VI. TRAFFIC FORECAST

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1. Telephone Traffic Forecast

1-1 Factors for Traffic Variation

It has been empirically known that the following factors vary the traffic.

(1) Quantitative and qualitative change of subscribers

Increase in the number of subscribers means development in understanding the usefulness of telephone and brings about increase in traffic. The frequency of use of telephone differs from subscriber to subscriber. In general, the frequency of use is: business company >industrial household> general resident. Accordingly, as the rate of spread of telephone becomes high and the percentage of resident telephone rises, the traffic per subsciber decreases.

(2) Economic change

In particular, toll calls are subject to change in economical circumstances.

(3) Change in urban characters

The traffic varies with the degree of social and ecomomic activeness in the areas (e.q., as to whether the area is a commercial or residential area) and with change in urban characters by such as invitation of manufacturing plants.

(4) Releationship between towns or cities

The traffic demand for toll calls depends on the distance between towns or cities and the type of combination between these towns or cities.

(5) Development in living stadard

With the sprend of telephones, use of telephone in daily life become habitual, which leads to increase in traffic demand.

(6) Service condition

If the communication condition is not good, telephone calls may be suspended. The traffic varies also with the method of treatment of calls. For example, when the service change from manual to STD, the traffic will increase.

(7) Change with charging rate system

Change in charging rate system naturally causes change in traffic. For example, the traffic changes with the change from flat rate service to message rate service of local calls and the change in rate

system by the introduction of STD.

These factors intersect each other as multidimensional social phenomena, so that it is extremely difficult to definitely know the relationship between these factors and the traffic.

In making traffic forecast, analysis of various data and references on these factors is necessary for determining the relationship with these factors synthetically, as well as wide knowledge and profound experience.

1-2 Model Equations for Traffic Forecast

Traffic variation is the results of influences of various factors. Accordingly, it is often difficult to anylyze traffic variation ascribable to a certain, single factor.

Here, let us consider the model equations between the traffic and several factors which seem to give serious influences to traffic variation.

This allows a method of traffic forecast to be made and the tendency of traffic variation to be known.

(1) Economical activities and traffic

(a) The following equation of traffic forecast is set out by a CCITT recommendation for the forecast of the total traffic of a country.

$$\text{Log } Q = Co + C \log Y$$

where
- Q: forecsst traffic
- Y: a measure of economic activity
- Co and C: constants determined by regression analysis on historical data

Y is the measure of economic activity which is obtained by the exterporation of Aistorical data. By this equation, forecast traffic Q can be obtained. (See CCITT Manual "Local Telephone Networks," GAS2, Chapter IV, ANNEX 2)

(b) The following two equations can empirically be obtained through experience in many countries.

$$Cp = 0.027 + 2.05\ Xp$$

where
- Cp: increase in the number of toll calls per year (%)
- Xp: increase in G.D.P. per year (%)

$$Cp = 1.96 + 1.79p + 0.74t - 0.55W$$

where
- Cp: rate of increase in the number of long distance calls per year
- P: rate of increase in customers' expenditure per year (%)
- t: rate of increase in the number of subscriber-originated toll calls per year (%)
- W: rate of increase in long distance call charging rate (%)

(See CCITT Manual "Economic Studies at the National Level in the Field of Telecommuncations," Chapter IV.)

(2) Distance and traffic

Traffic between two exchanges (A and B) can be roughly estimated as follows by using model equations.

(a) When traffic between exchange A and another exchange C is known, the following model equation is used for estimating the traffic between exchanges A and B.

$$A = \frac{as}{d^2}$$

where
- A: traffic between exchanges A and C (Erℓ)
- s: number of telephones covered by exchange C
- d: distance between A and C

When exchange areas B and C are similar to each other in relation with area A and no large differences exist.
"a" is obtained by substituting data between A and C into the above equation. Then the traffic between A and B can be estimated by using "a".

(b) When the traffic between exchanges A and C is not known, data of the traffic between exchanges C and D is obtained by the following model equation.

$$A = \frac{as_1 s_2}{d^2}$$

where
- A: traffic between exchanges C and D (Erℓ)
- s_1 and s_2: the numbers of telephones covered by exchanges C and D
- d: distance between exchanges C and D

First, the data between exchanges C and D is substituted to obtain "a". Then, the traffic between A and B is estimated by using "a" thus obtained.

In this case, it is to be noted what A-B section and A-C section do not differ greatly from each other in charging rate, etc., since otherwise the error may become large.

(3) Traffic and increase in the number of subscribers

An example of traffic forecast equations for increase in the number of subscribers is as follows.

$$Y = K\{a(s-1)^{\alpha} + c\}$$

Where Y: rate of increase of traffic per year at originating (terminating) office

s: rate of the number of subscribers per year at originating (terminating) office

α, a, and c: constants

K: coefficient for compensation for the rate per year for that year

1-3 Traffic Forecast Method

1-3-1 Traffic Forecast Years

Traffic forecast is made for 1987, 1990, and 1997.

The year 1987 will come 5 years after the implementation of Phase 1.

The year 1990 will be 5 years after the implementation of Phase II.

The results of forecast or these years are used for determining the initial capacities of facilities.

The year 1997 will be 15 years after the implementation of Phase 1 and the results of forecast for this year will be used for determining the ultimate capacities of facilities to be installed.

1-3-2 Premises for Forecast

(1) Subscribers to be covered

As per Paragraph III-1-5-1 "Scope of This Project." That is, all subscribers including the existing and expected subscribers in Regions I and II are to be covered.

(2) Installation plan

As per Part V "Telephone Demand Fulfilment plan." That is, all demands caused in a certain year are supposed to be, in principle, met within the year.

(3) Connection method

As per Capters III-3 "Natwork plan" and III-14 "Interface with Facilities of Private Operators." An outline of the connecting methods is as follows.

(a) Between BUTEL offices in Region I and II ..... STD

(b) From BUTEL office to Manila and major cities and Municipalities in Regions I and II ..... STD
From BUTEL office to other areas ..... Delay

(c) Outgoing calls from private operator's offices ..... Delay

(d) Connection of BUTEL network with private operator's networks is to be made by TS.

(4) Treatment of traffic by connection between subscribers of private operators

As per Section III-14 "Interface with Facilities of Prirate Operators."

That is, among traffics between private operators' subscribers, traffics in the following sections are excluded and will not be forecast.

Baguio - Manila
Dagupan - Manila
Baguio - Dagupan

(5) Network configuration and traffic

Traffic will pass in accordance with the network configuration and numbering plan described in Capter III-3 and III-5. An outline of the network configuration and traffic is as follows.

(1) All toll calls (by dialing "0" before telephone number) are to be via TS.

(2) Manual boards are to be concentrated to primary centers.

1-3-3 Traffic Forecast

The most useful thing for traffic forecast is the data of the present traffic distribution. In BUTEL, however, traffic measurement and management are not sufficient. In addition, existing facilities are not provided sufficiently for traffic demand. It may then happen that data obtained by measurement does not correctly represent actual traffic demand. In consideration of these circumstances, traffic forecast was made on the basis of the principles given in Sections 1-1 and 1-2 and with due consideration given to

a) Traffic measurements obtained during field survey at sites.

b) Survey on characteristics of respective areas and their circumstances of social activities.

c) Statistical data on population, the number of households, economical activities, etc.

d) CCITT references specifying actual conditions of respective countries.

e) Actual traffic trend from the past to the present in Japan

In making traffic forecast, the following statistical assumptions were used.

(1) Metro Manila has 400,000 telephone subscribers or nearly 80% of all subscribers in the country, plays a pivotal role in politics and economy, and receives most of toll calls from Regions I and II. This tends to comparatively raise the ratio of toll calls.

(2) In general, the number of toll calls from the central area to a rural area is smaller than that from the rural to central area.

(3) Traffic variation due to change in service

When, by the data obtained upon change in service, delay service is changed to STD,

a) Number of calls becomes approx. 2 times.

b) holding time becomes approx. 0.7 - 0.8 times.

(4) With increased distance between cities, the degree of closeness in in reletionship between them reduces rather abruptly. In particular, Regions I and II are separated by high mountains and their degree of closeness is rather small.

(5) Toll calls from large rural towns (centers in administrative economic activities in respective areas) to Manila and vice versa are more than those from small rural towns to Manila and vice versa.

Closeness in relationship between a certain rural town and a large rural town is more than that between the small rural town and another small rural town.

1-4 Results of Forecast

The results of forecast made on the assumptions mentioned in the preceding paragraph are as follows.

(1) Calling rates and toll call traffic for respective offices (Tables VIII-1-3-1 - VIII-1-3-8).

(2) Traffic conditions between primary centers (Table VI-1-3-1).

Table.VI-1-3-1 Toll Traffic Distribution

(Erlangs)

	From \ To	Lauag	Vigan	Baguio	Dagupon	Binalonan	Boyombong	Ilagan	Tuguegarao	Manila	Total
1987	Laoag	9.95	1.26	2.70	1.79	-	0.12	0.18	0.11	16.75	32.86
	Vigan	1.26	6.16	2.02	1.34	-	0.09	0.13	0.08	16.09	27.17
	Baguio	2.70	2.02	0.56	0.06	-	0.27	0.40	0.24	0.36	6.61
	Dagupan	1.79	1.34	1.37	10.41	-	0.18	0.26	0.16	5.81	21.32
	Binalonan	-	-	-	-	-	-	-	-	-	-
	Bayombong	0.12	0.09	0.27	0.18	-	3.80	1.94	0.87	10.89	18.16
	Ilagan	0.18	0.13	0.40	0.26	-	1.95	7.30	1.78	10.25	22.25
	Tuguegarao	0.11	0.08	0.24	0.16	-	0.87	1.78	3.50	8.00	14.74
	Manila	10.08	6.44	0.14	2.32	-	4.37	5.27	5.13	-	33.75
	Total	25.99	17.52	7.70	16.52	-	11.65	17.26	11.87	68.15	176.86

	From \ To	Laoag	Vigan	Baguio	Dagupon	Binalonan	Boyombong	Ilagan	Tuguegarao	Manila	Total
1990	Laoag	17.59	1.76	3.60	2.33	0.69	0.19	0.31	0.17	21.35	47.99
	Vigan	1.76	8.15	2.23	1.45	0.43	0.12	0.19	0.11	21.42	35.86
	Baguio	3.60	2.23	2.07	0.20	2.04	0.34	0.54	0.31	1.56	12.89
	Dagupan	2.33	1.45	1.18	7.78	3.45	0.22	0.35	0.20	6.00	22.96
	Binalonan	0.69	0.43	2.04	3.45	6.18	0.11	0.17	0.10	8.62	21.79
	Bayombong	0.19	0.12	0.34	0.22	0.11	6.00	2.72	1.21	16.32	27.23
	Ilagan	0.31	0.19	0.54	0.35	0.17	2.72	13.41	2.62	16.20	36.51
	Tuguegarao	0.17	0.11	0.31	0.20	0.10	1.21	2.62	6.01	11.62	22.35
	Manila	11.69	8.57	0.62	3.45	3.86	6.54	7.98	7.06	-	49.77
	Total	38.83	23.01	12.93	19.43	16.03	17.45	28.29	17.79	103.09	276.35

	From \ To	Laoag	Vigan	Baguio	Dagupon	Binalanan	Boyombong	Ilagan	Tuguegarao	Manila	Total
1997	Laoag	46.33	3.95	8.00	5.11	1.84	0.43	0.76	0.58	39.32	106.32
	Vigan	3.95	24.24	4.25	2.72	0.98	0.22	0.44	0.30	36.48	73.58
	Baguio	8.00	4.25	4.88	0.38	4.60	0.65	1.14	0.86	2.46	27.22
	Dagupan	5.11	2.72	2.47	20.48	8.76	0.41	0.73	0.55	10.25	51.48
	Binalonan	1.84	0.98	4.60	8.76	12.68	0.24	0.43	0.33	13.60	43.46
	Bayombong	0.43	0.22	0.65	0.41	0.24	16.98	4.81	2.15	27,62	53.51
	Ilagan	0.76	0.44	1.14	0.73	0.43	4.81	36.71	6.91	27.79	79.72
	Tuguegarao	0.58	0.30	0.86	0.55	0.33	2.15	6.91	27.16	24.56	62.80
	Manila	22.52	14.63	0.98	4.10	5.44	11.06	13.56	13.65	-	85.94
	Total	89.52	51,73	27.83	43.24	25.30	36.95	65.49	52.48	182.09	584.63

2. Telegraph Traffic Forecast

2-1 Telex

In Northern Part of Luzon, telex facilities are operating but only for telegram communication between BUTEL's telegraph offices and are not used by telex subscribers such as general business companies. Accordingly, data of telex traffic has not been achieved. The following basic values for traffic are exployed herein.

i) Busy-hour traffic
(Sending and receiving): 0.08 Erlangs/subscriber

ii) Average holding time per telex call: 38 minutes

2-2 Gentex

(1) Number of telegrams handled

In the present survey, no accurate traffic data of the respective telegraph offices was obtained. This is because of the unstability in operation due to the use of out-of-date telegraph facilities. Indeed, long-time nonavailability or failure ocuurs very often. The estimated traffic obtained by using data acquired in this survey and the traffic carried by private operators in the respective regions are given in Table VI-2-2-1. It is understood from this table that the percentage of telegrams covered by BUTEL is less than 50% of the entire amount of telegrams in each region. However, this percentage will greatly increase by improving the existing facilities of BUTEL. This remarkable increase in the percentage of the amount of telegrams will be ascribable to the return of telegrams from private operators to BUTEL by upgrading service through the improvement of BUTEL's facilities and natural increase caused by stimulation triggered by the improvement of facilities. In addition the population is expected to increase about 18% from now by 1985 and about 30% from now by 1990. In consideration of all these, it can be estimated that the traffic will increase about 30% from now by 1987 and about 50% from now by 1990.

(2) Holding time

Let us now estimate the time required for communication of one telegram. Telegrams are sent manually through typewriting by the operator. The procedure to be followed in sending a telegram is given in Table VI-2-2-2.

The table indicates a typical case of sending and receiving a telegram. Actually, some factors of redundancy must be added. Thus the following suppositions should be made.

(i) In sending a telegram, the redundant holding time which may be required for the recovery of trouble encountered and for retransmission is 20 secunds in average.

(ii) The required reduntandant holding time per incoming relegram is 10 seconds in average.

From these suppositions, the teleprinter occupying time for sending a telegram can be estimated to be 120 seconds and the period of time during which the circuit (or exchange) is occupied by a telegram is estimated to be 100 seconds.

(3) Distribution ratio of busy-hour traffic

In order to obtain busy-your traffic distribution, an example of telegram traffic distributions which has been obtained from a country having a similar business hour as in the Philippines was employed. Fig. VI-2-2-1 shows that the distribution ratio of busy hour traffic in 13.2%.

(4) It can be known by existing traffic distribution that outgoing traffic of Gentex stations is larger than incoming traffic of that.

(5) Those suppositions will lead to the following equation for traffic estimation.

Total traffic(T) = B x 1/30 x 13.2/100 x (100 + 120)/7200 [Erl]

Outgoing traffic = T x 120/220 [Erl]

Incoming traffic = T x 100/220 [Erl]

Table VI-2-2-1Average Telegram Traffic per Monthe

(in round numbers)

as of 1978

Area	BUTEL	RCPI	TELE-FAST	CAP-WIRE	UTS	CRS	Total
Baguio	16,000	14,000	4,500	500	200	200	35,400
Bontoc	400	1,000					1,000
Tuguegarao	4,500	7,500	500	200	500		13,200
Aparri	4,000	9,000	1,300		500		14,800
Tabuk	2,500	2,000					4,500
San Fernando	2,100	6,000	2,000		500		8,800
Agoo	1,000	1,500					2,500
Laoag	3,500	10,000	2,000	200			2,500
Batac	1,000	1,800					2,800
Vigan	1,200	6,500	400				8,100
Bangued	1,800	3,200					5,000
Candon	600	2,500					3,100
Dagupan	4,500	9,000	1,600	300		600	16,000
San Carlos	700	2,000					2,700
Lingayen	800	2,300					3,100
Alaminos	1,000	2,400	100				3,500
Urdaneta	2,500	5,100	200				7,800
Ilagon	2,300	3,800	500	4,300	600		11,500
Roxas	700	2,000					2,700
Santiago	4,500	7,500	900		600		13,500
Echague	600	1,000					1,600
Bayombong	3,200	4,400	700		400		8,700
Banaue	700	1,200					1,900
Cabarroguis	300	400					700

Table VI-2-2-2 Standard Holding Time Necessary for Sending and Receiving One Telegram at Gentex Position

Item	No. of charactors	Duration (sec)	Remarks
Depress the calling button. -- Lamp on		1	
Send selection signal (5 digits).		3	
Connection sets up.		6	
Called teleprinter starts up.		1	
ANS BACK receiving		4	
ANS BACK sending		4	
o Special code o Message (including address) o CR, IF and space o Day and time	20 200 50 10 280	Manual 85 Automatic 36	
ANS BACK sending		4	
Connection released		1	
Total		100	Transmission
		90	Reception

Note: Transmitting speed

Manual: 3.3 char. per sec.

Automatic: 7.7 char. per sec.

Table VI-2-2-3Gentex Traffic Forecast (Phase 1)

* as of 1977

** as of 1987

Station	Average Monthly Telegram Traffic (A)	** A x 1.3 = B	** Busy-Hour Traffic (Erl)		
			Total Calls	Outgoing Calls	Incoming Calls
Baguio	16,000	20,800	2.79	1.52	1.27
Tuguegarao	4,500	5,850	0.78	0.43	0.35
Aparri	4,000	5,200	0.69	0.37	0.32
San Fernando	2,100	2,430	0.33	0.18	0.15
Agoo	1,000	1,300	0.17	0.09	0.08
Laoag	3,500	4,550	0.61	0.33	0.28
Vigan	1.500	1,950	0.26	0.14	0.12
Bangued	1,800	2,340	0.31	0.17	0.14
Dagupan	4,500	5,850	0.78	0.43	0.35
Lingayen	800	1,030	0.14	0.08	0.06
Alaminos	1,000	1,300	0.17	0.09	0.08
Urdaneta	2,500	3,250	0.44	0.24	0.20
Ilagan	2,300	2,990	0.40	0.22	0.18
Santiago	4,500	5,850	0.78	0.43	0.35
Bayombong	3,200	4,160	0.56	0.30	0.26
Cabarroguis	300	390	0.05	0.03	0.02

Table VI-2-2-4Gentex Station Traffic Forecast (Phase 2)

* as of 1977

** as of 1990

Station	Average Monthly Telegram Traffic (A)	** A x 1.3 = B	** Busy-Hour Traffic (Erl)		
			Total Calls	Outgoing Calls	Incoming Calls
Baguio	16,000	24,000	3.17	1.70	1.42
Bontoc	400	600	0.08	0.044	0.036
Tuguegarao	4,500	6,750	0.88	0.48	0.40
Aparri	4,000	6,000	0.78	0.43	0.35
Tabuk	2,500	3,750	0.49	0.27	0.22
San Fernando	2,100	3,150	0.42	0.23	0.19
Agoo	1,000	1,500	0.20	0.11	0.09
Laoag	3,500	5,250	0.49	0.27	0.22
Batac	1,000	1,500	0.20	0.11	0.09
Vigan	1,500	2,250	0.30	0.16	0.14
Bangued	1,800	2,700	0.35	0.19	0.16
Candon	600	900	0.12	0.07	0.05
Dagupan	4,500	6,750	0.88	0.48	0.40
San Carlos	700	1,050	0.14	0.08	0.06
Lingayen	800	1,200	0.16	0.09	0.07
Alaminos	1,000	1,500	0.20	0.11	0.09
Urdaneta	2,500	3,750	0.49	0.27	0.22
Ilagan	2,300	3,450	0.45	0.25	0.20
Roxas	700	1,050	0.14	0.08	0.06
Statiago	4,500	6,750	0.88	0.48	0.40
Echague	600	900	0.12	0.07	0.05
Bayombong	3,200	4,800	0.62	0.34	0.28
Banaue	700	1,050	0.14	0.08	0.06
Cabarroguis	300	450	0.06	0.04	0.02

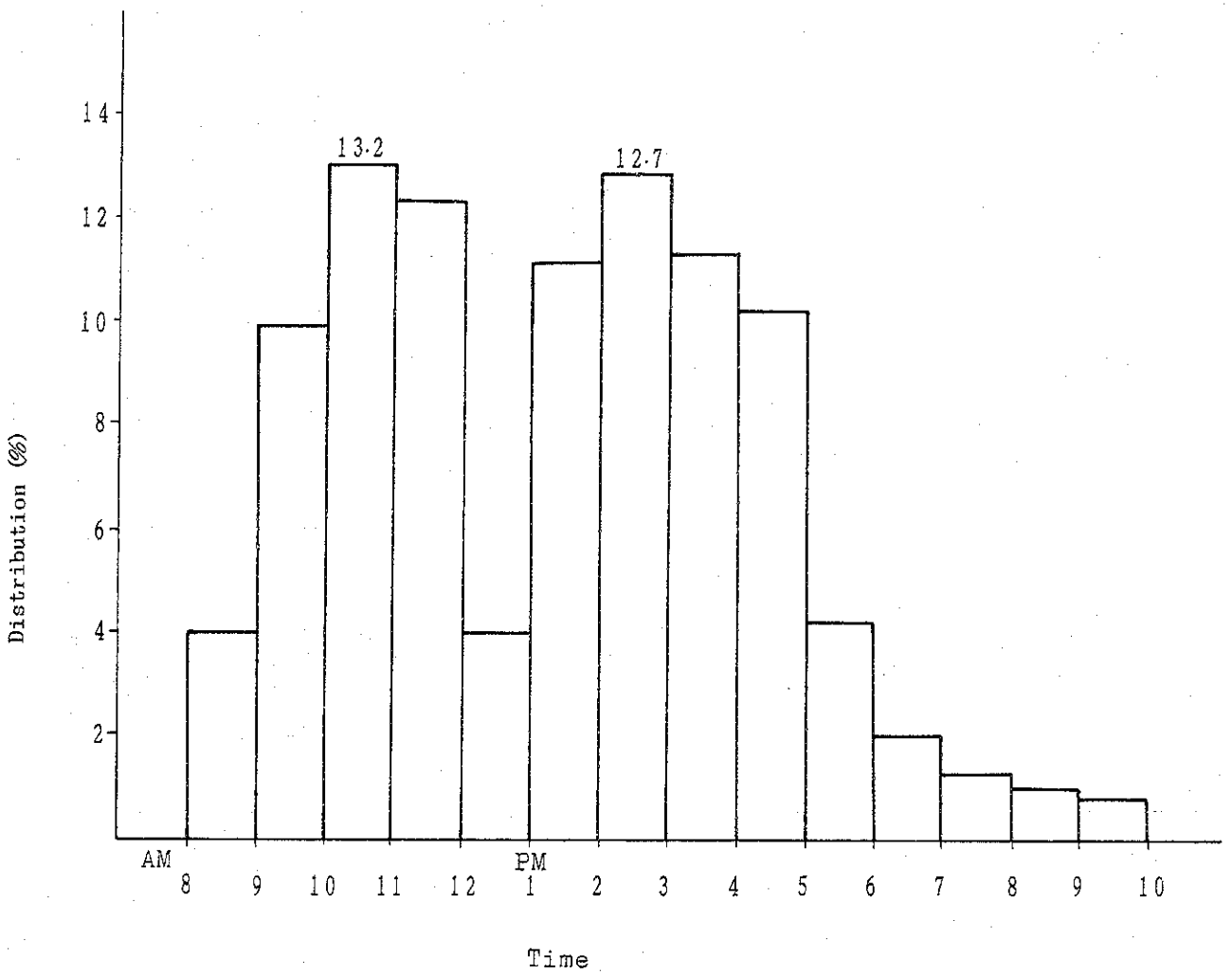


Fig. VI－2－1 Example of Hourly Traffic Distribution for One Day

VII. CIRCUIT ESTIMATION

VII. CIRCUIT ESTIMATION

1. Telephone

1.1 Routing Plan and Loss Provability

Circuit estimation is made in accordance with the routing plan mentioned in Chapter III-3 "Network Plan."

(1) Network configuration between primary center and office

a) The configuration of the network between primary center and end office will be a complete star type and all trunks from end offices will be final (basic) trunks to primary centers.

b) Miscellaneous trunks will be provided for number check, test, and outgoing calls from the switch board.

(2) Network configuration for connection between offices ranking higher than primary centers

The network uses mainly the basic trunk for connection with Baguio secondary center but will also include traversal trunks as follows.

The network to be established by this project will include the trunks to Manila and takes Manila for a primary center.

a) A high-usage trunk will be set between primary centers with a traffic exceeding a given level (5 erlangs), and overflown calls will be detoured to the final (basic) trunk.

b) Primary centers in Regions I and II can be classified into 3 groups geographically.

Northern Part of Region I:	Laoag, and Vigan
Southern Part of Region I:	Dagupan, and Binalonan
Region II:	Tuguegarao, Ilagan and Bayombong

A final traversal trunk will be set for calls between primary centers in the respective group irrespective of traffic.

This is because if calls in these groups are connected by the basic trunk, they must be sent via Baguio secondary center, which will require extremely high cost for transmission.

c) Calls originated from Manila will be interconnected with the BUTEL's network in Baguio.

According, in order to clarify the boundaries between private operators and BUTEL, no traversal trunk will be set irrespective of the traffic and the basic trunk, which will pass Baguio, TS will be set.

(3) Loss probability for estimation of the number of trunks

The loss probability used upon estimation of the number of trunks is made 0.01 in accordance with Chapter III-1.

In the traffice engineering standard, a loss probability of 0.01 is allotted to each basic route for the future network composed of tertiary center, secondary center, promary center, and end office in office hierarchy. Since this project employs a 3-stage network hierarchy excluding tertiary center, a loss probability of exceeding 0.01 can be allotted to the basic route but the standard loss probability is proposed to allow smooth transfer to the future network.

1-2 Erlang Table for Estimation of the number of trunks

The following erlang table prepared by NTT is employed for estimation of the number of trunks.

(1) Basic trunk

a) When no overflown call is included: Erlang table for full availability trunks (for random calls)

b) When overflown calls are included: Erlang table for full availability trunks (for non-random calls)

(2) Traveral trunk

a) When overflown calls are detoured to basic trunk: Erlang table for full availability high-usage trunks (for toll colls)

b) When overflown calls are treated as lost: Erlang table full availability trunk (for random calls)

1-3 Results of trunk Estimation

The results of the estimation of the number of trunks for the traffic data given in the proceeding part are as follows.

(1) Number of trunks between end office and primary center: Table VII-1-3-1(1/8)~(8/8)

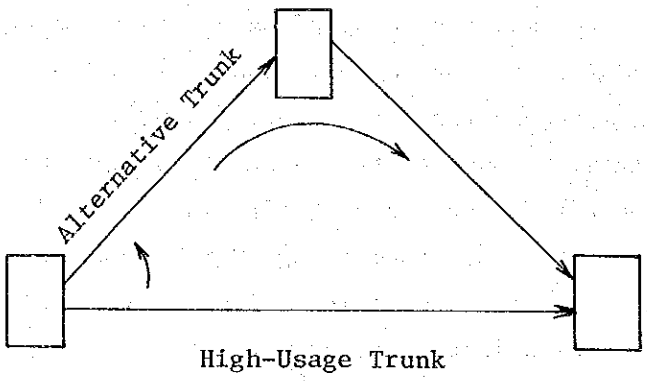
(2) Number of trunks between primary centers: Table VII-1-3-2 and Fig. VII-1-3-1

In this case, high-usage trunk is set in the sections between each primary center and Manila.

The configuration of the network to be established by this project (by completion of Phases 1 and 2) is shown in Fig. VII-1-3-2.

1-4 High-Usage Trunk Estimation

One of the major features of common control crossbar switch is the alternative routing function in which when a certain route is busy, detouring is allowed by taking a different route. This allows effective use of the network. That is, the network can be divided into high-usage trunks and final trunks for transmitting overflow calls for the purpose of economy of the entire network cost.



Triangular Network

(1) Estimation of high-usage trunks

When the number of high-usage trunks increases, the traffic to be carried by the final trunk of the high-usage trunk group decreases and the trunk cost for carried traffic increases. Accordingly, there is point over which it becomes more advantageous to detour overflown calls via the alternative route when the number of trunks exceeds a certain value. By this, the number of high-usage trunks is set. That is, the number of high-usage trunks should be determined so that the traffic to be carried by the final trunk in the high-usage trunk group should not be less than

$$LTC = \frac{ATC}{K}$$

where LTC: traffic carried by the final trunk in the high-usage trunk group

ATC: increment of the traffic carried by addition of one trunk in the alternative route

K: Trunk cost ratio of the alternative trunk to high-usage trunk

Estimation is made by using the erlang table for full availability high-usage trunks.

In the erlang table for full availability high-usage trunks, the relationship of offered traffic -- the number of high-usage trunks -- overflow traffic is tabulated for different cost ratios.

In setting high-usage trunks, it is necessary to judge synthetically from the standpoint of ease of maintenance and construction and other non-economical factors as well and it is not advantageous to set high-usage trunks for small traffic demand.

Accordingly, high-usage trunks should be set only for such sections that have traffic exceeding 5 elrangs.

(2) Estimation of trunks containing overflown calls

When a given traffic is applied to a certain trunk group, the traffic repeats instantenuous variation over a given value. It is empirically known that the variance of the number of calls at the respective instances approximates near to the average value. This type of calls is called random calls. Tables used for general trunks are intended for these random calls. The erlang table full availability trunk (for random calls) is an example.

On the other hand, overflown calls provide such a property that traffic appear instantenuously when the trunk group is completely occupied and do not appear in other occasions.

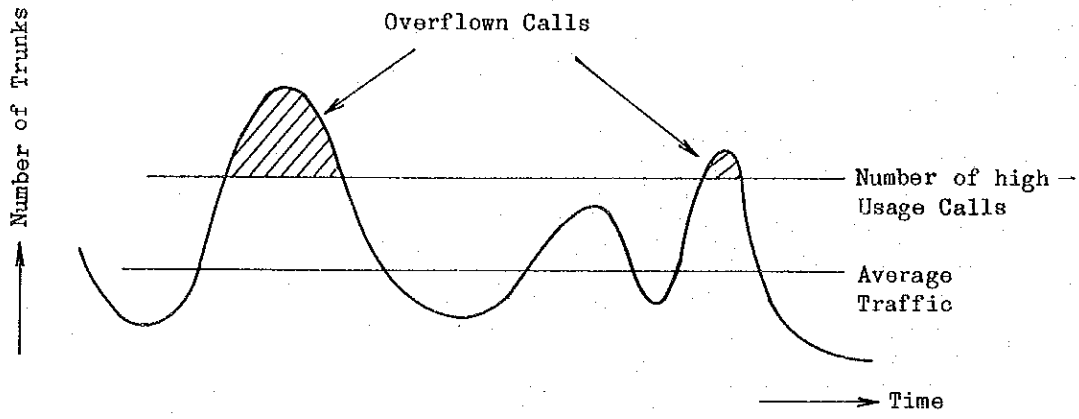
That is, overflown calls has considerably changed in property from the original calls.

It is empirically known that the variance of the number of overflown calls at respective instances is considerably large when compared with the average value.

It is then necessary to treat overflown calls separately from random calls. This type of calls is called non-random calls.

Under a given loss probability, more trunks are required by non-random calls of a given traffic than by random calls of the same traffic. This increment depends on the variance representing the magnitude of the peak characteristic of non random calls.

Accordingly, it is necessary to use a table for non-random calls for the estimation of trunks containing overflown calls. The erlang table for full availability trunks (for non-random calls) is intended for this purpose.



Instantaneous Variation of Calls

Fig.VII-1-3-1(1/8) Number of Toll Trunks

Laoag PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC				DEMAND	CAPACITY	OG		IC				DEMAND	CAPACITY	OG		IC				
					ERL	LINES	GENERAL		MISC LINES	TOTAL LINES			ERL	LINES	GENERAL		MISC LINES	TOTAL LINES			ERL	LINES	GENERAL		MISC LINES	TOTAL LINES	
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Batac	0.03	740	800	7.33	14	5.86	12	4	30	940	1000	7.31	17	8.29	16	4	37	1470	1500	14.55	24	11.64	20	4	48	LS
"	Dingras	"	260	300	2.57	8	2.06	7	4	19	320	400	3.17	9	2.82	8	4	21	500	500	4.95	11	3.96	10	4	25	"
"	Paoay	"	190	200	1.88	6	1.51	6	3	15	235	300	2.33	7	2.07	7	4	18	380	400	3.76	9	3.01	8	4	21	"
"	Sarrat	"	110	200	1.09	5	0.87	4	3	12	135	200	1.34	5	1.19	5	3	13	210	300	2.08	7	1.66	6	4	17	"
"	Currimao	"	100	20	-	-	-	-	-	3	128	20	-	-	-	-	-	3	200	200	1.98	7	1.58	6	3	16	IPTS→LS
"	Espiritu	"	40	20	-	-	-	-	-	3	52	20	-	-	-	-	-	3	80	20	-	-	-	-	-	-	IPTS
"	Pasuquin	"	100	20	-	-	-	-	-	3	125	20	-	-	-	-	-	3	190	200	1.89	6	1.51	6	3	15	IPTS→LS
"	Pidding	"	65	20	-	-	-	-	-	3	80	20	-	-	-	-	-	3	120	120	1.19	5	0.95	5	3	13	IPTS→LS
2	Badoc	0.03	160	-	-	-	-	-	-	-	210	300	2.08	7	1.85	6	4	17	340	400	3.37	9	2.69	8	4	21	LS
"	Pagudpud	"	80	-	-	-	-	-	-	-	98	200	0.97	5	0.86	5	3	13	160	200	1.58	6	1.27	5	3	14	"
"	Vintar	"	110	-	-	-	-	-	-	-	140	200	1.39	6	1.24	4	3	13	220	300	2.18	7	1.74	7	4	18	"
"	Pinili	"	40	-	-	-	-	-	-	-	52	200	0.52	4	0.46	3	3	10	85	200	0.84	4	0.67	4	3	11	"
"	Solsona	"	90	-	-	-	-	-	-	-	110	200	1.09	5	0.97	5	3	13	170	200	1.68	6	1.35	5	3	14	"
"	Bangui	"	40	-	-	-	-	-	-	-	52	20	-	-	-	-	-	3	80	20	-	-	-	-	-	3	IPTS
"	Burgas	"	20	-	-	-	-	-	-	-	26	20	-	-	-	-	-	3	40	20	-	-	-	-	-	3	"
"	Marcos	"	30	-	-	-	-	-	-	-	38	20	-	-	-	-	-	3	65	20	-	-	-	-	-	3	"
"	Nueva Era	"	25	-	-	-	-	-	-	-	28	20	-	-	-	-	-	3	50	20	-	-	-	-	-	3	"
T	Bacarra	"	280	-	-	-	-	-	-	-	345	400	3.04	9	3.04	9	4	22	530	600	5.25	12	4.20	10	4	26	LS

T: Transferred Exchange

Table VII-1-3-1(2/8) Number of Toll Trunks

Vigan PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC				DEMAND	CAPACITY	OG		IC				DEMAND	CAPACITY	OG		IC				
					ERL	LINES	GENERAL		MISC LINES	TOTAL LINES			ERL	LINES	GENERAL		MISC LINES	TOTAL LINES			ERL	LINES	GENERAL		MISC LINES	TOTAL LINES	
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Bangued	0.03	550	600	5.45	12	4.36	10	4	26	710	800	7.03	14	6.26	13	4	37	1120	1200	11.09	19	8.87	16	4	39	LS
"	Cabugao	"	110	200	1.09	5	0.86	4	3	12	135	200	1.34	5	1.19	5	3	13	210	300	2.08	7	1.66	6	4	17	LS
"	Narvacan	"	100	200	0.99	5	0.79	4	3	12	120	200	1.19	5	1.06	5	3	13	180	200	1.78	6	1.43	6	3	15	LS
"	Tagudin	"	75	200	0.74	4	0.59	4	3	11	90	200	0.89	5	0.79	4	3	12	140	200	1.39	6	1.11	5	3	14	LS
"	Santa	"	80	20	-	-	-	-	-	3	62	20	-	-	-	-	-	3	150	200	1.49	6	1.19	6	3	15	IPTS→LS
"	Santa Maria	"	90	20	-	-	-	-	-	3	115	20	-	-	-	-	-	3	170	200	1.69	6	1.35	5	3	14	IPTS→LS
"	Santo Domingo	"	65	20	-	-	-	-	-	3	80	20	-	-	-	-	-	3	120	200	1.19	5	0.95	5	3	13	IPTS→LS
2	Magsingal	"	95	-	-	-	-	-	-	-	115	200	1.14	5	1.01	5	3	13	180	200	1.78	6	1.43	6	3	15	LS
"	Sinait	"	80	-	-	-	-	-	-	-	100	200	0.99	5	1.88	5	3	13	150	200	1.44	6	1.19	5	3	14	LS
"	Caoayan	"	70	-	-	-	-	-	-	-	85	20	-	-	-	-	-	3	130	200	1.29	5	1.03	5	3	13	IPTS→LS
"	Santa Lucia	"	70	-	-	-	-	-	-	-	88	20	-	-	-	-	-	3	140	200	1.39	6	1.11	5	3	14	IPTS→LS
E	Candon	0.03	440	500	4.36	10	3.49	9	4	23	530	600	5.27	12	4.68	11	4	27	800	800	7.92	15	6.34	13	4	32	LS
E	Vigan	0.04	1030	1100	(100) 12.98 (Others) 0.618	(100) 22 (Others) 4	10.88	19	4	49	1410	1500	(100) 17.77 (Others) 0.85	(100) 27 (Others) 4	4.89	24	4	59	2000	2000	(100) 25.2 (Others) 1.2	(100) 36 (Others) 5	21.12	31	4	76	LS

E: Existing Exchange

(100): Calls handled by special code 100

Table VII-1-3-1(3/8) Number of Toll Trunks

Baguio SC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL						ERL	LINES	GENERAL						ERL	LINES	GENERAL				
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Bontoc	0.03	90	200	0.89	5	0.71	4	3	12	108	200	1.07	5	0.95	5	3	13	160	200	1.58	6	1.27	5	3	14	LS
2	Mankayan	0.03	180	-	-	-	-	-	-	-	245	300	2.43	7	216	7	4	18	400	400	3.76	9	3.01	8	4	21	LS
"	Bokod	"	30	-	-	-	-	-	-	-	36	20	-	-	-	-	-	3	60	20	-	-	-	-	-	3	IPTS
"	Sagada	"	50	-	-	-	-	-	-	-	70	20	-	-	-	-	-	3	110	200	1.09	5	0.87	5	3	13	IPTS→LS

Table VII-1-3-1(4/8) Number of Toll Trunks

Dagupan PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL						ERL	LINES	GENERAL						ERL	LINES	GENERAL				
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Alaminos	0.03	420	500	4.16	10	3.33	8	4	32	520	600	5.15	11	4.59	11	4	26	820	900	8.12	16	6.49	13	4	33	LS
"	Binalonan	"	620	700	6.14	13	4.91	11	4	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	LS
"	San Fabian	"	160	200	1.58	6	1.27	5	3	14	195	200	1.93	7	1.72	6	3	16	310	400	3.07	8	2.46	7	4	19	LS
"	Mapandan	"	80	20	-	-	-	-	-	3	104	20	-	-	-	-	-	3	170	200	1.68	6	1.35	5	3	14	IPTS→LS
"	San Jacinto	"	80	20	-	-	-	-	-	3	105	20	-	-	-	-	-	3	160	200	1.58	6	1.27	5	3	14	IPTS→LS
"	San Quintin	"	70	20	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IPTS
2	Bani	0.03	112	-	-	-	-	-	-	-	145	200	1.44	6	1.15	5	3	15	220	300	2.18	7	1.74	6	4	17	LS
"	Bolinao	"	85	-	-	-	-	-	-	-	105	200	1.04	5	0.83	4	3	12	160	200	1.58	6	1.27	5	3	14	LS
"	Uroiz-tondo	"	100	-	-	-	-	-	-	-	124	200	1.23	5	0.98	5	3	13	195	200	1.93	7	1.55	6	3	16	LS
"	Aguilar	"	75	-	-	-	-	-	-	-	93	20	-	-	-	-	-	3	140	200	1.39	6	1.11	5	3	14	IPTS→LS
"	Santo Tomas	"	75	-	-	-	-	-	-	-	96	20	-	-	-	-	-	3	150	200	1.49	6	1.19	5	3	14	IPTS→LS
T	Bugallon	0.03	155	-	-	-	-	-	-	-	197	200	1.95	7	1.59	6	3	16	310	400	3.07	8	2.46	7	4	19	LS
T	Santa Barbara	0.03	120	-	-	-	-	-	-	-	150	200	1.49	6	1.19	5	3	14	240	300	2.38	7	1.90	6	4	17	LS

T: Transferred Exchange

Table VII-1-3-1(5/8) Number of Toll Trunks

Binalonan PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL						ERL	LINES	GENERAL						ERL	LINES	GENERAL				
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Binalo-nan	0.03	620	-	-	-	-	-	-	-	790	800	7.82	15	6.26	13	4	32	1280	1300	12.67	21	10.14	18	4	43	LS
"	San Quintin	"	70	-	-	-	-	-	-	-	87	20	-	-	-	-	-	3	135	200	1.34	5	1.07	5	3	13	IPTS→LS
2	Alcala	0.03	80	-	-	-	-	-	-	-	98	200	0.97	5	0.78	4	3	12	160	200	1.58	6	1.27	5	3	14	LS
"	Asingan	"	160	-	-	-	-	-	-	-	200	200	1.98	1	1.58	6	3	16	320	400	3.17	9	2.54	8	3	20	"
"	San Nicolas	"	80	-	-	-	-	-	-	-	100	200	0.99	5	0.79	4	3	12	150	200	1.49	6	1.19	5	3	14	"
"	Santa Maria	"	70	-	-	-	-	-	-	-	88	200	0.87	5	0.70	4	3	12	150	200	1.49	6	1.19	5	3	14	"
"	Sison	"	90	-	-	-	-	-	-	-	115	200	1.14	5	0.91	5	3	13	180	200	1.78	6	1.43	6	3	15	"
"	Balungao	"	60	-	-	-	-	-	-	-	72	20	-	-	-	-	-	3	115	200	1.14	5	0.91	5	3	13	IPTS→LS
"	Bautista	"	65	-	-	-	-	-	-	-	80	20	-	-	-	-	-	3	125	200	1.24	5	0.99	5	3	13	IPTS→LS
"	Natridad	"	68	-	-	-	-	-	-	-	78	20	-	-	-	-	-	3	110	200	1.09	5	0.87	5	3	13	IPTS→LS
T	Pozorru-bio	0.03	290	-	-	-	-	-	-	-	365	400	3.61	9	2.89	8	4	21	580	600	5.74	12	4.59	11	4	27	LS
T	Umingan	"	280	-	-	-	-	-	-	-	340	400	3.37	9	2.69	8	4	21	510	600	5.05	11	4.04	10	4	25	LS

T: Transferred Exchange

Table VII-1-3-1(6/8) Number of Toll Trunks

Tuguegarao PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL						ERL	LINES	GENERAL						ERL	LINES	GENERAL				
							ERL	LINES							ERL	LINES							ERL	LINES			
1	Enrile	0.03	105	200	1.04	5	0.926	5	3	13	150	300	1.29	5	1.03	5	3	13	210	300	2,08	7	1.85	6	4	17	LS
"	Solana	"	160	200	1.58	6	1.411	6	3	15	220	300	1.98	7	1.58	6	4	17	320	400	3.17	9	2.82	8	4	21	"
"	Balloes-teros	"	110	20	-	-	-	-	-	3	160	20	-	-	-	-	-	3	220	300	2.18	7	1.94	7	4	18	IPTS→LS
"	Basco	"	11	20	-	-	-	-	-	3	16	20	-	-	-	-	-	3	21	20	-	-	-	-	-	3	IPTS
"	Claveria	"	110	20	-	-	-	-	-	3	160	20	-	-	-	-	-	3	220	300	2.18	7	1.94	7	4	18	IPTS →LS
"	Gonzaga	"	90	20	-	-	-	-	-	3	130	20	-	-	-	-	-	3	190	200	1.88	6	1.68	6	3	15	IPTS →LS
"	Lel-lo	"	90	20	-	-	-	-	-	3	130	20	-	-	-	-	-	3	180	200	1.78	6	1.59	6	3	15	IPTS →LS
"	Sanchez-Mira	"	120	20	-	-	-	-	-	3	170	]0	-	-	-	-	-	3	240	300	2.38	7	2.12	7	4	18	IPTS →LS
"	Tuao	"	140	20	-	-	-	-	-	3	200	20	-	-	-	-	-	3	280	300	2.77	8	2.47	7	4	19	IPTS →LS
2	Alcala	0.03	90	-	-	-	-	-	-	-	130	200	1.13	5	0.91	5	3	13	180	200	1.78	6	1.59	6	3	15	LS
"	Baggao	"	130	-	-	-	-	-	-	-	185	200	1.63	6	1.31	5	3	14	260	300	2.57	7	2.29	7	4	19	LS
"	Abulug	"	80	-	-	-	-	-	-	-	115	20	-	-	-	-	-	3	160	200	1.58	6	1.41	6	3	15	IPTS→LS
"	Buguey	"	95	-	-	-	-	-	-	-	135	20	-	-	-	-	-	3	190	200	1.88	6	1.68	6	3	15	IPTS →LS
"	Camala-niugun	"	65	-	-	-	-	-	-	-	90	20	-	-	-	-	-	3	130	200	1.29	5	1.15	5	3	13	IPTS→LS
"	Kabugao	"	30	-	-	-	-	-	-	-	50	20	-	-	-	-	-	3	70	20	-	-	-	-	-	3	IPTS
"	Lasam	"	90	-	-	-	-	-	-	-	130	20	-	-	-	-	-	3	180	200	1.78	6	1.59	6	3	15	IPTS →LS
"	Lubuagan	"	45	-	-	-	-	-	-	-	65	20	-	-	-	-	-	3	90	20	-	-	-	-	-	3	IPTS
"	Piat	"	60	-	-	-	-	-	-	-	90	20	-	-	-	-	-	3	130	200	1.29	5	1.15	5	3	13	IPTS→LS
"	Santo Nino (Faire)	"	80	-	-	-	-	-	-	-	110	20	-	-	-	-	-	3	160	200	1.58	6	1.41	6	3	15	IPTS→LS

Table VII-1-3-1(7/8) Number of Toll Trunks

Ilagan PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL ERL	GENERAL LINES					ERL	LINES	GENERAL ERL	GENERAL LINES					ERL	LINES	GENERAL ERL	GENERAL LINES			
1	Alicia	0.03	170	200	1.68	6	1.34	6	3	15	220	300	2.18	7	1.74	6	4	17	350	400	3.47	9	2.77	8	4	21	LS
"	Cabarroguis	"	50	200	0.50	4	0.40	3	3	10	65	200	0.64	4	0.51	4	3	11	110	200	1.09	5	0.88	5	3	13	"
"	San Mateo	"	300	300	2.98	8	2.38	8	4	20	380	400	3.76	9	3.01	8	4	21	590	600	5.84	12	4.67	12	4	28	"
"	Tumauini	"	90	200	0.89	5	0.71	4	3	12	115	200	1.14	5	0.91	5	3	13	180	200	1.78	6	1.42	6	3	15	"
"	San Manuel (Callang)	"	100	20	-	-	-	-	-	3	125	20	-	-	-	-	-	3	210	300	2.08	7	1.66	6	4	17	SPTS→LS
2	Angadanan	0.03	90	-	-	-	-	-	-	-	110	200	1.09	5	0.87	5	3	13	175	200	1.78	6	1.42	6	3	15	LS
"	Diffun	"	105	-	-	-	-	-	-	-	140	200	1.40	6	1.11	5	3	14	220	300	2.18	7	1.74	7	4	18	"
"	Gamu	"	85	-	-	-	-	-	-	-	110	200	1.09	5	0.87	5	3	13	180	200	1.78	6	1.42	6	3	15	"
"	Naguilian	"	100	-	-	-	-	-	-	-	125	200	1.24	5	0.99	5	3	13	200	200	1.98	7	1.58	6	3	16	"
"	San Mariano	"	150	-	-	-	-	-	-	-	185	200	1.83	6	1.46	6	3	15	300	300	2.97	8	2.38	8	4	20	"
"	Aurora	"	80	-	-	-	-	-	-	-	100	20	-	-	-	-	-	3	165	200	1.63	6	1.30	6	3	15	IPTS→LS
"	Cabagan	"	100	-	-	-	-	-	-	-	125	20	-	-	-	-	-	3	200	200	1.98	7	1.58	6	3	16	IPTS→LS
"	Jones	"	80	-	-	-	-	-	-	-	100	20	-	-	-	-	-	3	160	200	1.58	6	1.26	6	3	15	IPTS→LS
"	Maddela	"	100	-	-	-	-	-	-	-	130	20	-	-	-	-	-	3	430	500	4.26	10	3.41	10	4	24	IPTS→LS
"	Mallig	"	75	-	-	-	-	-	-	-	95	20	-	-	-	-	-	3	150	200	1.49	6	1.19	5	3	14	IPTS→LS
"	San Agustin	"	65	-	-	-	-	-	-	-	85	20	-	-	-	-	-	3	140	200	1.39	6	1.11	5	3	14	IPTS→LS
E	Santiago	0.04	730	800	9.64	17	8.59	16	4	37	940	1000		21	9.92	18	4	43	1470	1500	19.40	29	15.52	27	4	60	LS

E : Existing Exchange

Table VII-1-3-1(8/8) Number of Toll Trunks

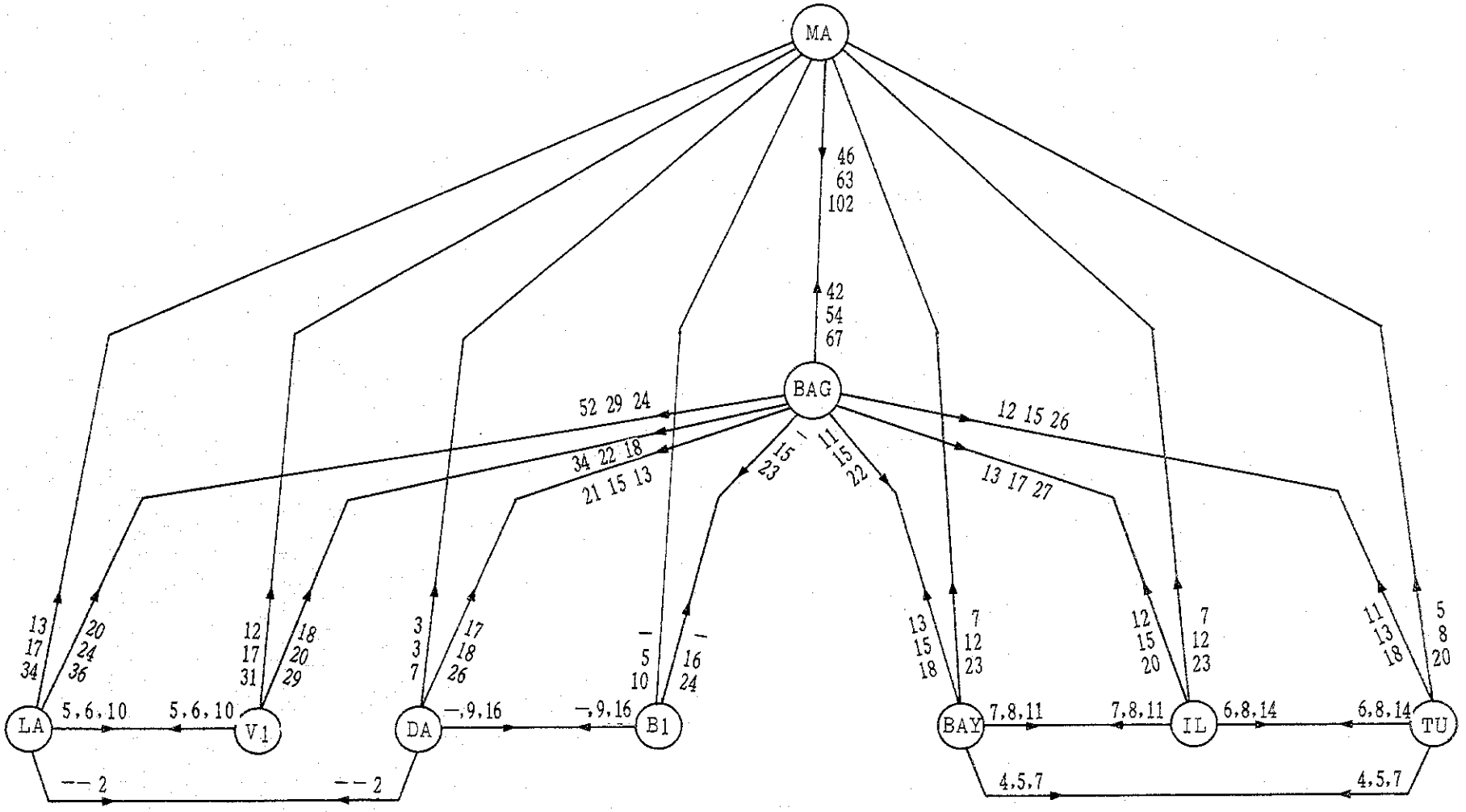
Bayombong PC

PHASE	NAME OF EXCHANGE	CR (OG)	1987								1990								1997								REMARKS
			DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	DEMAND	CAPACITY	OG		IC		MISC LINES	TOTAL LINES	
					ERL	LINES	GENERAL ERL	GENERAL LINES					ERL	LINES	GENERAL ERL	GENERAL LINES					ERL	LINES	GENERAL ERL	GENERAL LINES			
1	Bambang	0.03	145	200	1.44	6	1.15	5	3	14	180	200	1.83	6	1.47	6	3	15	290	300	2.87	8	2.30	7	4	19	LS
"	Banaue	"	80	20	-	-	-	-	-	3	100	20	-	-	-	-	-	3	155	200	1.54	6	1.23	5	3	14	IPTS→LS
2	Aritao	0.03	100	-	-	-	-	-	-	-	130	200	1.29	5	1.03	5	3	13	210	300	2.08	7	1.66	6	4	17	LS
"	Bagabag	"	120	-	-	-	-	-	-	-	150	200	1.49	6	1.19	5	3	14	240	300	2.38	7	1.90	6	4	17	LS
"	Dupax del Sur	"	100	-	-	-	-	-	-	-	125	200	1.24	5	0.99	5	3	13	210	300	2.08	7	1.66	6	4	17	LS
"	Dupax del Norte	"	100	-	-	-	-	-	-	-	125	20	-	-	-	-	-	3	200	200	1.98	7	1.58	6	3	16	IPTS→LS
"	Knangan	"	6	-	-	-	-	-	-	-	80	20	-	-	-	-	-	3	125	200	1.24	5	0.99	5	3	13	IPTS→LS
"	Mayoyao	"	75	-	-	-	-	-	-	-	95	20	-	-	-	-	-	3	150	200	1.49	6	1.19	5	3	14	IPTS→LS
"	Sta Fe	"	30	-	-	-	-	-	-	-	40	20	-	-	-	-	-	3	70	20	-	-	-	-	-	3	IPTS
E	Bayom-bong	0.04	870	900	(100) 10.96 (Oth-ers) 0.52	(100) 19 (Oth-ers) 4	9.19	17	4	44	1150	1200	(100) 1449 (Oth-ers) 0.69	(100) 23 (Oth-ers) 4	12.14	21	4	52	1720	1800	(100) 21.67 (Oth-ers) 1.03	(100) 32 (Oth-ers) 5	18.16	28	4	69	LS
E	Solano	0.04	370	400	4.88	20	3.91	10	4	25	470	500	620	13	496	11	4	28	750	800	990	18	7.93	15	4	37	LS

E : Existing Exchange ( ): Calls handled by special code 100

Tab. VII-1-3-2 Number of Trunks between TS. TSs

From	To	Kind of Route	1987		1990		1997	
			Offered Traffic	Number of Lines	Offered Traffic	Number of Lines	Offered Traffic	Number of of Lines
Laoag	Manila	H	16.79	13	21.35	17	39.32	34
	Dagupan	"	1.75	-	2.33	-	5.11	2
	Baguio	F	10.27	20	13.55	24	23.40	36
	Vigan	"	1.26	5	1.76	6	3.95	10
Vigan	Manila	H	16.09	12	21.42	17	36.48	31
	Baguio	F	9.31	18	10.74	20	17.16	29
	Laoag	"	1.26	5	1.76	6	3.95	10
Dagupan	Manila	H	5.81	3	6.00	3	10.25	7
	Laoag	"	1.75	-	2.33	-	5.11	2
	Baguio	F	8.46	17	9.27	18	14.75	26
	Binalonan	"	-	-	3.45	9	8.76	16
Binalonan	Manila	H	-	-	8.62	5	13.60	10
	Baguio	F	-	-	7.40	16	13.36	24
	Dagupan	"	-	-	3.45	9	8.76	16
Bayommbong	Manila	H	10.89	7	16.32	12	27.62	23
	Baguio	F	5.53	13	6.80	15	9.00	18
	Ilagan	"	1.94	7	2.72	8	4.81	11
	Tuguegarao	"	0.87	4	1.21	5	2.15	7
Ilagan	Manila	H	10.25	7	16.20	12	27.79	23
	Baguio	F	5.32	12	7.21	15	10.55	20
	Bayombong	"	1.94	7	2.72	8	4.81	11
	Tuguegarao	"	1.78	6	2.62	8	6.91	14
Tuguegarao	Manila	H	8.00	5	11.62	8	24.56	20
	Baguio	F	4.42	11	5.61	13	9.28	18
	Bayombong	"	0.87	4	1.21	5	2.15	7
	Ilagan	"	1.78	6	2.62	8	6.91	14
Manila	Baguio	F	33.75	46	49.77	63	85.94	102
Baguio	Manila	"	27.83	42	38.17	54	49.03	67
	Laoag	"	15.70	24	18.98	29	39.24	52
	Vigan	"	10.10	18	13.10	22	23.54	34
	Dagupan	"	6.07	13	8.20	15	12.41	21
	Binalonan	"	-	-	7.40	15	13.86	23
	Bayombong	"	5.03	11	7.52	15	13.01	22
	Ilagan	"	6.24	13	9.54	17	17.06	27
	Tuguegarao	"	5.72	12	7.94	15	16.27	26



Legend :

×× ×× ××
1987 1990 1997

Fig. VII—1—3—1 Number of Toll Lines between TSs

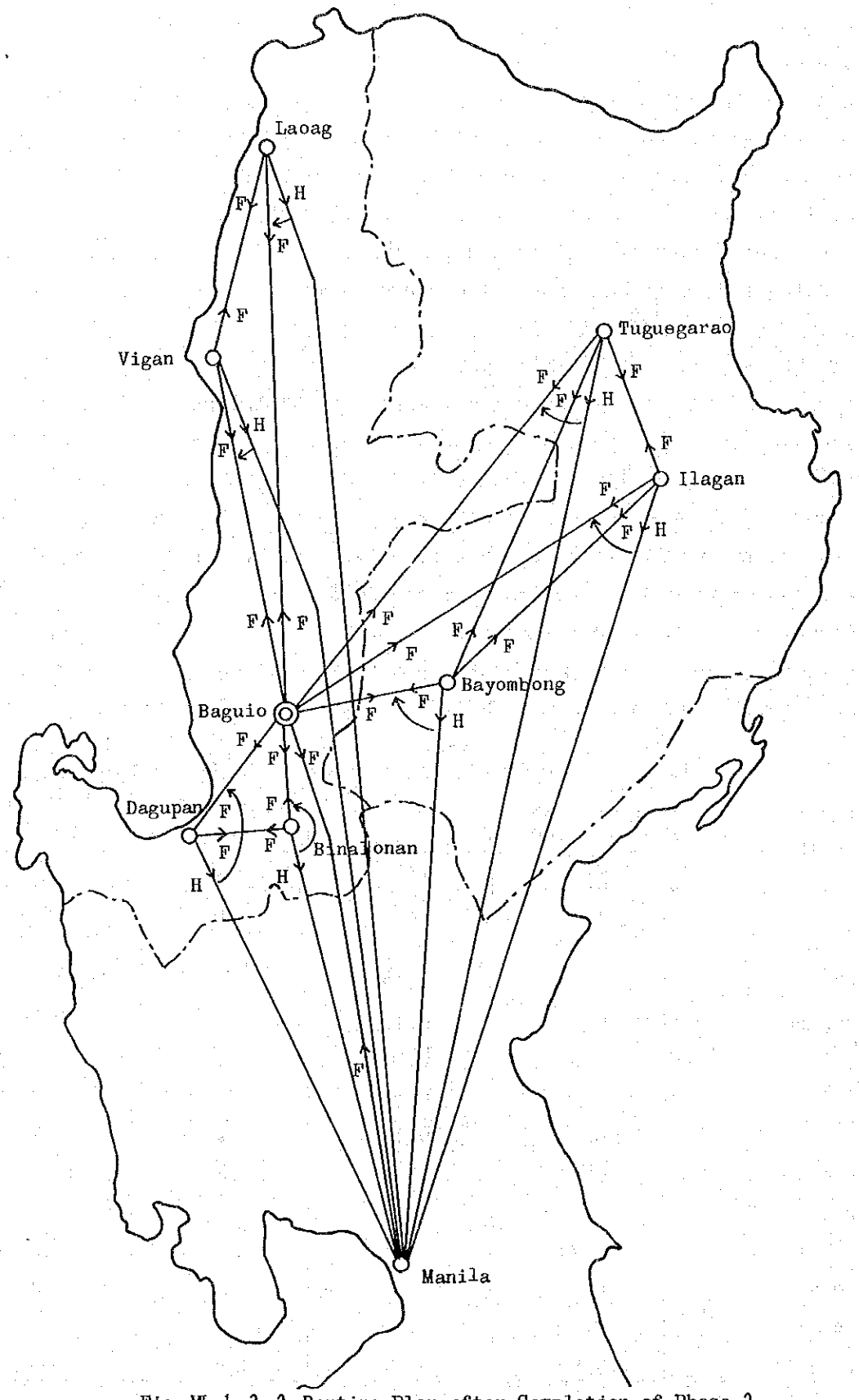


Fig. Ⅶ-1-3-2 Routing Plan after Completion of Phase 2

2. Telegraph

2-1 Gentex

When the number of teleprinter positions in telex concentartor of exchange or Gentex station is large, it is necessary to separate the sending and receiving positions from each other. At the sending position, telegrams arriving one after another are sent out through a teleprinter. In this case, the number of positions depends on the waiting time of telegrams waiting for being sent out. The standard waiting time suitable for telegram service is made 10 minutes. The required number of sending positions can be obtained by obtaining position efficiency from the average waiting time chart ($N = \infty$) by using the position holding time of the telegram, the average processing time per telegram (120 seconds), and the traffic applied to the sending position. The estimation of the number of receiving positions is achieved by using the Erlang table for full availability trunks (for random calls, loss probability 0.1). The required numbers of lines at respective Gentex stations are obtained by this estimation method and given in Tables VII-2-1-1 and VII-2-1-2.

Gentex stations not specified in this table will handle little traffic and require only one line usable for both outgoing and incoming telegrams.

Table VII-2-1-1 Required Numbers of Gentex Rines

(Phase 1)

Station	BHC (Erl)		Number of lines	
	O/G	I/C	O/G	I/C
Baguio	1.52	1.27	2	3
Tuguegarao	0.43	0.35	1	2
Aparri	0.37	0.32	1	2
San Fernando	0.18	0.15	1	2
Agoo	0.09	0.08	0.5	0.5
Laoag	0.33	0.28	1	2
Vigan	0.14	0.12	1	1
Bangued	0.17	0.14	0.5	0.5
Dagupan	0.43	0.35	1	2
Ilagan	0.22	0.18	1	2
Santiago	0.43	0.35	1	2
Bayombong	0.30	0.26	1	2
Cabarroguis	0.03	0.02	0.5	0.5

Note 1: Gentex stations not given in the table will require one line usable for both outgoing and incoming telegrams.

Note 2: "O/G=0.5 and I/C=0.5" means that O/G+I/C=1. that is, one line for both outgoing and incoming telegrams.

Table VII-2-1-2 Required Numbers of Gentex Lines

(Phase 2)

Station	BHC (Er1)		Number of lines	
	O/G	I/C	O/G	I/C
Baguio	1.70	1.42	2	4
Bontoc	0.05	0.03	0.5	0.5
Tuguegarao	0.48	0.40	2	2
Aparri	0.43	0.35	1	2
Tabuk	0.27	0.22	1	2
San Fernando	0.28	0.19	1	2
Agoo	0.11	0.09	0.5	0.5
Laoag	0.27	0.22	1	2
Batac	0.11	0.09	0.5	0.5
Vigan	0.16	0.14	1	2
Bangued	0.19	0.16	1	2
Candon	0.07	0.05	0.5	0.5
Dagupan	0.48	0.40	1	2
San Carlos City	0.08	0.06	0.5	0.5
Lingayen	0.09	0.07	0.5	0.5
Alaminos	0.11	0.09	0.5	0.5
Urdaneta	0.27	0.22	1	2
Ilagan	0.25	0.20	1	2
Santiago	0.48	0.40	1	2
Echague	0.07	0.05	0.5	0.5
Bayombong	0.34	0.28	1	2
Banaue	0.08	0.06	0.5	0.5
Cabarroguis	0.04	0.02	0.5	0.5

Note 1: Gentex stations not given in the table will require oneline usable for both outgoing and incoming telegrams.

Note 2: "O/G=0.5 and I/C=0.5" means that O/G+I/C=1, that is, one line for both outgoing and incoming telegrams.

2.2 Telex

2-2-1 Telex Concentrator

(1) Estimation of Capacity of Accomodated Subscribers

Telex concentrators will employ crossbar switches. Crossbar switches provide an economical advantage when they use lines in blocks of 20 lines. Accordingly, the numbers of lines obtained by the method described hereunder are all raised to numbers in blocks of 20 lines upon determining the scale of station facilities.

The capacity of concentrator should be determined by the estimated number of telex subscribers obtained through demand forecast, the number of Gentex lines obtained by traffic forecast.

The capacity of respective concentrator obtained by this method is given in Table VII-2-2-1.

(2) Estimation of Trunk Lines

The number of trunk lines of telex concentrator is estimated as follows.

- o Number of telex subscribers (including spares): T [subscribers]
- o Total Number of Gentex lines of General Gentex stations: G [lines]
- o Busy-hour traffic of ord, subscriber lines: 0.08 [Erl/line]
- o Busy-hour traffic of Gentex lines of general Gentex stations: 0.2 [Erl/line]
- o Busy-hour traffic of Gentex positions in concentrator station: S [Erl]
- o Safety factor: 1.1

The total outgoing and incoming traffic of a concentrator is given by

$$a = (T \times 0.08 + G \times 0.2 + S) \times 1.1 \text{ [Erl]}$$

By using the value obtained from the above equation, the required number of trunk lines can be ontained from the Erlang table for full availability trunk group (for random calls at loss probability of 0.01).

Since the outgoing and incoming traffic of each telex concentrator is small on the whole, it is recommended to employ both-way trunk lines (intended for both incoming and outgoing traffic) without using separate trunk lines for incoming and outgoing traffic.

Table VII-2-2-1 Capacity and Number of Tranks at Telex Concentrators

Station Name		Number of Subscriber Lines expected			Capacity of Concentrator (Number of lines)	Number of Trunks	
		Number of Ord.Sub. Lines	Number of Gentex Lines			Between Exchange	Number of Trunks (Traffic)
			Total Number of Lines for General Gentex stations	Number of Gentex Lines in Concentrator stations			
San Fernand	Phase 1	24	8	3	60	Baguio	10 (4.26 Erl)
	Phase 2	34	11	3	60	Baguio	12 (5.87 Erl)
Laoag	Phase 2	28	13	3	60	Baguio	12 (5.86 Erl)
Vigan	Phase 2	25	17	3	60	Bagui	13 (6.27 Erl)
Dagupan	Phase 2	60	34	3	100	Baguio	24 (14.78 Erl)
Ilagan	Phase 2	17	12	3	40	Tuguegarao	11 (4.63 Erl)
Santiago	Phase 2	22	6	3	40	Tuguegarao	10 (4.22 Erl)
Bayombong	Phase 2	16	11	3	40	Tuguegarao	11 (4.51 Erl)

2-2-2 Telex exchange

(1) Estimation of Capacity

Estimation of Capacity of telex exchange will be determined by the method as that of telex concentrator will be. In this case, it is notified that each telex exchange will require as many telex exchange lines as correspond to the number of telex concentrator lines in order to conduct charging and switching processings at the relevant telex exchange.

The capacity of Baguio and Tuguegarao telex exchange is estimated as shown in Table VII-2-2-2.

(2) Estimation of the number of trunk lines

In narrow rural areas, telex and telegraph traffic within the area is extremely small in amout and the majority of traffic is directed to large cities outside the range. In consideration of this tendency, it is necessary to think much of outgoing traffic to large exchange for the traffic carried via the exchange.

The traffic between concentrators belonging to a telex exchange, that is, the percentage of the traffic within the telex exchange local area can be considered rather small.

From all these, the estimation of telex exchange trunk lines is made on the following assumptions.

(i) The traffic of outgoing trunk lines for large exchanges will be larger than the traffic incoming trunk lines.

(ii) The outgoing and incoming traffic in a telex exchange area will be 20% of the entire traffic handled by the exchange.

(iii) Other conditions are to be the same as in the estimation of trunk lines of a telex concentrator.

The equation for the estimation of trunk lines is obtained on these conditions as follows.

o Number of ord. telex subscriber lines: T [lines]

o Total Number of Gentex lines of general Gentex stations: G [lines]

o Busy-hour traffic of ord. telex subscriber lines: 0.08 [Erl/line]

o Busy-hour traffic of Gentex lines of general Gentex stations: 0.2 [Erl/line]

o Total busy-hour traffic of Gentex positions in big Gentex stations, concentrator stations and exchange stations: S [Erl]

o Safety factor: 1.1

o Traffic from all relevant telex concentrators and exchanges:

C [Erl]

Total traffic T_0 = (T x 0.08 + G x 0.2 + S) x 1.1 + C [Erl]

Total outgoing traffic = T_0 x 0.8 x 0.85/2 [Erl]

Total incoming traffic = T_0 x 0.8 x 0.85/2 [Erl]

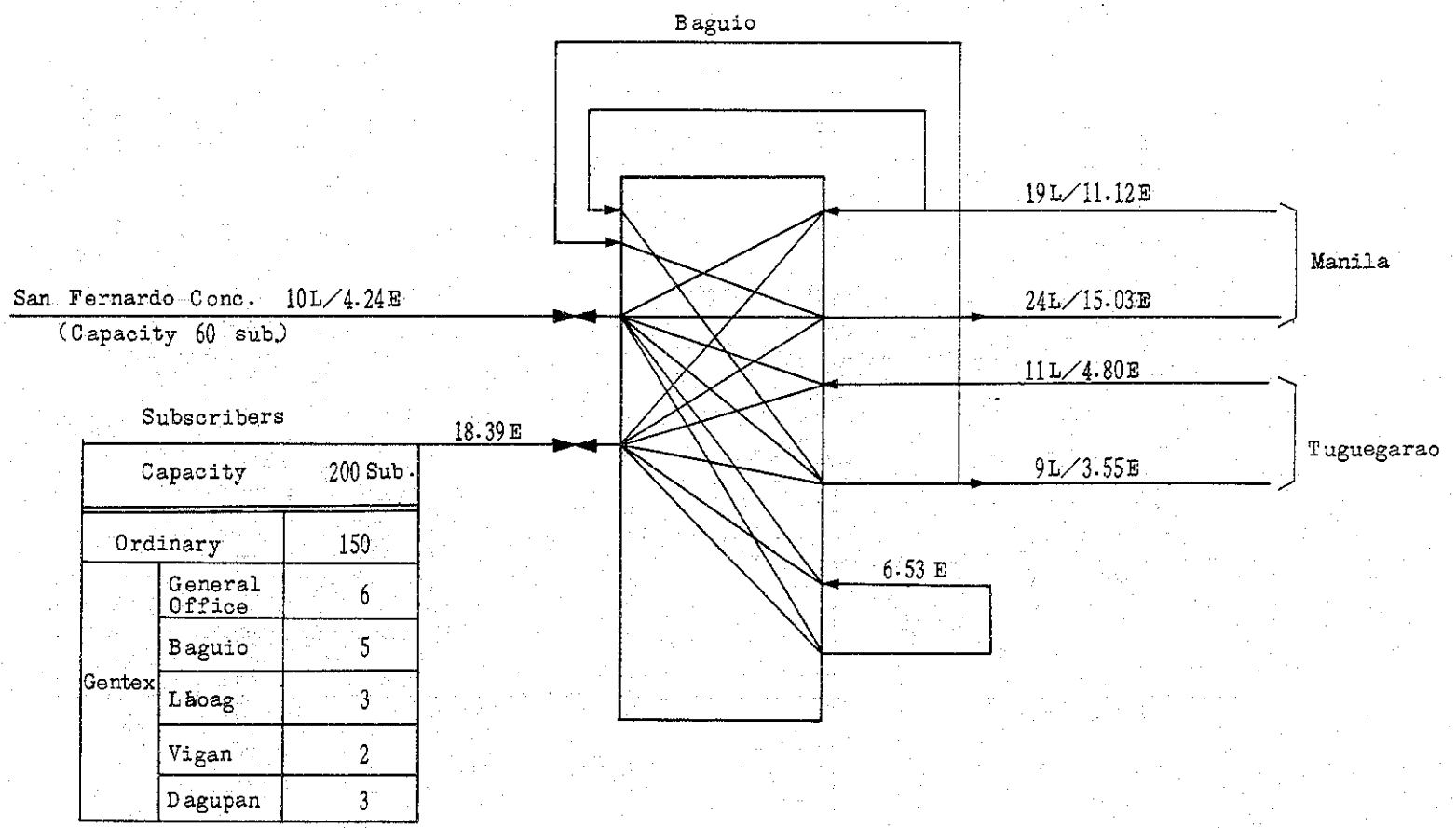
By using these amounts of traffic, the requires numbers of outgoing and incoming trunk lines are obtained from the Erlang table for full availability trunk group (for random calls, loss probability 0.01).

Table VII-2-2-2 is given the results which is calculated the number of trunks in Baguio and Tuguegarao exchange.

Fig.VII-2-2-1 ~ VII-2-2-4 show the trunking diagrams of these exchanges.

Table VII-2-2-2 Capacity and Number of Trunks of Telex Exchanges

Phase	Station Name	Number of Subscriber Lines expected				Total capacity of Concentrators within the Exchange Area	Capacity of Exchange (Number of Lines)	Number of Trunks			
		Number of Ord.Sub. Lines	Number of Gentex Lines					Total Number of Trunks to/from Concentrator (Traffic)	To/From Other Exchange		
			Total Number of lines for General Gentex Stations	Total Number of Lines for Big Gentex stations	Number of Gentex lines in Exchange Station				Kinds of Trunks	To/From	Number of Trunks (Traffic)
Phase 1	Baguio	150	6	9	5	60	480	10 (4.26 Erl)	I/C	Tuguegarao	11 (4.8 Erl)
										Manila	19 (11.12 Erl)
									O/G	Tuguegarao	9 (3.55 Erl)
										Manila	24 (15.03 Erl)
	Tuguegarao	37	20	8	3	-	200	-	I/C	Baguio	9 (3.55 Erl)
									O/G	Baguio	11 (4.8 Erl)
Phase 2	Baguio	180	8	-	6	280	480	61 (32.78 Erl)	I/C	Tuguegarao	19 (11.03 Erl)
										Manila	36 (25.00 Erl)
									O/G	Tuguegarao	16 (8.15 Erl)
										Manila	46 (33.82 Erl)
	Tuguegarao	47	25	-	3	120	200	32 (13.36 Erl)	I/C	Baguio	16 (8.15 Erl)
									O/G	Baguio	19 (11.03 Erl)



Capacity		200 Sub.
Ordinary		150
Gentex	General Office	6
	Baguio	5
	Laoag	3
	Vigan	2
	Dagupan	3

Fig. VII-2-2-1 Trunking Diagram of Baguio Telex Exchange in Phase 1

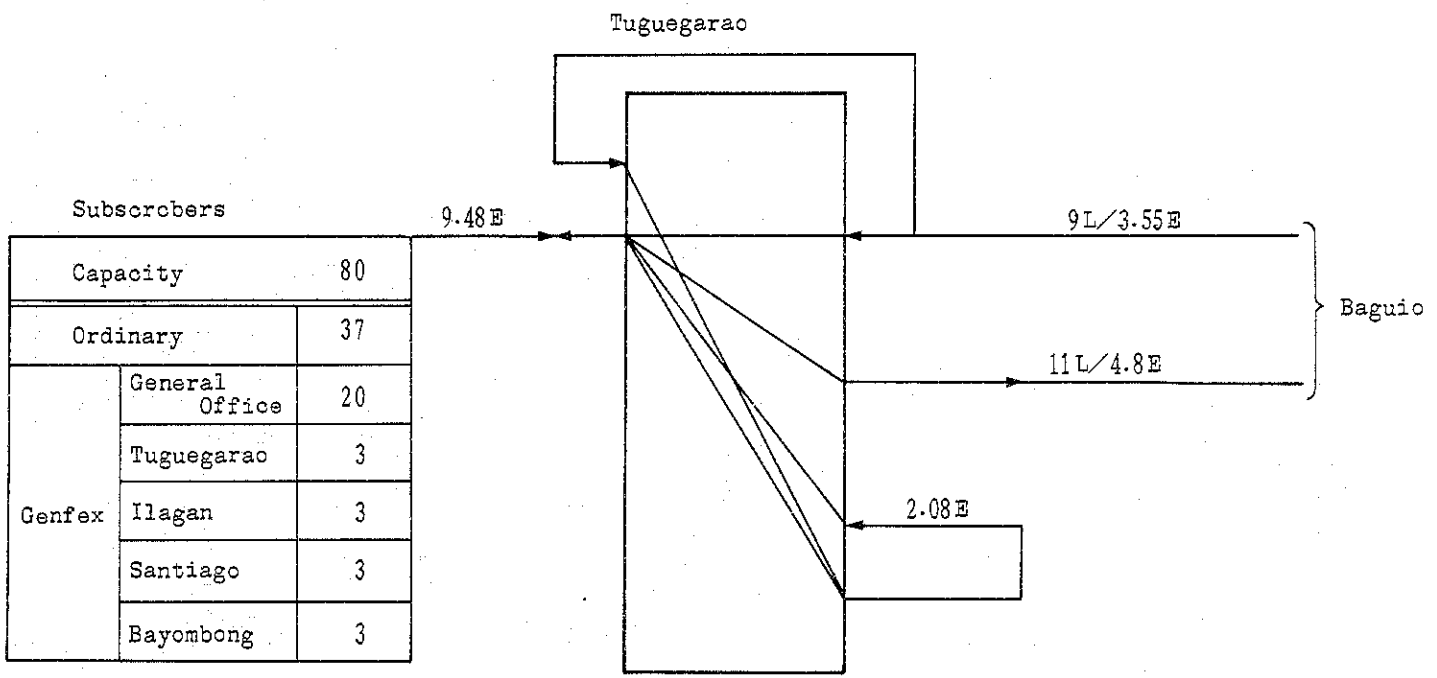
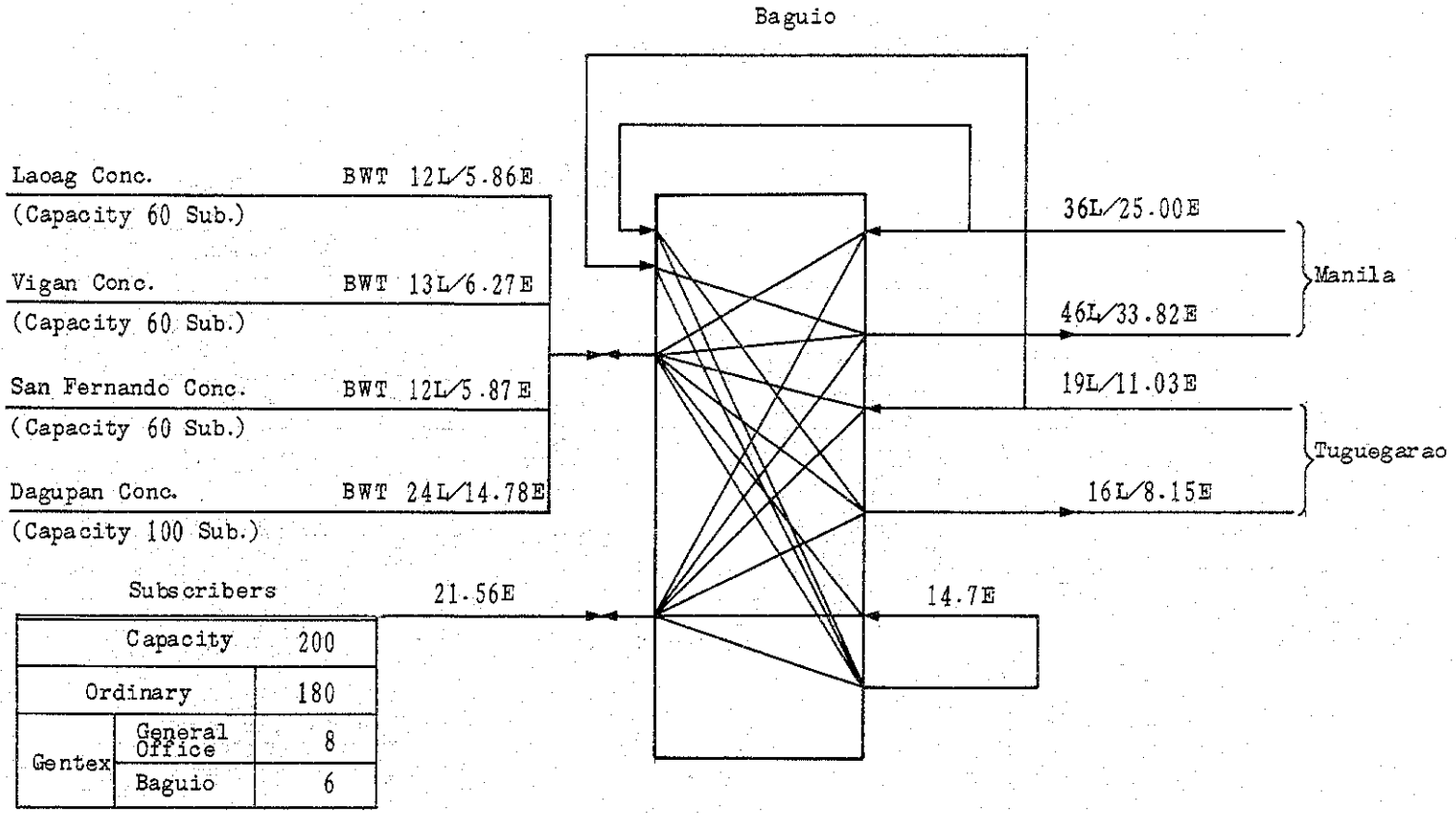
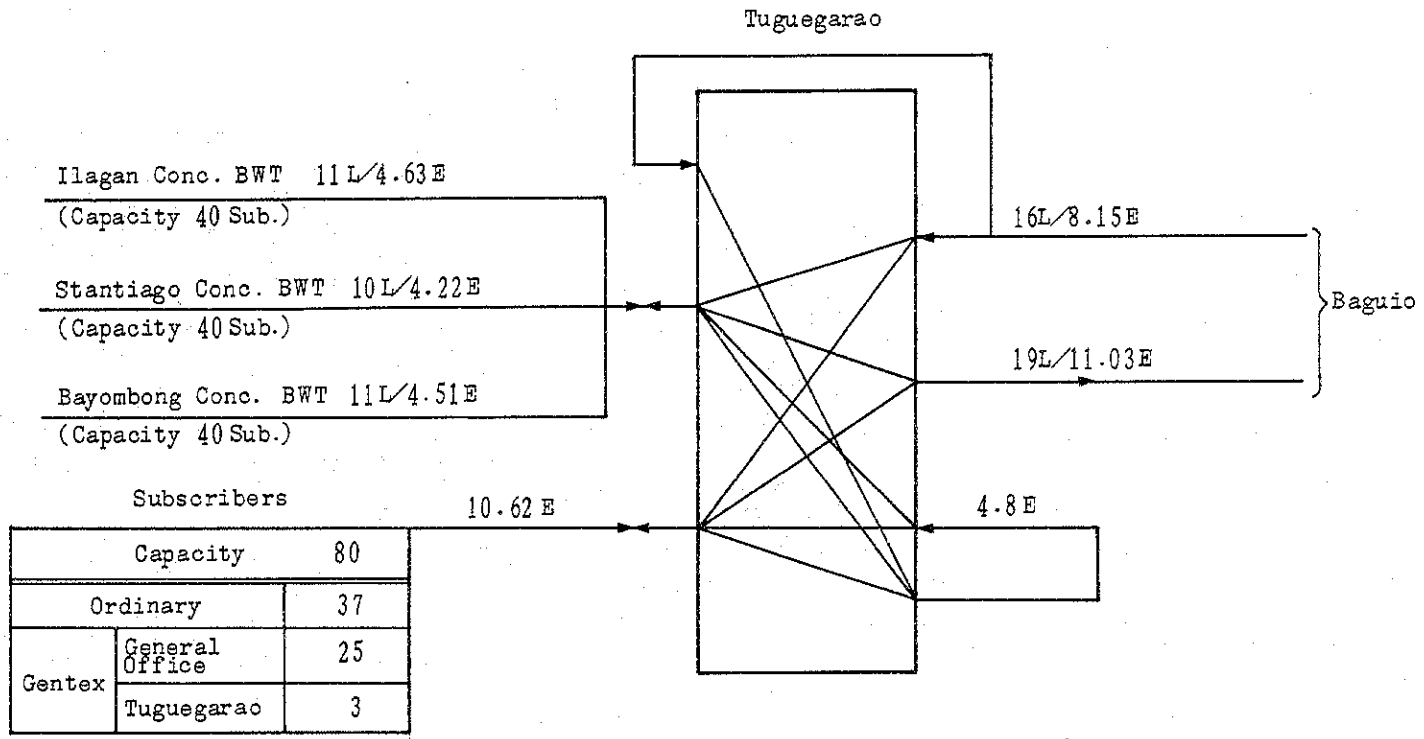


Fig. VII-2-2-2 Trunking Diagram of Tuguegarao Telex Exchange in Phase 1



Capacity		200
Ordinary		180
Gentex	General Office	8
	Baguio	6

Fig.Ⅲ－2－2－3 Trunking Diagram of Baguio Telex Exchange in Phase 2



Capacity		80
Ordinary		37
Gentex	General Office	25
	Tuguegarao	3

Fig.Ⅲ−2−2−4 Trunking Diagram of Tuguegarao Telex Exchange in Phase 2

VIII. SYSTEM DESIGN

VIII. SYSTEM DESIGN

1. Telephone Switches

1-1 General

The major items of installation procedures of switching facilities are:

(1) Installation of local switches and IPTS's

(2) Installation of toll switches for establishment of STD network

Requirements for the design of these facilities are discribed in the relavant chapters as follows.

(1)	Network configuration:	Chapter III-3
(2)	Charging method:	Chapter III-4
(3)	Numbering plan:	Chapter III-5
(4)	Signal system:	Chapter III-6
(5)	Design principles:	Chapter III-12
(6)	Circuit estimation:	Part VII

Of these requirements, the basic items to be noted in particular are as follows.

(1) Network configuration (Fig. III-3-1-7, 8)

a) Secondary center: Baguio

b) Primary centers: Laoag, Vigan, Dagupan, Binalonan, Tuguegarao, Ilagan, and Biralonan

(2) Charging method

a) Charging system for STD service: Periodic pulse metering method

b) Charging area: Province area

c) Charging equipment: To be installed at primary center

d) Number of charging areas per primary center: Maximum 3

(3) Numbering plan

a) Charging area identification: By maximum 3 digits of ABC

b) Route identification: By maximum 4 digits of ABCD

(4) Connection with private operators' facilities

a) Connecting point will be TS.

b) Meters will be installed at connecting point.

(5) Local switch

a) Only single lines and no party line will be accommodated.

b) Lines for pilot number service will be 15% of all lines.

(6) IPTS

a) Capacity: 20 subscribers

b) Number of toll lines: 3

(7) Switchboards will be installed concentratively at primary centers.

(8) Design periods

a) Phase 1

LS: Facilities to meet the demand by the end of 1987

TS: do.

(For traffic by existing offices and offices to be constructed in Phase 1)

b) Phase 2

LS: Facilities to meet the demand by the end of 1990

TS: do.

(For traffic by existing offices and offices to be constructed in Phases 1 and 2)

Toll switch board of Manila Toll Exchange Office

Telephone Number Information Board of Manila Toll Exchange Office

Toll Switch Board of Baguio Telephone Office of BUTEL

1-2 Installation Componect

The numbers of switching facilities to be installed are classified by types of exchange in Table VIII-1-2-1.

In Phase 1, the foundation of network will be established by instatlling mainly toll switching facilities.

In Phase 2, much more LS and IPTS offices will be serviced. Details of these items of installation of switching facilities are given in the following tables.

(1) List of local switching facilities → Tabel VIII-1-2-2

(2) List of local switching facilities classified by capacity → Table VIII-1-2-3

(3) Outline of toll exchange facilities → Table VIII-1-2-4

Table VIII-1-2-1 Number of Switches Classified by Types

Type of Switch		Phase 1	Phase 2	Remarks
LS	200L	13	24	
	300L	2	2	
	500L	1		
	600L	1		
	700L	1		
	800L	1		
	Total	19	26	
IPTS		19	31	
TS		7	1	

1-3 Trunking Diagram

Trunking diagrams for respective switches on the basis of the results of trunk estimation (Section VII) are as follows.

(1) Local switches

a) 200L Local switch trunking diagram: Fig. VIII-1-3-1(1)

b) 300L Local switch trunking diagram: Fig. VIII-1-3-1(2)

c) 500L Local switch trunking diagram: Fig. VIII-1-3-1(3)

d) 600L Local switch trunking diagram: Fig. VIII-1-3-1(4)

e) 700L Local switch trunking diagram: Fig. VIII-1-3-1(5)

f) 800L Local switch trunking diagram: Fig. VIII-1-3-1(6)

The trunking diagrams of a) - f) will be applied in response to the numbers of terminals given in Table VIII-1-2-2 or -3.

(2) Local switches

a) Local switch trunking diagrams for respective offices (1987): Fig. VIII-1-3-2(1) - (7)

b) Local switch trunking diagrams for respective offices (1990): Fig. VIII-1-3-3(1) - (8)

Table VIII-1-2-2 List of LS and IPTS

Phase	Type of Exchange	Name of Exchange	Capacity		Telephone Number	Primary Center	Remarks
			Initial	Final (1997)			
Phase 1	Local Exchange	1. Batac, Ilocos Norte	800L	1500L	5752-2xxx	Laoag	
		2. Dingras, "	300	500	5762-2xxx	"	
		3. Paoay, "	200	400	5754-2xxx	"	
		4. Sarrat, "	200	300	5743-2xxx	"	
		5. Cabugao, Ilocos Sur	200	200	5642-2xxx	Vigan	
		6. Narvacan, "	200	200	5612-2xxx	"	
		7. Tagudin, "	200	200	5662-2xxx	"	
		8. Bangued, Abra	600	1200	5672-2xxx	"	
		9. Bontoc, Mt. Province	200	200	5572-2xxx	Baguio	
		10. Alominos, Pangasinan	500	900	5292-2xxx	Dagupan	
		11. San Fabian, "	200	400	5214-2xxx	"	
		12. Binalonan, "	700	1300	532-22xxx	"	
		13. Enrile, Cagayan	200	300	5826-2xxx	Tuguegarao	
		14. Solana, "	200	400	5824-2xxx	"	
		15. Alicia, Isabela	200	400	5944-2xxx	Ilagan	
		16. San Mateo, "	300	600	5936-2xxx	"	
		17. Tumawini, "	200	200	5982-2xxx	"	
		18. Cabarroguis, Qurino	200	200	5962-2xxx	"	
		19. Bambang, N.Vizcaya	200	300	5042-2xxx	Boyombong	
	IPTS	1. Currimao, Ilocos Norte	20	20	5755	Laoag	
		2. Espiritu, "	20	20	5765	"	
		3. Pasuguin, "	20	200	5734	"	
		4. Piddig, "	20	200	5744	"	
		5. Santa, Ilocos Sur	20	200	5614	Vigan	
		6. Santa Maria, "	20	200	5616	"	
		7. Santo Domingo, "	20	200	5636	"	
		8. Mapandan, Pangasinan	20	200	5219	Dagupan	
		9. San Jacinto, "	20	200	5216	"	
		10. San Quintin, "	20	200	5354	Binalonan	
		11. Ballesteros, Cagayan	20	300	5862	Tuguegarao	

Phase	Type of Exchange	Name of Exchange	Capacity		Telephone Number	Primary Center	Remarks
			Initial	Final (1977)			
Phase 1	IPTS	12. Claveria, Cagayan	20L	300L	5866	Tuguegarao	
		13. Gonzaga, "	20	200	5857	"	
		14. Lal-Lo, "	20	200	5844	"	
		15. Sanchez Mira, "	20	300	5865	"	
		16. Tuao, "	20	300	5812	"	
		17. Basco, Batanes	20	20	5882	"	
		18. San Manuel, Isabela	20	300	5974	Ilagan	
		19. Banaue, Ifugao	20	200	5066	Bayombong	
Phase 2	Local Exchange	1. Badoc, Ilocos Norte	300	400	5757-2xxx	Laoag	
		2. Pagudpud, "	200	200	5774-2xxx	"	
		3. Pinili, "	200	200	5756-2xxx	"	
		4. Solsona, "	200	200	5763-2xxx	"	
		5. Vintar "	200	300	5735-2xxx	"	
		6. Magsingal, Ilocos Sur	200	200	5644-2xxx	Vigan	
		7. Sinait, "	200	200	5645-2xxx	"	
		8. Mankayan, Benguet	300	400	5562-2xxx	Baguio	
		9. Bani, Pangasinan	200	300	5294-2xxx	Dagupan	
		10. Bolinao, "	200	200	5202-2xxx	"	
		11. Urbiztondo, "	200	200	5254-2xxx	"	
		12. Alcala, "	200	200	5385-2xxx	Binalanan	
		13. Asingan, "	200	200	5362-2xxx	"	
		14. San Nicolas, "	200	200	5342-2xxx	"	
		15. Santa Maria, "	200	200	5364-2xxx	"	
		16. Sison, "	200	200	5336-2xxx	"	
		17. Alcala, Cagayan	200	200	5835-2xxx	Tuguegarao	
		18. Baggao, "	200	300	5833-2xxx	"	
		19. Angadanan, Isabela	200	200	5944-2xxx	Ilagan	
		20. Gamu, "	200	200	5913-2xxx	"	
		21. Naguilian, "	200	200	5912-2xxx	"	
		22. San Mariano, "	200	300	5918-2xxx	"	
		23. Diffun, Qurino	200	300	5963-2xxx	"	
		24. Aritao, N.Vizcaya	200	300	5052-2xxx	Boyombong	
		25. Bagabag, "	200	300	5032-2xxx	"	
		26. Dupax del Sur, "	200	300	5044-2xxx	"	
	IPTS	1. Bangui, Ilocos Norte	20	20	5772	Laoag	
		2. Burgos, "	20	20	5773	"	
		3. Marcos, "	20	20	5764	"	

Phase	Type of Exchange	Name of Exchange	Capacity		Telephone Number	Primary Center	Remarks
			Initial	Final (1997)			
		4. Nueva Era, Ilocos Norte	20L	20L	5766	Laoag	
		5. Caoayan, Ilocos Sur	20	200	5615	Vigan	
		6. Santa Lucia, "	20	200	5657	"	
		7. Bokod, Benguet	20	20	5544	Baguio	
		8. Sagada, Mt. Province	20	200	5573	"	
		9. Santo Tomas, La Union	20	200	5164	Dagupan	
		10. Aguilar, Pangasinan	20	200	5274	"	
		11. Balungao, "	20	200	5365	Binalonan	
		12. Bautista, "	20	200	5386	"	
		13. Natividad, "	20	200	5343	"	
		14. Abulug, Cagayan	20	200	5863	Tuguegarao	
		15. Buguey, "	20	200	5855	"	
		16. Camalaniugun, Cagayan	20	200	5854	"	
		17. Lazan, "	20	200	5846	"	
		18. Piat, "	20	200	5817	"	
Phase 2	IPTS	19. Santo Nino (Faire), "	20	200	5819	"	
		20. Kobugao, K.Apayao	20	20	5802	"	
		21. Lubuagan, "	20	20	5896	"	
		22. Aurora, Isabela	20	200	5972	Ilagan	
		23. Cabagan, "	20	200	5986	"	
		24. Jones, "	20	200	5948	"	
		25. Mallig, "	20	200	5976	"	
		26. San Agustin, "	20	200	5949	"	
		27. Maddela, Quirino	20	500	5966	"	
		28. Dupax del Norte, N.Vizcaya	20	200	5043	Bayombong	
		29. Santa Fe, "	20	20	5053	"	
		30. Kiangan, Ifugao	20	200	5064	"	
		31. Mayoyao, "	20	200	5067	"	

Table VIII-1-2-3 List of Exchange Classified by Capacity

Region	Primary Center	Local Switch						IPTS
		800T	700T	600T	500T	300T	200T	20T
1	Laoag	Batac				Dingras Badoc	Paoay, Sarrat Pagudpud, Vintar, Pinile, Solsona	Pasuquin, Pidding, Espiritu, Currimao, Bangui, Marcus Burgas, Nueva Era
	Vigan			Bangued			Cabugao, Narvacan Tagudin Magsingal, Sinait	Sto.Domingo, Santa, Sta Moria Caoayan, Sta Lucia
	Baguio					Mankayan	Bontoc	Bokod, Sagada
	Dagupan				Alaminos		San Fabian Bolimao, Bani, Urbitztondo	Mapandan, San Jacinto, Aguilar, Sto.Tomas,
	Binalonan		Binalonan				Sison, Asingan, Alcala, San Nicolas, Sta Maria	San Quintin, Balungao, Bantista
	Total	1	1	1	1	3	21	22
2	Bayombong						Boyombong, Aritao, Bagabag, Dupax del Sur	Banawe, Dupax del Norte Mayoyao, Kiangan, Sta Fe
	Ilagan					San Mateo	Tumawini, Alicia, Cabarroguis, San Mariano, Gamu, Angadanan, Diffun, Naguilian	Callang Jones, Mallig, San Agustin, Cabagan, Aurora, Maddela
	Tuguegarao						Enrile, Solana, Baggao, Alcala	Ballesteros, Tuao, Sanchez-Mira, Lal-lo, Gonzaga, Claveria, Basco, Abulug, Buguey, Camalaniugan, Piat, Lazan, Faire, Kabugao, Lubuagan
	Total					1	16	28
Toata		1	1	1	1	4	37	50

Legend: xxxxx Phase 1
xxxxx Phase 2

Table VIII-1-2-4 Oul line of Toll Centers

Toll Center	Items	As of 1987			As of 1990			Remarks (Final Capacity in 1997)
		BUTEL		Private Operator	BUTEL		Private Operator	
		Phase 1	Others		Phase 1 & 2	Others		
Laoag	No.of LS	4 + 4	-	2	9 + 8	1	2	
	No.of SUB	1380	-	2720	1940	345	3430	
	No.of TRK	230			388			less than 500 TRK
	No.of SWBD	1			3			
Vigan	No.of LS	4 + 3	2	1	6 + 5	2	1	
	No.of SUB	1025	1340	9	1594	1818	12	
	No.of TRK	253			320			less than 500 TRK
	No.of SWBD	8			10			
Baguio	No.of LS	1	-	7	2 + 2	-	7	
	No.of SUB	90	-	12,450	310	-	15,886	
	No.of TRK	314			454			less than 700 TRK
	No.of SWBD	1			1			
Dagupan	No.of LS	3 + 2	-	8	5 + 4	2	12	
	No.of SUB	1,260	-	11,221	1,169	347	14,292	less than 400 TRK
	No.of TRK	150			244			
	No.of SWBD	2			2			
Binalonan	No.of LS	-	-	-	6 + 4	2	-	
	No.of SUB	-	-	-	1,471	705	-	
	No.of TRK				248			less than 400 TRK
Tuguegarao	No.of SWBD	2 + 7	-	3	4+15	-	3	
	No.of SUB	396	-	2,075	986	-	2,585	
	No.of TRK	151			231			less than 450 TRK
	No.of SUBD	1			1			
Ilagan	No.of LS	4 + 1	1	4	8 + 6	1	4	
	No.of SUB	630	730	1,840	1,590	940	2,320	
	No.of TRK	225			360			less than 500 TRK
	No.of SWBD	5			6			
Bayombong	No.of LS	1 + 1	2	1	4 + 6	2	1	
	No.of SUB	165	1,240	70	685	1,620	80	
	No.of TRK	186			259			less than 450 TRK
	No.of SWBD	7			10			

Legend: $\frac{X}{LS} + \frac{Y}{IPTS}$ in the line of "No. of LS"

Outgoing CR : 0.03 erl/line

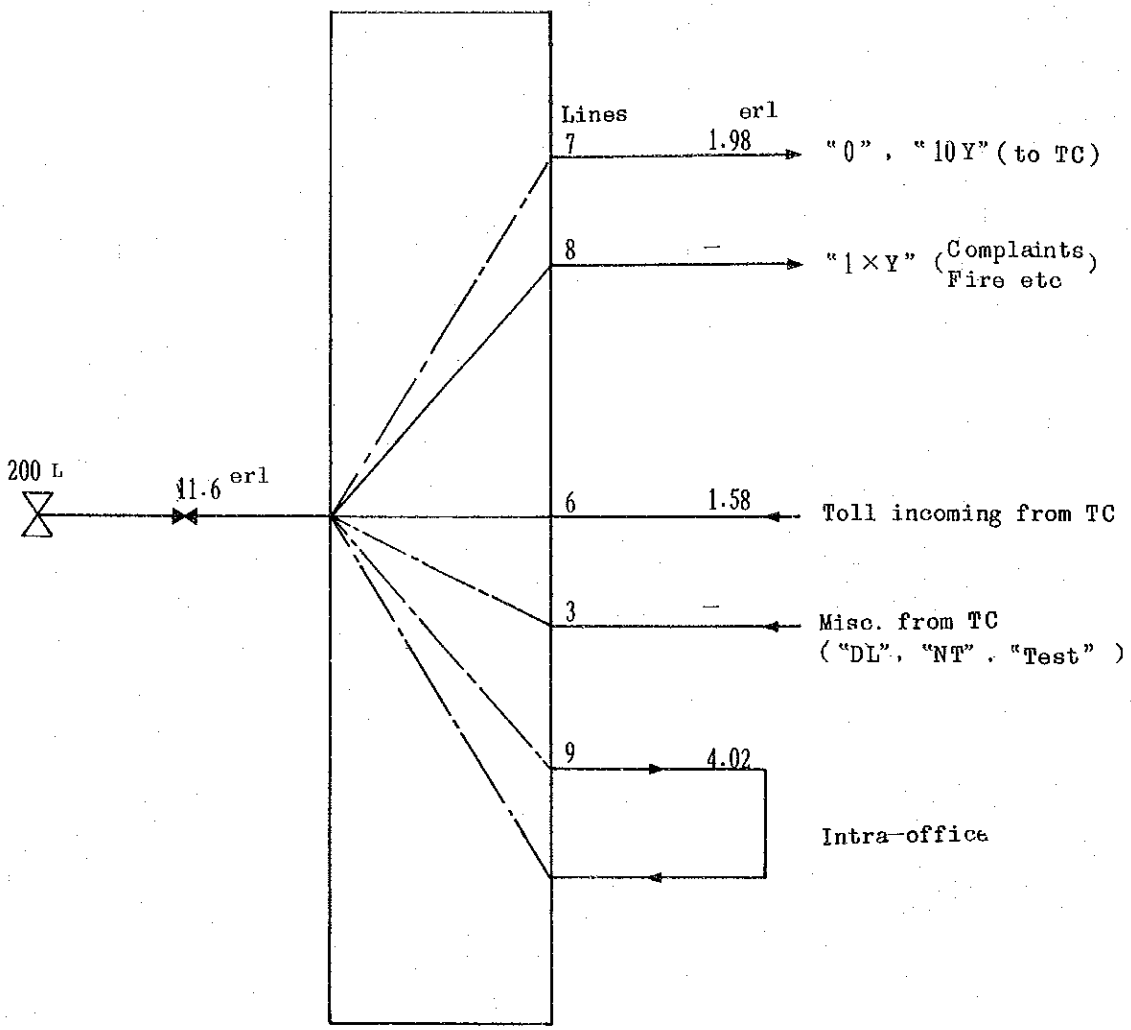


Fig. VII-1-3-1(1) Trunking Diagram of 200L Local Switch

Outgoing CR:0.03erl/line

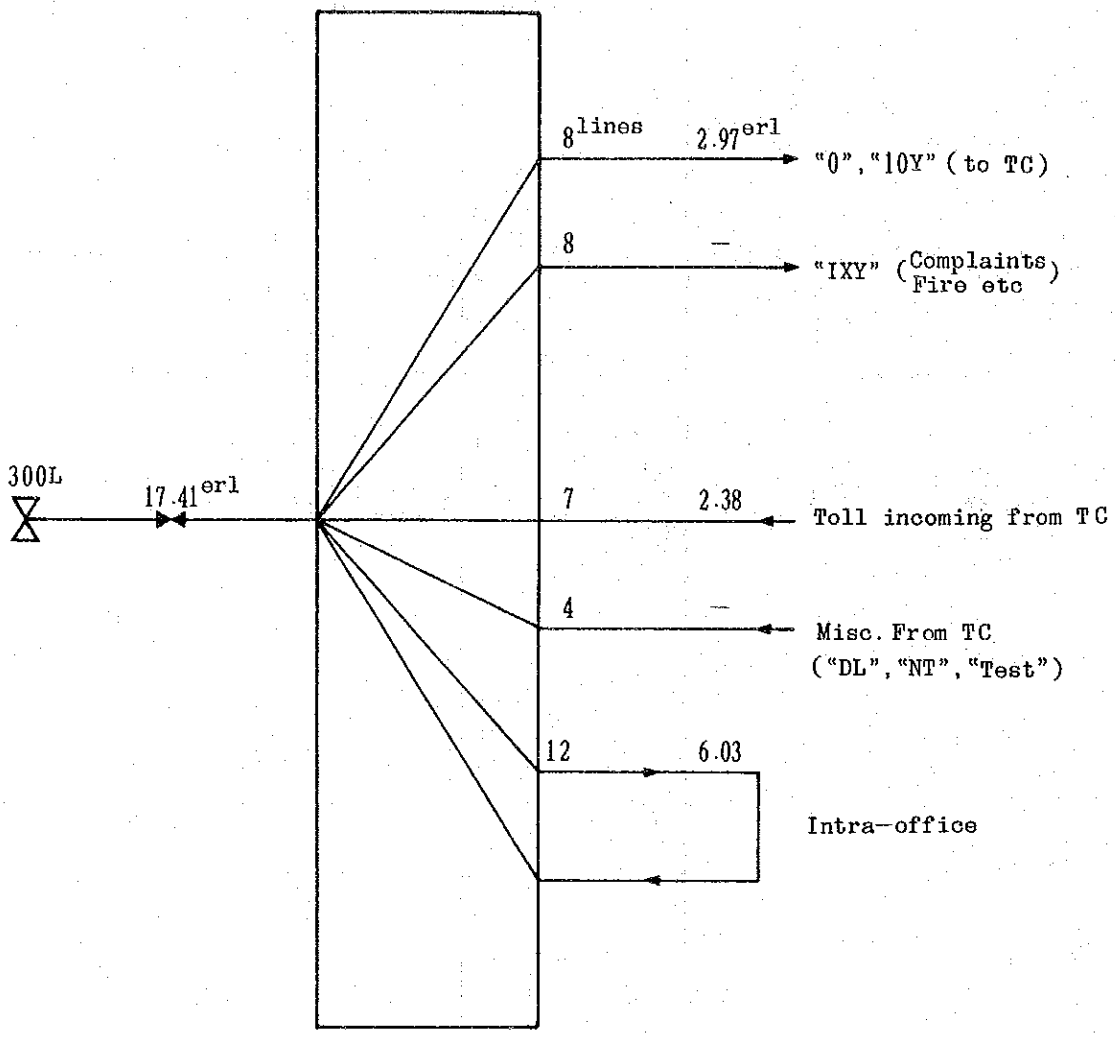


Fig.Ⅷ-1-3-1(2) Trunking Diagram of 300L Local Switch

Outgoing CR:0.03erl/Line

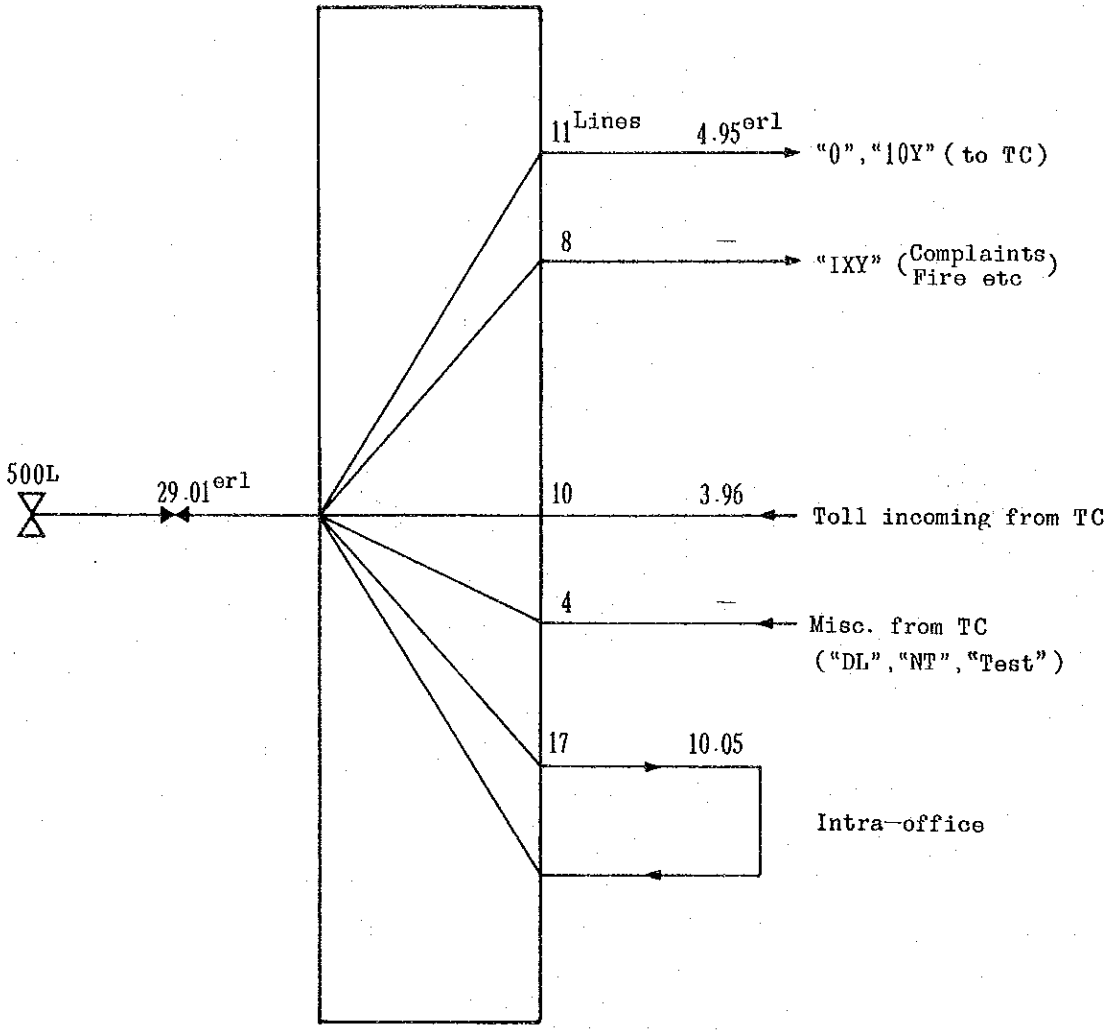


Fig.Ⅲ-1-3-1(3) Trunking Diagram of 500L Local Swich

Outgoing CR: 0.03 erl/line

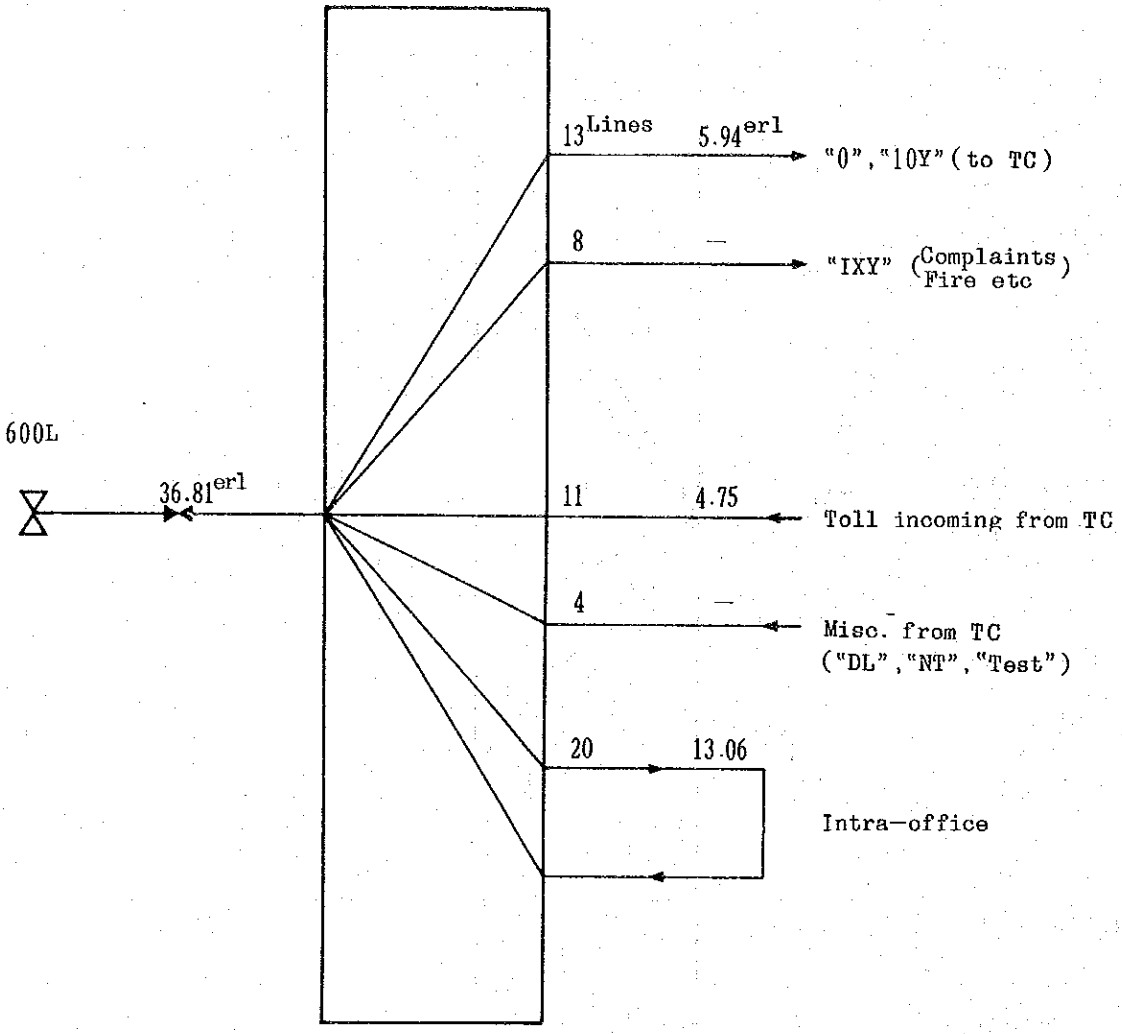


Fig. Ⅷ-1-3-1(4) Trunking Diagram of 600L Local Switch

Outgoing CR:0.03erl/line

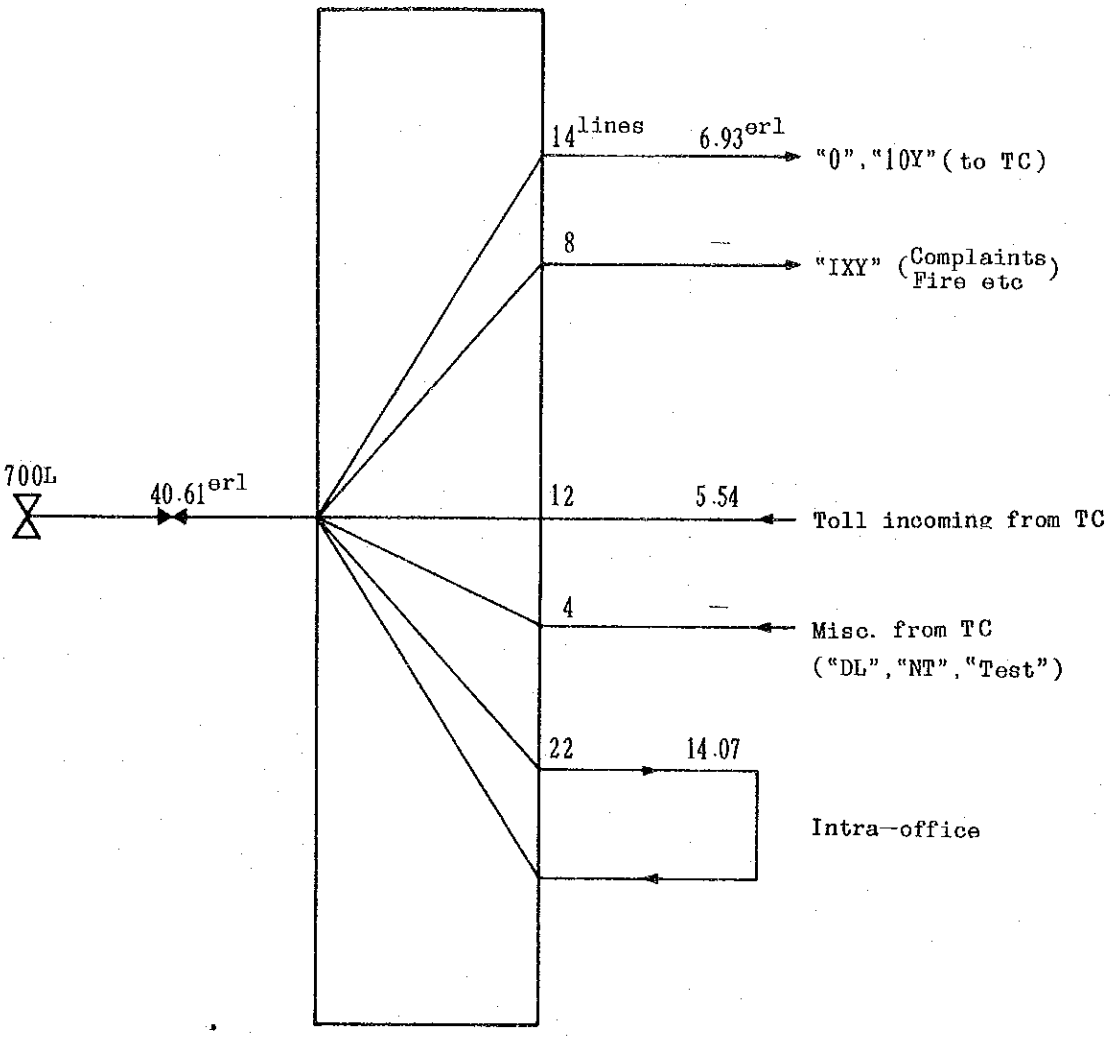


Fig. Ⅷ-1-3-1(5) Trunking Diagram of 700L Local Switch

Outgoing CR:0.03 erl/line

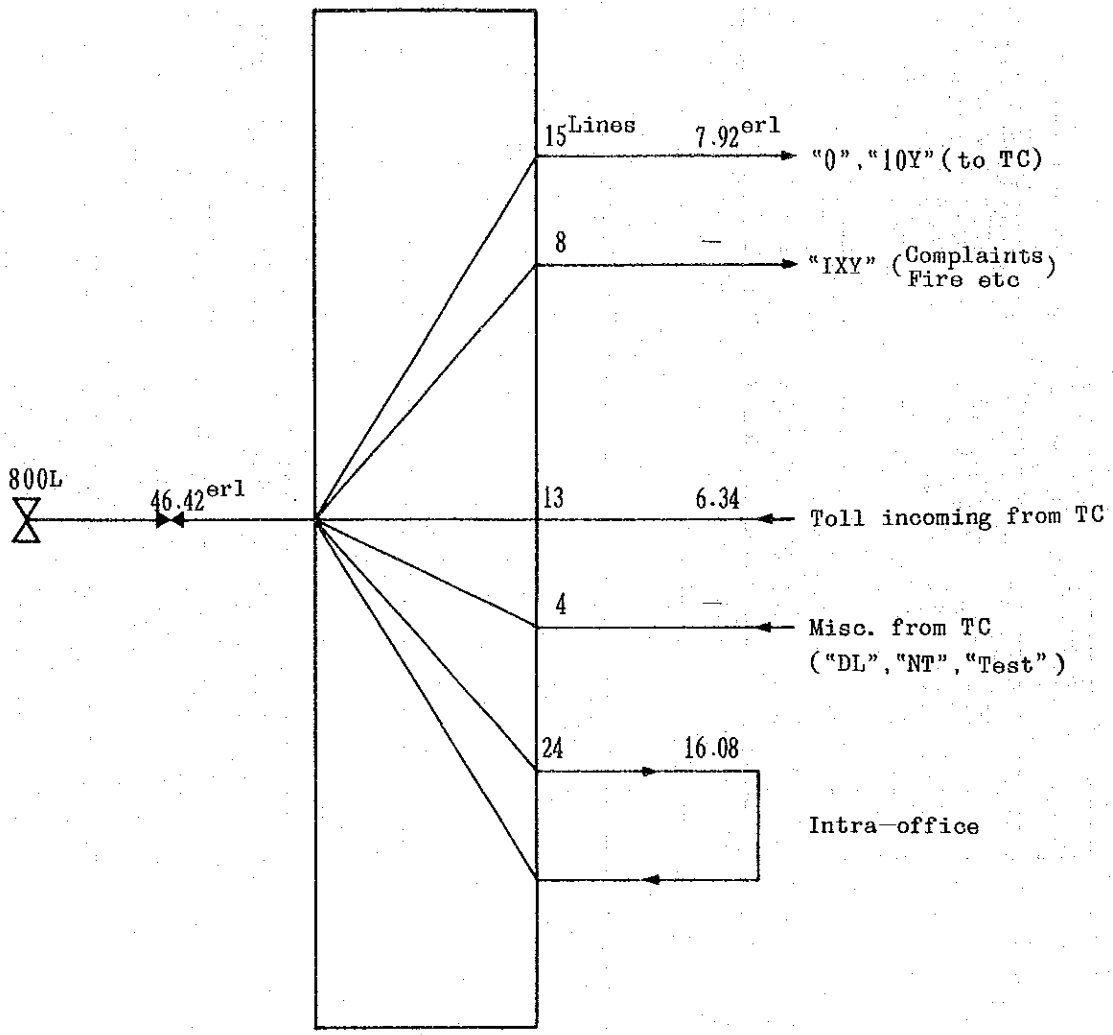


Fig. Ⅷ-1-3-1(6) Trunking Diagram of 800L Local Switch

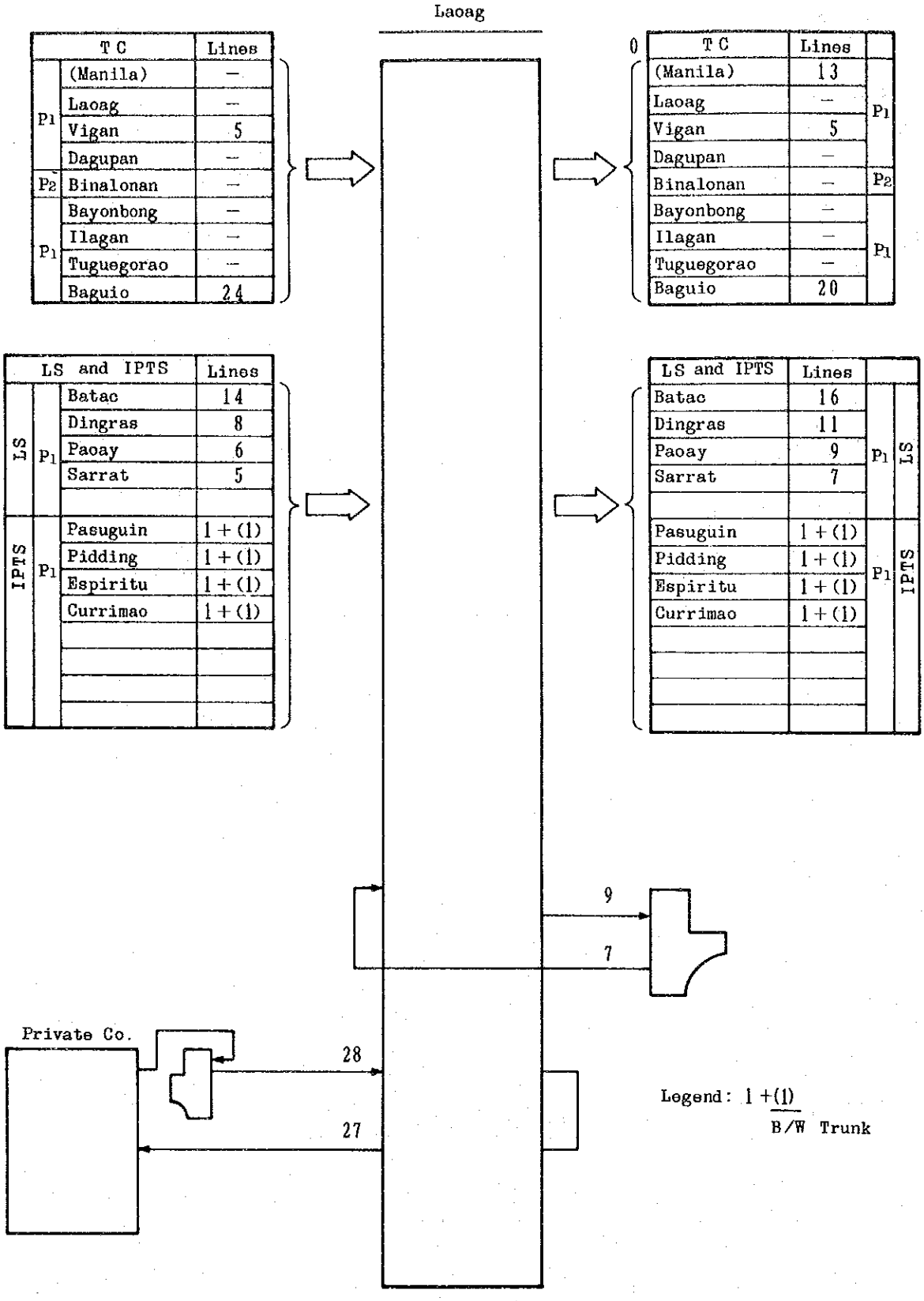
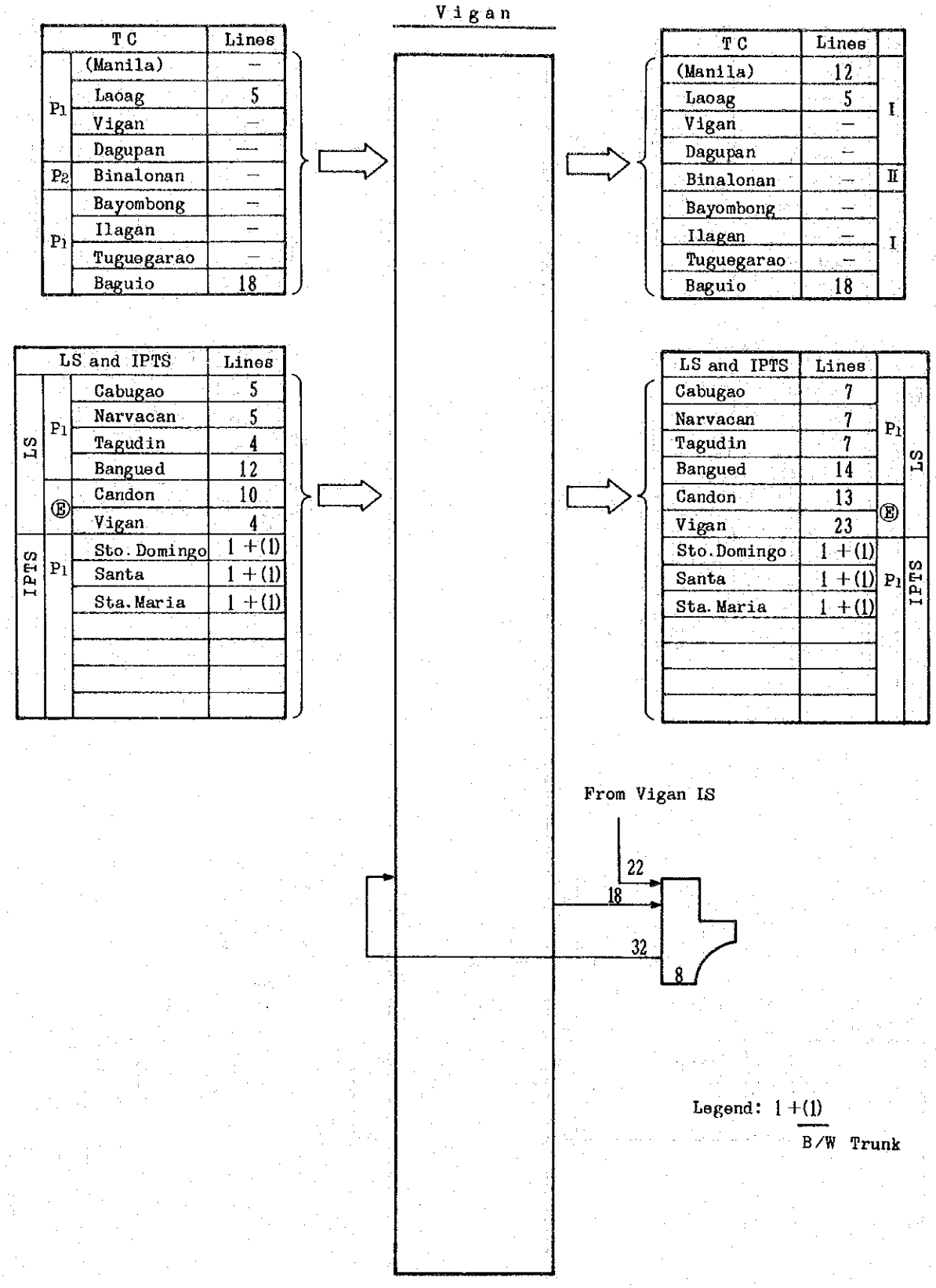


Fig. Ⅷ-1-3-2(1) Trunking Diagram of Loca Laoag (Phase 1)

1987



	TC	Lines
P1	(Manila)	—
	Laoag	5
	Vigan	—
	Dagupan	—
P2	Binalonan	—
P1	Bayombong	—
	Ilagan	—
	Tuguegarao	—
	Baguio	18

TC	Lines	
(Manila)	12	I
Laoag	5	
Vigan	—	
Dagupan	—	
Binalonan	—	II
Bayombong	—	I
Ilagan	—	
Tuguegarao	—	
Baguio	18	

		LS and IPTS	Lines
LS	P1	Cabugao	5
		Narvacan	5
		Tagudin	4
		Bangued	12
	Ⓔ	Candon	10
		Vigan	4
IPTS	P1	Sto. Domingo	1+(1)
		Santa	1+(1)
		Sta. Maria	1+(1)

LS and IPTS	Lines		
Cabugao	7	P1	LS
Narvacan	7		
Tagudin	7		
Bangued	14		
Candon	13	Ⓔ	
Vigan	23		
Sto. Domingo	1+(1)	P1	IPTS
Santa	1+(1)		
Sta. Maria	1+(1)		

Fig. VII-1-3-2(2) Trunking Diagram of Vigan TC (Phase 1)

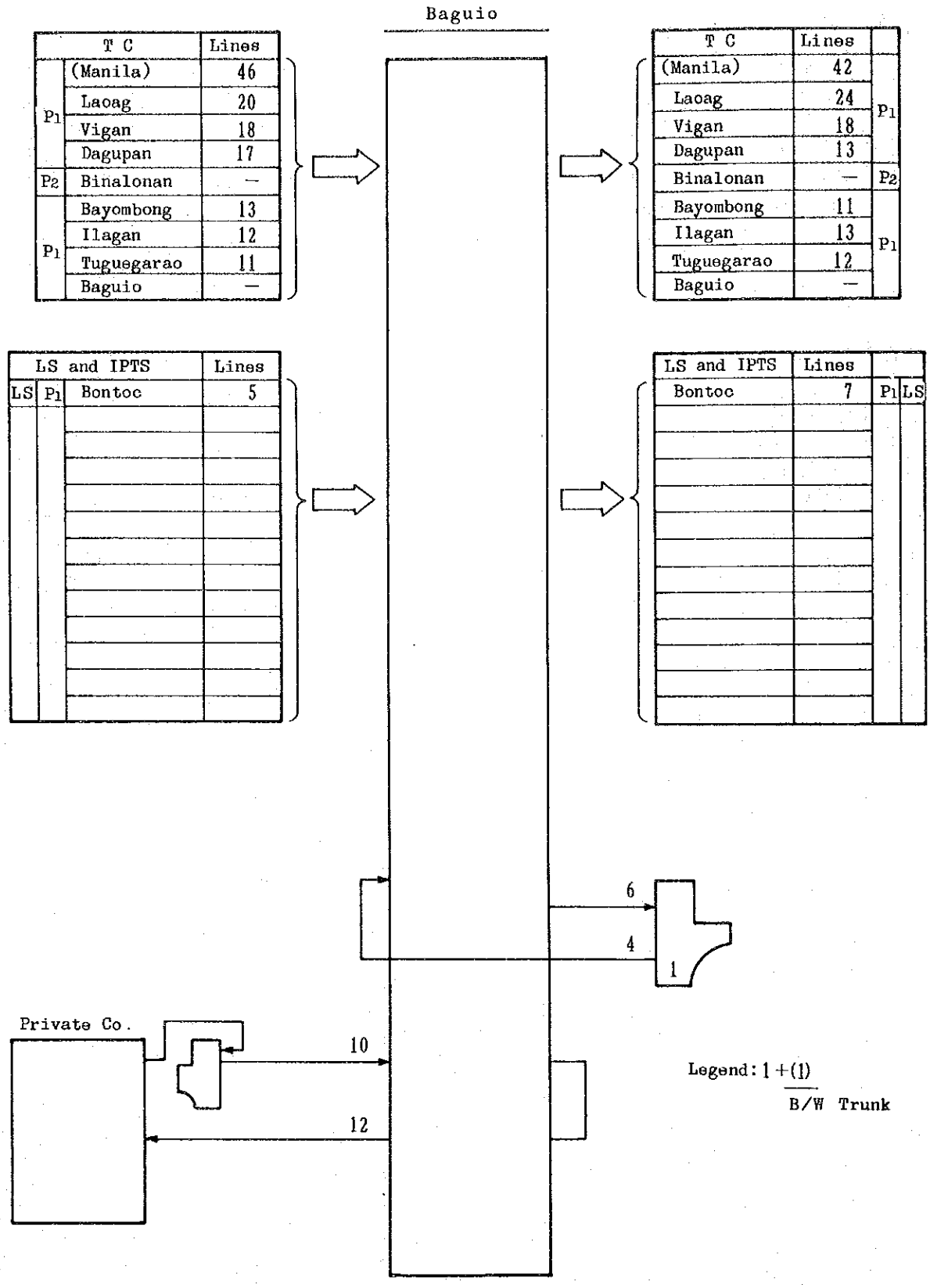


Fig. Ⅷ−1−3−2(3) Trunking Diagram of Baguio TC (Phase 1)

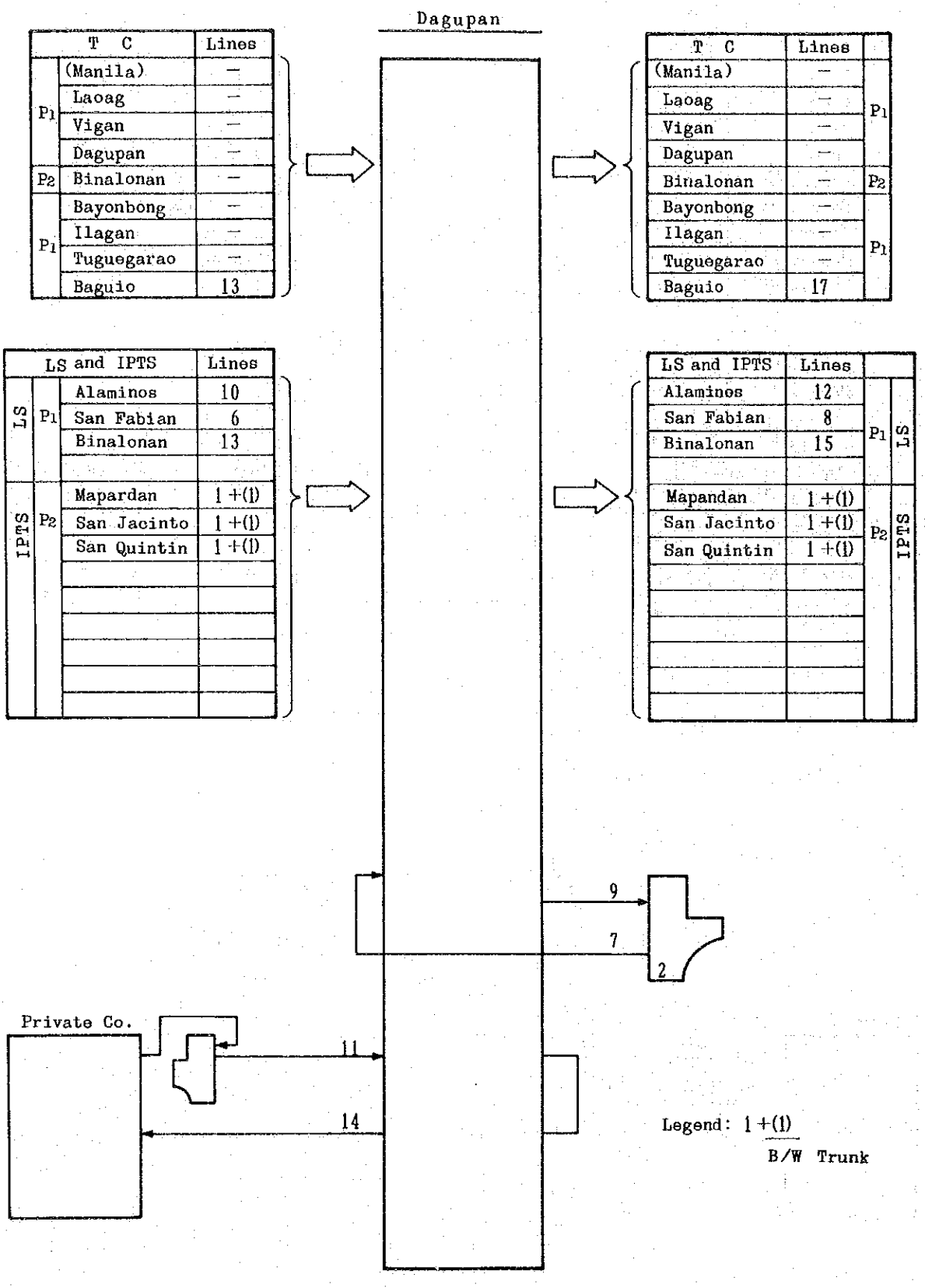


Fig. Ⅷ-1-3-2(4) Trunking Diagram of Dagapan TC (Phase 1)

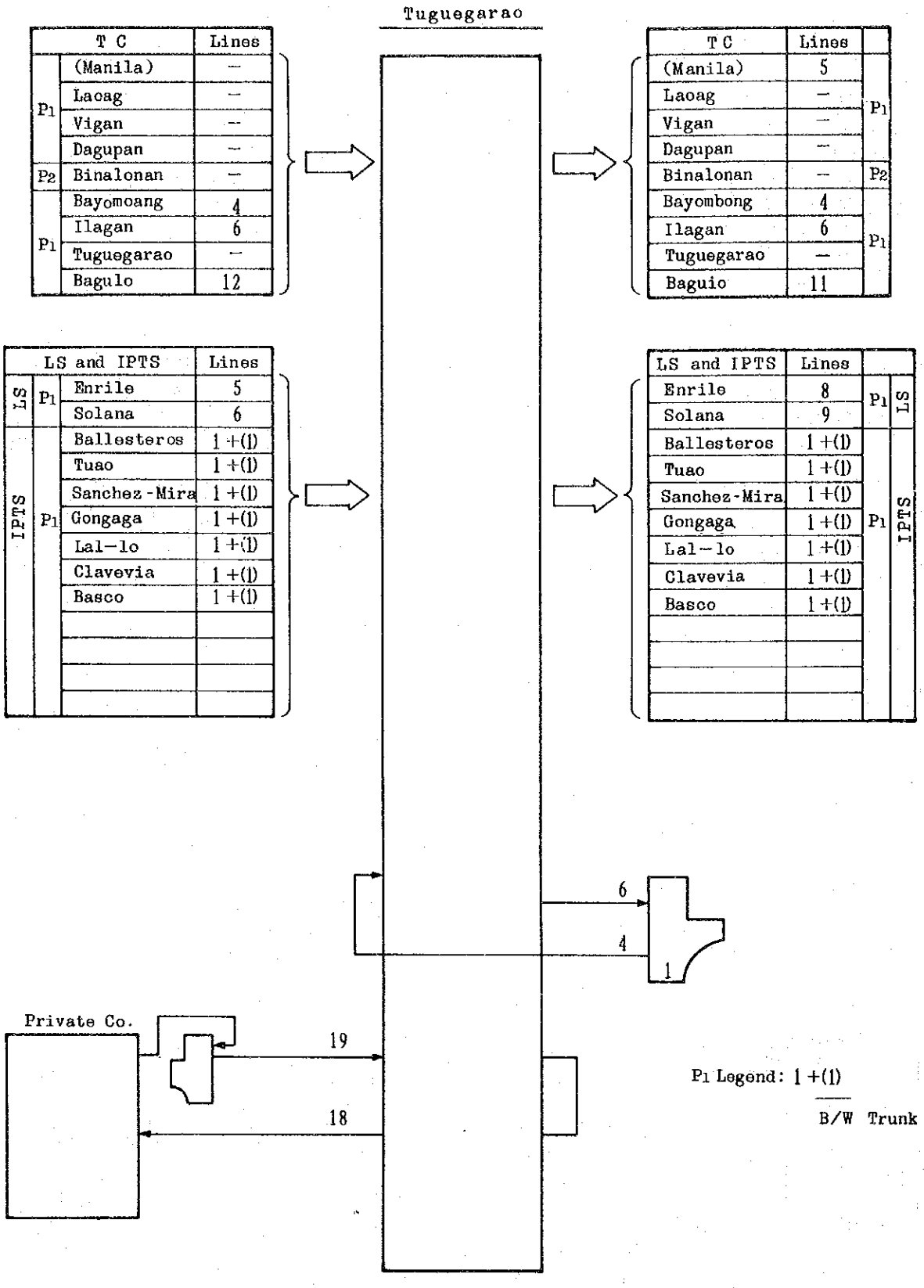


Fig. Ⅷ—1—3—2(5) Trunking Diagram of Tuguegarao TC (Phase 1)

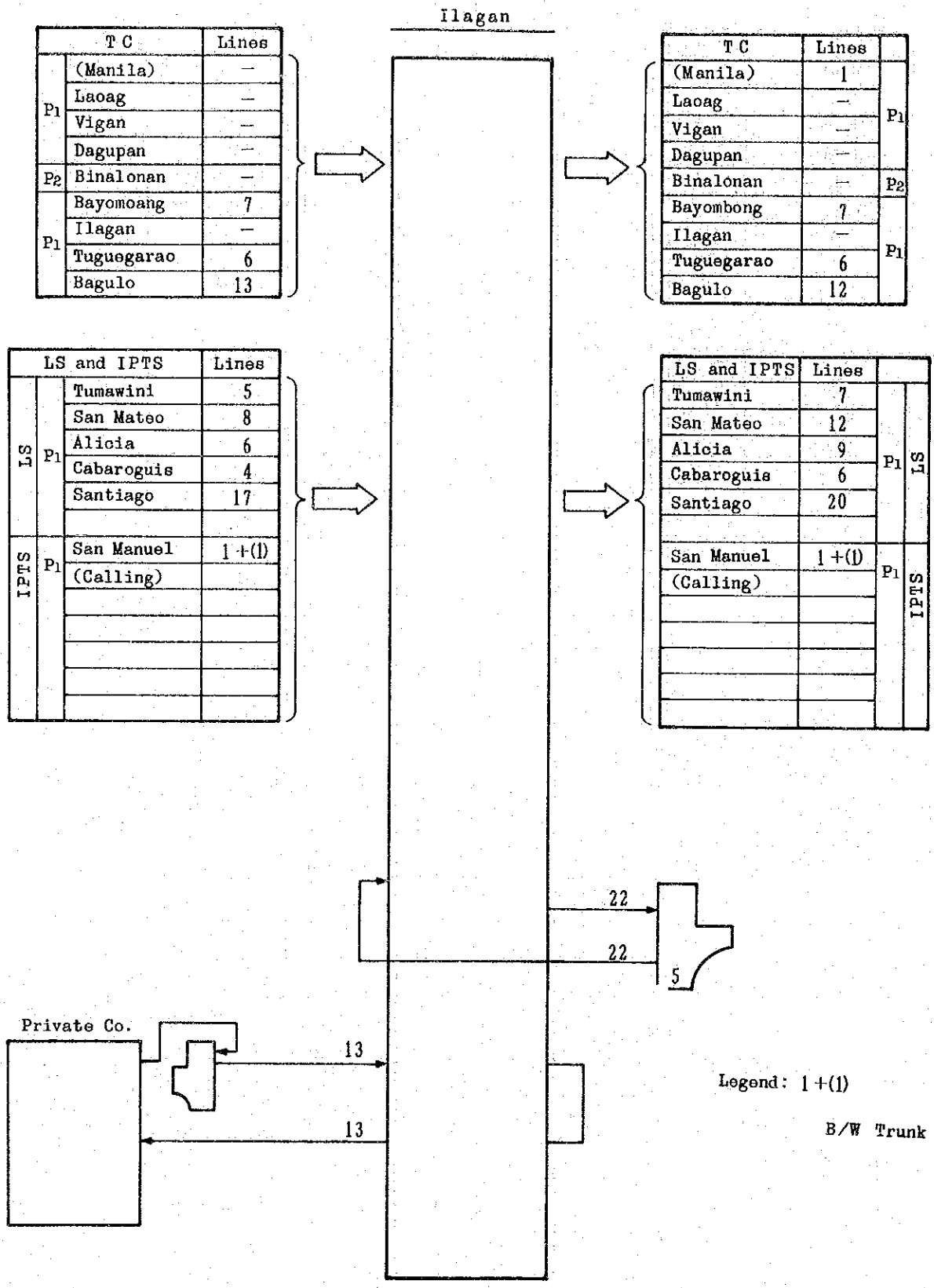


Fig.WM-1-3-2(6) Trunking Diagram of Ilagan TC (Phase 1)

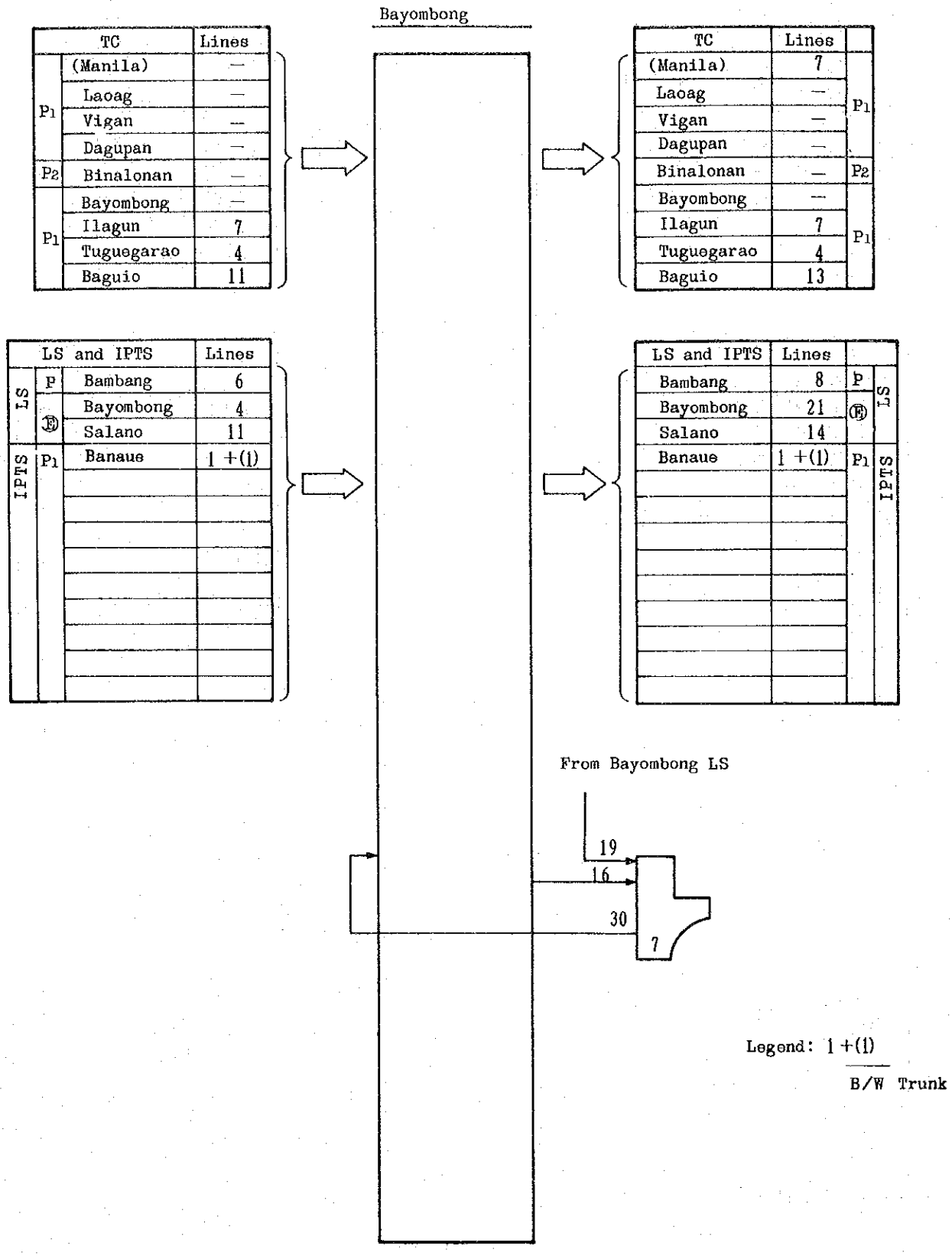


Fig. Ⅷ-1-3-2(7) Trunking Diagram of Bayombong TC (Phase 1)

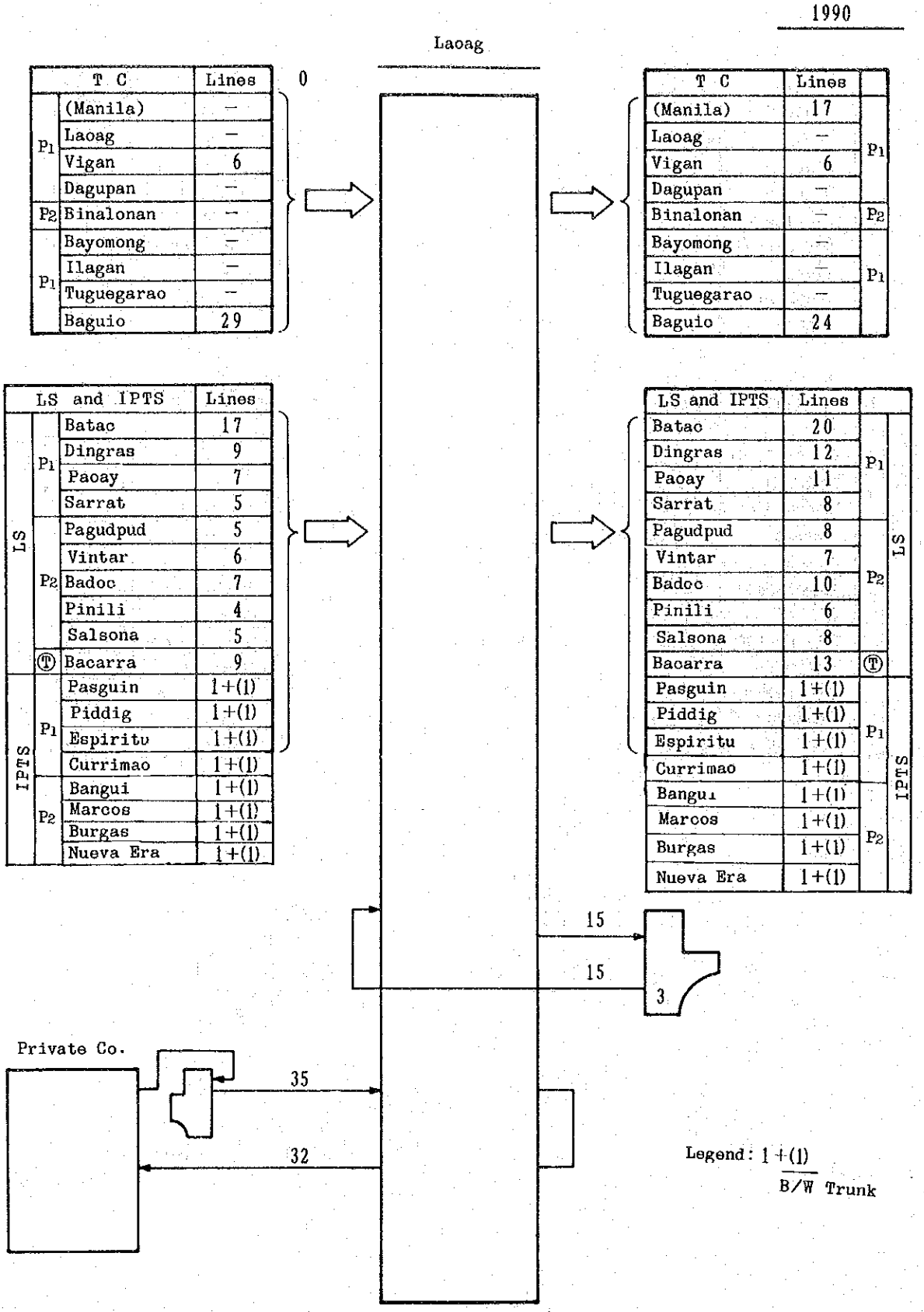


Fig.Ⅷ-1-3-3(1) Trunking Diagram of Laoag TC (Phase 2)

1990

Vigan

	TC	Lines
P1	(Manila)	—
	Laoag	6
	Vigan	—
	Dagupan	—
P2	Binalonan	—
P1	Bayombong	—
	Ilagan	—
	Tuguegarao	—
	Baguis	22

	TC	Lines	
	(Manila)	17	P1
	Laoag	6	
	Vigan	—	
	Dagupan	—	
P2	Binalonan	—	P2
P1	Bayombong	—	P1
	Ilagan	—	
	Tuguegarao	—	
	Baguis	20	

		LC and IPTS	Lines
LS	P1	Cabugao	5
		Narvacan	5
		Tagudin	5
		Bangued	14
		Candon	12
		Vigan	4
	P2	Magsingal	5
		Sinait	5
IPTS	P1	Sto.Domingo	1 + (1)
		Santa	1 + (1)
		Sta.Maria	1 + (1)
	P2	Caoayan	1 + (1)
		Sta.Lucia	1 + (1)

	LC and IPTS	Lines		
LS	Cabigao	8	P1	LS
	Narvacan	8		
	Tagudin	7		
	Bangued	17		
	Candon	15		
	Vigan	28		
	Magsingal	8	P2	
	Sinait	8		
IPTS	Sto.Domingo	1 + (1)	P1	IPTS
	Santa	1 + (1)		
	Sta.Maria	1 + (1)		
	Caoayan	1 + (1)	P2	
	Sta.Lucia	1 + (1)		

From Vigan LS

27

18

39

10

Legend: 1 + (1) / B/W Trunk

Fig. Ⅷ－1－3－3(2) Trunking Diagram of Vigan TS(Phase 2)

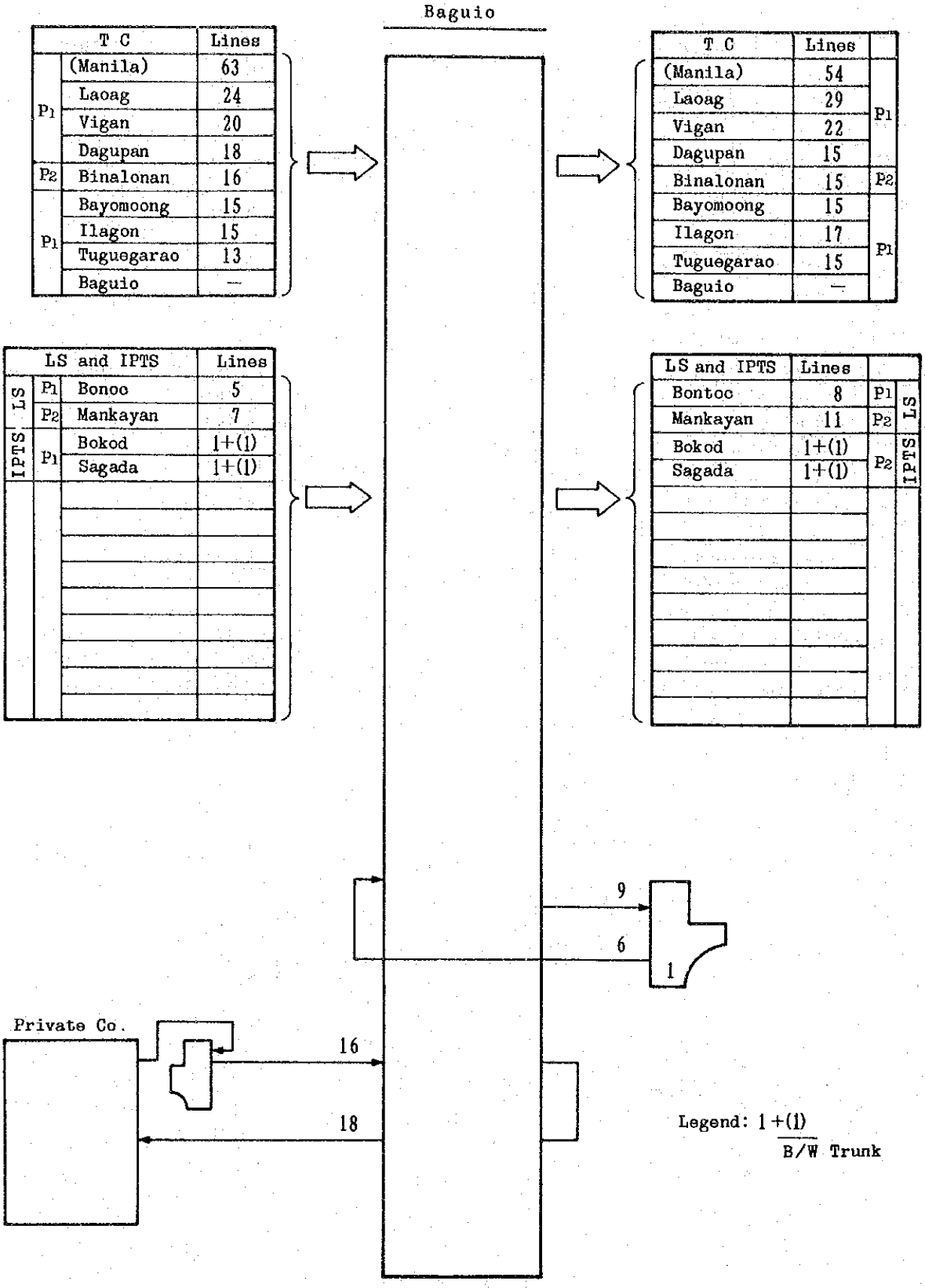


Fig. Ⅷ-1-3-3(3) Trunking Diagram of Baguio TC (Phase 2)

1990

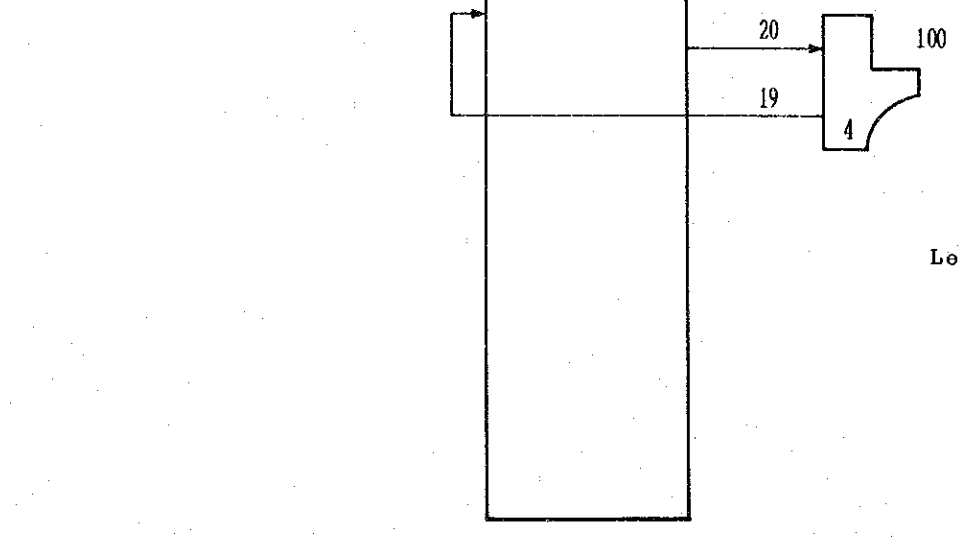
Binalonan

	TC	Lines
P1	(Manila)	—
	Laoag	—
	Vigan	—
	Dagupan	9
P2	Binalonan	—
P1	Bayombong	—
	Ilagan	—
	Tuguegarao	—
	Baguio	15

	TC	Lines	
	(Manila)	5	P1
	Laoag	—	
	Vigan	—	
	Dagupan	9	
P2	Binalonan	—	P2
P1	Bayombong	—	P1
	Ilagan	—	
	Tuguegarao	—	
	Baguio	16	

	LS and IPTS	Lines
LS P2	Binalonan	15
	Sison	5
	Asingan	7
	Alcala	5
	San Nicolas	5
	Sta. Maria	5
LS (T)	Pozorrubio	9
	Umingan	9
IPTS P2	San Quintin	1 + (1)
	Balungao	1 + (1)
	Bautista	1 + (1)
	Natividad	1 + (1)

	LS and IPTS	Lines		
LS	Binalonan	17	P2	
	Sison	8		
	Asingan	9		
	Alcala	7		
	San Nicolas	7		
	Sta. Maria	7		
	Pozorrubio	12	T	
	Umingan	12		
IPTS	San Quintin	1 + (1)	P2	
	Balungao	1 + (1)		
	Bautista	1 + (1)		
	Natividad	1 + (1)		



Legend : 1 + (1)
B/W Trunk

Fig. Ⅷ−1−3−3(5) Trunking Diagram of Binalonan PC (Phase 2)

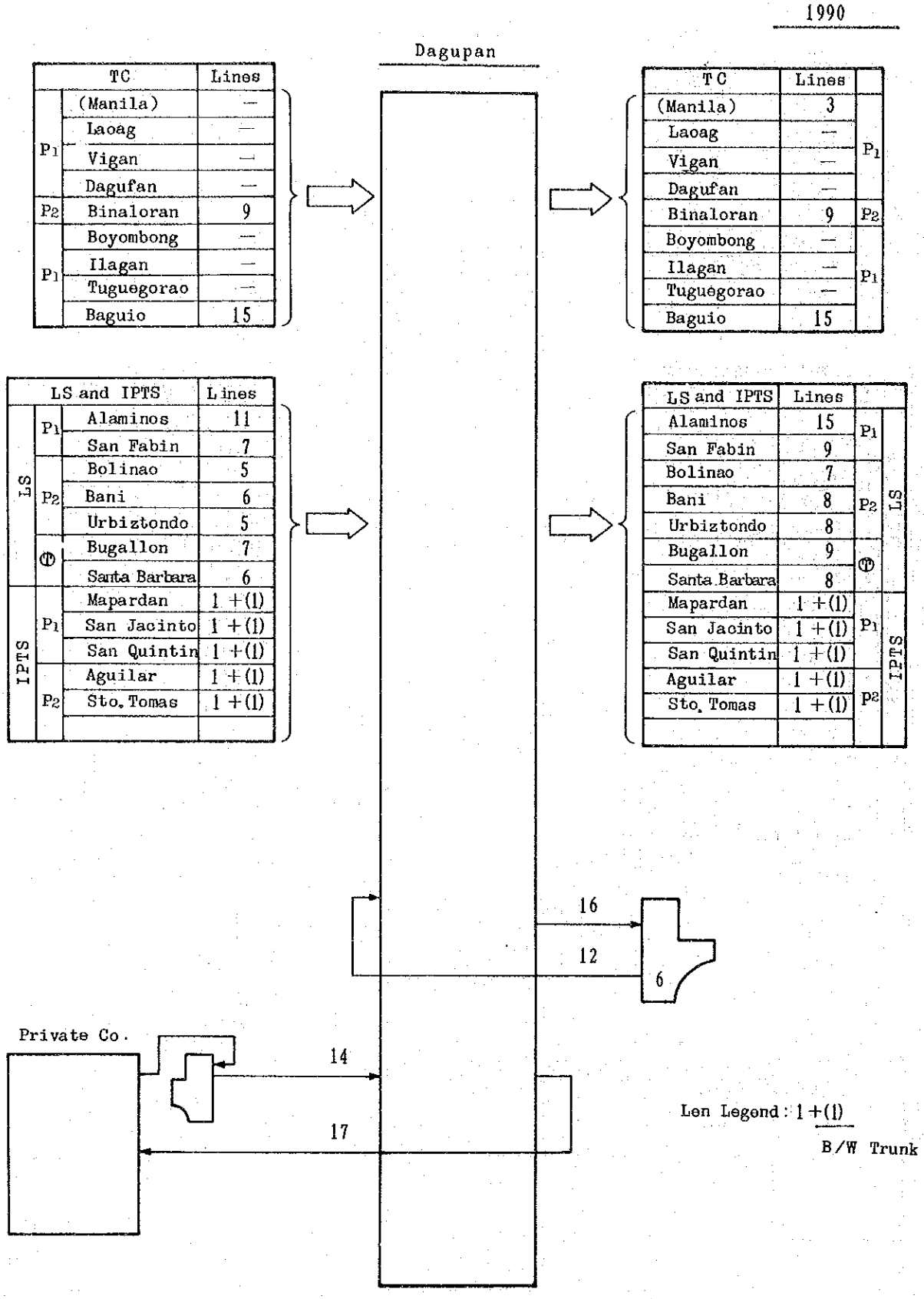


Fig. VM-1-3-3(4) Trunking Diagram of Dagupan TC (Phase 2)

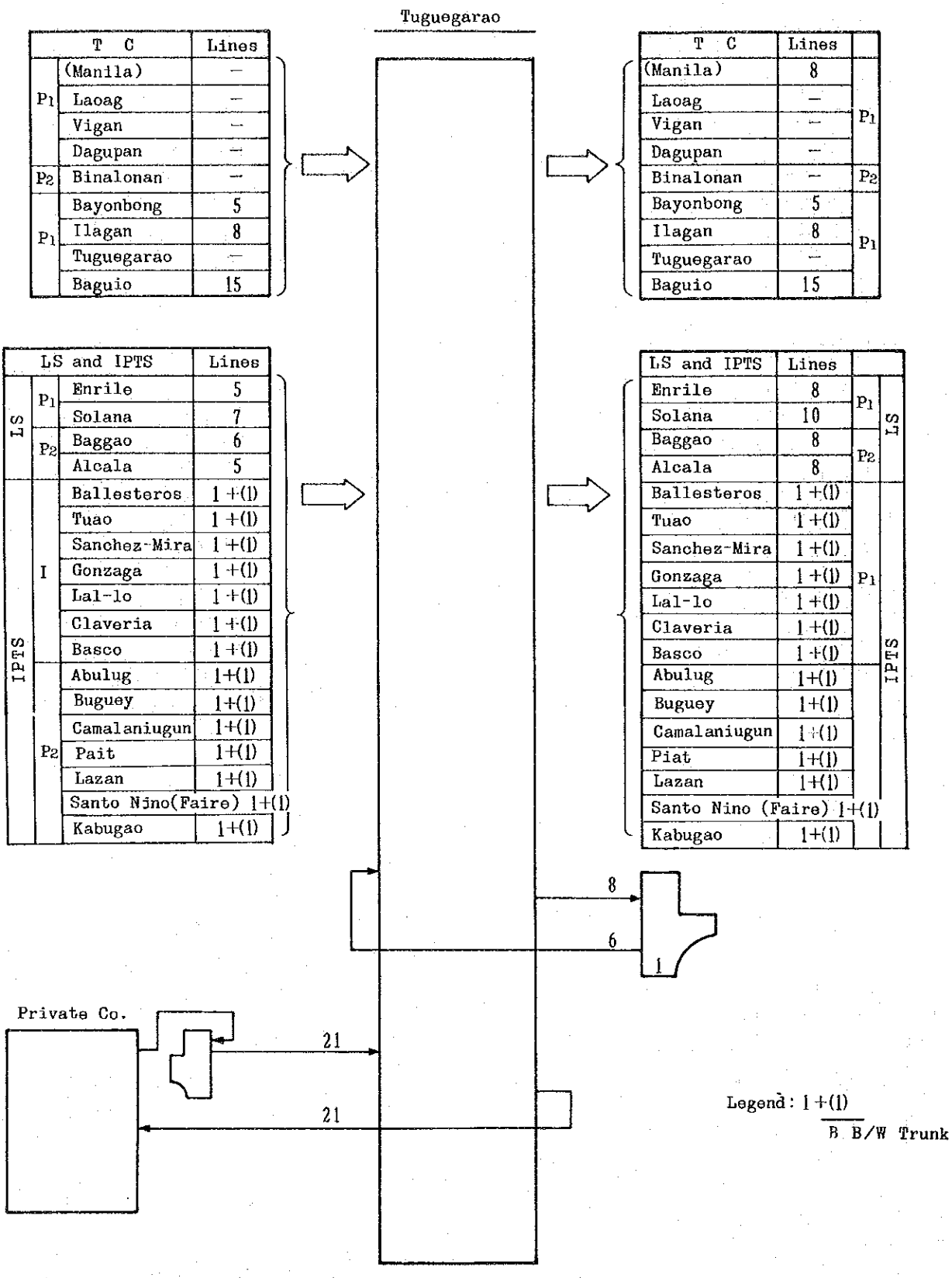


Fig. Ⅷ-1-3-3(6) Trunking Diagram of Tuguegarao (Phase 2)

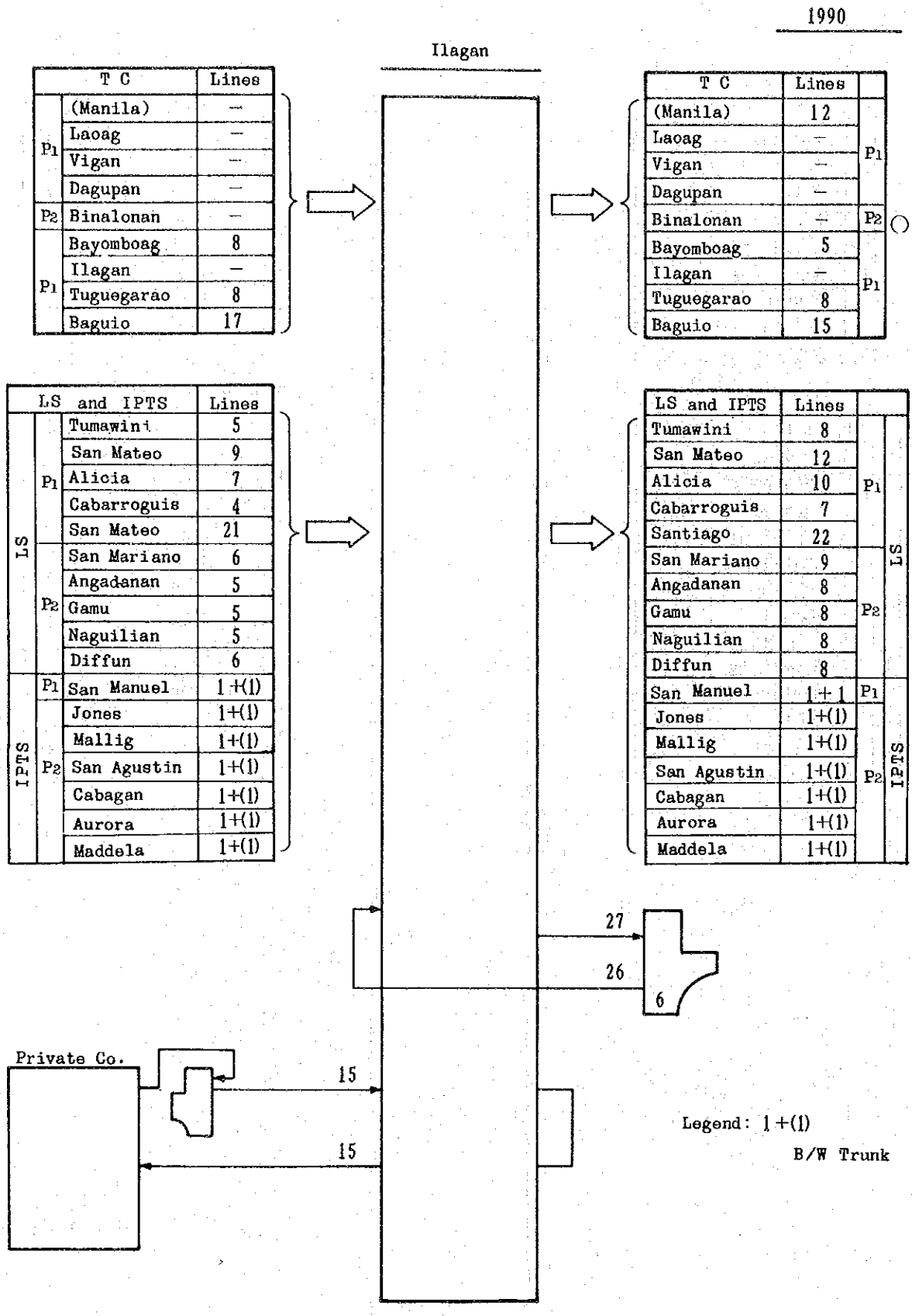


Fig. Ⅷ-1-3-3(7) Trunking Diagram of Ilagan TC (Phase 2)

Bayombong

	T C	Lines
P1	(Manila)	—
	Laoag	—
	Vigan	—
	Dagupan	—
P2	Bianlonan	—
P1	Bayombong	—
	Ilagan	8
	Tuguegarao	8
	Baguio	15

T C	Lines	
(Manila)	12	P1
Laoag	—	
Vigan	—	
Dagupan	—	
Bianlonan	—	P2
Bayombong	—	P1
Ilagan	8	
Tuguegarao	5	
Baguio	15	

		LS and IPTS	Lines
LS	P1	Bambang	6
	Ⓑ	Bayombong	4
		Salano	13
	P2	Aricia	5
		Bagabag	6
		Dupax der Sur	5
IPTS	P1	Banaue	1 +(1)
	P2	Dupax der Norte	1+(1)
		Mayayao	1 +(1)
		Kiangan	1 +(1)
		Santa Fe	1 +(1)

LS and IPTS	Lines		
Bambang	9	P1	LS
Bayombong	25	Ⓑ	
Salano	15		
Aricia	8	P2	
Bagabag	8		
Dupax der Sur	8		
Banaue	1 +(1)	P1	IPTS
Dupax der Norte	1+(1)	P2	
Mayayao	1 +(1)		
Kiangan	1 +(1)		
Santa Fe	1 +(1)		

From Bayombong LS

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Fig. Ⅷ—1—3—3(8) Trunking Diagram of Bayombong TC