy of network configuration. In general, a toll network is formed with a composite network which incorporates both "mesh" and "star" networks. That is, a "composite" network is constructed by piling up star networks cubically and by using direct trunks for sections with heavy traffic.

The systematization of areas between which communicatios are conducted by basically forming multi-stage "star" network is called toll zone system. Exchanges which become control exchanges in respective areas which are classified on the basis of the toll zone system are ranked into primary center (PC), secondary center (SC), tertiary center (TC), etc.

How many switching stages should be employed is determined in consideration of economy, technical requirements, distribution of calls, etc. Large-scale networks incorporate 5 office ranks whereas small-scale networks 2 office ranks.

3-1-3-3 Classification of Toll Trunks

Toll trunks used to connect exchanges can be classified into two types, i.e., basic trunk and traversal trunk, from the standpoint of network. These two types of trunks are described hereunder.

(1) Basic trunk

A basic trunk is such a trunk that is used for connection with upper-ranking offices by a "star" network or that is used between uppermostranking offices. Any two offices are necessarily connected by such trunks and transmission line loss between subscribers of the repective offices is controlled within a predetermined range. This basic trunk is a final route and calls overflown from it will be become loss.

(2) Traversal trunk

When a considerable traffic exists between certain two offices irrespective of their office ranks and it is more advantageous to establish a trunk between them, a traversal trunk is used to interconnect these two offices.

Traversal trunks generally allow detouring to other routes except when the traffic involved is extremely large.

3-1-4 Future Networks in Regions I and II

In planning a network, it is necessary to always consider the ultimate status of the network as a base.
The configuration of a network must be formed synthetically in consideration of the numbering plan and charging system to be adopted, as mentioned in the succeeding Capters Ⅲ-4 "Charging System" and Ⅲ-5 "Numbering Plan."

3-1-4-1 Premises for Future Network

In discussing future telephone network, telephone demand to be filled 50 years ahead should be considered so as to maintain the foundation of numbering plan and charging system in future. For this purpose, the following premises should be assumed.

(1) Population and number of households

Population and the number of households 50 years hence are assumed as follows from various statistical data.

Table Ⅲ-3-1-1 Pupulation and Number of Households (Regions I and II)

Item	Population	No. of Households	No. of Inhabitants per Household
Present	5,300,000	910,000	5.73
50 Years	12,900,000	3,225,000	4

(2) Number of subscribers and rate of spread of telephone

In consideration of the "10-Year Telecom Expansion Program" of BUTEL and future social and economical development of the Philippines, the present and future numbers of subscribers and existing and future rates of spread of telephone in Regions I and II are assumed as given in Table Ⅲ-3-1-2.

Table Ⅲ-3-1-2 Present and Future Numbers of Subscribers and Rate of Spread of Telephone (Regions I and II)

Item	Namber of Subscribers	Rate of Spread	
		Number of Subscribers per 100 Inhanitants	Number of Subscribers per 100 Households
Present (1)	10,300	0.19	1.1
50 Years Ahead (2)	774,000	6.00	24.0
(2) / (1)	75	32	22

(3) In principle, all cities and municipalities will be furnished with exchanges.

3-1-4-2 Toll Zone System

What kind of toll zone system should be adopted must be discussed synthetically in consideration of the scale of the toll network, traffic construction, numbering plan, charging system to be adopted. The scale of the toll network to be established will be as follows as mentioned later herein.

Number of local exchanges 257

Average number of subscribers per exchange ..... Approx. 3000

The number of exchanges, 257, is considerable large.
However, the average number of subscriber per exchange is approx. 3000. It means that subscribers will concentrate to cities or main municipalities and in many municipalities a large majority of small-scale exchanges will be located spread over wide areas.
Accordingly, it is clear that a rakned network of multi-stage type should be adopted as the basic future network configuration.
The office ranks to be employed are tertiary center, secondary center, primary center, and local switch, as shown in Table III-3-1-3 and Fig. III-3-1-6.

(1) Tertiary center .... Baguio

From the standpoint of the national network, the center of the area designated by Area Code 5 (Regions I and II and a part of Region III, IVA) or the uppermost-ranking office will be Baguio.
A large majority of toll calls from or to the Reigons I and II will be to or from Manila. Accordingly, it is suitable from the standpoint of transmission plan as well to concentrate the traffic to Baguio located rather near Manila.

(2) Secondary centers ..... Laoag, Vigan, Sanfernand, Baguio, Dagupan, Binalonan, Tuguegarao, Ilagan, and Bayombong (9 centers in total)

(3) Primary centers 34

(4) Local switch 257

For local switches which will be lowest-ranking in the network configuration, cities and municipalities will be set, in general, as local areas. However, such parts of municipalities that seem to promise only limited demand will be annexed to other bigger municipality and

Table. III-3-1-3 Toll Zone and Toll Number

TC	SC	PC	TOLL NUMBER	LOCAL AREA	NO. OF LS	PROVINCE
BAGUIO	SUN FERNAND	SAN FERNAND	512	(SAN FERNAND)	1	LAUNION
			513	(BAUANG) (NAGULIAN) (CABA) (ARINGAY) (BURGOS)	5	
			514	(BACNOTAN) (SAN JUAN) (SAN GAGRIEL) (BAGURIN)	4	
		BALAOAN	515	(BALAOAN) (LUNA) (BANGAR) (SUPIPEN) (SANTOL)	5	
		AGOO	516	(AGOO) (SANTO TOMAS) (TUBAO) (ROSARIO) (PUGO)	5	
	DAGUPAN	DAGUPAN	521	(MANGALDAN) (SUN FABIAN) (SUN JACINTO) (MAPANDAN)	4	PANGASINAN
			522	(DAGUPAN)	1	
			523	(SANTA BARBARA) (MARASIQUI) (CALASIAO)	3	
		SAN CARLOS	524	(SAN CARLOS)	1	
			525	(BAYABANG) (URBIZTONDO) (BASISTA)	3	
		LINGAEN	526	(LINGAEN) (BINMALEY) (LABADOR)	3	
			527	(BUGALLON) (AGUILAR) (MAN GATAREM)	3	
			528	(MABINI) (BURGOS) (DASOL) (INFANTA)	4	
		ALAMINOS	529	(ALAMINOS)(BANI) (ANGO) (SUAL)	4	
			520	(BOLINAO) (ANDA)	2	
	BINALONAN	BINALONAN	532	(BINALONAN)	1	
			533	(POZORRUBIO) (MANAOAG) (SISON)	3	
			534	(SAN NICOLAS) (NATIVIDAD) (TAYUG) (SAN MANUEL)	4	
		ASINGAN	535	(ASINGAN) (SANTA MARIA) (BALUNGAO)	3	
			536	(UMINGAN) (SUN QUINTIN)	2	
		URDANETA	537	(URDANETA) (VILIASIS)	2	
			538	(ROSALES) (SANTO TOMAS) (ALCALA) (BAUTISTA)	4	
	BAGUIO	BAGUIO	552	(BAGUIO)	1	BENGUET
			553	(LA TRINDAD) (TUBA) (SABLAN)	3	
			554	(ITOGON) (BOKOD) (KABAYAN)	3	
		TUBLAY	555	(TUBLAY) (ATOK) (KAPANGAN) (KIBUNGAN)	4	
			556	(MANKAYAN) (BUGIAS) (BAKUN)	3	
		BONTOC	557	(BONTOC) (SAGADA, RESAO) (SABANGAN) (BAUKO) (TADIAN) (SADANGA) (BARLIG, NATONIN) (PARACELIS)	8	
	VIGAN	VIGAN	561	(NARVACAN) (SANTA) (CAOAYAN) (SANTA MARIA) (SAN ESTEVAN) (BURGOS) (NAGBUKEL)	7	ILOCOS SUR
			562	(VIGAN)	1	
			563	(BANTAY) (SANTA CATALINA) (SAN VICENTE) (SAN ILOEFONSO) (SANTO DOMINGO)	5	
		CABUGAO	564	(CABUGAO) (SAN JUAN) (MAGSINGAL) (SINAIT)	4	
		CANDON	565	(CANDON) (SANTIAGO) (BANAYOYO, LIDLIODA) (GALIMYOD, SALCEDO) (SANTA LUCIA) (CONCEPCION, QURINO) (SAN EMILIO)	7	
		TAGUDIN	566	(TAGUDIN) (SANTA CRUZ) (SUYO) (SIGAY) (ALLIEM) (SUGPON) (CERVANTES)	7	
		BANGUED	567	(BANGUED) (LAPAZ, DANGLAS) (TAYUM, PEMARRUBIA)(VILLAVISIOSA, SAN ISIDRO, PILAR) (PIDIGA, LANGIDEN, SAN QUINTIN)	5	ABRA
			568	(DOLORES, LAGANGILANG) (SAN SUAN, LAGYAGAN, TINEG) (LICUAN, LACUR, MALIBCONG, DAGUIOMAN)	3	
			569	(BUCAY) (SAL LAPADAN, BUCLOC, BOLINEY) (MANABO, LUBA, TUBO)	3	
	LAOAG	LAOAG	572	(LAOAG)	1	ILOCOS NORTE
			573	(BACARRA) (PASUGUIN) (VINTAR)	3	
			574	(SAN NICOLAS) (SARRAT) (PIDDIG, CARASI)	5	
		BATAC	575	(BATAC) (PAOAY) (CURRIMAO) (PINILI) (BADOC)	5	
		DINGRAS	576	(DINGRAS) (SOLSONA) (MARCOS) (ESPIRITU) (NUEVA ERA)	5	
		BANGUI	577	(BANGUI) (BURGOS) (PAGUDPUD) (PUMALNEG) (ADAMS)	5	
	ILAGAN	TUGUEGARAO	581	(TUAO) (SOLANA) (ENRILE) (PIAT) (RIZAL) (FAIRE)	6	CAGAYAN
			582	(TUGUEGARAO)	1	
			583	(AMULUNG) (BAGGAO) (ALCALA) (IGUIG) (PENABLANCA)	5	
		GATTARAN	584	(GATTARAN) (LAL LO) (LASAM) (ALLACAPAN)	4	
		APARRI	585	(APARRI) (CAMARANIUGAN) (BUGUEY) (SANTA FERESITA) (GONZAGA) (SANTO ANA)	6	
			586	(BALLESTEROS) (ABULUG) (PAMPLONA) (SANCHEZMIRA) (CLAVERIA) (LANGANGAN)	6	
			587	(CALAYAN)	1	
			588	(BATANES)	1	BATANES
		TABUK	589	(TABUK) (TANUDAN) (TINGLAYAN) (LUBUAGAN, PASIL) (BALBALAN, QUIRINO) (PINOKPUK) (RIZAL)	7	K. APAYAO
			580	(KABUGAO) (CONNER) (CALANASAN) (PUDTOL) (LUNA) (ST MARCELA) (FLORA)	7	
		ILAGAN	591	(MAGUILIAN) (GUM) (REINAMERCEDES) (BURGOS) (QURINO) (NENTO SOLIVEN) (SAN MARIANO)	7	
			592	(ILAGAN)	1	
			593	(CAUAYAN) (LUNA) (CABATUAN) (SAN MATEO)	4	
		SANTIAGO	594	(ECHAGUE) (ALICIA) (ANGADANAN) (SAN GUILLERMO) (JOMES) (SAN AGUISTIN)	6	
			595	(SANTIAGO) (RAMON) (SAN ISIDRO) (CORDON)	4	
		CABARROGUIS	596	(CABARROGULS) (DIFFUN) (SNGUDAY) (AGLIPAY) (MADDELA)	5	QUIRINO
		ROXAS	597	(ROXAS) (CALLANG) (AURORA) (MALLIG) (QUEZOH)	5	ISABELA
		TUMAUINI	598	(TUMAUINI) (MAGSAYSAY) (SANTO TOMAS) (CABAGAN) (SANTA MARIA) (SAN PABLO)	6	
			599	(MACONACON, DIVILICAN)	1	
		ILAGAN	590	(PALANAN, DINAPIGUI)	1	
	BAYONBONG	BAYOMBONG	502	(BAYONBONG)	1	N. VIZCAYA
			503	(BAGABAG) (SOLANO) (VILLAVERDE) (DIADI) (QUEZON)	5	
		BAMBANG	504	(BAMBANG) (DUPAX DEL NORTE) (DUPAX DEL SUR) (KASIBU)	4	
			505	(ARITAO) (SANTA FE) (KAYAPA)	3	
		LAGAWE	506	(LAGAWE) (LAMUT) (KIANGAN) (HUNGDVAN) (VANAVE) (MAYOYAO) (POTIA)	7	IFUGAO

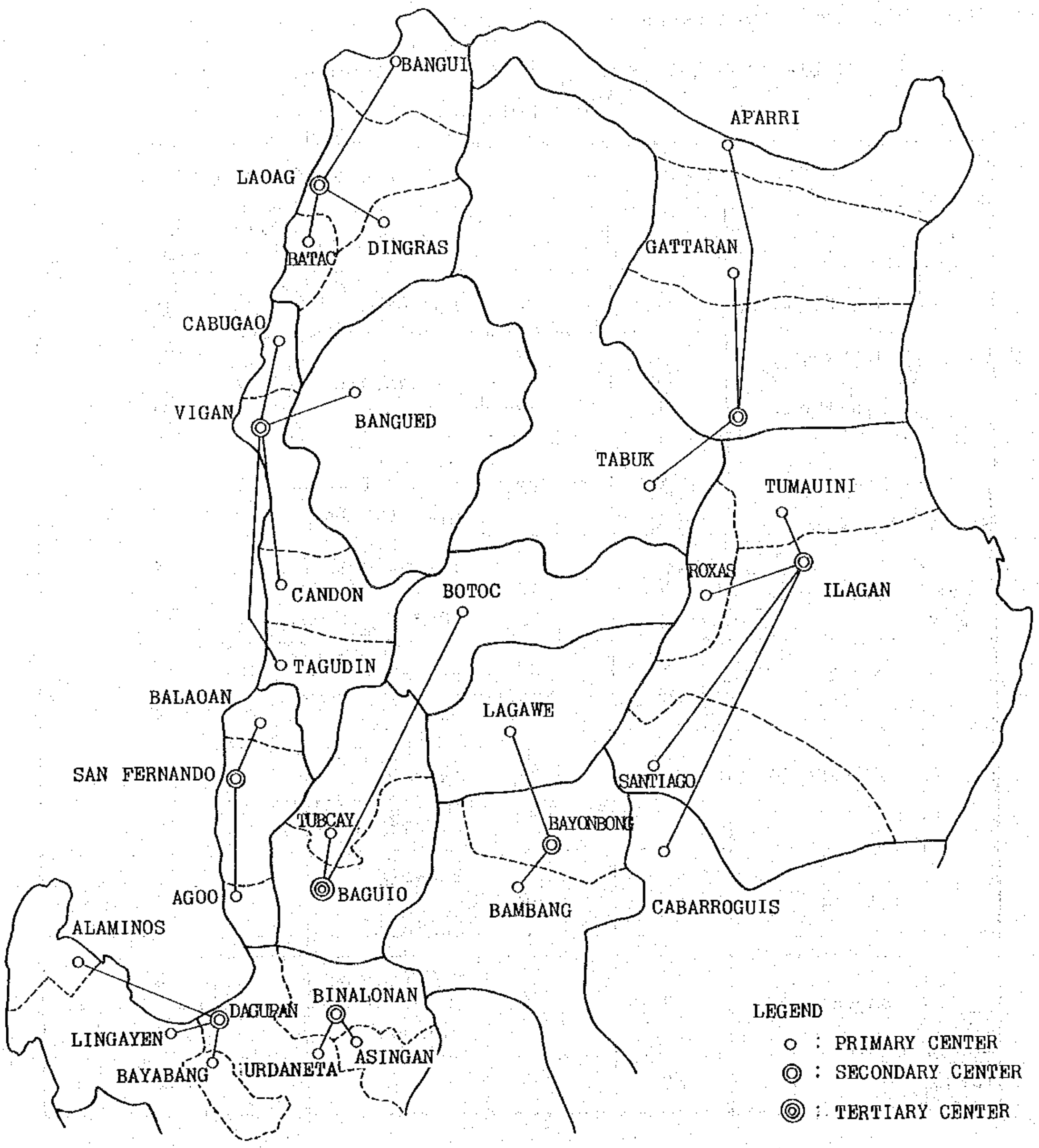


Fig. III－3－1－6 Toll Zone in Region I and II in some cases plural municipalities will form a single local area. Table III-3-1-4 gives estimated future numbers of offices in the respective office ranks.

Table III-3-1-4 Numbers of Offices in Respective Ranks (Future Network)

Office Rank				Administrative District	
TC	SC	PC	LS	Privince	Number of Cities and Municipalities
Baguio	San Fernando	3	20	La Union	20
	Degupan	4	27	Pangasinan	28
	Binalonan	3	19		19
	Baguio	3	22	Benguet	14
				Mt. Province	10
	Vigan	5	42	Ilocos Sur	34
				Abra	27
	Laoag	4	22	Ilocos Norte	23
	Tuguegarao	4	44	Cagayan	29
				Batanes	6
				K. Apayao	16
	Ilagan	5	40	Isabela	37
				Qurino	5
	Bayombong	3	20	N. Vizcaya	14
				Ifugao	7
Total	9	34	257	——	289

3-1-5 Network Plan of This Project

3-1-5-1 Scope

The scope of the network plan to be covered by this project is as follows.

(1) Plan of service to be covered by BUTEL

a) Existing offices

b) Offices proposed in this project

c) Offices planned to be transferred

(2) Plan of service to be covered by private operators

a) Existing office

b) Offices planned to be constructed newly

These service areas expected are enumerated in Table III-3-1-5 and arranged in Table III-3-1-6.

Table III-3-1-6 Numbers of Expected Service Areas in Regions I and II (Cities and Municipalities)

Region	BUTEL						Private Operators		Total
	Existing	This Project				Transferred	Existing	Planned	
		Phase 1		Phase 2					
		LS	IPTS	LS	IPTS				
I	3	12	10	16	13	5	17	15	19
II	3	7	9	10	18		3	7	47
Total	6	19	19	26	31	5	20	22	148

Table III-3-1-5 Telephone Serrice Area in Region I & II

REGION	PROVINCE	BUTEL						PRIVATE OPERATOR	
		EXISTING EX.	PROPOSED					EXISTING EX.	PROPOSED Ex.
			PHASE 1		PHASE 2		TRANSFERED EX.		
			LOCAL EX.	IPTS	LACAL EX.	IPTS			
I (ILOCOS)	ILOCOS NORTE		BATAC DINGRAS PAOAY SARRAT	CURRIMAO ESPIRITU PASUQUIN PIDDIG	BADOC PAGUDPUD PINILI SOLSONA VINTAL	BURGOS MARCOS NUEVA ERA BANGUI	BACARRA	LAOAG	SAN NICO-LAS LAOAG
	ILOCOS SUR	VIGAN CANDON	CABUGAO NARVACAN TAGUDIN	SNATA STA.MARIA STO. DOMINGO	MAGSINGAL SINAIT	CAOAYAN STA.LUCIA			
	ABRA	BANGUED	BANGUED						LICUAN
	MT. PROVINCE		BONTOC			SAGADA			
	LA UNION					STO.TOMAS		AGOO ARINGAY BAUANG NAGUILI-AN POSARIO SAN FERNANDO	BACNOTAN BALAOAN BANGAR LUNA
	BENGUET				MANKAYAN	BOKOD		BAGUIO LA TRI-NIDAD	ITOGON TUBA SABLAN
	PANGA-SINAN		ALAMINOS BINALONAN SAN. FABIAN	MAPANDAN SAN JACUNTO SAN QUINTIN	ALCALA ASINGAN BANI BOLINAO SISON URBIZ-TONDO SAN NICOLAN STA.MARIA	AGUILAR BALUNGAO BAUTISTA NATIVIDAD	BUGALLON POZORRUBIO STA BARBARA UMINGAN	DAGUPAN MANGAL-DAN CALASIAO SAN CARLOS BAYAM-BANG LINGAYEN ROSALES URDANETA	MANAOAG MANGA-TAREM SAN MANUEL TAYUG CALASIAO
II (CAGAYAN VALLEY)	BATANES			BASCO					
	CAGAYAN		ENRILE	BALLE-STEROS CLAVERIA GONZAGA LAL-LO SANCHEZ-MIRA TUAO	ALCALA BAGGAO	ABULUG BUGUEY CAMALA-NIUGAN LAZAM PIAT STO.NINO		TUGUE-GARAO	APARRI
	KALINGA -APAYAO					KABUGAO LUBUAGAN			TABUK
	ISABELA	SANTIAGO	ALICIA SAN MATEO TUMAWINI	SAN MANUEL	ANGADANAN GAMU NAGUILIAN SAN MARIANO	AURORA CABAGAN JONES MALLIG SAN AGUSTIN		ILAGAN	CAUAUAN ECHAGUE ROXAS LLAGAN
	IFUGAO			BANAUE		MAYAYAU KIANGAN			LAGAWE
	QUIRINO		CABARRO-GUIS		DIFFUN	MADDELA			
	N. VIZCAYA	BAYOM-BONG SOLANO	BAMBANG		ARITAO BAGABAG DUPAX DEL SUR	DUPAX DEL NORTE STA FE		BAYOM-BONG	
TOTAL		6	19	19	26	31	5	20	22

Note: Solano exchange which is constructing now is classified into existing exchange.

3-1-5-2 Principles of Network Examination

In scale, the network to be established by this project will cover nearly half area of Regions I and II. However, the rate of telephone spread is still in the process of being developing.
Even if telephone expansion plans are implemented one after another on the basis of this project, the number of subscribers and the rate of spread 10 years ahead will respectively become about 62,000 and 0.89. (See Part V.)
When compared with the present situation, both the number of service areas and subscribers will become about 6 times as large 10 years ahead but these numbers will still develop.
In addition, present telephone service in the Philippines is conducted by BUTEL and private operators, which is rather complicate.
In examining the network to be established by this project, these circumstances should be grasped and should be smoothly linked to the future network expected to be developed further.
The principles for network examination should be as follows.

(1) The ideal form of telephone service is STD service, so that STD survice should be adopted as much as possible.
When STD service is unachievable by some reason or other, the most similar service, that is, non-delay manual service should be employed as much as possible.
(2) Calls to or from Manila, which are the most majority of calls among toll calls, should be realized by STD as much as possible.
(3) No drastic modification should not be made at existing offices.
(4) Networks owned by the private operators should be paid high regard to and should not be planned to be demolished.
(5) Consideration should be given to allow smooth transfer in case the network of BUTEL and those of private operators are jointed together in future.

3-1-5-3 Connection Method

Exchanges to be constructed in this project are mentioned in Paragraph III-3-1-5-1. Connection between subscribers of these exchanges will be made by those methods given in Table III-3-1-7 by the principles mentioned in the preceding paragraph.
The methods of connection from local switches to be constructed newly in this project are briefly as follows.

(1) Connection between new LS's in Regions I and II: STD

(2) Connection with Manila

To Manila: STD

From Manila: Delay manual

(3) Connection with existing BUTEL offices in Regions I and II

To existing offices: STD

From existing offices: Non-delay manual

(4) Connection with private operators in urban areas where TS is in Regions I and II

To private operators: STD

From private operators: Delay manual

(5) Others: Delay manual

Calls originated from existing LS's will be connected not by STD but by non-delay manual. Existing offices are not furnished with any subscriber meter since the present charging system used flat rate charging.

For details of connection with the networks of the private operators see Chapter III-14.

Table III-3-1-7 Connecting Methods

From			BUTEL					Private Operators			
			Regions I and II			Manila	Other Areas	Regions I and II		Manila	Other Areas
			New LS	Existing LS	IPTS			City where BUTEL's TS Installed	Other Areas		
BUTEL	Regions I and II	New LS	◎	◎	Δ	◎	Δ	◎	Δ	◎	Δ
		Existing LS	○	○	Δ	○	Δ	Δ	Δ	Δ	Δ
		IPTS	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Manila		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Other Areas		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Private Operators			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ

<u>Legend:</u>

◎: STD

○: Non-delay manual

Δ: Delay manual

3-1-5-4 Network Configuration

Fig. III-3-1-7 shows the configuration of the network to be constructed in Phase 1 and Fig. III-3-1-8 that of the network to be constructed in Phase 2. The ultimate network configuration assumed is shown in Tables III-3-1-3, III-3-1-4 and Fig. III-3-1-6. In the stage of this project, the scale of the network is comparatively small and it is rather disadvantageous economically to adopt the 4-rank configuration of SC, PC, and EO will be adopted and consideration should be given to allow smooth transfer to the ultmeate network configuration. The comparison of the configuration of the ultimate network and that of the network to be established in this project is shown in Fig. III-3-1-9.

(1) The foundation of the network will be established in this project with the configuration of the upper two office ranks kept as much the same as that of the ultimate network configuration.

(2) Binalonan Primary Center will be constructed in Phase 2 depending on the traffic distribution. Accordingly, Binalonan LS and Sanguitin IPTS which will be constructed in the Binalonan PrimaRY Center area in Phase 1 will temporarily belong to Dagupan Primary Center. When Binalonan Primary Center is completed in Phase 2, Binalonan LS and Sanquitin IPTS will be transferred to belong to Binalonan Primary Center.

(3) San Fernand Primary Center will not be constructed until traffic to be treated reachs a predetermined amount.
Sto. Tomas Local Office (in the San Fernand Primary Center area) will temporarily belong to Dagupan Primary Center in consideration of the advantage from the standpoint of transmission line.

(4) It is generally more advantageous to treat an IPTS as a local office belonging to a TS from the standpoint of transmission quality.

(5) Connection with exchanges of private operators will be made at TS, althoguh not specified in Figs. III-3-1-7 and III-3-1-8. (For details, see Chapter III-14.)

(5) Manual operation of calls and telephone number information, etc., on switchboard will be conducted concentratively at offices furnished with TS.

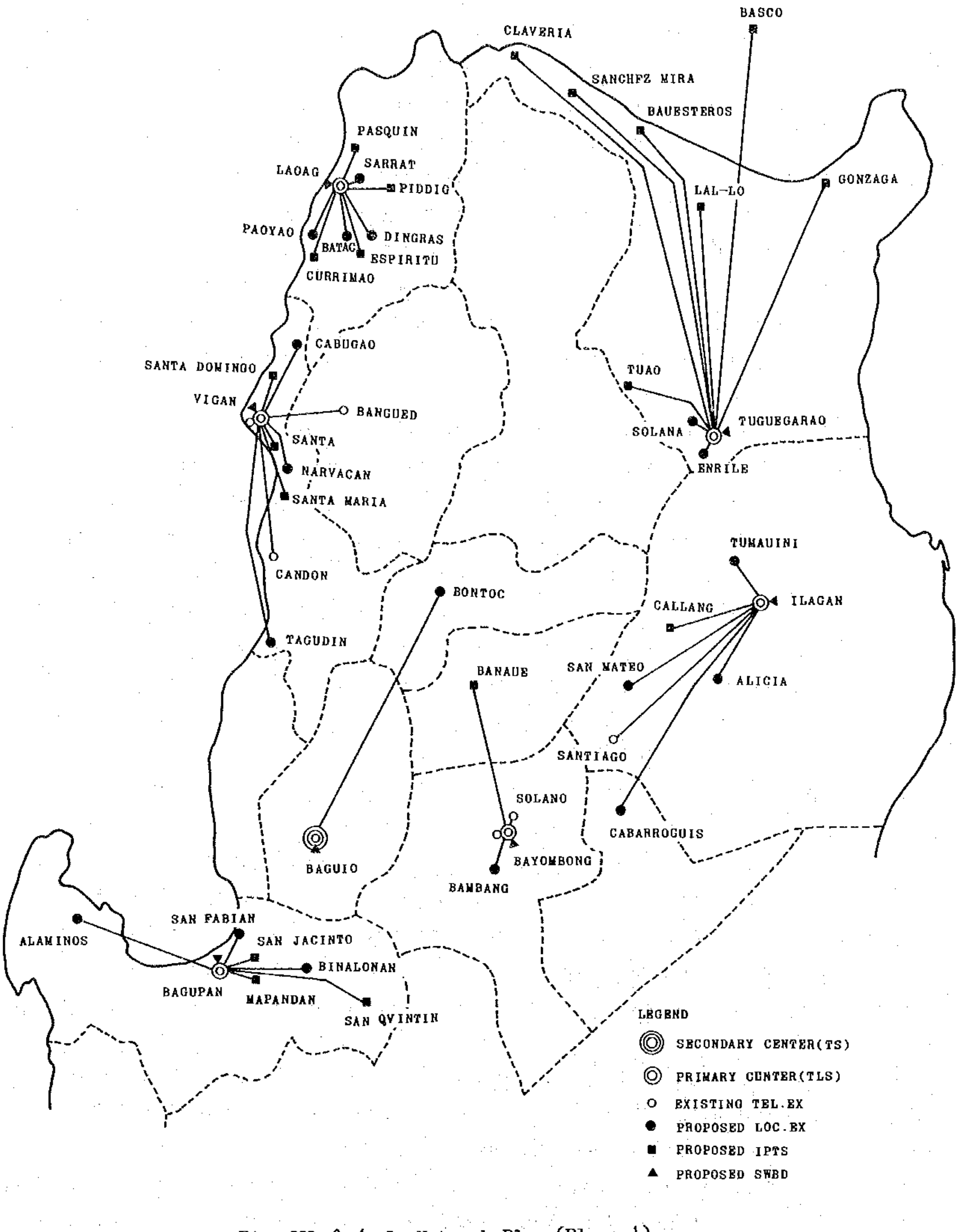
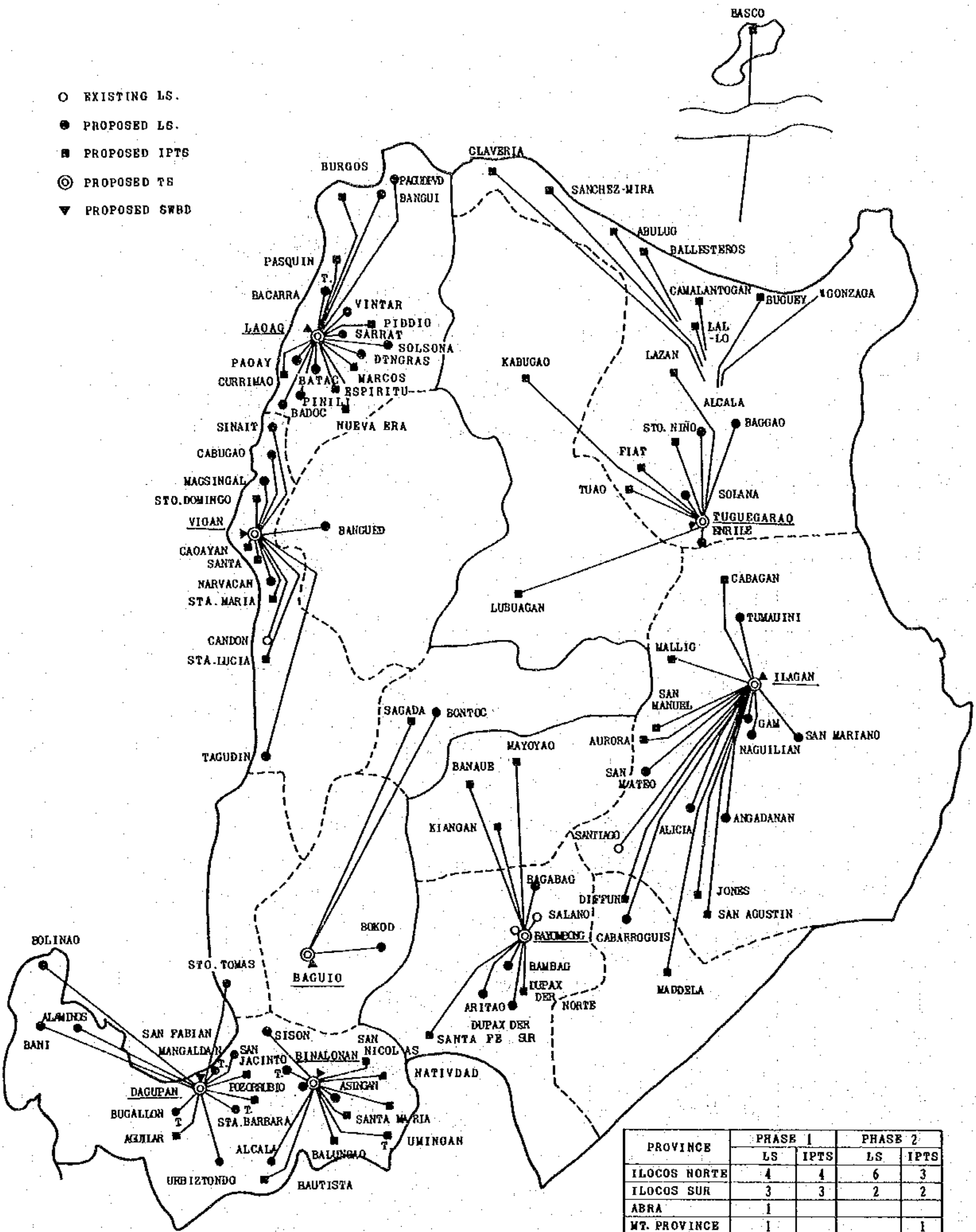
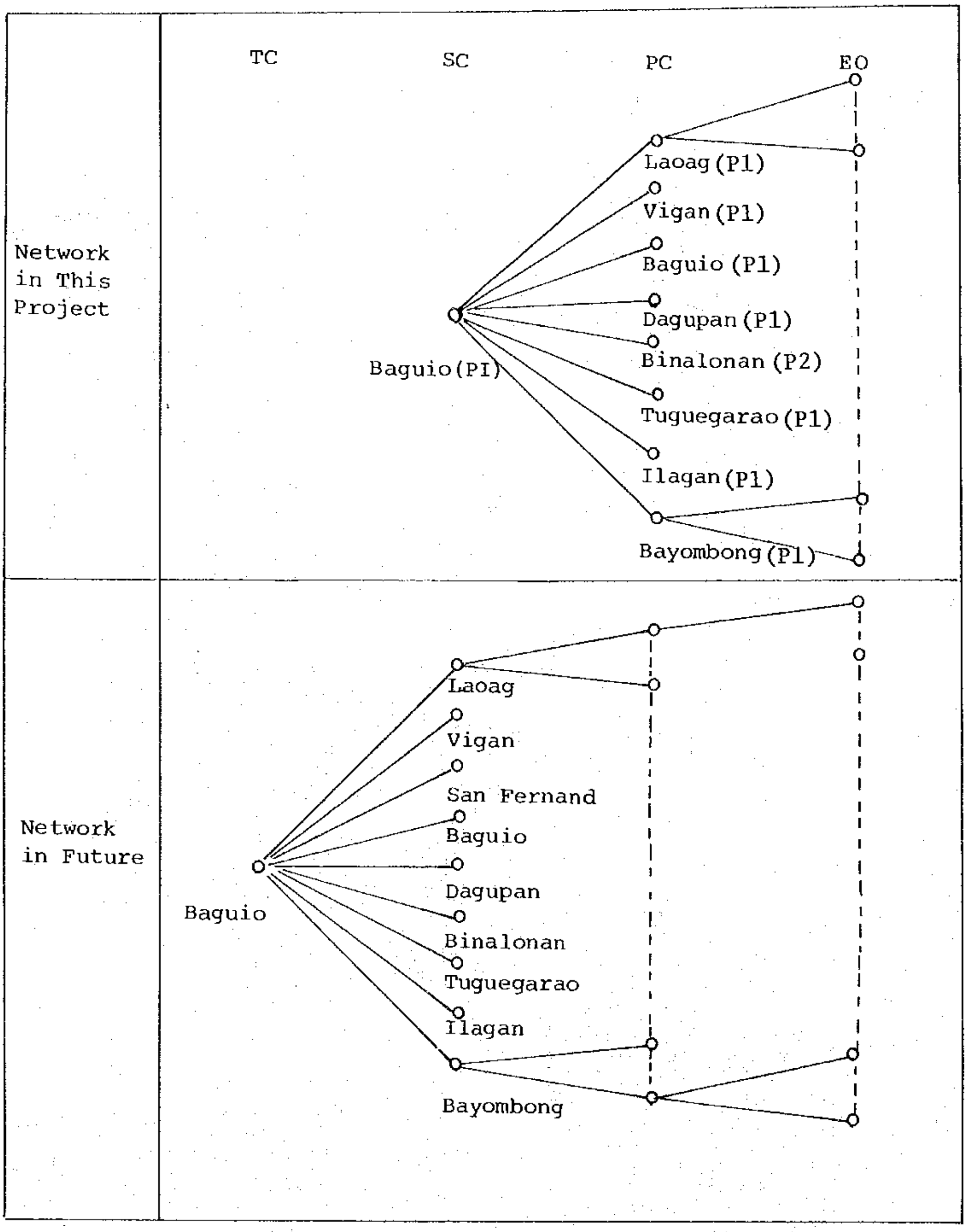


Fig. III-3-1-7 Network Plan (Plase 1)



PROVINCE	PHASE 1		PHASE 2	
	LS	IPTS	LS	IPTS
ILOCOS NORTE	4	4	6	3
ILOCOS SUR	3	3	2	2
ABRA	1			
MT. PROVINCE	1			1
LA UNION				
BENGUET			2	
PANGASINAN	3	3	6	6
BATANES		1		
CAGAYAN	2	6	2	6
KALINGA-APAYAO				2
ISABELA	3	1	4	5
IFUGAO		1		2
QUIRINO	1		1	1
N. VIZCAYA	1		3	2
TOTAL	19	19	26	31

Fig. III-3-1-8 Network Plan (phase 1,2)



P1 : Phase 1
P2 : Phase 2

Fig. III-3-1-9 Network Plan

3-2 Telegraph Network Plan

In planning an effective, economical telex network in the Northern Luzon, consideration should be given to the following.

1) To locate a telex main center at the center in each region.
2) To locate a telex concentrator office in a central city or municipality in each province. For those telegraph offices expected to be located very close to each other or involve less traffic between them, a telex concentration office will be located in the largest province. In the center of province where no telex cocentrator is provided, a Gentex office will be constructed.
3) In principle, accommodation of a Gentex station into a telex exchange office or telex concentrator office should be made not to extend over plural regions or districts in consideration of ease of administration, operation and maintenance.
4) The telex network should fall in line with telephone network to be constructed in this project as much as possible and radio and carrier transmission network intended solely for telegraph purpose should be avoided as much as practicable.
5) Telex concentration in the telex network in the Northern Luzon for connection with Manila should be conducted at Baguio as is the case with the toll telephone network.

Telex exchanges and concentrator offices to be constructed in Phases 1 and 2 should be as follows.

Phase 1	Phase 2
Telex exchange	Telex concentrator
Baguio	Laoag
Tugnegarao	Vigan
Telex concentrator	Ilagan
San Fernando	Santiago
	Bayombong

3-2-1 Telex Network to Be Established in Phase 1

The telex network to be established in Phase 1 will form the backbone of the telex network in the Northern Luzon.

That is, a telex exchange office will be constructed at the center of each region, to which the telegraph office located at the center of each province as the Gentex station will be connected. By this, a considerable amount of telegrams to be treated by BUTEL in the Nortern Luzon will

be automated, providing a remarkable development in service.
development in service.

It is necessary to discuss where to locate the regional telex center in Region I ——— in San Fernando or Baguio?

San Fernando: Expected to be developed as the Rigional Center of Region I. However, San Fernando is out of the Norther Luzon microwave main route.

Accordingly, if the telex exchange of the Regional Telex Center is installed at San Fernando, it is necessary to provide a San Fernando —— Banguio trunk line (incorporating carrier telegraph equipment) since San Fernando and Baguio are interconnected with a spur route (VHF circuit). This is rather uneconomical and is not advantageous from the standpoints of operation and maintenance. From all these, it will be suitable to introduce a telex concentrator office belong to the telex exchange office at Baguio.

On the other hand, Baguio exchange will be a large-scale one so as to make it have an intensive role of the telex network in the Northern Luzon. Accordingly, to install two large scale telex exchanges at both Baguio and San Fernand may be double investment.

Baguio: Baguio is a key position for communication with Manila.

In addition, Baguio is the center of the Northern Luzon and should install such a large telex switch that allows toll telex switching operation. That is, Baguio should become the Regional Center of Region I and, at the same time, should become the Main Center of the Northern Luzon for operation and maintenance purposes.

In Region II, Tuguegarao plays the role of the Regional Center, and it offers no problem from the standpoint of the microwave main route to install the telex switch of the Regional Center at Tuguegarao.

A telex concentrator itself does not have the functions of switching and charging. That is, the telex concentrator only concentrates the lines of telex subscribers and Gentex stations, and the telex exchange associated with the concentrator conducts switching and charging. Accordingly, if the telex concentrator office which belongs to the telex exchange office is located in any other region, it is inconvenient from the standpoints of operation and maintenance.

Stations where telex concentrators are expected to be installed in Phase 2 will be connected to the telex exchange office of the respective regions to which the station belongs, as Gentex stations in Phase 1.

3-2-2 Telex Network to Be Constructed in Phase 2

In Phase 2, a telex concentrator will be installed at six differnct locations aiming at development in service by the increase in the number of telex subscribers and automatization in telegram service after completion of the basic telex network in Phase 1.

By this, comparatively large telegraph offices in the respective regions will be incorporated as Gentex offices into the telex network.

The trunks with telegraph carrier equipment will be layed between the six offices which will be furnished newly with telex concentraters and the telex exchange office to which these offices belong.

The telex network to be constructed in Phase 2 in consideration of all these conditions is shown in Fig.III-3-2-2.

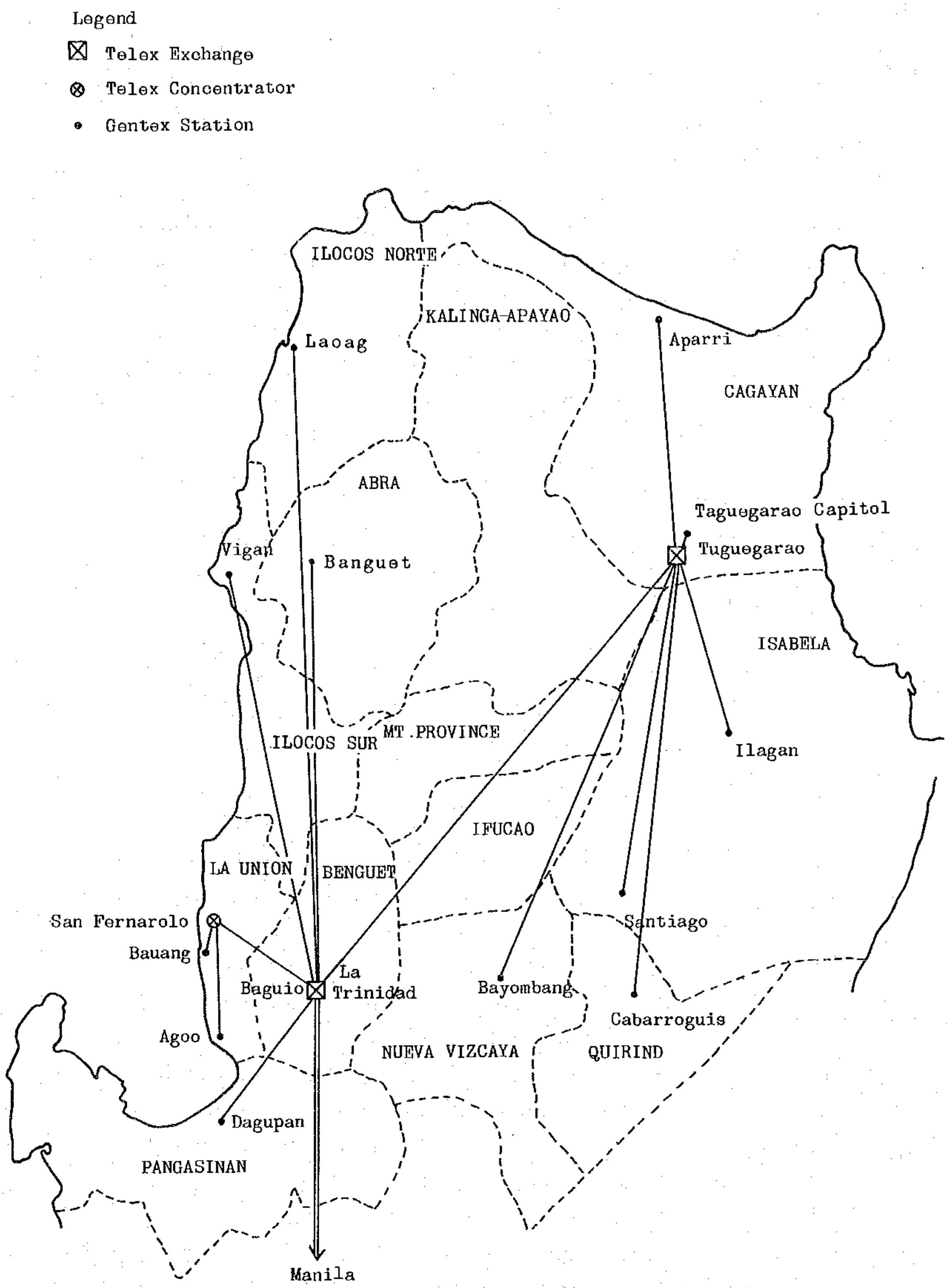


Fig. III-3-2-1 Telex Networh Plan (phase 1)

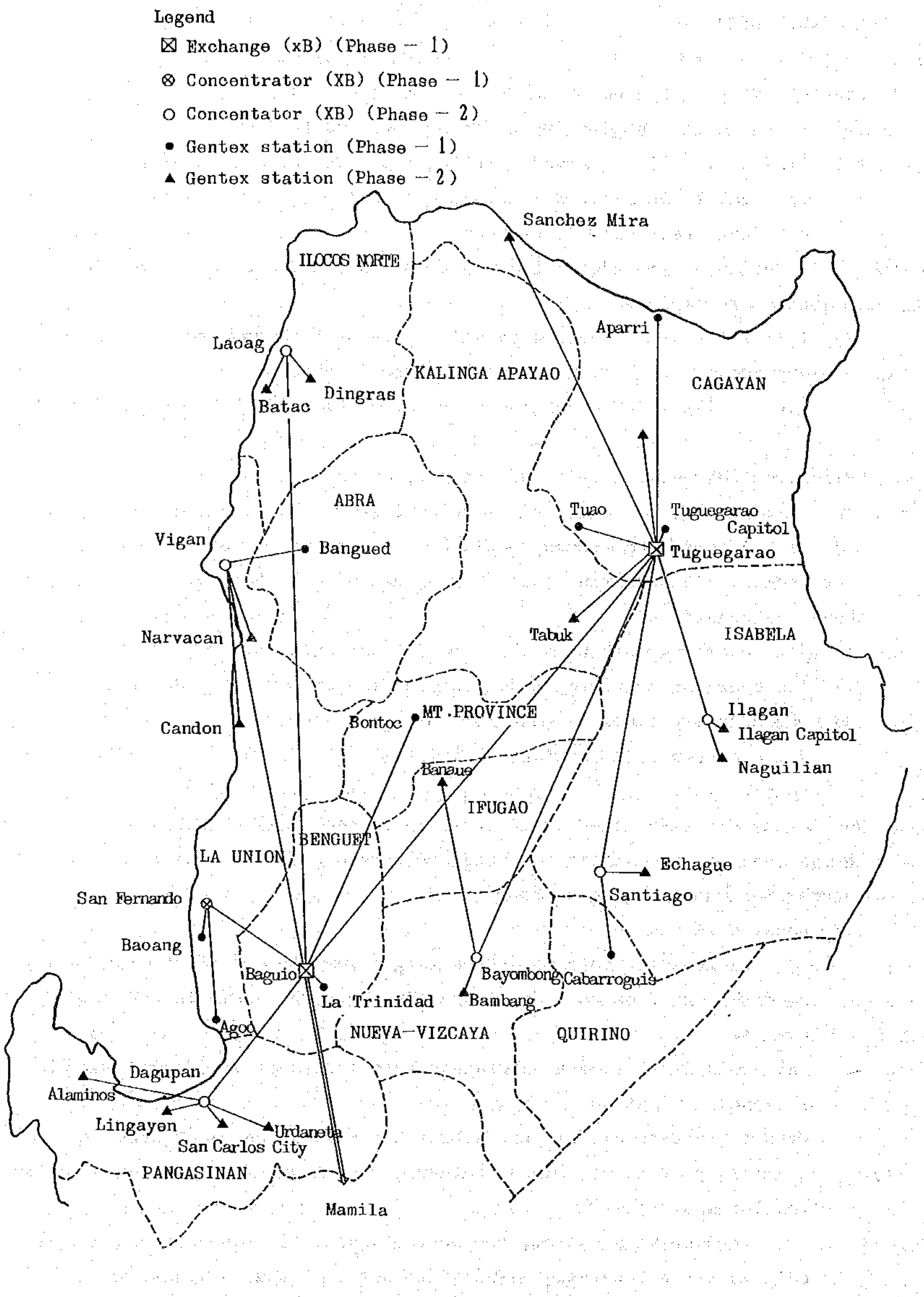


Fig.Ⅲ−3−2−2 Telex Netwrk Plan (Phase 2)

4. CHARGING SYSTEM

4-1 Present Charging System of BUTEL

The present charging system of BUTEL is as follows.

(1) For local calls, a given charging rate per month is employed and as many calls are allowed as desired during the period. That is, it is not that every call is charged.
Accordingly, no subscriber meter is installed even if automatic switches are employed.

(2) Toll calls are connected by delay service through a toll board and charged by the "two minutes/one minute" method.
For details of the chargiug method, see Part XIII "CHARGING SYSTEM."

4-2 Principles for Determination of Charging Method

In this project, toll calls are expected to be connected by STD, and what kind of charging method should be employed is one of the most important themes. In determining a charging method, the following principles should be considered.

(1) Fair charging must be applied to all subscribers.

(2) The charging system must be easy for subscribers to understand.

(3) The charging system, which is closely related with the function of switches employed, must be technically feasible and reasonable in equipment cost.

Now let us classify telephone charges into local call charge and toll call charge, and consider their features and considerations to be taken upon determining the charging method.

(1) Local call charge

In general, cost for connecting a call is considered not to be so different from that for connecting any other call in the same local call area.

Accordingly flat rate or message rate irrespective of call duration is generally set.

With flate rate system, the subscriber pays a monthly, quarterly, sixmonthly or annual fixed charge irrespective of the member of calls for local service.

With message rate system, the cost of each effective outgoing local call is met by charging a fee independent of the call duration.

That is, a uniform charge is generally chosen for local calls.

When administrations consider it suitable to take account of the call duration as well, the subscriber is usually charged a low unit fee at fairly lengthy intervals (every three minutes for example).
The time measurement means that metering equipment has to be provided at the local exchanges. This arrangement is more complicated and expensive than if calles alone had to be counted.

(2) Toll call charge

The cost for the connection of a toll call is considerably higher than the cost for a local call and varies with the following factors.

a) Duration of the call
b) Distance between telephone offices of which the calling and called parties belong.
c) Handling method (request for special service)
d) Time zone

Toll call charge should be determined by synthetically examining these factors and charging technique available for the execution of charging.

4-3 Introduction of bulk billing

For the charging method in this project, BUTEL considers as follows.

a) Local call charge: Charging for every call
b) Toll call charge: To be charged depending on the call duration and distance
c) Charge recording method: By subscriber meter

That is, this charging method is the so-called bulk billing method in which local and toll call charges are summed up and recorded by a subscriber meter. This charging method provides the advantages of simple facilities and economy.
The disadvantage of this method is that local and toll call charges can not be discriminated from each other and the price of each toll call made can not be indicated on the bill. Accordingly, in case severe subscribers request for the contents of charges or the like, there is no means to cope with it. It is to be noted that this may lead suspicion for the amounts asked for the subscribers.
In adopting this method, therefore, mismetering ascribable to the insufficiency of maintenance must not be caused. It is necessary to prevent troubles from occurring by routine inspection, etc., that is, ample maintenance is always required.

4-4 Introduction of Periodic Pulse Metering Method

When bulk billing by using subscriber meters is employed as the charging method, the following two methods can be considered as the methods of metering the distance factor in STD.

a) Periodic pulse metering method

Iu this method the unit charge, which form the base in charging, is constant and the time interval, during which talking is available in a unit charge depends on the distance. In more concrete, metering pulses are sent at a given period of time while talking.
This period varies with the distance.

b) Fixed period charging method

In this method, the unit time (e.g., 3 min. - 1 min. and 3 min. - 3 min.), which is the base in charging, is made constant and the charge, by which talking is allowed for a unit time interval, depends on the distance. In more concrete, a series of pulses are sent at the end of each unit time interval while talking and the number of these pulses depends on the distance.

By comparing these two methods with each other it is understood that the former method has the following advantages and it is recommended to introduce the former method for toll calls.

Advantages of periodic pulse metering method

a) Long-distance calls can be made at comparatively reasonable charges if the duration of the call is short and, unlike the fixed period charging method, the charge will not "jump" every 3 minutes. In connection, the charges of toll calls are equivalent to those of local calls and afer establishment of connection the talking is charged by the duration of time.
b) Technical handling is easy since metering is conducted by a single pulse while talking.
c) Change of pulse intervals can be technically achieved with ease, providing a great flexibility for changing the rate system. By this, night-time discount can be easily achieved technically.
d) In case a subscriber dials a wrong number, he is charged only by one message rate or so.

4-5 Setting of Charging Areas

Toll call charge is determined by the call duration and distance. If the distance between the calling and called subscribers is used as the distance for charging, such combinations of distances would amount to a great number, requiring complicate charging equipment of high prices.

In practice, however, exchanges are divided into groups each forming a charging area and charges are determined in steps by the distance between charging areas.

That is, all toll calls from a charging area are charged by a tariff.

4-5-1 Principles of Setting Charging Areas

In setting charge areas, consideration should be given to the following.

(1) Charging areas should be as much equal (in area and the number of subscribers) to each other not to give the impression of unfairness.

(2) A zone of life should entirely be covered in a charging area.

(3) Use of administrative borders as the border of charging areas is, in general, recommendable.

(4) When there is a difference between two areas in cost of toll transmission line forming an STD network, another area should be set, as in the csse of setting a charging area for an remote island.

(5) The smaller areas, the closer to actual distance.
However, this will involve increased numer of charging areas and expensive charging equipment.

(6) Charge areas can be identified by toll numbers.
Thus area setting should be discussed in relation with the numbering plan.

(7) One charging area should not go over plural primary center creas.
It should also be avoided to set too many unit charging areas in a single primary center area.

Now, let us consider item (7) above in more detail.

a) Charging area identification is achievable by the dialed toll number. On the other hand, the toll number has the aim of the identification of the route to be connected. All that is required for effecting these two types of identification most simpley and simultaneously by one toll number is to let charging areas and primary center areas, the latter of which form the unit for route selection, be identical. In case a charging area goes over plural primary center areas, their identification will become complicated.

b) Charging equipment used in the periodic pulse metering method are, in general, installed at primary centers. Necessary charging pulses from the charging equipment are sent to the end office so as to operate the subscriber's meter for charging.

When there are plural charging areas in a single primary center, the charging equipment first detects the charging area from which the call is made and sends out charging pulses in accordance with the tariff applicable to the charging area. Accordingly, when there are too many charging areas in one primary center, charging equipment will become complicated.

4-5-2 Setting of Charging Areas for Future Network

The recommended setting of charging areas for future network on the basis of the principles mentioned in the preceding paragraph is as follows.

(1) The areas given in the column of toll numers in Table III-3-1-3 will be set as charging areas. These charging areas are shown on a map in Fig.III-5-3-1. As stated in the succeeding paragraph, charging area identification is achievable by 3 digits of the toll number.

(2) The number of charging areas is 43 in Region I and 25 in Region II and 68 in total.
Except some special areas, the present average population of these charging areas is about 100,000.

(3) The maximum number of charging areas that can be set in a primary center is made 3.
The relationship between toll zones and charging areas are as shown in Table III-4-5-1. The number of charging areas in a primary center is 2 in average.

Table III-4-5-1 Toll Zones and Charging Areas

Region	SC	No. of PC	No. of Charging areas
I	San Fernando	3	5
	Dagupan	4	10
	Binalonan	3	7
	Baguio	3	6
	Vigan	5	9
	Laoag	4	6
II	Tuguegarao	4	10
	Ilagan	6	10
	Bayombong	3	5
Total		34	68

4-5-2 Setting of Tentative Charging Areas

As mentioned in Section III-3, the network to be constructed in this project is rather small in scale when compared with the future network and the number of primary centers is 8.

If the charging areas for the future network are applied as they are, a maximim of 10 charging areas will belong to a primary center. The number of charging areas to be identified by one primary center will then be rather large, which is the problem.

Accordingly, each province will be employed tentatively as a charging area. Then the relationship between charging areas and primary centers is given in Table III-4-5-2.

These tentative charging areas may be somehow large and transfer to more rational charging area setting should be discussed in future by the development of the telephone network.

Table III-4-5-2 Primary Centers and Charging Area

Region	Primary Center	Charging Area (Province)	Basic Point of Charging Distance
I	Dagupan Binalonan	Pangasinan	Dagupan
	Baguio	La union	San Fernand
		Bengued	Baguio
		Mt. Province	Bontoc
	Vigan	Ilocos Sur	Vigan
		Abra	Bangued
	Laoag	Ilocos Norte	Laoag
II	Tuguegarao	Cagayan	Tuguegarao
		K. Akayao	Tabuk
		Batanes	Basco
	Ilagan	Isabela	Ilagan
		Qurino	Cabarrougis
	Bayombong	N. Vizcaya	Bayombong
		Ifugao	Lagawe
	8	14	14

Note: Basic points of charging distance are such points that correspond to a center in traffic in the respective charging areas.

4-6 Tentative Charges

Let us consider the tariff for charging calls by the tentative charg-ging areas to be adopted in this project as mentioned in the preceding para-graph.

4-6-1 Classification of Calls

Calls can be classified as follows.

a) Local calls

Local calls are those to be made between subscribers within the area to be covered by a end office.

b) Intra-provincial calls

These calls are made between subscibers to be covered end off-ices in a province (that is, in a charging area).

c) Inter-provincial calls

Inter-provincial calls are those to be made between subsribers covered by end offices in different provinces (or different charging areas).

These calls classified into three types are illustrated in Fig. III-4-6-1.

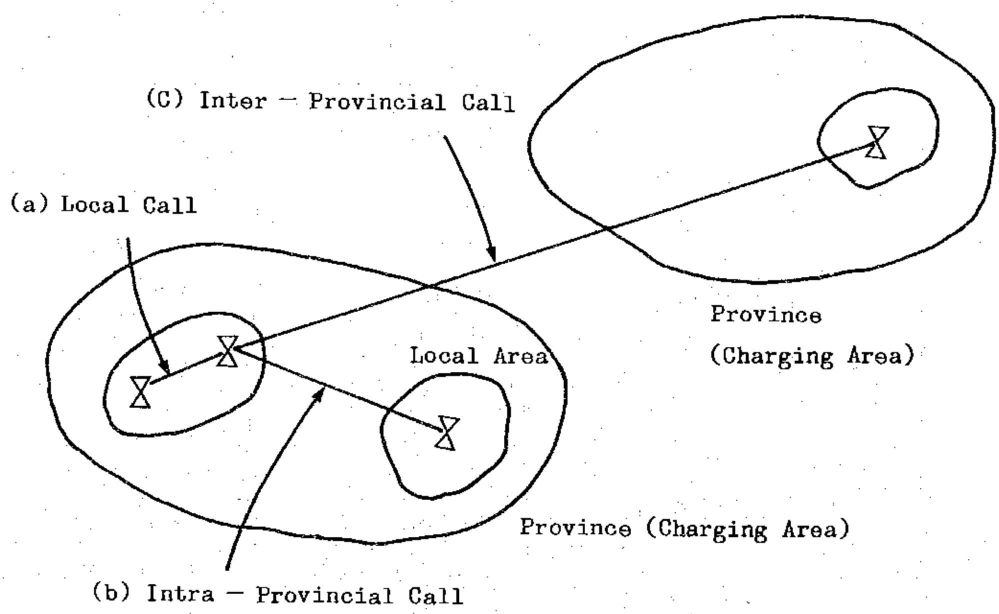


Fig. III-4-6-1 Telephone Call Classification

4-6-2 Charging Rate

Charging rate setting is important for the income of BUTEL. Described here are the results obtained by examinging the land area of the Philippines, telephone traffic condition in the Philippines, network configuration, charging techniques, and present trends of charging systems employed by countries in the world. (See Table III-4-6-1)

(1) For local calls, one message rate will be charged per call irrespective of its duration.

(2) For intra-provincial calls, one message rate will be charged per 30 seconds irrespective of the distance between the subscribers.

(3) Inter-provincial calls will be classified into 6 steps depending on the distance. In this case, the air distance between the basic points of charging distance in the respective charging areas (provinces) which are given in Table III-4-6-2 are used as the distance.

4-7 Outlines of Charging Equipment

STD charging equipment comprises the following sections.

i) Charging pulse generation section

ii) Charging pulse transmitting section

iii) Metering sention

Fig. VII-5-7-1 shows a block diagram of the charging equipment.

Table III-4-6-1 Charging Rate

Type of Call			Duration for Unit Rate		Example of Sectionins
			Daytime	Nighttime	
Local calls			No limit		
Intra-provincial calls			30 sec.		
Inter-provincial calls	I	<80	20 sec.		Ilocos Norte - Ilocos Sur Isabela - Tuguegarao
	II	80 - 150	12 sec.	*	Ilocos Sur - La Union N. Vizcaya - Cagayan
	III	150 - 250	8 sec.	*	Pangasinan - Manila Tuguegarao - La Union
	IV	250 - 450	6 sec.	*	Ilocos Norte - Manila Isabela - Manila
	V	450 - 750	4.5sec.	*	Manila - Cebe
	VI	>750	4 sec.	*	Region I, II - Cebu Manila - Davao

* Charging rate for nighttime should be set at BUTEL.

The charging pulse source (timer) will be installed, in principle, at the primary center.

The operation of the charging equipment is outlined hereunder.

(1) The toll number dialed by a subscriber is sent to TS at the primary Center.

(2) The TS converts the received codes to charging information.

(3) Then, by controlling the link frame which connects the timer and ICT to each other, required pulses are sent to the ICT.

(4) When the called subscriber answers, the ICT readily sends out one meter pulse to the end office.

Then, time pulses are sent one after another to the end office excluding the first pulse.

(5) At the end office the meter pulses are received by OGT and recorded on a call meter.

(6) OGT and ICT in the pulse transmitting section are furnished with the function of pulse transmission.

In addition to these functions of the charging equipment, the following functions are required as well.

(1) Switchover of daytime rate to/from nighttime rate.

(2) Identification of three originating zones and charging to the respective zones by different rates.

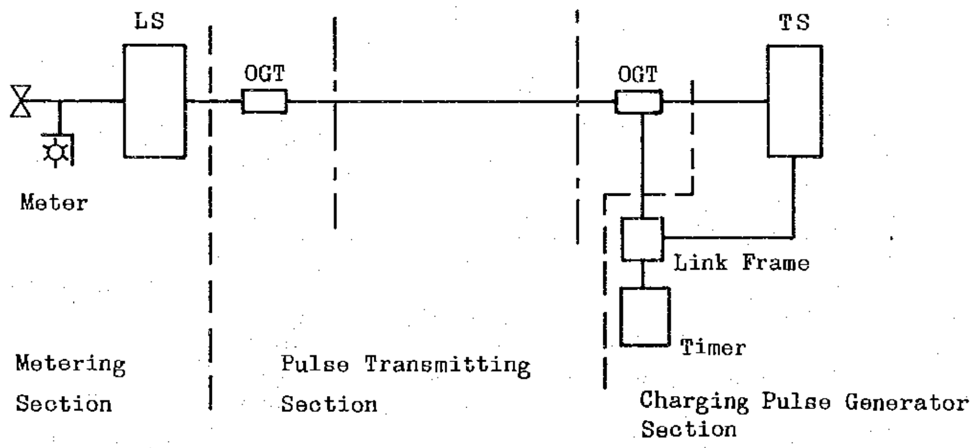


Fig.III−4−7−1 Block Diagram of Charging Equipment

Table III-4-6-2 Approximate Charging Distance in Rogion I & II

Unit:km

To / From	Ilocos Norte	Ilocos Sur	Abra	Mt. Province	La Union	Benguet	Panga-sinan	Batanes	Cagayan	Kalinga Apayao	Isabela	Ifugao	Qurino	Nueva Vizcaya
Ilocos Norte	—	73	66	129	177	197	241	275	137	122	181	165	219	199
Ilocos Sur	73	—	25	82	106	129	170	343	143	115	167	116	177	145
Abra	66	25	—	68	114	131	175	327	118	92	145	104	163	136
Mt. Province	129	82	68	—	88	85	135	359	99	67	101	36	95	70
La Union	177	106	114	88	—	38	64	437	187	156	178	89	136	91
Benguet	197	129	131	85	38	—	50	444	180	150	161	71	105	61
Panga-sinan	241	170	175	135	64	50	—	493	229	199	207	119	141	100
Batanes	275	343	327	359	437	444	493	—	280	303	329	385	410	417
Cagayan	137	143	118	99	187	180	229	280	—	33	56	111	129	140
Kalinga Apayao	122	115	92	67	156	150	199	303	33	—	58	83	113	115
Isabela	181	167	145	101	178	161	207	329	56	58	—	91	83	108
Ifugao	165	116	104	36	89	71	119	385	111	83	91	—	62	35
Qurino	219	177	163	95	136	105	141	410	129	113	83	62	—	46
Nueva Vizcaya	199	145	136	70	91	61	100	417	140	115	108	35	46	—

5. NUMBERING PLAN

5-1 Numbering Plan in "Development Plan in the Philippines"

5-1-1 BOC's National Numbering Plan

In 1976 BOC sets out the national numbering plan. This numbering plan is outlined hereunder.

(1) Objective

The objective of the numbering plan is to:

a) assign to each subscriber in the direct distance or subscriber trunk dialing (STD) system a unique and distinctive national telephone number that does not conflict with the number of any other sabscriber connected to the network.

b) encompass at least 50 years development with provision for future expansion without a change in the basic structure of the plan.

b) assign uniform spacial service codes which will be as short as possible and easy to remember.

d) provide for future international subscriber dialing capabilities.

(2) Number configuration

The closed numbering system is recommended where each subscriber is identified by a unique telephone number and can be called up by dialing the telephone number of the subscriber. Each number to be dialed for STD call consists of the following:

Trunk access code(0) + Trunk code (Area code) + Subscriber code (Area code) + (subscriber code) is called a national number and consists of 8 digits.

(3) Capacity of the numbering plan

When a national number consists of 8 digits, how many numbers can be used depeds on the method of numbering.
If national numbers form N-NNX-XXXX, the numbering plan provides 51,200,000 (= $8 \times 8 \times 8 \times 10^5$) in a capacity.
If the telephone numbering of N-NXX-XXXX is employed as required in future, the capacity of the numbering plan can be increased to 64,000,000 (= $8 \times 8 \times 10^6$).

Table III-5-1-1 Configuration of National Number
(BOC's Numbering Plan)

Trunk Code (Area Code)	Subscriber Code (Telephone Number on Telephone Directory)						
	Office Number			Station Number			
A	B	C	D	E	F	G	H
N	N	N (X)	X	X	X	X	X

Legend N: Any number of 2 to 9
X: Any number of 0 to 9

(4) Area Code selection

With the N-NNX-XXXX (A-BCD-XXXX) numbering system, each A digit corresponding to an area is capable of covering a total of 6,400,000 subscriber numbers.

The A digits of the area codes will be allotted as follows.

The numbering areas will be drawn to coincide with existing provincial borders.

A digit "1" : For special service
"2" : Metro Manila
"3" : Central Luzon & Part of Southern of Tagalog
"4" : Southern Part of Tagalog & Bicol
"5" : Northern Luzon & Part of Central Luzon
"6" : Visaya & Pulawan
"7" : Mindanao
"8" : For spare
"9" : For spare
"0" : Reserved for future international dialing service

Lower numbers are allotted to areas with probable heaviest incoming traffic. This is to achieve faster setting up of the large number of calls to these areas, reduce the amount of common equipment required, and provide greater convenience to subscribers.

(5) Special service codes

Special service codes employ 3 digits of which the first digit is "1." These codes are common to all subscribers in the network.

a) Local special service

103: Complaints

104: Local information

105: Connection with a local telephone operator

108: Information on long-distance (LD) charging

109: LD information at originating office

b) Long-distance special codes

These codes are dialed after "trunk acess code" + "trunk code."

121: LD information at distination

129: Assistance operator to extend calls to area not yet operating on STD

c) Maintenance special codes

127: Installers trunks

176: Inspectors trunks

177: Installers dispatch

178: Repair dispatch

d) Emergency service

191: Police

192: Ambulance

193: Fire

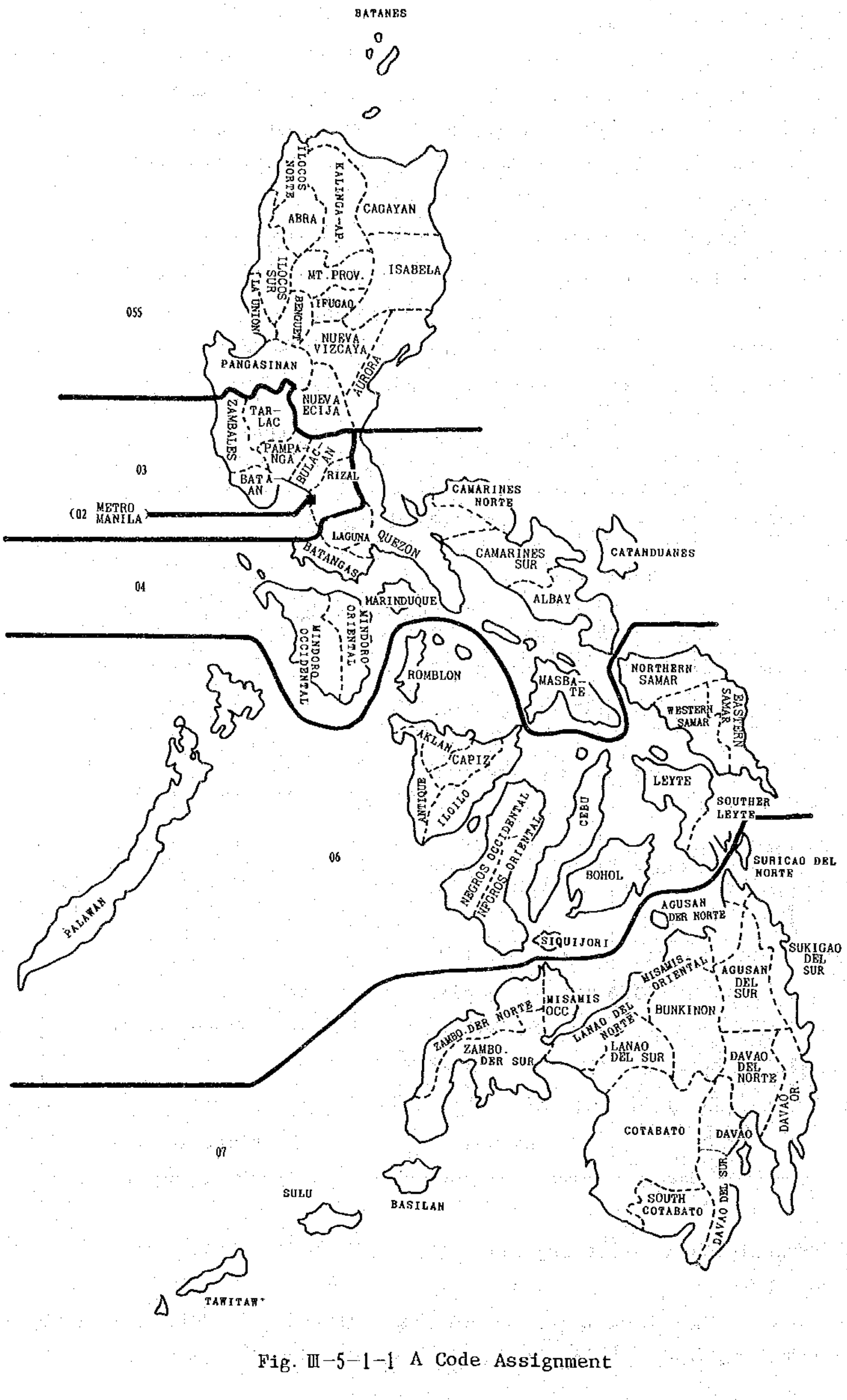


Fig. Ⅲ-5-1-1 A Code Assignment

5-1-2 BUTEL's Numbering Plan for Regions I and II

BUTEL is expected to develop STD (DDD) for the telephone development plan in Regions I and II on the basis of the BOC's national numbering plan muntioned in the proceeding paragraph.
However, the BUTEL's numbering plan is somehow different from the BOC's numbering plan in area code setting.
That is, BUTEL proposes such number configuration as given in Table III-5-1-2 for the numbering plan of this project for Regions I and II.
While the area code proposed by BOC consists of one digit of code A, that proposed by BUTEL consists of 3 digits of codes A, B, and C with closed numbering areas being made smaller.

Table III-5-1-2 National Number
(Proposed by BUTEL)

National Number							
Trunk Code (Area Code)			Subscriber Number				
			Office Code		Station Number		
A	B	C	D	E	F	G	H
5	N	X	N	X	X	X	X

Legend N: Any number of 2 to 9
X: Any number of 0 to 9

Table III-5-1-3 Comparison in Number Configuration

Code	A	B	C	D	E	F	G	H
Proposed by BOC	Trunk Code		Subscriber Number					
Proposed by BUTEL	Trunk Code			Subscriber Number				

5-2 Principles of Numbering Plan

5-2-1 Principles

The objective of developing telephone networks is to allow calls to be made readily from any place.

This is achievable by the accomplishment of a telephone network using STD. One of the important themes for realizing STD in a national scale is to determine the most suitable national numbering plan. The purpose of numbering plan is to assign unique numbers to individual subscribers in the telephone network which provides national subscriber dialing service. In determining the numbering plan to be adopted, consideration should be given to the following. First, numbers must be easy for subscribers to understand and use.

For this purpose, it is necessary

1) That ample margin is provided for future increase in the number of subscribers and less change will be required over long periods of time (permanency)
2) that connection to individual subscribers can be achieved by dialing their unique numbers from any place (uniformity).

Secondary, the numbering plan to be adopted should meet the switching and charging engineering method.

"To which route the connection should be made" and "how to charge," which are the functions of the telephone network, are all identified by the telephone number. Accordingly, in order to construct more economical network, an overall technical judging is required.

5-2-2 Closed Numbering Area and Numbering Plan

All subscribers have their own telephone numbers.

When subscribers in a certain area have telephone numbers quite different from each other and all that is required to call up a subsciber among them is to dial his number, this area is called a "closed numbering area."

A national telephone network is formed with a number of closed numbering areas. In order to call up a subscriber in a different closed numbering area, it is necessary to dial first the trunk code of the called subscriber for selecting the closed numbering area to which the called subscriber belongs. That is, the national number of the called subscriber is:

National number = Trunk code + Number in closed number area

Accordingly, it is necessary, in preparing a numbering plan, to determine

a) The ranges of closed numbering areas,
b) Trunk code Numberes to be given to individual closed numbering

areas,

c) The principles for giving numbers in each closed numbering area.

The ranges of the respective closed numbering areas should be determined as follows.

1) When a closed numbering area is small, connection in the area can be made by dialing a small number of digits. However, for connection of toll calls, a large number of digits must be dialed as the trunk code.

2) When a closed numbering area is large, the subscriber code consists of a large number of digits but the number of toll calls to be made by dialing trunk codes reduces.

Accordingly, in order to establish such a numbering plan that requires a simple dialing procedure for the majorities of traffic, relationship between respective areas is one of the most impertant factors in determining the ranges of the respective closed numbering areas.

5-2-3 Trunk Code Numbering

The methods of trunk code numbering can be classified into the following two.

(1) Allotment numbering system

In this system, the whole country is divided into a maximum of ten areas, to which digits 1 - 0 are allotted. Then each area is still divided into a maximum of ten subareas. Thus, the whole land is divided into smaller areas step by step by the denary system. This numbering system is advantageous in that its route setting is simple and its management is easy. But this is disadvantageous in that is lacks in the degree of freedom in numbering and a lot of spares digits should be prepared in consideration of future change and/or development.

(2) Free assignment numbering system

This system allows quite free numbering and facilitates future number change but its route setting and management are complicated. Which of these two numbering systems should be adopted is determined depending on the future development of the telephone network (scale of exchanges, distribution of exchanges, etc.) and technical factors such as switching and charging engineering.

5-2-4 Capacity of Numbering Plan

In establishing a numbering plan, it is necessary that the numbering plan should cope with change in situation over 50 - 100 years from now on without involving the change of the system over long periods of time.

The numbering plan should have an ample margin or freedom so as to be able to cope with the development of telephone on account of unpredictable social economic changes. At present, Regions I and II are thinly populated regions and transfer of population into these areas by future land development should also be taken into consideration.

Although numbering plan should be established so that each number should be established so that each number should comprise as small number of digits for ease of dialing by subscribers, provision of a margin in the capacity of numbering plan may result in increasing the numbering digits. Thus, the capacity of numbering plan must be determined in consideration of all these conditions.

5-3 Numbering Plan in This Project

Numbering plan is related to the convenience of use of telephone by subscrivers and is important for the economical design of the network. And yet, numbering plan should be applicable throughout the country and thus should be discussed carefully. Here, a numbering plan is recommended through examination of the principles mentioned in the preceding section on the basis of the numbering plan proposed by the Philippines. Since numbering plan should be usable without change over long periods of time, the numbering plan for the future network is determined first and measures to be taken for the network to be constructed in this project are then stated. Accordingly, the charging areas mentioned in this section are those of future network unless otherwise stated.

5-3-1 Principles for Numbering of National Telephone Numbers

5-3-1-1 Range of Closed Numbering Area

(1) Each local office area form a closed numbering area.

(2) Numbering should be so made that each charging area should form a closed numbering area.

Whether it is advantageous or disadvantageous to make a charging area a closed numbering area is determined by the flow of the traffic and the configuration of the transmission network.

The advantage of making a charging area a closed numbering area will not come out nuless the number of calls between cities or municipalities in the area increases. How the correlation between cities or municipalities in each charging area will develop can not easily be forecast for the time being.

However, numbering plan should be so effected that neighboring cities or municipalities will be able to form a closed numbering area when necessary.

5-3-1-2 Trunk Code Numbering

(1) Trunk codes should be determined by the allotment numbering system. This numbering system features simple route setting and management as well as understandability to subscribers.

Although this system may lack in the degree of freedom in numbering, the capacity of numbering provides a sufficient margin when the national numbers are formed with 8 digits.

(2) Charging areas should be identifiable within the first 3 digits of ABC.

This means that each trunk code consists of a maximum of 3 digits of ABC. This is because every charging area form a closed numbering area in numbering plan.

(Margin in capacity of numbering)

a) When every national number is made up of 8 digits, the capacity of numbering in the area corresponding to 5 in Code A covering mainly Regions I and II is theoretically 8,000,000 subscribers. Of the 7 digits (Codes B - H) alloted to this area, only the first digit in the closed numbering area does not allow the use of digits 0 and 1.

b) Meanwhile, the number of subscribers in this area 50 years ahead is estimated not to exceed 1,000,000.

The estimated number of subscribers in Regions I and II 50 years ahead is about 800,000 as mentioned in Chapter III-3. The number of subscribers will not exceed 1,000,000 even if a part of Region III and IV A is expected to belong to Area 5.

c) Accordingly, even if the disadvantage of the allotment numbering system in lacking the freedom of degree is considered, the capacity of numbering still provides a margin.

5-3-1-3 Numbering in Charging Area

(1) Numbers in a charging area are called subscriber number each of which consists of an office number and a station number as follows.

(Subscriber number) = (Office number) + (Station number)

(2) For the first digit of the office number, 0 or 1 can not be used.

(3) When a charging area comprises plural local office areas, local office identification should be made achievable by using a maximum of 4 digits.(Codes A - D) from the first digit including the trunk code.

5-3-1-4 Charging Area and Route Identification

The trunk code provides the function of charging area identification for charging and, at the same time, the function of connecting route identification.

These functions of identification are outlined hereunder.

(1) Charging area identification can be achieved within the first 3 digits of ABC (paragraph 5-3-1-2).

(2) Each primary center area consists of a maximum of 3 charging areas (paragraph 4-5-2).

(3) Accordingly, when the charging area is identified, the primary center to which the charging area belongs is automatically identified. That is, digit translation for charging and digit translation for route selection need not be made separately.

(4) However, if a direct transversal trunk is provided in a local office area, one digit of local office identification code for identification of the local office in the charging area is required. (paragraph 5-3-1-3)

Accordingly, it is necessary, for route selection upon connection, to provide the function of digit translation of a maximum of 4 digits (Codes A - D) from the first digit of the national number.

5-3-2 Configuration of Nation Numbers and Capacity of Numbering

Thus configuration of national numbers formed on the basis of the principles of numbering described in the preceding paragraph is shown in Table Ⅲ-5-3-1.

Table III-5-3-1 National Number Configuration

Pattern	National Number											
	Trunk Code				Subscriber Number							Applicable Areas
					Office Code			Station Code				
I	A N				B N	C X	D (X)	E X	F X	G X	H X	Manila
II	A N	B X				C N	D X	X	X	X	X	
III	A N	B X	C X				D N	X	X	X	X	Baguio, Dgupan Laoag, Tuguegarao, etc.
III'	A N	B X	C X	D N				N	X	X	X	Most areas in Regions I and II

Legend N : Any number of 2 - 9
X : Any number of 0 - 9
(X): May or may not be omitted

(1) Pattern I

Theoretical capacity in numbering: 8,000,000 subscribers
This pattern is applicable to the charging areas in which are expected to exceed 400,000 in the number of subscribers. Metro Manila applies to this pattern. At present the number of subscribers in numbers of 6 digits are used there. However, telephone demand in Manila is very strong, so that subscriber numbers will be required to be 7 digits in near future.
When this pattern is incorporated in the national STD network with its subscriber numbers being 6 digits, it should be so understood that Code D is omitted.

(2) Pattern II

Theoretical capacity in numbering: 8000,000 subscribers
This pattern is applicable to the charging area in which the future number of subscribers is expected to be less than 400,000. However, when the number of subscribers may exceeds 400,000, this pattern may be used in plural number.
Region I or II has no area to which this pattern is applicable.

(3) Pattern III

Theoretical capacity in numbering: 80,000 subscribers

This pattern is applicable to the charging area in which the future number of subscibers is expected to be less than 40,000 and which are formed with a closed number area.

When the estimated number of subscribers may exceed 40,000, this pattern may be used in plural number. This pattern is applicable, in principle, to all charging areas in Regions I and II.

However, as will be mentioned later, large cities or municipalities where a charging area for a local office area in this project will form closed numbering areas but other areas will not form closed numbering areas.

Accordingly, the applicable areas of this pattern are Baguio, Dagupan, Laoag, Tuguegarao, Bayombong, etc.

(4) Pattern 'III'

Theoretical capacity in numbering: 64,000 subscribers

This pattern is applicable to the charging area in which the future number of subscribers is expected to be less than 40,000 and which does not form a closed numbering area. This pattern is tranferred to pattern III when the charging areas to which this pattern is applied will be formed with a closed-numbering area. In case a part of the charging area is formed with a closed numbering area, pattern III and III' may be mixed in such area.

As will be mentioned later, this pattern is applicable to most of areas in Regions I and II except some areas to which pattern III is applicable.

5-3-3 Numbering of National Number

Numbering of national number in respective areas will be made as follows in accordance with the national number configuration mentioned in the preceding paragraph.

(1) Tabulation of ABC Code: See Table III-5-3-2.

(2) Illustration of ABC Code: See Fig. III-5-3-1.

(3) Tabulation of ABC-D Code: See Table III-5-3-3.

(4) Illustration of ABC-D Code for every provinces: See Fig. III-5-3-2.

5-3-4 Special Numbers

5-3-3-1 Special Numbers

Special numbers for subscribers should be:

(1) uniform over the whole country, and

(2) as much small in the numer of digits as possible.

Each number should consists of 3 digits of 1XY.

Special numbers are given in Table III-5-3-4.

Special numbers used for calls to be handled concentratively at primary centers form 10Y and other special numbers form 1XY (where X should not be 0).

Table III-5-3-4 Special Numbers for Subscrivers

Service	Special Number	Remarks
Local information	104	
Delay service	105	Connection whith subscribers of private sectors not providing STD service.
Information on LD charging	108	
LD information	109	
Non-delay manual service & dial service assistance	100	Toll calls from existing offices are connected by non-delay manual. DSA: Dial Service Assistance
Complain	113	
Police	191	
Ambulance	192	
Fire	193	

Number information is used as follows.

(1) In primary center area: 104

(2) Out of primary center area: 0 + (Trunk code of office to which the subscriber is asking) + 104

or 109

5-3-3-2 Special Numbers for Mainternance

The following special numbers are provided for maintenance work.

(1) Installer's trunks 175

(2) Inspector's trunk 176

(3) Installer's dispatch 177

(4) Repair dispatch: 178

5-3-5 Numbering Plan for Tentative Network of This Project

As mentioned in Section III-5-3 and III-5-4, the provinces are made tentative charging areas and the number of primary centers is limited to 8 in the tentative network of this project. Here, the numbering plan is as follows.

(1) The numbering plan for future network will be applied as it is to the tentative network.

a) The tentative charging area to which the subscriber belongs can be identified by the 3-digit code of ABC. This is because each charging area (or province area) is a simple combination of plural future network charging areas.

b) Route selection upon connection provides no problem, since each tentative primary center is a combination of plural future network primary center areas.

(2) "0" dialing is employed for all calls except those between subscribers in a local office area. Judging from the traffic condition in the network to be established by this project, it is too costy and not recommendable to let each charging area form a closed numbering area. Accordingly, the range of a closed numbering area should be limited to within local office area.
That is, "0" dialing is required for all calls but those between subscribers in a local office area.

(3) Trunk codes in the areas in Regions I and II use 3 digits or 4 digits depending on the area.

a) 3-Digit trunk code areas (areas to which Pattern III applies):
San Fernand, Dagupan, Binalonan, San Fernand
Vigan, Laoag, Tuguegarao, Ilagan, and Bayombong

b) 4-Digit trunk code areas (areas to which Pattern III' applies):
All areas exclunding those of a) above.

Table III-5-3-2 Code AB-C Assignment

Code AB \ Code C	1	2	3	4	5	6	7	8	9	10
51		SAN FERNANDO	BAUANG	BACNOTAN	BALAOAN	AGOO				
52	MANGALDAN	DAGUPAN	SANTA BARBARA	SAN CARLOS	BAYABANG	LINGAYEN	BUGALYON	MABINI	ALANINOS	BOLINAO
53		BINALONAN	POZORRUBIO	SAN NICOLAS	ASINGAN	UMINGAN	URDANETA	ROSALES		
54	←———				(NUEVA	ECIJA)				———→
55		BAGUIO	LA TRINIDAD		ITOGON	TUBLAY	MANKAYAN	BONTOC		
56	NARVACAN	VIGAN	BANTAY	CABUGAO	CANDON	TAGUDIN	BANGUED	POLORES	BUCAY	
57		LAOAG	BACARRA	SAN NICOLAS	BATAC	DINGRAS	BANGUI			
58	TUAO	TUGUEGARAO	AMULUNG	GATTARAN	APARRI	BALLESTEROS	CALAYAN	BASCO	TABUKU	KABUGAO
59	NAGUILIAN	ILAGAN	CAUAYAN	ECHAGUE	SNATIAGO	CABARRO-GUIS	ROXAS	TUMAUINI	MACONACON	PALANAN
50		BAYONBONG	BAGAOAG	BAMBANG	ARITAO	LAGAWE				

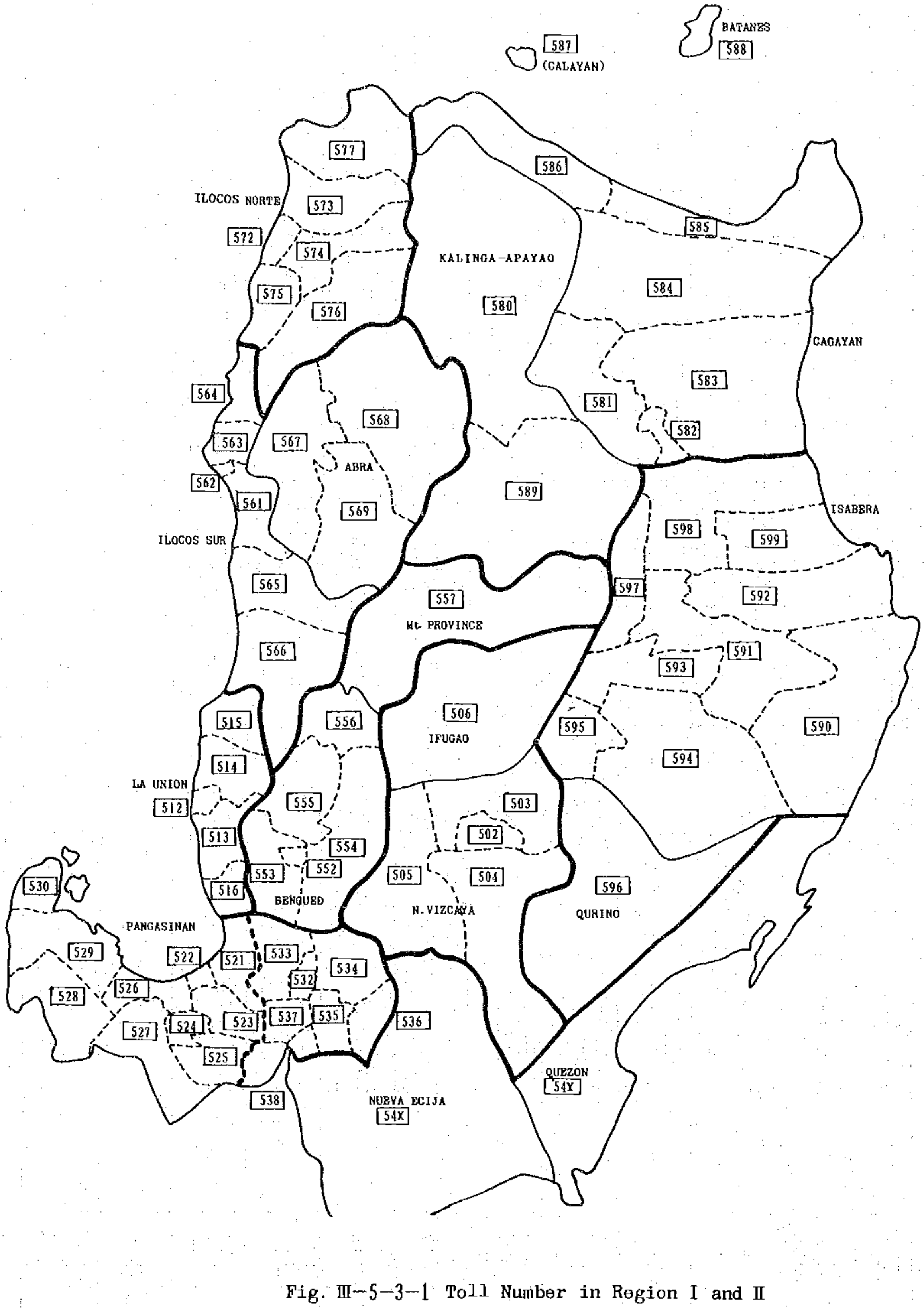


Fig. Ⅲ-5-3-1 Toll Number in Region I and Ⅱ

Table III-5-3-3(1/9) Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
	511	—									—
SAN-FERNANDO	512	—	← SAN FERNANDO →								—
	513	—	BAUGANG		NAGUILIAN	CABA	ARINGAY	BURGOS			—
	514	—	BACNOTAN	SAN JUAN	SAN GAGRIEL	BAGULIN					—
BALAOAN	515	—	BALAOAN	LUNA	BANGAR	SUPIPEN	SANTOL				—
AGOO	516	—	AGOO		SANTO TOMAS	TUBAO	ROSARIO	PUGO			—
	517	—									—
	518	—									—
	519	—									—
	510	—									—

Table III-5-3-3(2/9) Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
DAGUPAN	521	—	MANGALDAN	/	SAN FABIAN	/	SAN JACINTO	/	MAPANDAN	/	—
	522	—	← DAGUPAN →				/	/	/	/	—
	523	—	SANTA BARBARA	/	← MALASIQUI →		/	CALASIAO	/	/	—
SAN CARLOS	524	—	← SAN CARLOS →			/	/	/	/	/	—
	525	—	← BAYABANG →		URBIZ-TONDO	BASISTA	/	/	/	/	—
LINGAYEN	526	—	← LINGAEN →		BINMALEY	/	LABADOR	/	/	/	—
	527	—	BUGALLON	/	AGUILAR	MANGA-TAREM	/	/	/	/	—
	528	—	MARINI	BURGOS	DASOL	INFANTA	/	/	/	/	—
ALAMINOS	529	—	ALAMINOS	/	BANI	ANGO	SUAL	/	/	/	—
	530	—	BOLINAO	/	ANDA	/	/	/	/	/	—

Table Ⅲ-5-3-3(3/9) Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
	531	—									—
BINALONAN	532	—	←BINALONAN→								—
BINALONAN	533	—	POZO-RRUBIO		MANAOAG		SISON				—
BINALONAN	534	—	SAN NICOLAS	NATIVIDAD	TAYUG	SAN MANUEL					—
ASINGAN	535	—	ASINGAN		SANTA MARIA	BALUNGAO					—
ASINGAN	536	—	UMINGAN		SAN QUINTIN						—
URDANETA	537	—	←URDANETA→		VILLANSIS						—
URDANETA	538	—	ROSALES		SANTO TOMAS	ALCALA	BAUTISTA				—
	539	—									—
	530	—									—

Table III-5-3-3(4/9)Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
	551	—									—
BAGUIO	552	—	← BAGUIO →								—
	553	—	LA TRI-NIDAD	TUBA	SABLAN						—
	554	—	ITOGON		BOKOD	KABAYAN					—
TUBLAY	555	—	TUBLAY	ATOK	KAPANGAN	KIBUNGAN					—
	556	—	MANGAYAN	BUGIAS	BAKUN						—
BONTOC	557	—	BONTOC	SAGADA BESAO	SABANGAN	BAUKO	TADIAN	SADANGA	BARLIG NATONIN	PARACELIS	—
	558	—									—
	559	—									—
	550	—									—

Table III-5-3-3(5/9) Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
VIGAN	561	—	NARVACAN		SANTA	CAOAYAN	SANTA MARIA	SAN ESTEBAN	BURGOS	NAGBUKEL	—
	562	—	←VIGAN→								—
	563	—	BANTAY	SANTA CATALINA	SAN VICENTE	SAN ILDEFONSO	SANTO DOMINGO				—
CABUGAO	564	—	CABUGAO	SAN JUAN	MAGSINGAL	SINAIT					—
CANDON	565	—	CANDON		SANTIAGO	BANAYOYO LIOLIODA	GAUMYOD SALCEDO	SANTA LUCIA	CONCEPCION QURINO	SAN EMILIO	—
TAGUDIN	566	—	TAGUDIN	SANTA CRUZ	SUYO	SIGAY	ALILEM	SUGPON	CERVANTES		—
BANGUED	567	—	BANGUED		LAPAZ DANGLAS	TAYUM PENARRUBIA	VILLAVI-CIOSA SAN ISIDRO PILAR	PIDIGA LANGIDEN SAN QUINTIN			—
	568	—	POLORES LAGAN-GIANG	SAN JUAN LAGAYAN TINEG	LICUAN LACUB MALIBCONG DAGUIOMAN						—
	569	—	BUCAY	SAL-LAPADAN BUCLOC BOLINEY	MANABO LUBA TUBO						—
	560	—									—

Table Ⅲ-5-3-3(6/9)Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
	571	—									—
LAOAG	572	—	← LAOAG	LAOAG	LAOAG →						—
LAOAG	573	—	BACARRA		PASUQUIN	VINTAR					—
LAOAG	574	—	SAN NICOLAS	SARRAT	PIDDIG CARASI						—
BATAC	575	—	BATAC		PAOAY	CURRIMAO	PINILI	BADOC			—
DINGRAS	576	—	DINGRAS	SOLSONA	MARCOS	ESPIRITU	NUEVA ERA				—
BANGUI	577	—	BANGUI	BURGOS	PAGUDPUD	PUMALNEG	ADAMS				—
	578	—									—
	579	—									—
	570	—									—

Table III-5-3-3(7/9)Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
TUGUE-GARAO	581	—	TUAO		SOLANA		ENRILE	PIAT	RIZAL	FAIRE	—
	582	—	← TUGUEGARAO →								—
	583	—	AMULUNG	BAGGAO		ALCALA	IGUIG	PENAB-LANCA			—
GATTARAN	584	—	GATTARAN		LAL-LO		LASAM	ALLACAPAN			—
APARRI	585	—	APARRI		CAMALA-NIUGAN	BUGUEY	STFERE-SITA	GONZAGA	SANTA ANA		—
	586	—	BALLE-STEROS	ABULUG	PAMPLONA	SANCHEZ-MIRA	CLAVERIA	LANGANGAN			—
	587	—	CALAYAN								—
	588	—	BATANES								—
TABUK	589	—	TABUK		TANUDAN	TINGLAYAN	LUBUAGAN PASIL	BALBALAN QUIRINO	PINUKPUK	RIZAL	—
	580	—	KANUGAO	CONNER	CALANASAN	PUDTOL	LUNA	SANTA MARCELA	FLORA		—

Table Ⅲ-5-3-3(8/9) Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
ILAGAN	591	—	MAGUILIAN	GUM	REINA MERCEDES	BURGOS	QURINO	BENTO SOLIVEN	SAN MARIANO		—
	592	—	←ILAGAN→	←ILAGAN→	←ILAGAN→						—
	593	—	CAUAYAN		LUNA	CABATUAN	SAN MATEO				—
SANTIAGO	594	—	ECHAGUE		ALICIA		ANGADANAN	SAN GUILLERMO	JONES	SAN AGUISTIN	—
	595	—	←SANTIAGO→	←SANTIAGO→	←SANTIAGO→	RAMON	SAN ISIDRO	CORDON			—
CABARRO-GUIS	596	—	CABARRO-GUIS	DIFFUN	SAGUDAY	AGLIPAY	MADDELA				—
ROXAS	597	—	ROXAS		CALLANG	AURORA	MALLIG	QUEZOH			—
TUMAUINI	598	—	TUMAUINI		MAGSAYSAY	SANTO TOMAS	CABAGAN	SANTA MARIA	SAN PABLO		—
	599	—	MACUNACON DIVILICAN								—
ILAGAN	590	—	PALANAN DINAPIGUI								—

Table III-5-3-3(9/9)Code ABC-D Assignment

PC	Code ABC \ Code D	1	2	3	4	5	6	7	8	9	0
	501	—									—
BAYONBONG	502	—	←BAYOMBONG→								—
	503	—	BAGABAG	SOLANO		VILLAVE-RDE AMBAGUID	DIADI	QUEZON			—
BAMBANG	504	—	BAMBANG	PUPAX DEL NORTE	DUPAX DEL SUR	KASIBU					—
	505	—	ARITAO	SANTA FE	KAYAPA						—
LAGAWE	506	—	LAGAWE	LAMUT	KIANGAN	HUNGDVAN	BANAUE	MAYOYAO	POTIA		—
	507	—									—
	508	—									—
	509	—									—
	500	—									—

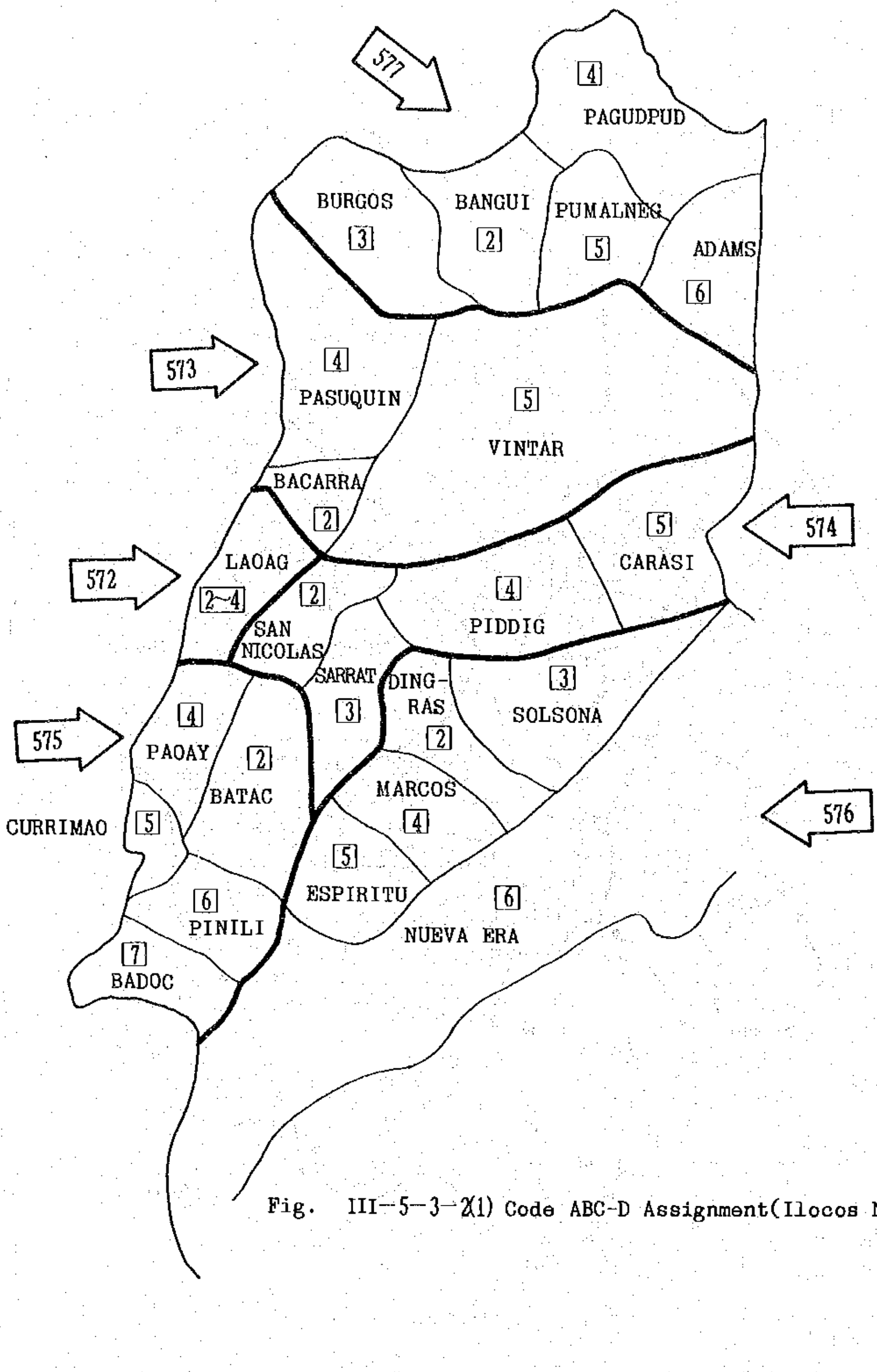


Fig. III—5—3—2(1) Code ABC-D Assignment(Ilocos Norte)

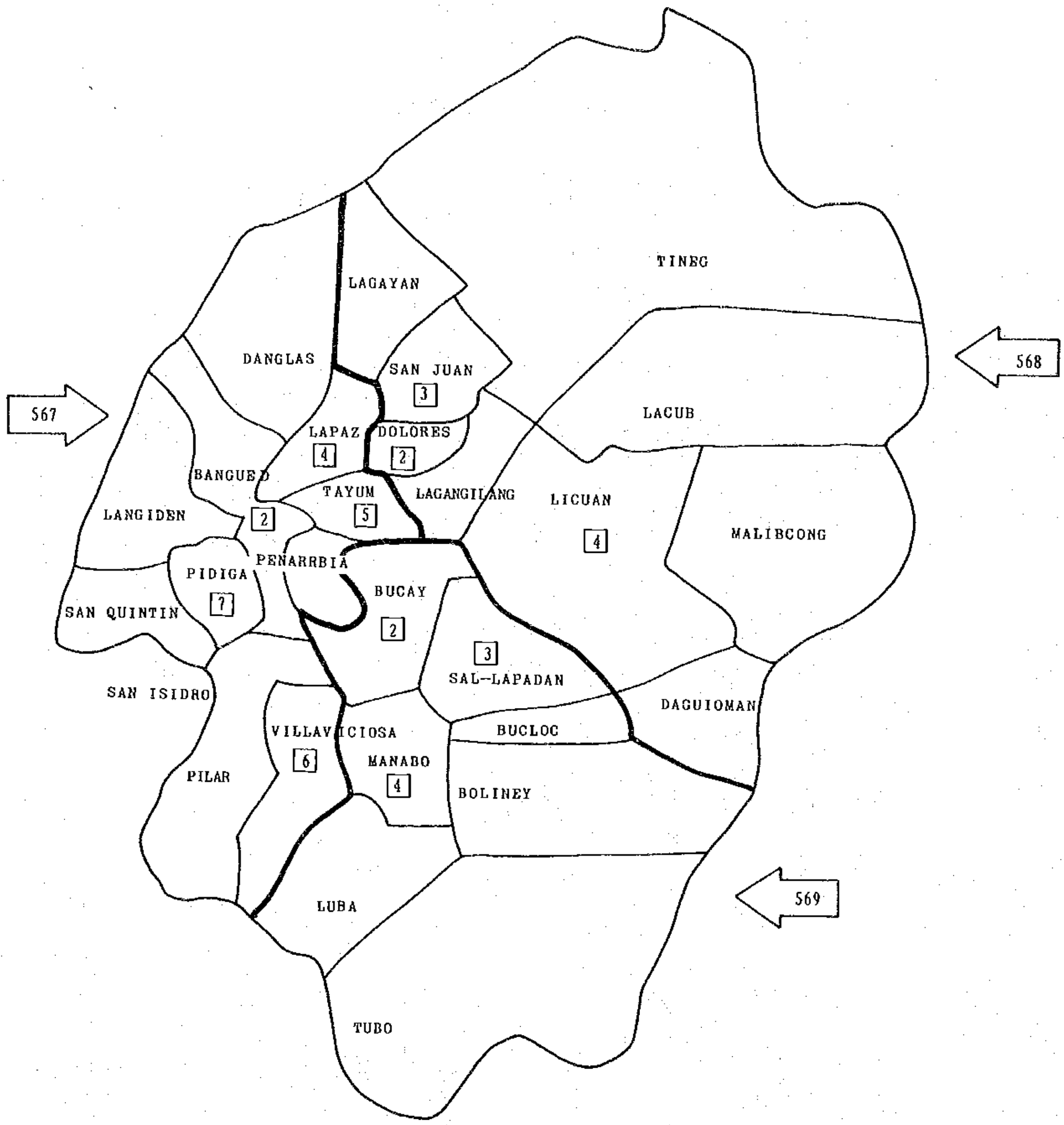


Fig. Ⅲ−5−3−2(2/9) Code ABC−D assignment (Abra)

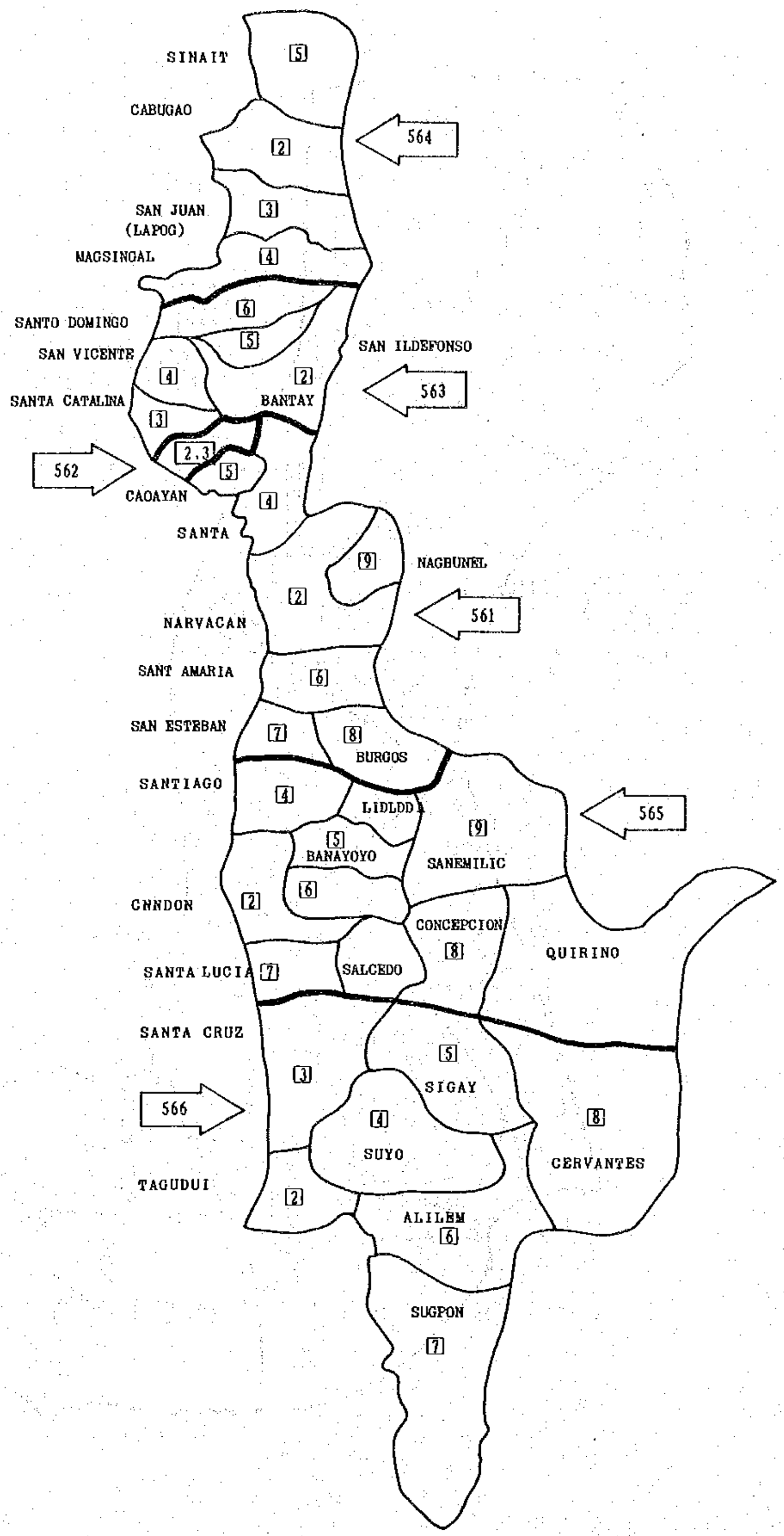


Fig. Ⅲ-5-3-2(3) Code ABC-D Assignnent(Ilocos Norte)

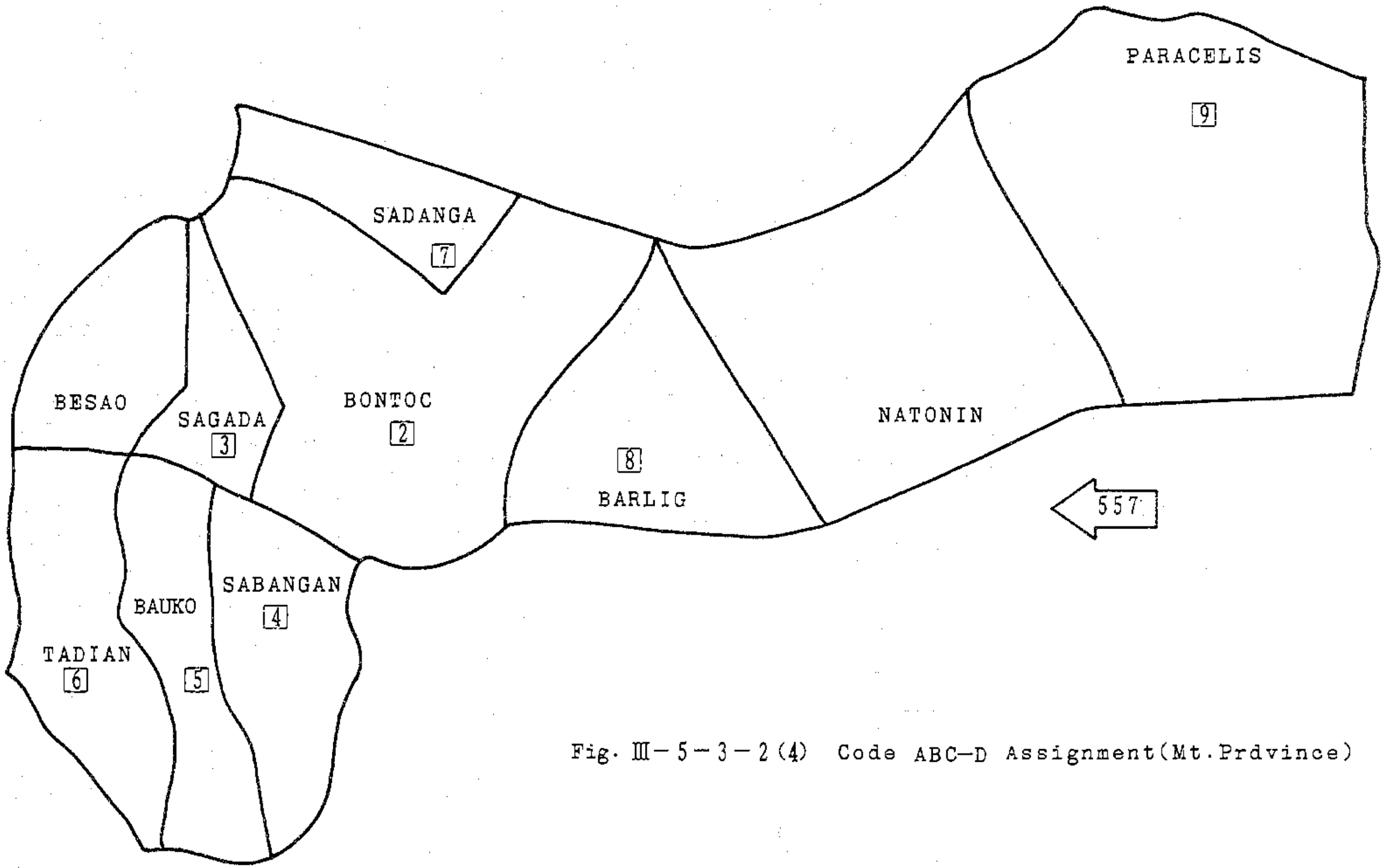


Fig. Ⅲ－5－3－2(4) Code ABC−D Assignment(Mt.Prdvince)

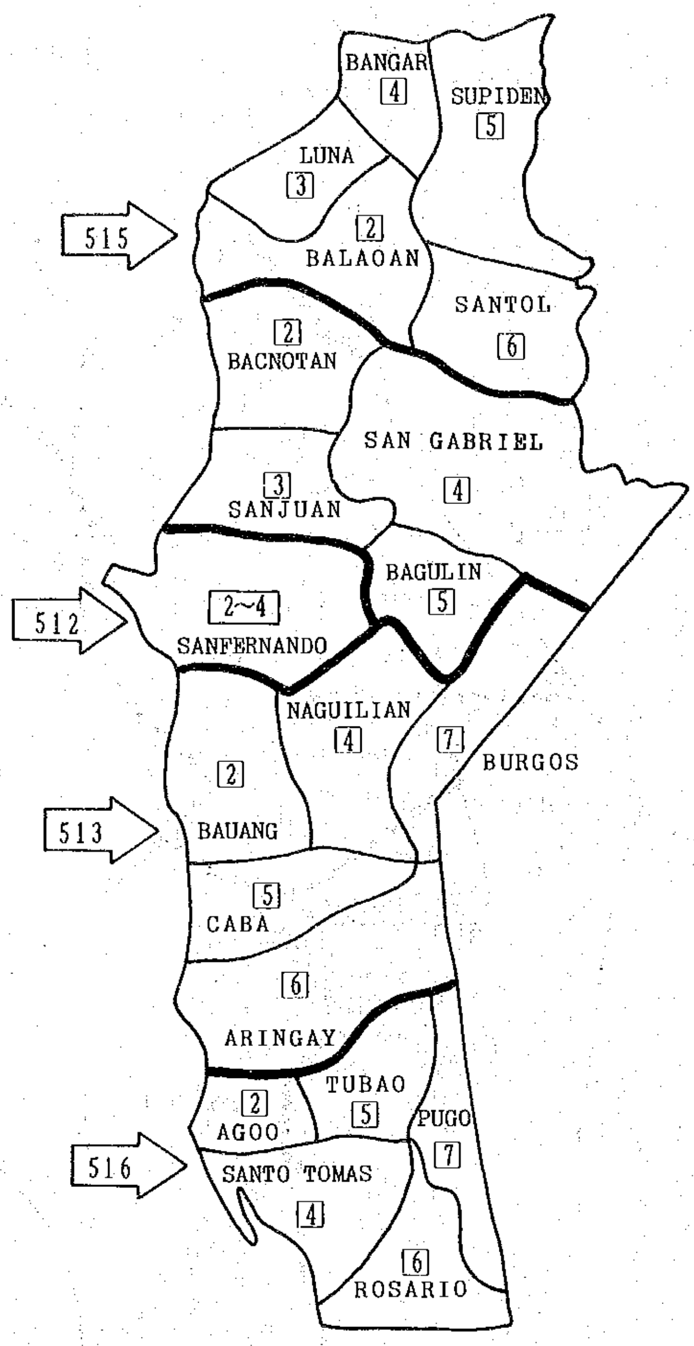


Fig. Ⅲ-5-3-2(5) Code ABC-D Assignment(La Union)

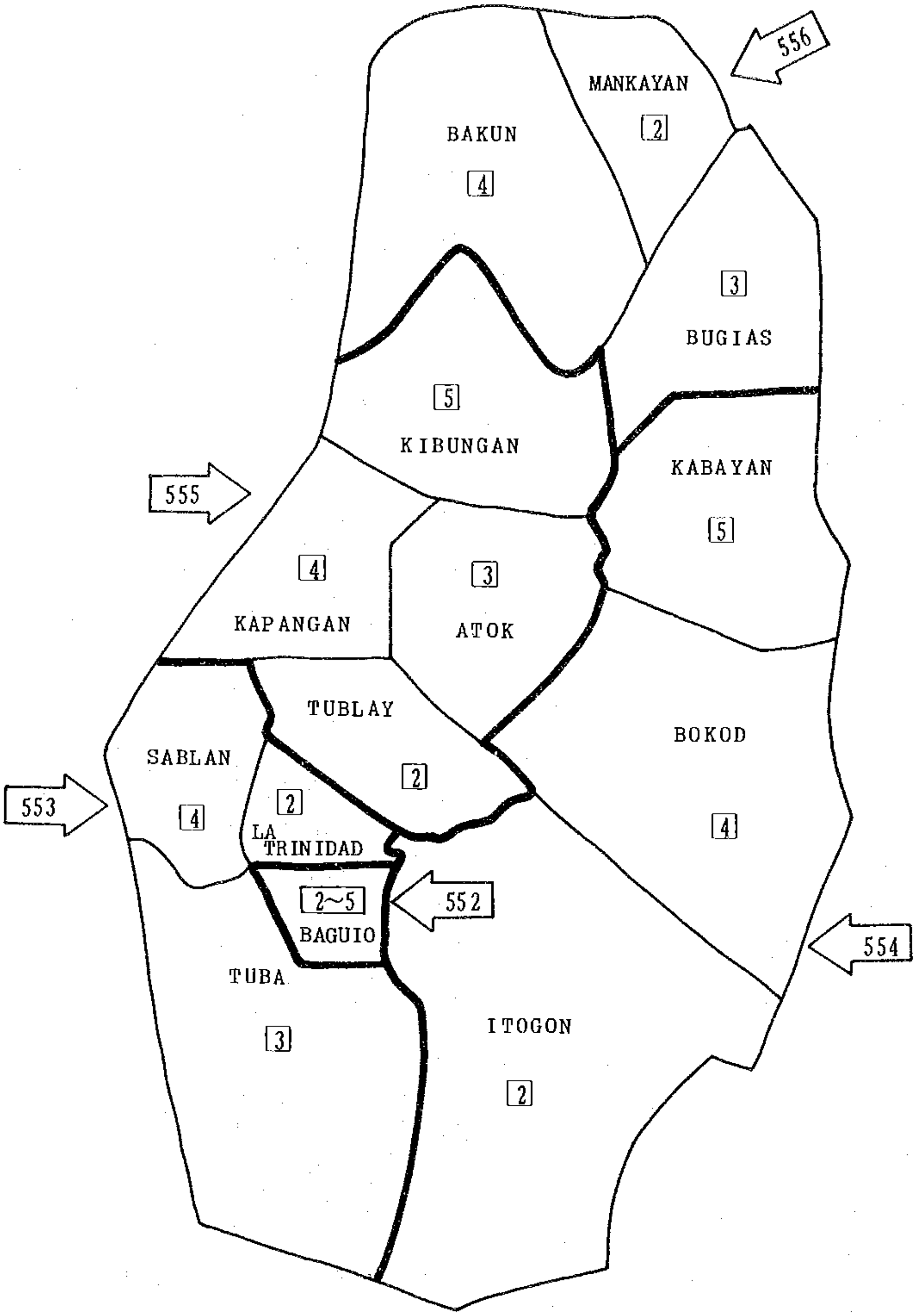


Fig. Ⅲ-5-3-3(6) Code ABC-D Assignment(Benguet)

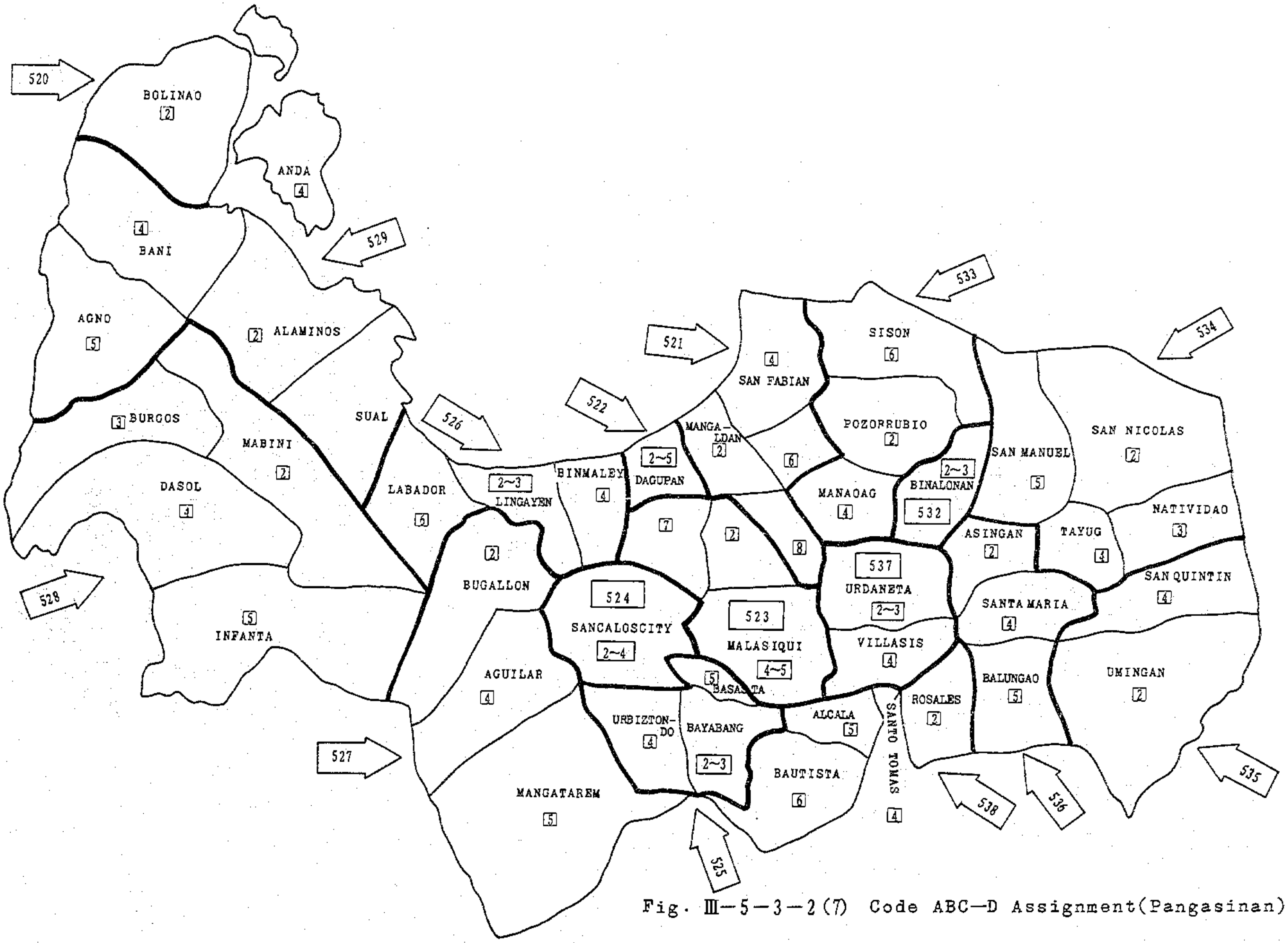


Fig. Ⅲ—5—3—2(7) Code ABC—D Assignment(Pangasinan)

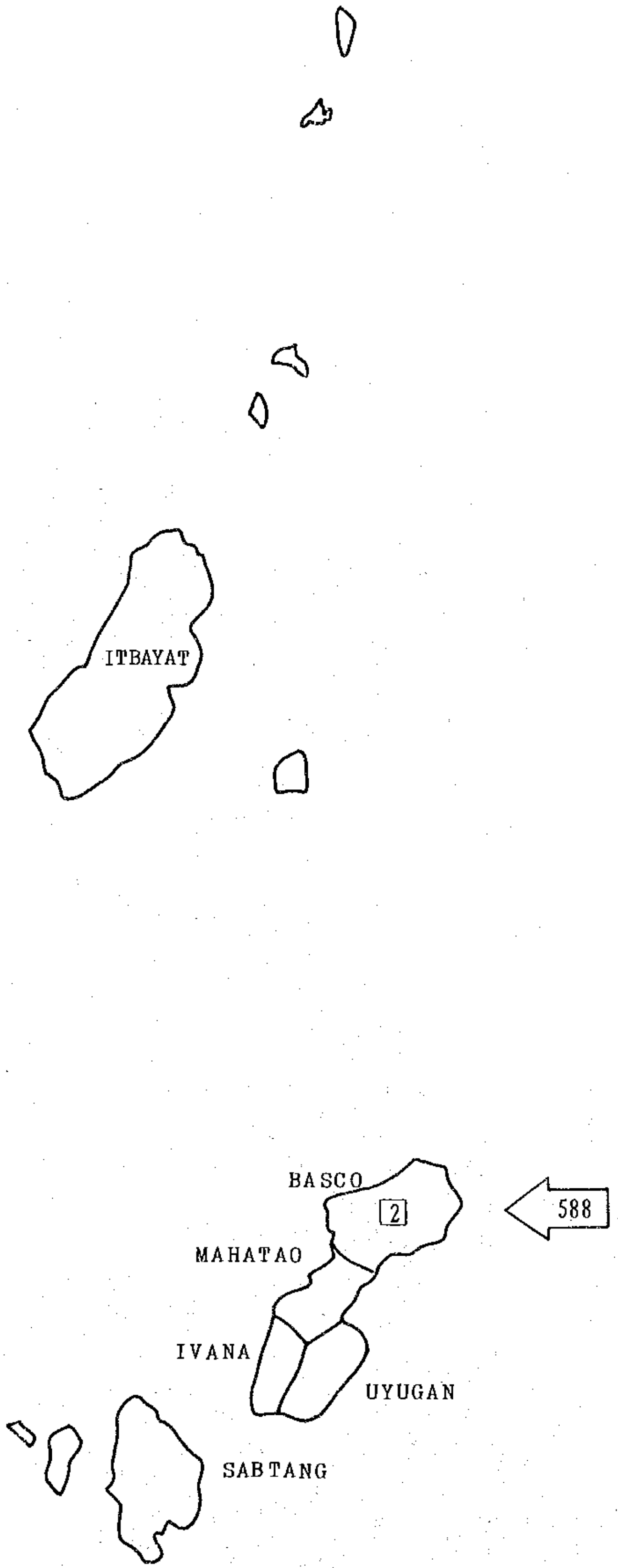


Fig. Ⅲ－5－3－2 (8) Code ABC－D Assignment(Batanes)

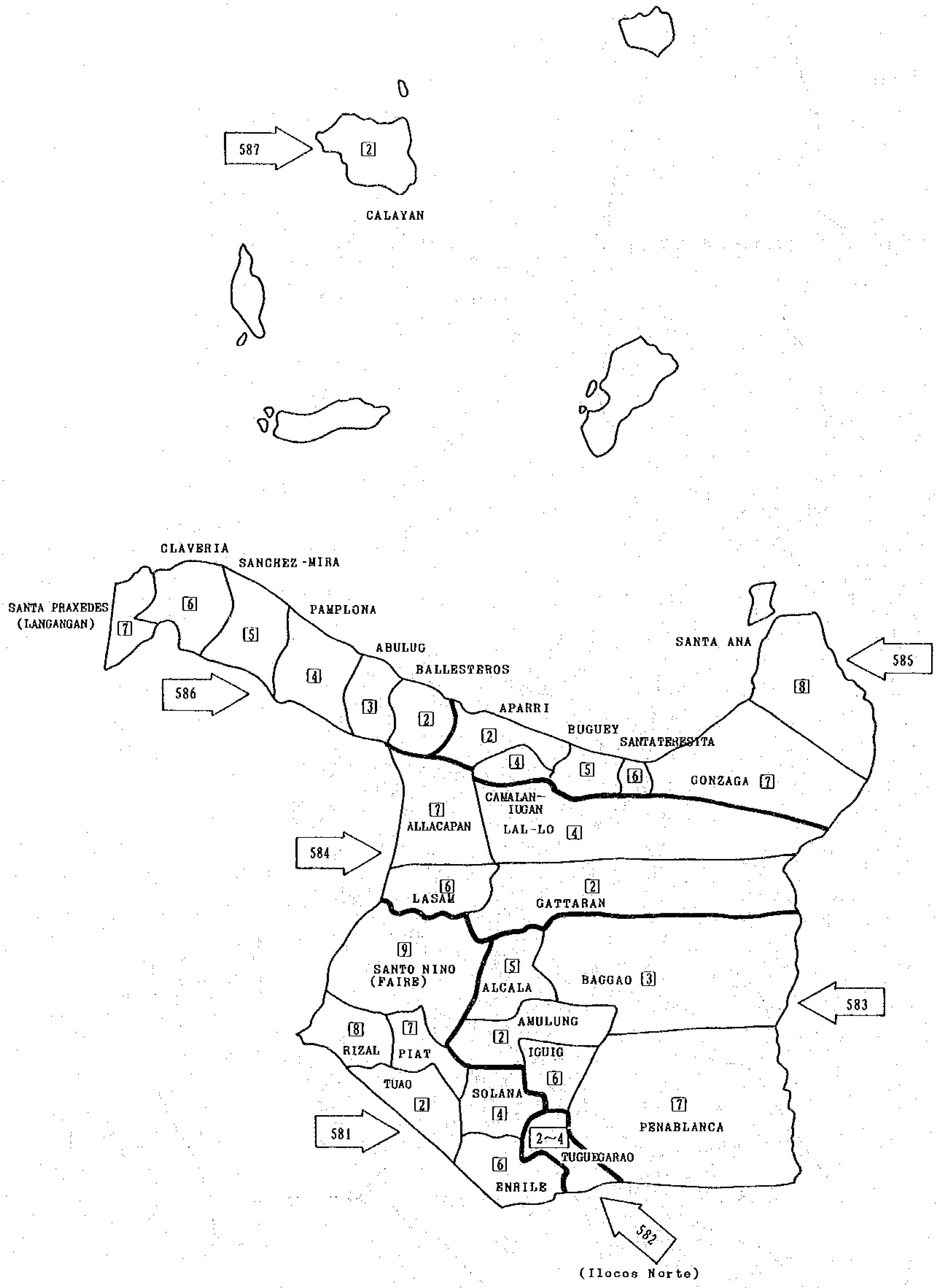


Fig Ⅲ−5−3−2 (9) Code ABC−D Assifnnent

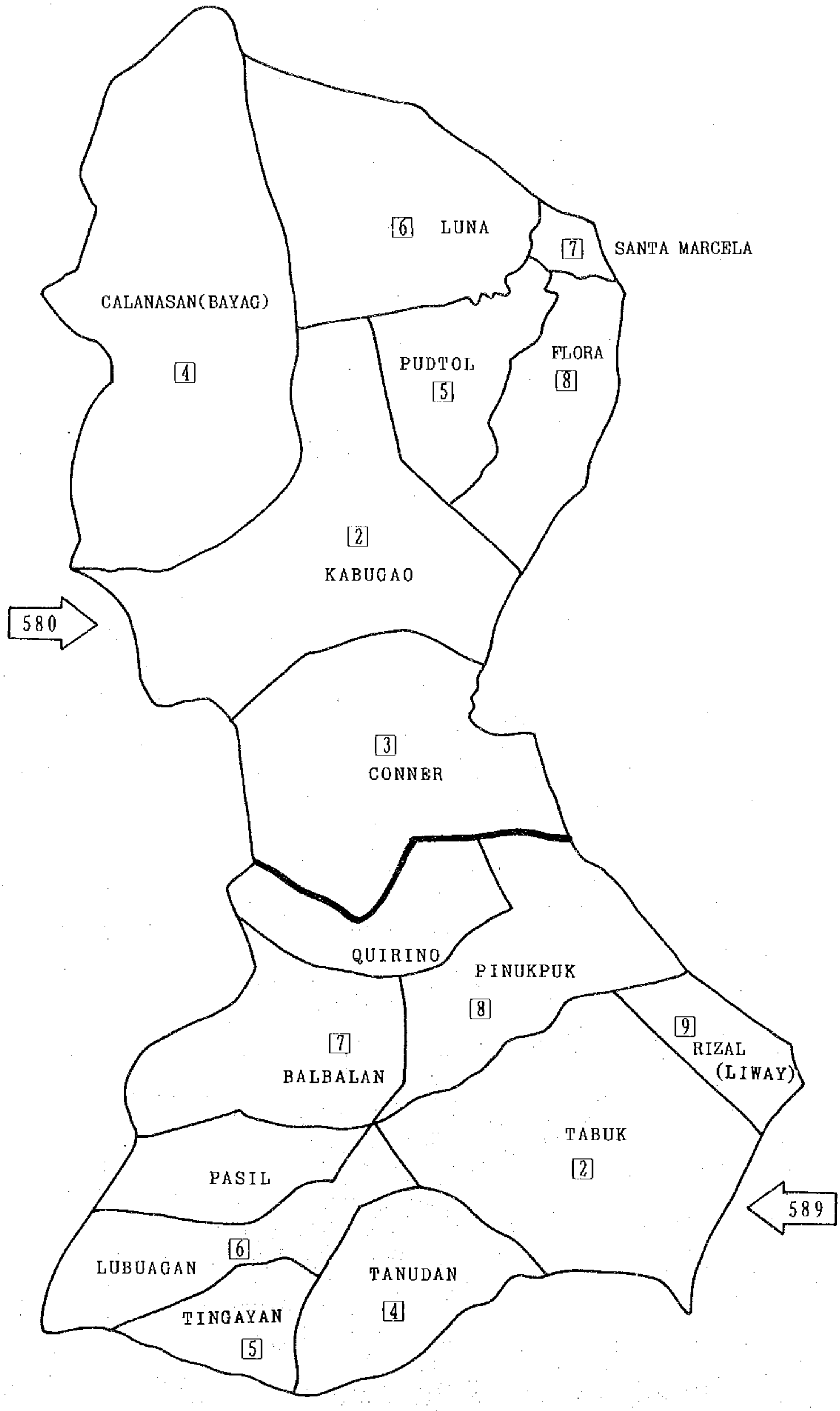


Fig. Ⅲ－5－3－2(10) Code ABC--D Assignment(Kalinga Apayao)

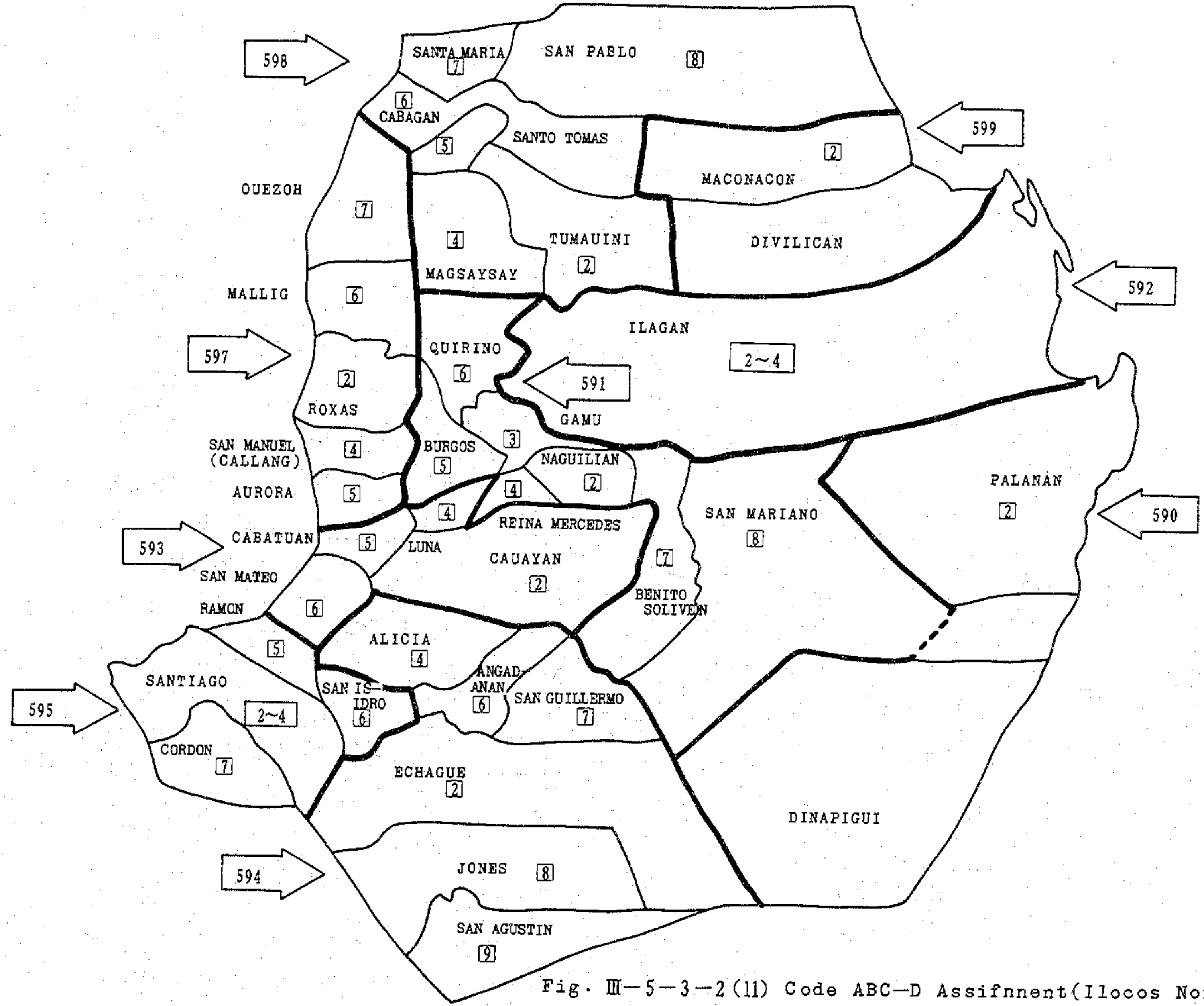


Fig. Ⅲ—5—3—2(11) Code ABC—D Assifnnent(Ilocos Norte)

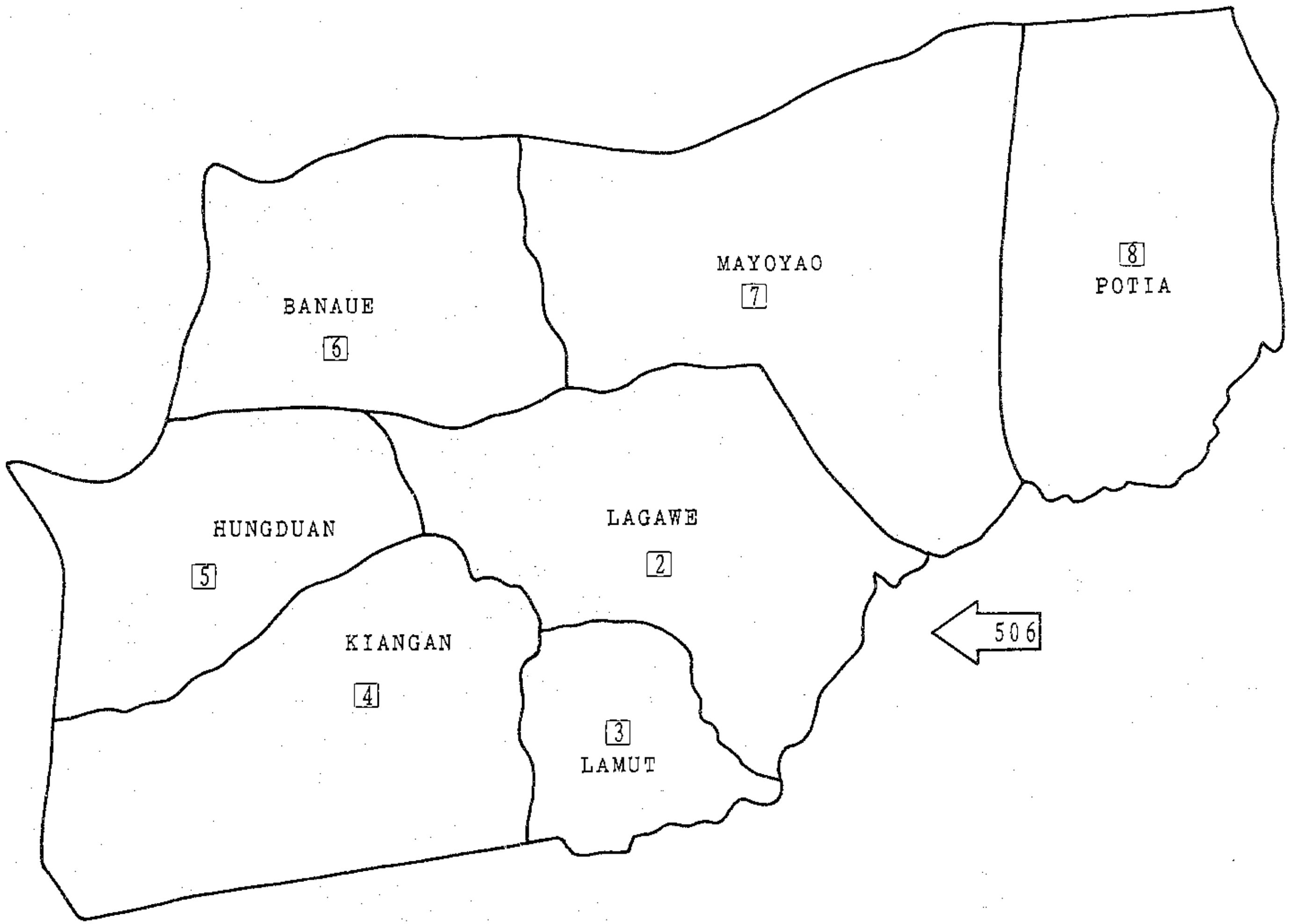


Fig. Ⅲ－5－3－2 (12)　Code ABC—D Assignmont (Ifugao)

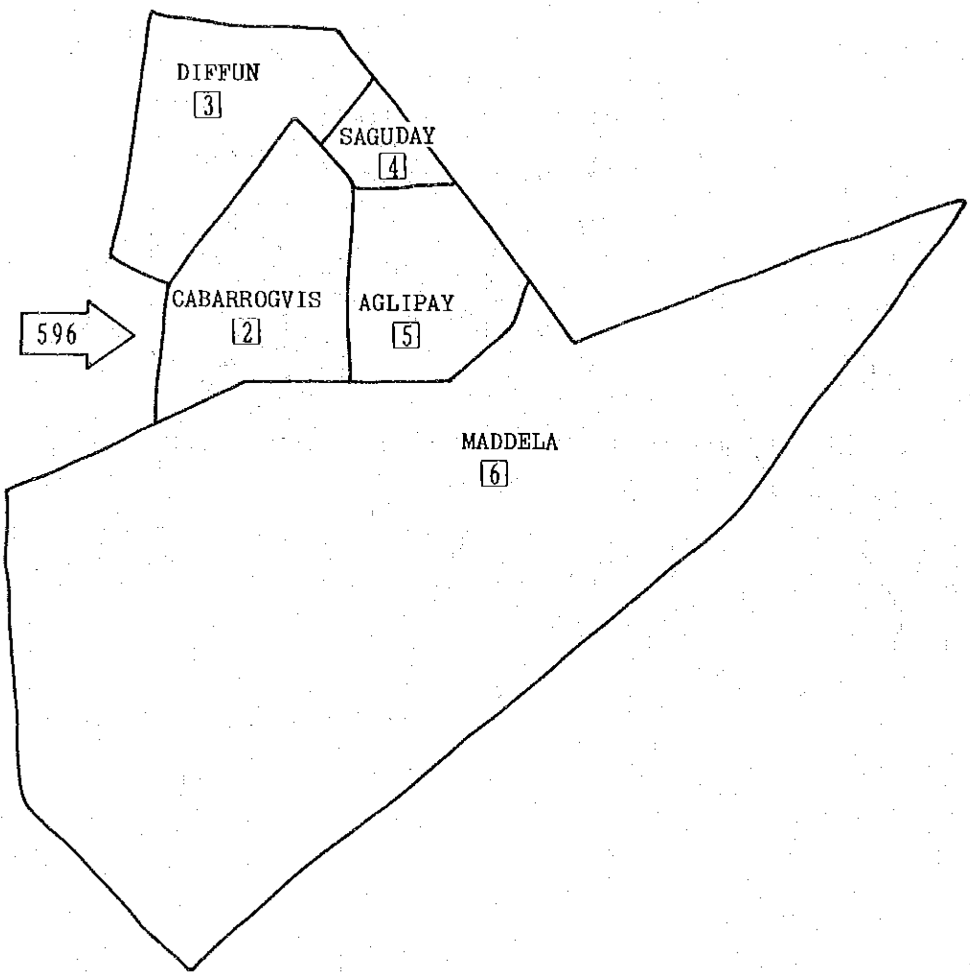


Fig Ⅲ-5-3-2(13) Cade ABC-D Assignment(Quirino)

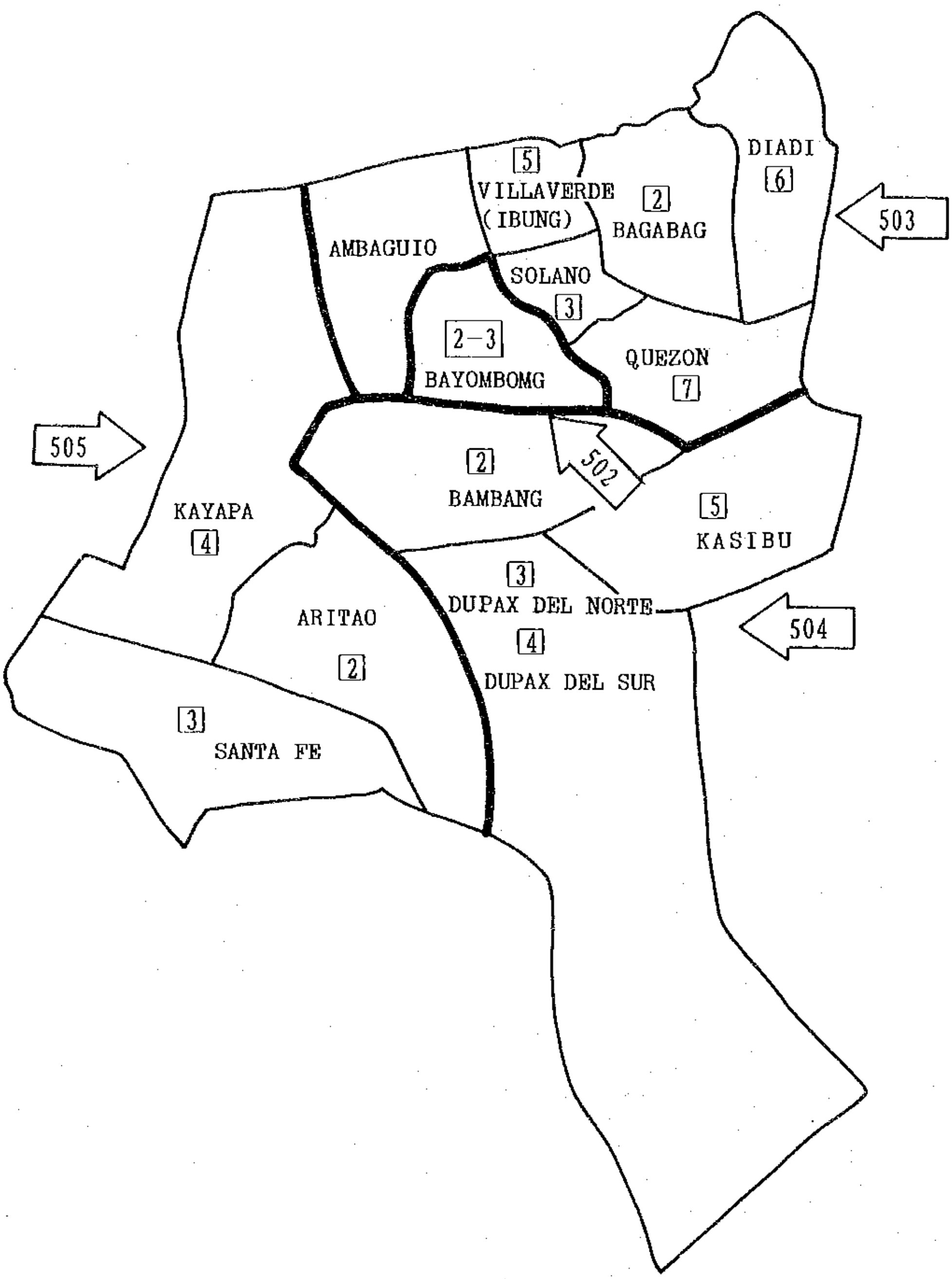


Fig-Ⅲ-5-3-2(14) Code ABC-D Assignment(Nueva Vizcaya)

6. Signalling System

6-1 Present Signalling System

At present, the following numbers of exchanges are engaged in telecommunication service in the Philippines.

Automatic switching	SXS:	73 offices (39%)
	XB:	75 offices (40%)
	Other system:	3 offices (2%)
Manual switching		37 offices (19%)

A half number of all automatic switching offices employ the SXS system and the remaining half the XB system.

In the number of terminals, 80% of all lines are in the Metro Manila area which use mainly the SXS system. All Connections of toll calls are made via toll boards (delay service). Toll call connection by STD is not employed. The following singnalling systems are employed.

(1) Dial pulse system is used for connection between automatic switching offices in such multiexchange areas as Manila

(2) Ring-down system is used for toll call connection between switchboards although part of connections to automatic switching offices are made by dial pulse system from originating toll boards.

6-2 Adoption of R_2-MFC Signalling System

STD will be adopted by using crossbar exchanges in this project. Thus, it is desired to meet the following requirements for the singalling system to be adopted.

(1) The signalling system should be such that assured as much high speed and high stability as practivable.

(2) The signalling system should suit common control which is a major feature of crossbar exchanges.

(3) Applicable to existing switching systems and switching systems to be developed in future.

(4) Applicable to future international STD

(5) Capable of picking up much information to cope with new services to be provided with future development in telephone network.

In order to meet these requirements, the adoption of the R_2-MFC signalling system recommended by CCITT is most suitable.

6-3 Outline of R_2-MFC Signalling System

The R_2-MFC signalling system was recommended by CCITT in 1968 as the standard signalling system.

Although this signalling system is intended mainly for international trunks, it is applicable to domestic trunks as well. The adoption of this signalling system for the domestic network will yield an advantage for base of establishing an international/domestic integrated system.

The R_2-MFC signalling system for use mainly for the domestic network is outlined hereunder.

6-3-1 Classification of signals

Signals incoming to or outgoing from common control exchanges such as crossbar exchanges can generally be classified into line and register signals. Moreover, each of them can be classified into some types by transmission method of signal and different signalling systems are employed for different combinations of these signals.

Register signal is a signal processed by common equipment register or a signal which indicates information on the route, the connection of the called subscriber, and the calling subscriber (dial number of the originating subscriber, type of the originated call-whether from a general subscriber or from the operator, etc.).

The exchange performs selection of the applicable connecting route and called subscriber by the register signal.

Line signal is such a signal that indicates the status change of the line or operating condition, etc., of subscriber's telephone (such as originating, answering, and disconnecting a call). The exchange is controlled to perform required operation by the line signal.

6-3-2 Register Signal

Iu the R_2-MFC signalling system, a signal obtained by combining two frequencies from among specific frequencies in the voice band is employed as the register signal. The register signal consists of a forward signal outgoing from the originating side and a backward signal sent back from the terminating side. Signal sending is so performed by the comelled method that the succeeding forward signal is sent out after confirmation of the backward signal. Originating register (sender) controls connection ranging from the originating office to the terminating office so as to allow signals to be sent one after another with the incoming registers of the respective transit offices.

Each incoming register of a transit office is released when connection from the originating register to the succeeding stage is set.

Thus, signals are transmitted by the end-to-end method. The end-to-end method provides the advantage of requiring no originating register (sender) at transit offices. (See Fig. III-6-3-1.)

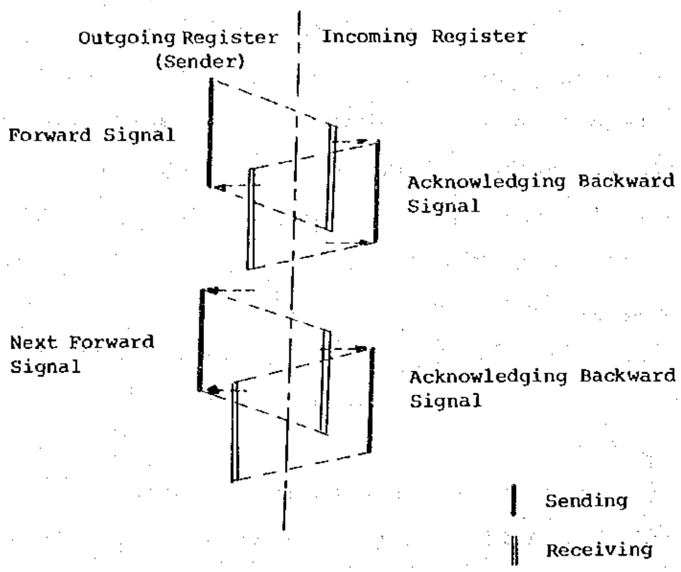


Fig. III-6-3-1 Continuous Compeled Signalling Procedure

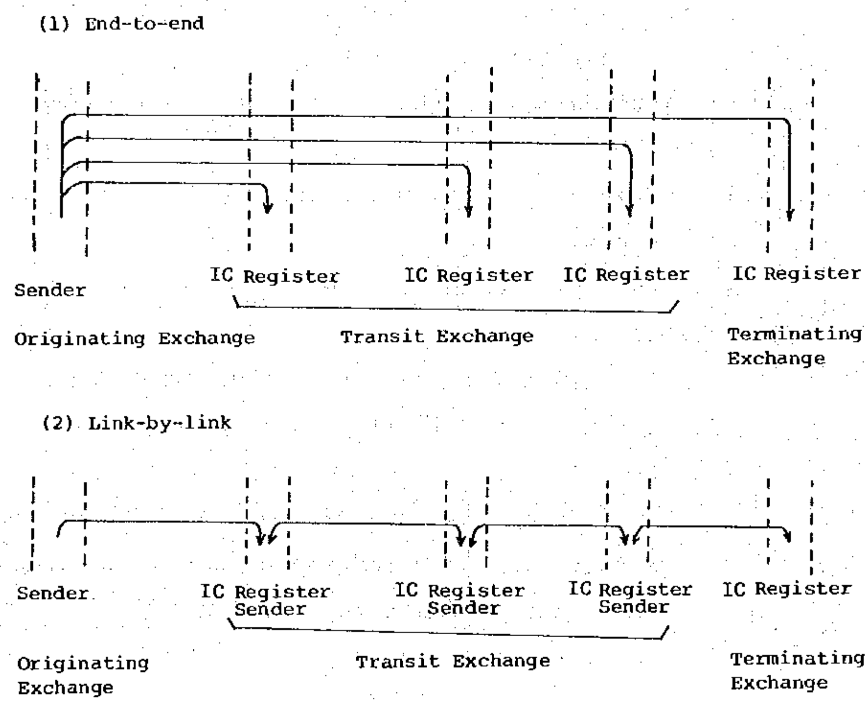


Fig. III-6-3-2 End-to-End and Link-by-Link Methods

(1) Multi-frequency code

The frequency range used in this signalling system is 500 to 2000Hz. Since frequencies above 2000Hz are not suitable for preventing interference with the line signal using frequencies within the voice band and frequencies below 500Hz will involve increased attenuation and increased transmission time.

Two frequencies from among 6 frequencies in different groups are used in combination so as to allow simultaneous transmission of forward and backward signals. Spaces between frequencies are in units of 120Hz.

Table III-6-3-1 gives signal codes formed by combining two frequencies. Each code is a combination of X and Y.

(2) Forward signal

This signal is used for transferring information on connection and information on the calling party (each 15 items of information, i.e., 30 items in total). The information on connection is designated group I signal, whereas the information on the calling party is designated group II signal.

The number of signals is limited to 15 (2 out of 6), but identical signal is used for different items of information in groups I and II. Signal switchover for this is conducted by the backward signal. The information on the calling party is needed in the following case.

(a) When connection is restricted by information on the calling party.

(b) For maintenance's sake

(3) Backward signal

This signal is sent from the terminating side and is still diveded into the following two subgroups.

(a) Code A

Code A is intended for controlling the transmission of information on selection signal or calling party and is used until the ultimate terminating office equipment knows the state of the called party.

(b) Code B

Code B is intended for reporting the state of the called party to the originating office equipment. These codes are used also as the confirmation codes for the forward signal group II transferred after the terminating equipment detects the state fo the called party.

Table III-6-3-1 MFC Signal Codes

Frequency (Hz)	Forward	1,380	1,500	1,620	1,740	1,860	1,980
	Backward	1,140	1,020	900	780	660	540
Code No.	X	0	1	2	3	4	5
	X + Y / Y	0	1	2	4	7	11
1	0 + 1	X	Y				
2	0 + 2	X		Y			
3	1 + 2		X	Y			
4	0 + 4	X			Y		
5	1 + 4		X		Y		
6	2 + 4			X	Y		
7	0 + 7	X				Y	
8	1 + 7		X			Y	
9	2 + 7			X		Y	
10	3 + 7				X	Y	
11	0 + 11	X					Y
12	1 + 11		X				Y
13	2 + 12			X			Y
14	3 + 11				X		Y
15	4 + 11					X	Y

Legend: X: Index

Y: Weight

Table Ⅲ-6-3-2 Meaning of Signals

Signal No.	Meanings of Signals			
	Forward Signal		Backward Signal	
	GroupI	Group II	Code A	Code B
1	Numerical information 1	Originating call from a general subscriber	Send next digit (n+1)	Spare signal for the national service
2	Nemerical information 2	Call with priority	Send only last one digit (n-1)	Called subscriber fransferred
3	Numerical information 3	Maintenance equipment call	Change to reception of B signal	Subscriber line engaged
4	Numerical information 4	Spare signal for the national service	Congestion on the national network	Congestion encountered after changeover from A signals to B signals
5	Numerical information 5	Call from operator	Send kind of call	Number not in use
6	Numerical information 6	Call for data transmission	Set up speech condition	Subscriber line free, with call charging
7	Numerical information 7		Send only last 2 digits (n-2)	Subscriber line free, non-chargeable call
8	Numerical information 8	For the internatio-nal service	Send only last 3 digits (n-3)	Subscriber line out of order
9	Numerical information 9		Spare signals for the national service	Spare signals for the national service
10	Numerical information 0			
11	Request for connec-tion to operator			
12	Request for connec-tion to operator of manual switch		For the internatio-nal service	Spare signals for the international service
13	Connection to main-tenance equipment	Spare signals for the national service		Spare signals for the international service
14	Request for inser-tion of echo supp-ressor		Request for echo Insertion of related with forward signal I-14	
15	Use of end-of-pulsing-key		For the international service	

6-3-2 Line Signal

In the R_2-MFC signalling system, various conventional line signal systems (which use other frequency ranges than the 500 - 2000Hz range used for the register signal) can be used as they are.

However, CCITT recommends a system in which an outband frequency (3825 Hz) signal is transmitted in both forward direction (from originating to terminating side) and backward direction (from terminating to originating side) during "line idel" periods of time. In this system, the line signal is transmitted on a link-by-link basis. (See fig. III-6-3-2.)

In this line signal system, all signals are transmitted by transferring from one signalling condition to another. That is, "signal tone on" or "signal tone off" represents a certain signalling condition.

By this, two conditions can be represented in both forward and backward directions, that is, a total of four conditions can be represented.

By including the factor of time sequence, six charecteristic operating conditions exist as given in Table VIII-6-3-3. Transfer from one signal condition to snother signal condition corresponds to one operation.

Table III-6-3-3 Line Signal

Line Operating Condition	Signalling Condition	
	Forward	Backward
1. Idle	on	on
2. Seized	off	on
3. Answered	off	off
4. Clear - back	off	on
5. Release	on	on and off
6. Blocked	on	off

(a) When the line is idle a low-level singal tone is sent out continuously in both direction of the line.

(b) When the line is seized, the signal in the forward direction is shut off.

(c) When the called party replies, the signal in the backward direction is shut off.

(d) When the calling party hangs up his handset, the forward signal tone recovers and the connection is released.
By this, the backward signal tone recovers.

(e) When the called party hangs up his handset first, the backward signal tone recovers first.

When, afterward, the calling party hangs up the handset or a given time has passed after the confirmation of the backward signal tone, the forward signal tone recovers.

7. Transmission Planning Standard

The transmission path can be divided into the main route ranging from Secondary Center to Primary Center and spur routes spread from Primary Center to respective end offices.

The main route will be the backbone of the transmission path of the Northern Part of Luzon (Regions I and II) and extend to Regions I and II in a U shape eith Bangrio where the Secondary Center is located being the Pivot.

In Region I the main route will extend to Laoag and in Region II it will extend to Tuguegarao. Since a condiderable amount of fufure trunk demands in BUTEL is anticipated including trunk line demand for long distance calls from the private companies, adoption of a large-capacity transmission system will be suitable. Although two different types of transmission means, i.e., microwave radio system and coaxial cable system, can be considered possible, mincrowave system is recommended from the economical standpoint. The transmission quality should meet the CCIR Recommendation for hypothetical reference circuits of 2500km and the relevant CCITT recommendation. Transmission of color TV signal should be available. Either radio link or wired circuit is recommended for the spur routes. Which of the two types of circuits should actually be adopted for respective spur routes should be determined in consideration of line demands, transmission quality and required construction expenses.

Consequently, the following are recommended.

(1) It is desirable to employ radio link when the distance between Primary Center and end office exceeds 15km.

However, when radio link is not recommendable on account of the unavailability of line-of-sight condition or some other reason, wired circuit is recommended. In some cases, radio link will be used for a certain portion of the route and wired circuit for the remaining portion.

(2) For spur routes of less than 15km in length, wired circuit will be employed in principle although radio link is recommended when cables can

not be easily layed because of the presence os a river with no bridge or the like.

(3) For spur routes to which wired circuit is recommendable and which exceed 15km in length and are expected to exceed 20 lines in final line demands, PCM system will be used. Negative impedance converter will be inserted in each line section exceeding about 11km in order to meet the loss distribution standard.

The spur routes will be equipped to meet relevand CCIR and CCITT recommendations.

8. Standards for Radio and Transmission Equipment

8-1 Multiplex and PCM Equipment Standards

The multiplex and PCM equipment standards to be employed in this project are as follows.

(1) Channel translator

1) Prequency allocation

As specified in CCITT Recommendation G-211.

2) Level and impedance (Channel side)

4W Send: -1dBr - -16dBr

4W Receive: -6dBr - +8dBr

Impedances on send and receive sides are equally 600Ω, balanced.

3) Level and impedance (Group side)

Send output: -37dBr

Receive input: -30dBr

Impedances on send and receive sides are equally 75Ω, balanced.

4) Attenuation distortion, carrier leak, linearity and crosstalk

As specified in CCITT Recommendation G-222.

5) Total noise

As specified in CCITT Recommendation G-222.

6) Signalling and frequency

Tone-on idle, 3825Hz

(2) Group translator

1) Frequency allocation

As specified in CCITT Recommendation G-233.

2) Level and impedance (Group side)

Send input: -37dBr

Receive output: -30dBr

Impedances on send and receive sides are equally 75Ω, balanced.

3) Level and impedance (Supergroup side)

Send output: -35dBr

Receive input: -30dBr

Impedances on send and receive sides are equally 75Ω, balanced.

4) Attenuation distortion

Less than 0.5dB in deviation in basic group band on both send and receive sides.

5) Crosstalk

Far-end crosstalk and near-end crosstalk at 84kHz are both more than 70dB.

6) Total noise

As specified inCCITT Recommendation G-222.

(3) Supergroup translator

1) Freguency allocation

As specified in CCITT Recommendation G-423.

2) Level and impedance

Send input: -35dBr

Receice output: -30dBr

Impedances on send and receive sides are equally 75Ω, unbalanced.

3) Attenuation distortion

Less than 1.0dB in basic supergroup band.

4) Crosstalk

Far-end crosstalk and near-end crosstalk at 412kHz are both more than 70dB.

5) Total noise

As specified in CCITT Recommendation G-222.

(4) Carrier current supplier

1) Frequency accuracy

Master oscillator and 60kHz pilot:	within $\pm 1 \times 10^{-6}$
Group and supergroup pilots:	within ±1Hz
Signal current:	within ±5Hz

2) Level stability

Carrier current:	within ±1dB
Various types of pilots:	within ±0.3dB
Signal current:	within ±0.5dB

(5) PCM equipment

1) Pulse code modulation of voice frequency

As per CCITT Recommendation G-711.

Sampling frequency: 8000Hz

Coding: A or μ coding law using decimal 8 digits

2) Channel quality

Attenuation distortion, group delay distortion, impedance, idle channel noise, total distortion, transmission loss, level characteristic, input/output relative levels, etc., are as per CCITT Recommendation G-712.

3) General characteristics of primary multiplex equipment

CCITT gives two recommendation, one for 1.544 Kbits/s and the other for 2.048 Kbits/s and these characteristics are to be as per Recommendations G-731 and G-733.

8-2 Radio Equipment standard

8-2-1 Connection with Carrier Multiplex Equipment

Transfer levels and impedances between radio circuit and carrier multiplex equipment are as follows.

Maximum Transmission Capacity (channels)	Carrier Transfer Level (dBr)	Carrier Receiving Level (dBr)	Impedance (Ω)	Radio Modulator Input (dBr)	Radio Demodulator Output (dBr)
24	-23	-36	150 bal.	-45	-15
60	-23	-36	75 unbal.	-45	-15
300	-23	-36	75 unbal.	-42	-20
960	-23	-36	75 unbal.	-45	-20

8-2-2 Operating Radio Frequencies

In establishing radio transmission lines their radio friquency bands are recommended to be as follows.

(1) Main route

- o 150MHz band for 3- and 6-channel systems
- o 400MHz band for 24-channel system
- o 800MHz band for 60- and 120-channel systems
- o 2GHz band as per CCIR Recommendation 283-2 for 300-channel systes

Concrete frequency bands to be employed are detailed in PART VIII "SYSTEM DESIGN."

This frequency assignment is an important theme which may determine the feasibility of the project, so that due consideration should be given by the frequency assignment authorities of the Government of the Philippines.

8-2-3 Modulation Index

Modulation index per channel in radio circuits for transmitting frequency division multiplexed telephone signals will be set as follows to achive effective utilization of frequeny spectrum and unification in interconnection.

Maximum Transmission Capacity (channels)	Frequency Deviation per Channel (rms.kHz)
3	10
6	20
24	35
60	100
300	200
960	200

9. Standards for Telegraph Facilities

Telex service is conducted by BUTEL. The standards of the telex facilities to be constructed by this project should meet those of the existing telex facilities. The standards of the telex facilities employed for the time being by BUTEL meet CCITT Recommendations. The basic standards to be met are as follows.

1) Operating mode: Half duplex
2) Transmission speed: 50 bauds
3) Characters: International Telegraph Alphabet No.2
4) Code: -do- (5 units)
5) Signalling: Type A signalling (keyboard selection) as per CCITT Recommendation UI
6) Service codes: OCC (Occupied or subscriber is engaged)
   NC (No connection)

DER (Line is disturbed)
NA (Call is not admitted)
NP (Called subscriber's number does not exist)
NCH (Called subscriber's number is changed)
ABS (Called subsciber is absent or his office closed)

7) Local circuit allowable length (Ascribable to signal distortion)

Uipolar:	less than 15km
Polar:	less than 30km

8) Operating voltage and current

Unipolar:	+60V, 20mA
Polar:	±60V, 40mA

9) Circuit distortion: less than 30%

10) Telex numbering

5 digits:	For local and distanced subscibers (including Gentex)
3 digits:	For special service

11) Charging method: Multi-metering

12) Telex terminal

Local marge:	more than 35%
Answer back mechanism:	Present
Power supply:	AC 110/220V, 60Hz

13) Carrier telegraph: 24 channels/voice band
(Voice band: 0.3 - 3.4Hz)

10. Standards for Outside Plants

10-1 Subscriver's Line Facilities

Subscriber's line facilities are facilities ranging from the line side terminal on the MDF of the telephone exchange to the wiring point to the subscriber, such as telephones set.

Subscriber's line facilities should meet the following basic requirements.

(1) Subscriber's line facilities should meet given electric requirements for sending speech and signals properly.

(2) Subscriber's line facilities should be such that can readily be opened

for application for the subscription of telephone.

(3) Subscriber's line facilities should be such that are economical from the standpoints of both construction and maintenance as they spread over a wide range.

(4) Being located outdoors, subscriber's line facilities should be sufficiently stable and safe against natural environment, traffic of vehicles, and electric disturebances.

Now let us consider concrete requirements for these mentioned above.

a) Subscriber's line loss and DC resistance

Subscriber's line loss is determined by the transmission loss allotment of the entire transmission system ranging from subscriber to subscriber, as stated in Chapter III-2. . CCITT recommends the transmission loss ranging from the MDF of the telephone office to each subscriber to be 11.5dB on the sending side and 0.5dB on the receiving side. These values include the losss of the telephone set. Accordingly, the loss to be allotted to the subscriber's line depends on the performance characteristics of the telephone set.

In the case of a combination of a Japanese-made type 600 telephone set and a cable of 0.5mm in core diameter, the limit of the transmission loss to be allotted to the subscriber's line is 9dB. When the cable is 0.4mm in core diameter, the limit of the transmission loss allotment is 7dB.

DC resistance limits are so provided as to keep the attenuation of the signal current transferred between the telephone set and switch within a given range for allowing the telephone set and exchange to operate satisfactorily.

The DC resistance limits is 1500Ω when the switch of the telephone office is crossbar system, 1000Ω when it is Strowger type automatic switching system, and 800Ω when it is a common-battery switch.

b) Line constants

In order to secure satistactory communication, it is necessary to set standards for respective line materials described herein are electrical standards most closely related to the communication quality. Examples of the line constants of subscriber's cable are given in Tables III-10-1-1 and III-10-1-2.

c) Cable planning

When constructing newly or expanding subscriber's line facilities, it is important to definitely know the relationship between the tele-

Table III-10-1-1 Line Constants of Nonloaded Cable

Item			Constant		
Core Diameter (mm)			0.5	0.65	0.9
Usage			Side	Side	Side
Primary Constants	Resistance of Conductor R (Ω/loop km)		187	113	58
	Inductance L (mH/km)		0.70	0.70	0.70
	Capacitance C (mμF/km)		50	50	50
	Conductance G (μ℧/km)		1.6	1.6	1.6
Secondary Constants	Phase Constant (α)	0.8kHz Rd/km	0.15	0.11	0.09
		1.5kHz Rd/km	0.21	0.16	0.12
	Attenuation Constant (β)	0.8kHz dB/km	1.29	0.99	0.70
		1.5kHz dB/km	1.75	1.33	0.93
	Characteristic Impedance $(Z_0 \lvert \overline{\theta})$	0.8kHz Ω.degree	$841 \lvert \overline{44.3}$	$647 \lvert \overline{43.9}$	$468 \lvert \overline{43.0}$
		0.8kHz Ω.degree	$614 \lvert \overline{43.8}$	$473 \lvert \overline{43.1}$	$342 \lvert \overline{41.5}$

Table III-10-1-2 Line Constants of Loaded Cable

Item			Constants		
Core Diameter (mm)			0.5	0.65	0.9
Loading Inductance (mH)			100	100	100
Loading Distance (m)			915 1,830	915 1,830	915 1,830
Usage			Side	Side	Side
Primary Constants	Resistance of Conductor R (Ω/loop km)		203	129	74
	Capacitance C (mμF/km)		50	50	50
Cutoff Frequency fc (kHz)			4.68 3.31	4.68 3.31	4.68 3.31
Secondary Constants	Characteristic Impedance $z_0\angle\theta$ (Ω.degree)	0.8kHz	$1,550\angle 9.5$ $1,900\angle 16.2$	$1,523\angle 6.0$ $1,120\angle 11.1$	$1,512\angle 3.5$ $1,080\angle 7.3$
		1.5kHz	$1,578\angle 5.2$ $1,200\angle 10.7$	$1,570\angle 3.3$ $1,200\angle 6.7$	$1,566\angle 1.9$ $1,200\angle 3.8$
	Attenuation Constant β(dB/km)	0.8kHz	0.57 0.72	0.37 0.46	0.22 0.26
		1.5kHz	0.57 0.74	0.37 0.47	0.22 0.27

phone demand and facilities.

For this purpose, it is often employed to divide the area under consideration into blocks (so that in general the demands 15 years ahead should be divided into groups of 100, 200, 600, and 800), forecast the demand for each block, and determine the necessary quantities of facilities. For which year ahead facilities should be installed to meet the demand should be determined in consideration of the economical efficiency of the facilities.

d) Others

The specifications, etc., of the respective items of components composing subscriber's line facilities are to be stipulated in the specification for the respective items.

Various roads and regulations for structures, etc., (such as provision for electric structures and traffic low) shall be obeyed.

10-2 Trunk Line Facilities

Trunk line facilities are cable transmission line facilities used between offices ranking above end office.

Trunk line facilities should:

(1) meet electrical requirements for satisfactory transmission of speech and signals,

(2) provide economical, ample transmission line for varying traffic, and

(3) have sufficient stability to exhibit required functions against the variation of natural environment such as wind and rain, assure ease of installation and maintenance, and be economical.

These requirements are described in more concrete hereunder.

a) Transmission loss allotment

Transmission loss allotment to trunk lines is as described in Chapter Ⅲ-2.

The loss described here denotes the sum of the loss of the transmission line and the other loss at the ends of the line.

Accordingly, the loss allotted to the line is equal to the loss (above-mentioend sum) subtracted by the intra-office loss, repeating coil loss, and hybrid coil loss.

b) DC resistance limit

Being allowed to local cable lines, the DC resistance limit depends on the type of switch and signaling system. DC resistance limits between offices to be constructed in this project and applicable distance limits in various cable transmission lines are given in Table III-10-21.

Table III-10-2-1

Signaling System	DC Resistance Limit loop (Ω)	Applicable Distance Limit (km)						Remarks
		Loading		Loading with No repeating		Loading Both Way Repeater		
		0.9mm	0.65mm	0.9mm	0.65mm	0.9mm	0.65mm	
DC Type (LD)	4,000 (with booster)	54.1	30.7	55.5	31.4	53.3	30.2	XB ⇄ XB
AC Type (R2)	4,000 (with booster)	54.1	30.7	55.5	31.4	53.3	30.2	do.

The applicable distance limit can be calculated from the DC resistnce limit as follows.

$$\text{Distance limit} = \frac{\text{Resistance limit} - (\text{Repeating coil DC resistance} \times \text{No. of coils}) - (\text{Both-way repeater DC resistance})}{\text{DC resistance per cable unit length}}$$

DC resistance values per cable unit length are extracted from Tables III-10-2-2 and III-10-2-3.

( ) in the above equation show resistance when repeating coil or both-way repeater is used. DC resistances of repeating coils and both-way repeaters are given in Table III-10-2-4.

c) Transmission system

Transmission will be employed by using toll cables:
Voice cable method and PCM method.
The voice cable method is still divided into the nonloading system and loading system (Type B or J cable) and when the transmission loss allotment is not met, boty-way repeater or end repeater will be employed.
The PCM method is of pulse code modulation and time division multiplex type and requires 4 nonloaded wires per system.

d) Selection of type of cable and core diameter

The type of toll cable to be used in a certain section and its core diameter should be determined in consideration of

Table III-10-2-2 Line Constants of Nonload Cable

Item			Constant			
Type of Cable			Toll PEF Cable (including PEF-P)			
Core Diameter (mm)			0.65		0.9	
Usage			Side	Phantom	Side	Phantom
Primary Constants	Resistance of Conductor R (Ω/loop km)		113	56.5	58	29
	Inductance L (mH/km)		0.76	0.24	0.76	0.24
	Capacitance C (mμF/km)		38.5	109	38.5	109
	Conductance G (μ℧/km)		0.2	0.5	0.2	0.5
Secondary Constants	Phase Constant (α)	0.8kHz Rd/km	0.10	0.12	0.08	0.09
		1.5kHz Rd/km	0.14	0.17	1.10	0.12
	Attenuation Constant (β)	0.8kHz dB/km	0.86	1.03	0.61	0.74
		1.5kHz dB/km	1.16	1.40	0.81	0.99
	Characteristic Impedance ($Z_0 \lvert \overline{\theta}$)	0.8kHz Ω.degree	$737 \lvert \overline{43.9}$	$310 \lvert \overline{44.3}$	$533 \lvert \overline{43.0}$	$224 \lvert \overline{43.7}$
		1.5kHz Ω.degree	$539 \lvert \overline{43.0}$	$226 \lvert \overline{43.8}$	$330 \lvert \overline{41.3}$	$164 \lvert \overline{42.6}$

Table III-10-2-3 Line Constants of Loaded Cable

Item			Constant		
Type of Cable			Toll PEF Cable (including PEF-P)		
Core Diameter (mm)			0.65	0.9	0.9
Loading Inductance (mH)			130 48	130 48	130 48
Loading Distance (m)			1,000	1,000	1,000
Usage			Side Phantom	Side Phantom	Side Phantom
Primary Constants	Resistance of Conductor R (Ω/loop km)		127.0 63.5	72.0 36.0	62.1 31.1
	Capacitance C (mμF/km)		38.5 104	38.5 104	38.5 104
Cutoff Frequency fc (kHz)			4.40 4.46	4.40 4.46	3.16 3.17
Secondary Constants	Characteristic Impedance $z_0\angle\theta$ (Ω.degree)	0.8kHz	$1{,}889\angle 5.1$ $687\angle 6.9$	$1{,}878\angle 3.0$ $680\angle 4.1$	$1{,}360\angle 5.0$ $513\angle 6.3$
		1.5kHz	$1{,}959\angle 2.7$ $711\angle 3.7$	$1{,}956\angle 1.6$ $709\angle 2.2$	$1{,}475\angle 3.4$ $550\angle 4.4$
	Attenuation Constant β(dB/km)	0.8kHz	0.28 0.39	0.16 0.23	0.20 0.28
		1.5kHz	0.28 0.39	0.17 0.23	0.21 0.38

Table III-10-2-4 DC Resistances of Repeating Coils and Both-Way Repeaters

Item	DC Resistance (Ω)	Loss (dB)	Application
VD-2-1-A Repeating Coil	50	0.2	Applicable for Type B loaded local (trunk) cables.
VD-2-2-A Repeating Coil	50	0.2	Applicable to loaded trunk cable without phantom circuits (applicable to Type B and Type H loaded cables).
VD-2-3-A Repeating Coil	30	0.2	Applicable to Type B loaded local (trunk) cables.
VR Repeating Coil	-	0.4	Applicable to loaded trunk cables with phantom circuits. In this case, DC resistance of coil is not considered.
S-1 Both-Way Repeater	50	-	Applicable to high-usage lines (Type B and Type J loaded cables for which required gain is compactively large).
S-2 Both-Way Repeater	60	-	Applicable to both basic trunks and high-usage lines (Type B loaded cables for which required gain is compactively small).
P-1 Both-Way Repeater	100	-	Applicable to high-usage trunks and installed at intermediate offices. (For Type B and Type J loaded cables for which high gain is required).

- o transmission loss allowed to the section,
- o DC resistance limit,
- o distance between offices,
- o required number of circuits and the types of circuits.

In this project, such types of cables that provide electric performance are shown in Tables III-10-2-2 and III-10-2-3. The core diameter of cables used in this project will be mainly 0.65mm. Sometimes 0.9mm wires and open wires will be usable.

11. Standards for Power Facilities

11-1 General

In general, the main power equipment will be composed of the following items although the equipment configuration of each office will be determined in detailed design in consideration of the facilities and operational requirements of the office.

(1) Batteries

(2) DC/DC converter

(3) Rectifier and regulator

(4) Engine generator and associated equipment

11-2 Batteries

(1) Batteries for switches

Every exchange (including telex exchange office) will be furnished with two sets of batteries having the following constructions and characteristics.

Construction: lead battery packaged in a totally-enclosed case made of plastics containging fiberglass or the like and capable of anode measurement.

Characteristics: 50V output voltage. Discharge capacity is such that allows discharge over 4 busy hours in consideration of the exchange condition to be assumed 15 years ahead.

(2) Batteries for radio and carrier transmission on a hill or mountain

For radio and carrier transmission, two sets of batteries having identical characteristics and construction to those for switches and capable of full-load operation over 8 hours in either single or parallel running mode at an output of 24V will be used.

11-3 DC/DC Converter

(1) DC/DC Converter for radio and carrier transmission DC/DC converter is used to obtain power to be fed to the radio and carrier transmission equipment from the batteries for switch use when a power supply is used in common for switch use and radio and carrier transmission use. This DC/DC converter should be of moisture-proof, heat-proof type for use in the tropical zone.

The input voltage, noise level, and ripple voltage ratings of the DC/DC converter should respectively be -50 ± 2V, less than 5mV at 800 Hz, and 25mVr.m.s. in continued operation. The converter should be doubleconnected with an automatic charger not to cause power interruption upon charging as well.

(2) DC/DC converter for telegraph use

The DC/DC converter for telegraph use is used for obtainng ±60V power to be used for telegraph code transmission. The construction and characteristics of this DC/DC converter are identical to those of the DC/DC converter for radio and carrier transmission use.

11-4 Rectifiers

Rectifiers are used to charge the switch batteries in full floating condition and are doubleconnected with the automatic charger. Rectifiers should be such that charging delay should not be caused to the transmission facilities, etc., that the initial maximum load of the first nuit in operating condition should be 95% of the rated value and adjustable in 75% to 95% range, and that the maximum load at the switching points of all other units should be 95%.

Control equipment should be such that allows expansion of rectifiers and allows single or parallel running of the batteries.

These rectifiers should have sufficient capacity for allowing step-up charging when required, should operate from a single-phase 220V (60Hz) commercial AC power, and should have required smoothing capability for suppressing the noise to less than 2mV at 800Hz.

These rectifiers should have the following alarm functions.

1) Input power interruption

2) Voltage variation outside predetermined voltage regulating range

3) Fault in all items of equipment

4) Fuse alarm

It is necessary that these alarms can be displayed by visual indications and can be remotely sypervised.

11-5 Engine Generator

A diesel engine generator which provides a single phase 220V output at 60Hz in continued operation at temperatures below 40°C will be used as the stand-by power supply for the commercial power or as the power supply for telecommucation in areas where no commercial power is available.

The engine generator should meet the following requirements.

1) The engine generator should automatically start operation in the event of commercial AC power interruption or variation over ±15%, should be adjustable continuously in a +15% to -15% variation range, and should be able to complete switchover within one minute.

2) When the commercial AC power is recovered, the set voltage level and frequency of the commercial power should be checked for normality and the engine generator should be automatically stopped after switchover to the commercial power.

3) When the engine fails to start three times, fault alarm indication should be given.

Then engine, which is rated to perform continued operation provide a running speed of 1000 r.p.m. or 1500 r.p.m. The cooling system of the engine should be water cooling. The radiator should be of air-cooled type.

The output voltage and frequency variations of the engine generator should be automatically adjustable to be set within allowable ranges, and the engine generator should stop automativally in the event of any of the following conditions.

1) Lowering of engine oil pressure

2) Excessive temperature rise

3) Overspeed

4) Overloading

5) Shortage of fuel

A visible/audible alarm indication and supervisory equipment which allows later expansion as required should be proveded to supervise or monitor fuctional faults which may be encountered in the engine and generator.

One large and one small fuel reservoirs each furnished with an electrical pump should be provided. The large fuel reservoir should be able to aff-

ord continued operation at full load for two weeks.
The engine start battery should be furnished with a charger so as to be chargeable by either engine generator or commercial power.
The controller in use should be capable of supervising the current, voltage and frequency of the generator and commercial power and should allow manual control of the engine loads.

12. CIVIL WORK

12-1 Requirements for Telecommunication Station/Office Buildings

In general, telecommunication buildings such as telephone office buildings are "intended for maintaining smooth, safe telecommunication services" and should be designed to prevent performance degradation and interruption of communication in the event of emergencies as well as in normal time, and due consideration should be given for preventing fire and disasters under the social, natural circumstances of ambient buildings. In particular, the Philippines are subject to typhoons and proper measures should be taken against typhons, although measures should also be taken against earthquake, flood, and high tide. That is, one of the most important rquirements in design is strength of facilities against various disasters. Communication equipment, etc., to be introduced by this project are rather sophisticated to have higher precision than the conventional equipment and require more stable ambient conditions. That is, due consideration should be given for dustproofing and temperature/humidity control for preventing failure from occurring in the communication equipment, etc.
The telephone offices and radio repeaters to be constructed by this project will be designed on the basis of these basic requirements. In more concrete, buildings should be constructed to meet the following basic requirements.

1) In construction, buildings should be made of reinforced-iron concrete.
2) Buildings should be made as much inflammable as practicable.
3) Fittings and furnishings in and near the equipment room should be made of steel.
4) The equipment room should be sufficiently separated from the office room, service yards, etc.
   Resting or dining within the equipment room will not be desirable

for the maintenance of required equipment performance.

5) Automatic switch room should be airconditioned.

12-2 Building Design Considerations for Individual Rooms

Design considerations to be given for the individual rooms of station/office buildings in this project are as follows.

(1) Switching room and radio transmission equipment room

1) These rooms will be furnished with local exchange, main distribution frame (MDF), call meters, test bench, telegraph equipment, and carrier-frequency radio equipment.

2) Switching rooms are to be airconditioned.

3) Cable vault and cable hall are to be provided in the lower section of the MDF.

4) Floors are to be concrete placing with slabs.

5) Provision of a front room is desirable for preventing dust from entering.

6) Windows and doors are to be of airtight construction.

7) Doors are to be made of steel and fireproof shutters are to be provided over windows.

8) The floor level should be set above the probable flood level of the area and, if this is not available, walls against submerge should be provided.

9) Equipment entrance should be provided for allowing equipment to be carried in and out.

(2) Manual exchange room

1) This room will be furnished with such types of switchboard as delay service board, nondelay service board, and information desk for operators and operating manager to work.

2) The ceiling material should be such that assures a good sound absorbing effect since otherwise operator voices and jack extraction/insertion click may become noise.

3) Doors and windows should be made airtight to prevent noise and dust from entering.

4) Air ventilation or airconditioning should be employed for the same purpose as mentioned in 3) above.

5) Window blinds or curtains should be employed for operators not to be subject to glare.

6) Doors should be of fireproof type and windows should be fitted

with fireproof shutters.

(3) Power room

1) The power room will be furnished with rectifier, charger, engine generator, battery, etc.

2) Since O_2 and H_2 gas will be generated upon charging batteries, compulsory ventilation of 5 times per hour should be made. A ventilating fan should be set on a wall near the batteries.

3) Insert rails should be provided under beams.

4) Fireproof doors and shutters should be provided as in the case with the switching room.

5) Equipment entrance should be provided.

6) Floor should be of anti-acid, anti-oil PVC tiles.

7) Incombustible gas fire extinguisher should be provided.

(4) Senior personnel room

1) This room will be a private room for senior personnel and should be usable as a reception room.

2) Consideration should be given for shutting off sound to outside.

(5) Office room

1) This room will be a general office room for operation/maintenance and managing office work.

2) Office equipment such a copying machine may be provided.

3) Illumination on desks should be about 400 lux.

4) Direct rays of the sun should be prevented by using blinds and curtains.

(6) Window office room

1) This room is intended for such office work as acceptance of applications for subscription, charge calculation, charge receept, and acceptance of telegrams and will be furnished with counters.

2) Charge counter should be located to assure safety against burglary.

(7) Public room

1) This room is intended for customers to apply for telephone subscription, pay charges, apply for telegrams to be sent, use public telephones, and make general consultation.

2) This room will be furnished with counters, display or demonstration table, chairs, benches, notice boards, etc.

12-3 Standardization of Station/Offices Buildings and Steel Towers

12-3-1 Concept for Standardization

In this project, it is required to construct small-scale station/office buildings at many sites spread over wide ranges and all together. In such cases as this, it is considered advantageous to introduce standardization for the purposes of efficiency and labor reduction. Although various methods of standardization may be considered, the adoption of sandardization of the entire building over a wider range will be recommendable. It may be generally considered that the use of prefabricated station buildings will make a remarkable effect in such cases, and this is discussed hereunder. For materials, two cases may be considered: Use of steel and use of concrete as the main material. Although both cases of materials are possible, it is to be noted that the use of steel as the main material may be much more expensive than the use of concrete to be prepared at the site. Prefabricated station buildings made of concrete are rather heavy, which is disadvantageous from the standpoint of transportation of materials to construction sites spread over wide areas in this project. It can be determined, through overall examination of construction expenses, transportation of materials, assembling at sites, etc., that buildings should be made of concrete prepared at the site. It is recommended, in preparing standard design, to classify scales and types, which are often very similar, into several categories for achieving economy, high efficiency, and uniform quality in design estimation, and control operations.

12-3-2 Introduction of Standardized Station Building

In this project, 45 telephone offices, 84 radio terminal/repeater stations will constructed and introuduction of stndard station building is recommended for the purposes of labor reduction and economy.

The present standard building can be employed as a type of standard station building also. This type of station building being employed by BUTEL at present should suitably be applied to stations/offices with a total number of personnel being less than 15, so that it should be adopted to:

- o telephone offices not comprising radio facilities and
- o singly attended radio repeater stations (excluding repeater stations atop mountains or hills)

in this project. Accordingly, another type of standard station building should be provided for telephone offices comprising radio facilities, microwave repeater stations, etc. Secondary ceters, which will be larger in scale and organization, should desirably be designed individually.

12-3-3 Steel Tower Standardization

In general, steel towers for communication use can be classified into two types: self-supporting tower and guyed mast. A self-supporting tower is more expensive than a guyed mast, requires less site area, and provides an advantage when installed atop a mountain or hill where it is difficult to obtain a wide site area.

The disign requirements to be met upon rough design are as follows.

1) Maximum wind load: 70m/sec (at 10m above the ground)

2) Loads

- o Steel tower on main route (Repeater)

  Initial load + 4mø parabola x 2
  + 400MHz 8-element Yagi antenna x 2

- o Steel tower on main route (Terminal station)

  Initial load + 4mø parabola x 2
  + 3mø grid parabola x 2
  + 400MHz 8-element Yagi antenna x 2

- o Steel tower on spur routes

  Initial load + 3mø grid parabola x 2
  + 400MHz 8-element Yagi antenna x 4

The principles of application of steel towers are as follows.

- o Self-supporting steel towers will be used at repeater stations on the main route.
- o Guyed mast at other repeater stations

The number of steel towers required in this project will be 90 (comprising 17 self-supporting towers and 73 guyed masts). In particular, the number of steel towers for V/UHF use is considerably large in this project and it is desirable to apply a standardized design to quyed masts of 20 - 30m which will be demanded in a particularly large number.

12-4 Accommodation of IPTS equipment

Each IPTS will be furnished with a switchboard of 20 lines in capacity and radio equipment, so that no station building will be provided for the equipment. It is recommendable to install these equipment in BUTEL's messege center in the municipal hall or other public building. The required area only for the radio equipment and switchboard will be $1.5m^2$. For an engine generator of about 3KVA, a hut of about $10m^2$ will be required.

12-5 Access Roads

Radio repeater stations may be constructed atop mountains or hill remote from residential areas and special roads different from general roads intended for the traffic of vehicles are necessary for access to the radio repeater stations for the purpose of maintenance unique to BUTEL. These access roads, although short in length, are mostly located in mountainous areas, involving many steep slopes and dangerous locations. The maintenance condition of these roads may affect the life of the maintenance personnel of the repeater stations, so that their ample maintenance should be kept continuously.

(1) Design conditions

An ordinary car to run at a speed of 20km/h is considered as the car to be used for the maintenance of the repeater station lacated atop a mountain or hill. The car load (gross weight) to be applied to bridges, etc., is up to 9 tons.

(2) Road construction

1) Road width

The road should be 3.0m in effective width, However, in curved portions the road width should be expanded properly depending on its curvature.

2) Road shoulder

The road shoulder should be 0.5m as standard.

3) Curvature

The minimum radius of the center line in curved portions should be 10m. However, in some special portions such as hairpin curves, the curvature can be reduced to 8m.

4) Longitudinal gradient

Although the road should desirebly be moderate in slope for vehicles to run safe and comfortable, its distance can not be helped being long. From the economical standpoint, the access road should be as short as practicable. The gradient of the access road to the top of the mountain or hill will be 10% as standard. In some particular portions the gradient may be increased to 14% but in a very short distance (less than 100m).

5) Latitudinal gradient

The road should have a latitudinal gradient for the purpose of drainage in the event of rainfall, etc. The latitudinal gradient should be 3 - 5% measured from the center line of the road to both shoulders. In curved portions a single gradient will be provided depending on the curvature.

6) Places of refuge should be provided at intervals of 200m.

7) The road surface should be made of gravel or, in some special portions, made of concrete or be asphalted.

12-6 Concept of Structural Design

Telecommunication should be secured even in the event of a disaster and thus requires safest measures against disasters. When a disaster is encountered in certain areas, communication between areas not subjected to the disaster should be maintained without fail. This requires investment for redundant facilities by providing, for example, a multi-routing of a communication network. In this point, it can hardly be said that the facilities to be provided by this project will not be sufficiently redundant even after being completed. Reinforced concrete buildings may serve physically over 50 - 70 years and so they must be designed with ample long-term prospect. Thus the structural safety of station buildings accommodating facilities is very important and the following objectives should be set for anti-disaster performance.

1) In order to maintain normal telecommunication service condition aginst disasters which may occur comparatively frequently in the area, damage to the station building, steel tower, and equipment should be limited to a light one without causing hindrance to the operation and service.

2) For such serius disasters which may occur once or so thronghout the service life of the building, the recovery of the respective facili-

ties shall be achievable smoothly while securing the safety of the personnel although the communication may be interrupted and the property of the station may be damaged. For the structual design of the steel tower, the wind pressure to be applied in the event of typhoon may be the most important factor. According to the structual cord of the Philipplines, the whole country is divided into 3 different areas (Areas I, II, and III) by wind pressure in structual design and the frequency of being struck by typhoon. The east side of the Northern Part of Luzon Island is classified as Area I or an area subjected to stroungest typhoons where the speed pressure reaches P = 40 psf at a hight of 10m above the ground. This corresponds to P = 195.3kg/m^2 and is equivalent to about 58m/sec in wind speed. According to the Meteorological Agency of the Philippines, as large wind speeds as 71.7m/sec (encountered in December 1970). 66.9m/sec (in September 1970). and 61.7m/sec (in July 1970) have been recorded. Since steel towers have considerable heights and are mostly situated to be subject to wind, a wind velocity (load) of 70 - 75m/sec should be taken into consideration upon designing steel towers.

13. PRINCIPLES OF DESIGN

13-1 Switching

The principles of the design of switching facilities are as follows.

(1) Requirements in service

a) Local switches should be furnished with facilities so as to meet all demands expected to be made.

b) Toll calls should be connected as much by STD as practivable.

c) Existing switches should be utilized effectively while improving toll connection service.

d) An IPTS should cover a maximum of 20 subscribers lines and 3 trunk lines. IPTS's will be used as they are for 10 years and afterward they will be changed one after another (started with those in areas of large demands) to local switches.

e) Connection with private operators' telephone should be made as much positively by STD as possible.

(2) Switches whether toll or local should be crossbar type.

(3) Toll switches should be classified, in consideration of transmission

loss allotment, into

- o Secondary center (Baguio) .... Four-wire system
- o Primary centers (Laoag, Vigan, Dagupan, Binalonan, Tuguegarao, and Bayombong) .... Two-wire system

(4) The standard planning periods of switches should be as follows.

- o Planning period of switches which determine final capacity .... 15 years
- o Planning period of switches which determine expansion capacity .... 5 Years

13-2 Radio

For the main route, a route protection method of one working radio channel plus one protection radio channel will be employed in consideration of the final channel demand to 1997 and the commencement of color TV signal transmission on the protection channel. However, color TV broadcasting will be presented at every corner in the country in future and TV program transmission on a protection channel will then be insufficient. Accordingly, the final configuration of the main route will be a route protection system using 3 working radio channels plus one protection radio channel in consideration of the provision of one radio channel for transmission of color TV signal and one other radio channel to be added to meet demand partially. For the spur routes, the maximum channel capacity is determined in consideration of the channel demand of 1997. Accordingly, no system expansion will be made before 1997. A preset stand-by method is mainly employed for securing stand-by channel at a rate of "1 + 1." For connection with the DOMSAT, a portable radio equipment will be provided to allow connection to Laoag or Tuguegarao terminal station when necessary.

13-3 Multiplex and PCM Equipment

Among various multiplex equipment, master oscillator, common carrier supply equipment, etc., will be designed to meet telephone channel demand 15 years ahead and various types of translating equipment, etc., which constitute the pivot of the multiplex equipment will be designed to meet the demand 5 years ahead. That is, since Phase 1 is expected to be completed by 1982, the channel demand to be made by 1987 will be met. Since Phase 2 is expected to be completed by 1985, the channel demand to be made by 1990 will be met. At stations where the installation work of Phase 2 will be performed multiplex equipment to be installed in Phase 1

will be expanded to meet the demand by 1990.
The above-mentioned channel demand include not only the demand for trunk lines for toll calls but also demand for telegraph circuits, circuit via DOMSAT, and circuit necessary for maintenance and others.
For supergroup and group translating equipment, as many SG units and group units will be installed as required. For channel translating equipment, channel units will be provided as required but in multiples of 3.
PCM equipment will be fully equipped.

13-4 Telegraph

Among the telegraph facilities to be installed in this project, telex switches, telex xoncentrator and carrier telegraph equipment are most important. The telex network should be designed so that the system should sufficiently cope with the traffic to be met 15 years after completion of Phase 1.

(1) Telex switching facilities

In this project telex switches and telex concentrators will employ crossbar switch as is the case with telephone exchanges. By this, telegraph and telephone have commonness in maintenances, assuring ease of training of maintenance personnel.
In the Northern Part of Luzon, telex concentrator whould be introduced, since this is more economically advantageous than using telex switches. However, it is to be noted that each telex concentrator has no switching function nor charging function and telex switch should be installed at least at one station per Region so as to take care of telex concentratiors in the region.
Telex switching facilities should use power facilitaties together with telephone switching facilities, radio facilities and multiplex equipment for the purpose of economy. However, since telex sigalling voltage requires ±60V, converter should be provided.

(2) Telegraph Transmission facilities

The pivot in telegraph transmission facilities is carrier telegraph equipment. In theory, 24 telegraph channels are usable for one telephone channel in the case of 50B and carrier telegraph equipment for 24 telegraph channels is called one system. Carrier telegraph equipment should be installed as much in blocks of 1 system as possible. However, the number of trunk lines between a telex switch and telex concentrator is small in many cases and carrier telegraph equipment will be installed in blocks of 12 channels in such cases. On the other hand, when a Gentex station is located remote from Telex switch, etc., it is necessary to employ carrier telegraph equipment. In such cases, as many channels as 1 - 3 channels will be requires. In such cases, it is recommended to employ superimposing channel equipment in which frequency assignment in one telephone channel is made as follows.

One telephone channel: 0.3 - 2.6kHz

Maximum 5 telegraph channels: 2.7 - 3.3kHz

This type of equipment is extremely compact in construction, so that the space required by this type of equipment is of no problem. In addition, when one type of AC or DC power is available, the required power can be obtained in the equipment through a converter, so that this type of equipment is suitable for amall stations.

(3) Telex terminal equipment

The teleprinter to be used for telex purpose employs 50B, 5 units, and No.2 alphabet characters and symbols usable for international telex communication. It provides answer-back mechanism and allows punching of paper tapes and transmission/reception by paper tape. General telex subscribers and Gentex stations will use the same type of telex terminal equipment, assuring ease of maintenance and operation.

Since it is not known that by what kinds of users telex terminal equipment will be used, the telex terminal equipment should be designed to operate from AC 110V or AC 220V. Telex terminal equipment should be stored concentratively at telex exchange or telex concentrator station. About 10% of the demand should be provided. However, as many terminal equipment for Gentex station use as required should be provided.

13-5 Outside Plant

13-5-1 Subscriber Line Facilities

(1) Areas for which design should be made

Subscriber line facilities should desirably be installed so as to meet all telephone demands in the area. In most cases, however, the service area is limited mainly by economical reason. In this project areas for which service is expected to be started by BUTEL (areas where subscriber lines will be layed) are, in principles, as follows.

- o Major urban districts in areas where automatic exchange will be installed
- o About 20 subscribers' lines for subscribers specified in the major urban districts (to be determined by BUTEL) in areas where IPTS's will be installed.

Technically, consideration should be taken so that telephone service will be available in area other than these areas.

(2) Design period

The design period of subscriber's line facilities can be obtained as a function of the cost of foundation required for construction, cost per cable line, increase in demand per year, and interest of the fund necessary for the construction.

The design period of the subscriber's line facilities to be constructed in this project is made 10 years in consideration of all above.

(3) Distribution Method

At present, the following three distribution methods are mainly employed in Luzon Island of Philippines.

- o Nonduplicate fixed distribution
- o Duplicate fixed distribution
- o Free-access distribution method by using ready access terminal box

In addition to these three distribution methods, distribution by using a cross-connection panel between the feeder and distribution cables is also used in general.

These distribution methods have their own advantages and disadvantages and proper method should be selected in consideration of the availability of necessary items for the distribution method, adaptability to natural environment, and ease of maintenance.

In Regions I and II, fixed distribution will be employed.

Whether duplicate or nonduplicate distribution should be employed will be determined upon design in cosideration of demand distribution, etc., of the area.

(4) Cable confuguration and major purposes of use

Cable between MDF and distribution point may be layed in the following methods.

- o Conduit cable

- o Direct-buried cable
- o Aerial (overhead) cable
- o Indoor cable

Conduit cable method is employed when the number of cable pairs is 600 - 800 or more. Conduit cable is mainly used for feeding cable and, in business quarters it is used as underground distribution cable. Direct buried cable is used in residential areas with stable demand and in areas where aericl cable can not be used because of local reguration, etc. Aerial cable is used in areas other than those in which conduit cable and direct buried cable are not usable. Indoor cable is used for wiring from frame type crossconnection panel installed in large buildings.

In the present design, all demands (10 years after starting service) will be less than 500 exept a few stations, so that the standard aerial cable method will be employed.

Local CCP aerial cable manufactured in the Philippines will be used for subscribers' cable in this project. Aerial cable should be supported by, in principle, wood poles (creosote-imprograted poles) and quy wires should be provided wherever necessary. When a required aerial cable is layed, it should withstand a maximum wind velocity of 40m/sec.

When there are power poles on the route, the aerial cable should be installed by the power poles unless the installation is unachievable by some reason or other.

- o Telephone pole intervals should be 40m as standard in the case of straight-line sections.
- o When it is necessary to install the aerial cable on the bridge, it should be suspended on the side of the bridge.
- o The separation from the power cable should be usually 60cm and at least 30cm.
- o The minimum height of cables, etc., should be 5m above the ground, although the height may be separately stipulated for roads where the traffic of vehicles in not influenced by aerial cable.

(5) Techniques for high-loss subscriber's line

When required transmission performance is not achievable by ordinary line design because of long line distances, the transmission performance can be improved by using telephone designed for high-loss subscribers, both-way repeater for subscriber line, or/ and loaded subscriber line.

(6) Telephone sets

All telephone sets in this project will be for single line.

13-5-2 Trunk Cable Facilities

Trunk cable facilities will be installed in varieties of natural circumstances. And yet, high reliability is required for these facilities as in switches and other transmission systems.

It is also important to design these facilities with economical advantages as well.

Trunk cable facilities will be constructed to keep a harmony among these requirements.

(1) Cable construction and route selection

A 0.65mm areial cable will be used for less than 400 pairs and a 0.9mm aerial cable for less thatn 300 pairs.

All sections in this project will employ aerial cables because of their numbers of pairs, although the aerial cable system should not be employed in the following cases.

1) Areas subject to flood, high tide, landslide, fire, and other disasters.
2) Areas with soft ground base such as deep paddy field and marshland.
3) Locations adjacent to or crossing special high voltage power cable.
4) Locations where buildings or plants may be constructed in future with the development of the circumstances and locations where roads are expected to be constructed.
5) Locations where rivers are under construction or tree planting will be made.
6) Areas where dried grass burning may be coducted.
7) Hunting areas

The location of aerial cable will be nearly equal to that of subscriber's line facilities.

Only difference from subscriber's line is that the interval of poles should be 50m as standard. Type H poles will be used in areas subject to strong wind or whenever heavy road may be applied because of long river or deep valley.

(2) Estimated design period

Regarding paragraph 10-2-e, the design period of trunk cables in this project is 15 years.

(3) Determination of the number of pairs

The numbers of trunk lines to be required in the year of the commencement of the service, 5 years ahead, 10 years ahead, and 15 years ahead are obtained on the basis of traffic forecast for the respective sections.

Then the required numbers of pairs are abtained for the respective types of circuits in respective sections from the following equations. By summing up these numbers, the total required numbers of pairs per section can be obtained.

- o Voice circuit using only side circuit

  Number of circuits x 1 + spare

- o Voice circuit using phantom circuit

  Number of circuits x $\frac{2}{3}$ + spare

- o PCM circuits

  Number of circuits x $\frac{1}{24}$ x 2 + spare

The cable size is obtained from the estimated number of pairs 15 years ahead which have been obtained by using Table III-13-5-2-1.

Table III-13-5-2-1 Required Number of Pairs and Cable Size

Required Number of Pairs	Cable Size (Pairs)	Required Number of Pairs	Cable Size (Pairs)
less than 16	14	125 - 174	150
17 — 33	28	175 - 249	200
34 — 63	54	250 - 349	300
64 — 124	100	more than 350	400

13-6 Power Plant

The design principles of power facilities will be as follows.

(1) When telephone switch, telex switch, radio and carrier equipment, etc., are installed in a station building, common power supplies should be employed for the purpose of economy.

(2) The power facilities to be installed should have a capacity to cover the demand to be made by 1997 so as to reduce labor and cost necessary for expansion or modification.

(3) Engine generator should be provided for stand-by use in all stations or offices.

(4) Special power, such as power for telex signalling voltage will be employed from a common battery through a converter without using any special battery for that purpose.

(5) The battery operating time will be 8 hours at wireless repeater stations and 4 hours at telephone exchange stations.

(6) Battery is mainly intended to supply power from the interruption of commercial power till starting of the stand-by engine generator.

(7) Battery should be of enclosed type and should not give undesirable influence to communication equipment even if installed in the same station building as the communication equipment.

(8) Power facilities should be designed to have sufficient margins in capacity.

(9) Power facilities should have sufficient margin against ambient conditions such as temperature and humidity.

14. Interface with Facilities of Private Operators

By the implementation of this project, the BUTEL's service area of the number of municipalities in Region I and II to be covered by BUTEL will increase to 106. This is more than twice the number of municipalities covered by private operators. However, the number of subscribers covered by private operators will amount to 2/3 of the total number of subscribers in Region I & II whereas that covered by BUTEL will amount to 1/3 thereof. This is because the private operators franchised cover the areas playing pivotal roles in politics and commerce, for example Baguio, Dagupan, San fernando, etc.

In Metro Manila, more than 400,000 subscribers exist which is nearly 80% of all subsribers in the whole country. Since Manila is the pivot of the Philippines in politics and economy regardress to mention, a great number of toll calls from Regions I and II will be directed to the Manila area. And yet, the Manila area is covered by the franchised private operators.

Under these circumstances, it is a very important theme in this project to "achieve smooth interface with facilities of the private operators."

14-1 Principles in Interface

The principles of interface with the facilities of the private operators are as follows.

1) It should be planned that double investment by BUTEL and private ope-

rators should be prevented and smooth service by both should be available.

2) Subscriber dialing should be progressed positively for connecting BUTEL's subscribers with private operators' subscribers which is an ultimate objective of the telephone network.

3) It should also be taken into consideration that the network of BUTEL and those of the private operators may be in future combined into a single network in the country.

14-2 Points of Interface with Facilities of Private Operators

1) Interface with private operator's facilities will be made in TS stages.

2) Transmission line between TS and private operator's facilities will be constructed by the private operator franchised in that area.

14-3 Method of Service by Interconnection of BUTEL's Facilities and Private Operators' Facilities

1) Originating calls from BUTEL will be connected as follows.

To Manila .... STD

To other major cities (Laoag, Baguio, Dagupan, Tuguegarao and Iragen) .... STD

To other areas .... Delay

2) Originating calls from private operators' subscribers will all be connected by delay service.

14-4 Call Meter for Interconnection

When interconnecting BUTEL's facilities and private operator's facilities, a rate system will be required for sharging interconnected calls. For this purpose, call meters will be installed at the points of connection with private operators' facilities so as to make calculation for charging by a tariff.

14-5 Transmission Network Plan

In this project, necessary transmission lines for connection of calls from BUTEL's subscribers in Regions I and II will, in principle, be provided. It is to be noted that there are also existing transmission line and transmission lines expected to be expanded by private operators. Accordingly, in order to prevent loss due to double investment, the relationship with private operators' transmission network is arranged by the following principles.

(1) Local sections covered by private operators will be secured by private operators and construction of transmission lines for such sections will not be included in this project.

(2) Long-distance lines will be as follows.

1) Southern Part of Region I (Benguet, Pangasinan, and La Union)

Present telephone service in this part is covered mainly by private operators and transmission lines therein will be secured by private sectors. Accordingly, transmission lines necessary for calls between different areas covered by different private operators will be maintained by private operators.

The major sections included in this part of the region are as follows.

Baguio - Manila
Baguio - Dagupan
Baguio - San Fernand

2) Other areas

In areas other than the Southern Part of Region I, main private operators' offices are expected to be constructed at Laoag, Tuguegarao, and Ilagan. In these areas, private operators' transmission lines are not sufficient. Accordingly, transmission lines in these areas should be planned considering that calls originated from or terminated to private operators in these areas (including not only calls originated from or terminated to BUTEL subscribers but also calls between private operators' officaes) will be superimposed on the network to be constructed in this project.

14-6 Transmission lines to Be Used

Transmission lines to be used for calls from or to BUTEL's subscribers to or from private operators' subscribers are as follows.

(1) Every originating call should be transmitted as much by the transmission line belonging to BUTEL or the private operator whichever made the call. That is, interconnection of BUTEL's subscribers and private operators' subscribers will be made in TS stages as much near the terminating offices.

(2) For example interconnection will be made at the following sites.

		Place of Interconnection
1)	Vigan Sub. (BUTEL) → Manila Sub. (PLDT)	Manila
	Manila Sub. (PLDT) → Vigan Sub. (BUTEL)	Baguio
2)	Alaminos Sub. (BUTEL) → Manila Sub. (PLDT)	Manila
	Manila Sub. (PLDT) → Alaminos Sub. (BUTEL)	Dagupan
3)	Bokod Sub. (BUTEL) → Dagupan Sub. (PLDT)	Dagupan
	Dagupan Sub. (PLDT) → Bokod Sub. (BUTEL)	Baguio

IV. DEMAND FORECAST

IV. DEMAND FORECAST

1. Telephone Demand Forecast

1-1 Purpose of Telephone Demand Forecast

This demand forecast is made for telephone subscribers in

(1) cities and municipalities (hereinafter referred to simply as areas) where telephone service is available at present and

(2) areas where telephone service is expected to be available within 10 years-3

among areas in Regions I and II.

This demand forecast is intended to

(1) discuss the feasibility of telecommunication network construction project from both economic and technical standpoints,

(2) recommend economical arrangement and required capacities of various facilities and estimate construction expenses and time schedule when the telecommunication network construction project is determined feasible,

(3) Discuss required maintenance systems and personnel, and

(4) discuss income and expenditure of the project.

1-2 Present Telephone Demand in Regions I and II

The total number of telephones present in the Philippines in 1967 was about 188,000, that in 1972 about 351,000 and that in 1977 about 542,000. The number of telephones per 100 inhabitants was 0.47 in 1967, 0.91 in 1972, and 1.2 in 1977.

Of the 542,000 telephones present in 1977, 49,000 telephones were in 13 major cities such as Metro Manila and the remaining 50,000 telephones were spread in other areas.

In Region I, telephone service is available 20 areas out of 175 areas and the number of telephones is about 9,600, that is, 0.28 telephones per 100 inhabitants.

The above-mentioned major 13 cities include Baguio and Dagupan. The number of telephones in the cities excluding these two cities is 4,000, that is, 1.2 telephones per 100 inhanitants.

In Region II, telephone service is available in 5 areas out of 114 areas and the number of telephones is about 1,600, that is, 0.08 telephones per 100 inhanitants.

Areas where telephone service is available in Regions I and II are listed in Table IV-1-2-1.

The total number of telephones, the population, and the number of tephones per 100 inhabitants of the respective areas are given in Table IV-1-2-1.

Table IV-1-2-1 (1/2)

Existing Exchange in Region I

at 1977

Region No.	Province	Municipality	Number of Telephones	Population (estimated)	Telephones per 100 inhabitants	Remarks
I	Ilocos Norte	Laoag City	500	69,000	0.72	
	Ilocos Sur	Vigan	550	32,800	1.68	
		Candon	119	35,700	0.33	
	Abra	Bangued	180	27,200	0.66	
	La Union	San Fernando	1,451	65,000	2.23	
		Agoo	100	34,500	0.29	
		Aringay	21	26,400	0.08	
		Bauang	43	39,900	0.11	
		Naguilian	43	28,300	0.15	
		Rosario	27	26,800	0.10	
	Benguet	Baguio City	3,250	103,100	3.15	
		La Trinidad	111	24,500	0.45	
	Pangasinan	Dagupan City	2,363	94,000	1.26	Including Calasiao and Mangaldan
		Calasiao	—	45,800	—	
		Mangaldan	—	48,300	—	
		San Carlos City	108	93,500	0.12	
		Bayambang	64	66,000	0.10	
		Lingayen	273	59,800	0.46	
		Urdaneta	168	69,200	0.24	
		Rosales	160	35,900	0.45	
-	-	Total	9,531	1,025,700	0.93	

Table IV-1-2-1(2/2)

Existing Exchange in Region II at 1977

Region No.	Province	Municipality	Numbers of Telephones	Population (estimated)	Telephones per 100 Inhabitants	Remarks
II	Cagayan	Tuguegarao	576	64.898	0.89	
	Isabela	Ilagan	262	74,327	0.35	
		Santiago	370	61,429	0.60	
	Nueva Vizcaya	Bayombong	392	30,259	0.59	Including Solano
		Solano	—	35,695		
-	-	Total	1,600	266,608	0.60	

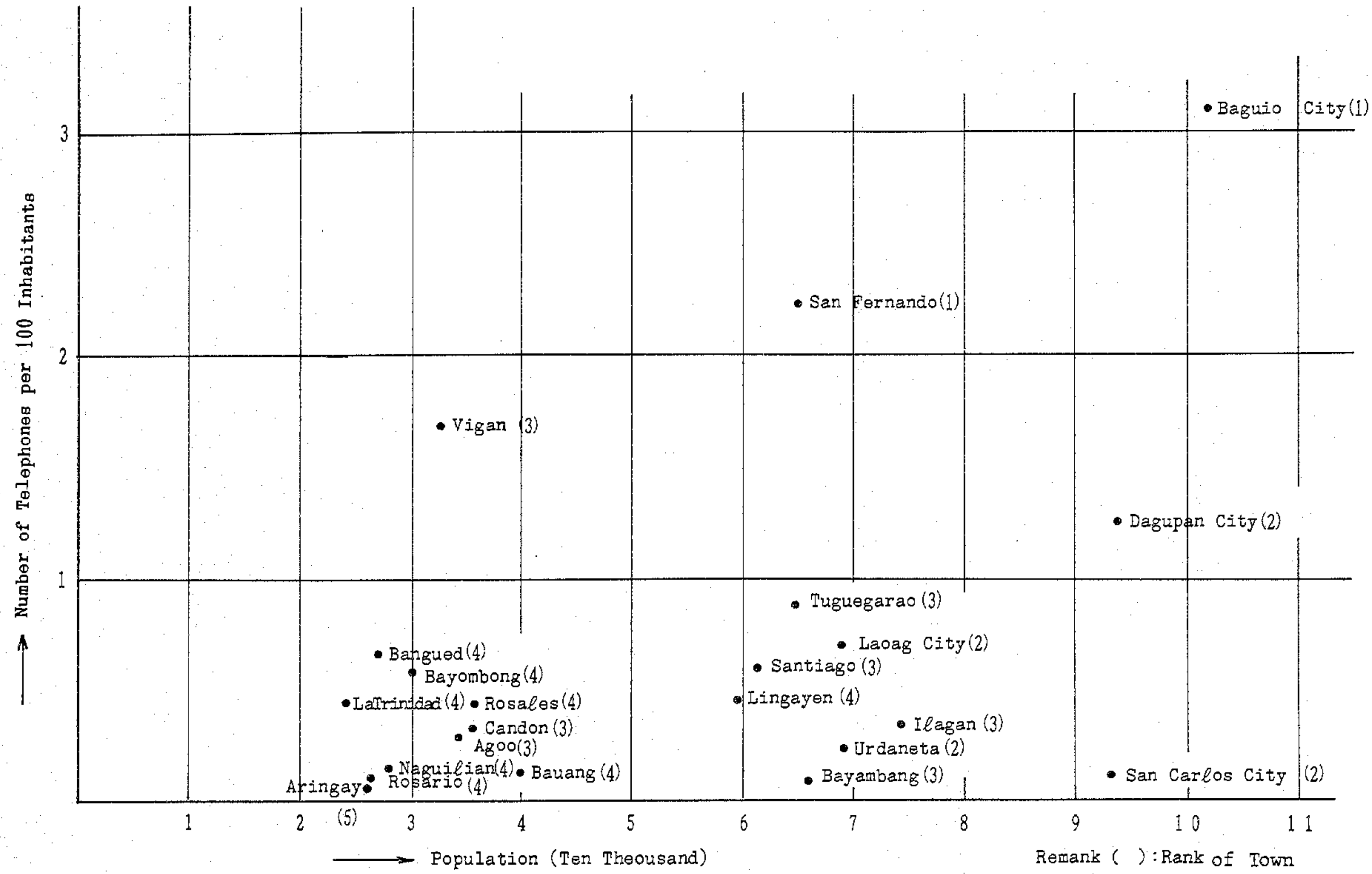


Fig. N-1-2-1 Relation of Number of Telephones per 100 Inhabitants to Population

1-3 Principles and Method of Demand Forecast

Demand forecast of telephone subscribers is made macroscopically in units of areas. Forecast is made for the next 20 years to come.

The basic demands (as of the end of 1977) were obtained mainly by field survey and the expected number of demands of each 5 years was estimated on the basis of the basic demands.

1-3-1 Basic Demands

Prior to field survey, the tentative number of demands was estimated from the number of households in urban and rural areas, the number of business offices or companies, and the ranks of areas (by Philippine Year Book of 1977 Edition).

By field survey, the site topography, town features, economical activities, relation with the central cities, the use of electricity and TV broadcasting service were grasped, determining the basic number of demands by correcting the above tentative number of demands.

]-3-2 Future Demands

Those future years that can be represented by S + 5n (where S is the year in which the service will be started by this project or tentatively 1982 and n = 0, 1, 2, 3, and 4), that is, 1982,1987, 1992, 1997 and 2002, are determined to be the years for which demand forecast is to be made.

The number of demands at each of these demand forecast years was obtained by the basic number of demands times the population increment of the demand forecast year times the product increment per capta of the demand forecast year (from the Five-Year Philippine Development Plan, 1978 to 1982).

The population of each demand forecast year was estimated from the forecast data of the NEDA (National Economic and Development Authority) and the population of 1977, and the estimated population of each demand forecast year is given in Table IV-1-3-1.

The amount of product per capta was derived from the forecast data given in the Development Plan, 1978 to 1982 (Table IV-1-3-2).

Table IV-1-3-2 Regional Product per Capita, 1977 to 1987

	1977	1978	1979	1980	1981	1982	1987
PHILIPPINES	1,733	1,804	1,885	1,967	2,064	2,163	3,148
Metro Manila	4,474	4,517	4,591	4,659	4,780	4,945	5,673
Region I	1,068	1,143	1,186	1,251	1,329	1,422	1,890
Region II	1,072	1,119	1,172	1,226	1,330	1,394	1,837

(in Pesos)

The estimated average development in the amout of production (output) to 1987 is 6% in both Regions I and II and this value is applied also to the period of 1988 to 2002.

The results of demand forecast for telephone subscribers in areas (cities and municipalities) in the respective regions are given in Table IV-1-3-3.

Table IV-1-3-1(1/8)

Estimated Future Population

Province	Ilocos Norte					(20)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Laoag City	75,600	82,300	87,200	89,800	91,200	
Bacarra	24,100	25,500	26,500	27,200	27,500	
Badoc	26,600	30,600	34,200	36,200	37,400	∇
Bangui	13,200	14,400	15,500	16,000	16,400	∇
Batac	40,500	44,200	47,300	49,100	49,900	∇
Burgos	6,100	6,700	7,300	7,800	8,300	∇
Currimao	12,900	14,900	16,500	17,400	17,900	∇
Dingras	28,900	30,700	31,800	32,500	32,800	∇
Espiritu	13,700	14,600	15,400	16,000	16,300	∇
Marcos	11,300	12,400	13,300	13,800	14,200	∇
Nueva Era	4,130	4,490	4,820	5,020	5,140	∇
Pagudpud	14,800	16,500	18,200	19,200	19,600	∇
Paoay	18,100	19,700	21,100	22,000	22,500	∇
Pasuquin	18,400	19,800	20,900	21,500	21,800	∇
Piddig	15,200	15,900	16,400	16,700	16,900	∇
Pinili	14,500	15,800	16,900	17,700	18,100	∇
San Nicolas	25,000	26,800	28,400	29,400	30,200	
Sarrat	20,100	21,500	22,700	23,400	23,700	∇
Solsona	15,100	15,800	16,200	16,700	17,000	∇
Vintar	24,300	26,200	27,600	28,400	28,700	∇
Total	422,530	458,790	488,220	505,820	515,540	

Legend: ( ) Number of Cities and Manicipalities

∇ Proposed station of BUTEL

Table IV-1-3-1(2/8)

Province	Ilocos Sur					(12)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Vigan	34,700	36,500	38,300	39,400	39,800	
Cabugao	24,500	25,200	25,600	25,800	26,000	∇
Candon	37,100	37,900	38,400	38,600	38,800	
Caoayan	14,300	14,900	15,500	15,900	16,100	∇
Magsingal	18,800	19,300	19,800	20,200	20,500	∇
Narvacan	29,050	29,300	29,500	29,700	29,900	∇
Santa	12,800	13,400	14,200	14,800	15,500	∇
Santa Lucia	19,300	20,700	21,900	22,800	23,300	∇
Santa Maria	21,300	22,200	22,900	23,500	23,900	∇
Santo Domingo	16,900	17,400	17,750	18,000	18,200	∇
Sinait	19,800	20,600	21,100	21,500	21,800	∇
Tagudin	21,000	21,400	21,700	21,900	22,100	∇
Total	269,550	278,800	286,650	292,100	295,900	
Province	Abra					(2)
Bangued	30,700	34,300	37,200	38,700	39,400	∇
Licuan	3,900	4,430	4,900	5,130	5,230	
Total	34,600	38,730	42,100	43,830	44,630	
Province	Mountain Province					(2)
Bontoc	18,100	18,500	18,800	19,000	19,200	
Sagada	13,600	16,900	19,900	21,400	22,000	∇
Total	31,700	35,400	38,700	40,400	41,200	

Table IV-1-3-1(3/8)

Province	La Union					(11)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
San Fernando	75,000	84,400	91,000	95,000	96,800	
Agoo	39,600	44,300	46,700	48,300	49,400	
Aringay	29,600	31,900	33,400	34,400	35,200	
Bacnotan	27,300	30,300	32,300	33,300	33,800	
Bangar	23,200	24,700	25,900	26,600	26,900	
Balaoan	28,100	30,900	33,000	34,200	34,900	
Bauang	44,500	49,000	51,800	53,000	53,400	
Luna	27,000	29,100	30,700	31,700	32,100	
Naguilian	31,200	34,000	36,900	39,300	40,200	
Rosario	30,000	32,700	34,300	35,100	35,500	
Santo Tomas	24,700	27,100	29,300	30,600	31,400	∇
Total	380,200	418,400	445,300	461,500	469,600	

Province	Benguet					(7)
Baguio City	118,000	132,300	146,900	161,600	173,500	
La Trinidad	28,600	31,400	32.900	33,700	34,200	
Bokod	11,000	11,400	11,800	12,200	12,600	∇
Itogon	42,800	44,000	45,200	46,400	47,400	
Mankayan	31,700	37,200	42,100	44,000	44,600	∇
Sablan	7,800	8,000	8,300	8,600	8,900	
Tuba	39,200	43,400	45,200	46,300	47,000	
Total	279,100	307,700	332,400	352,800	368,200	

Table IV-1-3-1(4/8)

Province	Pangasinan - 1					(34)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Dagupan City	102,500	111,500	120,000	129,000	137,800	
San Carlos City	101,500	112,700	127,000	133,000	136,800	
Lingayen	63,100	68,300	75,400	82,900	86,600	∇
Aguilar	23,200	25,000	26,100	26,700	27,000	∇
Alaminos	48,800	53,200	56,200	58,300	59,400	∇
Alcala	26,800	27,800	28,300	28,500	28,700	∇
Asingan	41,800	45,900	50,000	53,700	55,200	∇
Balungao	19,000	20,500	21,600	22,200	22,600	∇
Bani	31,600	33,200	34,300	35,200	35,900	∇
Bautista	18,800	20,200	21,300	22,000	22,450	
Bayambang	74,000	79,600	82,200	83,500	84,200	∇
Binalonan	40,500	43,800	47,800	50,500	51,000	∇
Bolinao	38,800	41,400	43,300	44,200	44,900	∇
Bugallon	42,800	46,800	50,000	52,000	53,100	
Calaciao	50,400	55,200	60,100	62,000	65,700	
Manaoag	55,500	60,500	64,900	66,700	67,700	
Mangaldan	53,400	58,500	62,900	65,100	66,400	
Mangatarem	41,800	44,600	47,600	50,600	53,400	
Mapandan	19,800	21,100	22,400	23,900	24,900	∇
Natividad	15,000	15,400	15,800	16,050	16,250	∇
Pozorrubio	40,100	44,900	48,400	50,200	50,900	∇
Rosales	39,000	41,300	42,750	43,700	44,200	
San Fabian	45,200	48,900	51,300	52,700	53,500	∇
San Jacinto	21,800	23,600	24,700	25,300	25,600	∇
San Manuel	32,700	36,500	39,500	41,200	42,200	

Table IV-1-3-1(5/8)

Province	Pangasinan - 2					
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
San Nicolas	25,100	26,300	26,700	27,000	27,200	∇
San Quintin	22,200	23,100	23,600	23,900	24,100	∇
Santa Barbara	39,800	43,200	45,700	47,600	48,800	∇
Santa Maria	21,500	23,200	24,800	26,200	27,300	∇
Sison	27,500	30,100	31,900	32,800	33,200	∇
Tayug	28,900	30,300	31,100	31,700	32,100	
Umingan	45,500	47,300	48,400	48,900	49,300	∇
Urbiztondo	27,700	30,300	32,700	33,800	34,400	∇
Urdaneta	78,200	87,200	93,400	96,700	98,800	
Total	1,404,300	1,571,800	1,622,150	1,687,750	1,731,600	
Region I Total	2,821,880	3,059,220	3,244,520	3,384,200	3,466,670	

Table IV-1-3-1(6/8)

REGION II

Province	Batanes					(1)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Basco	4,200	4,300	4,400	4,500	4,550	∇
Total	4,200	4,300	4,400	4,500	4,550	

Province	Cagayan					(18)
Tuguegarao	71,300	77,700	82,400	86,000	87,500	
Abulug	23,900	25,300	26,600	27,600	28,300	∇
Alcala	25,300	27,100	28,900	30,100	30,900	∇
Aparri	47,600	51,100	53,800	55,600	56,800	
Baggao	46,000	49,400	52,200	53,900	55,000	∇
Ballesteros	22,200	23,700	24,800	25,600	25,900	∇
Buguey	22,900	25,200	27,100	28,300	29,000	∇
Camalaniugan	15,200	16,000	16,700	17,200	17,600	∇
Claveria	26,100	28,200	30,200	31,500	32,300	∇
Enrile	23,700	25,300	26,900	28,300	29,200	∇
Faire (Santo Nino)	20,800	22,300	23,700	24,700	25,400	∇
Gonzaga	21,900	23,700	25,300	26,600	27,700	∇
Lal-lo	28,400	31,100	33,300	34,700	35,800	∇
Lasam	25,300	27,700	29,700	31,000	31,800	∇
Piat	14,000	15,500	16,700	17,600	18,200	∇
Sanchez Mira	20,200	22,000	23,500	24,800	25,500	∇
Solana	46,400	50,600	54,000	56,200	58,400	∇
Tuao	35,700	38,500	40,900	42,600	43,500	∇
Total	536,900	580,400	616,700	642,300	658,800	

Table IV-1-3-1(7/8)

Province	Kalinga Apayao					(3)
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Tabuk	41,500	47,200	51,400	54,400	56,600	
Kabugao	11,500	13,700	15,700	17,100	18,000	∇
Lubuagan	9,750	11,100	12,050	12,600	13,000	∇
Total	62,750	72,000	79,150	84,100	87,600	
Province	Isabela					(18)
Ilagan	85,300	96,200	106,500	112,300	115,800	
Alicia	36,100	41,000	44,500	46,600	48,200	∇
Angadanan	26,900	28,600	30,100	31,300	32,100	∇
Cabagan	32,100	35,600	38,800	40,700	49,800	∇
Callang (San Manuel)	18,400	21,300	23,900	25,700	26,800	∇
Cauayan	48,800	52,800	56,200	58,500	59,900	
Echague	39,900	42,400	44,500	46,100	47,200	
Gamu	17,700	20,500	22,900	24,200	25,200	∇
Jones	31,500	34,500	37,200	38,800	40,000	∇
Mallig	19,700	22,800	24,950	26,200	27,050	∇
Naguilian	21,900	23,900	25,600	26,600	27,200	∇
Roxas	33,800	37,100	39,500	41,200	42,300	
San Angustin	18,700	21,400	23,800	25,300	26,300	∇
San Mariano	29,600	32,900	35,500	37,200	38,400	∇
San Mateo	41,400	45,800	48,600	50,400	51,500	∇
Santiago	68,000	74,400	79,700	83,000	85,300	
Tumauini	35,400	40,800	44,300	46,400	47,700	∇
Aurora	22,100	24,600	27,100	28,800	29,900	∇
Total	627,300	696,600	753,650	789,300	820,650	

Table IV-1-3-1(8/8)

Province	Ifugao				(4)	
City/ Municipality	Population					Remarks
	1982	1987	1992	1997	2002	
Lagawe	15,000	15,400	15,800	16,000	16,200	
Banaue	22,600	23,600	24,600	25,400	25,900	∇
Kiangan	18,000	19,200	20,300	21,300	22,000	∇
Mayoyao	28,900	32,100	34,800	36,900	38,100	∇
Total	84,500	90,300	95,500	99,600	102,200	
Province	Quirino					(3)
Cabarroguis	16,300	19,700	22,100	23,700	24,600	∇
Diffun	24,300	28,700	31,900	33,900	35,300	∇
Maddela	29,400	36,000	40,200	42,500	43,800	∇
Total	70,000	84,400	94,200	100,100	103,700	
Province	Nueva Vizcaya					(8)
Bayombong	34,000	37,400	39,800	41,500	42,500	
Aritao	23,300	26,100	28,200	29,500	30,100	∇
Bagabag	23,100	25,700	27,500	28,800	29,500	∇
Bambang	27,000	29,800	31,900	33,100	33,900	∇
Dupax del Norte	18,000	20,000	21,900	23,300	24,100	∇
Dupax del Sur	14,600	18,000	20,800	22,200	23,000	∇
Santa Fe	7,620	8,800	9,700	10,200	15,300	∇
Solano	40,300	44,800	48,000	49,900	51,100	
Total	187,920	210,600	227,800	238,500	249,500	
Region II Total	1,573,570	1,738,600	1,871,400	1,958,400	2,027,000	

Table IV-1-3-3(1/8)

Telephone Demands Forecast

REGION I

Province	Ilocos Norte					(20)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Laoag City	1,650	2,320	3,380	4,660	6,330	
Bacarra	200	280	390	530	720	▽
Badoc	100	160	240	340	470	▽
Baugui	30	40	60	80	110	▽
Batac	510	740	1,070	1,470	2,020	▽
Burgos	15	20	30	40	60	▽
Currimao	65	100	145	200	280	▽
Diagras	190	260	360	500	670	▽
Espiritu	30	40	60	80	110	▽
Marcos	20	30	45	65	90	▽
Nueva Era	18	25	30	50	70	▽
Pagudpud	50	80	110	160	220	▽
Paoay	130	190	270	380	510	▽
Pasuquin	70	100	140	190	250	▽
Piddig	45	65	90	120	160	▽
Pinili	30	40	60	85	120	▽
San Nicolas	280	400	570	800	1,100	
Sarrat	75	110	150	210	290	▽
Solsona	65	90	125	170	230	▽
Vintar	80	110	160	220	300	▽
Total	3,653	5,200	7,485	10,350	14,110	

Legend: ( ) Number of cities and Municipalities
▽ Proposed station of BUTEL

Table IV-1-3-3(2/8)

Province	Ilocos Sur					(12)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Vigan	740	1,030	1,460	2,000	2,700	
Cabugao	80	110	150	210	280	V
Candon	320	440	590	800	1,080	
Caoayan	50	70	95	130	180	V
Magsingal	70	95	130	180	240	V
Narvacan	70	100	130	180	240	V
Santa	60	80	110	150	210	V
Santa Lucia	50	70	100	140	190	V
Santa Maria	70	90	120	170	240	V
Santo Domingo	50	65	90	120	160	V
Sinait	55	80	110	150	200	V
Tagudin	60	75	100	140	185	V
Total	1,675	2,305	3,185	4,370	5,905	
Province	Abra					(2)
Bangued	370	550	810	1,120	1,530	V
Licuan	6	9	14	20	27	
Total	376	559	824	1,140	1,557	
Province	Mountain Province					(2)
Bontoc	65	90	120	160	220	
Sagada	30	50	80	110	150	V
Total	95	140	200	270	370	

Table IV-1-3-3(3/8)

Province	La Union					(11)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
San Fernando	1,630	2,460	3,560	4,960	6,770	
Agoo	330	490	700	970	1,320	
Aringay	70	100	150	200	270	
Bacnotan	150	220	320	430	580	
Bangar	70	100	140	200	260	
Balaoan	140	210	300	410	560	
Bauang	220	320	460	630	840	
Luna	150	220	310	420	570	
Naguilian	180	260	370	540	730	
Rosario	160	240	330	460	620	
Santo Tomas	50	75	110	150	200	∇
Total	3,150	4,695	6,750	9,370	12,720	
Province	Benguet					(7)
Baguio City	4,500	6,800	10,100	15,000	21,400	
La Trinidad	170	250	360	490	670	
Bokod	22	30	40	60	80	∇
Itogon	250	340	470	650	880	
Mankayan	120	180	290	400	540	∇
Sablan	15	20	30	40	60	
Tuba	290	420	590	810	1,100	
Total	5,367	8,040	11,880	17,450	24,730	

Table IV-1-3-3(4/8)

Province	Pangasinan - 1					(34)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Dagupan City	2,900	4,260	6,180	8,520	12,070	
San Carlos City	900	1,460	2,200	3,080	4,230	
Lingayen	400	570	850	1,260	1,750	∇
Aguilar	50	75	105	140	200	∇
Alaminos	290	420	590	820	1,120	∇
Alcala	60	80	110	160	210	∇
Asingan	110	160	230	320	440	∇
Balungao	40	60	80	115	160	∇
Bani	80	110	160	220	300	∇
Bautista	45	65	90	125	170	
Bayambang	450	650	900	1,230	1,660	∇
Binalonan	430	620	900	1,280	1,720	∇
Bolinao	60	85	120	160	220	∇
Bugallon	105	155	225	310	430	
Calasiao	210	310	450	620	880	
Manaoag	400	580	830	1,140	1,550	
Mangaldan	410	610	880	1,220	1,650	
Mangatarem	120	170	240	340	480	
Mapandan	60	80	120	170	240	∇
Natividad	45	68	85	110	150	∇
Pozorrubio	195	290	415	580	780	∇
Rosales	240	330	460	640	860	
San Fabian	110	160	220	310	420	∇
San Jacinto	50	80	120	160	220	∇
San Manuel	105	160	230	320	430	∇

Table IV-1-3-3(5/8)

Province	Pangasinan - 2					
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
San Nicolas	60	80	110	150	200	∇
San Quintin	50	70	100	135	180	∇
Santa Barbara	80	120	170	240	320	∇
Santa Maria	50	70	100	150	200	∇
Sison	60	90	130	180	240	∇
Tayug	200	270	380	510	700	
Umingan	200	280	380	510	720	∇
Urbiztondo	70	100	140	195	260	∇
Urdaneta	880	1,310	1,890	2,620	3,580	
Total	9,605	13,998	20,190	28,040	38,740	
Region 1 Total	23,921	34,937	50,514	70,990	98,132	

Table IV-1-3-3(6/8)

REGION II

Province	Batanes					(1)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Basco	8	11	16	21	30	∇
Total	8	11	16	21	30	

Province	Cagayan					(18)
Tuguegarao	850	1,240	1,760	2,460	3,340	
Abulug	60	80	115	160	220	∇
Alcala	60	90	130	180	240	∇
Aparri	460	660	940	1,300	1,770	
Baggao	90	130	185	260	350	∇
Ballesteros	80	110	160	220	300	∇
Buguey	65	95	135	190	260	∇
Camalaniugan	45	65	90	130	170	∇
Claveria	80	110	160	220	310	∇
Enrile	75	105	150	210	290	∇
Faire (Santo Nino)	55	80	110	160	210	∇
Gonzaga	65	90	130	190	260	∇
Lal-lo	60	90	130	180	250	∇
Lasam	60	90	130	180	250	∇
Piat	40	60	90	130	180	∇
Sanchez Mira	80	120	170	240	330	∇
Solana	110	160	230	320	440	∇
Tuao	100	140	200	280	380	∇
Total	2,435	3,515	5,015	7,010	9,550	

Table IV-1-3-3(7/8)

Province	Kalinga Apayao					(3)
City/ Municipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Tabuk	115	175	255	360	500	
Kabugao	20	30	45	70	100	∇
Lubuagan	30	45	65	90	130	∇
Total	165	250	365	520	730	

Province	Isabela					(18)
Ilagan	440	660	980	1,400	1,900	
Alicia	110	170	250	350	480	∇
Angadanan	65	90	125	175	240	∇
Cabagan	65	100	140	200	320	∇
Callang (San Manuel)	60	100	140	210	290	∇
Cauayan	430	620	890	1,240	1,690	
Echague	280	400	560	780	1,070	
Gamu	55	85	125	180	250	∇
Jones	55	80	115	160	220	∇
Mallig	50	75	110	150	210	∇
Naguilian	70	100	140	200	270	∇
Roxas	110	160	220	310	430	
San Augustin	40	65	95	140	190	∇
San Mariano	100	150	210	300	410	∇
San Mateo	200	300	430	590	810	∇
Santiago	500	730	1,060	1,470	2,020	
Tumauini	60	90	130	180	250	∇
Aurora	50	80	115	165	230	∇
Total	2,740	4,055	5,835	8,200	11,280	

Table IV-1-3-3(8/8)

Province	Ifugao					(4)
City/ Mumicipality	Number of Telephone Demands					Remarks
	1982	1987	1992	1997	2002	
Lagawe	50	66	90	125	170	
Banaue	60	80	110	155	210	∇
Kiangan	45	65	90	125	175	∇
Mayoyao	50	75	110	150	210	∇
Total	205	286	400	555	765	
Province	Quirino					(3)
Cabarroguis	30	50	75	110	150	∇
Diffun	70	105	160	220	310	∇
Maddela	60	100	150	210	300	∇
Total	160	255	385	540	760	
Province	Nueva Vizcaya					(8)
Bayombong	588	870	1,240	1,720	2,350	
Aritao	70	100	150	210	280	∇
Bagabag	80	120	170	240	330	∇
Bambang	100	145	210	290	400	∇
Dupax del Norte	60	100	140	200	280	∇
Dupax del Sur	60	100	145	210	290	∇
Santa Fe	20	30	45	70	130	∇
Solano	250	370	530	750	1,020	
Total	1,228	1,835	2,630	3,690	5,080	
Region II Total	6,941	10,207	14,646	20,536	28,195	

1-4 Demand Forecast Tendency and Percentage of Business Telephones for Offices to Be Constructed in This Project .

Fig. IV-1-4-1 (1/18~18/18) shows future demand tendency for offices to be constructed in this project and the percentage of business telephones. The percentage of business telephone is obtained by calculation from Fig. IV-1-4-2 which shows the relationship between the percentage of business telephones among all types of telephones and the number of telephones per 100 inhabitants in the existing telephone service areas in Regions I and II.

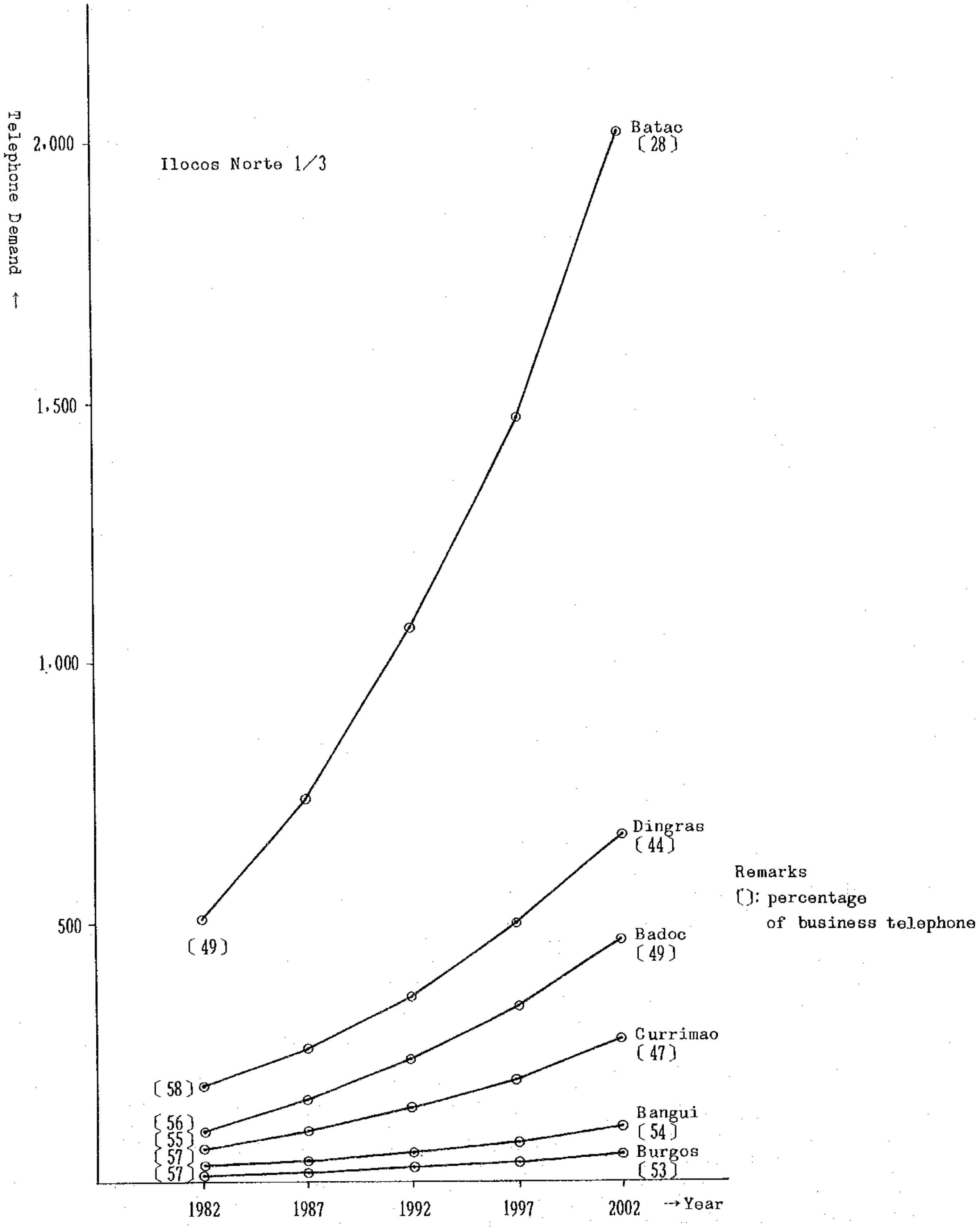
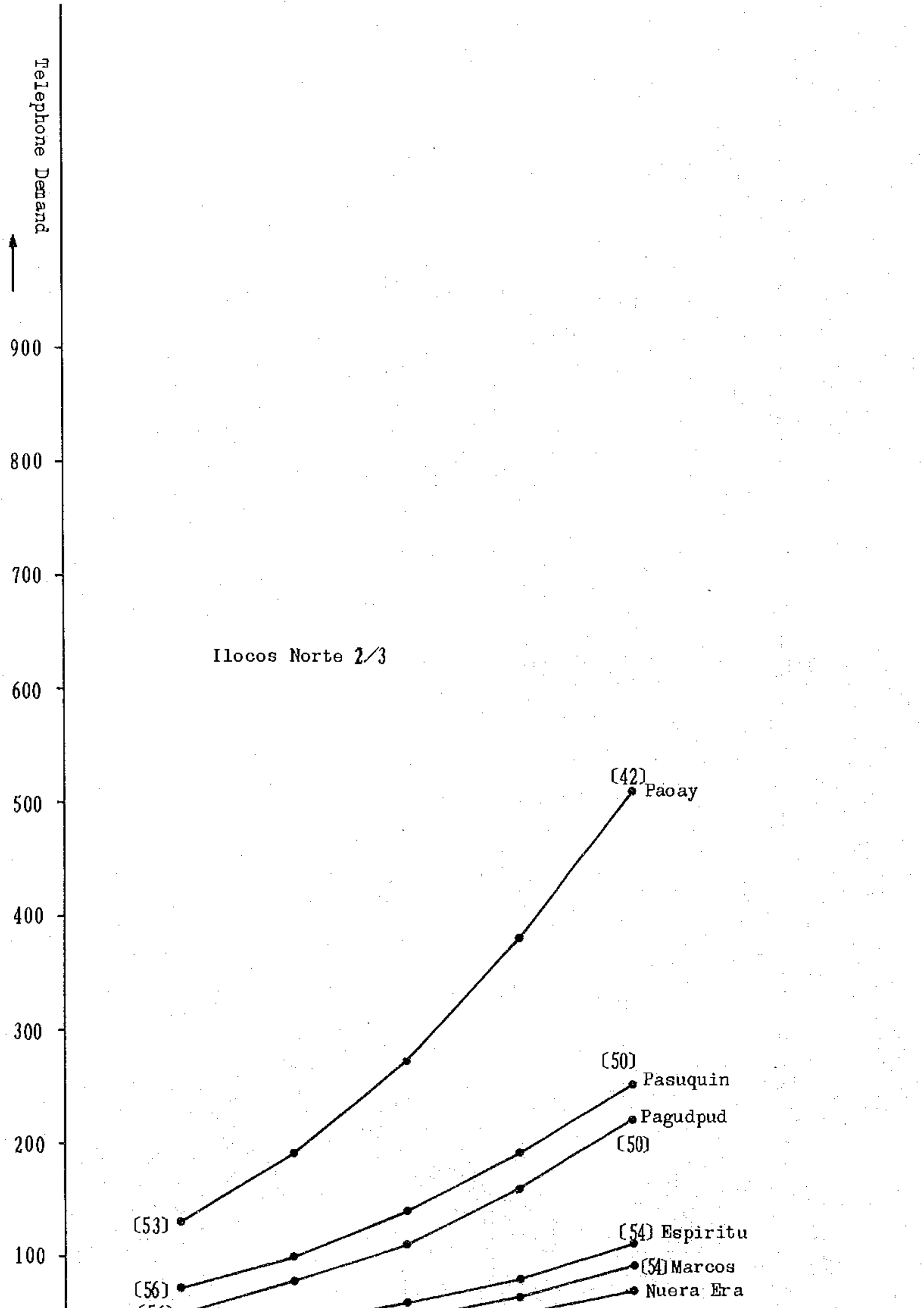


Fig IV-1-4-1 (1/18) Future Telephone Demand


Telephone Demand
900
800
700
Ilocos Norte 2/3
600
500
400
300
200
100
〔42〕 Paoay
〔50〕 Pasuquin
Pagudpud 〔50〕
〔54〕 Espiritu
〔54〕 Marcos
Nuera Era
〔58〕
〔53〕
〔56〕
〔56〕
〔57〕
〔57〕
〔59〕
1982
1987
1992
1997
2002
Year
Fig. Ⅳ－1－4－1(2/18)

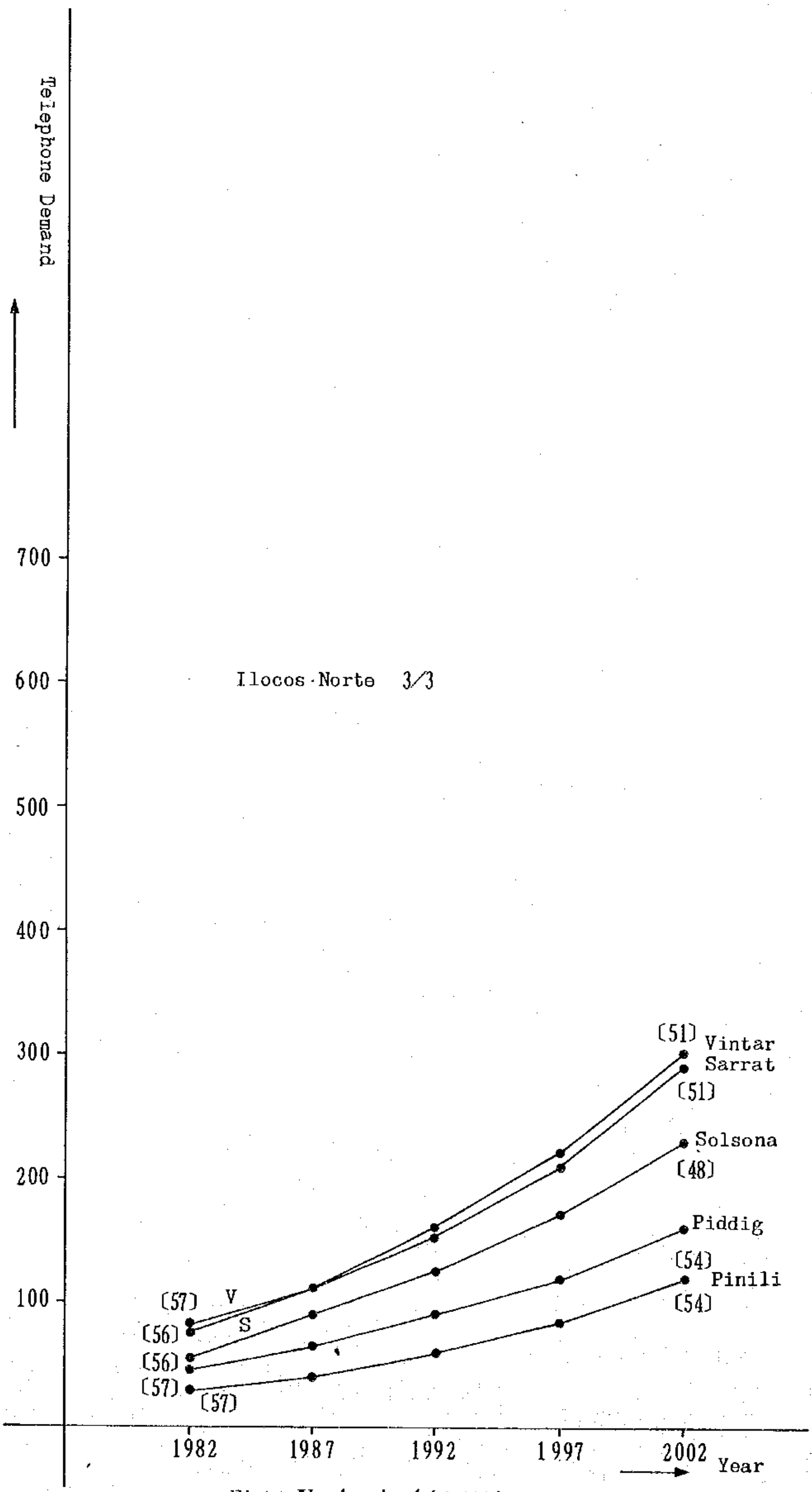

Telephone Demand
700
600
500
400
300
200
100
Ilocos·Norte 3/3
(51) Vintar
Sarrat
(51)
Solsona
(48)
Piddig
(54)
Pinili
(54)
(57) V
(56) S
(56)
(57)
(57)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ-1-4-1(3/18)

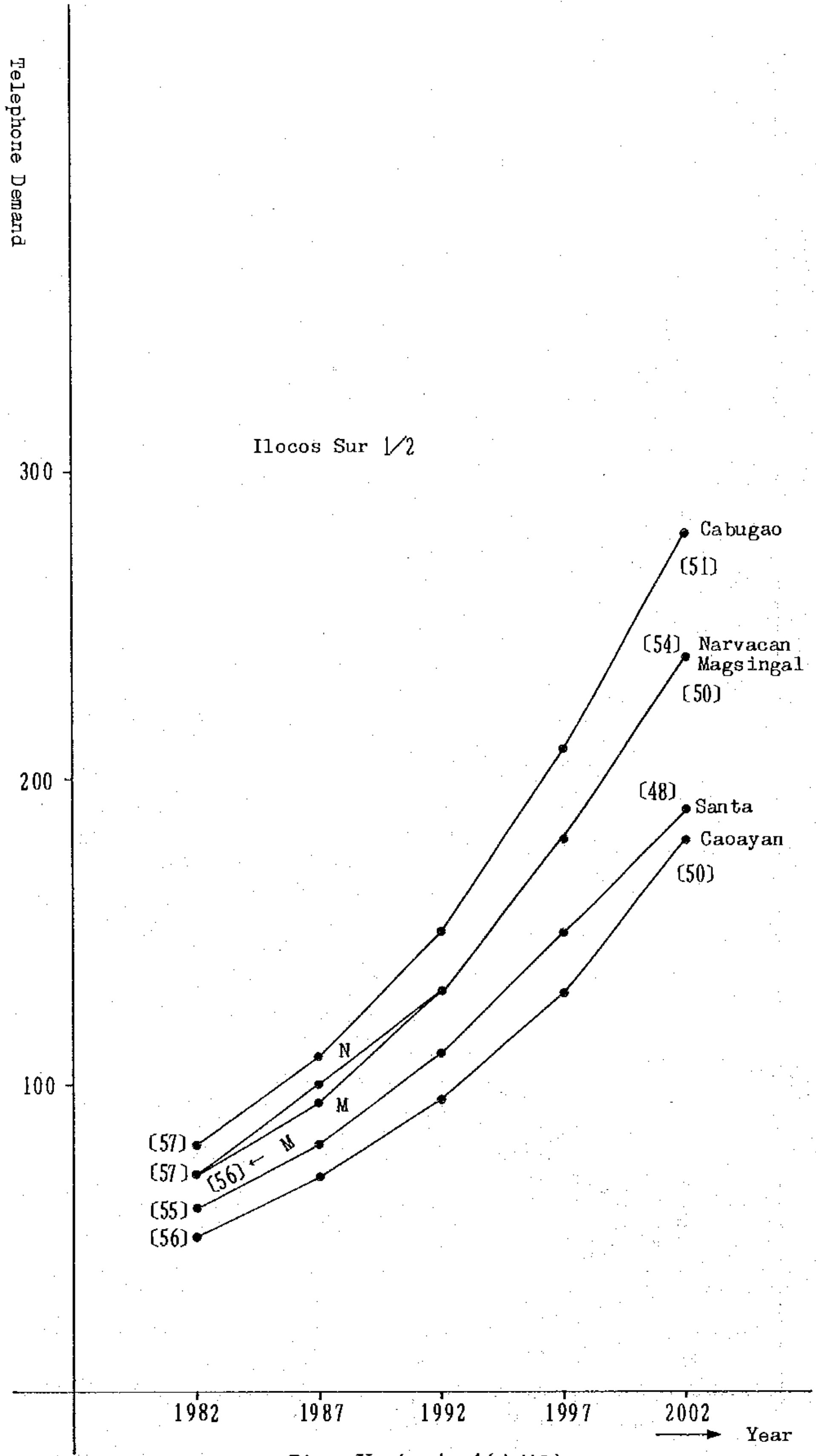

Telephone Demand
Ilocos Sur 1/2
300
200
100
Cabugao
(51)
(54) Narvacan
Magsingal
(50)
(48) Santa
Caoayan
(50)
N
M
(57)
(57)
(56) ← M
(55)
(56)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ-1-4-1(4/18)

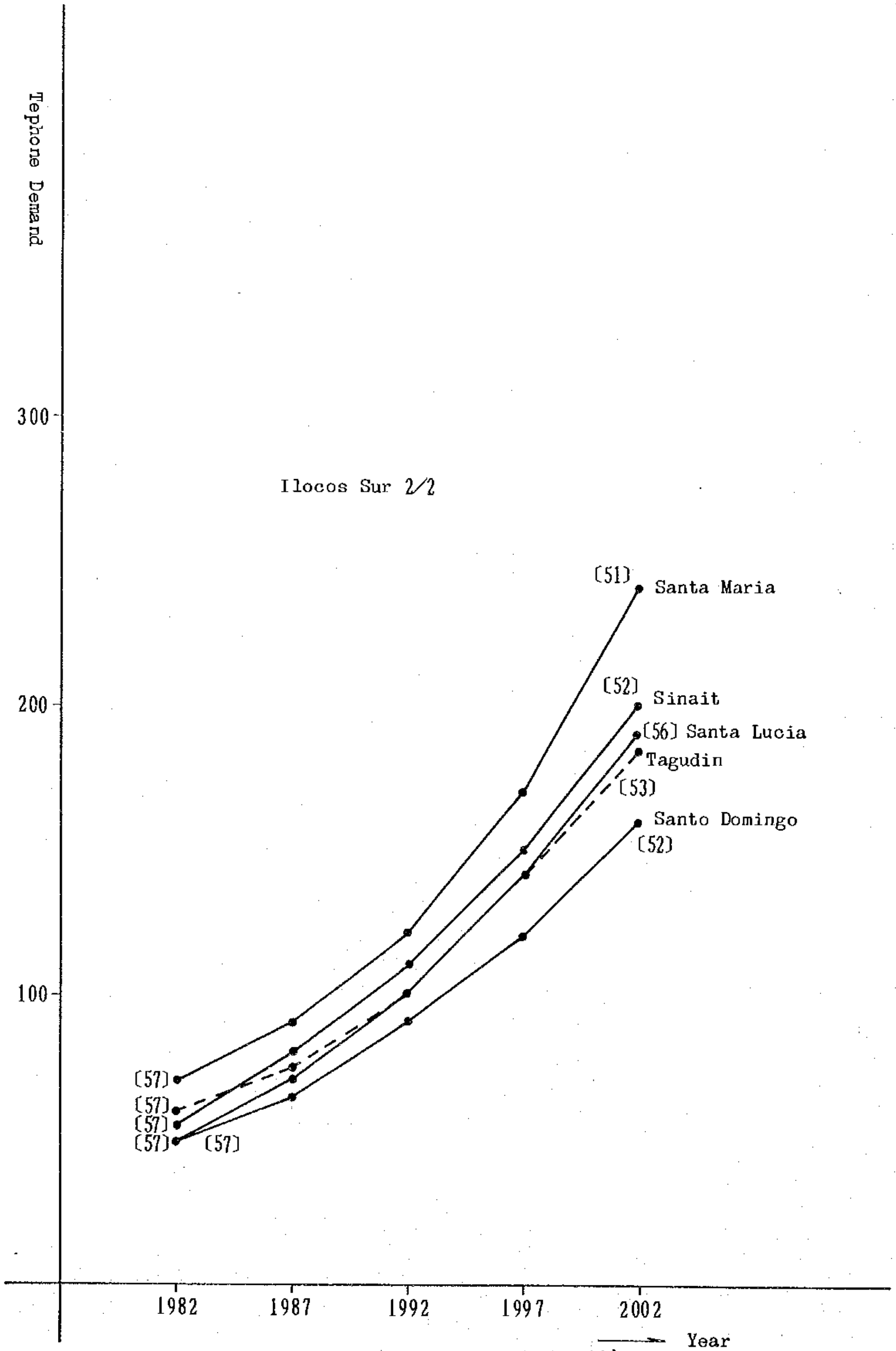

Tephone Demand
300
200
100
Ilocos Sur 2/2
〔51〕 Santa Maria
〔52〕 Sinait
〔56〕 Santa Lucia
Tagudin
〔53〕
Santo Domingo
〔52〕
〔57〕
〔57〕
〔57〕
〔57〕
〔57〕
1982
1987
1992
1997
2002
Year

Fig. Ⅳ－1－4－1(5/18)

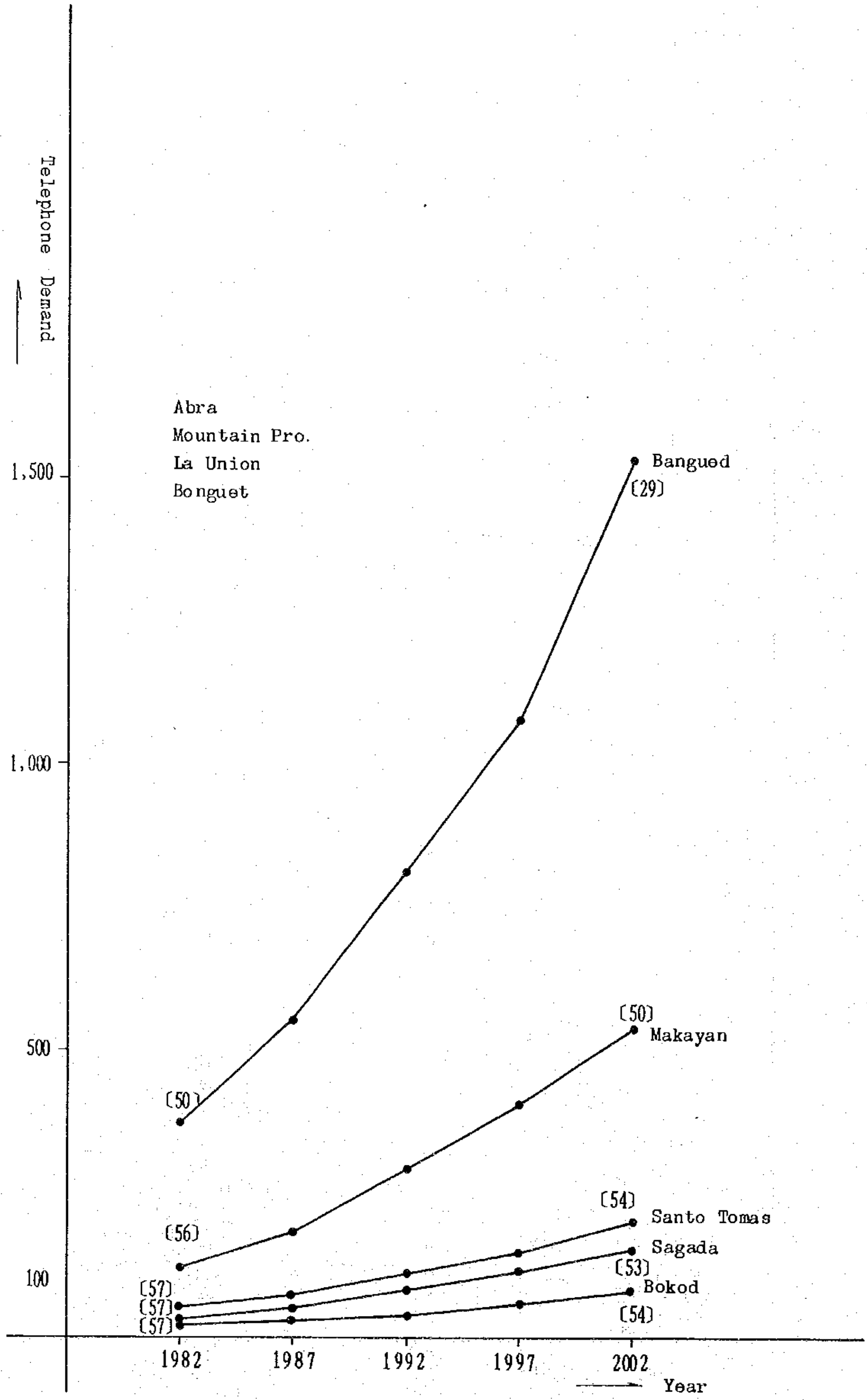
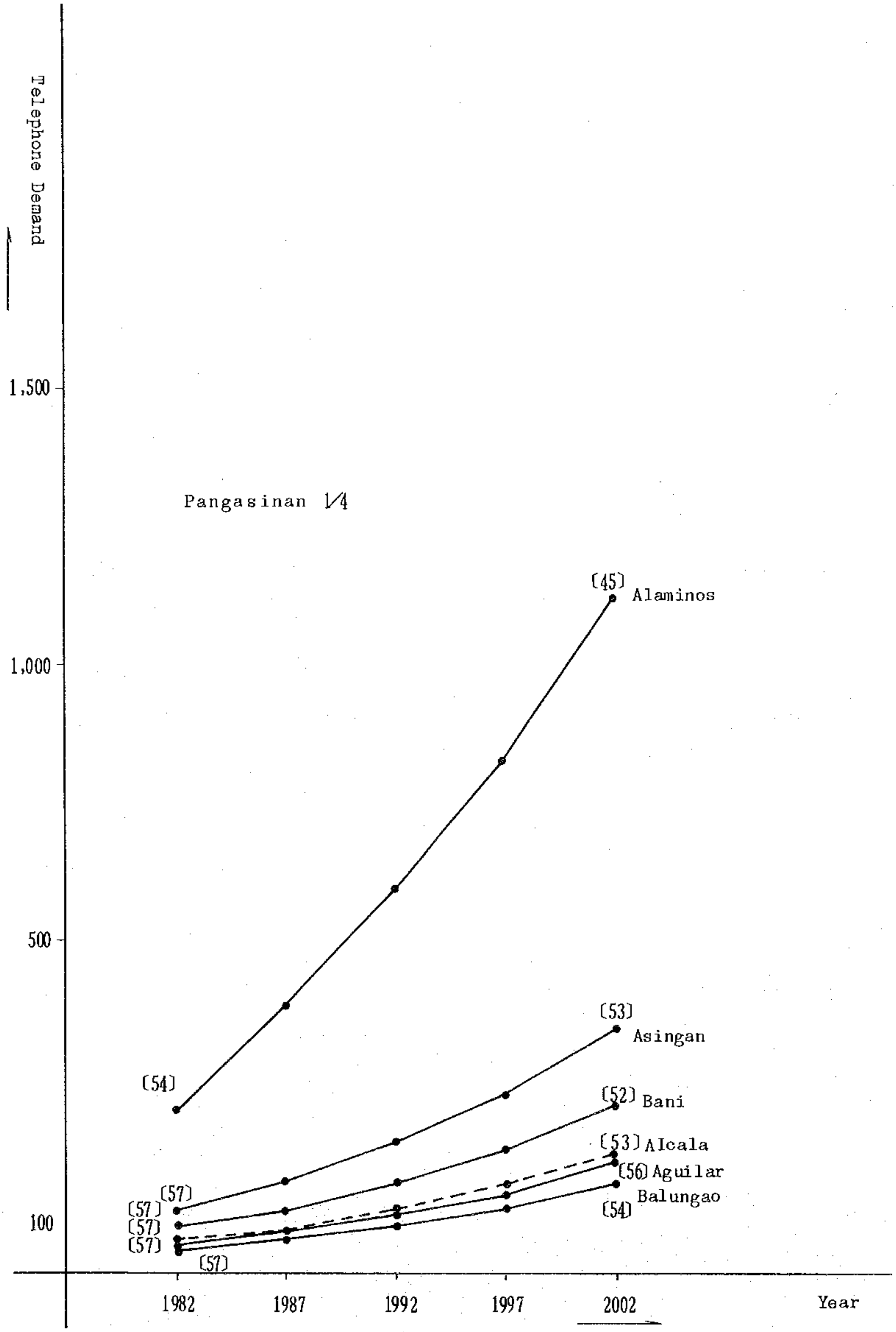
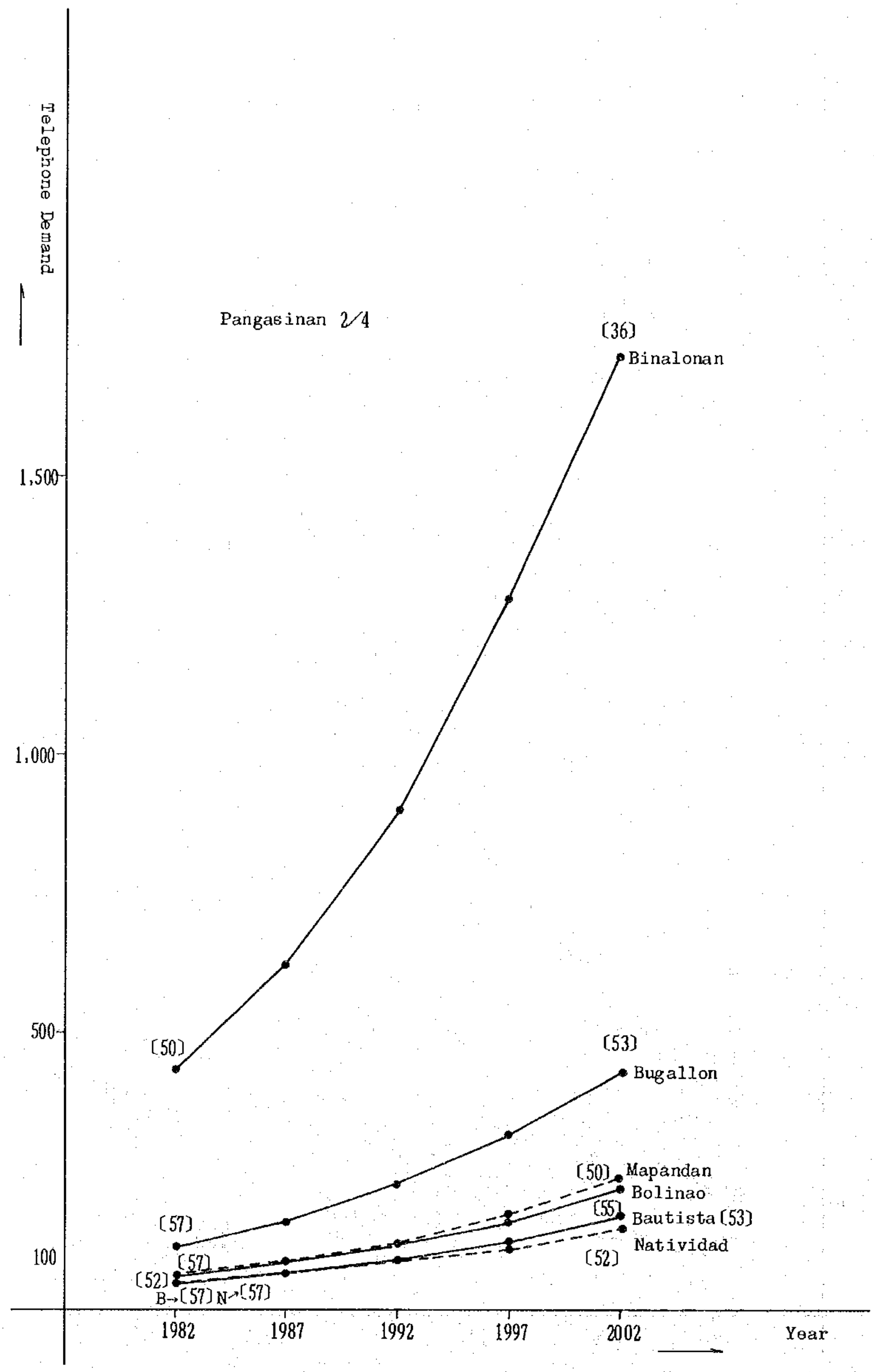

Telephone Demand
Abra
Mountain Pro.
La Union
Bonguet
1,500
1,000
500
100
Bangued
(29)
(50)
Makayan
(50)
(56)
(54)
Santo Tomas
Sagada
(53)
Bokod
(54)
(57)
(57)
(57)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ-1-4-1(6/18)



Telephone Demand
1,500
1,000
500
100
Pangasinan 1/4
(45)
Alaminos
(53)
Asingan
(54)
(52) Bani
(53) Alcala
(56) Aguilar
Balungao
(54)
(57)
(57)
(57)
(57)
(57)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ－1－4－1(7/18)



Telephone Demand
Pangasinan 2/4
(36)
Binalonan
1,500
1,000
500
(50)
(53)
Bugallon
(50)
Mapandan
Bolinao
(55)
Bautista (53)
(57)
Natividad
100
(57)
(52)
(52)
B→(57) N→(57)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ-1-4-1-(8/18)

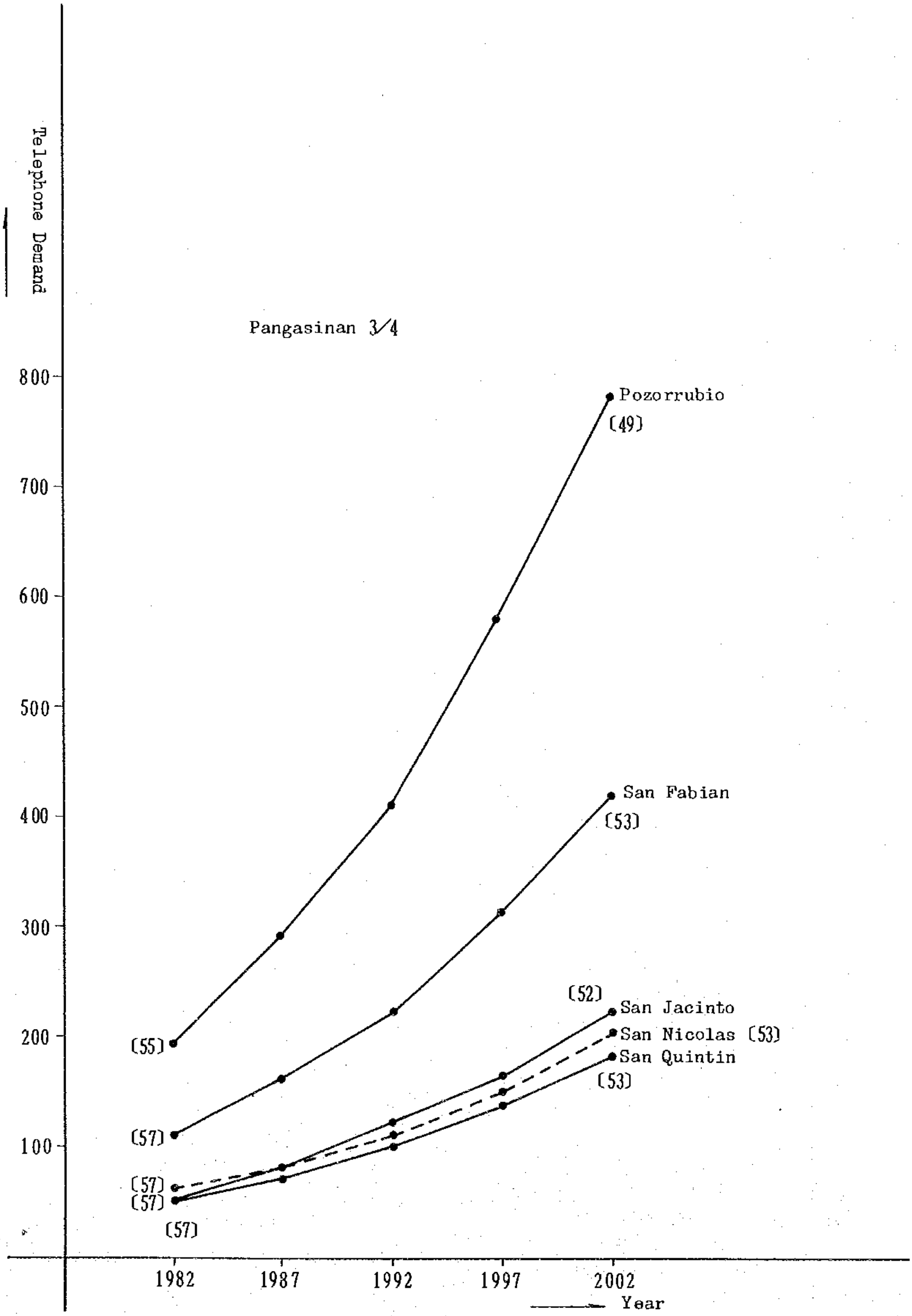

Telephone Demand
Pangasinan 3/4
800
700
600
500
400
300
200
100
Pozorrubio
(49)
San Fabian
(53)
(52)
San Jacinto
San Nicolas (53)
San Quintin
(53)
(55)
(57)
(57)
(57)
(57)
1982
1987
1992
1997
2002
Year

Fig. Ⅳ－1－4－1(9/18)

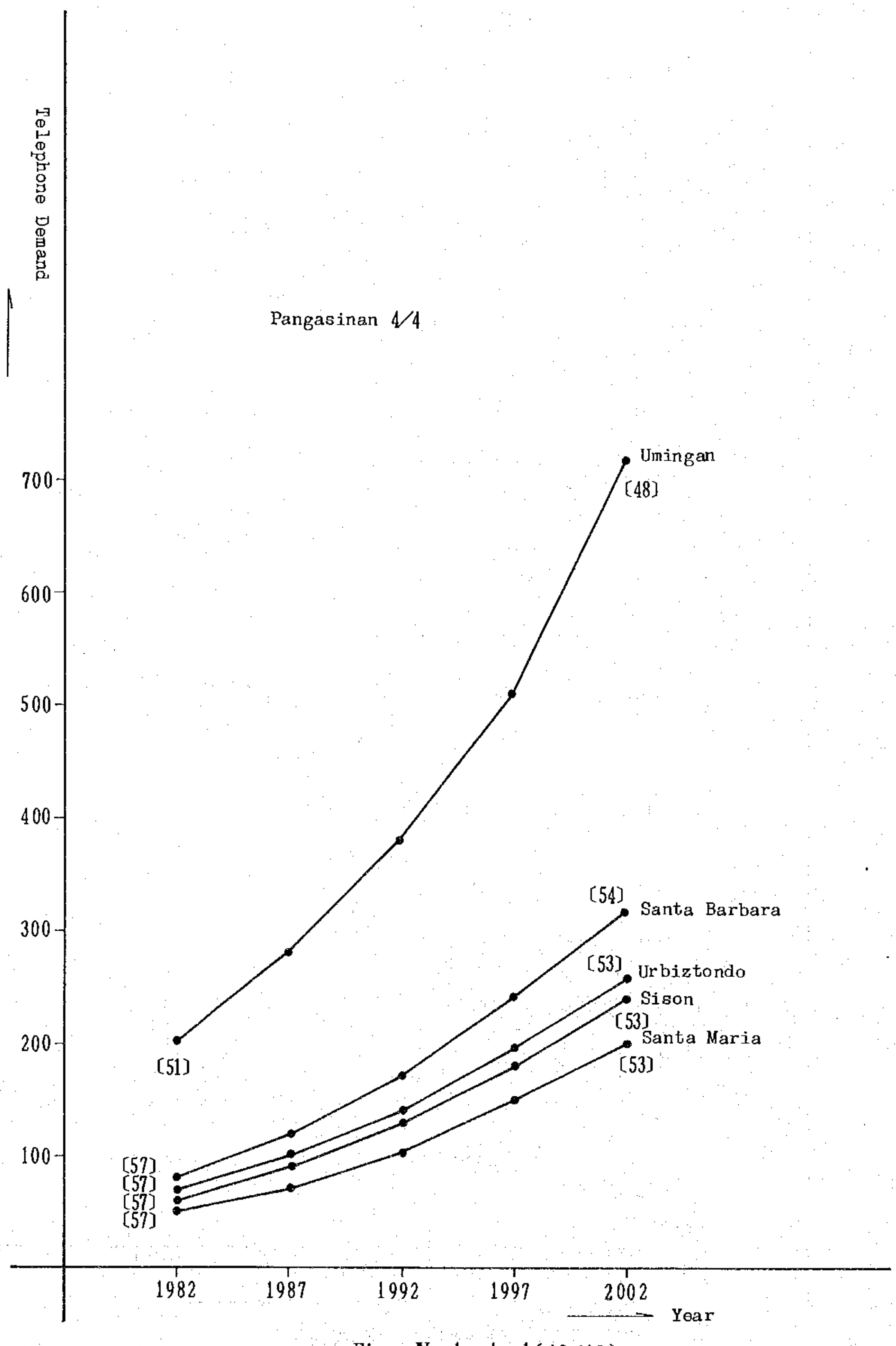


Fig. Ⅳ-1-4-1(10/18)

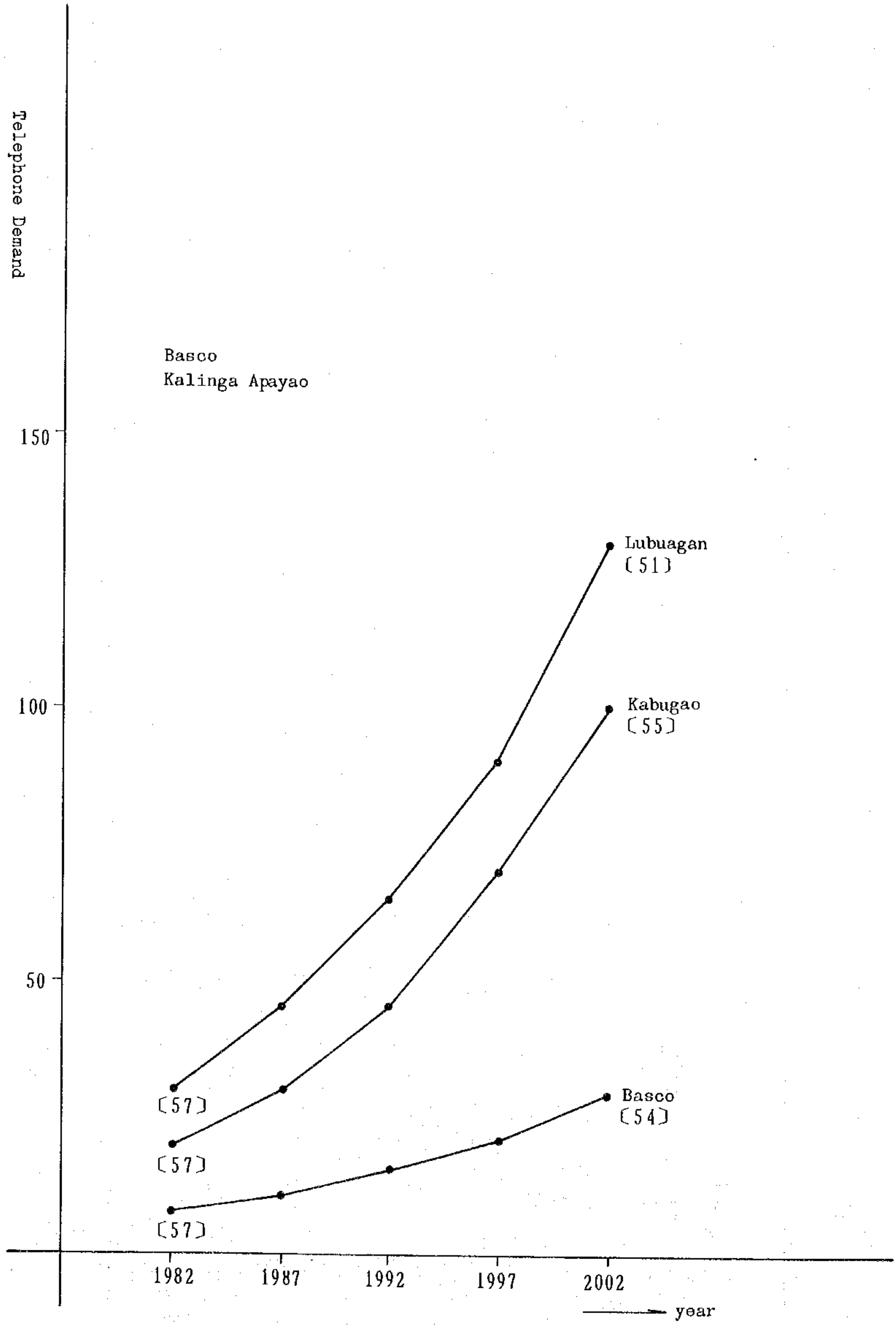


Fig Ⅳ-1-4-1(11/18)

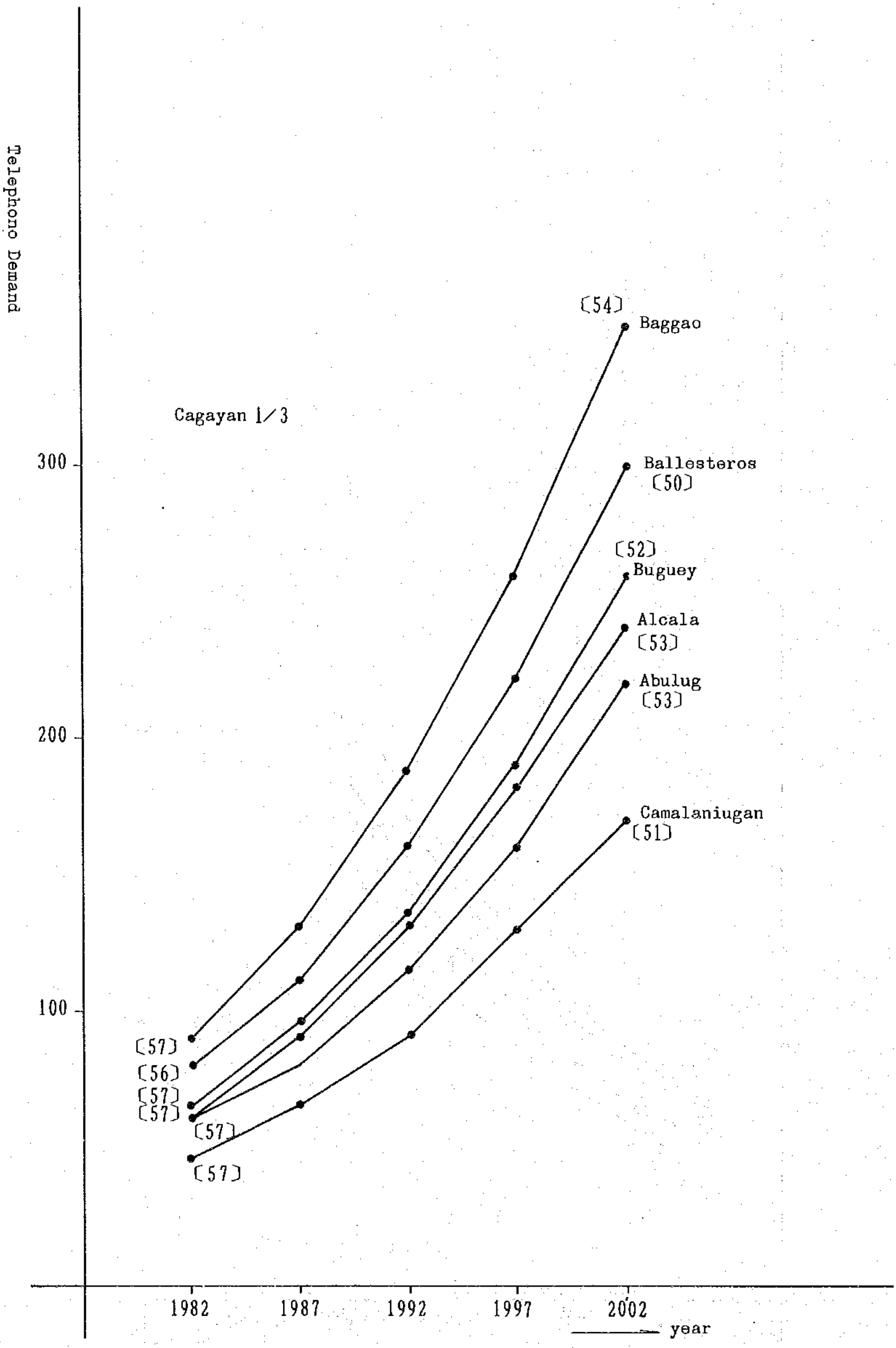


Fig Ⅳ-1-4-1(12/18)

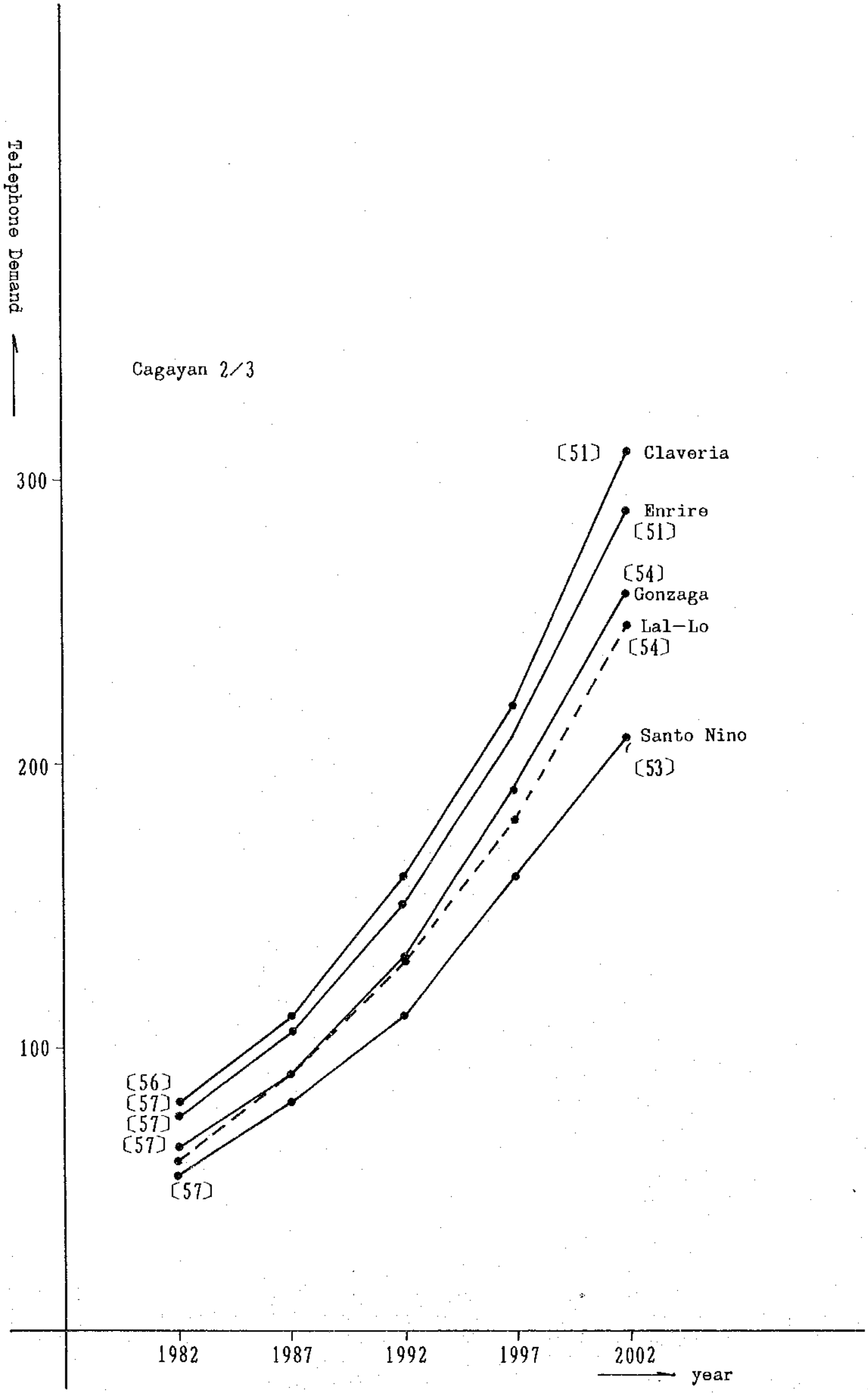


Fig Ⅳ-1-4-1(13/18)

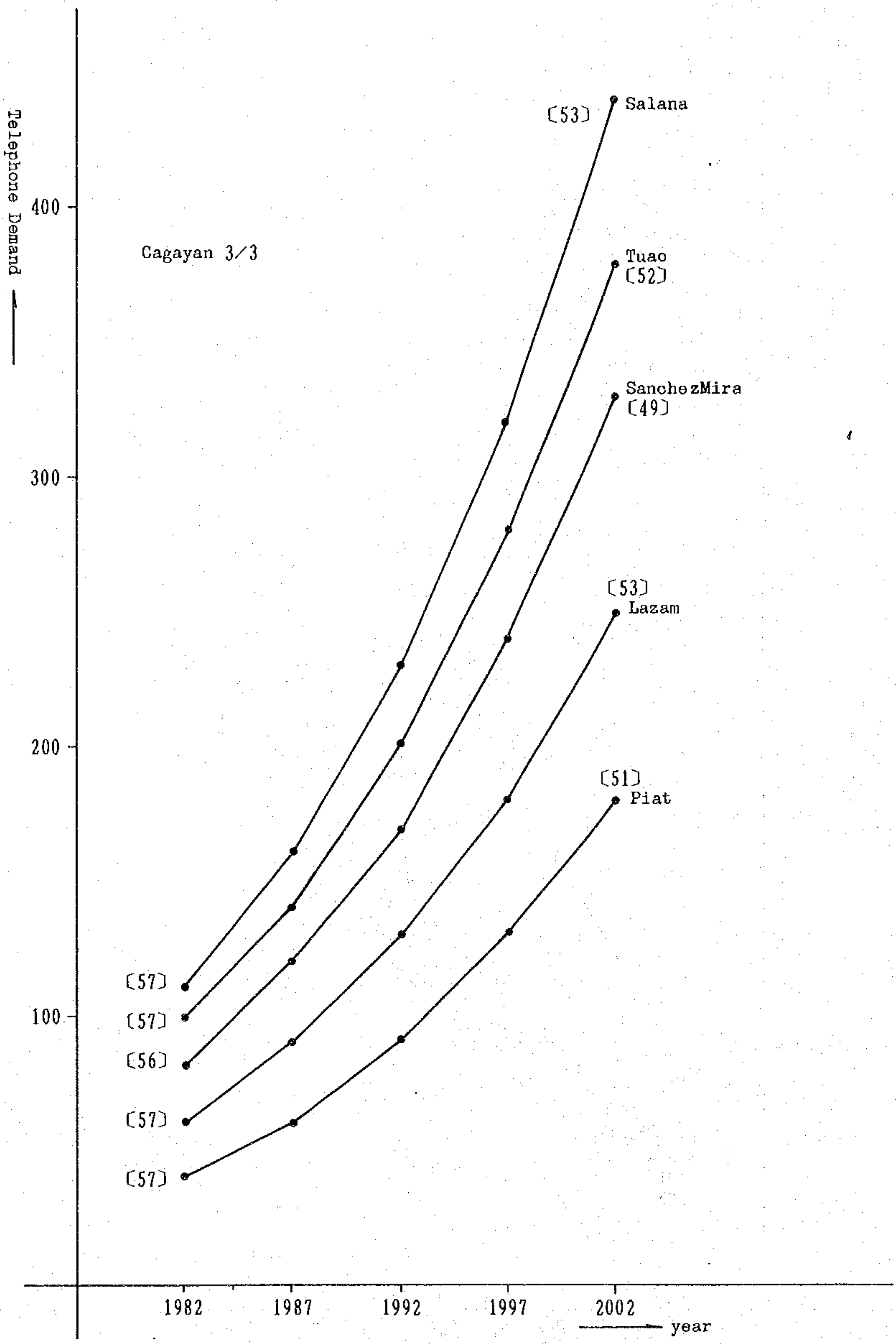


Fig Ⅳ-1-4-1 (14/18)

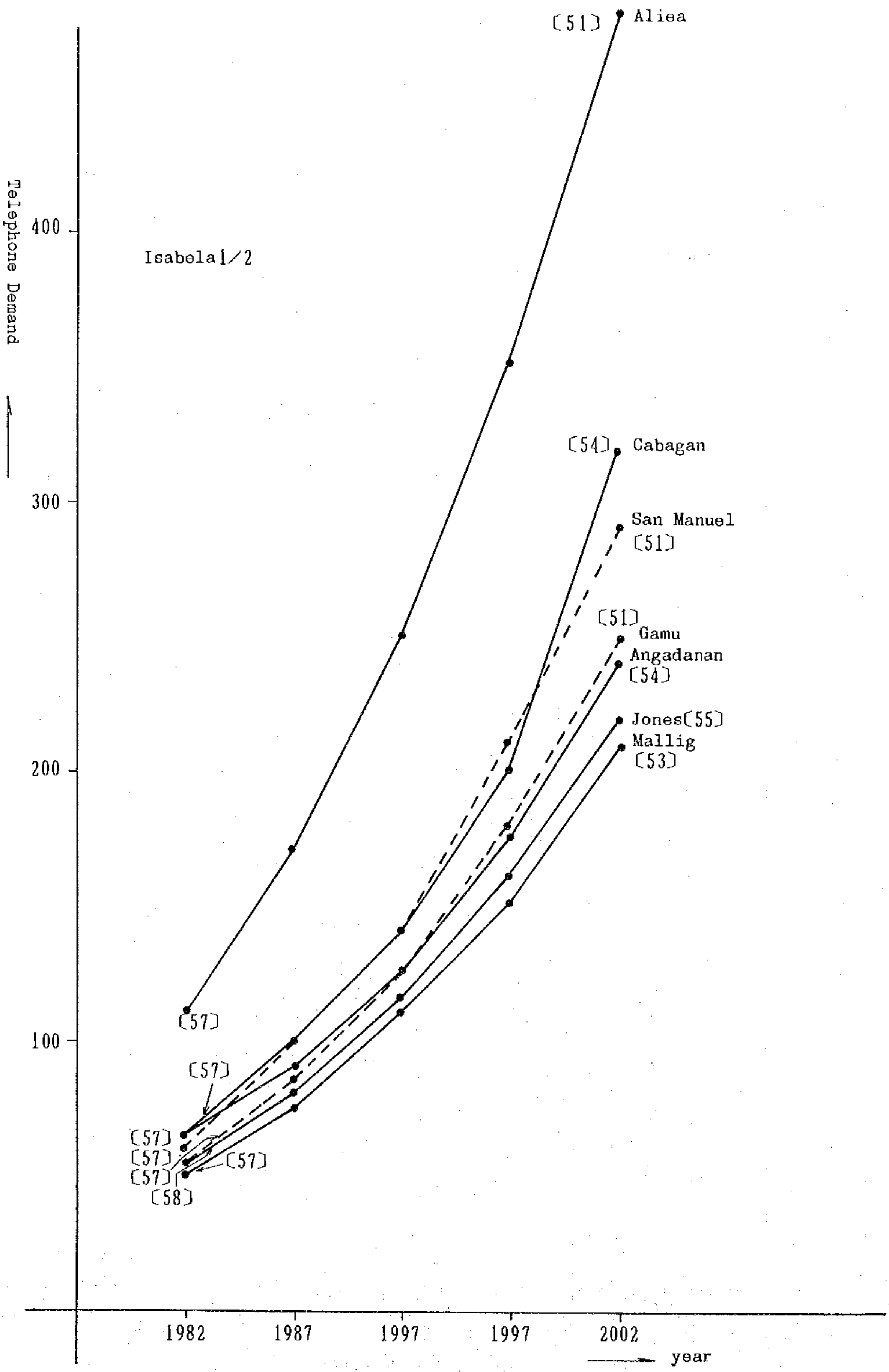


Fig Ⅳ-1-4-1-(15/18)

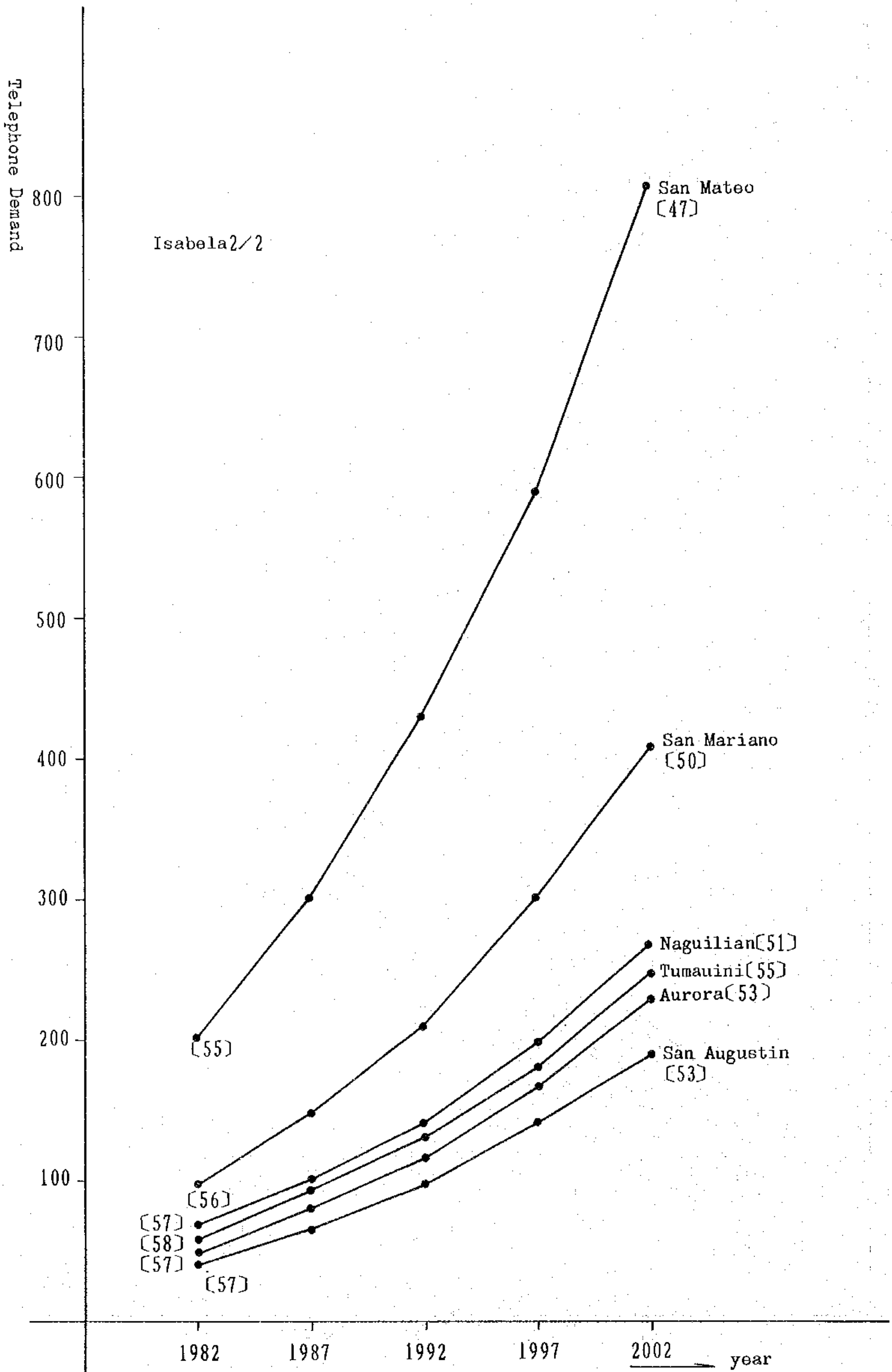


Fig Ⅳ-1-4-1(16/18)

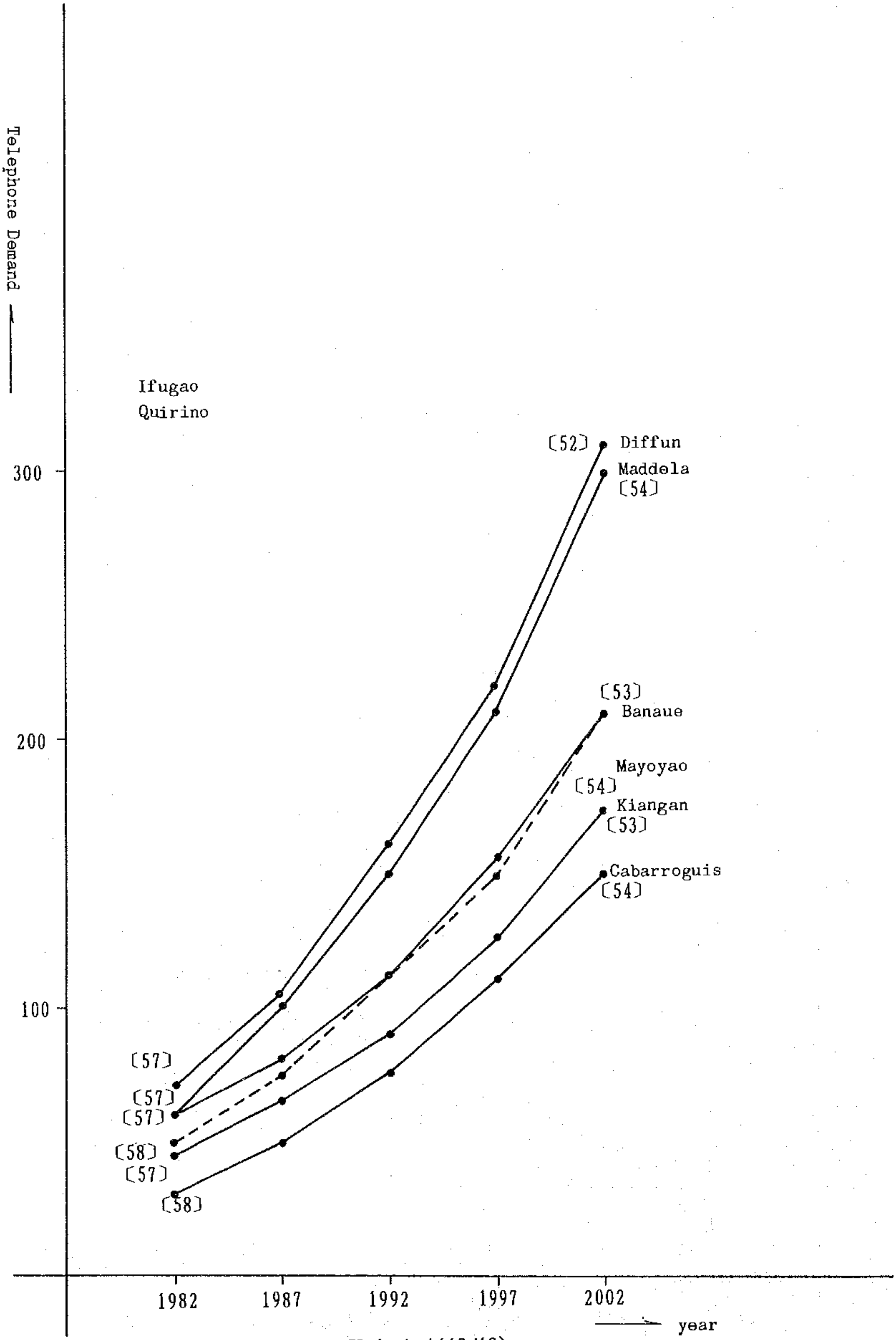


Fig Ⅳ-1-4-1(17/18)

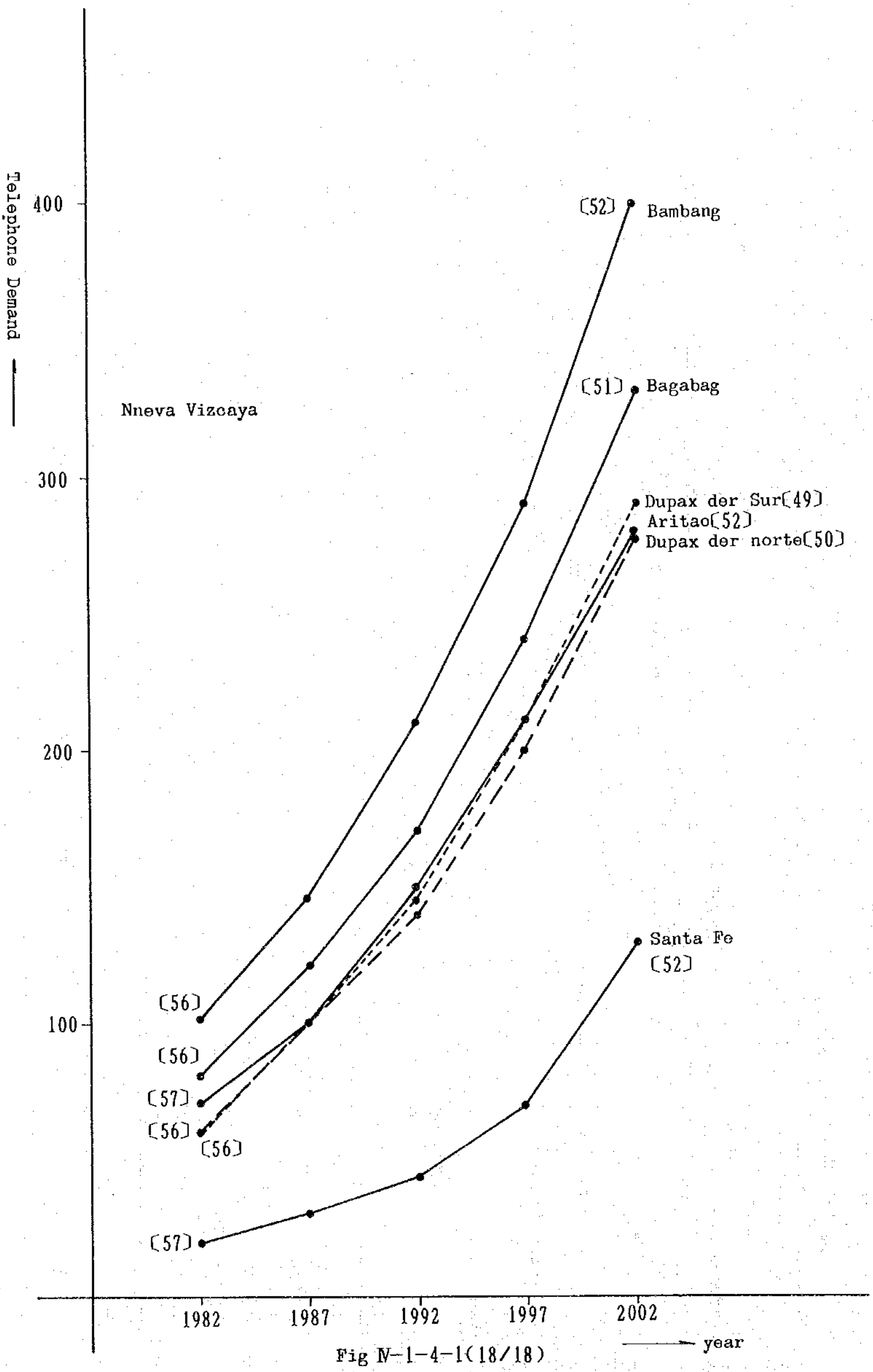


Fig Ⅳ-1-4-1(18/18)

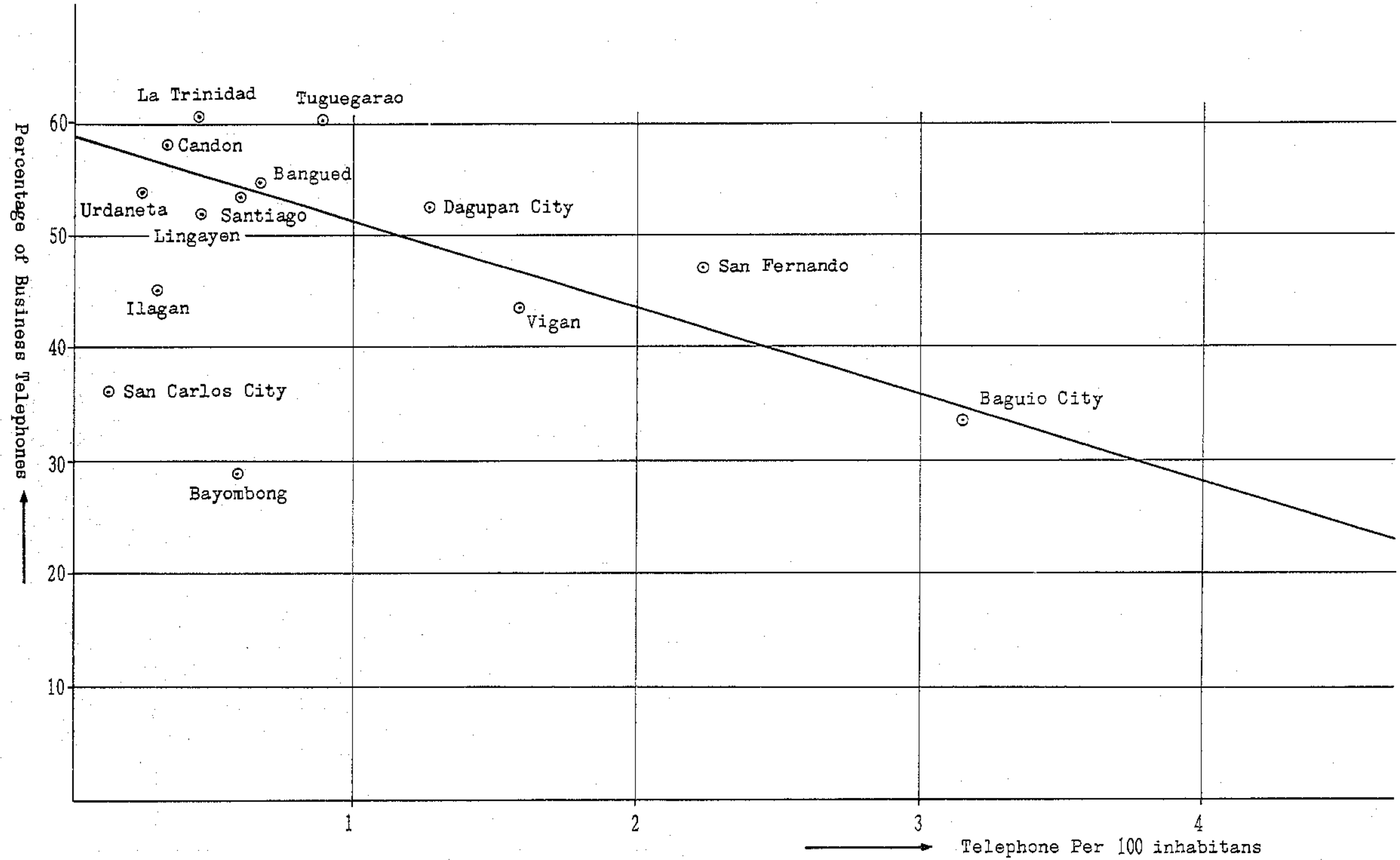


Fig. IV－1－4－2　Percentage of Business Telephones

1-5 Observation of Demand

The telephone demand forecast made in paragraph 1-3 is limited to the existing service areas and the areas expected to provide telephone service by 1987 by BUTEL or private operators.

Population and telephone demand forecast is made for 88 areas out of 175 areas in Region I and for 55 areas out of 114 areas in Region II.

Through macroscopic observation and forecast of population and telephone demand in the remaining areas, population and telephone demand for Regions I and II can be obtained as shown in Tables IV-1-5-1 and VI-1-5-2.

Table IV-1-5-1 Future Population

(Unit: thousand)

Region \ Year		1982	1987	1992	1997	2002
Region I	In Forecast Area	2,822	3,059	3,245	3,384	3,467
	Out of Forecast Area	852	892	955	1,082	1,250
	Total	3,674	3,951	4,200	4,466	4,717
Region II	In Forecast Area	1,534	1,739	1,871	1,958	2,027
	Out of Forecast Area	754	803	905	1,048	1,229
	Total	2,288	2,542	2,776	3,006	3,256

Table IV-1-5-2 Telephone Demand

(Unit: hundred)

Region \ Year		1982	1987	1992	1997	2002
Region I	In Forecast Area	239	349	505	710	981
	Out of Forecast Area	17	24	34	63	80
	Total	256	373	539	773	1061
Region II	In Forecast Area	69	102	146	205	282
	Out of Forecast Area	10	14	22	34	53
	Total	79	116	168	239	335

As a result, the number of subscribersper 100 inhanitants in Regions I and II for respective forecast years are as given in Table IV-1-5-3.

Table IV-1-5-3 No. of Subscribers per 100 Inhanitants

Region \ Year	1982	1987	1992	1997	2002
Region I	0.70	0.94	1.28	1.73	2.25
Region II	0.35	0.46	0.61	0.80	1.03

Values given in Table IV-1-5-3 are the numbers of subscribers, which cau be converted into the numbers of telephones as given in Table IV-1-5-4.

Table IV-1-5-4 No. of Telephones per 100 Inhanitants

Region \ Year	1982	1987	1992	1997	2002
Region I	0.76	1.05	1.47	2.02	2.70
Region II	0.36	0.48	0.66	0.88	1.16

The number of telephones per 100 inhabitants in the Philippines was 0.97 as of 1973 and 1.2 as of 1977.

Accordingly, Region I is about 13 years behind this and Region II is about 26 years behind.

Meanwhile, the amounts of production per inhabitant are obtained from the Development Plan (1978 - 1982) and given in Table IV-1-5-5.

Table IV-1-5-5 Regional per Capita Out put 1977 to 1987

	1977	1987	1979	1980	1981	1982	1987
PHILIPPLINES	1,733	1,804	1,885	1,967	2,064	2,163	3,148
Region I	1,068	1,143	1,186	1,251	1,329	1,422	1,890
Region II	1.072	1,119	1,172	1,226	1,330	1,394	1,837

In the amount of the production per inhabitant, Regions I and II are nearly equal to each other and are about 6 years behind the average of the Philipplines.

Here, let us make demand forecast by the model equstion given in CCITT document.

In general, the number of telephones per 100 inhabitants, q, can be represented as a function of the production per inhabitant (GNP/Population), x, and can be expressed as follows.

$$\log q = A + B \log X$$

where A and B are constants determined by the country or area and for Regions I and II we put B = 1.405 from an international model adopted because of the lack of past data for the regions.

Table IV-1-5-5 gives actual values achieved in 1977 in Regions I and II.

Table IV-1-5-5 as of 1977

Region	Per Capita Output	Telephone per 100 Inhanitant q
Region I	$ 146.3	0.28
Region II	$ 147.7	0.028

By substituting these values obtained from Table IV-1-5-5 into the equation

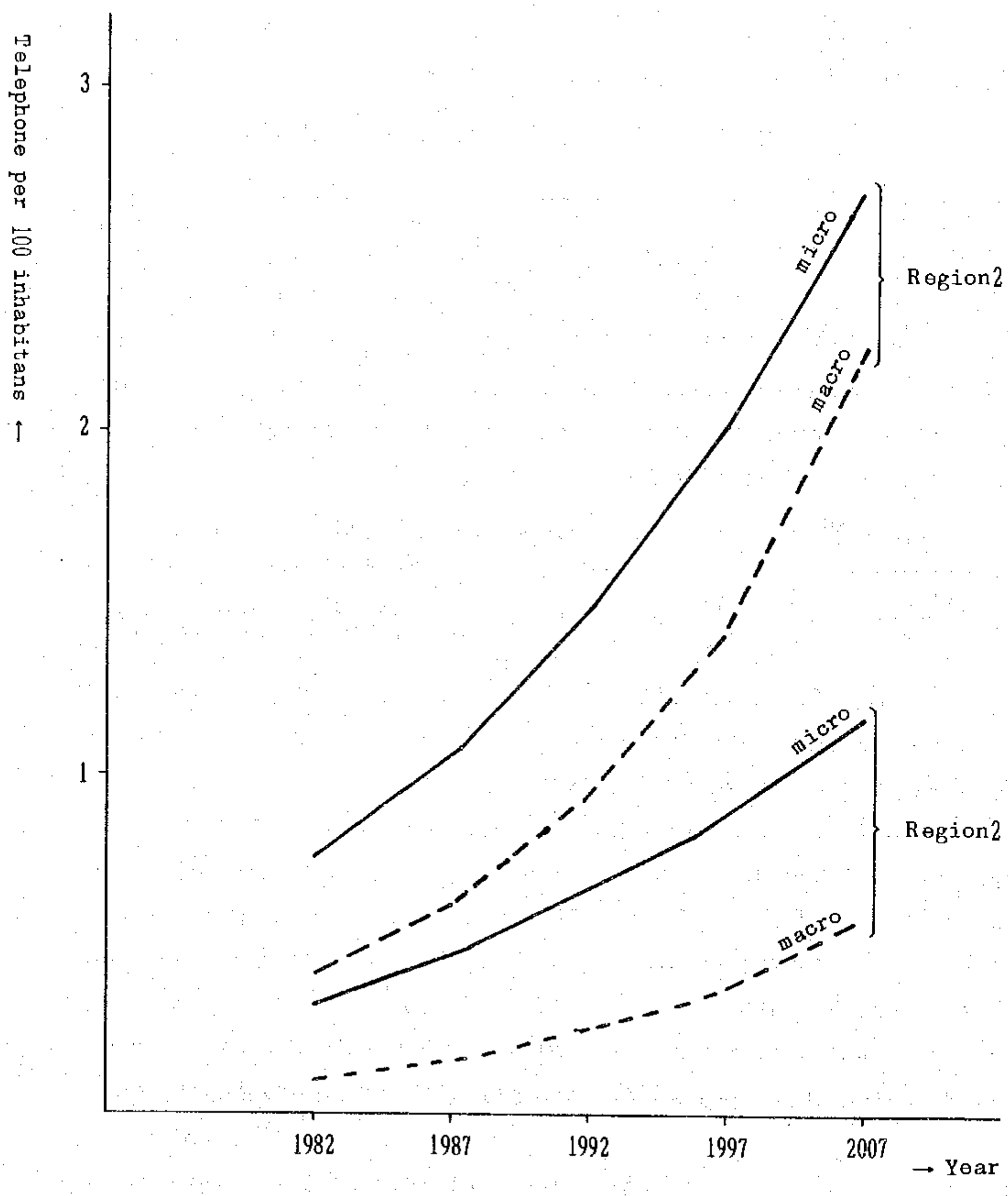


Fig Ⅳ－1－5－1 Telephone per 100 inhabitans in Futuer year of $\log q = A + 1.405 \log x$, we have

For Region I : $\log q = -3.595 + 1.405 \log x$ (1)

For Region II: $\log q = -4.145 + 1.405 \log x$ (2)

As mintioed in paragraph IV-1-3-2, the product per capita, x, in Regions I and II can be estimated as given in Table IV-1-5-6.

Table IV-1-5-6 Estimated Regional Product per Capita

($)

Year	1982	1987	1992	1997	2002
Region I	194.8	258.9	346.9	464.8	622.8
Region II	191.0	251.6	337.1	451.7	605.2

By substituting these values into equations (1) and (2), the numbers of telephones per 100 inhabitant for the respective forecast years can be obtained as given in Table IV-5-7.

Table IV-1-5-7 No. of Telephones per 100 Inhanitants

Region I	1982	1987	1992	1997	2002
Region II	0.42	0.62	0.94	1.42	2.14
	0.11	0.17	0.25	0.38	0.58

The relationship between Table IV-1-5-4 (microscopic values) and Table IV-1-5-7 (macroscopic values) is shown in Fig. IV-1-5-1.

Considerable differences are observed between macroscopic and microscopic values for both Regions I and II. This is because microscopic values are obtained by forecast in consideration of latent demand and macrscopic values are those obtained by forecast with the actual number of telephones in 1977 being the base.

It can be estimated that actual values to be obtained by the implementation of large-scale project by BUTEL will approach the microscopic values.

2. Telegraph Demand Forecast

2-1 Gentex

Demands for increase of Gentex stations, it is desirable to modify major existing telegraph offices one after another into Gentex stations.

It can be estimated that 2/3 of the existing telegraph offices will become Gentex stations up to 1990 in consideration of the completion of telephone local exchanges and IPTS to allow the use of telex lines.

For telegraph offices where telephone service is usable in the remaining 1/3 of the existing telegraph offices (where telegraph traffic is extremely little), introduction of telex facilities whil be rather uneconomical and the transmission of telegraph by telephone is recommended.
Table IV-2-1 gives basic data for obtaining Gentex demands and Table IV-2-2 shows the estimated number of Gentex stations.

2-2 Telex

It is necessary to consider that telex is usually used by offices and rarely used by private persons and that enterprises which use telex tend to concentrate in large cities. Accordingly, the number of demands is estimated by using the number of enterprises and population increment in large cities in consideration of the features of the respectiv cities.
Table IV-2-1 gives basic data for obtaining telex demands.
Tabel IV-2-2 gives the estimated number of required telex terminals obtained from the data of Table IV-2-1.
In more concrete, the estimated numbers of required telex lines at the respective cities are obtained as follows.

(1) Baguio This city is the pivot of the Northern Luzon.
During summer seasons, almost all administrative affairs of the government are transferred to this city at an altitude of 1500 meters, so that this city is very important in both politics and economy.
In the neighborhood of Baguio there are about 30 mines, which gives an indication of future industrial development. The number of existing enterprises in this city is about 4000 and the estimated population increment per 5 years is 13%, which indicates a rapid future development of this city when compared with other cities.
In consideration of all these, the expected number of telex lines made 180.

(2) Dagupan This city is a commercial city located in the Pangasinan Privnce which is most dinsely populated in the Northern Luzon.
Dagupan is surrounded by densely populated city and towns such San Calros City and Lingayen.
For telex demands, 60 telex lines are expected to be provided in consideration of demands by enterprises in the neighboring cities.

(3) San Fernando and Tuguegarao
It is San Fernando (La Union) that is expected by BUTEL to be the main area in Region I where telex demands will increase.

San Fernando is located as the regional center of Region I and about 87 regional offices are expected to be located there in the near future. These regional offices are expected to make communications with other regional offices by means of telex. In addition, trade and industrial activities will flourish increasingly in this regional center city, which will cause increased private companies to advance into this city.

In Region II, Tuguegarao is acting the role of the center city and is expected to develop as the regional center city.

In this sense, Tuguegarao can be considered very similar to San Fernando in Region I.

For these towns, 34 telex lines of San Fernand and 47 telex lines of Tuguegarao are estimated in cosideration of demands by enterprises and regional offices in respective towns.

(4) Other towns

For Laoag, Vigan, Ilagan, Santiago, and Bayombong, as many telex lines as shown on Table-VII-2-2 are enterprises in respective towns.

Table IV-2-1 Basic Data for Obtaining Telex and Gentex Demands

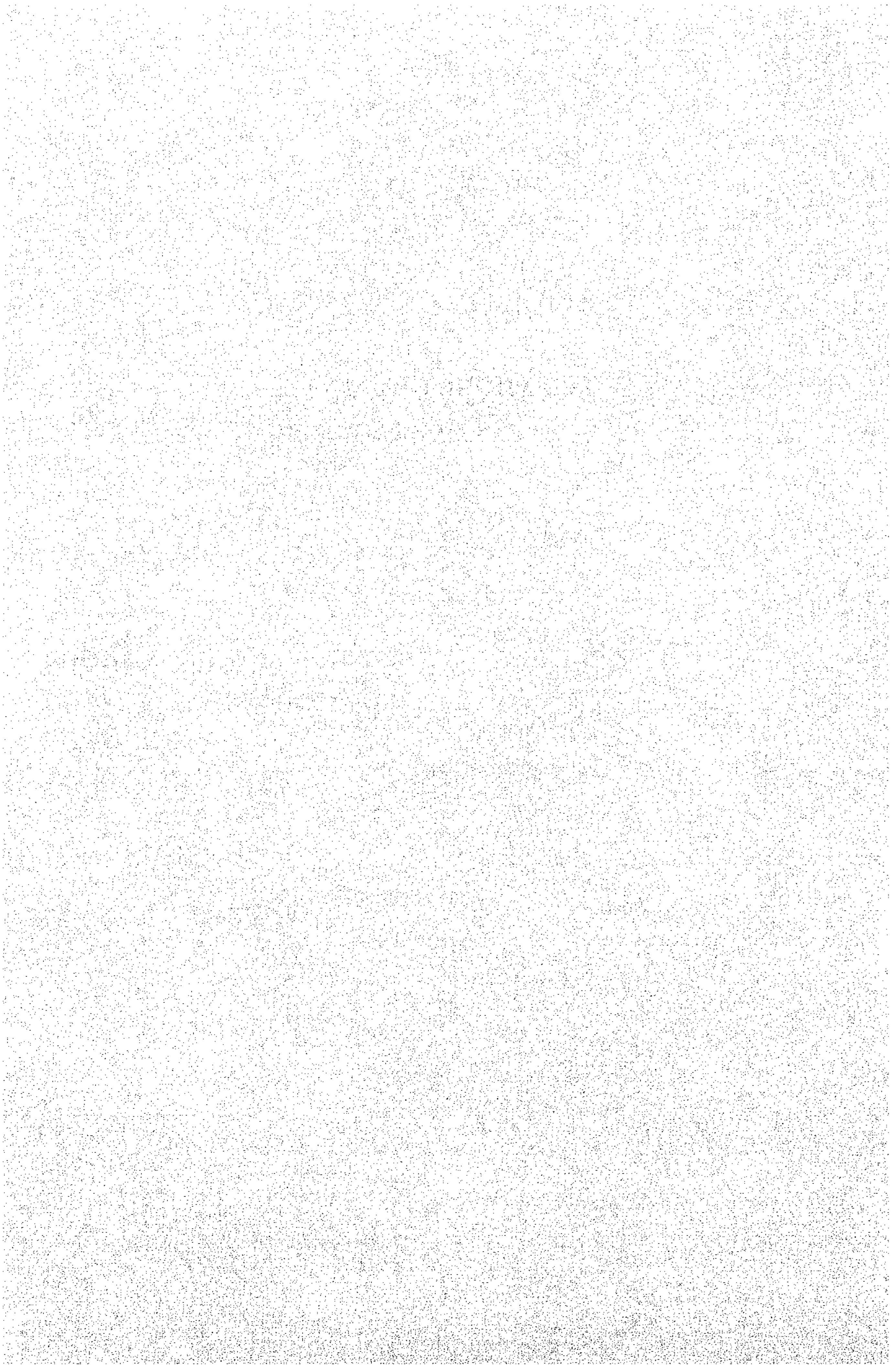
Station	No. of Associate Telegraph Offices	No. of Private Telegraph Offices	Telegrams per Month		No. of Enterprises	Population ($x10^3$)				
			Total No. of Telegrams	Telegrams Treated by BUTEL		1975	1980	1985	1990	Population Increment
Baguio	12 (including Mt.Province)	5	Approx. 35,400	46 %	3,909	97	110	125	140	13 %
Tuguegarao	31	4	13,200	35	2,339	63	68	75	80	8
San Fernando	16	3	8,800	24	1,056	61	70	80	88	12
Laoag	19 (including Batanes)	3	15,700	21	1,883	66	73	79	85	9
Vigan Bangued	22 (including Abra)	2 1	8,100 5,000	18	958 514	32 26	34 29	36 33	38 36	6 12
Dagupan San Carlos City Lingayen	47	4 1 1	16,000 2,700 3,100	28	2,106 867 969	90 91 59	98 98 61	107 107 66	116 120 72	9 10 7
Ilagan	18	4	11,500	23	667	79	80	91	101	13
Santiago	8	3	13,500	35	1,159	59	65	71	77	9
Bayombong	16 (including Ifugao and Quirino)	3	8,700	40	551	28	32	35	39	11

Table IV-2-2 Estimated Number of Telex Lines and Gentex Stations

as of 1990

Exchange or Concentrator	Number of Gentex Stations	Number of Telex Subscribers
Baguio	8	180
Tuguegarao	21	47
San Fernand	11	34
Laoag	13	28
Vigan	15	25
Dagupan	32	60
Ilagan	12	17
Santiago	6	22
Bayombong	11	16
Total	129	429

V. TELEPHONE DEMAND FULFILMENT PLAN



V. TELEPHONE DEMAND FULFILMENT PLAN

1. History of Telephone Installation in the Philippines

Recent trends in the number of telephone sets in the Philippines is as given in Table V-1-1.

Table V-1-1 Recent Trends in NUmber of Telephones in the Philippines

Year	Number of Telephone Sets (x1000)			Number of Telephones per 100 Inhabitants	Increase in Number of Telephones (x1000)
	Private Sector	Gov't Sector	Total		
Jan. 1974	375	35	410	1.04	-
Jan. 1975	418	28	446	1.09	36
Jan. 1976	460	29	490	1.17	44
Jan. 1977	513	29	542	1.20	52

It is unerstood from the table that the total number of telephones installed in the Philippines is increasing every year and since 1975 it has reached about 50,000.

The rate of spread of telephone has also increased and in January 1977 the number of telephones per 100 inhanitants was 1.20.

Most of the spread of telephone has been by facilities of private sector.

2. Telephone Installation Objectives in the "Five-Year Development Plan"

In the "Five-Year Development Plan" of the Government of the Philippines, the following objectives are set forth for installation of telephones.

(1) National Objective

a) To increase the number of telephones per 100 inhanitants from 1.29 to 2.18 in 10 years by increasing the number of telephones to 361,000.

b) To construct about 400 offices newly and install about 60,000 telephone lines in rural araas.

To construct 114 offices and lay 17,500 lines in the first 5 years.

To construct 283 offices and lay about 42,600 lines in the succeeding 5 years.

(2) BUTEL's Expansion Plan in Regions I and II

The installation and expansion plan proposed by BUTEL for Regions I and II in response to the above-mentioned national objective is as follows.

Table V-2-1 10-Year Telephone Expansion Plan for Regions I and II (Proposed by BUTEL)

Region	Local Exchanges		Number of IPTS's
	Number of Offices	Total Capacity	
I	36	9,400 Lines	15
II	25	5.500 Lines	19
Total	61	15,300 Lines	34

The installation of as many telephones as 361,000 in 10 years, which is set out as the national objective, means installation of about 36,000 telephones every year in average. This rate is nearly equal to the past record of installation as understood from the preceding paragraph. However, as far as the installation plan of BUTEL is concerned, 1000 - 1500 telephones will be constructed newly every year in Regions I and II by BUTEL. This is nearly equal to the sum of telephone installed so far or the present number of subscribers. This pitch of instalaltion is as rapid as unparalleled with the past pitches ever experienced.

3. Telephone instatllation Plan in This Project

3-1 Capacities of Fcailities

The installation plan of end offices in this project is outlined in Table V-3-1.

Table V-3-1 Installation Plan of End Offices

Phase	Local Exchange		I P T S	
	Number of Offices	Initial Total Capacity:	Number of Offices	Total of Capacity
Phase 1	19	5,800 Lines	19	380 Lines
Phase 2	26	5,400 Lines	31	620 Lines
Total	45	11,200 Lines	50	1,000 Lines

The expected design period of the initial capacity of exchange is 5 years after the commencement of the service.

That is, exchanges to be constructed in Phase 1 will be filled up with subscribers by 1987 and those to be constructed in Phase 2 by 1990.

The expansion of exchange capacity will be needed for telephone installation to be required afterword.

3-2 Telephone installation

The telephone installation plan in this project is as follows.

(1) Local exchange

In principle, telephone installation will be conducted for all demands.

However, telephone installation work should be scheduled and progressed systematically so that installation for all demands should be completed in 3 years after completion of the construction of facilities in Phases 1 and 2 for the purpose of installation balancing.

Afterward, installation will be made depending on the demand.

(2) IPTS

Each IPTS will be furnished with 20 lines. A maximum of 20 subscribers can be covered by each IPTS irrespective of the demand.

The installation plan corresponding to the demands mentioned in Part IV is shown in Table V-3-2.

In the 6-year period of 1982 - 1987, about 1300 - 1400 telephones will be installed per year.

This amount of planned annual installation corresponds to the BUTEL's annual installation plan of 1000 - 1500 telephones for Regions I and II which is mentioned in the preceding Item 2 (2).

In this project, a stress is put on forming the foundation of the network from the standpoint of making an effective long-term investment.

That is, construction of toll exchanges and that of transmission network for connecting exchanges higher than primary centers in office rank are designed to allow future expansion.

Further expansion and development can be anticipated on the basis of these facilities installed in this project.

Table V-3-2 Telephone Installation Plan of This Project

	Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total
Region I	Phase 1	999	999	999	209	209	209				3,624
	Phase 2				624	624	624	143	143	143	2,301
Region II	Phase 1	330	330	330	67	67	67				1,191
	Phase 2				475	465	475	95	95	95	1,710
T o t a l		1329	1329	1329	1375	1375	1375	238	238	238	8,826

4. Telephone Installation Plan is Regions I and II

The preceding paragraph describes the installation plan of facilities to be installed at exchanges to be constructed by this project.
Telephone installation in Regions I and II will be implemented also by BUTEL's expansion plan of the existing offices and transfer plan and also by expansion plans by the other operators.
All these installation plans are outlined in Table V-4-1 (in the upper half part) and shown in Fig. V-4-1 in the assumption that installation will be made for all forecast demands mentioned in Part IV. The lower half part of Table V-4-1 and Fig. V-4-2 show the trends of the number of subscribers and the rate of spread to be increased in Regions I and II by these installation plans.

(1) The oblique-line portion in Fig. V-4-1 indicates installation to be covered by this project.
(2) The peak of installation in the period of 1985 - 1987 is ascribable to BUTEL's installation plan for transferred offices.
(3) The rate of spread (or the number of subscribers per 100 inhabitants) will increase from 0.19 (in 1977) to 1.23 (in 1997) or over 6 times as large as that of 1977, which is nearly equal to the present national average of 1.2. More positive expansion is anticipated.

Table V-4-1 Number of Telephones and Subscribers to Increase per Future Year

Items		Year	1977	78	79	80	81	82	83	84	85	86	87	88 ~ 92	93 ~ 97
Number of Subscribers' Lines Installed	BUTEL	Region I	-	47	47	47	47	1,046	1,081	1,081	1,290	1,290	1,290	per year 639	per year 1,252
		Region II	-	124	124	124	124	454	456	456	668	668	668	358	1,203
		Total	-	171	171	171	171	1,570	1,607	1,607	1,958	1,958	1,958	997	2,455
	other Operators		2,019	2,019	2,019	2,019	2,019	2,019	2,320	2,320	2,320	2,320	2,320	2,740	3,628
Number of Subscrivers	BUTEL	Region I	827	874	921	968	1,015	2,061	3,142	4,223	5,513	6,803	8,093	(1992) 11,288	(1997) 17,548
		Region II	718	842	966	1,090	1,214	1,668	2,124	2,580	3,248	3,916	4,584	6,374	12,389
		Total	1,545	1,716	1,887	2,058	2,229	3,729	5,266	6,803	8,761	10,729	12,677	17,662	29,937
	Other Operators		8,690	10,389	12,728	14,747	16,766	18,785	21,105	23,425	25,745	28,065	30,385	44,085	62,225
	Total		10,235	12,105	14,615	16,805	18,995	21,514	26,371	30,228	34,406	38,794	43,062	61,747	92,162
Population (thousand)			5,467	5,566	5,665	5,764	5,863	5,962	6,068	6,174	6,280	6,386	6,493	6,976	7,472
No. of Subscribers per 100 Inhabitants			0.19	0.22	0.26	0.29	0.32	0.36	0.43	0.49	0.55	0.61	0.66	0.89	1.23

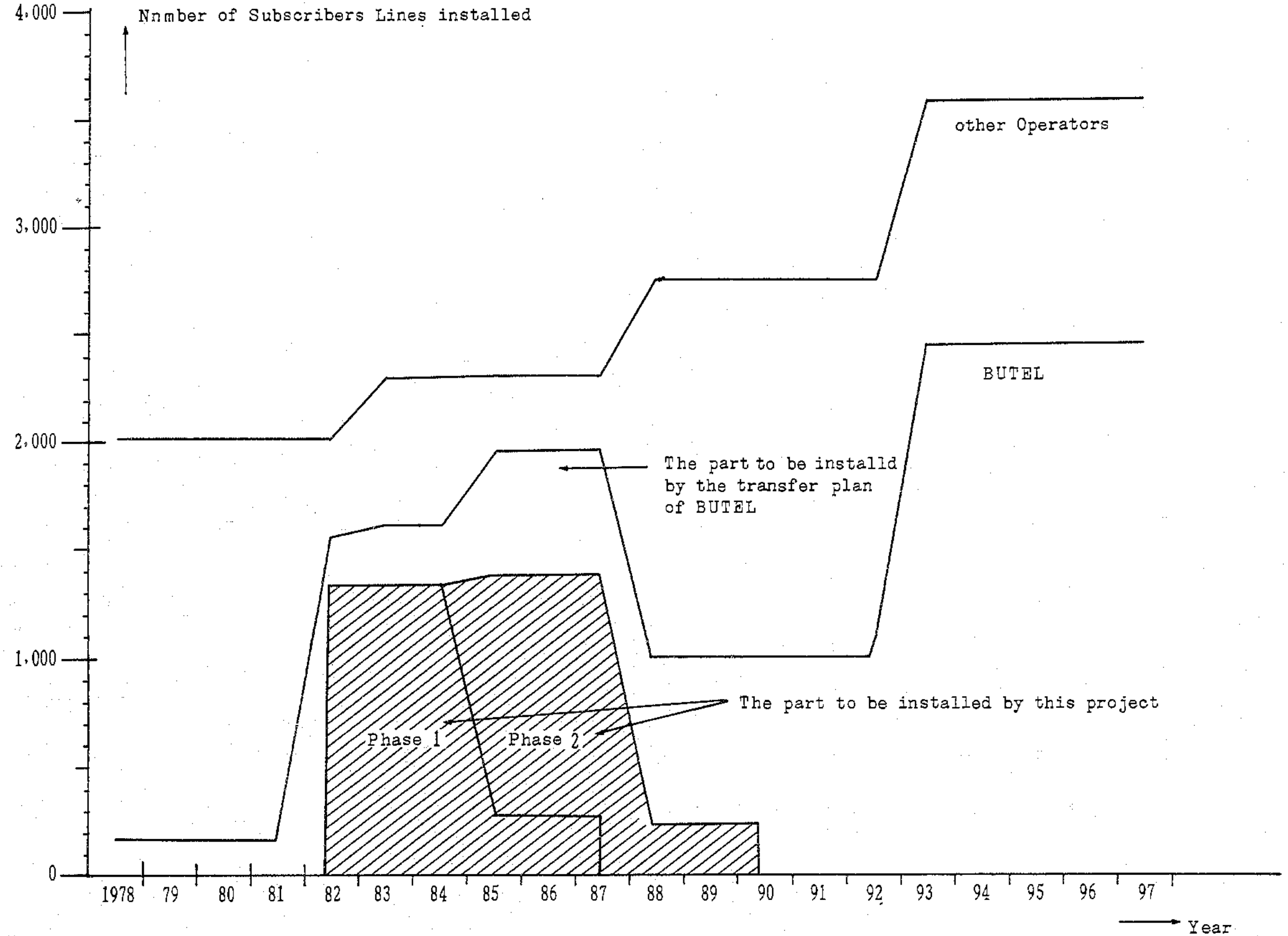


Fig. V−4−1 Number of Subscribers' lines Installed

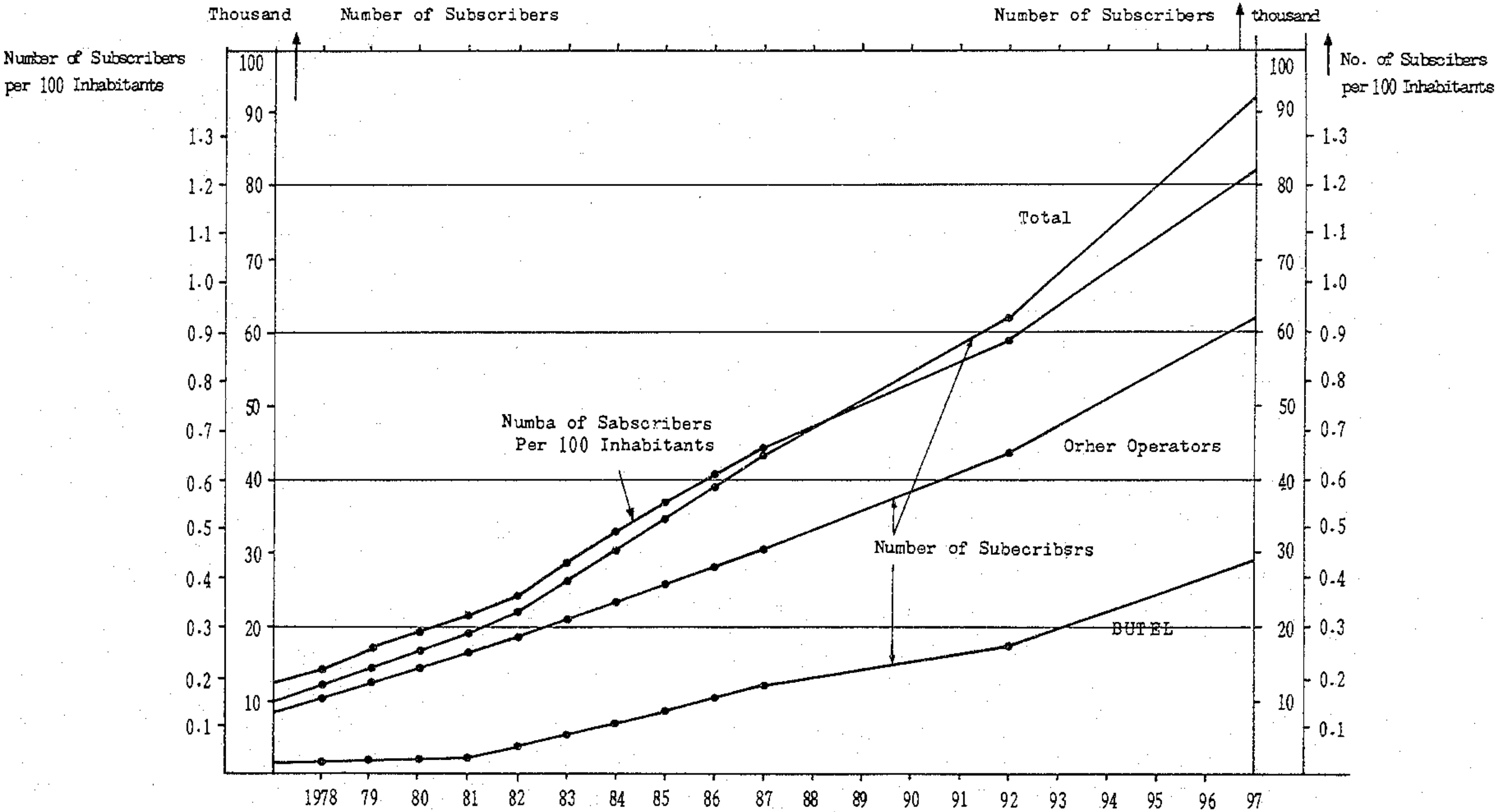


Fig. V－4－2 Number of Subscribers